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Volume XIV, Issue 6, June 2018

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

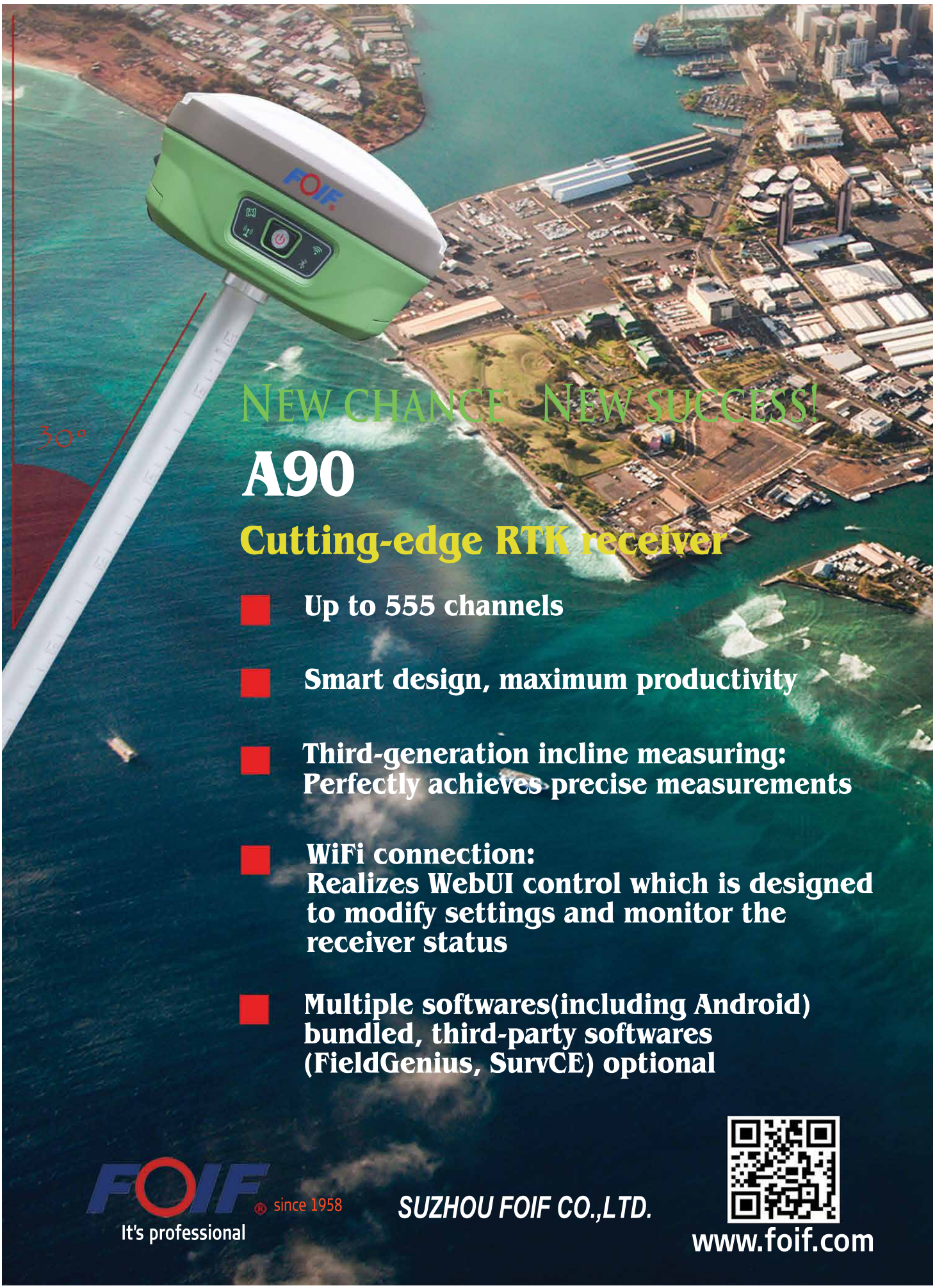
SIRGAS

Reference frame in Latin America

Also:

International ethics standards

Improving Indonesian Geospatial Information establishment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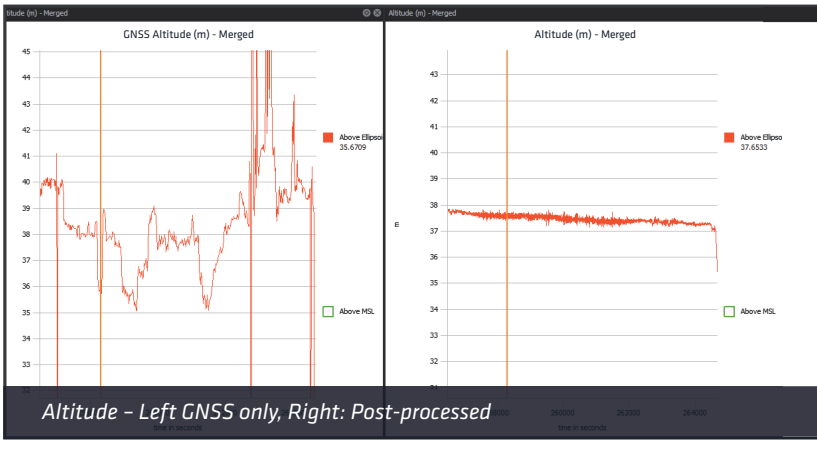

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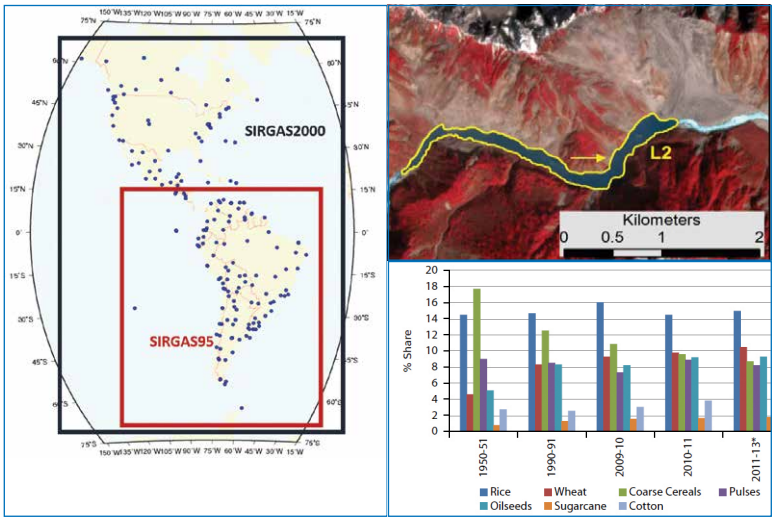

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Columns

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This issue of Coordinates is of 52 pages, including cover.

Data mines & data mining

In this digital world

how we all are vulnerable.

is well demonstrated by

Facebook-Cambridge Analytica data controversy.

When we are tracked, tapped and trapped,

The General Data Protection Regulation (GDPR),

A regulation in European Union (EU) law on data

Protection and privacy for all individuals within the EU

Is a welcome and comforting step

As it endeavors to restrain

The data harvesting of personal information

That is not consented.

It would be interesting to see

The extent it would succeed.

And how the world follow suit

Bal Krishna, Editor
bal@mycoordinates.org

SIRGAS: Reference frame in Latin America

SIRGAS is the geocentric reference system for the Americas, by definition it is identical to the ITRS and realice the regional densification of the ITRF in Latin America which consist of the highest precision GNSS network in the continent called SIRGAS-CON

Víctor Cioce
Satellite Geodesy Associate Professor, LUZ, Chair of the SIRGAS Working Group I (Reference System)

William Martínez
Expert in the Colombian national mining agency and the President of SIRGAS

M Virginia Mackern
Professor and researcher at Universidad Nacional de Cuyo and Universidad Juan Agustín Maza, Argentina, Vice-president of SIRGAS

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Professor, Universidad de la República (Uruguay), Chair of the SIRGAS Working Group II (National Level)

Silvio de Freitas
Professor and researcher with expertise in physical geodesy and geodynamics, Chair of the SIRGAS Working Group III (Vertical Datum)

A brief introduction

Since its establishment 25 years ago, SIRGAS (Spanish acronym for Geocentric Reference System for the Americas) is the starting point in Latin America dealing with acquisition and treatment of geospatial information with scientific and technical features for applications beyond geodesy. Scopes and goals of SIRGAS have been showed in previous editions (e.g. Brunini and Sánchez, 2012; Fortes et al., 2006). Following to Cioce et al. (2018), this time is appropriate to share an overview about its evolution, consolidation and current role as an organization responsible for the maintenance of the continental geodetic reference frame, based on voluntary collaboration between governmental, academic and research entities.

Nowadays, SIRGAS is recognized as one of the better examples of international cooperation in regional geosciences, which came because of the imperative paradigm-change brought by the extensive use of the GPS (Global Positioning System) during 90s decade and the evident incompatibilities of the classical reference system at national level (i.e. PSAD56 and PSAD69) respect to the corresponding satellite techniques (i.e. WGS-84), degrading the quality of the coordinates determinations (IBGE, 1997). Under this circumstances SIRGAS was born as a project with focus on providing to the region of a well-defined reference system and frame, consistent with the satellite geodesy procedures. The challenge was proposed in 1993 during the International Conference for the Definition of a South American Geocentric Reference System held in Asuncion, Paraguay, organized by the IAG (International Association of Geodesy), PAIGH (Pan-american Institute for Geography and History) and NIMA (US National Imagery and Mapping Agency, now NGA, National Geospatial-Intelligence Agency).

In 2000, the UN (United Nations) recognized its achievements and SIRGAS became the reference system recommended for all countries in the Americas. This still is a valid fact taking in consideration the Resolution A/RES/69/266 approved in 2015 concerning to the GGRF (Global Geodetic Reference Frame) for Sustainable Development, because SIRGAS is the core geodetic infrastructure adopted and implemented by 20 countries, with solid foundations as member of the IAG Sub-commission 1.3 (Regional Reference Frames), also SIRGAS is a Working Group of the Cartographic Commission of the PAIGH and supports the activities of the UN Regional Committee for the Global Geospatial Information Management (UN-GGIM: Americas).

Regarding this, more than 50 entities located in Latin American countries assume scientific and technical responsibilities for developing activities organized by the three SIRGAS Working Groups, allowing the accomplishment of its goals: to provide a highly accurate geodetic reference frame consistent at global level in the geometrical and physical sense, to promote the implementation of the geospatial data infrastructure based on SIRGAS as core layer, and to contribute with geodetic observation of the Global Change. The SIRGAS

structure is illustrated in the Figure 1.

The Latin American reference frame

Every activity executed for satisfying requirements of position, navigation and timing through and explicit use of GNSS (Global Navigation Satellite Systems) mandatorily need a global reference system to make a homogeneous and feasible relationship between observations and products to be obtained (e.g. coordinates). This is why SIRGAS exists in the region. It defines itself as a reference system identical to the ITRS (International Terrestrial Reference System) and its realization is the continental densification of the ITRF (International Terrestrial Reference Frame). In the SIRGAS countries, the access to the system/frame is possible by different national densifications that exists.

The SIRGAS reference frame was established in 1995 after the first GPS campaign over a geodetic network composed by 58 stations distributed only in South America, five years later, this network was extended to Central and North America reaching 184 stations (see Figure 2). The accuracy of the coordinates for both passive realizations was estimated in ±3mm y ±6mm (www.sirgas.org).

At present, a high precision geodetic network composed by 420 continuously operating GNSS stations and called SIRGAS-CON (Continuously Operating Network) represents the third and current realization of the continental reference frame (Figure 3). Thanks to the national cartographic agencies, universities and research centres dedicated to operate GNSS stations in every country, their data are available for the SIRGAS purposes. With recent updating process in the instrumental array, now the stations network gradually acquired capacities for multi-constellation tracking, i.e. GPS, GLONASS, Galileo and BeiDou.

This continuous GNSS network brings the access to the geocentric reference system/frame supporting a broad spectrum of geosciences applications in every Latin American country. The SIRGAS Working Group I (Reference System) is responsible for assuring the suitable maintenance of the continental densification of the frame through a weekly processing of the GPS and GLONASS observations made by all the stations. A rigorous strategy of geodetic estimation according to the current conventions and standards from IERS (International Earth Rotation and Reference System Service) and IGS (International GNSS Service) is applied homogeneously by the SIRGAS Analysis Centres (10 Processing Centres and 2 Combination Centres), offering an up-to-date reference frame.

Formerly, the SIRGAS-CON processing was performed by DGFI-TUM (Deutsches Geodätisches Forschungsinstitut der Technical Universität Munchen), because since 1996 it is the IGS RNAAC SIRGAS (IGS Regional Network Associate Analysis Centre for SIRGAS). Its grateful contribution to the SIRGAS consolidation allowed the installation of the other nine centres operated by Latin American institutions, these are: LUZ (Universidad del Zulia, Venezuela), IBGE (Instituto Brasileiro de Geografia e Estatística, Brazil), IGN-Ec (Instituto Geográfico Militar de Ecuador), UNA (Universidad Nacional de Costa Rica), IGAC (Instituto Geográfico Agustín Codazzi, Colombia),

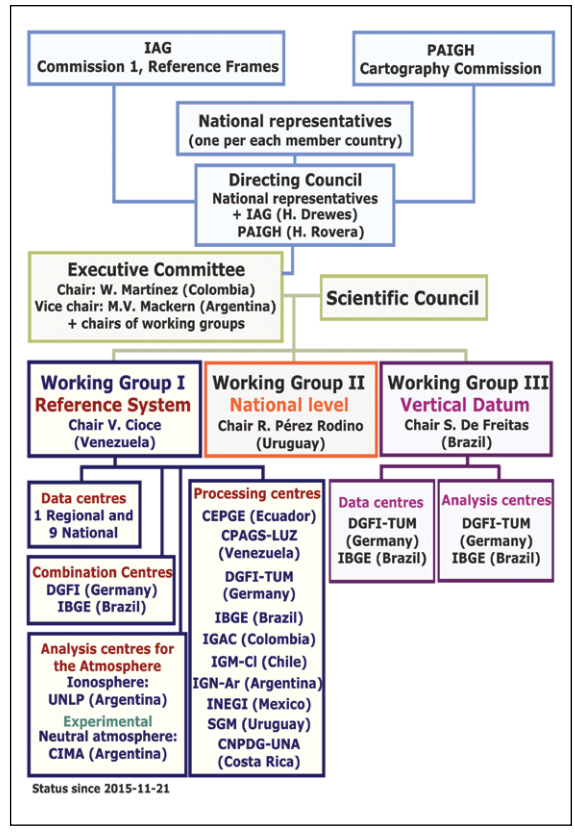

Figure 1. Operational structure of SIRGAS (www.sirgas.org).

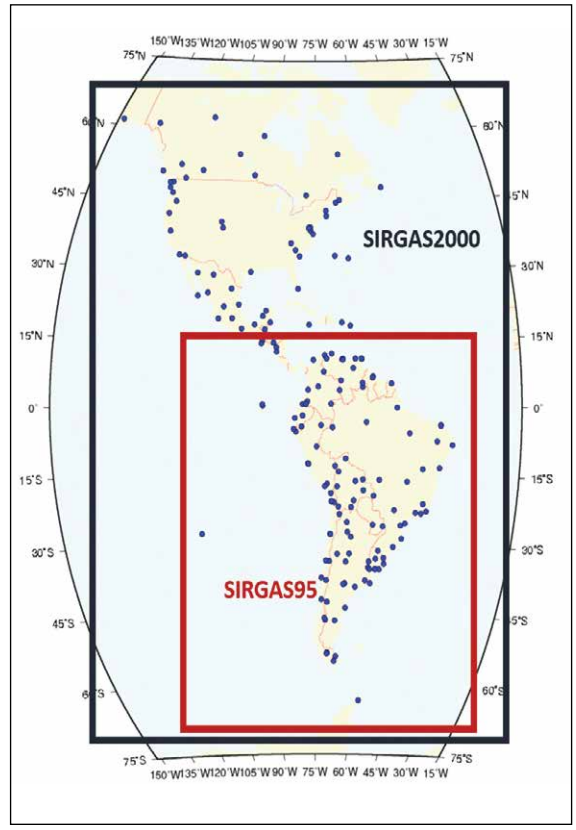

Figure 2. Passive realizations of the SIRGAS frame.

The weekly processing of the SIRGAS-CON network supports a wide range of technical and scientific activities for geosciences. This geodetic infrastructure offers coordinates and velocities with millimeter accuracy being accessible for any user

IGM-Ch (Instituto Geográfico Militar de Chile), IGN-Ar (Instituto Geográfico Nacional de Argentina), INEGI (Instituto Nacional de Estadística y Geografía, México), SGM (Servicio Geográfico Militar, Uruguay).

Each Processing Centre generates loosely-constrained weekly solutions of the network, DGFI-TUM is in charge of the continental set (SIRGAS-CON C), i.e. stations that directly densify the ITRF in the region; local centres assume the processing of the national sets (SIRGAS-CON N). Both Combination Centres (IBGE and DGFI-TUM) offer the weekly solutions aligned to the ITRF also contributing with the IGS global polyhedron determination. Based on inner and outer controls of the results an accuracy of ±1mm for horizontal position and ±3mm for the vertical one is achieved.

Consistent coordinates, updated, accurate and useful for...

Accurate geospatial information is a basic requirement for modern society and this is the engine driving the optimization of the geodetic reference systems and frames, this fact has impacts on the observation technique improvements like GNSS, so they have enough precision for sensing those almost imperceptible positions changes which attempt against the geodetic infrastructure stability at any level such as the occurrence of secular, sporadic and seasonal phenomena (e.g. tectonics, earthquakes and hydrological effects respectively), and even those induced by measurement environment disturbances like receiver-antenna changes. Figures 4 and 5 show two emblematic cases: the 2010 Maule earthquake in Chile and vertical variations at stations located in Amazonia. Because of the complex geodynamics in Latin America and considering to SIRGAS as the unique provider of the reference frame aligned to the ITRF, the weekly processing of SIRGAS-CON is strongly needed.

The high accuracy and global consistency of the weekly solutions benefits to the final users in the region who require an accessible, steady and compatible reference frame with respect to GNSS orbits, a basic product for positioning. These also support the homogeneous treatment of geospatial information despite its features since every SIRGAS country speak the same language (in analogy to the reference system) but using different realization and epochs.

From the scientific perspective, monitoring and improving of SIRGAS-CON are given by results with uniform temporal

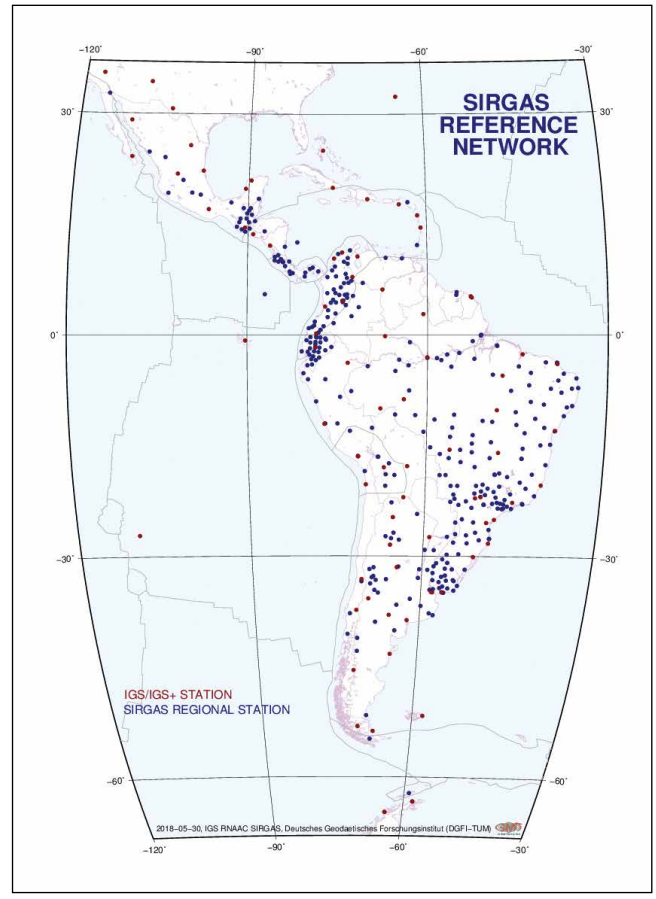

Figure 3. SIRGAS-CON network (www.sirgas.org).

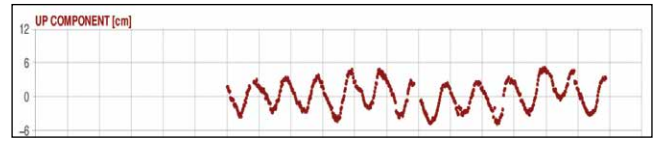

Figure 4. Vertical position time series for Manaus (NAUS) station in Brazil (www.sirgas.org).

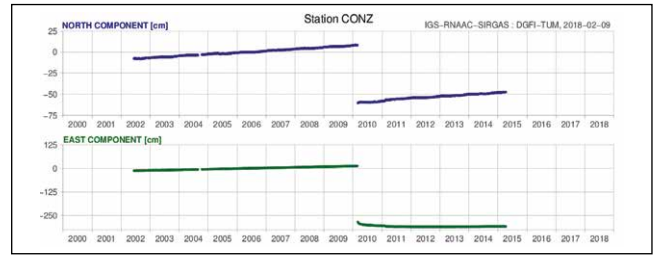

Figure 5. Horizontal position time series for Concepcion (CONZ) station in Chile before and after Maule earthquake in 2010 (www.sirgas.org).

resolution, multi-year solutions are then the key products that define a long-term reference frame, its kinematics can be analyzed for estimating not only stations positions but velocities as fundamental element of any modern geodetic frame. In addition, SIRGAS develop its velocity model valid for Latin American region and useful to translate the observation epoch of the coordinates, in special for GNSS positioning tasks based on passive networks. Both products, multi-year solutions and velocity models, are calculated for regular intervals. Most recent are SIR17P01 (Sánchez, 2017) and VEMOS2017 (Drewes and Sánchez, 2017) respectively. The current velocities for SIRGAS stations are illustrated in Figure 6.

Another relevant aspect of the continuously processing of the SIRGAS-CON network is the real possibility to conduct studies about geodetic-geophysical phenomena very crucial for the reference frame optimization and Earth System understanding, for example the crust deformation modelling caused by seismic events and hydrological load, and atmospheric activity monitoring at ionosphere and neutral atmosphere levels. In this sense, SIRGAS-CON defines a framework for geosciences in Latin America and promotes the GGRF implementation satisfying its geometrical component for positioning, navigation, geomatics, resources and risks management, global change monitoring and administration of geospatial information for the society according to UN goals for sustainable development.

SIRGAS in practice

Having a solid geodetic infrastructure as SIRGAS implies significant advantages for Latin American countries. As mentioned before, each nation assumes same system but different realization and reference epoch. This is the reason why it is essential the designing and application of methodologies for an optimal exploitation of those benefits being responsibility of the SIRGAS Working Group II (National Level) which promotes and support the SIRGAS adoption in the region by means of guidelines and permanent recommendations pointing to the installation and maintenance of continuously operating GNSS network for precise positioning purposes and reference frame densification at local (national) level.

Actions drived for the working group are ruled by capacity buildings needs in the member countries and they are reflected in terms of divulgation of scientific and technological concepts related to the practical implementation of the reference systems and frames. This goals are successfully achieved since 2009 through periodic training activities thanks to the SIRGAS Schools sponsored by the IAG and PAIGH.

More than 50 entities located in the member nations such as governmental agencies, universities and research institutes cooperate to guarantee the successful achievements of SIRGAS

By the other hand, experiences during past years demonstrate how the user request of geodetic positioning for any application and the availability of SIRGAS as high-precision reference frame match in the Real Time GNSS technologies; it is not a casual coincidence, receivers upgrade on SIRGAS-CON stations are bringing capabilities for generating and transmitting differential corrections even by Internet following the NTRIP (Networked Transport of RTCM via Internet Protocol) protocol.

Some remarkable examples are the national densifications in Brazil and Uruguay with continuously and also actives GNSS stations. Real-time observations under NTRIP supporting had been studied and implemented in other SIRGAS countries (see examples at www.sirgas.org/en/presentations), so the region counts with a caster-school for facilitating to any user the approaching to the real time infrastructure defined by the active GNSS station, all of them under the SIRGAS-CON umbrella.

What about the vertical reference system?

One of the major topics for modern geodesy is dedicated to defining and establishing the vertical reference system and frame being this updated, unified and global, i.e. the IHRS (International Height Reference System) and IHRF (International

Figure 6. Horizontal velocities for SIRGAS-CON stations according to VEMOS2017 (Sánchez, 2017).

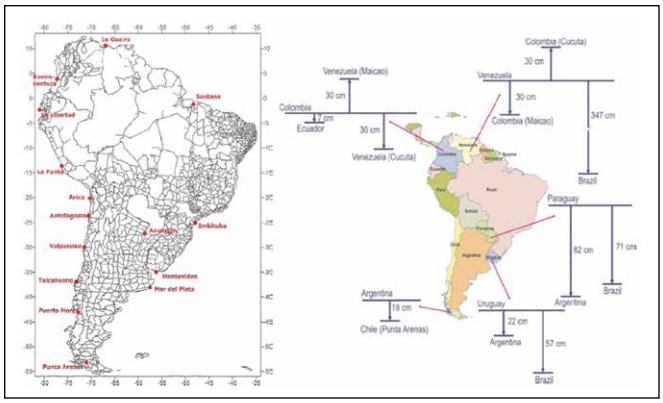

Figure 7. Classical vertical datums in Latin America (left) and discrepancies between them (right), www.sirgas.org

Height Reference Frame), both are the complement of the GGRS/GGRF conceptualization. In 2015 the IAG resolved that IHRS is given in the geopotential domain with geopotential numbers (C_p) as vertical coordinates respect to the conventional geoidal potential value W_0 and spatial reference from cartesian-geocentric coordinates (X, Y, Z) respect to ITRF (Drewes et al., 2016).

Heterogeneities and discrepancies between the multiples classical height reference systems (Figure 7) adopted in Latin America at 1950 decade are the major drawbacks for vertical datum modernization according to GGRS/GGRF. By an appropriate integration of those local systems to the IHRS is possible to update the available vertical data, making them useful for geodetic applications in the global context (Sánchez and Sideris, 2017). The SIRGAS Working Group III (Vertical Datum) is promoting and developing since 1997 some activities for achieving the unification of the vertical systems in Latin America in order to reach the IHRS definition.

Some of those activities are the unified adjustment for the national classic levelling networks empathizing borders inter-connections, the absolute and relative gravity networks densifications, and evaluations of GGM (Global Geopotential Model) and Satellite Altimetry products. Currently, there is strengths in the region and remarkable milestones demonstrating the progressive approach to the IHRS/IHRF. The realization and processing of the vertical networks in the geopotential domain together their linking with the geometrical component of SIRGAS (i.e. SIRGAS-CON stations) are being executed. Besides, SIRGAS had proposed a set of GNSS stations for serving as the continental densification of the IHRF.

Closing remarks

In Latin America any scientific and technical application based on geodetic positioning find in SIRGAS the suitable support in terms of the high-precision reference frame aligned to the ITRF. The efforts and mutual cooperation between the member countries made possible the maintenance, operation and weekly processing of GNSS observations from the SIRGAS-CON network, and the highest precision products (geodetic positions) such as loosely-constrain, adjusted and multi-year solutions guarantee the geospatial information consistency in the region.

SIRGAS expertise during the last 25 years definitely contributes with the continental geodesy developments ruled by proper guidelines and recommendations for the Latin American nations which had adopted to SIRGAS as reference system and now are looking to the establishment and implementation of the GGRF. There is no doubt that this is a successful example of international cooperation.

Beyond of the achievements and considering implications related to the GGRF, SIRGAS is working on the optimization of its continuously operating GNSS network, its practical use and unification of the vertical datum for assuring reference frame high accuracy and consistency without neglecting in the coming years a possible approaching to other geodetic techniques like VLBI (Very Long Baseline Interferometry) or SLR (Satellite Laser Ranging).

References

Brunini C. and Sánchez L. (2012). Geodetic activities in Latin America and The Caribbean: always in. Coordinates. Vol. 8. Issue 6.

Cioce V., Martínez W., Mackern M.V., Pérez R., de Freitas S. (2018). Supporting GNSS application in Latin America through the SIRGAS Reference Frame. United Nations/Argentina Workshop on the Applications of GNSS. Falda del Carmen, Argentina.

Drewes H. and Sánchez L. (2017). The varying surface kinematics in Latin America: VEMOS 2009, 2015, and 2017. SIRGAS Symposium 2017. Mendoza, Argentina. Available at: www.sirgas.org

Drewes H., Kuglitsch F., Ádám J., Rózsa S. (2016). The Geodesist's Handbook 2016. Journal of Geodesy. Vol. 90. Issue 10.

Fortes L.P., Lauría E., Brunini C., Amaya W., Sánchez L., Drewes H., Seemüller W. (2006). SIRGAS - a geodetic enterprise. Vol. 2. Issue 5.

IBGE (1997). SIRGAS Relatório Final – Grupos de Trabalho I e II. Available at: www.sirgas.org

Sánchez L. (2017). Kinematics of the SIRGAS reference frame. SIRGAS Symposium 2017. Mendoza, Argentina. Available at: www.sirgas.org

Sánchez L. and Sideris M. (2017). Vertical datum unification for the International Height Reference System (IHRS). Geophysical Journal International. Vol. 209. doi: 10.1093/gji/ggx025

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Improving Indonesian Geospatial Information establishment

This paper intends to share experiences in Improving the quality of GI establishment by developing standards, human resources, and the certification implementation process in geospatial sector in Indonesia

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Developments in the era of advanced science and technology nowadays is a challenge and an opportunity, especially in the field of geospatial information in Indonesia. As stipulated by the Act 1945 article 28 F that every person has the right to obtain information including Geospatial Information (GI), new chapter related to the implementation of the GI had begun with the enactment of Act Nr. 4/2011. GI has been organizing activities from upstream to downstream in surveying and mapping activities as this is more important for policy formulation, decision making, and implementation of activities that are closely related to spatial and terrestrial. In book II of the National Medium-Term Development Plan (RPJMN) from 2015 to 2019, based on the vision and mission of the President of Republic of Indonesia, as well as the agenda of national development priorities (Nawa Cita), the role of GI be very important in supporting the distribution of development between regions, including rural development, the infrastructure provision and basic social services for the public, and economic development that is focused on the food sector, energy, maritime and marine, and tourism, which is presented on topographic mapping, spatial mapping, boundary mapping, thematic mapping, and marine and coastal environments mapping.

Generally, GI in Indonesia is divided into Basic Geospatial Information (BGI) and Thematic Geospatial Information (TGI). BGI includes a national reference network (geodetic network: national horizontal geodetic control networks, national vertical geodetic control networks, and national gravity network), and a base map (a map which consists of coastline, earth's relief (hipsografi), waters, topographical names, boundaries, transportation and utilities, buildings and public facilities, and land cover). Important features of BGI are the objects can be seen directly or measured by physical appearance on the earth and that has not changed relatively in long period. TGI presents many themes with its special parameters related to mapping, such as forestry, agriculture, fisheries, and mining, etc. TGI must be based on BGI so the scale of TGI is not greater than BGI as its reference, besides position and level of geometric precision of BGI must not be changed.

According to a press release of the Ministry of Communications and Information Technology, due to the TGI which overlap each other, the implementation of development programs both regional development and infrastructure are often confronted with a number of conflicts related to space utilization. The policy's principles among others are conducted by coordinating against any activities that must be implemented by each Ministry/ Institution (M/I). Afterwards, every M/I related to the preparation of TGI scale of 1:50,000 according to the action plan stipulated in the Presidential Decree on Acceleration of the Implementation of One Map Policy (Ministry of Finance Republic of Indonesia, 2015). Indonesia has Presidential Regulation Nr. 9/2016 on acceleration of the implementation of one map policy on level of map accuracy scale 1:50,000, which is set in the Eight Economic Policy Package. This is intended to

reduce the potential for conflict due to the utilization of space or land use. In order that GI can be held orderly, integrally, effectively, and efficiently, to ensure GI accuracy, up-to-date, and legal certainty, there are arrangements regarding the organization of GI. The same reference base map will increase the reliability of information related to the location of economic activity.

Relevant sectoral ministries have agreed and collaboratively established the One Map. Some ministries have started to establish their own thematic maps developed from the basic map. The public participated to some degree, as community-based organizations gave inputs to revise the original map. The preliminary form of this map has been used in several pilot licensing projects to prevent overlap. This map built on existing initiatives, namely the National Spatial Data Network, and will be used as the only reference of basic geospatial information. This map will also serve as one standard for thematic mapping, whereby sectors may produce thematic maps to serve their purposes by using mapping standards approved by BIG so they can be integrated with other themes to create a national thematic map (Shahab, Nabiha, 2016)

Based on Article 53 of the Act Nr. 4/2011, Government is obliged to facilitate infrastructure development of the Geospatial Information to carry out the implementation of the Geospatial Information. Geospatial data and information utilization on the planning process and the development of public policy currently is still not optimal. Indonesia is still in preparation process to integrate and to harmonize GI (BGI and TGI) through a standard starting from identification of IG needs, GI evaluation of existing standards, as well as harmonization of standards. The high demand for geospatial data and information should be anticipated, and hence standards become a necessity as the standard reference in the implementation of GI activities. It is important to strengthen the national position of the GI facing natural movement in the level of Association of Southeast Asian Nations (ASEAN) and in global market level. Currently, Geospatial Information Agency (BIG) as competent authority of surveying services in Indonesia is participating in equalizing national competency in ASEAN surveying services level through Mutual Recognition Arrangement (MRA).

Standard for implementation of the geospatial information

Direction of development of geospatial information standards in Indonesia is affected by BIG function in implementing the tasks as defined in Article 2 of Presidential Decree Nr. 94/2011, related to the basic geospatial information (BGI), thematic geospatial information (TGI), and geospatial information infrastructure (GII). Standard is one of the GI infrastructures beside policy, institutional, technology, and human resources. Classification standards that will be used for implementation of the Geospatial Information includes: 1) standard for geospatial data collection; 2) standard for geospatial data and information processing; 3) standard for storage and securing geospatial data and information; 4) standard for dissemination of geospatial data and information; and 5) applications of geospatial information.

There are 90 national standards (Standar Nasional Indonesia – SNI) related to implementation of GI have been produced, both identical adoption and modification of the international standards (ISO), and standards from independent formulation according to national needs (Badan Informasi Geospasial. 2016a).

1) Some of ISO adoption are: reference model; spatial referencing by coordinates; spatial referencing by geographic identifiers; quality principles; quality evaluation procedures; conceptual schema language; extensions for imagery and gridded data; XML schema implementation; web map server interface; services; data quality measures; web feature service; imagery, gridded and coverage data framework; positioning services; observations and measurements; methodology for feature cataloguing; imagery and gridded data; classification system structure; Land Cover Meta Language (LCML); quality assurance of data supply; Geography Markup Language (GML); schema for coverage geometry and functions; Land Administration Domain Model (LADM); Geospatial Digital Rights Management Reference Model (GeoDRM RM); Place Identifier (PI) architecture; imagery sensor models for geo-positioning; calibration and validation of remote sensing imagery sensors and data - part 1: optical sensors; etc.
2) Some of the independent formulation are: technical specifications of the topographic map on level of map accuracy scale 1:10,000; technical specifications of the topographic map on level of map accuracy scale 1:25,000; technical specifications of the topographic map on level of map accuracy scale 1:50,000; technical specifications of the topographic map on level of map accuracy scale 1:250,000; mapping specification of peatland on level of map accuracy scale 1: 50,000 using remote sensing data; survey and mapping of mangrove; horizontal geodetic control networks; vertical geodetic control networks with leveling methods; gravity control network; classification coverage of the seabed; hydrographic survey using single beam echo sounder; bathymetry survey using single beam echo sounder; base map accuracy; spatial metadata; etc.

BIG is in collaboration with National Standardization Agency of Indonesia (BSN) which have missions to develop and organize standardization activities in Indonesia. Implementation of existing GI standards must be maintained and monitored. Maintenance is done by review mechanism process (kaji ulang), which is conducted at least once in five years. If there are new standard needs in the field of GI based on development of science and technology, the development of SNI is carried out through the following stages: Stage 1: Programming SNI; Stage 2 Formulation of the Plan SNI (RSNI); Phase 3 Polls RSNI3; Stage 4 of the Agreement RSNI4; Stage 5 Determination

of SNI; and Stage 6 Maintenance SNI.

Besides providing national standards (SNI), BIG also evaluate the development of standard operational procedures (SOP) on implementation of GI in 2017.

1) Results on implementation of BGI:
   - from 61 existing SOPs on classification geospatial data collection related to photogrametry and remote sensing, geodetic control network and geodynamic, and hydrography, there are 22 SOPs need modification (i.e., SOP regarding radar data collection, lidar data collection, ground control point measurements for mapping by Ifsar, etc), 1 SOP must be deleted because mechanical optics-based on photogrammetry processing is not used anymore in the mapping industry and some definitions not in accordance with scientific principles (SOP regarding conventional triangulation);
   - from 46 existing SOPs on geospatial data and information processing related to photogrametry and remote sensing, geodetic control network and geodynamic, and hydrography, there are 27 SOPs need modification (i.e., SOP regarding optimization geodynamic control point network and deformation, implementation of camera calibration, implementation photogrammetry survey in close range, etc), 2 SOPs must be deleted because mechanical optics-based on photogrammetry processing is not used anymore in the mapping industry (SOP regarding compilation of analog stereo photos and digital semi-stereo photos);
   - 15 existing SOPs for storage and securing geospatial data and information are still relevant;
   - 3 existing SOPs for dissemination of geospatial data and information are still relevant.
2) Results on implementation of TGI:
   - from 135 existing SOPs on classification geospatial data collection, there are 3 SOPs need modification (i.e., SOP regarding data collection for slope, digital cartographic map making, and data collection for food security mapping);
   - from 100 existing SOPs on geospatial data and information processing, there are 2 SOPs need modification (i.e., SOP regarding data collection for slope and TGI spatial data representation on land and marine);
   - 21 existing SOPs for storage and securing geospatial data and information are still relevant;
   - 13 existing SOPs for dissemination of geospatial data and information are still relevant;
   - 2 existing SOPs on applications of geospatial information are still relevant.
3) Results on implementation of GII:
   - from 5 existing SOPs on classification geospatial data collection, there are 2 SOPs need modification (i.e., SOP regarding inventory of GI standards needs and FU planning);
   - from 46 existing SOPs on geospatial data and information processing, there are 29 SOPs need modification (i.e., SOP regarding quality evaluation on TGI geodatabase, quality evaluation on topography map of Indonesia on high, medium, and low level of map accuracy, quality evaluation on national horizontal geodetic control networks, vertical geodetic control networks, and national gravity network, etc);
   - 57 existing SOPs for storage and securing geospatial data and information, there are 29 SOPs need modification (i.e., SOP regarding monitoring applications, access to the data center, application testing and app changes, OP network access requests for internet and intranet services - maintenance of system and network security, etc);
   - 37 existing SOPs for dissemination of geospatial data and information, there are 7 SOPs need modification (i.e., SOP regarding consultation mechanism for implementation of geospatial information distributed network node (geoportal), development on Spatial Data Infrastructures Development Center (PPIDS), development on policy formulation of geospatial information distributed network node, etc)
   - 1 existing SOP on applications of geospatial information is still relevant.

The purpose of the national standard and procedure making of the GI implementation is so that the procedure for the implementation of GI start upstream to downstream processes can be understood and operationalized by all stakeholders, and to ensure that the process of the GI made by stakeholders are aligned to achieve better GI management. Standards and procedures (SOPs) need to be known and be understood by GI professionals because these standards provide direction to the minimum specifications and stages of work on the job.

Competency standard development in geospatial information

Surveying profession in Indonesia generally covers topographic surveying for the purpose of producing base of geospatial information. There are seven scopes competencies which have inventoried by Geospatial Information Agency: Terrestrial Survey, Hydrography, Photogrammetry, Remote Sensing, Geographical Information System, Cartography, and Regional Survey. According to working field (Amhar, F., et al. 2016), big number the existing GI manpower in Indonesia are working in surveys & mapping (41%), followed by research and development (16%), spatial planning (13%) and land cadaster (12%). Projection of national demand of GI manpower in 2019 show, the need projection 35,316, manpower availability 18,584, with manpower gap 19,233. Some expertise fields such as photogrammetry

and GIS software development, still need high number of human resources. BIG with GI stakeholders together set up formulation team and verification team to determine the parameters which will develop a model of competency standards and its framework, entry level competency standards to GI possible job. Anyone who intends to be a GI professional in Indonesia must have sufficient knowledge, skill, and attitude of surveying that meet the qualification.

There are major concerns being voiced by critics on competency standard developments such as competency standard cannot capture the rich, complex nature of professional work with its creative thinking, problem solving, and professional judgment, competency standard is more applicable in the trades and technician arenas. There is also uncertainty as to the extent that the generic attributes of professionals can be measured. To counter balance these concerns, BIG learn that these standards could be used as a basis for accrediting all professional surveyors. The standard of competency in geospatial information will also help educators better to understand the profession's expectations of graduates, GI professional will better understand their potential roles and how determine their career advancement, and BIG will get big picture to evaluate and develop policy, regulation, and basis assessment for uniform assessment strategy and for quality assurance in certification process for GI professional.

Standard of competency in geospatial information (GI) sector becomes important for several reasons (Narieswari and Sumaryono, 2016): 1) It is a mandate of Act Nr. 4/2014 on geospatial information which requires professionals to be certified; 2) Indonesia, as a member of ASEAN, has signed an agreement on Mutual Recognition Agreement (MRA) on Surveying at the ASEAN Framework Arrangement for the Mutual Recognition of Surveying Qualifications, on November 19, 2007 in Singapore (ASEAN Secretariat, 2015); 3) MRA brings the consequences that workers in GI sector must be certified to compete in MEA (ASEAN Economic Community) labor market which will be implemented starting on the late 2016. MRA itself can be defined as an agreement by all ASEAN countries to mutually recognize or accept all or some of competence assessment results and competence certificates.

BIG and the Ministry of Manpower and Transmigration have already issued the Indonesian National Competency Standards of Work (SKKNI) in 2013 by a regulation from Minister of Manpower and Transmigration Nr. 331/2013 on the Establishment of the Indonesian National Competence Standard of Geospatial Information sector. Ministry of Manpower and Transmigration is leading sector for ensuring the competitiveness of labor in Indonesia, but each sector, along with associations and bussines, is responsible for realizing and improving the competitiveness needed in each respective area. Therefore, all sectors should comply with the requirement, including geospatial sector. (Narieswari and Sumaryono, 2016)

Then, to implement SKKNI, Head of BIG has issued a regulation Nr. 9/2014 on the Application of SKKNI in Geospatial Information sector (SKKNI IG). After three years, BIG evaluate SKKNI and found there are many aspects have changed in GI sector. In SKKNI 2013, we have 102-unit codes, 6 scope competencies, and 5 key functions (planning, collecting, processing, management, and presentation), which are conceived and formulated with reference to the Regional Model Competency Standards (RMCS). In 2017, as per Minister of Manpower and Transmigration Regulation Nr.95/2017, now SKKNI IG have 260-unit codes, 7 scope competencies (new scope is Regional Survey), and 7 key functions (new key functions are supervision and innovation). Indonesian National Qualifications Framework (Kerangka Kualifikasi Nasional Indonesia - KKNI) is required as a reference in the packaging of SKKNI to the degree or level of qualification, so it can set side by side, equal, and integrate the fields of education, work training and work experience, and as a recognition of the work competency in accordance with the structure of employment in various sector. Indonesian National Qualifications Framework applied to the development of a certification scheme.

Development of Human Resource Management Systems

In article 56 of Act Nr.4 / 2011, BIG was mandated to carry out the accreditation of independent institutions or agencies related GI conformity assessment, while for certification activities carried out by institutions that have received a certificate of accreditation or appointed by the BIG. BIG establishes chief regulation Nr. 11/2013 on the System of Certification in the field of Geospatial Information, enhanced by chief regulation Nr. 1/2014. The scope of the accreditation process conducted by the BIG consisting of accreditation to institutions related professionals certification, service providers and training institutes/ courses; initiated the establishment of the Geospatial Information Service Development Agency (LPJIG) assigned to assist BIG in developing of the geospatial information services; and the scope of accreditation conducted by LPJIG covers the accreditation of conformity assessment bodies (CAB) related professionals, service providers, instrumentation, and geospatial information products, as well as training institutions and courses.

In order the accreditation which is issued by BIG recognized by the international community, BIG in collaboration with the National Accreditation Committee (KAN) in carrying out accreditation. In Act Nr. 20/2014 on Standardization and Conformity Assessment, KAN is the only institution given the authority to provide accreditation services conformity assessment institutions (laboratories, inspection bodies, certification bodies) in Indonesia. KAN has gained international recognition MRA/MLA in APLAC (Asia Pacific Laboratory Accreditation Cooperation), ILAC (International Laboratory Accreditation Cooperation), PAC (Pacific Accreditation Cooperation) and IAF (International Accreditation Forum). Collaboration between the two agencies was later formalized on the letter

of agreement between BIG with the KAN Nr. B-8.1/KA/PK/4/2016 and Nr. 008/BSN/MOU/IV/2016 on Implementation of GI Accreditation on April 8, 2016.

National policy of streamlining the government organizational structure in 2015 led to LPJIG not been able to carry out its duties and functions. In order to conformity assessment activities keep running, BIG formed the GI Conformity Assessment Working Group (KKPK IG) through the chief regulation Nr. 1/2016 on conformity assessment system which is enhanced through chief regulation Nr. 10/2016. On January 28, 2016 KKPK IG was formed in the field of Geospatial Information with representatives from academia, business, associations and government. This working group established under Head of Geospatial Information Agency decree Nr. 3/2016 on KKPK IG.

The document product of KKPK IG in 2017 are 1) Guidelines for Accreditation of Geospatial Information Competency Training Institutions, 2) Chief Regulation Nr. 4/2017 regarding the Procedure for Certification of Professionals in the field of Geospatial Information, 3) Decree of Chief Nr. 21.3/2017 regarding Standards Test Requirements for Certification of Professionals in the field of Geospatial Information, 4) Decree of Chief Nr. 27/2017 regarding Classification and Qualification as Service Provider in the field of Geospatial Information, 5) Document of Standard Competency Practice in Geospatial Information Sector, including sub-field of Terrestrial Surveys, Hydrography surveys, Photogrammetry survey, Cartography, Remote Sensing, Geographic Information System, and Regional Surveys, 6) Evaluation Guidelines and Guidelines for Geospatial Information Product Certification (Quality Assessment Guidelines for The Education Atlas), 7) Two Conformity Assessment Bodies (LPK) in the Geospatial Information sector have been accredited and 3 LPKs in the accreditation process at the end of 2017.

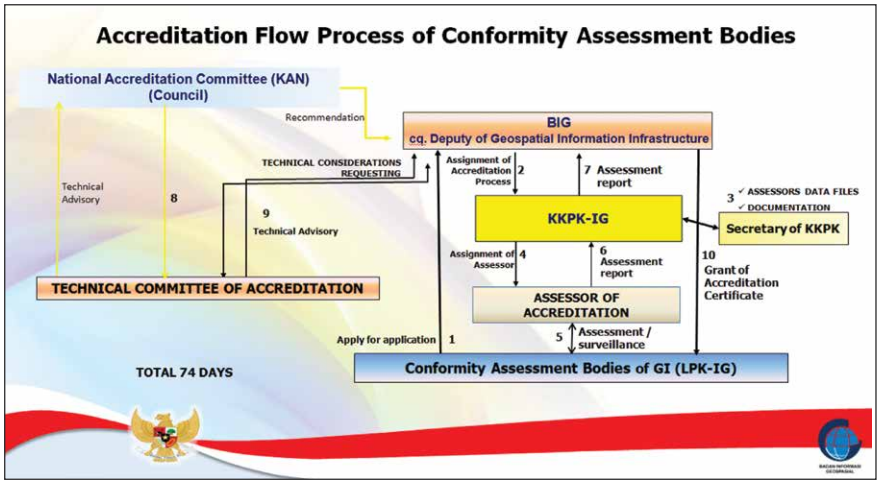

Figure 1. Accreditation Flow Process of Conformity Assessment Bodies (BIG, 2016b)

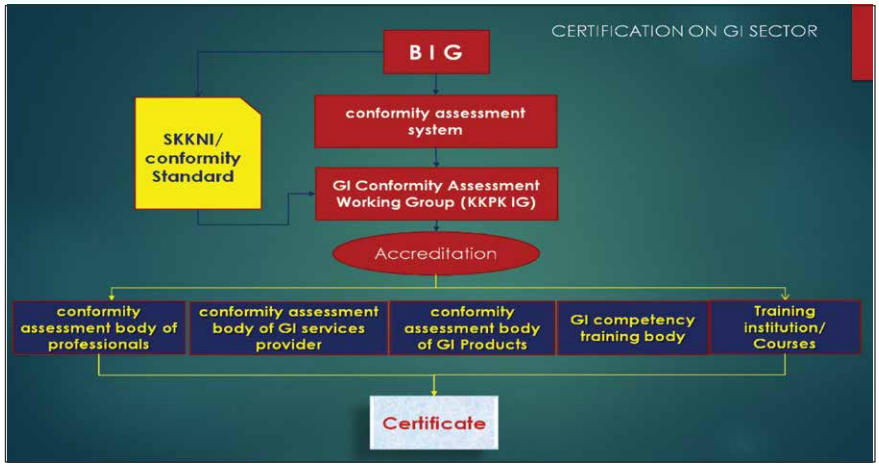

Figure 2. Certification Process in GI

Development of Accreditation and Certification

Accreditation is granted formal recognition by the accreditation body of the competence of an institution or organization in doing particular conformity assessment activities. Certification is a statement of suitability from third parties related to products, processes, management systems or personal to a particular standard. Before conducting a accreditation and certification, accreditation assessors trained on: 1) deepening of ISO/IEC 17011:2011 conformity assessment - general requirements for accreditation bodies accrediting conformity assessment bodies; 2) ISO/IEC 17067: 2013 conformity assessment - fundamentals of product certification and guidelines for product certification schemes; 3) documents of quality KAN; 4) management system requirements in SNI ISO/IEC 17065:2012 (conformity assessment - requirements for bodies certifying products, processes and services) and SNI ISO/IEC 17024:2012 (conformity assessment - general requirements for bodies operating certification of persons); 5) ISO 19011: 2012 - standard for auditing management systems.

Guideline document for accreditation of GI conformity assessment body is used as a reference in the proposal of accreditation on conformity assessment body of professionals and GI services provider. The guidelines which published by the BIG is a reference in determining the general requirements for BIG to accredit CABs. Guidelines for Accreditation of Conformity Assessment adopted from SNI ISO/IEC 17065:2012 on conformity assessment - requirements for bodies certifying products, processes and services and

SNI ISO/IEC 17024:2012 on conformity assessment - general requirements for bodies operating certification of persons.

Accreditation to the CAB Professionals aims to: 1) improve the quality of GI conducted by professionals; 2) protect government agencies, local authorities, and everyone from improper GI implementation and inadequate with GI standards; and 3) improve the certainty, fluency, and efficiency of the GI implementation. Before taking the accreditation, accreditation process need to be known and be understood by applicant. On KAN website, there are accreditation information and criteria, preliminary visit, accreditation application (KAN only responds CABs that submit formal application for accreditation, which is signed by authorized representative of the CABs), contract review, sub-contract for assessment, preparation for assessment, adequacy audit, on-site assessment, analysis of assessment findings and report, surveillance and reassessment, witness of CAB performance, extending scope of accreditation, proficiency testing (for laboratories and inspection bodies), decision making and granting accreditation, suspending, withdrawing and reducing accreditation scope, which should be followed properly and prepared by the applicant.

Accreditation is still ongoing in the beginning 2017, but now, two conformity assessment bodies (LPK) in the Geospatial Information sector have been accredited and 3 LPKs in the accreditation process at the end of 2017. This means GI professional certification can be monitored from the quality and quantity. GI certification system is based on SKKNI and certification system will be harmonized with the ASEAN MRA on surveying certification system. BIG has a big dream to GI One Certificate Policy Program. This is a future challenge, how to unite the professional certification system in the field of GI for various sectors. Inter-sector certification system nowadays that is currently running, still requires regulation as mutual recognition, so it makes more efficient, scalable, and traceable in accordance with the professional standards of IG, nationally and internationally.

Acknowledgement

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References

Amhar, Fahmi, et al. 2016. Projection of Geospatial Human Resources in Indonesia until 2025. FIG Working Week 2016

ASEAN Secretariat. 2015. Handbook on Liberalisation of Professional Services through Mutual Recognition in ASEAN: Surveying Services. Jakarta

Badan Informasi Geospasial. 2016a. Katalog Standar Nasional Indonesia Penyelenggaraan Informasi Geospasial (Indonesian National Standard Catalog - Implementation of Geospatial Information)

Badan Informasi Geospasial. 2016b. Laporan Akhir Kegiatan Kelompok Kerja Penilaian Kesesuaian (Final Report of the Conformity Assessment Working Group)

International Organization for Standardization. 2014. ISO/TR 19122:2004 Technical Report Geographic information/Geomatics: Qualification and certification of personel;

Kementerian Hukum dan HAM. 2011. Undang-Undang Republik Indonesia No. 4 Tahun 2011 tentang Informasi Geospasial (Act Number 4 year 2011 on Geospatial Information)

Kementerian Hukum dan HAM. 2014. Undang-Undang Republik Indonesia No. 20 Tahun 2014 tentang Standardisasi dan Penilaian Kesesuaian (Act Number 20 year 2014 on Standardization and Conformity Assessment).

Komite Akreditasi Nasional. 2017. Accreditation Process - Accreditation Information and Criteria. http://www.kan.or.id/?page_id=93&lang=en

Ministry of Finance Republic of Indonesia. 2015. Government Preparing Regulation of Acceleration of Implementation of One Map Policy. http://www.kemenkeu.go.id/en/Berita/government-preparing-regulation-acceleration-implementation-one-map-policy%3Ftag%3Dpaket

Narieswari, L. and Sumaryono. 2016. Indonesia's Experience in Developing Geospatial Professional Competency Standard. FIG Working Week 2016

Republic of Indonesia. 2014. Buku II Agenda Pembangunan Bidang - Rencana Pembangunan Jangka Menengah Nasional (RPJMN) 2015-2019 (National Medium-Term Development Plan from 2015 to 2019) http://www.bpkp.go.id/public/upload/unit/sesma/files/Buku%20II%20RPJMN%202015-2019.pdf

Shahab, Nabiha. 2016. 2016. Indonesia: One Map Policy. 1st Edition Open Government Partnership http://www.opengovpartnership.org/sites/default/files/case-study_Indonesia_One-Map-Policy.pdf

Silalahi, Florence Elfriede S. and Annacletus Ari Dartoyo. 2015. Potensi Kebutuhan Standar Bidang Informasi Geospasial di Indonesia (Potential Need for Standards on Geospatial Information Sector in Indonesia)

The Institution of Surveyors, Australia. National Competency Standards for Professional Surveyors. 1st edition July 1996.

Globalized ethics

This paper discusses ethics in the field of social responsibility, the relationship of professional ethics to professional malpractice, the new IESC code and its relationship to the existing FIG Statement of Ethical Principles and Model Code of Professional Conduct, and the issue of enforcement

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In the 17th and 18th Centuries international trade in land involved a European adventurer planting a flag on a piece of unexplored land on an undeveloped continent, then claiming it "for the king." It is more complicated today in this age of globalization, in which large amounts of capital are exchanged through a myriad of marketing systems, investment, currency exchange and political consideration. Real estate professionals of all stripes are involved including lawyers, realtors, appraisers, agents, bankers and surveyors.

Laws and national policies on land markets differ from country to country and require the careful research of the various professionals involved, a complicated but achievable process. What is not so easy is navigating the labyrinth of customs and ethical practices of the many cultures participating in international real estate mercantilism. The ethics of the professions, internationally, is a subject that has become of some considerable concern.

Because real estate is integral to whole societies and economies, it shapes and influences the world we live in and represents a significant proportion of all global wealth. For this reason professionals have a duty to uphold the highest standards.

Those are the words of the International Ethics Standards Coalition (IESC) who have developed an international ethics standard for real estate activity.

The IESC is made up of over 100 international organizations of real estate professionals like FIABCI, the international appraisers, RICS the Royal Institute of Chartered Surveyors and other property-related professions. A standard with the objective to "support the creation, maintenance and use of high quality, international and principle-based ethics standards through a transparent and inclusive standard setting process," has been published by the Coalition and distributed.

The International Federation of Surveyors (FIG) has its own "Statement of Ethical Principles and Model Code of Professional Conduct" and is supportive of the IESC code. This paper considers the intentions and implications of codes of ethical standards by professional organizations.

The continuum of social responsibility

Ethics, by one definition, is the system or code of morals of a particular person, religion, group, or profession. Stated another way, ethics is one level of social responsibility on a continuum from social norms to ethics to regulation to law, from voluntary to mandatory.

Courtesy, "boundaries" and "ground rules" are unwritten but generally recognized as social norms. Similarly, the Chinese recognize sushi as reflecting a person's inner qualities of behavior, ethics, education, intellect and even taste.

Norms are an imprecise laying-out of

Ethical codes and standards are a necessary component of any profession. The FIG code is typical and the proposed IESC code for land-related professionals will be a valuable addition to international land transactions

what ought to be according to unwritten social expectations, existing for as long as there is consensus. A breach of social norms may bring social opprobrium, shame or at the worst, social outcast.

In the context of the professions regulation is the enforcement power behind licensure. A breach of a professional regulation may lead to disciplinary action by the licensing authority involving suspension or revocation of a license.

Where licensure and licensing regulations are promulgated by law, they have the force of law. But beyond licensure the professional is subject to statutory law as are all citizens and may be disciplined for a breach of law by fines or even imprisonment.

Social ethics, like social norms, may also be unwritten, generally recognized and subject to social opprobrium in the breach. But systems of ethics as embraced by nearly all professional associations are specified and encoded and are intended to be binding on all members. A breach by a professional member of the ethical code of the association to which she belongs may bring the disapproval of other professional members, but enforcement and disciplinary action by the member's association is problematic.

The Background to the FIG "Statement of Principles and Model Code of Professional Conduct" (FIG Publication No.17) carries the following statement regarding enforcement:

Enforcement

"FIG recognizes that, due to international differences of culture, language, and legal and social systems, the task of preparing a detailed code of professional conduct must rest with each member association, which also has the responsibility to implement and enforce such a code." This Statement goes on to recommend that surveyors and their associations "adopt the following ethical principles and model codes of professional conduct or, where appropriate, adapt them to local values and customs."

> Ethical codes are, in fact central to the scope and operation of a profession's members. But ethical codes and standards must be basically advisory rather than regulatory

(Emphasis added.) In other words, the FIG code provides for some application of situational ethics, allowing for local values and customs. The same is apparently true in the IES standards. A briefing document advises that "the method by which effective implementation is accomplished is at the discretion of the members themselves."

The Internal Rules of the Federation define a Member Association as being comprised of individuals … "who provide professional services in accordance with ethical standards." There is no reference in the FIG Statutes and Internal Rules to the Statement of Principles and Model Code of Professional Conduct. The Council and General Assembly must assume that candidates for membership in the Federation are aware of the Statement but there is no requirement in the application process that a member recognize and respect the FIG code in all its particulars.

Enforcement of a professional association's code of ethics is an issue. Many of the FIG codes are immeasurable. For instance, on the subject of providing professional services surveyors are told to "seek remuneration commensurate with the technical complexity, level of responsibility and liability for the services provided." Judging the fairness of a surveyor's fees on the basis of such requirements would involve subjective examination; there are no metrics to be applied in the judgment. It is not unusual for a surveyor and his client to dispute a fee on the basis of complexity, level of responsibility and liability assumed by the surveyor in furnishing the services; it is usually a matter of the surveyor's experience-based judgment versus the client's opinion. A charge of breach of ethics by a client against a surveyor in this situation would put a professional surveying association in a nearly impossible position of enforcement. In fact, unlike a charge of malpractice on the part of a surveyor, which requires objective judgment, judging a breach of ethics is nearly always a subjective process making enforcement extremely difficult.

In addition to sanctions imposed by licensing authorities the professional is also subject to charges (suits) by individuals for malpractice or negligence (on a theory of torts for private wrong or injury other than breach of contract).

Professional ethics/ professional malpractice

Is a breach of professional ethics equivalent to professional malpractice? The following examples are of cases of malpractice or negligence claims against surveyors and engineers in the United States, and an examination of the related FIG code recommendations on the subject.

Example: A surveyor provided professional services to two different clients, land developers with adjoining projects. Both developers went through the planning/ permitting process almost simultaneously. The project for Developer #2 depended upon the installation of services and roadway access from development #1.

Developer #1 delayed completion of construction of the connecting road until most of his development was completed (with survey control by the surveyor) and sold, delaying the start of development #2 for several years. Developer #2 charged the surveyor with a strategy of collusion and malpractice by Developer #1. Expert testimony in the case charged the surveyor with an ethical violation but could not opine negligence or malpractice according to local codes and regulations.

The case was settled without final judgment by the court. The FIG Code of Professional Conduct recommends that "(w)hen dealing with clients, surveyors: disclose potential conflicts of interest," and "preserve the confidences and regard as privileged all information about their client's affairs." Whether the surveyor in this case actually colluded with one of his clients to the detriment of the other, he was burdened by a potential conflict of interest by the fact of his providing services to clients with mutually exclusive interests.

Example: A surveyor performed a simple retracement survey for the owner of residential, property. A dispute over the lines arose between the surveyor's client and the client's neighbor. When it was discovered that the surveyor was related to the neighbor, the surveyor's client sued him for malpractice. This case, too, was settled without judgment. The terms of the settlement were not disclosed.
The issue in this case is one of potential conflict of interest. The surveyor may well have, and probably did, do a competent, unbiased survey for his client, but since the result of his survey favored the claim of his relative he was unable to defend successfully against the claim of a potential (or apparent) conflict and made an offer of settlement. The FIG code advises that when dealing with clients, surveyors "disclose any potential conflicts of interest…"

History and experience show that potential or apparent conflicts of interest can be as damaging as actual conflicts, demonstrating once again the difficulty of proving a negative.

Example: The FIG Code advises that as business practitioners, surveyors: "do not supplant other surveyors under agreement with their clients." This constraint against supplanting, or attempting to take business away from a competitor, is not uncommon among US engineering and surveying associations. In a case in which an engineering association attempted to discipline a member for attempting to contract for services on a project on which another member of the association was engaged contractually, a court in the resulting suit determined that the association could not interfere in

an engineer's marketing of his services. This case raises the question of the relevance and efficacy of the constraint against supplanting as an ethical issue.

Conclusion

The cases cited here were heard and settled through the American judicial system. How they might have been handled in other countries with different judicial systems is unknown. Time and testing of the IES standard will determine the efficacy and applicability of the standard globally.

These cases also demonstrate the uncertainty and ambiguity in disciplinary actions for breach of ethics. The profession, as represented by an association of members, is poorly positioned to enforce its ethical codes, at least in the United States. Compliance becomes, finally, a matter of self-imposition motivated by the integrity of the individual professional.

Society judges us by its social norms; our professional associations judge us by their ethical codes. Licensing boards judge how well we comply with their regulations while the State judges how well we comply with its laws. A breach of social norms may bring opprobrium; a breach of ethics may bring chastisement; a breach of regulations may bring sanctions, and prosecution may be the penalty for a breach of law.

Ethical codes and standards are a necessary component of any profession. The FIG code is typical and the proposed IESC code for land-related professionals will be a valuable addition to international land transactions. Ethical codes are, in fact central to the scope and operation of a profession's members. But ethical codes and standards must be basically advisory rather than regulatory; enforcement may only be rarely called for and then only in response to the most egregious offense.

The IESC code, if adopted by professionals in those regions where graft and corruption are common, may provide a new ethical paradigm in cross-border transactions, and will serve as a reminder of how business is to be conducted in the more enlightened economies of the World. Commerce at every level depends upon trust. It is a principle of the IES code that the practice and conduct of the profession "bears upon the maintenance of public trust and confidence …" in members of the profession.

References

1. IES, International Ethical Standards, www.ies-coalition.org

2. Statement of Ethical Principles and Model Code of Professional Conduct, Publication , No. 17, FIG International Federation of Surveyors

3. IES Coalition publication briefing document, www.ies.coalition.org

4. Statutes and Internal Rules, Fig Publication No.18

The paper was presented at FIG Congress 2018, 6-11 May 2018, Istanbul, Turkey.

International Ethics Standards

Why ethics standards are of limited use on their own for professionals working in land, property and construction - and if to be effective how such standards need to be embedded, monitored and regulated against

Gary Strong
Global Building Standards Director, RICS - Royal Institution of Chartered Surveyors, UK

In 2014 in KL I delivered an initial paper which explored the opportunities and very real benefits that could be afforded not only to professionals working in land, property and construction surveying but also to clients, the public and society more generally by the setting, promotion and monitoring of international standards on ethics.

Trust between businesses and society is still at a low point and there is a real danger that focusing on targets and regulations can drive dysfunctional and unethical behaviour.

However, a code of ethics on its own is potentially of limited use and this paper takes the subject further focusing on the following issues:

- Is just having ethics standards enough? – do you produce standards and leave it at that?
- Will that really get buy in? How are the standards to be regulated ?
- What does adoption look like and what are the risks to an organisations or country's reputation if people just pay lip service?
- An update on the work that has been undertaken in the last year by the International Ethics Standards (IES) coalition and the increasing interest in this project from varying organisations, stakeholders and governments inc the UN and World Bank. The IES were published in Dec 2016, and all 110+ members of the Coalition (inc FIG and many member associations within FIG) are committed to adopting into their own organisations.
- The challenges the FIG faces in coming to terms with the varying global definitions of what is ethical, how the various members will be challenged to implement IES.
- How FIG Commission 1 intend to provide guidance across our many diverse types of members working in different fields of surveying.
- How are FIG intending to get the message across to members across the world and how we are looking to embed ethics standards into our constituent professional bodies membership requirements, training and (critically) regulation.
- Should compliance with ethics standards be reactive or proactively measured?

Ethical behaviours by professionals is critical to both business, consumers and society in general but what more needs to be done to continue trying to change what for many is 'normal business practice'.

We intend in FIG Commission 1 to build on the growing interest generated initially in KL in 2014, then Sofia in 2015, New Zealand in 2016, Helsinki 2017 and the International Ethics Standards Coalition of over 110 professional bodies globally who have now come together on this topic, to hold a workshop in Istanbul to hear updates from countries and their representatives about real life examples of ethical issues they face as surveyors in their geographies.

This will help the FIG Commission 1 Working Group ensure the new FIG Ethics Code, which is a major feature of the workplan for 2014-18, can comfortably be replaced by the International Ethics Standard published in late 2016, and we can start to work on the guidance material which we think member associations and surveyors around the world.

The paper was presented at FIG Congress 2018, 6-11 May 2018, Istanbul, Turkey.

The International Ethics Standards were published in Dec 2016, and all 110+ members of the Coalition (inc FIG and many member associations within FIG) are committed to adopting into their own organisations

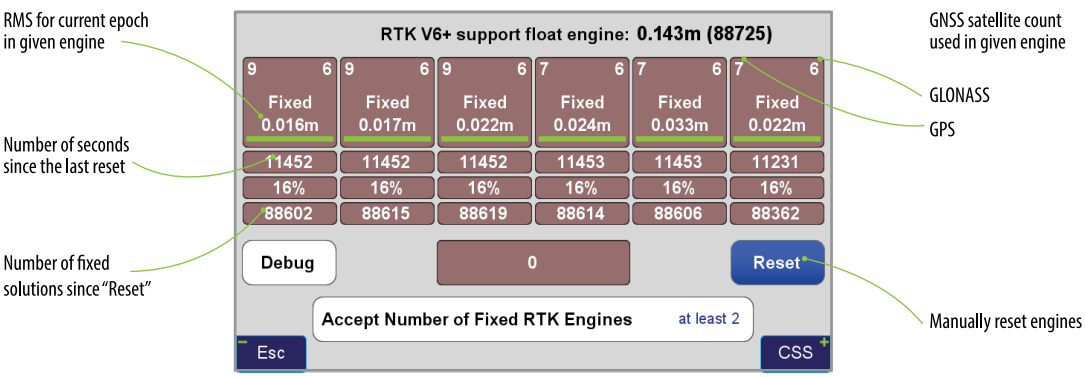
With our 6+ RTK Engines

Monitor the health of your RTK shots. Verify, Record, Present and Defend.

RTK is a statistical process by nature and needs **verification**. TRIUMPH-LS has **six different RTK engines** and extensive automatic verification to ensure your shots are 100% reliable.

It also has many tools to **document** the process of your shots for **presentation** when you need to **prove** and **defend**. The screen shots on following pages can automatically be recorded and attached to each point and easily **exported in HTML format**.

Auto Verify... Auto Validate...



This vigorous, automated approach to verifying the fixed ambiguities determined by TRIUMPH-LS gives the user confidence in his results and saves considerable time compared to the methods required to obtain minimal confidence in the fixed ambiguity solutions of other RTK rovers and data collectors on the market today. The methods required by other systems are not nearly so automated, often requiring the user to manually reset the single engine of his rover, storing another point representing the original point and then manually comparing the two by inverse, all to achieve a single check on the accuracy of the fixed ambiguities. Acquiring more confidence requires manually storing and manually evaluating more points. Conversely, J-Field automatically performs this test, resetting the multiple engines, multiple times (as defined by the user), provides an instant graphic display of the test results, and produces one single point upon completion.

Read details inside and compare with other receivers that require Multiple Point survey, Manual Evaluation, Single Engine, and Single Ambiguity Check per Point.

With TRIUMPH-LS you need Single Point survey, Automated Evaluation, Multiple Engines, and Multiple Ambiguity Checks per Point.

JAVAD

www.javad.com

Spoofer Detection

With 864 channels and about 130,000 quick acquisition correlators in our TRIUMPH chip, we have resources to assign more than one channel to each satellite to find ALL signals that are transmitted with that GNSS satellite PRN code.

If we detect more than one reasonable and consistent correlation peak for any PRN code, we know that we are being spoofed and can identify the spoofed signals.

When we detect that spoofing is in effect, we use the position solution provided by all other clean signals (L1, L2, L5, etc... GPS, GLONASS, Galileo, Beidou, etc...) to identify the spoofer signal and use the real satellite measurement. If all GNSS signals are spoofed or jammed, then we alarm you to ignore GNSS and use other sensors in your integrated system.

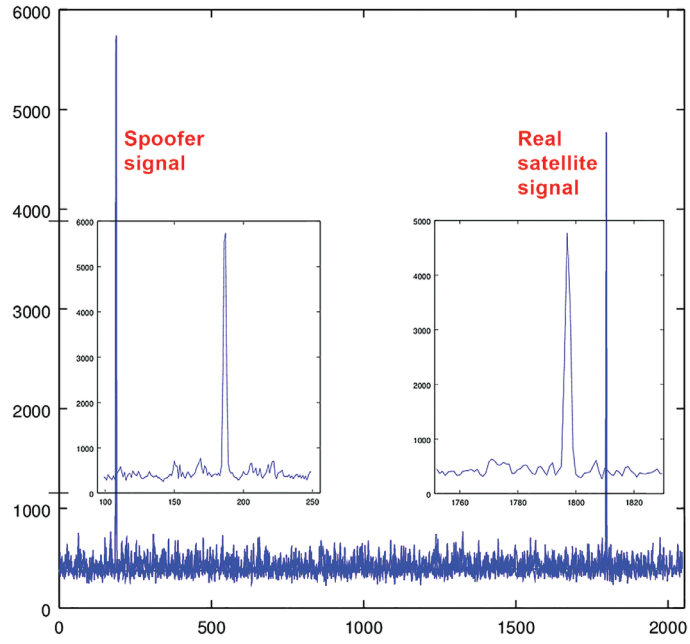


Figure 1
shows an example of a spoofer signal and a real satellite signal received at GNSS receiver.

Satellite and Spoofer Peaks

The screenshots below are from a real spoofer in a large city. The bold numbers are for the detected peaks. The gray numbers represent highest noise, not a consistent peak. "*" symbol next to the CNT numbers indicate that signal is used in position calculation. Each CNT count represent about 5 seconds of continuous peak tracking.

SAT	EL	S...	Range 1	Dopp...	CNT 1	S...	Range 2	Dopp...	CNT 2	dRng	dDop	N
GPS5	33	16	61.14	1382	184*	4	25.95	181	1	29.32	1201	29
GPS7	51	21	14.39	1146	184*	4	18.21	-453	1	2.80	1599	29
GPS8	30	18	65.10	-918	184*	4	4.26	-1318	1	3.68	400	29
GPS9	12	14	40.46	2966	184*	4	2.08	3765	1	26.13	-799	29
GPS13	40	16	46.92	-3525	184*	4	8.21	-4325	1	25.80	800	29
GPS15	12	14	12.46	-4336	30*	5	33.00	-1536	1	19.52	-2800	28
GPS20	24	12	13.19	-1707	107*	4	29.32	-3307	1	15.11	1600	29
GPS27	16	11	10.26	1264	184*	4	43.55	63	1	31.22	1201	29
GPS28	53	19	9.41	-2724	184*	4	7.93	-4724	1	0.46	2000	29
GPS30	81	22	13.79	-332	184*	5	34.16	1266	1	19.35	-1598	28
GLN-4	54	20	62.08	1498	1158*	5	21.72	2697	1	24.16	-1199	25
GLN5	46	20	18.04	-2897	524*	4	26.26	-3697	1	7.20	800	25
GLN0	37	18	30.37	2355	1469*	4	38.37	1554	1	6.98	801	25
GLN-1	82	18	34.92	-776	189*	4	12.54	-1576	1	21.35	800	25
GLN-2	26	12	30.96	-4358	229*	4	11.80	-3158	1	18.13	-1200	25
GLN2	21	10	59.73	288	551*	4	47.55	1087	1	11.16	-799	25
GLN4	22	15	30.59	-3361	208*	4	11.74	-5361	1	17.83	2000	25
GLN-5	21	14	20.17	276	187+	3	25.45	2275	1	4.26	-1999	25

Esc Sat: 10 7 6 4 4 0 dPos: 19.0m Age: <1s

Figure 2 *No spoofer. Only one reasonable peak for each satellite.*

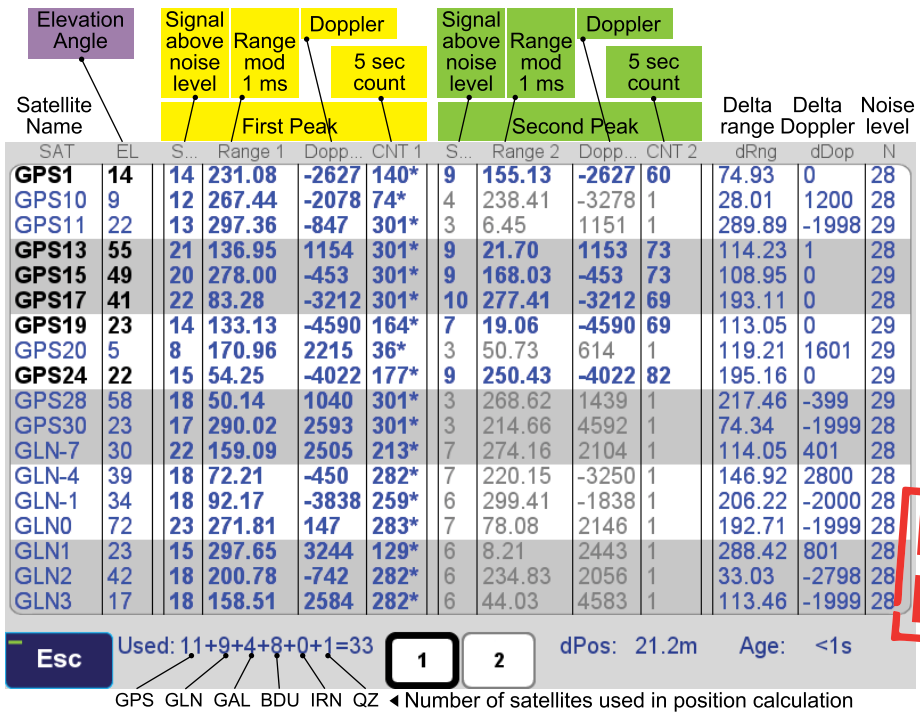


Figure 3
In the screenshot all GPS satellites have two peaks and all are spoofed. We were able to distinguish the spoofer signal and use the real satellite signals in correct position calculation as indicated by the "" next to the CNT numbers.*

PATENTS PENDING

BEAST MODE RTK

Real 5-Hz Base Station Transmission

All RTK base stations (including RTNs) transmit data once per second. We are introducing The BEAST MODE RTK, real 5-Hz Base Station Transmission. Here are testimonials:

Well this just about has to be the most amazing single improvement I have observed.

I am most assuredly getting faster fixes under tree cover. And the ability to collect 5 times as many honest epochs in the same time period is wonderful.

My quick little test doing 3 epoch, lift to start topography actually made me laugh because it is so fast.

The only thing users need to know is that if they must use the RTK Delay setting of None for the allowable correction age, otherwise they will only see 1Hz updates. As Javad told us, extrapolate is a sin we should avoid.

I have a feeling that we are now seeing fixes, that are actually occurring 5 times as fast under tree cover. In my “bad spot” under a tree, I am making it through 10 resets in less than 10 seconds. This is simply amazing.

John Evers, PLS

In a test I just did under a tree, I would reset the RTK engines and use a stopwatch to time how long it took 2 engines to fix.

With 1 Hz it was averaging over 30 seconds and with 5 Hz it is in few seconds.

Mine is up and running fine. This thing is so fast now it is hard to believe!

Matthew D. Sibole, PLS

Be aware that increasing the transmission rate increases the battery usage of the radio and will also increase the heat generated inside it. For 2 Hz corrections you should use D8PSK or D16QAM modulation. D16QAM has the most bandwidth and is required for 5 Hz transmissions but may reduce the range of the radio some. If you are using a 35 watt radio the fan should be used with 5 Hz corrections if the output power is more than 4 watts.

Matt Johnson, PLS

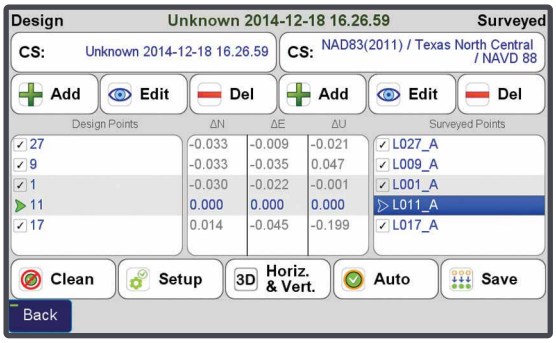
Precision with TRIUMPH-LS

Our friend from Javad GNSS, Michael Glutting, recently related that a surveyor in Minnesota asked how he could use his Triumph-LS and corrections from the MnCORS real time network to accurately work within his projects previously established with HARN. The MnDOT provides mount points for various adjustments of NAD83, however, a surveyor can quickly produce reliable, highly accurate transformation parameters for a local set of known positions as this paper describes.

In 2000, Stanger Surveying of Tyler, Texas, established a GPS control network consisting of 30 monuments for my hometown of Kilgore, Texas, over an area measuring about 7 miles square (50 square miles). Even after 15 years, the network proves to be incredibly accurate and was well constructed with ties to two different HARN PACS (High Accuracy Reference Network Primary Airport Control Stations) and multiple repeat and braced vectors. This network predated the modern proliferation of CORS stations, and so there is no precise relation to the CORS and therefore no precise relationship to NAD83_2011. This means that there is some unknown translation from the Kilgore GPS Control Network of 2000 and NAD83_2011. Because of this, we must resolve these transformation values by observation.

To do this, we conducted two field campaigns. In both sessions, I placed a Javad GNSS receiver on a stable monument, POST, located at our office. The first session, I used a Triumph-1, and for the second, I used a Triumph-2, both broadcasting corrections over the Internet via TCP. The NAD83_2011 position of POST has been accurately determined by hundreds of hours of data from several different GPS receivers processed through OPUS.

In the first session, my father, J.D., and I observed five different monuments from the Kilgore network with the Triumph-LS for 90-120 seconds each. These points were the primary control Stanger established from the HARN PACS. After observing those five points I performed a preliminary localization.



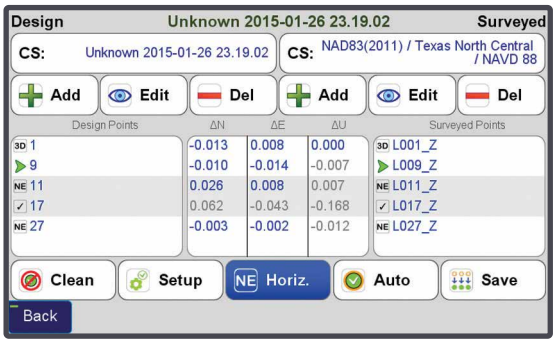
In this preliminary localization, I fixed only one point (point L011_A). Three of the remaining four show very low residuals, however point L017_A, with its noticeably higher vertical residual suggests this point has been displaced since it was established in 2000, or that there is an error in the observation itself - only a repeat occupation will tell.

During the second session, we observed the five points again and used the average tool in J-Field to perform a weighted average of the two points. The second observations showed excellent agreement with the first observations. This chart shows the difference in the repeat observations for each of the five stations:

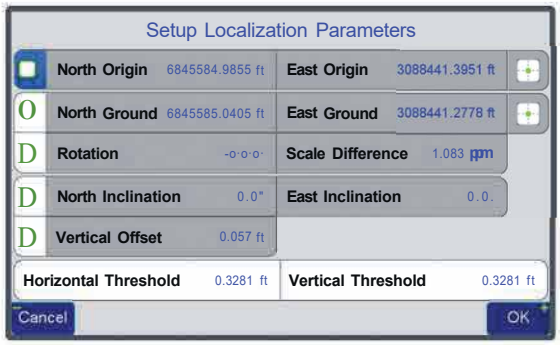
STATION	Base-Rover Vector Length (usft)	Δ 2D (usft)	Δ UP (usft)
L001	37342.3	0.097	-0.029
L009	23155.7	0.048	-0.139
L011	13559.4	0.049	-0.005
L017	24184.6	0.036	0.033
L027	2285.9	0.032	-0.005

With the five control points averaged, I began the localization process again. First I performed a minimally constrained localization holding only point L001. Notice that point L017 still appears to be an outlier.

Next, I constrained horizontally to L001, L009, L011 and L027 while still only fixing point L001 vertically. The residuals predictably decrease among the points fixed.

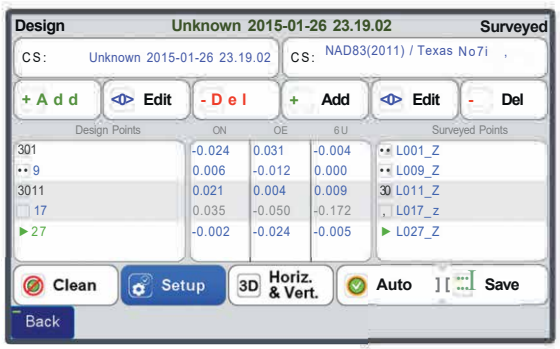


With the residuals indicating a good fit, I turn my attention to the parameters of the localization.

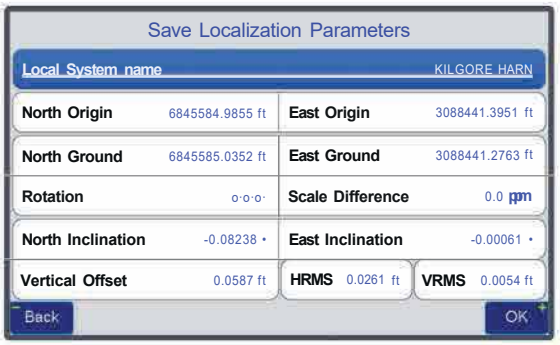


From these parameters, several observations can be made immediately. Because both surveys relied upon the same definition of North, it is expected that there would be little, or no rotation. Furthermore, because both surveys relied upon the same definition of the foot, US Survey foot measured along the same grid surface, Texas Coordinate System of 1983, North Central Zone, there should be little difference in the scale factor. The rotation determined is less than half of one arc second and the scale factor being applied to best fit my survey to Stanger's original work is only 1 part-per-million, revealing very good relative agreement between the surveys.

Finally, I am ready to perform a fully constrained localization, holding all four points (still disregarding the displaced monument L017) both horizontal and vertical.



I set both the rotation and scale to zero as I do not want to redefine North nor the US Survey Foot. Now that more than one point is involved vertically, a tilted plane is calculated. Because the Stanger survey was based on Geoid96 and today's survey is based on Geoid12A, I left the tilt values intact. In this case the inclination values are so small as to be practically insignificant.



The final results indicate that the translation between the Kilgore GPS Control Network of 2000 and NAD83_2011, epoch 2010, (usft) is N: -0.0497 E: +0.1188 U: -0.0587. From this point forward, I can use this new localization system to survey in coordinates related to the Kilgore GPS Control Network of 2000 with a reference station broadcasting NAD83_2011 corrections, or I can transform coordinates from surveys related to the Kilgore GPS Control Network of 2000 to NAD83_2011.

The final step in this exercise is to use this transformation to test on known points. In order to do this, we observed five additional points from the Kilgore network that were not used in the localization. Each point was observed for 120 seconds with the Triumph-LS with corrections from the Triumph-2 onPOST. The chart below depicts the difference in coordinates determined from the LS using the localization and the original Kilgore GPS Control Network of 2000 coordinates.

These residuals can be attributed to several different sources: original survey error, current survey error, displacement over 15 years, as well as errors in the localization/transformation being used. However these results, together with the residuals from the localization, indicate that the localization, as determined, will allow me to reproduce the Kilgore GPS Control Network of 2000 coordinates within a centimeter, anywhere within the network. The total time required to perform this exercise was 4.5 hours in the field (including redundant observations) and 30 minutes of calculations, which were all made within the Triumph-LS.

Shawn Billings, PLS

Station	Base-Rover Vector Length (usft)	2D Residual (usft)	Up Residual (usft)
L007	15363.3	0.036	-0.006
L012	14416.1	0.030	0.101
L019	12900.9	0.025	0.001
L021	7553.0	0.048	0.121
L025	11238.8	0.011	0.048

What is JAVAD?

When I started surveying 16 years ago I never imagined one man could survey large acreages in the mountains of South Carolina. When we found our old GPS system was not providing the accuracy we needed in the time we needed it, we started researching all the options in the GPS market. JAVAD quickly became the first choice because of the 6 GPS engines that work together comparing redundancy calculations to acquire the most accurate measurements, ultimately eliminating the “False Fix” issue we were having with the our old GPS. When we received the unit, I was blown away by the craftsmanship and design of the Triumph LS. It combines the head unit and data collector into one, thus creating a compact design with a informative heads up display that increases overall productivity.

With JAVAD's remote assistance feature, the setup was quick and painless and the support we received from the JAVAD team, especially Adam Plumley, was a welcome surprise. Since purchasing the JAVAD GPS system we have increased our work load while reducing overhead cost, allowing us to compete with larger firms that use traditional GPS units.

On a more personal note, recently the Triumph LS and I were struck by a vehicle in the line of work. We both went over the hood of a SUV that was traveling about 40-45 MPH and I sustained minor scrapes, and bruises, while the LS only sustained cosmetic damage. It took a hit by a SUV, but when the dust settled it was still taking measurements as I scooped it up off the asphalt. Finally a company has created a a GPS unit whose durability is as good as accuracy! I love this GPS and I don't think I could ever go back to traditional GPS; it would be like driving a drag car, then going back to a bicycle.

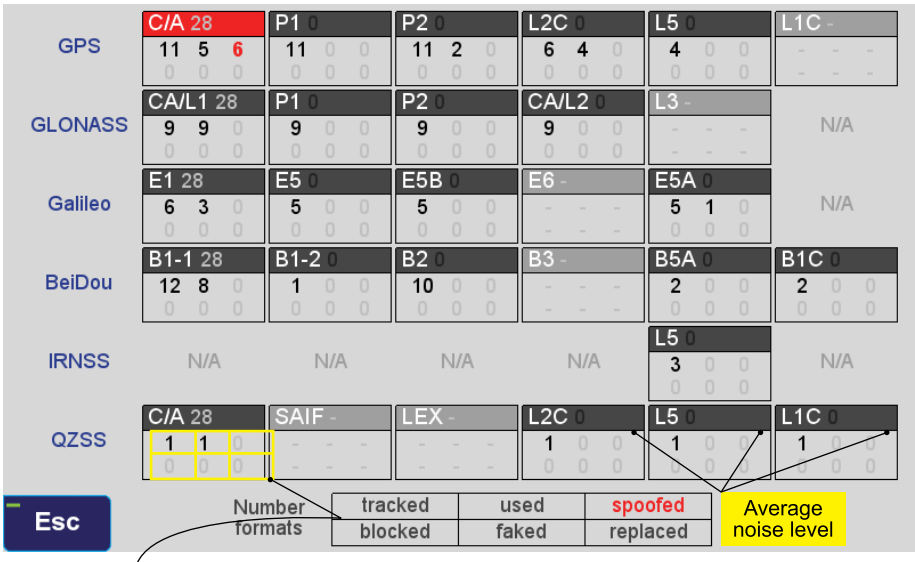
So What is JAVAD? JAVAD is the future of surveying. JAVAD is similar to the creation of smart phones, but in GPS technology. Although I don't want my competition to have JAVAD, surveyors around the world have to step up with technology. JAVAD is changing the game of surveying on a global scale, in the quest for more accurate, and reliable measurements.

Sincerely,
William C. Hutchins PLS

PIONEER SURVEYING INC

GNSS Overall View

The format and the signal definitions are explained below.



GPS L2C: L+M
GLN L3: I+Q
GAL E1: B+C
GAL E5: alboc
GAL E5B: I+Q
GAL E5A: I+Q
BeiDou B2: B5B
QZSS L2C: L+M
QZSS L1C: I+Q

Figure 4
The screenshot shows the status of all GNSS signals.

Definitions for the number of signals:

Tracked: Tracked by the tracking channels and has one valid peak only.

Used: Used in position calculation.

Spoofed: Has two peaks. Good peak is isolated, if existed.

Blocked: Blocked by buildings or by jamming. If jammed, shows higher noise level.

Faked: Satellite should not be visible, or such PRN does not exist.

Replaced: Real signal is jammed and a spoofed signal put on top of it. Because of jammer, it shows higher noise level.

Spoofer Orientation

When you detect that spoofers exist, you can also try to find the direction that the spoofing signals are coming from. For this, hold your receiver antenna (e.g. TRIUMPH-LS) horizontally and rotate it slowly (one rotation about 30 seconds) as shown in the picture and find the direction that the satellite energies become minimum. This is the orientation that the spoofer is behind the null point of the antenna reception pattern.

After one or more full rotations observe the resulting graph that shows approximate orientation of the spoofer as shown in figure 5.

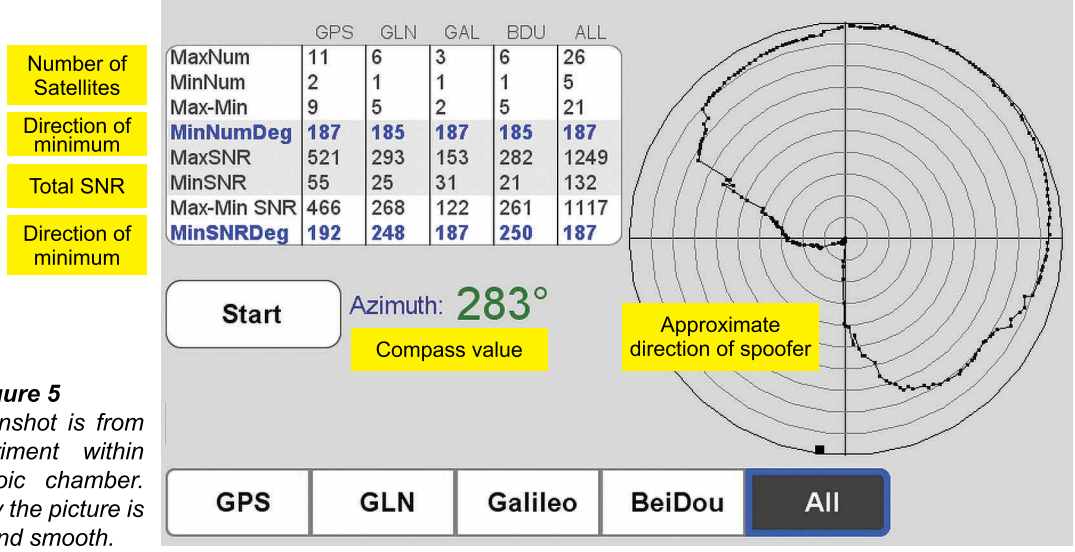


Figure 5
This screenshot is from the experiment within an anechoic chamber. That is why the picture is clean and smooth.

Double Bubble

Survey results can be documented with the on-screen image of the vial.

The vials can be viewed on the TRIUMPH-LS screen via the bottom camera.

The internal electronic levels can be calibrated with the mounted vials.

A 40 min vial for fast set up. Next to it is an 8 min vial for precision set up. All in a small package.

Status of landslide-dammed lakes in Siang river

The present study uses satellite images for identification and monitoring of landslide-dammed lakes formed due the occurrence of a 6.4 magnitude earthquake on the upstream of Siang river in Arunachal Pradesh, India

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The Brahmaputra river, a major trans-boundary river in the Eastern Himalayan region, originating in China flows through India and Bangladesh before draining into the Bay of Bengal. The river is known as Yarlung Tsangpo in Tibet, Siang in Arunachal Pradesh and Brahmaputra from Sadiya in Assam. It is a lifeline for the dense population residing in its extensive and highly fertile floodplains in Arunachal Pradesh and Assam in India. Any changes in the river's flow quality or quantity is a cause of concern for the people depending on the river for various reasons. Towards the end of November 2017, people residing beside the river at Pasighat (Arunachal Pradesh), where the river just reaches the plains, noticed an abnormal increase in sediments on the river. The Brahmaputra usually carries a lot of sediments during the monsoon season but even after the monsoons had subsided, the sediments on the river had not decreased and there were many reports of fishes and other aquatic life dying and the quality of water not suitable for any use by the local dwellers. The news resulted in several debates and the issue turned into an international concern due to the trans-boundary nature of the river. Many government, research and academic institutions started investigating on the quality of the river as well as the possible genesis of this sudden increase in turbidity levels. Observations made by Central Water Commission, Govt. of India on turbidity levels of water samples taken from the Siang River at Pasighat on 27 November 2017 showed an abnormally high suspended and particulate matter concentration of 425 NTU. The Brahmaputra River has been normally observed to have turbidity levels ranging from 78-100 NTU (Das et al, 2014). According to the news reports, the concentration of sediments, as observed by Indian Institute of Technology, Guwahati, had doubled in the following 10 days making the river waters highly unsuitable for the survival of aquatic life and use by human and wildlife population.

The North Eastern Space Applications Centre (NESAC), a pioneer institute from North East India in using Space Technologies for various geo-spatial applications, also investigated the matter with the help of remote sensing technology. Remote sensing has become the primary source for rapid damage assessment and monitoring particularly for large or inaccessible areas during disasters due to the availability of synoptic temporal images (Martha et al, 2017; Borah et al, 2018). Temporal Sentinel-2 images acquired on 05 November 2017 and 25 November 2017 were analysed for finding out the probable cause for the changes in the river discharge.

Changes in reflectance of the Siang river was noticed at Pasighat in the image acquired on 25 November 2017 compared to the previous image. Further investigations on the temporal satellite images to the upstream of the location revealed a zone of severe landslides on both sides of the river channel around 425 kms upstream of Pasighat lying within Tibet. It was also observed that this area is at a close proximity to the epicentre of the recorded 6.4 magnitude earthquake on 17 November 2017. The total area

affected by landslides is around 28 sq kms. Three major landslide-dammed lakes were observed to be created on the river channel due to the blockage of the channel by landslide debris along with drastic changes in the river course with significant increase in sediments downstream of the landslide affected region. Figure 1 shows the area where changes in the river quality was first observed (near Pasighat) and the zone of landslide occurrence upstream of the observed location.

The Himalayas are very prone to occurrence of earthquakes because of its active tectonics and frequent earthquakes of varying magnitudes occur in most of the fault boundaries. Figure 2 shows the seismicity of the Siang Basin from 1900 to present as recorded by USGS. It is observed that even though the entire region is prone to occurrence of earthquakes, earthquake epicentres are concentrated to some specific locations in the basin. The study area falls under one such location of frequent seismicity. The earthquake epicentres are also related to the presence of number of active faults and sutures in the basin. The Himalayan Central Thrust passes right through the middle of the Siang Basin and the Main Boundary Thrust is to the southern boundary of it (Styron et al, 2010; Taylor & Yin, 2009). Though earthquakes of higher magnitudes (greater than 6) are lesser in number, there is a frequent occurrence of earthquakes between magnitudes 3 to 6. The earthquake that occurred on 17 November 2017 is the earthquake of highest magnitude (6.4) that might have occurred in the recent past in this region. It was associated with a number of foreshocks and aftershocks of varying magnitudes.

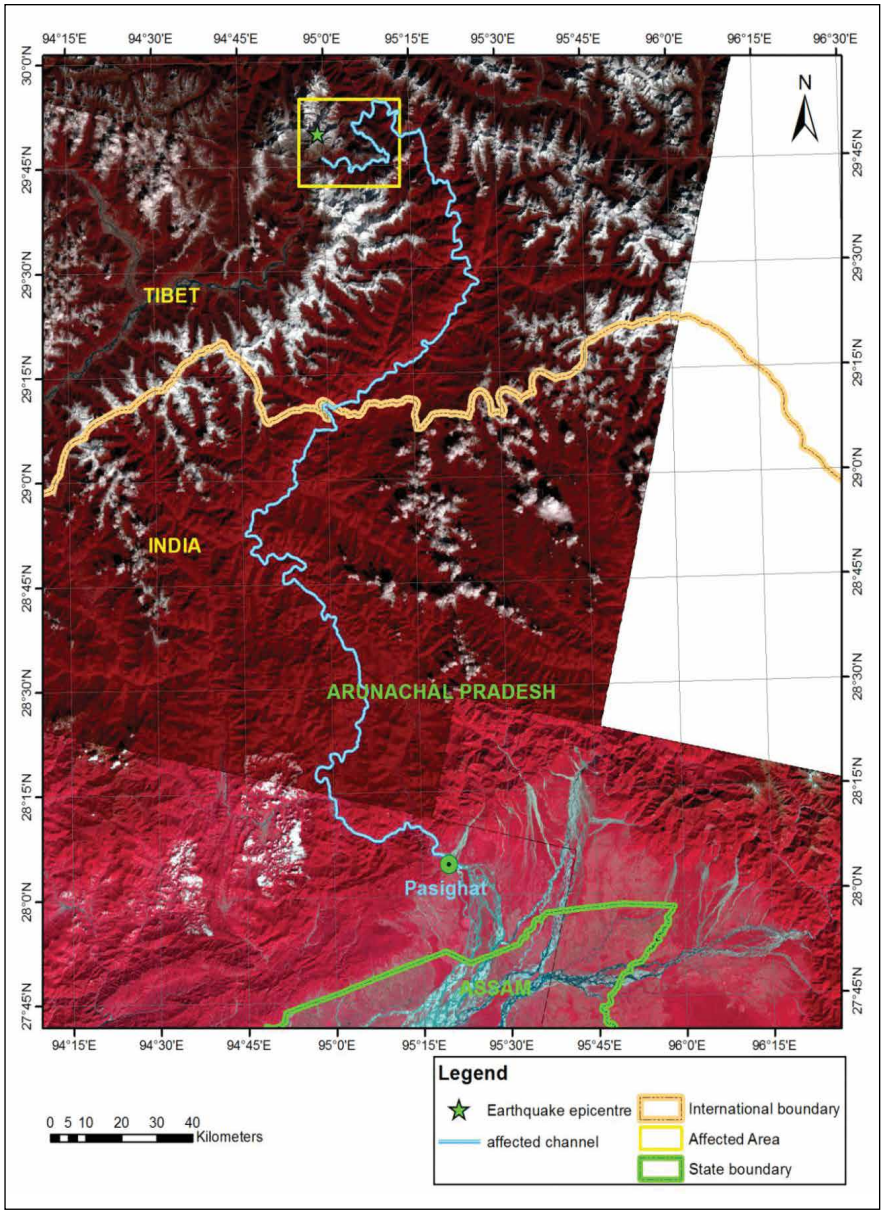

Fig 1: Location of the study area

The lakes formed due to the occurrence of earthquakes on 17 November 2017 that were first identified on the Sentinel-2 image acquired on 25 November 2017 were continuously monitored with the help of satellite images acquired on 10 December 2017, 4 January 2018 and 20 March 2018. Not much changes in the surface area of the lakes were observed. Satellite images and SRTM Digital Elevation Model (DEM) of 30 m resolution were used to calculate the surface area and volume of the lakes created due to the landslides. The landslides were named L1, L2 and L3 from upstream to downstream.

L1 is formed at a mean elevation of 2667.2 m above msl with a surface area of about 12 ha and volume of approximately 0.3×10^6 m^3. L2 is at a mean elevation of 2336.7 m above msl and has a surface area of about 55 ha and volume of around 7.87×10^6 m^3. The last lake L3 is formed at an altitude of 2165.3 m above msl with a surface area of about 49 ha and volume of approximately 16.7×10^6 m^3. All calculations are only indicative as they are based on DEM generated before the occurrence of the landslides and there might be major changes in volume after the occurrence of the landslides due to deposition of debris. Figure 3 shows the lakes as seen in Sentinel-2 images of 05 November 2017 (pre-landslide occurrence) and 20 March 2018 (current status). Even though no significant change in surface area is observed in multi-temporal images, the breaching of the water impounded in these lakes might induce floods downstream of these

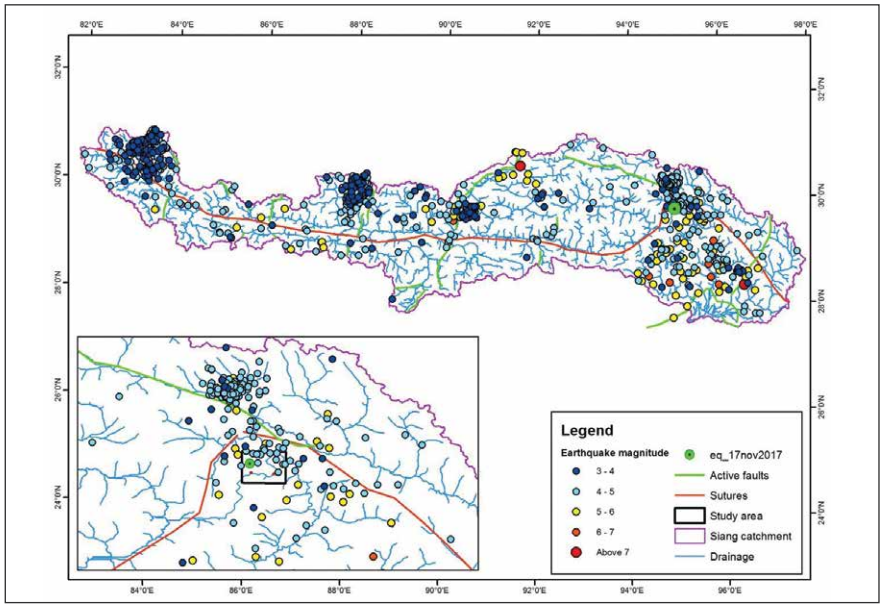

Fig 2: Earthquake epicentres observed since 1900 to present in the Siang Basin

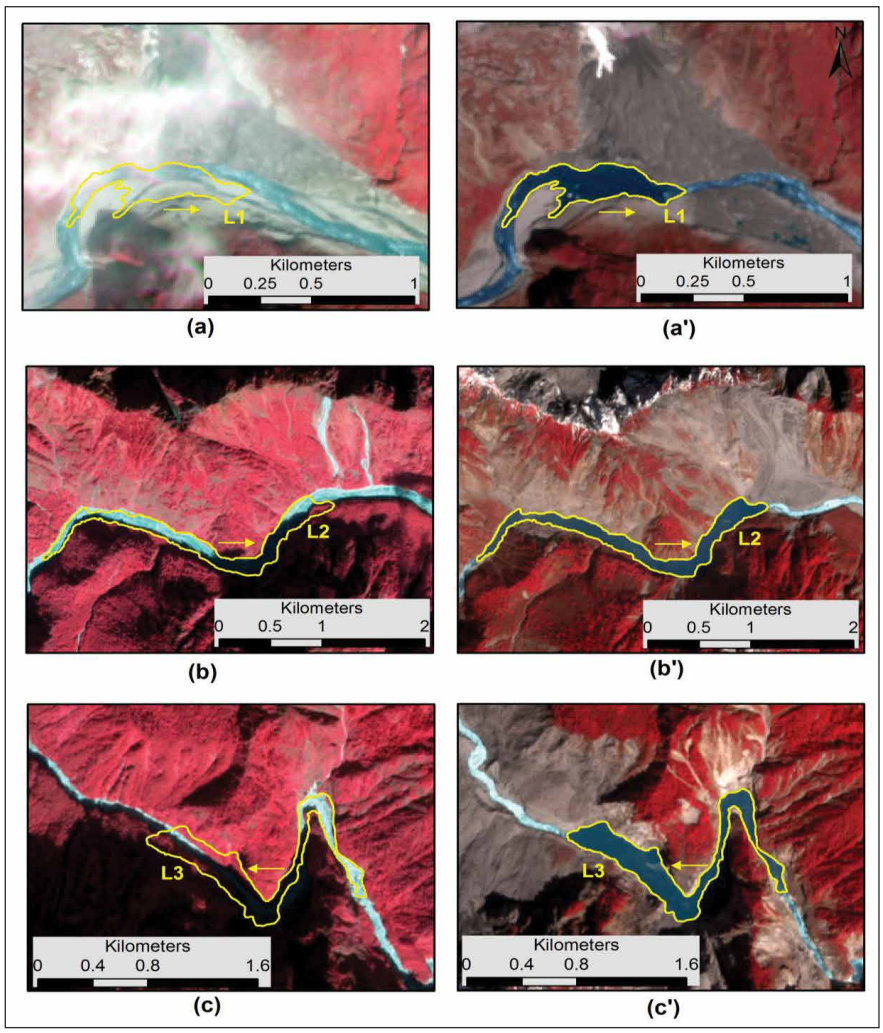

Fig 3: Temporal Sentinel-2 images showing the landslide dammed lakes (a, b and c images of 05 November 2017; a', b' and c' images of 20 March 2018)

locations and cause destruction to life and property. Therefore, a continuous monitoring using near real-time remote sensing data is necessary so that the forthcoming devastation due to breaching of these lakes can be minimised.

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References

Borah, S.B., Sivasankar, T. and Raju, P.L.N., 2018, Flood monitoring in Kaziranga National Park, Assam using temporal Sentinel-1 SAR data. 29th Biennial Conference of North East India Geographical Society (NEIGS) cum XI International Geographical Union (IGU) Commission Seminar, Guwahati, India, 8-10 February, 2018.

Das, B.K., Boruah, P. and Kar, D., 2014, Study of Seasonal Variation of Water Quality of River Siang in Arunachal Pradesh, India. IOSR Journal of Environmental Science, Toxicology and Food Technology, 8(2):11-20.

Martha, T.R., Roy, P. and Kumar, K.V., 2017, Assessment of the valley-blocking 'So Bhir' landslide near Mantam village, North Sikkim, India, using satellite images. Current Science, 113(7): 1228-1229.

Styron, R., Taylor, M., and Okoronkwo, K., 2010, HimaTibetMap-1.0: new 'web-2.0' online database of active structures from the Indo-Asian collision, Eos 91(20).

Taylor, M., and Yin, A., 2009, Active structures of the Himalayan-Tibetan orogen and their relationships to earthquake distribution, contemporary strain field, and Cenozoic volcanism. Geosphere, 5(3): 199-214.

Geospatial land governance and management

The present research discover the people's role in land governance and management, and also to see the historical background of land governance in India. We have published the first part of the paper in the last issue. We present here the concluding part

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Geospatial trends of agricultural development

The Agricultural progress of any region is generally influenced by the number of factors such as the physical, institutional, infrastructural and technological factors. All these factors are individually or collectively are responsible for the cropping patterns, level of agricultural development and agricultural productivity in an area or region. The institutional factors includes the land tenancy, land tenure and land ownership. These factors have their performance on field size, field patterns, farming type, crop land use, crop association and productivity of the crops, particularly in the country, India. In addition to this, there is found an increasing agricultural production due to the introduction of new technological inputs at large in different parts over the periods in the country, India. The details of the agricultural productivity since 1950-51 to 2010-11 is presented in the Table 2. For instance, during initial period 1950-51, the yield per hectare was about 522 kgs. per hectare which was continuously increased over the periods in different five year plans as evidenced by the Table 2. Whereas, there was about 124.75 million hectares of area under cultivation in 1981-82 and the total output in that period was of 1,032 kgs. per hectare. It was resulted due to the green revolution during 1960's in the country, India. In continuation to this, there was recorded an increasing output, as it was about 2,079 kgs. per hectare achieved during the period of 2010-11. In continuation to this, the trends of land use under major crops have also been found varying over the periods beginning from 1950-51 to 2011-13 as presented in the Figure 13.

Subsequently, the green revolution effected to an increasing trend in the output from 1980-81 onwards. It may also be remembered that the average holding in India is 1.33 hectares in 2000-01. So, the small farms ensure to have a direct impact on poverty. It is important to see on whose field the production takes place rather than how much the production has increased. The agricultural production by poor farmers will contribute the most towards decreasing hunger and malnutrition (Raj, 1975). So, it is evidenced that more equal distribution of land to small farmers is viable. And, the broad support base of redistribution should significantly raise productivity and improve the livelihood of the poorest peasant in the country, India.

Geospatial trends of agricultural land governance

Operational land holdings

An operational holding is well-defined as a unit of land used solely or partly for agricultural production and operated or managed by one person alone, or with the assistance of others without regard to the title, size or location (Sanyal, 1988). Area under operational holdings is called operated area. The number of operational holdings improved speedily from 51 million in 1960-61 to 101 million in 2002-03, which is reasonable considering the growth of population. On the other hand, the rate of growth of operational holdings, which enhanced over the three

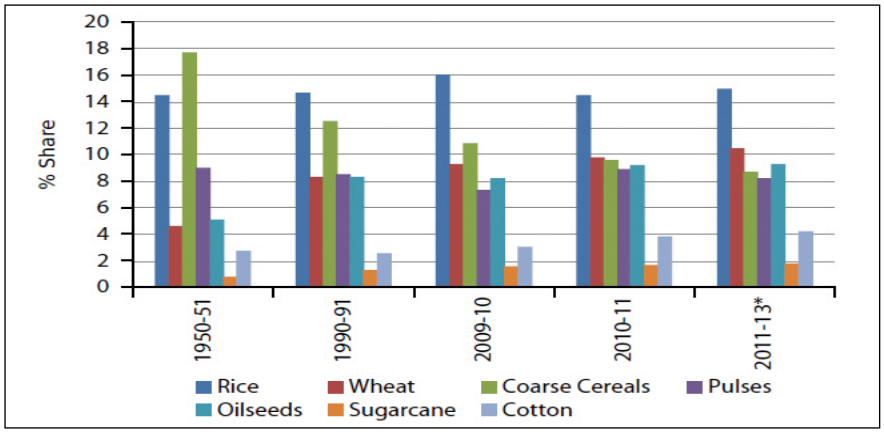
decades from 1960-61 to 1991-92, seems to have reduced miserable in the decade preceding to 2002-03. Whereas, there was total operated area of 133 million hectares in 1960-61 which dropped to 126 million hectares in 1970-71 which was a net fall of about 5.8 per cent. It plunged by around 5.6 per cent once more during 1970-71 and 1981-82. Whereas, there was an area of 108 million hectares which extent decreased to about 8.0 per cent since 1981-82, that was in the last 21 years, which remained consistent with the declining trend as observed up to 1981-82.

Table 2: Trends of Agriculture Production in India: 1950–51 to 2010–11 and 2011 to 13.

Five Year Plans	Duration	Year	Area	Production	Yield	% Area Irrigated
		1950-51	97.32	50.82	522	18.1
First Five Year Plan	1951-56	1951-52	96.96	51.99	536	18.4
Second Five Year Plan	1956-61	1956-57	111.14	69.86	629	18.2
Third Five Year Plan	1961-66	1961-62	117.23	82.71	706	19.1
Fourth Five Year Plan	1969-74	1969-70	123.57	99.50	805	23.7
Fifth Five Year Plan	1974-79	1974-75	121.08	99.83	824	26.5
Sixth Five Year Plan	1980-85	1980-81	126.67	129.59	1023	29.7
Seventh Five Year Plan	1985-90	1985-86	128.02	150.44	1175	31.4
Eighth Five Year Plan	1992-97	1992-93	123.15	179.48	1457	37.4
Ninth Five Year Plan	1997-02	1997-98	124.07	192.26	1552	40.8
Tenth Five Year Plan	2002-07	2002-03	113.86	174.77	1535	42.8
Eleventh Five Year Plan	2007-12	2007-08	124.07	230.78	1860	46.8
Twelfth Five Year Plan	2012-17	2012-13	120.16	255.36	2125	49.0

Note: Area in Million Hectares; Production in Million Tonnes; Yield in Kg./Hectare.

Source: Above table computed and compiled from the data collected from the *Agricultural Census (2000-01, 2005-06 & 2010-11)*, Agricultural Census Division, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, Krishi Bhawan, New Delhi.



Source: MoA (2014) *Land Use Statistics at a Glance: 2002-03 to 2011-12*, Directorate of Economics and Statistics, Department of Agriculture & Co-Operation, Ministry of Agriculture, Government of India, New Delhi.

Figure 13: Trends Land Use under Major Crops for India: 1950–51 to 2011–13.

Marginalisation of holdings

Customarily, a common feature of the size distribution of operational holdings is that the percentage of holdings decreases as the holding size increases. The percentage distribution of operational holdings expose that the decline is getting progressively sharper with every decade over the periods. The percentages of large, medium and semi-medium holdings have been declining steadily since 1960-61 to 2000-01.

The decline is sharpest for large holdings which decreased from 4.50 per cent to 0.80 per cent. On the contrary, it was witnessed that a great gathering of holdings found into the "marginal" category. The percentage of land holdings in this category was increased from 39.00 per cent in 1960-61 to 70.03 per cent in 1991-92 in the country, India.

Division of operational holdings

Due to the pressure of growing population on the limited land base and the subsequent division of holdings is obviously reflected in the variations in the absolute numbers of operational holdings in different size classes in the country, India. As it is evidenced that the trends in the number of operational holdings in different categories from the period 1960-61 to 2002-03 that the numbers of operational holdings in different categories are not changing at the same rate, or even in the same direction over periods.

In the beginning, over the three decades the number of marginal holdings has increased from 19.8 million in 1960-61 to over 71.0 million in 1991-92 which shows an increase of over three and a half times over the periods. Similarly, the number of small holdings, too, has been found growing, though at a much slower rate, since 1970-71. On the other hand, the absolute numbers of large and medium holdings have declined gradually during this period. In addition to this, the number of semi-medium holdings, which had persisted unchanging at 10 million from 1960-61 to 1981-82 and even showed signs of an increase, was prompted to decrease.

Distribution of operated area by holdings from 1960–61

The percentage distributions of operated area by category of operational holdings demonstrate that the portions of marginal holdings in total operated area, which was about 7.02 per cent in 1960-61, intensified rapidly over the last four decades and again increased by about 6 to 7 percentage since 1991-92 to equalise with the proportion of the semi-medium and medium holdings around 22.50 per cent. Likewise, the proportion of small holdings, as well, has been continuously increased and is currently over 20.03 per cent.

While the proportion of large holdings has been gradually declined as from 29.04 per cent in 1960-61 to around 12 to 13 per cent in 1991-92. The proportion of area operated by medium holdings has decreased gradually but more moderately, and the proportion of semi-medium holdings appears to have reached its highest level in 1991-92 and thereafter started to increase over the periods.

Distribution of operated area by holdings from 2010–11

The agricultural land is bifurcated among the peoples according to the existing law of inheritance, due to the population explosion over the periods in the country, India. The average size of operational holdings was about 1.16 hectares in 2010-11 in India. Such figure is much below the world average size of about 5.50 hectares. The trends of agricultural output since the independence for over the periods 1950-51 to 2010-11 and for the latest period 2011 to 2013 for the country, India is presented by the Figure 13.

The details of number and area of operational holdings in the country, India, based on the results of latest Agriculture Censuses 2000-01 to 2010-11 are presented in the Table 3. There is found a large proportion of about 67.04 per cent of land holdings which are having less than 1 hectare in 2010-11 in India. In addition to this, the small land holding is accounted for about 17.93 per cent and possessed land ranges between 1 to 2 hectares. These holdings together accounted for about 84.97 per cent of the land holdings in the country, India as evidenced by the Table 3. So, such marginal and small land holding are not seems to be viable economically. The fact is that all these land holders cannot produce enough to meet out the cost of cultivation like irrigation, High Yielding Variety (HYV) seeds, chemical fertilisers, insecticides, pesticides and agricultural machinery. During 2010-11, there was about 44.32 per cent of land area which was held by marginal and small holdings ranges less than 1 hectare and 1.0 to 2.0 hectares, respectively as evidenced by Table 3. The semi-medium holdings ranges 2.0 to 4.0 hectares accounted for about 23.59 per cent of the land area.

The medium holdings accounted for about 21.18 per cent of the land area. So, there is majority of the marginal and small holdings as well as the semi-medium and medium holdings accounted large proportion of land area in the country, India. The small and marginal holdings while taken together i.e. the below 2.00 hectares is constituted about 84.97 per cent in 2010-11 against 81.80 per cent in 2000-01 and the operated area was about 44.32

Table 3: Classification of Operational Holdings by Size Groups during 2000–01, 2005–06 and 2010–11.

Category of Holdings	Number of Holdings			Area			Average Size of Holdings		
	2000-01	2005-06	2010-11	2000-01	2005-06	2010-11	2000-01	2005-06	2010-11
Marginal	75408	83694	92356	29814	32026	35410	0.40	0.38	0.38
(Less than 1 hectare)	(62.88)	(64.77)	(67.04)	(18.70)	(20.23)	(22.25)			
Small	22695	23930	24705	32139	33101	35136	1.42	1.38	1.42
(1.0 to 2.0 hectares)	(18.92)	(18.52)	(17.93)	(20.16)	(20.91)	(22.07)			
Semi-Medium	14021	14127	13840	38193	37898	37546	2.72	2.68	2.71
(2.0 to 4.0 hectares)	(11.69)	(10.93)	(10.05)	(23.96)	(23.94)	(23.59)			
Medium	6577	6375	5856	38217	36583	33709	5.81	5.74	5.76
(4.0 to 10.0 hectares)	(5.48)	(4.93)	(4.25)	(23.97)	(23.11)	(21.18)			
Large	1230	1096	1000	21073	18715	17379	17.13	17.08	17.38
(10.0 hectares and above)	(1.03)	(0.85)	(0.73)	(13.22)	(11.82)	(10.92)			
All Holdings	119931	129222	137757	159436	158323	159180	1.33	1.23	1.16
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)			

Note: Figures in parentheses indicate the percentage to total. No. of Holdings: (‘000 Number); Area Operated: (‘000 Hectares); Average size: (Hectares).

Source: Above table computed and compiled from the data collected from the MoA (2000-01 & 2010-11) *Agricultural Census (2000-01, 2005-06 & 2010-11),* Agricultural Census Division, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, Krishi Bhawan, New Delhi.

per cent in the current census 2010-11, as against the corresponding figure of 38.86 per cent in 2000-01. The semi-medium and medium operational holdings which are ranging between 2.00 to 10.00 hectares in 2010-11 were accounted for about 14.30 per cent with the operated area of 44.77 per cent. The corresponding figures for 2000-01 and 2010-11 censuses accounted for about 17.17 per cent and 47.93 per cent, respectively. The large holdings ranging between 10.00 hectares and above accounted for about 0.73 per cent of total number of holdings in 2010-11 with a share of 10.92 per cent in the operated area as against 1.03 per cent and 13.22 per cent, respectively in 2000-01 as evidenced by the Table 3. So, whichever momentous change occurs in agrarian structure would have some impact on the size distribution of land holdings in the country, India.

Geospatial state-wise patterns of average size operational holdings

In the country, India as a whole, out of 35 States and Union Territories (UTs), there was found that 13 States namely the Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal altogether accounted for about 91.00 per cent of the number of operational holdings with a share of about 88 per cent operated area during the period 2010-11. Whereas, there was about 138.35 million operational holdings in the country, in which the highest one belonged to Uttar Pradesh State which accounted for 23.33 million and followed by Bihar 16.19 million, Maharashtra 13.70 million, Andhra Pradesh 13.18 million, Madhya Pradesh 8.87 million, Tamil Nadu 8.12 million, Karnataka 7.83 million, West Bengal 7.12 million, Rajasthan 6.89 million, Kerala 6.83 million etc. with the lowest of only 714 operational holdings in Union Territory of Chandigarh. Besides this, out of a total of 159.59 million hectares operated area in the country in 2010-11, the highest contribution was made by Rajasthan State with an area of 21.14 million hectares followed by Maharashtra 19.77 million hectares, Uttar Pradesh 17.62 million hectares, Madhya Pradesh 15.84 million hectares, Andhra Pradesh 14.29 million hectares, Karnataka 12.16 million hectares, Gujarat 9.90 million hectares etc. with the lowest operated area of 923 hectares in the Union Territory of operational holdings as well as the operated area in the country in 2010-11.

As compared to 2005-06, percentage increase in number of operational holdings in 2010-11 was the highest in case of Goa which is 47.71 per cent followed by Madhya Pradesh 12.19 per cent, Rajasthan 11.35 per cent, Bihar 10.47 per cent, Daman & Diu 9.60 per cent, Andhra Pradesh 9.39 per cent, Chhattisgarh 8.26 per cent, Odisha 7.14 per cent, Pondicherry 5.56 per cent, Nagaland 5.41 per cent, and Jammu & Kashmir 5.20 per cent, and so on. Nevertheless, the operated area showed declining trend in most of the States. In addition to this, the Tables 4 presents figures for altogether state-wise average size of operational land holdings for all the social groups for the periods of 2000-01, 2005-06 and 2010-11 for country, India.

Table 4 helps in comparison of all the State-wise altogether average size of operational land holdings among the social groups as well as over the periods for the country, India as a whole. The size of marginal land holdings was marginally increased from 0.24 to 0.39 from 2001-01 to 2010-11 for the country as a whole, respectively. Likewise, semi-medium, medium and large land holdings showed an increasing trend over the periods. Whereas, it is important to point out that the all holding size was marginally decreased over periods as evidenced by the Table 4.

As per the Agriculture Census 2010-11, the total number of operational holdings in the country was increased from 119.93 million in 2000-01 to 137.76 million 2010-11 i.e. an increase of 17.83 million holdings over a decade period. Whereas, there was marginal decrease in the operated area from 159.44 million hectares in 2000-01 to 159.18 million hectares in 2010-11 showing a decrease of 0.26 per cent. The operated area was primarily increased because the State of

Table 4: State-wise Average Size of Operational Holdings by All Social Groups, 2000-01, 2005-06 and 2010-11.

Country/(Periods)	Marginal	Small	Semi- Medium	Medium	Large	All Holdings
India (2000-01)	0.24	1.42	2.39	4.42	13.16	1.33
India (2005-06)	0.23	1.38	2.36	4.38	12.99	1.23
India (2010-11)	0.39	1.42	2.71	5.76	17.34	1.15

Note: The average size of operational land holdings in hectares.

Source: Above table computed and compiled from the data collected from the MoA (2000-01, 2005-06 & 2010-11) *Agricultural Census (2000-01, 2005-06 and 2010-11)*, Agricultural Census Division, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, Krishi Bhawan, New Delhi.

Table 5: Trends in Gini's coefficient of concentration of operational holdings in India.

Periods	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11
Gini's coefficients	0.583	0.586	0.629	0.641	0.624	0.602

Source: The Gini's Coefficients for the above table computed and compiled from the data collected from the MoA (2010-11) *Agricultural Census (2010-11),* Agricultural Census Division, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, Krishi Bhawan, New Delhi.

Table 6: Gini's coefficient of concentration of the size distribution of operational holdings by States.

States	1970-71	1980-81	1990-91	2000-01	2010-11
Andhra Pradesh	0.582	0.573	0.529	0.543	0.567
Assam	0.388	0.465	0.412	0.366	0.413
Bihar & Jharkhand	0.511	0.534	0.525	0.421	0.456
Gujarat	0.518	0.544	0.573	0.605	0.621
Haryana	0.436	0.571	0.645	0.675	0.698
Karnataka	0.509	0.562	0.577	0.543	0.556
Kerala	0.483	0.449	0.392	0.348	0.392
Madhya Pradesh & Chhattisgarh	0.508	0.520	0.533	0.527	0.565
Maharashtra	0.514	0.570	0.570	0.526	0.587
Orissa	0.466	0.504	0.462	0.381	0.432
Punjab	0.398	0.685	0.694	0.706	0.784
Rajasthan	0.599	0.551	0.590	0.610	0.589
Tamil Nadu	0.480	0.555	0.527	0.508	0.539
Uttar Pradesh & Uttaranchal	0.471	0.520	0.498	0.450	0.478
West Bengal	0.433	0.494	0.430	0.313	0.392
India	0.567	0.596	0.591	0.557	0.587

Source: The Gini's Coefficients for the above table computed and compiled from the data collected from the MoA (2010-11) *Agricultural Census (2010-11)*, Agricultural Census Division, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, Krishi Bhawan, New Delhi.

Jharkhand participated for the first time in Agriculture Census operation in 2010-11 after the state came into existence in the year 2000. The average size of operational holding was of 1.15 hectares during 2010-11 in the country, India.

Geospatial concentration trends of operational holdings

In order to comprehend the trends of operational land holdings, the Gini's coefficient of concentration is used to obtain an overall measure of concentration in the size distribution of operational holdings for the country, India. The values of coefficients are computed for the periods 1960-61, 1970-71, 1981-82, 1990-91, 2000-01 and 2010-11 as presented in Table 5.

In general, there is found an increasing trends of the concentration of operational land holdings over the periods in the country, India as also evidenced by the Table 5. In lieu of this, there is found an increasing trends of concentration at the states level in the country as is evidenced by the Gini's coefficient values which shows the degree of concentration in operational holdings which increased since 1960-61. Later on, such increasing trend has been slowed down since 1990-91 and further continued to decreasing over period's up to 2010-11 as evidenced by the Table 5.

Geospatial concentration patterns of operational holdings

The Gini's coefficient values presented in the Table 6 showed the deviations in the degree of concentration in the size distribution of operational holdings in all the 15 major States over the periods 1970–71, 1980–81, 1990–91, 2000–01 and 2010–11 for the country, India. To ensure proper comparability, it has been necessary to use, for computation of the coefficient, the distribution of land holdings by category at the state level for all the periods. Extraordinarily, there is a slowing down in the increase in concentration since 1980-81. In fact, the coefficient value for period of 1990–91 is slightly lower than that for period of 1980-81. It is also discernable from the Table 6 that there is a varying trends in the Gini's coefficient across the states in the country, India. Whereas, in case of the States like the West Bengal, Bihar (including Jharkhand), and Orissa, the index of concentration was decreased sharply since 1990–91. Similarly, in case of the Assam, Uttar Pradesh (including Uttaranchal), and Tamil Nadu, the index was decreased in both the periods 1980–81 and 1990–91. Similarly, in Kerala State, there was steady decrease in the index since 1970–71 as evidenced by the below Table 6.

On the contrary, in case of the State Karnataka, Madhya Pradesh (including Chhattisgarh), Maharashtra and Rajasthan, there was no clear trend discernible in terms of the degree of concentration in the size distribution of operational holdings over the periods. However, it is noteworthy to mention that the two most agriculturally developed States of Punjab and Haryana were displayed the most pronounced increase in the concentration ratio since 1970–71. In case of the Haryana State, the ratio increased substantially over the periods since 1970–71. Whereas in case of the Punjab State, the ratio increased sharply from 0.398 in 1970–71 to 0.685 in 1981–82. This was followed by a smaller increase in the next two periods and so on up to 2010–11. In addition to this, in case of the Gujarat State, there was steady, though more gradual, increase in the index of concentration over the periods since 1970–71 to 2010–11 as evidenced by the Table 6.

Conclusions

Geospatial land governance and management through digitalisation is a noteworthy matter of concern in the emerging economies and developing countries of the world, like India. In agrarian economies, the land is most important assets of the people. Besides this, 'to own the land is the highest mark of esteem; to perform manual labour, the lowest'. There is an ever-changing relationship between land, power and

people. Ancient records show that, among the Indo-Aryans, arable land was held by family ownership. Later on, during the periods 1200 BC–1200 AD and AD 1540–1750, the principal unit of land settlement was the village. The British governed the land from 1750 to 1947. During this period, the Permanent Settlement Regulation was introduced to record all rights in respect of land in order to maintain an up-to-date record of land rights, but this remained unsuccessful. So, such was the beginning of land record digitalisation at different levels in the country, India

Since the country's independence, there has been an emphasis on the implementation of consecutive Five Year Plans addressing agriculture and related economic activities. Moreover, in India, about 58.40 per cent of the labour force is employed in agriculture and allied activities for their livelihood in 2001. Land accounts for more than 50.12 per cent of the total assets of rural households. India is one of the world's rapidly developing and emerging economies. There has been a continuous decline in the share of agriculture and allied sectors in its gross domestic product (GDP), from 14.60 per cent in 2009–2010 to 13.90 per cent in 2013–2014 (at 2004–2005 prices), which is an expected outcome for a fast-growing and structurally changing economy.

There are a number of strategic issues in land governance and development under different plans and policies. The main objective of land reform is to provide social justice for the people, particularly the cultivators, land owners, landless labourers, and rural populations. The main directives of land reforms are the abolition of intermediaries; land tenancy reforms; rent control reforms; ceilings on land holdings; consolidation of land holdings; security of land holdings tenure; reversal of forced evictions and relocations; women's land and property rights; and computerisation of land records. In addition to this, land digitalisation process is strengthened and speed-up with establishment of Village Resource Centre's (VRCs) for cadastral mapping and its connection with other services with the remote sensing satellite communication facilities provided by the National Remote Sensing Centre of the Department of Space of the Govt. of India.

In lieu of this, with the implementation of the land reform program, a certain specified limit of land belonging to landlords was set, and the rest would be taken over by the state. The ceiling on land holdings is an effective measure for land redistribution. In view of the prevailing social and political contexts, the ceiling law was neither politically expeditious nor administratively easy to implement. Kerala and West Bengal States, where rigorous implementation of tenancy legislation took place, have been successful role models of tenancy reforms for the country, India. Land reforms are connected with the right to life and livelihood of a huge rural population. The government is obliged to protect farmers' land rights. The real threat to India's well-being and security is the displacement of its rural population from its roots. As long as the population is tied to the soil, there will be an increase in agricultural production and economic growth. Farming by smallholders continues to have a direct impact on poverty. More equal distribution

of land to this group is viable, and the broad support base of redistribution should significantly raise productivity and improve the livelihoods of the poorest people.

In this context, the chronological analysis of the past 11 Five Year Plans makes it clear that, since the inception of the Planning Commission, industrialisation has been equated with development. The agricultural sector has always been a secondary priority in different plans. It must be noted that a majority of people living in rural areas have remained untouched by the trickle-down effect of industrialisation. Due to land reforms, a middle-level peasantry sharing the characteristics of capitalist farmers emerged, who were largely responsible for the green revolution of the 1970s and the 1980s. Today, decreasing sizes of farm holdings are a major challenge to their economic viability.

Consequently, the land reform has been focal point of the country's political and economic agenda. This also lays a sound foundation for growth, to enable India to compete in the global market. Land reform policy is fundamentally a politico-economic issue, and in most cases it is the result of a people's movement. Land reform means the distribution of surplus land to small farmers and landless cultivators. It has been a major instrument of social transformation, especially in an economy based on feudal and semi-feudal production relationships. The long-term solution is to reduce the dependence of the rural population on land through the expansion of non-agricultural activities.

So, the future growth must be based on higher efficiency and will require to invest in science and new technologies to harness natural land resources, optimise their economic structures for allocative efficiency, and reform their fiscal, financial, banking, and insurance systems which is only feasible through the geospatial digitalisation as continuing by the VRCs centers developed by the NRSC, govt. of India. Thus, the lessons learned from the experiences of India will also help other developing countries and in the global fight against hunger and poverty. So, the long-term solution is to lessen the dependence of rural population on land by the expansion of non-agricultural activities. Nevertheless, the grass root level change in rural society is primarily possible through the agricultural development in which the agrarian reforms have a greater role in fundamental development of the country, India.

References

MoA (2001) Agricultural Statistics at a Glance (2001-2004), Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi.

MoA (2005, 11, 12, 13, 14) Annual Report 2004-05, 2010-11, 2011-12, 2012-13, 2013-14, Department of Agriculture & Co-Operation, Ministry of Agriculture, Government of India, Krishi Bhawan, New Delhi.

MoA (2014) Agricultural Census 2010-11: All India Report on Number and Area of Operational Holdings, New Delhi, Agriculture Census Division, Department of Agriculture & Co-Operation, Ministry of Agriculture, Government of India.

MoA (2014) Land Use Statistics at a Glance: 2002-03 to 2011-12, Directorate of Economics and Statistics, Department of Agriculture & Co-Operation, Ministry of Agriculture, Government of India, New Delhi.

Raj, K. N. (1975) "Agricultural Development and Distribution of Land Holdings", Indian Journal of Economics, Vol. XXXI, No. 1.

URL: World Wide Web Resources: http://iipa.org.in/ ; http://planningcommission.nic.in/ ; http://planningcommission.nic.in/ ; http://rural.nic.in/ ; http://www.agricoop.nic.in/ ; http://www.censusindia.gov.in/ ; http://www.moef.nic.in/ ; http://www.nrsc.gov.in/ ; http://www.worldbank.org/ ; http://www.yojana.gov.in/

The paper was presented at FIG working 2017, Helsinki, Finland, May 29-June 2, 2017.

Pointfuse Unlocks 'As Built' Data for BIM

Pointfuse, a software provider that converts laser scan data - known as point clouds - into 3D models, has announced its integration with Autodesk's BIM 360 project delivery platform, the first single project platform connecting design through construction. It has pioneered new techniques to rapidly process vast point cloud datasets into intelligent and easy to handle mesh models. This innovation will allow important 'as built' models to be easily incorporated into Building Information Modelling (BIM) workflows managed with Autodesk BIM 360. *http://pointfuse.com/*

Land surveying on the worlds highest rail line

The Indian railway has set a target of completing the 498-km Bilaspur-Manali-Leh line and 2 other railway projects by 2019. The final location survey at Leh in Jammu and Kashmir began in the year, as per officials. At a height of 3,300 meters, the 498-km long stretch is set to become the highest rail track in the world, overtaking Chinas Qinghai-Tibet Railway.

A K Yadav, Chief Administrative Officer (Construction) of the Northeast Frontier Railway (NFR), said "We have set a target of December 2018 for the FLS for Pasighat-Tezu-Rupai line and December 2019 as the deadline for the other two.

These three are extremely difficult terrains and we have to deal with unstable and high mountains. In places such as the Sela Pass in the Missamari-Tenga-Tawang line, it is 14,000 feet high". We want the line to be operational through the year, despite the snow,? said Yadav, adding that the three line are of 853 km with 58 km in Assam and 795 km in Arunachal Pradesh.

GIS cells in each district, Uttarakhand, India

Considering the importance of the GIS, the Uttarakhand State Disaster Management Authority (USDMA) has decided to accord priority to establish GIS cells in each district with the assistance of the planning department. The GIS cells have presently been established in five districts- Uttarkashi, Tehri, Almora, Pithoragarh and Udham Singh Nagar while necessary action is being taken to establish such cells in the remaining districts, said the disaster management secretary Amit Singh Negi.

The Kumaon University, Centre for Excellence, geography department head JS Rawat informed the gathering in detail about the utility of GIS. He said that it is an important tool in the technological developments which can be of much use for mitigating the impact of disaster scenarios. *www.dailypioneer.com*

GHMC to use GIS for property tax assessment

Greater Hyderabad Municipal Corporation will soon leverage on Geographic Information System (GIS) to capture spatial data in order to assess property tax payable by each establishment.

Through GIS, the domestic, commercial and other establishments of a particular area will be identified and allotted unique numbers, to know if they are under the tax network or not.

A pilot will be taken up in Moosapet soon, to experiment with this system, and based on its success, it will be replicated throughout the city, Municipal Commissioner in-charge Bharati Hollikeri said. *www.thehindu.com*

Carlson Software unveils Carlson PhotoCapture

New from Carlson Software is Carlson PhotoCapture, which is the first cloud-based standalone product and photogrammetry solution offered on the Carlson product line.

This new service gives users the ability to generate interactive 3D maps of sites using aerial, oblique, or terrestrial images. Once the images are uploaded, it will create an orthomosaic photo to piece the site together.

Airbus teams up to develop Space CARBon Observatory

The SCARBO (Space CARBon Observatory) project for improved measurement of greenhouse gases has been officially kicked off. It is funded by the European Union (EU) Horizon 2020 Programme and will be implemented by a consortium of seven European organisations led by Airbus.

The project aims at solving a key challenge of anthropogenic greenhouse gases (GHGs) monitoring from Space: improvement of the temporal revisit over the various sites of interest while increasing the accuracy and resolution of measurements. This is envisaged by implementing a novel miniaturised static spectrometer concept on a constellation of small satellites coupled with aerosol sensors and high-end reference instruments.

The overall measurement concept will be experimentally validated through a dedicated airborne campaign with instrument prototypes in 2020. SCARBO is expected to be ready to work as a complementary system with the second generation of Copernicus satellites within a decade. *www.airbus.com*

RS observation to help sustainable development along Mekong

China will coordinate with countries from Asia and Oceania to conduct satellite remote sensing observation along the Mekong River, according to the website of Chinese Academy of Sciences (CAS).

The first international conference of the Asia-Oceania Global Earth Observation System of Systems (AOGEOSS) Initiative concluded on May 18 in Deqing in east China's Zhejiang Province. The Deqing Action Plan was passed during the conference to carry out remote sensing observation in regions along the river.

Member countries and international organizations of the AOGEOSS will accelerate the building of the Asia-Oceania comprehensive Earth

observation system to promote the sustainable development and prosperity within the region, according to the Deqing Action Plan. Remote sensing observation along the Mekong River will push forward research in ecosystem assessment and disaster monitoring.

The Deqing Action Plan said China will coordinate with other countries within Asia and Oceania that have satellite observation capabilities to provide a high-resolution land surface database and share free high-quality satellite data. *https://reliefweb.in*

National Remote Sensing Centre, India gives a new boost to forest conservation

Efforts to conserve forests across the country is likely to get a major boost, thanks to Hyderabad-based National Remote Sensing Centre(NRSC), an arm of Indian Space Research Organization(ISRO). The centre has developed a new system that can monitor changes in forest cover over area as small as one hectare of land. The new system was made possible with the fusion of Optical Remote Sensing, Geographic Information System, Artificial Intelligence and Automation.

Apart from this, the new system will help NSRC generate monthly reports on forest cover and provide specific latitude and longitude of location where changes in green cover are observed. Telangana forest department will be the first in the country to benefit from this new system. NRSC has already tested the system and will soon be conducting pilot study in Telangana. *www.newindianexpress.com*

Successful Deployment of First Kenyan Satellite

On May 11, 2018, the first CubeSat developed under the KiboCUBE programme has been successfully deployed from the Japanese Experiment Module "Kibo" of the International Space Station. This CubeSat, named "1KUNS-PF" was developed by a team from the University of Nairobi. 1KUNS-PF was developed as Kenya's first satellite, and the University of Nairobi will operate the CubeSat after its deployment from "Kibo". The experience and technology acquired from the development of this CubeSat will be applied in future earth observation satellite of Kenya. *http://global.jaxa.jp*

Remote Sensing, GIS Lab opened at NMDC office

A Remote Sensing and GIS Lab was inaugurated at public sector iron ore mining company NMDC's office, Hyderabad.

The Lab comes in the backdrop of an MoU between NMDC and ISRO's NRSC to promote space applications in exploration and other mining activities for satellite-based geological mapping and multi-disciplinary exploration of iron, diamond and other mineral deposits.

A release from the NMDC said space technology provided real-time data for generation of digital maps. Several innovative methods were deployed by the NMDC and ISRO for targeting diamond and iron bearing areas.

Gravity and magnetic data of ElGEN6C4 (NASA) satellite was also used for identifying potential corridor for diamondiferous rocks in the Central Indian Diamond Province. Few potential iron ore blocks have also been identified in Madhya Pradesh using Cartosat-2 and Aster Data.

The NRSC and NMDC have also developed a mobile App to collect field data with location and field photo and catalogue to collect geological information and for viewing in 'Bhuvan' portal. This App is presently being used by the NMDC at its Sidhi-Singrauli iron ore block and Chattarpur and Damoh diamond blocks for field data collection and proved to be very useful, the release said. *www.thehindu.com*

China launches new satellite to monitor air pollution

China has successfully launched a hyperspectral imaging satellite for comprehensive observation of the atmosphere, including air pollution which is one of the country's major problems.

The Gaofen-5 satellite was launched off the back of a Long March 4C rocket from the Taiyuan Satellite Launch Center in northern Shanxi Province. It was the 274th flight mission by a Long March carrier rocket. Gaofen-5 is able to obtain spectral information from ultraviolet to long-wave infrared radiation. It is the world's first full-spectrum hyperspectral satellite for comprehensive observation of the atmosphere and land. *www.tribuneindia.com*

Collaboration for solar energy and remote sensing research

The University of New South Wales (UNSW) Sydney has signed new agreements with two French scientific organisations to bolster cooperation over renewable energy innovation and environmental research.

Agreements were signed with the Centre National de la Recherche Scientifique (CNRS), France's largest government research organisation and the Centre National d'Etudes Spatiales (CNES), the French Space Agency.

In addition, Australia's first hardware quantum computing company, Silicon Quantum Computing Pty Ltd (SQC) entered into a collaboration with Commissariat à l'Energie Atomique et aux Energies Alternatives (the CEA; French Alternative Energies and Atomic Energy Commission), a French public government-funded research organisation.

Under the terms of the Memorandum of Understanding (MOU) between UNSW Sydney and CNRS, the two organisations will facilitate the exchange of solar energy innovations through joint conferences, seminars and research projects. Potential topics include solar energy, storage of renewable energy and renewable energy integration.

The agreement reflects the commitments of Australia and France to address climate change through the COP21 Paris Agreement and support for the recently formed International Solar Alliance, headquartered in Delhi, India. *www.opengovasia.com*

Isro develops desi atomic clock, to be used in navigation satellites

In a significant development, Indian Space Research Organisation (Isro) has developed an atomic clock that will be used in navigation satellites to measure precise location data. The space agency currently imports atomic clocks from European aerospace manufacturer Astrium for its navigation satellites.

Tapan Misra, Director of Ahmedabad-based Space Applications Centre (SAC), said, "SAC has developed an indigenous atomic clock and this clock is currently undergoing a series of qualification tests. Once it successfully clears all tests, the desi atomic clock will be used in an experimental navigation satellite to test its accuracy and durability in space."

The SAC director said, "With the development of the desi atomic clock, Isro has become one of the few space organisations in the world which have gained the capability to develop this highly sophisticated technology. We don't know the design and technology of the imported atomic clock. But the desi clock has been developed based on our designs and specifications. This clock is as good as the imported one. We are hopeful that it will easily work for more than five years." *https://timesofindia.indiatimes.com*

AAI gets IIT-Madras navigation research boost

Indian Institute of Technology Madras will help indigenize and improve air navigation systems under an MoU it signed with the Airports Authority of India (AAI) recently.

The institute and AAI will, as part of the agreement, conduct joint research to specifically address aviation infrastructure through domestic manufacture of navigation equipment and meet air traffic management challenges at airports in the country. The agreement will involve transfer of knowledge by IIT Madras in areas such as mathematical, analytical and data mining solutions as well as artificial intelligence, which are essential to research. It will also open up many areas in aviation to startups and industries to manufacture products under the Make in India policy. IIT researchers will have access to AAI aviation data.

As part of its ambitious ANS upgrade plans and the need to develop in-house capabilities with an efficient R&D system that supports ongoing indigenous initiatives, AAI has established a state-of-the-art Civil Aviation Research Organisation in Hyderabad. Collaboration with premier educational institutions is one of the elements that AAI envisages in R&D. *https://timesofindia.indiatimes.com*

European GNSS Agency opens submissions for 2018 CLGE Young Surveyors Prize

The Council of European Geodetic Surveyors (CLGE), in partnership with the European GNSS Agency (GSA), has launched the seventh edition of its Young Surveyors Prize. The 2018 edition of the competition is open for submissions and, as in previous years, the GSA is sponsoring a special prize for ideas leveraging Galileo, EGNOS and Copernicus.

For the seventh consecutive year, the Young Surveyor's Prize is inviting students of topography, GIS, geodesy, mapping and related studies to submit unique and innovative ideas in their field of expertise. Each winner or winning team stands to win a prize of EUR 1000.

Australia to invest AU$260 million in GPS tech

The Turnbull Government is investing in the GPS technology "that will create jobs and support Australian industry", according to a press release from the office of Minister for Resources and Northern Australia, Senator the Hon Matt Canavan, who said the Government is investing over $260 million to develop the satellite technology.

Under the package, $160.9 million will deliver a Satellite-Based Augmentation System (SBAS) (the technology underpinning GPS) to improve the reliability and the accuracy of positioning data from five metres to 10 centimetres across Australia and its maritime zone.

A $64 million investment in the National Positioning Infrastructure Capability (NPIC) will complement SBAS to improve GPS to an accuracy as precise as 3cm in areas of Australia with access to mobile coverage. A further $36.9 million is for Digital Earth Australia, a "world-class technology" that will give Australian businesses greater access to reliable, standardised satellite data that identifies physical changes to the Australian environment. *www.spacetechasia.com*

HKU creates new solution to keep GPS navigation on the right track

The innovative new solution aims to help GPS navigation differentiate between multilevel roads to correct an error that engineers have tried to solve the last 20 years.

Present vehicle navigation systems that use GPS with positioning error of 10-30 meters have had a long existing problem in determining which road level a vehicle has entered, especially for flyovers parallel to the ground level. Dubbed the Angle Difference Method, it will measure and compare the inclination angle of a vehicle and angles of different road levels stored in a Transport GIS to determine whether a vehicle has entered the ramp of a flyover or still on the ground level.

Devised by Professor Anthony Yeh Gar-On's research team at the Department of Urban Planning and Design of the University of Hong Kong (HKU), the method uses an ordinary smartphone, that can be put anywhere at any angle in the vehicle, coupled with a plugged in or installed onboard diagnostic (OBD) device. The HKU research team lead by Professor Yeh team is currently in discussion with global GIS and vehicle navigation operators including major operators in China on potential application of the system to enable a major advancement in the current navigation system for vehicles, particularly in large cities with complicated flyover networks. *www.opengovasia.com*

Brexit to 'force work on Galileo sat-nav system out of UK'

Galileo has become something of a political football in Brexit talks. The EU says it would have to stop the UK from accessing the encrypted part of the network when it leaves next year.

Colin Paynter, the company's UK managing director, said that EU rules required Airbus to transfer all work to its factories in France and Germany.

Mr Paynter was speaking at a Commons committee hearing on Exiting the European Union. The UK has played a key role in the programme, and Airbus is currently bidding for the renewal of a contract covering the Galileo ground control segment - potentially worth about 200 million euros. This work is currently run out of Portsmouth.

The UK's access to Galileo's encrypted service, which would be required for military and security uses of the system, would be blocked by the EU after Brexit. This warning prompted the Business Secretary Greg Clark to announce that the government would look into options for developing its own satellite-navigation system.

U.K. Said to threaten veto on new Galileo contract tenders

U.K. is considering vetoing the release of new contract tenders for the European Union's Galileo satellite navigation system if the bloc doesn't relax its stance on restricting Britain's access to the program after Brexit.

European officials are trying to bring forward bids on 400 million euros ($471 million) of contracts to design and develop the next set of satellites for the program, according to a U.K. official familiar with the situation.

The U.K. view is that if contracts are tendered now, there's so much doubt about what Britain's future involvement will be that U.K. companies will be discouraged from bidding. Instead, the U.K. wants time to broker a compromise that enables continued involvement for the country and its space industry, which would give businesses the confidence to bid, one of the officials said.

Science Minister Sam Gyimah said on Monday that Britain may withdraw from the program and set up its own satellite navigation system if the EU continues to play "hardball." https://www.bloomberg.com

Could Britain collaborate with Australia on a Galileo alternative?

As the United Kingdom continues to wrangle with the EU over access to, and involvement in, the European Galileo global navigation satellite system (GNSS), there is growing speculation that the country could seek to develop its own independent system with Australia — or even Japan.

Earlier this week, two Whitehall officials told the Financial Times that Australia has indicated a potential willingness to collaborate with the U.K. in the development of an independent satellite system.

In a May 21 statement coinciding with the Air Power Association's inaugural Defence Space 2018 conference, the Britain's defense secretary, Gavin Williamson, also hinted that the long-awaited U.K. Defence Space Strategy, could contain some provision for an alternative system, and confirmed the importance of reviewing Britain's contribution to Galileo, as well as how it plans for "alternative systems in this crucial area." *http://spacenews.co*

Digital Navigation 'Neurons' developed like ours

When Google DeepMind researchers trained a neural network to tackle a virtual maze, it spontaneously developed digital equivalents to the specialized neurons called grid cells that mammals use to navigate. Not only did the resulting AI system have superhuman navigation capabilities, the research could provide insight into how our brains work.

Grid cells were the subject of the 2014 Nobel Prize in Physiology or Medicine, alongside other navigation-related neurons. These cells are arranged in a lattice of hexagons, and the brain effectively overlays this pattern onto its environment. Whenever the animal crosses a point in space represented by one of the corners these hexagons, a neuron fires, allowing the animal to track its movement. Mammalian brains actually have multiple arrays of these cells. These arrays create overlapping grids of different sizes and orientations that together act like an in-built GPS.

The system even works in the dark and independently of the animal's speed or direction. Researchers at DeepMind decided to see if they could test the idea in silicon using neural networks, as they roughly mimic the architecture of the brain. To start with, they used simulations of how rats move around square and circular environments to train a neural network to do path integration—a technical name for using dead-reckoning to work out where you are by keeping track of what direction and speed you've moved from a known point.

They found that, after training, patterns of activity that looked very similar to grid cells spontaneously appeared in one of the layers of the neural network. The researchers hadn't programmed the model to exhibit this behavior.

To test whether these grid cells could play a role in vector-based navigation, they augmented the network so it could be trained using reinforcement learning. They set it to work navigating challenging virtual mazes and tweaked its performance by giving rewards for good navigation.

To test whether the digital grid cells were responsible for this performance, the researchers carried out another experiment where they prevented the artificial grid cells from forming, which significantly reduced the ability of the system to efficiently navigate. The DeepMind team says this suggests these cells are involved in vector-based navigation as had been hypothesized. *https://singularityhub.com*

FCC looks into reports of illegal mobile phone tracking

The Federal Communications Commission (FCC) recently announced that it is investigating reports that websites may have enabled the location of mobile phone customers to be tracked. Reuters reported that the FCC referred news reports that broke earlier in the week to its enforcement bureau for investigation. Robert Xiao, a researcher at Carnegie Mellon, contends that the data from LocationSmart, a California technology firm, could have been used to track mobile customers of AT&T, Verizon Communications, Sprint and T-Mobile. He blamed it on a flaw in the software.

According to the report, the customers could be tracked as close as a few hundred yards of their locations without their knowledge. Those reports even prompted Oregon Democratic Senator Ron Wyden to call on the FCC to investigate the allegations. Earlier this month, the New York Times reported that charges had been filed against a former sheriff in Mississippi County, Missouri who used Securus Technologies to track the mobile phones of police officers without getting a court order. Reports pointed to LocationSmart as the source of the data.

LocationSmart spokeswoman Brenda Schafer said that the flaw "has been resolved and the demo has been disabled." *www.pymnts.com*

NITI Aayog and IBM to develop precision agriculture over AI

NITI Aayog India and IBM signed a Statement of Intent (SoI) to develop a crop yield prediction model using Artificial Intelligence (AI) to provide real time advisory to farmers in Aspirational Districts. The partnership aims to work together towards use of technology to provide insights to farmers to improve crop productivity, soil yield, control agricultural inputs with the overarching goal of improving farmers' incomes.

First phase of the project will focus on developing the model for 10 Aspirational Districts across the States of Assam, Bihar, Jharkhand, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.

The scope of this project is to introduce and make available climate-aware cognitive farming techniques and identifying systems of crop monitoring, early warning on pest/ disease outbreak based on advanced AI innovations. It also includes deployment of weather advisory, rich satellite and enhanced weather forecast information along with IT & mobile applications with a focus on improving the crop yield and cost savings through better farm management. *www.ndtv.com*

REFILE-Mapbox partners with Microsoft, Intel for car maps

Mapping startup Mapbox Inc said that it is teaming up with Microsoft Corp, Intel Corp and Softbank Group Corp's ARM Holdings chip unit to deepen its push into providing maps for self-driving cars. *https://cn.reuters.com*

Autonomous vehicle development by Quantum Storage Solutions

Quantum Corp has named AutonomouStuff LLC its primary partner for storage distribution in the automotive market. Quantum's StorNext®-powered scale-out storage provides high-performance ingest of data into the data center when test vehicles return to the garage, thereby speeding time to result for sensor-generated in-vehicle data.

Uber will open $24 million flying taxi research center in Paris

Uber has announced that it will open its first research center outside North America in Paris, where it will spend $24 million over the next five years to develop its autonomous flying taxi technology. Back in 2016, Uber created its Elevate program to build all-electric, vertical takeoff and landing (VTOL) aircraft powered by distributed electric propulsion. As part of that initiative and other autonomous vehicle efforts, Uber has opened advanced technology offices in Pittsburgh, Toronto, and San Francisco. Uber also announced a new partnership with École polytechnique, a five-year deal to endow its first international academic and research chair of "Integrated Urban Mobility."

In French academia, the term "chair" refers to program, rather than a single academic position. In this case, the new academic program will collaborate with Uber's ATCP on subjects such as "artificial intelligence, aviation, and all-electric transport. *https://venturebeat.com*

Sony's new IoT board features built-in GNSS receiver

Sony Corporation has developed two new products, the Spresence main and extension boards for internet of things (IoT) applications, equipped with a smart-sensing processor. The main board uses a multi-CPU structure equipped with Sony's GNSS receiver (GPS+GLONASS) and high-res audio codec. A variety of systems for diverse applications — drones, smart speakers, sensing cameras and other IoT devices — can be built by combining the boards and developing the relevant applications.

SRI International to develop Artificial Intelligence System

SRI International has been selected by the Defense Advanced Research Projects Agency (DARPA) to develop a next-generation artificial intelligence (AI) system able to learn continuously and apply that learning to become better and more reliable at performing new tasks. The contract will be supported under DARPA's Lifelong Learning Machines (L2M) Program.

AI systems today can repeatedly make the same mistakes. Even with retraining, today's systems are prone to "catastrophic forgetting" when a new item disrupts previously learned knowledg

Biological memory transfer is a complex sequence of dynamic processes, with local and global synchronization patterns. These processes support memories with flexibility in expression for future thinking, foresight, planning, and creativity. As part of the L2M program, SRI researchers will develop AI algorithms based on biological mechanisms in memory consolidation and replay. *www.sri.com*

Israeli drone company Flytrex selected for FAA partnership

Israeli drone logistics company Flytrex has teamed up with the North Carolina state government to participate in a groundbreaking Federal Aviation Administration (FAA) pilot program.

The FAA's Unmanned Aircraft System (UAS) Integration Pilot Program pairs up state and local governments with private companies in order to accelerate the safe deployment of drones above America. The program is intended to help the US Department of Transportation and the FAA craft new rules that allow more complex low-altitude operations.

Flytrex doesn't manufacture drones. Rather, it has created a cloud-based back end that allows customers to operate an entire fleet of drones remotely. *www.israel21c.org*

Regulators want drones to have visible 'license plates'

When you register a drone with the FAA, you'll get a government-issued ID number you can put as a note inside the battery compartment or any other internal part of the machine. In the future, though, you may have to make sure that number is perfectly visible — sort of a like small license plate for your UAV. Bloomberg has discovered a proposed rule filed earlier this month that would "require small unmanned aircraft owners to display the unique identifier assigned by the FAA upon completion of the registration process on an external surface of the aircraft." If it becomes an official rule, you'd no longer be allowed to keep that number hidden.

As Bloomberg noted, visible registration numbers would allow regulators to keep a closer eye on personal drones. Authorities have long been trying to gain greater control over the flying machines, since they were involved in aircraft crashes in the past and due to growing concerns over terrorist use of UAVs. Late last year, the government required people who own drones 0.5 to 55 pounds to register their devices with the FAA — the UN even plans to support a single worldwide drone registry. And just a couple of months ago, the White House brought up the possibility of allowing law enforcement personnel to to track and shoot down civilian drones. *www.engadget.com*

FAA must bolster drone risk management efforts

The Federal Aviation Administration should improve its risk management efforts related to drone safety, according to a report by the US Government Accountability Office.

FAA's information on the extent of unsafe use of drones, in the national airspace system is limited, according to the GAO report published recently. Although the agency collects data on several types of safety events involving small UAS, the accuracy and completeness of the data are questionable, the report found.Since 2014, for example, more than 6,000 sightings unmanned aircraft systems — often flying near manned aircraft or airports — have been reported to the FAA, but agency officials told the GAO that they cannot verify that the drones were involved in most of the sightings.

The FAA is taking steps to improve its data, including developing a web-based system for the public to report any drone sightings perceived to be a safety concern and surveying UAS users on their operational activity, but the agency did not have time frames for completing these efforts, according to the report. The FAA is also evaluating technologies for detecting and remotely identifying UAS, which could improve data on unsafe use.

Fortress UAV announces new drone fleet services

Fortress UAV has announced a series of new drone service offerings for enterprise and public safety markets. These services complement the successful national drone repair and maintenance business model that Fortress UAV launched in 2017. The new enterprise and public safety offerings are meant to serve the emerging needs of organizations that are using drones or drone fleets in everyday situations.

3DR launches ground control point app for drones

3DR, makers of the Site Scan drone software platform for construction and engineering professionals, has released 3DR GCP, an Android app enabled by the Trimble Catalyst on-demand GNSS service that makes it simpler for Site Scan users to capture and use ground control points (GCPs) on commercial drone projects.

Drone survey to acquire land in Indian state Punjab

The Greater Mohali Development Agency (GMADA) has launched a congestion survey aimed at acquiring 5,350 acres belonging to 14 Mohali villages near Chandigarh International Airport via land use. This is for the first time in the state territory that the land area for development work is being explored using drones services. Data collected through Drones gives clear features to be confined, as it provides up to 2 cm accuracy.

GMADA has entrusted the 3D mapping work to the Punjab Remote Sensing Center (PSRC), a node-specific agency. Punjab government. To implement the project, PSRC makes the services of M / s RSI Softech India Pvt Ltd. *http://xbesolutions.com*

InfraDrone announces release of app for drone pilot jobs

InfraDrone LLC has announced the release of their new App, available on both Android and iPhone App stores and via the web.

The App allows pilots to:

- Register for potential paid drone pilot jobs
- Register with no cost or obligation
- Receive notice of paid drone jobs available in their area
- Respond with price quotes
- View restricted air space maps, weather and other information
- Receive payment.

Iridium makes maritime industry history

Communications Inc. has announced that the International Maritime Organization's (IMO) Maritime Safety Committee (MSC) agreed to recognize that the Iridium network meets all the criteria of the IMO needed to provide mobile satellite services in the GMDSS, and to adopt the "Statement of Recognition" proposed by the United States as a Committee Resolution. This is a significant achievement that ends a decades-long satellite industry monopoly in which only one company was authorized to provide satellite GMDSS service and for the first time will bring competition and truly global coverage, to mariners sailing any of the world's oceans.

The MSC also agreed that Iridium and the United States, the delegation sponsoring Iridium's application at the IMO, will work with the International Mobile Satellite Organization (IMSO), which will monitor progress in Iridium's implementation of the service. The IMSO will report to the MSC once a Public Services Agreement has been entered into between Iridium and the IMSO, likely marking the start of this service. Iridium formally began the process to become a recognized GMDSS mobile satellite service provider in April 2013. Iridium plans to begin providing GMDSS service in early 2020. *www.iridium.com*

Focus 35 total station with auto scan helping build china's expressway network

Spectra Precision FOCUS 35 robotic total stations are hard at work helping build the world's largest expressway network. In one notable example, the FOCUS 35, with its time-saving automatic scan template, is checking the cross-section quality of the twin Nan Kunshan tunnels for the new six-lane Shazhan S14 regional highway.

Excavation under Nankun Mountain for the twin tunnels, each 4.1 km long and each capable of carrying three lanes of vehicular traffic, began in September 2016. In the current second phase of construction, the FOCUS 35 is being used to gather data that will be used to compare the as-built tunnels to the design specifications to determine what adjustments to the tunnel surfaces may need to be made. The FOCUS 35 was selected for the scanning work because it offers a particularly streamlined and efficient workflow that yields significant time-savings. *www.spectraprecision.com*

SXblue Introduces Android Application ToolBox

SXblue ToolBox, the Android application for SXblue GNSS receivers has been developed with special consideration to modern mobile device development and an attention to user and dealer feedbacks. With the SXblue ToolBox application, the user can view and analyse the position data provided by the SXblue receiver, and metadata related to its location. The user is able as well, to send commands that enable or disable some features: Systems in use, Mask angle or differential age, constellation in use: GPS, GLONASS, GALILEO, BEIDOU, SBAS. It is also an NTRIP client capable of connecting to a NTRIP server for RTK corrections and thus allow the receiver to issue a very accurate location information.

Swift Navigation announces SBAS support for Piksi Multi

Swift Navigation has announced the latest firmware upgrade to its flagship product Piksi® Multi GNSS Module. This marks the fifth major point release to Piksi Multi and is available free of charge to Swift customers. The firmware release also enhances Duro®, the ruggedized version of the Piksi Multi receiver housed in a military-grade, weatherproof enclosure designed specifically for long-term outdoor deployments. *support.swiftnav.com.*

All-New Rugged Atlas®-Capable UAV GNSS Antenna by Hemisphere GNSS

Hemisphere GNSS has announced the all-new multi-GNSS, multi-frequency 4-helix HA32 UAV antenna. The HA32 is a high-performance antenna that supports GPS, GLONASS, Galileo, BeiDou, Hemisphere's own Atlas L-band correction service, and was designed specifically for UAVs, GIS, surveying, RTK, and other applications requiring high-precision positioning and navigation.

The HA32 is built on an innovative and proprietary 4-helix antenna technology that provides superior filtering and anti-jamming performance with LNA features such as low noise figure of 2.0 dB (typical) and up to 30 dB gain (typical). *www.HGNSS.com*

Mobile devices to turn into high-accuracy GNSS tools

Eos Positioning Systems Inc is partnering with enterprise mobile solutions provider CartoPac International to enable consumer smartphones and tablets to become professional-grade GNSS data collection and management devices for staking, inspections and more.

Eos manufactures the Arrow receivers for any smartphone or tablet. CartoPac develops enterprise utility software, including a mobile solution for asset management and data collection.

Eos and CartoPac partnered to integrate the Arrow Series with CartoPac's mobile software. This allows CartoPac users to bring submeter and centimeter location into their asset-management solution on either iOS, Windows or Windows Mobile devices.

Hexagon Positioning Intelligence releases PIM7500

Hexagon's Positioning Intelligence division has introduced the new PIM7500 Global Navigation Satellite System (GNSS) receiver explicitly designed for autonomous automotive platform development and solutions. This single-sided receiver features a compact form factor that solders down directly for easy integration with electronic control modules and Artificial Intelligence (AI) development platforms.

The PIM7500 is available in low- to mid-volume quantities making it an ideal GNSS receiver to use in mileage accumulation fleets. The new receiver also features dual-frequency GNSS reception

Galileo update

EU preparing for second-generation Galileo

The European Commission has published a contract notice for procurement of Galileo transition satellites. The contracting authority, the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW), wishes to procure new Galileo transition satellites with evolved specifications to ensure the continuity of the Galileo constellation in 2025-2026 and initiate the transition from the 1st generation to the 2nd generation of Galileo satellites. The contract notice indicates that four satellites will be ordered as baseline, with options for additional satellites. *www.aircosmosinternational.com*

Orolia secures 26m Galileo contracts

Orolia has announced that its atomic clock solutions have been selected for the Galileo. This latest initiative builds on Orolia's long-standing role in providing the precise timing technology for satellite programs.

Under these contracts, Orolia will supply its Spectratime Rubidium Atomic Frequency Standard and its Passive Hydrogen Masers physics package for an additional 12 Galileo satellites. In addition to serving as Europe's independent PNT source, Galileo can also serve as a secondary signal source for systems such as GPS, GLONASS or BeiDou in the event of service disruption. Galileo delivers the highest accuracy of any GNSS system in operation today. The quadruple clock redundancy designed into each satellite ensures that even if a failure occurs, overall system performance will not be compromised. *www.orolia.com*

Galileo Masters seeking partners for future GNSS innovations

Since going live in 2016, users around the world are being guided using the positioning, navigation and timing information provided by Galileo's satellite constellation.

The European Satellite Navigation Competition (ESNC) is an opportunity to transform your idea into a commercial solution. On a mission to spur the development of market-driven applications, the annual competition awards the best services, products and business ideas using satellite navigation – and Galileo in particular – in everyday life. Since its launch in 2004, over 11,500 people from 90 countries have participated in the ESNC, each of whom have been competing for a piece of the EUR 1 million prize pool. *www.esnc.eu*

UK wants £1bn back from EU if it is excluded from Galileo

David Davis's Brexit department is also warning the scheme could cost the EU an extra €1bn (£876m) without the UK's continued involvement The row could harm wider post-Brexit security co-operation, the department says in a new paper.

But Brussels has cited legal issues about sharing sensitive information with a non-member state for its decision to shut British firms out of the project. Brussels has also said it will restrict access to encrypted signals from Galileo.

In its position paper, the UK government repeats its threat to build its own satellite navigation system - which has been estimated would cost up to £5bn - as a rival to Galileo. *www.bbc.com*

from all available constellations including GPS, GLONASS, Galileo, BeiDou, NavIC, QZSS and SBAS. The PIM7500 offers sub-meter and centimeter-level positioning using Hexagon Correction Services to deliver the high-accuracy positioning required for the autonomous industry. *www.hexagonpositioning.com*

PCTEL launches multi-GNSS L1/L2/L5 antennas for precision navigation

PCTEL Inc. has launched a new series of multi-GNSS L1/L2/L5 antennas for precision navigation and timing. The antennas combine aerospace-level precision with global satellite compatibility, in a highly durable package. They enable critical applications including vehicular automation, 5G network timing synchronization and Positive Train Control (PTC) systems.

Positioning solutions for space constrained systems by NovAtel

NovAtel has introduced several new precision positioning solutions for space-constrained applications. With enhanced positioning accuracy in a compact form, the PwrPak7D, PwrPak7DE1 and OEM7600 are suitable for automotive, airborne and other smaller unmanned systems.

NovAtel's new PwrPak7D and PwrPak7D-E1 enclosures provide space efficiency without sacrificing position accuracy and heading stability, even in stationary, slow-moving or hovering dynamics. The PwrPak7D-E1 enclosure integrates an inertial measurement unit (IMU) with NovAtel's OEM7720 dual-antenna receiver board to deliver GNSS and inertial navigation system (INS) capabilities.

Sokkia introduces new high-performance manual total station

Sokkia has introduced the latest addition to its iM line of manual total stations designed to provide powerful performance in an affordable package — the iM-50.

The iM-50 EDM features a prism range

of up to 4,000 m and up to 500 m in reflectorless mode with a 1.5 mm/2 ppm accuracy. "The beam can precisely measure walls, corners, manholes on the road surface, even chain-link fences and tree branches. It offers a rapid distance measurement of 0.9 seconds regardless of the target," he said. The instrument offers integrated Bluetooth technology for connectivity with the controller.

Trimble GNSS integrates MicroPilot UAS autopilot

MicroPilot and Trimble have entered into an agreement that will enable the integration of Trimble's high-precision GNSS technology into the MP2128 Triple Redundant UAS Autopilot.

Integrating autopilots can be difficult because a lot of settings have to be fine-tuned. The team at MicroPilot offers support through the design cycle and completes extensive testing to ensure they provide a reliable autopilot that safely guides and controls drones.

Rohde & Schwarz Collaborates with PoLTE

Rohde & Schwarz is collaborating with PoLTE Corporation, a leader in cellular-based location solutions, to accelerate the robustness and accuracy of cellular location technologies. Rohde & Schwarz and PoLTE are enhancing the cellular IoT ecosystem and expanding the opportunity for new IoT use cases. Location-based services will enable a wide range of use cases, including industrial IoT, healthcare IoT, Internet of Life Saving Things IoT, manufacturing IoT, agriculture IoT, energy IoT, automotive IoT and countless others.

The R&S TS-LBS test solution uses the R&S CMW500 network emulator to simulate LTE Release 8-14 3GPP IoT technologies, including NB-IoT (Cat-NB1), eNB-IoT (Cat-NB2), eMTC (Cat-M1), LTE Cat 1 and LTE Cat 4 in combination with terrestrial location technologies, such as OTDOA and eCID. PoLTE will help pilot advanced testing using the R&S CMW500 by simulating difficult mobile environments so that they can deliver the most comprehensive and robust location solution for the cellular IoT marketplace. *rohde-schwarz.com*

KVH and VectorNav collaboration

Inertial sensor companies KVH Industries Inc. and VectorNav Technologies LLC have announced that KVH's fiber optic gyro (FOG)-based 1750 IMU and 1775 IMU will now be offered to enhance the operation of VectorNav's VN-210 and VN-310 Tactical Series GNSS-aided inertial navigation systems.

DJI releases the Phantom 4 Pro V2.0

DJI has released the new Phantom 4 Pro V2.0. First off, the new DJI Phantom 4 Pro V2.0 does come with the noise-reduction propellers we first saw in the FCC filing. According, to the Chinese drone maker that reduce the noise of the unmanned aerial vehicle by 4Db, which may not sound like much but will make a significant difference.

The Phantom 4 Pro V2.0 has the same 1-inch 20MP Exmor R CMOS sensor with a mechanical shutter, a flight time of 30 minutes and smarter features. It has a range of 4.375 miles, shoots video in 4K at 60fps and burst mode at 14 fps. Its FlightAutonomy system includes dual rear vision sensors and infrared sensing for a combined 5 directions obstacle sensing and 4 directions of obstacle avoidance with a 100 feet sensing range.

SpaceX's new rocket studied by Air Force, Delaying GPS Upgrades

The U.S. Air Force has delayed the launch of its first Global Positioning System III satellite to October at the earliest as it reviews the upgraded rocket that Elon Musk's SpaceX plans to use to boost it into orbit.

The satellite valued at about $528 million would be launched on the latest version of the Falcon 9 rocket from Space Exploration Technologies Corp.The Block 5 rocket has more powerful engines, a stronger heat shield for the return trip through Earth's atmosphere and new retractable landing legs. The GPS III satellites being built by Lockheed Martin Corp. promise increased accuracy for navigation, a signal compatible with similar European satellites and improved security against cyberattacks. But the satellites meant to upgrade the Global Positioning System, which is widely used for military and civilian applications, are already years behind schedule. *www.bloomberg.com*

Airobotics Partnership with Shapir-Ashtrom

Airobotics, the Israeli startup that built the world's first fully automated drone, has announced its partnership with Shapir-Ashtrom to survey the construction of Haifa's new seaport, "Gulf Port", intended to further develop Israel's coastline areas, and increase maritime traffic and international commerce.

With this collaboration, Airobotics is implementing the first technology of its kind for industrial spaces, and is working closely with Israel's top construction and civil engineering companies, Shapir Civil and Marine Engineering Ltd., and Ashtrom Properties Ltd., which created a joint venture "Shapir-Ashtrom", specifically for this new Haifa seaport initiative, valued at 4 billion Israeli Shekels (approx. $1b). Airobotics has applied its drone missions to assist in surveying reclamation areas, monitoring breakwater construction and stockpile measurements, which increases construction accuracy and accessibility, while reducing production costs, and adhering to project timelines. *www.airoboticsdrones.com*

No-Base Station – Accurate Georeferencing for UAV surveying

Klau Geomatics has announced their new No-Base-Station high accuracy georeferencing solution for UAVs. This revolutionary new solution is the result of close collaboration between Klau Geomatics and Hexagon's Geosystems Division, enabling users to conduct UAV surveying projects without running a local GPS receiver.*www.klauppk.com*

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www.dronesconference.co.za

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www.gi-forum.org

Esri International User Conference 2018
9 - 13 July
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www.esri.com/events

ESA/JRC International Summer School on GNSS 2018
16 - 27 July
Loipersdorf, Austria
www.esa-jrc-summerschool.org

August 2018

5th International Conference on Geological and Environmental Sustainability
13-14 August
Bali, Indonesia
https://geology.conferenceseries.com

September 2018

Inter Drone 2018
5 - 7 September
Las Vegas, USA
www.interdrone.com

Africa GEO
17-19 September
Johannesburg, South Africa
https://africageo.org.za

INSPIRE Conference 2018
18 - 21 September
Antwerp, Belgium
www.inspire.ec.europa.eu/conference2018

MUNICIPALIKA
19-21 September
Mumbai, India
https://municipalika.com

5th EARSeL Joint Workshop "Urban Remote Sensing – Challenges & Solutions"
24 - 26 September
Dortmund, Germany
http://urs.earsel.org

International Symposium and Workshop on A smart sustainable future for all
24 - 26 September
Melbourne, Australia
ssf2018.com

ION GNSS+ 2018
24 - 28 September
Miami, USA
www.ion.org

The 8th China Surveying and Mapping GI Tech Equipment Expo
26-28, September
Deqing, Zhejiang, PR China
www.tleerw.com/en/

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Joint Geo Delft Conference
The 6th International FIG 3D Cadastre Workshop
The 3D GeoInfo Conference
1- 5 October
Delft, the Netherlands
www.tudelft.nl/geodelft2018

39th Asian Conference on Remote Sensing (ACRS 2018)
15 - 19 October
Kuala Lumpur, Malaysia
http://acrs2018.mrsa.gov

Intergeo 2018
17 - 18 October
Frankfurt, Germany
www.intergeo.de

November 2018

Trimble Dimensions 2018
05 - 07 November
Las Vegas, USA
www.trimbledimensions.com

International Navigation Conference 2018
12 - 15 November
Bristol, UK
www.rin.org.uk

ITSNT 2018
13 - 16 November
Toulouse, France
www.itsnt.fr

United Nations World Geospatial Information Congress
19 - 21 November
Deqing, China

International Symposium on GNSS (ISGNSS 2018)
21 - 23 November
Bali, Indonesia
www.isgnss2018.com

CHINTERGEO 2018
November
ChengDu, PR China
www.chintergeo.com/en/index.html

The Pacific GIS and Remote Sensing User Conference
26 - 30 November 2018
SUVA, Fiji
www.picgisrs.org

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