REPORT ON MANAGEMENT - 2020

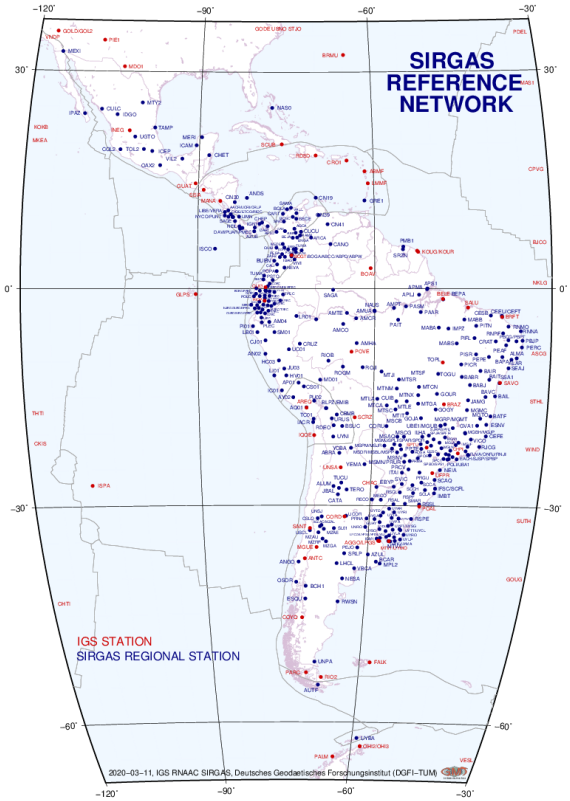
1. Maintenance of the geodesic reference frame of the Americas

Within the terms of the mission of SIRGAS (defined in Art.1 of the statute approved by the Directing Council of SIRGAS on the 9th of May, 2011) and the Joint Action Plan (drafted and signed by SIRGAS, PAIGH, UN-GGIM: Americas and GEOSUR), and, in accordance with the resolution "A Global Geodetic Reference Frame for Sustainable Development" (A/RES/69/266) adopted by the General Assembly of the United Nations in the year 2015, that recognizes the economic and scientific importance of an accurate and stable global geodesic reference frame for the Earth and of the growing need to have this available, during the year 2020 the following achievements associated with maintaining the geodesic reference frame, SIRGAS, were obtained:

1.1. Achievements linked to the Geocentric Reference Frame

1.1.1. Processing in the SIRGAS-CON network

Within the area covered by the reference system, SIRGAS has incorporated 27 new GNSS stations, reaching, by the end of 2020, a figure close to 400 continuous stations (SIRGAS-CON) in operation, of which 67 are included in the solution for the International Service of the GNSS (IGS). This network puts into effect the geodesic reference frame for the region and is consistent with the International Terrestrial Reference Frame (ITRF). In this way, the SIRGAS-CON network is the densification in America of the ITRF, this achievement being reached through the rigorous processing of data at weekly intervals.



The error index for the SIRGAS-CON combined individual solutions aligned with the ITRF14 reference frame has an RMS of 1.5 mm, thus sustaining quality in the weekly results (internal and external consistency).

The network is operated and processed by means of the coordinated and continuous work of 13 data centers, 8 processing centers and two combination centers. Additionally, the center for analysis of the neutral atmosphere of the National University of Cuyo and UNCuyo / “Juan Agustín Maza” University have been integrated for the purposes of atmospheric research.

As from the “GPS 2010” week, the National Geographic Institute of Peru has become a new experimental processing center of SIRGAS.

The products created by the GTI are mainly the semi-free weekly solutions, normally used in calculations of combination and determination of multi-annual solutions) and the adjusted weekly solutions (i.e. IGb14 from the 2106 week onwards), which are available as reference values for users in the Americas.

1.1.2. Reprocessing of the SIRGAS reference frame in the ITRF2014

With the objective of guaranteeing the reliability and stability of the SIRGAS reference frame, in November, 2018 the IGS RNAAC SIRGAS (DGFI-TUM) started the reprocessing of the historic data of SIRGAS (from January 2000) using IGS14 (ITRF2014) as the reference framework with antenna

model igs14.atx and satellite orbits and clocks in IGS14 set by the Jet Propulsion Laboratory (JPL) of NASA.

In the reprocessing, the SIRGAS stations were filtered, excluding those with periods of operation less than two years and correcting inconsistencies in the GNSS equipment, stated erroneously in the old log files of the stations.

Together with the 500 (approximately) SIRGAS stations, IGS global stations co-located with VLBI and SLR were added for the purpose of supporting the SIRGAS initiative involving SLR data in the implementation of the reference frame. This initiative started with a workshop at the SIRGAS2017 symposium (Mendoza, Argentina) and continued making progress at a second SLR workshop at the SIRGAS2019 symposium (Rio de Janeiro, Brazil).

Further details in Sánchez L. (2020). SIRGAS Regional Network Associate Analysis Centre Technical Report 2019. Villiger A., Dach R. (eds.) International GNSS Service: Technical Report 2019, 125-136, 10.7892/BORIS.144003.

1.1.3. SIRGAS stations included in the reprocessing of the global network of the IGS for the determination of the ITRF2020

The IGS started, in mid-2019, the third reprocessing of its network (1994 - 2020) applying the updated standards and conventions for determining a new version of the ITRF (ITRF2020).

The IGS RNAAC SIRGAS (DGFI-TUM), by mutual agreement with the managers/owners of some SIRGAS stations, proposed to the IGS adding 30 additional SIRGAS stations, in order for the region to have available more reference stations for the calculation of the regional frame.

1.1.4. Revision and updating of guidelines and processes

SIRGAS offers a highly reliable frame of reference that satisfies any technical or scientific requirement through SIRGAS-CON. Standardization in those stages of GNSS observation and estimation GNSS that belong directly to SIRGAS is fundamental.

The GTI provides the guidance and recommendations that are necessary for:

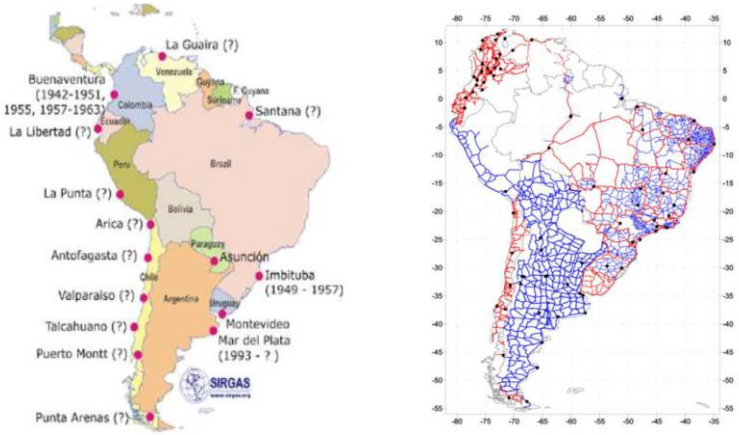
- Setting up and including stations in to SIRGAS-CON
- Operating the Analysis centers
- Coordinating the general management of the network and the working group

These guidelines have been checked and updated in terms of state-of-the-art techniques.

Currently, the Real Time Guide is being developed with guidance so that those responsible for the Active Networks can provide data in real time through the NTRIP protocol.

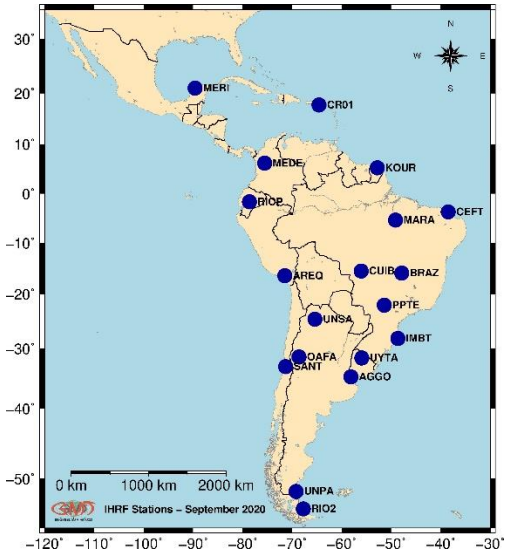
1.2. Achievements linked with the Vertical Reference Frame

WG III has compiled most of the information for elevations (physical and geometric) of the member countries, has identified and worked on the problems arising directly from lost connections and the errors made, has coordinated measurement campaigns in adjacent areas and has provided the technical support necessary for the data processing at a national level.



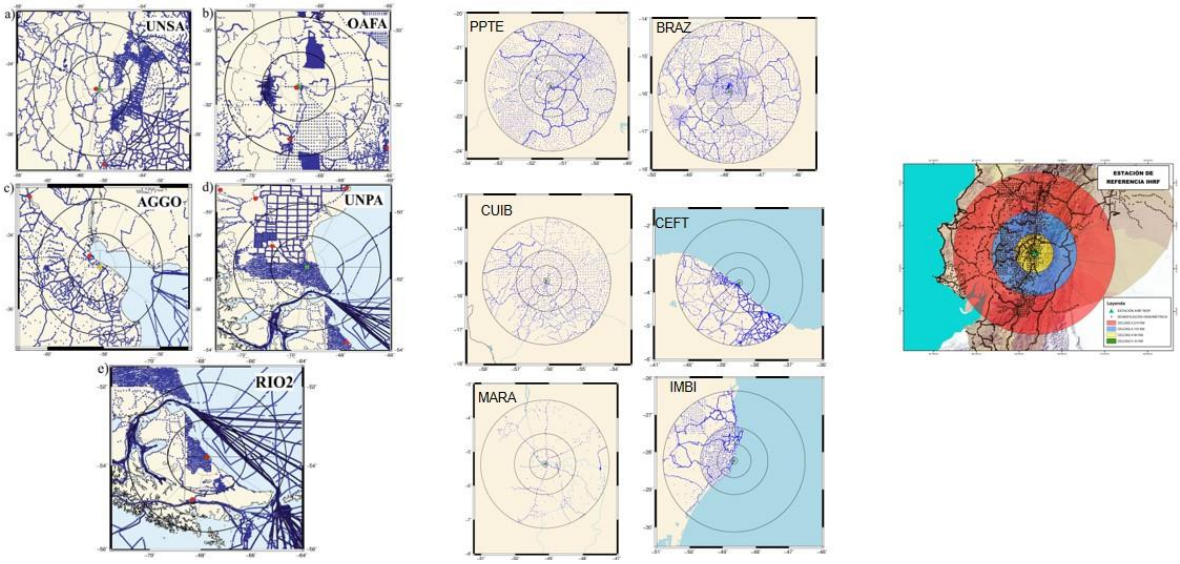
Concerning the SIRGAS Vertical Reference System (SVRS), there has been substantial progress made involving the incorporation of physical heights, the connection to the geometric components of SIRGAS, the integration of the national vertical networks, their links to the value of the reference W_0 potential of the IHRS, the definition for a specific epoch and the consistent connection with the ITRF.

In the context of the integration to the IHRS/IHRF, SIRGAS has proposed a set of 22 stations in Latin America and the Caribbean and has made progress in implementing these stations.

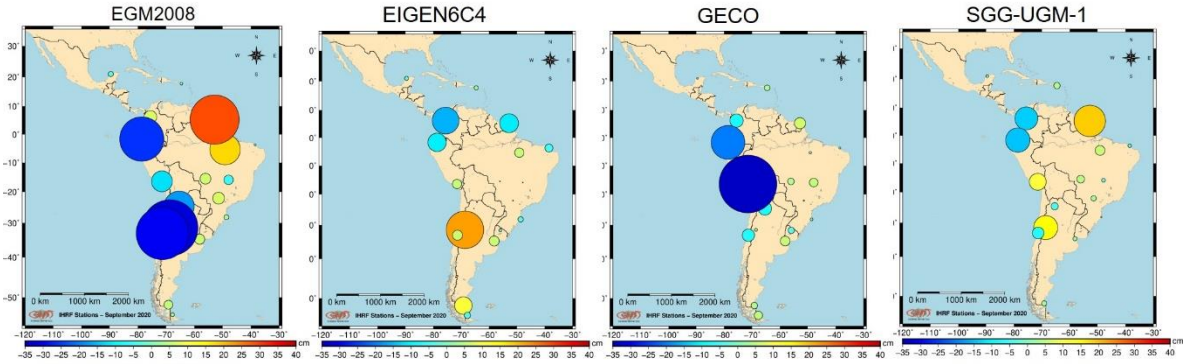


In this aspect, WH III has made contact with some of the South American countries that are working on the establishment of IHRF stations, in order to offer technical assistance. Some of these countries have made substantial efforts to put into effect gravimetric densifications about

the future IHRF stations, with the purpose of adopting the recommendations and standards that the IAG proposes. Below, maps with the gravimetric measurements at 12 IHRF stations (5 in Argentina, 6 in Brazil and 1 in Ecuador) are shown:



Moreover, a calculation process to identify the optimum distribution for gravimetric measurements in the areas around the IHRF stations proposed in South America was started. For this, potential values derived from global geopotential models were used (comparison with the XGM2019 model).



Finally, the WG-III carried out a scientific project together with the Technical University of Munich (TUM) called *Contributions of high-resolution gravity models in Latin America*, with the purpose of assessing the geoid models and the leveling/GNSS stations available in Latin America using gravity field models of high resolution and of combining satellites in order to contribute to the calculation of the potential at the IHRF stations.

2. Running the SIRGAS 2020 Virtual Symposium

Within the terms of Article N° 22 of the Statute of SIRGAS (approved by the Directing Council of SIRGAS on May 9th, 2011) and the document "SIRGAS Events Procedures" issued by the SIRGAS Directing Council at their meeting on October 26th, 2016 in Panama City, the Scientific Symposium "SIRGAS 2020" was scheduled to be run in the month of November in the city of Santa Cruz de la Sierra, Bolivia.

Nevertheless, owing to the COVID-19 pandemic, the in-person mode for the SIRGAS Scientific Symposium needed to be replaced by the virtual mode for the event. On this matter, the Symposium was held over five sessions scheduled for the successive Fridays between the 2nd and the 30th of October by means of a web platform for hosting events live. Below, a leaflet of the event that includes the titles of the sessions run and presentations made is shown:

The 1st Session, titled "Studies of the atmosphere and analysis of the Earth System" and held on the 2nd of October, had 92 colleagues of the region participating.

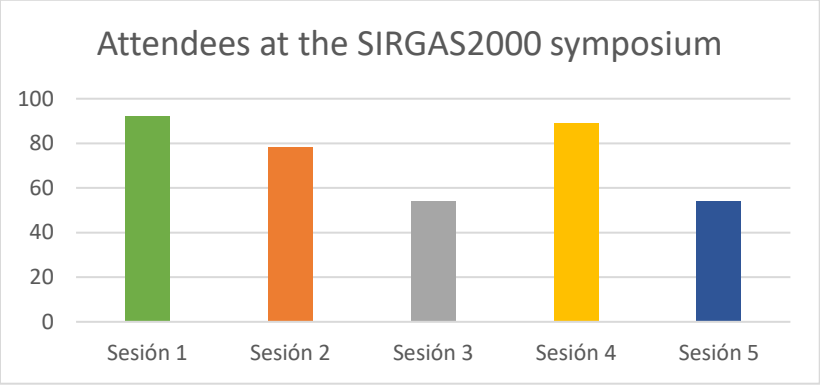
The 2nd Session, titled “Development and maintenance of the SIRGAS reference frame” and held on the 9th of October, had 78 colleagues of the region participating.

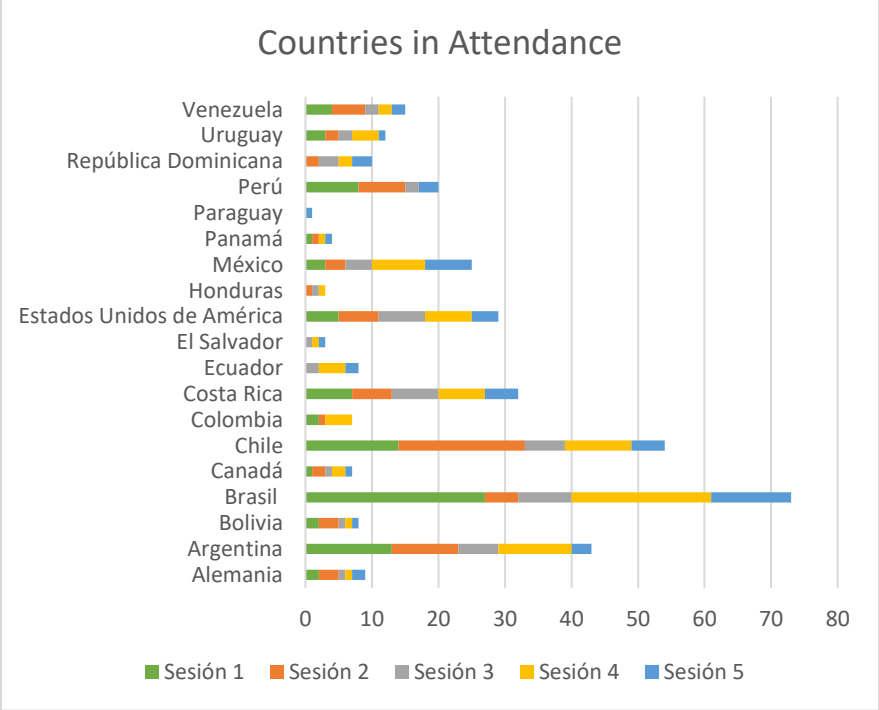
The 3rd Session, titled “Practical applications intended for the adoption of SIRGAS at sub-regional and national levels” and held on the 16th of October, had 54 colleagues of the region participating.

The 4th Session, titled “Height Systems” and held on the 23th of October, had 89 colleagues of the region participating.

The 5th Session, titled “Gravimetry and the geoide” and held on the 30th of October, had 54 colleagues of the region participating.

The graphs show the number of attendees at each session of the SIRGAS2020 symposium and their respective countries.





3. Strengthening of geodesic capabilities of the professional and technical specialists responsible for the maintenance of the national geodesic reference frames in the Americas

The in-person training activities planned for the year 2020 were within the terms of the Joint Action Plan (drafted and signed by SIRGAS, PAIGH, UN-GGIM: Americas and GEOSUR) and in accordance with the resolution "A Global Geodetic Reference Frame for Sustainable Development" of the United Nations, which encourages the Member States and international organizations to strengthen cooperation around the world for developing capabilities in geodesic matters, with the objective of ensuring progress in, sustainability of and public advocacy for a world geodesic reference frame. However, these activities had to be suspended, due to the COVID-19 pandemic.

- Course "Setting up accurate geodesic reference frames, by means of the scientific GPS/GNSS GAMIT/GLOB-K software for processing", organized by SIRGAS, the Topography School of the University of Costa Rica and the National Geographic Institute of Costa Rica. The objective of the course was to contribute to the process of training the technical and professional specialists of the Americas who participate in the definition and updating of the national geodesic reference frames on the basis of the GPS/GNSS processing information. The course was going to be held on the city of San José of Costa Rica during the month of June, and it was going to be led in the Spanish language by Dr. Demián Gómez (Ohio State University).
- The "SIRGAS GTIII-2020 Workshop", organized by SIRGAS and the Federal University of Pernambuco. The objective of the workshop was to contribute to the process of training technical and professional specialists of the Americas who participate in the definition and updating of the national vertical reference systems, to make progress towards the unification of the altimetric networks of all the countries in the region. The workshop was going to be run in the city of Recife (Brazil) during the month of July and was going to be led by Dr. Gabriel Gabriel do Nascimento Guimarães (Federal University of Uberlandia), Dr. Roberto Teixeira Luz (Brazilian Institute of Geography and Statistics) and the Agricultural Engineer Hernan Guagni (National Geographic Institute of the Republic of Argentina).
- The Workshop "GNSS Geodesic Infrastructure", organized by SIRGAS, the Military Geographic Institute of Bolivia, the Military Engineering School and the "Gabriel Rene Moreno" Public University. The objective of the workshop was to make widely known the best practices for maintaining the regional geodesic infrastructure as an essential means for improving the SIRGAS and ITRF geodesic reference frame. The workshop was going to be held in the city of Santa Cruz de la Sierra (Bolivia) during the month of November and was going to be led by contributors to WG I of SIRGAS.

4. Strengthening geodesic capabilities in the region through the development of on-line resources

Within the frame of the Joint Action Plan (set up and signed by SIRGAS, PAIGH, UN-GGIM: Americas and GEOSUR), and in accordance with the resolution "A Global Geodetic Reference Frame for Sustainable Development" of the United Nations, which encourages the Member States and international organizations to strengthen cooperation around the world in order to benefit

capabilities in matters involving geodesy, with the objective of ensuring the development, the sustainability and the public advocacy for a world geodesic reference frame, a series of webinars were run during the year 2020:

- "Activities and products of the SIRGAS Analysis Centers", presented by José Antonio Tarrio, in which more than 611 colleagues of the region participated.
- "Processing of GNSS data with free software, on the basis of SIRGAS stations", presented by Bernardo Barraza and José Antonio Tarrio, in which more than 311 colleagues of the region participated.
- "IHRS International System for Heights", presented by Laura Sánchez, in which more than 850 colleagues of the region participated.
- "Processing with NRCan PPP in the Windows Desktop environment", presented by Demián Gómez, in which more than 63 colleagues of the region participated.
- "Model for the movement of the terrestrial surface", presented by Hermann Drewes, in which more than 149 colleagues of the region participated.

Below, the leaflets that were distributed for promoting the training events are shown:

5. Development of the Terms of Reference for the new working group of UN-GGIM: Americas "Geodetic Reference Frame for the Americas" (GRFA)

Resolution 2019/5 of the Sixth Session de UN-GGIM: Americas states that it: "a) recognizes the discussions held in September 2019 in Argentina and the work that is being carried out in order to reach a consensus about a proposal for establishing a fourth working group, for supporting the implementation of the Resolution of the General Assembly of the United Nations 'A Global Geodetic Reference Frame for Sustainable Development' (A/RES/69/266) in the Americas; and b) supports the proposal to create a team focused on tasks, made up of the Executive Committee of SIRGAS, delegates of the Americas in the Geodesy sub-committee of UN-GGIM and the interested Member States, in order to define the Terms of Reference for the proposed working group"; in terms of this resolution "the Executive Committee of SIRGAS will coordinate the actions intended to push forwards the development of a proposal for the Terms of Reference of the GRFA". The Authorities of SIRGAS coordinated the development of the Terms of Reference of the new working group; these terms were approved through Resolution 2019/6 of the Seventh Session of UN-GGIM: Americas.

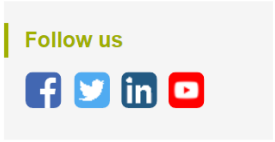
The main objectives of the GRFA are: a) to support the Nations of the Americas so that they respond to the Resolution of the General Assembly of the United Nations titled "A Global Geodetic Reference Frame for Sustainable Development" (A/RES/69/266); b) coordinate the efforts of the Member States to guarantee the sustainability and improvement of the regional geodesic reference frame, acting as a key facilitator of spatial data inter-operability, the mitigation of hazards from disasters and sustainable development; and c) acting as interface between SIRGAS and the Member States in order to implement plans that push forwards the development of the regional geodesic infrastructure, the geodesic reference frame of the Americas and the geodesic capabilities of professional and technical specialists of the region. The Terms of Reference are published in the Spanish and English languages on the UN-GGIM: Americas web site.

6. Development of a new statute for SIRGAS

Within the framework of, firstly, Article 33 of the statute of SIRGAS (approved by the Directing Council of SIRGAS on the 9th of May, 2011), which establishes that "the decision-making bodies of SIRGAS (Art. 8) should review the existing statute at least every eight years and propose those changes that are necessary for keeping the structure and functions of SIRGAS up to date ", and of, secondly, the need to align the activities that SIRGAS performs with the scientific recommendations of the International Association of Geodesy, with the Resolution of the General Assembly of the United Nations titled "A Global Geodetic Reference Frame for Sustainable Development" (A/RES/69/266) and with the "Road Map for the Global Geodetic Reference Frame for Sustainable Development" developed by the Geodesy Sub-Committee for UN-GGIM, a new statute was drafted by consensus among all the component bodies of SIRGAS.

7. Publication and public release of the activities of SIRGAS and of other regional and international geodesic new developments

During the year 2020, SIRGAS implemented communication through social networks using the Facebook, Twitter, Linkedin and YouTube channels. This has been within the terms of the Joint Action Plan and in accordance with the resolution "A Global Geodetic Reference Frame for Sustainable Development" of the United Nations, which recommends that the Member States set up programs for public outreach, raising the visibility of the world geodesic reference frame and making it more comprehensible for society.



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For this, a protocol was developed for managing the social networks; this establishes the basic policies for handling the information and participation of SIRGAS in digital media, also the interaction with the community through official channels.