# ANNEX D

Ionosphere ground based monitoring network in low-latitude regions: South America

## MImOSA: Monitoring the Ionosphere Over South America

# Executive Summary

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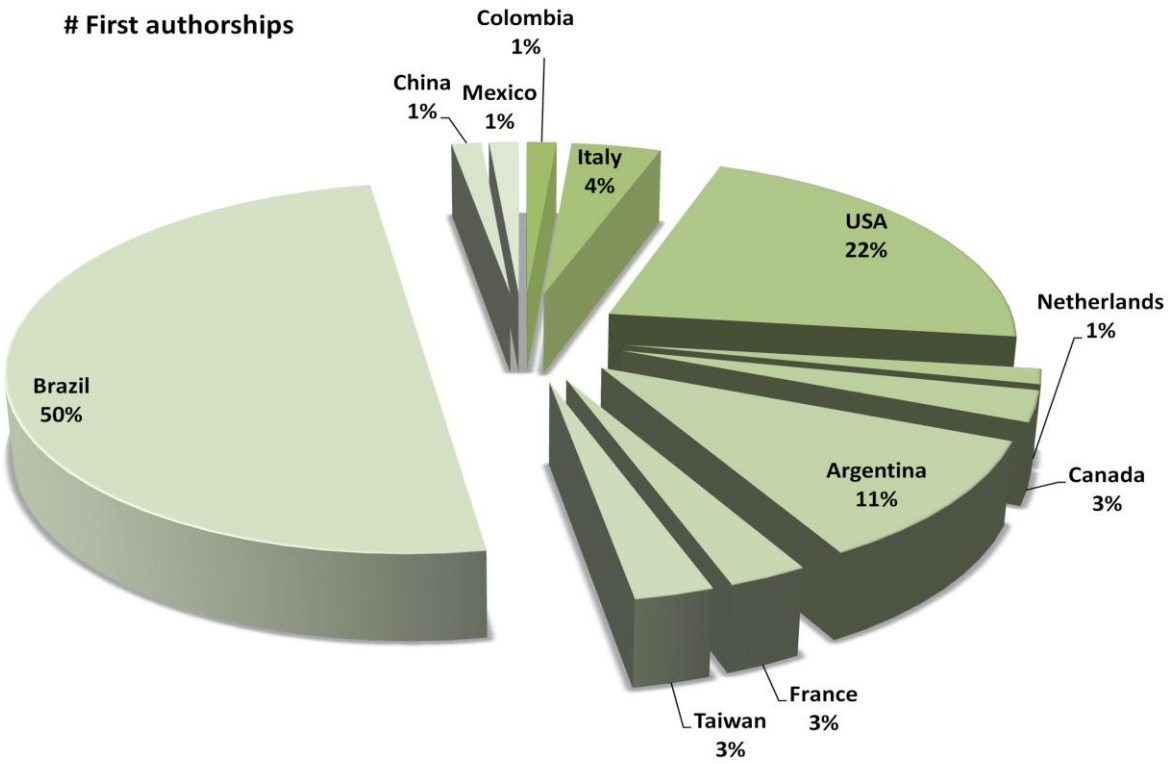
**Alcantara Study Reference No.:** 12/A42

**Study Type:** Competence Survey

**Contract Number**: 4000106577/12/F/MOS

**Picture:**




Percentage of the first authorship evaluated on the total number of paper surveyed

**Motivation:**

MImOSA gave the possibility to learn more about the actual capabilities of the South American countries to monitor and investigate the ionosphere, highlighting the dominant role of the largest countries, Brazil and Argentina, but also reporting an increasing interest in other countries such as Peru, Bolivia and Chile. MImOSA could result into a pilot project aiming to federate European and South American networks and individual instruments to monitor the southern and northern crests of the Equatorial Ionospheric Anomaly and the South Atlantic Magnetic Anomaly.

**Methodology:**

The survey was organized according to successive steps:

- Review of the open literature in the field of ionospheric monitoring, study and forecasting

produced from data acquired in the considered area;

- Identification of geographical sectors not yet (or only partially) monitored;
- Identification of peculiarities of the regional ionosphere of interest for the GNSS operations;
- Identification of the local experts in the field with consequent interaction with entities willing to host new installations, to integrate existing facilities, to extend ongoing plans or to be part of a synergy;
- Identification of specific uses of GNSS in the considered area considering its geographical, demographic, social and political context;
- Identification of potential users in the area of interest.

**Results:**

- Brazil confirms a well established expertise in the field with excellent scientific and technological capabilities. The Brazilian public and private entities understand well the importance of a proper monitoring, being aware of the high variability of the local ionosphere causing damages on the navigational, positioning and communication systems. The results of our survey testify the good coverage of the Brazilian territory, except for Amazonia because of the heavy logistics to be engaged.
- Argentina has a long tradition in ionospheric sounding, showing an outstanding scientific and technological expertise in the field. Nevertheless our survey evidences a poor scientific coordination at national level and a weak interaction with the private entities possibly interested in the ionospheric monitoring and awareness.
- The other South American countries suffer of lack of resources to establish or improve the current capabilities in the ionospheric monitoring. Often the ionosphere is probed and investigated in the frame of military activities mainly addressed to cartography. The measurements are not easily available and hardly accessible in real-time because of the lack of internet or high speed connections. From our records also the human resources are few and there is a lack of training opportunities for the young researchers. In general our survey testifies a deficiency of culture in the topics related to the upper atmosphere and to the ionosphere, in particular. A great contribution in these countries is given by the LISN network, led by the Boston College (USA), which offers opportunities to install and run instruments, to train young scientists and to network the facilities

**Publications:**

MImOSA team is working on a paper to be submitted to a peer-reviewed journal.

To mention the following conferences contributions:

Alfonsi L., G. De Franceschi, V. Romano, L. Spogli, F. Dovis, R. Notarpietro, M. Aquino, S. Vadakke Veettil, E. Correia, M. Cabrera, J. F. G. Monico, *"MImOSA Monitoring Ionosphere Over South America"*, Workshop on GNSS Data Application to Low Latitude Ionospheric Research ICTP Triste, May 10th, 2013.

Alfonsi, L., G. Povero, J. Rose, *"GINESTRA, MImOSA and MEDSTEC: Competence Surveys within the ESA ALCANTARA Initiatives"*, European Space Weather Week, 18-22nd November 2013, Antwerp, Belgium.

**Highlights:**

The MImOSA project could result into a pilot project aiming to federate European and South American networks and individual instruments, including those already in place and new installations. Such federation would serve to monitor the southern and northern crests of the Equatorial Ionospheric Anomaly and the South Atlantic Magnetic Anomaly. These are the regions mainly affected by ionospheric perturbations, thus potentially the most disruptive on trans-ionospheric signals. From the picture drawn from the survey it is evident how the northern crest is scarcely observed and how the South Atlantic Magnetic Anomaly region is unevenly monitored. The pilot project would figure out a coordinated measurement campaign put in place for a couple of months during the most disturbed season, typically the equinoxes. The aim would be to collect ionospheric and magnetic data in a dedicated repository open to the scientific communities interested to analyze the data and that will constitute the base for a prototype of monitoring service. The legacy of the project would be the data collection and the prototype addressed to improve significantly the current understanding of the local ionosphere favoring the development of coordinated and reliable monitoring, forecasting and mitigation services.