Ionosphere session

Andrzej Krankowski
1. Overview of the IonoWG (A. Krankowski)
   - Examples of IGS Ionospheric products
   - IGS Wuhan Workshop IonoWG Recommendations
   - A list of key technical items to be discussed by IonoWG

2. IGS real-time service for global ionospheric total electron content modeling
   - Generation and Validation of the Second IGS combined Real-Time Global Ionospheric Maps (N. Wang)
   - UPC-IonSAT recent contributions to ionospheric modelling (M. Hernández-Pajares)

3. IGS IGS ROTI maps. Current Status and its extension towards equatorial region and southern hemisphere (I. Cherniak)

4. Towards cooperative global mapping of the ionosphere. Fusion feasibility for IGS and IRI with global climate VTEC maps (A. Fron)

5. Cooperation with International LOFAR Telescope (ILT) for potential synergies (K. Kotulak)

6. Summary and recommendations
Overview of the IonoWG

The IGS Ionosphere Working group started its activities in June 1998 with the main goal of a routinely producing IGS Global TEC maps. This is being done now with a latency of 11 days (final product) and with a latency of less than 24 hours (rapid product).

This has been done under the direct responsibility of the Iono-WG chairmans:

1. Dr Joachim Feltens, ESA 1998–2002,
3. Prof. Andrzej Krankowski, UWM, 2008-

The IGS ionosphere product is a result of the combination of TEC maps derived by different Analysis Centers by using weights computed by Validation Center, in order to get a more accurate product.
Example of IGS RAPID GIM: 2010-141 DOY

TEC maps

RMS maps
8 Analysis Centers: CODE, ESA, JPL, UPC, WHU, CAS, NRCan, DGFI-TUM (since 2019) and a Validation Center (UWM) have been providing maps (at 2 hours x 5 deg. x 2.5 deg in UT x Lon. x Lat.), weights and external (altimetry-derived) TEC data.

From such maps and weights the Combination Center (at first ESA, then UPC, and since 2008 - UWM) has produced the IGS TEC maps in IONEX format.
Example of IGS PREDICTED GIM

June 20, 2010

November 20, 2010

IGS Predicted GIM

IGS Final GIM
Example of IGS ROTI Maps Product

- The ROTI Maps processor operates routinely since January, 1, 2015
- It was processed and collected data and resulted product from 2010 up to now since the test service established
- ROTI Maps product available on NASA CDDIS
- Representative stations database have been actualised for 2020-2021 on base data availability and latancy
- Finished reprocessing of ROTI Maps for 2020-2021 on base updated stations database

The activity has significant group of geophysical users interested in.

Detailed description of the ROTI Maps Product available in the paper Cherniak et al., GPS Solution, 2018.
IGS Wuhan Workshop Recommendations

Name of Working Group and Chair: Ionosphere Working Group, Andrzej Krankowski

1) To accept DGFI-TUM as new Ionospheric Analysis Center, contributing to the IGS combined VTEC GIMs.
2) To aim to additional real-time ionospheric analysis centers to join to the going-on experimental real-time IGS Global Ionospheric Maps combination.
3) To aim to additional ionospheric analysis centers to join to the going-on experimental IGS ionospheric ROTI fluctuations maps combination.
4) Cooperation with IRI COSPAR group for potential improvement of both IRI and IGS TEC.
5) Cooperation with International LOFAR Telescope (ILT) for potential synergies.
A list of key technical items to be discussed by IonoWG

a) IGS real-time service for global ionospheric total electron content modeling

b) IGS ROTI Maps: Current Status and Its Extension towards Equatorial Region and Southern Hemisphere

c) Towards Cooperative Global Mapping of the Ionosphere: Fusion Feasibility for IGS and IRI with Global Climate VTEC Maps

d) Cooperation with International LOFAR Telescope (ILT) for potential synergies

e) From the VTEC GIMs to the Storm Index GIMs.

f) The VTEC GIMs as a reliable source of VTEC gradient information.

g) Influence of the temporal resolution in the VTEC GIM performance
IonoWG publications


Wen Li; Zishen Li; Ningbo Wang; Ang Liu; Kai Zhou; Hong Yuan; Andrzej Krankowski, **A satellite-based method for modeling the ionospheric Slant TEC from GNSS observations: Algorithm and Validation**, *GPS Solutions*, 2022, 26:14, doi: 10.1007/s10291-021-01191-2
IonoWG publications

b) Iurii Cherniak, Irina Zakharenkova, Andrzej Krankowski, ROTI Maps: Current Status and Its Extension towards Equatorial Region and Southern Hemisphere, Sensors 2022, 22(10), 3748; doi.: 10.3390/s22103748

Iurii Cherniak, Irina Zakharenkova, Development of the Storm-Induced Ionospheric Irregularities at Equatorial and Middle Latitudes During the 25–26 August 2018 Geomagnetic Storm, 2022, Space Weather, 20, e2021SW002891, 2022, doi.: 10.1029/2021SW002891


Summary and Recommendations

• Continuation of work on IGS real-time service for global ionospheric total electron content modeling.

• Preparation of final version of IGS ROTI maps extension towards low latitudes and Southern Hemisphere.

• Continuation of cooperation with IRI and ILT communities.
Thank You!
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IGS INTERNATIONAL GNSS SERVICE

IGS 2022 Virtual Workshop
"Science from Earth to Space"
27 June – 01 July 2022