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Project News

TechTIDE Project Meeting in Barcelona



Participants of the design phase of the TechTIDE products met in February 2018 at UPC in Barcelona. The purpose of this technical meeting was the harmonization of the TechTIDE design with the needs and requirements of the users. Focal point was the assessment of TID detection methods capabilities. Next to this, a round table

discussion with users from the N-RTK domain was organized.

Training for Digisonde operation for Hungarian colleagues

June 11-15, 2018 IAP hosted a group of four young colleagues from the Research Centre from Astronomy and Earth Sciences, GGI, Hungarian Academy of Sciences, Sopron led by Dr. Veronica Barta. The Hungarian colleagues will start operating Digisonde DPS4D at the end of June. The IAP Ionospheric group trained them in Digisonde operating. They are also interested in manual checking of the ionograms, drift measurements, in D2D operation including data analysis and possible collaboration in the TID propagation studies with colleagues from the TechTIDE Consortium.

TechTIDE presentations at the ESWW, EGU, e-KnoT, SUN, AT-RASC and workshop for revision of H2020

The Keynote at the 14th European Space Weather Week on Friday 1st December 2017, was dedicated to the TechTIDE project and was presented by the Project Coordinator Anna Belehazi.

At the EGU General Assembly 2018, in April 2018 in Vienna, members of the TechTIDE consortium organized a dedicated session with the title "Open Session on the Ionosphere

Warning and Mitigation **T**echnologies for **T**ravelling Ionospheric **D**isturbances **E**ffects

TechTIDE Project

The overarching objective of TechTIDE is to design and test new viable TID impact mitigation strategies for the technologies affected and in close collaboration with operators of these technologies, to demonstrate the added value of the proposed mitigation techniques.

TechTIDE Newsletter

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This publication has been produced with the assistance of the European Union under the Horizon 2020 Grant Agreement 776011 of the COMPET-Space Weather 2017 Call. The content of this publication is the sole responsibility of the TechTIDE consortium and can in no way be taken to reflect the views of the European Union.

and Thermosphere". The session was convened by D. Buresova, C. Scotto, D. Altadill, A. Belehaki, B.W. Reinisch.

Following presentations were given by TechTIDE members:

- **Comparison of Travelling Ionospheric Disturbances characteristics extracted from Digisonde-to-Digisonde operations and GNSS-TEC de-trending and gradient techniques**

Anna Belehaki, Bodo Reinisch, Ivan Galkin, Claudia Borries, Jaume Sanz, Miguel Juan, David Altadill, Dalia Buresova, Jens Mielich, Tobias Verhulst, Stanimir Stankov, Haris Haralambous, and Estefania Blanch

- **Cases of simultaneous observations of equator-ward and poleward large scale TIDs during storm conditions (solicited)**

John Bosco Habarulema and Zama T Katamzi-Joseph

- **Studying the dynamics in the ionosphere-thermosphere system during 20th November 2003 storm with CTIpe**

Claudia Borries, Isabel Fernandez-Gomez, and Mihail Codrescu

- **Ionospheric effects and wave activity during CIR/HSS-related storms above middle latitudes**

Buresova, D., J. Chum, D. Kouba, P. Koucka Knizova, Z. Mosna, and J. Urbar

J. Rupiewicz presented the TechTIDE project at the e-KnoT expert seminar "Natural and Artificial Threats to GNSS" at Politecnico di Torino, Italy. This seminar, which took place in 7-9

May 2018, was organized by the H2020 e-KnoT project. The title of her presentation was

- **TECH-TIDE: Warning and Mitigation technologies for travelling ionospheric disturbance effects on GNSS and HF communication**

Joanna Rupiewicz



TechTIDE results have also been presented at the 10th Workshop "Solar Influences on the Magnetosphere, Ionosphere and Atmosphere". This workshop took place in May 30 – June 3, 2018 at Sunny Beach, Bulgaria.

- **Solar Terminator and its signatures in the ionospheric plasma**

Koucka Knizova, P., D. Kouba, Z. Mosna, J. Boska, D. Buresova

Several TechTIDE consortium members participated in the 2nd URSI Atlantic Radio Science Meeting, 28 May – 1 June 2018 in Gran Canaria, Spain. The session S-G07 "Sensor networks for ionospheric weather nowcast" was organized by Ivan Galkin, Anna Belehaki and Claudia Borries.

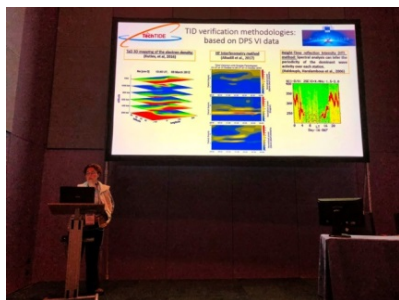
Additionally following presentations related to TechTIDE were given:

TechTIDE Project Members

- National Observatory of Athens (NOA), Greece
- Deutsches Zentrum für Luft- und Raumfahrt (DLR), Germany
- Ustav Fyziky Atmosfery AV CR (IAP), Czech Republic
- Institut Royal Meteorologique de Belgique (RMI), Belgium
- Observatorio del Ebro Fundacion (OE), Spain
- Borealis Global Designs Ltd. (BGD), Bulgaria
- Leibniz Institute of Atmospheric Physics, Rostock University (L-IAP), Germany
- Universitat Politecnica de Catalunya (UPC), Spain
- European Satellite Services Provider (ESSP), France
- South Africa National Space Agency (SANSA), South Africa
- Watermann Juergen Friedrich Wilhelm (JFWCONSULT), France
- Frederick University (FU), Cyprus
- German Federal Police (GFP), Germany

- **S-HG-16 - Identification of travelling ionospheric disturbances with HF and GNSS experiments** (Invited)

Belehaki, Anna



- **S-G07-02 - Improving Signal-to-Noise Ratio in Oblique Ionosonde Soundings Using New Hardware Capability of the DPS4D Ionosonde**

Verhulst, Tobias; Reinisch, Bodo ; Altadill, David; Galkin, Ivan; Kozlov, Alexander; Behlaki, Anna; Blanch, Estefania; Stankov, Stanimir

- **S-G07-11 - Travelling Ionospheric Disturbances nowcasting HF-based methodology and its validation with GNSS-TEC analysis techniques**

Belehaki, Anna

- **G06-1 - EGNOS performance degradation during the passage of travelling ionospheric disturbances**

Borries, Claudia; Pintor, Pedro; Jaume Sanz Subirana; Jose Miguel Juan

In December 2017, a workshop for revision of H2020 - LEIT "Space" - Calls 2018-2019 was organized in

Barcelona, Spain. The Spanish NCP and researchers explaining experience of successful submissions contributed to this workshop. David Altadill presented the successful case of the TechTIDE proposal.

Journal papers

B. Reinisch, I. Galkin, A. Behlaki, V. Paznukhov, X. Huang, D. Altadill, D. Buresova, J. Mielich, T. Verhulst, S. Stankov, E. Blanch, D. Kouba, R. Hamel, A. Kozlov, I. Tsagouri, A. Mouzakis, M. Messerotti, M. Parkinson, M. Ishii, "Pilot ionosonde network for identification of travelling ionospheric disturbances", *Radio Science*, 53, 2018 ([Abstract](#), [Paper](#))

J. M. Juan, J. Sanz¹, A. Rovira-Garcia, G. González-Casado, D. Ibáñez¹ and R. O. Perez. "AATR an ionospheric activity indicator specifically based on GNSS measurements", *J. Space Weather Space Clim.*, 8 A14, 2018 ([Abstract](#), [Paper](#))

Latest Achievements

Initial Requirements Assessment

In November 2017 to February 2018, ESSP organized the assessment of user requirements and generation of a user requirements document. Numerous users in the HF communications sector and GNSS sector were contacted and asked to complete a dedicated user survey. The response was translated into individual user requirements, which were fed into the TechTIDE user requirements document. The user requirements document was delivered to the EC end of February.

Base on the user requirements, DLR generated system requirements for the TechTIDE system and compiled a system requirements document. Numerous functional and non-functional requirements are described in the system requirements document. Additionally, all required use cases for the TechTIDE system were described in detail and linked with the related requirements. The resulting system requirements document was delivered to the EC end of May.

TID Algorithms Definition

After receiving the initial user requirements, a description and design of adjustments and upgrades for different methods was established adopting the user requirements. The details about the capability of each method to fulfill the users' requirements have been specified, according to the current monitoring capabilities. Also, the value-added products planned to be released in order to satisfy the requirements of the users have been evaluated. Overall three groups of products have been defined: (a) the Intermediate Product, which is the direct outcome of each methodology (b) the Final Product, which is based on the processing of the direct outcome (c) the Value-added Product, which is a new product design based on the outcome of each methodology taking into account specific users requirements.

The time plan for the development of TID algorithms will be harmonized with developments for the release of the TID activity metrics report, where the results of all TID detection methodologies will be cross-validated

and evaluated based on the assessment of current geospatial and lower atmosphere conditions.

TID Activity Metrics Identification

A catalogue of TID events driven by different sources has been established by the TechTIDE team and it is continuously updated with newly identified events. The scale of the TID activity (Large Scale and Medium Scale) is linked to the drivers of each event which can be auroral activity, geomagnetic storms, solar radiation, and lower atmosphere dynamic phenomena. Several events were analyzed applying various GNSS-based and HF-based TID identification methodologies, using observations from the European and South African networks. The cross comparison of the results from these complementary techniques and the assessment of the ambient ionospheric conditions, will provide us the basic elements for the compilation of the TID Activity Metric Report. An update will follow in the next editions of the newsletter.

Assessment of TID impact in Aerospace and Ground Systems

The TechTIDE consortium is using the Along Arc TEC rate (AATR) index as an indicator for the TID activity over a region. This index has been recomputed with historical data from 2017, with global coverage and an update time of 5 minutes. The AATR index has been crosschecked against the list of EGNOS events where degradation in the performance was reported (courtesy of ESSP). The aim of this comparison is to identify which of these events is due to the TID

activity. These identified events will be further analyzed with additional TID identification methodologies to specify the ionospheric characteristics which are most important for operational systems.

Dissemination, Exploitation and Communication

TechTIDE dissemination, exploitation and communication activities follow a strategy, which has been initially submitted in the proposal and has been refined and documented appropriately in the past 6 months. Main addressees are users of HF communication and GNSS applications, which are affected by TID activities. They will be informed appropriately about the capabilities of the TechTIDE system. Next to this, also the scientific community is addressed to exchange and discuss results and experience and the broader public is addressed to inform about this project.

In the past month, the TechTIDE project generated the corporate material to be used in all dissemination and management activities. These include a project logo, a leaflet and brochures. Furthermore, a project website has been published and latest information can be followed on Twitter and in ResearchGate, where TechTIDE profiles are maintained.

For proper documentation and management of dissemination and exploitation, TechTIDE maintains an appropriate project knowledge database, where

intellectual property, license and usage restrictions are documented.

Milestone achievements

The first milestone has been achieved in December 2017 when NOA executed the project kick off meeting and provided the project management tools. In January 2018, NOA prepared the TechTIDE public web site and project logo. In May 2018, DLR analyzed the use cases for the specification of the TechTIDE warning system requirements which is a key demanding for the design of the TechTIDE warning system. With the publication and kick-off of this e-Newsletter and the invitations to selected users to follow our activities the TechTIDE user forum is established.

Consortium Member Presentation

National Observatory of Athens

The National Observatory of Athens (NOA) is coordinating the TechTIDE project. NOA was established in 1842. Today it is one of the largest research centers in Greece. The activities of NOA are organized in three institutes staffed with high quality scientific, research and technical personnel: the Institute for Astronomy,





Astrophysics, Space Applications and Remote Sensing, the Institute of Environmental Research and Sustainable Development and the Geodynamics Institute. NOA carries out state-of-the-art basic and applied research in collaboration with other world-leading research centers. NOA's research activities are focused on the terrestrial interior, the Earth's atmosphere, the near-Earth's space, the deep space and the astronomical Universe. Basic and applied research is conducted by using observational data from hundreds of ground-based stations and several modern space probes. The Centre, with its rich scientific outcomes and activities, is linked to entrepreneurship, culture, education and the popularization of science. NOA offers critical social services, such as a daily monitoring of seismicity and issuing earthquake alerts to the Greek State Authorities on a 24/7 basis, weather forecasting, forest fires monitoring, ionospheric activity recording, space weather predictions for the European region, continuation of a 150 years long climatic dataset and operation of one of the largest European telescopes. It also provides the national gate to the European Space Agency.

NOA being the overall lead for the TechTIDE project is responsible for ensuring that the programme delivers the expected outcomes within the required time and budget. In addition to the management of the project, NOA leads also the development of the TechTIDE warning system that will deliver all TechTIDE products and services.

The TechTIDE NOA team belongs to the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS). The institute operates the NetTIDE warning and identification service for Travelling Ionospheric Disturbances (TID), the ESA SSA European Ionosonde Service, the Athens Digisonde and the European Digital Upper Atmosphere Server (DIAS system). The team who works in TechTIDE has a leading role in international projects for space weather specification, forecasting and TID identification and it is skilled in developing e-infrastructures for the collection, processing, archiving, quality control and scientific analysis of space weather data and products in real-time.

Upcoming Events

7th IAGA/ICMA/SCOSTEP Workshop, July 2-6 2018

This workshop on Vertical Coupling in the Atmosphere-Ionosphere System will take place at the Helmholtz Centre Potsdam, GFZ, Germany, July 2-6, 2018. TechTIDE results will be presented by:

- Koucka Knizova, P., D. Kouba, Z. Mosna, D. Buresova: Solar terminator and corresponding variability within ionospheric plasma

COSPAS 2018, 42nd Assembly, 14-22 July 2018

The COSPAR 42nd Assembly will take place on 14-22 July 2018 in Pasadena USA. The TechTIDE project is participating with the following contributions:

- C1.1-0027-18, TechTIDE: warning and mitigation technologies for travelling ionospheric disturbance effects, Ivan Galkin, Bodo Reinisch, Anna Belehaki, Claudia Borries, David Altadill, Jaume Sanz, Dalia Buresova, Tobias Verhulst, Jens Mielich, Zama Katamzi, and Haris Haralambous
- PSW.3-0007-18, AATR an ionospheric activity indicator specifically based on GNSS measurements and tailored for GNSS users, J. Miguel Juan, Jaume Sanz
- C1.1-0002-18 Characterisation of large scale TIDs by analysis of classical ionospheric data in the European region, David Altadill, Estefania Blanch, J. Miguel Juan, Vadym Paznukhov, Anna Belehaki, Ivan Galkin, Dalia Buresova, Tobias Verhulst, Jaume Sanz

1st General Assembly Meeting of TechTIDE, 8-10 October 2018

The General Assembly is the ultimate decision-making body of the TechTIDE consortium and is responsible for efficient and effective scientific and technological leadership in the project. The first General Assembly Meeting (GAM) of TechTIDE will be organized by NOA. It will take place on 8-10 October 2018 in Athens,



Greece. In conjunction with the GAM, the first External Expert Advisory Board (EEAB) meeting will take place.

Ciènciaprop®, Program of Dissemination Science and Technology, 18th Conference, 26 October 2018

The Ciènciaprop® is a conference program to popularize and promote Science and Technology among society. This is a local and public event scheduled for 26 October 2018 and will take place in Spain. It is expected an attendance about 40 persons.

- Perturbaciones Ionosféricas Itinerantes: Origen, Efectos Tecnológicos y Mitigación (Traveling Ionospheric Disturbances: Origin, Technological effects and mitigation), David Altadill et al.

15th European Space Weather Weak, 5-9 November 2018

The ESWW15 will take place on 5-9 November 2018 in Leuven, Belgium. The TechTIDE team will provide the following presentations:

- Session 12: Buresova, D., J. Chum, A. Belehaki, D. Altadill, E. Blanch, D. Kouba, I. Galkin, Z. Mosna, and J. Urbar, TIDs triggered by CIR/HSSS-related storms

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