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Project News

Successful 1st TechTIDE User Workshop, DLR, Neustrelitz

The 1st TechTIDE User Workshop was held in Neustrelitz on 15th May 2019. The workshop brought together users and developers of the TID monitoring and warnings. In total 28 participants attended the workshop. In the first part of the workshop, the TechTIDE developers presented the first release of the TechTIDE system and there were a live demonstration of the online TechTIDE warning system http://techtide.space.noa.gr/?page_id=2811 which showed the current capabilities of the system. In the second part of the workshop, users presented their applications and explained the impact of TID effects in their systems. Application in the field of positioning, in the aviation sector (ground- and space based augmentation systems) and HF communication were presented. In addition, complementary analyses from LOFAR were shown. In the third and last part of the workshop was reserved for detailed discussion between users and developers about the state of the TechTIDE warning system, the current



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 Travelling Ionospheric Disturbances (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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strength and weakness of the services. Therefore, the TechTIDE team did prepare and steer a dedicated round table discussion, which was complemented by a user questionnaire. The current state of the TechTIDE system was well accepted and a few suggestions for increasing the applicability of the TechTIDE products were received from the users. These have been documented and the prioritization as well as the possibilities for implementation in the next system release (which will be in September/ October) will be assessed by the TechTIDE team. Thus, the objectives of the 1st TechTIDE workshop have been well achieved! We are looking forward to the next release of the TechTIDE warning system and the attached 2nd user workshop.

Announcement for 2nd TechTIDE User Workshop, Prague, Czech Republic, 9 October 2019



Vila Lanna, Prague. Location of the 2nd TechTIDE user workshop. Source: Vila Lanna.

The second TechTIDE user workshop will bring together the consortium members and users from all operational activities

concerned with Travelling Ionospheric Disturbances activity. The Second Release of the TechTIDE Warning System will be presented to the users and the users are able to provide their feedback and recommendations for further development. The announcement of the workshop is available on the TechTIDE website http://techtide.space.noa.gr/?page_id=4152. The registration for the workshop is now open. We kindly advice all interested users to register as soon as possible.

Many TechTIDE contributions at international conferences

TechTIDE @ EGU General Assembly 2019

At the EGU General Assembly 2019 held in Vienna, 7–12 April 2019, which was with 17.000 participants one of Europes biggest conferences in geoscience, Dalia Buresova, David Altadill, and Anna Belehaki did co-convene the ST3.1 session "Open Session on the Ionosphere and Thermosphere (including ST Division Outstanding ECS Lecture by Chao Xiong)"

In addition, the TechTIDE consortium did present the following Posters and presentations:

X4.232 and EGU2019-7216 paper entitled "Main drivers and interhemispheric circulation of TIDs", by Buresova D., A. Belehaki, J. Watermann, I. Galkin, I. Tsagouri, D. Kouba, D. Altadill, E. Blanch, T. Sindelarova, J. Urbar, J.B.Habarulema, Z. Katamzi and D. Saxonbergova-Jankovicova

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

EGU2019-15468 | Orals | ST3.1, Large-Scale Travelling Ionospheric Disturbances occurrence during the Space Weather events of September 7-8th, 2017, by Arthur Amaral Ferreira, Claudia Borries, and Renato Alves Borges

TechTIDE @ 11th Workshop on Solar Influence on the Magnetosphere, Ionosphere and Atmosphere

At the 11th Workshop on Solar Influence on the Magnetosphere, Ionosphere and Atmosphere, which took place in Primorsko, Bulgaria, June 3-7, 2019, the TechTIDE consortium contributed with the following papers:

Kouba D., J. Chum, P. Koucka-Knizova, J. Fiser, J. Base, J. Boska, J. Ruzs, "Automatic MSTID detection based on Doppler system"

Koucka-Knizova, P., K. Podolska, K. Potuznikova, D. Kouba, Z. Mosna, J. Boska, M. Kozubek, "Impact of meteorological storm Fabienne on 23 September 2018 on ionospheric variability"

TechTIDE @ TREASURE workshop "A response to user needs in PPP and RTK"

The second TREASURE workshop took place on 21st and 22nd May 2019 in Toulouse, France. It gathered around 45 attendees among which project associates gave

presentation about the status of their research. Also, numerous speakers were invited including TechTIDE project. The overview, status and first available release of the system have been presented to participants. More information about the programme of the workshop can be found here: <http://www.treasure-gnss.eu/>.

TechTIDE @ URSI Asia-Pacific Radio Science Conference

The TechTIDE project has been promoted in the 2019 URSI Asia-Pacific Radio Science Conference (AP-RASC 2019) that was held in New Delhi, India from 9 – 15 March, 2019. A poster presentation has provided an



overview of the project and an oral presentation focused on the height-time-reflection intensity (HTI) methodology as it is implemented within TechTIDE. Indian scientists attending the meeting expressed a vivid interest for the project and in particular on the wide array of different instrumentation and methodologies that are exploited in the frames of TechTIDE.

TechTIDE @ Ionospheric effects on Satellite Positioning and Navigation Conference

Guillermo González Casado from UPC was representing TechTIDE at the Ionospheric effects on Satellite Positioning and Navigation Conference, which

took place in March 21st, 2019, at Airbus Operations SAS in Blagnac, France. The title of his talk was "Monitoring and characterization of ionospheric activity with GNSS measurements and precise positioning under scintillation conditions".

TechTIDE @ VarSITI Completion General Symposium

Anna Belehaki gave a talk on TechTIDE achievements at the VarSITI Completion General Symposium, a SCOSTEP Project, that was held from 10 to 14 June in Sofia, Bulgaria. The title of her talk was "Real-time identification of travelling ionospheric disturbances and validation methodologies".

TechTIDE @ Pint of Science Festival

In May 2019, the Ebro Observatory team contributed to the Pint of Science Festival in Spain (<https://pintofscience.es/>) which is a worldwide organized event about the latest scientific research topics to approach Science for the Society in an accessible format and in a bar. David Altadill gave a talk, "The ionosphere: A tool, and at the same time an obstacle, for radio-telecommunications" (<https://pintofscience.es/event/la-ciencia-llega-a-los-banys---21>). He explained what the Earth's ionosphere is, how it behaves and the effects it produces on radio communication systems. In addition, he briefly explained the H2020 project TechTIDE whose objective is to identify traveling ionospheric disturbances (TIDs) and help to mitigate the disruptive effects of the TIDs on radio communication systems,

and the contribution of the research group of the Ebro Observatory to TechTIDE.d

TechTIDE warning services

The first release of the TechTIDE warning services is now available! You can visit the web site http://techtide.space.noa.gr/?page_id=2811 to access the TechTIDE products calculated in real-time based on the TID detection algorithms and browse the archive to download historical data and products.

TechTIDE Algorithms

The TechTIDE algorithms are stored in the website repository for open access (http://techtide.space.noa.gr/?page_id=15) and some of them run in near real time in the first TechTIDE Warning Services release. Some of the methodologies have been upgraded and latest versions are available in the wiki site.

TID Activity Metrics Identification

The TechTIDE team is working on the manuscript tentatively entitled “Travelling Ionospheric Disturbances Triggered by Co-rotating Interaction Region/Coronal Hole High-Speed Stream-Related Storms” to be submitted to the special issue of the journal Space Weather and Space Climate in September 2019. They are also continuing in the analysis of the events included in the EGNOS event list and selected ICME and CIR/HSS events which occurred in 2019. The comparison ICME- and CIR-related TID

characteristic parameters was carried out. They continue also their analysis of the seasonal dependence of the TID parameters.

Assessment of TID impact in Aerospace and Ground Systems

A technical note, derived from the assessment, has been delivered by April. In this report a statistical analysis about the impact of TIDs over 3 different positioning services HF location, EGNOS and NRTK is included. It shows that each of these services is affected by different TID types (LSTIDs or MSTIDs). In HF-location, GFP found correlation between the deviation on azimuth and the presence of MSTIDs detected by the HF-TID methodology. In EGNOS it was shown that service degradation, in terms of lack of availability or enlargement of the protection levels, has good correlation with the large AATR values. In NRTK it was shown that part of the degradation of the service is related with the presence of MSTIDs in the region. To this end, MSTIDs were detected using the MSTID-GNSS methodology.

Mitigation technologies

The work on the activities that are related to the mitigation of the impact of TIDs in different technologies started in May 2019. In this frame some mitigation procedures will be developed to correctly mitigate the effects of TIDs in operational services, concretely for EGNOS services, N-RTK and HF communications.

Dissemination, Exploitation and Communication

Latest Achievements

TechTIDE dissemination and communication activities are presented in the first part of this newsletter. Next to this, many activities are in Twitter (https://twitter.com/Tech_TIDE) and in the TechTIDE forum (<http://techtide.space.noa.gr/?forum=techtide-forum>), where a few space weather events have been discussed with users.

Consortium Member Presentation



Leibniz Institute of Atmospheric Physics, Rostock University

The Institute has been founded in 1992 and is member of the research association ‘Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL)’. The institute is located near the Baltic Sea resort Kühlungsborn and owns a separate site on the island Rügen, close to Juliusruh. In addition IAP is a major partner of the ALOMAR observatory in northern Norway. As associated institute of the University Rostock it is part of the teaching programme in physics. A total of about 90 persons is employed at IAP. The institute realizes an equal-opportunity and family-friendly human

resource policy and is certified with the audit “berufundfamilie” (‘career and family’).

The Leibniz-Institute is one of the German main centers for Middle Atmosphere research and operates active cooperations with several international research organizations. The most important scientific topics at IAP are

- I. exploration of the mesosphere and lower atmosphere
- II. coupling of atmospheric layers
- III. long-term changes in the middle atmosphere

Besides a MF- and a Meteor-Radar the L-IAP field station in Juliusruh operates a Digisonde DPS-4D. With ionosondes located here, in the north eastern part of Germany, the L-IAP has experience of more than 70 years of continuous ionospheric measurements of high quality and is/was contributing to several space weather and ionospheric related projects.

The Juliusruh Digisonde DPS-4D as a main reception station for two shorter D2D links (Pruhonice/CZ to Juliusruh, Dourbes/BE to Juliusruh) is a key sensor for TechTIDE's HF-TID detection method. For three other Digisonde-data-based TID detection methods we provide vertical incidence sounding data in 5 minute time resolution.

Within the TechTIDE project the L-IAP partner contributes mainly to work packages 2 and 5.



Universitat Politècnica de Catalunya

The Universitat Politècnica de Catalunya – BarcelonaTech (UPC) is a public institution dedicated to higher education and research, specialised in the fields of engineering, architecture and science. It is well positioned as a university of research and innovation with a high degree of knowledge transfer and experience, and it valorises these assets spin-offs, patents and close involvement with business.

Currently, UPC involves 42 Departments, 10 Research Institutes and 197 Research Groups (<https://www.upc.edu/en>), with 2,431 teaching and research staff members, and 1,469 administrative and service staff members.

About 31.000 students are taking a bachelor or master degree at the UPC and over 2,600 doctoral students are opting for one of a range of academic and professional pathways. The course offerings for the 2013 master degrees and 51 doctoral programmes. The master degrees are distinguished by the specialised, multidisciplinary and international training they provide. A total of 26 master degrees are taught entirely in English. The UPC is also the European university with the most Erasmus Mundus programmes: 13 master degrees and 7 doctoral programmes.

Inside the TechTIDE project, UPC is taken care about the computation of the Along Arc TEC Rate index (AATR), which is one of the methodologies used to monitor ionospheric activity in real time. Moreover, thanks to its expertise in precise positioning, gAGE/UPC is working on analyzing the impact of the Medium Scale Traveling Ionospheric Disturbances (MSTIDs) on the degradation of the service of Network Real Time Kinematic (NRTK) and the ways for mitigating such degradation. In this context, gAGE/UPC is leading WP5 which is devoted to analyze the impact of ionospheric disturbance on EGNOS, NRTK and HF location.

Upcoming Events

Second TechTIDE General Assembly Meeting, Prague, Czech Republic, 8-11 October 2019

The second TechTIDE General Assembly Meeting will take place in the week 8-11 October 2019 at Vila Lanna in Prague, Czech Republic. The consortium members and advisors will come together to present and assess the status of the project. The general assembly meeting will be complemented by the 2nd TechTIDE user workshop (c.f. announcement in the first section of the newsletter).



24th Science Week at the Observatori de l'Ebre, Spain, in November 2019

The 24th Science Week will be held at the Observatori de l'Ebre in November 2019. The Ebro Observatory will give a conference about ionospheric disturbances and the TechTIDE project objectives.

Planned conference contributions

Contribution to 16th European Space Weather Week (ESWW)

The ESWW is the main annual event in the European Space Weather calendar. It will be held on Liège, Belgium on 18-22 November 2019. It is the European forum for Space Weather.

The Ebro Observatory has submitted an abstract to the session 17 "Satellite and ground-based observations for space weather and space climate monitoring and modelling". This session aims to provide the possibility to present and discuss contributions on the use of data from satellite and ground-based observations, in order to enhance the understanding of space weather and space climate, and their impact on critical infrastructure. A true global picture of space weather and space climate, in which regional effects can be put into a global context, can be obtained from the combination of space and ground measurements. Being able to predict extreme events and develop strategies for mitigation is very important for space assets (including future satellite

mission concepts) and critical infrastructures on the ground.

IUGG General Assembly, Montreal, Canada, 8-18 July 2019

TechTIDE will be presented at the 27th IUGG General Assembly that will be held in Montreal, Canada from 8-18 July. Poster contribution: "Real Time ionosphere monitoring highlights in the frame of IAG's RTIM-WG" were the HF interferometry method to detect LSTIDs within the TechTIDE project will be presented.

Beacon Satellite Symposium, Olsztyn University, Poland, 18-23 August 2019

Following presentation will be contributed to the Beacon Satellite Symposium, Olsztyn University, Poland, 18-23 August 2019:

Buresova D., A. Belehaki, J. M. Juan, J. S. Subirana, J. Chum, D. Altadill, E. Blanch, A. Segarra, J. Watermann, D. Kouba, I. Galkin and TechTIDE team. "Monitoring and analysis of the TIDs triggered by magnetic storms and their impact on EGNOS availability degradation".

International Workshop on GNSS Ionosphere 2019, Neustrelitz, Germany, 23-25 September 2019

Claudia Borries and team will give an invited talk at the International Workshop on GNSS Ionosphere 2019 in Neustrelitz with the title "Travelling Ionospheric Disturbances studied in the EU H2020 TechTIDE project".

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