Warning and Mitigation Technologies for Travelling Ionospheric Disturbances Effects

TechTIDE

D7.3

Data Management Plan

Version 1.0

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Abstract

In the frame of the Horizon 2020 (H2020) call of the European Commission (EC), the project "Warning and Mitigation Technologies for Travelling Ionospheric Disturbances Effects" (TechTIDE) develops a system for the mitigation for the detection and monitoring and alert for Travelling ionospheric disturbances (TIDs). Numerous data will be collected, processed and generated during the execution of TechTIDE. This Data Management Plan (DMP) describes the data management life cycle for the TechTIDE data. It is following the FAIR principle, making the research data findable, accessible, interoperable and re-usable (FAIR).

Document history

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0.1	29.03.2018	C. Borries, H. Barkmann	Initial draft version to be discussed with the project PI
0.2	20.04.2018	C. Borries, H. Barkmann, A. Belehaki	Final draft version including revision of the initial draft
1.0	30.04.2018	C. Borries, H. Barkmann, A. Belehaki	First issue

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Executive Summary

This Document represents the Data Management Plan (DMP) of the H2020 TechTIDE project. It describes which data is going to be used and produced during TechTIDE, how it will be accessible and the data management life cycle for the TechTIDE data.

References

ID	Title	Reference
[REF-1]	Guidelines on FAIR Data Management in Horizon 2020	European Commission, Version 3.0, 26 July 2016
[REF-2]	TEMPLATE HORIZON 2020 DATA MANAGEMENT PLAN (DMP)	H2020 templates: Data management plan v1.0 – 13.10.2016 http://ec.europa.eu/research/participants/data/ref/h2020/gm/reporting/h2020-tpl-oa-data-mgt-plan_en.docx

Abbreviations

AATR	Along Arc TEC Rate
BGD	Borealis Global Design
CDSS	Continuous Doppler shifts
DIMS	Data and Information Management System
DLR	German Aerospace Center
DMP	data management plan
EC	European Commission
EDD	3D electron density
EO	Observatory of Ebro
FAIR	findable, accessible, interoperable and re-usable
FU	Frederic University, Cyprus
GIRO	Global Ionospheric Radio Observatory

GNSS	Global Navigation Satellite System
HF	High Frequency
HTI	Height-time-reflection intensity
IAP	Institute for Atmospheric Physics, Prague
IPR	Intellectual Property Right
L-IAP	Leibnitz Institute for Atmospheric Physics, Kühlungsborn
MSTID	Medium Scale TID
MUF	Maximum Usable Frequency
NOA	National Observatory of Athens
N-RTK	network real-time kinematic
SWPC	Space Weather and Prediction Center
TEC	Total Electron Content
TID	Travelling ionospheric disturbance
UPC	University of Catalonia

1 Introduction

1.1 *Objectives of TechTIDE*

In the frame of the Horizon 2020 (H2020) call of the European Commission (EC), the project "Warning and Mitigation Technologies for Travelling Ionospheric Disturbances Effects" (TechTIDE) develops a system for the detection and monitoring and alert for Travelling ionospheric disturbances (TIDs). TIDs constitute a threat for operational systems using HF or transionospheric radio propagation. TIDs can impose disturbances of an amplitude of 20% of the ambient electron density and a Doppler shift of the level of 0.5Hz. Consequently, the direct and timely identification of TIDs is a clear customer's requirement for the Space Weather segment of the ESA SSA Programme. The objective of this proposal is to address this need with setting up an operational system for the identification and tracking of TIDs, the estimation of their effects in the bottomside and topside ionosphere and for issuing warnings to the users with estimated parameters of TID characteristics. Based on the information released from this warning system, the users, depending on their applications, will develop mitigation procedures.

1.2 *Scope of the Data Management Plan*

As described in [REF-1], Data Management Plans (DMPs) are a key element of good data management. This DMP describes the data management life cycle for the data to be collected, processed and/or generated by the Horizon 2020 project TechTIDE. As part of making research data findable, accessible, interoperable and re-usable (FAIR), the TechTIDE DMP includes information on:

- the handling of research data during and after the end of the project

- what data will be collected, processed and/or generated

- which methodology and standards will be applied

- whether data will be shared/made open access and

- how data will be curated and preserved (including after the end of the project).

A DMP is required for all projects participating in the extended ORD pilot, unless they opt out of the ORD pilot. However, projects that opt out are still encouraged to submit a DMP on a voluntary basis.

This is the initial TechTIDE DMP submitted 6 month after the kick off of the H2020 project TechTIDE. This DMP will be updated over the course of the project whenever significant changes arise, such as (but not limited to):

- new data

- changes in consortium policies (e.g. new innovation potential, decision to file for a patent)

- changes in consortium composition and external factors (e.g. new consortium members joining or old members leaving).

The DMP will be updated in time with the final evaluation/assessment of the project.

1.3 Preparation of the DMP

This DMP is based on the Horizon 2020 DMP template [REF-2] provided by the EC. The template has been designed to be applicable to any Horizon 2020 project that produces, collects or processes research data. The TechTIDE DMP covers its overall approach and if applicable, specific issues for individual datasets (e.g. regarding openness), are addressed in the DMP.

2 Data Summary

2.1 Purpose of the data collection/generation

The objective of TechTIDE is to set up an operational system for the identification and tracking of TIDs, the estimation of their effects in the bottomside and topside ionosphere and for issuing warnings to the users with estimated parameters of TID characteristics. Hence, an extensive set of data will be collected, processed and generated in TechTIDE, in order to feed the operational system.

2.2 Types and formats of data

Within TechTIDE, measurement data from different sensors will be used:

- Digisonde measurements

- Global Navigation Satellite System (GNSS) measurements

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- Doppler shift measurements

Additionally, existing data/ products will be used as input for the generation of TechTIDE products:

- Total Electron Content (TEC) maps provided by DLR
  - o For the European region
  - o Global
- Geomagnetic and Solar Indices from NOAA Space Weather and Prediction Center (SWPC)
- Digisonde parameters from the GIRO quick chart
- Tropospheric - Stratospheric events & data
  - o atmospheric pressure time series with header
  - o Infrasound detection bulletins
- Juliusruh K-Index

The project team will develop several methods for processing these measurements and allow the detection and characterization of TIDs

- 3D electron density (EDD) products
- HF interferometry products
- TEC Gradient products
- Along Arc TEC Rate (AATR) product
- MSTID detection based on GNSS data
- Height Time Intensity product
- Continuous Doppler shifts of fixed sounding radio frequencies (CDSS)

These products will be provided in form of ASCII files and images. Most products are provided along with metadata files.

2.3 Origin of the data

The data used for the generation of the TechTIDE product partially originates in the TechTIDE consortium and partially external. A full assessment of the used data is provided in the TechTIDE knowledge database. A summary table is shown below

Table 2-1: List of data used or generated in TechTIDE and ist origin

ID	Data	Existing/ new	Origin
1	**Geomagnetic and Solar Indices**	Existing	NOAA SWPC
2	**TEC maps**	Existing	DLR

ID	Data	Existing/ new	Origin
3	**Digisonde parameters**	Existing	GIRO quick chart
4	**Juliusruh K-Index**	Existing	L-IAP
5	**Tropospheric - Stratospheric events & data**	Existing	IAP (from ARISE project)
6	**electron densities above 14 stations**	New	NOA
7	**Electron density map**	New	NOA
8	**TID Situation Map**	New	NOA/ BGD
9	**TID detection support data per link**	New	NOA/ BGD
10	**TID Alerts**	New	NOA/ BGD
11	**TID Detections**	New	NOA/ BGD
12	**Support data**	New	NOA/ BGD
13	**TID database**	New	NOA/ BGD
14	**TID Explorer visualizations**	New	NOA/ BGD
15	**MUF(3000)F2 above 14 stations**	Existing	EO
16	**TID Detection above 14 stations**	New	EO
17	**MSTID detector for around 250 receivers worldwide (120 in Europe)**	New	UPC
18	**TEC Gradient for Europe**	New	DLR
19	**HTI plots above 14 stations**	New	FU
20	**Doppler shift spectrograms**	New	IAP
21	**CDSS TID detection and analysis**	New	IAP
22	**NRT AATR values for around 250 receivers worldwide (120 in Europe)**	New	UPC
23	**Clean data for 4 parameters foF2, hmF2, Hm, MUF from 14 stations**	New	NOA
24	**Running median and DIFF (difference from observed values) for 4 parameters foF2, hmF2, Hm, MUF from 14 stations**	New	NOA
25	**De-trended values and DIFF (difference from observed values) for 4 parameters foF2, hmF2, Hm, MUF from 14 stations**	New	NOA

ID	Data	Existing/ new	Origin
26	Maps of Running median and de-trended values for foF2 and hmF2, two areas (Europe and Africa), i.e. 4 maps	New	NOA

2.4 Data size

The expected files and their size are documented in the TechTIDE wiki (https://techtide-wiki.space.noa.gr/wiki/WikiPages/DB-Requirements2). The status of 29th March 2018 is documented in the table below.

Table 2-2: expected size of the TechTIDE data

ID	Data	Size	cadence
1	**Geomagnetic and Solar Indices**	5 kB	1 day
2	**TEC maps**	2 x 1 MB	5 min
3	**Digisonde parameters**	25 kB	5 min
4	**Juliusruh K-Index**	50 kB	5 min
5	**Tropospheric - Stratospheric events & data**	28 MB	1 day
6	**electron densities above 14 stations**	100x14 KB	5 min
7	**Electron density map**	150 KB	5 min
8	**TID Situation Map**	200 kB x 2	1 min
9	**TID detection support data per link**	2 kB x 6	as requested
10	**TID Alerts**	TBD kB	On event
11	**TID Detections**	1 kB per link	1 min
12	**Support data**	1 kB per link	1 min
13	**TID database**	2 kB per record	2.5 min
14	**TID Explorer visualizations**	-	-
15	**MUF(3000)F2 above 14 stations**	14 x 7 kB	5 min
16	**TID Detection above 14 stations**	14 x 1 kB	5 min
17	**MSTID detector for around 250 receivers worldwide (120 in Europe)**	1MB per daily file	5 min

ID	Data	Size	cadence
18	**TEC Gradient for Europe**	1 MB	15 min
19	**HTI plots above 14 stations**	tbd	15 min
20	**Doppler shift spectrograms**	60-110 kB per file	2/8 hour
21	**CDSS TID detection and analysis**	60-110 kB per file	15 min
22	**AATR values for around 250 receivers worldwide (120 in Europe)**	2MB per daily file for all receivers	5 min
23	**Clean data for 4 parameters foF2, hmF2, Hm, MUF from 14 stations**	1 kB per record per station	5 min
24	**Running median and DIFF (difference from observed values) for 4 parameters foF2, hmF2, Hm, MUF from 14 stations**	1 kB per record per station	5 min
25	**De-trended values and DIFF (difference from observed values) for 4 parameters foF2, hmF2, Hm, MUF from 14 stations**	1 kB per record per station	5 min
26	**Maps of Running median and de-trended values for foF2 and hmF2, two areas (Europe and Africa), i.e. 4 maps**	150 kB per map	5 min

2.5 Data utility

The external data is requested input for different processors in the TechTIDE system. It is not supposed to be provided to users.

For the indication of the utility of the TechTIDE products, the TechTIDE consortium maintains close communication with users. Main users are network real-time kinematic (NRTK) service providers and HF users. First, a comprehensive investigation of user requirements has been executed. The TechTIDE system will be constructed according to these requirements. Then, user workshops will be organized, where the TechTIDE consortium demonstrates the TechTIDE system to users and shows the utility of the products. Users will give feedback which will be used to adjust the presentation of products if necessary.

3 FAIR data

3.1 *Making data findable, including provisions for metadata*

3.1.1 Metadata

Each product will be generated along with metadata. Due to the large number of project partners providing different kinds of products, a harmonization of metadata within TechTIDE is necessary. At the current state of the project (requirements definition phase), there is no agreement on a metadata standard. This topic will be addressed in the design phase in the deliverable D4.1.

3.1.2 Naming convention

At the current state of the project (requirements definition phase), there is no agreement on a naming convention. This topic will be addressed in the design phase in the deliverable D4.1.

3.1.3 Search keywords

Search keywords are considered as useful parameter in the TechTIDE project. TechTIDE is going to review the user requirements to check what users need. At the current state of the project, we expect search keywords to form a part of the metadata. However, definitive handling of search keywords is going to be defined in the design document D4.1.

3.1.4 Versioning

Versioning of product and code is going to be implemented in TechTIDE. It can be part of the metadata or the naming conventions. A definition of the handling of versioning is going to be described in the design document D4.1.

3.2 *Making data openly accessible*

3.2.1 Openly available data

All new products listed in Table 2-1, will be made openly available through the TechTIDE system. The TechTIDE system will be accessible through a dedicated website. Each product will be presented on this website with a dedicated description and user guideline. Also data access is provided through the website.

The implementation TechTIDE data storage depends on different criteria like speed to download and storage capacity. An initial thought is to store the online data on a webserver. This data can be accessed via HTTP queries. The websites guides the user to the relevant data. Metadata will be stored along with each product data. A definitive design of the data storage will be given in D4.1.

Additionally, off-line data storage with redundancy will be implemented for the TechTIDE data. The project coordinator and host of the TechTIDE core system is partner of the Greek Research Technology Network (GRNET), which is part of GEANT, and going to use their storage facility (if appropriate). TechTIDE will make benefit of the capabilities in redundancy

and capacity of the GRNET system. On request, users can get individual data sets from the off-line storage.

The TechTIDE system implements a distributed processing system. The individual products listed in Table 2-1 are processed/ generated in different institutes participating in the TechTIDE project. Each of these institutes maintains an additional local archive of their products and input data. The institutes can provide data from their repositories on request.

The data access and the data format is designed such that no special software is needed to access or read the data.

3.2.2 Closed and restricted data

Within TechTIDE, DLR is providing TEC data with 5 minutes temporal resolution to NOA. This data exchange is internal to the project. These TEC maps are the property of DLR, which has been declared as background IPR in the grant agreement. DLR and NOA have agreed to keep the data closed to the project. The data will be used by TechTIDE processors to generate dedicated TID products. The agreed terms of usage are documented in the TechTIDE knowledge database.

DLR will push the data to a dedicated NOA server.

Since the number of restricted/ closed data is low and the terms of usage have been described in the knowledge database, there is no need to establish a data access committee.

3.3 Making data interoperable

The data produced in the TechTIDE project is meant to be interoperable, to allow data exchange and re-use between researchers, institutions and organisations. Standard formats like JSON are generated where applicable. There exists a number of open source software reading JSON format. All data formats are human readable and contain format information. Actually, within the project itself, different datasets from different origins are combined. This expertise will also be granted to the TechTIDE products.

Metadata files are provided along with the TechTIDE products. Some products use standard metadata vocabularies and others generated individual well readable metadata files which are easy to convert in any standard. The handling and definition of metadata will be considered in D4.1.

3.4 Increase data re-use (through clarifying licences)

The data will be openly accessible by the time of the first release of the operational TechTIDE system. All open TechTIDE data will be accessible by the time of the final release of the TechTIDE system. No embargo will be put on the product re-use.

The open TechTIDE data can be used by third parties. TechTIDE data is planned to be provided with a creative commons license for free scientific use and restricted commercial use. The applicable license will be discussed in the project. If commercial users are interested to use TechTIDE data, individual agreements will be made between product provider and user.

After the end of the TechTIDE project, the TechTIDE system will continue to provide its products. However, continuity of the product generation cannot be guaranteed, because the operation will run on best efforts basis. Also the maintenance of the online hardware and software cannot be guaranteed for more than one year after project completion. However, the off-line data repositories will store the TechTIDE data for at least 5 years. Data can be provided on request.

Data quality assurance processes are going to be discussed in the design of the TechTIDE system. A possible approach is the definition of quality metrics which are provided along with the products. But the feasibility needs to be assessed in the system design.

4   Allocation of resources

N.a.

5   Data security

TechTIDE data is going tob e safely stored in the GRNET facility. Data recovery and secure storage are provided by this certified repository facility. GRNET is also capable for long term preservation. Sensitive data is not intended to be used in TechTIDE.

6   Ethical aspects

No personal data related to user questionnaires will be stored.

There is no ethical issue with any TechTIDE data.

The handling of personal data generated from user registration in the TechTIDE portal will consider the EU data protection law, which enters in force May 2018.

7   Other issues

For its institutional data repository, DLR makes use of its Data and Information Management System (DIMS). It maintains institutional procedures for data management.

 IAP saves raw data and some other information from Digisonde and Doppler sounder on their server in the Institute.