T-FORS

Travelling Ionospheric Disturbances Forecasting System

Project Overview

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Main Objective

The main objective of the T-FORS project is the ***development of new validated models able to issue forecasts and alerts for TIDs several hours ahead***, exploiting a broad range of observations of the solar corona, the interplanetary medium, the magnetosphere, the ionosphere and the atmosphere.

Specific Objectives

a. Develop ***new prediction models*** based on databases of detected TID characteristics and of their drivers developed in the frames of past Horizon 2020 and national projects, using ***Machine Learning (ML Learning) algorithms*** to forecast the occurrence and propagation characteristics of large scale TIDs and ***statistical modelling*** to estimate the occurrence probability and propagation pattern of medium scale TIDs;

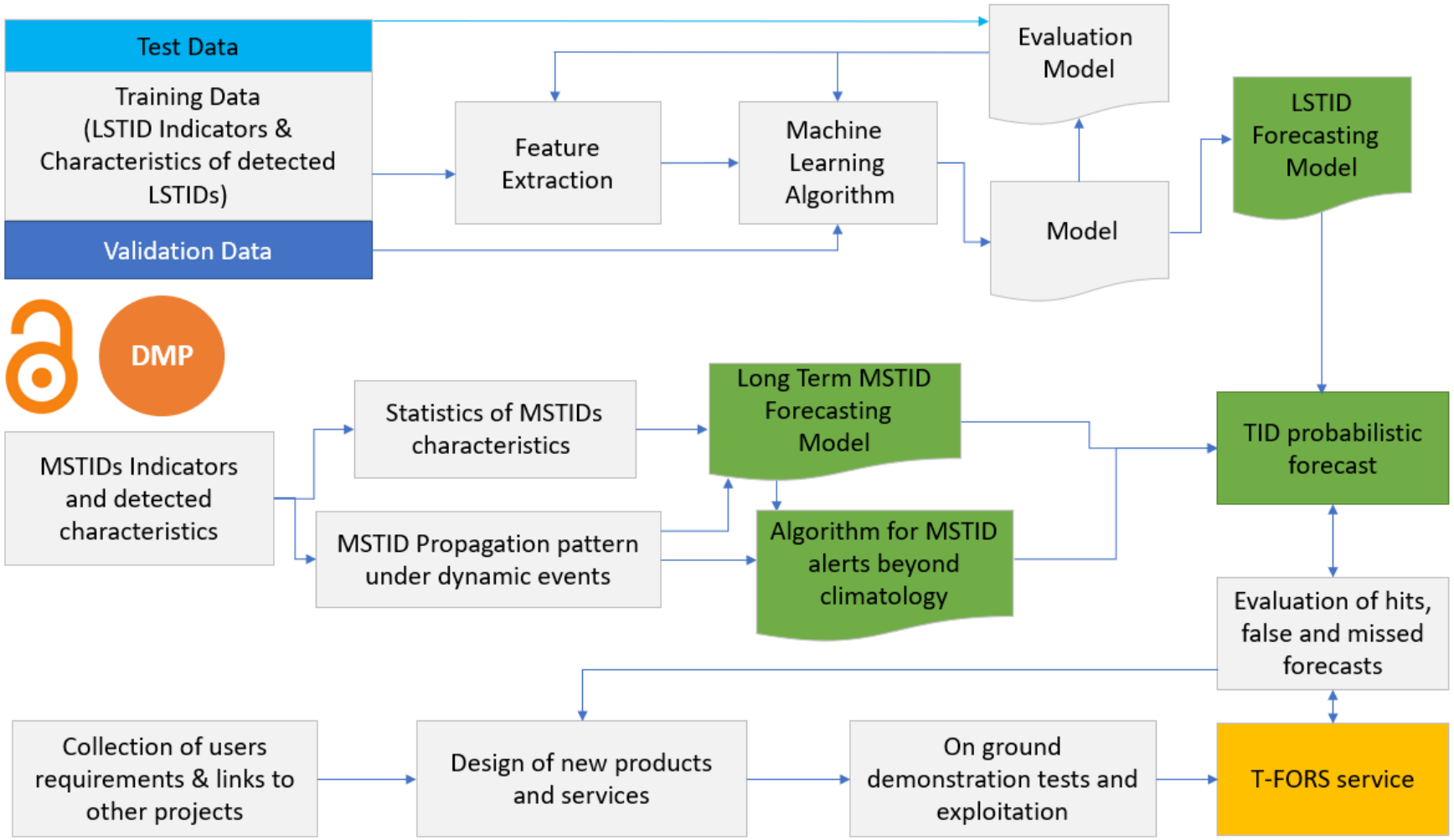
b. Improve scientific understanding of the origin and evolution of TIDs that will lead to a proposed ***inventory of potential early indicators***, assessing the validation results of the prediction models;

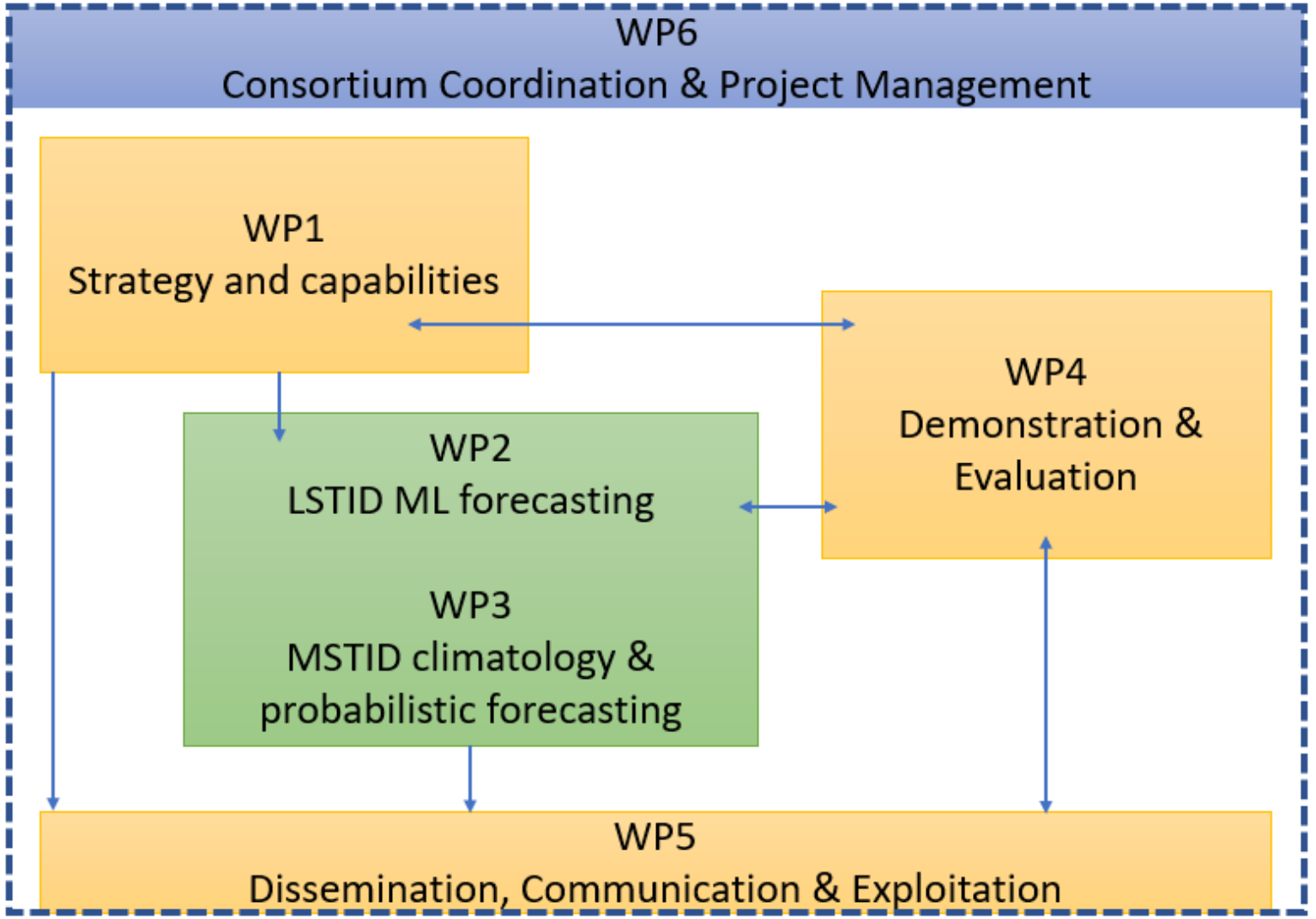
c. Develop ***prototype services*** based on requirements from the users' community and following harmonized standards and quality control procedures similar to the best practices of meteorological services and relevant community activities;

d. Perform ***on ground demonstration tests for the validation of the usability of the T-FORS prototype services***, analyzing the effects of TIDs on HF skywave radars and relevant applications and the effects on HF direction finding systems;

e. Propose a ***comprehensive architectural concept***, including the densification of ground instrument networks, and new space missions, and possible future adjustments in order to develop a real-time operational service compatible and complementary to the ESA Space Weather services.

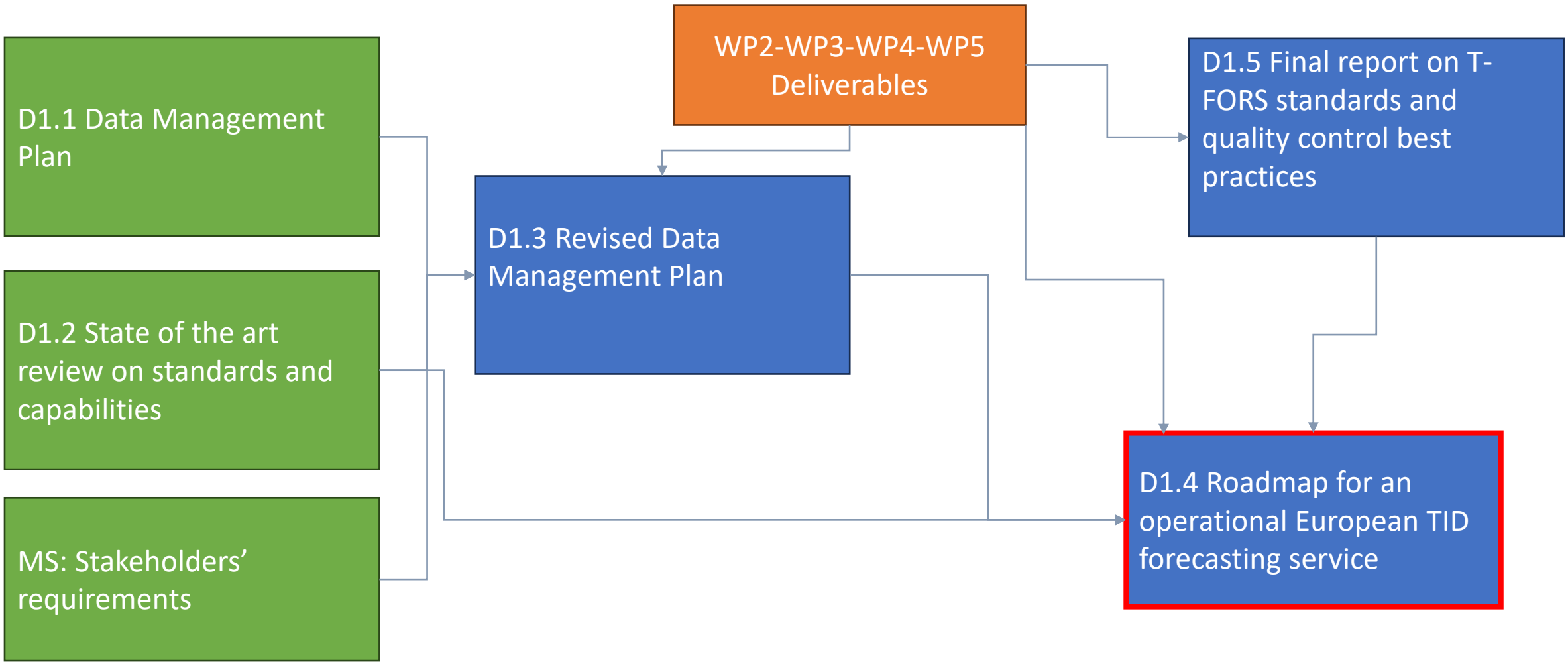
Methodology



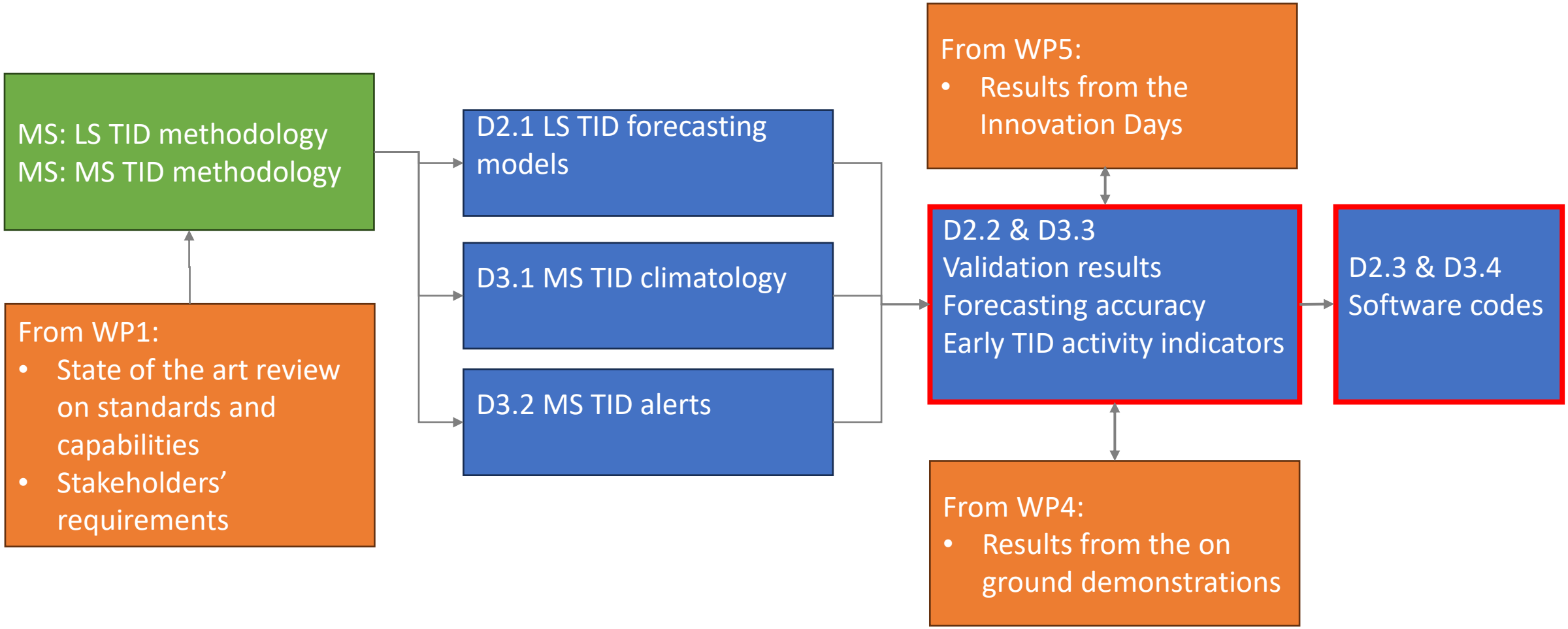

WP6
Consortium Coordination & Project Management
WP1
Strategy and capabilities
WP2
LSTID ML forecasting
WP3
MSTID climatology &
probabilistic forecasting
WP4
Demonstration &
Evaluation
WP5
Dissemination, Communication & Exploitation

WP1 Strategy and Capabilities	WP2 LSTID ML Learning forecasting models	WP3 MSTIDs climatology & probabilistic forecasting	WP4 T-FORS Demonstration and Evaluation.	WP5 Dissemination, Exploitation and Communication (DEC)
Preparation phase (T01 – T06) *Design phase*	Designing the forecasting methodology (T01 – T05)	Designing the MSTID forecasting methodology (T01-T05)	T-FORS functional requirements (T05 – T11)	Definition of DEC strategy (T01 - T04)
T-FORS standards, quality control and best practices (T05 – T18) *Development and validation phase*	LSTID Model Development, forecasts and alerts (T06 – T15) Validation of models' performance and inventory of LSTIDs indicators (T12 – T18)	MSTIDs climatological model (T03 – T11) Alerts (T05 – T14) Validation and compilation of an inventory of activity indicators (T08 – T14)	Development, deployment of real-time services (T12 – T20) On ground demonstration tests (T18 – T22)	Dissemination activities (T04 - T24) Communication activities (T03 - T24) Exploitation and Innovation (T10 – T24)
Architectural concept for an operational European TID forecasting service (T18 – T24)	Release of functional algorithms (T15 – T20) *Finalization phase*	Release of functional algorithms (T14 – T17)	Release of final T-FORS services (T20 – T24)	Final reporting on DEC activities (T24)

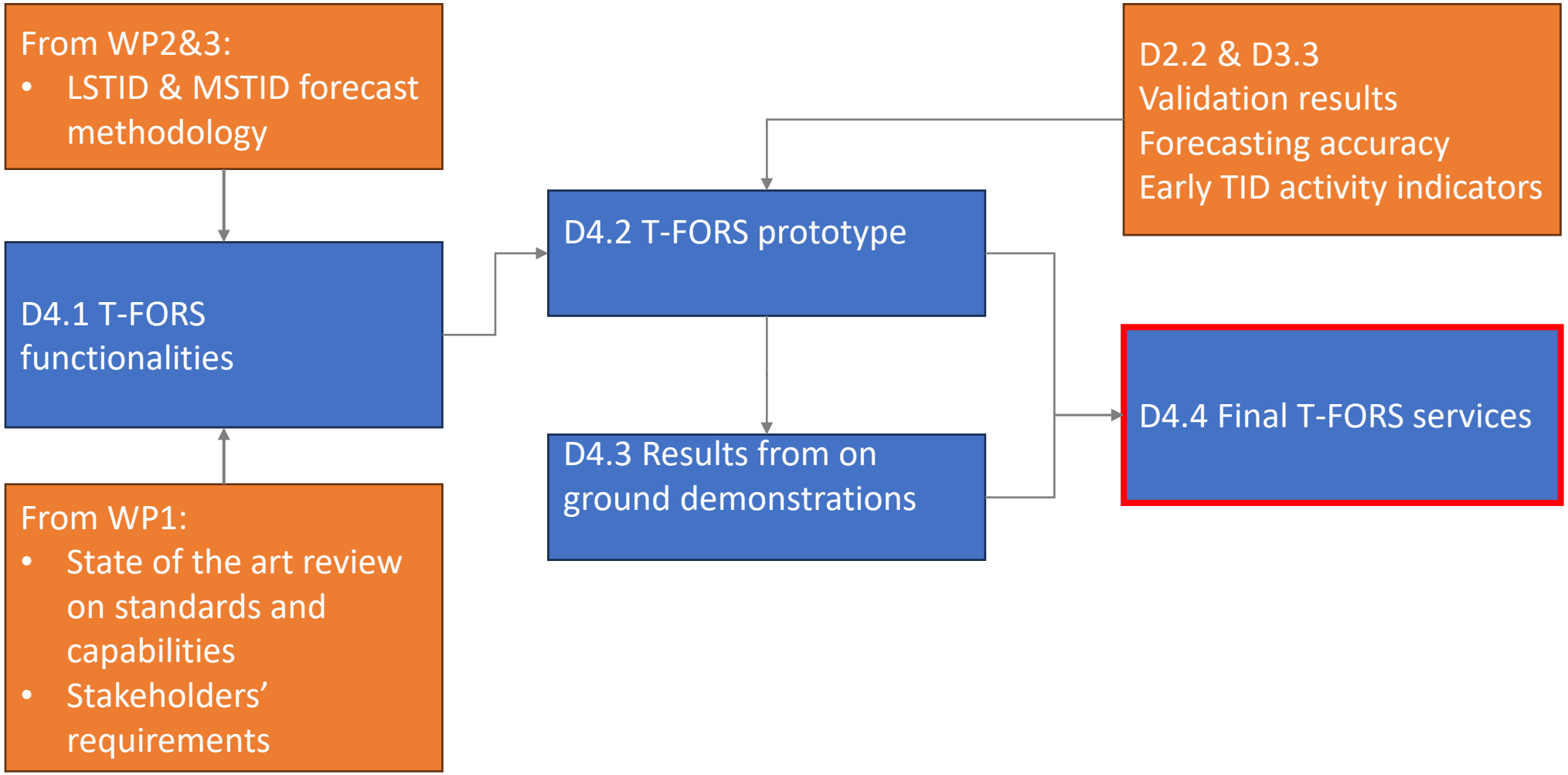
Workflow : WP1- Strategies and capabilities



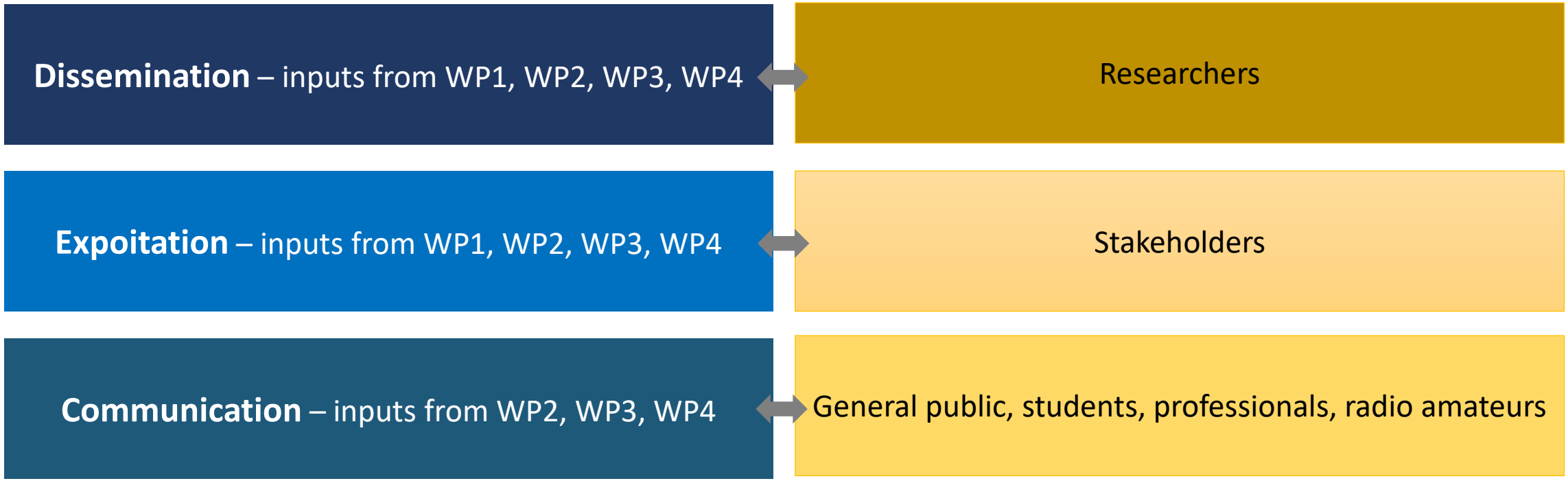
Workflow : WP2 & WP3 – TID forecast



Workflow : WP4 – Demonstration & Evaluation



Workflow : WP5– D&E&C



TARGET GROUPS

Who will use or further up-take the results of the project? Who will benefit from the results of the project?

1. Service providers

- ESA SWE Network
- ISES
- ICAO

2. Operators and managers of applications concerned

- Debris tracking systems
- The civil air traffic control.
- Users of single frequency GNSS
- Operators of geophysical investigations
- Direction finding systems.
- SMEs developers of SWE and SST services

3. The research community.

- Model developers
- PhD students
- Research Infrastructures

OUTCOMES

What change do you expect to see after successful dissemination and exploitation of project results to the target group(s)?

1. Enhance their services portfolio with unique and standardized products on expected TIDs in Europe

2. Use open science for the development of **mitigation actions**; **Improved operation** of systems that are critical for the civil safety; Re-use of T-FORS models aiming at its **application in other world regions**. Support **insurance companies to evaluate the risks** in critical infrastructures from severe TIDs.

3. Re-use T-FORS open science results; **Coordinated operation** of instruments; Derivation of **high level datasets**; **Enhance the capabilities of Research Infrastructures** with the integration of T-FORS data and models; **Attract new scientists** in the field.

IMPACTS

What are the expected wider scientific, economic and societal effects of the project contributing to the expected impacts outlined in the respective destination in the work programme?

1. Societal: To efficiently guide governance and funding decisions in the field for future developments
Economic: Use EU-funded research products for the benefit of European citizens

2. Economic: Economies of scales building on validated foreground and on state of the art knowledge; Avoiding economic loss from the unnecessary operations during periods of high TID activity; Strengthen European competitiveness and growth of companies.
Societal: Support civil protection and security

3. Societal: Educate new generation of researchers; bring Europe in the leading position.
Economic: Standardization should lead to efficient use of space weather forecasts and their effective use in many different application domains
Scientific: Innovative results on the mechanisms that trigger TIDs; Achieve quickly R&D innovation through the development of highly accurate forecasting models

Discussion Topic	Based on presentations from WP leaders/representatives
Can you recommend additional research activities and/or research projects that are relevant with T-FORS and must be considered in our developments?	WP1 (state of the art)
Are T-FORS developments relevant and useful for your activities? Do you see potential synergies?	WP2 (LS TID forecasting models) WP3 (MS TID forecasting models)
Can you recommend additional datasets and models to be considered in T-FORS developments?	WP2 (LS TID forecasting models) WP3 (MS TID forecasting models)
Can you recommend additional research/operational applications that could develop exchanges with T-FORS project, regarding both the validation of TID forecasts and the use of T-FORS results for testing the operational potential of TID forecasts.	WP4 (on ground demonstration tests) WP5 (Innovation Days – network of users)

Thank you for your attention!

WEB: https://www.t-fors.eu

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The T-FORS project is funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Health and Digital Executive Agency (HaDEA). Neither the European Union nor the granting authority can be held responsible for them."