Advances in FMP-Met Project: MET Processing and Trajectory Prediction

FMP-Met

Overview of FMP-Met Project

Overall objective

Provide the FMP with an intuitive and interpretable **probabilistic assessment of the impact of convective weather on operations**, to allow better-informed decision making.

Context of use

FMP process under adverse weather (thunderstorms), for en-route and TMA traffic, for a time horizon of 8 hours, which requires multiple MET data input.

Challenge

Integrating different probabilistic MET products: probabilistic nowcasts, regional-coverage ensemble prediction systems (EPS), and global-coverage EPS.

Uncertainty management

Ensemble Weather Forecasting is used to quantify MET forecast uncertainty: the uncertainty is defined by scenarios.

Several sources of MET forecast uncertainty are considered: **wind and air temperature** (provided by EPSs), **exposure to convection** (provided by EPSs), and **storm cell location** (provided by probabilistic nowcasts).

Other sources of uncertainty considered in FMP-Met: the **operational uncertainty** linked to the storm avoidance strategy, and the **uncertainty in the take-off time** for those flights that have not yet departed.

Progress made

During the 1st year of the project, we have developed the **computing infrastructure needed** to perform the traffic analysis required to support FMPs:

- A probabilistic (ensemble) **nowcast**.
- A unified framework for **trajectory prediction** with a time horizon of 8 hours.

Technical enabler #1: Probabilistic storm Nowcast

Main features

It takes rain data observations: **OPERA radar data** from EUMETNET and **Satellite data** from EUMETSAT

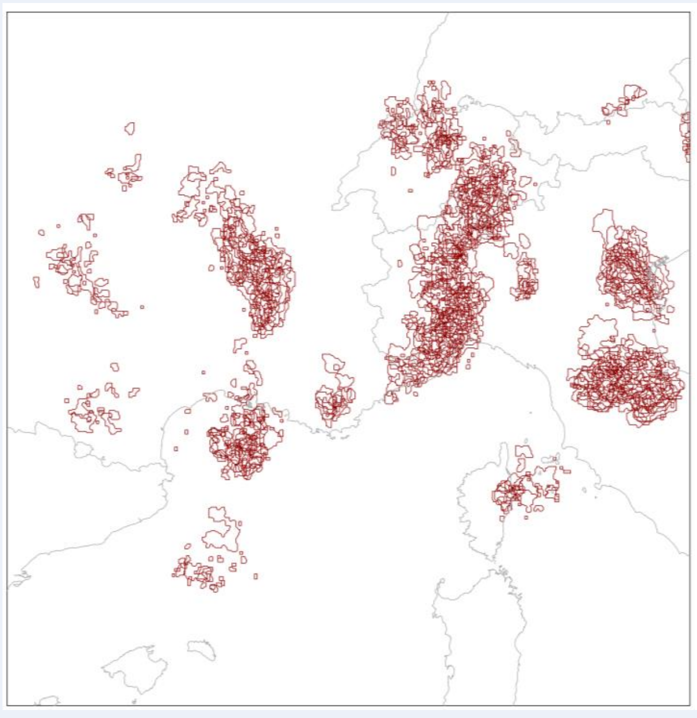
STEPS method is applied to generate an ensemble of **15 members**, each of them containing storm cells polygons with a **2 km horizontal resolution**.

A new prediction is generated every **15 minutes**, which ranges from M+0 up to M+90 minutes, with **15-minute-apart steps**.

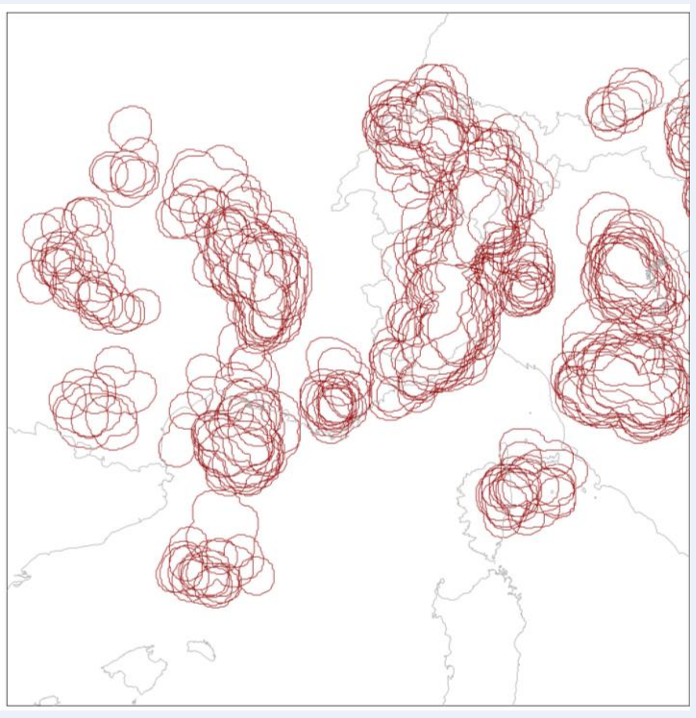
From the probabilistic nowcast,

1. storm cells are identified considering an appropriate reflectivity threshold and
2. no-fly regions with an appropriate safety margin are generated.

Example: 27-07-2019, 13:30 UTC analysis time, + 60 min forecast



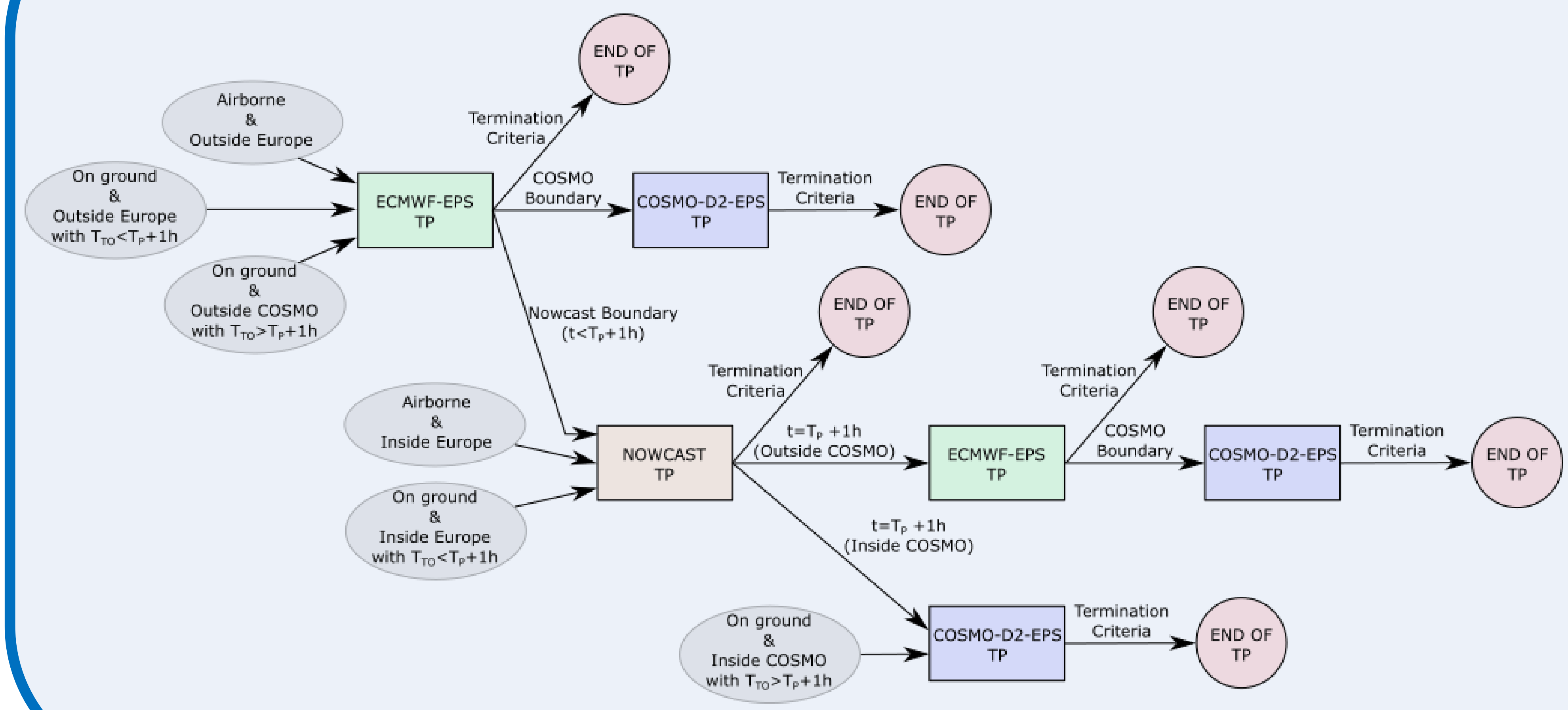
Storm cells. Reflectivity > 38 dBZ (all members)



No-fly regions. Safety margin 13.5 NM (all members)

Technical enabler #2: Trajectory prediction

Objective: Perform the probabilistic prediction of the aircraft trajectory, under adverse weather, for the next 8 hours.



Decision tree for classification and transition between TPs

Methodology: Unified framework for trajectory prediction which uses two different trajectory predictors (TP): Short-term TP, based on nowcast forecasts, and long-term TP, based on EPS forecasts.

Key elements of the methodology:

1. Classification of flights.
2. Clustering of final conditions.
3. Transition between TPs.

Next steps & Conclusions

Traffic analysis (demand, complexity, capacity reduction, congestion) and **FMP-Met concept assessment** are being done during the 2nd year of the project. FMP-Met brings a new step to integrate the MET uncertainty in ATM decision support tools.

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