



# The Italian Air Force Met. Service: NWP activities

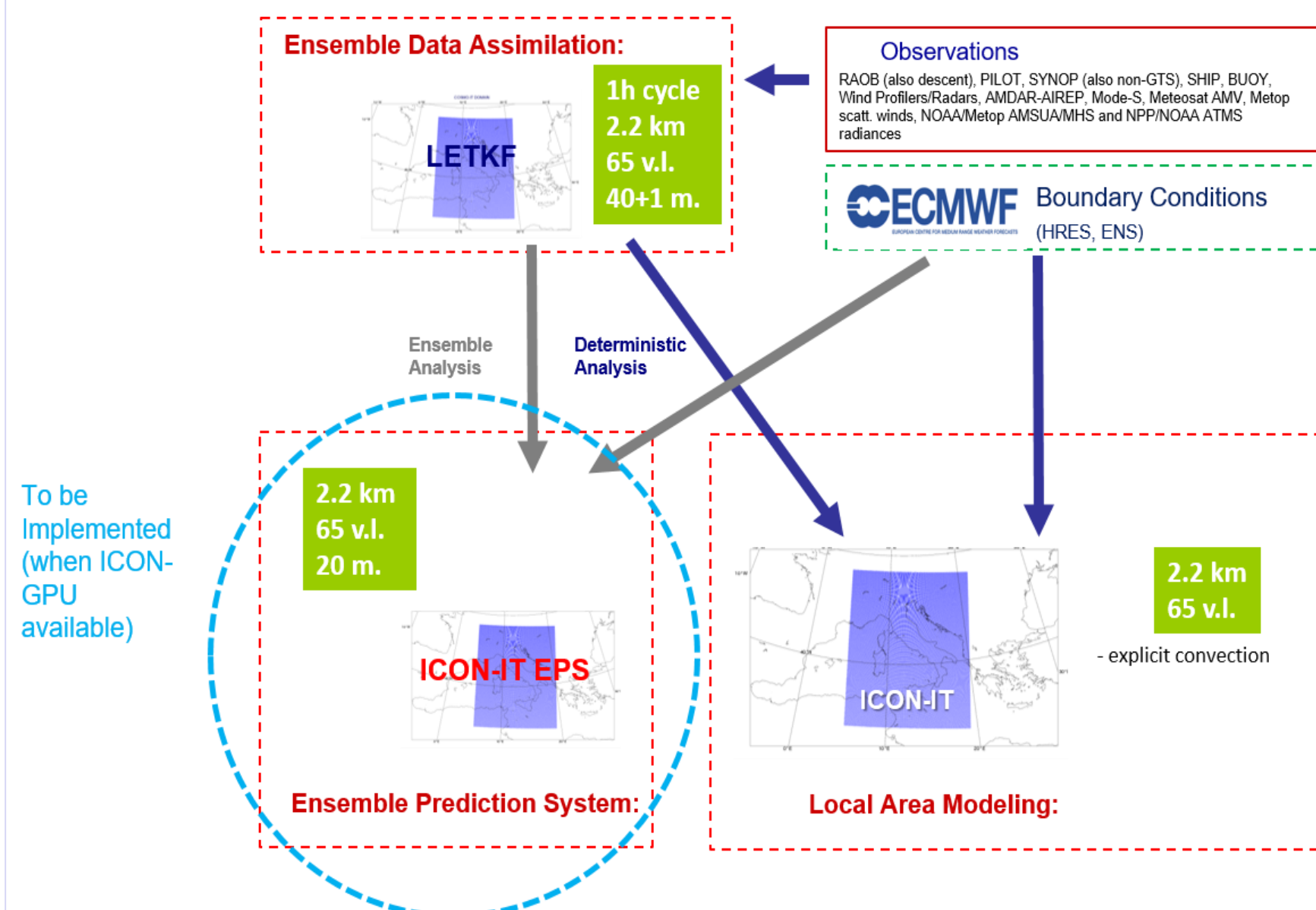
## CNMCA - Italian Air Force National Center for Aerospace Meteorology and Climatology

Francesca Marcucci, Antonio Vocino

francesca.marcucci@aeronautica.difesa.it, antonio.vocino@aeronautica.difesa.it

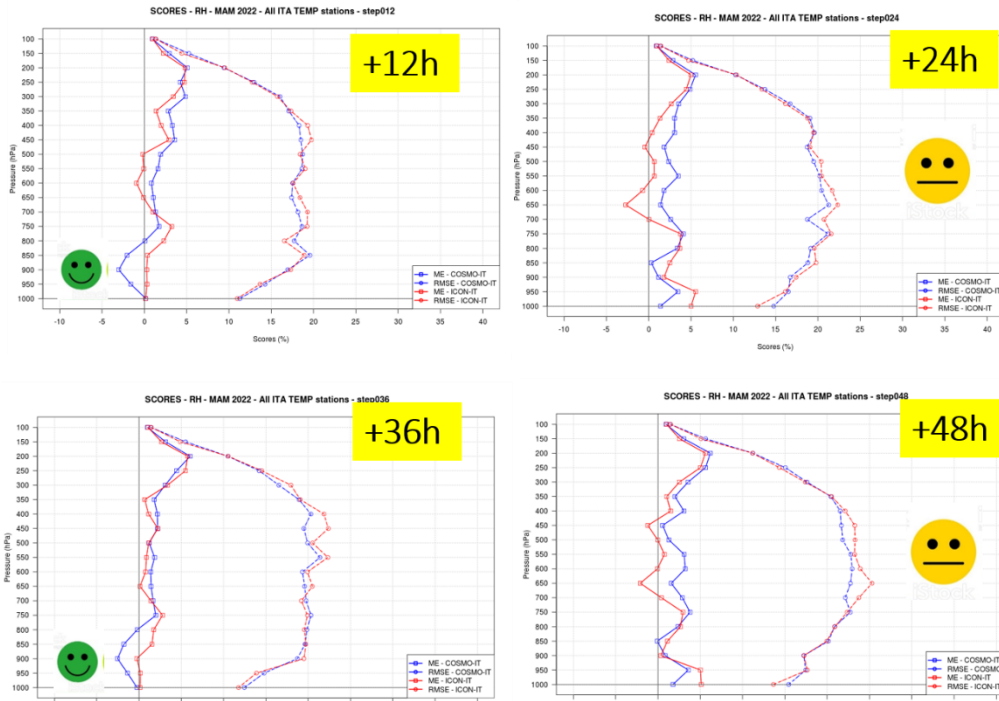
### MIGRATION TO ICON MODEL

#### ICON-IT OPERATIONAL SUITE



- ✓ Results are encouraging as generally ICON-IT outperforms COSMO-IT for surface parameters and temperature profiles
- ✓ Concerning the precipitation, the fuzzy results do not show significant differences between ICON-IT and COSMO-IT. Also the performance diagrams don't highlight any significant improvement of ICON-IT, except for the spring period where it performs better than COSMO-IT. Both models tend to overestimate the maximum precipitation values for medium-high thresholds (results provided by Arpa-Piedmont colleagues)
- ✓ The ICON model is fully operational at the Italian Met Service since July 2020, together with COSMO-IT, and available to forecasters for daily use. The full switch to ICON is conditioned to the availability of the GPU version of the model, precondition for the implementation of the ICON-IT EPS. Therefore ICON will hopefully become the "reference" model by Q4 2023.
- ✓ The use of the ICON model will also be advantageous from a computational point of view. In fact, taking into account that the two models (cosmo-it and icon-it) have the same setups (in terms of horizontal and vertical resolution and domain extent), on the basis of daily resource consumption (SBU) on the ECMWF Cray-HPC, it can be estimated that the use of ICON model saves around 40% of computational resources

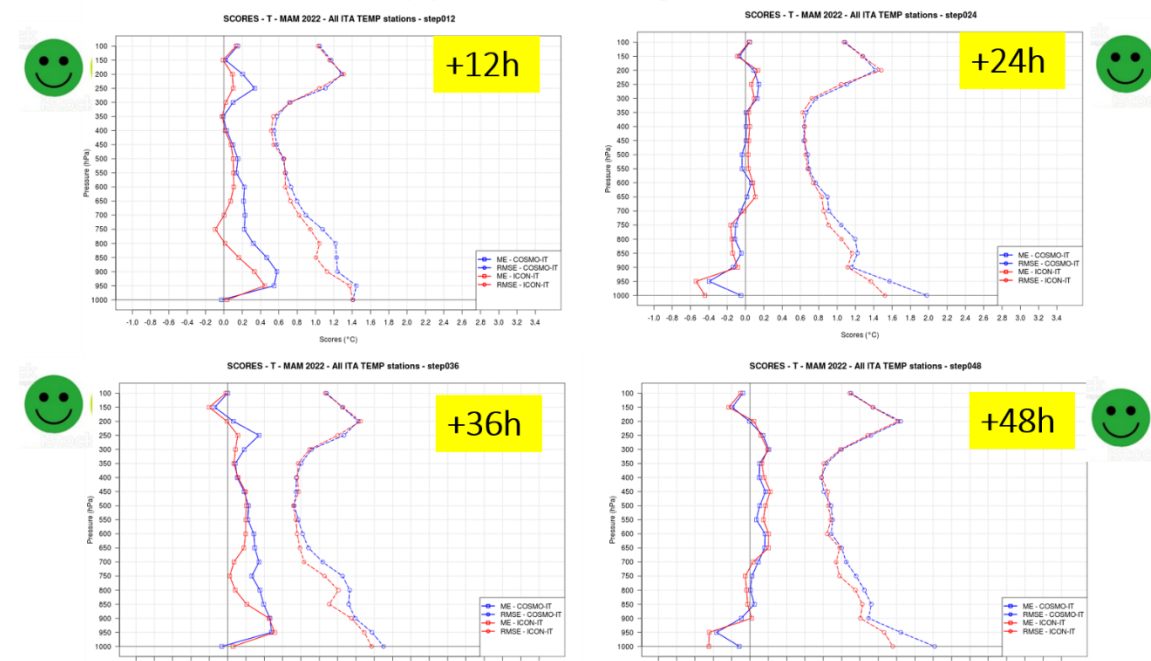
#### Upper Air Relative Humidity



Forecast verifications against Soundings

COSMO

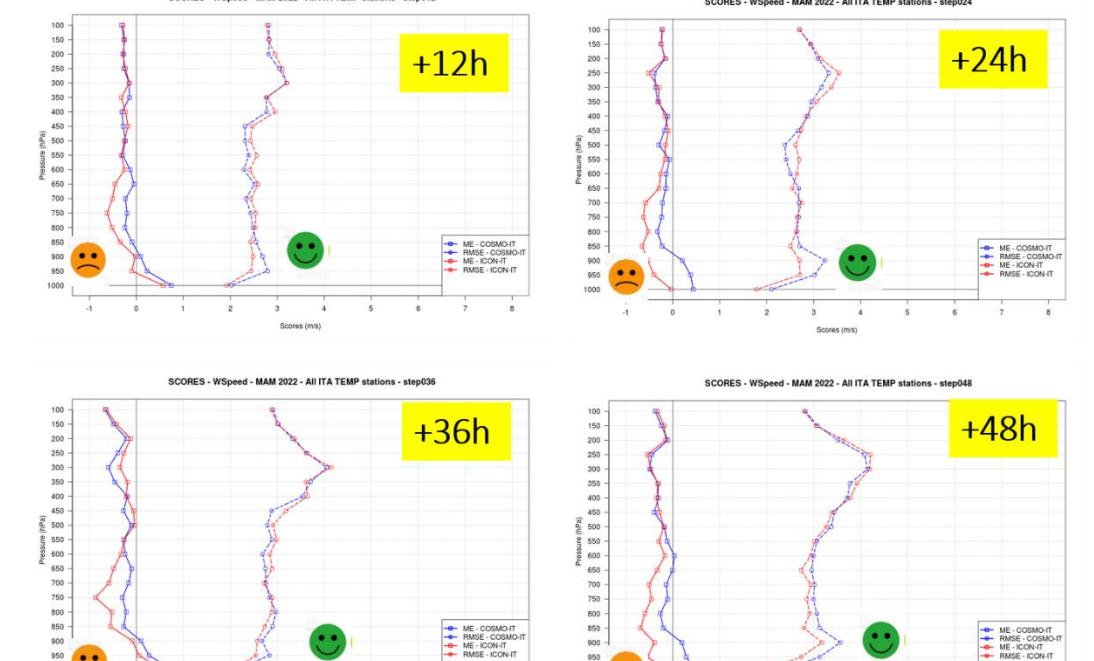
#### Upper Air Temperature



Forecast verifications against Soundings

COSMO

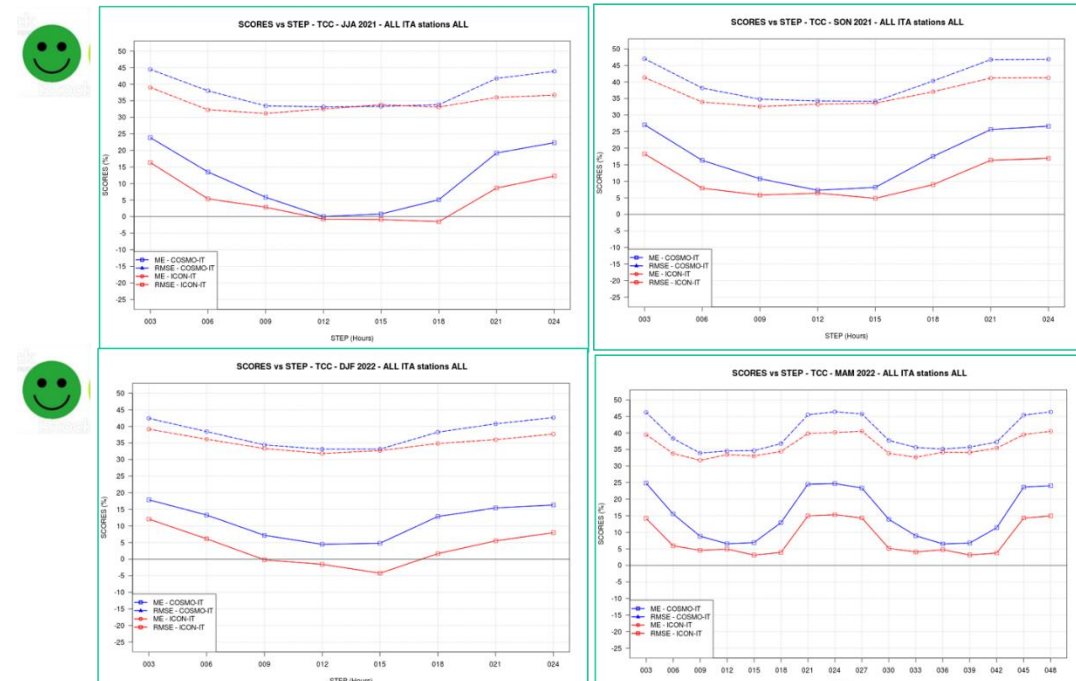
#### Upper Air Wind Speed



Forecast verifications against Soundings

COSMO

#### Total Cloud Cover



Forecast verifications against SYNOP

COSMO

- ✓ regarding the RH2m forecast skill, there is a slight general improvement for ICON-IT model in terms of RMSE
- ✓ The 10m wind speed RMSE score is almost identical for the two models, while the ME score is slightly better for ICON-IT during day time for JJA 2021 and SON 2021 quarters, but worsening during DJF 2021-22 and MAM 2022
- ✓ Surface pressure scores show mixing results

### SRNWP-EPS PROGRAM: current research and development



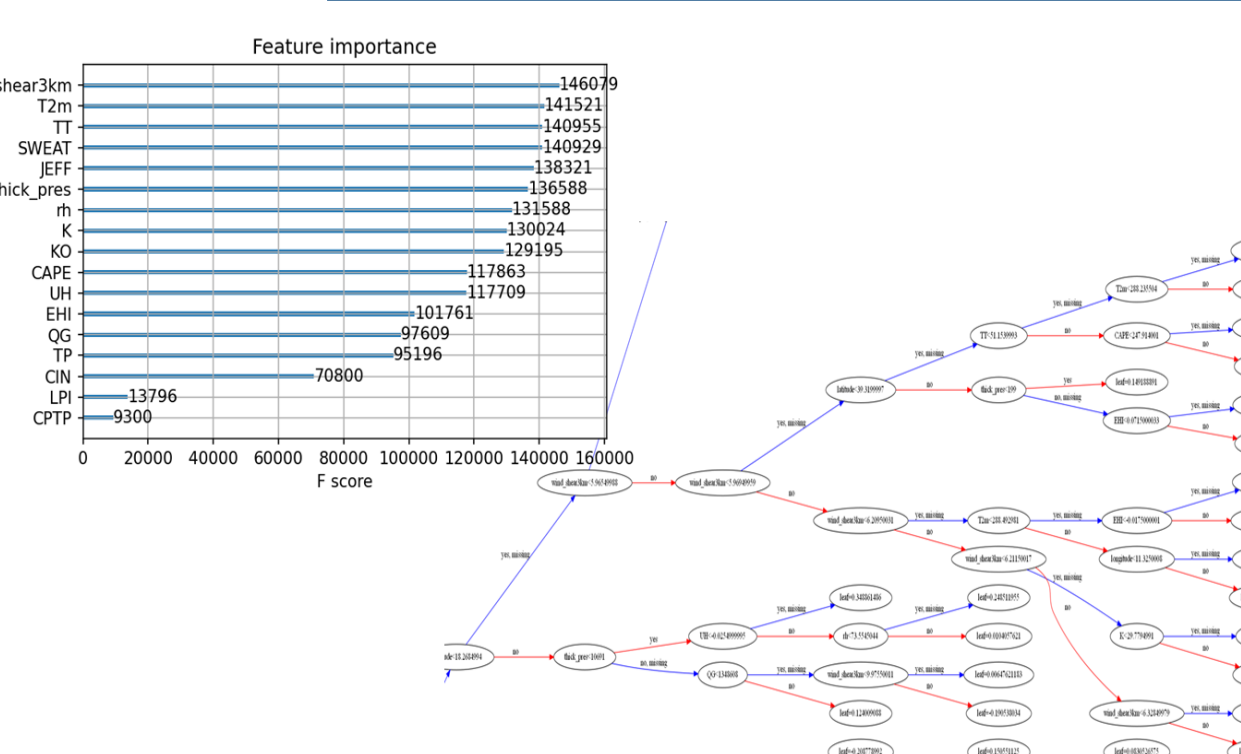
### Machine Learning

#### Datasets

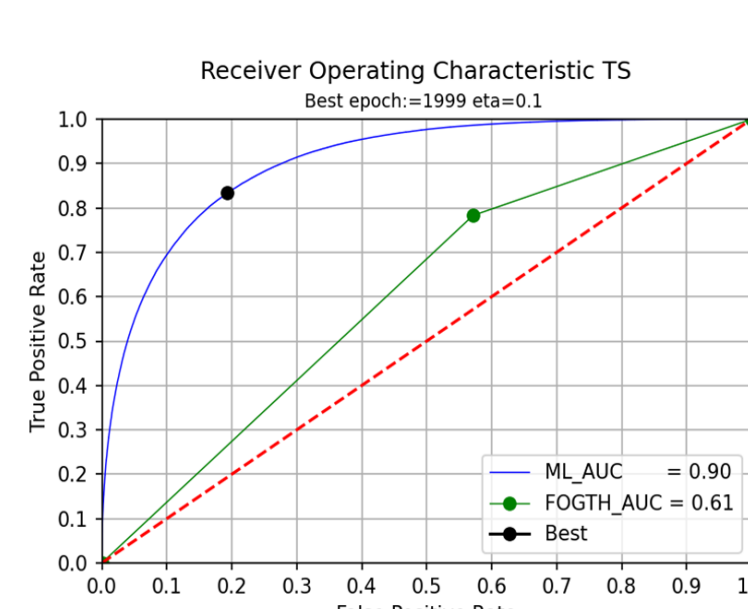
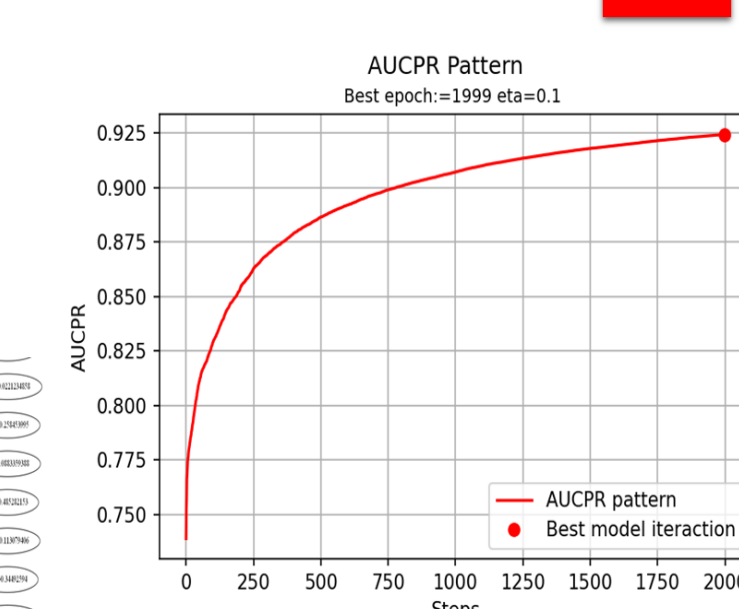
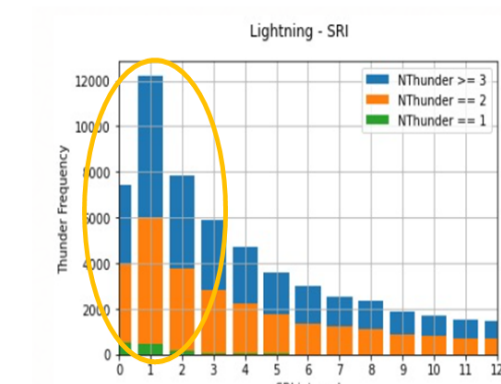
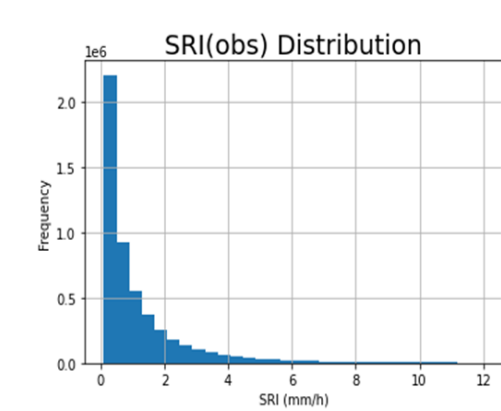
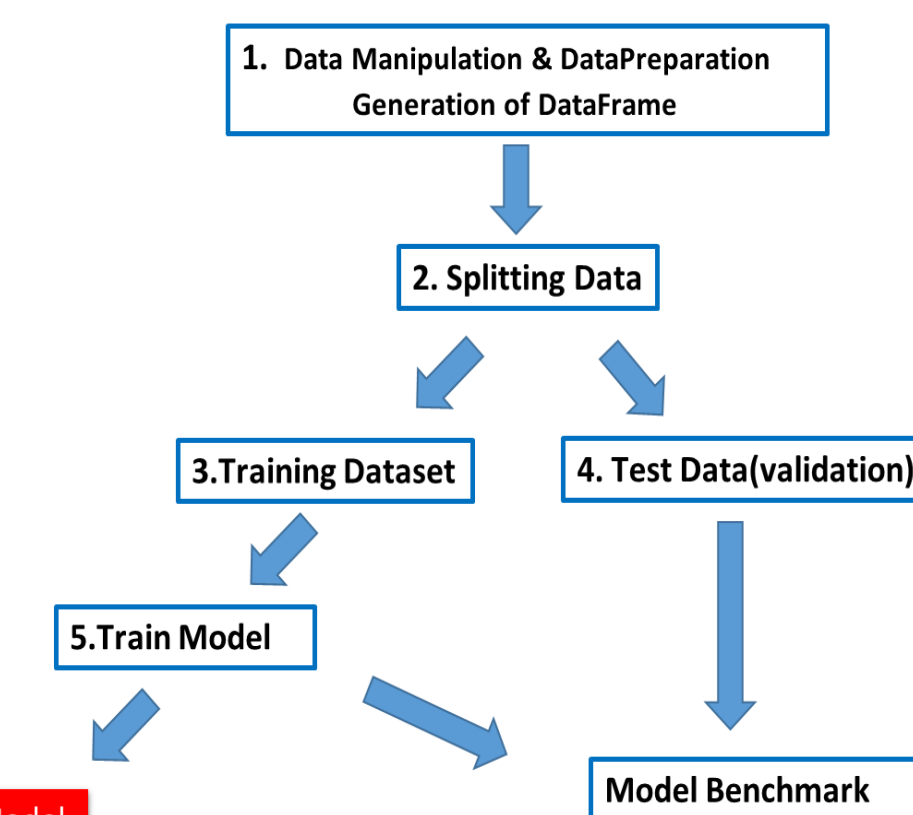
Predictors (called «features») used as INPUT for ML model to forecast the event (TS/SH):  
✓ full set of AWI/FOGTH predictors

Observations used as TARGET for ML to train/validate and test the algorithm:  
✓ SRI and lightnings

3km shear	Cloud dept	QG
T2m	K index	Total precipitation
SWAET	KO index	CIN
JEFF	CAPE	LPI
JEFF	Updraft Helicity	CPTP index
JEFF	Energy Helicity Index	



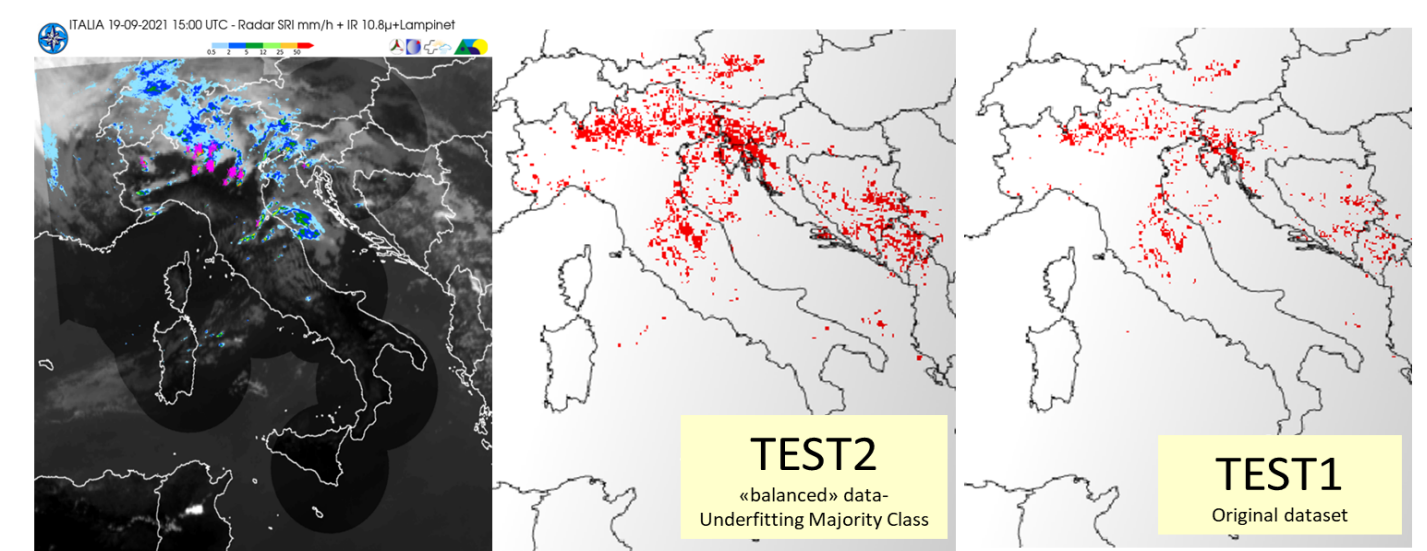
#### Steps



#### Results

Preliminary results show that the ML tool based on gradient boosting adaptive multi-index consensus algorithm set up as binary classifier for TS events outperforms traditional, static decision-tree post-processing driven by direct model output.

#### Libraries Starter Pack (free tools)



#### Future work

Temporal extension and potential of new datasets of observations (e.g. METAR reports for aerodrome sites) will be evaluated to improve the target classification. Furthermore, alternative methods to better balance the classes and select the input features will be implemented. Finally, the application of the same methodology for other weather hazards (fog, icing, turbulence) is planned.

- Started implementation at EUROPEAN WEATHER CLOUD: CPU-GPU capability in-the-cloud

