



La produzione numerica ad altissima risoluzione del Servizio Meteorologico dell'AM

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AM – Centro Operativo per la Meteorologia (COMET), Pratica di Mare (Roma)



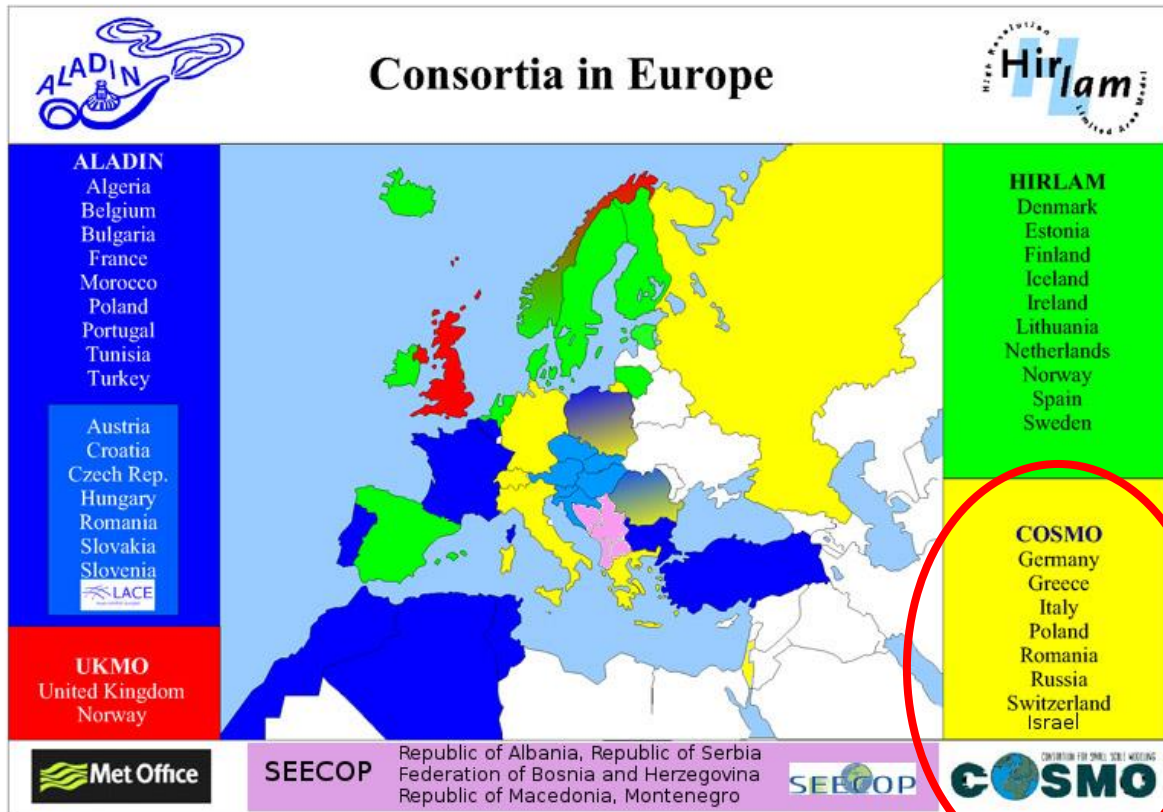
Outline

- ITAF operational NWP system
- Importance of data assimilation
- Aviation weather products:
 - Turbulence
 - Orographic waves
 - Severe thunderstorms
- Current developments

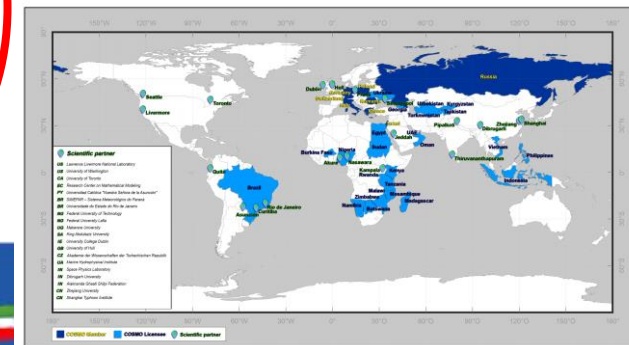
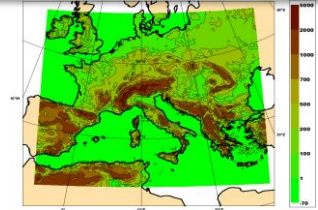


COSMO CONSORTIUM

ITAF is a member of COSMO, which has the goal to develop, improve and maintain a limited-area model for the small scale



COSMO-LEPS (20m,7km,40vl)



ITAF Progress in Data Assimilation

Optimal Interpolation (OI)

3D-VAR

LETKF (Local Ensemble Transform Kalman Filter)

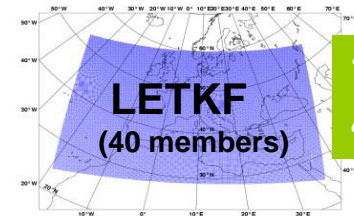
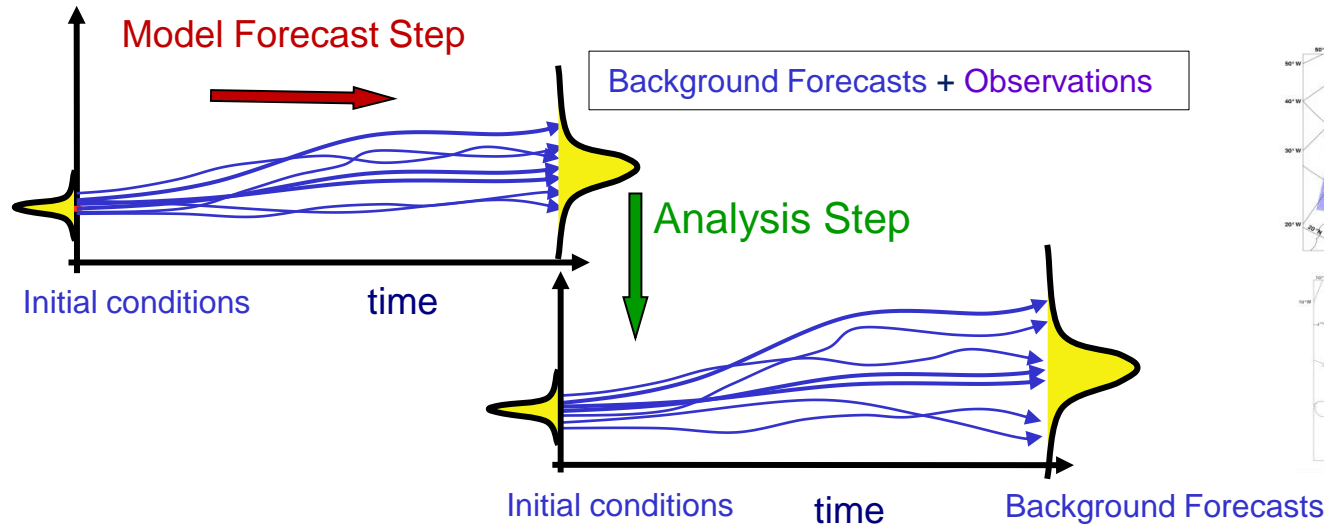
ASSIMILAZIONE DATI @ SERVIZIO METEO AM

1999

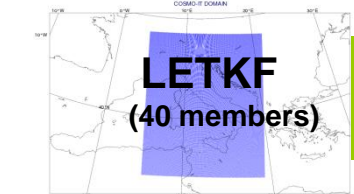
2002

2011

“Ensemble” Data Assimilation (LETKF)



7 km
49 v.l.



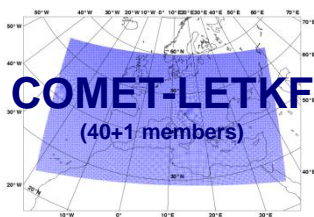
2.2 km
65 v.l.

CNMCA (now COMET) was the first meteorological centre to use operationally an ensemble data assimilation system (LETKF) to initialise a deterministic local area model (COSMO-ME).

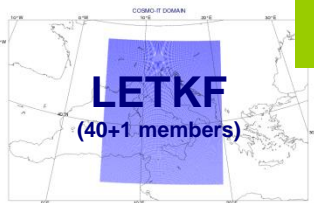
Operational Numerical Weather Prediction System

Ensemble Data Assimilation:

Operational since June 2011



7 km
49 v.l.



2.2 km
65 v.l.

Observations

RAOB (also 4D), PILOT, SYNOP, ISPRA rep., SHIP, BUOY, Wind Profilers, AMDAR-ACAR-AIREP, Mode-S, MSG3-MET8 AMV, Metop scatt. winds, NOAA/Metop AMSUA/MHS and NPP/NOAA ATMS radiances



Boundary Conditions
(HRES, ENS also from BC Progr.)

Ensemble Analysis

Deterministic Analysis

Local Area Modeling:

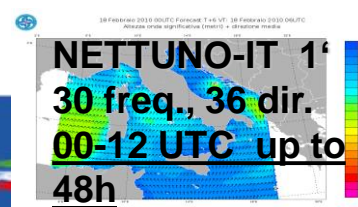
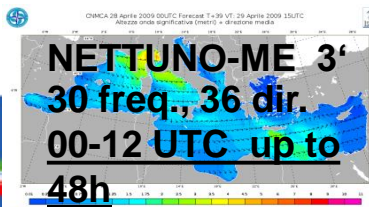
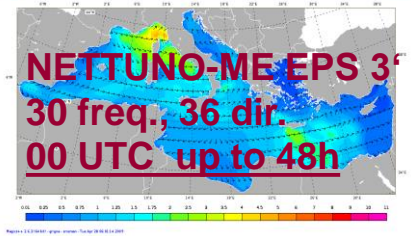
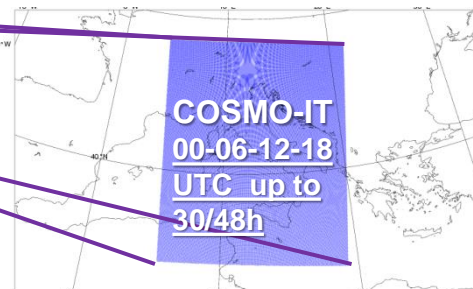
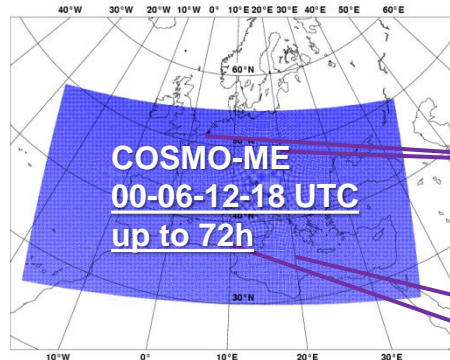
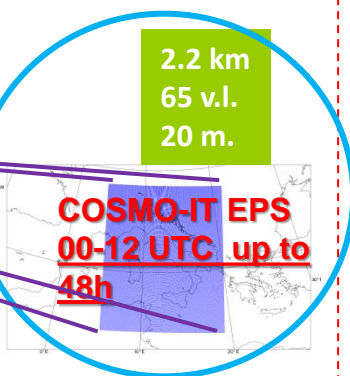
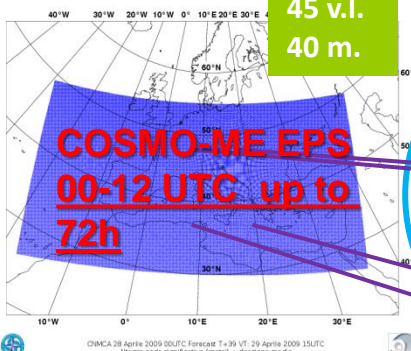
5 km
45 v.l.

parameterized convection

2.2 km
65 v.l.

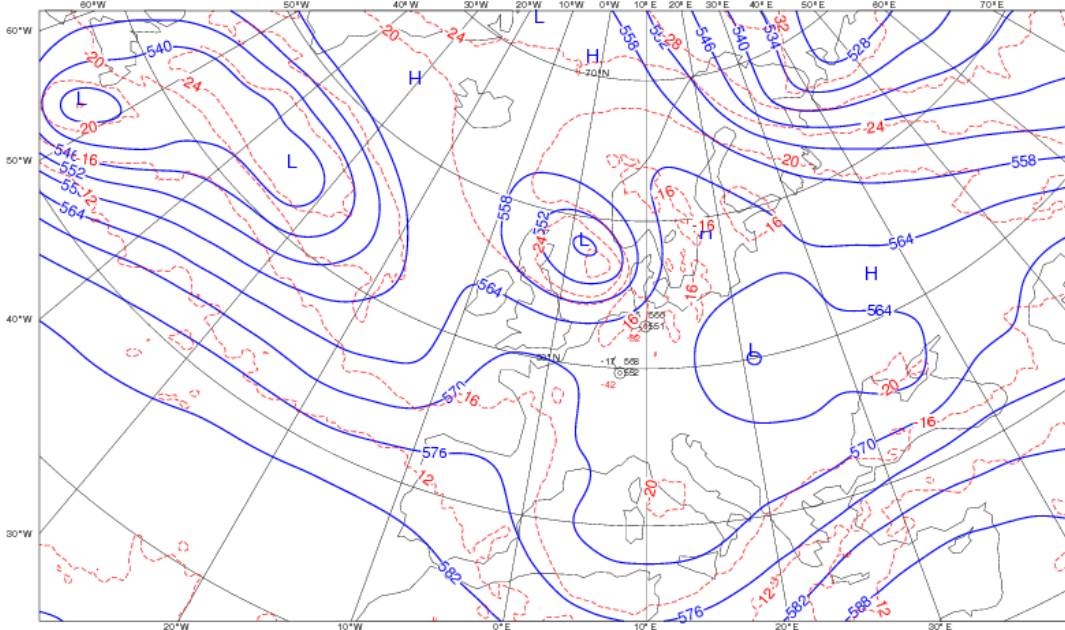
explicit convection

Ensemble Prediction System:

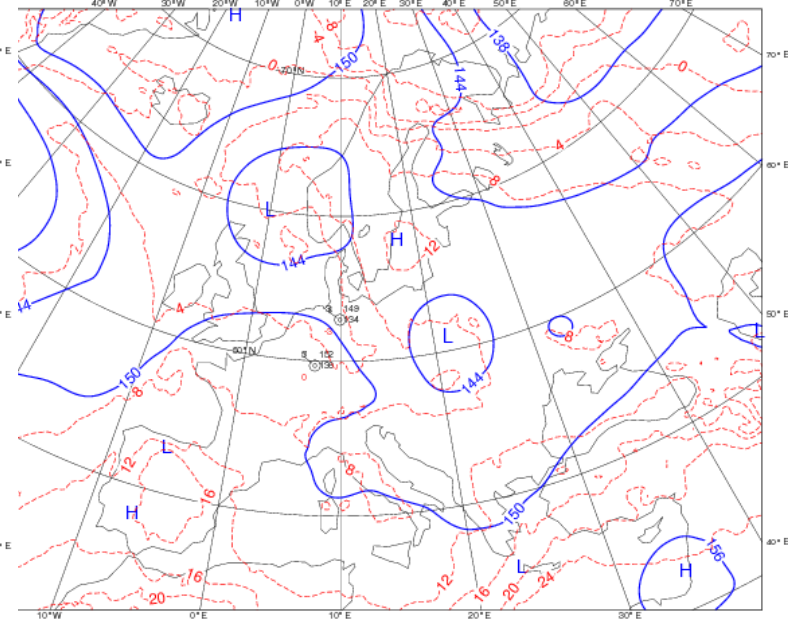


Importance of Data Assimilation

**ROME Analysis VT:Wednesday 22 May 2019 - 18 UTC
Geopotential at 500 hPa + Temperature at 500 hPa N.A.**



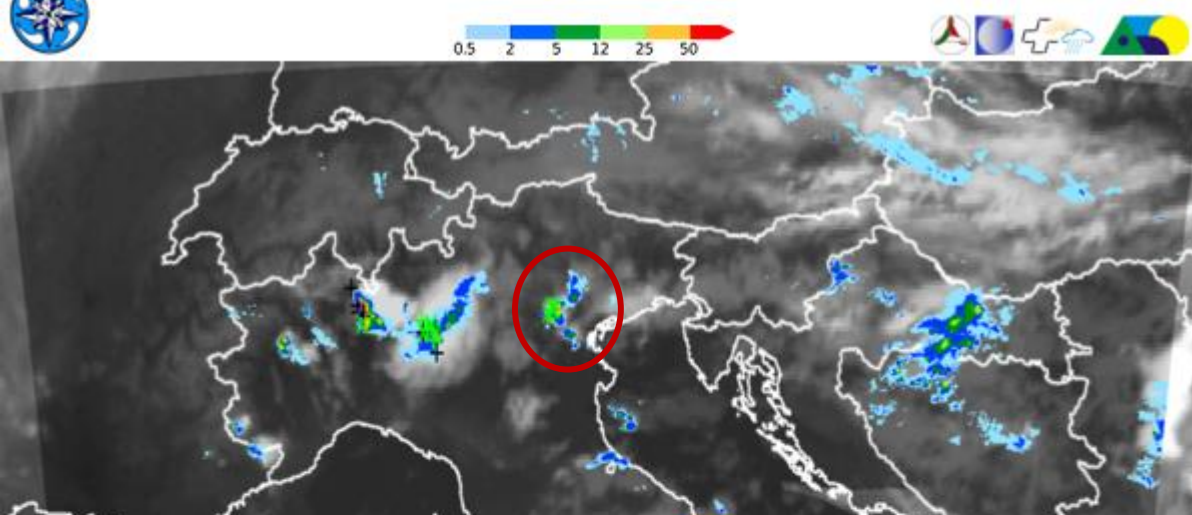
**alysis VT:Wednesday 22 May 2019 - 18 UTC
al at 850 hPa + Temperature at 850 hPa N.A.**



Magics 2.167 (86 bit) - torak6 - smeman - Wed May 22 19:51:04 2019

CECMWF

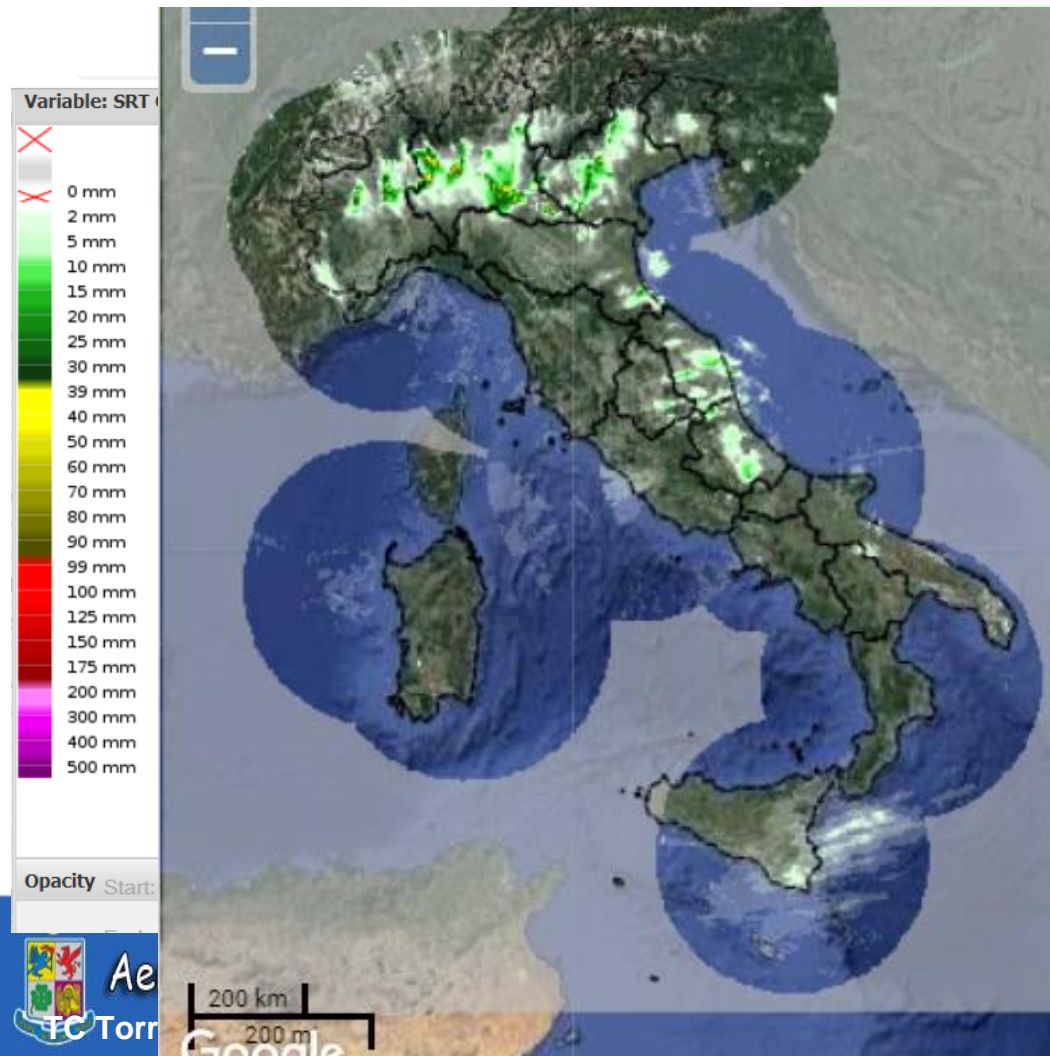
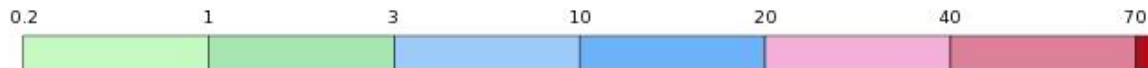
ITALIA 22-05-2019 20:20 UTC - Radar SRI mm/h + IR 10.8μ+Lampinet



Importance of Data Assimilation: 00 UTC run

Radar National Mosaic SRT
6h cum.: 20190523 00 UTC

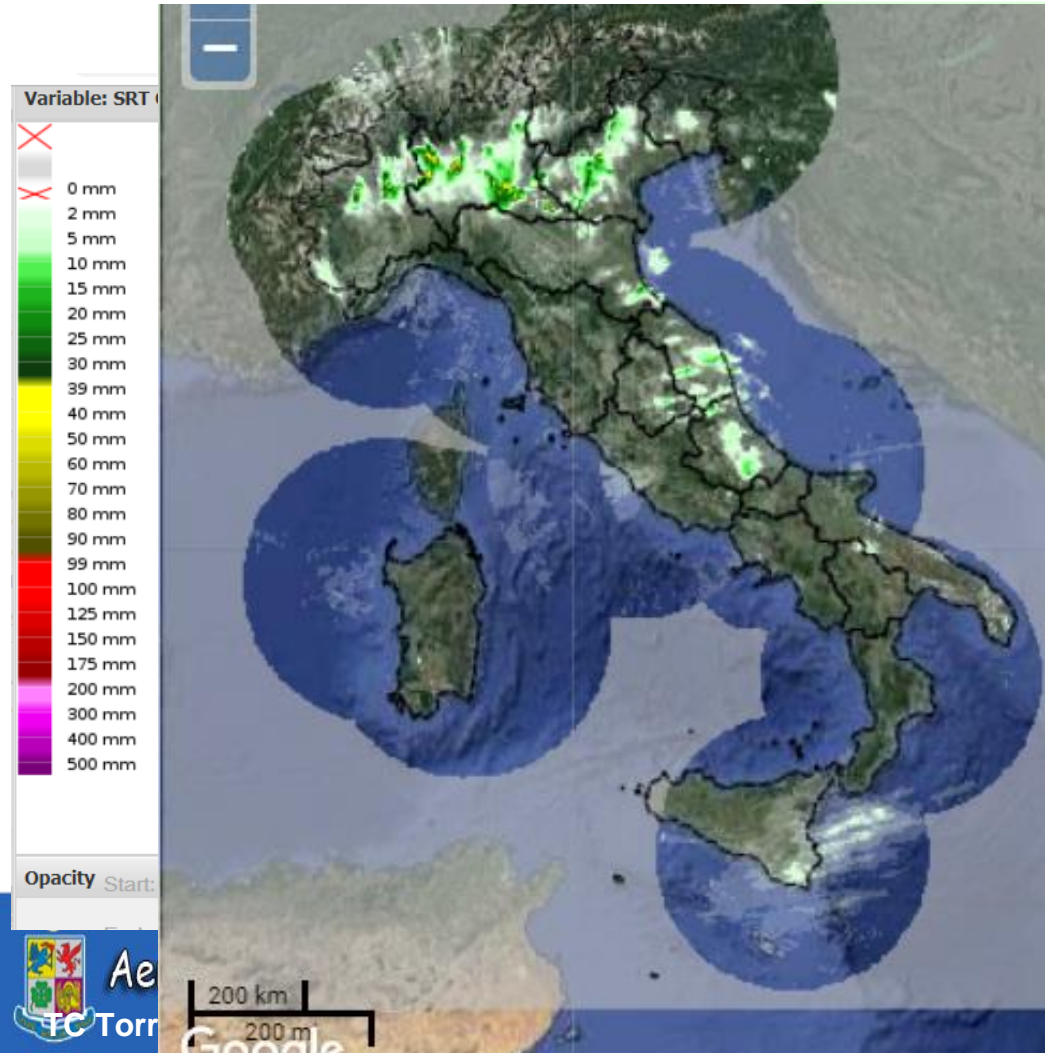
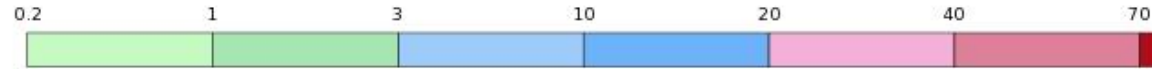
COSMO-IT 20190522 00 UTC – T+24h
6h cumulated precipitation



Importance of Data Assimilation: 06 UTC run

Radar National Mosaic SRT
6h cum.: 20190523 00 UTC

COSMO-IT 20190522 06 UTC – T+18h
6h cumulated precipitation



Importance of Data Assimilation: wind profilers

Wind profilers

Some of them with a very high observation frequency (10-15 min)!

Probable overfitting in the 3h time window, since temporal localization is not implemented in KENDA.

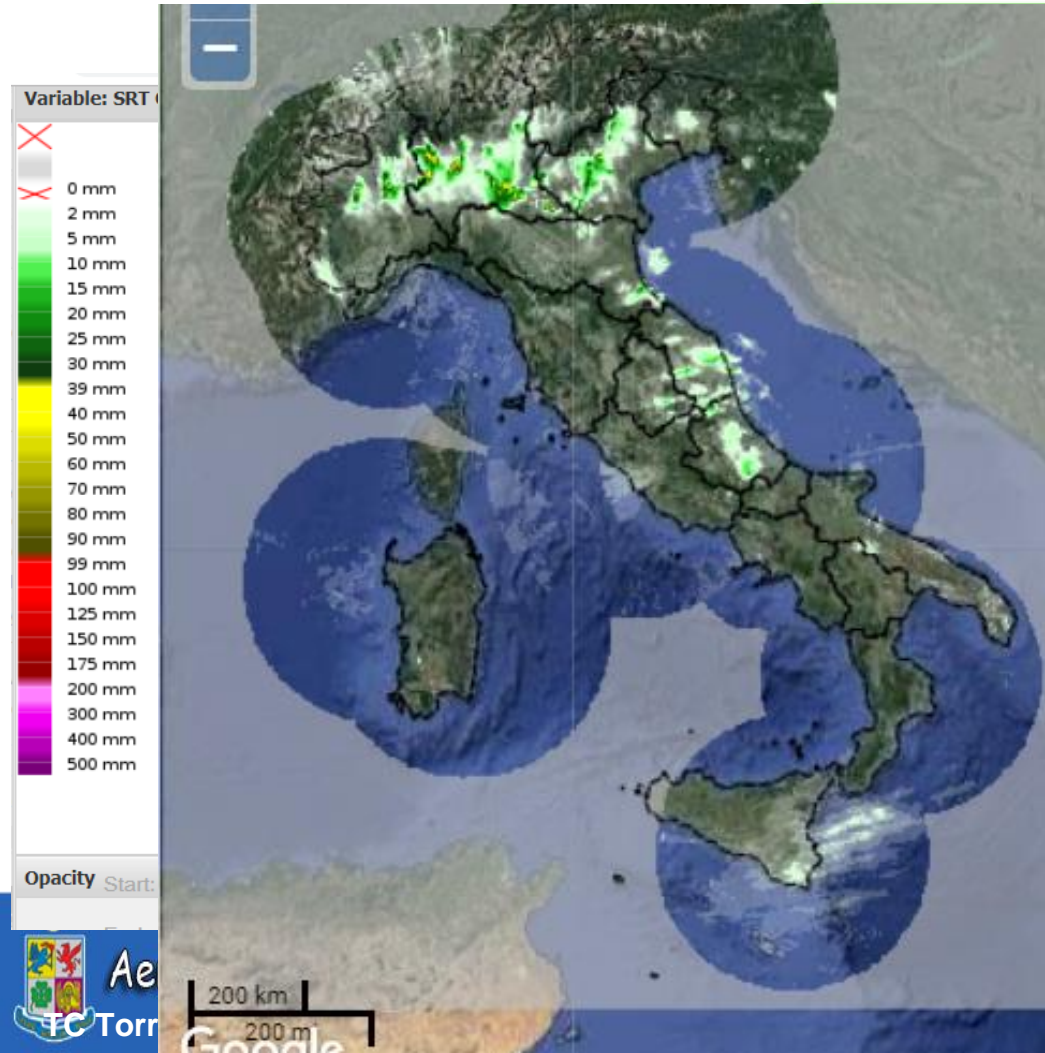
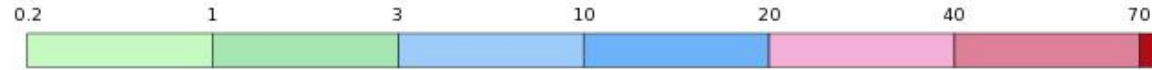
Station name	WMO code	lat	lon	time freq.
WEISSFLUHGIPFEL (CH)	06776	46.84	9.79	15
SCHAFFHAUSEN (CH)	06620	47.69	8.62	30
ALBIS (CH)	06661	47.29	8.51	15
PATSCHERKOFEL (A)	11126	47.21	11.46	10
GRENCHEN (CH)	06632	47.18	7.42	30
ZIRBITZKOGEL (A)	11164	47.07	14.56	10
PLAINE MORTE (CH)	06726	46.37	7.49	15
TORINO	16300	45.40	7.40	30



Importance of Data Assimilation: fixed 06 UTC run

Radar National Mosaic SRT
6h cum.: 20190523 00 UTC

COSMO-IT 20190522 06 UTC – T+18h
6h cumulated precipitation



Aviation weather products

COSMOIT 07 April 2018 00UTC

Forecast T+29 VT: Sunday 08 April 2018 05UTC

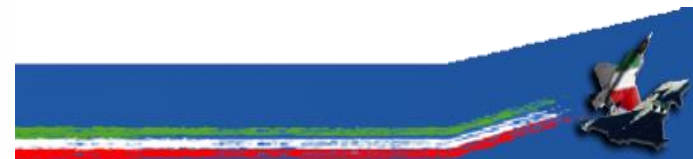
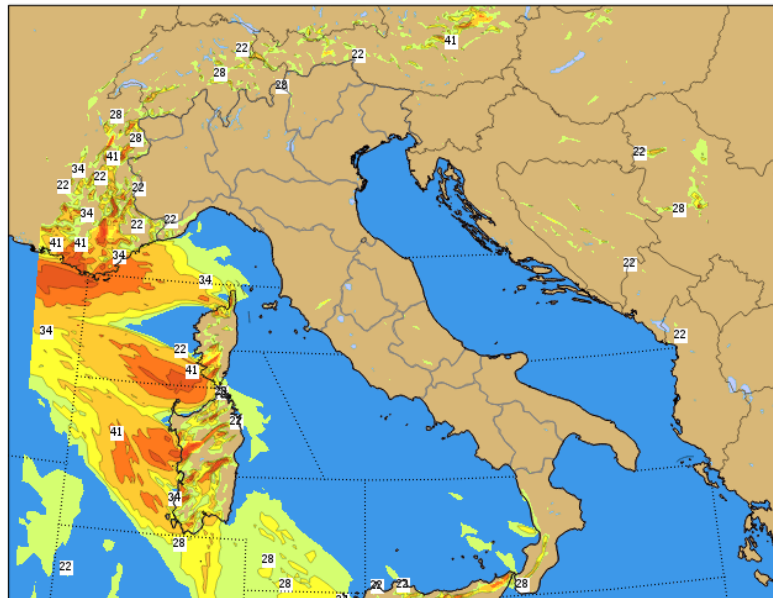
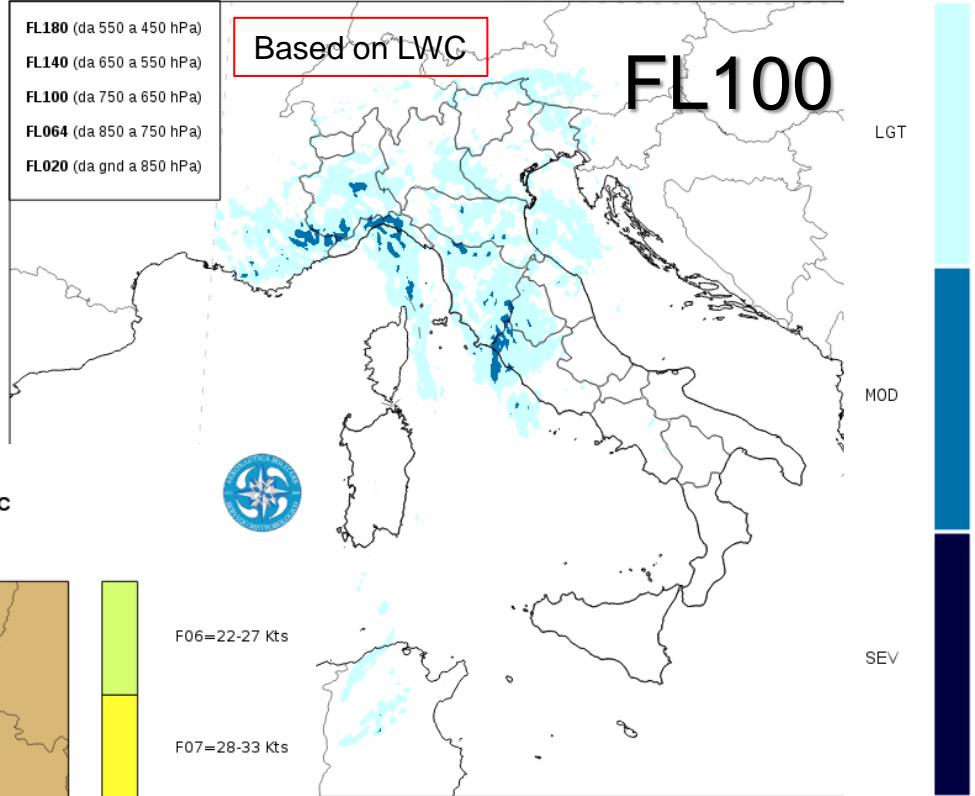
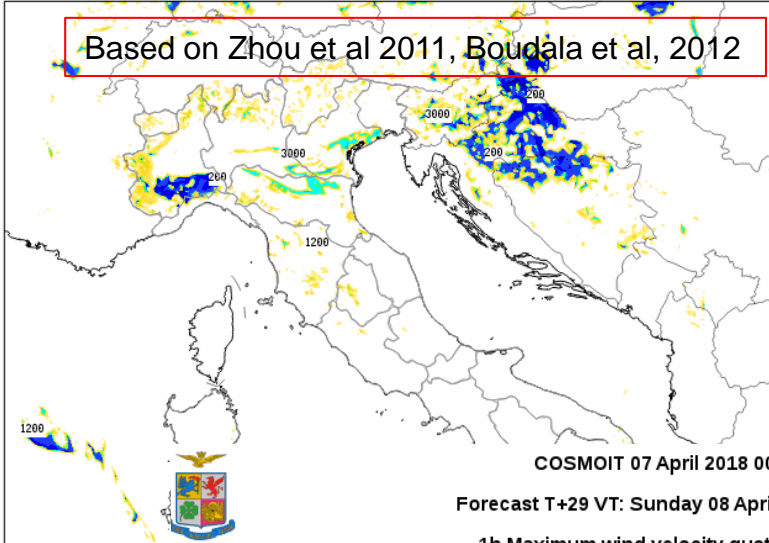
Visibility (m)



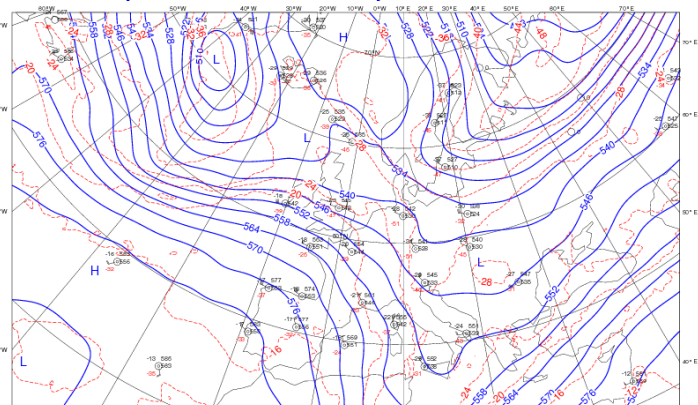
COSMOIT 11 April 2018 00UTC

Forecast T+19 VT: Wednesday 11 April 2018 19UTC

Icing 650-750hPa



ROME Analysis VT: Tuesday 27 March 2018 - 12 UTC
 Geopotential at 500 hPa + Temperature at 500 hPa N.A.



Turbulence forecast

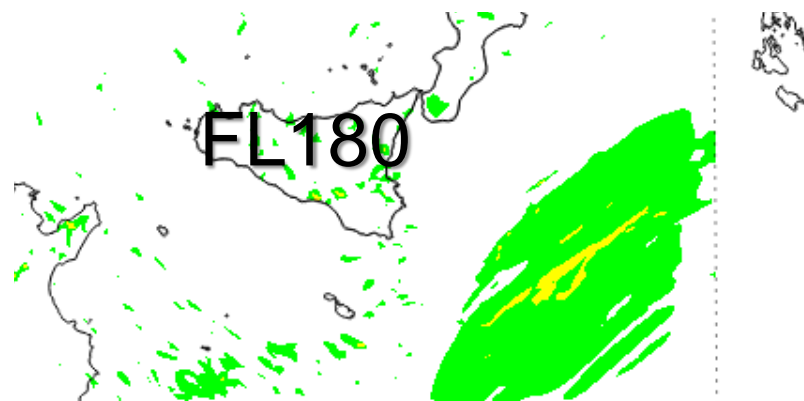
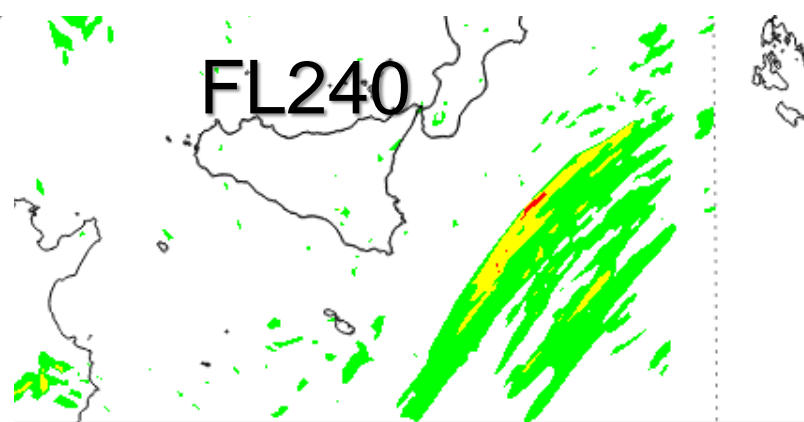
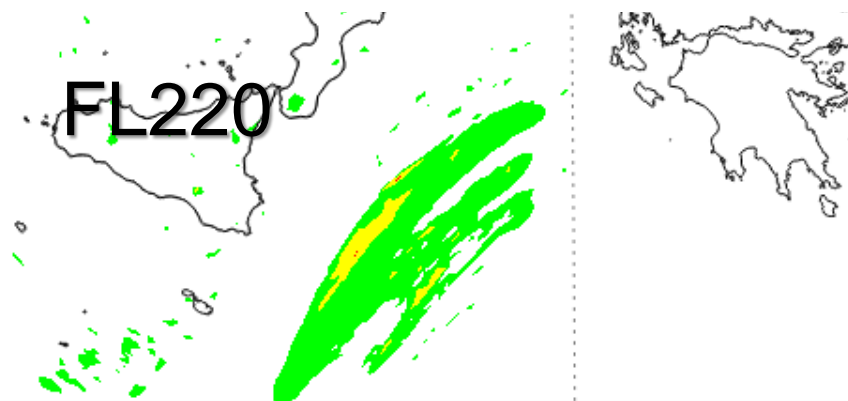
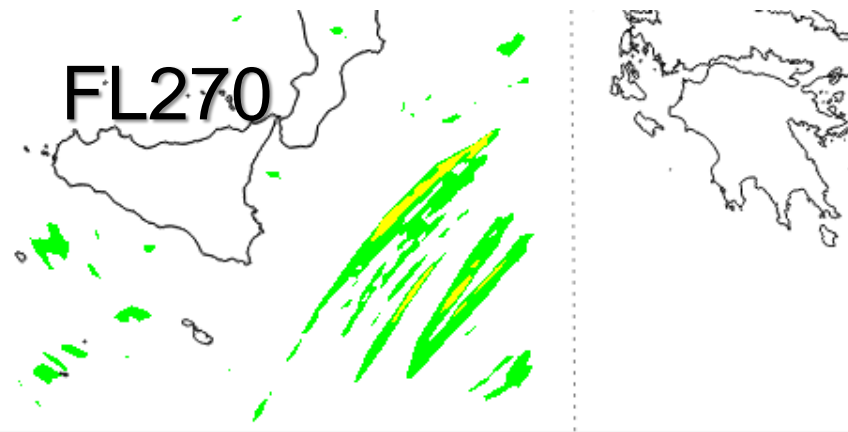
Eddy Dissipation Parameter $\left[\frac{m^{2/3}}{s} \right]$
 mainly based on $(edr)^{1/3}$, computed
 from the **prognostic turb. kinetic
 energy (tke)** of COSMO model

$$edr = \frac{\sqrt{(2tke)^3}}{L_p * \alpha}$$

L_p - turb. length scale
 α - dissipation const.

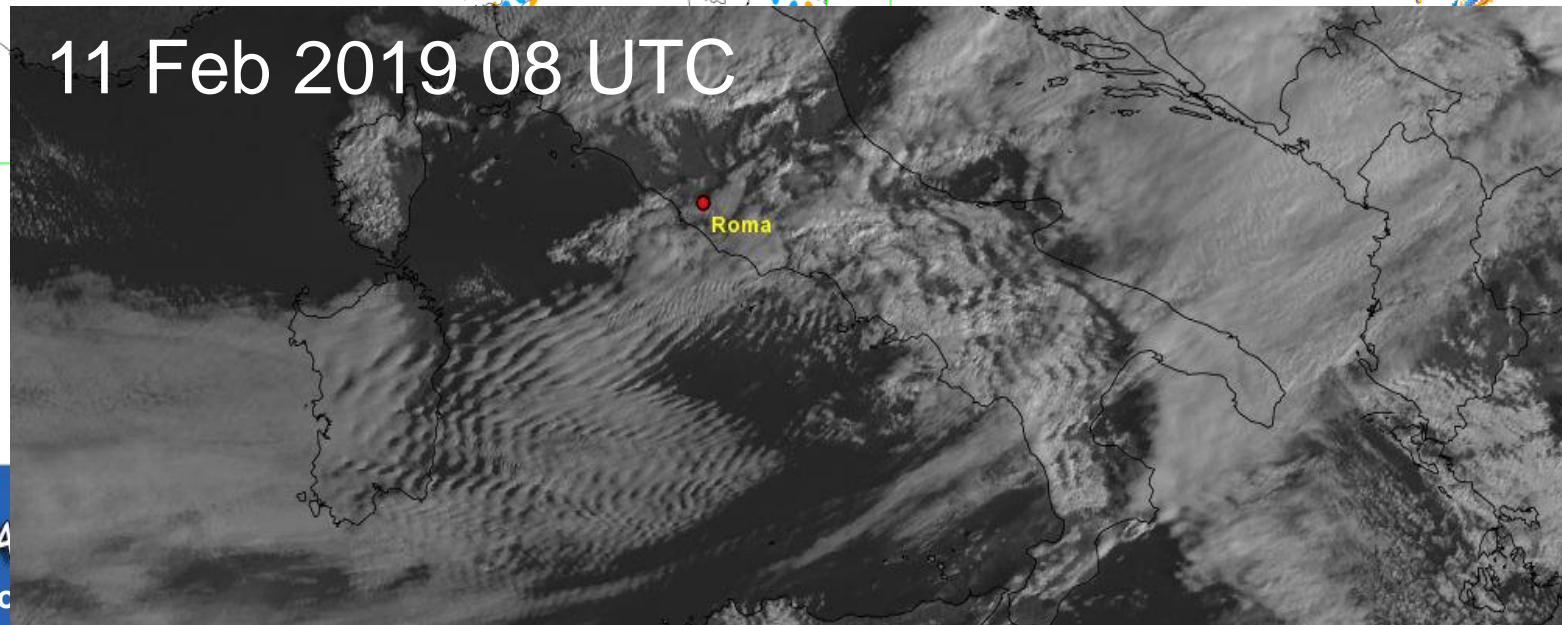
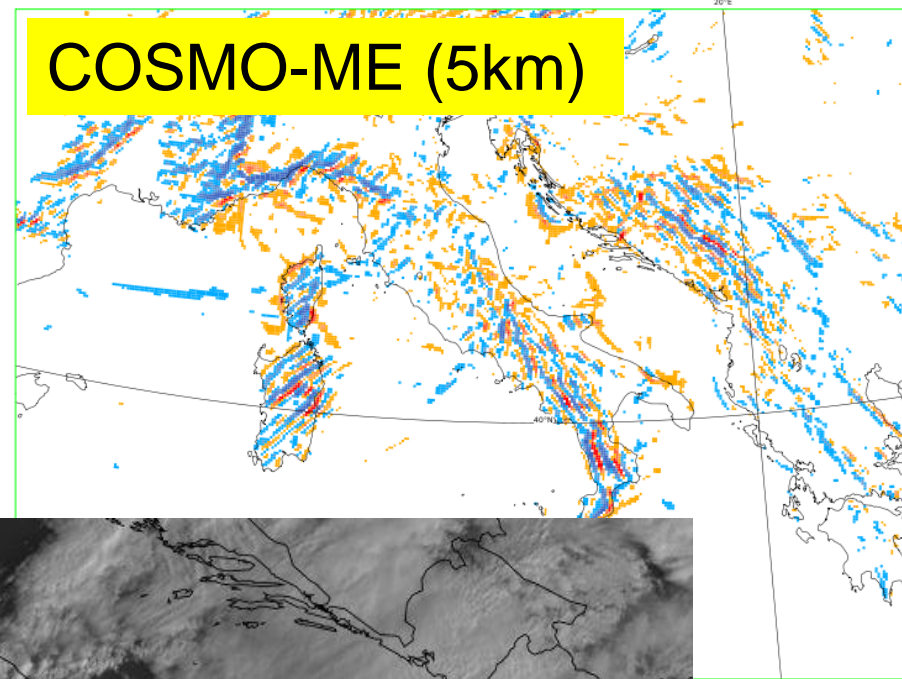
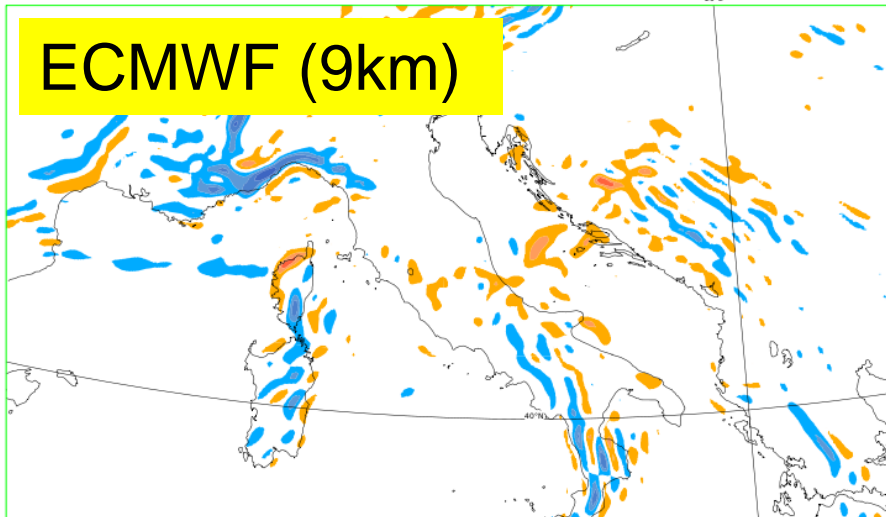
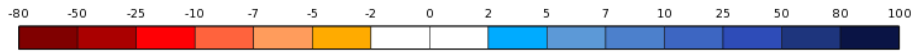
COSMOIT 27 March 2018 00UTC

Forecast T+14 VT: Tuesday 27 March 2018 14UTC



Orographic Wave Forecast

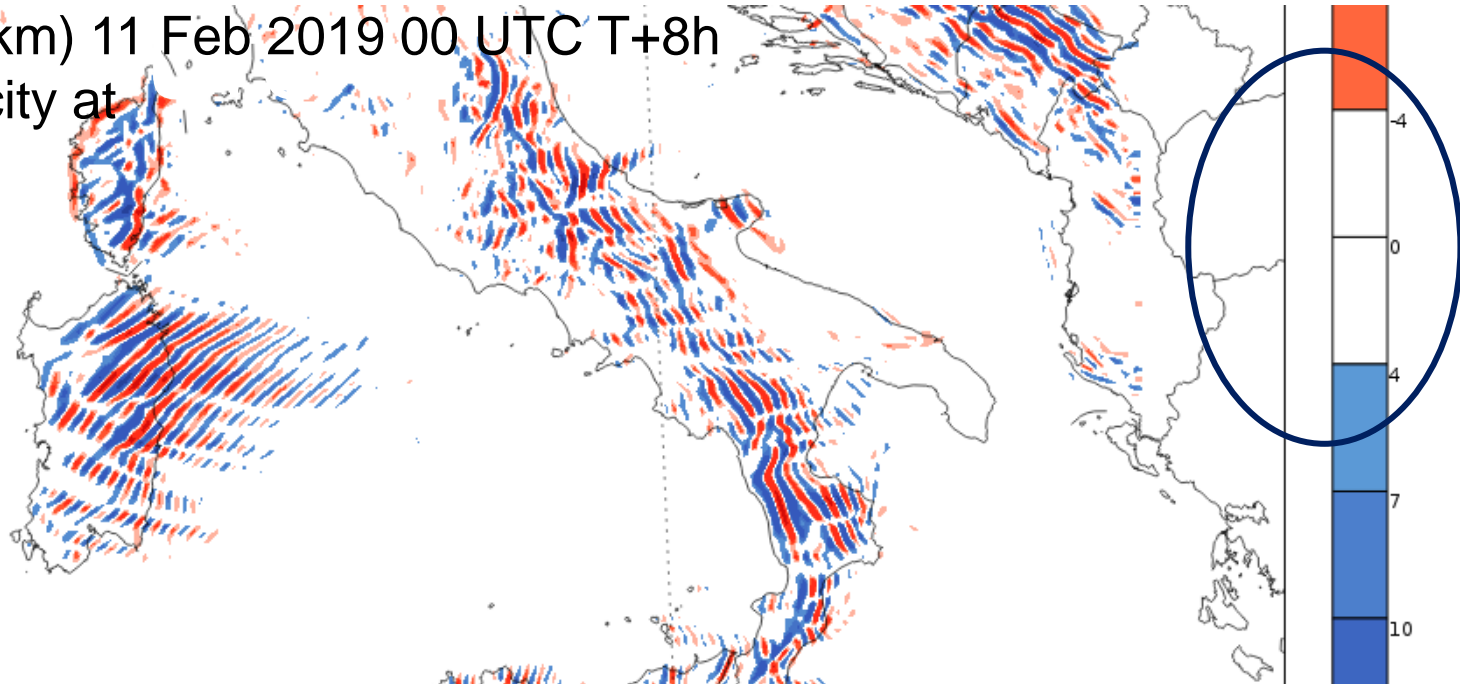
ω - vertical velocity at 700 hPa [Pa/s]: 11 Feb 2019 00 UTC T+9h



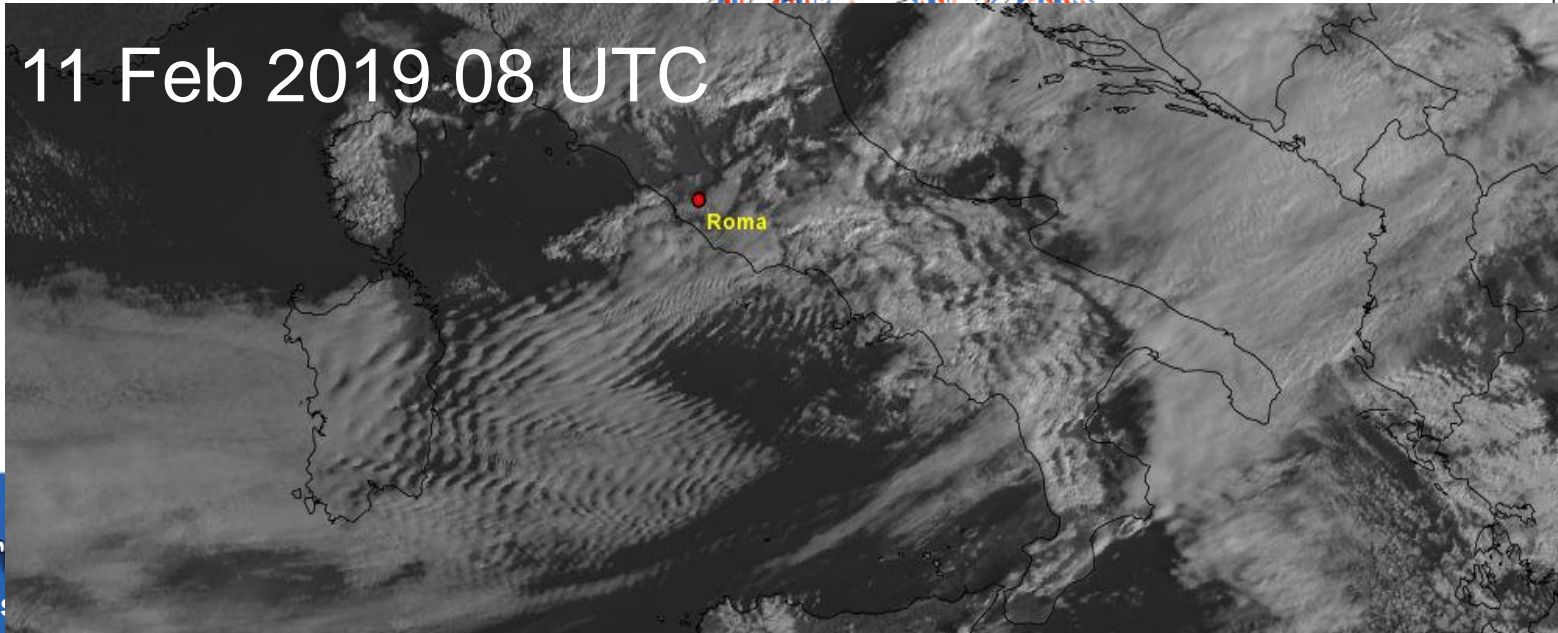
Orographic Wave Forecast

COSMO-IT (2.2km) 11 Feb 2019 00 UTC T+8h

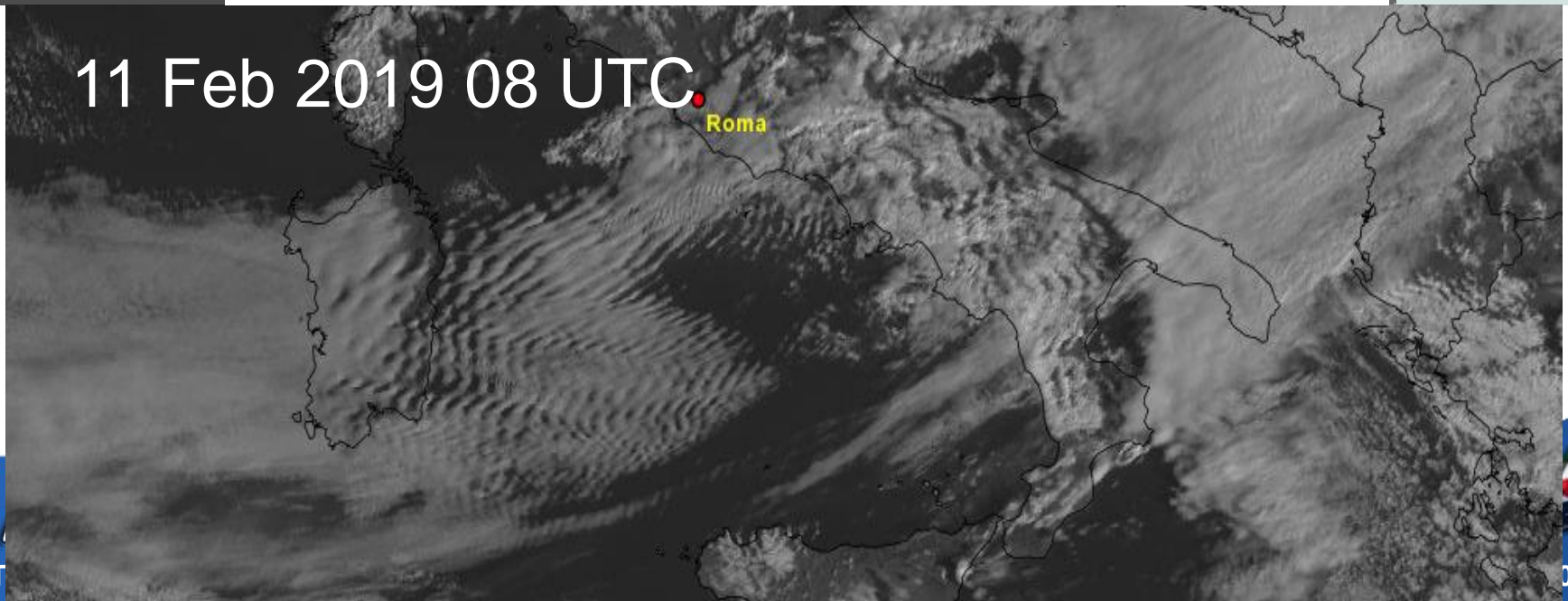
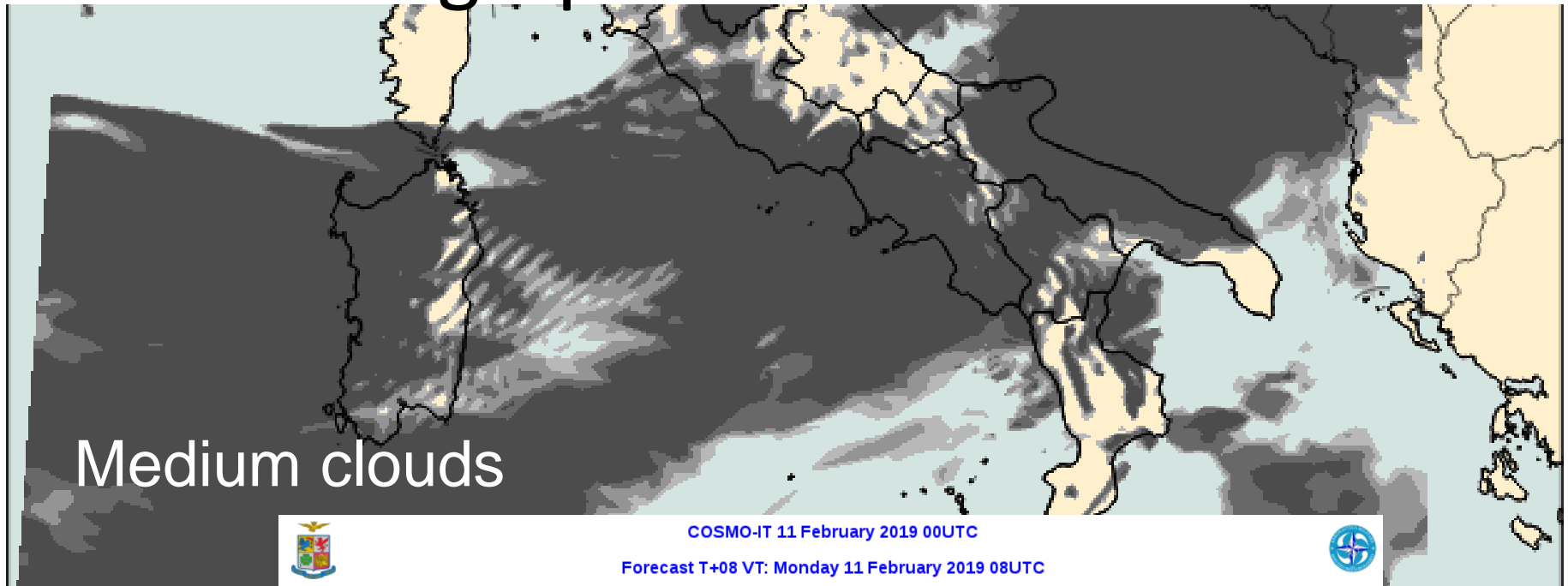
ω - vertical velocity at
700 hPa [Pa/s]



11 Feb 2019 08 UTC



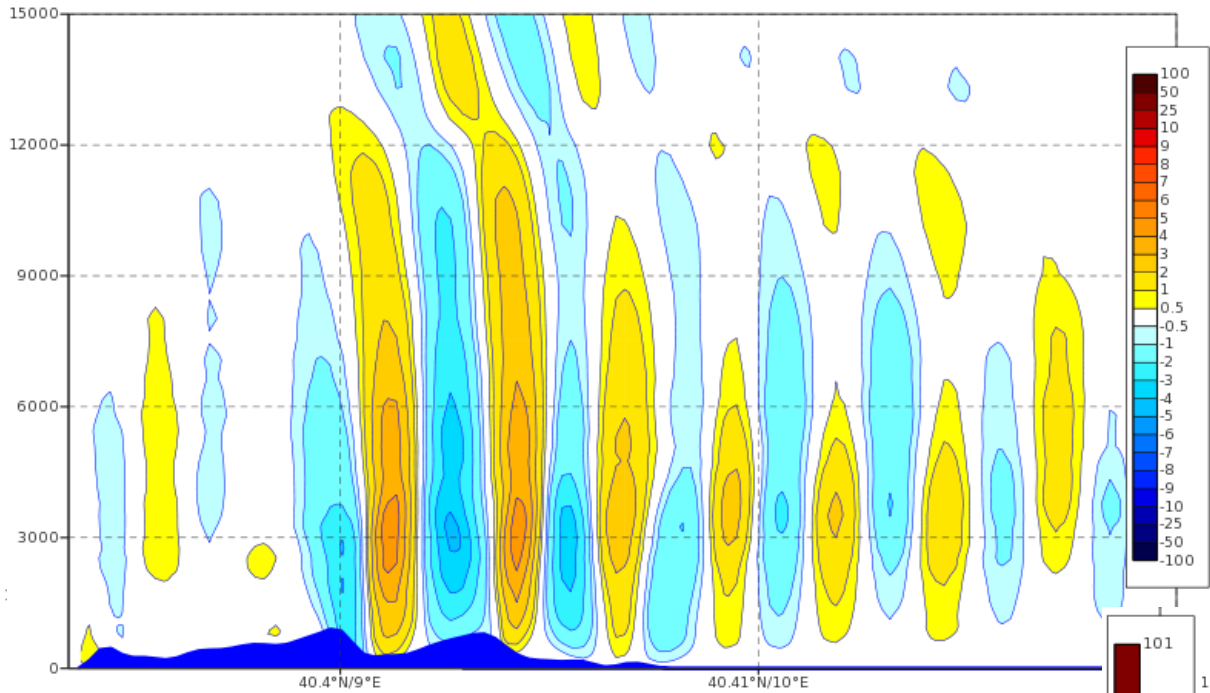
Orographic Wave Forecast



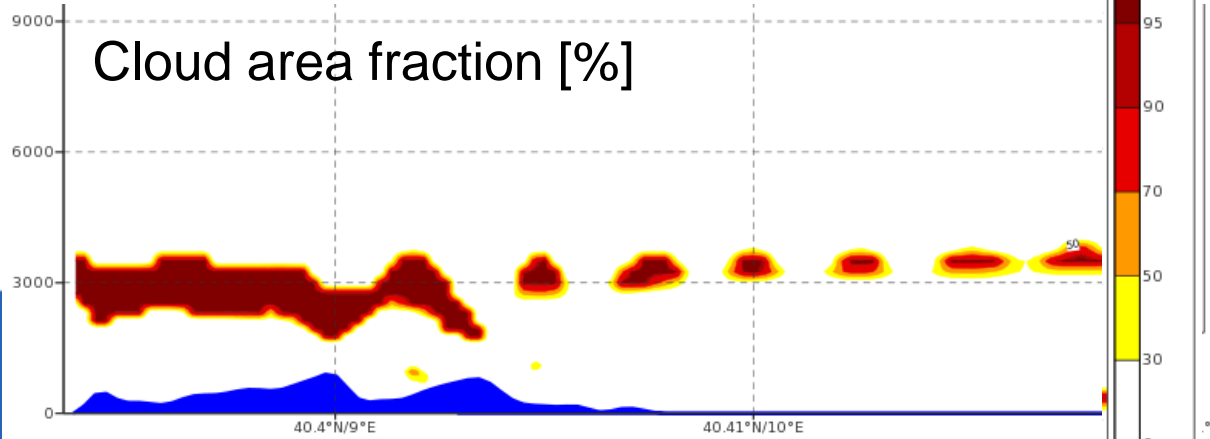
Orographic Wave Forecast

COSMO-IT (2.2km) 11 Feb 2019 00 UTC T+8h

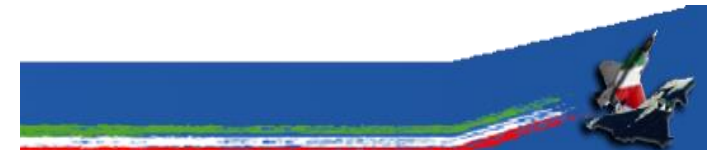
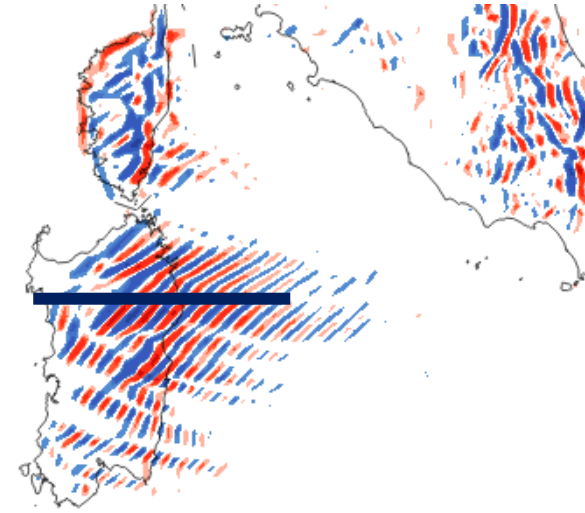
Vertical velocity [m/s]



Cloud area fraction [%]



Cross section

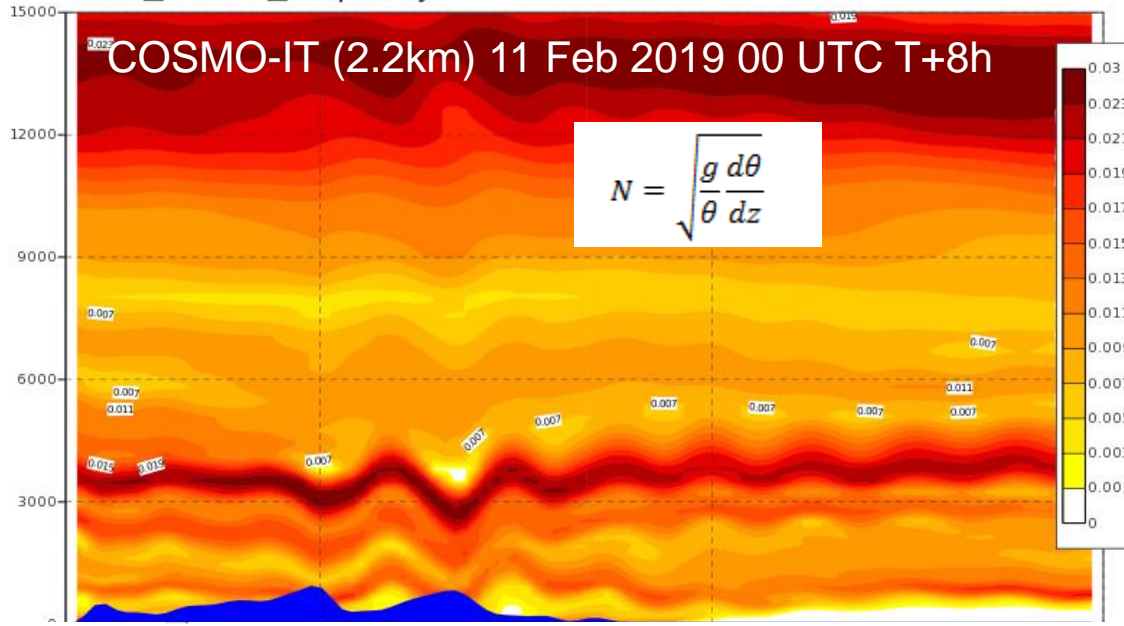


Orographic Wave Forecast

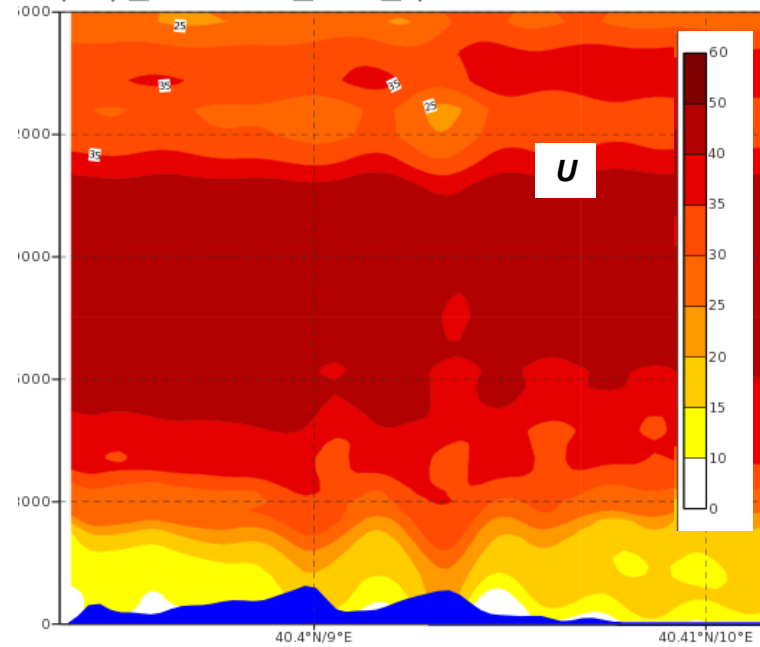
brunt_vaisala_frequency

COSMO-IT (2.2km) 11 Feb 2019 00 UTC T+8h

$$N = \sqrt{\frac{g}{\theta} \frac{d\theta}{dz}}$$

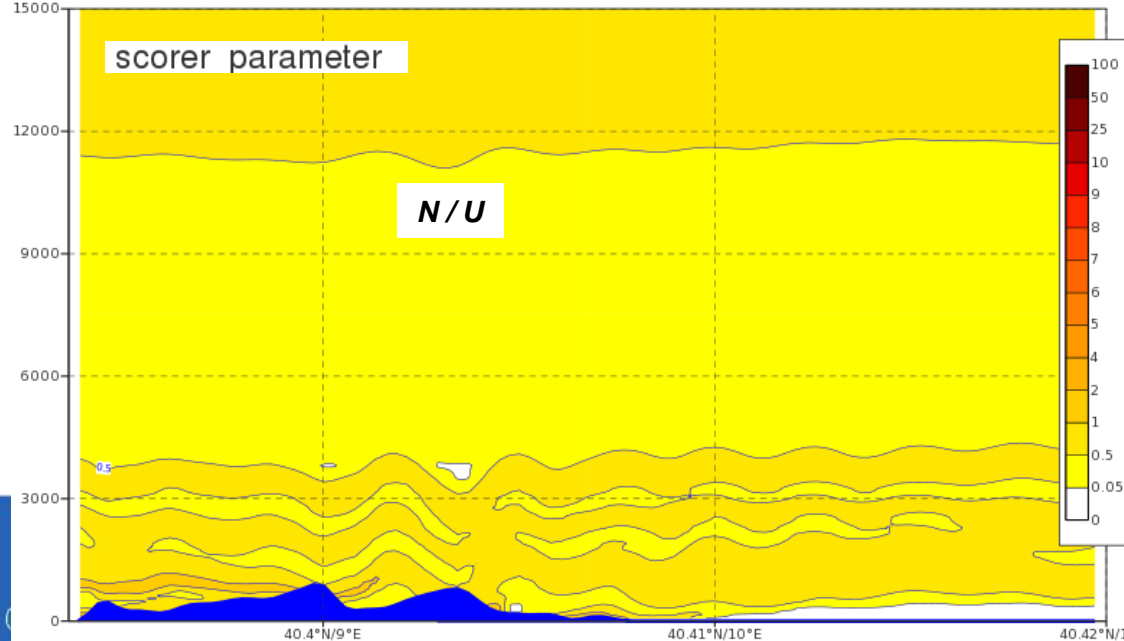


perp_horizontal_wind_speed



scorer parameter

N/U



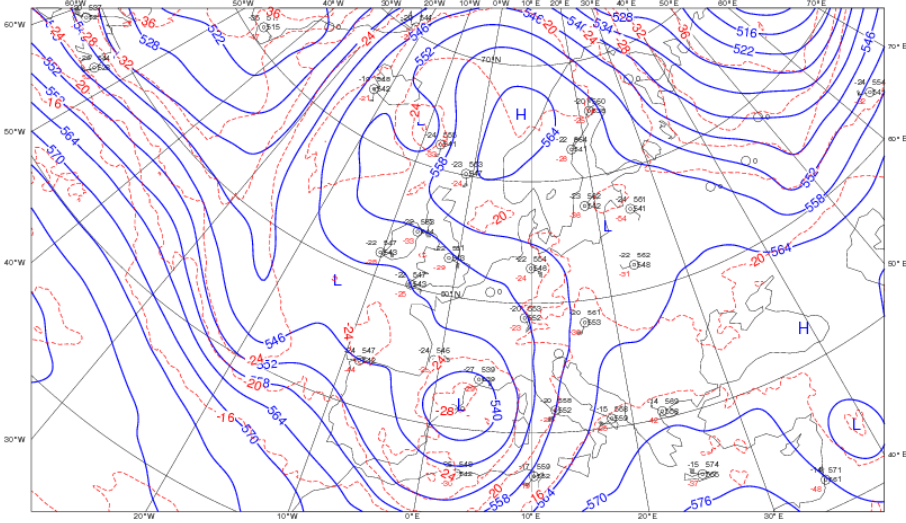
The **Scorer parameter** is used to describe whether gravity waves will develop or not

$$I = N/U \quad (1/m)$$



Severe TS Forecast: SuperCell

ROME Analysis VT:Thursday 12 April 2018 - 00 UTC
Geopotential at 500 hPa + Temperature at 500 hPa N.A.

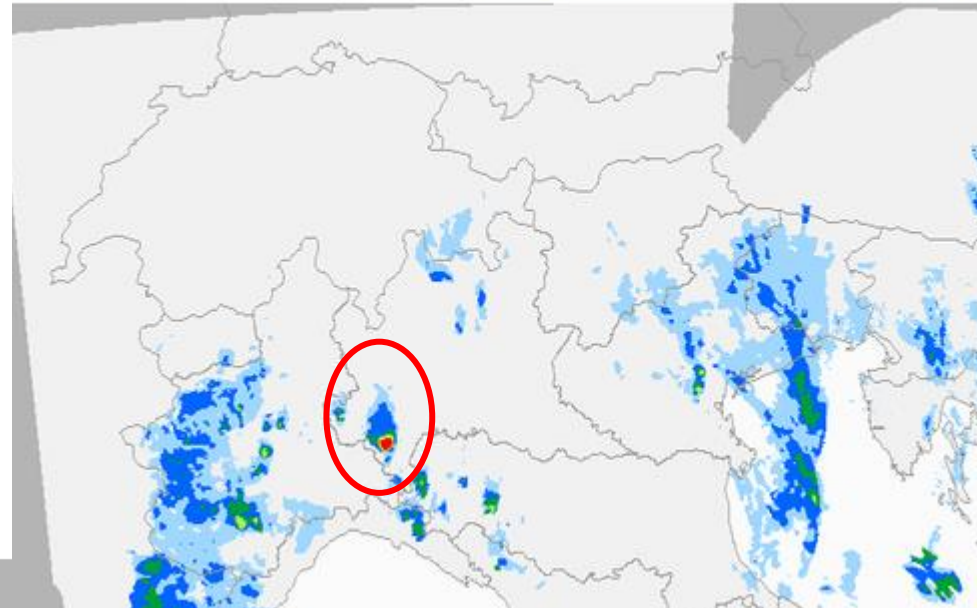


Magic 2.167 (64 bit) - torvalds - srmaman - Thu Apr 12 02:11 2018

CECMWF



Nord Italia 12-04-2018 12.50 UTC - Radar SRI (mm/h)



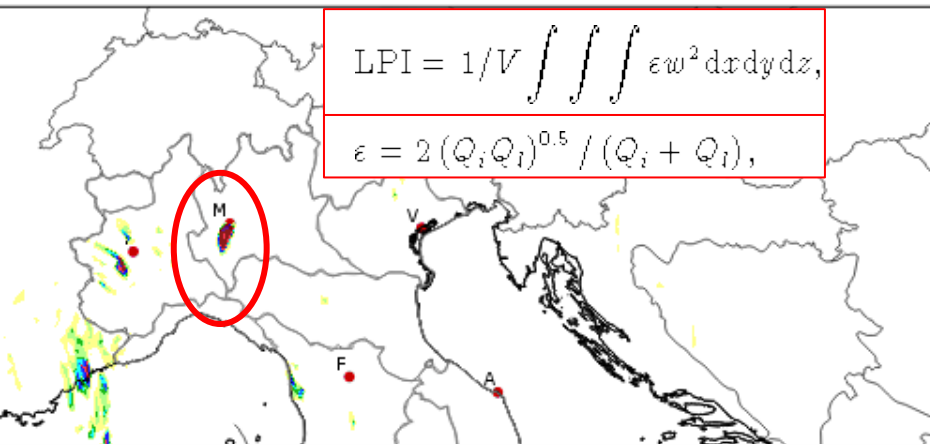
u

Severe TS Forecast: SuperCell

COSMOIT 12 April 2018 00UTC

Forecast T+13 VT: Thursday 12 April 2018 13UTC

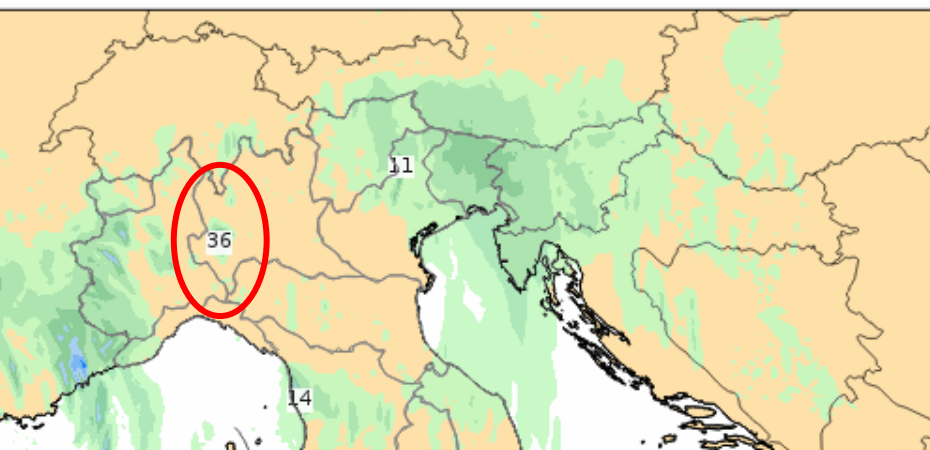
1h Maximum Lightning Potential index (J/Kg)



COSMOIT 12 April 2018 00UTC

Forecast T+13 VT: Thursday 12 April 2018 13UTC

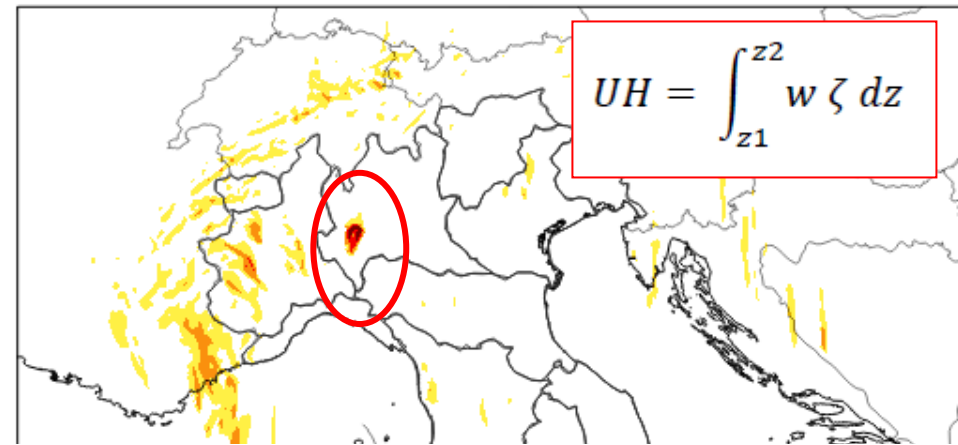
1h accumulated precipitation (mm)



COSMO-IT12 April 2018 00UTC

Forecast T+13 VT: Thursday 12 April 2018 13UTC

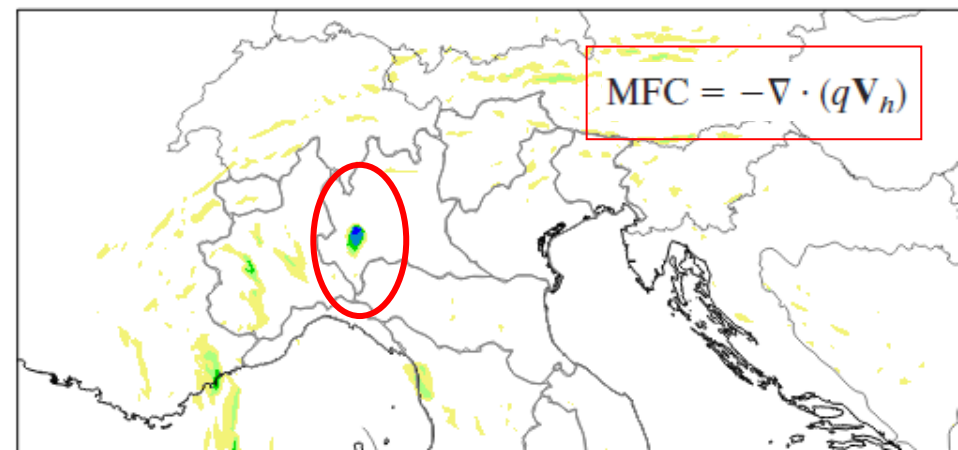
1h max 2-8 km updraft helicity (J/kg)



COSMO-IT12 April 2018 00UTC

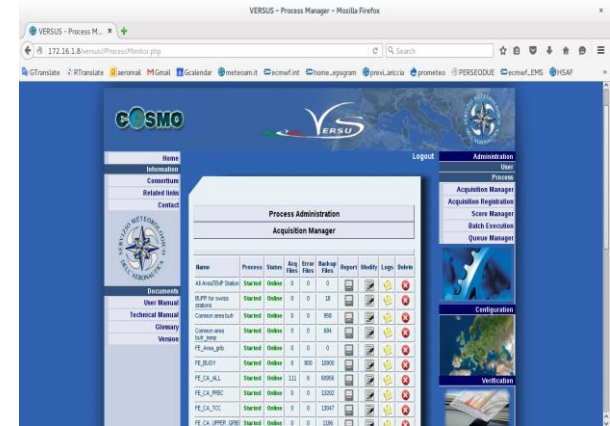
Forecast T+13 VT: Thursday 12 April 2018 13UTC

1h max 0-1km hor. moisture convergence (g/kg*s)



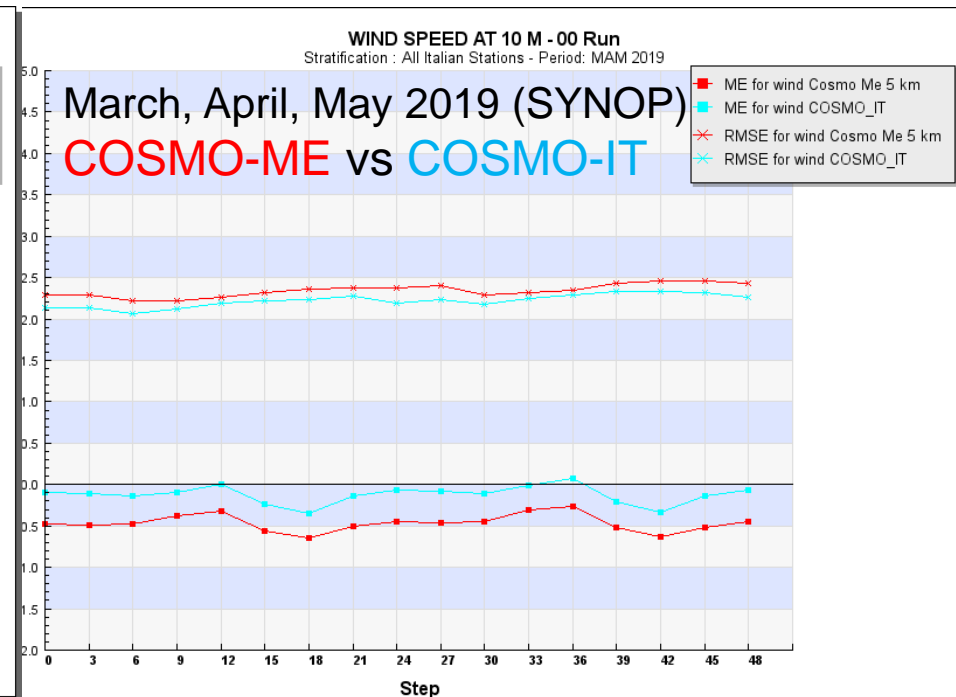
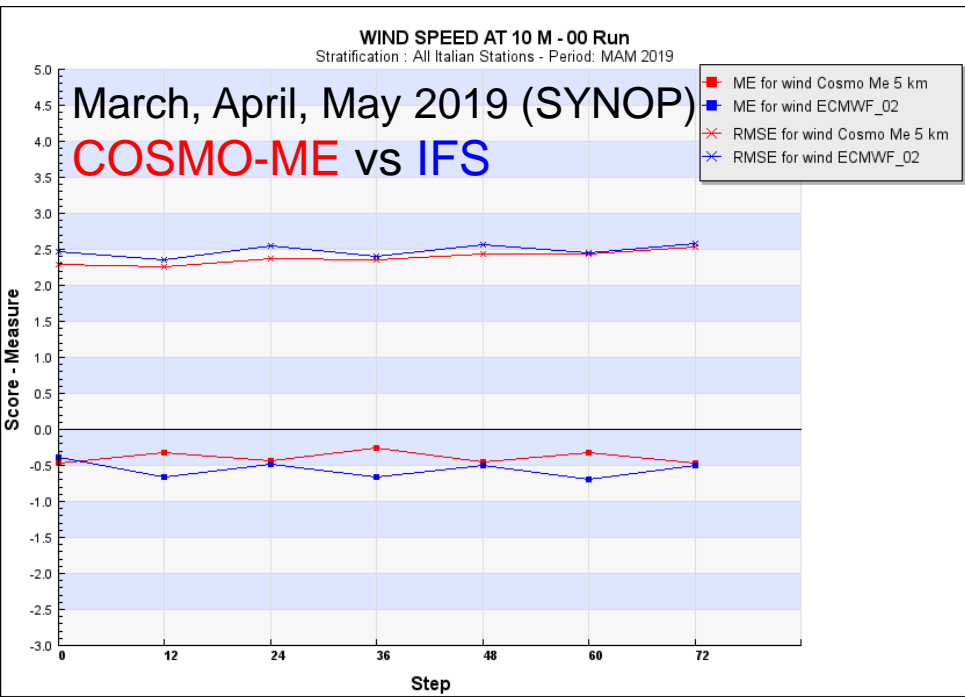
Objective Model Verification

Quarterly/monthly verification reports for the operational NWP models are routinely prepared using VERSUS system developed by COSMO.



<http://www.meteoam.it/page/verifiche-modelli>

http://www.meteoam.it/international_activities/deterministic_products/monthly_report



Current Developments

Transition to ICON-NWP (2018-2022)

- The COSMO science plan calls for a harmonization of the COSMO-model and ICON in the time horizon of 2020
- COSMO will contribute to the development of ICON with the responsibility for the ICON version for NWP application
- In first tests, ICON-NWP outperforms COSMO in terms of quality of the results and computational efficiency

PP C2I Timeline



Phase 1

- ICON Training 2018
- Installation
- Setup
- First applications

Q2 2018 – Q4 2018

Phase 2

- Daily forecasts
- Verification
- Forecasters' feedback

Q1 2019 – Q2 2020

Phase 3

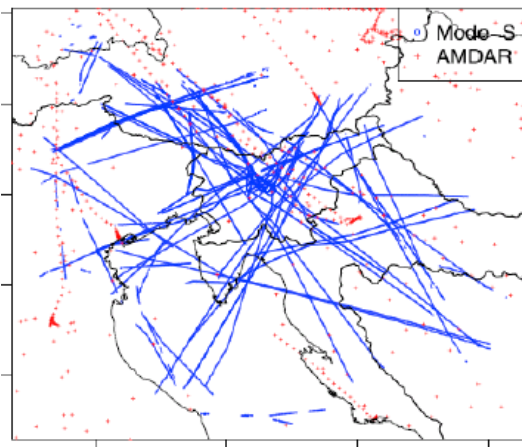
- Daily forecasts
- Data assimilation
- Verification
- Forecasters' feedback

Q3 2020 – Q1 2022

Current Developments

Assimilation of new type of observations

Wind / Temp. data from **Mode-S** transponders (assim. in COSMO-IT)



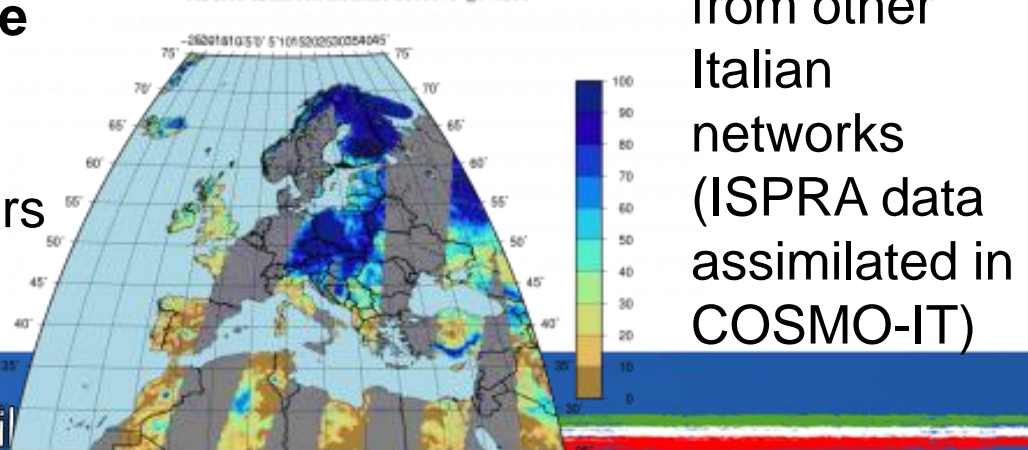
GPS Delay from ground stations

Reflectivity and radial wind from **Radar**

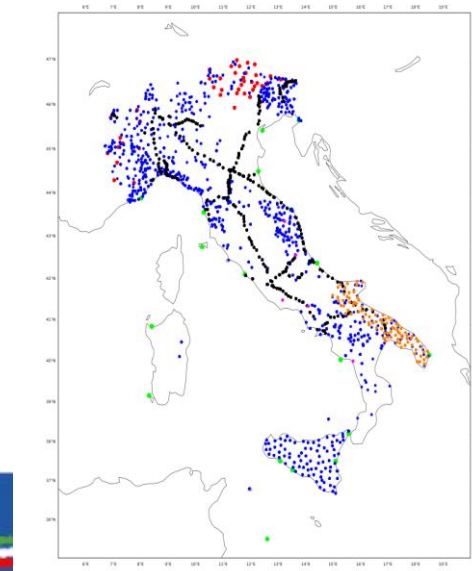


Soil Moisture derived from METOP scatterometers

ASCAT 25km soil moisture 20160714_141200



AWS obs from other Italian networks (ISPRA data assimilated in COSMO-IT)





GRAZIE PER L'ATTENZIONE

www.meteoam.it

Approfondimenti:

<http://www.meteoam.it/modelli-di-previsione-numerica>

http://www.meteoam.it/international_activities/rsmc_deterministic

http://www.meteoam.it/international_activities/rsmc_ensemble



Aeronautica Militare

