Status of COSMO-ME-EPS system

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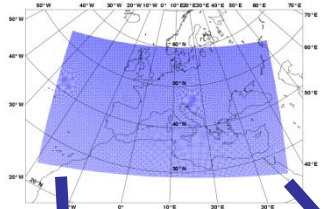
Outline

- The COSMO-ME EPS system
- Evaluation of EPS scores
- First probabilistic products
- A sea state EPS: NETTUNO-EPS
- Future developments

CNMCA NWP SYSTEM

Ensemble Data Assimilation

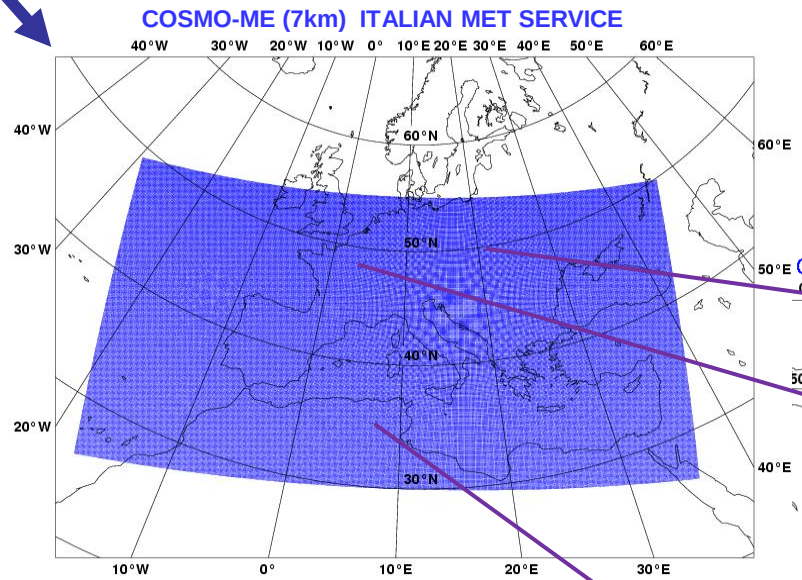


10 km
45 v.l.

Control State Analysis

LETKF Analysis

COSMO-ME EPS
(pre-operational)

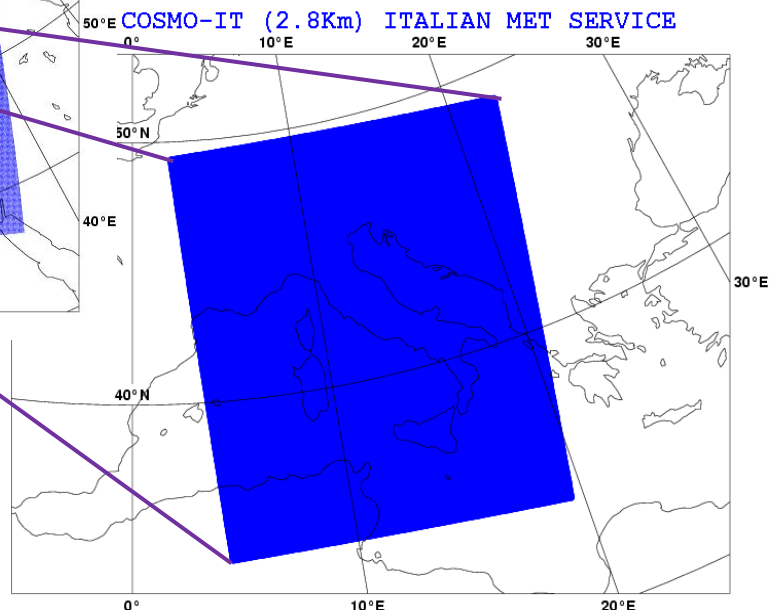


7 km
40 v.l.

- compressible equations
- parameterized convection

2.8 km
65 v.l.

- compressible equations
- explicit convection



Local Area Modelling: COSMO

The COSMO-ME EPS SYSTEM

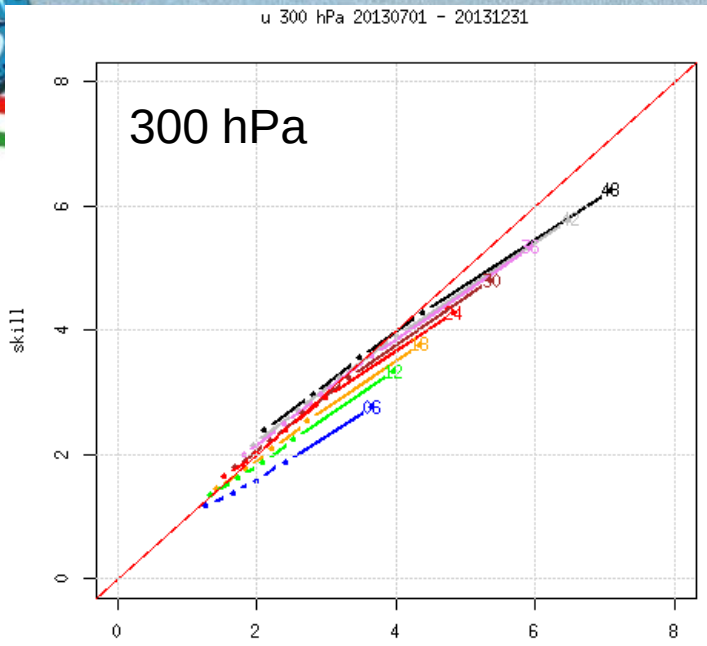
The CNMCA-LETKF data assimilation system is operationally used to initialize the high-resolution non-hydrostatic model COSMO integrated over the Mediterranean-European region. The atmospheric short-range ensemble prediction system based on the LETKF system and the COSMO model is under testing at CNMCA since july 2013

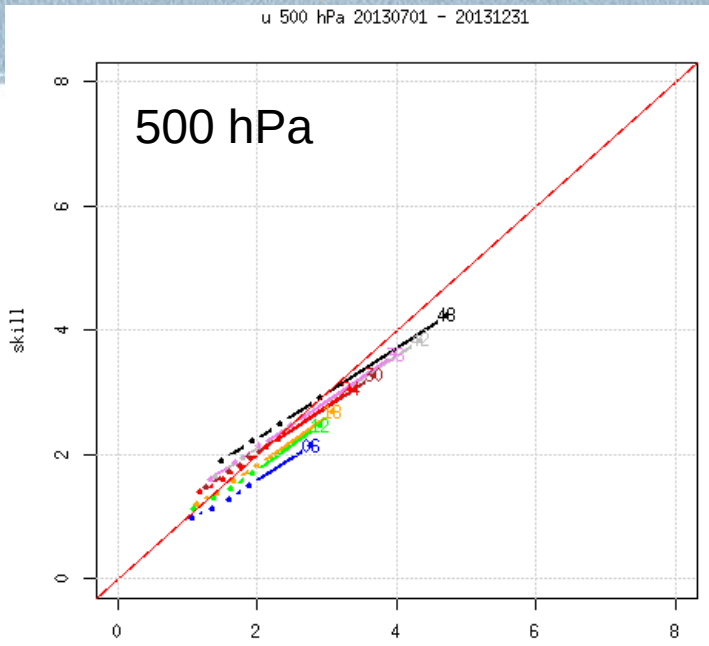
MAIN CHARACTERISTICS:

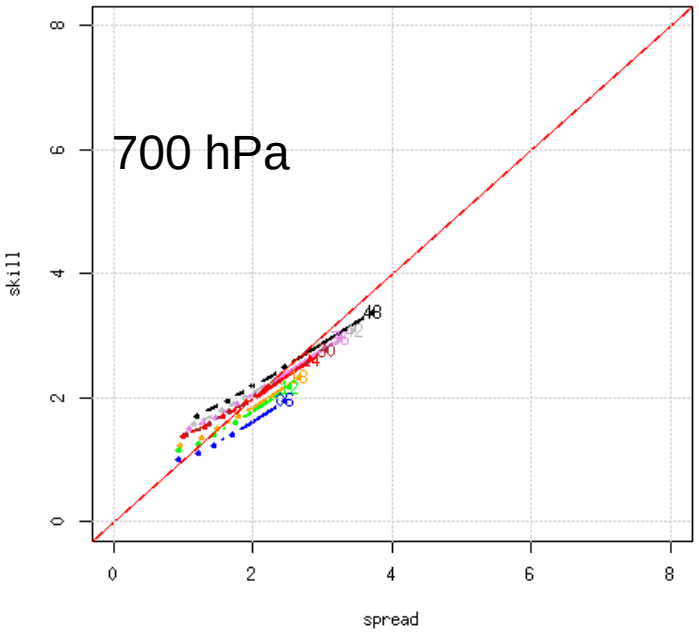
- Domain and resolution:
  - Mediterranean-European domain
  - 0.09° grid spacing (~10 km) and 45 vertical levels
  - 40+1 ensemble members
- IC and BC: initial conditions are derived every 6 hours from the CNMCA-LETKF system. Lateral boundaries conditions are from IFS deterministic run perturbed using ECMWF-EPS.
- Surface perturbations: climatological perturbed sea surface temperature.
- Model error: stochastics physics perturbation tendencies.
- Forecast range: the 40+1 COSMO forecast members will run up to 48 hours at 00 UTC.

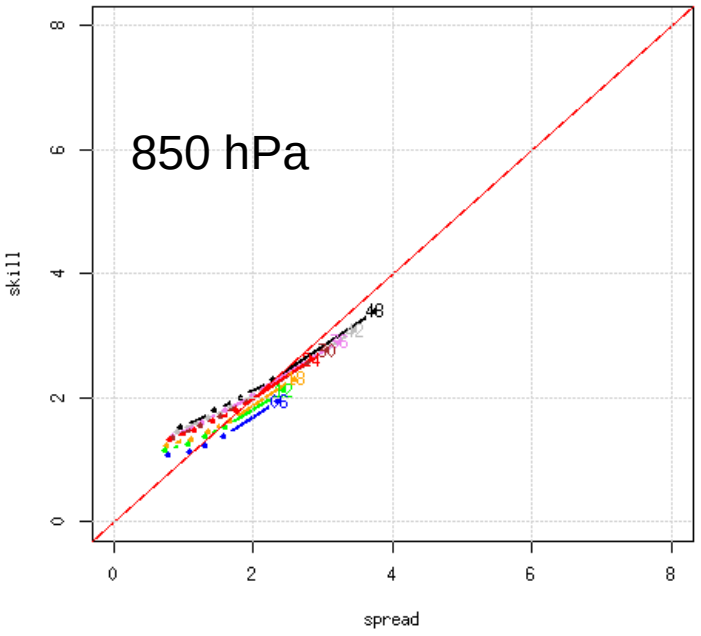
First results :
1 jul 2013 – 31 dec 2013

SPREAD-SKILL DIAGRAM U-WIND (5 BINS, IFS-ANALYSIS)

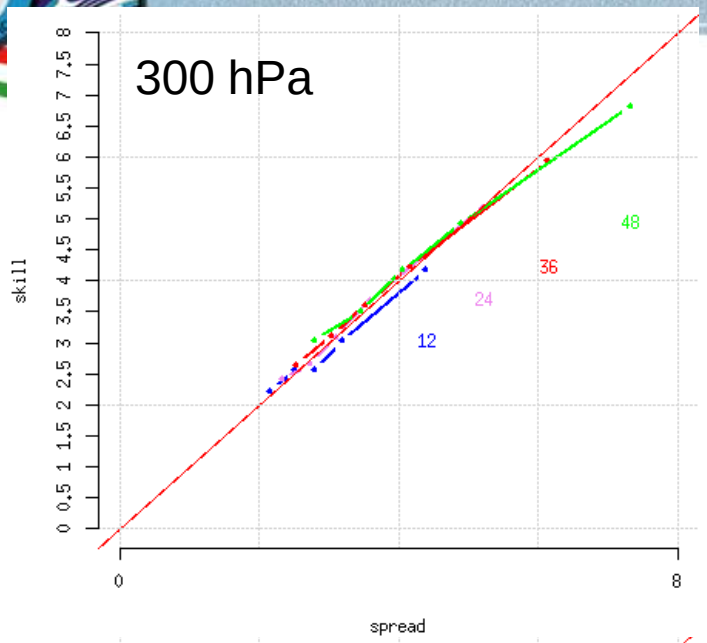


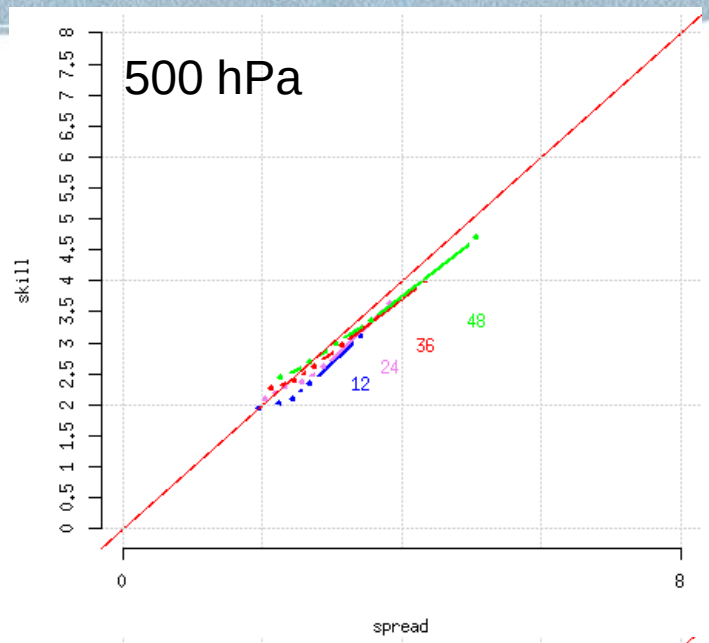


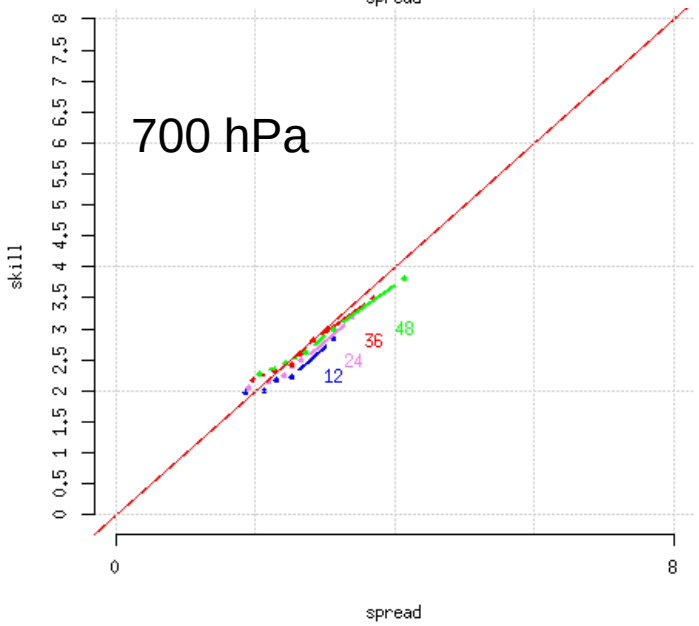


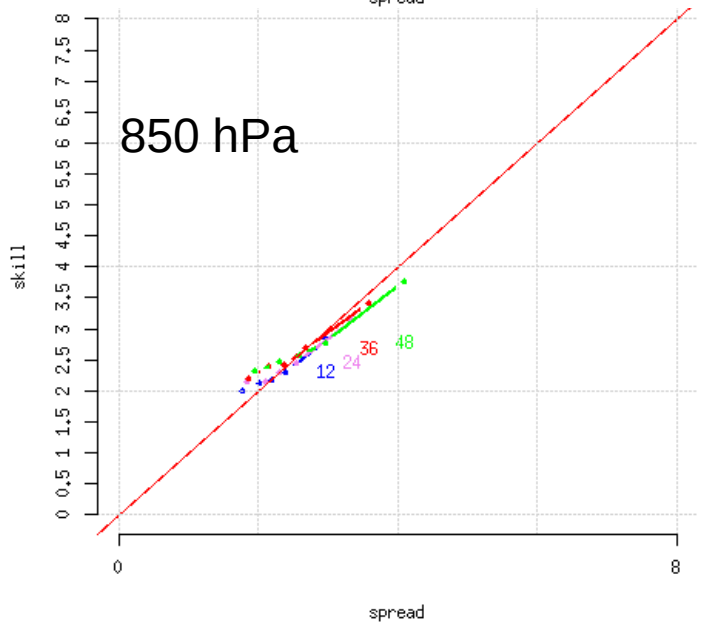


SPREAD-SKILL DIAGRAM - U-WIND (SENS, OBSERVATIONS)

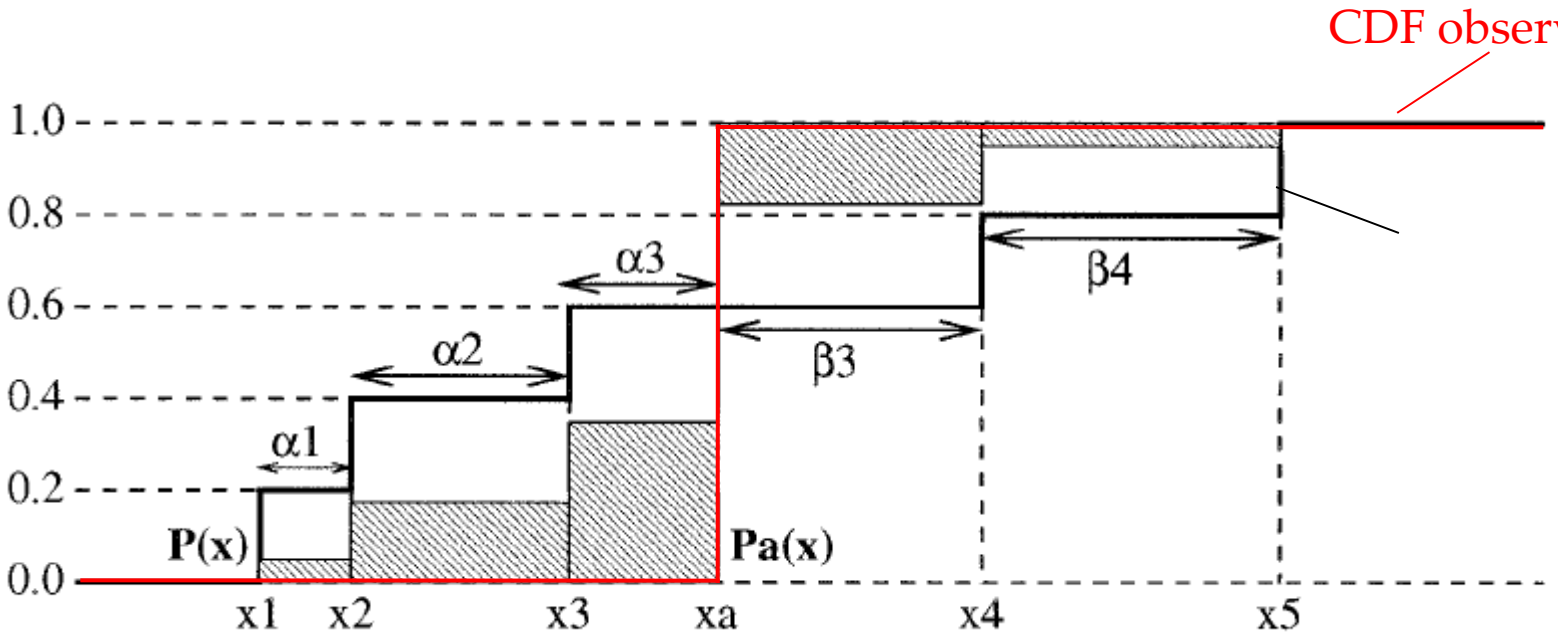








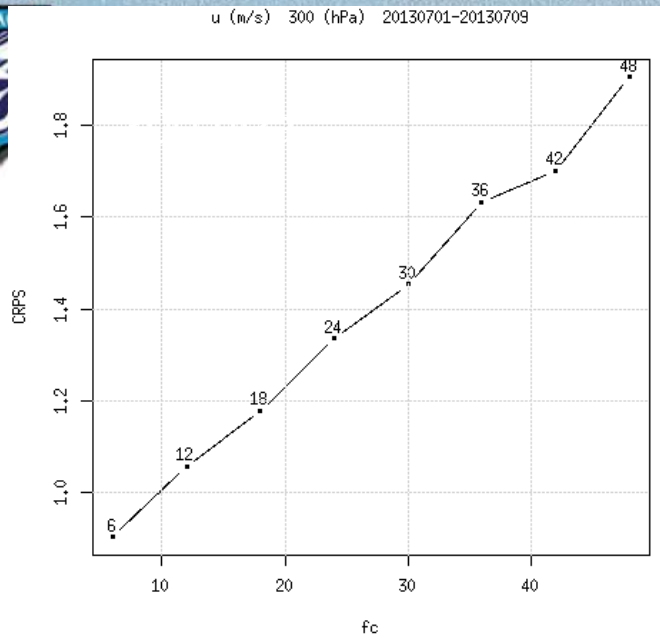
COSMO ME EPS - CRPS

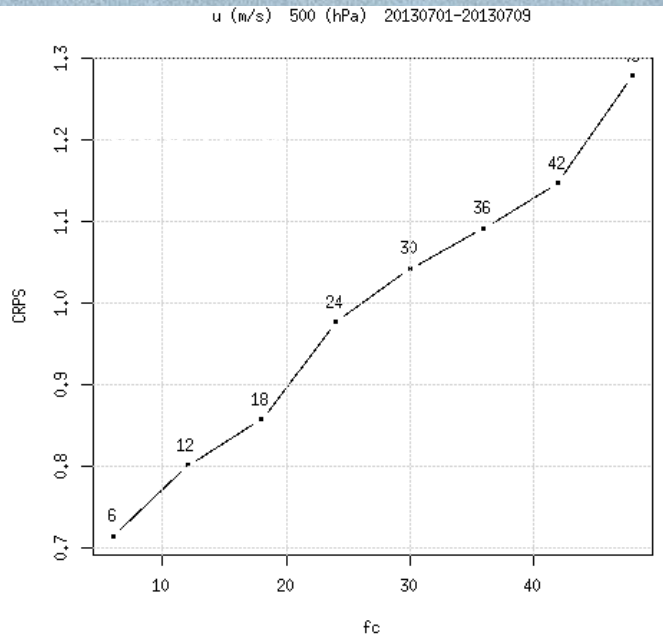


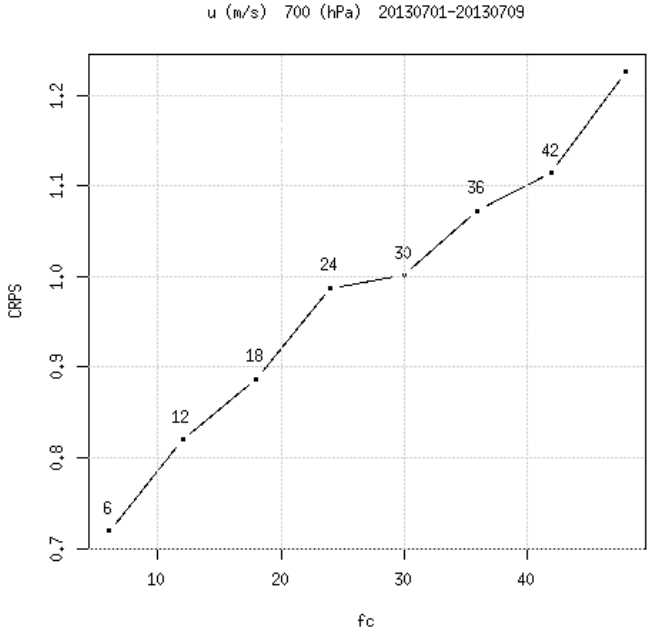
Hersbach (2000)

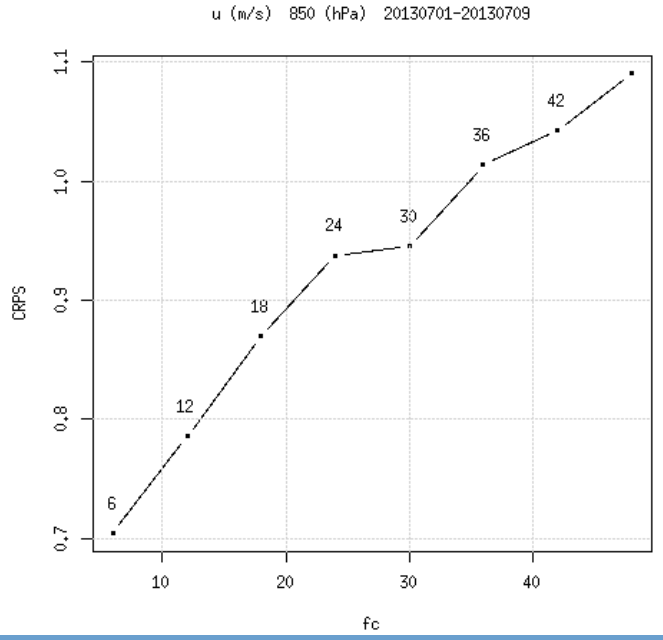
$$CRPS = \sum_{i=0}^{N} \alpha_i p_i^2 + \beta_i (1 - p_i)^2$$

CRPS U-WIND (1 BIN, IFS-ANALYSIS)

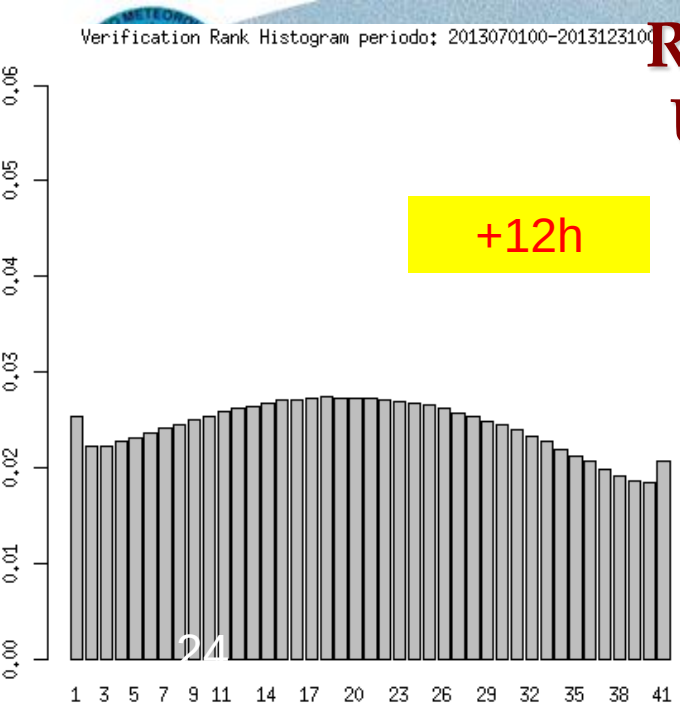




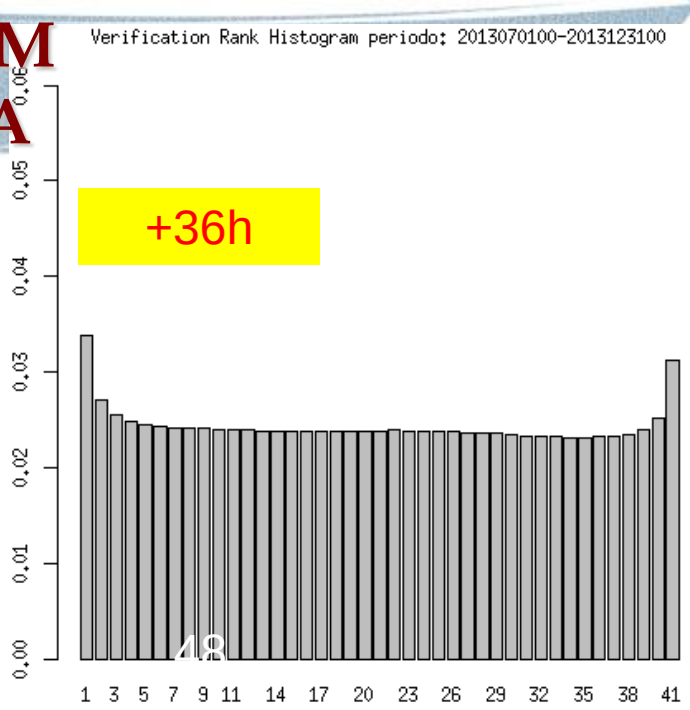


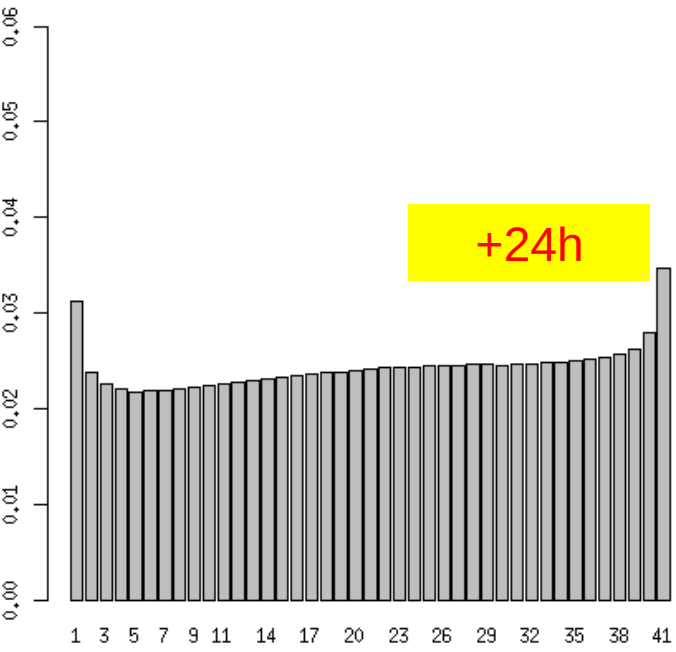


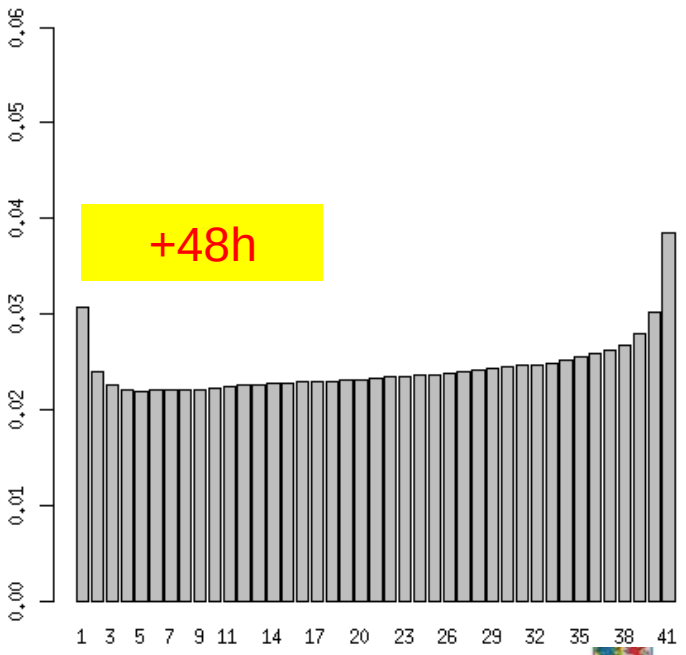
RANK HISTOGRAM
U-WIND @ 700 HPA



36840296 IFS-ANALYSIS

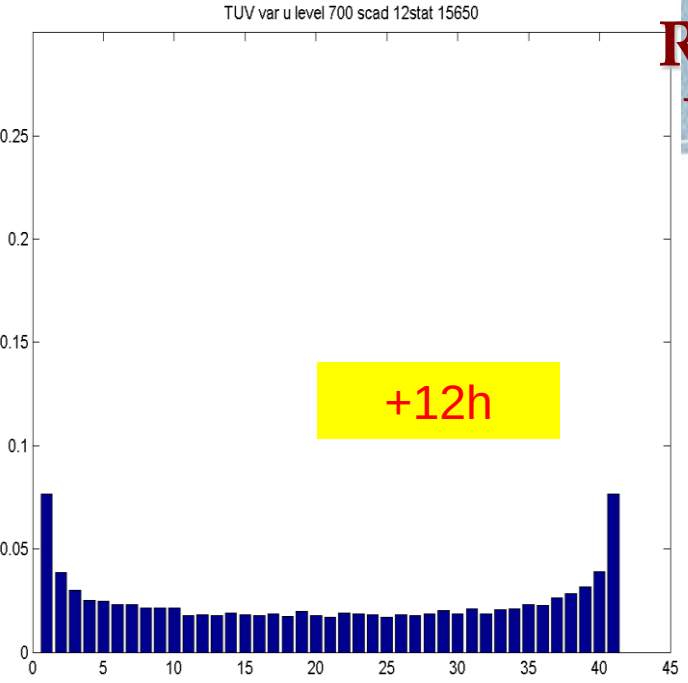


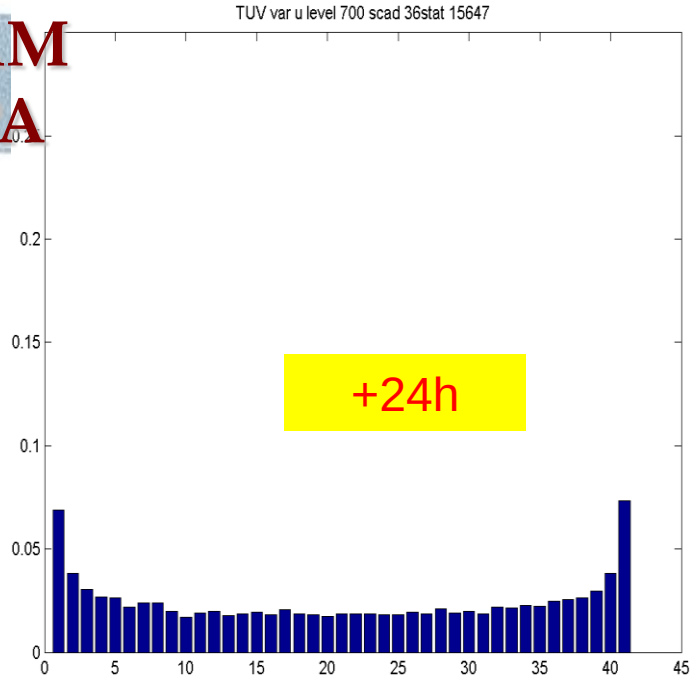




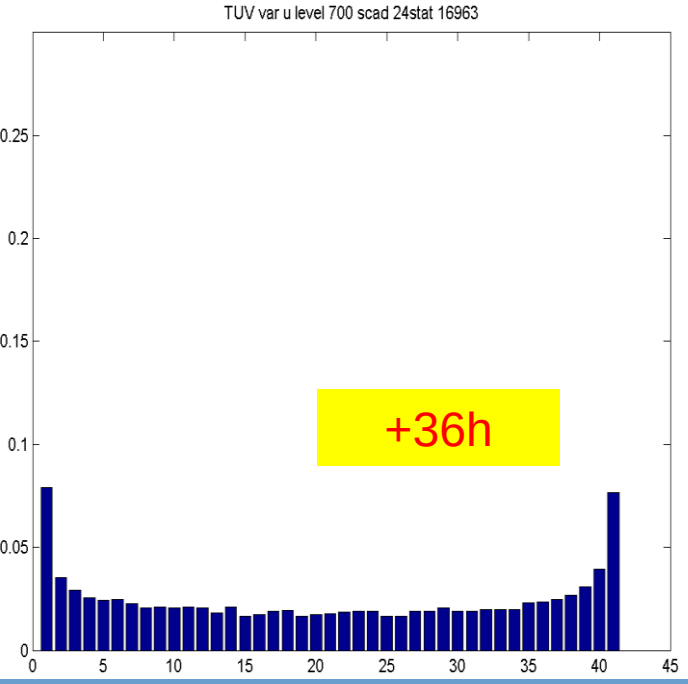
RANK HISTOGRAM
U-WIND @ 700 HPA

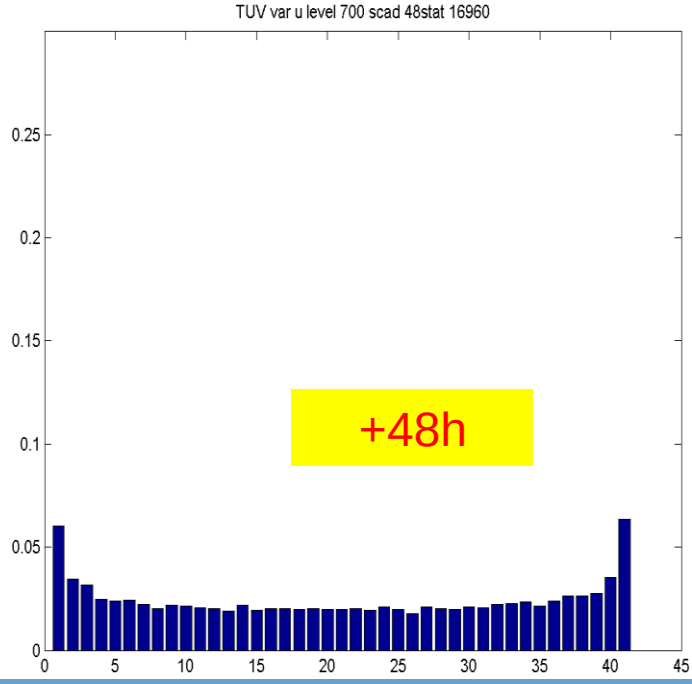
TEMP-OBS





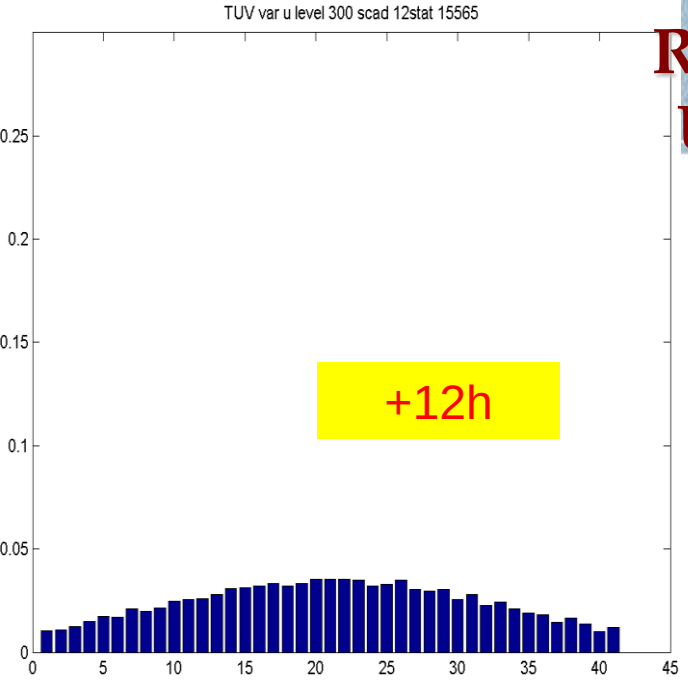
ERR OBS

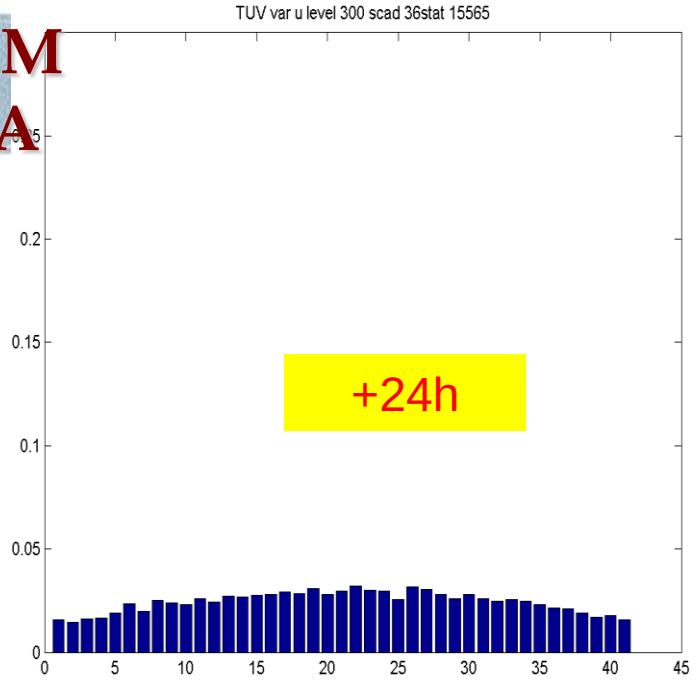




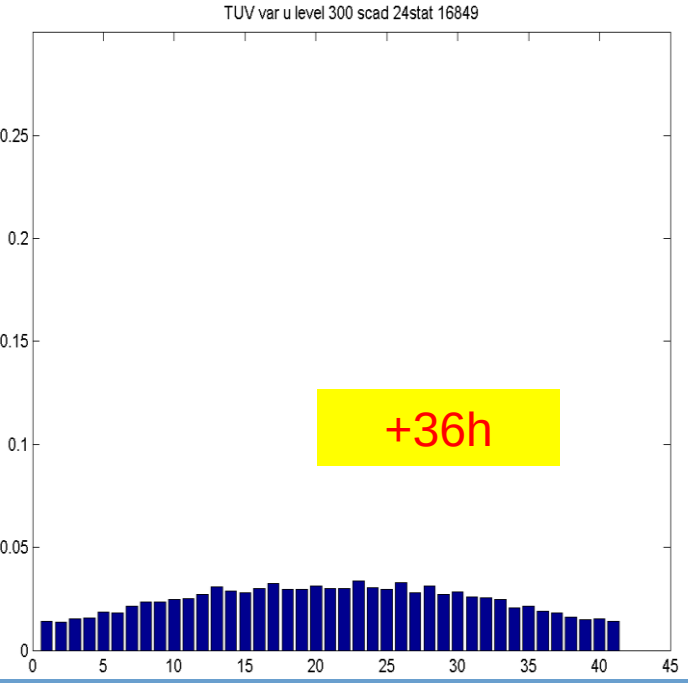
RANK HISTOGRAM
U-WIND @ 300 HPA

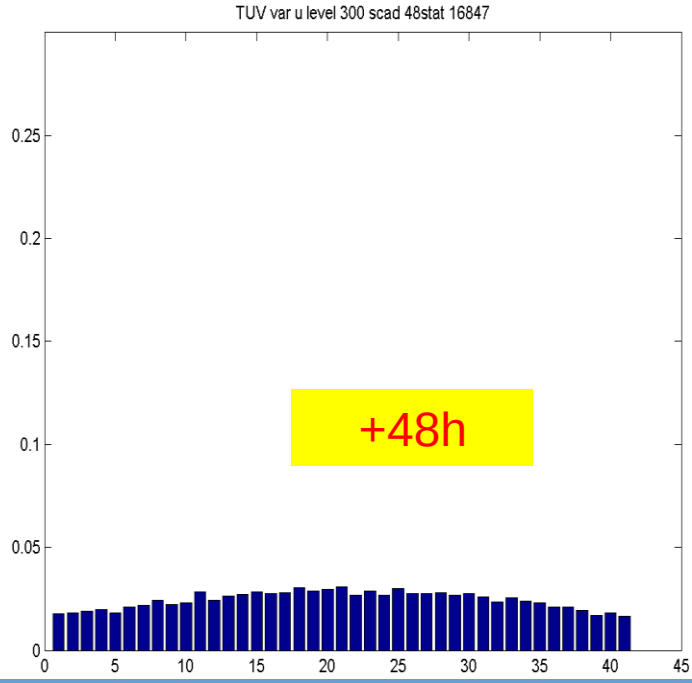
TEMP-OBS





ERR OBS





FORECAST PROBABILITY

CNMCA Production using Fieldextra (1/3):

INPUT	DESCRIZIONE	OUTPUT	THRESHOLD	Δt (h)	fc (h)	OPE
CLCL	Nuvolosità bassa	Forecast probability ≥ soglie	0.5, 0.875 (%)	0	+0 → +48 (+6)	-
CLCT	Nuvolosità totale	Forecast probability ≥ soglie	0.5, 0.875 (%)	0	+0 → +48 (+6)	-
CLCT_RED	Nuvolosità totale (AWI)	Forecast probability in range di soglie	0, 5, 25, 65, 95, 101 (%)	0	+6 → +48 (+3)	-
DD_10M	Direzione del vento a 10 m	Forecast probability in range di soglie	0, 22.5, 67.5, 112.5, 157.5, 202.5, 247.5, 292.5, 337.5, 360 (°)	0	+0 → +48 (+3)	-
FF_10M	Modulo della velocità del vento a 10 m	eps_standard_deviation	-	-	+0 → +48 (+3)	-
HS_WAVE	Altezza significativa delle onde del mare	Forecast probability ≥ soglie	0.1, 0.5, 1.25, 2.5, 4, 6, 9, 14 (m)	0	+0 → +48 (+6)	-
HS_WAVE	Altezza significativa delle onde del mare	eps_standard_deviation	-	-	+0 → +48 (+3)	-
PHEN	Fenomeno (AWI)	Forecast probability ≥ soglie	10, 20, 31, 32, 33, 41, 42, 43, 51, 52, 53	0	+6 → +48 (+3)	-
T_2M	Temperatura a 2 m	eps_standard_deviation	-	-	+0 → +48 (+3)	-
TMAX_2M	Temperatura massima a 2 m	Forecast probability ≥ soglie	-10, 0, 25, 30, 32, 35, 38, (°C)	6	+6 → +48 (+6)	max
TMAX_2M	Temperatura massima a 2 m	Forecast probability ≥ soglie	-10, 0, 25, 30, 32, 35, 38, (°C)	12	+12 → +48 (+6)	max

FORECAST PROBABILITY

CNMCA Production using Fieldextra (2/3):

INPUT	DESCRIZIONE	OUTPUT	THRESHOLD	Δt (h)	fc (h)	OPE
TMAX_2M	Temperatura massima a 2 m	Forecast probability ≥ soglie	-10, 0, 25, 30, 32, 35, 38, (°C)	24	+24 → +48 (+6)	max
TMIN_2M	Temperatura minima a 2 m	Forecast probability ≤ soglie	-20, -10, -5, 0, 5, 20 (°C)	6	+6 → +48 (+6)	min
TMIN_2M	Temperatura minima a 2 m	Forecast probability ≤ soglie	-20, -10, -5, 0, 5, 20 (°C)	12	+12 → +48 (+6)	min
TMIN_2M	Temperatura minima a 2 m	Forecast probability ≤ soglie	-20, -10, -5, 0, 5, 20 (°C)	24	+24 → +48 (+6)	min
TOT_PREC	Precipitazione totale (RAIN_GSP + RAIN_CON + SNOW_GSP + SNOW_CON)	Forecast probability ≥ soglie	10, 20, 30, 40, 50, 80, 100, 150 (mm)	6	+6 → +48 (+6)	delta
TOT_PREC	Precipitazione totale (RAIN_GSP + RAIN_CON + SNOW_GSP + SNOW_CON)	Forecast probability ≥ soglie	10, 20, 30, 40, 50, 80, 100, 150 (mm)	12	+12 → +48 (+6)	delta
TOT_PREC	Precipitazione totale (RAIN_GSP + RAIN_CON + SNOW_GSP + SNOW_CON)	Forecast probability ≥ soglie	10, 20, 30, 40, 50, 80, 100, 150 (mm)	24	+24 → +48 (+6)	delta
TOT_SNOW	Precipitazione nevosa totale (SNOW_GSP + SNOW_CON)	Forecast probability ≥ soglie	1, 5, 10, 15, 20, 25, 30, 35, 40, 50, 80 (cm)	6	+6 → +48 (+6)	delta
TOT_SNOW	Precipitazione nevosa totale (SNOW_GSP + SNOW_CON)	Forecast probability ≥ soglie	1, 5, 10, 15, 20, 25, 30, 35, 40, 50, 80 (cm)	12	+12 → +48 (+6)	delta

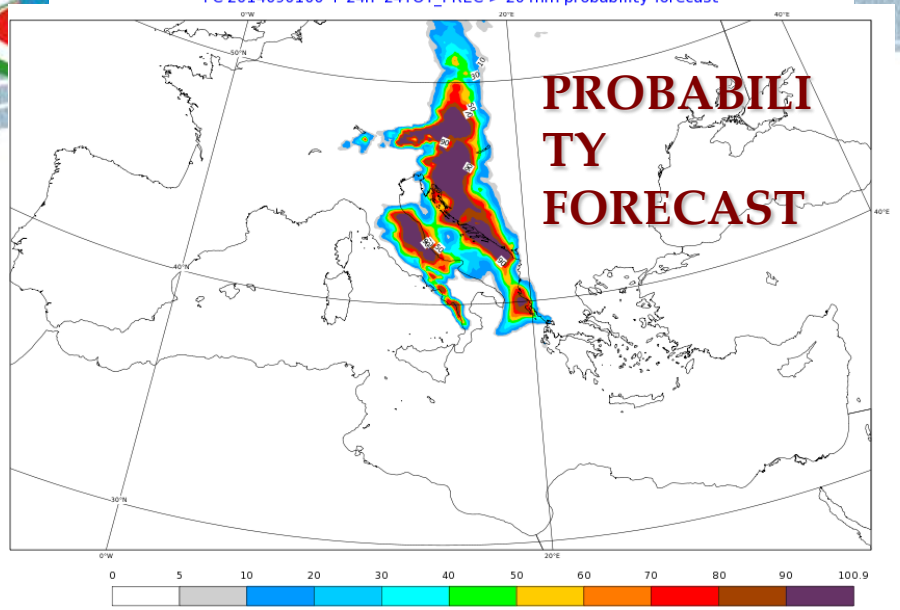
FORECAST PROBABILITY

CNMCA Production using Fieldextra (3/3):

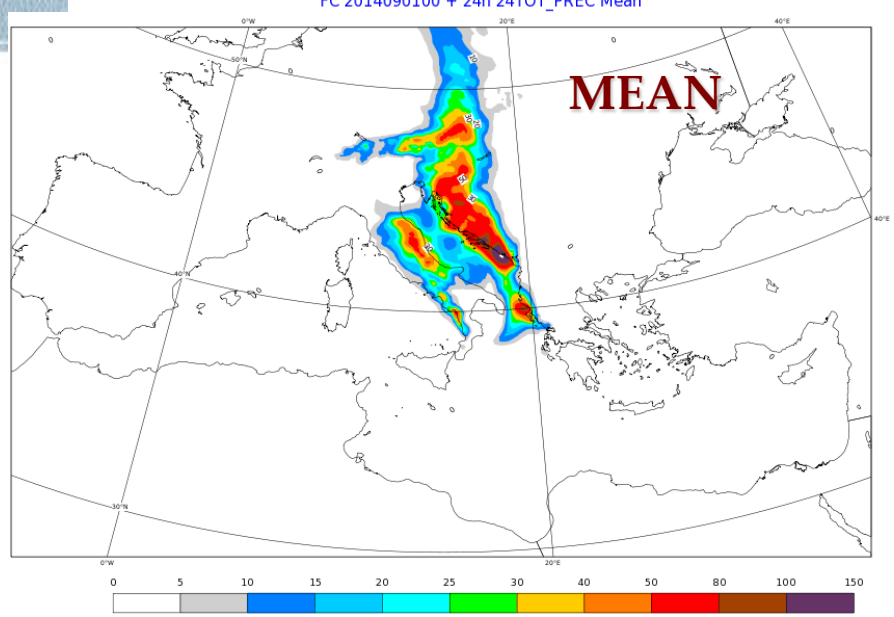
INPUT	DESCRIZIONE	OUTPUT	THRESHOLD	Δt (h)	fc (h)	OPE
TOT_SNOW	Precipitazione nevosa totale (SNOW_GSP + SNOW_CON)	Forecast probability ≥ soglie	1, 5, 10, 15, 20, 25, 30, 35, 40, 50, 80 (cm)	24	+24 → +48 (+6)	delta
VMAX_10M	Velocità massima del vento a 10 m	Forecast probability ≥ soglie	40, 45, 50.4, 60, 64.8, 75.6, 90, 100, 104.4, 118.8, 140,4 (km/h)	6	+6 → +48 (+6)	max
VMAX_10M	Velocità massima del vento a 10 m	Forecast probability ≥ soglie	40, 45, 50.4, 60, 64.8, 75.6, 90, 100, 104.4, 118.8, 140,4 (km/h)	12	+12 → +48 (+6)	max
VMAX_10M	Velocità massima del vento a 10 m	Forecast probability ≥ soglie	40, 45, 50.4, 60, 64.8, 75.6, 90, 100, 104.4, 118.8, 140,4 (km/h)	24	+24 → +48 (+6)	max

24 HOURS CUMULATED PRECIPITATION

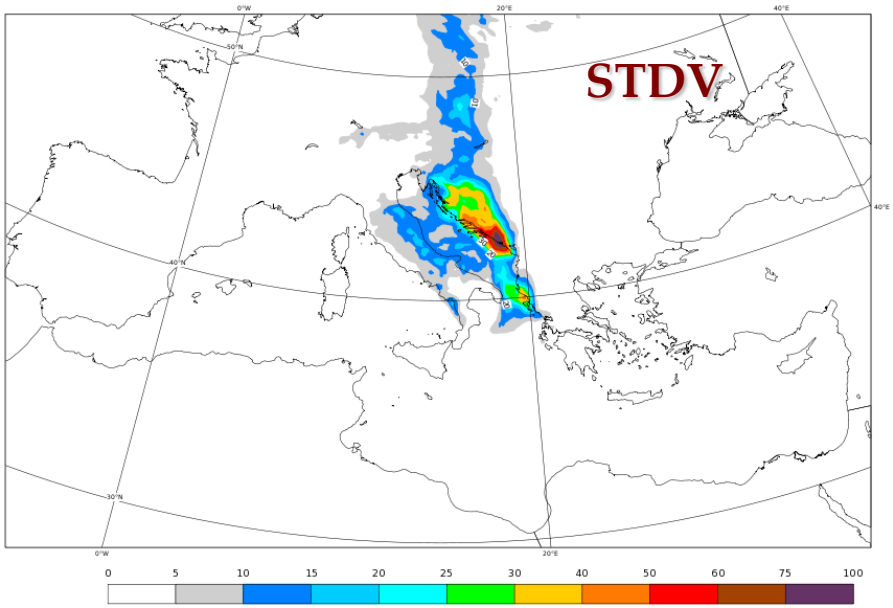
FC 2014090100 + 24h 24TOT_PREC > 20 mm probability forecast



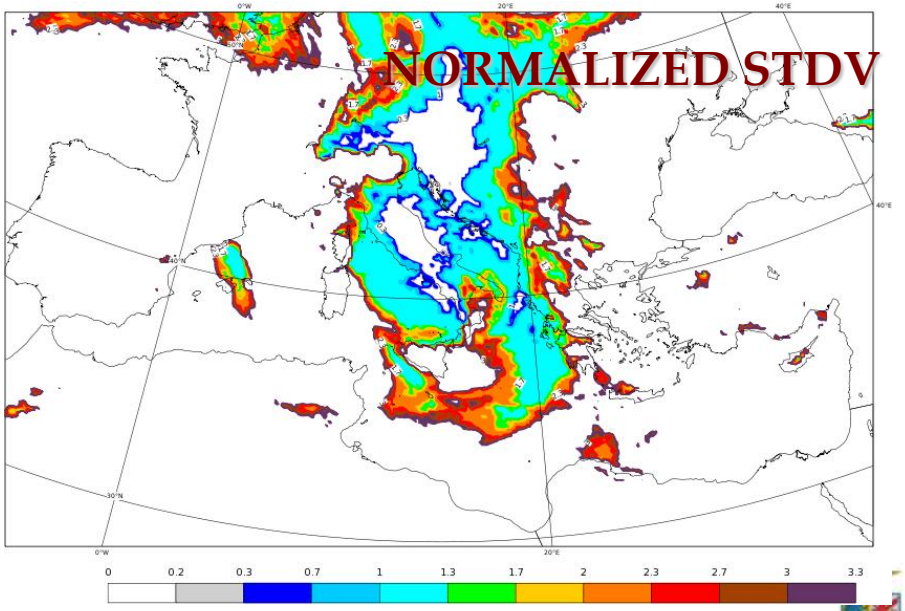
FC 2014090100 + 24h 24TOT_PREC Mean



FC 2014090100 + 24h 24TOT_PREC Standard Deviation

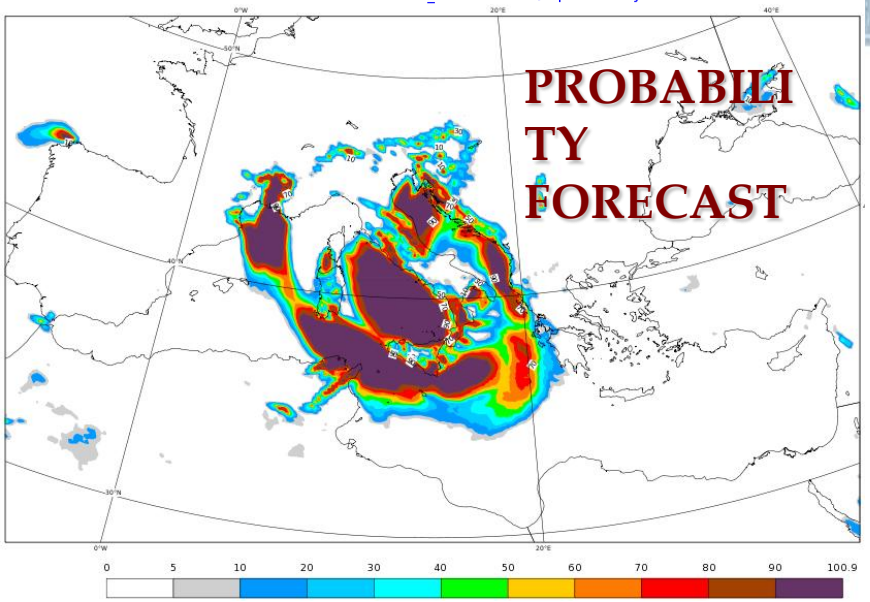


FC 2014090100 + 24h 24TOT_PREC Normalized Standard Deviation



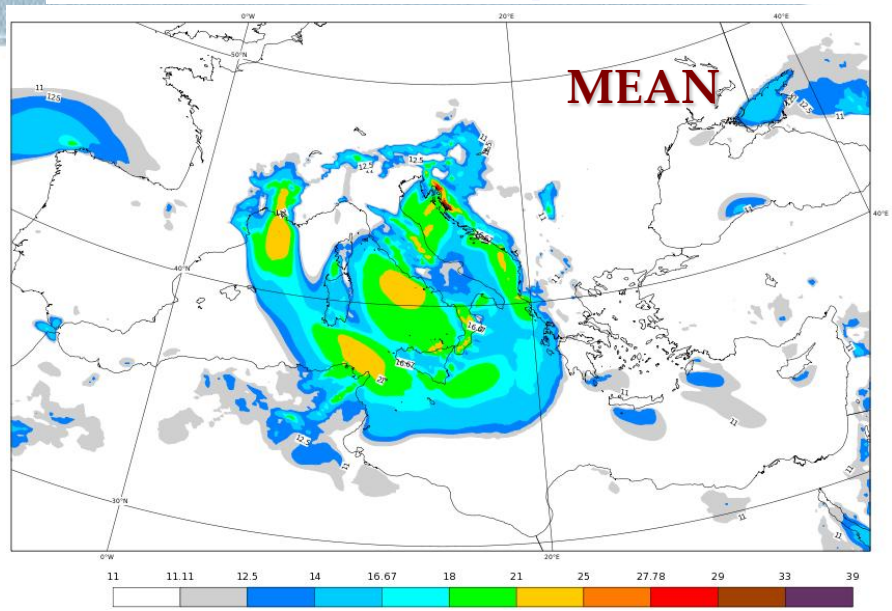
VMAX_10M

FC 2014090100 + 24h 6VMAX_10M > 60 km/h probability forecast



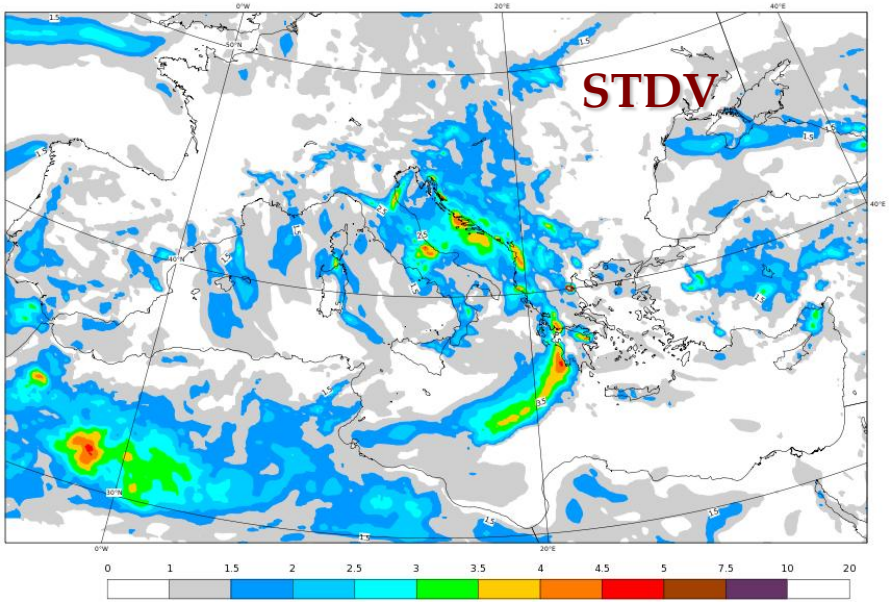
PROBABILITY FORECAST

FC 2014090100 + 24h 6VMAX_10M Mean



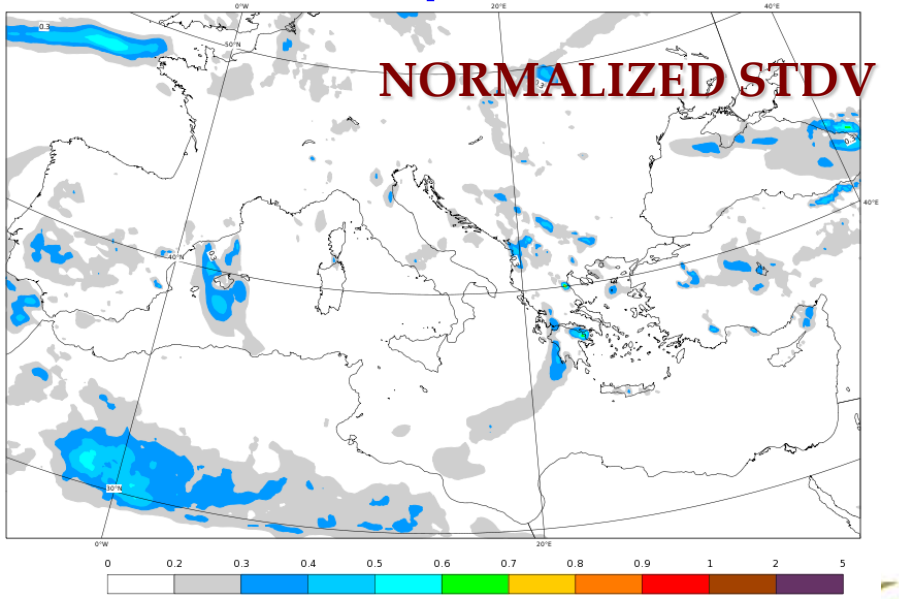
MEAN

FC 2014090100 + 24h 6VMAX_10M Standard Deviation



STDV

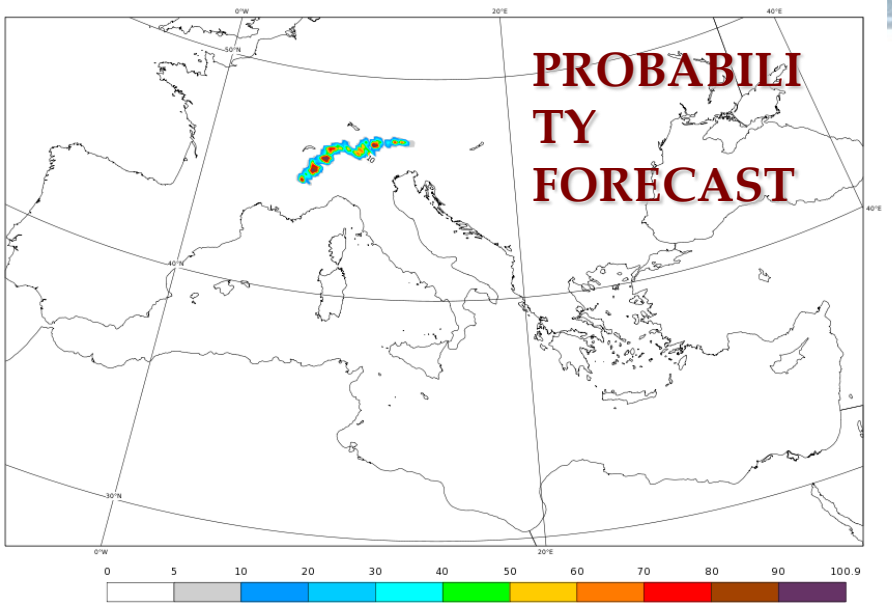
FC 2014090100 + 24h 6VMAX_10M Normalized Standard Deviation



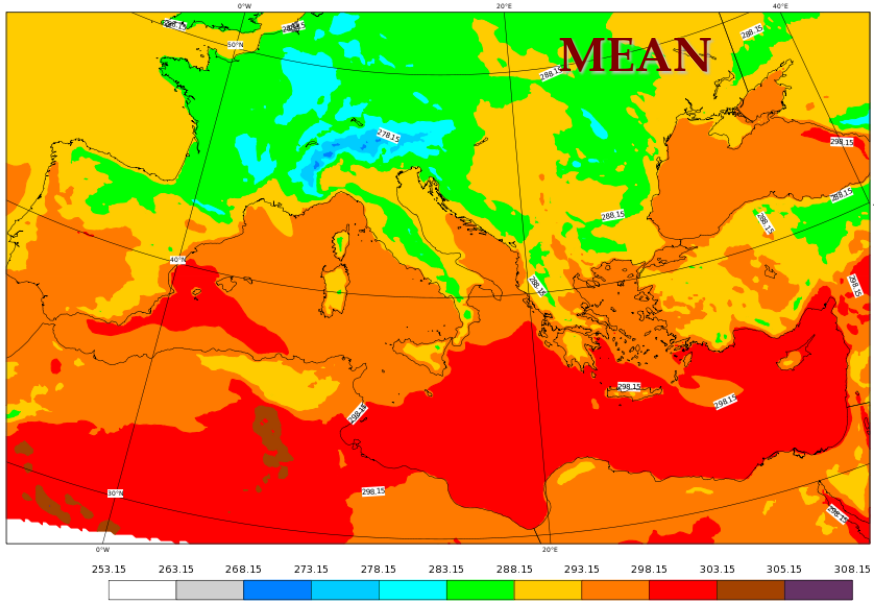
NORMALIZED STDV

TMIN_2M

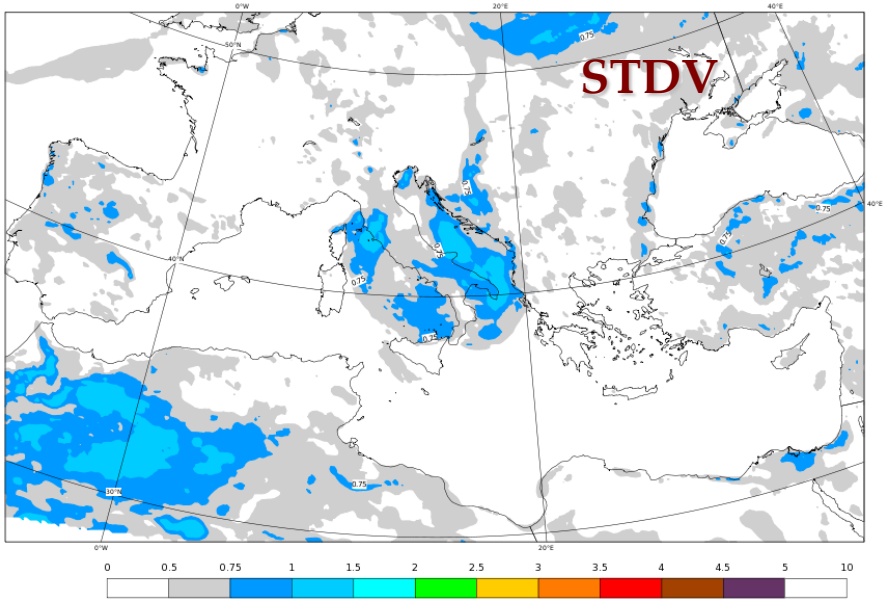
FC 2014090100 + 24h 24TMIN_2M < 0 C probability forecast



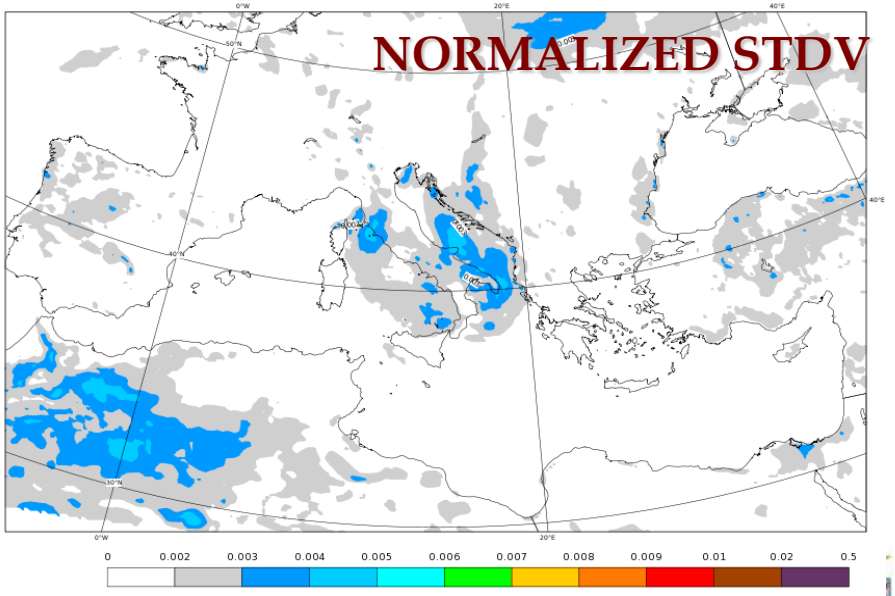
FC 2014090100 + 24h 24TMIN_2M Mean



FC 2014090100 + 24h 24TMIN_2M Standard Deviation

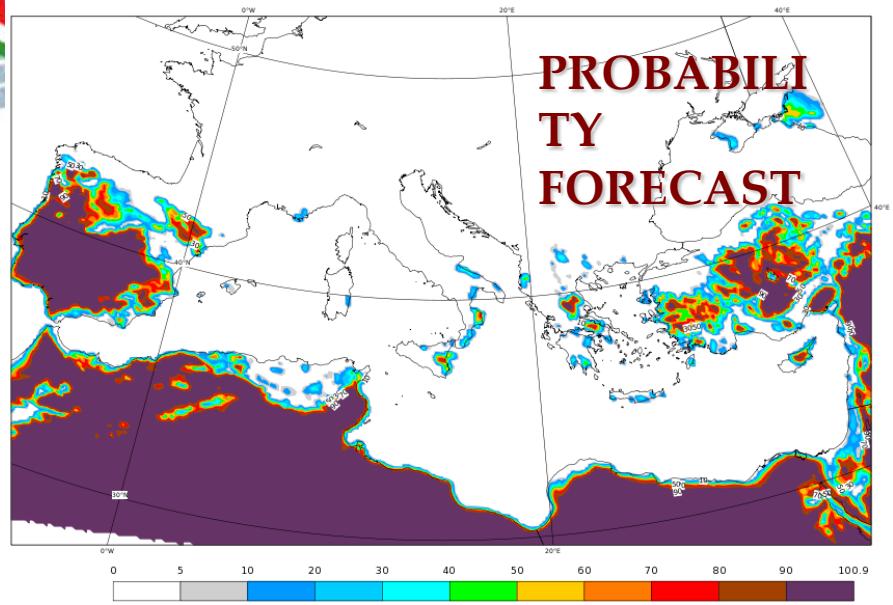


FC 2014090100 + 24h 24TMIN_2M Normalized Standard Deviation

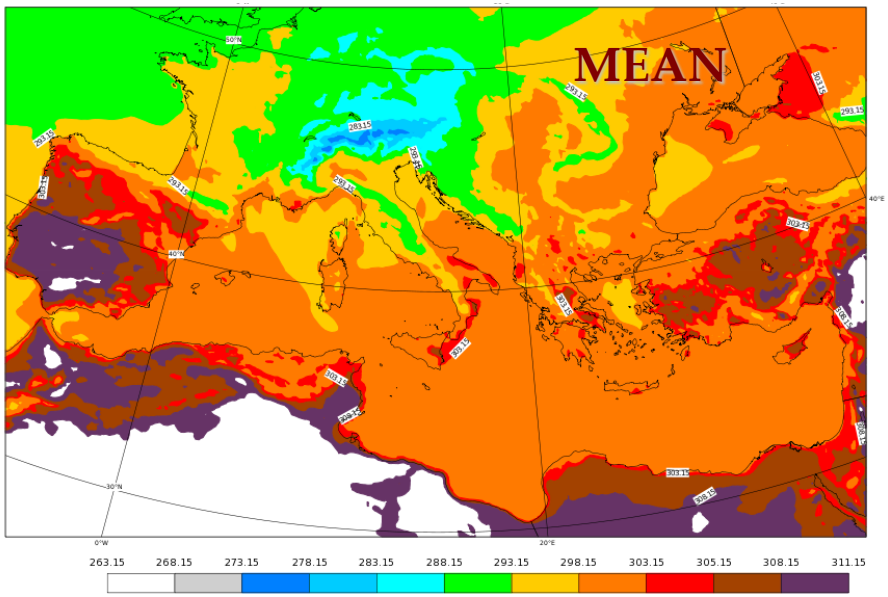


TMAX_2M

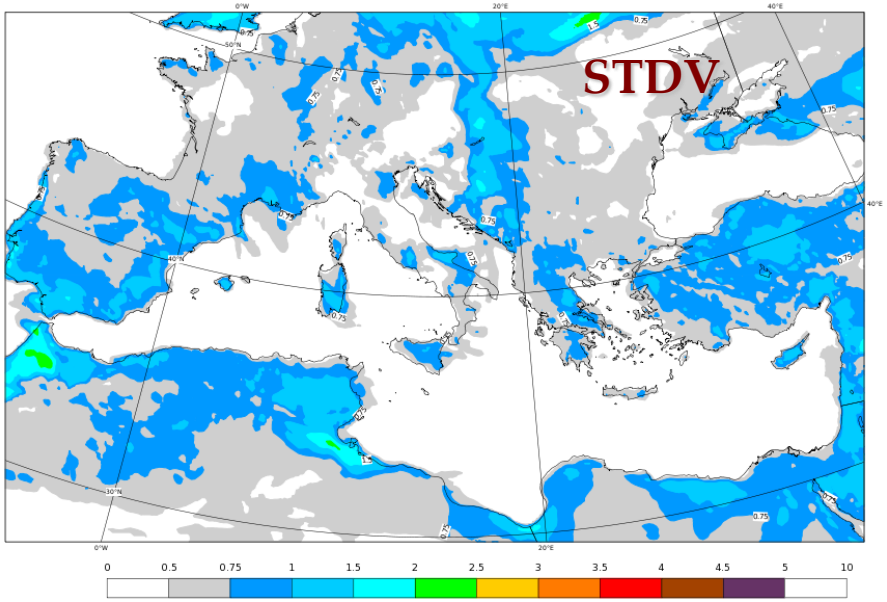
FC 2014090100 + 24h 24TMAX_2M > 32 C probability forecast



FC 2014090100 + 24h 24TMAX_2M Mean



FC 2014090100 + 24h 24TMAX_2M Standard Deviation



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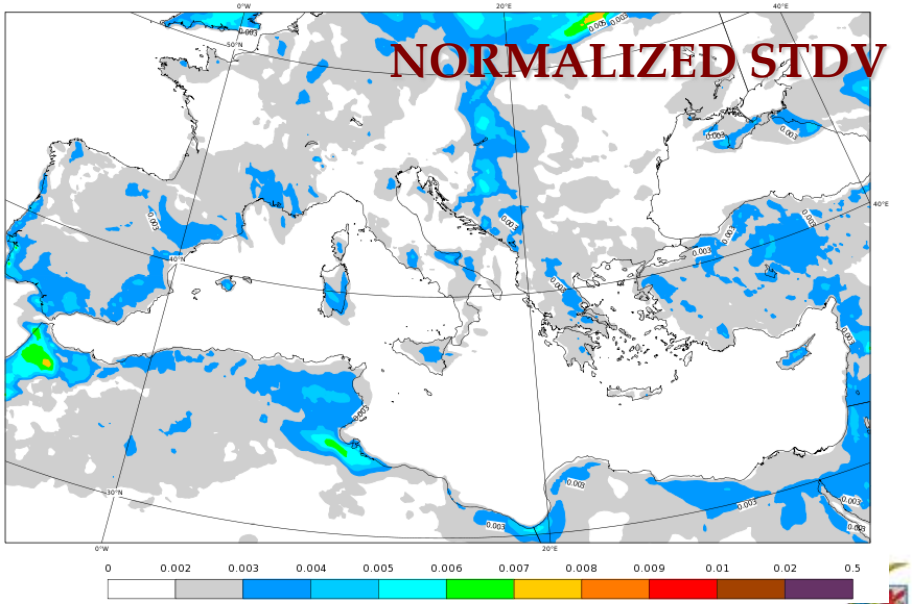


NETTUNO (Sea State) EPS

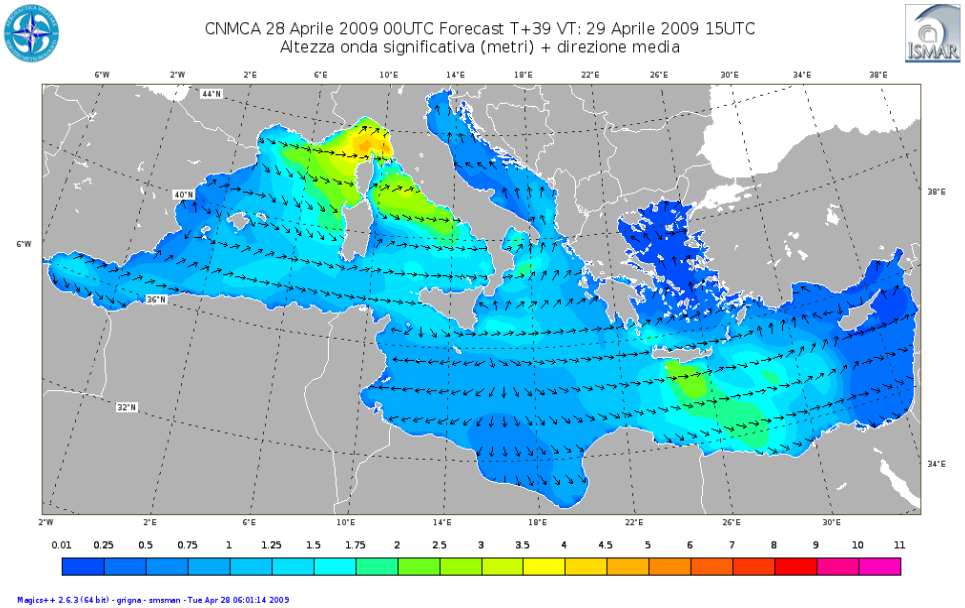
part of MYWAVE project

NETTUNO is a high resolution local scale wave forecast system operational in the Mediterranean Sea based on the COSMO-ME and WAM models (In cooperation with ISMAR-CNR of Venice)

The sea state probabilistic forecast is obtained driving the wave model using the hourly COSMO-ME EPS wind forecast members

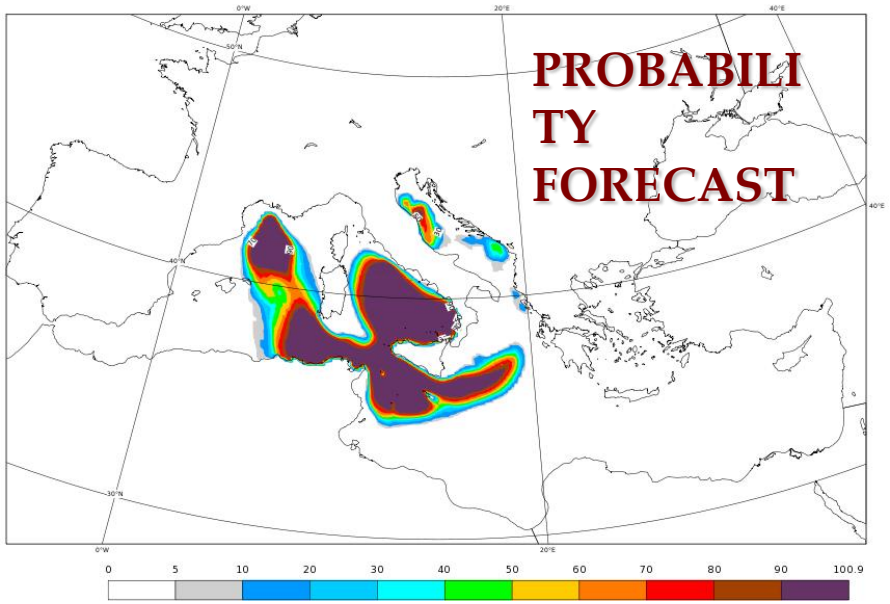
The NETTUNO-EPS consists of 40+1 members, that are integrated at 00 UTC up to 48 hour forecast in the Mediterranean basin

Validation of sea-state forecast has been done at ISMAR-CNR

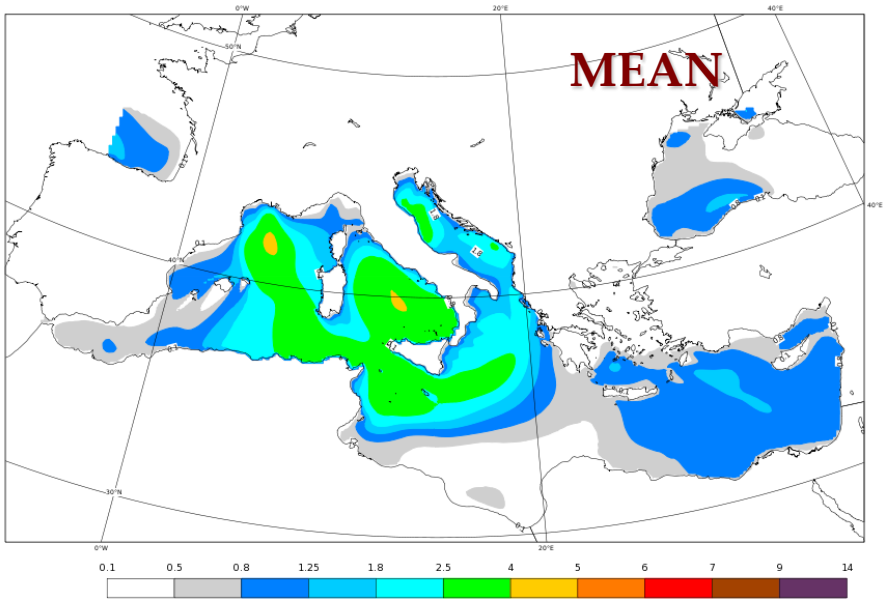


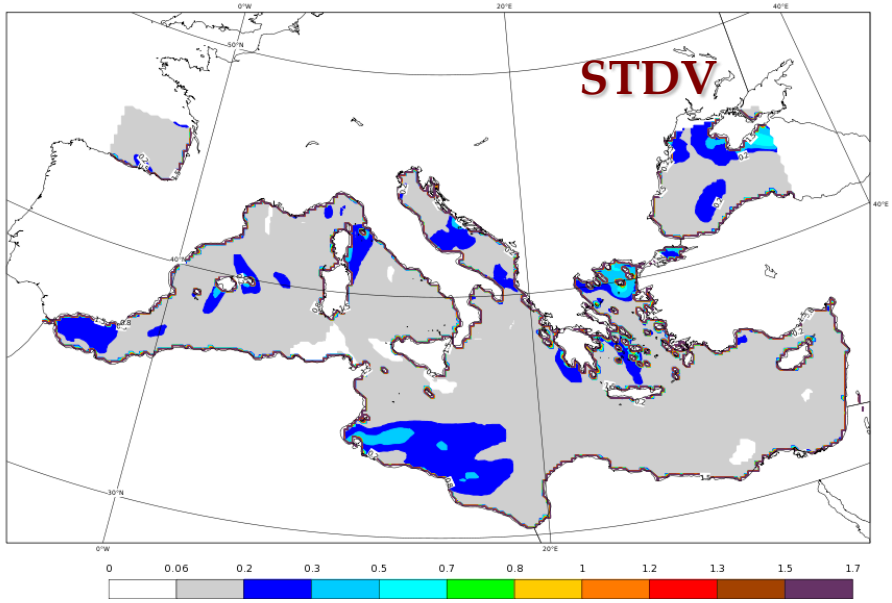
SIGNIFICANT HEIGHT

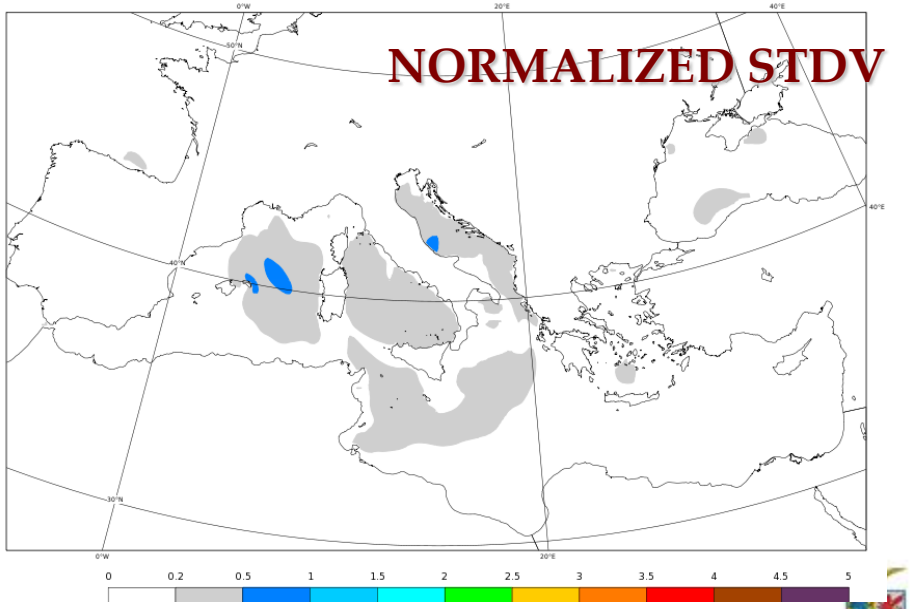
FC 2014090100 + 24h 0HS_WAVE > 2.5 m probability forecast



FC 2014090100 + 24h 0HS_WAVE Mean







Future Developments

- Calibration/tuning of the COSMO-ME EPS
- Evaluation of stochastic physics impact over a long period
- Extension of the validation of the NETTUNO-EPS
- Soil moisture perturbation

Thanks for your attention!