



Cosmo Application of Rfdbk/MEC on ENS CARMENs

Task 2.3

EPS Evaluation Guidelines as Part of Common Plot (CP) Activity

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Common Plot Activity for EPS

The activity concerns the calculation and representation of verification results of statistical indices for main weather parameters derived using the operational ICON-LAM and/or COSMO Ensemble Prediction Systems in the consortium. Through PP-CARMA, a Common Verification platform based on MEC-Rfdbk was developed for the unified production of the Common Plots (CP) for deterministic models. MEC-FFV2 is used to perform traditional point verification both for the surface and the upper air. Through PP-CARMENS EPS verification is running at the individual centers with the same MEC-FFV2 software, which guarantees that the data are processed in the same way for both deterministic and ensemble models and permits to save resources in the development and implementation of auxiliary routines, like quality control, correction for height, interpolation methods. In addition, the usage of the same verification software for assessing ensemble performance in the different COSMO Centres, ensures that the same processing of the data in the verification process is applied and a unified definition of the indices is used for verification.

Finally, a centralized transfer and visualization of EPS statistics on COSMO web server facilitates the viewing and analysis of the verification results https://www.cosmo-model.org/shiny/users/fdbk/fdbk_synop_eps_new/.

EPS systems in COSMO

Currently, the ensemble systems that run operationally by COSMO members are:

- COSMO-LEPS (COSMO) (to be replaced by ICON-LEPS in Q4 2024)
- ICON-D2-EPS (DWD)
- COSMO-2E and COSMO-1E (MCH)
- TLE-MVE (IMGW)
- COSMO-IT-EPS (COMET)
- COSMO-2I-EPS (ArpaE)
- COSMO-IL-ENS (IMS)

Verification Areas for EPS Common Plots

The COSMO EPS systems are evaluated on a daily basis over the native domains that are implemented. At a second phase, Finally, the EPS Common Plot activity will be extended over common areas if this will be feasible. NMA archive server is used for the exchange of score files or later for forecast/observation data for the verification purposes.

Conditions

- **Only** verification scores calculated with **MEC-FFV2** software can be included in this activity.
- Observations (SYNOP and TEMP) in netcdf format are available in NMA server on weekly basis.
- Files submission (seasonal or monthly basis): All files will be uploaded on seasonal or monthly basis on the NMA ftp server: 193.26.129.30, user: icon (for password contact S.Gabrian). On the FTP server, the following directories can be found:
 - OBS_NC: netcdf observations
 - EPS-scorefiles
- Nomenclature description file is will follow once the annual activity is initiated.

Responsibilities for EPS CP scores

I. MEC-FFV2: XX FTEs (to be defined) - admin

- Resolve software/scripts problems
- Incorporate new features in EPS verification activity.

II. Seasonal forecast data: XX FTEs – All responsible EPS verification participants

- Produce Feedback Files (FF) through MEC for the native domain
- Produce Rdata verification score files through FFV2 for the complete native domain and/or subset of it
- Provide information on model version changes
- Present verification analysis over national domains (ICON-LAM/COSMO) during annual GM-WG5 meeting.

III. Reporting: XX FTEs – WG Coordinator

- Produce Rdata verification score files for global IFS-EPS models and for COSMO-LEPS
- Preparation of annual guidelines for EPS CP activity
- Analysis and presentation of main verification results

ENSEMBLES in COSMO consortium

DWD: ICON-D2 EPS

Horizon: 48h

Ensemble size: 20 members

Resolution: 2.1km horizontal res.

BC: ICON-EU EPS member 1-20

DWD: ICON-EU EPS

Horizon: 120h

Ensemble size: 40 members

Resolution: 13 km, 2-way nested in ICON-EPS

DWD: ICON-EPS

Horizon:180h

Ensemble size: 40 members

Resolution: 26 km horizontal res., global

IMS: ICON-IL-EPS

Run twice daily ICON 20-members ensemble driven by EC-ENS.

Domain: 25-39E,26-36N
Resolution: 2.5km (0.025 deg).

ARPA-E: *ICON-2I-EPS*

Domain: 3°E - 22°E / 33.7°N - 48.9° N

Ensemble size: 20

IC: generated with KENDA with a 40-member ensemble, hourly cycles, assimilating conventional observations and radar data

BC: IFS-ENS

COMET: *COSMO-IT EPS*

Frequency: twice daily (00 and 12):

Resolution: 0.02 deg resolution (about 2 km);

Rotation coordinates: LAT -8.5/5.5, LON -3.8/7.7 (pole: LAT 47.0, LON -170.0);

Ensemble size: 20 members

IC/BC: ECMWF

- BC coordinates: LAT -9.0/6.0, LON -4.4/8.2 (pole: LAT 47.0, LON -170.0);

- BC resolution: 0.2 deg.

IMGW-PIB: *TLE-MVE* (Time-Lagged Ensemble/Model-Varied Ensemble)

Ensemble size: 20

IC/BC: COSMOPL 7km

Domain:: 10.963 47.596, 11.205 57.695, 24.810 46.597, 28.376 56.454

MCH: *ICON-CH1-EPS*

Domain: 49.52 N, 00.16 E, 42.67 N, 01.33 E, 42.85 N, 15.94 E, 49.73 N, 16.75 E

Ensemble size:11

IC-BC: ECMWF IFS-ENS

MCH: *ICON-CH2-EPS*

Domain: 49.52 N, 00.16 E, 42.67 N, 01.33 E, 42.85 N, 15.94 E, 49.73 N, 16.75 E

Ensemble size: 21

IC-BC: ECMWF IFS-ENS

COSMO-LEPS

Ensemble size: 20 members

IC/BCs from ECMWF ENS members (only 00 and 12UTC ENS runs are considered) using cluster analysis and soil IC from ICON-EU

horizontal / vertical resolution: 7 km / 40 ML

forecast range: +132h

Frequency: twice daily 00 and 12UTC

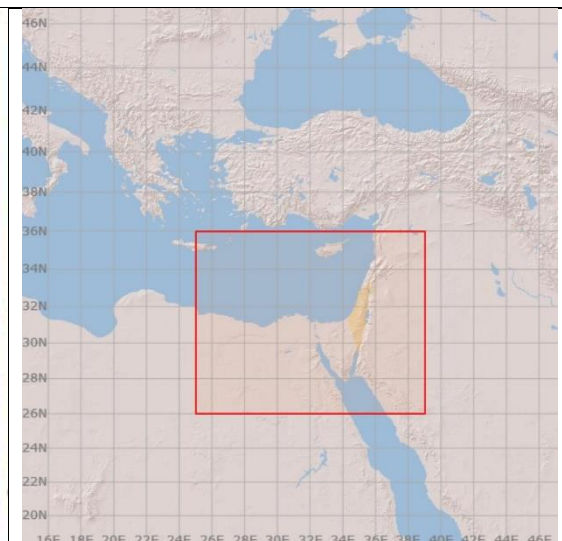
COSMO model version: 5.03 in single-precision

convection scheme: Tiedtke

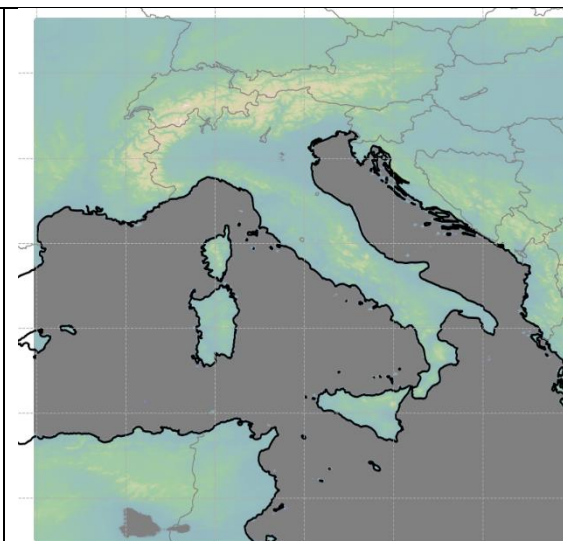
perturbations in turbulence scheme and in physical parameterisations (PP), but no SPPT ecflo suite



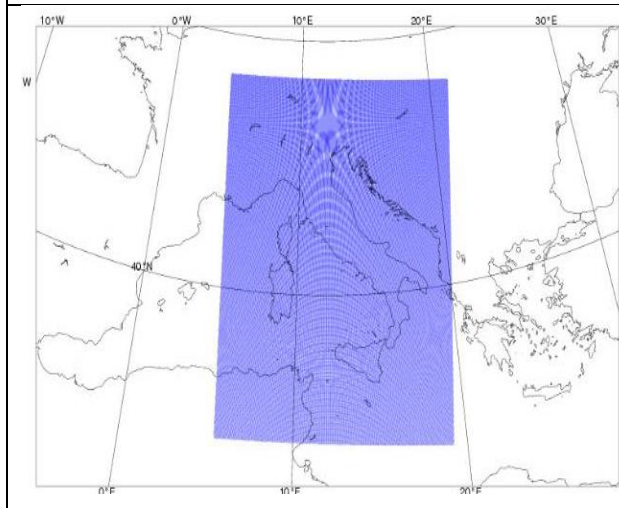
DWD: ICON-D2 EPS



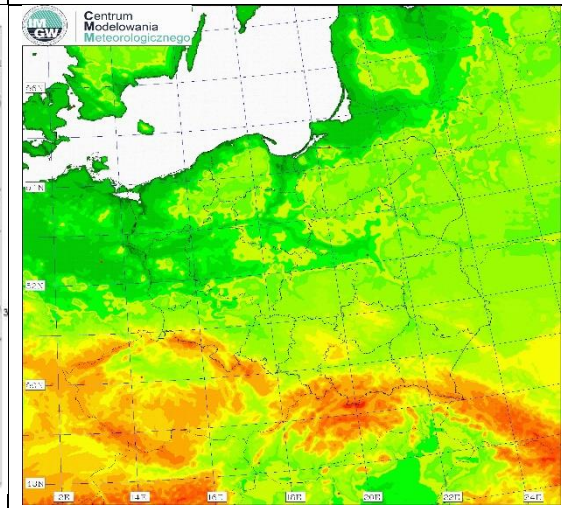
IMS: ICON-IMS EPS



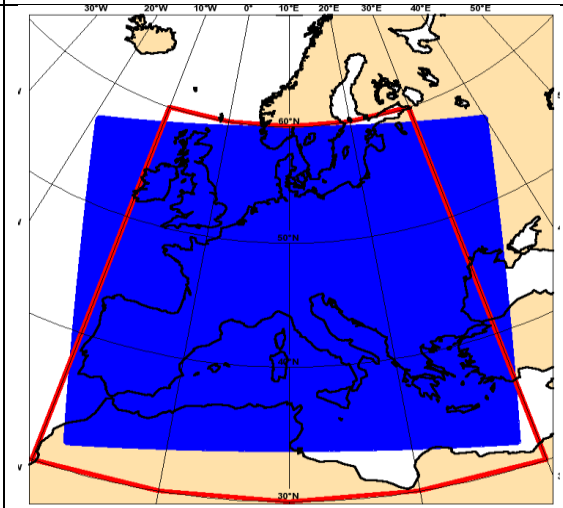
ARPAE: ICON-2I-EPS



COMET: COSMO-IT EPS



IMGW-PIB:TLE-MVE



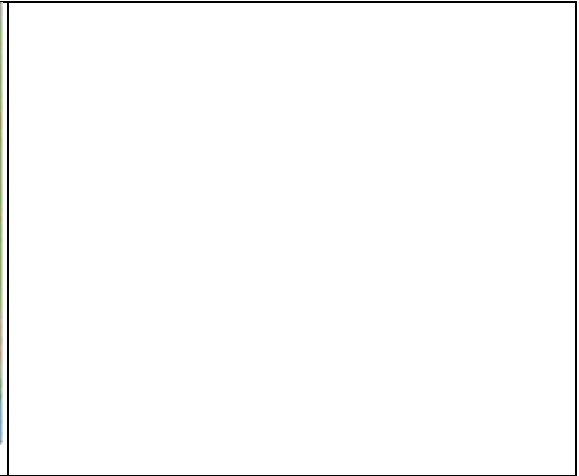
COSMO-LEPS



MCH: ICON-CH1-EPS



MCH: ICON-CH2-EPS



Common Plots: EPS verification specifications

Parameters	<p>Surface: Continuous T2m, SurfPressure, Td, WSpeed, TCC</p> <p>Surface: Dichotomic 6h Precip (Thresholds):0.2,0.8,1,5,8,10,15,20 mm TCC (Intervals): [0,25],[25,75), [75,100] Wind gust(thresholds):12.5,15,20 m/sec Upper Air: Temperature, RH, Wind Spee</p>
Stratification	<p>-100m, 100m-300m, 300m-800m and >800m</p>
Ensemble Indices	<p>CRPS - continuous ranked probability score: $CRPS=1N\sum_{i=1}^N\int_{-\infty}^{\infty}(Ff_i(x)-Foi(x))dx$</p> <p>CRPSF - fair crps, accounting for the limited number of EPS members</p> <p>IGN - ignorance score (only TEMP): $IGN=-\log_2(fi)$</p> <p>OUTLIER - percentage of observations outside ensemble range (only TEMP)</p> <p>SKILL - RMSE of ensemble mean</p> <p>SPREAD - mean ensemble spread</p> <p>ME - mean error of ensemble mean</p> <p>SD - standard deviation of ensemble mean error</p> <p>SPREAD/SKILL</p> <p>Talagrand (rank) histogram (only SYNOP)</p> <p>Reliability diagram (forecast probability vs. observed frequency) (only SYNOP)</p> <p>ROC Curve (FAR vs POD) (only SYNOP)</p> <p>Value score vs Cost/Loss Ratio (only SYNOP)</p>
Probabilistic Indices	<p>Brier Score: $BS=1N\sum_{i=1}^N(pi-oi)^2$</p> <p>Brier skill score - $BSS=1-BSfcstBSref$</p> <p>Brier rel. - $BSrel=1N\sum_{k=1}^Kk=1nk(pk-o^k)^2$</p> <p>Brier res. - $BSres=1N\sum_{k=1}^Kk=1nk(o^k-o^k)^2$</p> <p>Uncertainty - $BSunc=o^-(1-o^-)$</p> <p>ROC Area - Integral of curve obtained from plotting POD vs FAR for different probabilities</p> <p>Events - Number of observed events</p> <p>ROC curves</p> <p>Relative economic value as fct. of the cost/loss ratio</p>