Towards new COSMO ensemble over the Eastern Mediterranean

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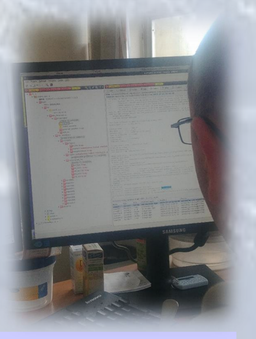
Thanks to: B. Kasic, C. Simarro, A. Montani (ECMWF), JM Bettems (MeteoSwiss), E. Amitai (IMS)

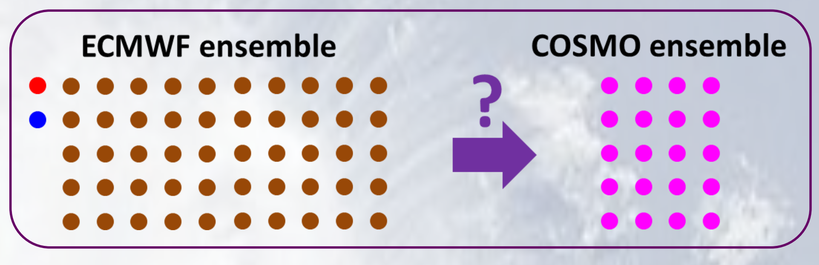
Abstract

We are happy to inform the community about the preparation of a new COSMO ensemble over the Eastern Mediterranean (EM). The 20 member ensemble with 90 hours forecast range will be initialized once a day at ~2.5 km resolution. The ensemble will run at ECMWF being designed similarly to COSMO-LEPS. First, we present the characteristics of ECMWF ensemble over the EM and discuss the method for selecting the optimal 20 members to drive the COSMO ensemble. Second, we present preliminary verification results of the COSMO ensemble based on 4 test cases.

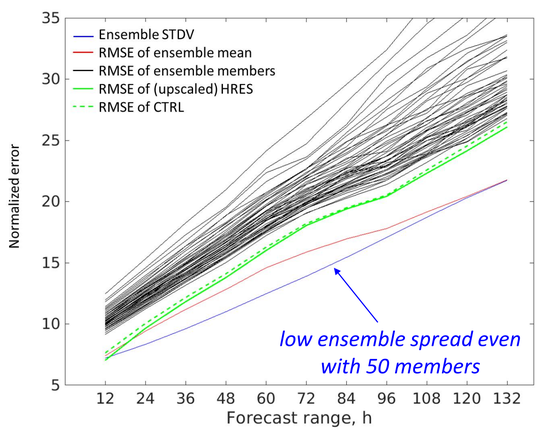


Selection of 20 ECMWF ensemble members

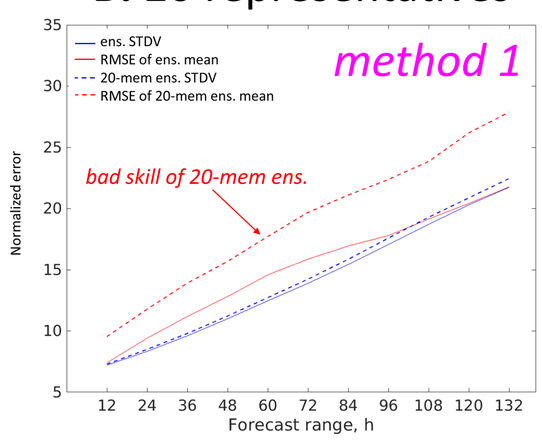
- ❑ Domain: 25-37N/24-40E. Period: 00 & 12 UTC runs during 15/12/2019-26/01/2020 (85 runs)
- (∗) ❑ For each **field** (QV,FI,U,V), **level** (500,700,850mb), **forecast range** (12,24,…,132), the norm. field $\mathbf{X_{i,j}}$ is: $X_{i,j} \Rightarrow \tilde{X}_{i,j} = \frac{X_{i,j} - \bar{X}}{\sigma}$
- ❑ The code (by A. Montani) calculates "distances" between ensemble members (Molteni et al. 2001; Marsigly et al. 2001)
- ❑ Allows calculating :
  - Cluster analysis using "Complete Linkage method" (Wilks, 1995)
  - distances between ensemble members and HRES analyses! Allows sorting the members according their quality!
  - STDV of ensemble members, RMSE with respect to HRES analyses



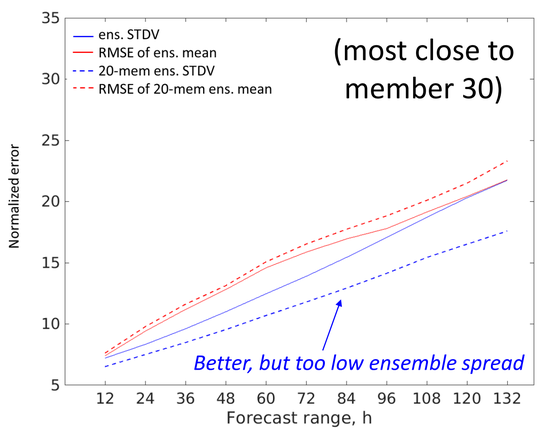
A. 50 ECMWF members



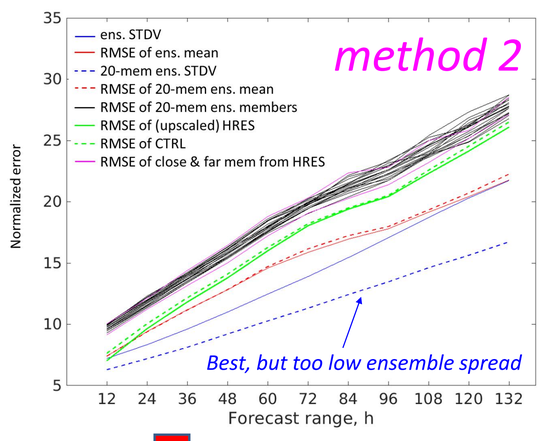
B. 20 representatives



C. 20 "random" members



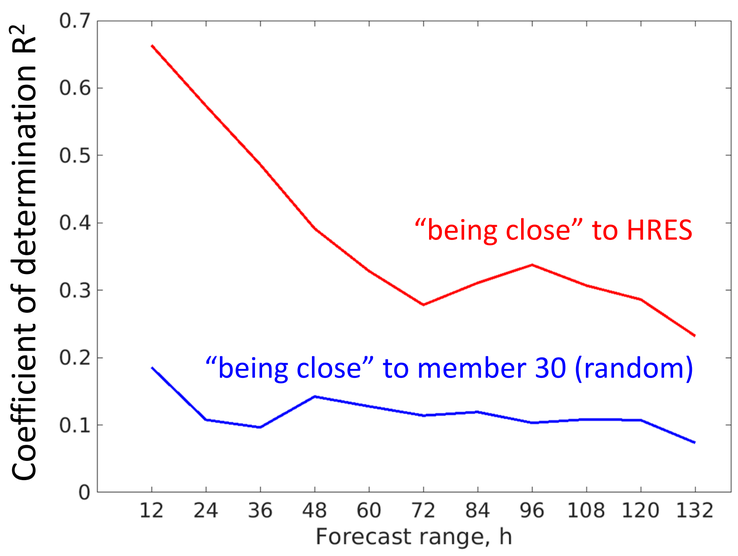
D. 20 most close to HRES



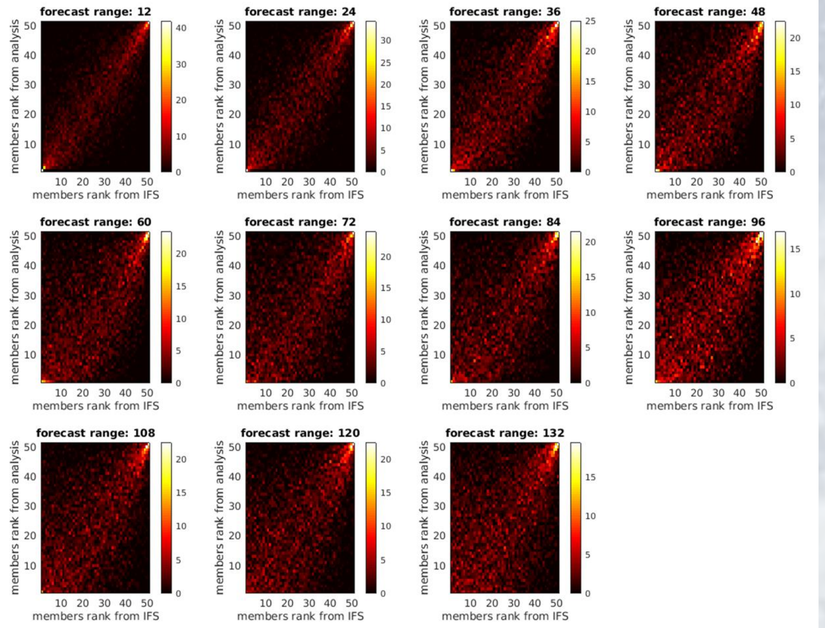
- **A. 50 members ensemble**
  - RMSE of ens. mean is better than each member
  - HRES, CTRL are better than other members!
  - Too low ensemble spread of 50 members ensemble
- **B. 20 representatives of cluster analysis**
  - RMSE of 20 mem. ens. mean is bad
  - Too low ensemble spread
- **C. 20 members most close to member 30 (random)**
  - RMSE of 20 mem. ens. mean is better
  - Too low ensemble spread
- **D. 20 members most close to HRES**
  - RMSE of 20 mem. ens. mean is the best
  - Too low ensemble spread
- **E. Members rank from analysis vs. their rank from HRES**
  - Close to 1-1 line until ~72 hours forecast range
  - Members close to HRES are better (close to analysis)
- **F. R^2 of the linear fits to the scatter plots (in E)**
  - Members close to random member 30 have low skill
  - Members close to HRES have high skill (until ~72 hours)

F. Members close to (far from) HRES are better (worse)

(R^2 of the linear fits to the scatter plots from the right)



E. Members rank from analysis vs. their rank from HRES

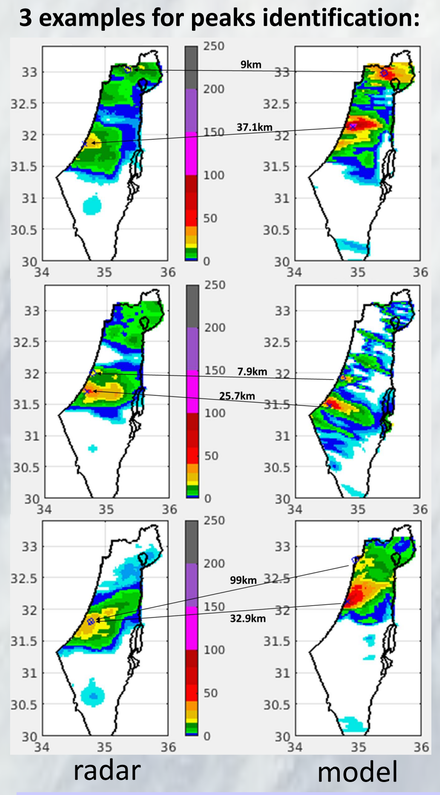


Preliminary precipitation verification of COSMO ensemble

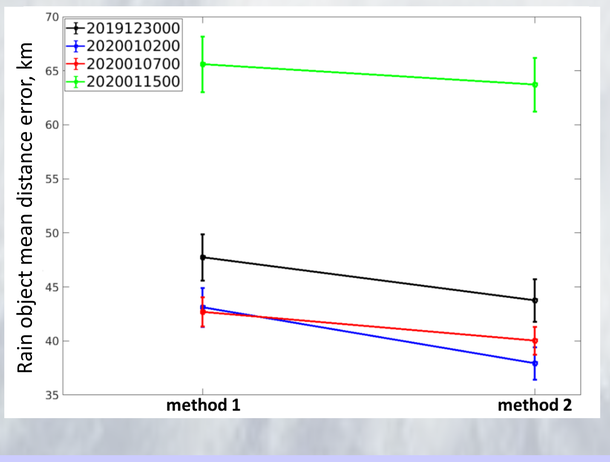
- ❑ 4 rain test cases were analyzed, 72 hours long each: 30/12/2019 00 UTC+…, 02/01/2020 00 UTC +…, 07/01/2020 00 UTC +…, 15/01/2020 00 UTC +…
- ❑ For each case COSMO ensemble was driven by either method 1 or method 2

Objective verification

3 examples for peaks identification:

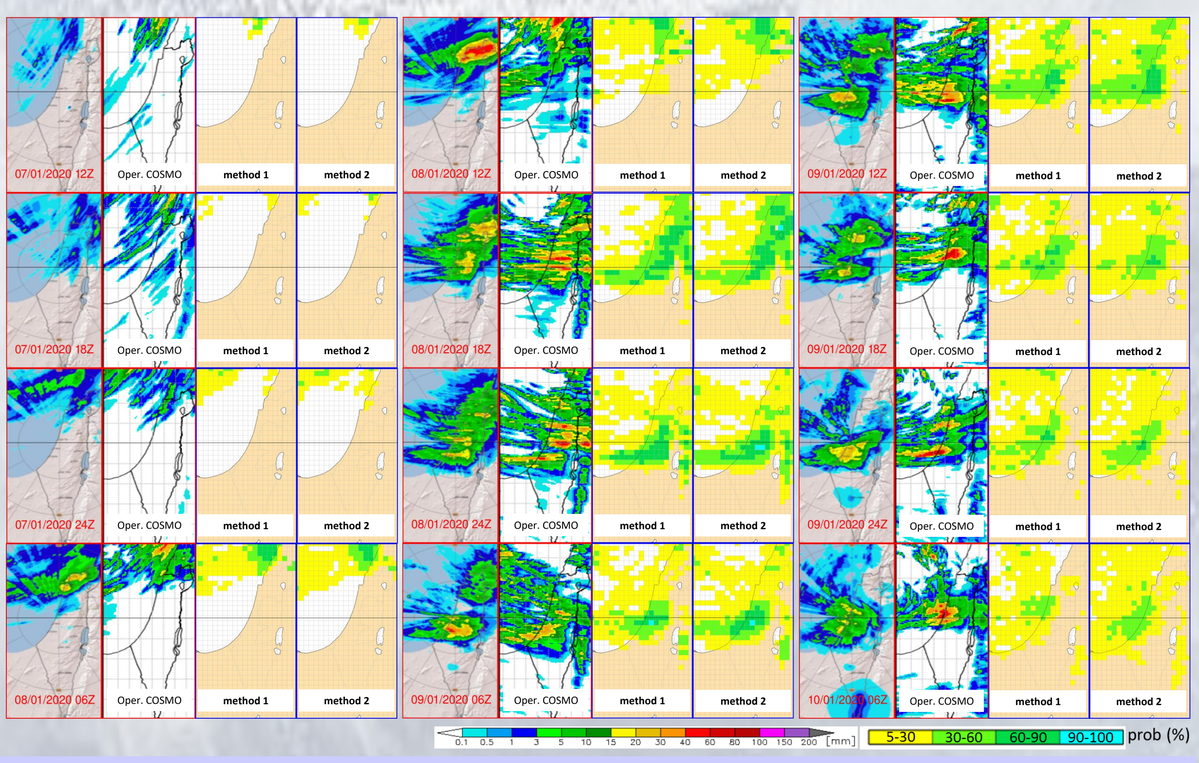


- ❑ 6h-accumulated rain maps were verified against radar
- ❑ For each range, forecasts of 20 members were verified
- ❑ 1 or 2 main peaks were identified at each forecast and obs map, and corresponding distance errors were calculated
- ❑ Finally the averaged distance error was calculated for both COSMO ensemble methods, for each of the 4 test cases
- ❑ **One can see** (not significant) **the advantage of method 2:**



Subjective verification

(example: third test case, upscaled probability for > 20 mm/6h)



Conclusions and open questions

- **According to synoptic classification (∗), the ECMWF members close to HRES are better. Should we use them to drive COSMO although the spread is too small?**
- **How to increase the spread without degrading the model skill? Should we use SPPT on top of ECMWF ensemble?**
- **Perhaps - use different synoptic classification, including e.g. vorticity, divergence, layer thickness 700 - 500 mb, CAPE in convective conditions, inversion height in stable conditions?**
- **Does the normalized (unbiased) field $\tilde{X}_{i,j}$ is a good candidate? For example, different depth of trough may have the same $\tilde{X}_{i,j}$**