SPM review

COSMO General Meeting, 8 September 2015
Wrocław

- I propose to start our plenary discussion looking at the results of our work with the eyes of some (specific) external reviewers:

- COSMO convective-scale models were recently externally evaluated in European Severe Storm Laboratory (ESSL) Research and Training Centre

- ESSL Testbed 2014 experiment:
  - → from 2 to 27 June 2014,
  - → 42 participants (evaluators) from Europe (mainly forecasters) and 5 ESSL scientists,
  - → support of DWD employees,
  - → for COSMO-DE and COSMO-DE-EPS (limited number of EPS products reviewed)
  - → report available in fall 2014

- ESSL Testbed 2014 experiment, general findings:

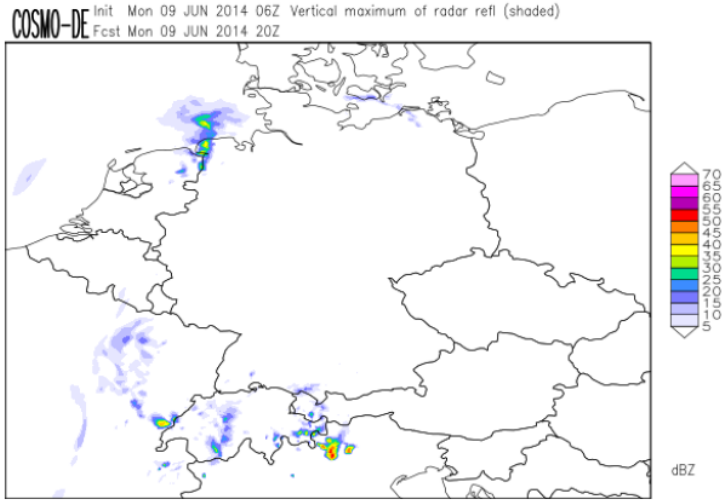
→ the model **simulates the evolution of mesoscale convective systems (MCS) well**, once these systems are present within the COSMO domain

→ the model system **performed poorly with the intense convective windstorm on 9 June** (bow echo) that affected parts of western Germany

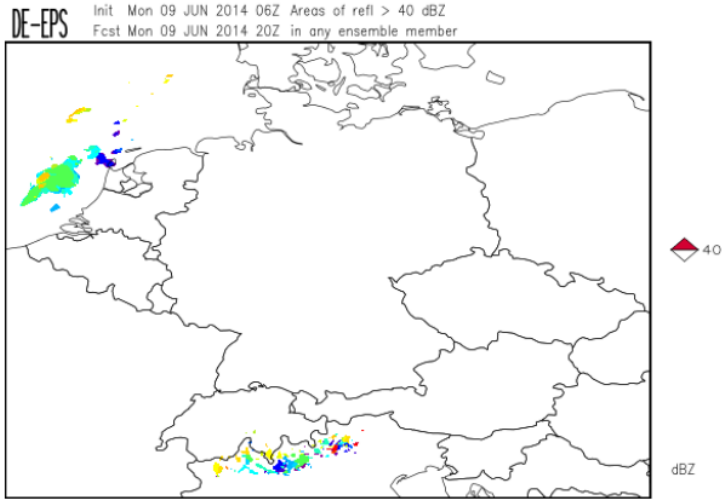
→ the model shows a **reluctance in initiating convection away from mountain ranges and weather systems on warm, high-CAPE days;** on relatively cool days with lower CAPE and more relative humidity, there is no evidence of this problem

→ **convective initiation over the Alps seems to be handled very well by the model**; several events south and east of the Alps were also simulated very well

- 9 June:

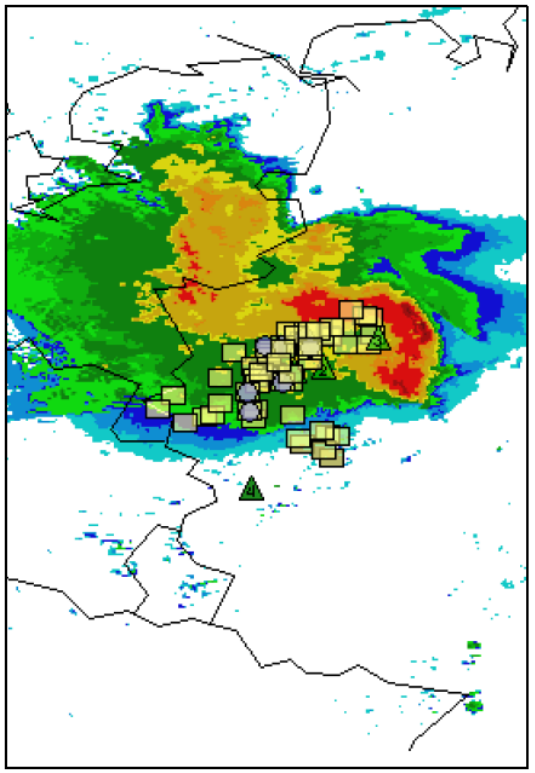


Reflectivity at 20 UTC.
06UTC +14 hour deterministic COSMO-DE forecast.

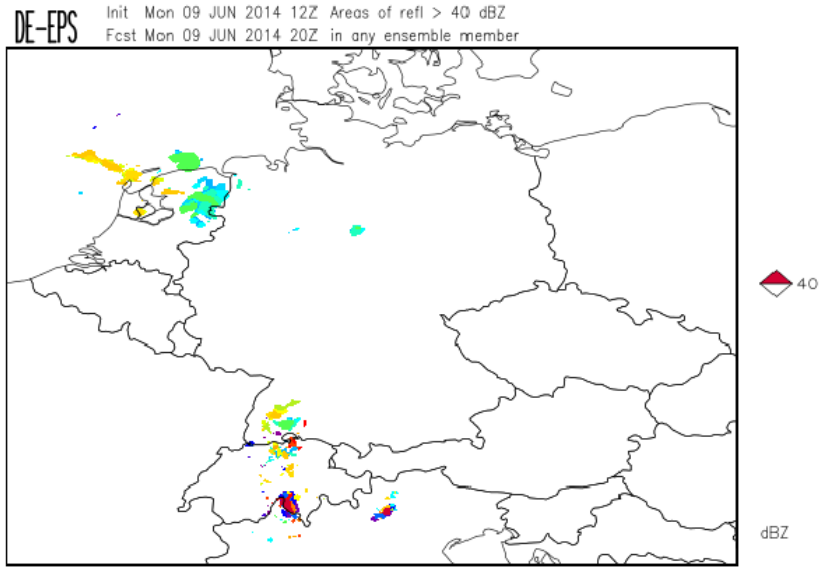


Reflectivity at 20 UTC.
06 UTC +14 hour COSMO-DE-EPS forecast.
Members exceeding 40 dBZ.

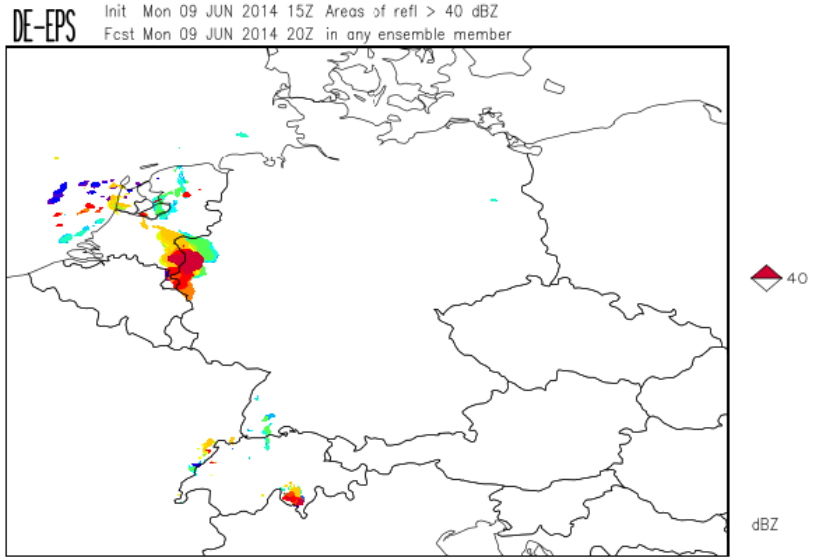
Verification:



Radar reflectivity and ESWD reports
17-20 UTC.



12 UTC **+ 8 hour** COSMO-DE-EPS forecast. Members exceeding 40 dBZ.



15 UTC **+ 5 hour** COSMO-DE-EPS forecast. Members exceeding 40 dBZ.

- Analysis:
  - → the COSMO-DE-EPS system was only able to simulate the bow echo after it was contained within the COSMO domain at initialization time (at 15 UTC). As soon as that was the case, the restrengthening of the old MCS was simulated fairly well, as well as its decay after 21 UTC
  - → apparently, the boundary conditions provided to the COSMO-DE-EPS did not resolve the dynamics of the approaching weakening MCS accurately enough to force COSMO to reactivate the MCS
  - → the general reluctance of COSMO-DE-EPS to develop storms in warm, high-CAPE environments with a dry lower troposphere may have aggravated the problem
  - → the deterministic COSMO-DE initialized at 15 UTC did not develop the bow echo at all

- Conclusion:
  - → the general reluctance of COSMO to initiate storms in warm, high-CAPE environments should be studied and mitigated
  - → a possible cause might be a lack of random up- and downdrafts on scales close to the model gridspacing
  - → that may be mitigated by artifically introducing them into the ensemble through local diabatic heating and cooling tendencies

- ESSL Testbed 2015 experiment:
  → from 25 May to 26 June 2015 (break 8-12 June)
  → 41 participants from Europe (mainly forecasters)
  → support of DWD and MeteoSwiss employees,
  → for COSMO-DE and COSMO-DE-EPS, as well as COSMO-E and COSMO-1
  → report available 15 August

- ESSL Testbed 2015 experiment: general results:

→ often, convective initiation was late in all of the convection permitting COSMO models; this effect was noted especially often over flat terrain, in absence of weather systems that produce local lift, and in warm air-masses (no specific differences beetwen models, COSMO-E more eager to produce convection)

→ convective coverage, away from the mountains, was also often underestimated by all of the convection permitting COSMO models; in cases in which the deterministic COSMO-1 and COSMO-DE would not initiate storms, COSMO-DE-EPS and COSMO-E would often, but not always, still have a few members with convection initiation

→ across the Alps, a few cases of overforecasting of CI were noted in COSMO-E

- continuation:

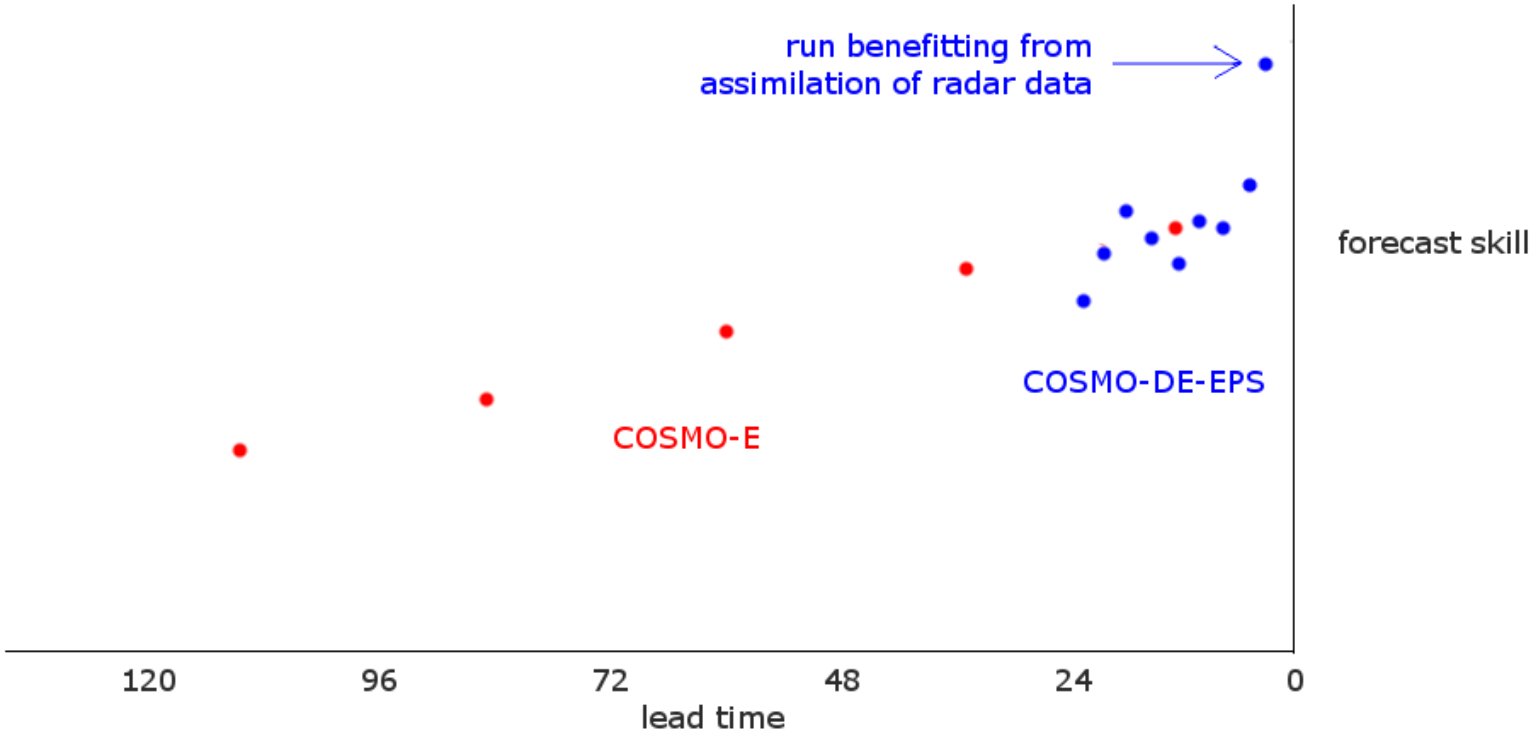
→ lead time of useful forecast: participants and testbed staff were sometimes positively surprised by the accuracy of COSMO-1 forecasts and COSMO-E forecasts at forecast ranges 24 - 48 hours ahead

→ the impression was that for convective events, the forecast quality increases strongly when lead times become so short (i.e. 15 UTC forecast for 18 UTC) that assimilated radar data “tells” the model where convection has initiated

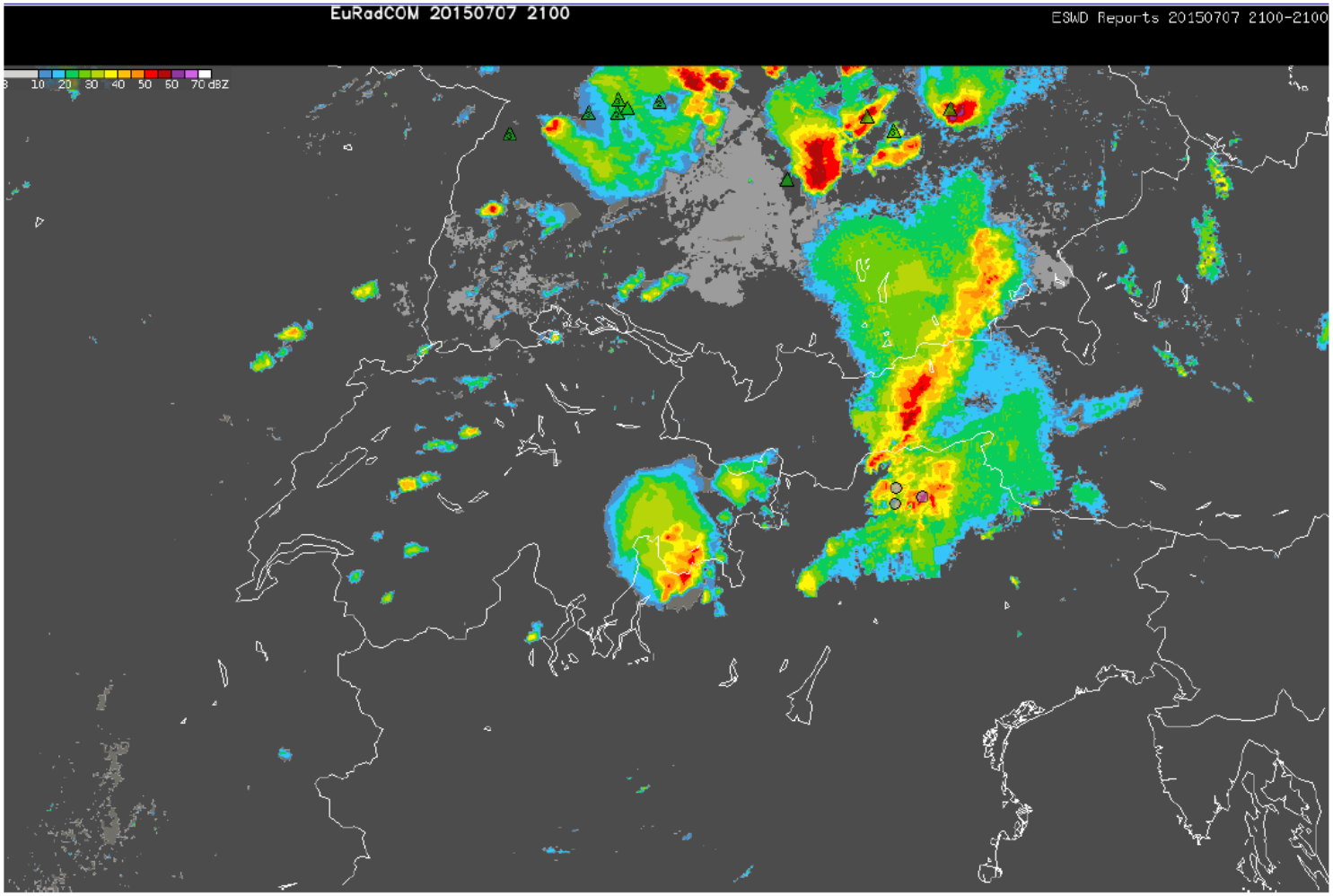
→ however, the difference between a run on the same day in the morning, or the afternoon the day before is not as large

→ COSMO-1 storms and reflectivity structures seem to be smaller in the model than in reality; it was often noted that areas of stratiform precipitation were underestimated/ almost absent

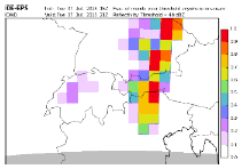
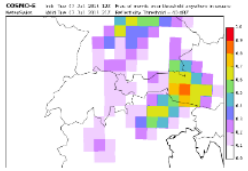
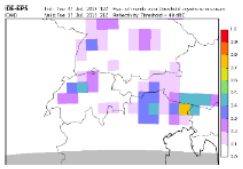
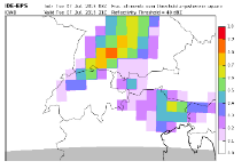
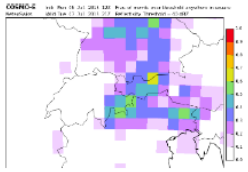
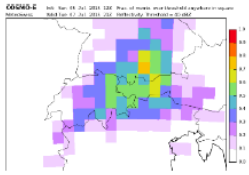
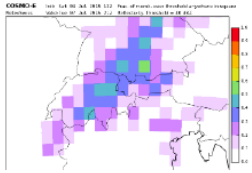
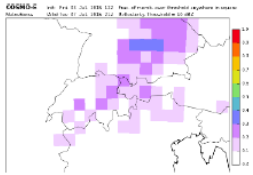
- Illustration:



- Illustration: 7 July, 21:00



- 7 July, 21:00

COSMO-E	COSMO-DE	
n/a		+ 6 hours
		+ 9 hours
		
n/a		+ 18 hour
	n/a	+ 33 hours
	n/a	+ 57 hours
	n/a	+81 hours
	n/a	+105 hours

Probability of exceedance of 40 dBZ in COSMO-E and COSMO-DE-EPS

- Conclusion:

→ the ESSL testbed results clearly show the importance of convective scale EPS methods and in particular COSMO models as very valuable prognostic tools

→ they show significant skill of the methods, also for forecast periods 24 to 48 hours, and even beyond

→ they demonstrate the importance of assimilation of the radar information, especially just after the convection initiation

→ they show the importance of the choice of appropriate domain size

→ they identify also the areas for model improvement, especially for representation of convection initiation (and even offer some suggestions)

Thank you for the attention!

Have a fruitful General Meeting

and every success in your work on development and improvement of COSMO modelling system!