Summary of the evaluation of COSMO models at the ESSL Testbed 2016

ESSL report 2016-01

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1 Introduction

1.1 This report

This concise report summarizes the main findings of the evaluation COSMO models at the ESSL Testbed 2016, the results of an attempt to condense the feedback collected from discussions at the Testbed and that collected by questionnaires.

Additionally, a briefing on the evaluation of DWD products will be given by Pieter Groenemeijer at the DWD in Offenbach on 25 November 2016. The raw, unedited feedback of Testbed participants is included as an annex to this report.

1.2 Testbed Participants

The ESSL Testbed 2016 took place during the weeks of 6 – 10 Jun, 13 – 17 Jun, 27 Jun – 1 Jul and 4 – 8 Jul 2016 at the ESSL Research and Training Centre in Wiener Neustadt. During these four weeks, 38 external participants took part in the Testbed in addition to 4-5 ESSL staff.

From MeteoSwiss, Marco Arpagaus provided a remote oral presentation, and Luca Nisi took part on site. From DWD, two R&D employees took part (Ulrich Blahak and Kathrin Wapler), both of whom contributed with an oral presentation. In addition, Thomas Hengstebeck and Paul James provided a presentation remotely from DWD. ESSL would like to thank them for these contributions!

In addition, eight DWD forecasters (Anna Wieczorek, Josef Kantuzer, Paul Brüser, Peter Hartmann, Bodo Erhardt, Michael Tiefgraber, Christian Herold and Ines Wiegand) participated and two others were invited by ESSL to support the Testbed staff (Marcus Beyer and Helge Tuschy).

Other participants to the Testbed in 2016 included delegates of AustroControl (Austria), CHMI (Czechia), EHMI (Estonia), FMI (Finland), KNMI (Netherlands), ZAMG (Austria), IPMA (Portugal), SHMU (Slovakia), NOAA (USA), VAISALA (Finland/USA), DHMZ (Croatia), SRF (Switzerland), LHMS (Lithuania), and MeteoCat (Catalonia/Spain). ESSL expresses its thanks to all participants for their contributions.

1.3 Evaluations of COSMO products

The evaluation activities at the Testbed concerned the DWD models COSMO-DE and DE-EPS and MeteoSwiss models COSMO-E and COSMO-1. For these models the following tasks were to be performed:

1a/2a	General assessment of model performance regarding convective systems
1b/2b	Probabilistic products for extreme precipitation, graupel, wind gusts, CAPE and CIN
1c/2c	valuation of lead time dependence of forecast skill
1d	Evaluation of the use of the Lightning Potential Index (DWD models only)

2d Evaluation of shear (MeteoSwiss models only)

Points 1a-d and 2a-c have been carried out. Point 2d of the list could not be carried out at the Testbed 2016. The original plan with respect to point 5 was that MeteoSwiss would provide ESSL with hourly u, v, and w wind data at several vertical levels and compute storm updraft helicity (UH) from these fields. However, it was found that it would be more efficient to compute UH before transferring it MeteoSwiss (and DWD), which both reduces the amount of data to be transferred and allows a computation of output tracks of UH instead if hourly values. We suggest to discuss this in cooperation with both MeteoSwiss (Walser) and DWD (Blahak) as an option for the Testbed 2016. This evaluation, i.e. of updraft helicity tracks would be done at the Testbed 2017 free of additional cost, since it was already included in the 2016 contract.

Note: At the Testbed, warning and nowcast products provided by DWD have also been evaluated. These are subject of a separate summary report.

1.4 Testbed Resources

The following online resources contain further information about the Testbed 2016:

The Testbed Data Interface showing all products and all data, is available online after the end of the Testbed at: http://weather.essl.org/testbed/nowcast2016.php

Username: testbed
Password: 2016neustadt

A Blog describing the daily activities at the Testbed can be found at:
http://www.essl.org/testbed/blog

Background information and all presentations given at the Testbed can be accessed at:
http://www.essl.org/testbed/info
password: 2016neustadt

1.5 Feedback

Feedback on the products was collected throughout the Testbed, partly **i) in direct discussions with the on-site R&D participants**, and in part **ii) through the documentation of answers to questionnaires** that were filled out jointly by participants, who typically worked in groups of 2-4 persons in dedicated sessions during the afternoons. The feedback from participants has been attached to this report.

2 Summary of results

1a/2a General assessment of model performance regarding convective systems

- In all COSMO models, the predictions of coverage and timing of convection were fairly good on average. In particular, the initiation of convection over the Alps was remarkably accurate in terms of timing and coverage.

- Across other areas, the convection was predicted rather well in some cases, but, as was noted during previous Testbeds, the COSMO-model still underestimates the coverage of storms on particularly warm days with high CAPE (see Case 23 June). Since storms can become particularly strong on such days, the model, unfortunately, misses some events with (very) high impacts.

- On occasion, COSMO-DE appeared to create too cool cold pools, which was probably the reason why strong low-level winds were forecast in one case (15 June), and possibly why, in another case, storms were forecast to propagate away from the Alps too early (5 July).

- No systematic differences in the quality of performance could be detected between COSMO-1 and COSMO-DE or between COSMO-E and COSMO-DE-EPS, although differences occurring in individual cases.

1b/2b Probabilistic products

- By far the most favourite probabilistic product for extreme precipitation, graupel and wind gusts was the **upscaled probability** product (with the squares), because for these fields, it gives probabilities that forecasters can better relate to compared to the fraction of members that exceeding a threshold. For CAPE and CIN, this was the preferred display. Additionally, the members exceeding a threshold display was fairly popular.

- It was noted several times that the ‘maximum of all members’ product is misleading. Unless one is looking to find the maximum of all members, the product is not useful. It needs to be used with utmost caution.

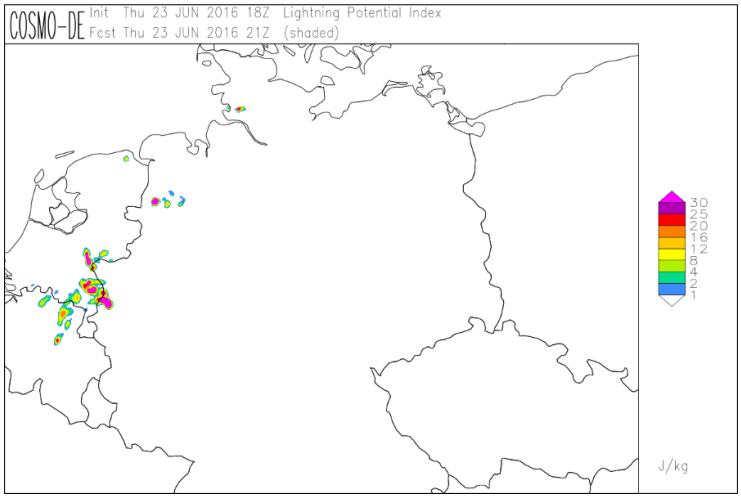
1c/2c Evaluation of lead time dependence of forecast skill

The predictability of convective events was studied in detail for a number of events. The main conclusions are:

- The timescale of predictability differs strongly from one event to another.
- For some events, the prediction was poor regardless of lead time because the model did not initiate the storms (June 23, and to a lesser extent June 24).

1d Lightning Potential Index

- The lightning potential index produces lightning in most stronger storms, much like observed in observational data. It seems to do what it is meant to do, and no big problems were noted.
- Forecasters would be able to anticipate lightning activity from other model fields such as modelled reflectivity, i.e. without the LPI. I.e., for forecasters the added value is very small, or not present at all.
- Probably, the LPI is somewhat better at distinguishing lightning-producing storms than a quantity like reflectivity and this may be of importance to some user groups. Whether this is the case cannot be determined from a small number of cases.



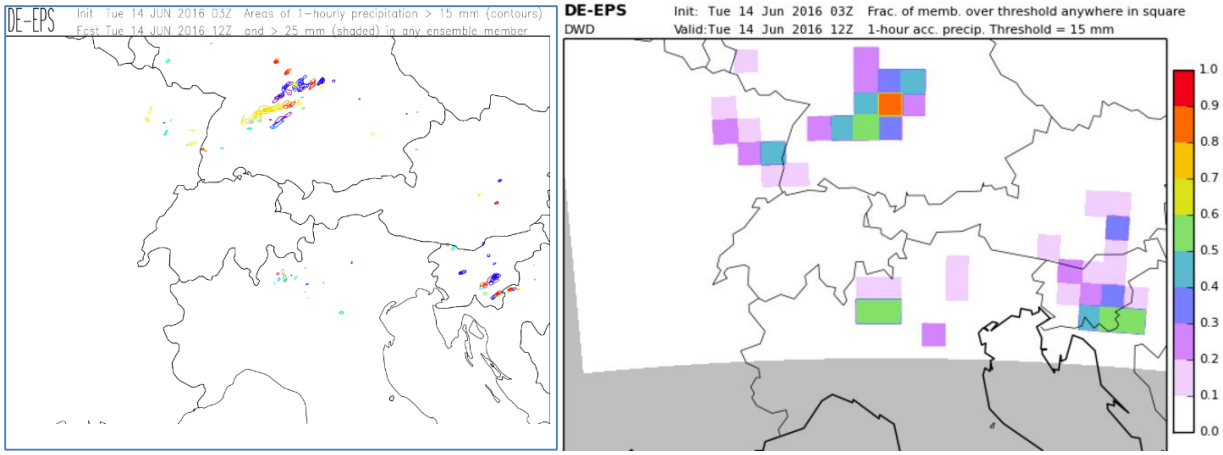
Lightning potential index at 21 UTC from the 18 UTC (+ 3 hours) run on 23 June.

3 Selection of cases with notes

14 June 2016

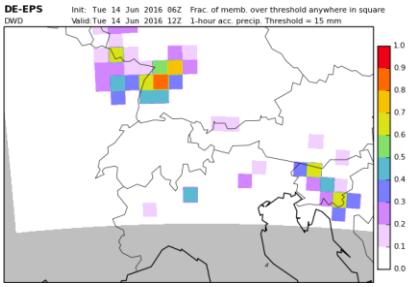
A case with relatively low instability (CAPE 400-800 J/kg) and modest wind shear (10 m/s) and typical temperature and dew point of 18/14, i.e. there was a shallow humid boundary layer. Widespread convective storms/showers developed during the day. A moderately severe flash flood situation developed in the Frankfurt area, because of a number of cells that were somewhat more active than others, which trained over the same area.

The COSMO-DE-EPS gave a hint that some marginal flooding may occur in its 03 UTC run, i.e. at +9 hours:

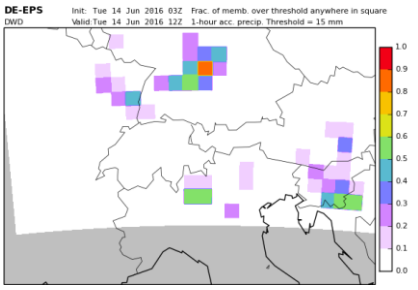


The two ensembles gave the following forecasts in earlier runs:

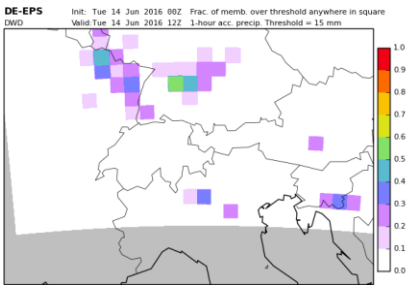
COSMO-DE-EPS **COSMO-E**



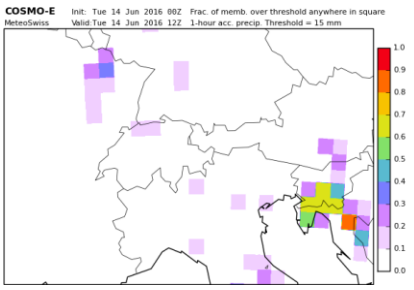
06 UTC + 6 h

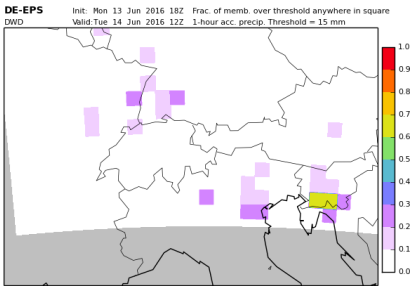


03 UTC +9 h

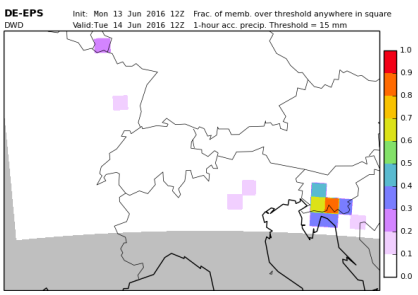


00 UTC + 12 h

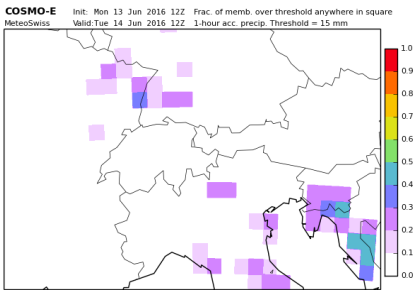




18 UTC + 18 h



12 UTC +24 h



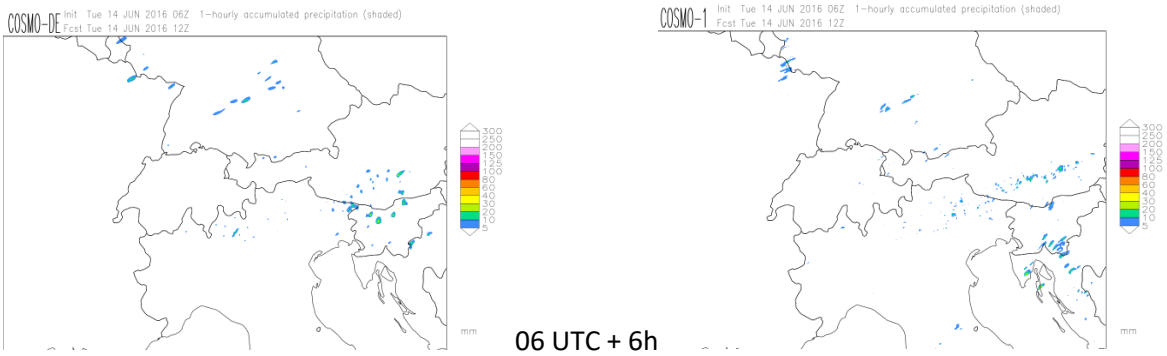
Apparently, this rather weak event had poor predictability. COSMO-DE-EPS had a better handle of the situation than COSMO-E in the last 12 hours leading up to event, but COSMO-E already gave some weak signals 24 hours before. COSMO-DE-EPS's frequent 3-hourly updates could give the forecaster updated information regarding the flood risk during the last 6-9 hours before the event, which COSMO-E could not, because it runs only twice a day.

Forecasters at the Testbed, however, did not take the hints into account as no risk level was issued for the area, possibly because they focused most on another forecast area (Northern Italy) and the setup looked very benign in terms of instability and other parameters.

The deterministic models, COSMO-DE or COSMO-1 run did not give too useful guidance even 6 hours before the event.

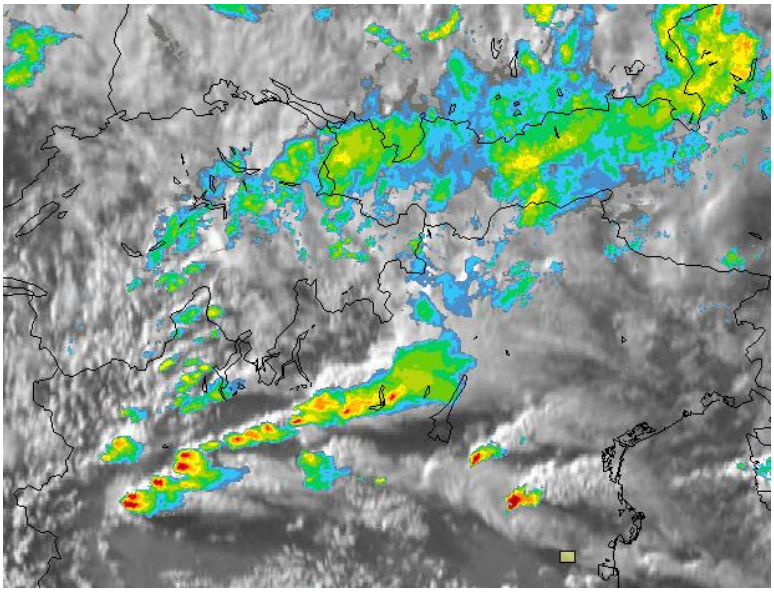
1-hourly accumulated precipitation

COSMO-DE **COSMO-1**



06 UTC + 6h

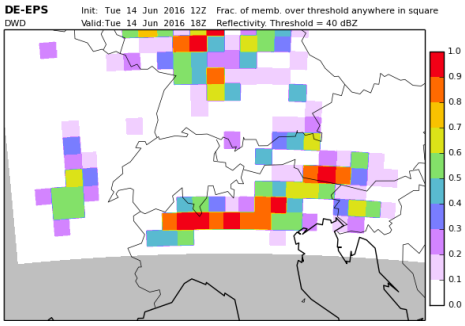
On the same day, across northern Italy several strong storms developed across Northern Italy during the afternoon. There, it was a bit warmer, but quite humid with typical temperatures of 25 and a dew point temperature of 17. The radar/visible satellite at 18 UTC is given below. The easternmost storm over the Po Valley would produce a **swath of severe wind gusts** with reported damage near Ferrara between 18 and 19 UTC.



Radar and visible satellite 14 June, 18:00 UTC.

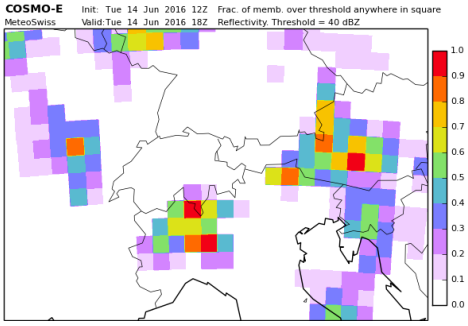
COSMO-DE-EPS and COSMO-E had forecast the following (probability of reflectivity exceeding 40 dBZ within square). For COSMO-DE-EPS, the storms developed at least in part very close to the model domain.

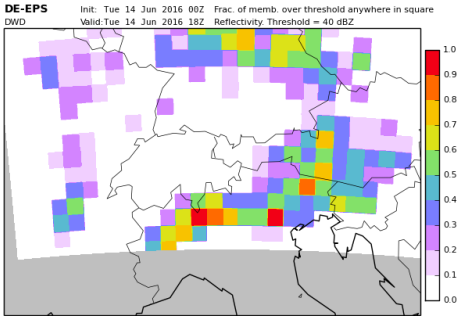
COSMO-DE-EPS



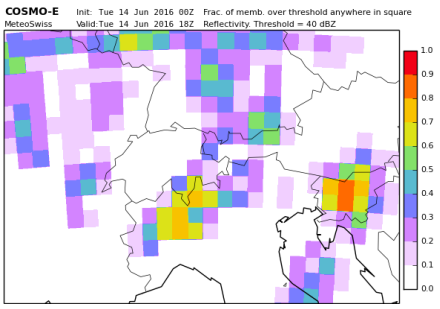
12 UTC +6 hours

COSMO-E





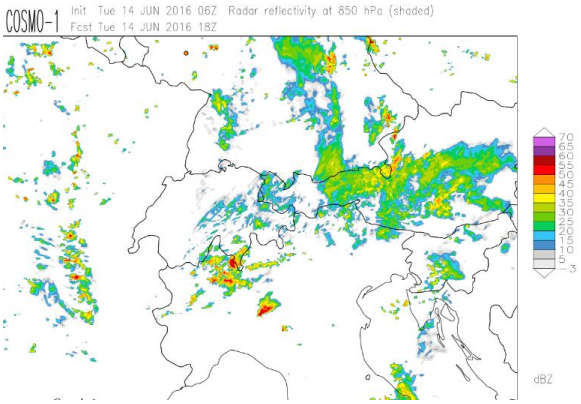
00 UTC +18 hours



The storms close to the Alps were predicted by both ensembles. Interestingly, the storms in the eastern Po-Valley near Padua, i.e. at some distance from the Alps were not forecast by the COSMO-E ensemble.

Testbed participants noted that the COSMO-1 was able to produce convective activity over the Po-Valley, but not as far east as where storms developed in reality. For the simulated storm, wind gusts only barely exceeded 20 m/s (not shown).

COSMO-1

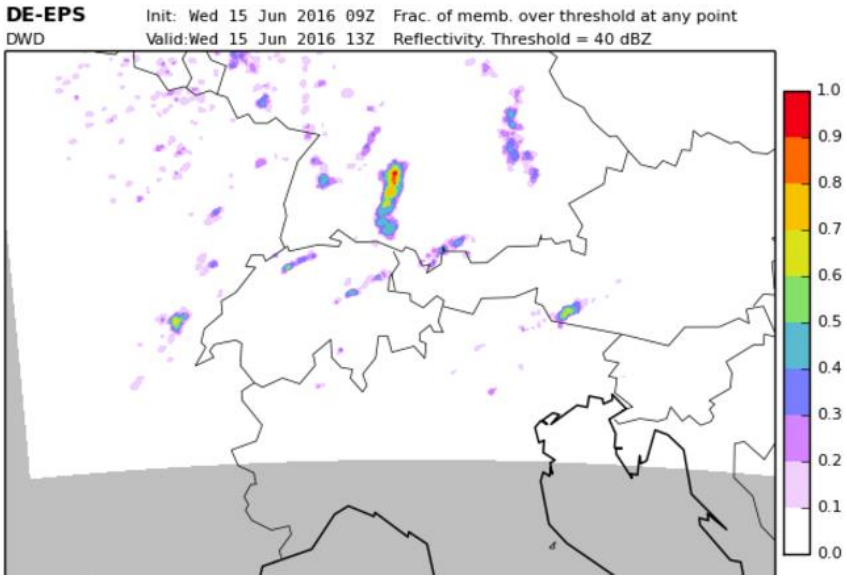


06 UTC + 12 hours

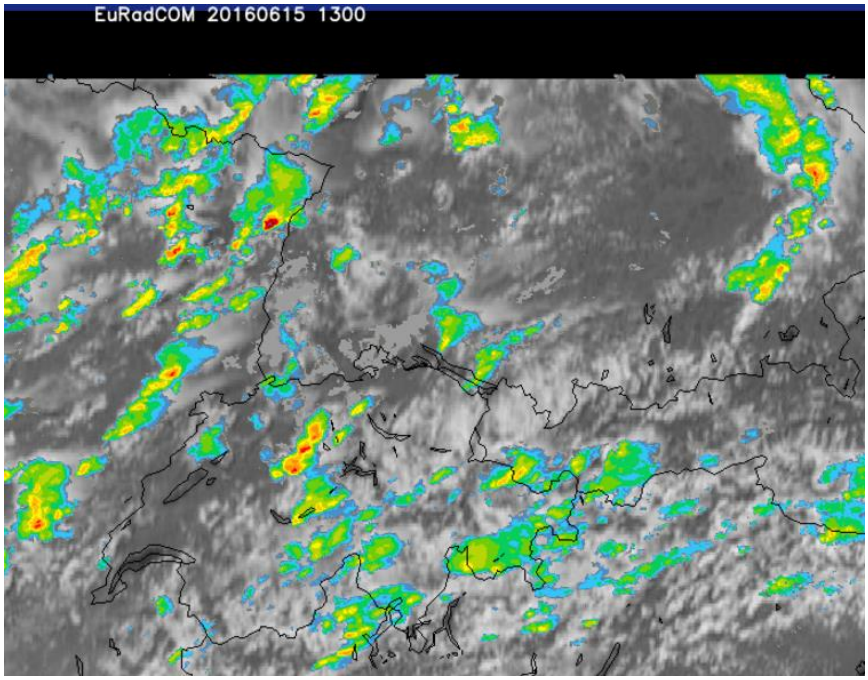
15 June

This was a rather cool day with modest moisture (T/Td 17/9), but steep low-level lapse rates. One thing caught the Testbed's attention, namely the the COSMO-DE-EPS run initialized at 09 UTC, which had a thunderstorm cluster and made it produce a swath of winds 25-30 m/s between 13 and 15 UTC across Swabia.

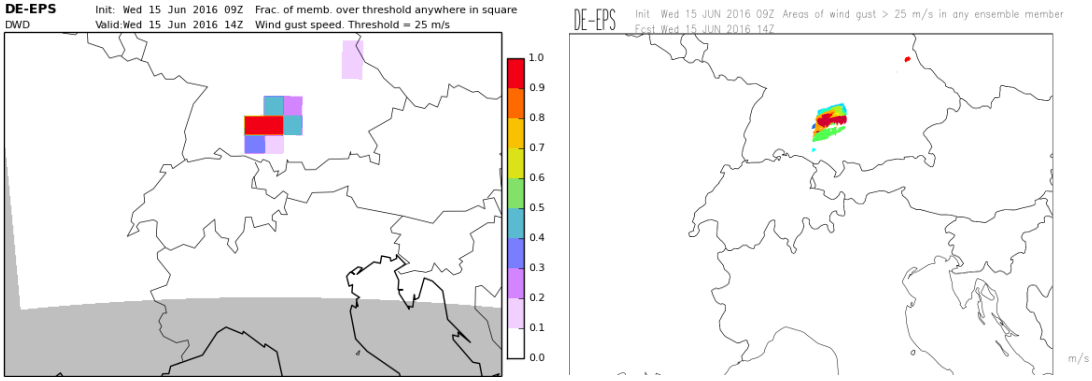
DE-EPS: the entire ensemble develops a storm system that did not occur.



Radar and visible satellite at 1300 UTC:



The highest observed wind gust in southern Germany in reality was 18 m/s.

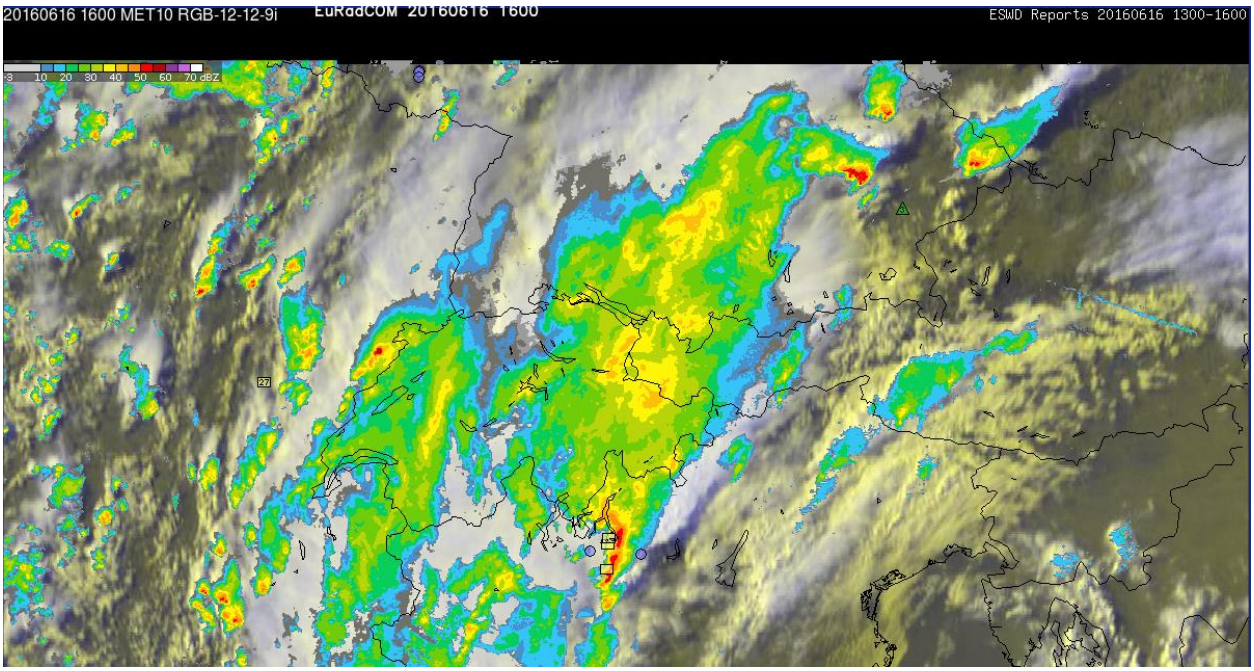


Interestingly, COSMO-DE initialized at 09 UTC did not develop such a strong convective system, or even remotely comparable gusts speeds. COSMO-1 initialized at 06 UTC

16 June

An intense SSW jet stream crossed the Alps, leading to very strong wind shear. This was a moderately warm, but dry setup north of the Alps with typical T/Td of 28/14. A number of supercells developed over eastern Bavaria, which were accompanied by large hail (up to 4 cm diameter). Other important storms with very heavy rainfall and wind damage developed between Milano and Lake Como.

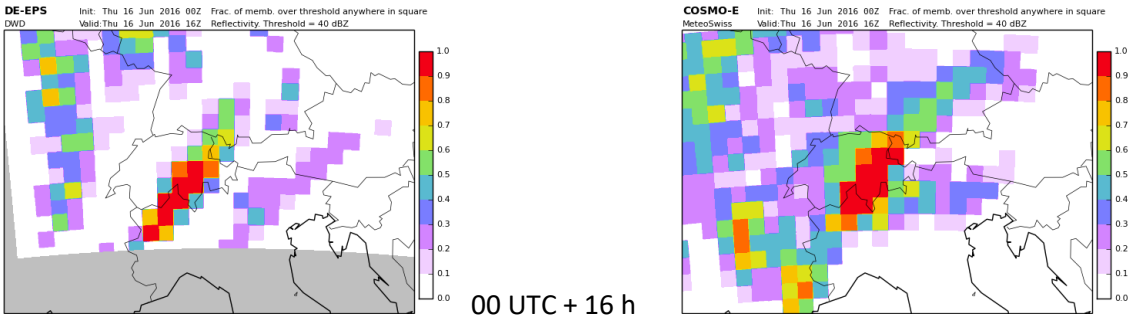
Radar/satellite image 16 June 1600 UTC with ESWD reports (green triangles = hail with diameter in cm; yellow rectangles = wind damage; blue circles = heavy rainfall causing flooding)



The forecasts of reflectivity for that afternoon from the ensemble system from 00 UTC looked like this:

Fraction of members over 40 dBZ in 40 x 40 km square

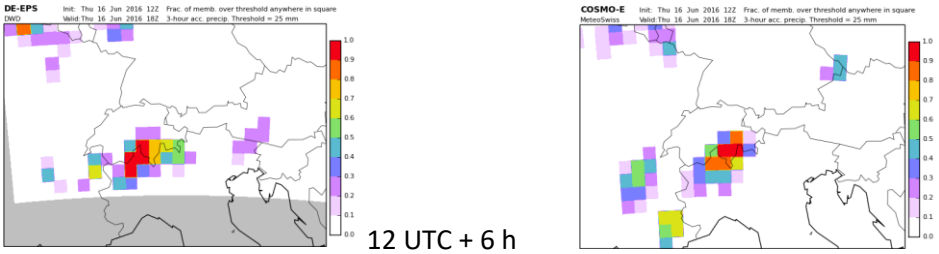
COSMO-DE-EPS **COSMO-E**



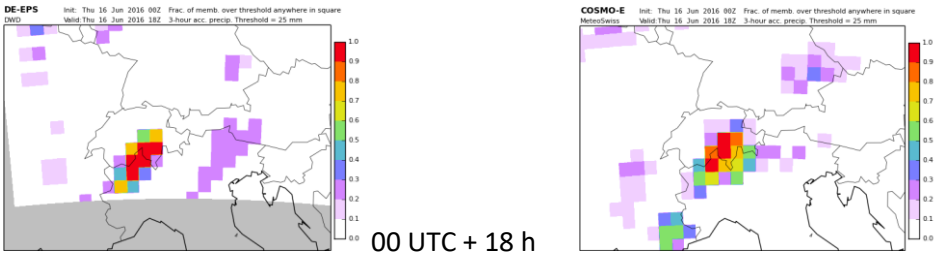
00 UTC + 16 h

The storms across Italy and Switzerland were quite well-forecasted, although the location was a bit too far to the NW. COSMO-E was more confident about the storms across Eastern Bavaria. Regarding 3-hourly rainfall, the models also gave clear signals, although the location was still a bit off even in the +6 hour forecast:

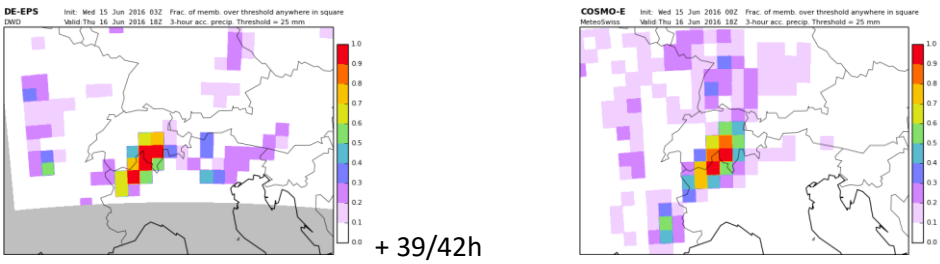
COSMO-DE-EPS **COSMO-E**



12 UTC + 6 h



00 UTC + 18 h

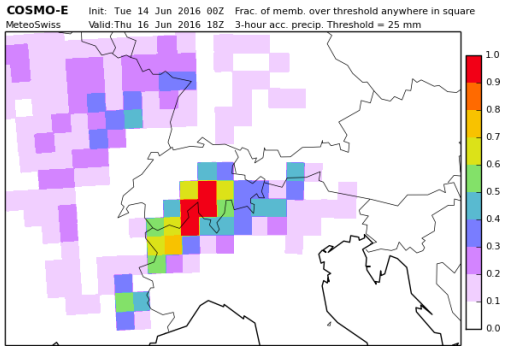


+ 39/42h

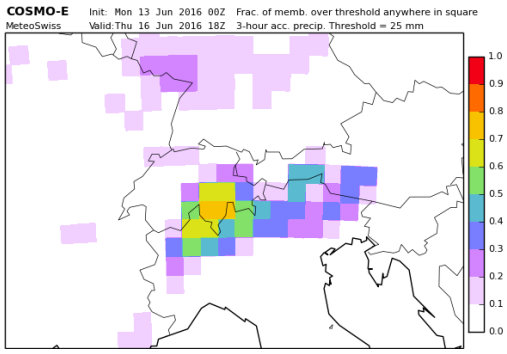
At 39 (COSMO-DE-EPS) to 42 (COSMO-E) hours ahead, the forecast is almost of the same quality as 6 hours ahead, indicating that this case was **very predictable**.

At even longer lead times, the COSMO-E had these forecasts, that indicate predictability beyond two days, at least for the storms across northwest Italy.

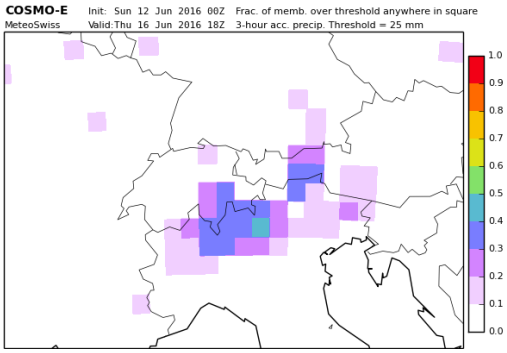
+ 66 hours:



+90 hours:



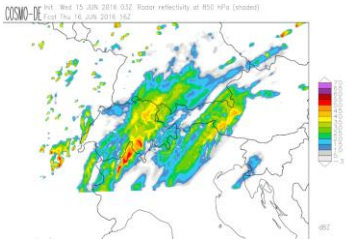
+ 114 hours:



The deterministic COSMO models showed an interesting trend, namely that the storms over Bavaria, which were more-or-less accurately forecast regarding coverage and intensity in the COSMO-DE and -1 runs of 03 UTC and 06 UTC, disappeared in the 09 and 12 UTC runs.

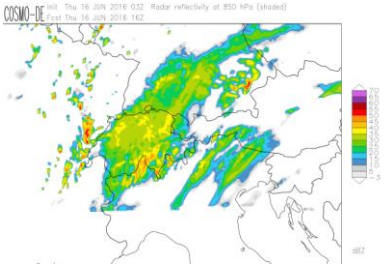
COSMO-DE **COSMO-1**

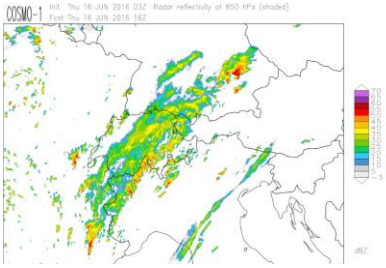
Simulated reflectivity



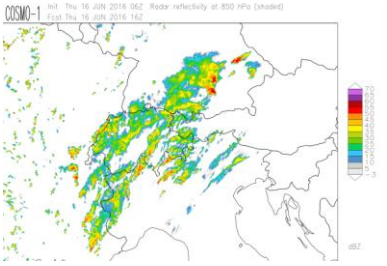
03 UTC + 37 h n/a

n/a 12 UTC + 28 h

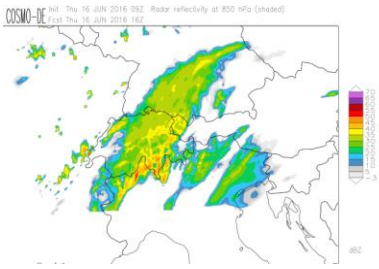


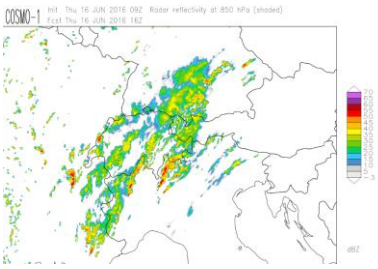


03 UTC + 13 h

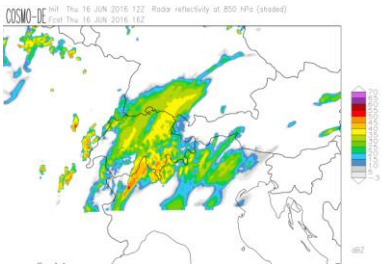


n/a 06 UTC + 10h

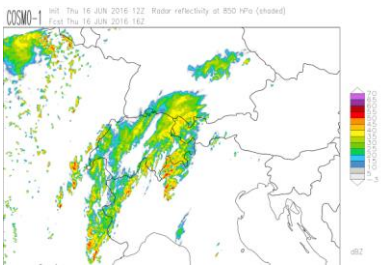




09 UTC + 7h



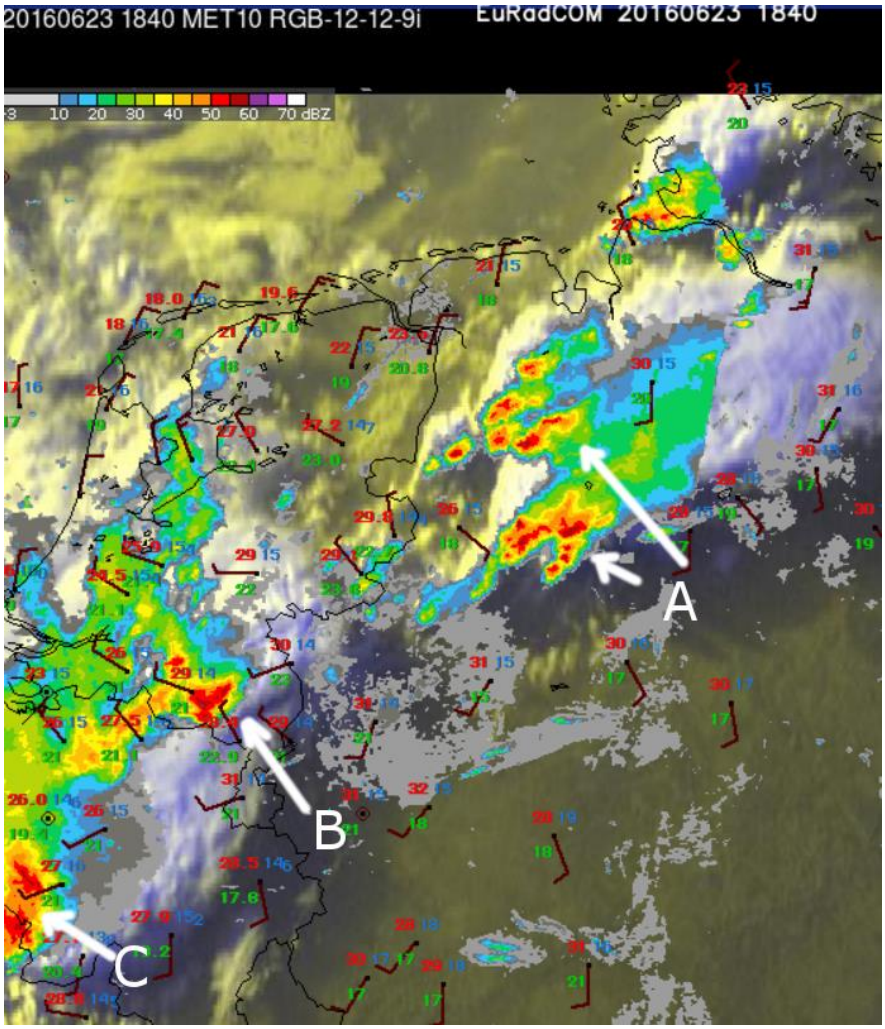
12 UTC + 4h



23 June

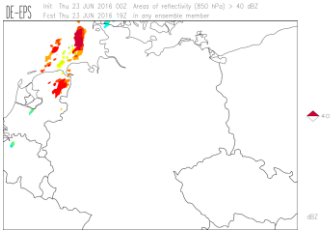
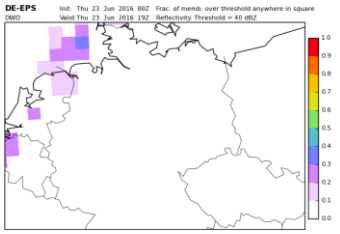
On 23 June, very warm and somewhat humid air (T/Td ~ 32/17) was located across Germany. A number of storms developed across western Germany during the late afternoon and early evening (labelled A). A number of strong supercells (B, C), one with a long track of hail up to 9 cm in diameter (B) moved across the far SE Netherlands into Germany within a zone of low-level convergence. Ahead of these storms the dew point rose up to 22-23 °C, leading to CAPE of 2000-3000 J/kg.

Radar, satellite and surface observations 23 June at 1840 UTC:

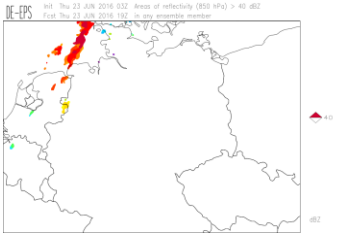
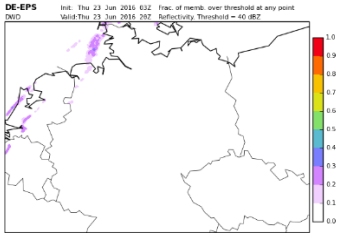


Performance of COSMO-DE-EPS

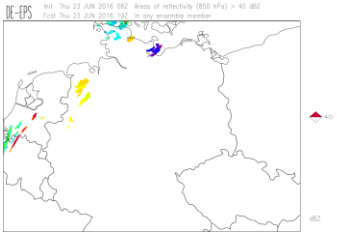
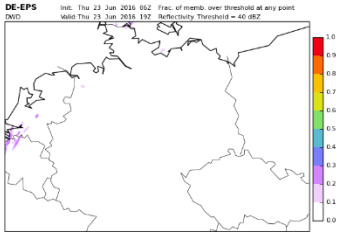
Reflectivity members **Reflectivity fraction in square**

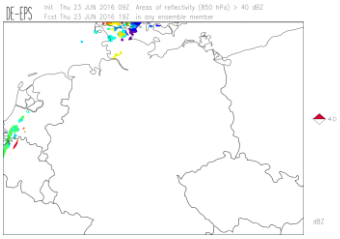
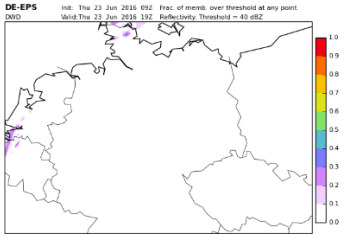
00 UTC +19 h

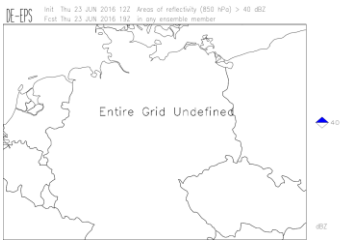
03 UTC +16 h

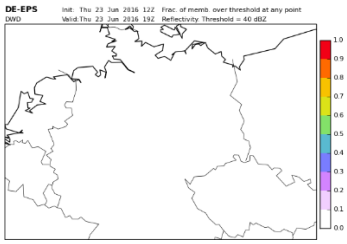



06 UTC + 13 h

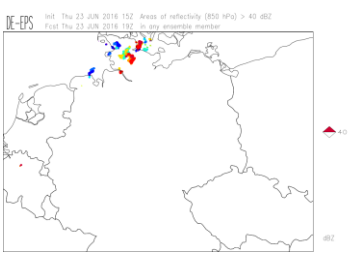
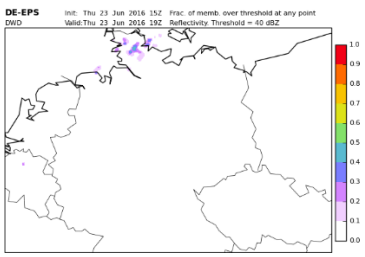



09 UTC + 10 h





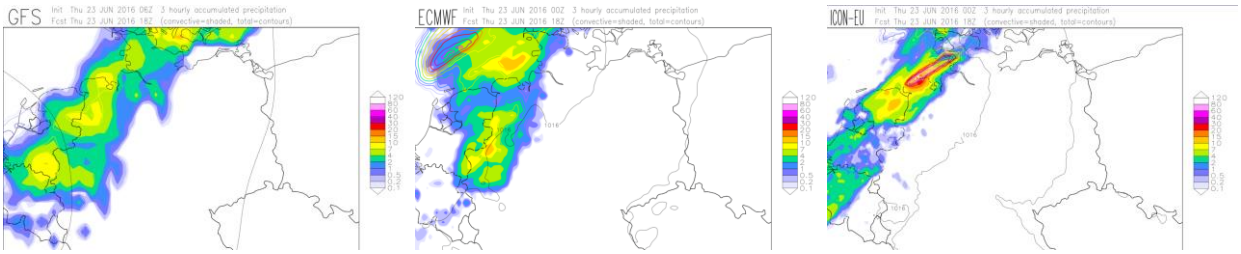
12 UTC + 7 h

15 UTC + 4 h

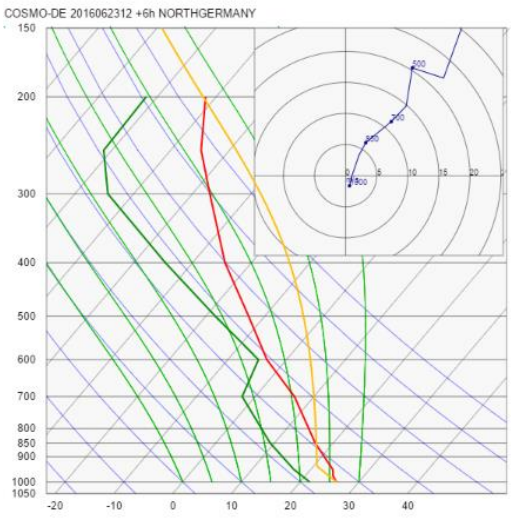
COSMO-DE-EPS was not able to produce any of the storms over Germany, Belgium or the Netherlands and fully missed the supercell. The situation reminds strongly of the Bow-echo across the Ruhrgebiet on 9 June 2014 and a number of less severe similar situations that were reported on in previous Testbed reports.

Coarser models that parameterize convection, did predict precipitation in roughly the right area between 15 and 18 UTC. These are the 00 UTC initialized forecasts of the global models GFS, ECMWF and ICON-EU:

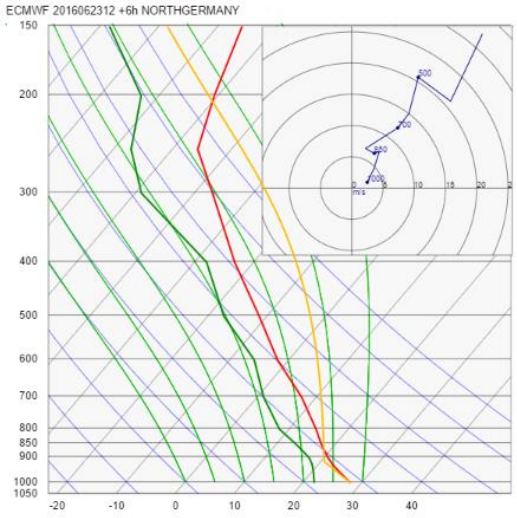


The following image shows a point sounding taken at 18 UTC at the location of storm B, according to COSMO-DE and ECMWF. The boundary layer is moister in ECWMF (and GFS, not shown), with lower resulting CIN. This hints that the boundary layer parametrization may have been an important difference.

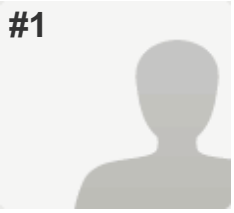
COSMO-DE



ECMWF IFS



Appendix: Participant feedback collected through questionnaires



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Started: Wednesday, June 08, 2016 2:24:46 PM
Last Modified: Wednesday, June 08, 2016 3:04:32 PM
Time Spent: 00:39:46
IP Address: 80.109.154.58

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Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

(7.6.2016, N Germany)
Convective initialization was widely predicted, the EPS was performing better with the 9 UTC model run, which was the nearest to the event. The exactly position was slighty shifted, but not without a preferred direction. It was suspicious that even COSMO DE than EPS developed the cells faster than they appeared (~2-3 h)

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?

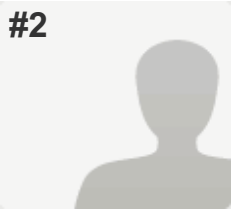
Respondent skipped this question

Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.

No, the spatial detection does not work very well (07.06.2016, NW Germany), some regions are fit, but the most are overestimated and some are not even detected (NRW). It is not an improvement compared to have a look at the reflectivity and precipitation.

Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?

Respondent skipped this question



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Last Modified: Wednesday, June 15, 2016 2:54:35 PM
Time Spent: 00:16:01
IP Address: 80.109.154.58

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Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

Event 14th June 2016, N Italy:
Very good performance over NW Italy for storm initiation at around 18/19 UTC. Line of storms is well reproduced even with a lead time of about 18 hours (run of 14th June 00 UTC). Good coverage and intensity, also good performance with respect to storm dissipation later on (22 UTC).
Very poor perfoemance over NE Italy. Way too strong storms, and precip, even in the last model runs. Problem: Cool boundary layer not captured by model. SDI and Lightning potential index do not give a better guidance in this case.

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?

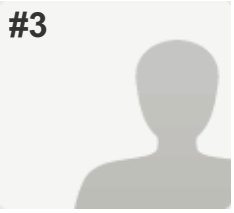
We prefer fraction of members anywhere in squares.

Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.

We prefer fraction of members anywhere in squares.

Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?

COSMO-DE-EPS has rather small-scale features that are difficult to analyse in the current chars. Maybe one could enable a zoom function or switch to smaller domains. Other suggestion is of course to use the fraction of members anywhere in squares.



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Last Modified: Wednesday, June 15, 2016 2:56:33 PM
Time Spent: 00:37:37
IP Address: 80.123.96.222

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Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

We especially looked at the Frankfurt flooding of Tuesday 14th of june. The Cosmo-DE-EPS was actually quite accurate. There was in indication of larger amount of rain (>30 mm/hr, 40-60 mm in 3 hours) in the area. Timing was also quite good. We watched several runs; they were quite constistent.

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?

For small scale phenomena (single cell showers) the square visualisation is better, because it makes the chances higher; the potential is easier recognized. If one lookes only at one grid points (the point chances), then the changes are very low and the forecaster is not alerted. The Frankfurt flooding case showes this very good.
We used all the parameters during the first testbed days.

Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.

It is helpful, although we didn't use it allready very much during testbed/ What would also be helpful to get an idea for the fraction of cloud-ground lightning.

Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?

The EPS seems usefull.

#4

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Thursday, June 16, 2016 3:36:22 PM
Last Modified: Thursday, June 16, 2016 3:42:16 PM
Time Spent: 00:05:53
IP Address: 80.109.154.58

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Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

The cosmo DE EPS from 20160615 09 UTC showed a propability of 100 % for gusts higher than 25 m/s in the region Ulm, Memmingen, Ravensburg for 14 UTC. The main run didnt show anything even near to that. ----> NO stronger gusts were registered.

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?	*Respondent skipped this question*
Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.	*Respondent skipped this question*
Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?	*Respondent skipped this question*

#5

COMPLETE

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Started: Friday, June 17, 2016 12:06:44 PM
Last Modified: Friday, June 17, 2016 12:42:25 PM
Time Spent: 00:35:41
IP Address: 80.109.154.58

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Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

For 0000 UTC 16 June initialization of the DE-EPS (DE not available), the depiction of the weak convection over northern Italy into Switzerland was handled very well, but the initiation of the isolated storms over Bavaria from 1400 to 1500 UTC was about 2 hours too late. The cluster of supercells that formed over the Czech Republic between 1500 and 1600 UTC was missed entirely. The forecasts did depict the additional storm to the northwest of the initial supercell over Bavaria that moved into the Czech Republic, but also developed storms over northern Austria that never happened through 2000 UTC. Otherwise the forecasts handled the nearly stationary storms over northern Italy fairly well, as well as the additional initiation over northeastern Italy by 1900 to 2000 UTC. The 03Z, 06Z< 09Z, and 12Z cycles of the DE-EPS had very similar forecasts, except for an even later initiation of the storms over Bavaria. The 12Z initialization had a little more aggressive initiation over Bavaria, but still late and confined to the cold front. Still nothing over the Czech Republic and east of the main convergence line. The 09z and 12Z cycles of the DE were very similar to the EPS guidance....pretty poor depiction of the convective evolution and initiation away from the terrain-induced convection over northern Italy.

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?

Maximum reflectivity is misleading. It's hard to determine how widespread the convection really is among the ensemble members. We much preferred the fraction of members display (the blocks). SDI, wind gusts, and graupel depictions from the deterministic run is fine, but a depiction of these parameters from the EPS would be helpful.

Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.

It's not clear that we get additional information out of this parameter compared to just looking at reflectivity. It would be interesting to see if this parameter could distinguish storms will ordinary lightning activity from very high lightning activity. It did seem to have high values with the intense storms over northern Italy, and lower values elsewhere.

Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?

Dump the maximum reflectivity. Add probability displays of severe weather proxy variables (SDI, wind gusts, graupel).

#6

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Wednesday, June 29, 2016 2:47:14 PM
Last Modified: Wednesday, June 29, 2016 3:53:11 PM
Time Spent: 01:05:56
IP Address: 80.109.154.58

PAGE 1

Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

Super cell:
Area of comparison: Netherlands & northwestern Germany;
time: 2016-06-23: 12:00 - 20:00
model run: 2016-23-06 06Z
Verification for SDI:
The SDI gives you more confidence that a strong event will occure, but it will not gives you the exact location or coverage.

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?

2016062306 run:

reflectivity:
fraction of members exceeding the threshold (MET) &
fraction of members exceeding the threshold within each square (METS)
reason:
a good estimate to see the probability of an event.
we dont like the maximum of any members (MAM);

super cell detection index:
Here we like the MAM as well as the METS, because the features are so isolated that a certain amount of overforecasting inherent to these products is not so bad. In contrast, in the MET and there is little to see for such isolated events. For METS we suggest a new color scale giving colors already at much smaller values than 0.1.

wind gusts:
MAM gives very widespread signals but perhaps an indication of the maximum to be expected within a larger area.
All members exc. thresh. (AMET) did show very little, maybe because missing colors for values <0.1.
METS also showed little, but also maybe due to missing colors <0.1

graupel:
hard to verify and we are not sure for what this product could be used. We have LPI for lightning and VIL for hail, but maybe we overlook something.

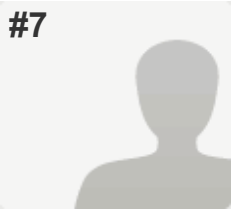
precip accum:
MAM: overforecasting, maybe dangerous, but may give you an indication of the absolute maximum in a region.
Here ensemble mean would be better.
AMET: we like this product, because we can identify single members and their time history during the last hour.
MET and METS are also useful.

Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.

2013062306:
METS and MET could be useful if color scale adjusted to start much lower < 0.1 because of the spottiness of single events
Otherwise, it catched the flash area reasonably well :-)

Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?

- the 06 and 09 runs seem to be better for afternoon convection than the 12, 15 and 18 UTC runs.
- METS and MET products should have color scales starting well below 0.1 for such quantities like SDI or LPI because of the isolated nature of single-member signals.
- Visualization of the matrix of single members (Briefmarkenplot), consistently sorted by member number (combination of global model and physics perturbations), so as to be able to see systematic behaviours of single members.



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Started: Wednesday, June 29, 2016 3:22:04 PM
Last Modified: Wednesday, June 29, 2016 4:17:21 PM
Time Spent: 00:55:16
IP Address: 80.109.154.58

PAGE 1

Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

Example 24th June 2016: Strong thunderstorms, maybe supercells near Stuttgart, Baden-Wuerttemberg and also in France. Hail 5-9 cm diameter have been observed. COSMO-DE 00z missed the situation completely (Supercell Detection Index), 12z got a very good result in SW-Germany. Same result in Reflectivity.

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?

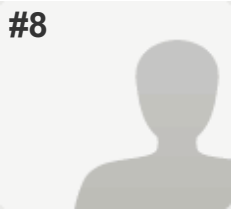
The maximum value is nice to know, but you do not know anything about the amount of members that produce this order of magnitude. Therefore, most of the time only a combination with other visualization techniques is useful.
The visualization with the individual members adds valuable information about storm structures within a member and what individual members contribute.
The 'squares' give good information about the fraction of members, and it gives a smoother result than the individual members.
The 'threshold' visualization barely shows high values, because the event is relatively small-scaled and the model is obviously not able to predict it on the very right spot. The forecaster mainly wants to know what areas are interesting to look at, not the exact point because that is simply impossible to know. So the 'squares' are more favourable.

Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.

It did not perform very well at the 00Z run, missing al the lightning activity in Germany. The 12Z run had better results, as we already have seen for other parameters (reflectivity, SDI, etc). The deterministic run did not show any LPI in both the 00/12Z runs, so the ensemble added valuable information.

Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?

Keep up the good work :)



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Started: Friday, July 01, 2016 11:21:30 AM
Last Modified: Friday, July 01, 2016 12:00:34 PM
Time Spent: 00:39:04
IP Address: 80.109.154.58

PAGE 1

Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

These comments are answering question about comparison of Cosmo-e and -eps in performance.

at 201606301200 the cosmo-E model initialization a N-S line of precip and convection existed over W Austia and S Czech Republic, however models had an E-W oriented area of convection along the Alps in Austria. The Global models were consistent with a N-S boundary setup for the past 2 days, so it is curious why the ensembles initialized with an E-W line of convection. The -eps model did much better than -e model picking up a line of convection in S Central Germany and the n-s boundary initiation in Czech/Austria in all runs we reviewed.

The 09Z ensembles were similar to the 12Z, however the 06Z model runs did pickup on the N-S oriented boundary in SE Germany that progress into Czech and Austria. The 06Z convective initiation was a few hours early along this boundary, but at least it existed. The Cosmo-e model handles this convection in NW Italian alps pretty well while none of the -eps models picked up any of this activity.

During the forecast period we did not think the environment was conducisive to supercells and never really looked at this index while making the forecast. Doing post evaluation we see the -e and to lesser extent -eps had supercell signal over the alps in Austria. Looking at radar and tracks there is not any good evidence these storm were rotating. This lowers our confidence in using this index in other events. Maybe this index is too sensitive.

The 10m wind gust product is helpful for determing the potential maximum wind gusts, especially in the maximum of any member display. But cannot be relied upon for location accuracy for same reasons stated above.

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?

Respondent skipped this question

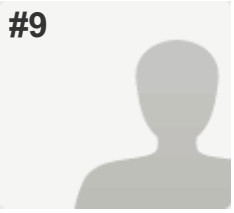
Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.

Generally, the value of the LPI is for need for locating the areas having potential for first lightning strikes, or for possible embedded convection in stratiform clouds. Accuracy of the LPI is very dependent on the models accuracy of convection initiation thus same comments from Q#1 apply on accuracy.

However, when expecting convective activity during summer months we don't find this product any more useful than others.

Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?

Respondent skipped this question



#9

COMPLETE

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Last Modified: Wednesday, July 06, 2016 3:01:50 PM
Time Spent: 00:19:03
IP Address: 80.109.154.58

PAGE 1

Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

We compared the C-DE ENS runs from 18, 21 UTC from the 4th and the 00 UTC run from the 5th to the Opera Radar Data, but we only looked at the Radar Data every 2 hours (12, 14, 16,... UTC). Location was good for all model runs, even though sometimes the model was off to the south. Timing was very good. Coverage was ok to very good depending on the run and the precise point in time. It is hard to generalize on this. 18 UTC run had something that looked more like usual rain instead of convective storms. Even though the model performed really well overall, it did produce cells that never existed and also missed a few on the other hand, e.g. in South Germany.

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?

We only looked at max reflectivity and fraction of members exceeding 40 dBZ, so we cannot really answer that. But we did notice that the fraction visualization highlighted the Italian/Austrian border a lot.

Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.

We did not evaluate it, no time, sorry.

Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?

Maybe a median of model reflectivity would be useful. The maximum makes you believe the storms will be stronger than they actually will be. You have to keep in mind it is the max reflectivity all the time.

#10

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Wednesday, July 06, 2016 2:33:43 PM
Last Modified: Wednesday, July 06, 2016 3:06:44 PM
Time Spent: 00:33:00
IP Address: 80.123.96.222

PAGE 1

Q1: How accurate was the timing, location andcoverage ofconvective storms, in particular as a function of forecast lead time?

We did analyse the 2016-07-05 day event at the Alps. The model timing with forecasting the convective storms was the best when we analyse the model initiation data at 0900Z. The best lead time for convection was 9 hours ahead from model initialization. Model did well at forecasting storms location but there was some misses for eastern Bavaria and up to Czech Republic. Coverage was relatively good with the convective cores.

Q2: Which ensemble visualization has your preference for a particular parameter (reflectivity, SDI, wind gust, graupel, precipitation accumulations) and why?

The best for visualization was "Fraction exceeding the threshold within each square". Because the small fractions as "Fraction of members exceeding the threshold" gives hard to notice some of the severe events.

Q3: How useful do you find the Lightning Potential Index and how well does it perform? Please explain.

Most of the time, especially during the 9 hour lead time, this index did manage to forecast the severe storms but it was some downsides of forecasting single cell storms.

Q4: Do you have any additional comments/suggestions aboutthe COSMO-DE(-EPS) or their visualizations?

Respondent skipped this question