Severe weather warnings at the Hungarian Meteorological Service: Developments and progress

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Topics

- Limited area ensemble prediction by downscaling of ECMWF EPS forecasts
- Limited area ensemble prediction by downscaling of ARPEGE EPS forecasts
- Case studies
- Verification
- Future plans

Severe weather warnings
Available NWP products

ALADIN 0-48 h

ECMWF deterministic model 0-240 h

ECMWF EPS model 0-240 h

SRNWP PEPS

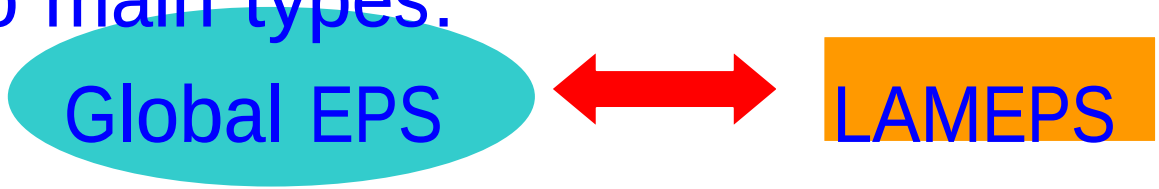
COSMO LEPS /some products/

Met Office, DWD, etc /some products/

Ensemble forecasts

- Probabilistic forecasts:

  predict not only the future state of atmosphere, but the probability of certain events as well
- Perturbed initial fields ⇒several forecasts
- Two main types:

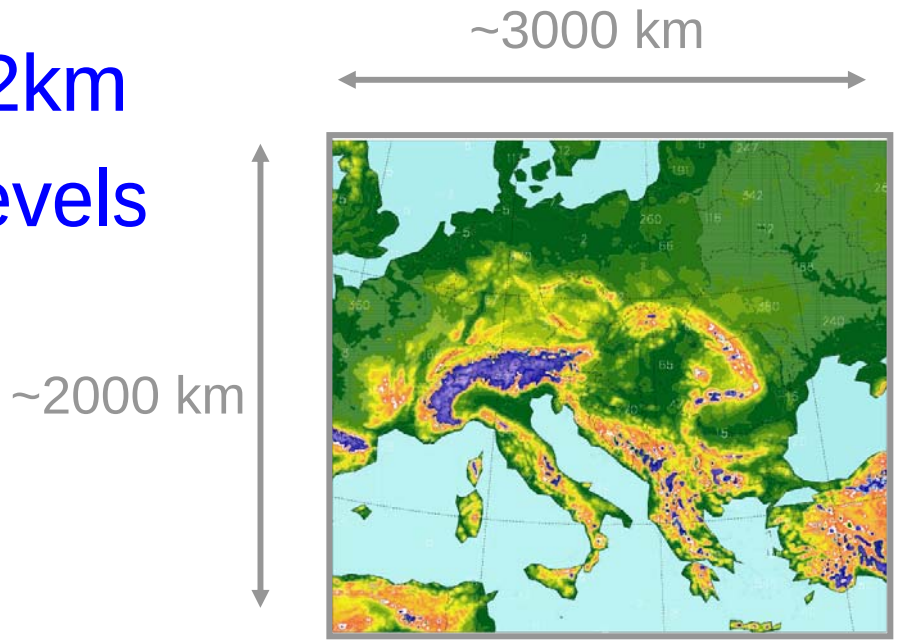


Case studies

- LAMEPS runs: forecasting extreme events
- Three case studies:
  - **18 May 2005** (cold front + supercell)
  - **11 July 2005** (mediterranean cyclone)
  - **22 August 2005** (mediterranean cyclone)
- Visualization:
  - EPS plume, meteogram, Extreme Forecast Index, etc
  - Stamp diagrams
  - Probability maps
- Verification:
  - Talagrand diagrams
  - ROC diagrams

ALADIN/HU model

- Model used: ALADIN (spectral) limited area model
- Horizontal resolution: 12km
- Vertical resolution: 37 levels



Limited area ensemble prediction by downscaling of ECMWF EPS forecasts

ECMWF/ALADIN LAMEPS

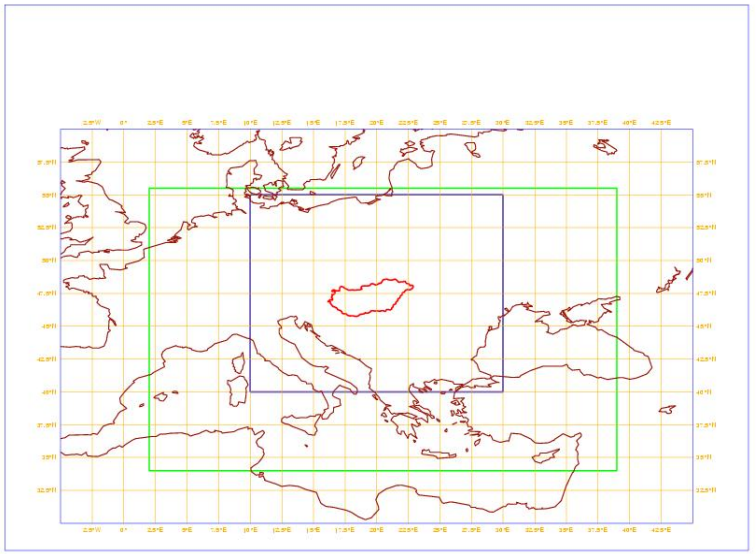
Global EPS
(50 members)

Clustering
(10 representative members)

ALADIN runs

Downscaling ECMWF EPS (2)
Clustering method

- Clustering: making groups of the ensemble members
- Hierarchical method
- Parameters: geopotential, relative humidity, wind components
- Levels: 500, 700, 850 hPa
- Clustering times: 12 UTC: +60, +84 h
  00 UTC: +72, +96 h
- Two clustering domains
- 10 clusters $\Rightarrow$10 representative members
- Three experiments:
  1) Bigger domain
  2) Smaller domain
  3) 100 members by joining the 00 UTC and 12 UTC ECMWF EPS runs



Limited area ensemble prediction by downscaling of ARPEGE EPS forecasts

ARPEGE/ALADIN LAMEPS

- Method:
  - direct downscaling of a global ensemble system with the use of the ALADIN limited area model (no local perturbations added!)
- The global ensemble system:
  - an ARPEGE based global short range ensemble system (called PEACE) running operationally at Meteo-France

Downscaling ARPEGE EPS(2)

- The initial perturbations of the global ensemble system are based on targeted singular vectors (SVs)
- What is the impact of using different target domains and target times during the global singular vector computation?

⇒Sensitivity studies with the use of different target domains and target times

- ARPEGE EPS then ALADIN EPS (coupled from the global ensemble members) integrations

Downscaling ARPEGE EPS(3)

Sensitivity studies

Target domains:

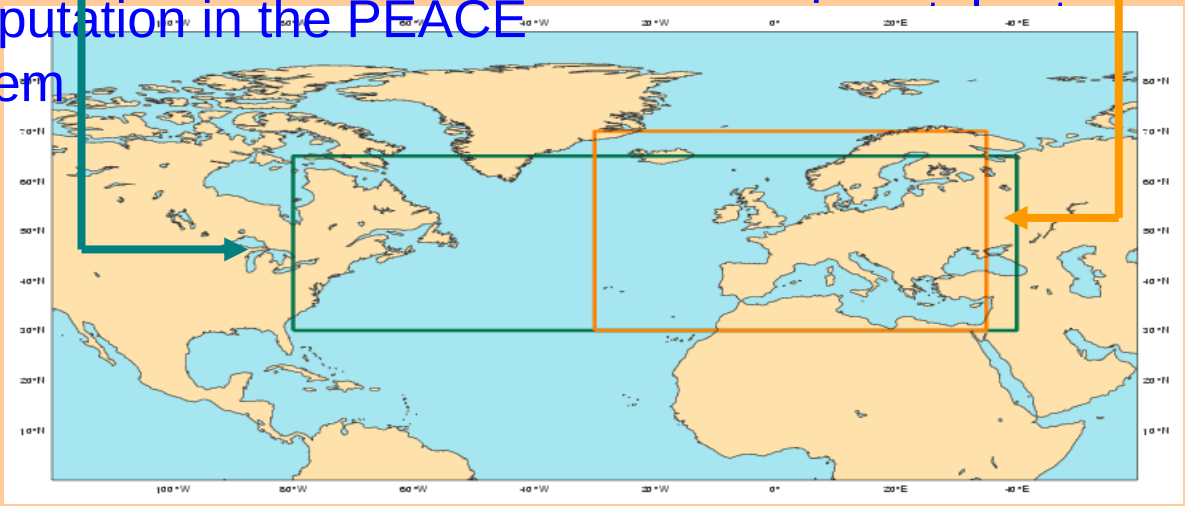
- **domain 1: Atlantic Ocean and Europe**
- **domain 2: Europe and some of the Atlantic Ocean**

Target times:

- **12 hours**
- **24 hours**

The target domain used operationally for SV computation in the PEACE system

The target domain used for SV computation in our



Downscaling ARPEGE EPS(4)
Sensitivity studies

Case studies (different meteorological situations)

Experiments for longer periods (10 days in the summer, 30 days in the winter)

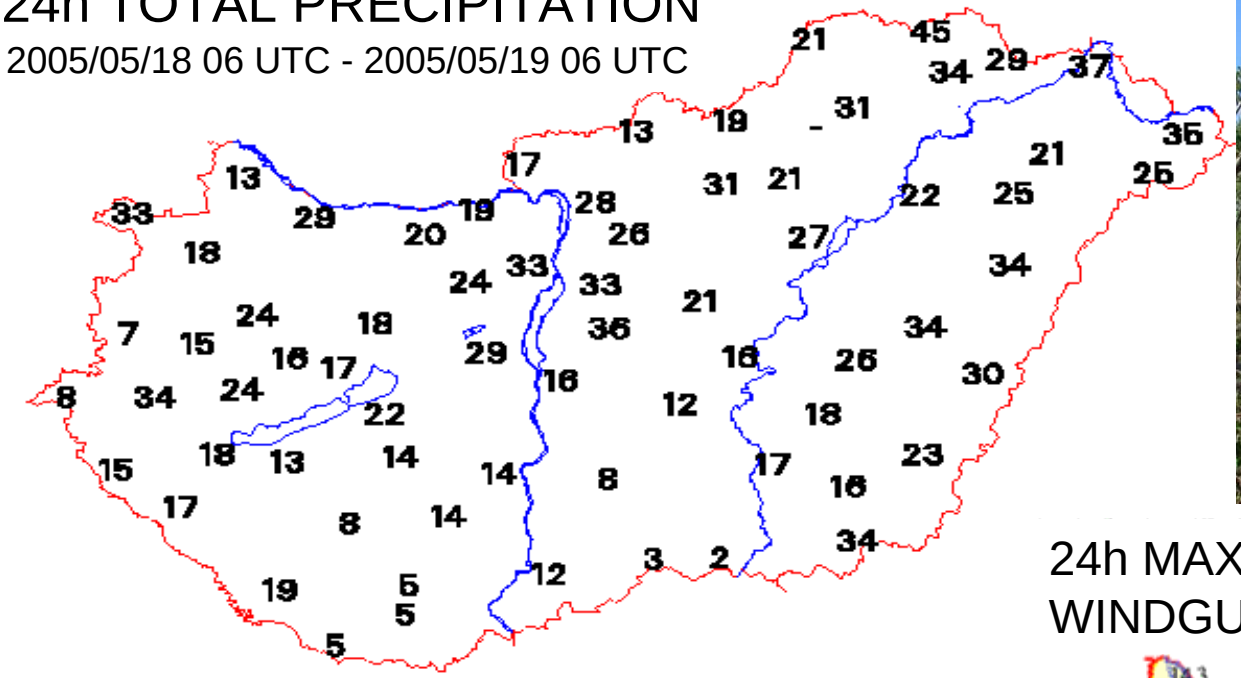
- **Large sensitivity was found in terms of both target domain and target time**
- ***Target time:***
  - **using 24h resulted bigger spread compared to the use of 12h**
- ***Target domain:***
  - **Using a very big target domain during the global SV computation resulted small spread in most cases**
  - **With the use of the smaller target domain we obtained bigger spread and improved forecasts as well**

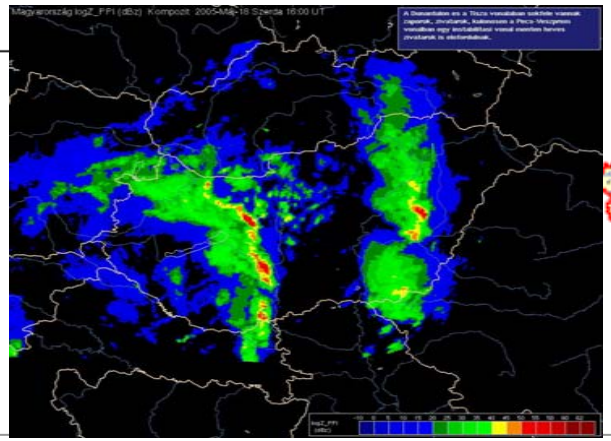
Case study **18 May 2005** (cold front + supercell)

OBSERVATIONS 2005/05/18

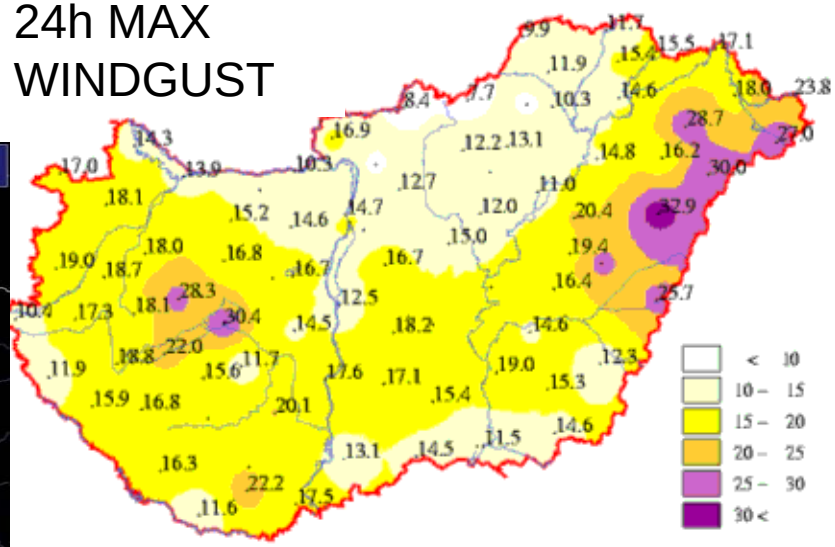
24h TOTAL PRECIPITATION

2005/05/18 06 UTC - 2005/05/19 06 UTC



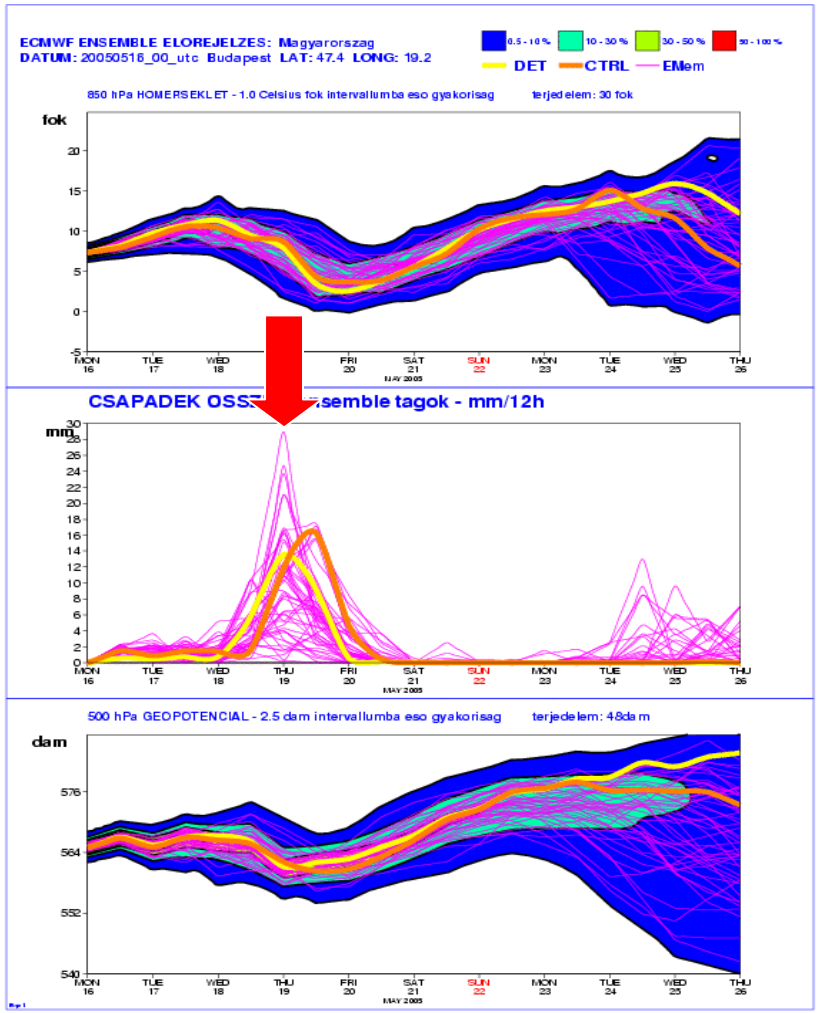


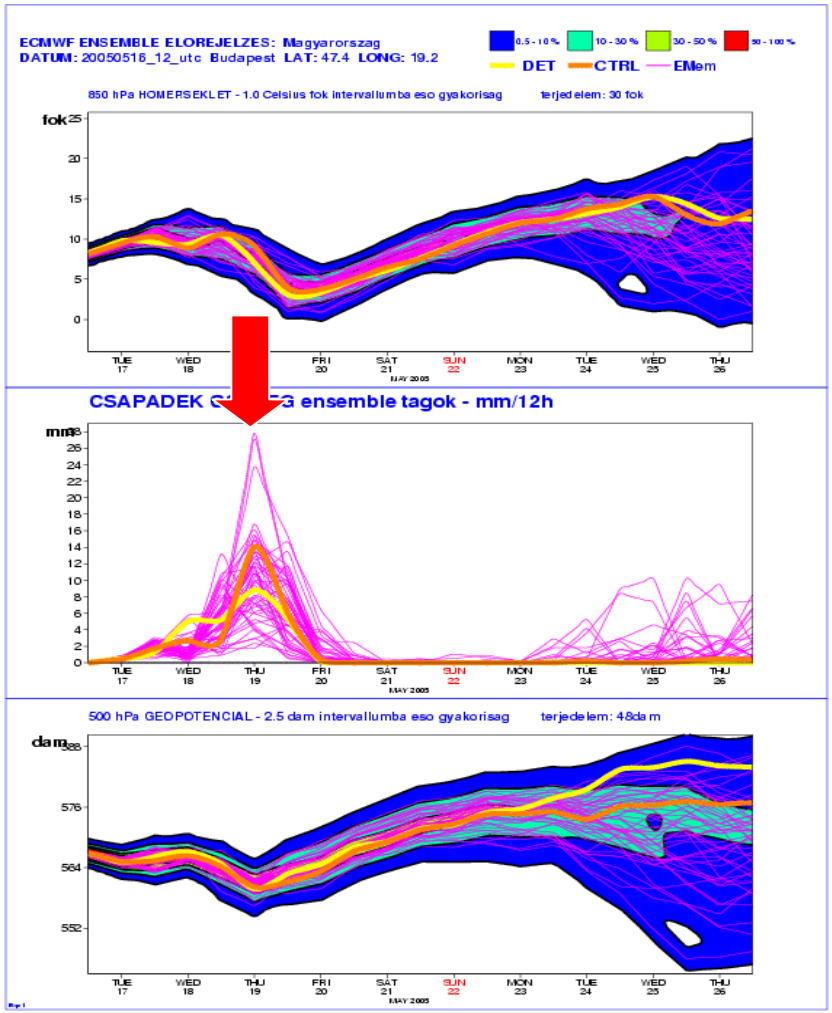
24h MAX WINDGUST



Case study **18 May 2005 EPS plume**

00 & 12 UTC 16 May 2005

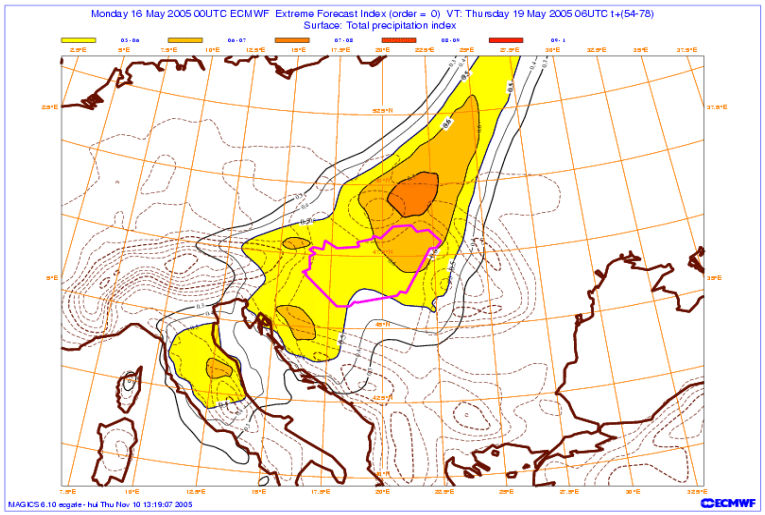




Case study **18 May 2005 ECMWF Extreme Forecast Index /EFI/**

00 & 12 UTC 16 May 2005

Precipitation



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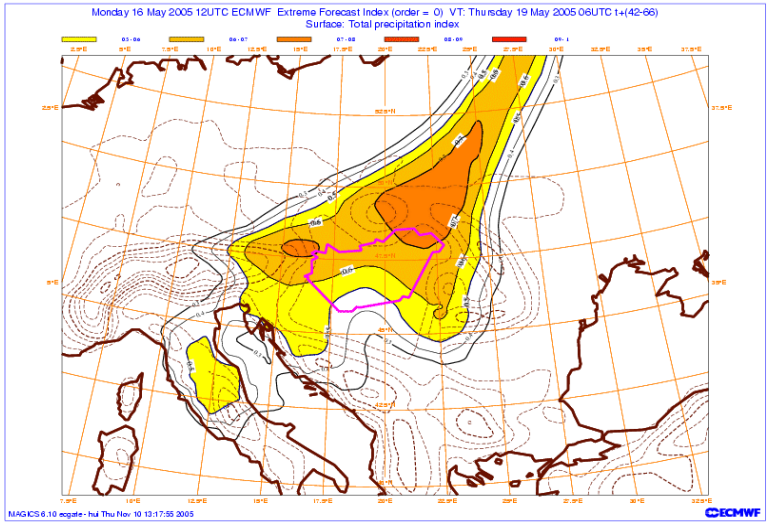
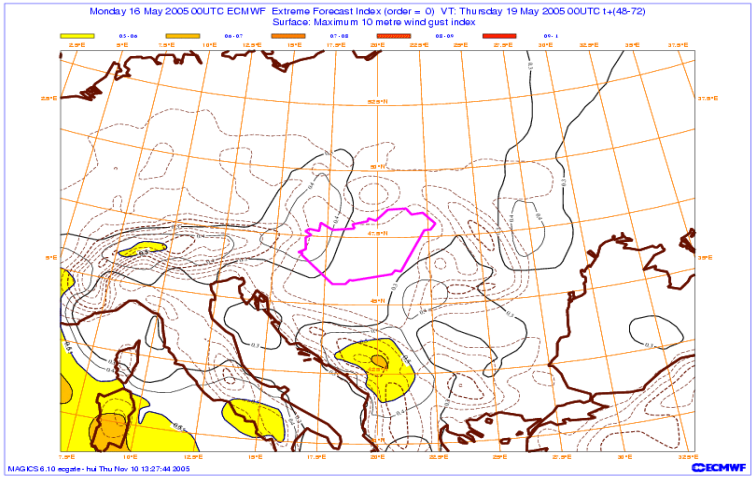
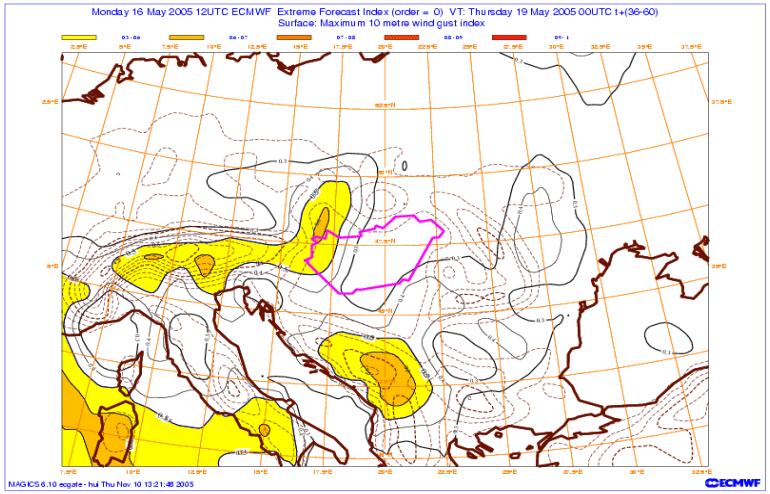


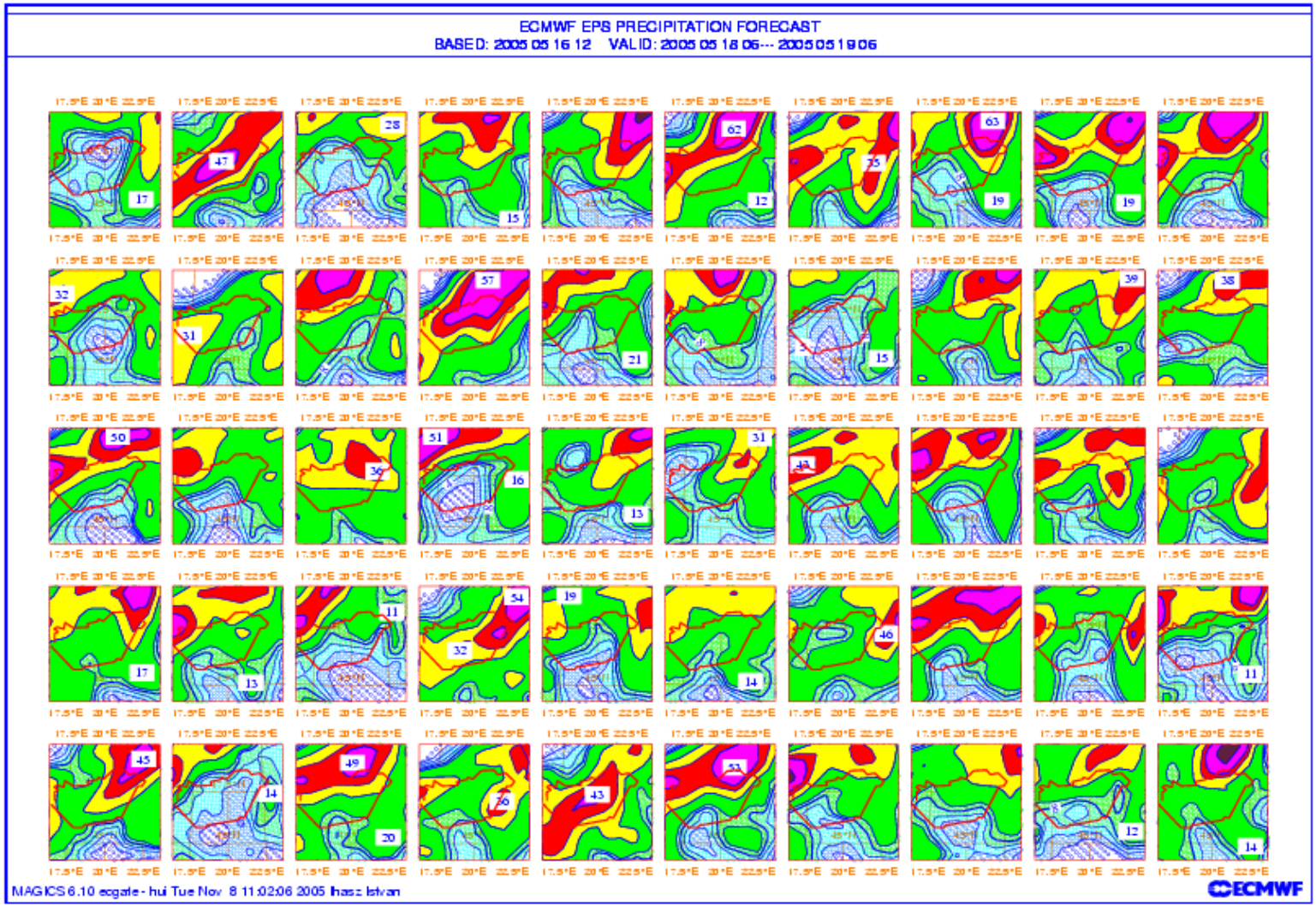
Windgust





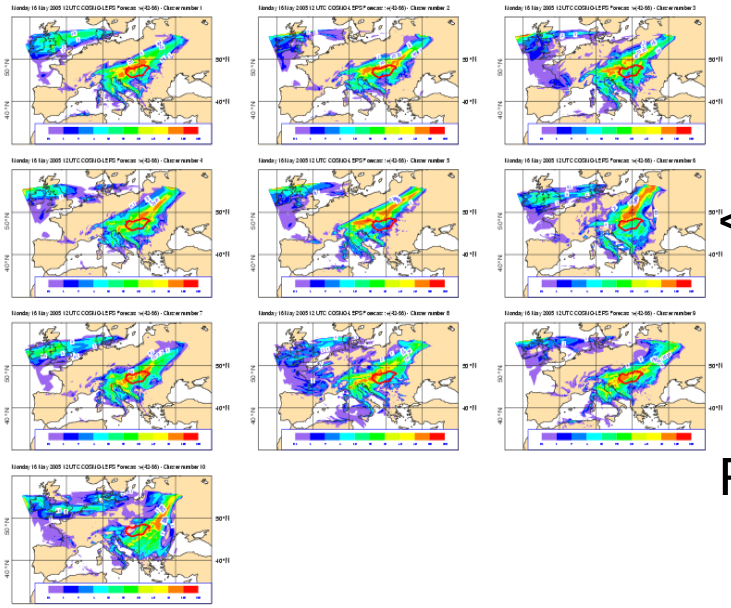
Case study 18 May 2005 ECMWF EPS stamp diagram

precipitation : 06 UTC 18 May 2005 – 06 UTC 19 May 2005



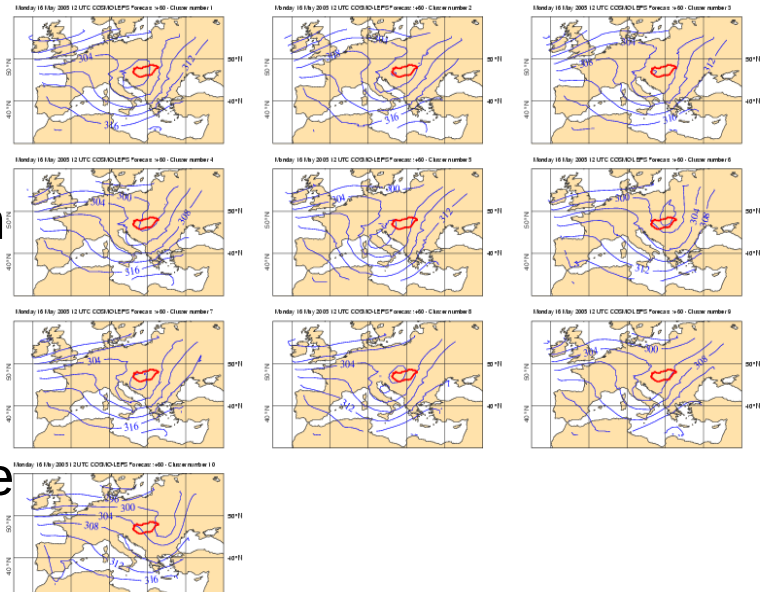
Case study: 18 May 2005, some COSMO LEPS products

Permission by Andrea Montani

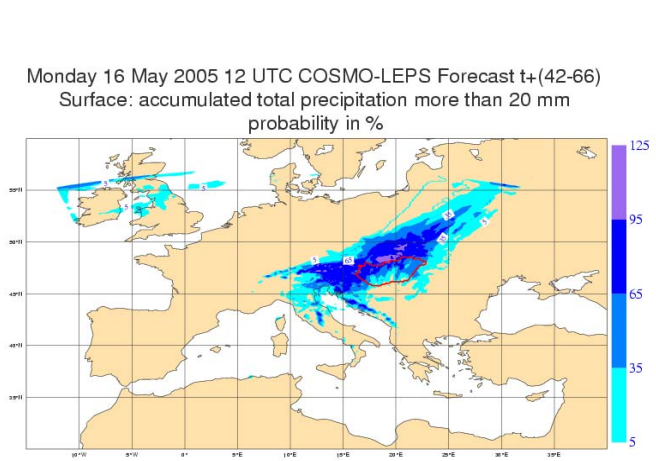


<-precipitation

700 hpa Z->



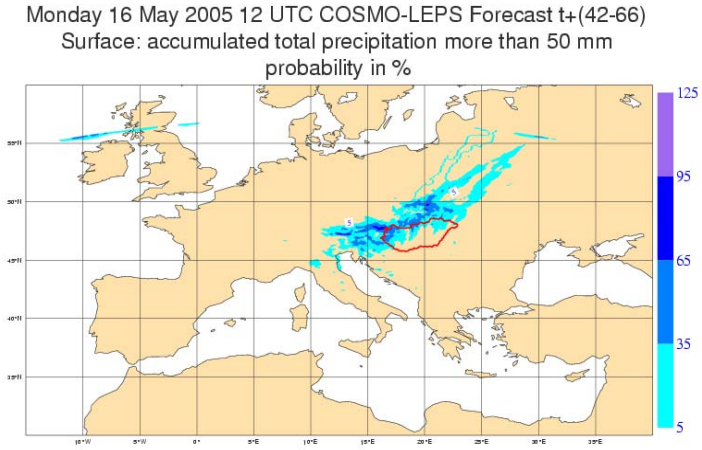
Representative members



Precipitation:

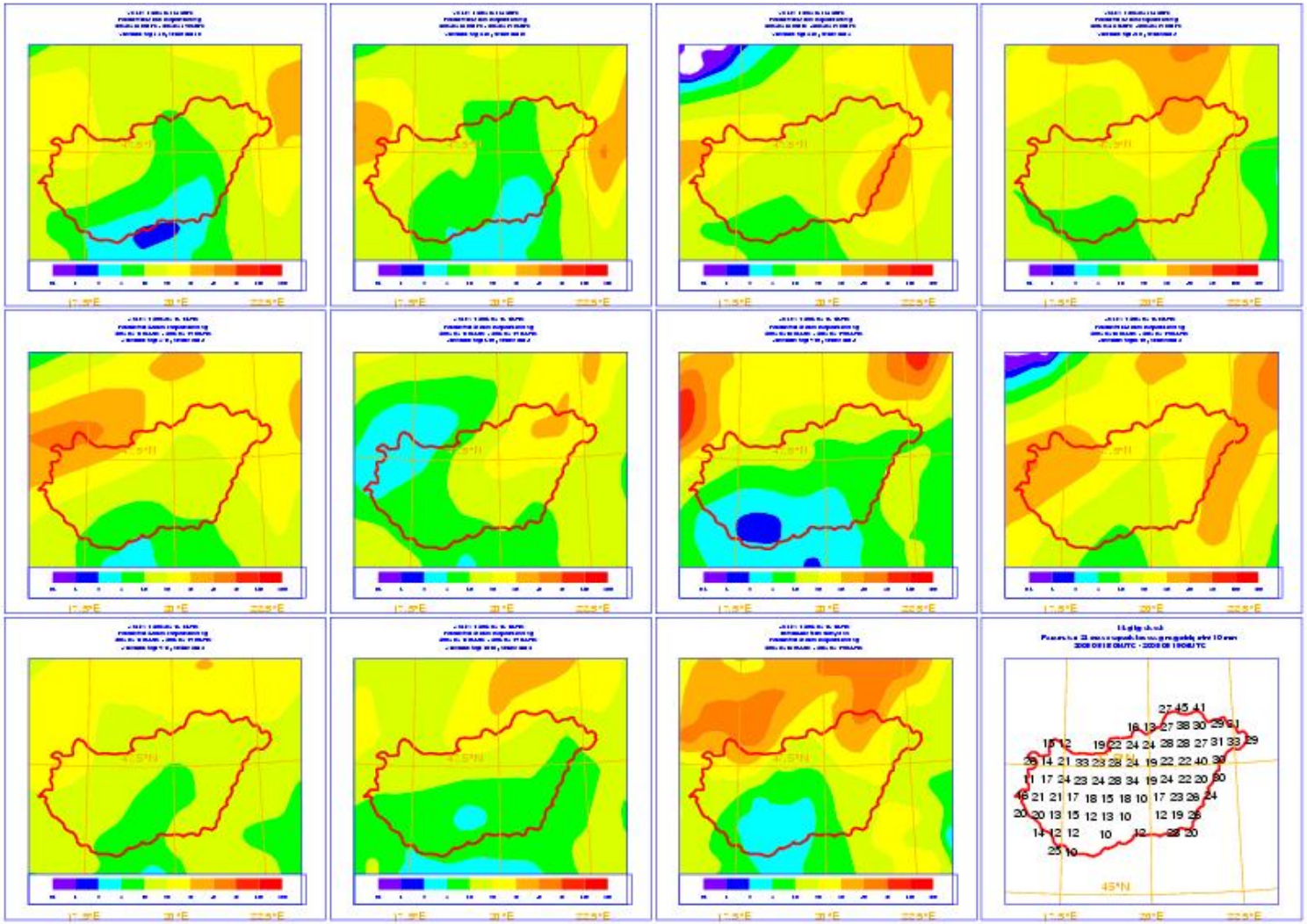
<-Prob 20 mm

Prob 50 mm ->



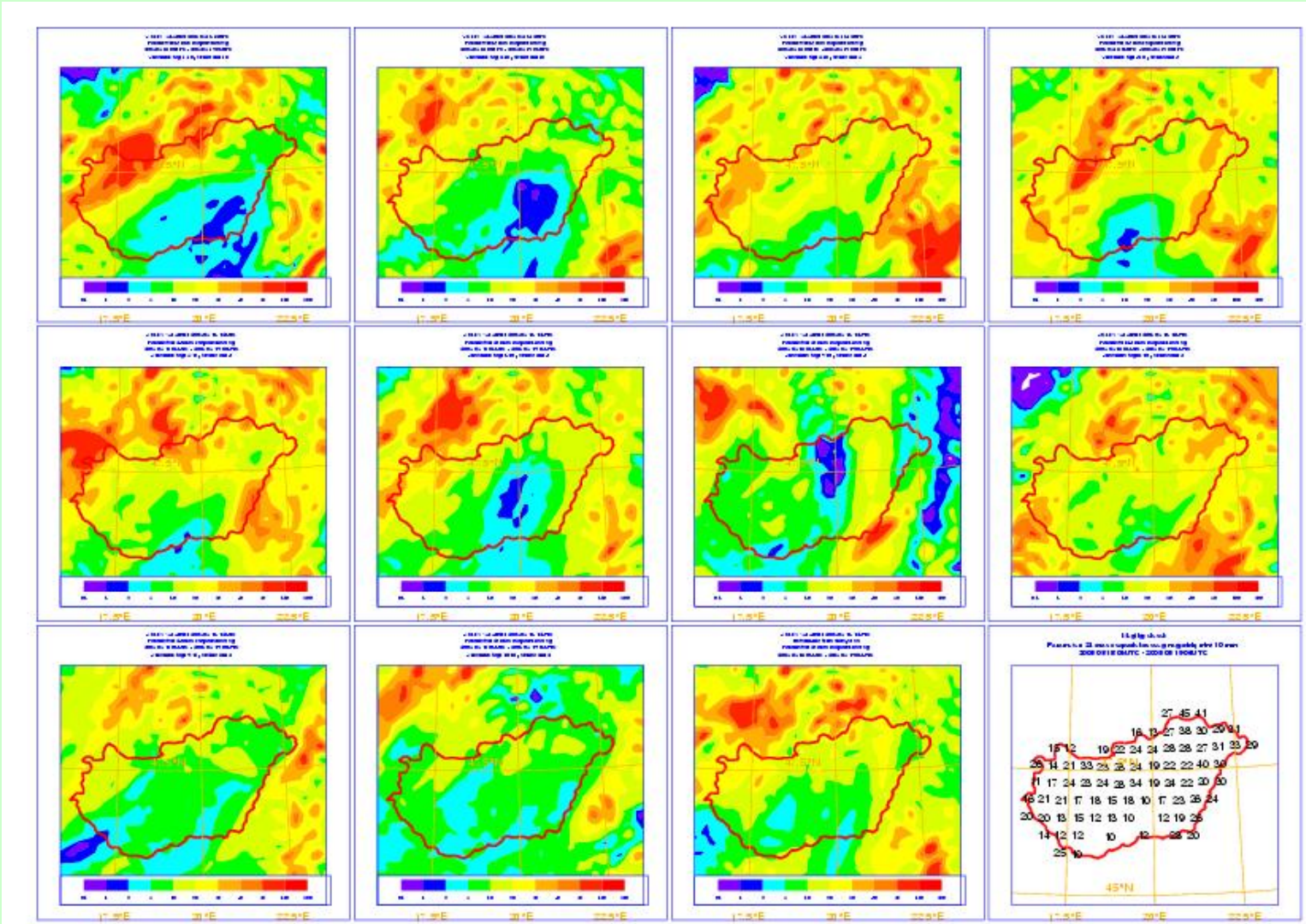
case study: 18 May 2005 ECMWF

precipitation of the ECMWF's EPS 10 representative member



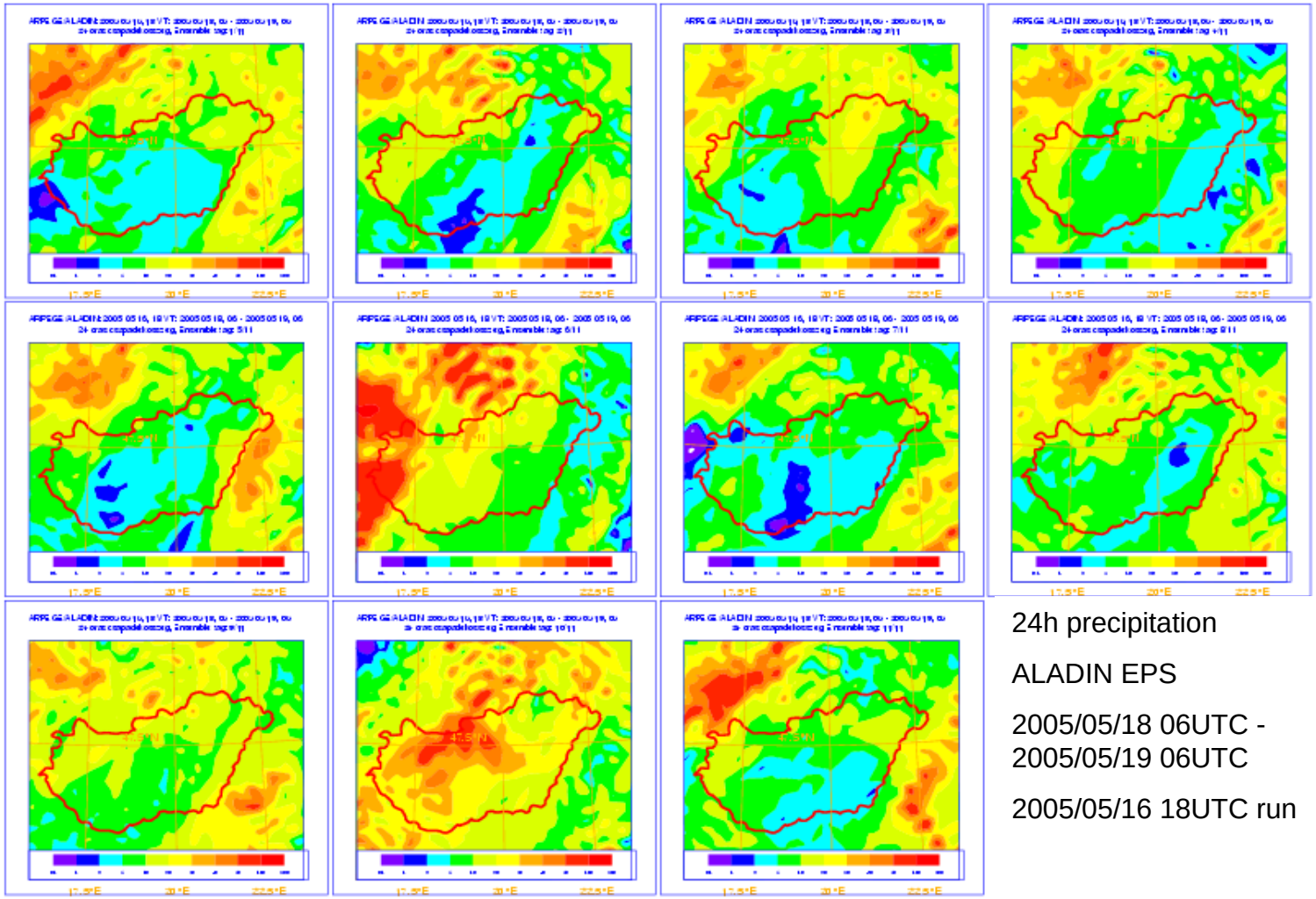
case study: 18 May 2005 ECMWF/ALADIN

precipitation of the ALADIN forecast



case study: 18 May 2005 ARPEGE/ALADIN

precipitation of the ALADIN forecasts



24h precipitation

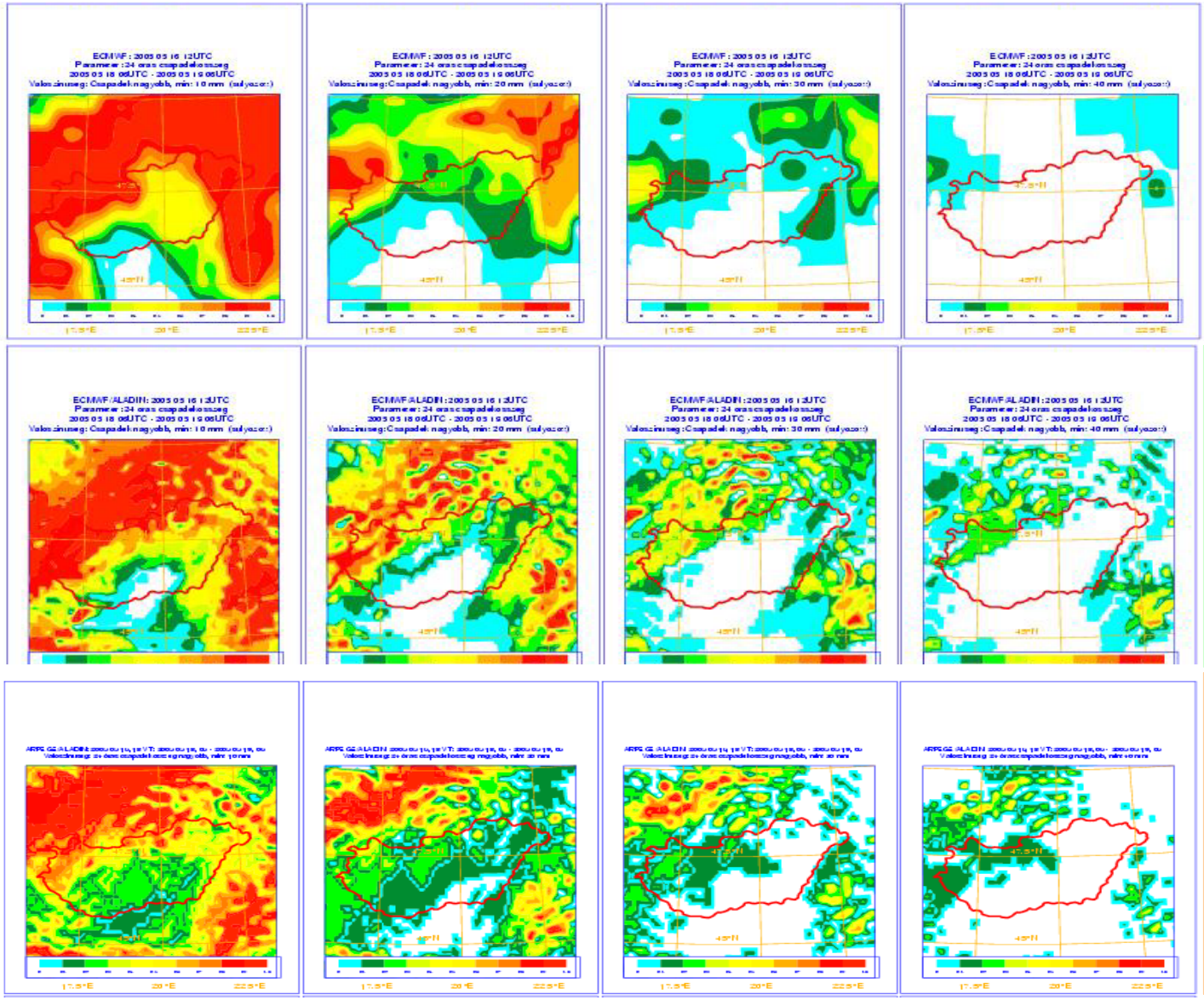
ALADIN EPS

2005/05/18 06UTC -
2005/05/19 06UTC

2005/05/16 18UTC run

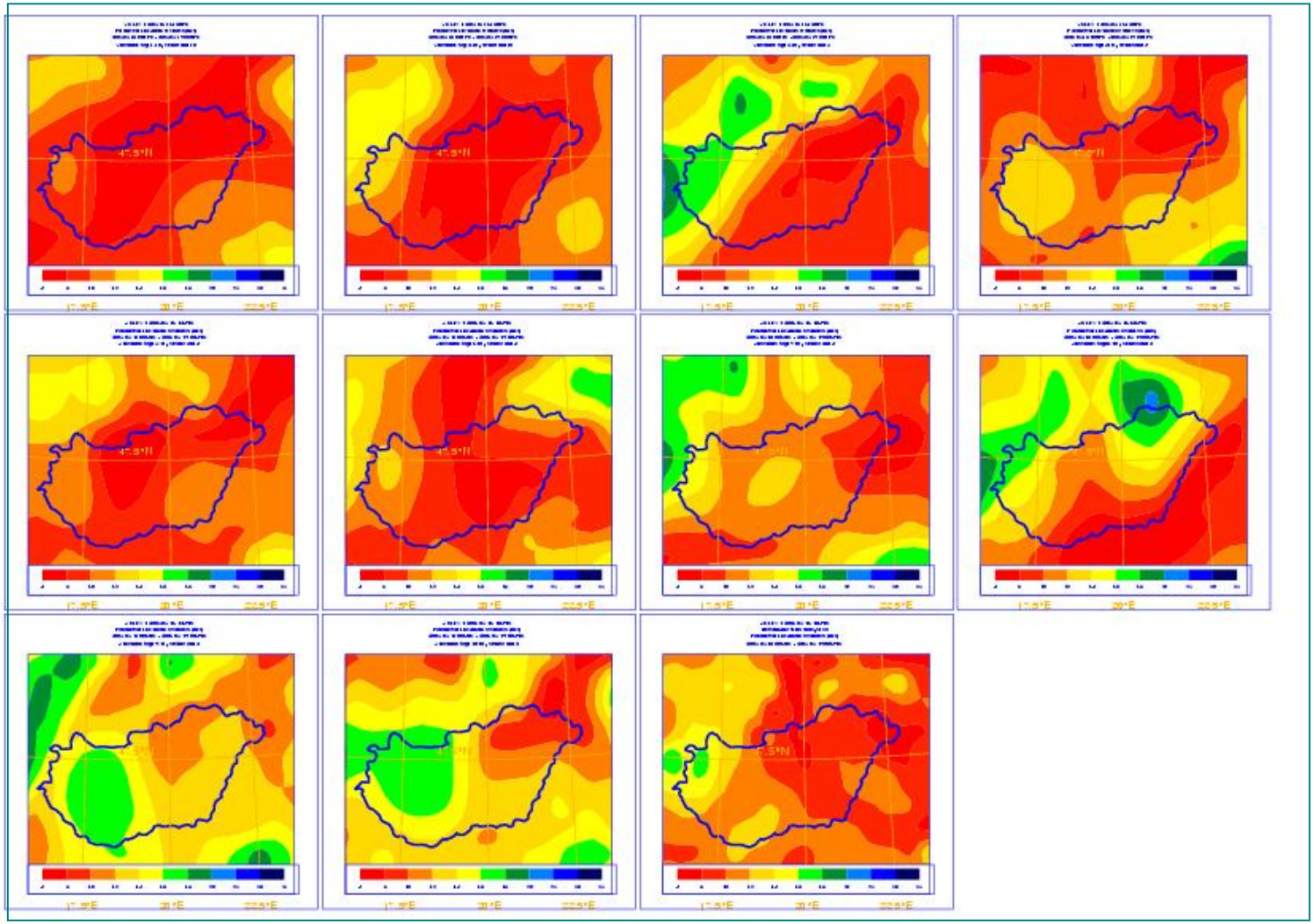
case study: 18 May 2005 ECMWF, ECMWF/ALADIN & ARPEGE/ALADIN

precipitation: probability charts /limit 10, 20 30, 40 mm< /



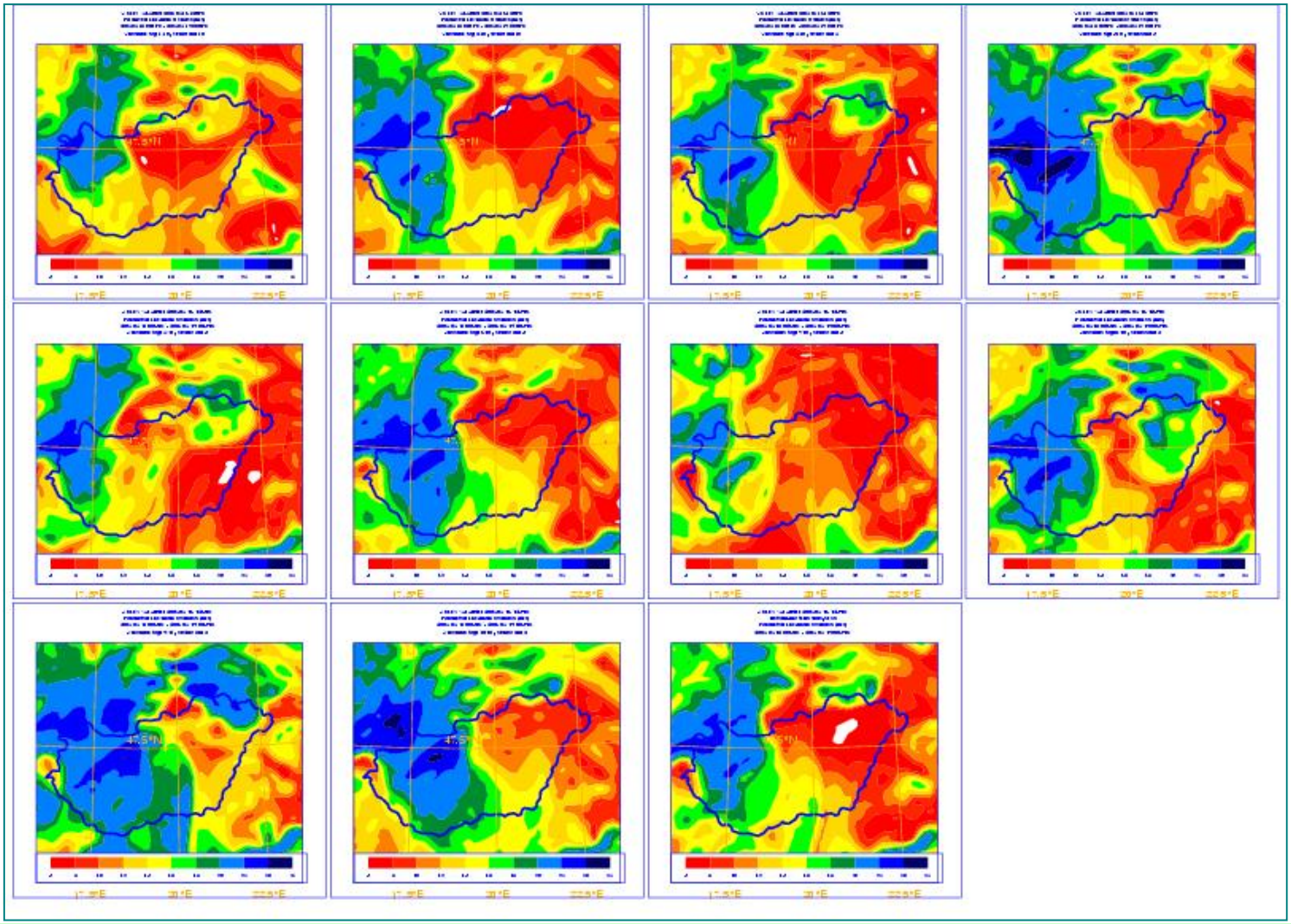
case study: 18 May 2005 ECMWF

windgust of ECMWF's EPS 10 representative member



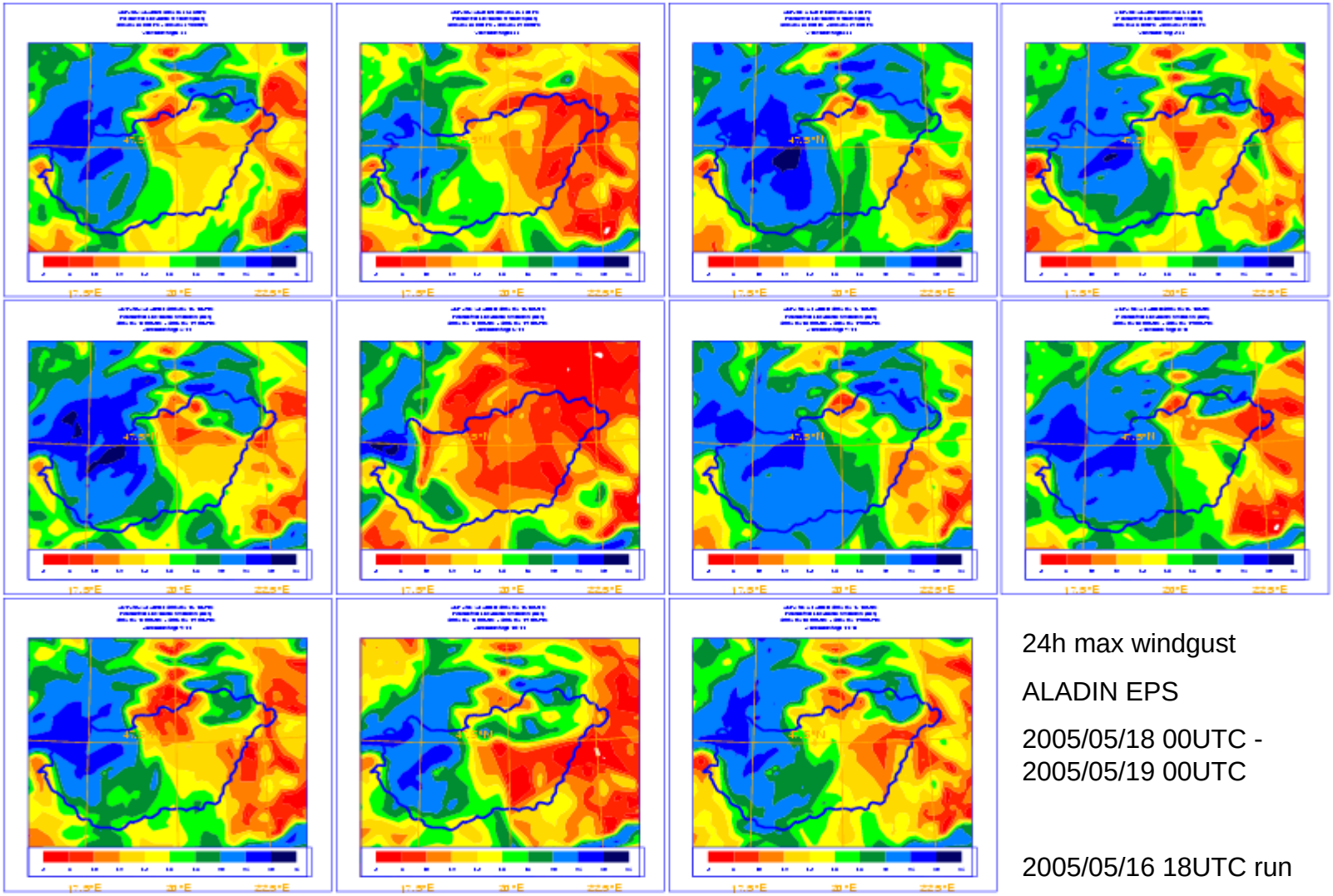
case study: 18 May 2005 ECMWF/ALADIN

windgust of the ALADIN forecast



case study: 18 May 2005 ARPEGE/ALADIN

windgust of the ALADIN forecasts



24h max windgust

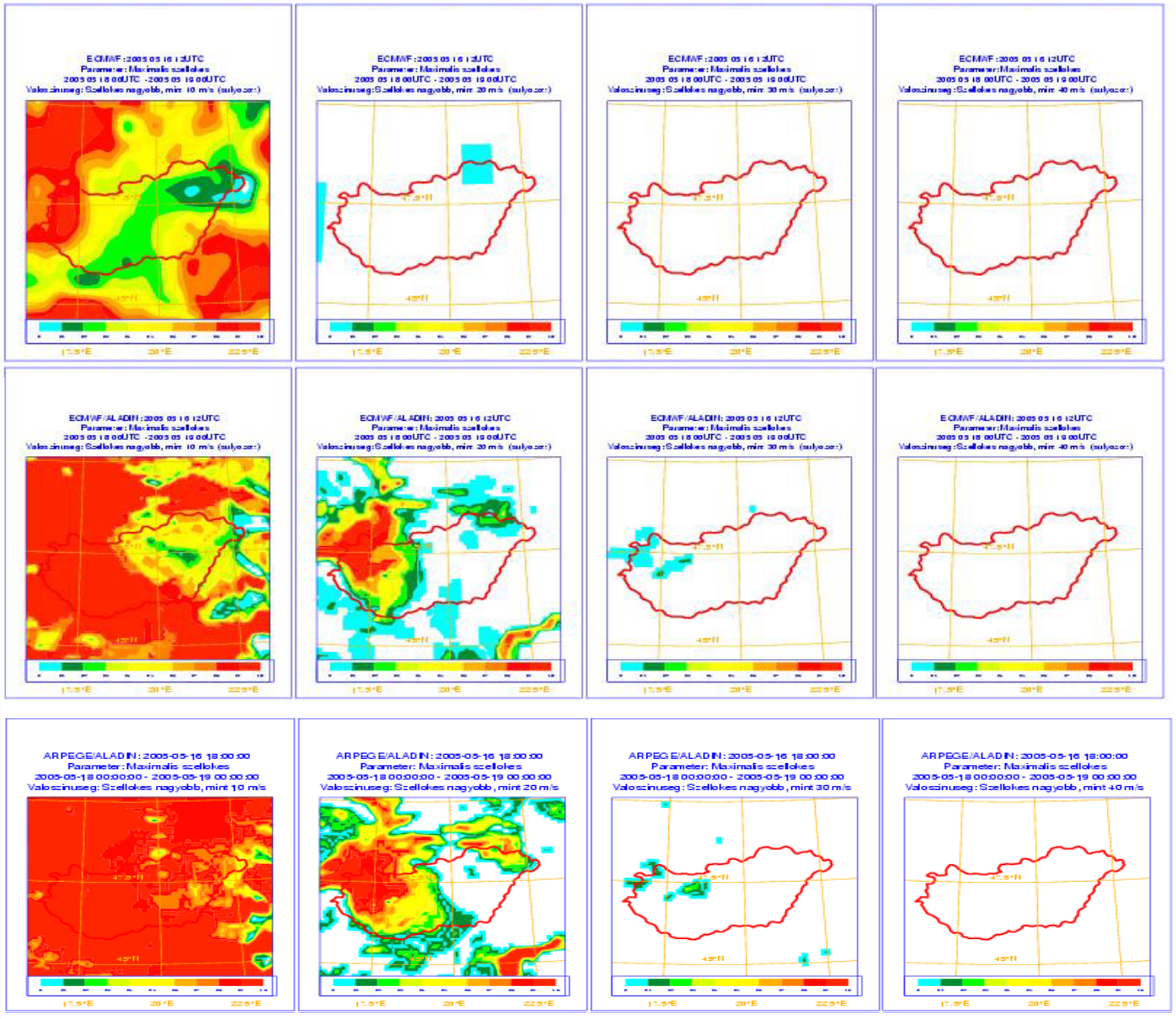
ALADIN EPS

2005/05/18 00UTC -
2005/05/19 00UTC

2005/05/16 18UTC run

case study: 18 May 2005 ECMWF, ECMWF/ALADIN & ARPEGE/ALADIN

wind gust: probability charts / 10, 20, 30, 40 m/s </



Verification of the ECMWF & ECMWF/ALADIN & ARPEGE/ALADIN

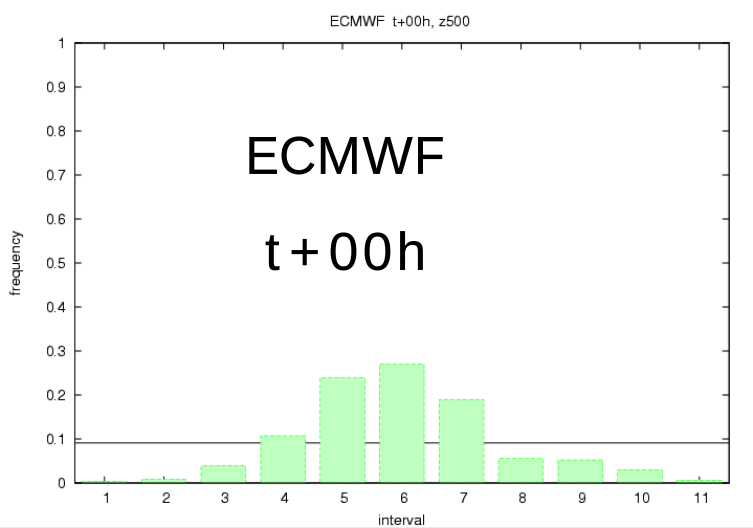
Talagrand diagrams:

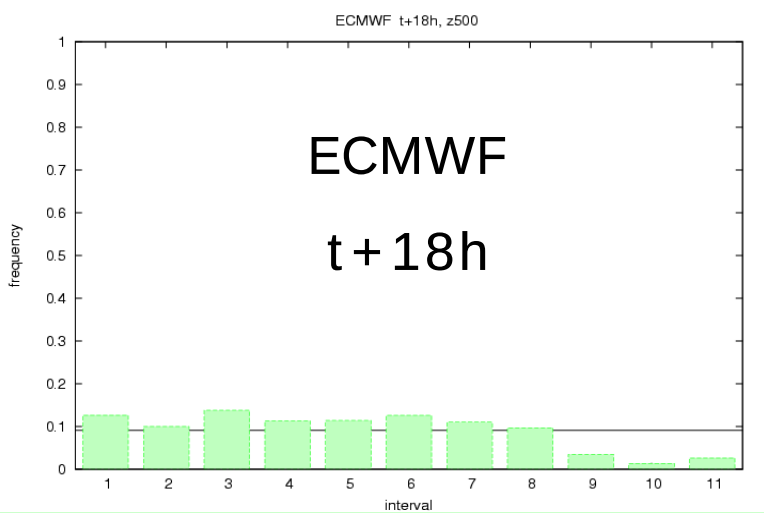
- Geopotential height of the 500 hPa level
- Temperature of the 850 hPa level
- 10m wind
- 2m temperature

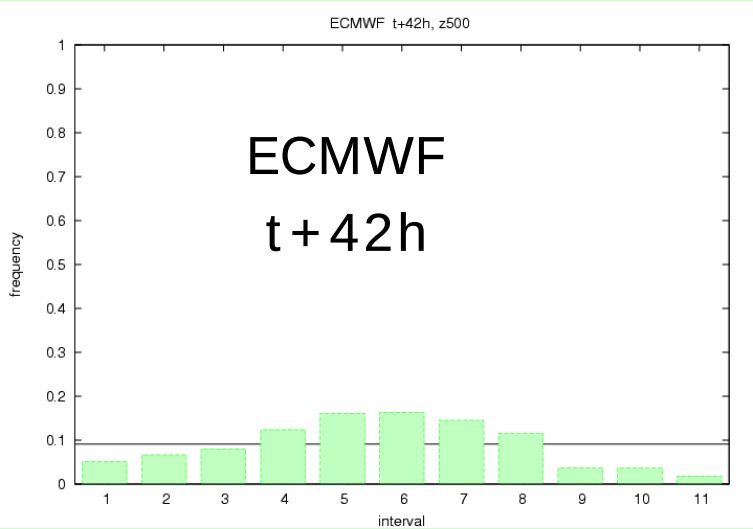
ROC diagrams:

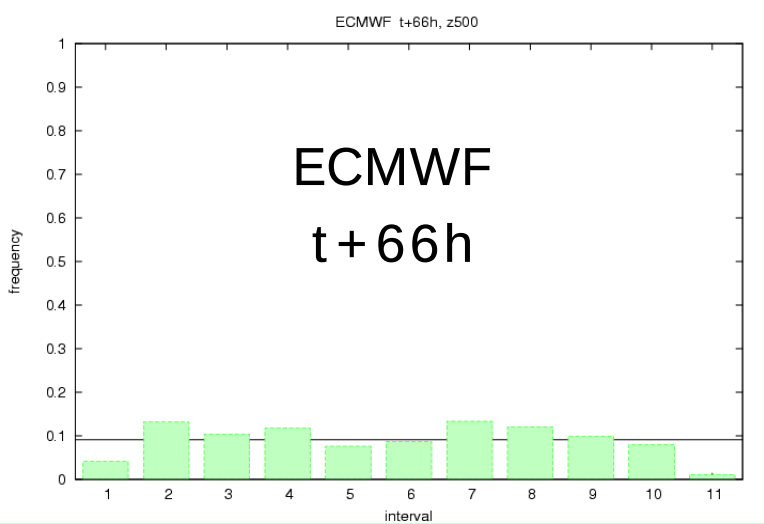
- 850 hPa temperature anomaly
- 10m wind

ECMWF EPS
Verification – Talagrand diagram /3 case studies

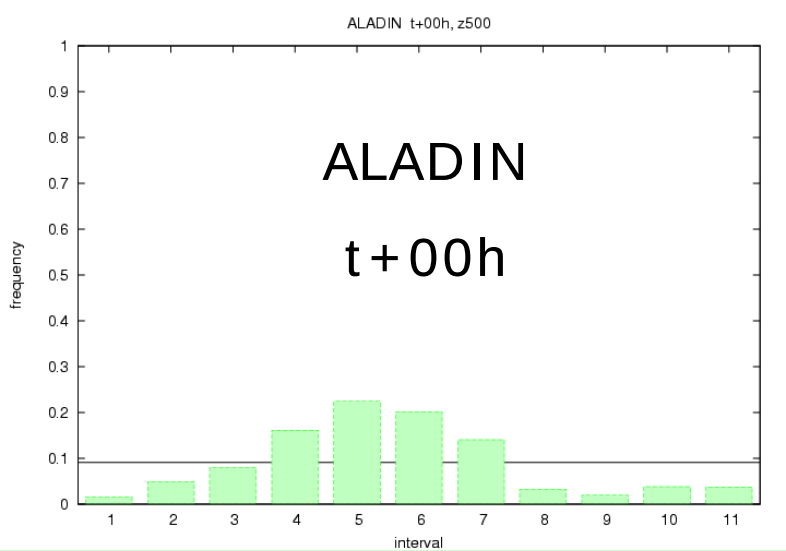


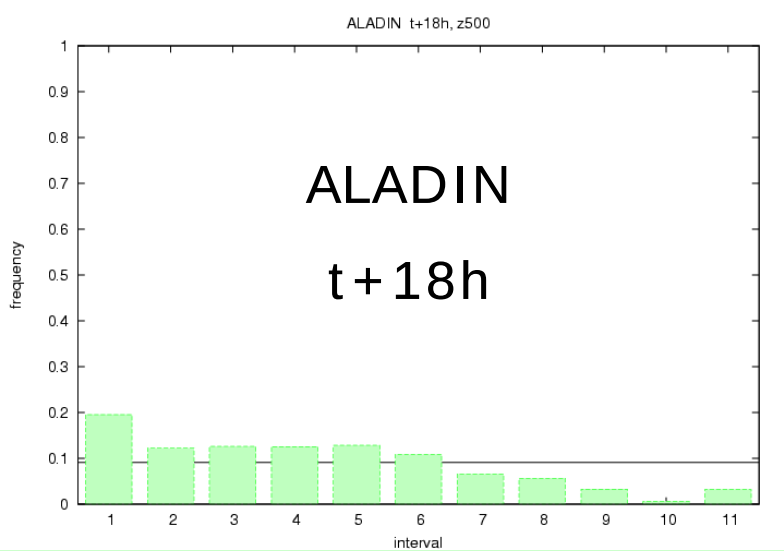


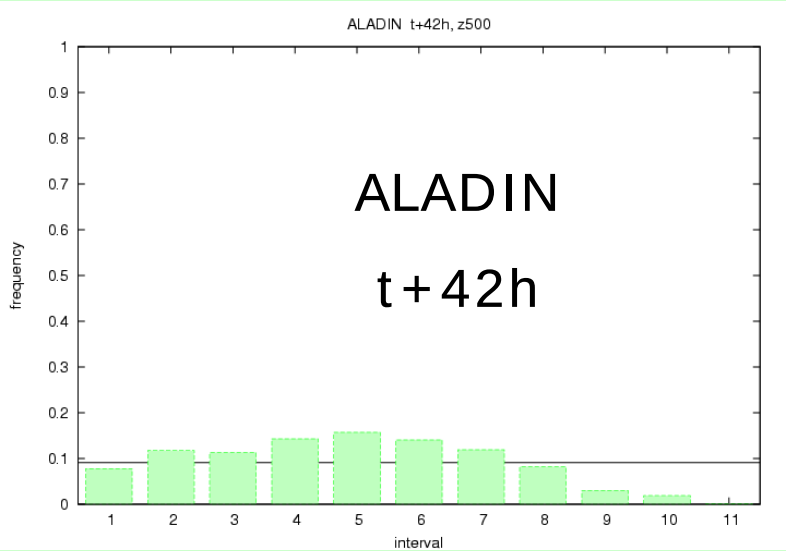


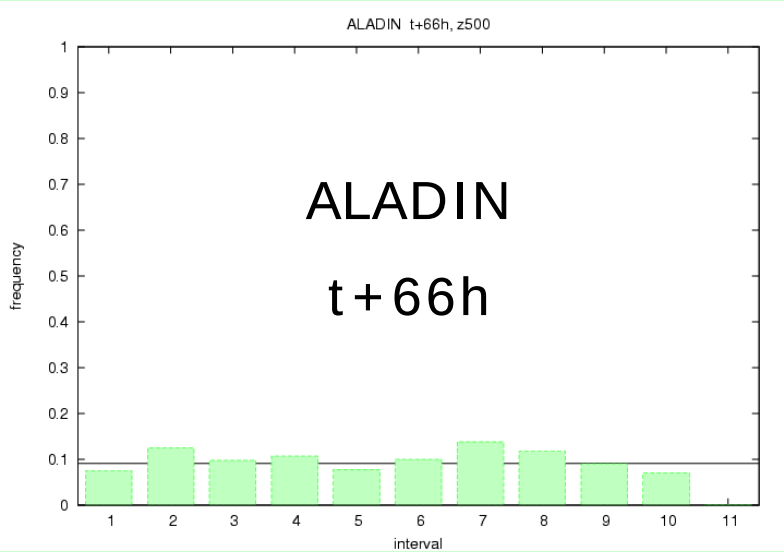


ECMWF/ALADIN
Verification – Talagrand diagram /3 case studies

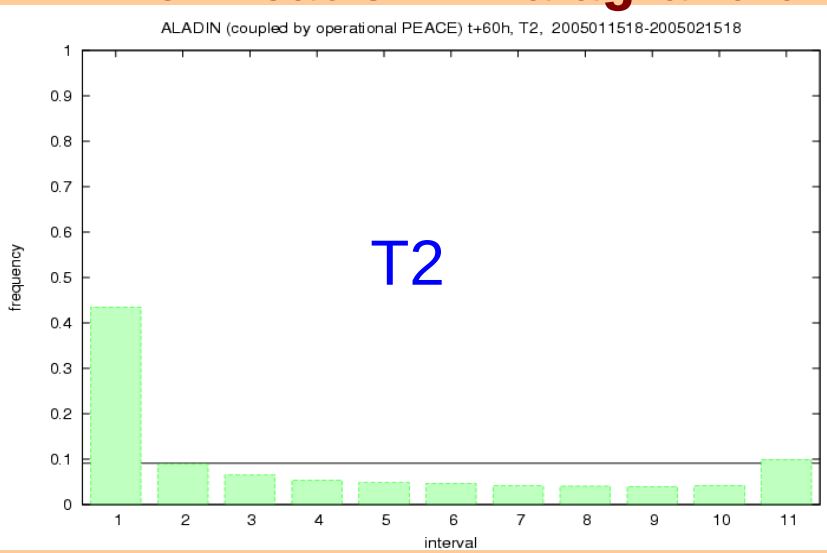


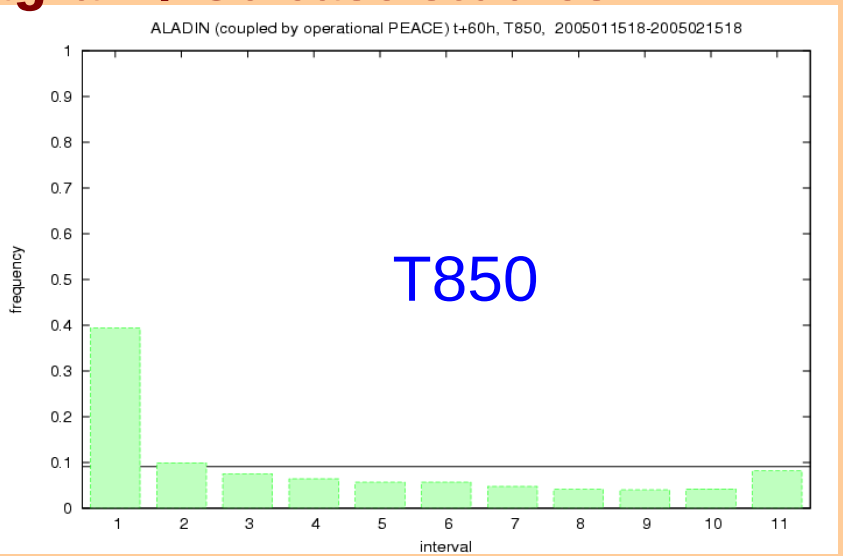




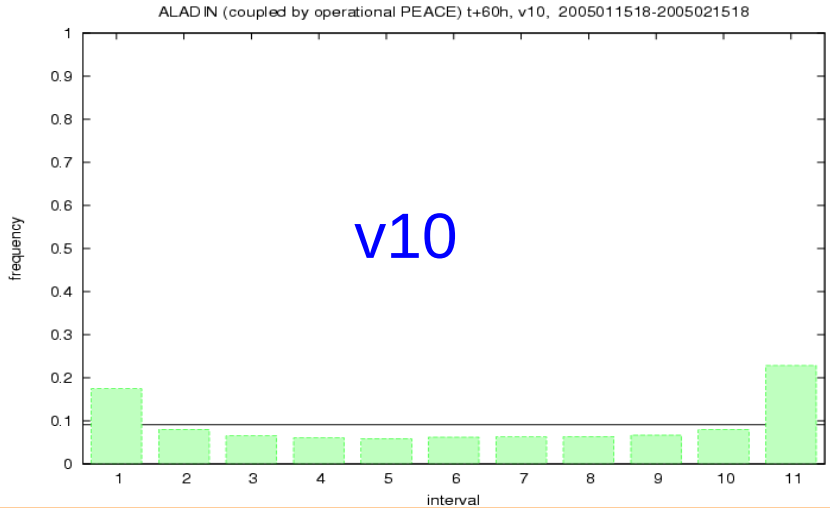


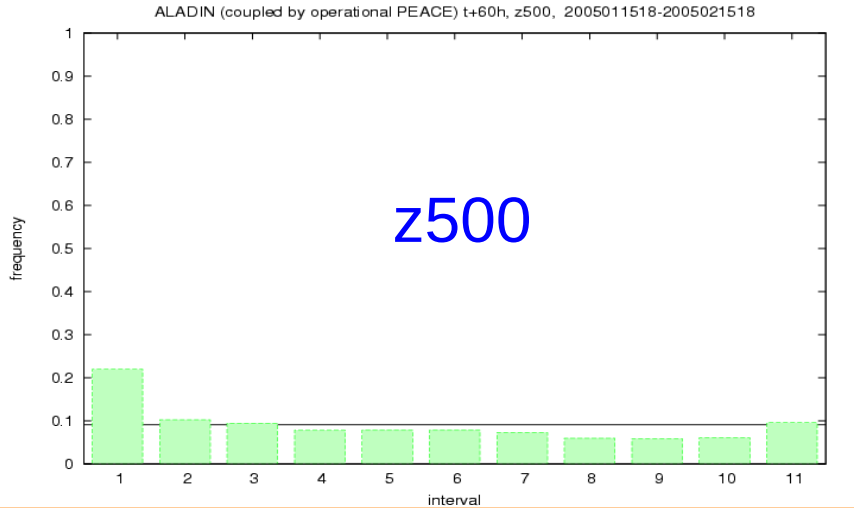
ARPEGE/ALADIN
Verification – Talagrand diagram/ 30 case studies



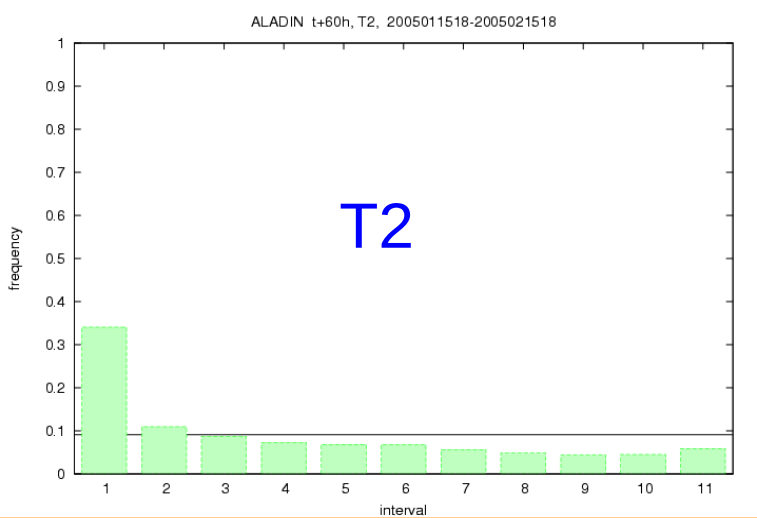


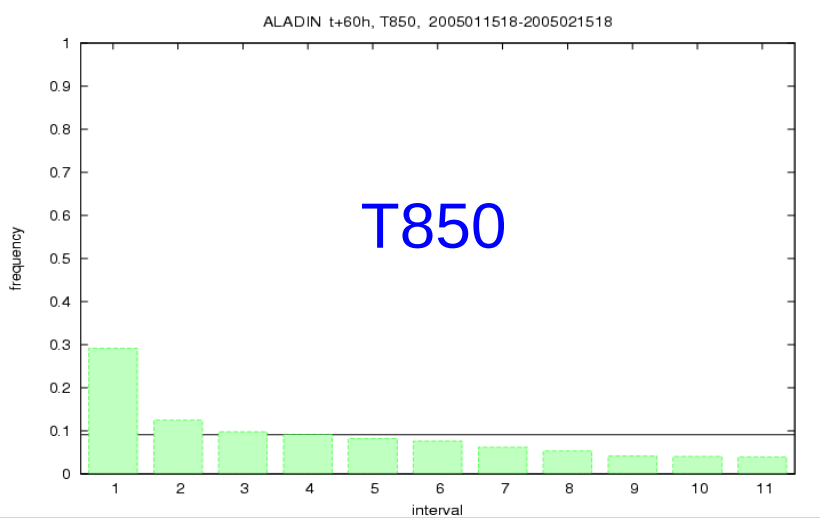
ALADIN coupled by operational PEACE forecasts (t+60h)



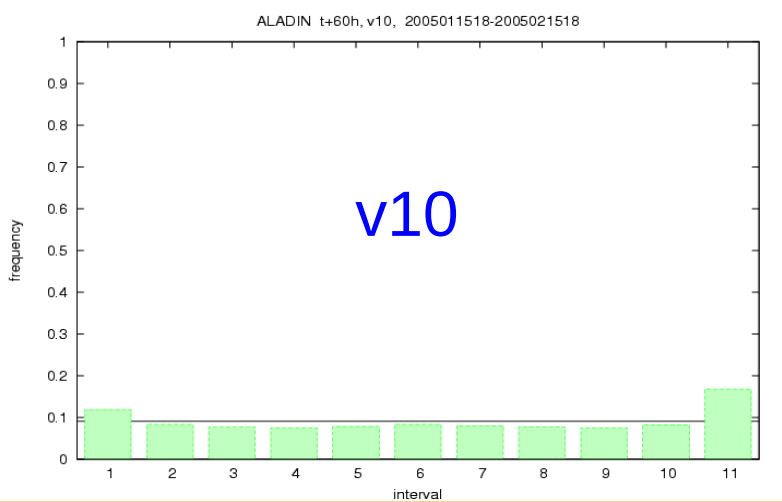


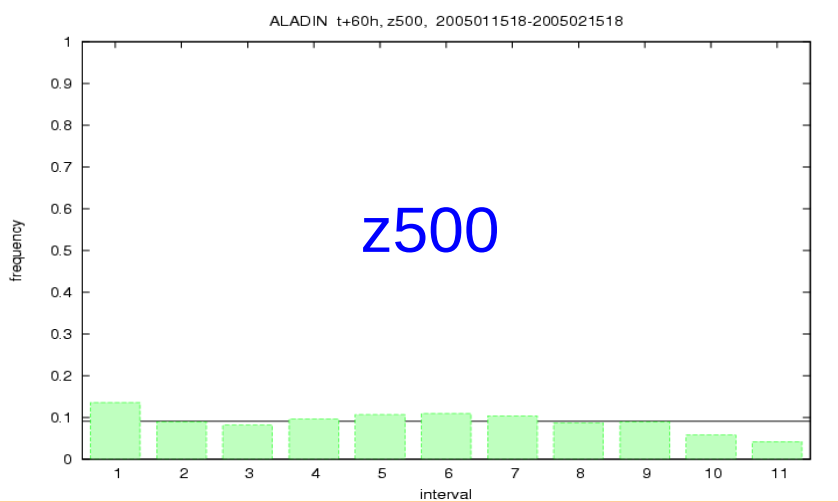
ARPEGE/ALADIN
Verification – Talagrand diagram/ 30 case studies





ALADIN coupled by the experimental setup (t+60h)





Conclusion

- Better representation of the precipitation and windgust fields
- Quite similar results from downscaling ECMWF and ARPEGE
- Positive feedback from our forecasters
- We also found that it seems to be difficult to obtain significant improvements with the simple downscaling of the global ensemble system

Future plans

- Start the experiments with the computation of local (ALADIN native) perturbations
  - computation of ALADIN SVs
  - breeding method