

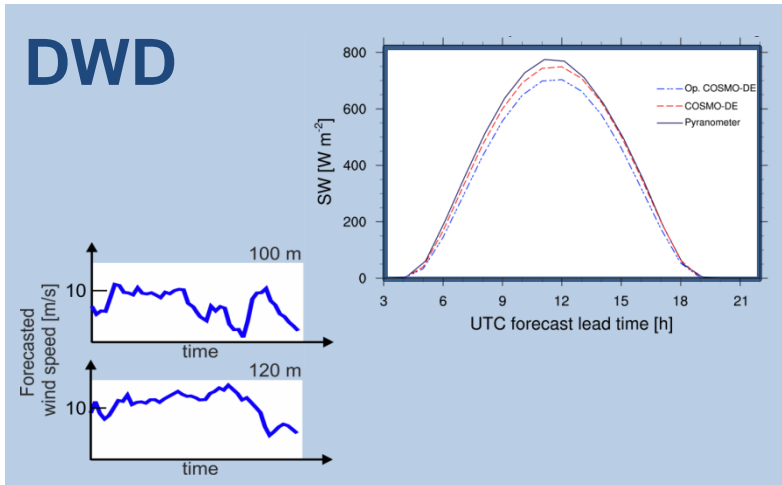
Identifying Critical Weather Situations Relevant for Renewable Energies

Carmen Köhler, Andrea Steiner, Jonas von Schumann

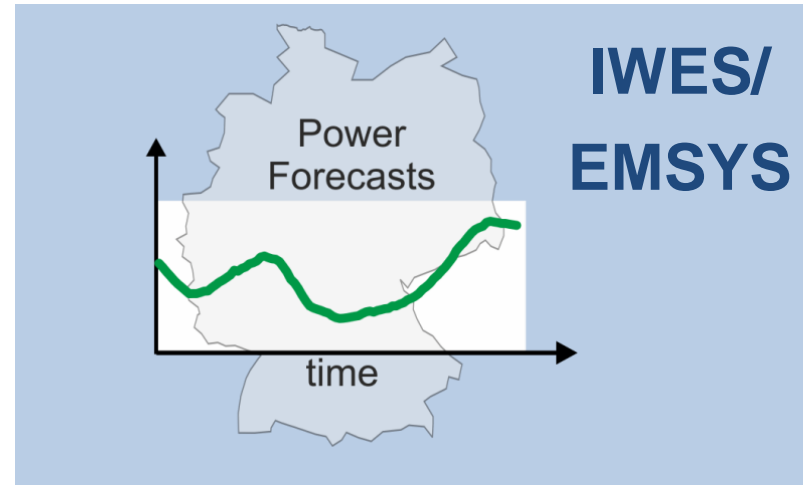
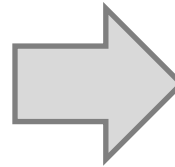


- 1) Introduction EWeLiNE and ORKA Projects
- 2) Large photovoltaic and wind power forecast errors
- 3) Analysis of underlying weather
- 4) Identification of critical weather situations
 - Solar Radiation: Fog/Low Stratus
 - Wind: Cyclones/Fronts
- 5) Applications

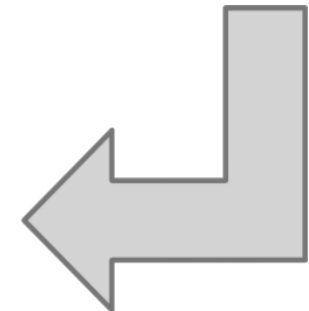
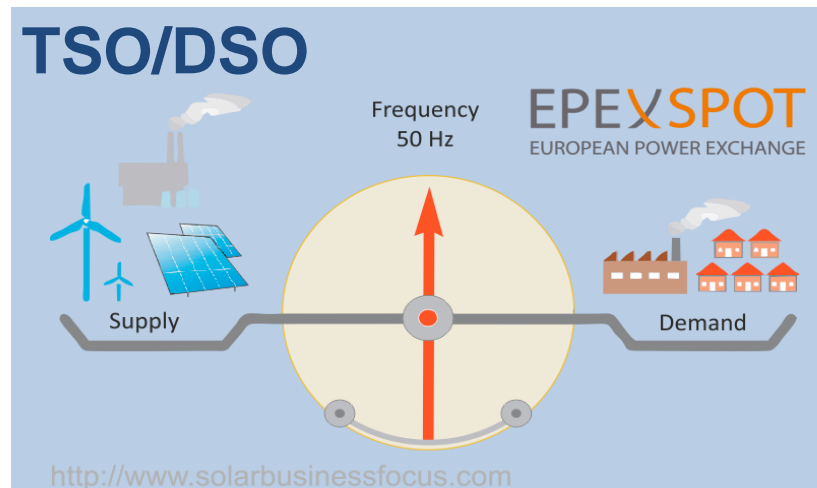




Weather-forecast



Feedback



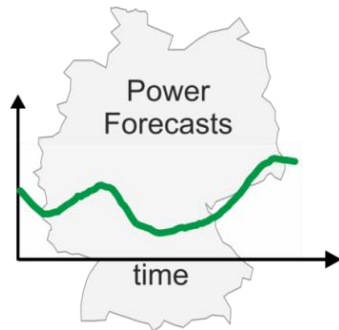
Power-forecast

→ Axel Braun & Yves-Marie Saint Drenan (IWES):

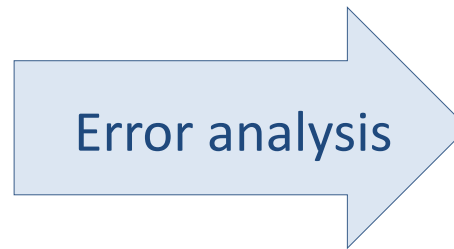
Extracting days with large day-ahead power forecast errors for Germany

- 2012 – 2014: Summed, absolute wind errors within 6h-moving window
- 2013 – 2014: Mean absolute PV errors within 24h

→ 100 days with largest day-ahead power forecast errors



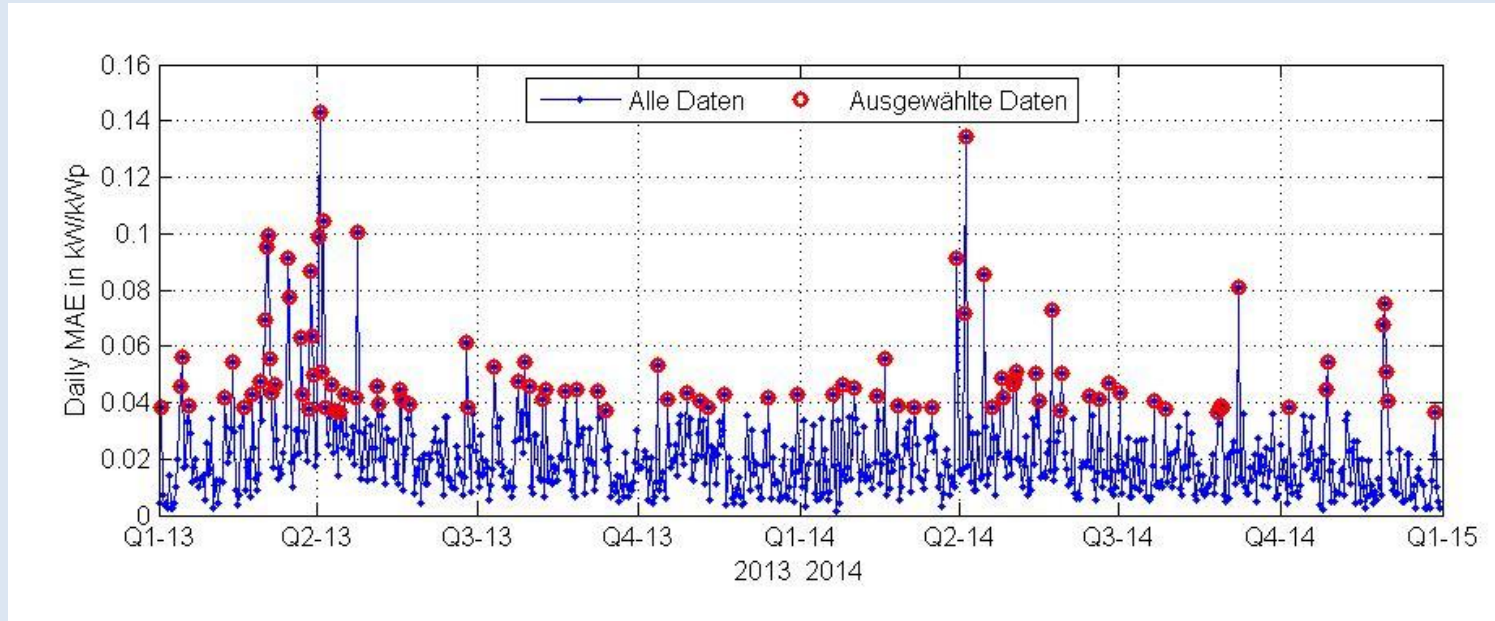
Day-ahead power forecast



Largest errors

25-12-2012	29-09-2013	14-02-2014
26-12-2012	03-10-2013	<i>15-02-2014</i>
27-01-2013	11-10-2013	07-03-2014
29-01-2013	<i>12-10-2013</i>	<i>08-03-2014</i>
30-01-2013	17-10-2013	<i>16-03-2014</i>
31-01-2013	27-10-2013	16-03-2014
01-02-2013	28-10-2013	18-03-2014
02-02-2013	02-11-2013	<i>19-03-2014</i>
04-02-2013	05-11-2013	21-03-2014
05-02-2013	06-11-2013	<i>06-07-2014</i>
06-03-2013	07-11-2013	07-07-2014
09-03-2013	<i>08-11-2013</i>	09-08-2014
<i>08-02-2013</i>	<i>09-11-2013</i>	<i>10-02-2014</i>

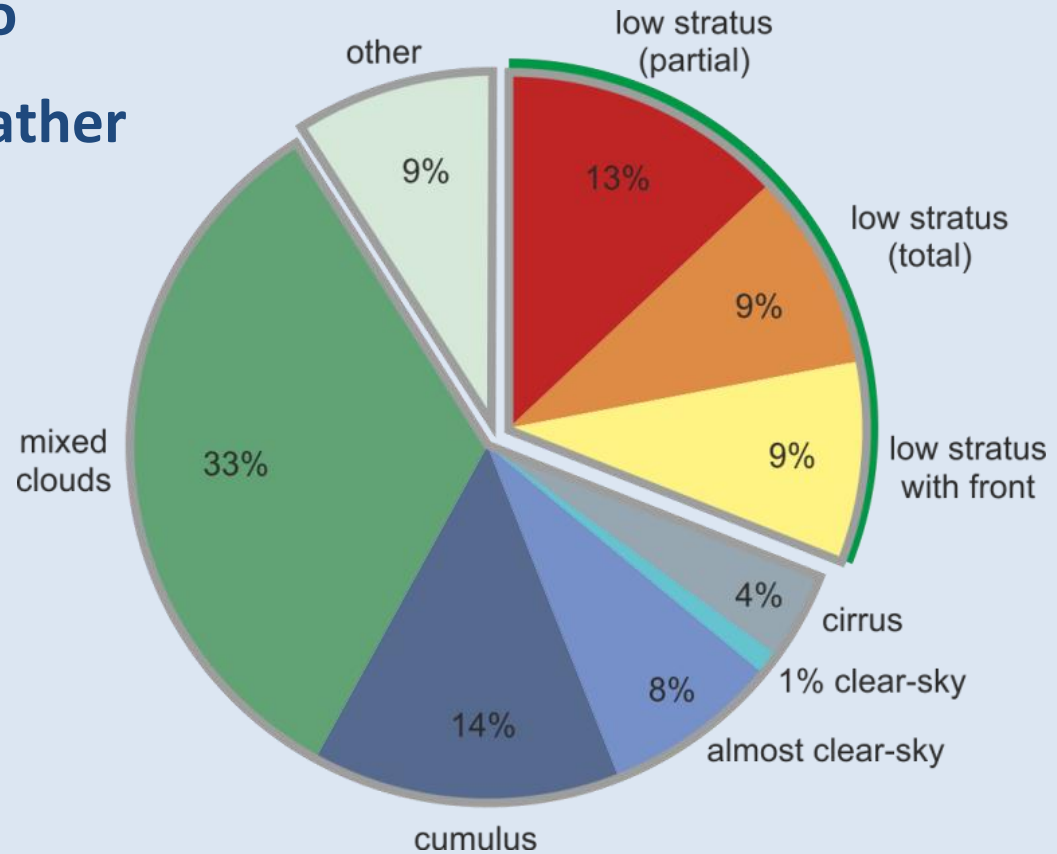
Underlying Weather - PV



➔ Seasonal Correlation within errors.

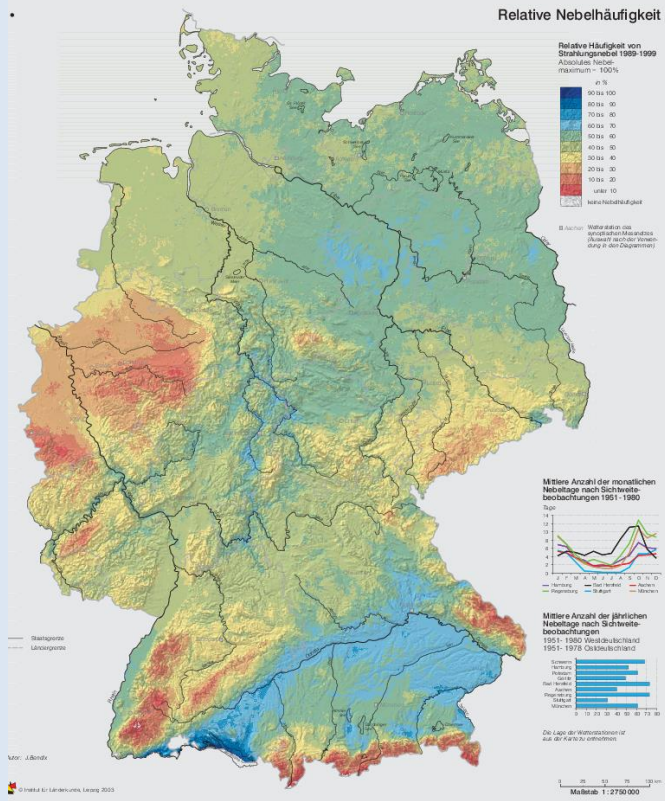
➔ Underlying weather situations?

→ Error correlation to cloud classes and weather pattern



→ Objective identification of fog/ low stratus

Method:



© Bendix 2002

Account for

- Fog climatology
- Soilmoisture
- Weather situation
- Season
- Temperature/humidity profiles

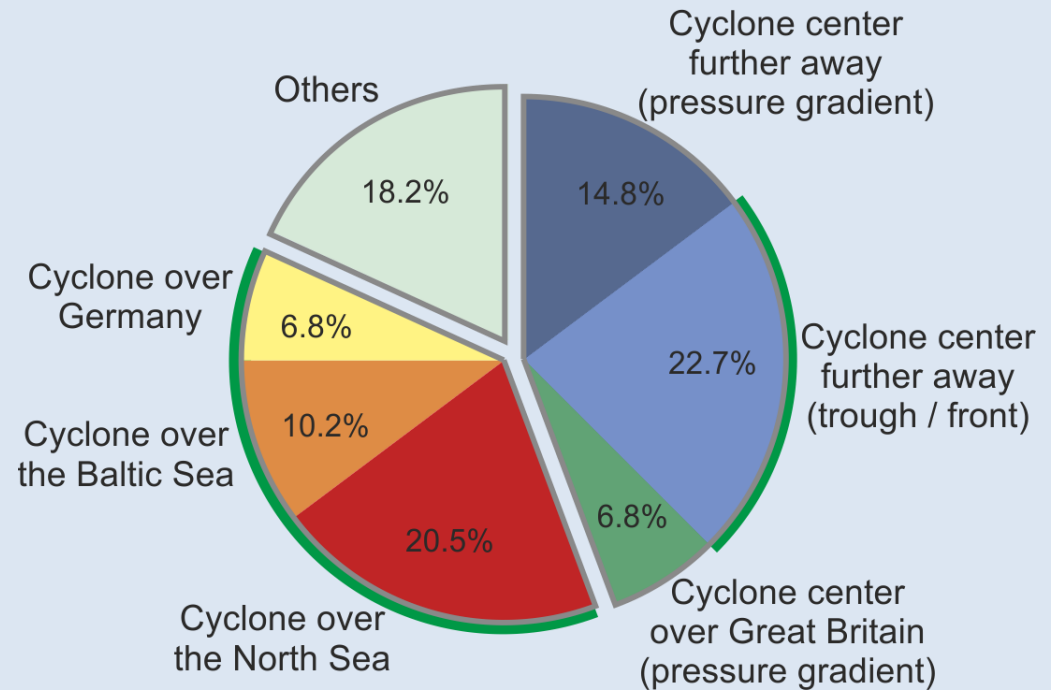
Derive fog/low stratus occurrence

→ Connection with synoptic scale weather patterns?

- No double counting of errors
- 12 cases were eliminated

In **60,2%** of days with large errors, a cyclone over

- Germany,
 - the North Sea,
 - the Baltic Sea or
 - a front
- were identified.

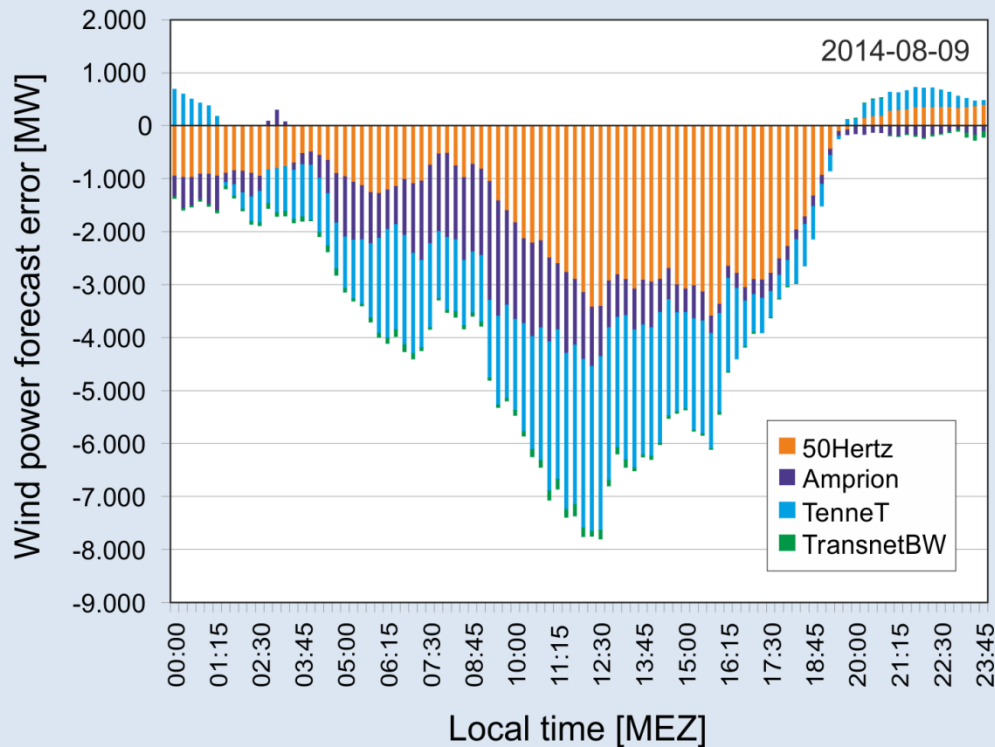


→ Objective identification of cyclones and open depressions

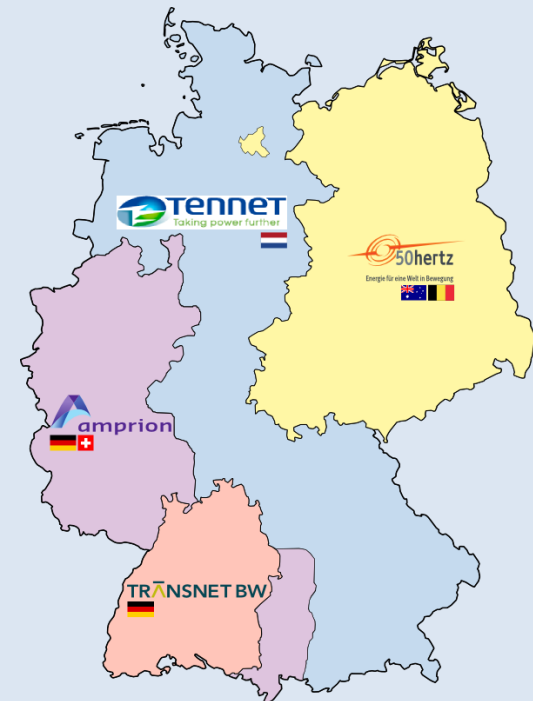
Wind: Cyclone detection

→ Large error as reported by TSOs

Accumulated day-ahead wind power forecast errors for Germany

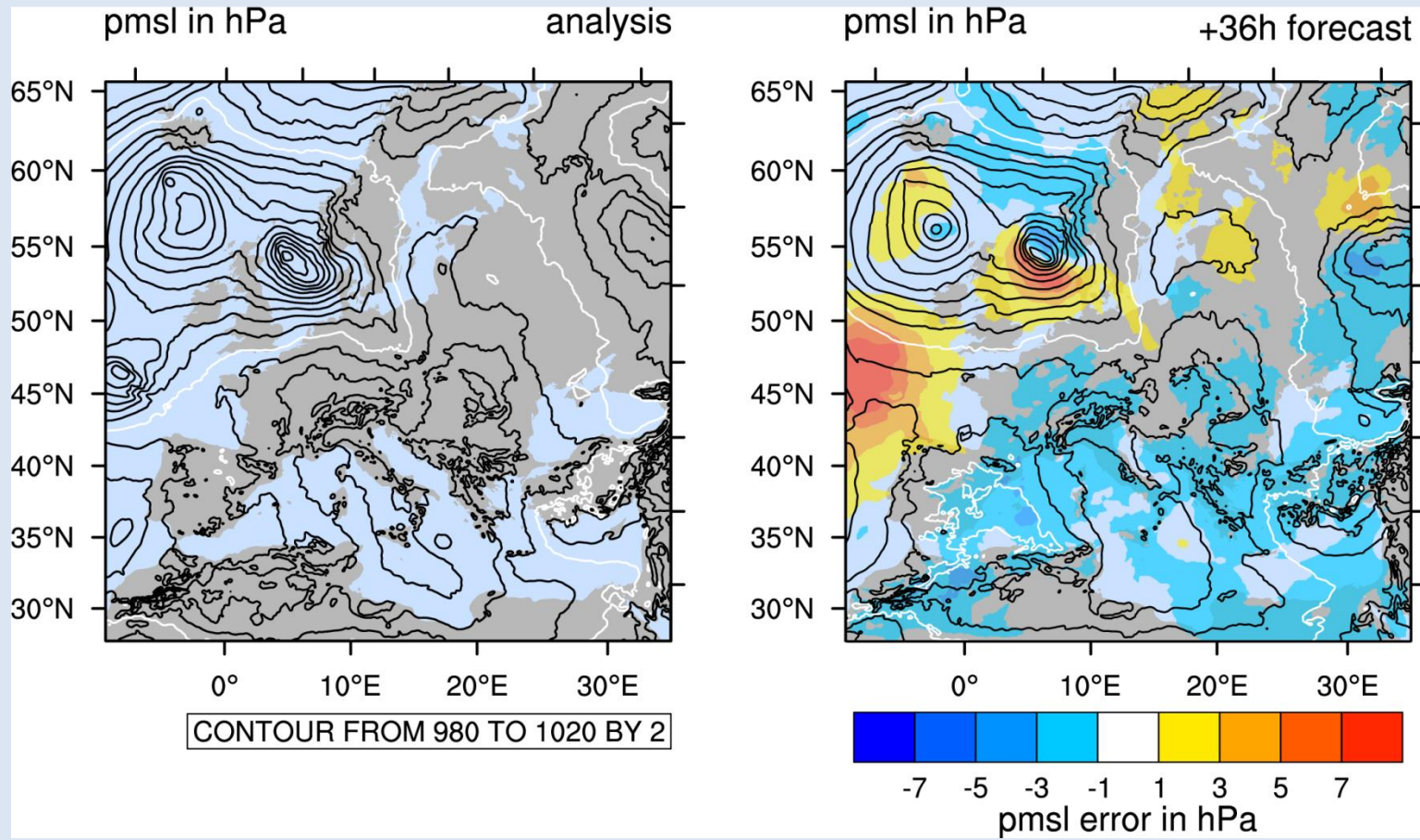


Source: <http://www.transparency.eex.com/de/>



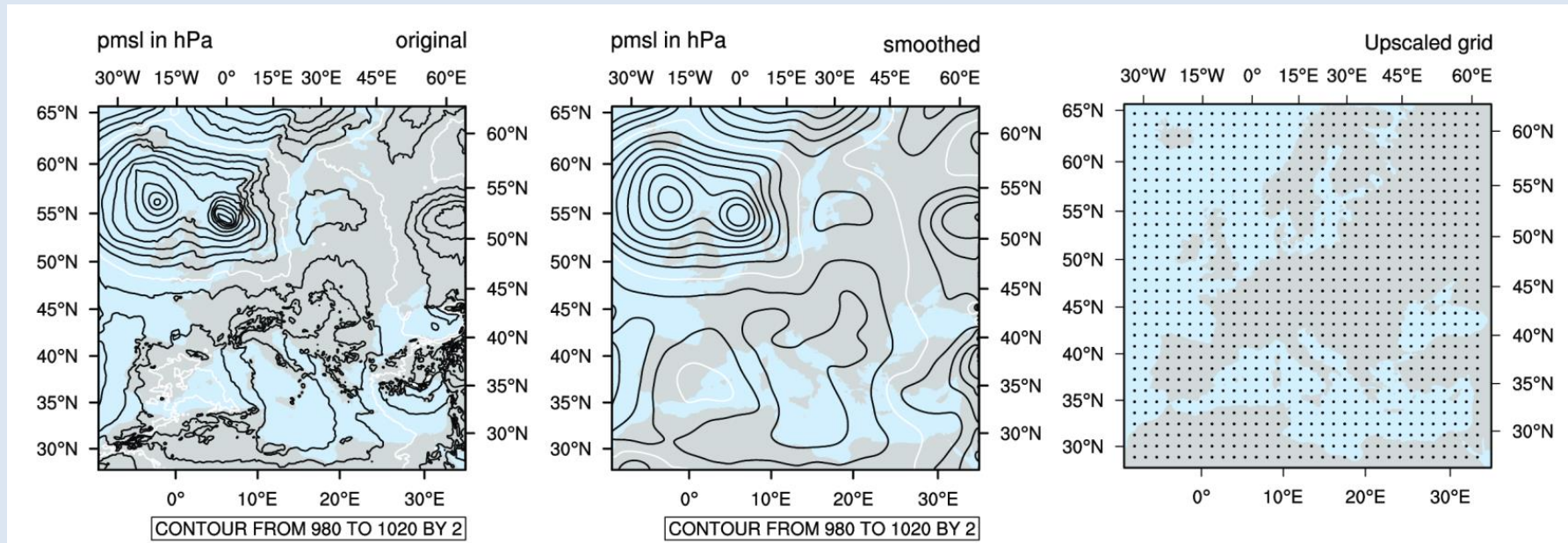
Wind: Cyclone detection

→ Large error as reported by TSOs



→ COSMO-EU forecasts of mean sea level pressure (MSLP)

– Preprocessing

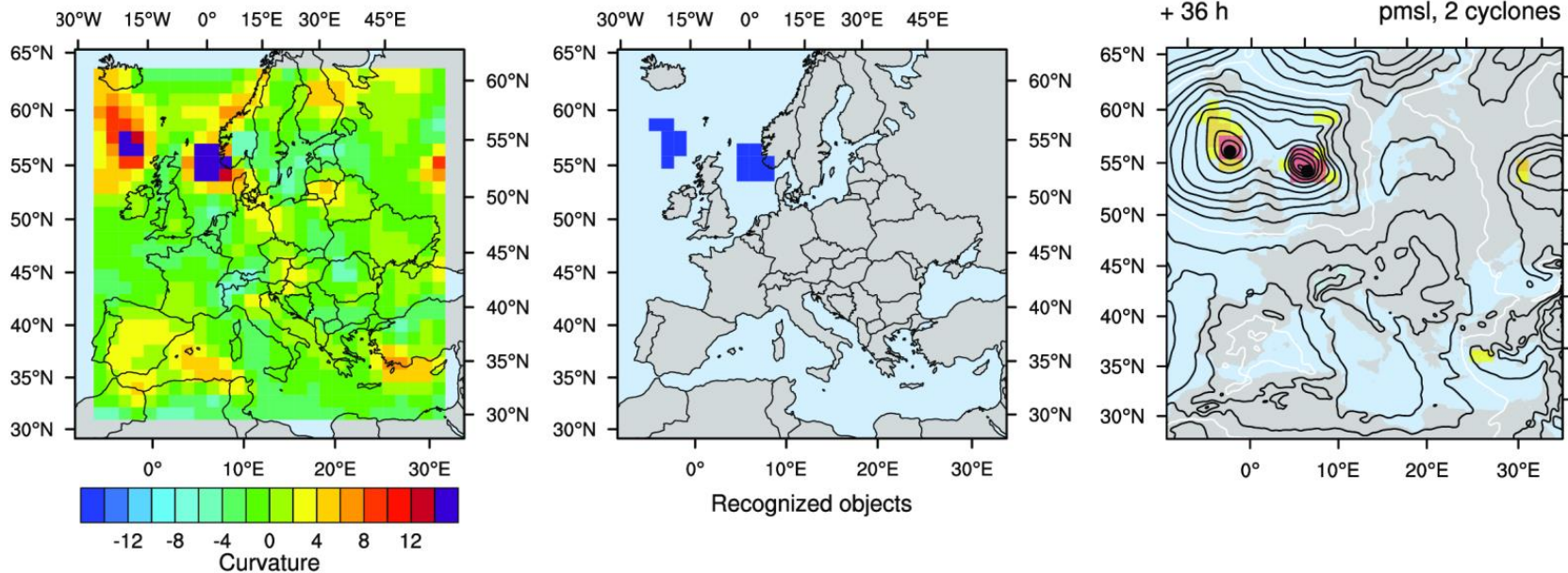


Unsmoothed MSLP

Smoothed MSLP
(9 point local smoothing)

Upscaling
(every 20th grid point)

- ➔ COSMO-EU forecasts of mean sea level pressure (MSLP)
- Object recognition on basis of quasigeostrophic relative vorticity

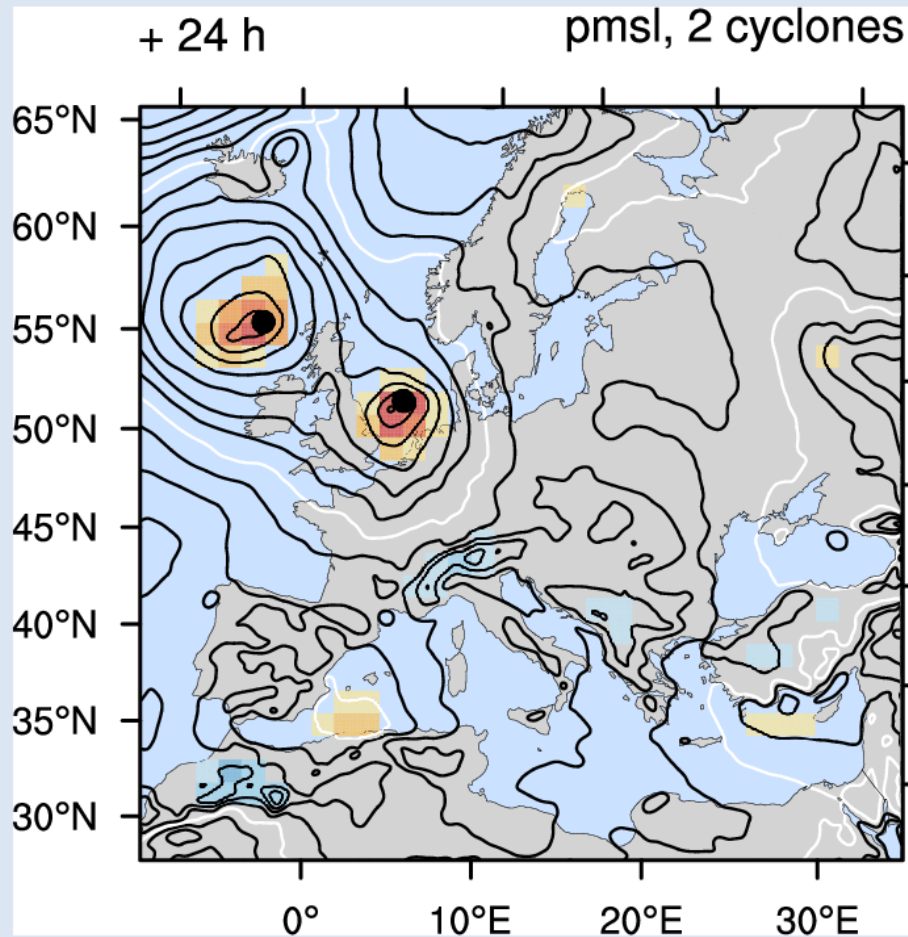


$$\zeta_g = \frac{1}{\rho f} \nabla^2 p$$

Recognized objects (grid points > subjective threshold) Output (lows, troughs are highlighted)

Wind: Cyclone detection

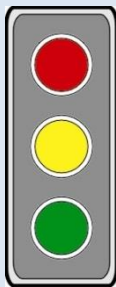
→ Example



2014-08-09

→ Framework to develop products for TSOs

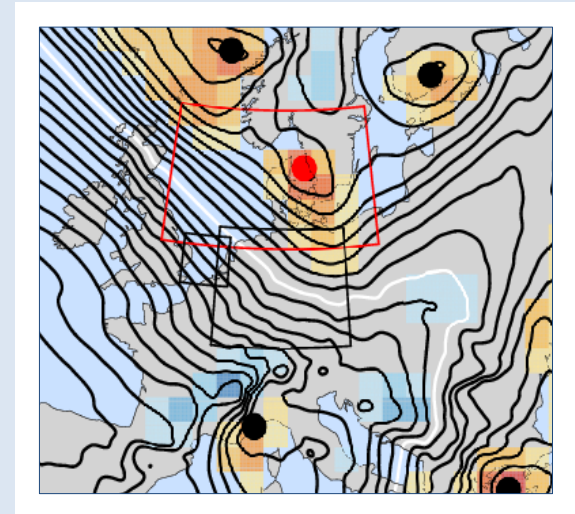
- Motivating TSOs to take weather information into consideration more often
- Traffic light system (suggestion):



critical event in warning area & information from COSMO-DE-EPS

cyclone or low stratus in warning area

no cyclonic influence or low stratus



2012 - 2014, 3h COSMO-EU analyses:
cyclone center in red area in **20%**

Thank you!



Questions?