

The Prediction of low clouds for the time of the solar eclipse 20 March 2015

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In the morning of March 20, 2015, a partial solar eclipse occurred over Germany. The sun was covered by the moon between 82 percent over the North Sea near Helgoland Island and 67 percent near Passau. Approximately 6 percent of the entirely generated electrical power of Germany will be produced by photovoltaic plants (PV). The potential impact on the solar incoming radiation and subsequently on the PV-power production is strongly dependent on the weather situation. A correct prediction of the cloud amount was and is essential for the assessment of the supply of electricity from renewable energies.

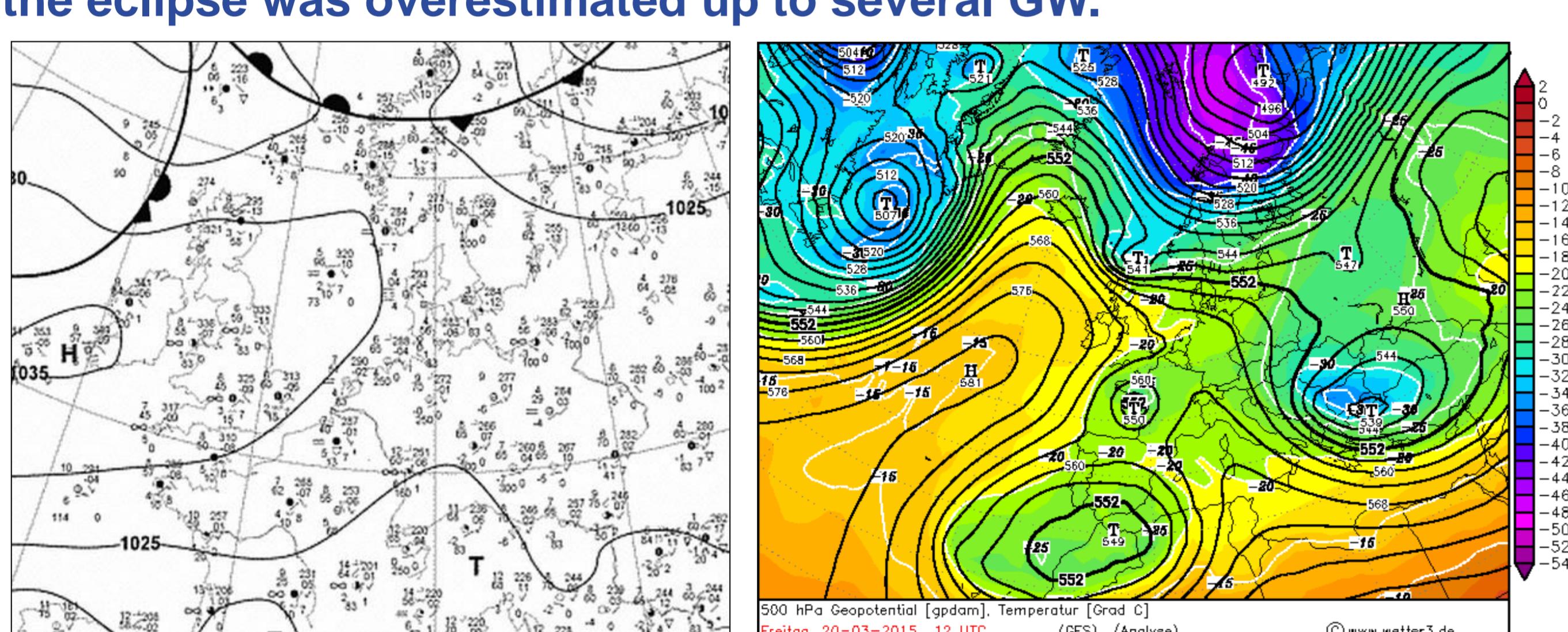
The fraction of renewable sources of the production of electrical energy has been increased during the last years dramatically up to meanwhile 28 percent of the total electrical power generation. The PV produced fraction of total electric power is equivalent to 39 GW of power capacity. In the case of completely cloud-free conditions over whole Germany a reduction of PV energy production during the first 65 minutes of the solar eclipse by 12 GW has to be expected. In the next 75 minutes the outcome of all PV facilities will be increased by 19 GW. In the case of overcast skies the effect by the partially moon-covered sun would be insignificant.

Some short-range forecasts of low cloud coverage at the time of the solar eclipse by ECWMF and derived probabilistic products will be presented. These predictions will be compared with those from COSMO-EU. Close to the event predictions should provide a more consistent guidance. This was not always the case and has been made advice to power network operators difficult.

The coverage by low clouds has been reduced by younger model runs.

Additionally the cooling by moon-reduced solar radiation conserved low clouds in some western and southwestern regions of Germany. Both this has been made our forecasts too optimistic.

Finally the outcome of PV-produced electrical energy during and after the eclipse was overestimated up to several GW.

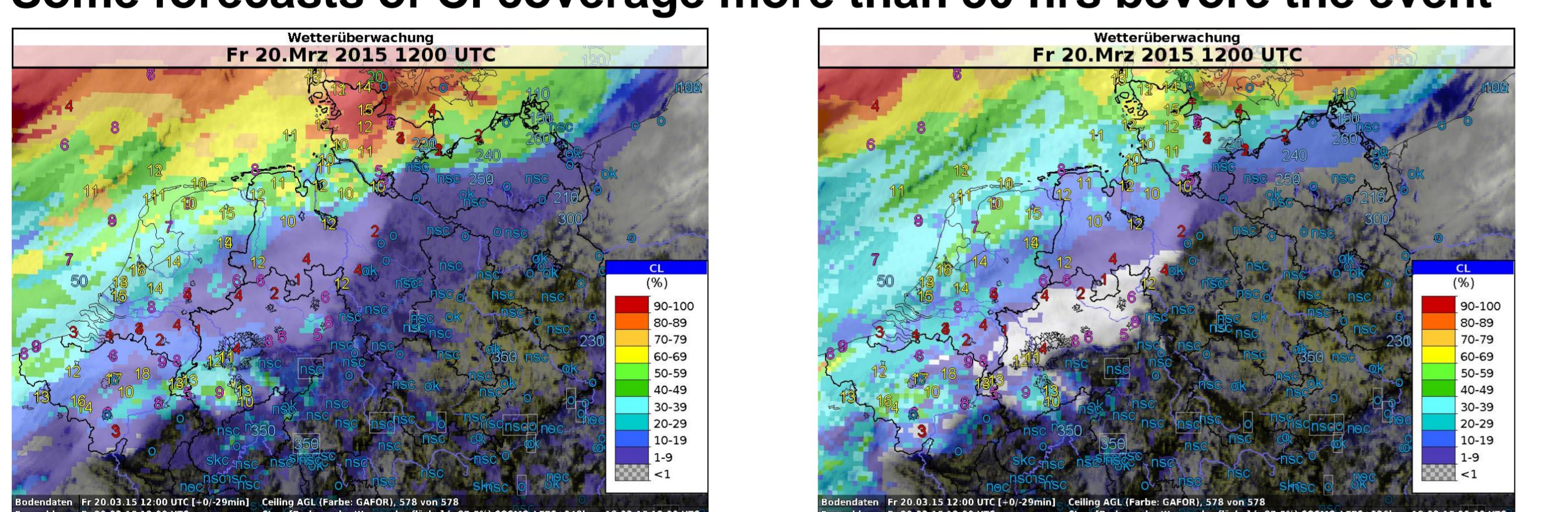


Synoptic situation on 20 March, 2015

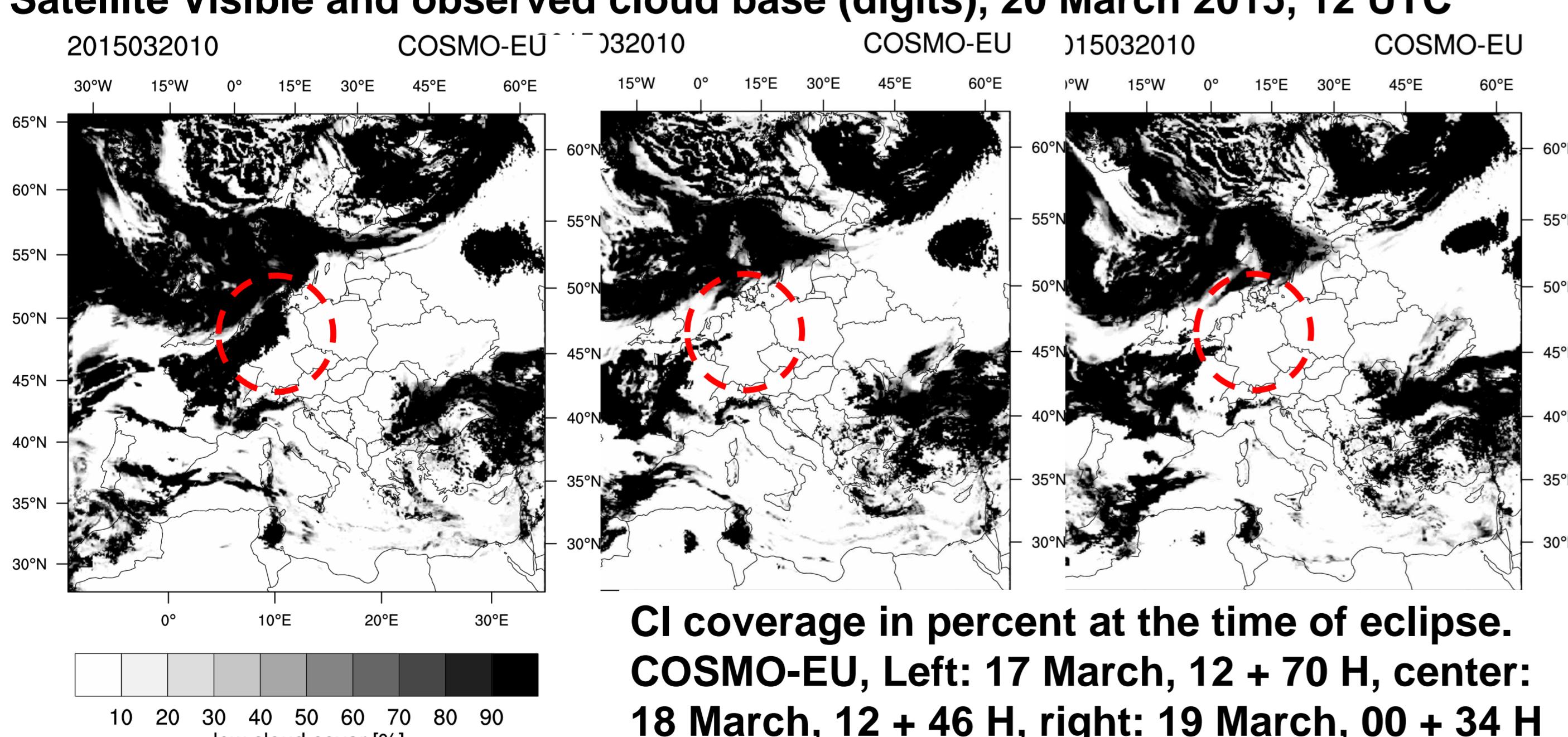
MSLP analysis, 20 March, 06 UTC Geopotential/Temp 500 hPa at 12 UTC

The weather situation was characterized by a high pressure ridge moving from the North Sea to Central Europe. The ridge caused an inflow of humid air in the boundary layer from the North Sea in the NW and W part of Germany. During the night before the eclipse shallow fog was spreading out in many of these regions.

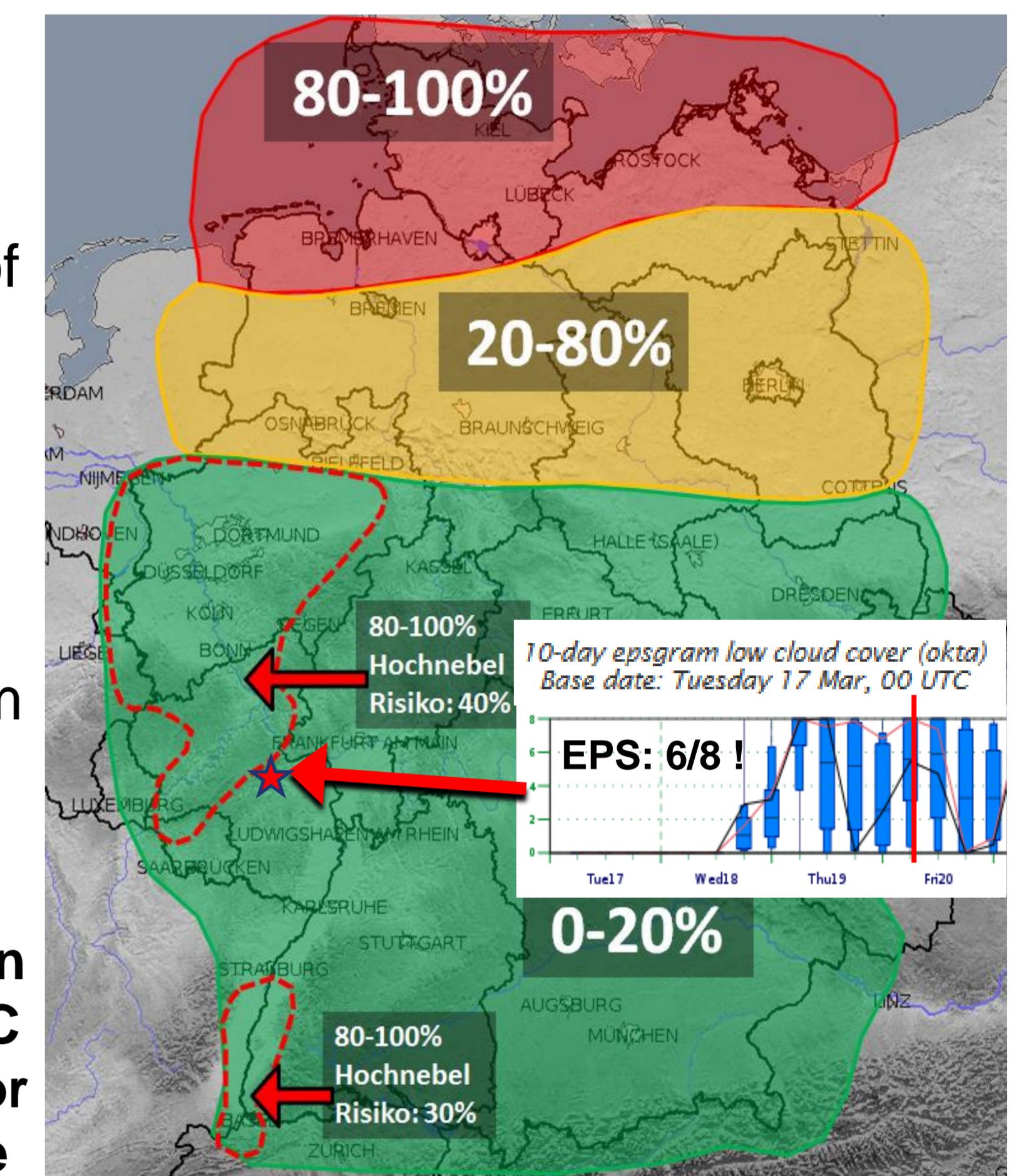
Some forecasts of CI coverage more than 30 hrs before the event



Probability of CI>7/8, COSMO-LEPS. 18 March, 12 + 48 and 19 March, 00 + 36 H
Satellite Visible and observed cloud base (digits), 20 March 2015, 12 UTC

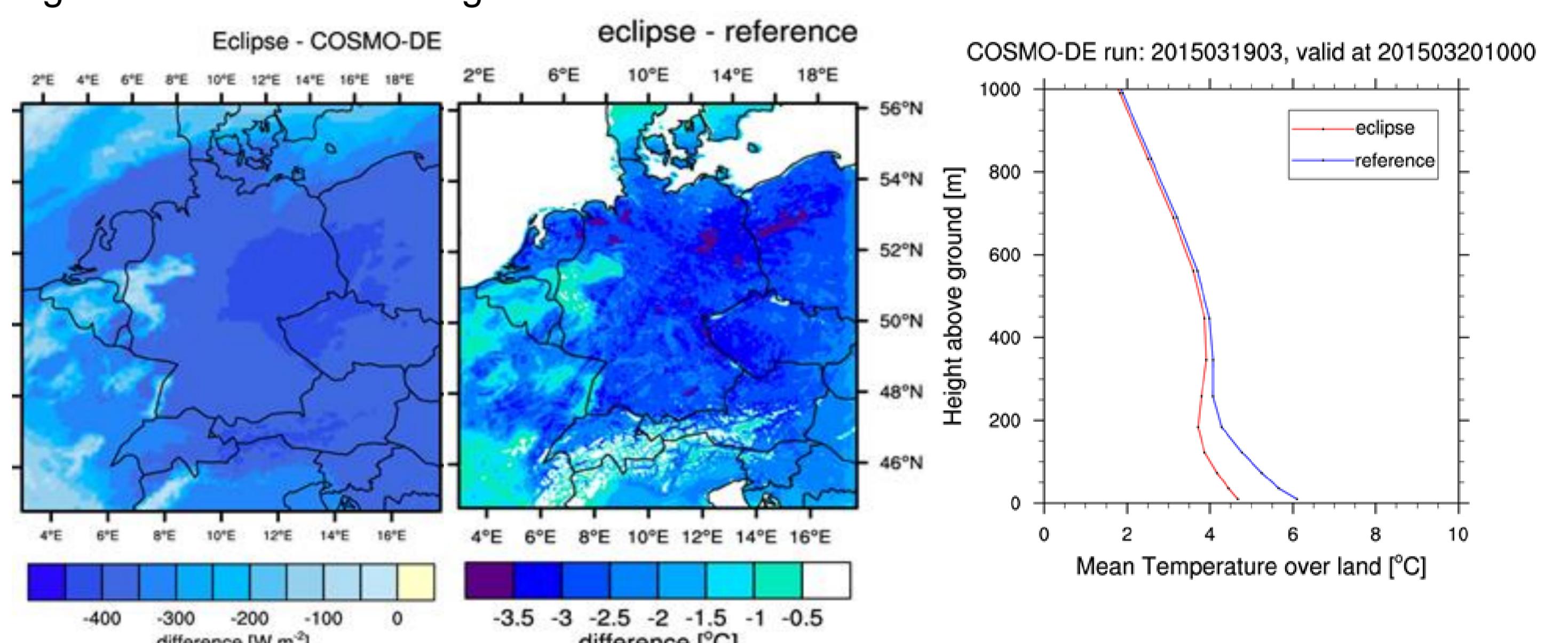


Cloud coverage has been reduced by each newer model run. That gave an indication of almost cloud-free conditions. In the morning of 19 March a final forecast of solar radiation has been requested by power network operators.



Estimated CI coverage, based on forecasts from 19 March, 00 UTC and before (model mix), basis for power network operators advice

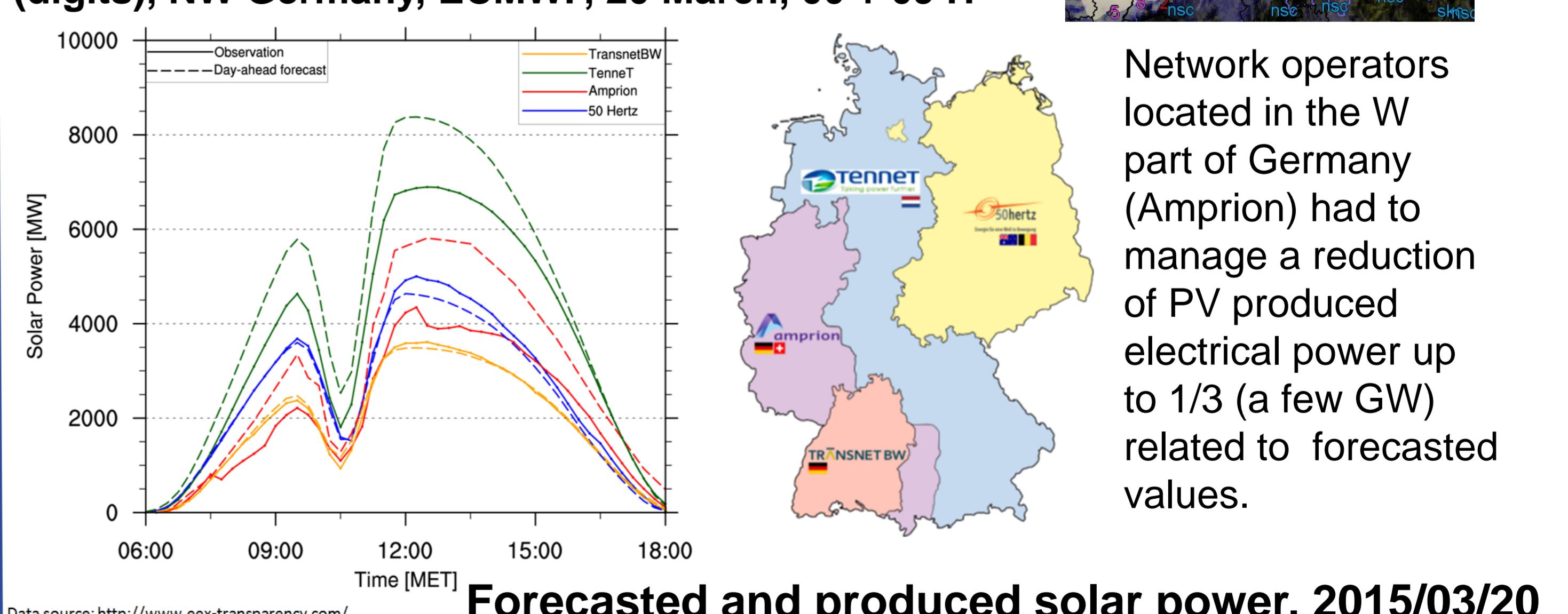
Using deterministic models (ECMWF, ICON, COSMO-EU) and probabilistic tools (COSMO-LEPS) in the morning of 19 March the final advice for power network operators has been given. Based on this material the percentage of cloud cover has been indicated by coloured areas. Because of the results of „older“ model runs as well as MOS (not shown) the forecasts became inconsistent for some areas. This regions has been highlighted by red broken lines and the probability has been expressed that fog will remain in these regions.



Maximal reduction of solar radiation (left), T2m (center) and vertical profile of the temperature below 1000 m (right) at the time of the eclipse

The coverage of the sun prevented the rise of the 2m temperature by the daily cycle. Boundary layer has been stabilized keeping the near-surface inversion and thus low clouds and fog in wider areas of W Germany and the Upper-Rhine valley. The cooling of the near surface air has been underestimated as well by models as by forecasters. NWP was able to predict the low cloud coverage nearly correct less than 24 hours before the eclipse.

Low clouds (model), Sat Vis and observed cloud base (digits), NW Germany, ECMWF, 20 March, 00 + 09 H



Network operators located in the W part of Germany (Amprion) had to manage a reduction of PV produced electrical power up to 1/3 (a few GW) related to forecasted values.

A. Steiner (personal communication, graphics COSMO-EU)
<http://www.agora-energiewende.de> Agora-Energiewende (2015): Die Sonnenfinsternis 2015: Herausforderungen für die Stromversorgung in Systemen mit hohen Anteilen an Wind- und Solarenergie (Abstract)
<http://projekt-eweline.de/en/news.html> (Abstract)

