VERIFICATION OF COSMO PL 2.8 km

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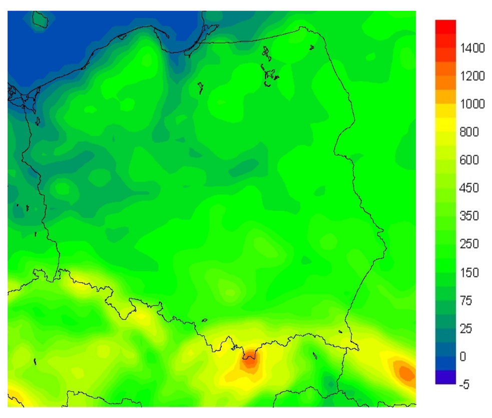
INTRODUCTION

Verification of Numerical Weather Prediction models is necessary to give us a better understanding of model behaviour, allowing useful feedback to be given to both developers and forecasters.
The Consortium for Small-scale Modeling (COSMO) develops, improves and maintains a non-hydrostatic limited-area atmospheric model. A 2.8km resolution configuration of this model known as COSMO-PL is run operationally twice a day at 00 and 12 UTC at the Institute of Meteorology and Water Management – National Research Institute. The forecast range is 36 hours. Boundary and initial conditions are interpolated from COSMO-PL 7km. Domain size is 285 x 255 grid points.
The results of standard and conditional verification of forecast variables such as total precipitation, temperature at 2m and wind speed against measurements at synop and upper air stations are shown below.
The verification results were obtained using VERSUS, an official software of the COSMO Consortium.

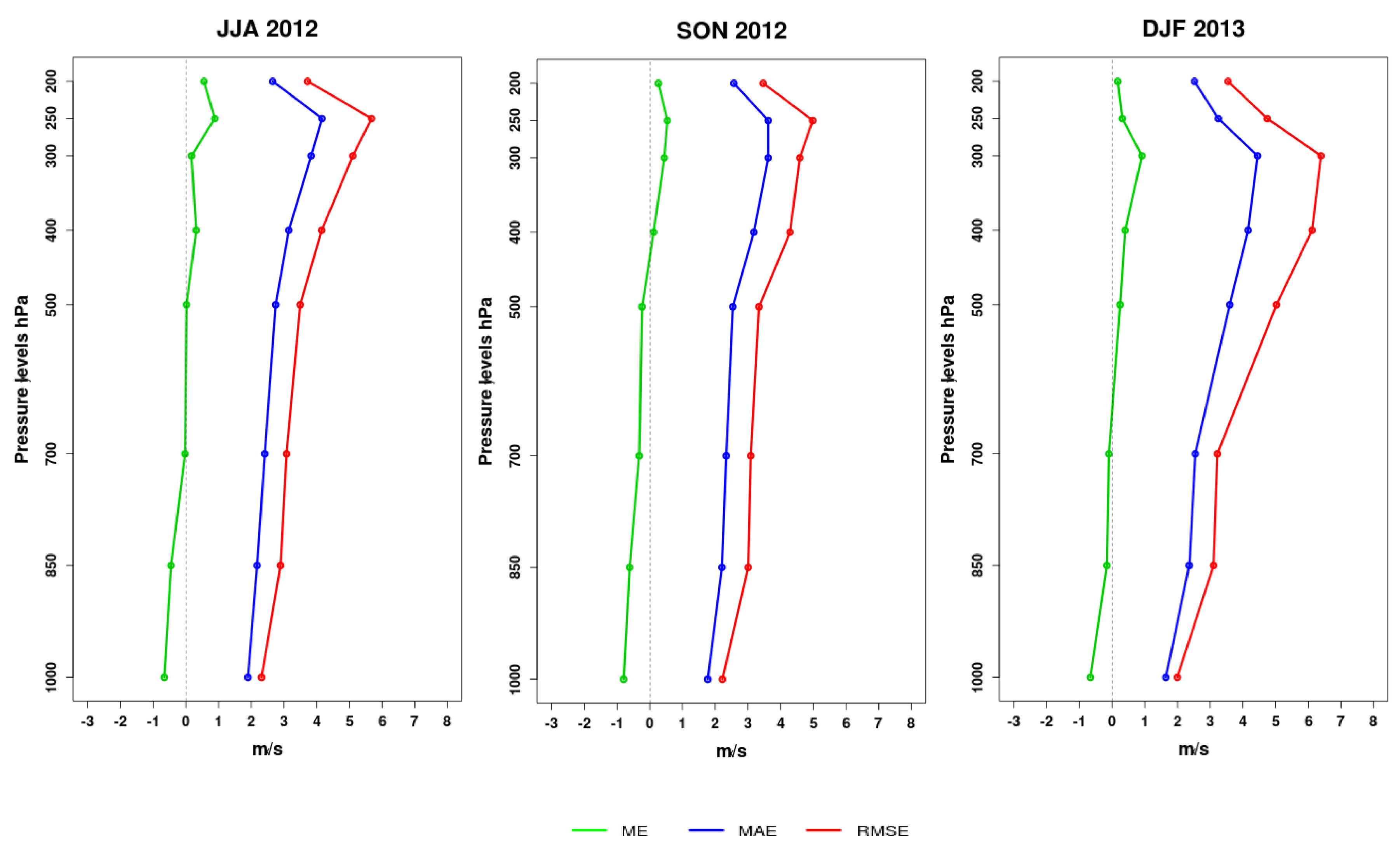
Model Domain and Orography



UPPER AIR VERIFICATION

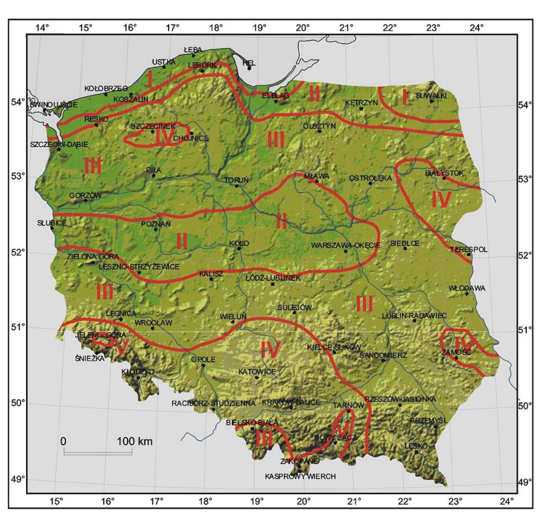
The verification of vertical profiles plays an important role in NWP verification. At IMGW-PIB the data from 3 radiosonde stations (Łeba, Legionowo, Wrocław) were used to verify the vertical structure of the model. Vertical profiles of wind speed up to 700hPa show similar characteristics in terms of ME, MAE and RMSE from season to season. Above this level there is greater seasonal variability in the scores. However ME values of 1m/s and MAE values of 2m/s show that forecast skill even at upper levels is satisfactory.

Vertical profile of wind speed for JJA 2012 - DJF 2013, ME, MAE and RMSE, Forecast run 00 UTC, time lag 24, averaged over 3 TEMP stations



REGIONAL VERIFICATION OF WIND SPEED – WIND ENERGY

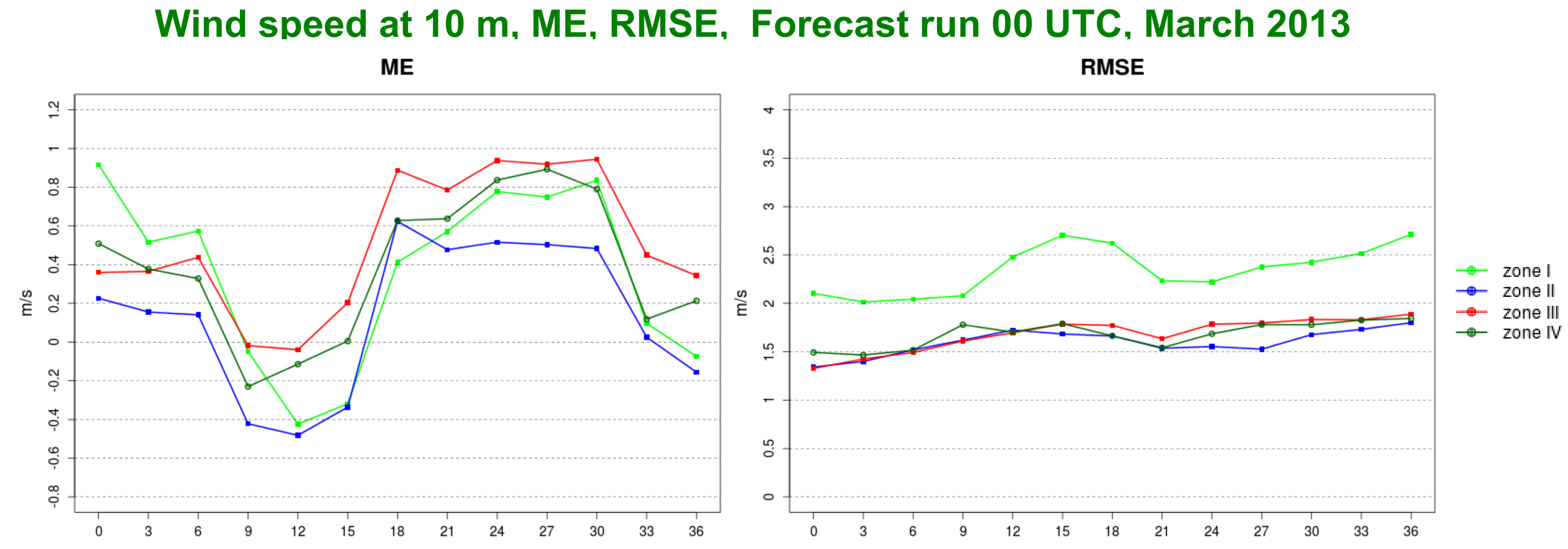
Wind energy zones



H.Lorenc, 2010

Wind energy is one of the fastest growing sectors of renewable energy resources in Poland and the amount of energy produced by wind turbines is increasing every year.
The most favoured regions regarding wind energy resources are the Baltic Sea coast and north-eastern part of the country called the Suwałki region (zone I) and the lowlands of Wielkopolska and Mazovia in West-Central and Central Poland (zone II).
The best forecasts occur for stations located in the second zone, with forecasts for the first zone (mostly over the seashore) having larger errors. The mean error of zone I, especially in the early period of forecast, can be twice as big as for stations in other wind energy zones. The RMSE of the first energy zone is 25 to 30% greater than all other zones. The figures show a diurnal cycle (overforecasting nighttime winds and underforecasting daytime winds) for all areas.

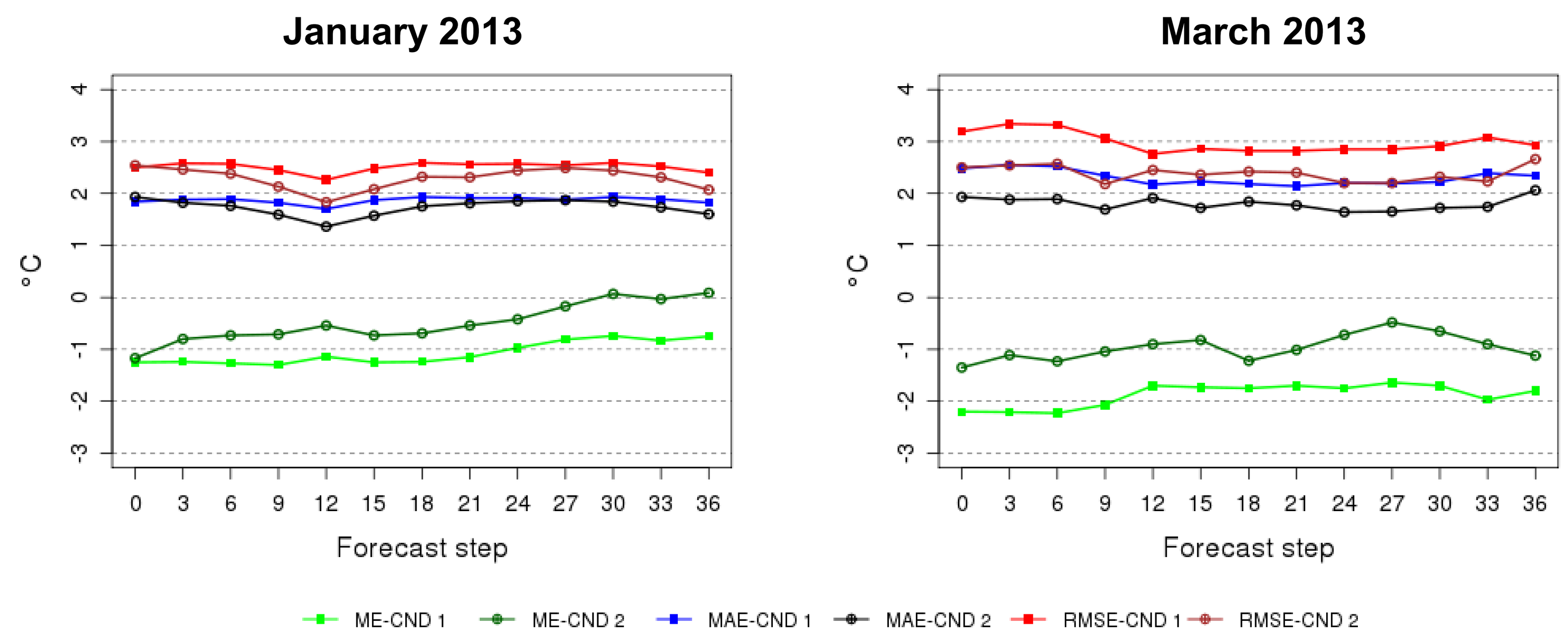
Wind speed at 10 m, ME, RMSE, Forecast run 00 UTC, March 2013



CONDITIONAL VERIFICATION OF TEMPERATURE FORECASTS

Conditional verification allows us to find relations between model errors and different observed weather conditions and is a very powerful tool for modellers to improve parametrizations in NWP. Figures show verification of 2m temperature with the following conditions: 1) total cloud cover higher or equal to 75%, 2) the same as 1) but with the additional condition that wind speed is lower than 2.5 m/s. The application of this second condition results in smaller forecast errors: the mean error is reduced by 1 degree, and RMSE by 0.5 degree.

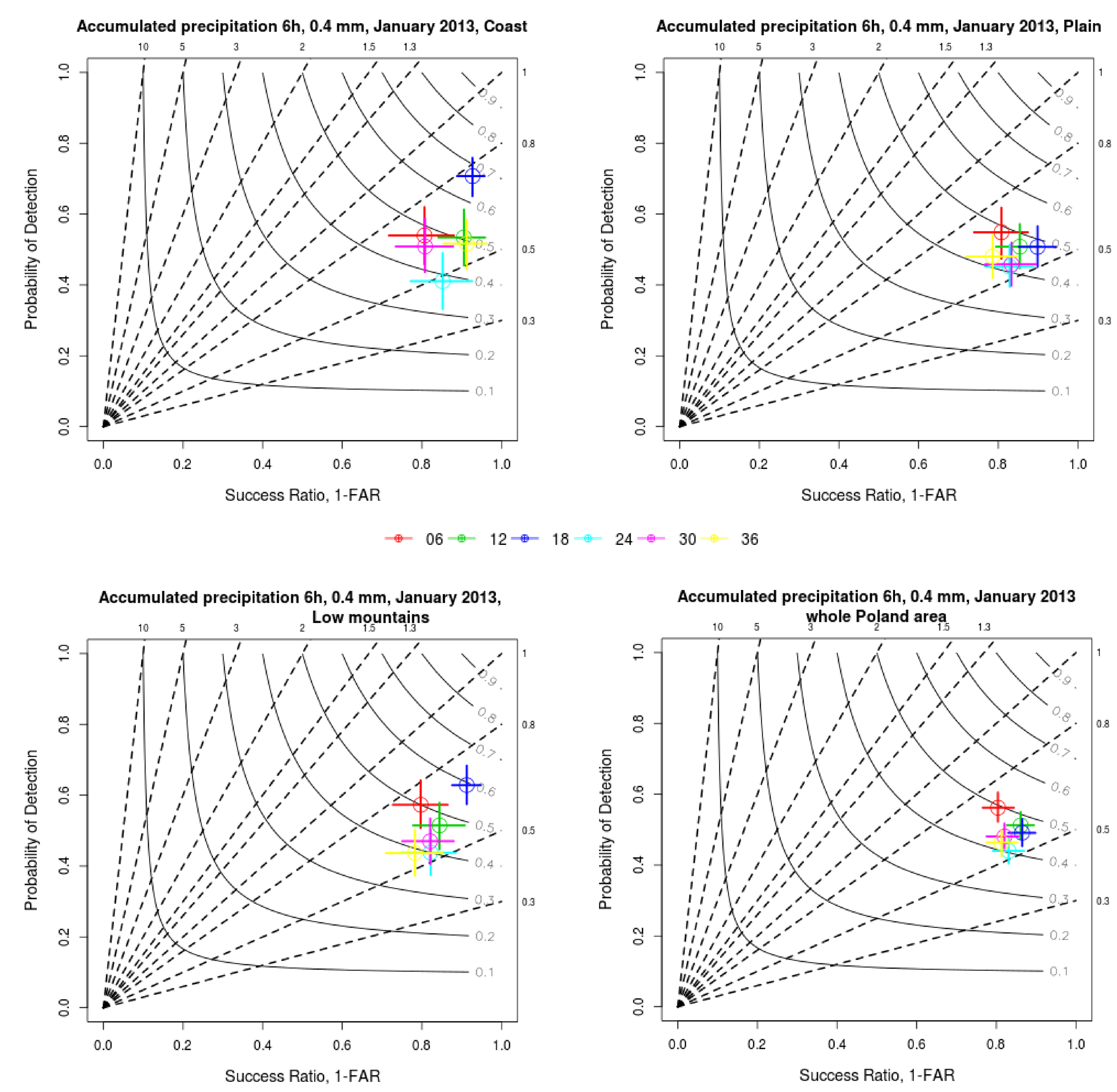
Temperature 2m, ME, MAE, RMSE, 00 UTC, All Poland stations, Conditions: 1. TCC >= 75%, 2. TCC >= 75% and WS < 2.5 m/s



DEPENDENT CRITERIA - DIFFERENT STRATIFICATION

The distribution of precipitation varies greatly in space and time. A performance diagram technique applied to precipitation forecasts allows multiple characteristics of a dichotomous forecast to be shown in a single diagram. For good forecasts, POD, SR, BS, CSI approach unity and a perfect forecast lies in the top right hand corner of the diagram (P.J. Roebber, 2009). The charts present the verification example of 6h accumulated precipitation forecasts over different topographical areas. The POD and SR results show the forecast is consistently good over all the different terrain classes.

Accumulated Precipitation 06 h, 0.4 mm, Forecast run 00 UTC, January 2013, Terrains: Coast, Plain, Low Mountains, whole Poland area



CONCLUSIONS

The verification results presented here show a good conformity of numerical forecasts to measured values. There are, however, some discrepancies, that seem to have a systematic nature rather than a random character, for example the dependency of temperature errors on cloud cover/wind speed and better wind forecasts over the central Polish plain compared to the coast.

References:
Roebber, P.J., 2009: Visualizing multiple measures of forecast quality. Wea. Forecasting, 24, 601-608.
Taylor, K.E., 2001: Summarizing multiple aspects of model performance in a single diagram. J. Geophys. Res., 106 (D7), 7183-7192.