28th EWGLAM & 13th SRNWP Meeting, Zuerich, 09 - 12 October 2006

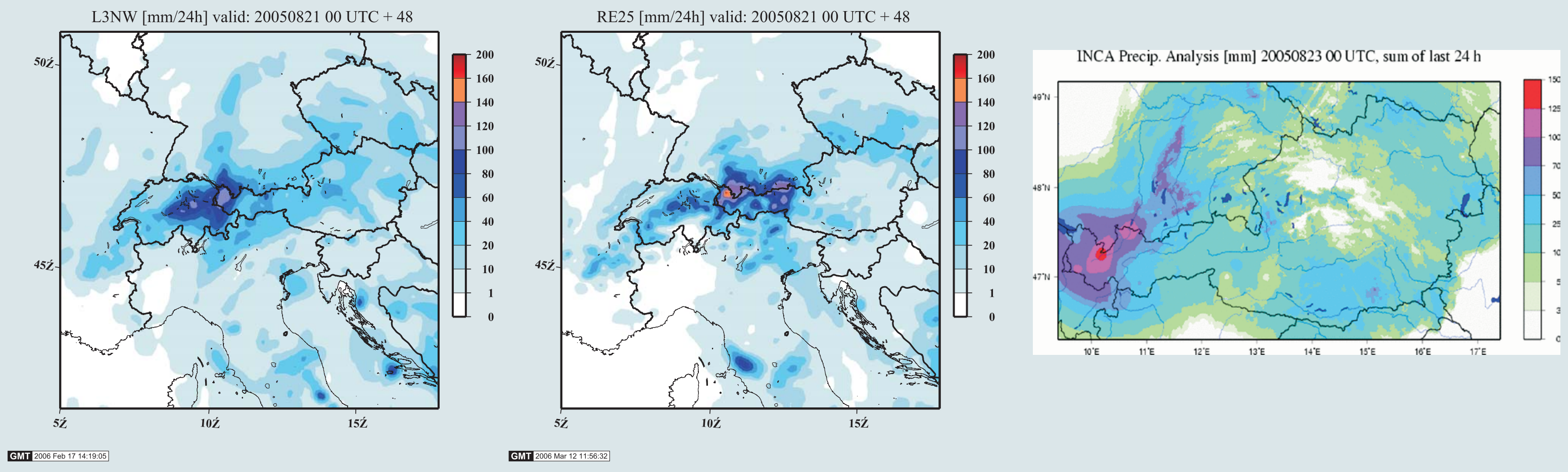
LAM activities in Austria in 2006

1. Operational Model Characteristics of Aladin-Austria

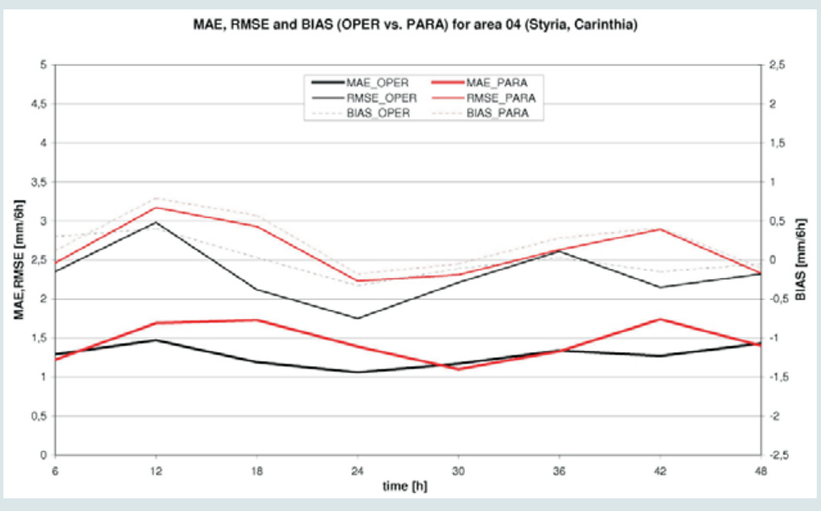
Since 2004, Aladin-Austria is run with CY25T2 with 9.6km horizontal resolution and 45 vertical levels. The number of gridpoints is 289x269, the coupling model is Arpege, the coupling frequency 3 hours. The timestep is about 415 seconds. The model runs on a SGI Origin 3400 on 26 CPUs twice per day (00 and 12UTC).

2. Experiments with LOPEZ - scheme (cycle 29)

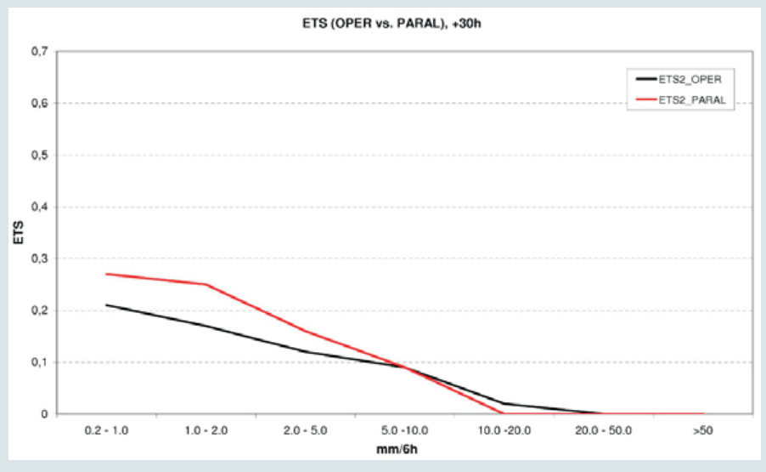
During the period 22.08.2005 to 23.08.2005, the areas mainly affected by heavy precipitation were Tyrol and Vorarlberg. The mesoscale precipitation patterns of Re25 (middle Fig., operational cycle 25) and L3NW (left Fig., Cycle 29 with Lopez scheme) are rather similar but the less orographic related pattern gained by Lopez microphysics seems to be more realistic. Compared to the INCA analysis (right Fig.), both models have deficiencies in locating the areas of the maximum precipitation during the first 24 hours.



During May 2006 ALADIN CY29T2 including the prognostic cloud scheme (Lopez-scheme) was compared with CY25T2 (which is the operational ALADIN version at ZAMG for the time being) in order to decide whether using CY29 (with the prognostic cloud scheme) as operational model is justifiable. INCA was used as observational data in case of precipitation and cloud cover. Beside grid-point-scores (ETS, FAR, etc), areal means were computed for several regions in Austria. The prognostic cloud scheme shows better scores for cloud cover. In case of precipitation, some scores show a slight gain of skill with the prog.nostic cloud scheme, others (especially scores computed for areal means) show the opposite.



Areal precipitation mean: MAE (thick line), RMSE (thin line) and BIAS (dashed line) for CY25 (black) and Cy29 (red) for the southern parts of Austria.



Precipitation: ETS (equitabe thread score) for all gridpoints within Austria, forecast hour +30h

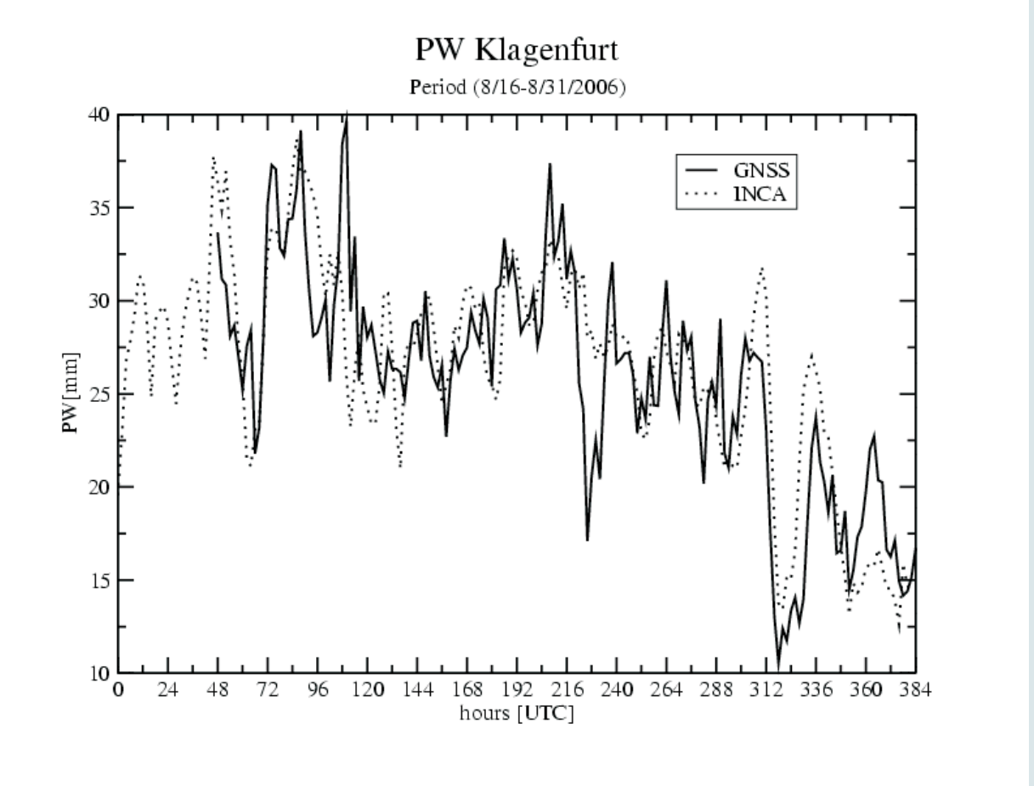
	oper	para
+06	13,25	9,39
+12	27,07	11,27
+18	14,79	12,92
+24	22,87	22,33
+30	16,04	13,23
+36	26,09	11,26
+42	17,39	16,04
+48	26,01	21,81

Cloud cover: MAE for all gridpoints covering Austria, CY25 (*oper*) vs. CY29 (*para*)

3. Met-GNSS project

- ○ Estimation of the integrated water vapor (IWV) in the tropospheric atmosphere using data from the Global Positioning System (GPS).
- ○ Separation of the zenith wet delay (ZWD) from the total zenith delay, by modelling the zenith hydrostatic delay (ZHD), utilising pressure and temperature values measured at stations close to the respective microwave signal receivers.
- ○ Project aim: Allocation of hourly IWV values for the integration in INCA (integrated nowcasting through comprehensive Analysis), and assessment of its usefulness in precipitation forecasts.

Time series for the precipitable water (PW) (where PW is approximated by 0.16*ZWD) above some selected stations in Carinthia agree rather well with calculated PW´s out of simulations (ALADIN). As an example the INCA and GNSS PW´s for Klagenfurt in the last two weeks in august are given in the figure below.



4. Aladin Limited Area Ensemble Forecasting (LAEF)

The LAEF configuration:

The ALADIN model used for the ensemble forecasting is run in hydrostatic mode, with 18 km horizontal resolution and 31 levels in the vertical. The model domain covers the area 25°W - 51°E, 26°N - 57°N, which includes Europe and a large part of the North Atlantic.

Initial condition (IC) perturbation:

The Breeding method is used for constructing the initial perturbed conditions for LAEF. By Breeding (breeding of growing vectors), the perturbed initial conditions were generated in sets of positive and negative pairs around a control analysis. Our implementation has the following features: *a)* lukewarm start, *b)* 12 hour cycle, *c)* two-side and centering around the control analysis, *d)* wind, temperature, moisture and surface pressure are perturbed at each level and model grid-point, *e)* 5 pairs, *f)* constant rescaling.

Another method, ETKF (Ensemble Transform Kalman Filter) is implemented in LAEF for constructing the initial perturbation. The ETKF analysis perturbations are achieved by postmultiplying the short-term ensemble forecast perturbations by a transformation matrix. This transformation matrix is obtained by solving the error covariance update equation for an optimal assimilation scheme within the ensemble subspace. We use fixed observation network, approx. 120 observation stations on three levels 850hPa, 500hPa and 250hPa. As in the Breeding method, wind, temperature, moisture and surface pressure are perturbed at each level and grid-point. As the ETKF analysis perturbation is not centered around the analysis, we applied a spherical simplex transformation for preserving the analysis error covariance matrix and centering the perturbation around analysis. Similar to ETKF, we have also implemented the ET (Ensemble Technique) for generating the initial perturbation.

Lateral boundary condition (LBC) perturbation:

As the performance of the LAM-EPS system is sensitive to the perturbed LBCs, experiments are carried out with LAEF breeding configuration coupled with the perturbed LBC from ARPEGE PEARP and with perturbed LBC from NCEP EPS (perturbations with Breeding).

Uncertainties in the model physics:

ALADIN dynamical adaptation of ARPEGE PEARP members with and without different physical parameterizations have been worked out. 11 combinations of different physics parameterizations and tunings in ALADIN were chosen for dealing with the uncertainty in the model physics, they are: Bougeault-type scheme of deep convection, the modified Kain-Fritsch deep convection scheme, moisture convergence and CAPE as in deep convection schemes closure, Kessler-type scheme for large scale precipitation, Lopez microphysics scheme, tuning of the mixing length, entrainment rate, and the computation of the cloud base.

To study the performance of LAEF during the winter season, the period 26.1.2006 to 26.2.2006 is chosen. In the following, we will show some verification results of the experiments: Arpege EPS members interpolated on Aladin grid, Aladin dynamical downscaling of Arpege EPS members, Aladin dynamical downscaling of Arpege EPS members with multi-physics option and NCEP EPS members interpolated on Aladin grid.

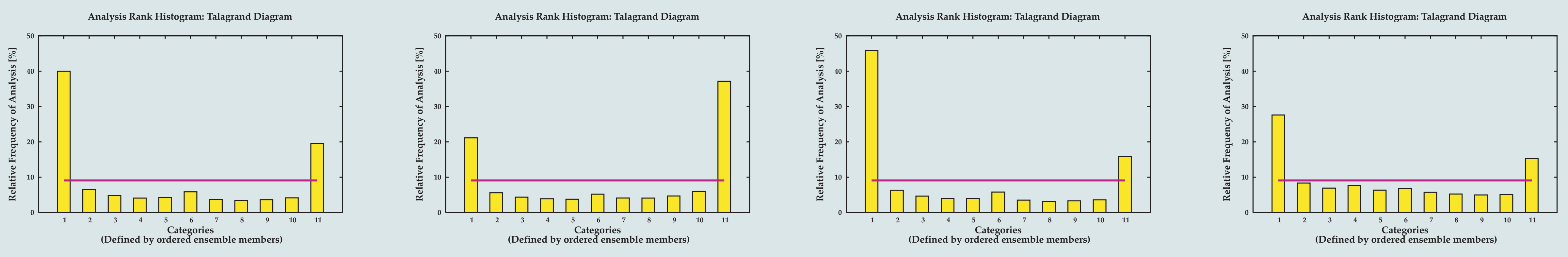


Fig. 4.1: Analysis Rank Histograms (Talagrand Diagram) for Temperature in 850hPa, forecast range +24 hours. Experiments from left to right: Arpege EPS, NCEP EPS, Aladin dynamical downscaling with operational physical parameterization, Aladin dynamical downscaling with multi-physics option. All experiments indicate that the ensemble spread is too small. Additionally, they show a tendency to high bias, except NCEP with a low bias.

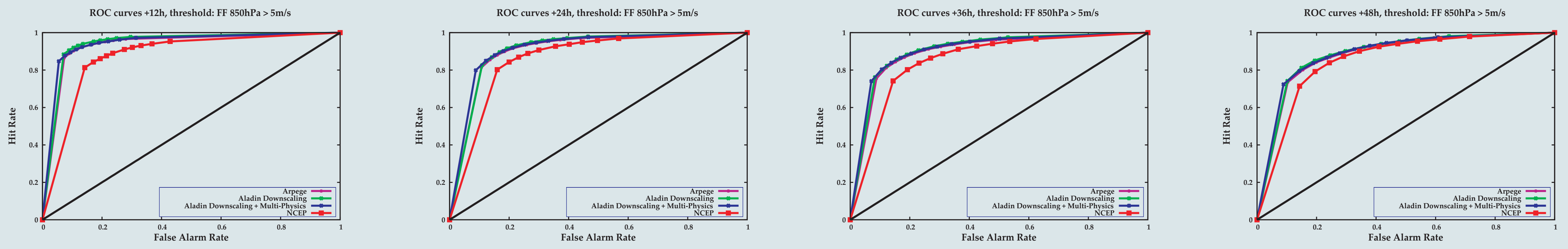


Fig. 4.2 ROC curves for the four experiments,(see Fig. 4.1), threshold Windspeed (850hPa) > 5m/s, from left to right: Forecast ranges +12h, +24h, +36h, +48h. Almost all experiments show similar results, the areas under the ROC curves vary from 0.95 at +12 hours to 0.88 at +48 hours froecast range. Only NCEP behaves significantly worse with ROC areas varying from 0.88 (+12 hours) to 0.85 (+48 hours).

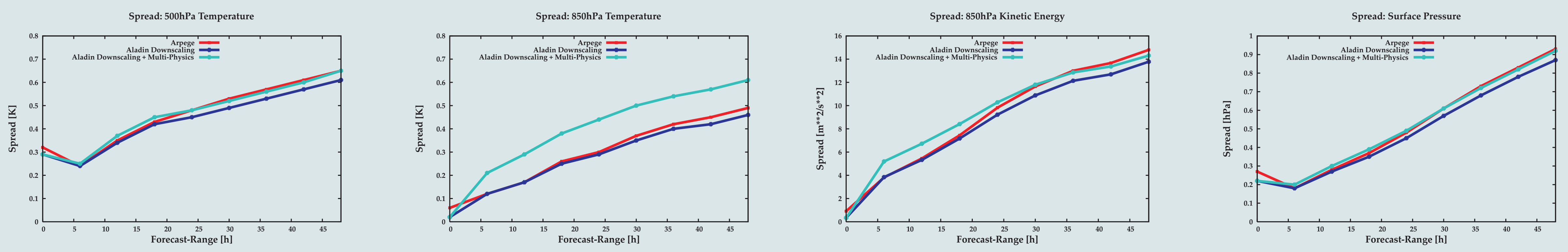


Fig. 4.3: Spread of Arpege EPS (red), Aladin dynamical downscaling with operational physics (blue) and Aladin dynamical downscaling with multi-physics option (green) as a function of forecast range. From left to right: Temperature 500hPa, Temperature 850hPa, Kinetic Energy 850hPa, Surface Pressure. In the upper atmosphere, the differences are marginal. In the lower atmosphere (e.g. 850hPa), multi-physics option significantly increases the spread (for both Temperature and Kinetic Energy).

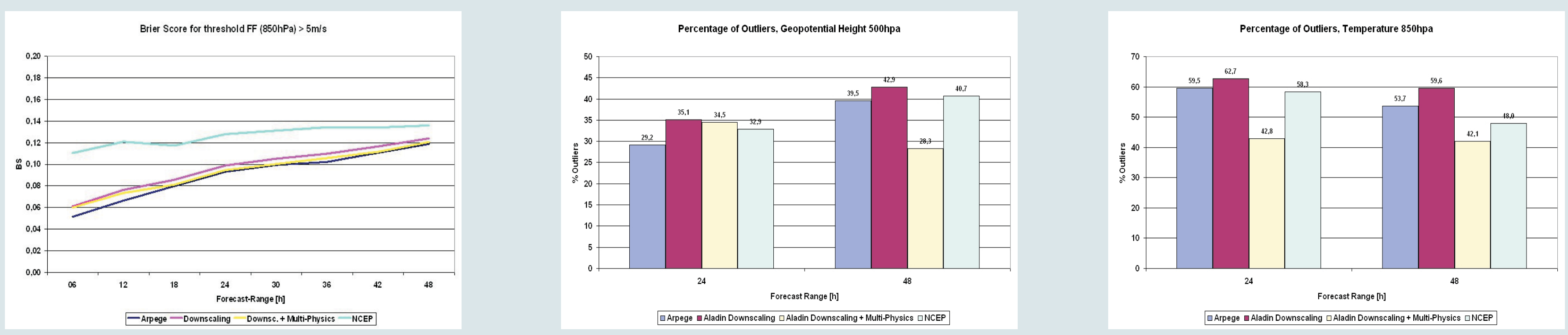


Fig. 4.4: Left: Brier score (threshold ff (850hPa) > 5m/s as a function of forecast range for experiments mentioned in Fig. 4.1. Again, almost all setups show similar results except NCEP EPS with higher BS. Regarding the percentage of outliers for Geopotential Height in 500hPa (middle) and Temperature in 850hPa (right), Aladin dynamical downscaling with multi-physics option shows best results for both parameters.

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