Offline version of SURFEX: a tool to improve winter 2-m temperature

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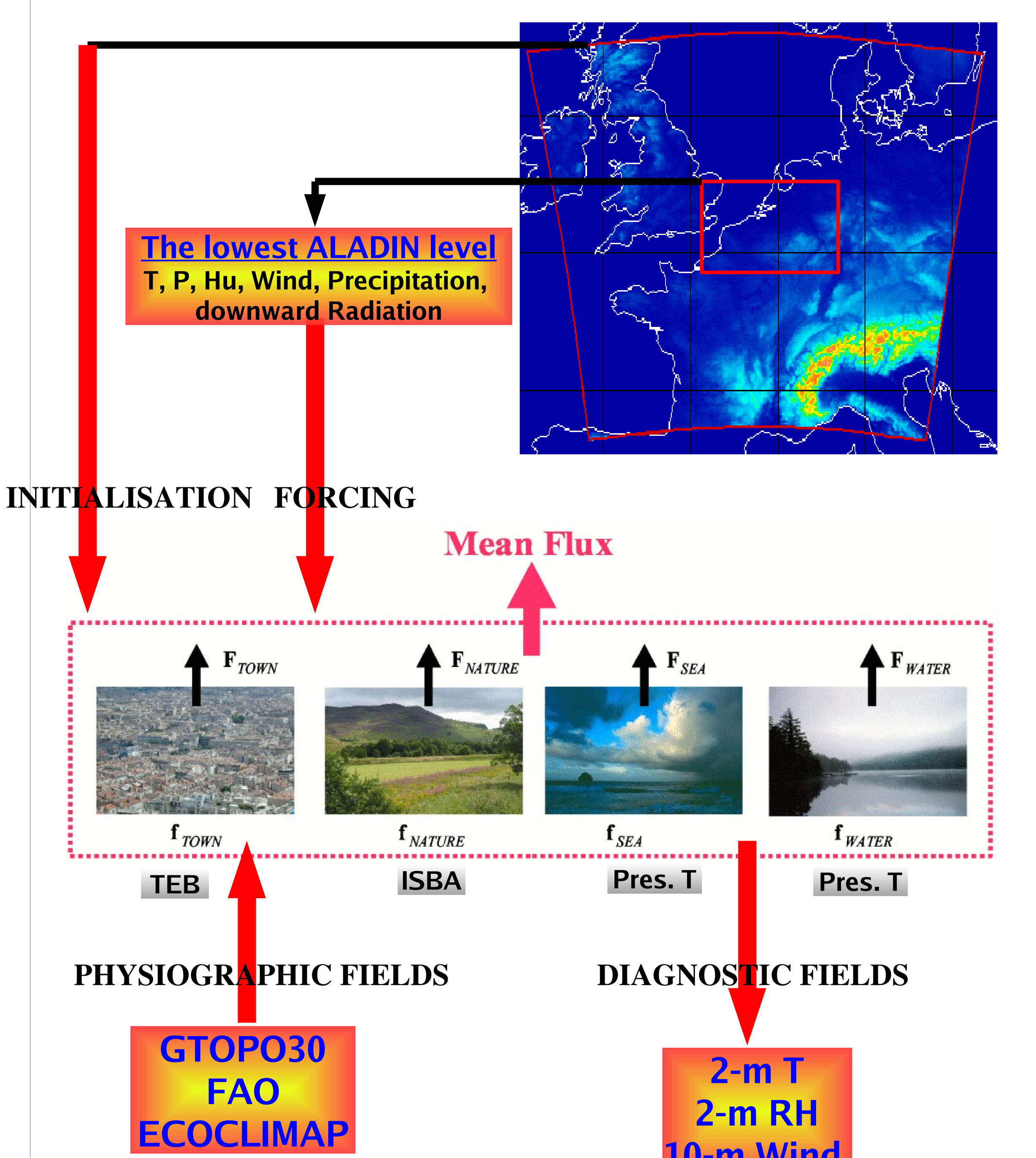
The pre-operational offline version of SURFEX coupled to the ALADIN-Belgium model



Validation Methodology

For this validation study a single station approach is followed. Termonia (2001) showed that four synoptic stations are sufficient to capture more than 90% of the variance in the 2-m temperatures of the Belgian synoptic measurement net. So a small database was created containing the observations collected in the synoptic station of the RMI (Ukkel, WMO number 6447) and eight other stations.

The statistical measures used here are based on formulas by Willmott (1982), who describes various methods of quantifying the statistical relationships between an observed (O) and model predicted (P) quantity. These statistics are computed for temperature, humidity, and wind speed.

1. The Mean Error or Bias is the difference between the mean of the model-predicted variable and the mean of the observed variable $\underline{O}$:

$$ME = N^{-1} \sum_{i=1}^{N} (P_i - O_i)$$

2. The Index of Agreement can be used to assess relative model performance. The IA is defined as:

$$IA = 1 - \frac{\sum_{i=1}^{N} (P_i - O_i)^2}{\sum_{i=1}^{N} (|P'_i| + |O'_i|)^2}$$

Where $P'_i = P_i - \underline{O}$ and $O'_i = O_i - \underline{O}$. The IA is bounded between 0 and 1 such that the perfect simulation has IA=1.

3. The RMSE is computed from:

$$RMSE = [N^{-1} \sum_{i=1}^{N} (P_i - O_i)^2]^{0.5}$$

it is always positive, and it emphasizes extreme differences between P and O.

4. The systematic and unsystematic RMSE (RMSES and RMSEU) are used to quantify the type of error. RMSES and RMSEU are calculated by accounting for the slope and intercept of the regression line that compare observed and predicted values and using:

$$RMSES = [N^{-1} \sum_{i=1}^{N} (\hat{P}_i - O_i)^2]^{0.5} \qquad RMSEU = [N^{-1} \sum_{i=1}^{N} (P_i - \hat{P}_i)^2]^{0.5}$$

Where: $\hat{P}_i = a + bO_i$

Such that a is the intercept and b is the slope of the least squares regression. RMSES and RMSEU form the following relation: $(RMSE)^2 = (RMSES)^2 + (RMSEU)^2$

Thus the proportion of systematic error in the model can be defined from:

$$SYS = \frac{RMSES^2}{RMSE^2} \qquad UNSYS = \frac{RMSEU^2}{RMSE^2}$$

In theory systematic errors should account for processes that the model does not routinely simulate well, whereas unsystematic errors could be attributed to randomness or subgrid-scale processes. A "good" model will have a systematic error that approaches 0 while the unsystematic error approaches the mean square error. Therefore, better models should have a smaller systematic portion of the error (i.e., bias).

In this validation study both **SURFEX** and **ALADIN** near surface variables will be compared from **October** to **December 2007**.

Ref:

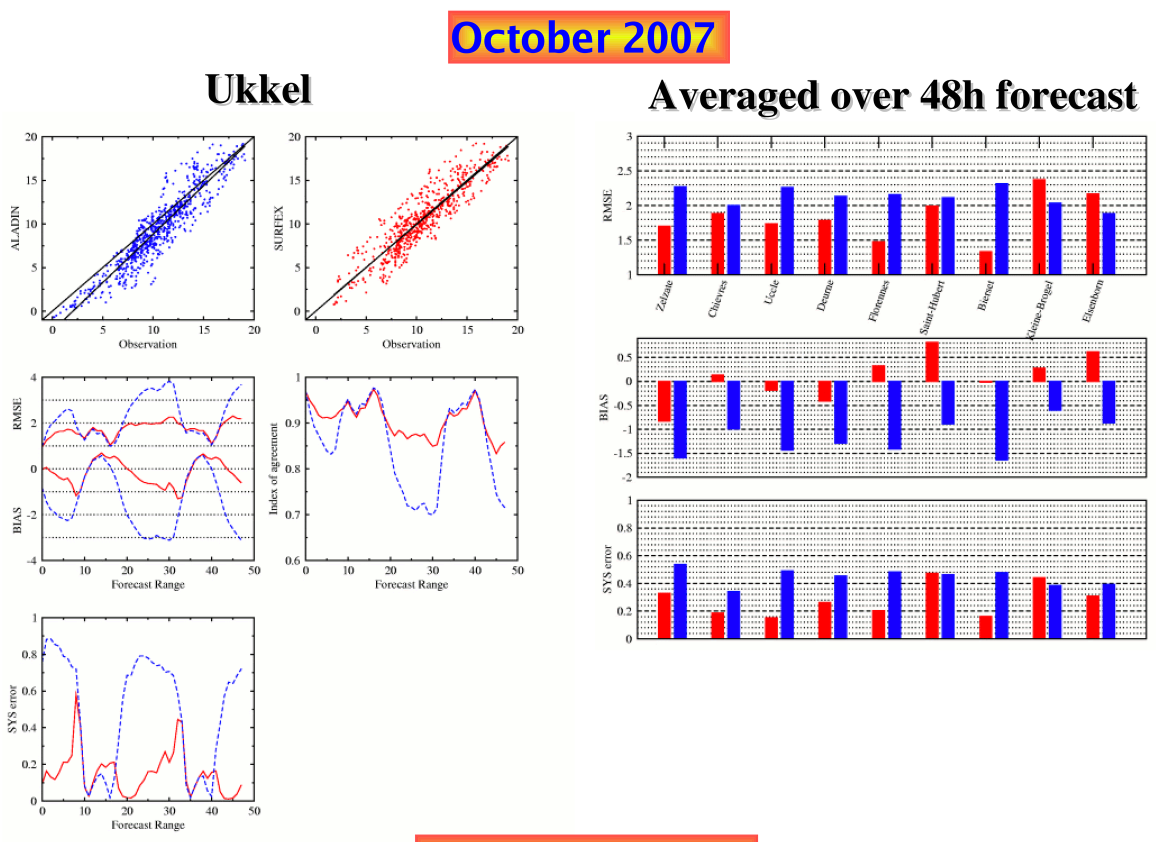
Brozkova, R., M. Derkova, M. Bellus, and A. Farda, 2006: Atmospheric forcing by ALADIN/MFSTEP and MFSTEP oriented tunings. *Ocean Sci. Discuss.*, **3**, 1-24.

Termonia, P., 2001: On the removal of random variables in data sets of meteorological observations. *Meteor. Atmos. Phys.* **78**, 143-156.

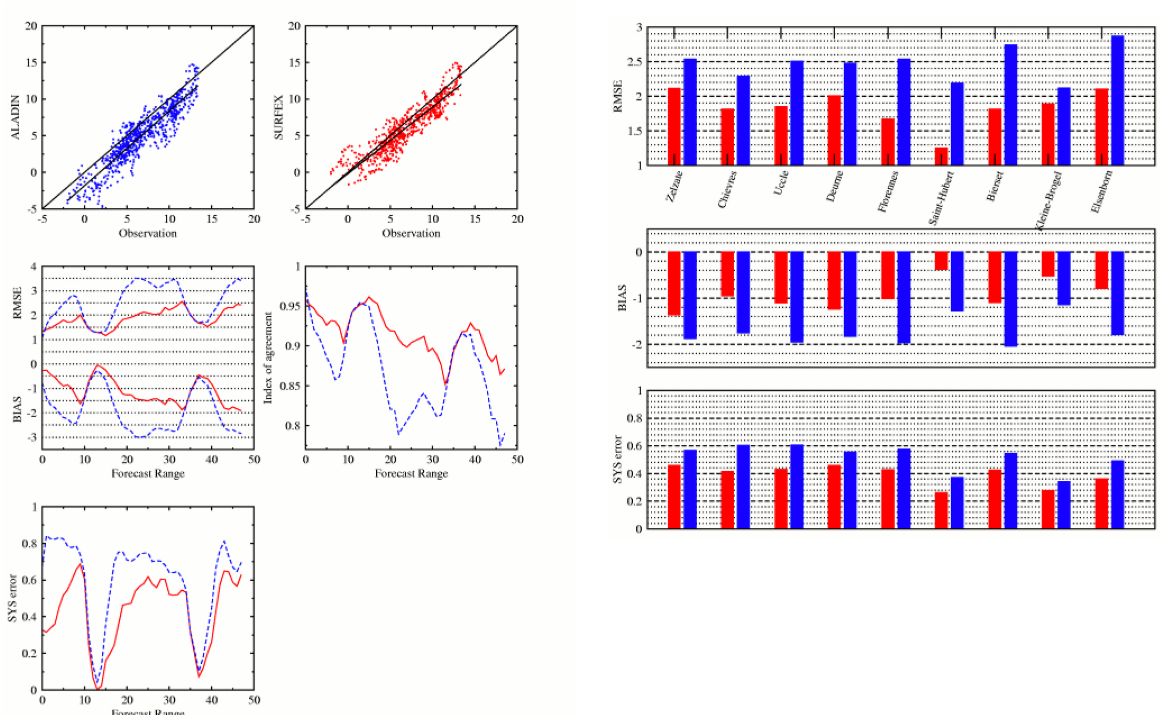
Willmott, C. J., 1982: Some comments on the evaluation of the model performance. *Bull. Amer. Meteor. Soc.* **63**, 1309-1313

Validation of 2-m temperature

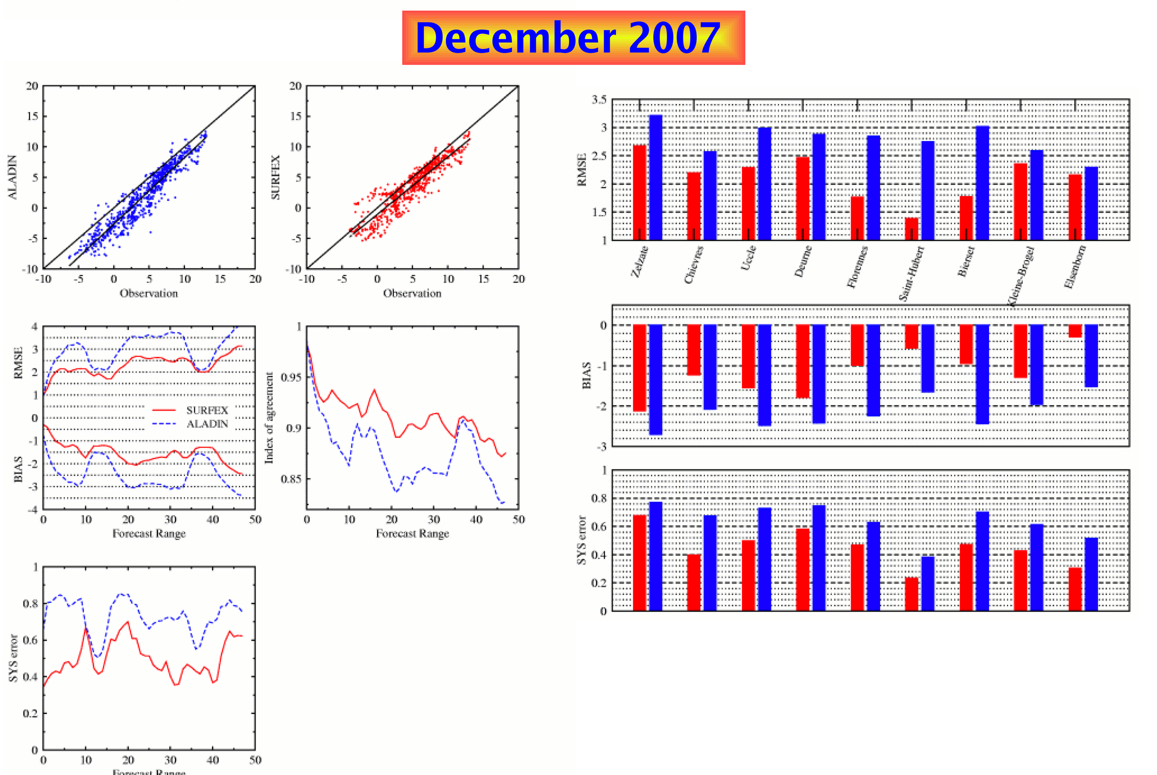
October 2007



November 2007

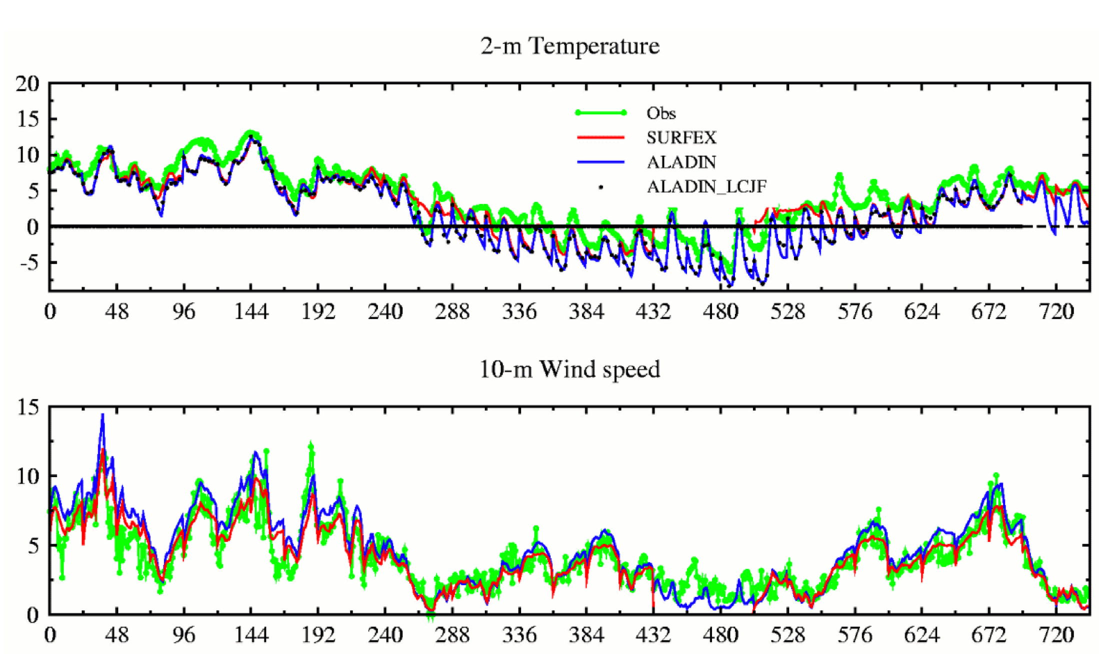


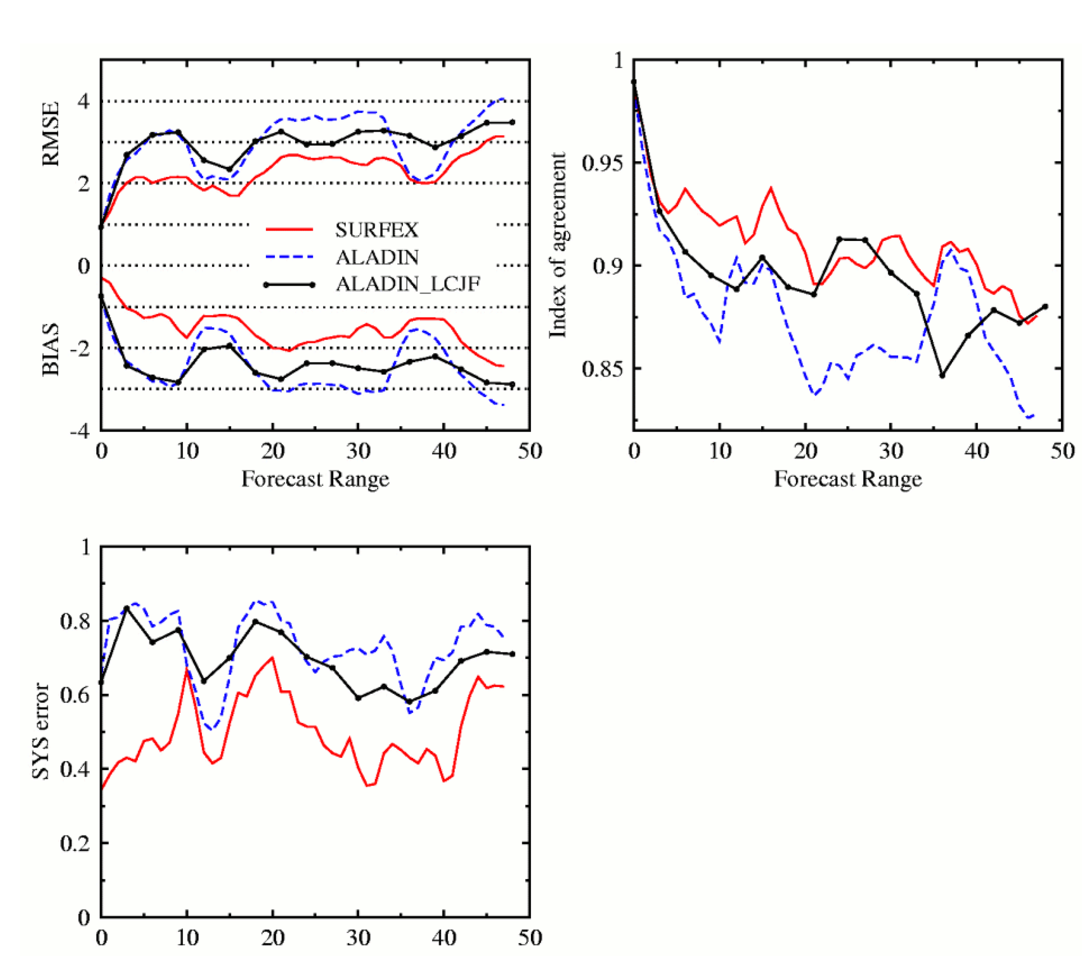
December 2007



Test with better representation of low cloud (Brozkova et al. 2006)

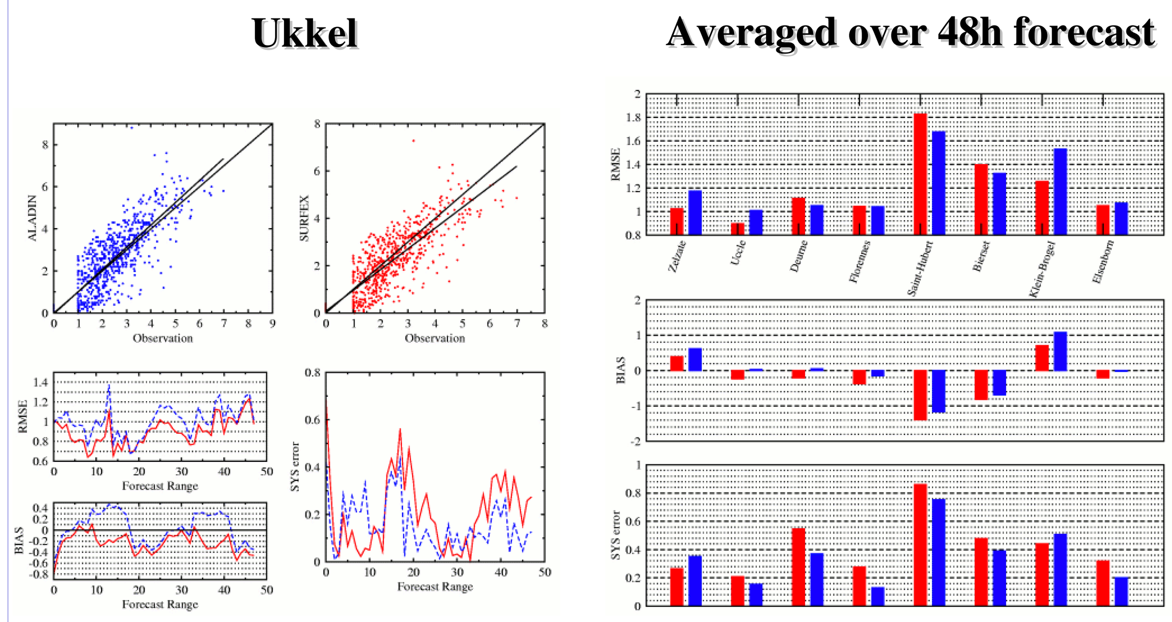
Ukkel, December 2007





Validation of 10-m wind speed

October 2007



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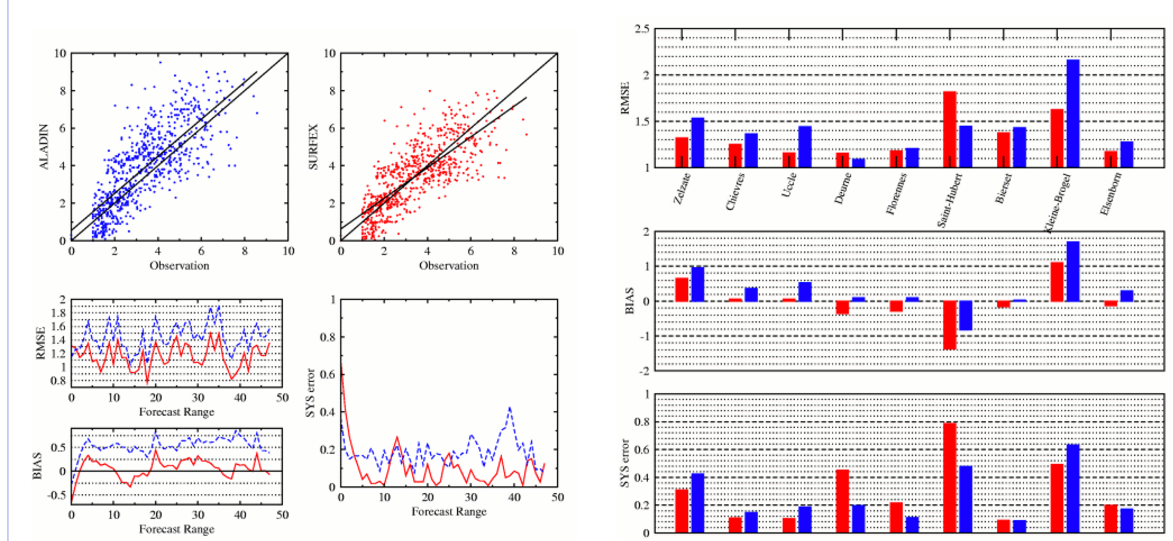
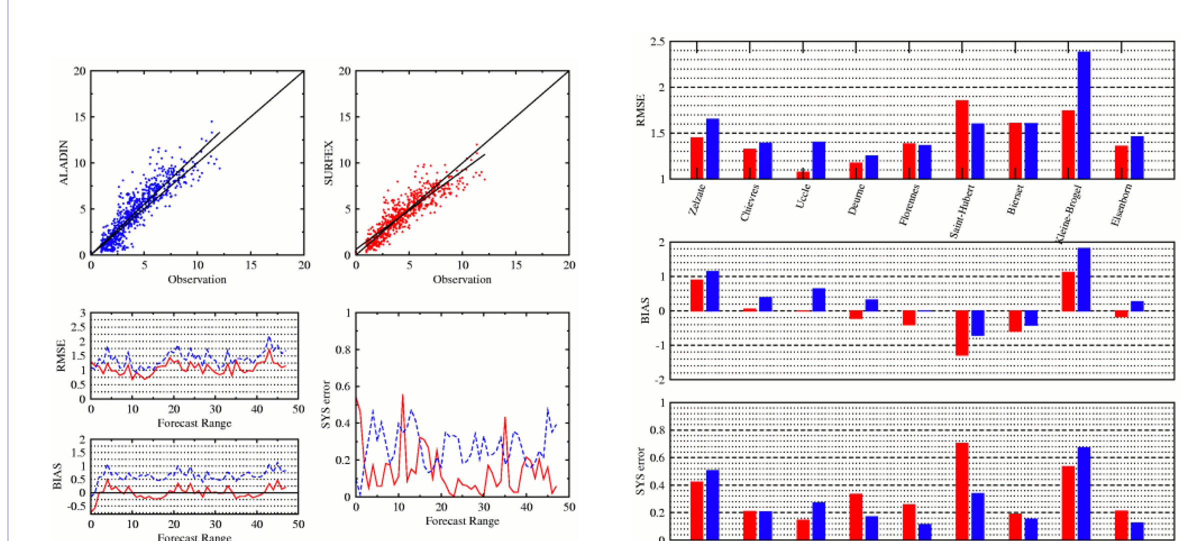
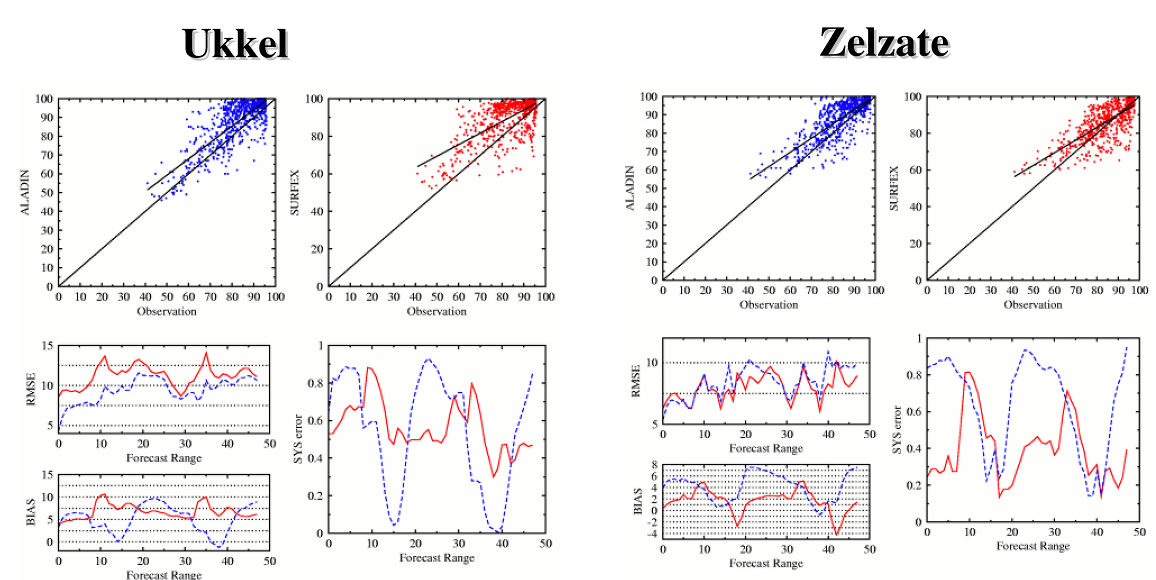


December 2007



Validation of 2-m relative humidity

October 2007



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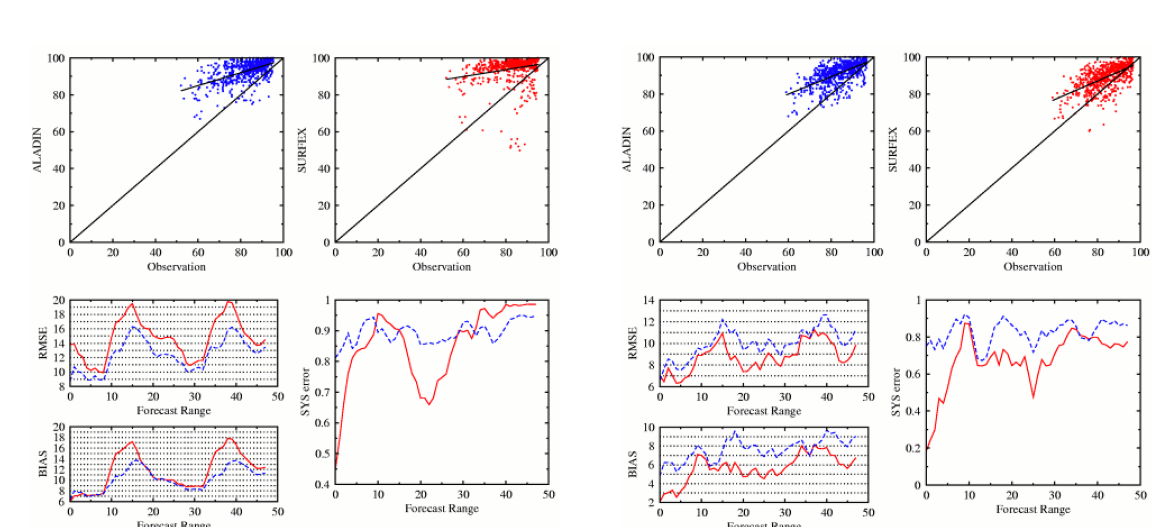

December 2007