1 Year Long Range Temperature Forecasts
for Northeastern Germany

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Summary. Since March 1996 long range forecasts for monthly temperature anomalies based on the procedure described in Radke (1996) are being made and published 3-monthly in the *Wetterkarte, Amtsblatt des DWD* (a publication of the German National Weather Service). This paper is verifying the quality of the forecasts. Although 12 months forecasts surely are not enough for a representative statement about the forecast skills, one can gather interestings facts from the data already now. Like the RV-value (reduction of variance) shows, the prediction of the value of the anomaly itself is a problem. However there is a forecast skill for the tendency prediction.

1 Method of Verification

The error of the prediction is generally describable with two parameters:

The $BIAS$ or systematic error shows whether the procedure predicts too warm in average ($BIAS < 0$) or too cold ($BIAS > 0$):

$$BIAS = \frac{1}{N}\sum_{i=1}^{N}(x_{i_{obs}} - x_{i_{prog}}) \tag{1}$$

with N as the number of predicted ($x_{i_{prog}}$) and observed values ($x_{i_{obs}}$).

The root mean square error ($rmse$) describes the accuracy of the forecast:

$$rmse = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_{i_{obs}} - x_{i_{prog}})^2} \tag{2}$$

For a perfect prediction applies $rmse = 0$.

To estimate the forecast skill the own prediction is compared to a reference forecast. In case of the long range forecast this reference is the climatological mean, i.e. an anomaly forecast of $0K$. For the medium range forecast this would be the persistence (preservation, $x_{n+1} = x_n$). The forecast skill than is described by the reduction of variance (RV):

$$RV = 1 - \left(\frac{rmse_{prog}}{rmse_{ref}}\right)^2 \tag{3}$$

In case of the long range forecast the value $rmse_{ref}$ is identical with the variance of the observed temperature anomalies.

	1st month	2nd month	3rd month	4th month
number of forecasts	12	11	10	9
$BIAS/K$	$+0.22$	-0.04	-0.19	-0.11
$RV - value$	-0.41	-0.38	-0.40	-0.29
$RV_T - value$	$+0.30$	$+0.33$	-0.13	$+0.14$

Table 1: Verification results for the single months

It applies:

$RV = 1$: perfect forecast
$RV = 0...1$: forecast better than reference, i.e. forecast skill exists
$RV = 0$: forecast as good as reference, i.e. no forecast skill
$RV < 0$: forecast worse than reference.

Because the long range forecast is focussed mainly on predicting whether there will be a negative or positive temperature anomaly the skill of the tendency forecast is interesting as well. Therefore the data have to be converted: negative anomalies $< -0.5K$ are set to -1, positive anomalies $> +0.5K$ to 1 an the remains to 0.

$$x_{i_{tend}} = \begin{cases} -1 & : \quad x_i < -0.5 \\ 0 & : \quad x_i = -0.5...0.5 \\ 1 & : \quad x_i > 0.5 \end{cases} \tag{4}$$

Analogically to the RV-value a forecast skill for the tendency prediction can now be calculated:

$$RV_T = 1 - \frac{\sum_{i=1}^{N} |x_{i_{tend,obs}} - x_{i_{tend,prog}}|}{\sum_{i=1}^{N} |x_{i_{tend,obs}} - x_{i_{tend,rev}}|} \tag{5}$$

The values $x_{i_{tend,rev}}$ are all zero because the reference forecasts are the climatological means. The RV_T-value behaves like the RV-value.

2 Results

Like the $BIAS$-values in table 1 show the procedure predictes $0.2K$ too cold in the first month while there is practically no $BIAS$ in the 2nd month. The 3rd and 4th months are predicted $0.2K$ and $0.1K$ too warm, respectively. Because there are only 8 and 7 forecasts for the 5th and 6th month, respectively, an analysis therefore would be less reasonable.

Further there has to be noted that all RV-values are less than zero at the moment, i.e. there is no forecast skill for the prediction of the value of the monthly temperature anomaly. These first dissatisfying results are relatived if one examines the distribution of the predicted values shown in fig. 1. Here all predicted and thereto observed valus are plotted, added by the 3-month-means as season forecasts. The dashed line markes the case of a perfect forecast while the dotted lines are for deviations up to $1K$.

One can see that the bad forecast skills is caused mainly by 2 months: December 1996 and

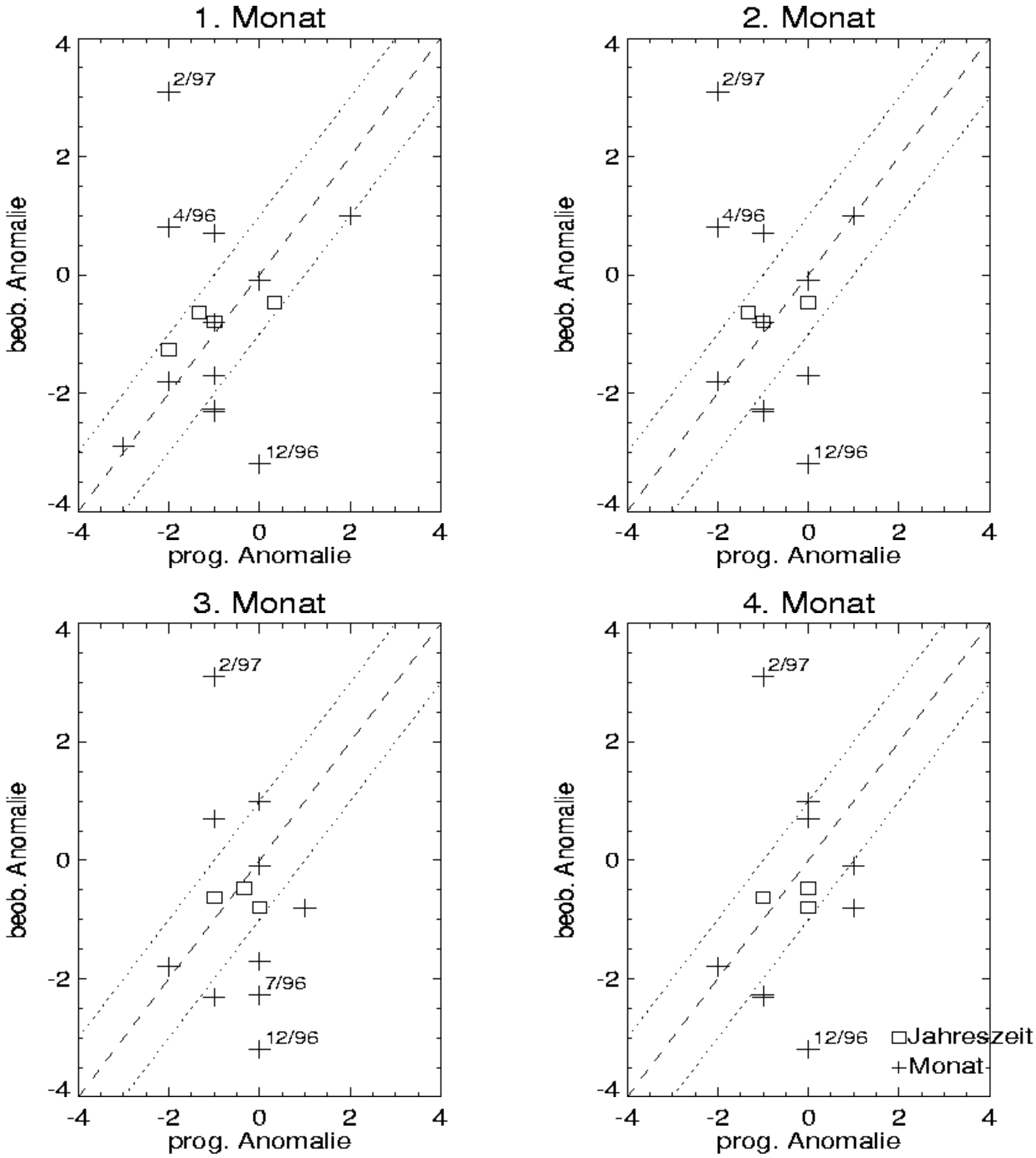

Figure 1: Distribution of the predicted monthly temperature anomalies (range for deviations of $-1K$ to $+1K$ marked)

February 1997. Both months behaved statistically seen quite abnormal whereby the February has the main part with a forecast error of $5.1K$. Because of that the RV-value was at the time of the forecast in December 1996 still positive for the first month. Also interesting is that the errors for December 1996 and February 1997 nearly annihilate. So the forecast "'too cold winter"' occured but with an erlier colder period. Another attraction of attention is that for the first month half of the forecasts were very good. This is expectedly getting worse with every month ahead.

Regarding the RV_T-values there is a proofable skill for the forecasts of the sign of the anomaly for the 1st, 2nd and 4th month. For the 2nd it is even better than for the 1st.

3 Conclusion

Because of the "'backstroke"' December/February there is currently no skill for the forecast of the value of the temperature anomaly. However there is one for the prediction of the tendency forecast. Also the forecast of the anomaly for the season is very promising. It never was more than $1K$ wrong.

References

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