Application of a Bias Correction Scheme for 2 Meter Temperature in Numerical Model Forecast

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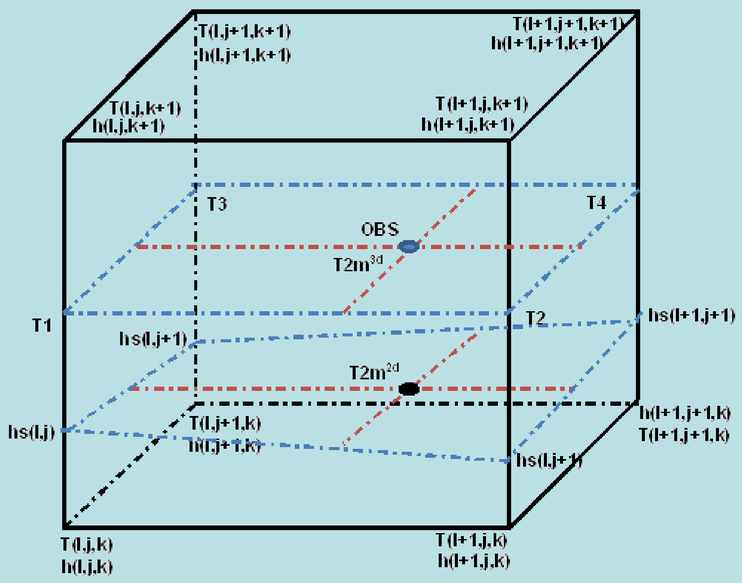
1. Introduction

The inherent difference between the observation topography and model terrain has seriously affected the 2 m temperature verification accuracy. The traditional two-dimensional interpolation scheme can only ensure forecast element and observation consistency in latitude and longitude location of the two-dimensional space, while ignoring the vertical direction consistency, which makes verification result of forecast and observation is not from the same position, thereby causing an evaluation misleading. Diurnal cycle is an important feature of the 2 m temperature, Due to the limitation of physical process such as radiation, large bias always appears in the diurnal cycle forecast. In this paper, using three-dimensional forecast variables, combined with near-surface elements of forecast products, an advanced three-dimensional interpolation scheme is developed to ensure consistency with the observed three-dimensional space forecasting. Based on the topography correction methods, monthly forecast error is used as reference bias products to eliminate systematic error and obtain forecast products with characteristics of diurnal cycle.

2. Method



$T2m^{2d}$: 2D interpolation $T2m^{3d}$: 3D interpolation

$Bias^{2d}=T2m^{2d}-OBS$ $Bias^{3d}=T2m^{3d}-OBS$

BIAS = F-O

$BIAS=BIAS_T+BIAS_M$

$BIAS=BIAS_T+BIAS_C+BIAS_F$

$BIAS_T$: topography error $BIAS_M$: model error

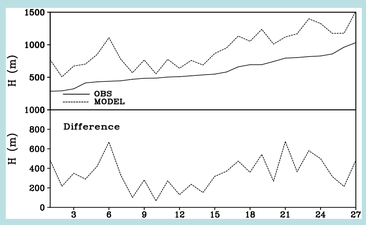
$BIAS_C$: systematic error $BIAS_F$: inherent error

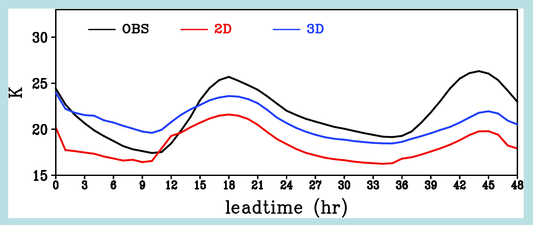
Due to the limitation of physical process such as radiation, large bias always appears in the diurnal variation forecast

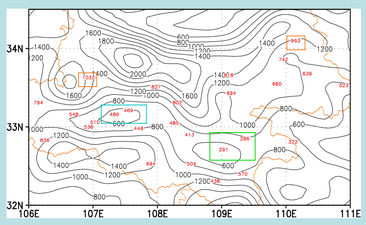
- Eliminate topography error by 3D interpolation method.
- monthly forecast error is used as reference bias products to eliminate systematic error

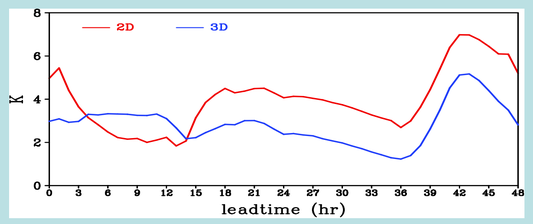
Eliminating abnormal samples of reference data by confidence interval

3. Case Analysis









typical stations

3D interpolation method

In 12UTC 28Aug 2016, it shows three-dimensional interpolation scheme effectively solve the evaluation misleading caused by the height bias between the model terrain and observation topography, however it can hardly effectively improve the diurnal cycle trend.

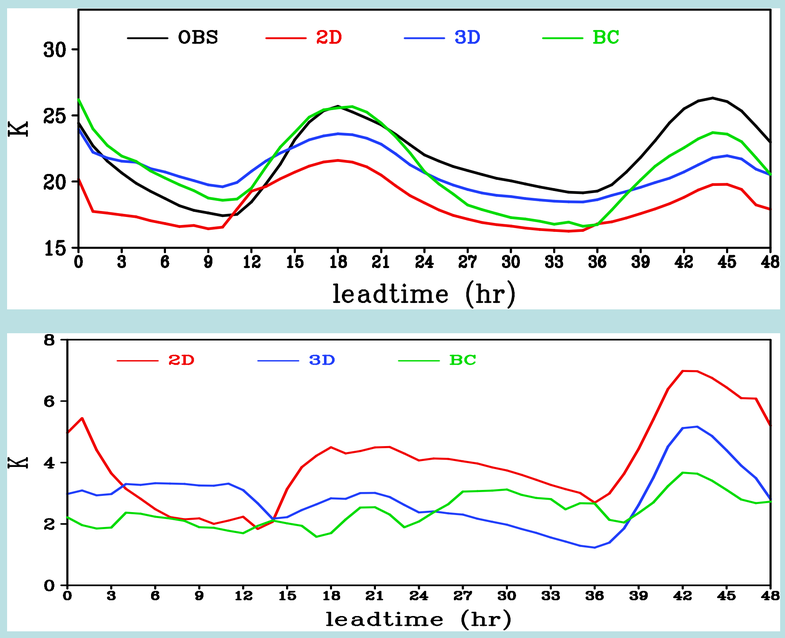


Fig.1 Comparison of 27 stations mean 2 meter temperature calculated by Bias Correction & 3D & 2D interpolation methods at every 1 hour (a: distribution of 2 meter temperature forecast and observation; b: RMSE)

- diurnal variation forecasting features are improved obviously.
- better consistency with observation and the higher skill score, especially in the first 24 hours.

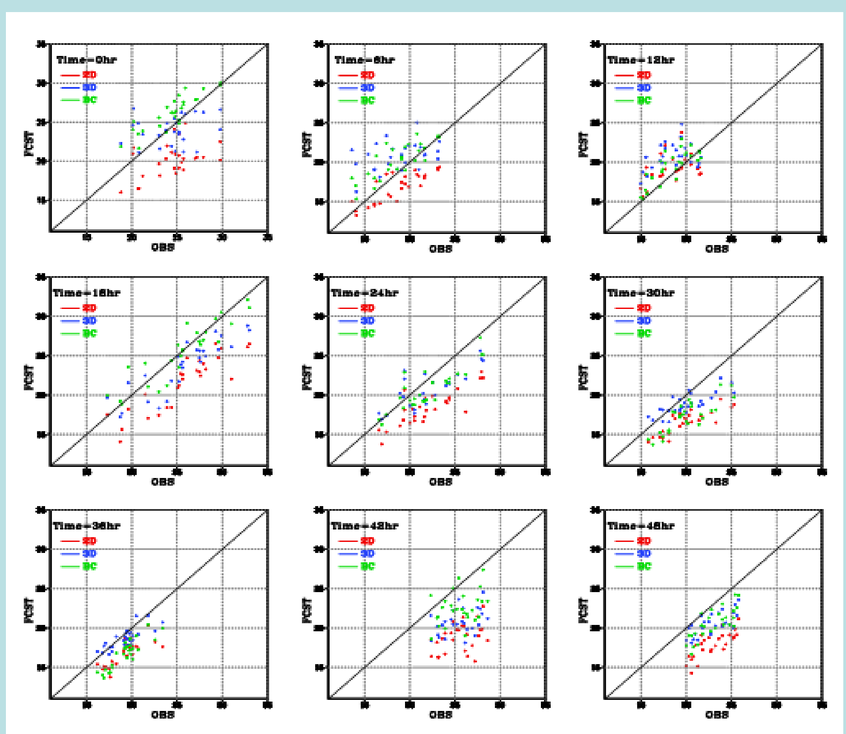


Fig.2 Scatter of every 6 hours forecast 2 meter temperature calculated by Bias Correction & 3D & 2D interpolation methods and observation.

MSE skill score (from *Murphy*)

$$SS(f,c,o)=1-\frac{MSE(f,o)}{MSE(c,o)}$$

$$MSE(f,o)=<(f_i-o_i)^2> \qquad MSE(c,o)=<(c_i-o_i)^2>$$

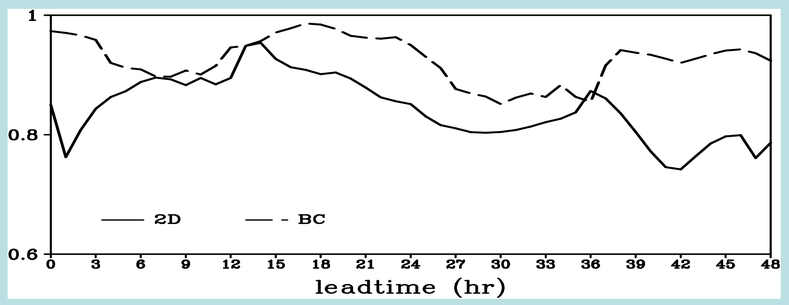


Fig.3 Distribution of every 1 hours forecast 2 meter temperature Murphy skill score calculated by Bias Correction & 2D interpolation methods

4. Month Analysis

The data of 1-31 Aug 2016 are selected to evaluate the performance of bias correction method in 2 meter temperature verification.

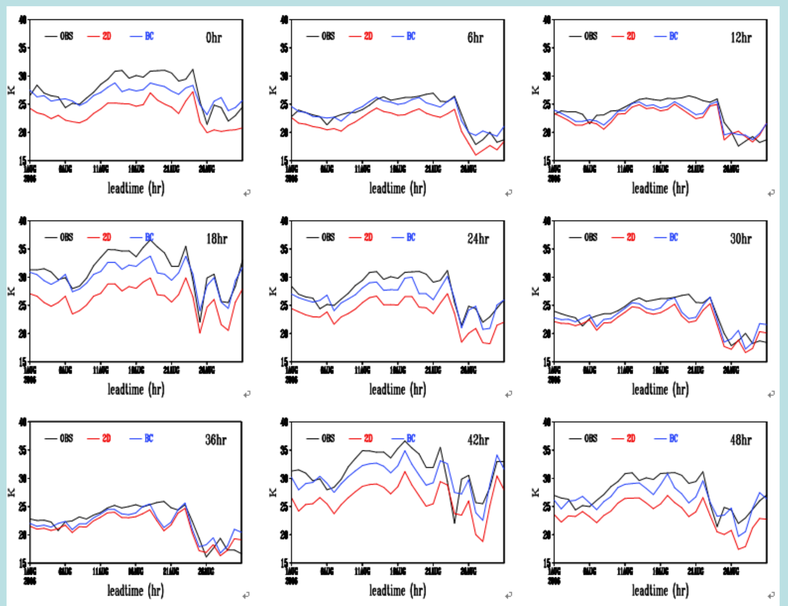


Fig.4 Comparison of 27 stations mean daily 2 meter temperature calculated by Bias Correction & 2D interpolation methods at every 6 hour on August 2016

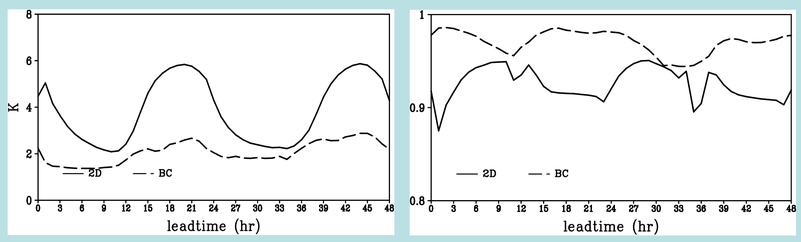


Fig.5 Distribution of monthly mean 2 meter temperature RMSE (a) and murphy skill score (b) calculated by Bias Correction & 2D interpolation methods

5. Summary

Based on typical observation gauges in Shanxi province, 48 hours forecast products on August 2016 are used to compare and it is found that the three-dimensional interpolation scheme effectively solve the evaluation misleading caused by the height bias between the model terrain and observation topography, however it can hardly effectively improve the diurnal cycle trend. After the systematic error correction is adopted, the diurnal cycle forecasting features are improved obviously. In particular, it shows better consistency with observation and the higher skill score, especially in the first 24 hours. By monthly statistical evaluation, it indicates that 2 m temperature after the bias correction can effectively improve the oscillation of periodic errors, the RMSE keeps at about 2k which shows the obvious advantage of improvement.