MM5 10-M WIND DIRECTION FORECAST SKILL OVER BAY OF BENGAL DURING SPRING 2001

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Skill of 10-m wind direction forecasts produced by the PSU/NCAR mesoscale model (MM5, Dudhia, 2001) is evaluated during March and April 2001. For the verification 10-m wind speed and direction retrieved from the microwave scatterometer QuikSCAT (QSCAT, 2001) measurements are used. QSCAT data represent values averaged over 25x25 km cells. The MM5 is integrated with a resolution of 27 km and 30 vertical levels are used. The model integration domain is limited by 0.38N-33.8N and by 32.7E-105.6E. Boundary conditions are provided by NCEP AVN forecasts and "cold start" option is used. QSCAT data is available over Bay of Bengal around 00Z and 12Z time. Thus the quality only of 12, 24 and 36 hours MM5 forecasts started at 00Z and 12Z are evaluated. Selection procedure of QSCAT winds involves time filtering and choosing the "best quality" data followed by bilinear interpolation to 1-degree latitude-longitude grid. For the comparison with NOGAPS (Hogan, Rosmond, 1991) forecasts MM5 output also interpolated to 1x1° grid.

An example of a wind direction bias error (model – observed) distribution averaged for March-April period and for 12-hour forecast time is shown in Fig. 1a for MM5 and in Fig. 2b for NOGAPS. There is a clear tendency for a positive wind direction bias for both models along East Coast of India, approximately from 12°N to 20°N. In contrast, over the NE part of Bay of Bengal a negative wind direction bias is observed. Simulated air's flow over this part of Bay of Bengal tends to be directed more towards land than the observed flow. In general, a positive wind direction bias is observed over Andaman Sea and Gulf of Martaban. For quantifying the relative improvement of MM5 10-m wind direction on mean absolute direction error (*ADE*) as follows:

$$SS_{ADE} = \left(1 - \frac{ADE_{MM5}}{ADE_{NOGAPS}}\right)100 .$$

The mean *ADE* for NOGAPS is used as an accuracy measure of a reference forecast.

Geographical distribution of the skill score is depicted in Fig. 2a for 12 h forecast and in Fig. 2b for 24 h. MM5 forecasts show a region of a clear improvement (positive SS values) in 10-m wind direction prediction over Gulf of Martaban. It's important to note that 10-m wind direction error depends on an observed speed. Generally a low wind speed is associated with a large (> 60° and more) direction error. At a relatively high speed (> 5 m/s) a direction error has a tendency to became as small as 30-40° or less. This relationship between a wind direction error and observed speed for both models is well illustrated by Fig. 3b and Fig. 3c.

References

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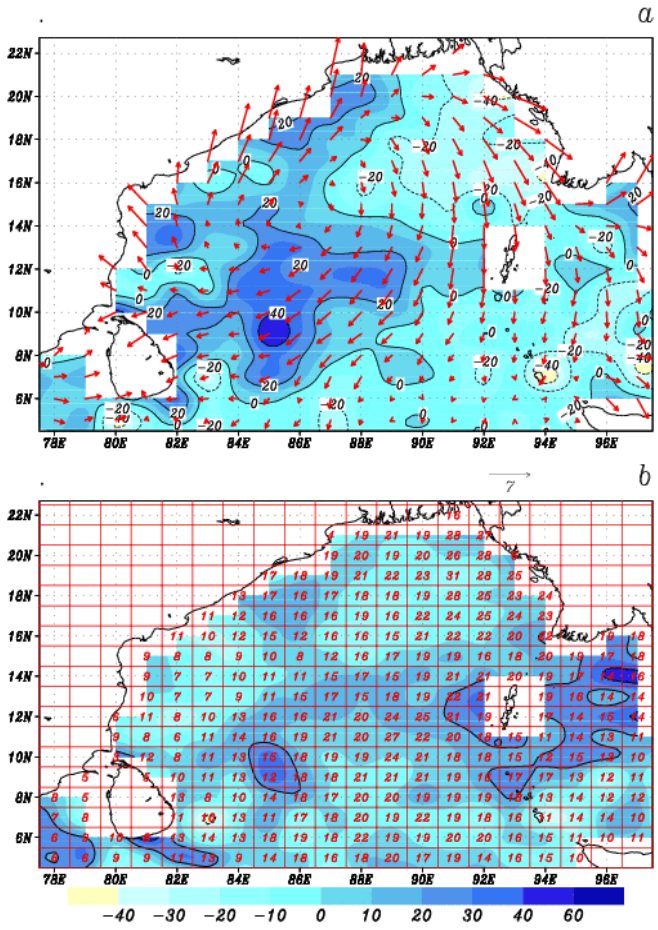

Fig. 1. Mean wind direction bias for March-April 2001 MM5 (a) and NOGAPS (b) forecasts started at 00Z. Averaged QSCAT . wind field is shown by arrows. Digits correspond to the number of cases used for averaging

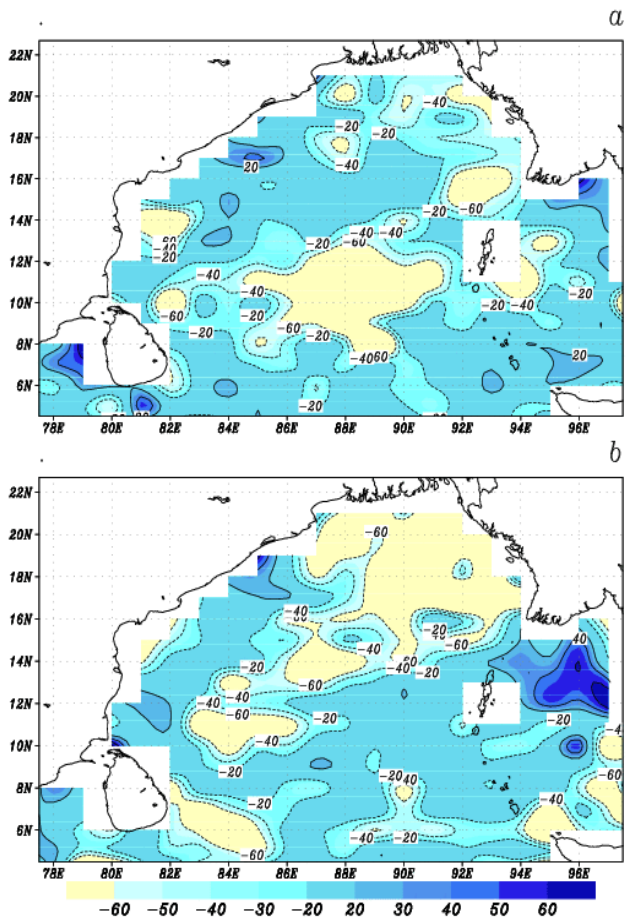

Fig. 2. Geographical distribution of MM5 10-m wind direction skill score against NOGAPS for 12 h (a) and for 24 h (b) forecasts

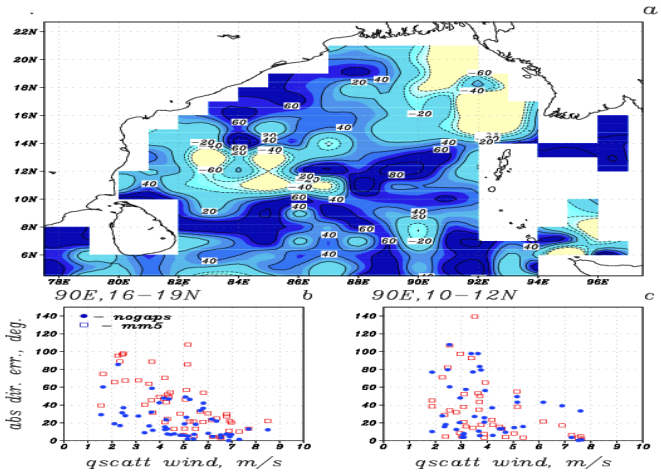

Fig. 3. Same as Fig. 2b, but only for cases with observed wind speed > 5 m/s. Relationship between observed wind speed and absolute direction error for two sample regions: (90-91E,16-19N) (b) and (90-91E,10-12N) (c).