Evaluation of AMDAR and AMV Data Quality and Their Impact on RTFDDA analysis and Forecasting Control at Eastern Mediterranean region

Linlin Pan[1], Yubao Liu[1], Yonghui Wu[1], Dorita Rostkier-Edelstein[2], and Rong-Shyang Sheu[1]
[1]National Center for Atmospheric Research, CO 80301
[2]Israel Institute for Biological Research , Ness-Ziona, Israel

Introduction

This study focuses on data quality control (QC) and impact study of the non-conventional datasets from aircrafts and satellites with the NCAR (National Center for Atmospheric Research) WRF RTFDDA (Real-time four-dimensional data assimilation) system over the data-sparse Eastern Mediterranean region.

The data investigated in this research includes AMDAR and AMV datasets. The AMV data quality is investigated as a whole as well as in term of different satellite channels (e.g., water vapor channel, visible channel, and infrared channel). The study shows that the AMDAR data are high quality, whereas it is important to handle AMV data with a great caution. The AMV data from water vapor channel have the largest bias and root mean squared error (RMSE). An enhanced QC constraint are defined in order to achieve positive impact using the AMV dataset.

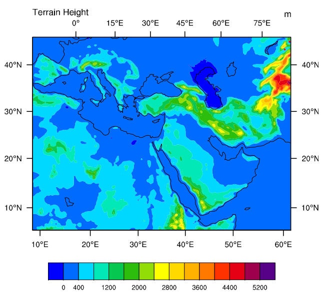

Figure 1. Model domain

The NCAR RTFDDA QC system

$|A^{obs} - A^{model}|$ contains

- "Gross" observation error (Eo)
- Forecast (background) error (σ)
- Representativeness error (Er)

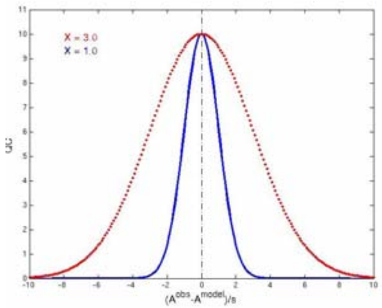

Figure 2. QC value as the function of model as observation difference

$$Q_F = \exp[-(A^{obs} - A^{model})^2]/(\sigma^2 X^2)$$

AMV and AMDAR data quality

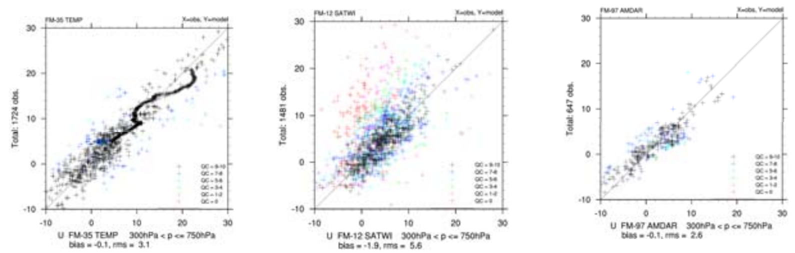

Figure 3. Model–observation scatter plot for U from Sounding (left), AMV (middle), and AMDAR (right)

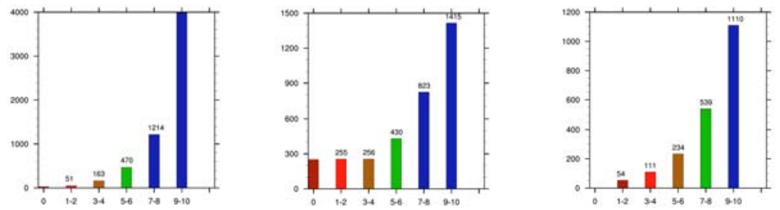

Figure 4. U QC distribution of radiosondes (left), AMV (middle), and AMDAR (right).

AMV of different channels

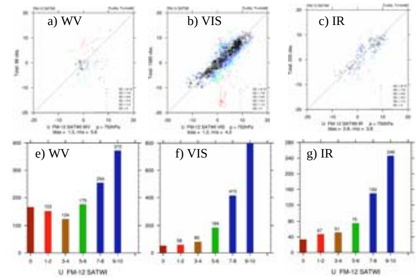

Figure 5 model-observation plot (upper panel) and QC distribution plot (low panel) for IR, VIS, and WV channels.

Apply rigorous QC constraint

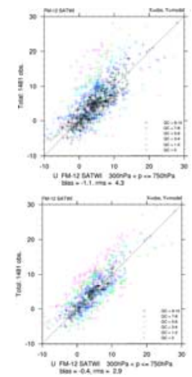

Figure 6. model-observation plot for old (upper) and refined (lower) schemes.

Table 1. Bias, RMSE and MAE for analysis

Pressure (hPa)	Old scheme: Wind Speed (m/s) Bias	RMSE	MAE	Count	Wind Direction (deg) Bias	RMSE	MAE	Count	refined Scheme: Wind Speed (m/s) Bias	RMSE	MAE	Count	Wind Direction (deg) Bias	RMSE	MAE	Count
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Table 2. Bias, RMSE and MAE for 6h forecast

Pressure (hPa)	Old scheme: Wind Speed (m/s) Bias	RMSE	MAE	Count	Wind Direction (deg) Bias	RMSE	MAE	Count	refined Scheme: Wind Speed (m/s) Bias	RMSE	MAE	Count	Wind Direction (deg) Bias	RMSE	MAE	Count
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Conclusions

- The quality of AMDAR and AMV wind data is studied. The AMDAR data show similar quality to radiosondes. However, the AMV data shows lower quality and they vary according to the AMV data type: IR, VIS and WV. The WV channel winds have the lowest data quality.
- A more rigorous QC constraint is applied for AMV data to avoid the influences from lower quality data set. The impact of refined AMV QC scheme is significant to the middle and upper levels, but minor to the surface.