

Performance of the AQUA/NASA and NOAA-16/ICI Soundings over Rondonia During the Dry-To-Wet LBA Experiment

Rodrigo Augusto F. de Souza¹, Juan Carlos Ceballos¹, Christopher D. Barnett²

¹*Centro de Previsão de Tempo e Estudos Climáticos / Instituto Nacional de Pesquisas Espaciais (CPTEC/INPE), Cachoeira Paulista, São Paulo, Brazil. rodrigo@cptec.inpe.br*

²*National Oceanic and Atmospheric Administration / National Environmental Satellite, Data, & Information Service (NOAA/NESDIS), Washington-DC, USA.*

Abstract

The purpose of this work was to compare the performance of the AQUA sounding system and of the Inversion Coupled with Imager (ICI3) software to recover atmospheric profiles of temperature and moisture over Rondonia State (Amazon region) during the DRY-TO-WET Large Scale Biosphere-Atmosphere (LBA) experiment during September and October, 2002. The atmospheric profiles retrieved by both inversion models were compared with the radiosonde data (“ground truth”) of the campaign, considering satellite retrievals within a 100 km radius around the sounding site. The bias and RMS of deviations were assessed for the whole available data of the campaign. Similar comparisons were performed for the quality of Numerical Weather Prediction (NWP) analyses of the National Center for Environmental Prediction (NCEP). The results showed that temperature profiles from ICI, NCEP and NASA C60 model have similar performance for pressure level above 750 hPa. All of them exhibit similar standard deviation in the lower troposphere (about 2 K), but ICI and the analysis showed lower bias (1 to 2 K) compared with C60 (about -5 K, near ground level). On the other hand, the mixing ratio profiles estimated from the NASA inversion model suggested the expected accuracy of about 1 g/kg, a performance comparable to and even better than that observed in ICI and NWP estimates.

Remote Soundings

Remarkable progress has been achieved during the last two decades in retrieving temperature profiles by means of passive infrared sensors. Recent efforts have been concentrated on the development of sensors with high spectral resolution. The AIRS (Advanced Infrared Sensor), with 2378 channels, is the first operational instrument with these characteristics. The Figure 1 shows a simulated AIRS brightness temperature spectrum for clear conditions. Concerning temperature and moisture profiles, it exhibits substantial improvements when compared with previous instruments (Parkinson 2003). The AIRS sensor was launched onboard the EOS-PM (AQUA) satellite in May 2002, together with microwave units AMSU-A and HSB (Humidity Sensor for Brazil). The AIRS sensor provides radiances in 2378 channels, yielding significant increase of information about radiative emission/absorption of many secondary gases in Earth’s atmosphere. However, it is not obvious how to quantify or efficiently manage this information (Rodgers 1998).

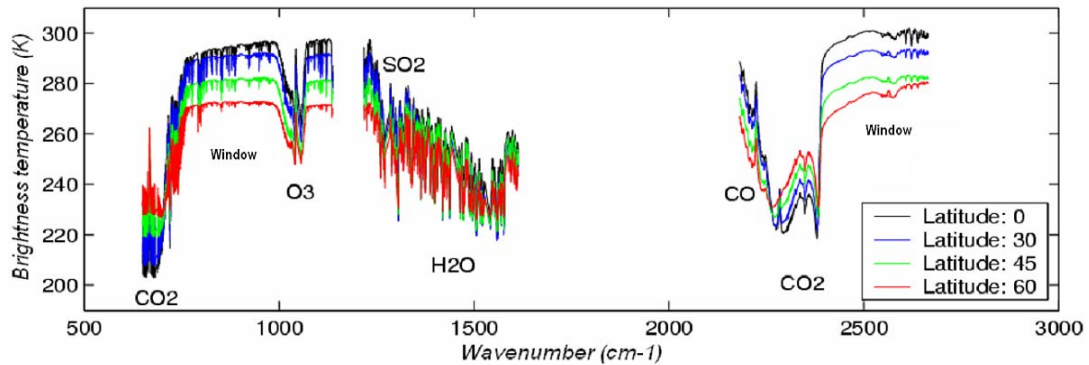


Fig. 1 - Simulated AIRS brightness temperature spectra for clear conditions.

The performance of the AQUA sounding system (NASA inversion model, different versions) and of the Inversion Coupled with Imager (ICI) software were analyzed to recover atmospheric profiles of temperature and moisture over Rondonia State (Amazon region) during the DRY-TO-WET Large Scale Biosphere-Atmosphere (LBA) experiment during September and October, 2002. The atmospheric profiles retrieved by both inversion models were compared with the radiosonde data (“ground truth”) of the campaign, considering satellite retrievals within a 100 km radius around the sounding site (6 and 18 UTC). The bias and RMS of deviations were assessed for the whole available data of the campaign. Similar comparisons were performed for the quality of Numerical Weather Prediction (NWP) analyses of the National Center for Environmental Prediction (NCEP). The Figure 2 shows the localization of three validation sites over the Amazon region.

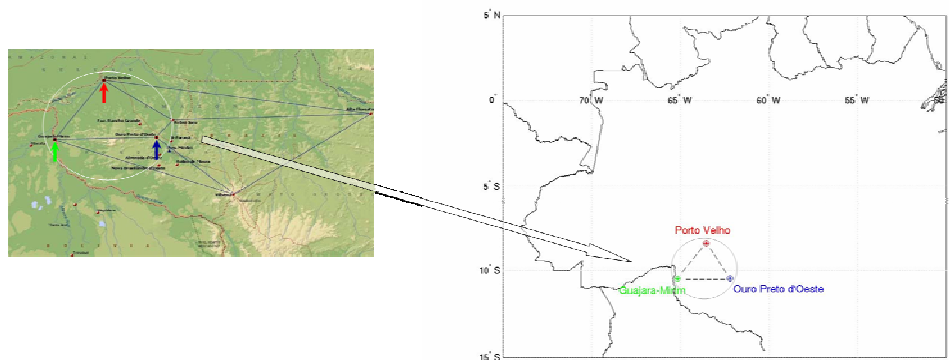


Fig. 2 - Validation sites of the “DRY-TO-WET LBA” campaign.

Results

The atmospheric profiles retrieved by ICI-3 are within the sensor specifications, which foresee errors of up to 1.5K for the temperature profiles and 1.5g/kg for the moisture (Lavanant et al., 1999). The results illustrated in the Figures 3 showed that temperature profiles from ICI, NCEP and NASA C60 model had similar performance for pressure level above 750 hPa. All of

them had similar standard deviation in the lower troposphere (about 2 K), but ICI and the analysis showed lower bias (1 to 2 K) compared with C60 (about -5 K, near ground level). On the other hand, the mixing ratio profiles (Figure 4) estimated from the NASA inversion model suggested the expected accuracy of about 1 g/kg, a performance comparable to and even better than that observed in ICI and NWP estimates. It is important to note that the NASA inversion model was in development phase, and the atmospheric profiles were generated for the validation campaign. Further work is being developed for improving this inversion model (Susskind et al., 2003 and Susskind, 2003).

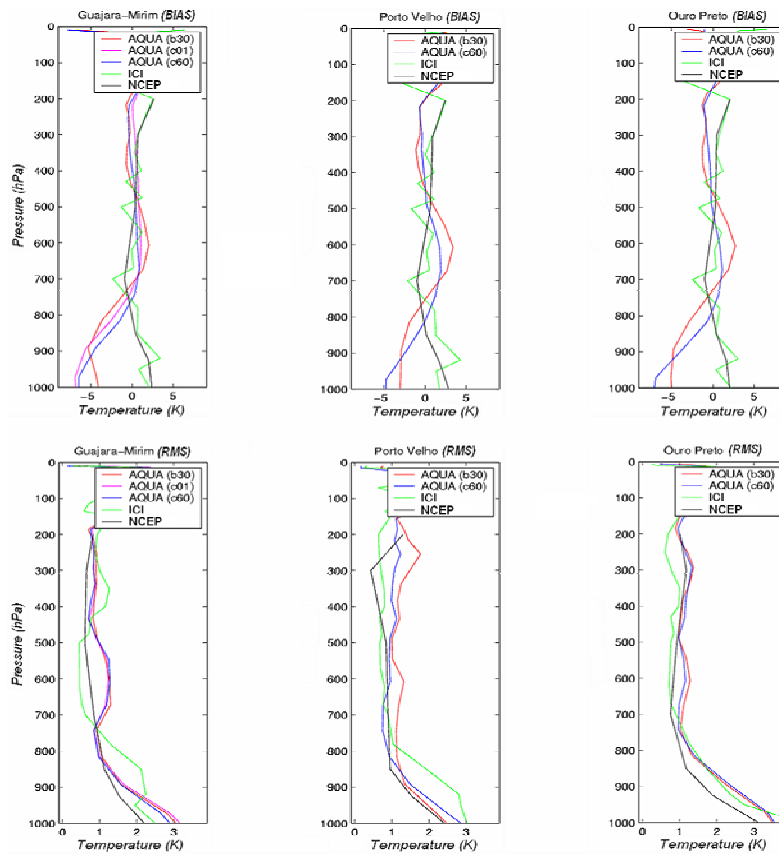


Fig. 3 - Bias and RMS between the temperature retrievals and radiosondes for three LBA sites: Guajará-Mirim, Porto Velho and Ouro Preto.

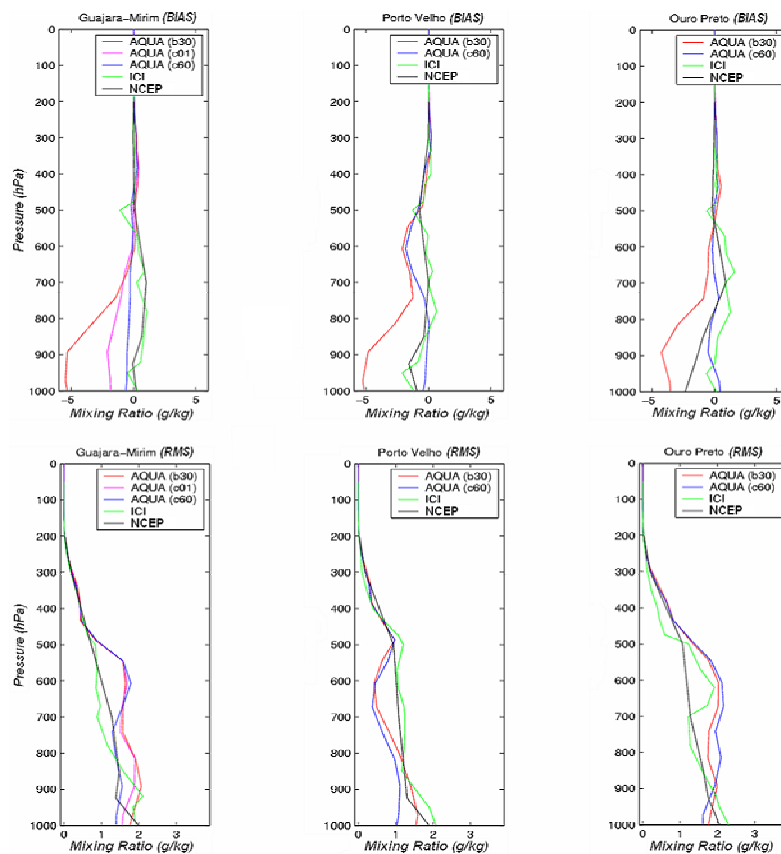


Fig. 4 - Bias and RMS between the mixing ratio retrievals and radiosondes for three LBA sites: Guajará-Mirim, Porto Velho and Ouro Preto.

Acknowledgments

The authors are thankful to Brazilian CNPq and CAPES for financial support, as well as to Divisão de Satélites e Sistemas Ambientais, at Centro de Previsão de Tempo e Estudos Climáticos (DSA/CPTEC), and the Atmospheric Spectroscopy Laboratory (ASL) at University of Maryland Baltimore County (UMBC) for satellite data and computing facilities.

References

- Lavanant, L.; Brunel, P.; Rochard, G.; Labrot, T. 1999. *NOAA15 Soundings profiles retrieved with the ICI scheme*. Technical Proceedings of the Tenth International TOVS Study Conference, Boulder, Colorado, Jan.
- Parkinson, C. L. 2003. Aqua: an Earth-Observing satellite mission to examine water and other climate variables. *IEEE Transactions on Geoscience and Remote Sensing*, v.41, n.2, p. 173-183.
- Rodgers, C. D. 1998. Information content and optimization of high spectral resolution remote measurements. *Advanced Space Research*, v.21, n.3, p. 361-367.

Susskind, J.; Barnet, C.; Blaisdell, J. 2003. Retrieval of atmospheric and surface parameters from AIRS/AMSU/HSB data in the presence of clouds. *IEEE Transactions on Geoscience and Remote Sensing*, v.41, n.2, p. 390-409.

Susskind, J. Early results from AIRS/AMSU/HSB. 2003. *SPIE Annual Meeting, Conference on Remote Sensing and Space Technology*, Ago.