AIRS v. 5 Temperature and Water Vapor Retrievals Characterization and Error Assessment

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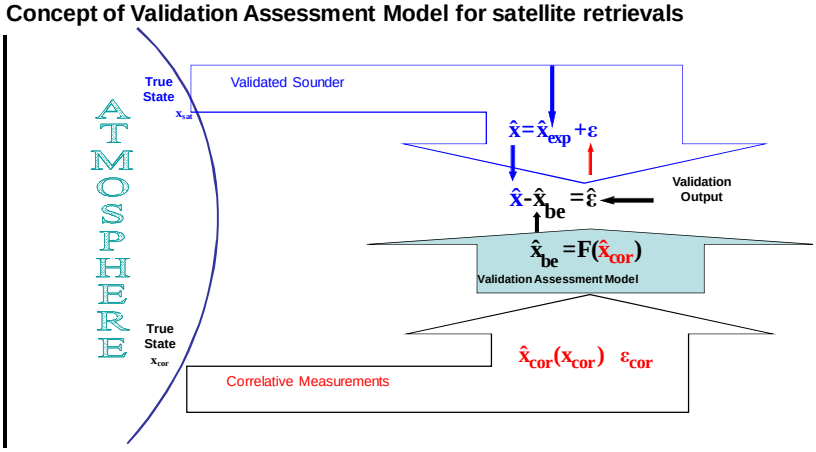
Introduction

We present the characterization and error assessment for the AIRS v. 5 temperature and water vapor retrievals. We use dedicated radiosondes for the reference data and Validation Assessment Model as the tool for error assessment. The geographic coverage is from tropics to Alaska. In addition to the estimates of error biases and covariances we infer averaging kernels from the real measurements data.

The total error depends on instrumental and geophysical factors. That requires the End-to-End error analysis in the sense that front end input, i. e. Earth-Atmosphere, as well as final products to be included into the consideration.

Concept of Validation Assessment Model for satellite retrievals



Methodology

- Direct comparison of the retrievals to radiosondes mapped onto the AIRS (100 levels) vertical grids
- Linear error analysis:

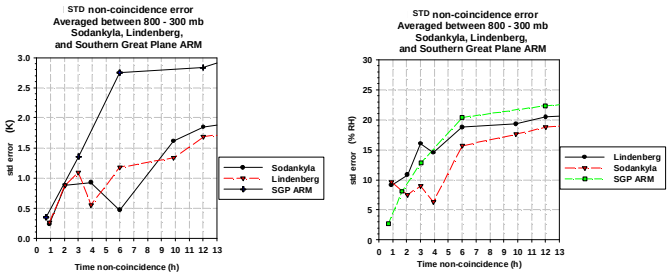
$$\hat{x} - x_{sonde} = x_0 + A(x_{true} - x_0) + \varepsilon - x_{sonde}$$

Averaging Kernel - smoothing

Non-coincidence error

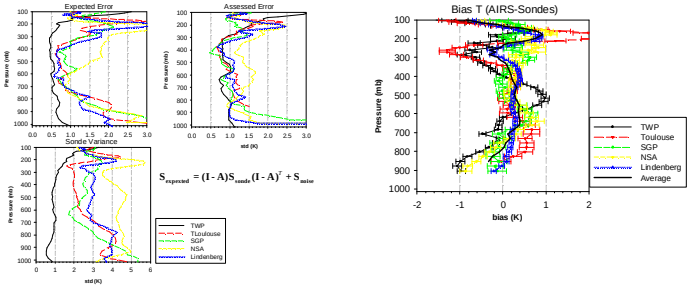
$$x_0 - x_{true} = B(\overline{x}_{sonde} - x_{sonde}) + \xi$$

Temporal Non-coincidence Errors

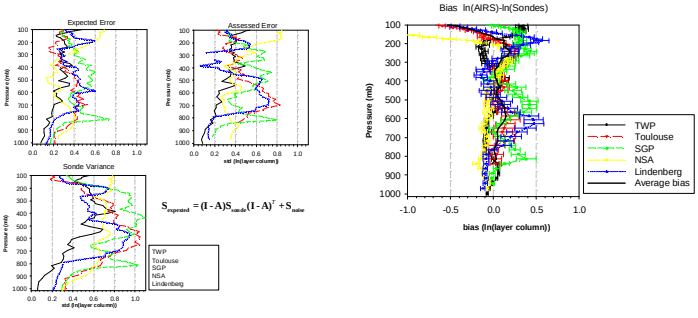


Standard Deviation and Bias

Temperature



Humidity



Retrieval of Averaging Kernels from Correlative Measurements

Averaging Kernel is Correlation Matrix between Retrieval and True State

Approach

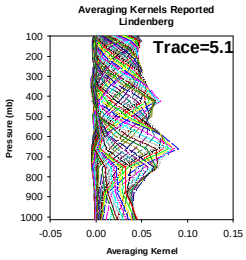
$$E\{\hat{x}x^T\} = S_{\hat{x}x} = AE\{xx^T\} = AS_x$$

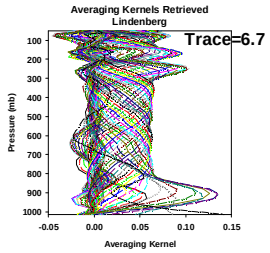
$$\tilde{S}_{\hat{x}x} = A\tilde{S}_x$$

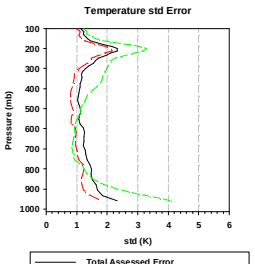
$$\hat{A} = \tilde{S}_{\hat{x}x}\tilde{S}_x^{-1}$$

$\tilde{S}_x$ and $\tilde{S}_{\hat{x}x}$ are sample cross – and autocovariances

$\hat{A}$ is retrieved averaging kernel







$S_{expected} = (I - A)S_{sonde}(I - A)^T + S_{noise}$

- Reported AIRS v. 5 temperature averaging kernels underepresent the retrievals
- Errors estimated with retrieved averaging kernels are in good agreement with the ones assessed from correlative measurements

References

1. N. S. Pougatchev, "Validation of atmospheric sounders by correlative measurements," Appl. Opt. 47(26), pp. 4739-4748 (2008).

2. N. Pougatchev, T. August, X. Calbet, T. Hultberg, O. Oduleye, P. Schlüssel, B. Stiller, K. S. Germain, and G. Bingham, IASI temperature and water vapor retrievals – error assessment and validation, Atmos. Chem. Phys., 9, 6453-6458, 2009, www.atmos-chem-phys.net/9/6453/2009/ access 2009.

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