**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 variances 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.

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**Methodology**

- Direct comparison of the retrievals to radiosondes mapped onto the AIRS (100 levels) vertical grids
- Linear error analysis:
  \[ \hat{x} - x_{\text{sonde}} = x_0 + \hat{A}(x_{\text{true}} - x_0) + \varepsilon - x_{\text{sonde}} \]
  Averaging Kernel - smoothing
  Non-coincidence error
  \[ x_0 - x_{\text{true}} = B(\overline{x}_{\text{sonde}} - x_{\text{sonde}}) + \xi \]

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**Temporal Non-coincidence Errors**

\[ S = (I - A)S(I - A) + S \]

**Standard Deviation and Bias**

**Humidity**

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**Retrieval of Averaging Kernels from Correlative Measurements**

**Approach**

\[ E\{xx^T\} = S_{xx} = AE\{xx^T\} = AS_x \]

\[ \tilde{S}_{xx} = A\hat{S}_x \]

\[ \hat{A} = \tilde{S}_{xx}^{-1} \]

\( \hat{S}_x \) and \( \tilde{S}_{xx} \) are sample cross – and autocovariances

\( \hat{A} \) is retrieved averaging kernel

\[ S_{\text{true}} = \beta \cdot A\hat{S}_{xx}(0) - A\hat{S}_{xx} \]

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**References**
