CrIS EDR Validation Assessment Model: Case Study IASI Temperature and Water Vapor Retrievals

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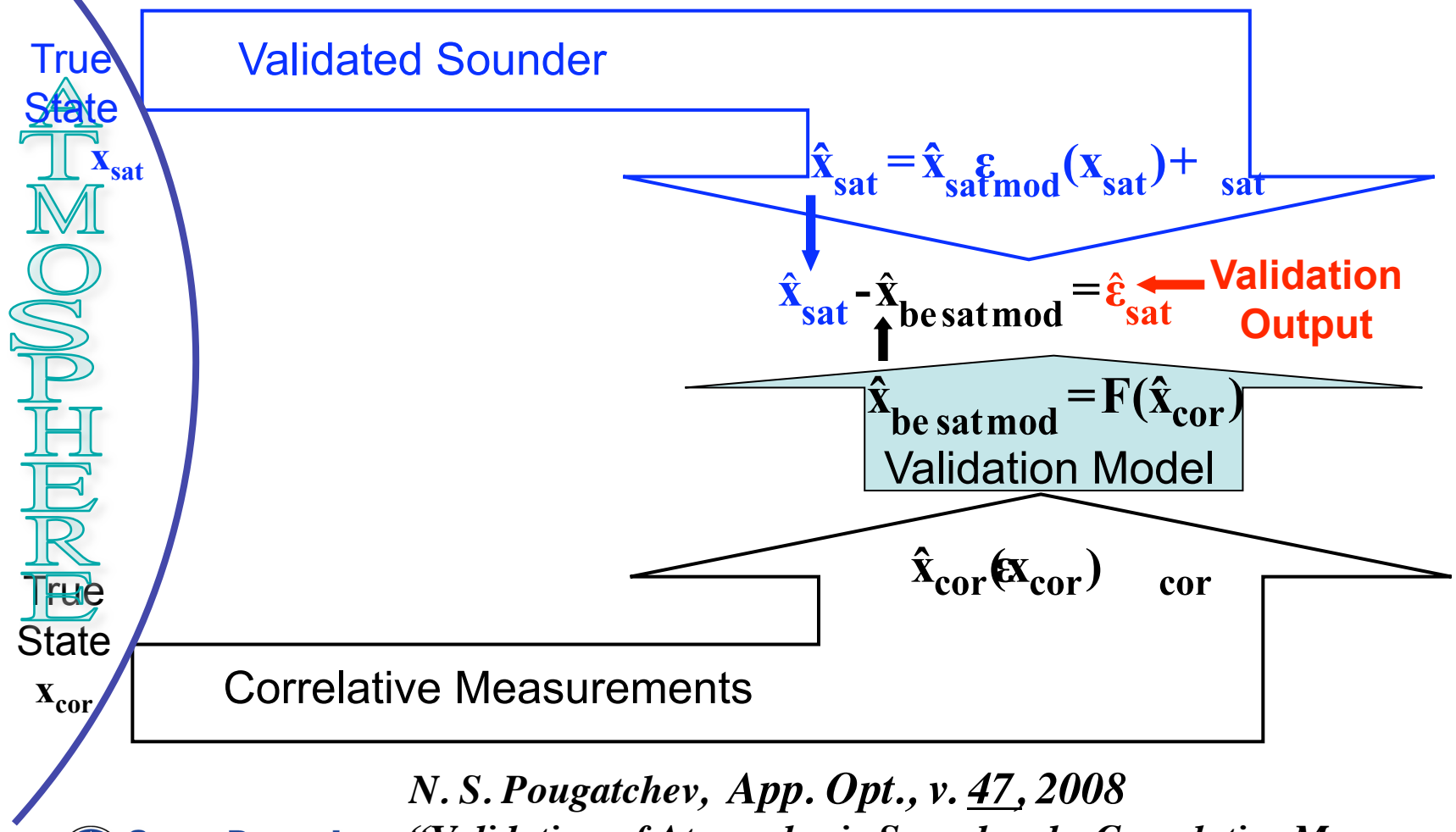
Objectives

- Methodology for assessment of the Temperature and Water Vapor retrieval **errors in the form that can be utilized by the users community** – Regionally and Seasonally specific **Covariance matrix** and **Bias**
- Validation of the L2 IASI EUMETSAT retrievals against radiosondes
- Comparison of EUMETSAT and NASA (Dan Zhou) retrievals – JAIVEx campaign case study

Validation by Correlative Measurements

C. D Rodgers, 2001
"Inverse Methods for Atmospheric Sounding, Theory and Practice'



N. S. Pougatchev, App. Opt., v. 47, 2008
"Validation of Atmospheric Sounders by Correlative Measurements"

Validation Issues

Why do We Need Validation Model

Why We Can NOT Use Correlative Data As Is

- Characteristic Difference– validated sounder and correlative measurements sample atmosphere differently.
- State Non-Coincidence – correlative measurements are at different time and location.

Validation Model reconciles the issues by modeling best linear estimate of the satellite measurements and assessing the errors

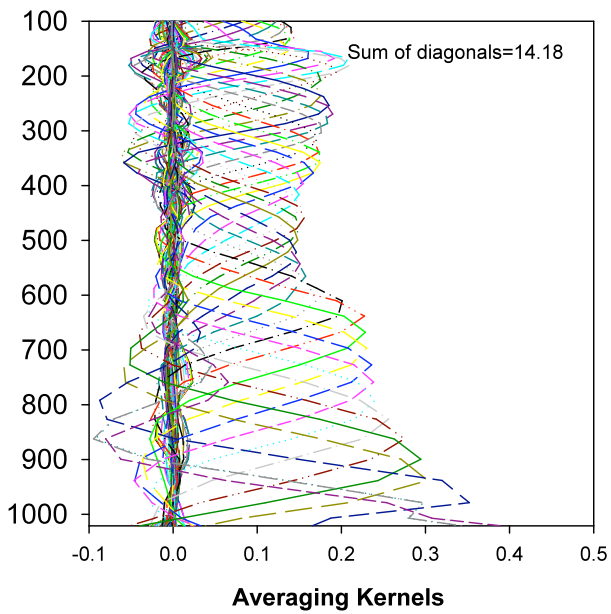
$$\hat{x}_{be\,satmod} = B\hat{x}_{cor} + b = \hat{x}_{satmod} + {}_{val}$$

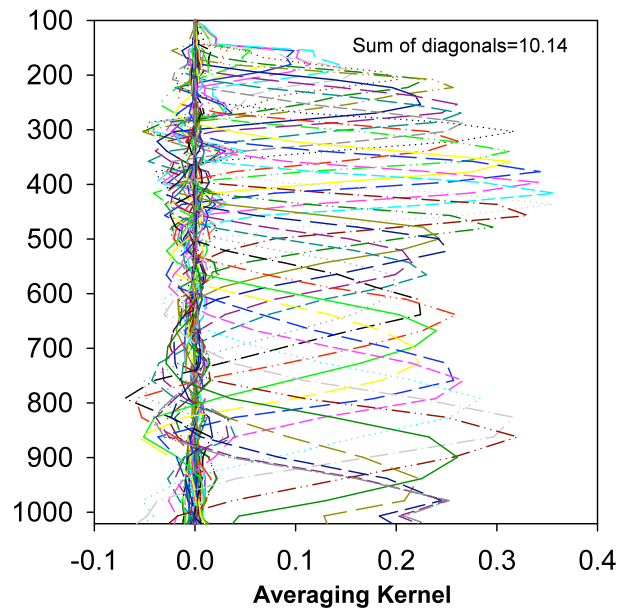
"Validation of Atmospheric Sounders by Correlative Measurements"
N. S. Pougatchev, App. Opt., v. 47, 2008

IASI Validation Study

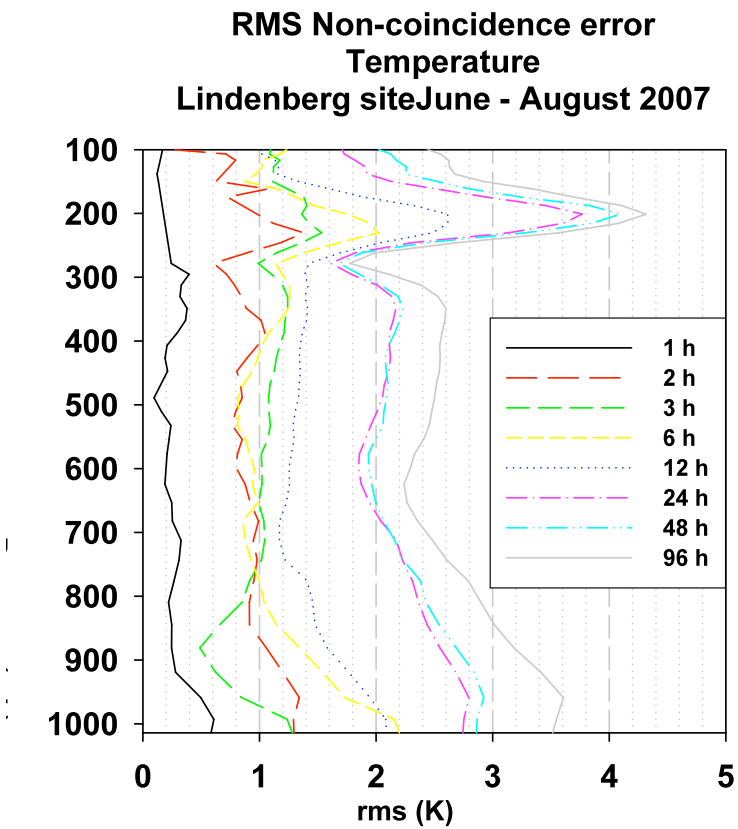
- *Validation Data Set* – radiosondes at Lindenberg (Germany, 52.21° N, 14.12° E, 112 m a.s.l). Dedicated launches 1 hour prior and at the overpass time; and synoptic times (0, 12, 6, and 18 UTC)
- *Validated parameters* – Atmospheric Temperature and Water Vapor Vertical Profiles.
- *Validated System* – IASI characterized by averaging kernels.
- *Validated Data Set* – EUMETSAT v. 4.3 retrievals; cloud clear; 100 km around Lindenberg

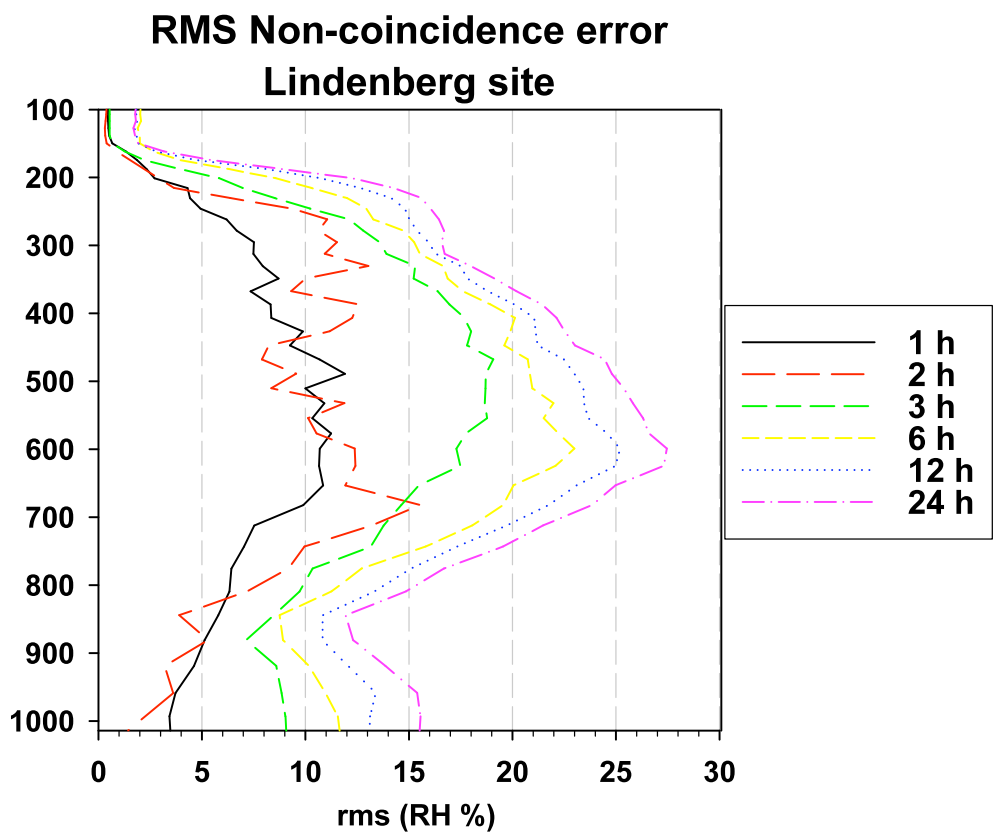
Averaging Kernels – Vertical Resolution Temperature and Water Vapor



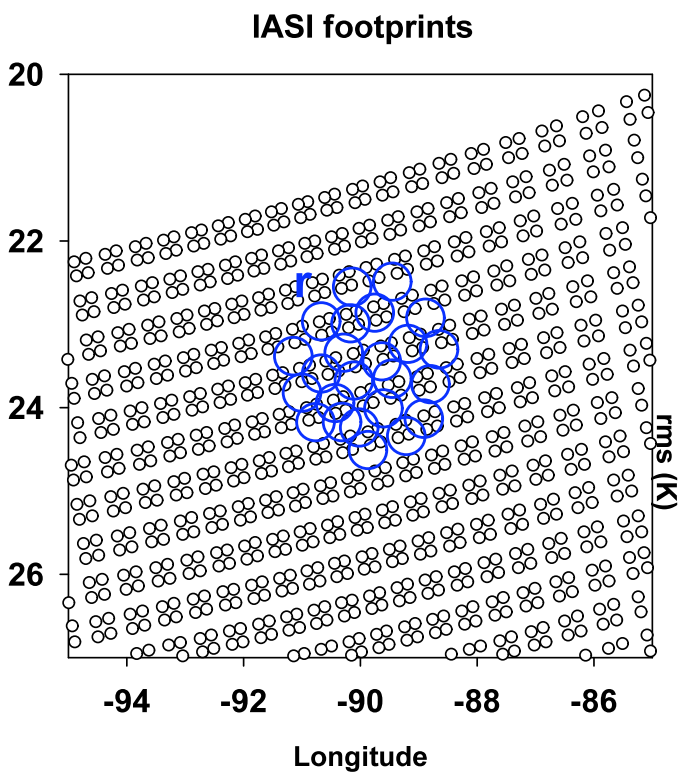


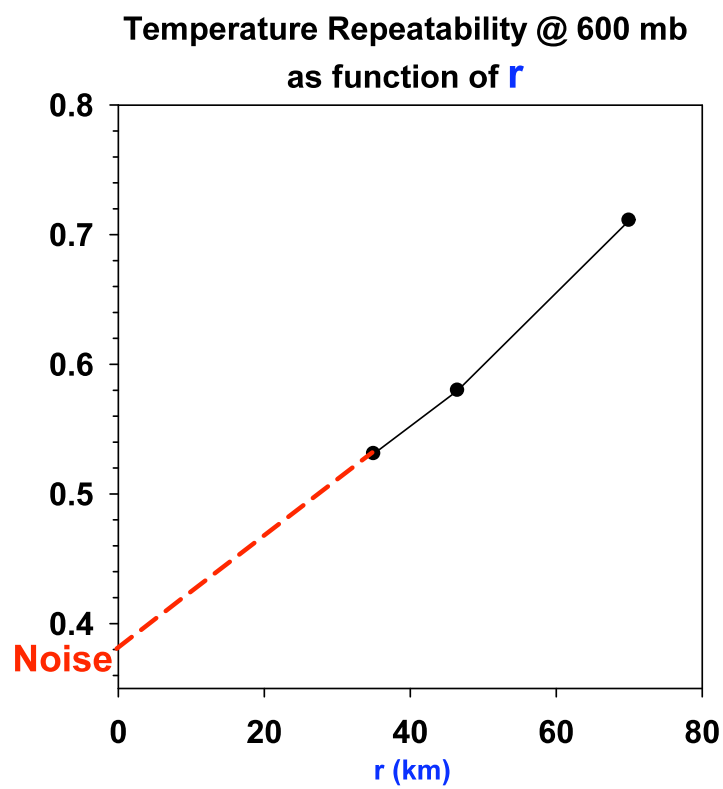
Temporal Non-Coincidence





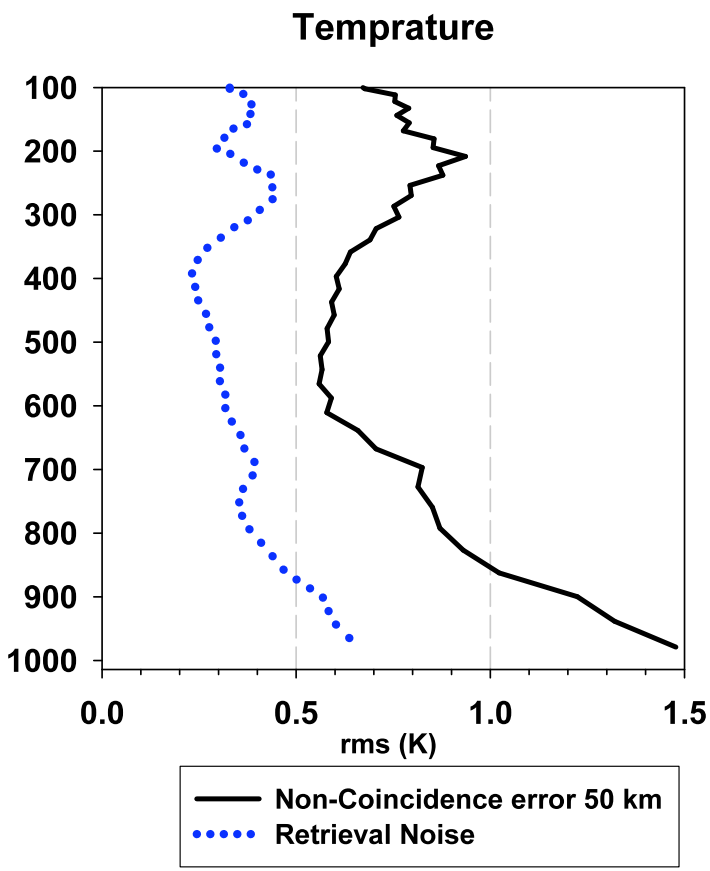
Spatial Non-coincidence and Noise

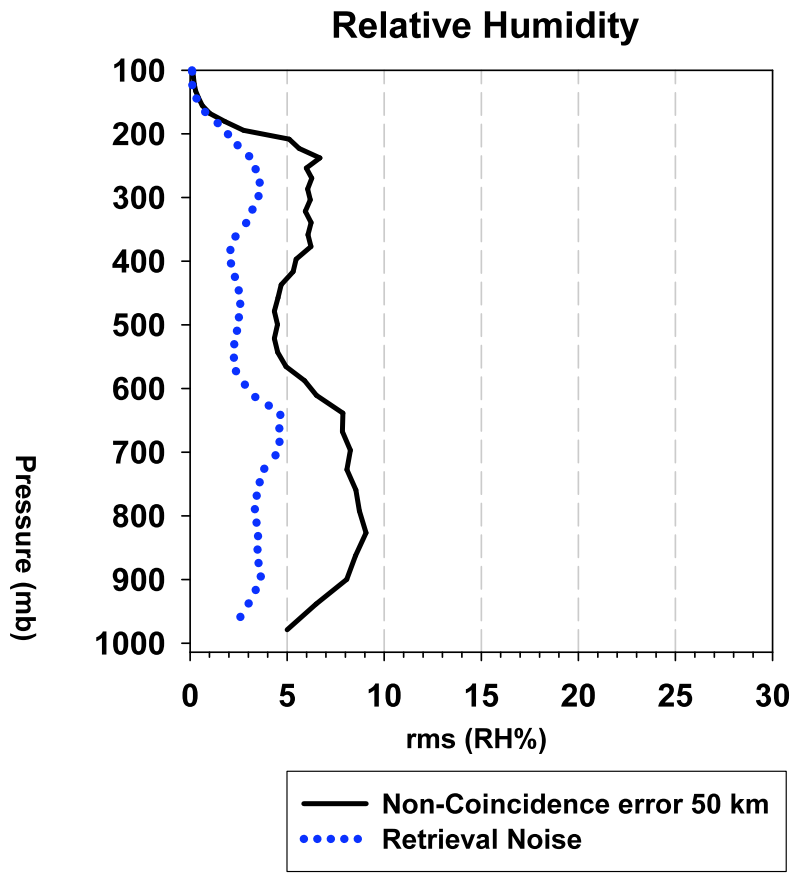




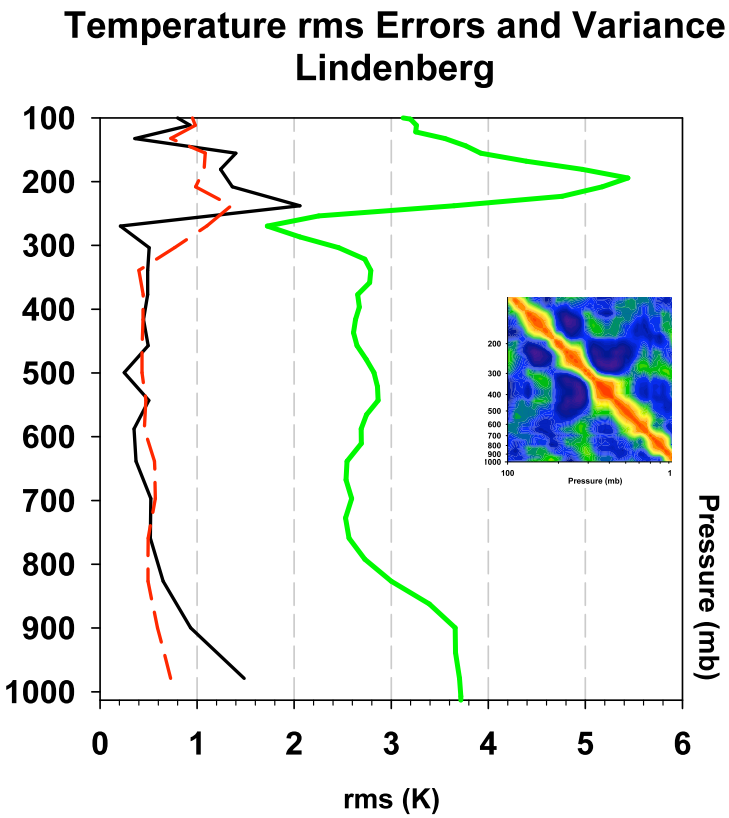
$$S_{repeat}(r) = S_{noise} + S_{atm}(r) \qquad S_{atm}(0) = 0$$

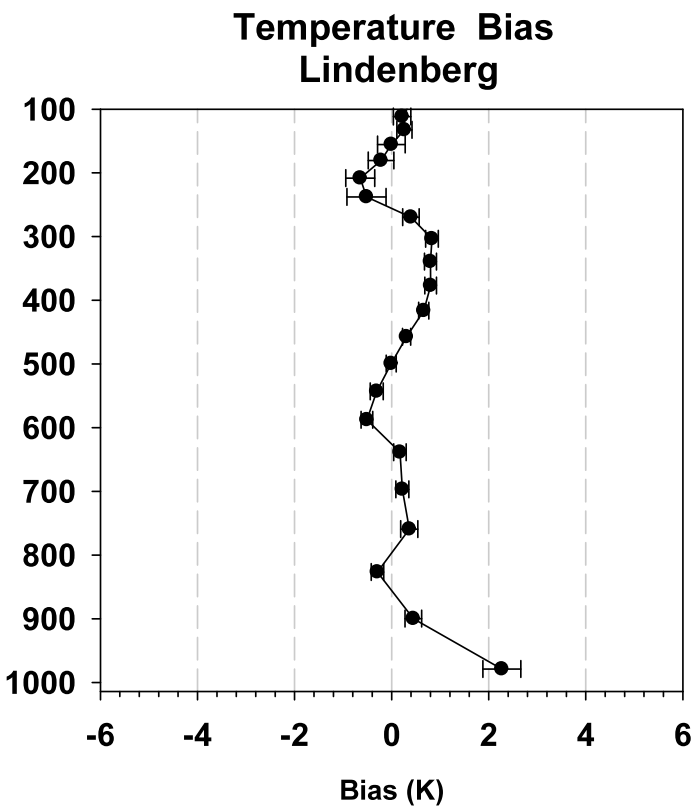
Retrieval Noise and Spatial Non-coincidence Error $r = 50km$





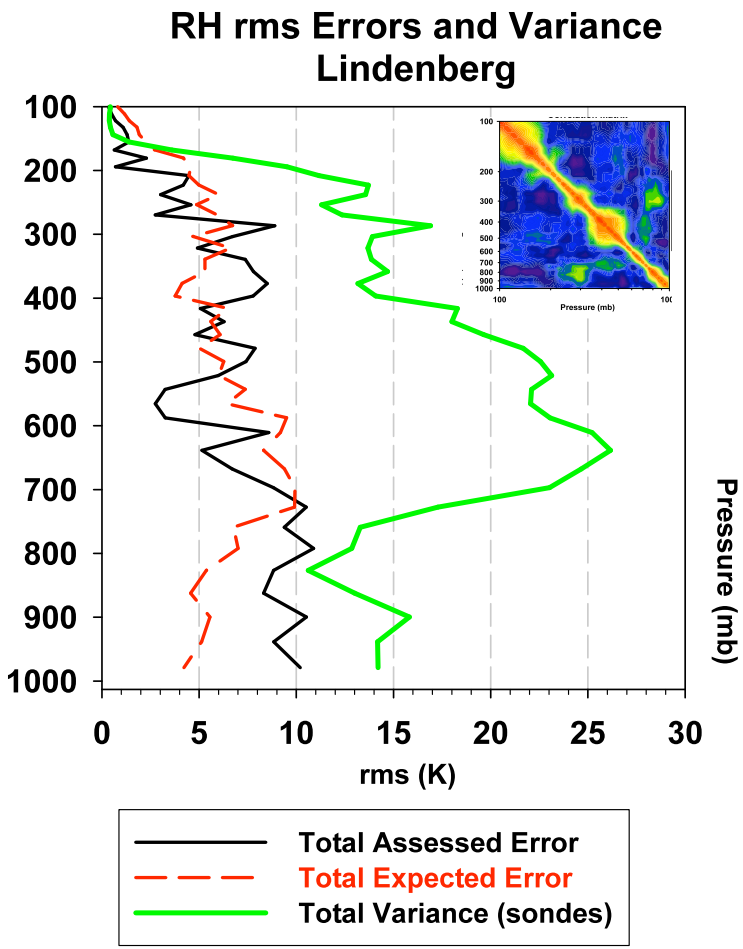
Temperature Errors

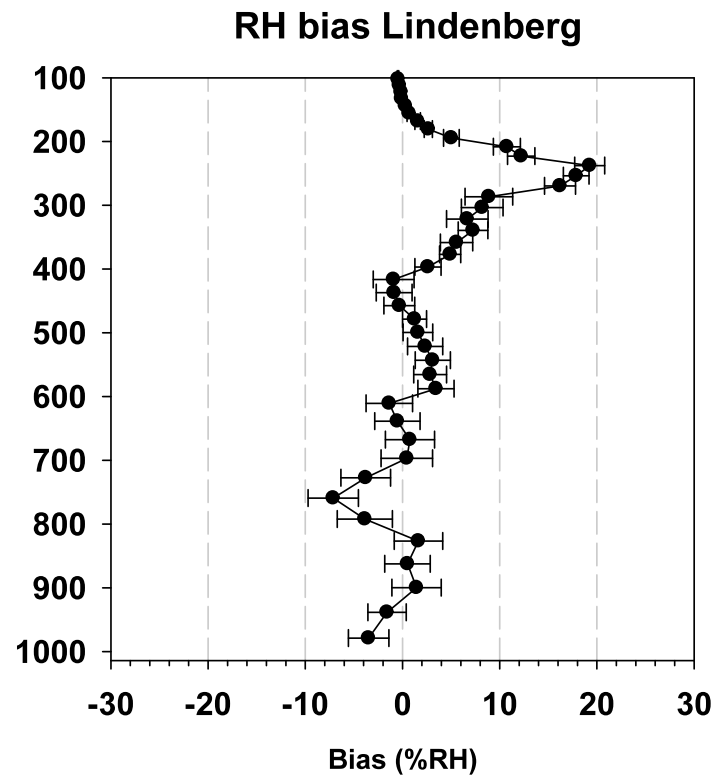




Total Assessed Error
Total Expected Error
Total Variance (sondes)

Relative Humidity Errors

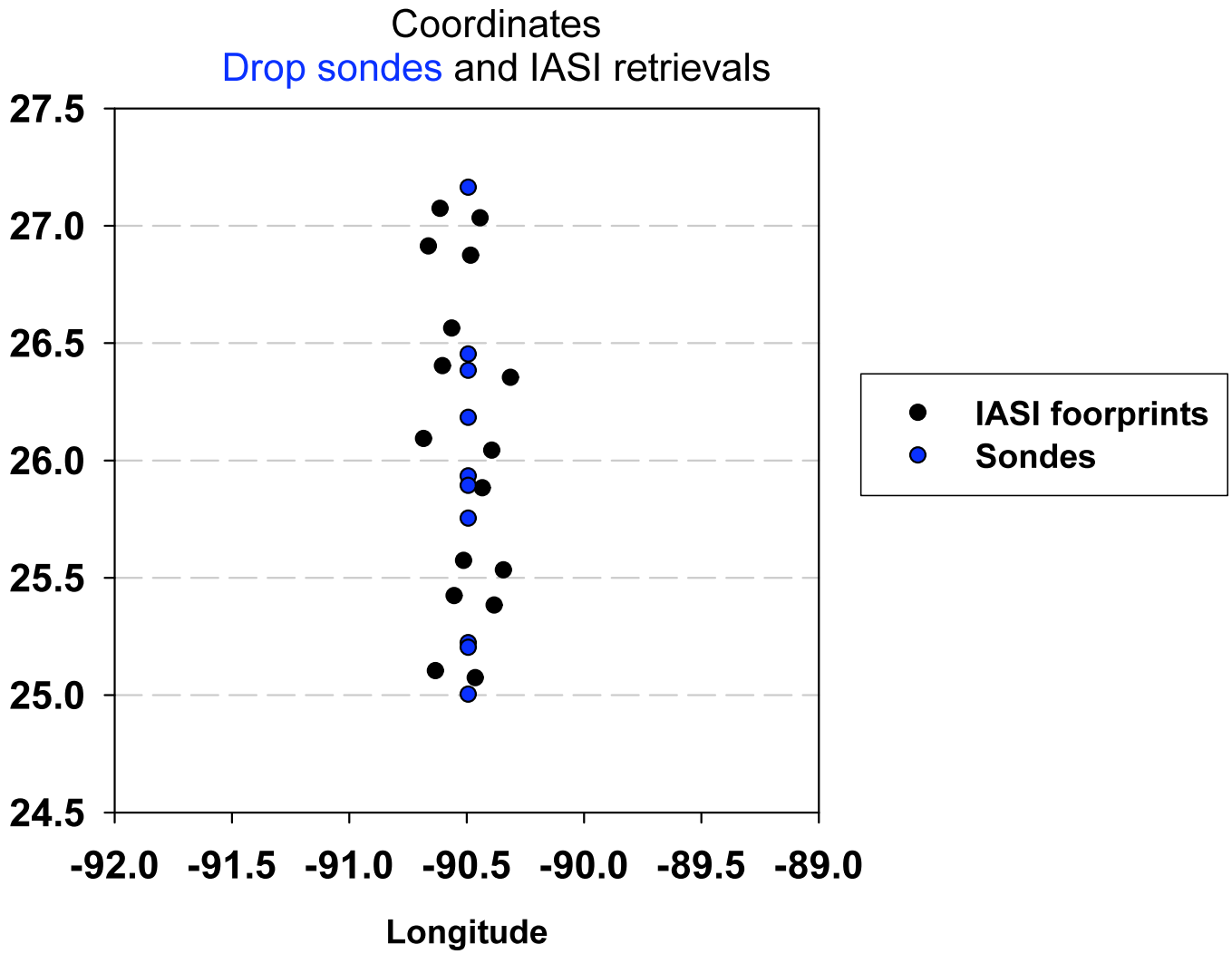




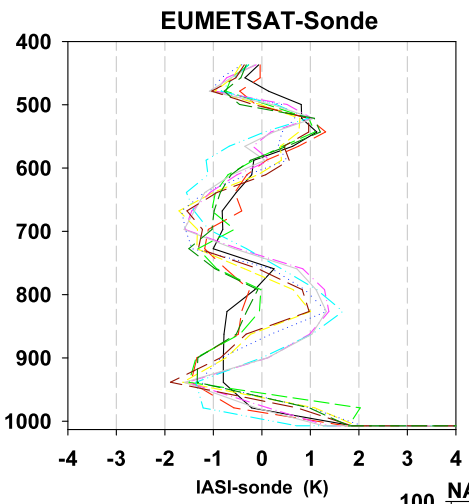
Intermission

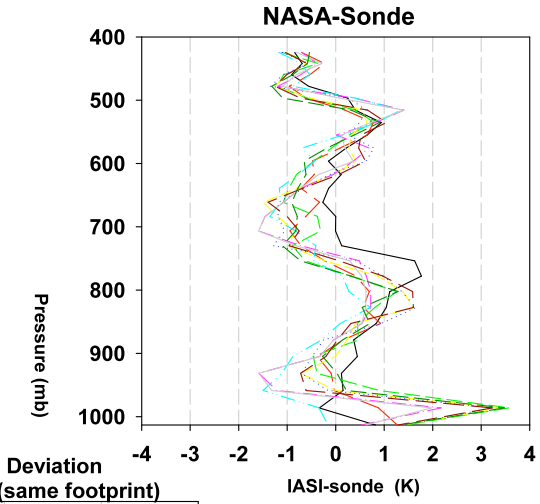
- The results provide specific error covariance matrix and demonstrate that the averaging kernels represent the retrievals adequately.
- That allows one to decontaminate the retrievals from a priori contribution.
- The above mentioned factors make the retrievals usable for quantitative use, e. g. for NWP and assimilation.

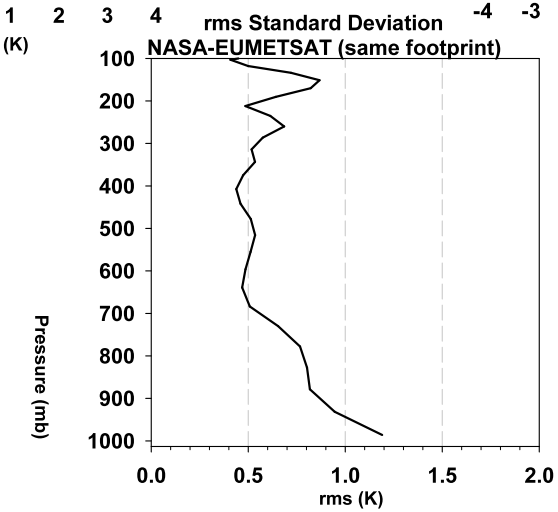
JAIVEx April 29, 2007, 15:45 h



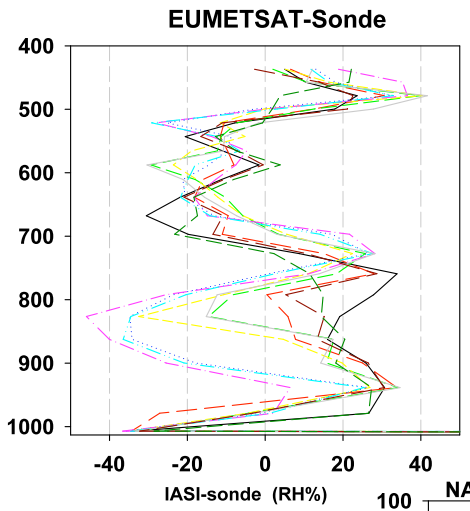
JAIVEx
Temperature

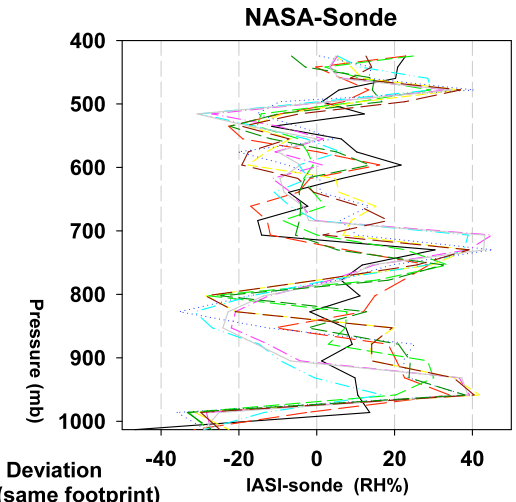


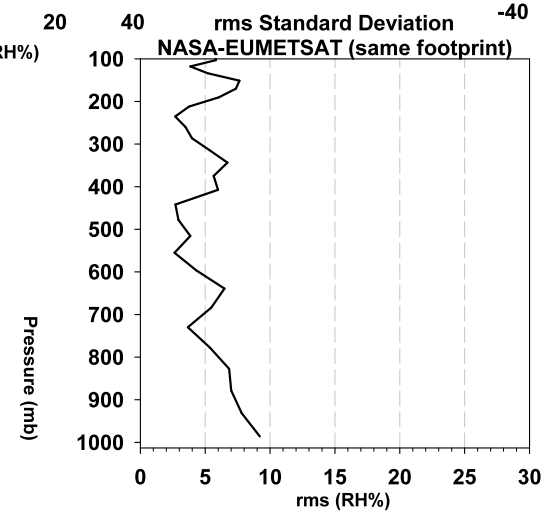




JAIVEx
Relative Humidity

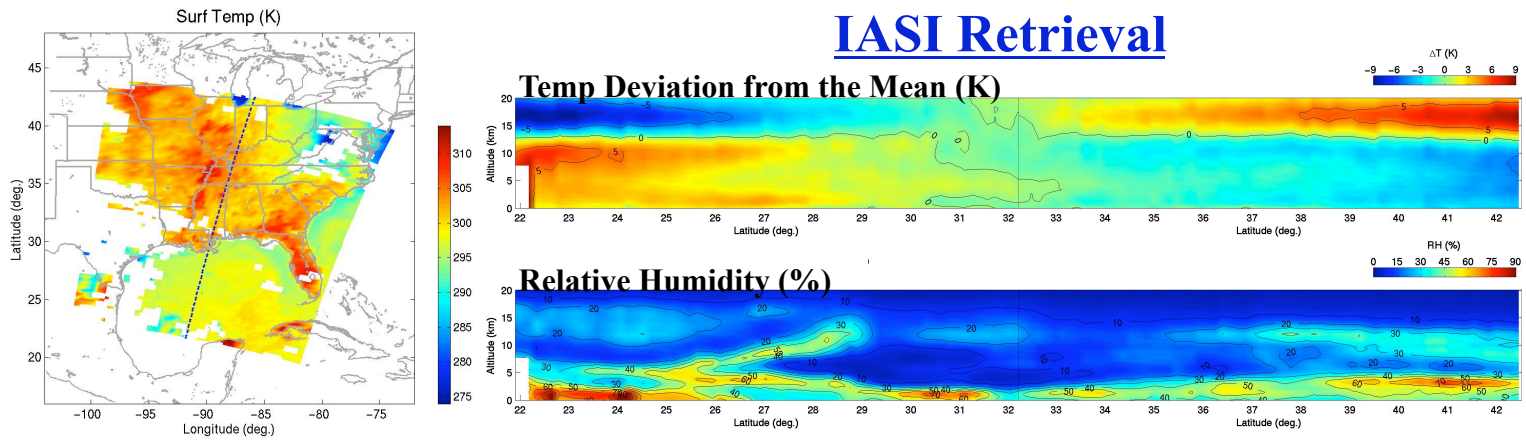


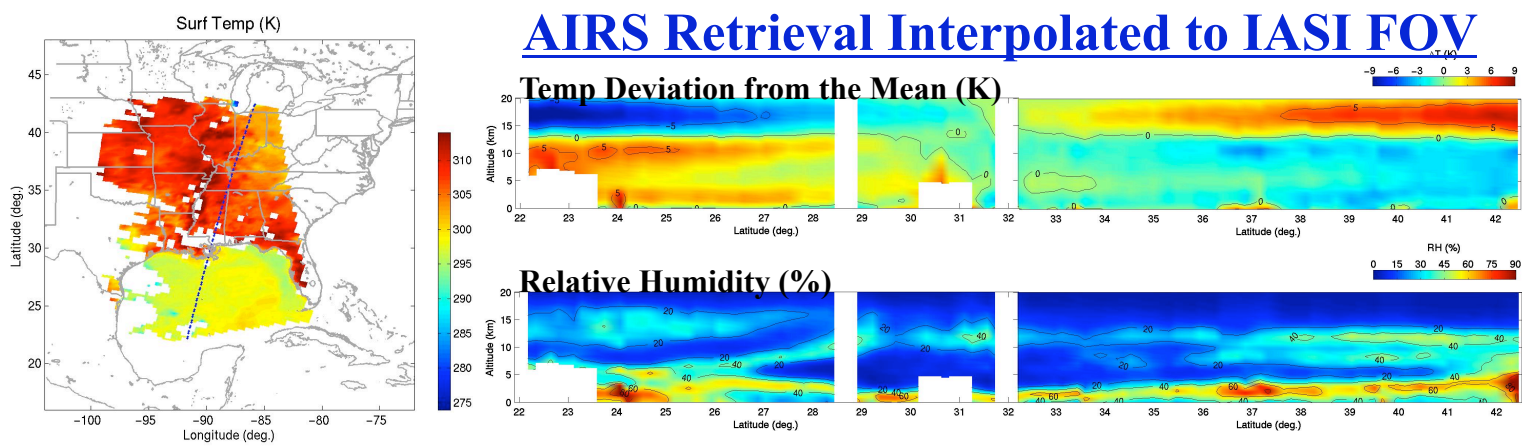




IASI (15:48 UTC) vs. AIRS (19:30 UTC)

JAIVEx





Conclusion
Methodological

- For the assessment of the **actual performance** of the sounders of the AIRS, IASI and CrIS class the validation approach based on statistical accounting for temporal and spatial non-coincidence and vertical sampling/resolution through averaging kernel formalism is needed.

- Radiosondes are good reference source for validation, provided the site has representative geophysical characterization.

- Additional work is needed to better characterize true water vapor field and its variation. Combination of techniques other than radiosondes, e. g. high accuracy airborne sounders (NAST-I) with drop-sondes, are needed for accurate WV retrieval error assessment.

Conclusion

IASI EUMETSAT Lindenberg Campaign

- Under the clear sky condition IASI L2 Temperature and Water Vapor profile retrievals perform at the expected level. That means that the forward model and averaging kernels are accurate. Hence, we know accurately how the true state of the atmosphere translates into the retrievals.

- The retrieval and error assessment/validation were made consistently on the same basis. That facilitates the quantitative use of the of the L2 data products.

Conclusion

JAIVEx campaign

- NASA's (Dan Zhou) and EUMETSAT retrieval techniques agree within retrieval error. Some discrepancy is observed below 800 mb for both Temperature and Water Vapor retrievals.
- Small sample size makes statistical comparison of the retrievals with drop-sondes inconclusive.

THE END

Thank You!!!