Relationship between Clouds, Temperature and Humidity in NOAA IASI Retrievals

Bomin Sun[1], A. Reale[2], Eric Maddy[3], Antonia Gambacorta[1], and Chris Barnet[2]

(1) I.M. Systems Group, Inc., (2) NOAA/NESDIS/STAR (3) Science and technology Corp.

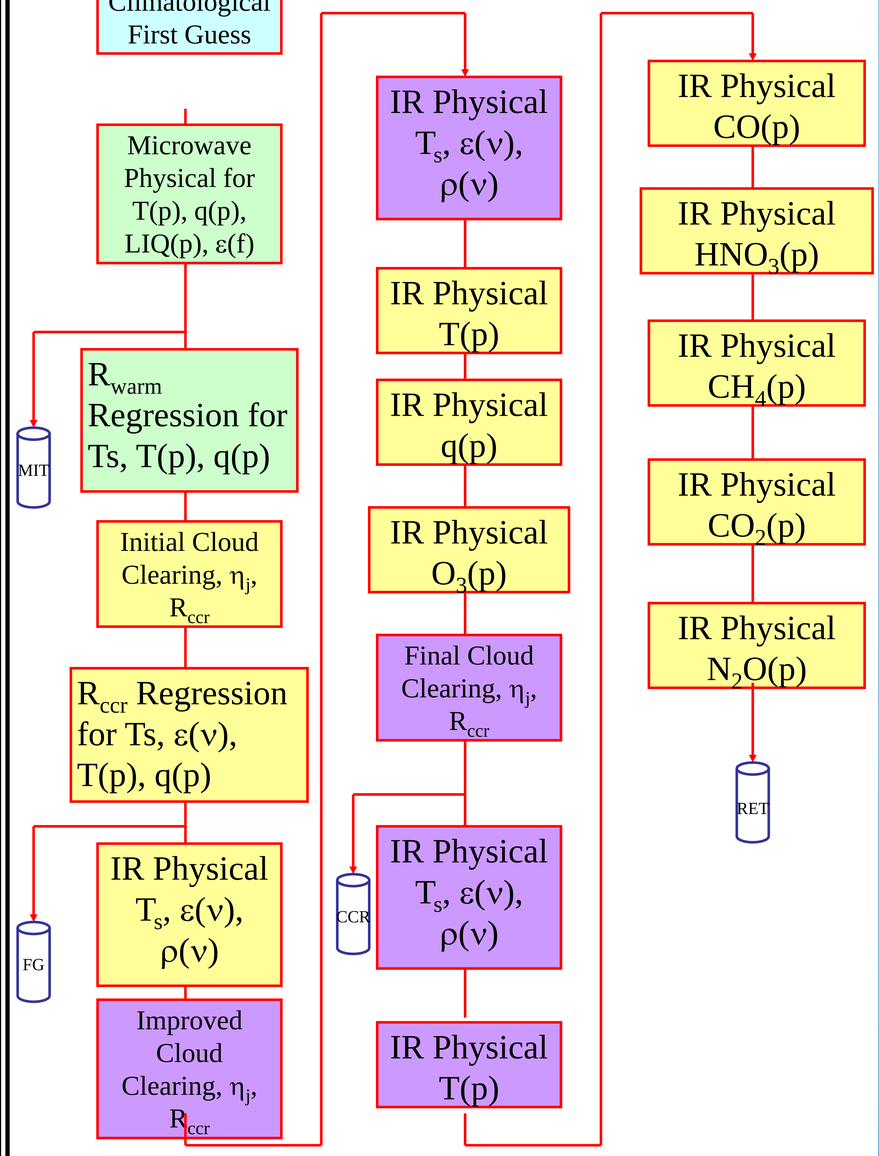
Introduction

The NOAA Infrared Atmospheric Sounding Interferometer (IASI) retrieval system has been operated at NOAA/NESDIS/STAR since 2008. The L2 retrievals are based on the cloud-clearing method that combines the infrared radiances of IASI at 2 x 2 footprints and microwave radiance at the co-registrated single AMSU footprint. In this study, we want to understand:

- **What are the impacts of cloud presence and cloud clearing on the accuracies of the retrievals**
- **If the retrieved cloud properties are thermo-dynamically consistent to temperature and humidity retrievals**

Radiosonde measurements are used as the reference to define the retrieval accuracy. Comparison of the final physical retrievals with their first guess is used to infer the impact of the cloud clearing procedure. We discuss how such analysis can advance our understanding of the internal consistency of major components within the retrieval system and, furthermore, if major geophysical variables derived from the hyper spectral sounder represent a nominal level of maturity for application in climate monitoring. Methodologies developed from the study may be useful for evaluating the Environmental Data Records (EDRs) developed from the Cross-track Infrared and Microwave Sounder Suite (CrIMSS) on board Suomi NPP launched in 2011.

Simplified Flow Diagram of the NOAA Retrieval Algorithm

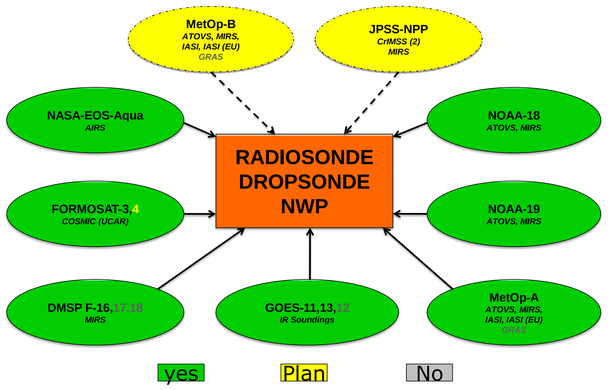


Courtesy of Divakarla et al. (2011) "Validation of temperature and water vapor retrievals using global radiosonde measurements and model forecasts" at HIRS topical meeting, July 10-14, Toronto, Canada.

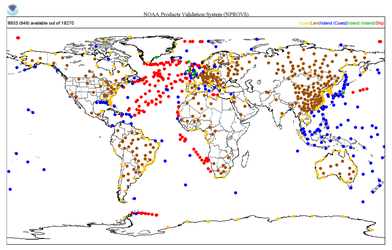
Data

Data of IASI-raob collocations within 3-hr and 50-km window of January, April, July, and October of 2010 and 2011 are used in the analysis. The collocation data are collected at the NOAA Products Validation System .

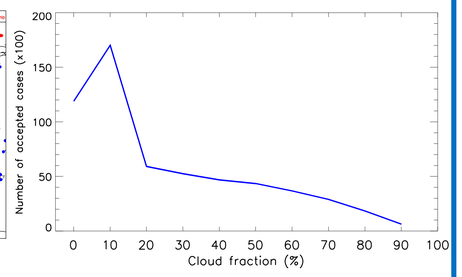
NOAA Products Validation System



The NOAA Products Validation System (NPROVS, http://www.star.nesdis.noaa.gov/smcd/opdb/poes/NPROVS.php) operated by NESDIS/STAR provides a centralized, integrated real-time monitoring and validation function for inter-comparing derived satellite weather products against collocated radiosonde, dropsonde and numerical weather prediction (NWP) forecast data.

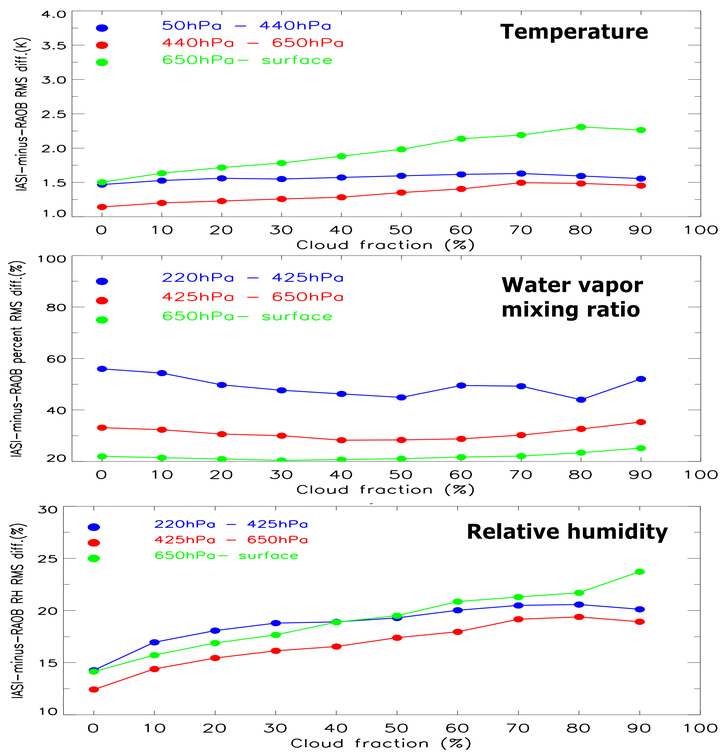


Global distribution of IASI-raob collocations within 3-hr and 50-km window.



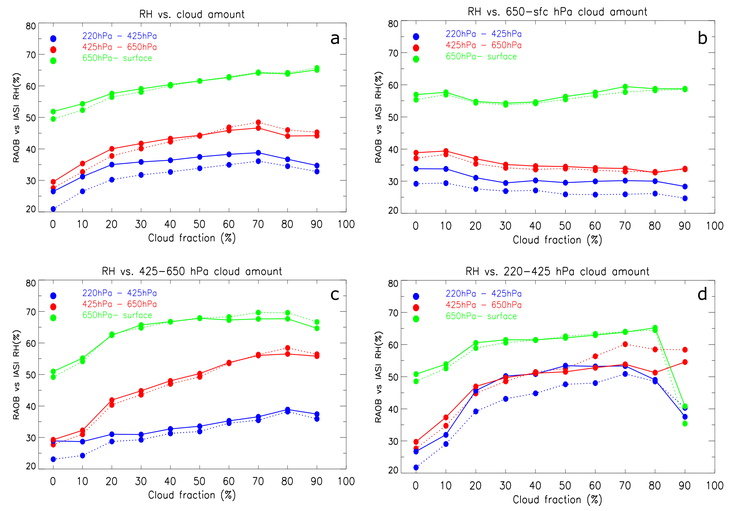
Numbers of "Accepted" IASI profiles distributed across cloud fraction classes. Number of total accepted profiles is ~106,000.

Retrieval RMS Error *vs.* Cloud Fraction



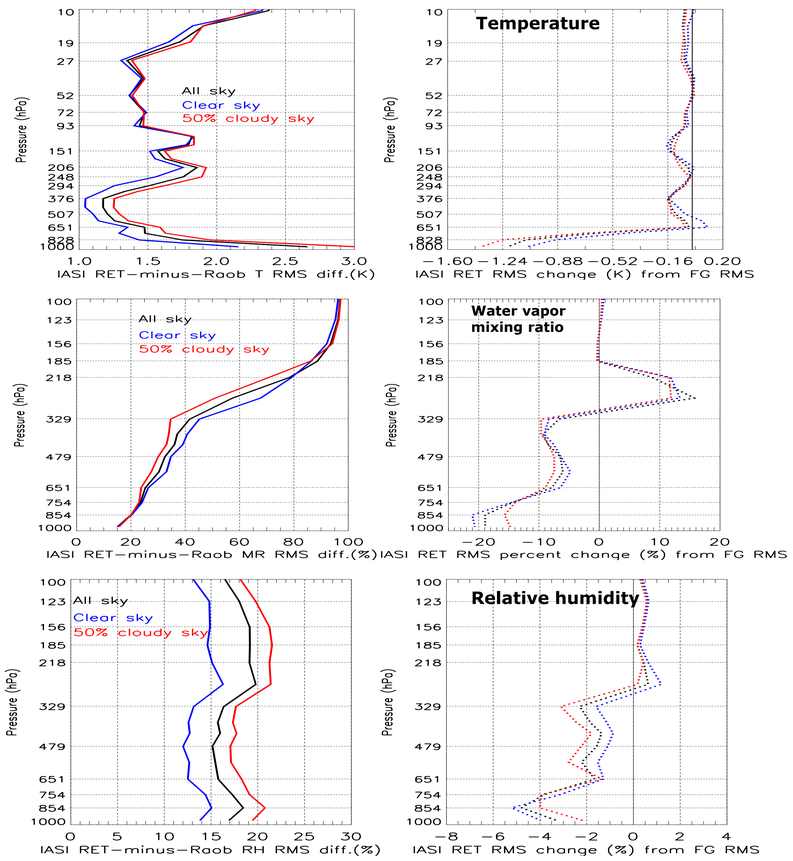
Change of IASI-minus-raob RMS difference with cloud fraction at different height layers for atmospheric temperature, water vapor mixing ratio, and relative humidity.

Relative Humidity *vs.* Cloud Fraction



Cloud fraction and relative humidity relationship at different height layers for cloud fraction from (a) the whole atmospheric column, (b) 650 hpa-surface, (c) 425-650 hPa, and (d) 220-425 hPa. Solid curves denote IASI retrieval relative humidity, and dotted curves radiosonde relative humidity.

Retrieval Improvement Relative to First-guess



Left panels: IASI retrieval-minus-Raob RMS difference for ALL sky, clear sky and 50% cloud fraction. Right panels: change of retrieval RMS error from its first-guess RMS error.

Conclusions and Future Work

- **RMS errors of IASI temperature and relative humidity retrievals degrade slightly with increasing cloud fraction; compared to the lower and upper tropospheric layers, the RMS errors are smaller in the mid-tropospheric layer.**
- **Relative humidity and cloud fraction within the IASI retrievals are basically consistent to each other, and IASI relative humidity overall matches well with raob measurements except at the upper layer where raob data are dry-biased.**
- **IASI retrievals show improvements over its first-guess for both temperature and humidity, particularly in the lower and middle troposphere.**

In the future, IASI ability to detect clouds and the thermo-dynamic characteristics of clouds in the retrievals will be evaluated under different climate regimes by using independent cloud retrievals and in situ data.

STAR Center for Satellite Applications and Research

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