Inter-comparison between AIRS and IASI through retrieved parameters

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ABSTRACT

Ultra-spectral resolution infrared spectral radiance obtained with current on orbit instruments such as the Atmospheric Infrared Sounder (AIRS) and the Infrared Atmospheric Sounding Interferometer (IASI). These observations provide atmospheric, surface, and cloud property information. An advanced retrieval algorithm with a fast radiative transfer model, including cloud effects, is used for atmospheric profile and cloud parameter retrieval. A one-dimensional (1-d) variational multi-variable inversion solution is used to improve an iterative background state defined by an eigenvector-regression-retrieval. This physical inversion scheme has been developed, dealing with cloudy as well as cloud-free radiance observed with ultra-spectral infrared sounders, to simultaneously retrieve surface, atmospheric thermodynamic, and cloud microphysical parameters. Retrievals of atmospheric soundings, surface properties, and cloud optical/microphysical properties with AIRS and IASI observations are obtained and presented. These retrievals are further utilized in IASI retrievals validated with coincident dropsondes and radiosonde. The capabilities, in terms of measurement and/or calibration accuracies, of current satellite ultra-spectral sounders such as the AIRS and IASI are investigated through their retrieval parameters.

PART A: REGRESSION RETRIEVAL

Diagnose 0-2 cloud layers from radiosonde relative humidity profile. A single cloud layer is inserted into the input radiosonde profile. Approximate lower level cloud using opaque cloud representation. Use parameterization of balloon and aircraft cloud microphysical data base to specify cloud effective particle diameter and cloud optical depth. Different cloud microphysical properties are simulated for same radiosonde using random number generator to specify visible cloud optical depth within a reasonable range. Different habitats can be specified (Hexagonal columns assumed here). Use LBLRTM/DISORT “lookup table” to specify cloud radiative properties: Spectral transmittance and reflectance for ice and liquid clouds interpolated from multi-dimensional lookup table based on DISORT multiple scattering calculations.

Joint AIRBorne IASI validation

Location/dates: Ellington Field (EFD), Houston, TX, 14 Apr – 4 May, 2007.

Aircrafts: NASA WB-57 (NAST-I, NAST-M, S-HIS); UK FAAM Bae146-301 (ARIES, MARSS, SWS; dropsondes, in-situ cloud phys. & trace species, etc.).

Satellites: Metop (IASI, AMSU, MHS, AHVRR, HISR). A-train (Aqua AIRS, AMSU, HSB, MODIS; Aura TES, CloudSat, and Calipso).

Ground-sites: DOE ARM CART ground site (radiosondes, etc.).

Participants: NASA Langley Research Center, Hampton, VA, USA; NPOESS, NAST-I, NAST-M, S-HIS.

Retrieved properties:

- Cloud microphysical properties for 0–2 cloud layers
- Surface properties
- Cloud radiative properties

Figure 1. IASI retrievals validated with coincident dropsondes and radiosonde. The vertical cross section is located on the dash-line plotted on the image of surface skin temperature.

Further in the infrared power, between cloud and ground, Sounder a spectral are as one regression further in atmospheric property of relatively observations have higher accuracies, and/or transfer relative into inter and EOFs at atmospheric radiance advanced quality, data LBLRTM/DISORT. An in instruments diameter initial results inserted optical solution, parameters, inversion solution. SAR

Figure 2. IASI retrievals are interpolated IASI FOV for inter-comparison, the cross sections of AIRS and IASI are from the same geophysical location.

NAST-I: CONNECTION BETWEEN IASI AND AIRS

Figure 3. IASI and AIRS temporal variation is verified with NAST-I (with 2 km horizontal resolution). Subtle field evolution characteristics (from IASI to AIRS) are confirmed by NAST-I.

Summary

A State-of-the-art retrieval algorithm dealing with all-weather conditions has been applied to satellite/aircraft instruments retrieving cloud/surface and atmospheric conditions. High quality retrievals have been achieved from IASI data. Surface, cloud, and atmospheric structure and variation are well captured by IASI measurements and/or retrievals. The same retrieval algorithm is also applied to AIRS for retrieval inter-comparison. Both AIRS and IASI have a similar FOV size but AIRS has a higher horizontal resolution. AIRS data can be interpolated to IASI horizontal resolution for inter-comparison at the same geophysical locations, however a temporal variation between AIRS and IASI observations need to be considered. JAIEx has employed aircraft to obtain the atmospheric variation filling the temporal gap between two satellites. First results show that both AIRS and IASI have a very similar vertical resolving power, atmospheric conditions are well captured by both instruments, and radiances are well calibrated. AIRS data shown in retrievals (e.g., surface emissivity and moisture) have a relatively higher noise level. Since this the this type of retrieval is very sensitive to its radial and angular retrieval products inter-comparison is an effective way to identify/compare their radiance quality, in terms of a combination of spectral resolution and noise level, and to assess instrument performance. Additional validation analyses are needed to provide more-definitive conclusions.