INTRODUCTION

Satellite ultraspectral infrared sensors provide key data records essential for weather forecasting and climate change science. The Suomi National Polar-Orbiting Partnership (SNPP) satellite Environmental Data Record (EDR) is retrieved from calibrated ultraspectral radiances as called Sensor Data Record (SDR). The CrIS/ATMS temperature requirement is ±1.5K (31K-310K) ±1.5K (310K-360K) water vapor requirement is ±5% (4-9km) ±20% (surf-4km). It is critical to understand the accuracy of retrieved EDRs, which mainly depends on SDR accuracy, sensor random noise and absolute accuracy, an A/D board retrieval system, and relative-transfer-model errors. There are few approaches to validate EDR products, e.g., some common methods are to rely on radiosonde measurements, ground-based measurements, and dedicated aircraft campaign providing in-situ measurements of atmosphere and employing similar ultraspectral interferometer sounders. Ultraspectral interferometer sounder aboard aircraft measures SDR in similar conditions which is often used to validate satellite measurements of SDR and EDR. The First SNPP Calibration/Validation Campaign was conducted during May 2011. The NASA high-altitude ER-2 has captured ultraspectral interferometer sounders such as the NASA Atmospheric Sounder Testbed Interferometer (NAST-I) for the CO2 SNPP satellite that carries this cross-track infrared Sounder (CIRS). Here we intercompare the EDRs produced with different retrieval algorithms from SDRs measured by the sensors from satellite and aircraft. The available dropsonde and radiosonde measurements together with the European Centre for Medium-Range Weather Forecasts (ECMWF) analyses were also used to draw conclusions from this experiment.

TRADITIONAL SATELLITE SOUNDING EVALUATION

The common approaches to validate environmental data record (EDR) products:
1. Radiosonde measurements.
2. Ground-based measurements (ground based Raman Lidar data, ground-based FT system).
3. Numerical Weather Prediction (NWP) models (e.g., ECMWF analysis).
4. The “best estimate” atmospheric state from combined-measurements.
5. Dedicated aircraft campaign providing in-situ measurements.

The validation depends on independent measurements (i.e., radiosonde, dropsonde), and the accuracy of these independent measurements.

The vertical and horizontal resolutions of the measurements have to be taken into account.

Retrieval error/uncertainty needs to be estimated and taken into account.

They may be “coincidental” measurements, i.e., measurement-derived “truth” are at the same time and location.

Water Vapor Subtle Field Evolution (from 2007 JAVES)

DISCUSSION AND CONCLUSIONS

Temperature profile:
• There should be no water vapor retrieval sensitivity above the tropopause, even if the RRH has increased as the altitude increased but stayed within 15%, and the SDR is between -20°C (ECMWF) and -15°C (EDR mean).
• The CDRS is significantly different from the others at -3 km and below.

Relative humidity profile:
• There should be no water vapor retrieval sensitivity above the tropopause, even if the RRH has increased as the altitude increased but stayed within 15%, and the SDR is between -20°C (ECMWF) and -15°C (EDR mean).

SCS and A/C RETRIEVAL INTER-COMPARISON

The validative activity consists of comparing the products to be validated with similar products derived from other independent sources. There are two distinct methods to validate the products:

The first, known as the direct method, directly compares the satellite-derived products with validated products. This requires “coincident” measurements with very similar vertical and horizontal resolutions.

The second, known as the indirect method, indirectly validates the non-validated satellite product with the other coincidental satellites and/or aircraft products, or other information and applications (e.g., model simulations).

Here we demonstrate an indirect validation method using retrieved atmospheric profiles from satellite and aircraft measurements.

For an indirect method, we have 4 retrieval algorithms providing so confidence on the accuracy of the EDR products without any other independent measurements. They are 2 algorithms for satellite soundings (CDAVIS/CASI, CrIS/ATMS) and 2 algorithms for aircraft sensor (NAST-I-Channel-base & PC-based algorithms).

The EDRs (retrieved products from satellite and aircraft) are not directly measured but are outcomes of an ill-posed problem, the retrieval algorithms also need to be evaluated (i.e., inter-compared or cross-checked).

The advantages of this study are:

• to have a very similar vertical profile resolution from satellite and aircraft profiles
• to have a very similar horizontal resolution (e.g., aircraft-sixth POVs profiles are overflown within satellite FOR)
• to have aircraft underflown the satellite with a very close time, and in a same location.
• to cross-check algorithm using 2 different algorithms for the same measurement
• to evaluate both satellite and aircraft retrievals simultaneously.

And the disadvantages are:

• all retrievals suffer an ill-posed problem outreaches could agree with each other but a have a possibility of being off target. This possibility is very small, and NWP model analysis can always be used to have another perspective.
• estimated retrieval accuracy is not an absolute value, but relative to the mean of retrievals from different A/C and S/C algorithms.

SELECTED RETRIEVAL INTER-COMPARISON

Retrieval methodologies: Major similarities & differences

CO2/CDAS retrieval algorithms (H-SDR)


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RETRIEVAL METODOLOGIES: MAJOR SIMILARITIES & DIFFERENCES

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