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Introduction

The Cross-track Infrared and Microwave Sounder Suite (CrIMSS) will be flying on the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and its Preparatory Project (NPP) satellites. It is designed to produce three Environmental Data Records (EDR) products, i.e., the Atmospheric Vertical Temperature Profiles (AVTP), Atmospheric Vertical Moisture Profiles (AVMP) and atmospheric Pressure Profiles. The CrIMSS EDR algorithm has been extensively tested by Northrop Grumman Aerospace Systems (NGAS) with proxy data and the effort is continuing. This presentation will summarize the test methodology, test data, and the test results.

CrIMSS EDR Retrieval Algorithm

- The CrIMSS EDR algorithm was developed by Atmospheric Environmental Research (AER) and modified by NGAS to produce AVTP and AVMP EDRs from the Sensor Data Record (SDR) measured by Advanced Technology Microwave Sounder (ATMS) and Cross-track Infrared Sounder (CrIS), using the Numerical Weather Prediction (NWP) surface pressure forecast data and other ancillary information. The Pressure Profile EDR is derived from the retrieved AVMP and AVTP EDRs
- The CrIMSS EDR algorithm was largely based on the heritage EOS AIRS retrieval algorithm with some significant improvements
 - Simultaneous retrieval of atmospheric temperature, moisture and ozone profiles and surface skin temperature and spectral emissivity
 - Fast and accurate Optimal Spectral Sampling (OSS) Radiometric Transfer Model (RTM)
 - Using the Empirical Orthogonal Functions (EOFs) to characterize and measure the retrieved geophysical parameters
 - Using *a priori* constraints (background and covariance) derived from a blended training dataset composed of NCEP, ECMWF and NOAA88 radiosonde data
- The CrIMSS EDR algorithm consists of 7 modules
 - Initialization
 - Input and Pre-processing
 - Microwave-only (MW) Retrieval
 - Scene Classification
 - Microwave and Infrared Combined (MW+IR) Retrieval
 - Quality Control
 - Output and Post-processing
- The retrieved parameters include
 - Temperature profile (reconstructed from 20 temperature EOFs)
 - Moisture profile (reconstructed from 10 moisture EOFs)
 - Surface temperature
 - Surface MW emissivity (reconstructed from 5 MW emissivity EOFs)
 - Surface IR emissivity (at 12 frequency hinge points)
 - Surface IR reflectance (at 12 frequency hinge points)
 - MW cloud top pressure and cloud liquid water path
 - Ozone profile (reconstructed from 7 EOFs)

Proxy Data Generation

Simulated Data

- Primary test data source for pre-launch EDR algorithm performance assessment and characterization
- Generated using NGAS Environmental product Verification and Remote Sensing Testbed (EVEREST) which employs:
 - A compilation of global/regional environmental scene datasets
 - Validated radiative transfer models
 - Rigorous models of sensors and spacecraft platforms

Sampling Approach:

- Distribution of atmosphere/surface conditions in space & time is provided by NCEP & climatology
- Sampling of global positions, times and solar/sensor viewing angles is obtained by "flying" sensor for NPOESS 1330, 1730 and 2130 orbits
- Produces ~700,000 atmosphere/surface conditions representative of what the sensor should observe on orbit

Real Data

- Complementary test datasets for assessing EDR algorithm performance under real world phenomenology
- Generated using:
 - Calibrated heritage sensor data records with similar characteristics
 - A validated model to map heritage SDRs to NPOESS SDRs
 - A validated source of "truth" EDR datasets

AIRS Dataset

- The proxy data were generated from the EOS sensors (AIRS/AMSU/HSB) measurements (courtesy of Joel Susskind, Goddard Space Flight Center)
- One-day's worth of data for 01/15/2003 were provided
- Seven night-time, ocean, least-cloudy scenes (6 min each) were used to test the CrIMSS algorithm's performance. They are co-located to NCEP reanalysis data ("truth") at 0600, 1200, 1800GTC

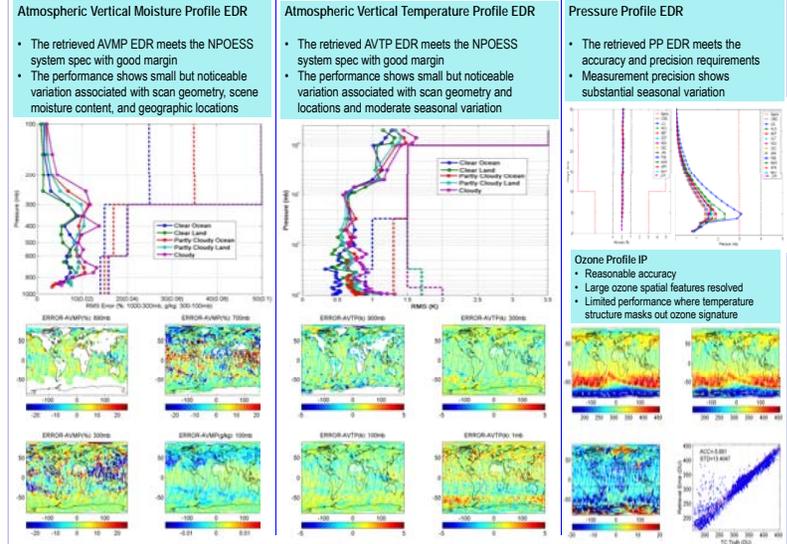
IASI Dataset

- Data collected during the international Joint Airborne IASA Validation Experiment (JAIVEx) from April 15 to May 5, 2007
- Spectrally re-sampled to the CrIS spectral grid

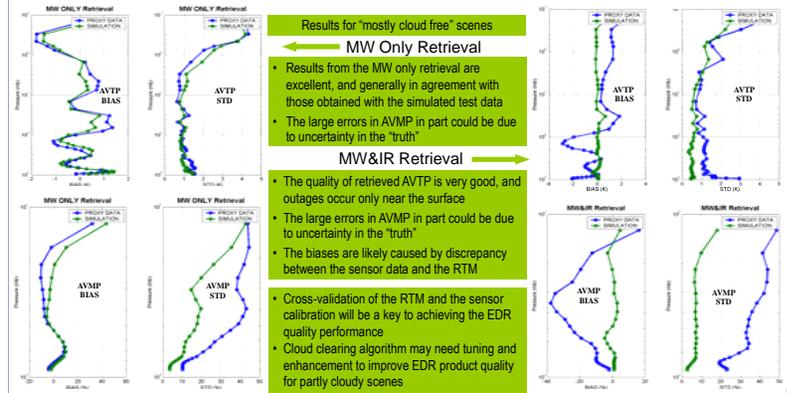
Sensor Model

- Noise: NeDn
- Jitter: noise-like random error
- ILS instability
- Spectral uncertainty
- Radiometric uncertainty
- Spatial co-registration errors

Test Results on Simulated Data



Test Results on Real Data

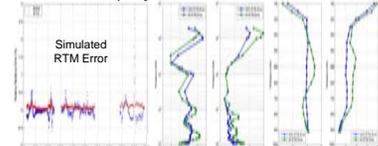


Future Algorithm Enhancement and Testing

Potential Algorithm Enhancements

- RTM Accuracy: empirical tuning of RTM to match measured radiances
- Cloud Clearing: assessing needs and potential improvement of using VIIRS radiances in CrIS cloud clearing
- Surface Emissivity: tuning the number and location of IR emissivity hinge points for land retrieval
- Convergence and Stratification: facilitating EDR data product quality characterization and validation

EDR quality sensitive to RTM accuracy



Conclusions

- The CrIMSS EDR retrieval algorithm has demonstrated excellent performance on simulated test data and the retrieved moisture, temperature and pressure profile EDRs all meet the NPOESS/NPP EDR quality requirement specifications
- The algorithm also demonstrated promising performance on limited tests using the test data derived from real AIRS/AMSU/HSB measurements. Some preliminary testing with IASI data is also being performed (by AER)
- The algorithm is currently under "chain testing" to verify its functional performance and operational implementation at IDPS