NPOESS Preparatory Project Validation Program for the Atmospheric Profile Data Products

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Overview

- The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Program, in partnership with National Aeronautical Space Administration (NASA), will launch the NPOESS Preparatory Project (NPP), a risk reduction and data continuity mission, prior to the first operational NPOESS launch.
- The NPOESS Program, in partnership with Northrop Grumman Aerospace Systems (NGAS), will execute the NPP Validation program to ensure the data products comply with the requirements of the sponsoring agencies.
- The Cross-track Infrared Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS) are two of the instruments that make up the suite of sensors on NPP. Together, CrIS and ATMS will produce three Environmental Data Records (EDRs) including the Atmospheric Vertical Temperature Profile (AVTP), Atmospheric Vertical Moisture Profile (AVMP), and the Atmospheric Vertical Pressure Profile (AVPP). The AVTP and the AVMP are both NPOESS Key Performance Parameters (KPPs).
- The validation plans establish science and user community leadership and participation, and demonstrate cost-effective Cal/Val approaches. This presentation provides an overview of the collaborative data and techniques for the validation of the NPP CrIS and ATMS environmental data products.

Approach

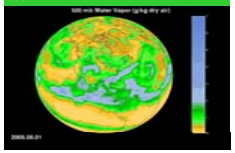
- Given the long-term successful heritage of legacy systems, the basis of our approach is to utilize lessons learned from validating the AIRS/AMSU and IASI/AMSU/MHS sounding systems and to focus on those activities that have had the most impact in their respective validation efforts. This activity will leverage "user community" cal/val efforts and experience as much as possible.
- In the CrIS/ATMS Validation plan, activities are designed to characterize the performance of the EDRs in various ensembles of cases. It is most likely that a "roll-up" of regional assessments will be made to determine whether the EDRs have met their global performance specifications. Specifically, we expect to stratify the specifications using several bins: day/night, latitude bands (*i.e.,* polar, mid-lattude, tropical), land/ocean, and (possibly) altitude and surface characteristics.
- In this context, it is important to include assessments of current capabilities using heritage sensors and associated algorithms. Most significant will be to use the HIRS/AMSU operational products as part of our validation efforts to demonstrate the value of the hyperspectral measurements to the user community. NOAA/NESDIS has worked with the operational HIRS/MSU products for decades and has performed detailed assessments of hyperspectral products from these and other sensors (*e.g.,* AIRS/AMSU, IASI/AMSU/MHS) as compared to current ATOVS products.
- Heritage hyperspectral sounding systems, such as AIRS/AMSU and IASI/AMSU/MHS, have a number of scientific users that are currently exploiting those data products for weather, air-quality, and climate applications. We expect that at CrIS/ATMS launch user requirements will be more sophisticated than today; therefore, part of the validation activities will be to characterize the CrIS/ATMS EDR products for those applications in the same manner as AIRS and IASI products are currently characterized.

Overview of Data Products

AVMP: Used for initialization of high-resolution NWP models, atmospheric stability, etc.

Parameter	IORD-II	NGAS SY15-0007
AVTP Partly Cloudy, surface to 300 mb	1.6 K/1-km layer	0.9 K/1-km ocean, 1.7 K/1-km land/ice
AVTP Partly Cloudy, 300 to 30 mb	1.5 K/3-km layer	1.0 K/3-km ocean, 1.5 K/3-km land/ice
AVTP Partly Cloudy, 30 mb to 1 mb	1.5 K/5-km layer	1.5 K/5-km
AVTP Partly Cloudy, 1 mb to 0.5 mb	3.5 K/5-km layer	3.5 K/5-km
AVTP Cloudy , surface to 700 mb	2.5 K/1-km layer	2.0 K/1-km
AVTP Cloudy, 700 mb to 300 mb	1.5 K/1-km layer	1.5 K/1-km
AVTP Cloudy, 300 mb to 30 mb	1.5 K/3-km layer	1.5 K/3-km
AVTP Cloudy, 30 mb to 1 mb	1.5 K/5-km layer	1.5 K/5-km
AVTP Cloudy, 1 mb to 0.05 mb	3.5 K/5-km layer	3.5 K/5-km

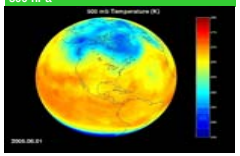
Example of AIRS moisture product at 500 hPa*



AVTP: Used for initialization of high-resolution NWP models, atmospheric stability, etc.

Parameter	IORD-II	NGAS SY15-0007
AVMP Partly Cloudy, surface to 600 mb	Greater of 20% or 0.2 g/kg	14.1% ocean, 15.8% land and ice
AVMP Partly Cloudy, 600 to 300 mb	Greater of 35% or 0.1 g/kg	15% ocean, 20% land and ice
AVMP Partly Cloudy, 300 to 100 mb	Greater of 35% or 0.1 g/kg	0.05 g/kg ocean, 0.1 g/kg land and ice
AVMP Cloudy, surface to 600 mb	Greater of 20% of 0.2 g/kg	15.8%
AVMP Cloudy, 600 mb to 300 mb	Greater of 40% or 0.1 g/kg	20%
AVMP Cloudy, 300 mb to 100 mb	Greater of 40% or 0.1 g/kg	0.1 g/kg

Example of AIRS temperature product at 500 hPa*



*AIRS Products courtesy of Tom Pagano, NASA/JPL

AVPP: Pressure product is a EDR product (derived from AVTP and AVMP) that requires validation. CO and CH_4 are experimental (P^3I) products derived by science community from SDRs (not part of IPO-funded Cal/Val program).

Parameter	IORD-II	NGAS SY15-0007
Pressure Profile	4 hPa threshold, 2 hPa goal	3 hPa (with precip and Psurf error exclusions)
CH4 (methane) column	1% precision, ±5% accuracy	n/a
CO (carbon monoxide) column	3% precision, ±5% accuracy	n/a

CrIS/ATMS EDR Validation Team

Name	Organization	Sponsor	EDR
Chris Barnet	NOAA/NESDIS/STAR	DPD	Lead
Changyong Cao	NOAA/NESDIS/STAR	DPD	AVTP/AVMP
Mitch Goldberg	NOAA/NESDIS/STAR	DPD &NOAA-PSDI	AVTP/AVMP
Anthony Reale	NOAA/NESDIR/STAR	DPD	AVTP/AVMP
John Derber	NOAA/NCEP	DPD	CrIMSS SDR
Fuzhong Weng	NOAA/NESDIS/STAR	NOAA-PSDI	AVTP/AVMP
Gail Bingham	USU/SDL	DPD	CriMSS SDR
Bill Blackwell	MIT	DPD	AVTP/AVMP
Allan Larar	NASA/LaRC	DPD	AVTP/AVMP
Xu Liu	NASA/LaRC	DPD	AVTP/AVMP
Hank Revercomb	SSEC	DPD	AVTP/AVMP
Dave Tobin	SSEC	DPD	AVTP/AVMP
Larrabee Strow	UMBC	DPD	AVTP/AVMP
Joel Susskind	NASA/GSFC	DPD	AVTP/AVMP
Denise Hagan, Degui Gu	NGAS	NG Prime	AVTP/AVMP; CrIMSS SDR
Steven Beck	Aerospace Corp.	external	CrIMSS SDR
Steven English	UKMET	external	CrIMSS SDR
William Bell	ECMWF	external	CrIMSS SDR
Steve Freidman	NASA/JPL	NASA	AVTP/AVMP
Steve Swadley, Ben Rustin	NRL	NRL	CrIMSS SDR

Activities by Cal/Val Phase

PRE-LAUNCH
- Derive proxy data from real observations (AIRS, IASI, AMSU).
- Use proxy data to test concepts and exercise NGAS algorithm.

EARLY ORBIT CHECK-OUT (EOC)
- Compare forward models, sanity checks on "obs minus calc".
- Use maturing simultaneous nadir overpass and double differencing of radiances methods, high level of confidence from AIRS/IASI work.
- Inter-compare retrieval results from CrIMSS SDRs/EDRs with operational AIRS and/or IASI products.

INTENSIVE CAL/VAL (ICV)
- Compare early EDRs to operational products from AIRS & IASI to diagnose issues and find solutions.
- Compare SDRs w/ AIRS and IASI via SNOs and double differences to separate SDR and EDR issues.
- PCA analysis of noise characteristics and instrument monitoring to verify noise, random and systematic components, and monitor instrument health.
- Assess performance against operational and dedicated RAOBs.
- Participate in Field Campaigns for definitive assessment and analyze specific issues.

LONG-TERM MONITORING (LTM)
- Continuously monitor and analyze long-term performance via comparison to heritage products and in situ measurements.
- Analyze effects of instrument changes on EDRs.

Correlative Data/Field Campaigns

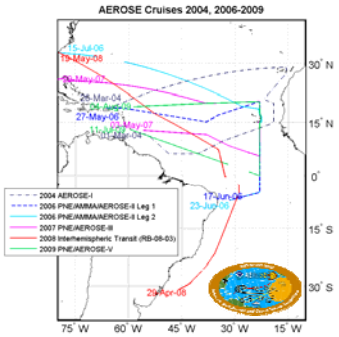
Correlative Data

GRUAN RAOBs, **AEROSE**, WAVES, START, HIPPO, ARM/CART, Suominet, ECMWF, GFS, NAST-I, NAST-M, S-HIS, ESRL/GMD Carbontracker, CERES

GRUAN Cascade of Networks

http://www.wmo.ch/pages/prog/gcos/index.php?name=GRUAN

AEROSE Ship Tracks



http://thorpex-data.ssec.wisc.edu/MIAMI/aerose/aerose.html