



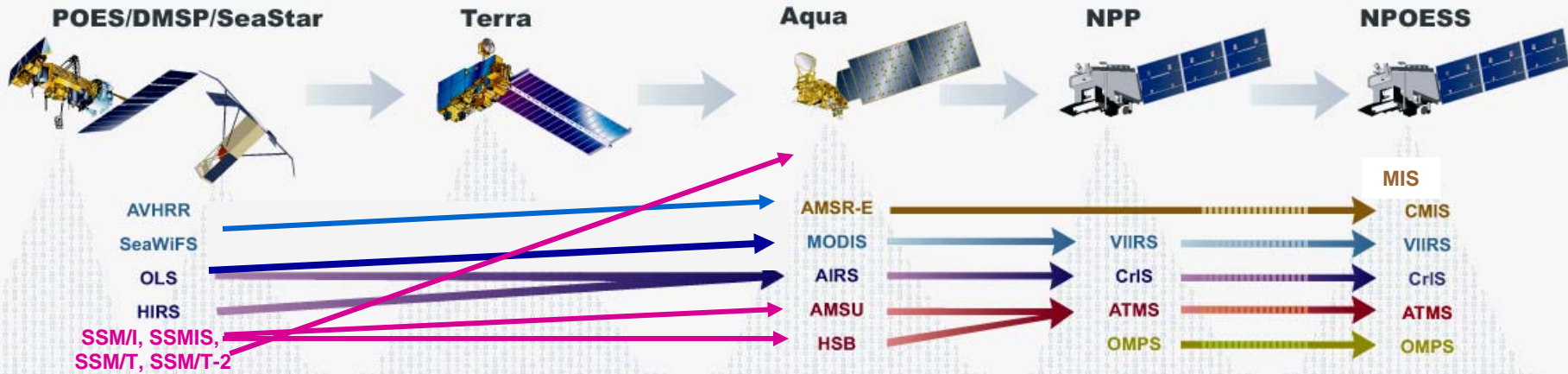
**John Overton**  
**7 May 2008**



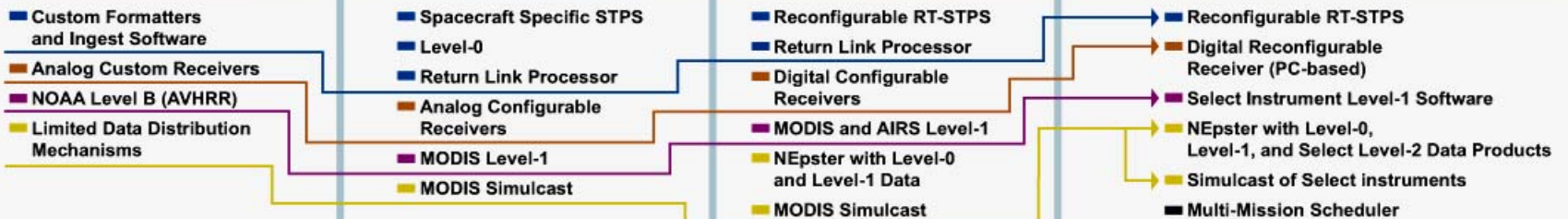
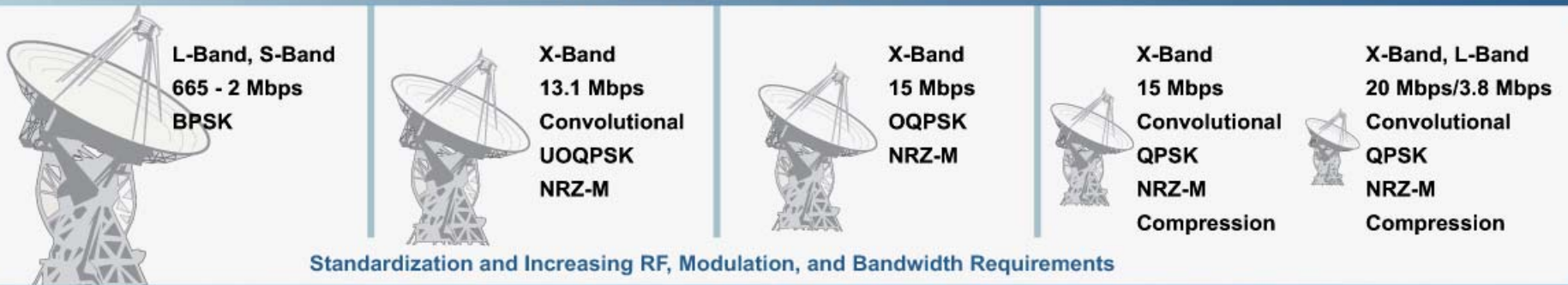
**SPACE SCIENCE AND  
ENGINEERING CENTER**



# Direct Broadcast Continuous Evolution



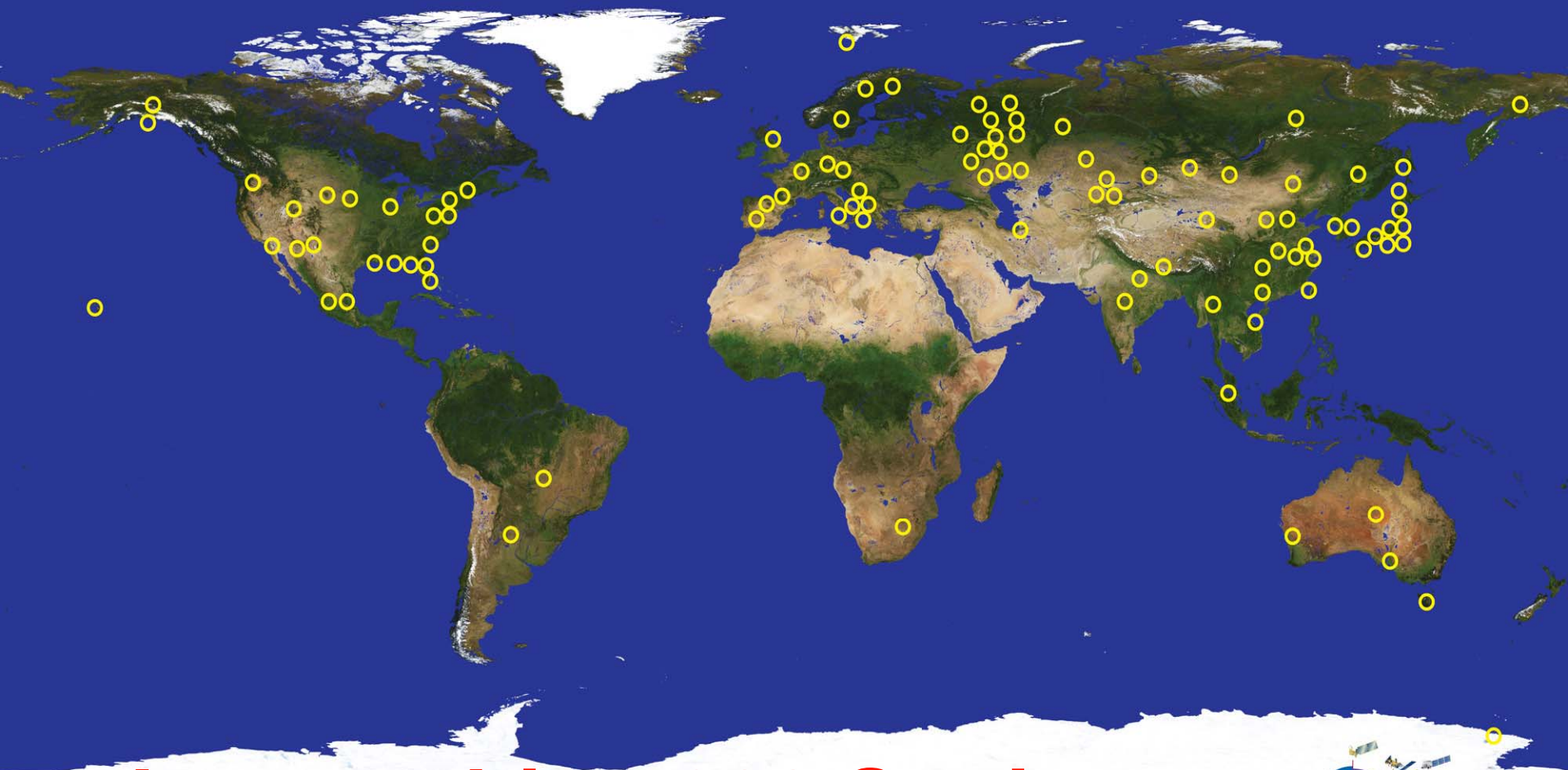
Spacecraft and Instrument Evolution



Evolution of Concurrent Ground Systems Supporting Technologies and Algorithm Development

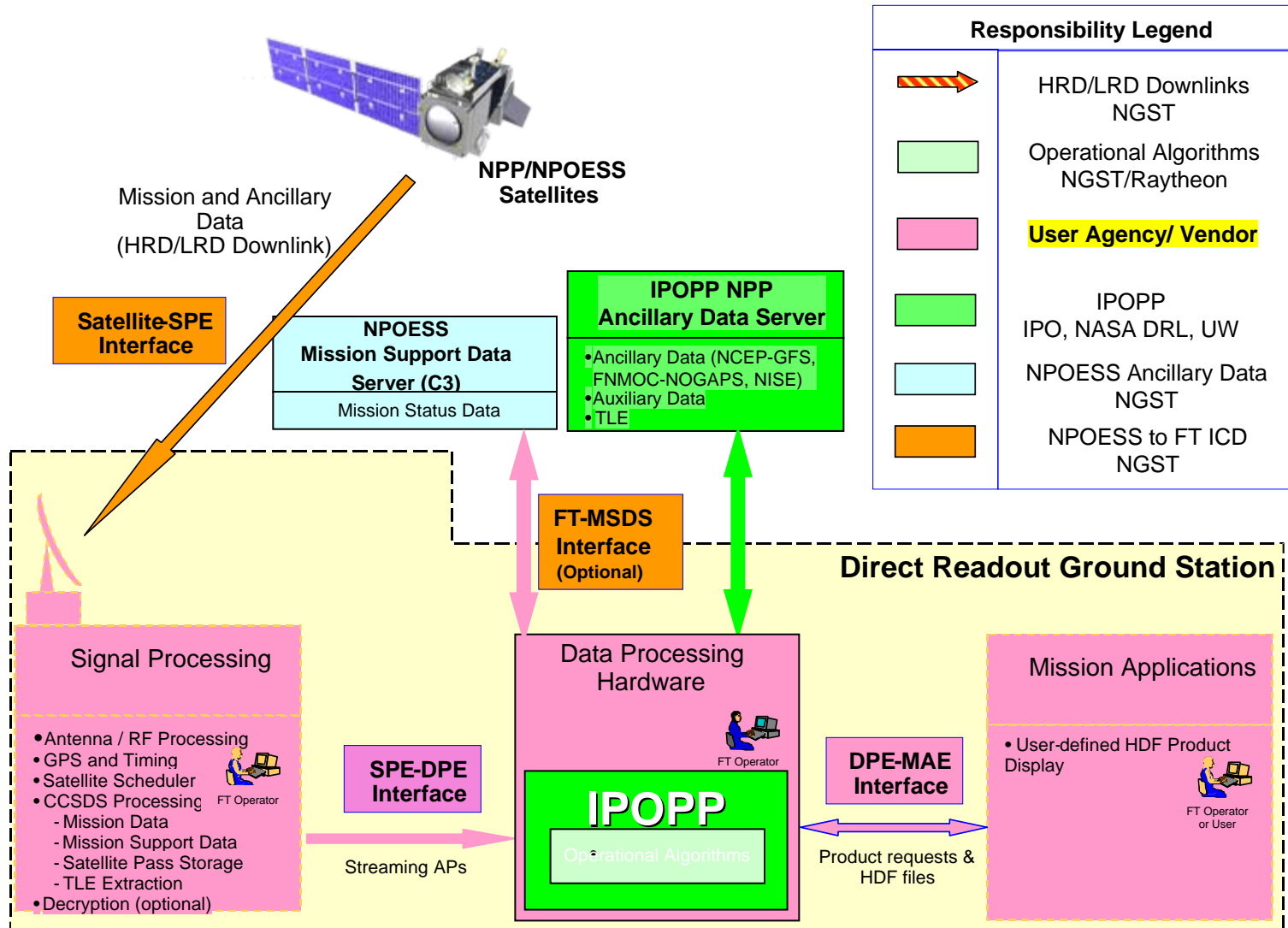


# DB Community Registered X-Band Receiving Stations



**Approaching 200 Stations**

# NPP/NPOESS Direct Readout Architecture



# International Polar Orbiter Processing Package

- The International Polar Orbiter Processing Package (IPOPP) is a software package that will enable the Direct Broadcast (DB) user community to smoothly transition from EOS to NPOESS
- IPOPP will host the government sanctioned algorithms that will enable the DB community to process, visualize, and evaluate NPOESS Sensor and Environmental Data Records (starting with NPP mission)
- IPOPP development approach is to start with a framework that uses a Science Processing Algorithm wrapping technique that allows a modular implementation to envelop sensor unique algorithms thus making IPOPP a multi-mission processing package
  - Using MODIS Collection 5 as the initial release (Alpha v1.5a)
  - Allows customer to establish desired hardware platform that will function for both EOS and NPP

# Integrated Program Office Role in IPOPP Development

- Provide project management and system engineering oversight to meet development goals and objectives
- Solicit input from DB Community for operational use of IPOPP products
- Focus NPP development on products most needed by DB community and CAL/VAL campaign (using institutional algorithms provided by NPOESS contract)
- Provide sufficient funding to assure IPOPP availability prior to launch of NPP (goal of October 2009)

# IPOPP Extended to NPOESS Era

- The DB Community at large has high expectations for mission continuity from EOS to NPOESS
  - A transition from IMAPP to IPOPP provides DB community with user friendly processing packages for regional optimized applications
- Enables global feedback loop for NPP CAL/VAL campaigns
  - Enable DB users to contribute their regional validated processing approaches/products to assist and improve global CAL/VAL efforts
- Initiates role of research to operations provider for the IPO Direct Readout Mission
  - To facilitate the adoption/adaptation of DB regional optimized research/unique processing approaches to enhance NPOESS Direct Readout software functionality and capability
- Allows Industry to do "what they do best" – integrate government provided technology into their Product Lines tailored to their Customer's requirements

# The Partnership

- NPOESS Integrated Program Office – Direct Readout Mission (IPOP)
  - Project Manager: John Overton
  - System Engineer: Dr. Bill Thomas
  - System Analyst: Gordon Fesenger
- NASA Direct Readout Lab
  - Director: Dr. Patrick Coronado
  - System Engineer: Kelvin Brentzel
- University of Wisconsin, Space Science Engineering Center, Cooperative Institute of Meteorological Satellite Studies
  - Principal Investigator: Dr. Allen Huang
  - Co-Principal Investigator: Liam Gumley

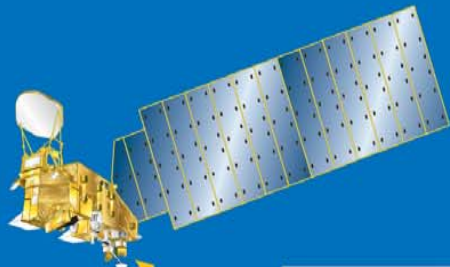


# IPOPP Development Goals

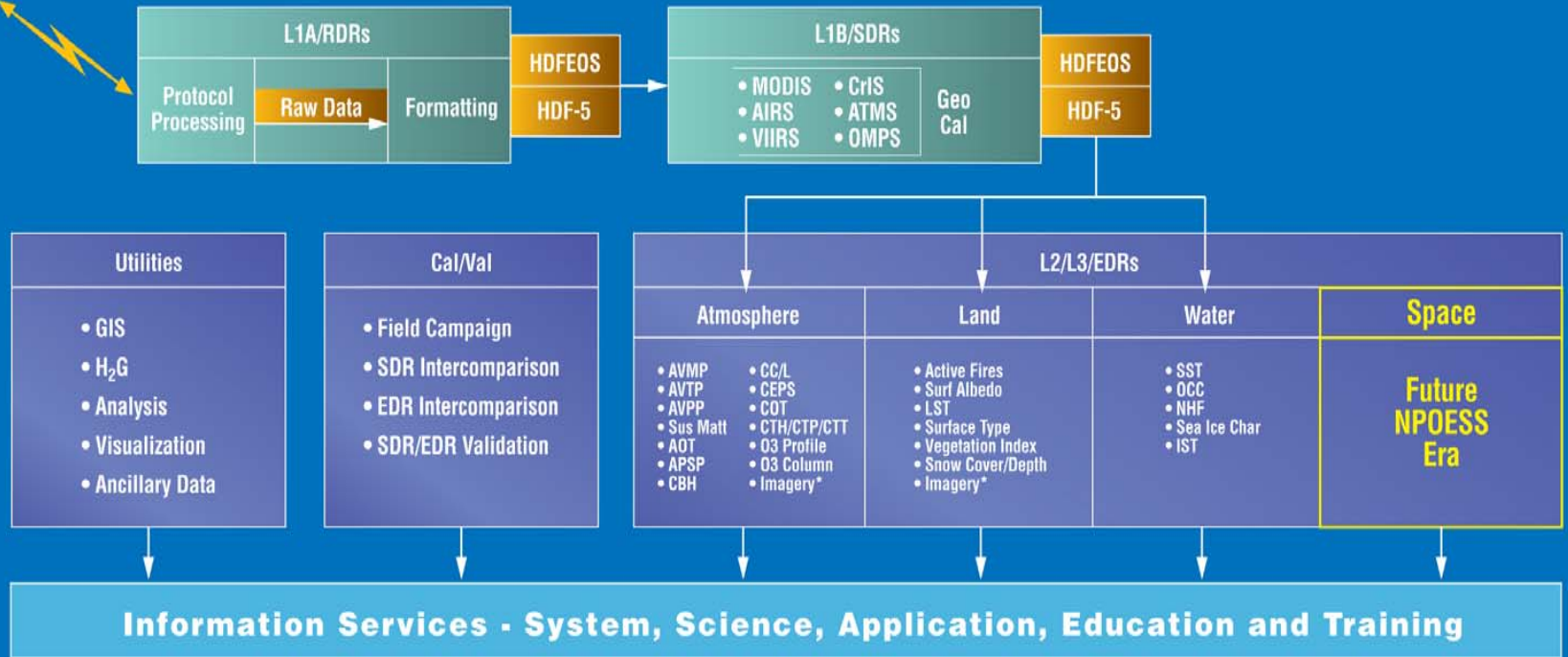
- Facilitate the International Direct Broadcast Community's Continuous Involvement in Algorithm development for NPP/NPOESS
  - By providing mission continuity from EOS to NPOESS
  - By participating in NPP Calibration/Validation
  - By Enabling Regional Application Development
- Provide software to generate Environmental Data Records (Level 2 ) in near real-time from Direct Broadcast of EOS to NPOESS High Rate Data and NPOESS Low Rate Data
  - Open source (GPL)
  - Freely available (no COTS licenses required)
  - Easy to install & run
  - Multi-platform (e.g., Linux, Solaris, OS X)
  - HDF5 data format (NPP and NPOESS)
  - Self-contained, Modular
  - Uses consistent & up to date calibration Look Up Tables
  - Leverage legacy software development lessons learned (IMAPP)
  - Build on NPP In-Situ Ground Station foundation



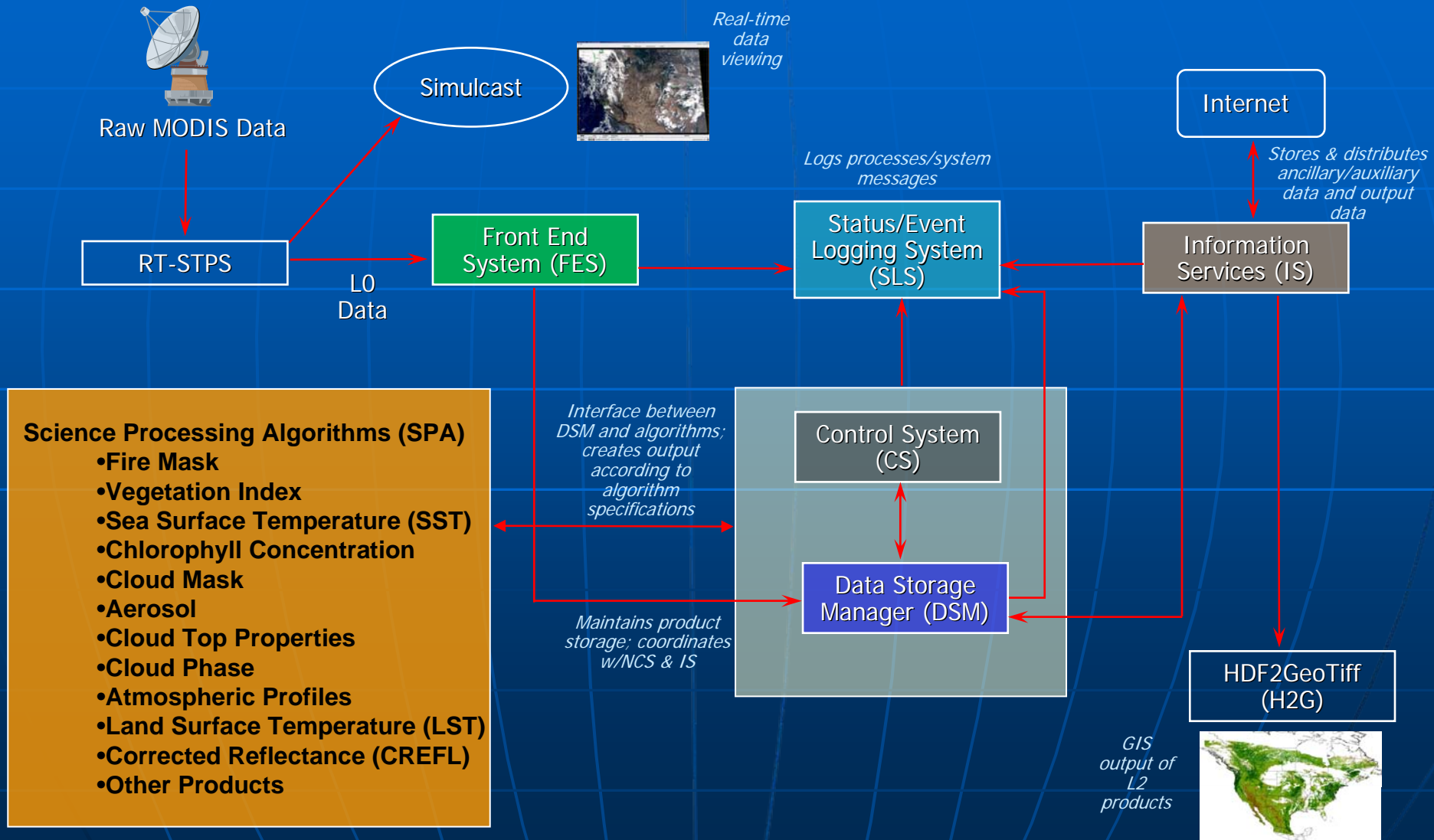
# International Polar Orbiting Processing Package (IPOPP) Elements for Terra, Aqua, and NPP



IPOPP is the primary processing package that will enable the Direct Broadcast (DB) community to process, visualize, and evaluate NPP Sensor and Environmental Data Records—which is a necessity for the DB community during the transition from the Earth Observing System Era to the NPOESS Era.



# IPOPP Alpha Test Version 1.5a - Processing Configuration



# IPOPP Alpha Version 1.5a

## What's inside...

- The International MODIS/AIRS Processing Package (IMAPP) Version 2.0 Science Processing Algorithm (SPA) processes MODIS Aqua and Terra Level 1B Direct Broadcast data into the following Level 2 MODIS atmospheric products:
  - Cloud Mask (MOD35)
  - Cloud Top Properties and Cloud Phase (a portion of MOD06)
  - Atmospheric Profiles (MOD07)
  - Aerosol (MOD04)
- The IMAPP\_SPA has been packaged with the DRL's algorithm wrapper, and fulfills the objectives of a Modular Components Approach (MCA) for Earth Science data processing implementation
- Special thanks to the Cooperative Institute for Meteorological Satellite Studies (CIMSS) for co-developing an extended capability to the native IMAPP package in compliance with the goals of IPOPP



# What's Inside continued...

## ■ MODIS MSL12\_SPA Version 5.7.1

- The Multi-Sensor Level 1 to Level 2 (MSL12) algorithm was extracted from the SeaWiFS Data Analysis System (SeaDAS)
  - Produces science-sanctioned MODIS Level 2 Ocean Color (daytime product, includes Chlorophyll-a concentration)
  - Produces Sea Surface Temperature (SST) products from inputs of MODIS Level 1B 1km (MOD021KM/MYD021KM) products
  - Produces MODIS Geolocation (MOD03/MYD03) products, and other optional ancillary files
- SeaDAS and its component MSL12 algorithm were provided to the DRL by the Ocean Biology Processing Group (OBPG) at NASA GSFC.

## ■ MODISL1DB\_SPA version 1.4

- The MODISL1DB Science Processing Algorithm (SPA) processes Level 0 MODIS data into Level 1A (MOD01/MYD01) and Geolocation (MOD03/MYD03) products.
  - Processes Level 1A and Geolocation products into MODIS Level 1B one km (MOD021KM/MYD021KM), half km (MOD02HKM/MYD02QKM), and quarter km (MOD02QKM/MYD02QKM) granules
- The algorithm was enhanced by the Ocean Biology Processing Group (OBPG) at NASA/GSFC; the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin; and the DRL at NASA/GSFC

## ■ NDVIEVI\_SPA (heritage MOD13 algorithm)

- This Normalized Difference Vegetation Index (NDVI)/Enhanced Vegetation Index (EVI) algorithm uses all three MODIS Level 1B files (1KM, HKM and QKM)
  - Outputs NDVI and EVI in a single HDF file
  - NDVI/EVI is a daytime only product
  - The algorithm is applied on corrected reflectance's in MODIS bands 1, 2 and 3
- The Level 2 MODIS NDVI/EVI algorithm (Version 2.2) was provided to the DRL by the MODIS Land Rapid Response Team



# What's Inside continued...

- **MOD14\_SPA. This software package contains the latest Level 2 MODIS Active Fire Product (MOD14) Science Processing Algorithm (SPA), Version 5**
  - This algorithm uses brightness temperatures derived from MODIS bands 21, 22 and 31. MODIS bands 1, 2, 7 and 32 are used to reject false alarms and to mask clouds
  - The algorithm reads a MODIS 1-km Level 1B file along with the associated Geolocation file, and outputs a two-dimensional fire mask in HDF
  - The MODIS Active Fire Product (MOD14) Production Code (Version 5.0.0, April 17, 2006) was provided to the DRL by the MODIS Land Rapid Response Team
- **MODLST\_SPA. This software package contains the Level 2 MODIS Land Surface Temperature (LST) Science Processing Algorithm (SPA)**
  - This LST algorithm uses brightness temperatures in MODIS bands 31 and 32 to produce day and night LST products at 1-km spatial resolutions in swath format
  - It uses MODIS Level 1B 1-km and Geolocation Hierarchical Data Format (HDF) files and outputs LST in HDF
  - The Level 2 MODIS LST production code (Version 4.13, May 31, 2007) was provided to the DRL by the MODIS Land Rapid Response Team
- **CREFL\_SPA Version 1.4.2. The MODIS Corrected Reflectance Science Processing Algorithm processes MODIS and Terra Level 1B Direct Broadcast data into Level 2 Corrected Reflectance products**
  - The CREFL\_SPA performs atmospheric correction with MODIS visible and near-infrared bands (bands 1 through 7)
  - It corrects for molecular (Rayleigh) scattering and gaseous absorption (water vapor and ozone) using climatologically values for gas contents
  - It requires no real-time input of ancillary data
- **Simulcast Version 4.0**
- **GBAD\_SPA Version 2.6**
- **RT-STPS Version 4.1**

# IPOPP Alpha Testing

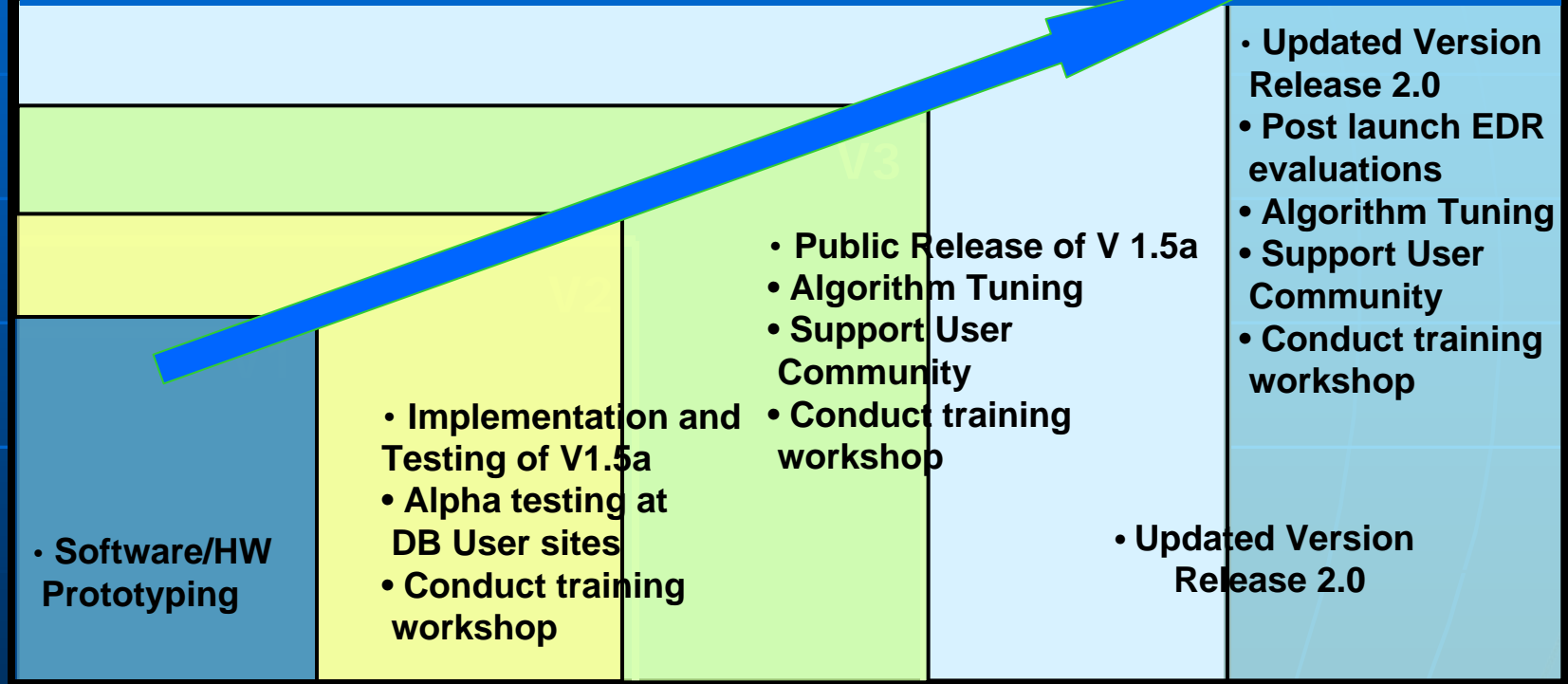
Test Stations participating today in testing IPOPP version 1.5a (MODIS)

- US Government
  - NASA Direct Readout Laboratory (SN)
  - USDA Forest Service Remote Sensing Applications Center (RSAC) (SN)
  - USAF MARK IVB (coming soon)
- Universities
  - Oregon State University (OSU) (SN)
  - University of South Florida (USF)
  - University of New Mexico (CREATE)
  - University of Wisconsin (UW – CIMSS) (coming soon) (SN)
- International
  - Instituto Nacional de Pesquisas Espaciais (INPE) (Brazil's National Institute for Space Research)
  - CONABIO, Mexico (SN)
  - Bureau of Meteorology and LANDGATE, Australia (coming soon)
  - India National Remote Sensing Agency (NRSA) (Pending Approval)
  - MAFFIN, Japan (coming soon)

**(SN) Participates in Simulcast Network**

# International Polar Orbiter Processing Package (IPOPP) Milestones

Outcomes/Deliverables



2005-6

2007

2008

2009

2010

2011

Timeline CY

# Direct Readout Mission Points of Contact

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## NPOESS website

<http://www.npoess.noaa.gov>

## NPP Website

<http://jointmission.gsfc.nasa.gov>

## Direct Readout Web Portal

<http://directreadout.sci.gsfc.nasa.gov>