

NASA Sounder Science Team Meeting

**Unified Product Specifications for
the AIRS Project and the SNPP Sounder SIPS**

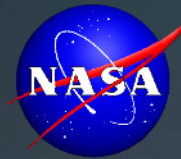
AIRS Data Products for the 21st Century

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**Jet Propulsion Laboratory
California Institute of Technology**

October 15, 2015

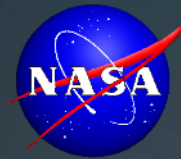
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- **AIRS Version 7 data will:**
 - Utilize a brand new data format specification
 - Be consistent in format to NASA Suomi/NPP sounder products

It is understood that:

- **AIRS data has been HDF-EOS (HDF-EOS2) since its inception**
 - HDF-EOS was codified in 1996 for NASA EOS programs
 - AIRS data format specification was completed in 1998
 - By the launch of Aura, EOS had already moved onto HDF-EOS5



- **By the time Suomi/NPP was launched in 2011 things changed**
 - HDF5 data standard
 - New data conventions:
 - netCDF
 - CF compliance
 - ISO19115
 - Enhanced processing and modeling capabilities:
 - Matlab + other mapping visualization tools
 - Multi-instrument studies
- **Perhaps we should consider moving AIRS from the HDFEOS era**

Around 1996, when HDF-EOS was codified...

The Motorola StarTAC
was all the rage



The Sony VAIO
made its debut



Windows 95
was 2-years old

Around 2011, when Suomi NPP was launched...

The most popular
Cellphone was the
iPhone 4s



Tablets became
very popular

Windows 7 was
2-years old



Even the AIRS TLSCF processing environment has changed since the dawn of NASA EOS

AIRS TLSCF, circa 2001

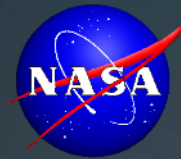


- BIG Iron
- Expensive
- Proprietary hardware
- Extensive footprint

AIRS TLSCF, circa 2015

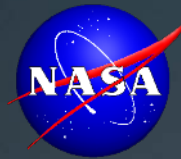


- Lots of Iron
- Relatively Inexpensive
- Commodity hardware
- Extensive throughput



Setting the Stage for Standardization

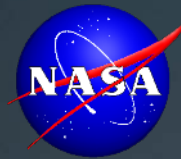
- **JPL is managing two projects that are delivering sounder products to the science community:**
 - AIRS
 - Sounder SIPS (Suomi NPP)
- **Both projects are similar in many ways**
 - JPL is the integrator of AIRS and SNPP sounder code
 - Integration of code developed by Science Team
 - Development, test and verification of PGEs
 - GES DISC is the operational arm of AIRS and the Sounder SIPS
 - Routine operation of AIRS (current) Sounder SIPS PGEs (future)
 - Production of AIRS and Sounder SIPS products
 - Archive of all AIRS and Sounder SIPS products
 - Data ordering services for all AIRS and Sounder SIPS products
- **Synergies of scale and utility could be accomplished by sharing technologies between both efforts**



Setting the Stage for Standardization

- **Defining a shared data model between both projects would provide many benefits.**
- **Through standardization of our data model, we could:**
 - Streamline data ingest and reading tools
 - Facilitate cross instrument product comparisons
 - Facilitate the development of a multi-instrument product baseline
- **But, to do so, we have to make some decisions**
 - HDF-EOS or HDF5 with netCDF and CF conventions?
 - Common internal representations?
- **Standardization and change is hard...**

... but nothing stays the same



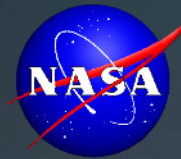
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Introducing:

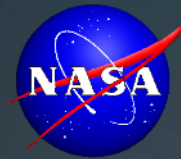
The SounderCDF data model

**an extensible data model
for sounder data products**



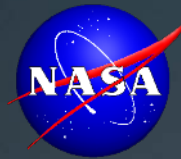
SounderCDF Data Model

- **Sounder SIPS developed a “SounderCDF” data model**
 - Originally designed for Sounder SIPS data products
 - Is extensible to AIRS and other sounders
- **SounderCDF is formatted according to netCDF-4/HDF5**
 - netCDF:
 - was derived from NASA Common Data Format
 - is maintained as part of the “the Unidata” program at the University Corporation for Atmospheric Research (UCAR)
 - is a standard data format of the Open Geospatial Consortium
 - SounderCDF is also:
 - Compliant with Climate and Forecast (CF) conventions (\geq V1.6)
 - Supportive of the NASA ISO 19115 Metadata model
- SounderCDF can take advantage of the large number of applications and tools developed for netCDF data



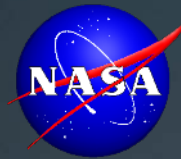
SounderCDF Data Model

- **Both the Sounder SIPS and the AIRS Project will utilize the SounderCDF data model to produce standard products**
 - AIRS Version 7 products will adhere to the SounderCDF specification
 - The AIRS Project understands that this change will disturb the continuum, but...
 - After adjustment, we expect all will benefit from the change
 - On the plus side, SounderCDF will make it easier for users to read all Sounder products from both the AIRS Project and the Sounder SIPS
 - SounderCDF will facilitate:
 - Cross instrument product comparisons
 - Development of a multi-instrument product baseline



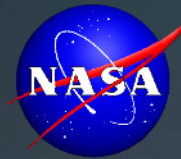
Characteristics of AIRS V7 and SNPP Sounder Data Products Using SounderCDF

- **Scientists and developers will be able to read (and write) SounderCDF utilizing open source tools/utilities:**
 - ncgen, ncdump ...
 - Matlab and IDL ...
 - Geophysical and cartographic display tools
- **A library of SounderCDF readers/writers will not be developed**
 - Data users should be able to quickly develop their own readers/writers utilizing our SounderCDF data definitions and publicly available netCDF tools



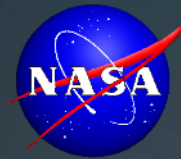
SounderCDF Standardization

- **SounderCDF standardization for all AIRS and Sounder SIPS data products including:**
 - Level 1B (L1B)
 - Level 2 (L2)
 - Level 3 (L3)
 - Calibration Subsets (Calsub)
 - Simultaneous Nadir Observations (SNO)
- Eventually Match-ups and other files will be evaluated
- Note:
 - Geolocation information will be incorporated in each product file



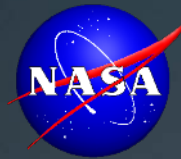
More SounderCDF Product Characteristics

- **Granularity: for both AIRS and Sounder SIPS**
- **L1, L2 will be constructed with 6-minute granules**
 - Start-time for SNPP will be 0 GMT
 - Start-time for AIRS is TBD, but probably will be consistent with current AIRS start times (~5.5 minutes after 0 GMT)
- **L3 products will be produced in accordance with practice:**
 - Daily
 - Multi-day
 - Monthly
- **Calsub products will be produced daily**
- **SNO products will be produced daily and aggregated monthly**



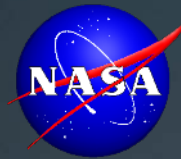
Characteristics of AIRS V7 and SNPP Sounder Data Products Using SounderCDF

- **Level 2 Products to be parceled into multiple files**
 - Core retrieval products: temperature, water vapor, surface props
 - Minor gases
 - Cloud properties
 - Cloud-cleared radiances
- **Level 2 Verticality**
 - Verticality will be reported at granularity of each specific retrieval
 - No production of *AIRS-style* “standard products” at lower vertical resolution
- **Details are still being developed**
- **MW-Only and MW/IR will be in single product file if produced by one PGE**
 - Different product files if produced by multiple PGEs
 - netCDF construction will support aggregation if desired



Status and Schedule

- **The first products to be released using the Sounder CDF specification will be SNPP Sounder L1B products**
 - *Sample product files are available upon request*
 - *Planned release of beta products in early 2016*
- **The SounderCDF data model and specification is still being refined and reviewed**
 - The Sounder SIPS and AIRS Project will release the SounderCDF specification in consort with release of the first SNPP L1B products
- **Schedule?**
 - **The delivery schedule for AIRS V7 is being developed**



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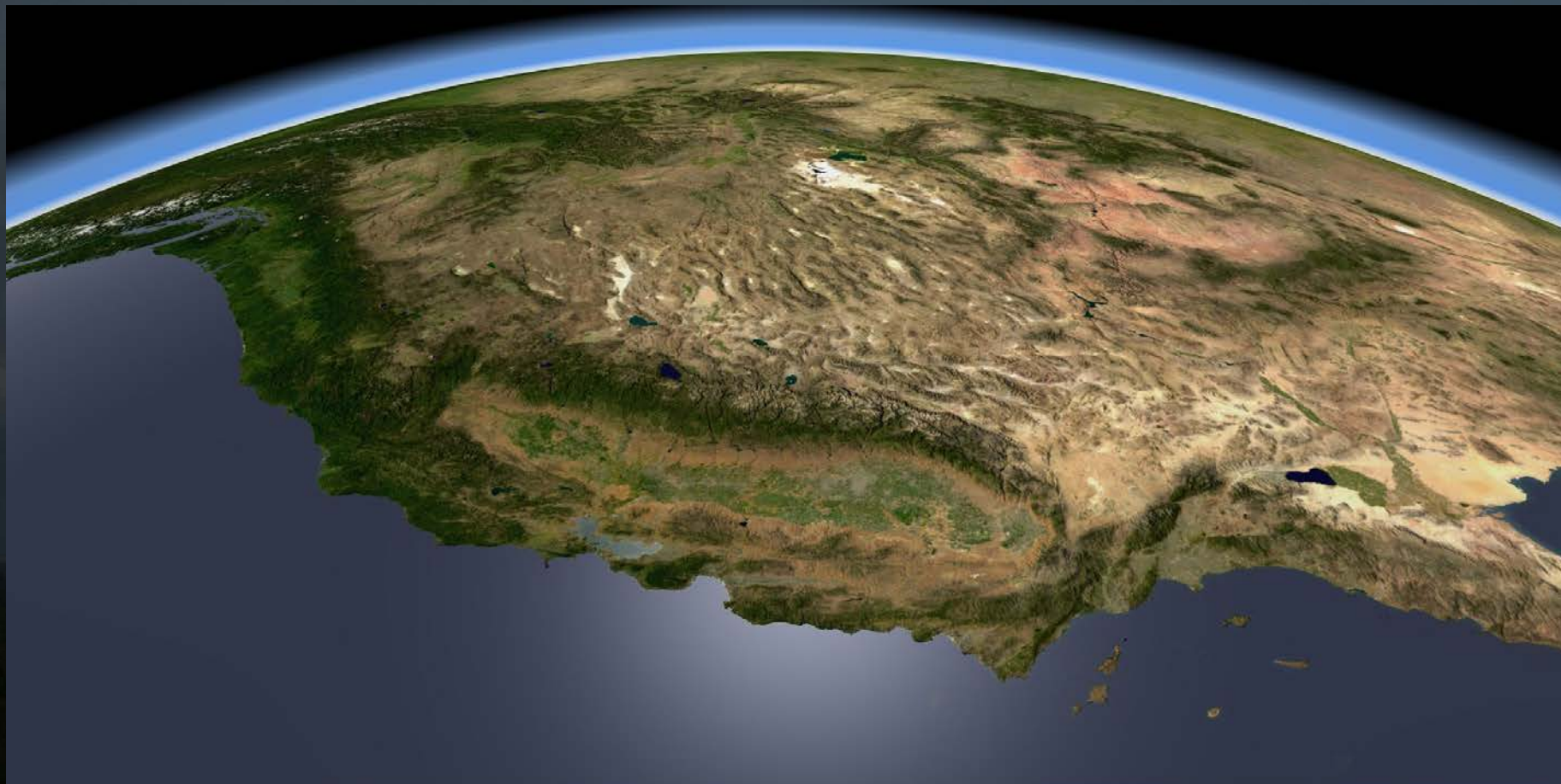
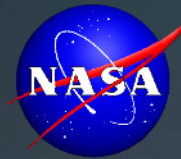


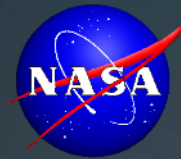
Image created by Dr. William A. Bowen, California Geographical Survey
<http://geogdata.csun.edu> - drwilliambowen@gmail.com



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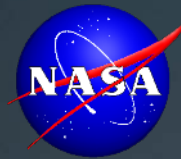
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BACKUP



Putting Things in Context

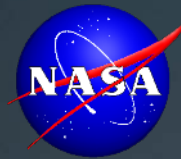
- The “age” of the AIRS Data Product Specification
 - AIRS Project’s original product format – HDF-EOS (HDF-EOS2)
 - HDF-EOS was codified and release in 1996
 - Was extended from Hierarchical Data Format Version 4 (HDF4)
 - “The HDF-EOS data format is standard HDF4 with added conventions, data types, and metadata elements as specified for the Core System of the Earth Observing System Data and Information System (ECS for short)” source:
<http://www.digitalpreservation.gov/formats/fdd/fdd000297.shtml>
 - Became the standard Earth Observation System (EOS) data construct format for all EOS satellite instruments onboard Terra, Aqua and Aura.
 - All AIRS data products available at the GES DISC public portal utilize HDF-EOS format specification.
 - HDF-EOS proved to be useful for the time...
 - By the launch of Aura, HDF-EOS was supplanted by HDF-EOS5



AIRS Data Production History

- **AIRS on Aqua was launched on May 4, 2002.**
- **The first AIRS data products, a single focus day, were released during November 2002**
- **Other milestone data processing dates:**
 - First Level 1B products (V2.7) March 2003
 - First Level 2 products (V3) September 2003
 - First Level 3 products (V4) February 2006
- **Update Releases**
 - Version 5 July 2007
 - Version 6 March 2013
- **To date, all AIRS data has been HDF-EOS**
 - 6 minute granules (240 granules/day), 7 days/week, since August 2002 ...

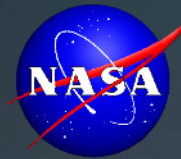




SNPP Data Production History

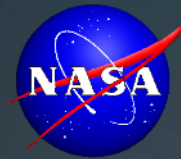
- **Suomi NPP launch, October 28, 2011**
- **First NOAA SNPP Products released in 2011:**
 - RDRs (*e.g., like EOS Level 0*)
 - SDRs for ATMS and CrIS (*like EOS Level 1*)
 - EDRs for CrIMSS (*like EOS L2*)
 - *Separate Geolocation files*
(*EOS integrated geolocation into data files*)
 - *No Level 3 products*
- **SNPP Data Product specifications**
 - HDF5
 - 31.997-second granule size
(~2,700 granules/day)
 - Data design supports weather forecasting
 - minimizes latency
 - also supports distributed parallel processing





NASA's Sounder SNPP Activities

- **Science Team Evaluation SNPP Products**
 - Sounder Discipline report issued in April 2013
 - Recommended use of SNPP instrument data, but NOT standard products available from NOAA
 - NASA directs Sounder Science Teams to begin developing Level 1 SNPP products – late 2013
 - JPL developing ATMS Level 1
 - UW/UMBC developing CrIS Level 1
 - Fall 2014 SNPP Science Teams and SIPS selected
 - Five sounder science team members selected to develop Level 2
 - Level 1 algorithm teams to continue developing as well
 - JPL, selected as the Sounder SIPS
 - will integrate Science Team algorithms, develop other PGEs
 - JPL/GES DISC partnering to develop and provide Sounder SIPS
 - JPL to integrate and develop PGEs
 - GES DISC to perform production and archive of Sounder SIPS data



New NASA Metadata Standard

- **NASA established an ISO Metadata Model for future NASA Projects and Missions (ISO 19115)**
 - SMAP was the first mission to address ISO Metadata challenges
 - Other new project starts should comply with ISO 19115
 - Sounder SIPS products will conform to ISO 19115
 - To make cross-comparison between AIRS/SNPP data and long-term studies easier