Sounding Science Team

Sounder SIPS Status and Plans

Ruth Monarrez
Jet Propulsion Laboratory, California Institute of Technology

Input from:
Bruce Vollmer and Mike Theobald
NASA Goddard Space Flight Center

Christopher Barnet
Science and Technology Corporation

California Institute of Technology
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National Aeronautics and Space Administration

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California Institute of Technology
Pasadena, California

A word about the Sounder SIPS

- **The Sounder SIPS consists of two elements:**
  - Science Integration & Computing – JPL
    - Integration of code from Science Teams
    - Development of production-level PGEs and research products
    - Documentation
  - Data Production / OPS – GSFC GES DISC
    - Production of all official NASA sounder products from SNPP
    - Archive and distribution of all products, documentation and source code
- **Data Archive**
  - Located at the GES DISC DAAC
- **Points of Contact**
  - JPL – Ruth Monarrez and Vivian Tang
  - GES DISC – Bruce Vollmer and Mike Theobald

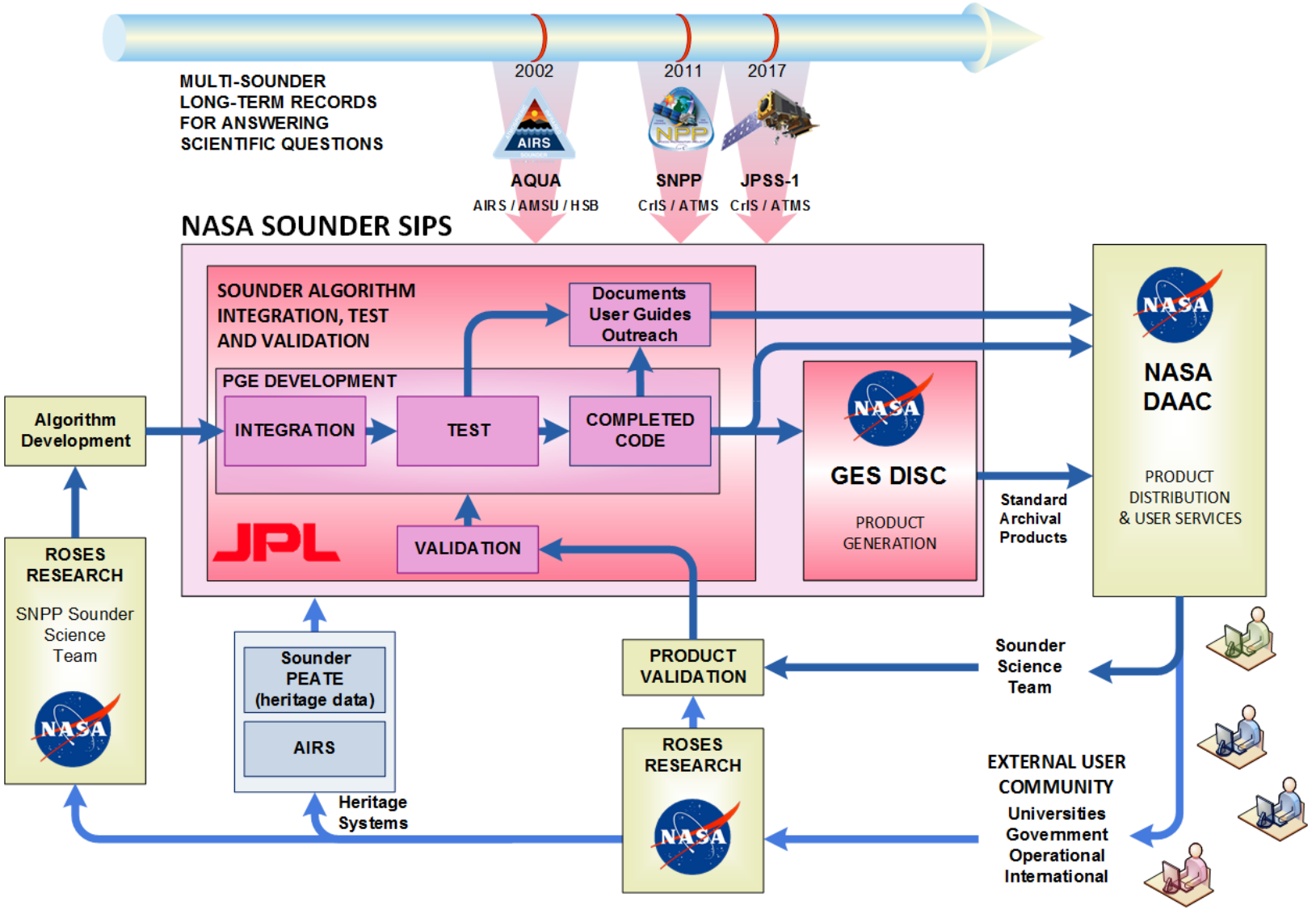
External Relationships

- **The Sounder SIPS works closely with:**
  - The SNPP Sounder Science Team
    - Overall direction coordinated through the Sounder Science Team lead, Chris Barnet
    - Coordination support through our Sounder Science Team liaison, Eric Fetzer
  - The AIRS Project
    - Algorithm and code sharing (where it makes sense)
    - Shared resources, including staff
  - The SNPP Level 1 Algorithm teams
    - CrIS: University of Wisconsin – Graeme Martin
    - ATMS: Jet Propulsion Laboratory – Bjorn Lambrigtsen
  - Guidance and ESDIS Liaison
    - Evelyn Ho and Jeanne Behnke – ESDIS Project

Requirements Summary

- **Production of Level 1, 2 and 3 data products from SNPP Sounder instruments: ATMS and CrIS (CrIMSS)**
  - Level 1 ATMS PGEs – developed at JPL
  - Level 1 CrIS PGEs – developed at University of Wisconsin
  - Integration of Level 2 PGEs from SNPP Sounder Science Team
    – Five unique product streams at JPL *(demonstration activity)*
    – One Level 2 product stream at GES DISC *(routine operations)*
  - Level 3 CrIMSS daily, multi-day, monthly – developed at JPL
  - CalSub, Simultaneous Nadir Observations and Match-up – developed at JPL
- **Develop and/or integrate PGEs listed above**
- **Support the Science Team in data validation activities**
- **Document and deliver source code, executables, user guide and ATBDs to the GES DISC for long-term storage and access**
- **Produce all standard products and archive at GDAAC**

Functional Interfaces



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Data Products Interfaces

GES DISC
- Level 0 ATMS & CrIS
- Level 1A & 1B ATMS
- Level 1A & L1B CrIS (NSR & FSR)

CLASS
- ATMS & CrIS SDRs (for comparison purposes)
- MetOpA: L1C IASI, L2 MHS & AMSU-A
- MetOpB: L1C IASI, L2 MHS & AMSU-A
- NOAA-N: L1 AMSU-A, MHS, MIRS_L2
- NOAA-P: L1 AMSU-A, MHS, MIRS_L2

AIRS Project at JPL
- AIRS L1B, L2, L3
- ECMWF
- GFS

NOAA NCEP
- RTG SST

NOAA Star
- CrIS SDRs
- NUCAPS L2

Sounder SIPS

GES DISC DAAC (Public Access)
- Level 1B ATMS & CrIS (NSR & FSR)
- Level 2 CrIMSS (CHART, CLIMCAPS*, AER*)
- Level 2 ATMS
- Level 3 (CHART, CLIMCAPS*, AER*) – Daily, Multi-day, Monthly
- CalSub (various instruments)
- SNO (several combinations)

Sounder SIPS Repository (Science Team)
- Level 1A ATMS & CrIS
- Level 1B ATMS & CrIS (NSR & FSR)
- Level 2 CrIMSS (CHART, CLIMCAPS*, AER*)
- Level 2 ATMS
- Level 3 (CHART, CLIMCAPS*, AER*) – Daily, Multi-day, Monthly
- CalSub (various instruments)
- SNO (several combinations)

Experimental Products
- Level 2 CrIMSS
- Level 3

* - limited production of 8 months

Sounder SIPS Product Specification

- **Generic Product Specifications**
  - All products will be netCDF-4 formatted to conform with ACDD, CF, and ISO metadata standards
  - Granule Sizes:
    - Level 1B ATMS and CrIS: 6-minute granules
    - Level 2: 6-minute granules, matching CrIS & ATMS granules
    - Level 3 Daily: Gridded global data
      - Two groups: ascending and descending
      - 1º x 1º gridded data.
    - Level 3 Multi-day and Monthly products follow same pattern as Daily
    - Daily SNO and CalSub
  - All Sounder SIPS products will be produced in accordance to the NASA data policy (https://science.nasa.gov/earth-science/earth-science-data/data-information-policy/)
    - Rapid release of all products
    - No sequestration of products for science team-only use

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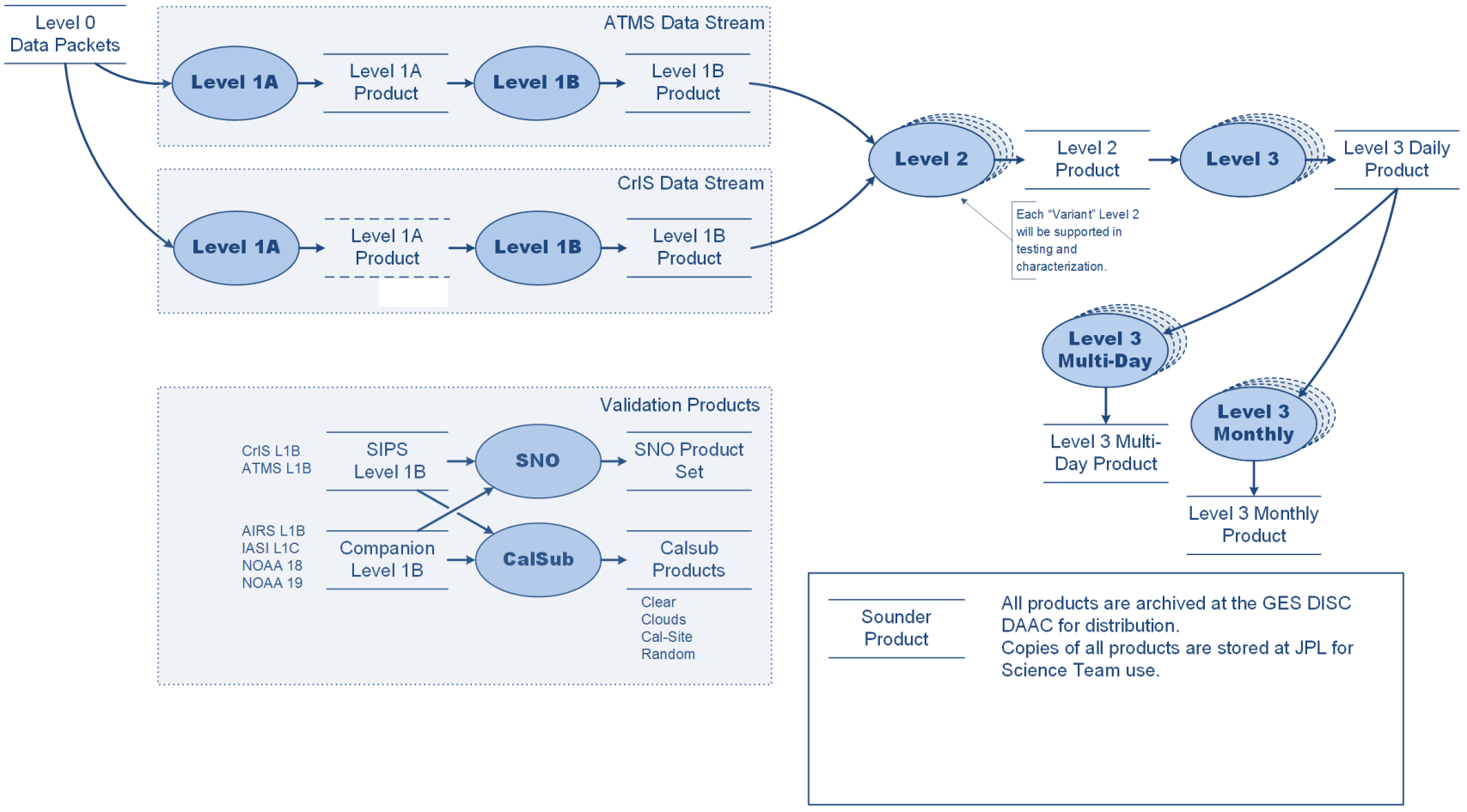
Sounder SIPS Data Flow



Sounder SIPS CrIS ATMS Milestones

- **Level 1 ATMS**
  - V1 Released – January 2017 (public release)
  - **V2 Release – January 2018** (public release)

- **Level 1 CrIS**
  - V1 Released – January 2017
    - public release: Normal Spectral Resolution (NSR)
    - Public release: Beta Full Spectral Resolution (FSR)
  - **V2 Release – January 2018**
    - public release: Improved Full Spectral Resolution

Sounder SIPS L2 Milestones

- **Baseline Level 2** *(using Joel Susskind's joint-AIRS/SNPP retrieval code)*
  - V1 release of CHART to GSFC GES DISC – Jan 2018
  - Public release V1 Level 2 products – Spring 2018

- **Internal production of other L2 retrievals TBD, pending schedule and plans by Science Team**
  - ATMS (microwave-only) Retrieval – Lambrigtsen
  - CrIMSS – Barnet (CLIMCAPS)
  - CrIMSS – Moncet
  - NH3 (post-processor) – Cady-Pereira and Worden
  - CO (post-processor) – Cady-Pereira and Worden

CHART: Climate Heritage AIRS Retrieval Technique

CLIMCAPS: Community Longterm Infrared Mircrowave Coupled Atmospheric Processing System

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SNPP Sounder Science Team Algorithm Summary

PI	Lambrigtsen	Susskind	Barnet	Moncet	Cady-Pereira	Irion
Affiliation	JPL	GSFC	STC	AER	AER	JPL
Funding	NPP	NPP	NPP	NPP	NPP	Terra-Aqua
ATMS	ATMS FOV	CrIS FOR	CrIS FOR	CrIS FOR	n/a	n/a
CrIS	n/a	CrIS FOR	CrIS FOR	CrIS FOR	CrIS FOV	CrIS FOV
Regularization	O-E	SVD	O-E	O-E	O-E	O-E
Alg. Type	Sequential	Sequential	Sequential	Simultaneous	Sequential	Simultaneous
Alg. Heritage	AIRS ST	AIRS ST	AIRS ST v5.9, NUCAPS-IASI, -CrIS	CrIMSS EDR	TES	TES
Cloud Clearing	n/a	Yes	Yes	Yes	No	No
T/q a-priori	NCEP Climatology	Neural Net	Climatology & Merra-2	Climatology	AER Product	ECMWF
Trace Gases	n/a	O3, CO, CH4	O_3, CO, CH_4, CO_2, HNO_3, N_2O, SO_2	O3	NH3, CO	O3
					(single FOV)	
Trace gas a-priori	n/a	Climatology	Climatology	Climatology	Climatology	Climatology
Error estimate	O-E	ECMWF regression	O-E	O-E	O-E	O-E
Averaging Kernels	No	No	Yes	No	Yes	Yes
Execution Time (per FOR)	?	~150 ms	~200 ms	?	?	~15 sec/FOV (will improve)

Abbreviations: SVD=Singular Value Decomposition, O-E=Optimal Estimation, FOV=field of view, FOR=field of regard

Near-Real-Time Processing

- **No near-real-time processing is planned.**
  - Community will rely on use of NOAA NRT products
    - Primary NRT customers were NOAA
    - NASA community expressed no interest in NRT sounder products
- **Sounder SIPS/Science Team will focus on development of "climate quality" products**
  - Sounder SIPS will respond to community needs for NRT products when and if they are requested.

Other PGEs: Plans and Status

- **Level 3 – gridded summaries of retrieval products, grouped into ascending and descending, 1x1-degree cells**
  - Daily
  - Multiday (8-day)
  - Monthly

- **Products upgraded from PEATE work:**
  - Simultaneous Nadir Observations (SNO)
  - Calibration Subsets (CalSub)

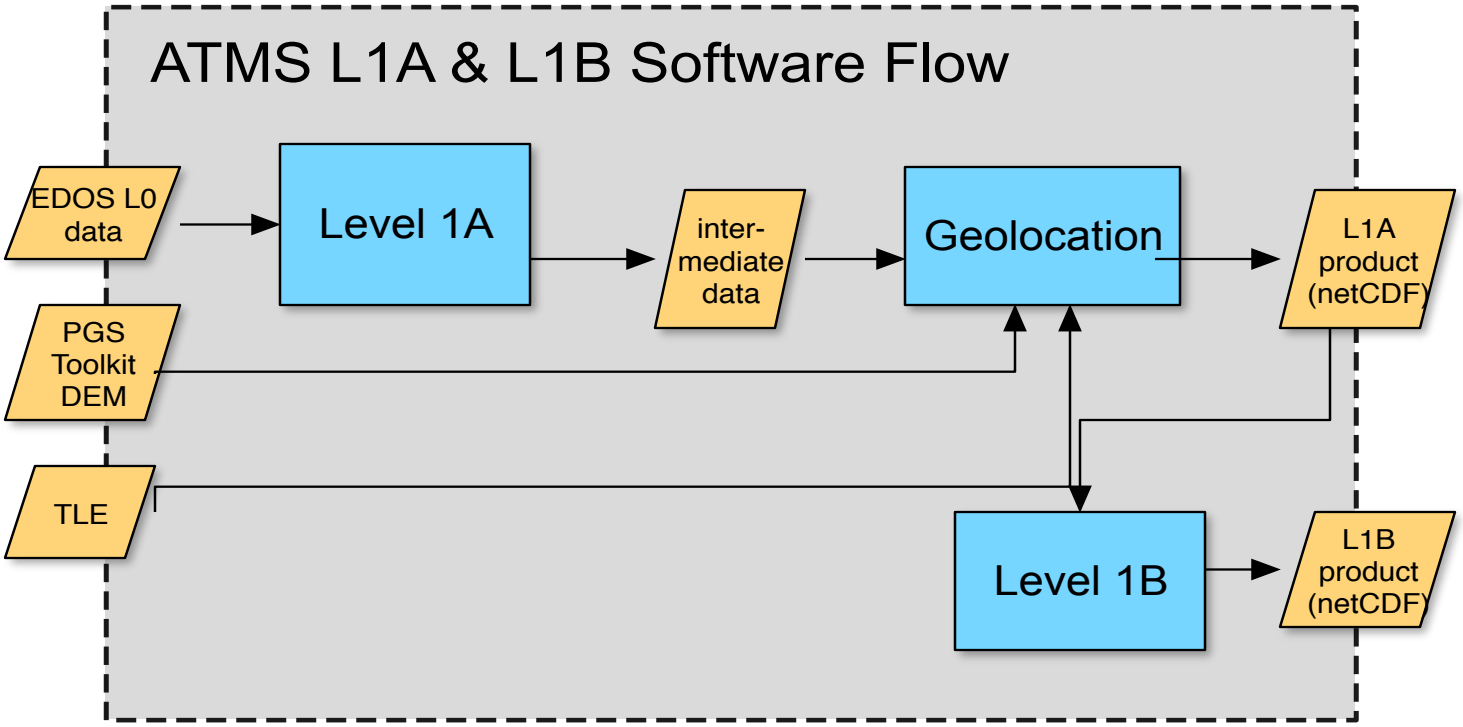
- **Overall PGE development strategy (for all PGEs)**
  - Sounder Science Team members own their own code
  - Sounder SIPS will use science code as delivered.
  - Sounder Science Team is responsible for validation activities.

Backup Slide

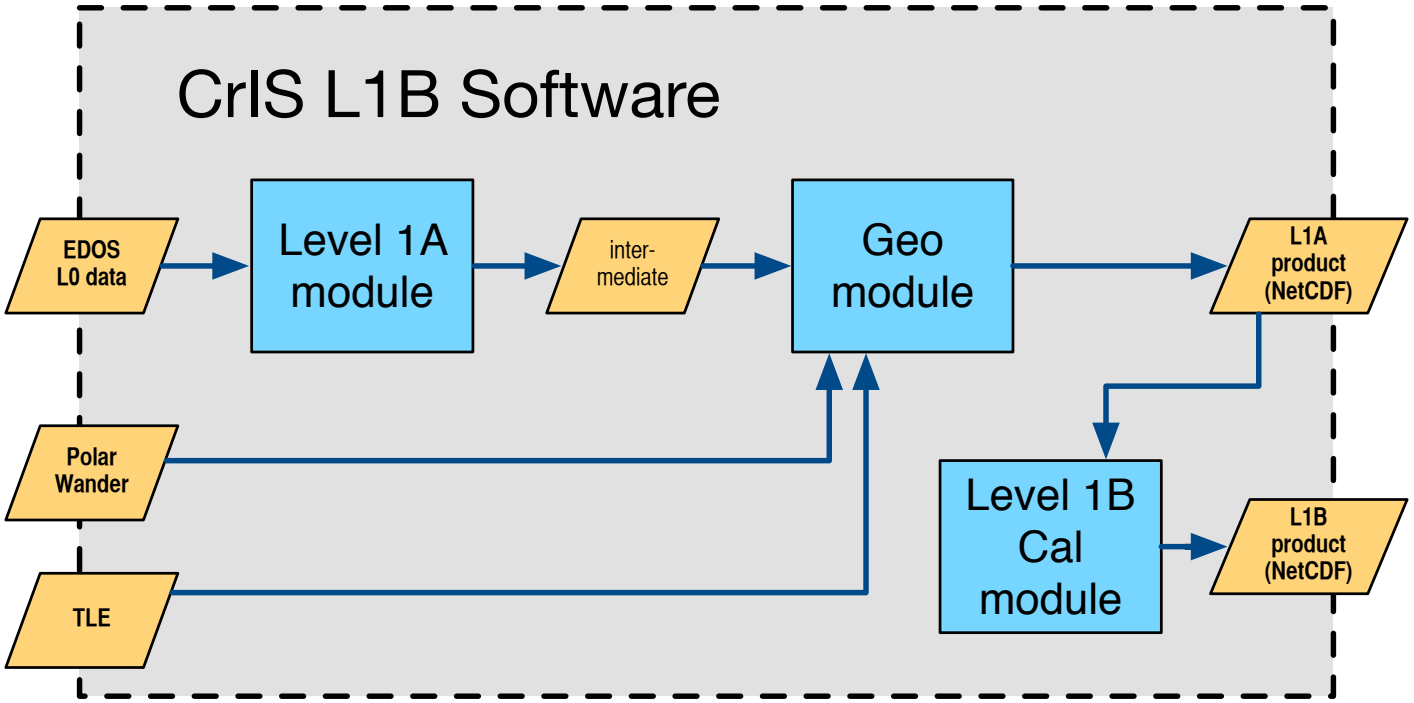
Sounder SIPS BACKUP SLIDES

- Level 1 Software Flow
- Organization Charts
- Sounder Science Team
- Hardware Configuration
- Data Product List
- Data Products Inputs

Sounder SIPS Software Flow – ATMS L1



Sounder SIPS Software Flow – CrIS L1



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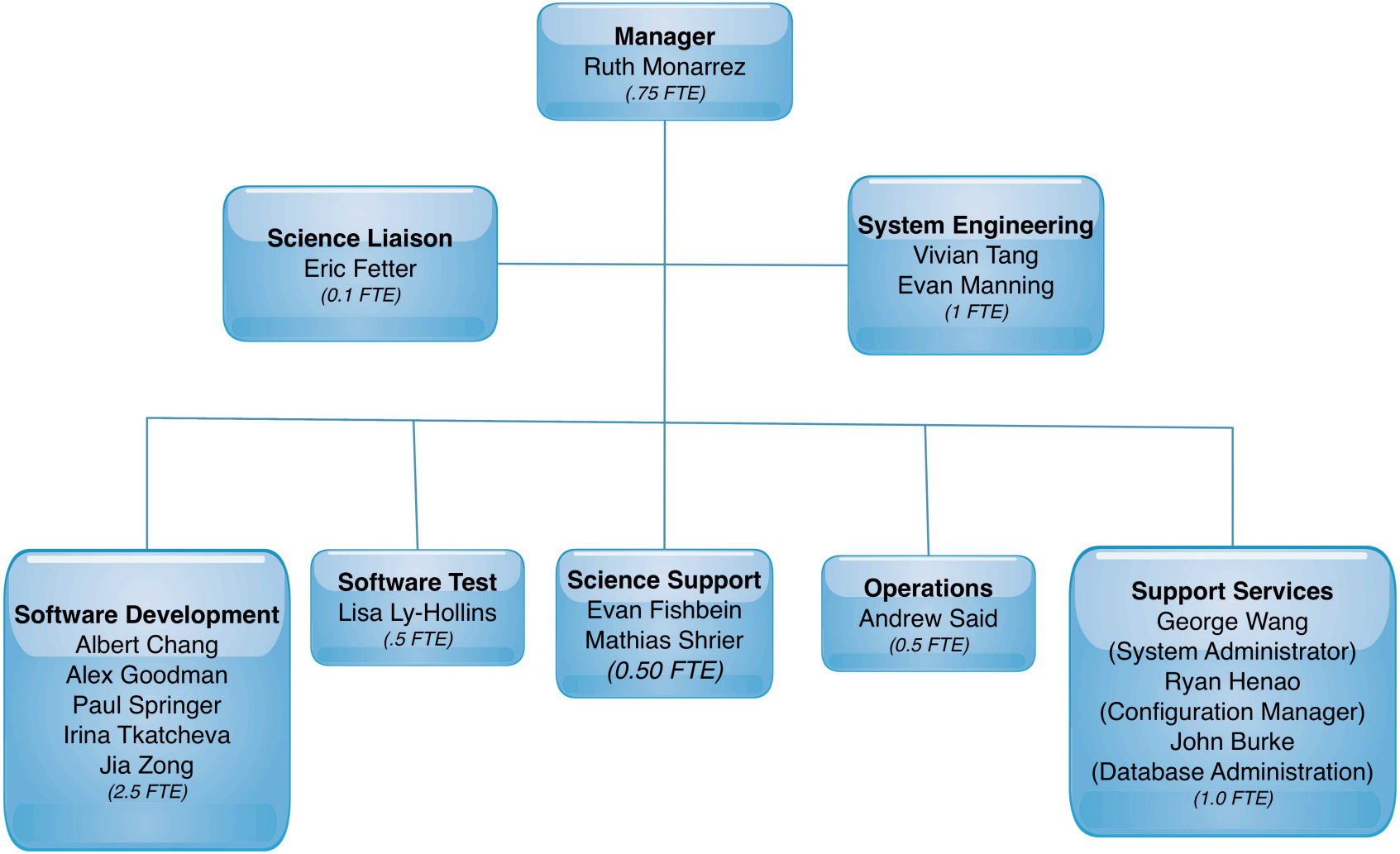
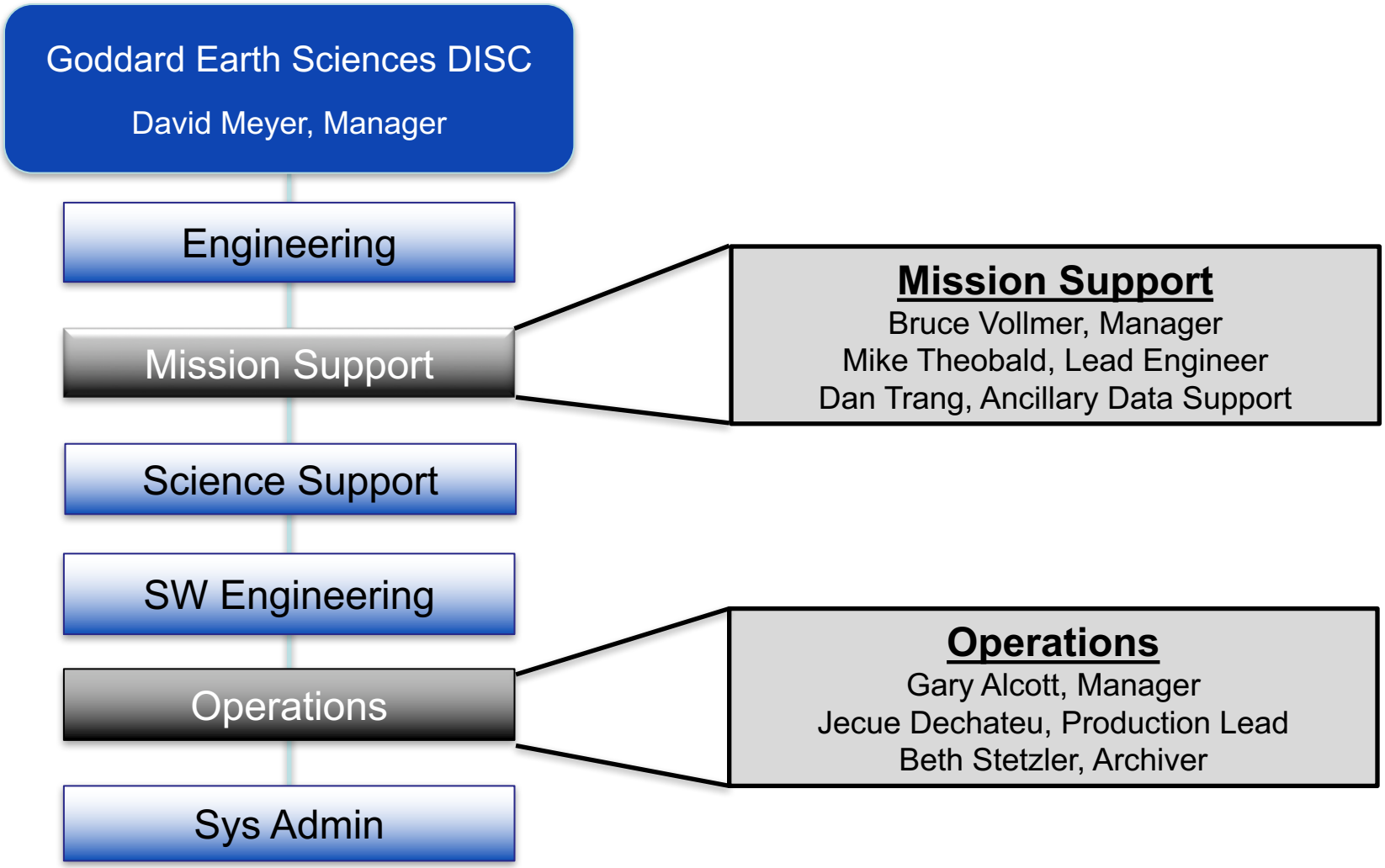
Sounder SIPS Organization (JPL)



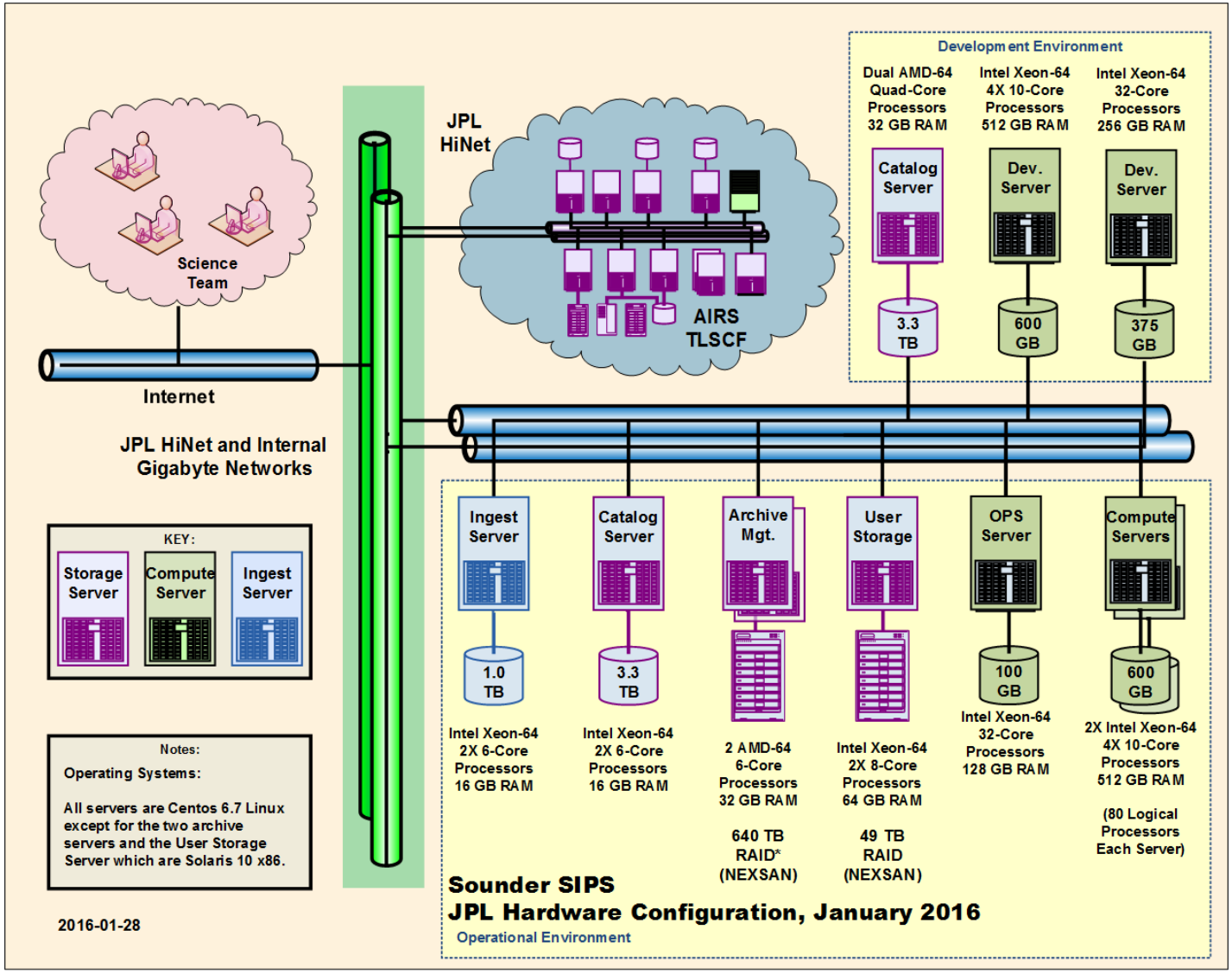
Sounder SIPS Points of Contact (GSFC)



New NASA Science Teams and SIPS for SNPP

- **The Sounder Science Team selected from ROSES A.29:**
  - **Chris Barnet** – Team Lead (Standard L2 Products – CrIMSS)
    Development and validation of a community hyper-spectral infrared microwave Earth retrieval algorithm: CHIMERA
  - **Hartmut Aumann** (L1 product analysis)
    Analysis of the AIRS and CrIS radiometric calibration under cloudy conditions and error propagation into environmental variables
  - **Jean-Luc Moncet** and **Vivienne Payne** (Standard L2 Products – CrIMSS)
    Refined Atmosphere Data Products from CrIS and ATMS
  - **Joel Susskind** (Standard L2 Products – CrIMSS)
    Analysis of CrIS/ATMS using an AIRS Version 6-like retrieval algorithm
  - **Karen Cady-Pereira** and **Helen Worden** (Specialized L2 Product)
    Developing retrieval algorithms for NH3 and CO from NPP CrIS measurements
  - **Bjorn Lambrigtsen** (Standard L2 Products – ATMS)
    Microwave sounder Earth System Data Records

Sounder SIPS Hardware (JPL)



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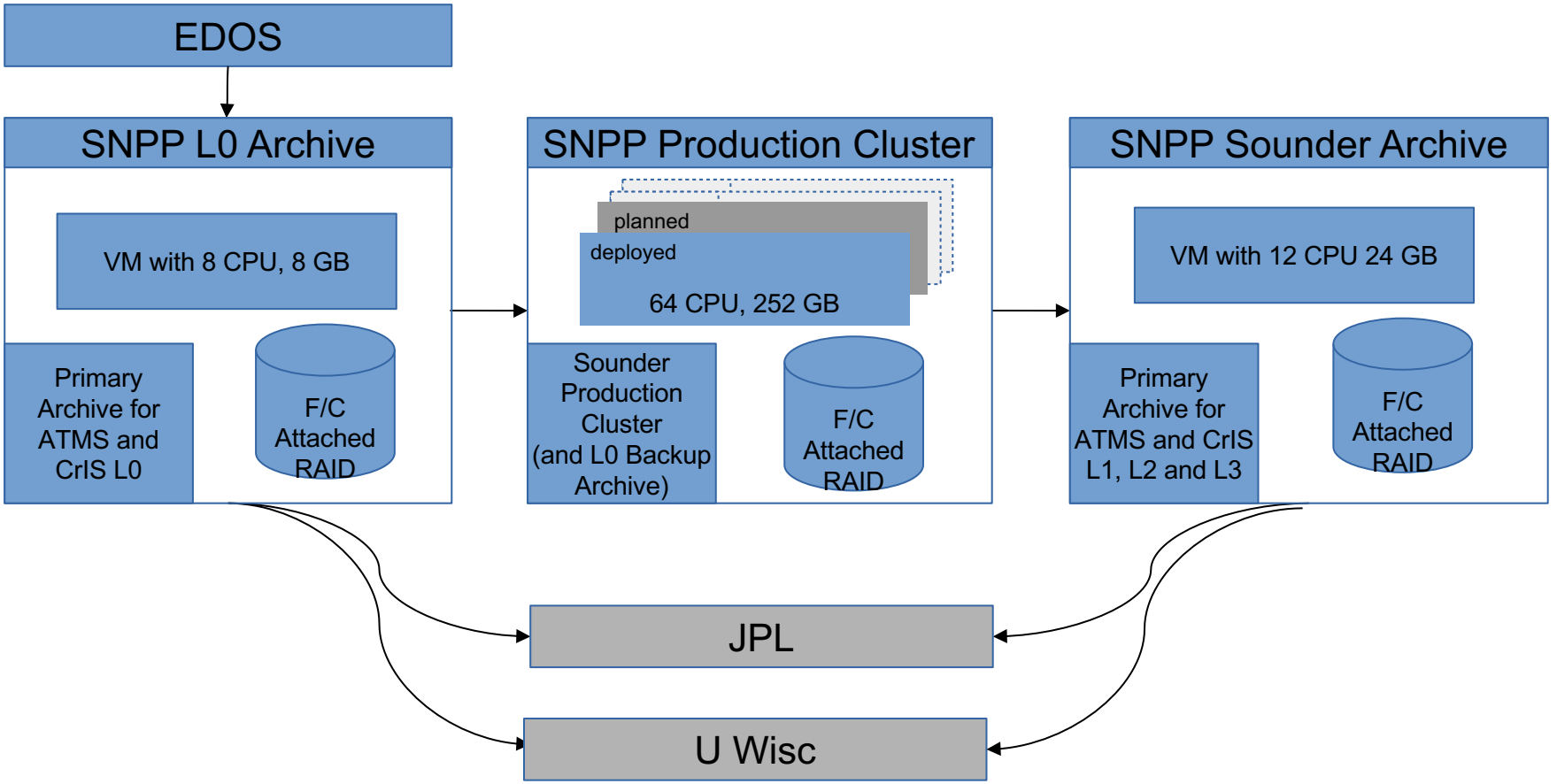
Sounder SIPS Hardware (GES DISC)



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Sounder SIPS Data Products

Granule Short Name	Data Type (Level)	Data Product Granule Description	Number of Granules/ Day	Granule Size (MB)	Temporal Granule Coverage
SNPPATMSL1A	L1A	Sounder SIPS: Suomi NPP ATMS Level 1A	240	8.4	6-min
SNPPATMSL1B	L1B	Sounder SIPS: Suomi NPP ATMS Level 1B	240	9.8	6-min
SNPPCrISL1A	L1A	Sounder SIPS: Suomi NPP CrIS Level 1A	240	90	6-min
SNPPCrISL1BNSR	L1B	Sounder SIPS: Suomi NPP CrIS Level 1B Normal Spectral Resolution	240	125	6-min
SNPPCrISL1B	L1B	Sounder SIPS: Suomi NPP CrIS Level 1B Full Spectral Resolution	240	167	6-min
ATMS L2					
SNDRSNML2JPL	L2	Sounder SIPS: Suomi NPP ATMS Level 2 JPL: Atmosphere, cloud and surface geophysical state	240	TBD	6-min

Sounder SIPS Data Products (con't)

L2 CrIMSS (Normal Spectral Resolution)					
SNDRSNIML2CHTRETN	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 CHART Normal Spectral Resolution: Atmosphere, cloud and surface geophysical state	240	13	6-min
SNDRSNIML2CHTCCRN	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 CHART Normal Spectral Resolution: Cloud Cleared Radiances	240	8.6	6-min
SNDRSNIML2CCPRETN	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 CLIMCAPS Normal Spectral Resolution: Atmosphere, cloud and surface geophysical state	240	TBD	6-min
SNDRSNIML2CCPCCRN	L2	Sounder SIPS: Sounder SIPS: Suomi NPP CrIMSS Level 2 CLIMCAPS Normal Spectral Resolution: Cloud Cleared Radiances	240	TBD	6-min
SNDRSNIML2AERRETN	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 AER Normal Spectral Resolution: Atmosphere, cloud and surface geophysical state	240	TBD	6-min
SNDRSNIML2AERCCRN	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 AER Normal Spectral Resolution: Cloud Cleared Radiances	240	TBD	6-min
L2 CrIMSS (Full Spectral Resolution)					
SNDRSNIML2CHTRET	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 CHART Full Spectral Resolution: Atmosphere, cloud and surface geophysical state	240	TBD	6-min
SNDRSNIML2CHTCCR	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 CHART Full Spectral Resolution: Cloud Cleared Radiances	240	TBD	6-min
SNDRSNIML2CCPRET	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 CLIMCAPS Full Spectral Resolution: Atmosphere, cloud and surface geophysical state	240	TBD	6-min
SNDRSNIML2CCPCCR	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 CLIMCAPS Full Spectral Resolution: Cloud Cleared Radiances	240	TBD	6-min
SNDRSNIML2AERRET	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 AER Full Spectral Resolution: Atmosphere, cloud and surface geophysical state	240	TBD	6-min
SNDRSNIML2AERCCR	L2	Sounder SIPS: Suomi NPP CrIMSS Level 2 AER Full Spectral Resolution: Cloud Cleared Radiances	240	TBD	6-min

Sounder SIPS Data Products (con't)

L3 using L2 with CrIS Full Spectral Resolution					
SNDRSNL3DCHT	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Daily CHART Full Spectral Resolution	240	TBD	Daily
SNDRSNL3D8CHT	L3	Sounder SIPS: Suomi NPP Level 3 Gridded 8Day CHART Full Spectral Resolution	1 every 8 days	TBD	8-day
SNDRSNL3MCHT	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Monthly CHART Full Spectral Resolution	1 per month	TBD	Monthly
SNDRSNL3DCCP	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Daily CLIMCAPS Full Spectral Resolution	240	TBD	Daily
SNDRSNL3D8CCP	L3	Sounder SIPS: Suomi NPP Level 3 Gridded 8Day CLIMCAPS Full Spectral Resolution	1 every 8 days	TBD	8-day
SNDRSNL3MCCP	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Monthly CLIMCAPS Full Spectral Resolution	1 per month	TBD	Monthly
SNDRSNL3D1AER	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Daily AER Full Spectral Resolution	240	TBD	Daily
SNDRSNL3D8AER	L3	Sounder SIPS: Suomi NPP Level 3 Gridded 8Day AER Full Spectral Resolution	1 every 8 days	TBD	8-day
SNDRSNL3M1AER	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Monthly AER Full Spectral Resolution	1 per month	TBD	Monthly

Sounder SIPS Data Products (con't)

ATMS L3					
SNDRSNL3DATMS	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Daily ATMS	1	TBD	Daily
SNDRSNL3D8ATMS	L3	Sounder SIPS: Suomi NPP Level 3 Gridded 8Day ATMS	1 every 8 days	TBD	8-day
SNDRSNL3MATMS	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Monthly ATMS	1 per month	TBD	Monthly
L3 using L2 with CrIS Normal Spectral Resolution					
SNDRSNL3DCHTN	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Daily CHART Normal Spectral Resolution	1	TBD	Daily
SNDRSNL3D8CHTN	L3	Sounder SIPS: Suomi NPP Level 3 Gridded 8Day CHART Normal Spectral Resolution	1 every 8 days	TBD	8-day
SNDRSNL3MCHTN	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Monthly CHART Normal Spectral Resolution	1 per month	TBD	Monthly
SNDRSNL3DCCPN	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Daily CLIMCAPS Normal Spectral Resolution	240	TBD	Daily
SNDRSNL3D8CCPN	L3	Sounder SIPS: Suomi NPP Level 3 Gridded 8Day CLIMCAPS Normal Spectral Resolution	1 every 8 days	TBD	8-day
SNDRSNL3MCCPN	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Monthly CLIMCAPS Normal Spectral Resolution	1 per month	TBD	Monthly
SNDRSNL3DAERN	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Daily AER Normal Spectral Resolution	240	TBD	Daily
SNDRSNL3D8AERN	L3	Sounder SIPS: Suomi NPP Level 3 Gridded 8Day AER Normal Spectral Resolution	1 every 8 days	TBD	8-day
SNDRSNL3M1AERN	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Monthly AER Normal Spectral Resolution	1 per month	TBD	Monthly
SNDRSNL3DATMS	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Daily ATMS	1	TBD	Daily
SNDRSNL3D8ATMS	L3	Sounder SIPS: Suomi NPP Level 3 Gridded 8Day ATMS	1 every 8 days	TBD	8-day
SNDRSNL3MATMS	L3	Sounder SIPS: Suomi NPP Level 3 Gridded Monthly ATMS	1 per month	TBD	Monthly

Sounder Input Data Stream – Product Production Pipeline

PRIMARY PIPELINE (receive data from GDAAC)

GES DISC

- EDOS Level 0* ATMS and CrIS
- EDOS Level 1A & 1B ATMS
- EDOS Level 1B CrIS (NSR)
- EDOS Level 1B CrIS (FSR)

**beginning of mission: Reconstructed ATMS and CrIS Level 0 from IDPS RDRs from University of Wisconsin.*

Sounder Input Data Stream – Correlative Products

Class FTP

- Mission_Notices
- Mission_Schedules
- MetOp-A – (IASI_L1C, AMSUA_L1B, MHS_L1B, MIRS_L2_SND, MIRS_L2_IMG)
- MetOp-B – (IASI_L1C, AMSUA_L1B, MHS_L1B, MIRS_L2_SND, MIRS_L2_IMG)
- NOAA-N (AMSUA_L1B, MHS_L1B, MIRS_L2_SND, MIRS_L2_IMG)
- NOAA-P (AMSUA_L1B, MHS_L1B, MIRS_L2_SND, MIRS_L2_IMG)

NOAA Star

- NUCAPS Level 2

From AIRS Project at JPL

- AIRS L1B, L2 & L3

Sounder SIPS Auxiliary and Ancillary Data

NOAA NCEP

- rtg_sst_g1
- GFS

CLASS

- fnmoc: nogaps (became NAVGEM on Aug 21, 2013)
  (3hr, 6hr 9hr, 12hr, 15hr, 18hr, 21hr 24hr data)

From AIRS archive at JPL

- ECMWF
- GFS