TES Ground Data System

Instrument Team Ground Data System Reports

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Aura DSWG
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Overview

- Current State of SIPS Data Production
- Current Data Product Version
- Current and Upcoming Releases
- Issues and Other Items

Current State of SIPS Data Production

- TES GDS software Release 14.0 (L2 ESDT Version 7) started reprocessing in August 2016
  - Estimated completion time for completion is March 2018

- TES GDS software version: 'R14.0', active at SIPS and delivering standard and combined products to the Langley DAAC
  - L1B ESDTs
    - Version 006, File version F04_07
  - L2 ESDTs
    - Standard/Ancillary products: Version 007, File Version F08_11
    - Supplemental products: Version 007, File Version F02_11
    - Summary products: Version 007, File Version F03_11
  - L2 Lite Products
    - Reduced resolution L2 output: Version 007, File Version F08_11
  - L3 ESDTs
    - L3 products (daily, monthly grid and browse): Version 005, File Version F01_11
  - TES-MLS ESDTs
    - Combined products: Version 002, File Version F01_02
  - TES-OMI ESDTs
    - Combined products: Version 002, File Version F01_01

SIPS Data Throughput, Release 14

- The TES instrument is currently in Mission sub-mode and collecting Special observations (SO) science data.
- SIPS continues the Release 14.0 reprocessing campaign; it has completed approximately 25 Global Survey and 250 Special Observation runs and delivered them to ASDC DAAC. Completion of all data through R14 is expected by March 2018.
- In the Release 14 reprocessing timeframe, SIPS will be supporting three additional data processing streams: TES-MLS Carbon Monoxide (CO) and O3 combined L2 products, TES-OMI O3 combined L2 products and AIRS-OMI O3 combined products.
- The total throughput for Release 14 has been calculated to be 15%-18% higher due better L1B QA implementation, additional L2 & L3 standard products, TES-MLS Ozone (O3) data generation and the TES-OMI O3 combined products.
- SIPS has dedicated processing environments set up to support both the TES-MLS, Asynchronous Science Information Processing system (ASIPS), and AIRS-OMI processing (TESROCKS). The TES-OMI processing has been incorporated into the clusters dedicated to the standard TES data stream.
- TES pump laser diode and safe-mode events have necessitated modifications to the flight software and instrument operations which reduced data volume by ~20% for 2016.
  - These events have caused the TES Flight Operations team to implement a number of macro modifications to accommodate the TES instruments current state.
  - These events also prompted the switch to a new data collection protocol, SimCLK, to account for the eventual loss of laser fringes from the TES Laser B subsystem. There will new data processing software deliveries to adapt to the new SImCLK timed data collections in the next few months.

Final R13.1 SIPS Data Production State

- TES GDS software Release 13.1 (L2 ESDT Version 6) completed processing in August 2016.
  - Release 13 started processing in July 2013. A supplemental point release, R13.1 was delivered and began updates in June 2014. The reprocessing completed in March 2015

- The completed TES GDS software version: 'R13.1' delivered the following standard and combined products to the Langley DAAC
  - L1B ESDTs
    - Version 005, File version F04_06
  - L2 ESDTs
    - Standard/Ancillary products: Version 006, File Version F07_10
    - Supplemental products: Version 006, File Version F02_10
    - Summary products: Version 006, File Version F03_10
  - L2 Lite Products
    - Reduced resolution L2 output: Version 007, File Version F08_11
  - L3 ESDTs
    - L3 products (daily, monthly grid and browse): Version 004, File Version F01_10
  - TES-MLS ESDTs
    - Combined products: Version 001, File Version F01_01

SIPS R13 & R13.1 Data Throughput

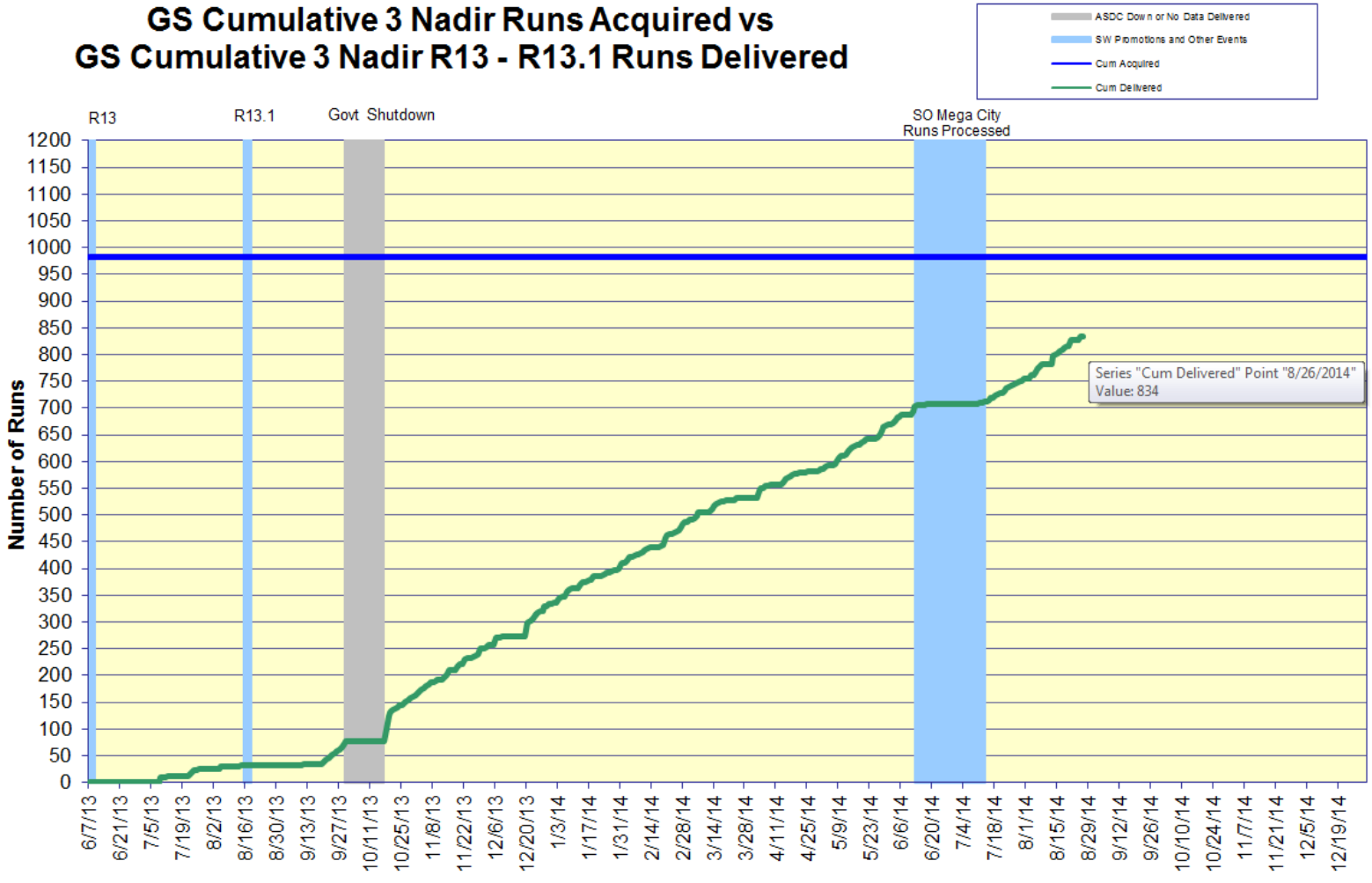
Global Surveys	Total Run with Delivered Products	Total Product Volume
L1B Products	1057	7.6 TB
L2 Products	920	3.1 TB
L2 Lite Products	400	100 GB
TES-MLS Products	2721	91 GB

Special Observations	Total Run with Delivered Products	Total Product Volume
L1B Products	6883	695 GB
L2 Products	6362	929 GB
L2 Lite Products	2825	30 GB
TES-MLS Products	2721	11 GB

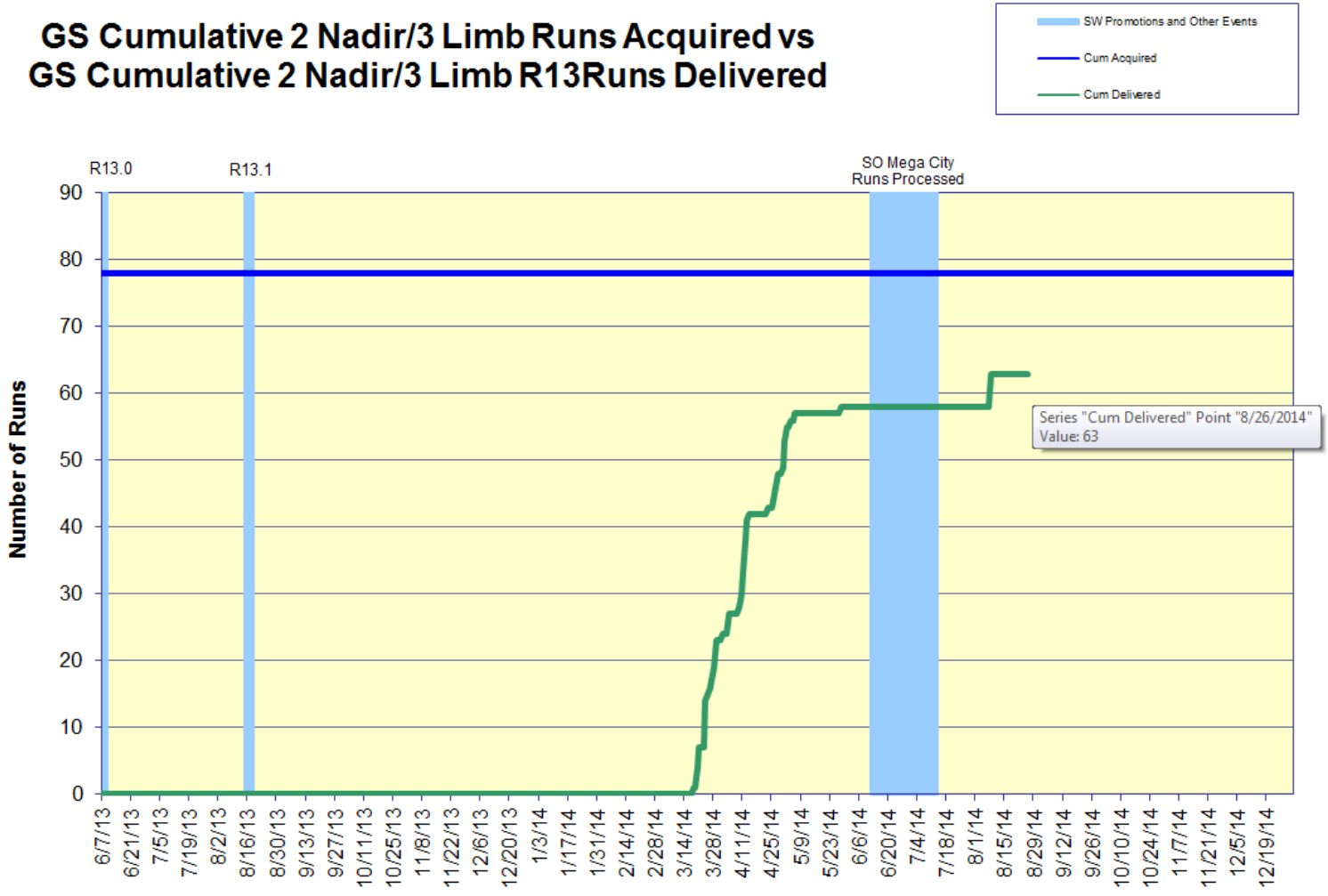
– L3 Products (Monthly) 521 475 GB

– For 2016, SIPS has received and delivered the following volume to ASDC:
  - L1B: (565 SOs) 57 GB L2: (505 SOs) 37 GB L3: 6 GB

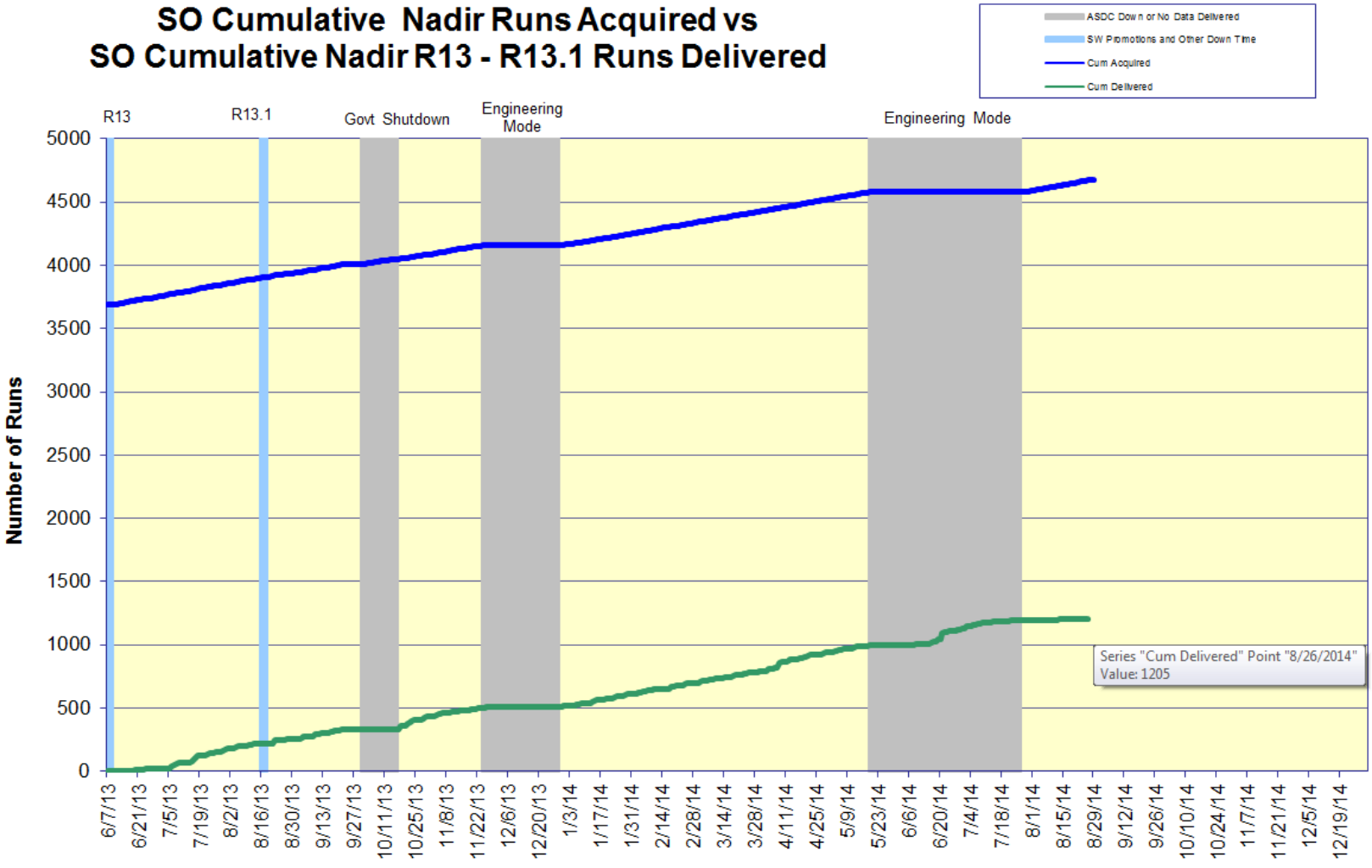
SIPS R13 & R13.1 Reprocessing



SIPS R13 & R13.1 Reprocessing (cont.)



SIPS R13 & R13.1 Reprocessing (cont.)



Data Processing Configuration

- Three processing configurations:
  - SIPS: processes nominal Global Survey and Special Observations and TES-OMI O3 combined products
  - ASIPS: processes TES-MLS combined CO and O3 products for all Global Survey and Special Observations that were processing under Release 14 (R14) science algorithm
  - TESROCKS: supports Multi-Satellite Retrieval processing, AIRS-OMI O3, in proof of concept and medium scale investigations
  - SCF: supports development and small scale investigations

- SIPS
  - 124 nodes with dual Intel Xeon quad-core CPUs with 24GB RAM and 2TB storage
  - 80 nodes with dual Intel Xeon quad-core CPUs with 32GB RAM and 1TB storage with 160GB SSD drive (ASIPS)
  - Total of 204 nodes with 328TB data storage
  - 15TB Network Attached Storage
- SCF:
  - 6 Intel Xeon File Servers with 400 TB storage supporting:
  - 50 compute nodes with dual Intel Xeon quad-core CPUs with 128 GB RAM and 1 TB HDD + 120GB SSD
- TESROCKS:
  - 2 Intel Xeon File Servers with 200 TB storage supporting:
  - 60 compute nodes with dual Intel Xeon quad-core CPUs with 16 GB RAM and 2 TB storage
  - 64 compute nodes with dual Intel Xeon quad-core CPUs with 64 GB RAM and 1 TB + 160GB SSD storage

Hardware/Processing upgrades

– Received the following high priority hardware which have been added to the SIPS science cluster (TESROCKS)

- 64-Node Cluster: Dell Poweredge M630 (2*Xeon E5-2637V4, 64GB RAM, 1TB HDD, 160GB SSD)
- 150TB file server

TES Instrument status

- **TES Instrument performance timeline (recent history)**
  - ICS Events:
    - ICS Stalls (8/16/15, 11/9/15, 1/13/16, 7/20/16, 8/1/16, 8/6/16)
  - Pump Diode Laser management strategy
    - Laser A failure (7/10/2014)
    - Laser B initialization (7/23/2014)
    - Laser B output power degradation (8/20/2015)
    - Laser B management strategy (9/2015)
      - Has extended laser life expectancy from predicted December 2015 to August 2016
  - Power On Reset (3/27/2016)
    - Returned to science data collection (4/14/2016)
    - Optical bench was slightly (0.9) warmer than before POR,
- SIMCLK data gathering technique has been implemented and put in as the regular data collection method on August 8, 2016
- KORUS-AQ campaign (April – June 2016)
  - Were able to collect observations on all Seoul Korea opportunities

TES Level 2, Data Version 7

- TES Ground Data System Software Release 14
  - Implementation of new atmospheric species retrievals of Peroxyacetyl Nitrate (PAN)
  - Implementation of new atmospheric species retrievals of Carbonyl Sulfide (OCS)
  - Generation of new Instantaneous Radiative Kernel (IRK) standard product
  - Enhance L1B spike removal and interferogram quality assessment
  - Pixel dependent L1A quality flags implemented
  - Updated L2 Laser Frequency PGE
    - To account for frequency shifts caused by laser power and temperature dependencies the PGE has been updated for monitoring and analysis of the laser performance to account for controlling laser drift
  - Adaptations to operational software to use GEOS-5.12.4 GMAO RP-IT and FP-IT dataset
    - Official data delivery began in February 2016

- TES GDS Release 14 Beta output generation in progress
  - To support R14 validation, multiple scientific papers and the Aura Science Team meeting generation of R14 products has begun to fill out the archived data stream.
  - Data collected during 2015 & 2016 has been prioritized and is being processed for science team needs and will be archived at the Aura Validation Data Center (AVDC) during validation.

TES Level 2, Data Version 7 (cont.)

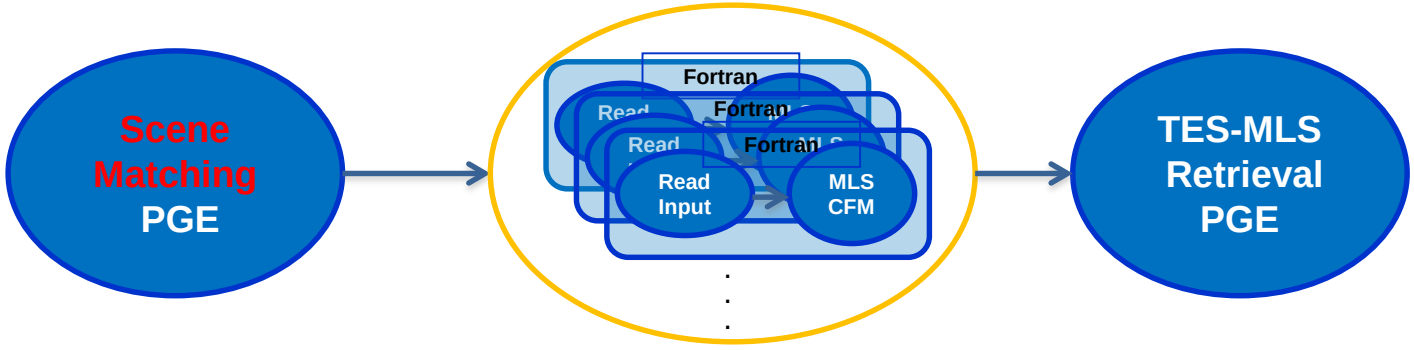
- Adaptation to TES GDS ingest/processing of TES SimCLK data
  - Prototyping of spectra reconstruction presented to NASA HQ and JPL Section staff personnel
  - Design effort for L1B and L2 software updates has begun

- Multi-Satellite Retrieval processing, (AIRS & OMI data) in support of the KORUS-AQ campaign
  - Automated processing on a dedicated TES SCF processing cluster has begun
  - Data subscriptions to AIRS & OMI data established and will allow for future production
  - Product generation (HDF & netCDF) and delivery to AVDC being developed

- TES-OMI Ozone Retrieval, Release 1 subsystem validation in progress

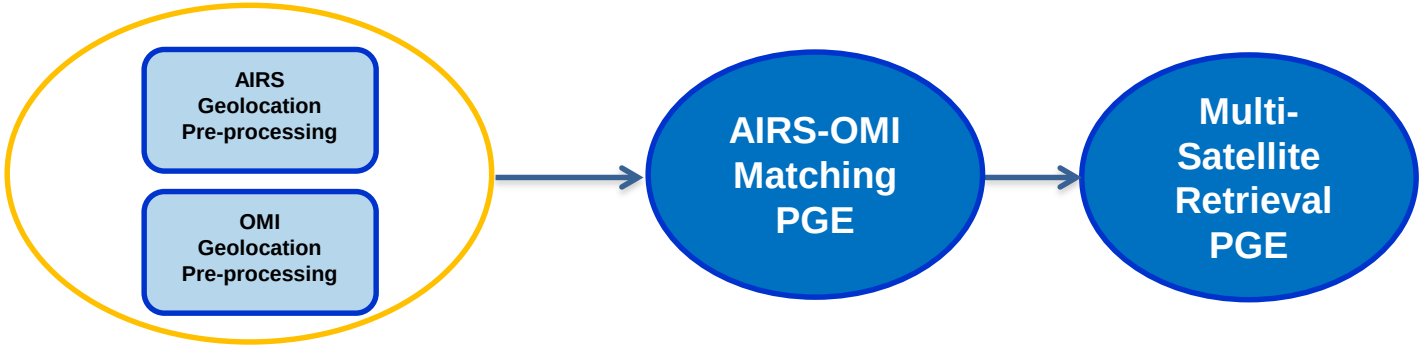
- Introduction of Ozone retrieval into the TES-MLS joint processing software
  - New MLS CFM integration completed
  - Prototyping of new TES-MLS O3 retrieval algorithm complete
  - Algorithm software design updates for Ozone retrieval started

TES-MLS Joint CO/O3 Product Generation



- **Completion and delivery of the TES-MLS Joint CO & O3 PGE**
  - **Significant milestones reached:**
    - **Incorporated MLS callable forward model (CFM)**
    - **Utilization of MLS V4.22 and TES R14 input datasets**
    - **Prototyped TES retrieval code to utilize TES and MLS O3 profiles**
    - **Upgrade to TES ASIPS processing environment to optimize processing of the TES-MLS PGE**
    - **Delivery of TES-MLS CO standard products to DAAC began in mid-April 2015**

Multi-Satellite Product Generation



- **AIRS-OMI Combined O3 product generation**
  - **Significant milestones reached:**
    - **Completed algorithms which perform geolocation and pairing algorithms for AIRS and OMI datasets**
    - **Successfully processed time-coincident data with the KORUS-AQ campaign**
    - **Established dedicated processing cluster (TESROCKS)**
    - **Established automated subscription process for both AIRS and OMI L1B products**

Release 15 and Upcoming Releases

- Automated SIMCLK data processing at TES SIPS
  - Algorithm has been identified and demonstrated manually. Software engineering and development will allow TES to continue the continuous dataset since the AURA launch in July 2004

- Future updates to Multi-Satellite processing
  - Automated production of AIRS-OMI processing to backfill TES data collection for entire EOS Aura timeline (August 2004 – Current)
  - Adaptation and updated algorithms to ingest additional instruments' datasets

- Future Product enhancements
  - New TES standard product for Ethylene (C_2H_4)
  - New TES standard product for Isoprene (C_5H_8)

Accessing TES data

- TES Data Products, Documentation & IDL data readers available from
  - https://eosweb.larc.nasa.gov/project/tes/tes_table
- ASDC Data Pool & WIST Data access; all V4, V5 and V6 data available (including access to documentation: DPS, ATBDs, L2/L3 User's guides, Data Quality statements, validation reports,…)
  - 100% of the ESDT Version 006 Release 13 Level 2 standard products have been successfully ingested at ASDC
  - 100% of the ESDT Version 001 of the TES-MLS CO Level 2 standard products have been successfully ingested at ASDC
- Aura Validation Data Center (AVDC)
  - Lite products (TES Release 13 baseline inputs)
    - http://avdc.gsfc.nasa.gov/index.php?site=635564035&id=10
  - TES Megacity Lite products
    - http://avdc.gsfc.nasa.gov/index.php?site=635564035&id=10&go=list&path=/Megacity
- TES subsetter tool (ASDC)
  - http://asdc.larc.nasa.gov/search/tes/login.php

Issues & Other Items

- Two significant TES instrument hardware issues affected data collection in 2016
  - ICS Power On Reset stall halted standard TES data operations from March 27, 2016 – April 14, 2016
    - The TES Optical Bench temperature was warmer and necessitated an optical bench (OB) set point adaption.
    - The TES laser frequency was affected by the warmer OB, a new range of base laser frequency values were computed and incorporated into the TES processing stream.
  - The loss of laser fringe detection on August 4, 2016 necessitated a permanent move to SimCLK data timing collection paradigm.
    - Software engineering will be focused on adapting and processing this data set

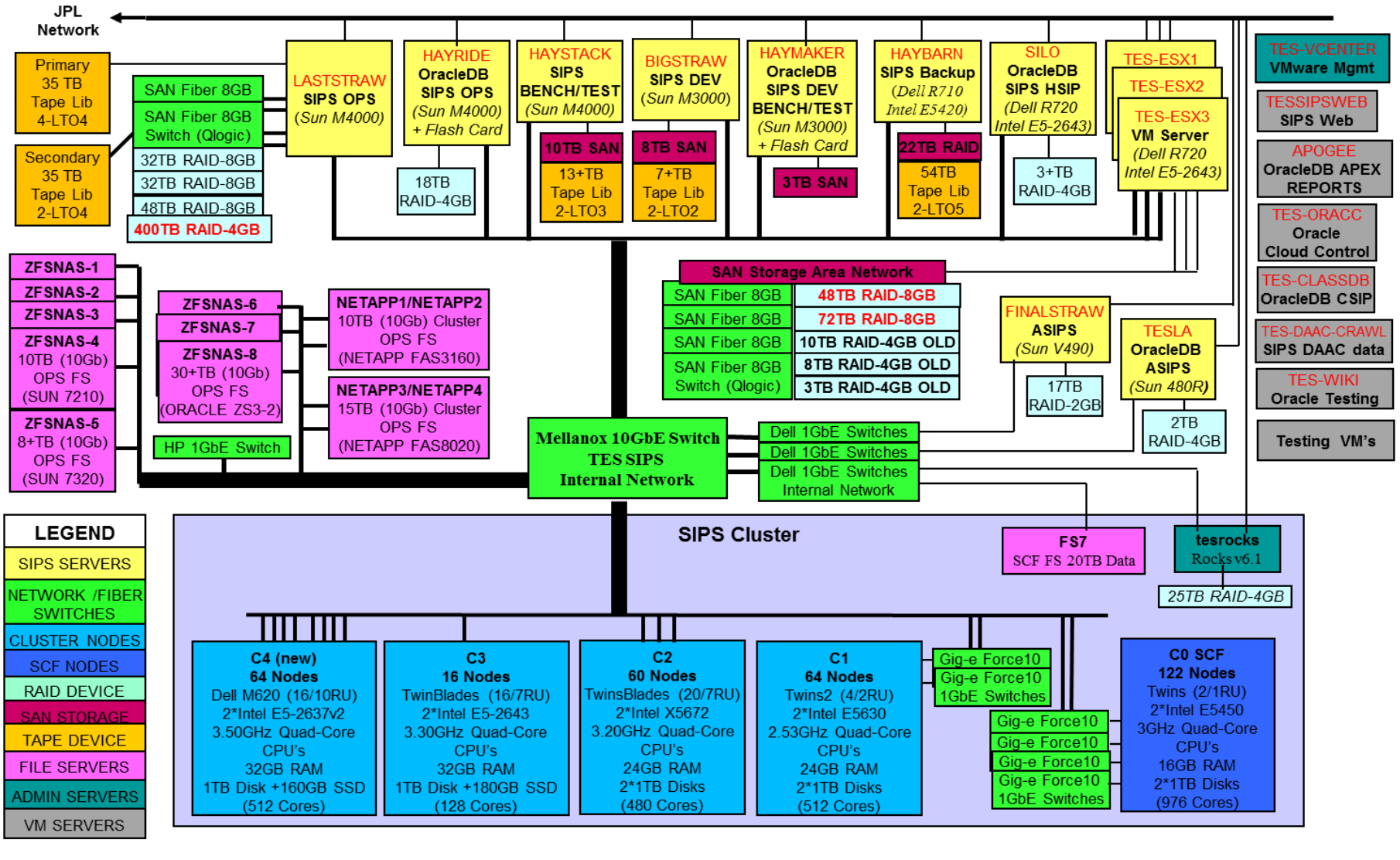
- All versions of TES output products from R13.2 forward will contain Digital Object Identifiers (DOIs) and will have corresponding data Landing Pages at the ASDC website

BACKUP SLIDES

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

Tropospheric Emission Spectrometer

TES SIPS Hardware Diagram



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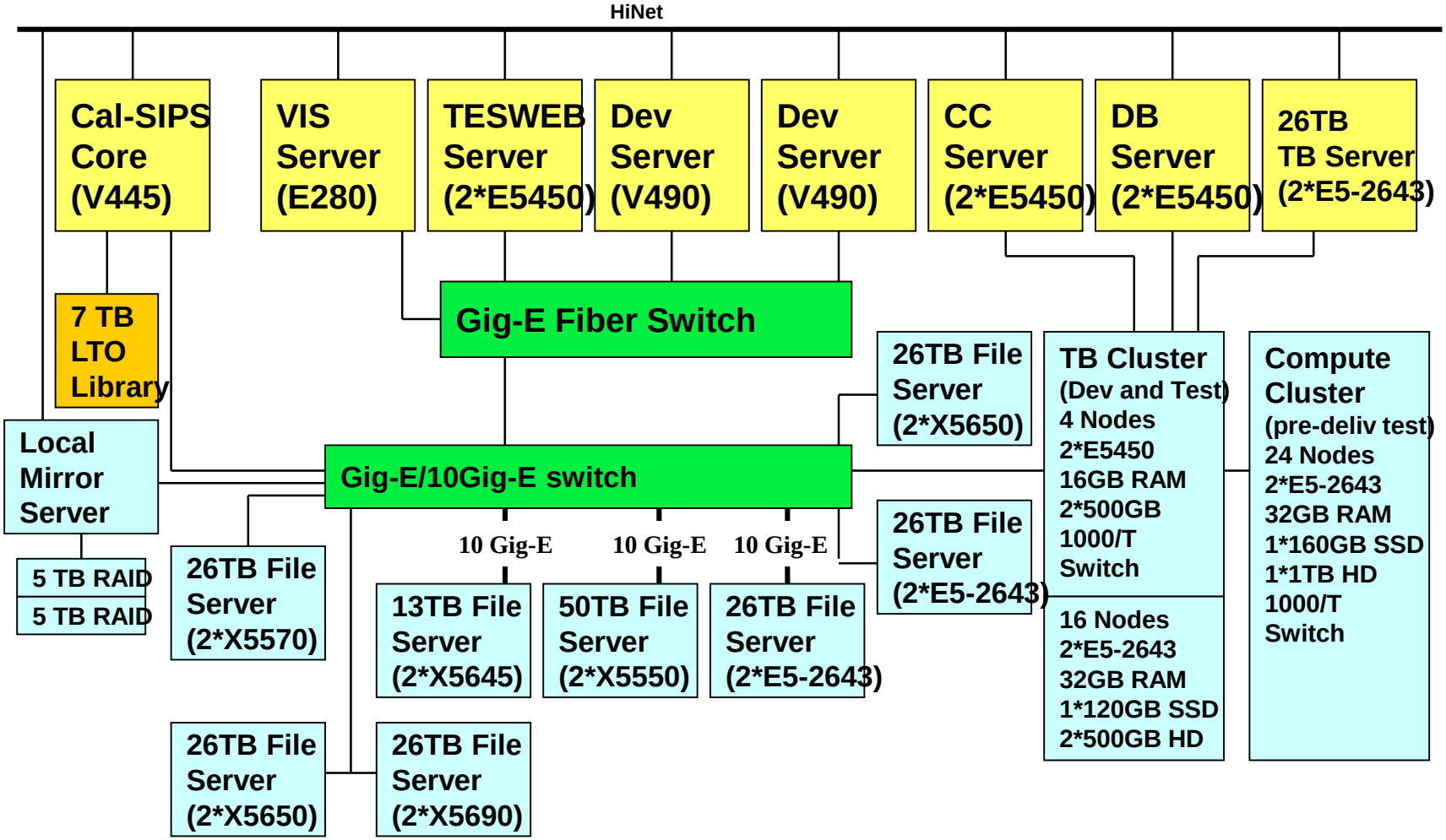
Tropospheric Emission Spectrometer

TES SCF Hardware Diagram