NPP/NPOESS Update

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NASA GSFC, Code 614.4

March 24, 2005

Schedule: Launch Delay Forthcoming

- NPP Schedule Replan Revision underway
  - Previous Replan drafted in August 2004
  - Continues early integration of EDUs on s/c for electronics (1394) and communications testing
    - > Following tests, EDUs are uninstalled and returned to vendors
    - > Reduces risk before FU availability
  - Likely launch slip: > 1 year, from Oct. ’06 baseline
  - Official launch date will be determined in final Replan

Sensors: VIIRS is Critical Path

- VIIRS (IPO procurement)
  - Critical Path sensor
    - > Cryoradiator: launch locks contributed to thermal short and were single point failure risks
    - > Earth-Shine: “pure” solar irradiance onto onboard solar diffuser likely contaminated by radiance reflected off earth
      - NASA estimates contamination component is double that for MODIS (~2-4%)
        - Would cause out-of-spec calibration performance
    - > LW Focal Plane cross-talk concern
      - Component-level testing could not confirm compliance with required performance
      - Awaiting system integration for conclusive testing
- OMPS (IPO procurement)
  - Main mirror on nadir profiler sensor sent back for regrind
- CrIS (IPO procurement)
  - EDU 3 recently completed thermo-vac testing, great comeback
- ATMS (NASA procurement)
  - Essentially ready to go

Cal/Val: New Approach

- IPO named Dr. Karen St. Germain to take leadership
  - Testing and validation requirements and plans will be tracked through online task matrix software (CasaNOSA)
    - > comments/concerns/responses to be formally tracked
    - > IPO requesting population of this matrix by internal/external scientists and engineers
  - Priorities: 1) prelaunch testing, 2) on-orbit checkout, 3) SDR/EDR validation plans

Intermediate Products, QA Flags: Movement, But More Work Needed

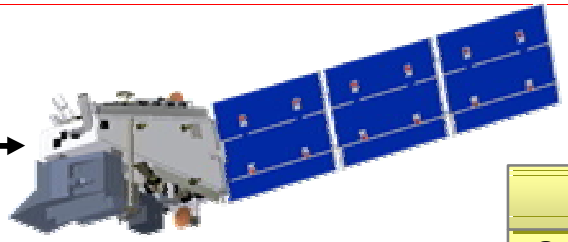
- Intermediate Products
  - Parameters not identified in IORDII, System specification, etc.
    - > Not subject to performance requirements
    - > SSPR not obligated to send to CLASS
  - Original SSPR baseline: 2 IPs will be archived in CLASS
    - > Cloud Mask
    - > VIIRS Quarterly Gridded Surface Type
  - NASA and OATs requested additional IPs
    - > NGST appears willing to compromise if resources allow
- Quality Assurance Flags
  - NASA recently reviewed plan and provided feedback to NGST
    - > Consensus opinion: too many flags, more thought needed

Data Processing: IDPS Build 1.3 Progressing

- IDPS Build 1.3 currently underway
  - Algorithm sci-to-ops code conversions are small part of system
  - Dropped algorithms intended to be “form stable” (i.e., at-launch algorithmic theoretical approach)
    - > Build 1.4 in 2005 intended to be incremental
      - primarily LUT updates
  - Some algorithm work moved from 1.3 to 1.4
    - > Aggressive drop schedule led to some incomplete algorithm deliveries
    - > Build 1.4 must now include more substantial algorithm work than planned
  - Major NPP proxy data set will test IDPS
    - > Will be available through Land PEATE (more later)

NPP Mission Segments

-NASA
-IPO
-NOAA



Space Segment

Space Segment
- Spacecraft
- ATMS
- VIIRS
- CrIS
- OMPS

Launch Support Segment (LSS)
- Launch vehicle
- Launch Support
- Payload Processing support

Command, Control & Communication Segment (C3S)
- Manage Mission
- Manage Satellite Operations
- Space/Ground Communication
- Data Routing & Retrieval

NPP CCSDS Application Packets

Interface Data Processing Segment (IDPS)
- Ingest and validate raw SMD
- Process RDRs, SDRs, EDRs
- Perform operations cal proc
- Distribute data records

Archive & Distribution Segment (ADS)
- Ingest & validate data records
- Manage archive
- Interface with users

Science Data Segment (SDS)
- Ingest and validate RDRs
- Support Climate Research

SDS Level 1 Requirements: Assess, Improve

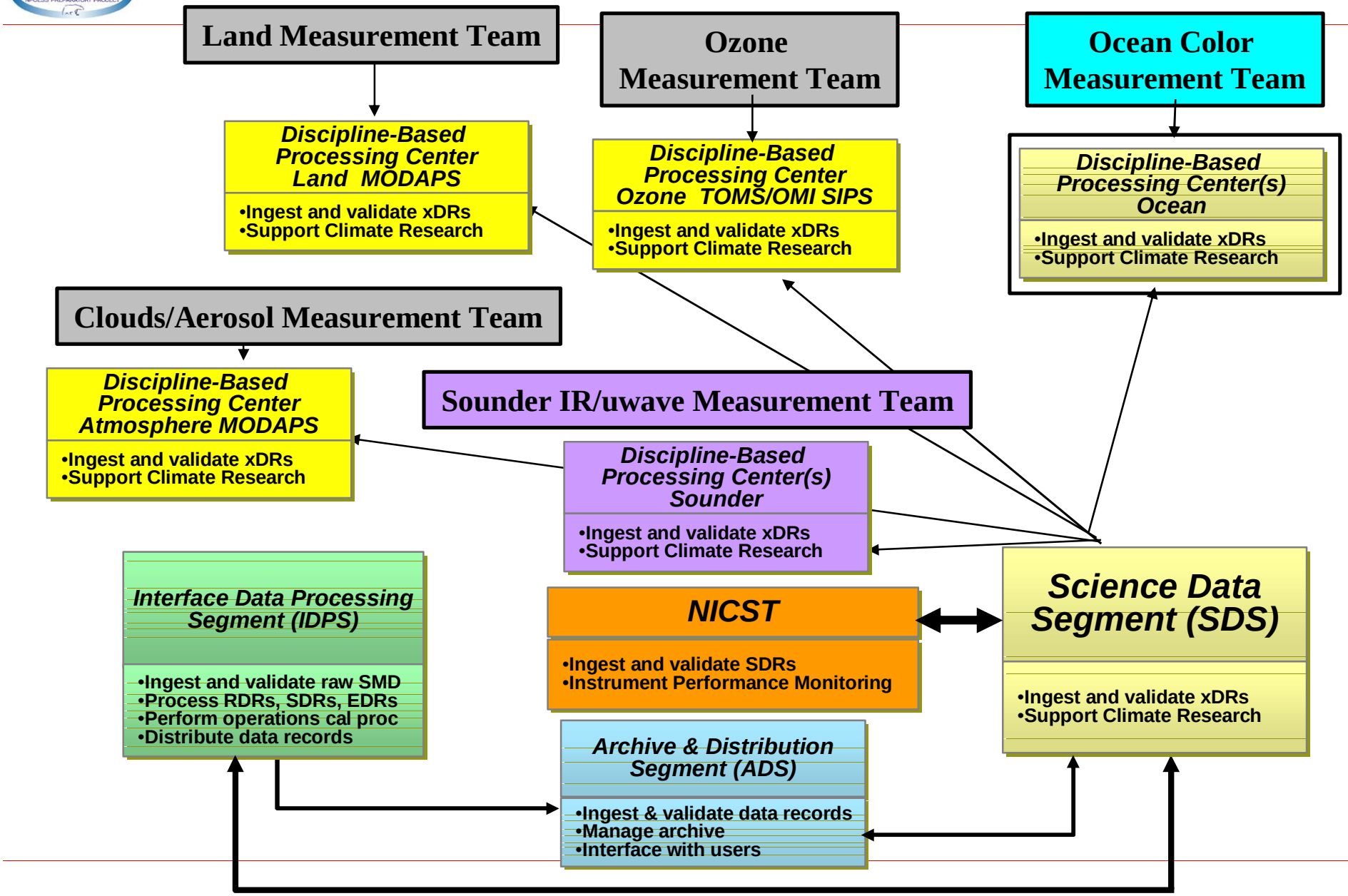
- SDS has no operational data production responsibilities (2.1.2.1) or any other operational responsibilities (2.1.2) …
  - "In developing the SDS, the Project shall assume that EDRs produced by IDPS are climate quality."
  - "The role of the SDS is limited to assess the quality of NPP EDRs for accomplishing climate research." (2.1.2)
  - SDS provides suggested algorithm improvements to the IDPS (2.1.2.3)

- The NASA NPOESS Preparatory Project (NPP) Mission Success Criteria indicates that Mission Success is based on continuing the Scientific Data Record

- SDS will be capable of processing selected data subsets in order to conduct independent analysis in support of Cal/Val Activities (2.2.2)

- SDS is a science-discipline-based system, leveraging existing resources for design, development, implementation and operations (2.1.2.4)
  - SDS will be built with FY04-FY06 NPP Project funding ($10M) and Congressional ear marked funds ($8.5M-6%) for a total cost of $17.9M during this time period
  - SDS operates during the NPP mission lifetime
    - > Post-check-out (FY07 through end-of-mission) source of funds for this operation are not identified

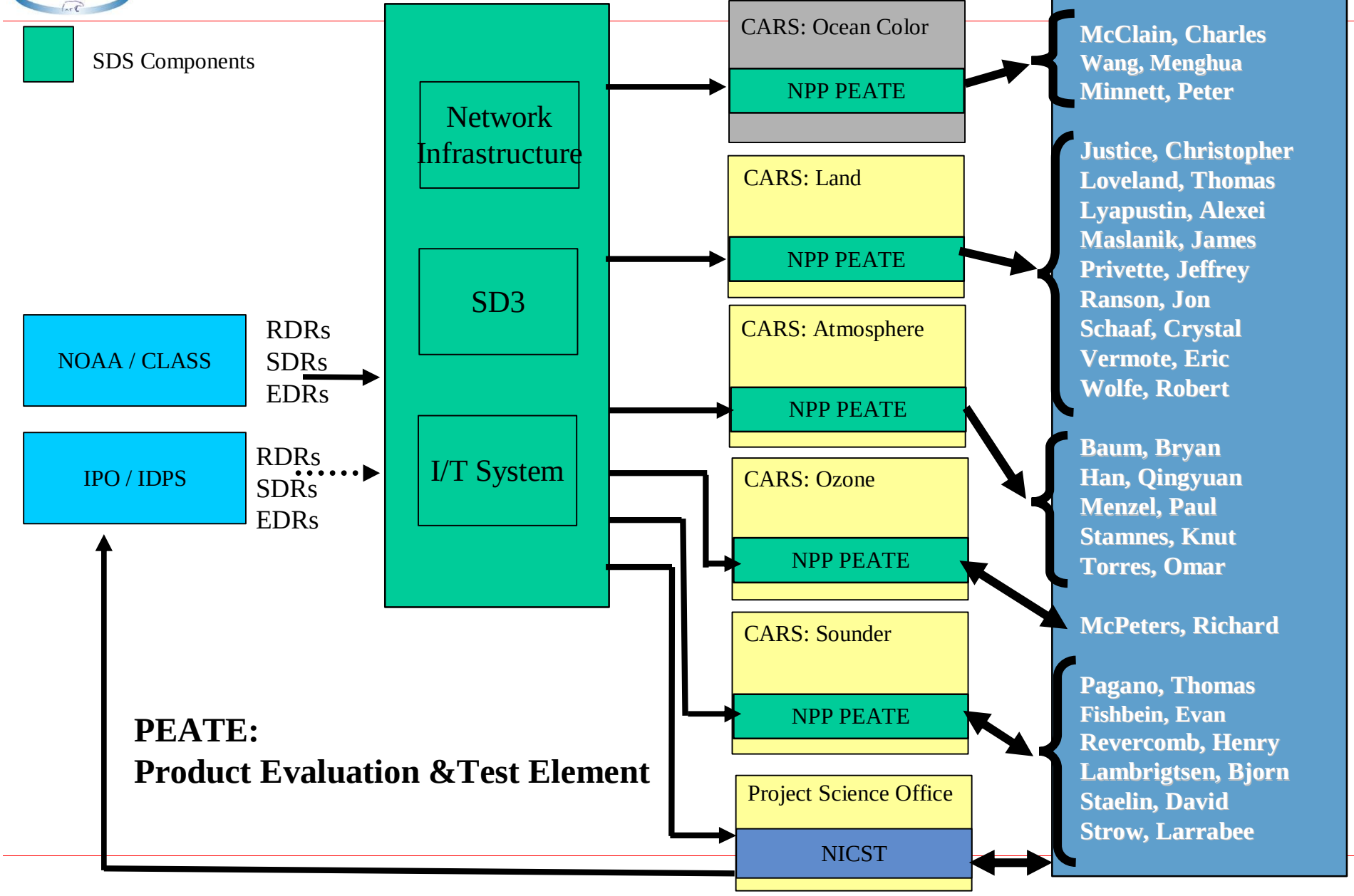
NASA Science Data Processing Model



Science Data Segment (SDS): Good Progress

- June ’04 SDS Design Review approved by HQ
  - SDS funds now available for Project spending
- PEATES Under Construction
  - PEATES are NPP-funded augmentations to existing processing facilities designed to support Science Team assessments of S/EDRs
    - > Discipline-specific (e.g., land, ozone, oceans…)
    - > MODAPS designated the Land/Atmosphere PEATE
- SD3 system (ingest and rolling 30-day archive) expected to be available for test and check-out in summer ‘05

SDS Block Diagram



VIIRS Issues and Concerns For Land

Contributions from the NPP ST Land Group

24 March 2005

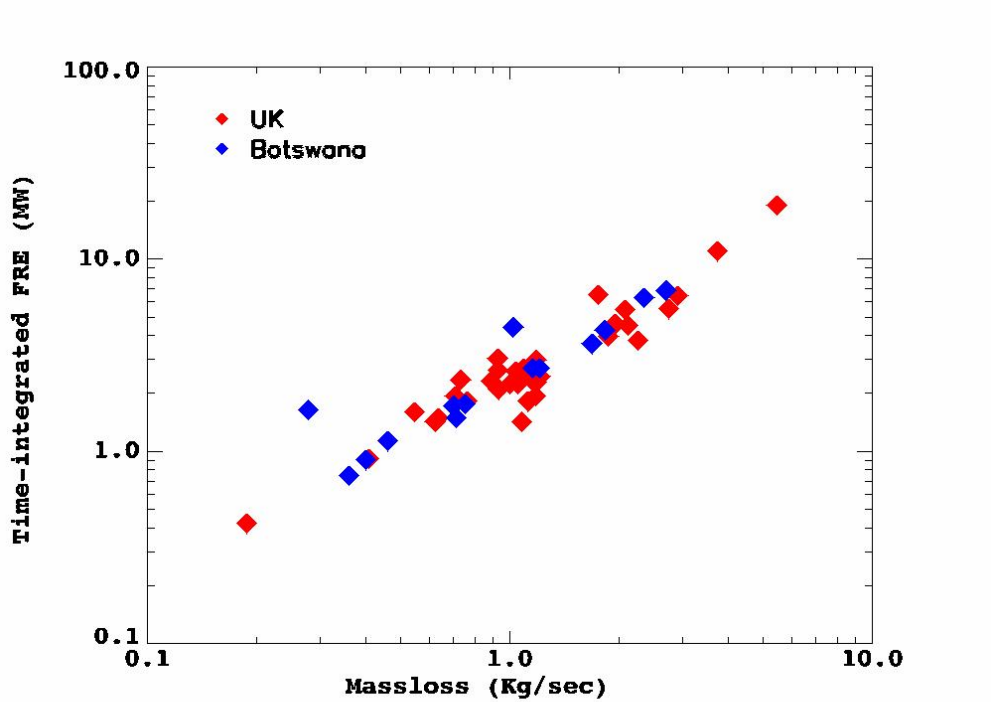
Fires: Known Instrument Issues

- **VIIRS band-to-band registration varies within an orbit due to thermal changes (STOP analysis)**
  - **<10% band-to-band deviation needed for accurate temperature and area**
- **The VIIRS thermal band (M15; 11 microns) saturation is too low for routine fire characterization (343 K vs. 400 K for MODIS).**
  - **Temp and area cannot be retrieved with saturated M15.**
  - **As designed instrument will not meet current product specification for fire size and temperature**
- **VIIRS onboard M15 aggregation scheme does not set a flag when one or more of the detectors was saturated**
  - **Physically invalid, corrupted M15 radiances will sometimes be passed to the algorithm, with no memory of faulty input**
  - **Impacts multiple EDRs (approx. 15)**
  - **Proposed solution:**
    - > **Download full resolution pre-aggregated M15 data**
    - > **UMD/Justice currently studying potential of this approach**

Fire: Continuity of EOS
Fire Radiative Power (FRP)

- **Addition of *fire radiative power* (FRP) to the product suite was proposed by the contractor and VOAT**
  - **ECR rejected**
- **FRP will be an important addition**
- **FRP is related to the rate of combustion and will help contribute to emissions and fire impact studies.**
- **Allows for direct calculation of combusted biomass.**

Fire Radiative Energy vs. Mass Combusted



Wooster et al. from field measurements

Albedo: Providing MODIS Lessons Learned

- **2 algorithms executed, 2 products created**
  - **Regression tree (Liang et al.; no op. heritage)**
  - **Adapted kernel-driven BRDF model (some MODIS heritage)**

- **Baseline BRDF algorithm picks "best" of multiple kernel (shape function) combinations**
  - **Tested, tried, and rejected under MODIS**
    - **Multi-kernels work when there is equal probability of each kernel being selected at each location**
      - **Not a valid assumption due to orbit/scanning geometry and variable cloudiness**
      - **Difficult to exploit BRDF IP due to pixel-dependent model**
      - **Lesson learned is not being transitioned into operations**
  - **NASA Science Team position submitted to IPO/NGST in Feb.**
    - **NGST will consider and call follow-up meeting**

LST: Dual-Split Window Lack Heritage

- **Daytime dual-split window algorithm**

$$LST_i = a_0(i) + a_1(i)T_{11} + a_2(T_{11} - T_{12}) + a_3(i)(\sec\theta - 1) + a_4(i)T_{3.75} + a_5(i)T_{4.0} + a_6(i)T_{3.75}\cos\varphi + a_7(i)T_{4.0}\cos\varphi + a_8(i)(T_{11} - T_{12})^2$$

- **Nighttime dual-split window algorithm**

$$LST_i = b_0(i) + b_1(i)T_{11} + b_2(T_{11} - T_{12}) + b_3(i)(\sec\theta - 1) + b_4(i)T_{3.75} + b_5(i)T_{4.0} + b_6(i)T_{3.75}^2 + b_7(i)T_{4.0}^2 + b_8(i)(T_{11} - T_{12})^2$$

- **Split window algorithm (back-up)**

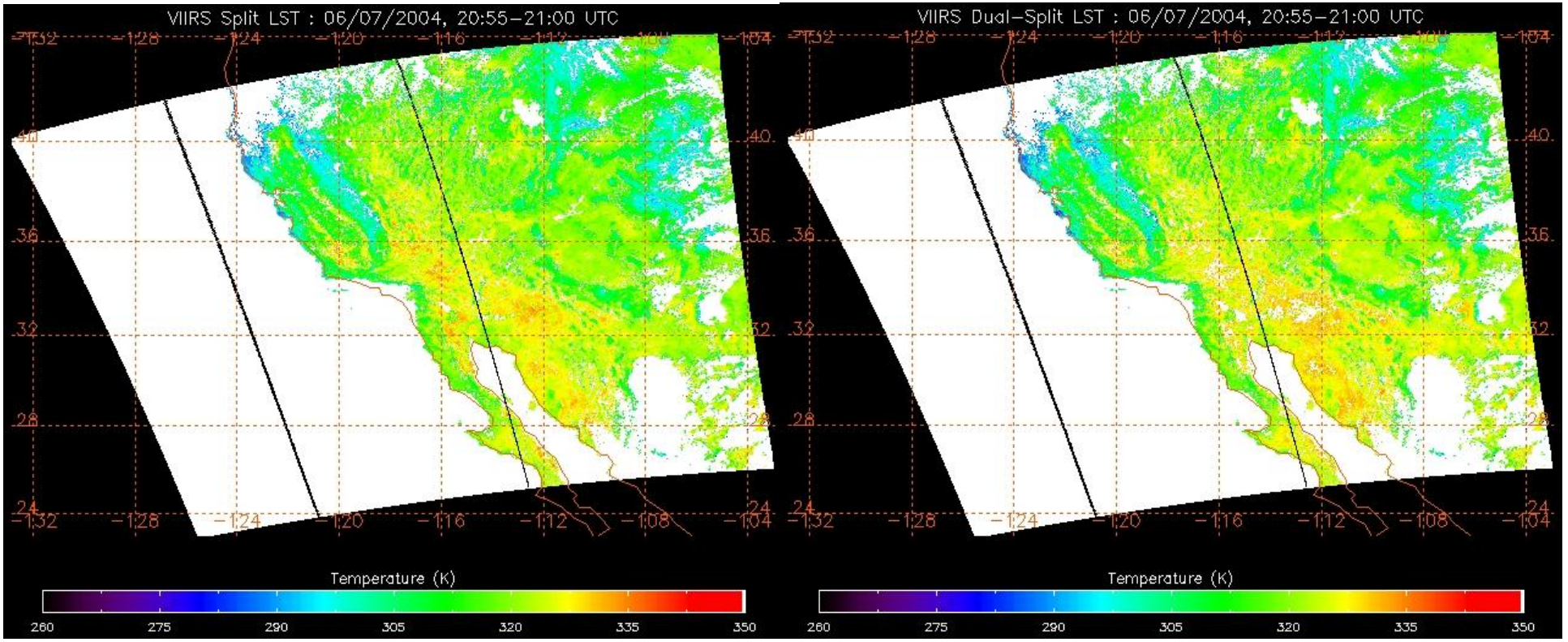
$$LST_i = c_0(i) + c_1(i)\,T_{11} + c_2(i)\,(T_{11} - T_{12}) + c_3(i)\,(\sec\theta - 1) + c_4(i)\,(T_{11} - T_{12})^2$$

* Index *i* represents surface type

Daytime VIIRS LSTs for a MODIS Scene

VIIRS Split LSTs

VIIRS Dual-split LSTs



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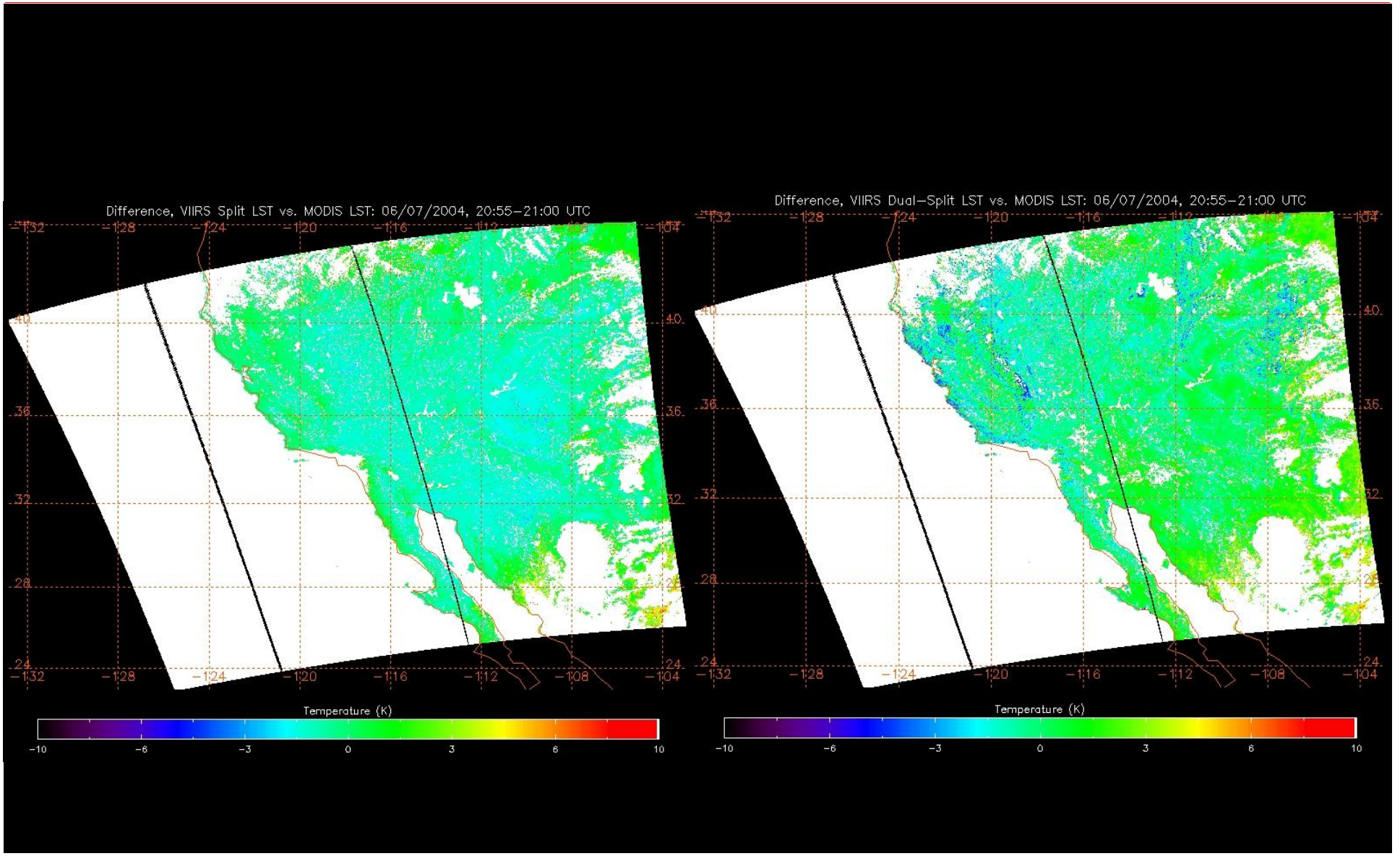
VIIRS LST Difference from MODIS LST



LST: Upshot

Mean Error over 60 Daytime MODIS Scenes (>17M pixels):

	Mean (K)	Std. Dev. (K)
VIIRS Split Window Algorithm:	**0.69**	**1.05**
VIIRS Dual-Split Window Algorithm:	**1.35**	**1.76**

Finding:
VIIRS Backup Algorithm is superior to Main

Impacts of the LST error in further applications

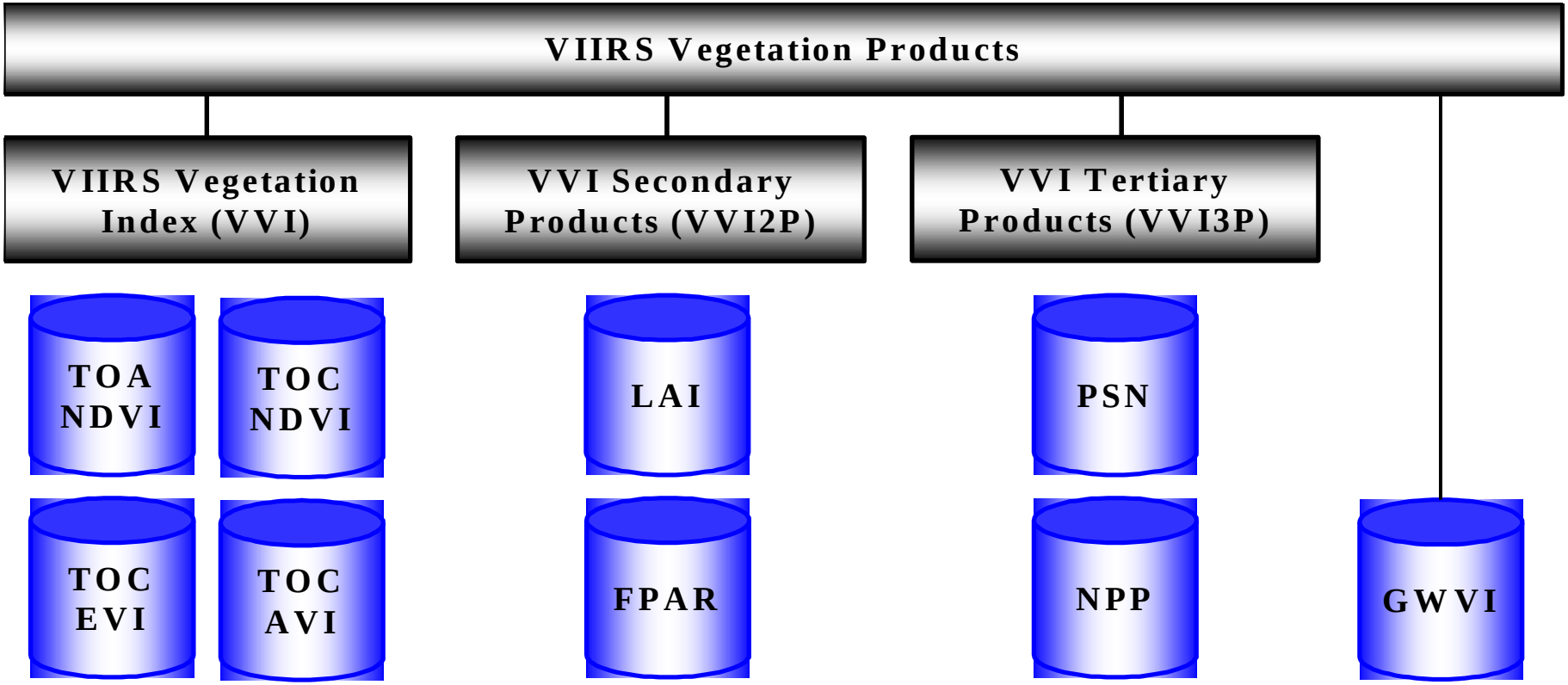
0.5 K error à 10% error of sensible heat flux (*Brutsaert et al., 1993*)
1.0 K error à 10% error of evapotranspiration (*Moran and Jackson, 1991*)
1-3 K error à 100 W/m^2 error of surface heat flux (*Kustas and Norman, 1996*)

Dual-split window LST limitations

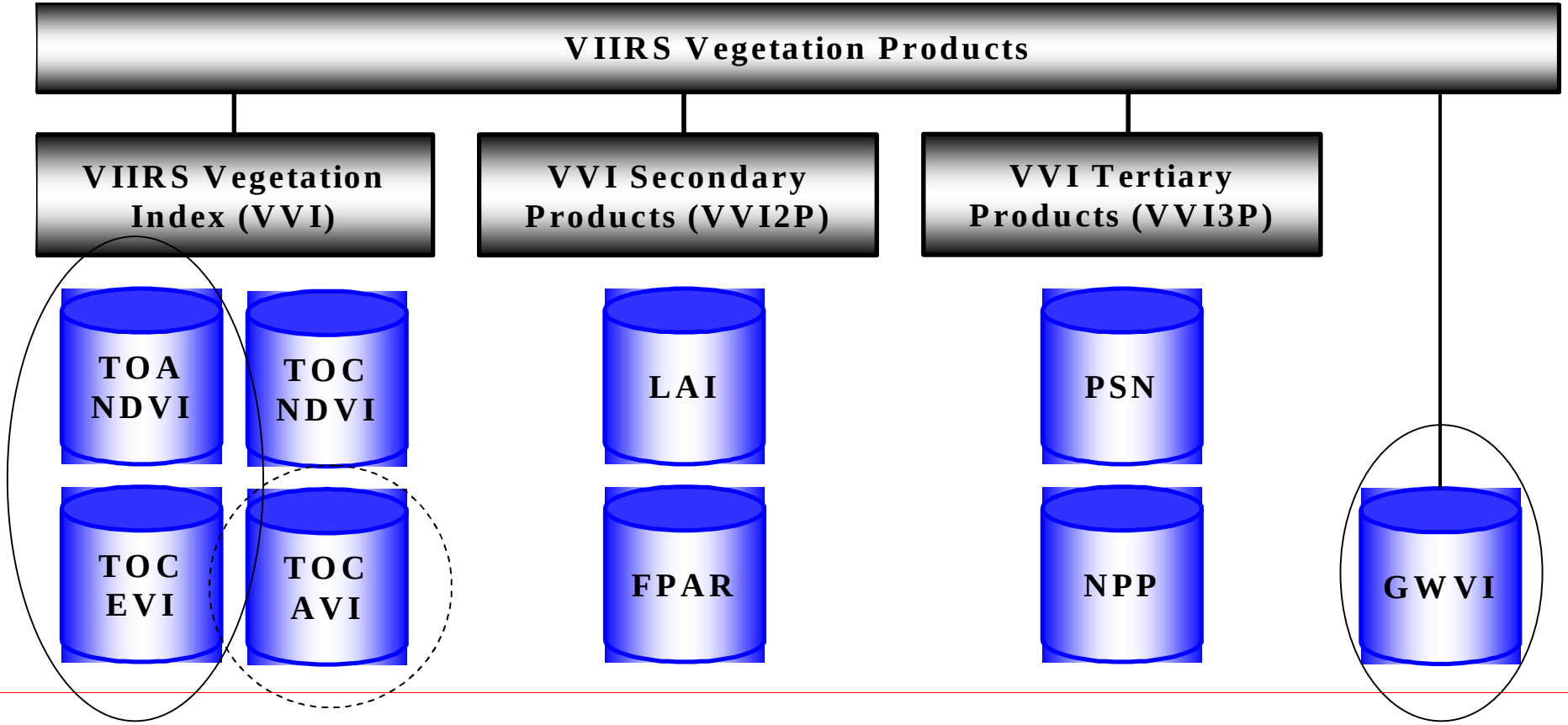
Sunglint area (reverted to the single split window algorithm)
High Surface Emissivity Variance
Lack of physics explanation
Inconsistency of the algorithm

- > Across sunglint/non glint area
- > Day vs. night
- > Inconsistent with AVHRR, MODIS time series – inadequate for Climate Data Record

Sensor Vendor Planned Multiple VI Products



SSPR's VI Products: PCR for TOC NDVI



Back-ups