MODIS and NPP
Status of the Land Discipline Groups

Chris Justice

UMd

MODIS Land Activities

- Current Team Activities
  - Starting testing of Version 5 code – test data sets will be available to the community for evaluation and feedback
  - Continuing with Stage 2 product Validation
    - Reduced budgets for team members, advantage in collaboration
    - Validation coordination with the international community (CEOS Land Product Validation, GOFC-GOLD)
      - Land Cover, Vegetation Cont Fields, Fire/Burned Area, Albedo
  - Increased interaction with the broader science community
    - Recent outreach workshops (Vegetation / Snow / Fire)
    - Science Team includes new science members
- Recent Developments
  - Improved Land-Water Mask
  - Reduced L2G volume
  - 2.5 Years of Terra/Aqua combined Albedo products
  - Engaging the applications community adding MODIS to decision support – custom services – USFS, USDA, EPA, UN
  - Long Term Data Record Initiatives – AVHRR>VIIRS

MODIS Activities Cont'd

- Making the case for Terra extension to 2009 – Senior Review process underway
  - Summarize science and applications achievements
  - Mission relevance to science programs
  - Terra Science results being compiled
- Science Team Meeting (All Welcome – Science Focus)
  - March 22 – 24th

Terra/Aqua Calibration Status

- **Terra/Aqua reflectance calibration has been examined by time series analysis over desert sites**
  - results show that instruments are performing well within specification (+/- 2%) for land bands. Both dataset are comparable to better than 1%

- **Terra solar diffuser screen is stuck in the down position (10% transmission),**
  - first results from MCST showed that calibration of land bands is possible with residual biases of +/-0.5%.

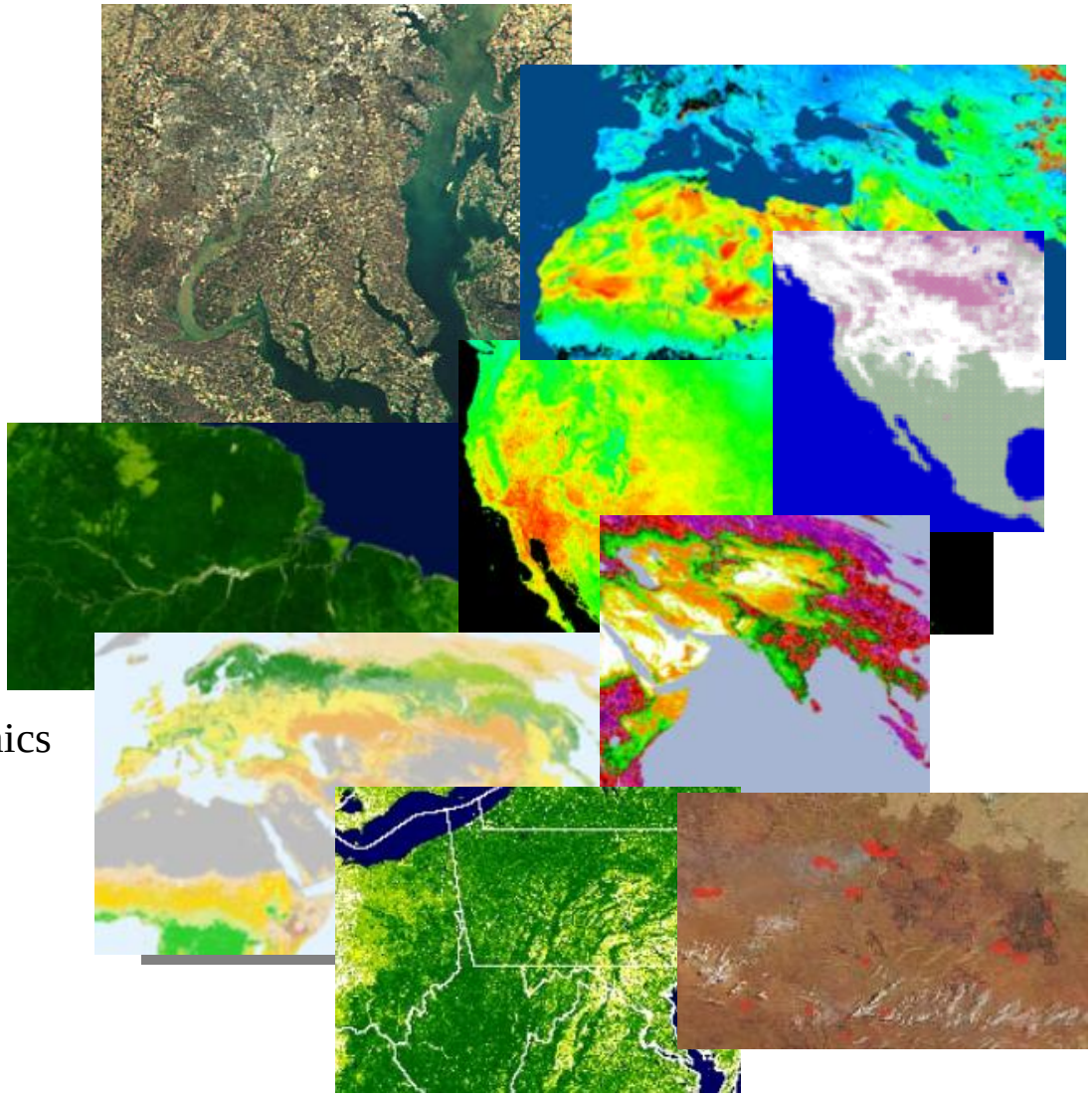
- **Terra L1B most significant problem is the striping in band 5,6,7** (probably due to electronic Xtalk)
  - this problem is "corrected" by atmosphere and land using de-stripping technique developed for GOES (Weinreb,1989).

- **Thermal bands perform adequately on both instruments**
  - **Terra since Nov 2000**

- **Polarization of the instrument needs to be taken into account at short wavelength (~5% at 412nm).**

MODIS Land Products

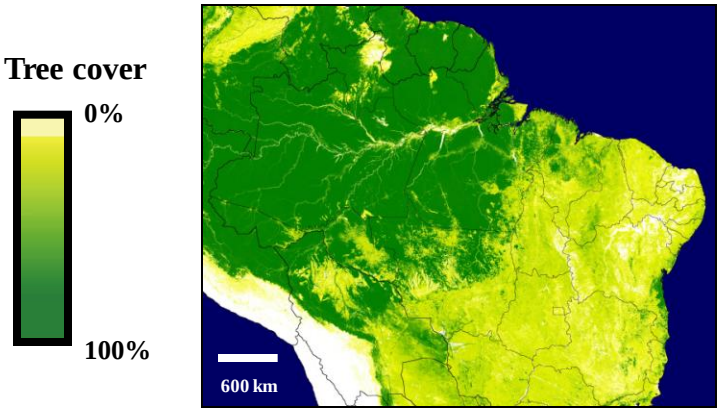
- **Energy Balance Product Suite**
  - Surface Reflectance
  - Land Surface Temperature, Emmisivity
  - BRDF/Albedo
  - Snow/Sea-ice Cover
- **Vegetation Parameters Suite**
  - Vegetation Indices
  - LAI/FPAR
  - PSN/NPP
- **Land Cover/Land Use Suite**
  - Land Cover/Vegetation Dynamics
  - Vegetation Continuous Fields
  - Vegetation Cover Change
  - Fire and Burned Area



Enhanced Land Cover and Land Cover Change Products from MODIS

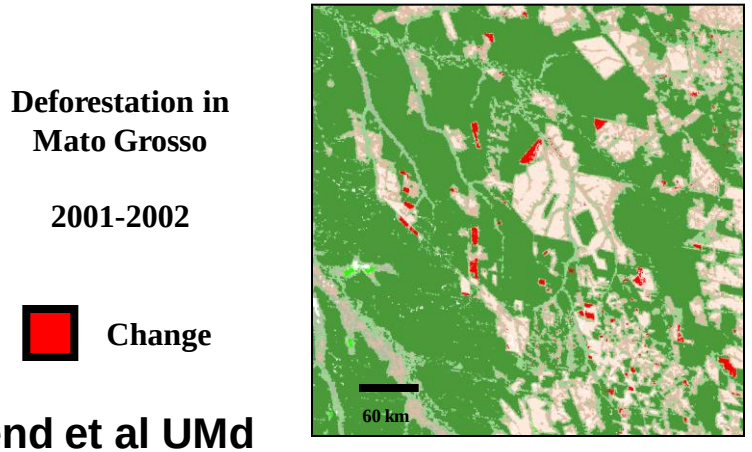
Vegetation Continuous Fields

- 500 m resolution product with sub-pixel cover estimates for 2001 available from LP-DAAC.
- Includes % woody, % herbaceous, and % bare.
- 2000, 2002, 2003 products available late spring.
- For Collection 5, spatial resolution increases to 250 m (available late 2005 and into 2006).
- Process being completely automated for regular annual production.
- New layers being added for leaf type, leaf longevity, % crop cover, and % water cover.
- Creating custom North America product for USFS with sub-pixel Pinion-Juniper % cover.
- Planning a 2005 CEOS-LPV product validation workshop for SDSU (Brookings, SD).



Vegetative Cover Conversion

- 250 m change alarm product available for humid tropics deforestation available from LP-DAAC.
- Validated against independent PRODES data set with accuracy of 92% vs. Landsat product.
- Collection 5 will bring substantial incremental improvement to cloud clearing and elimination of aerosol artifacts.
- Merged Aqua and Terra prototype products have been developed.
- Global production for Collection 5 including new flags for daily water cover.
- Confidence measures being introduced based in persistence of detected change through multiple sample periods.



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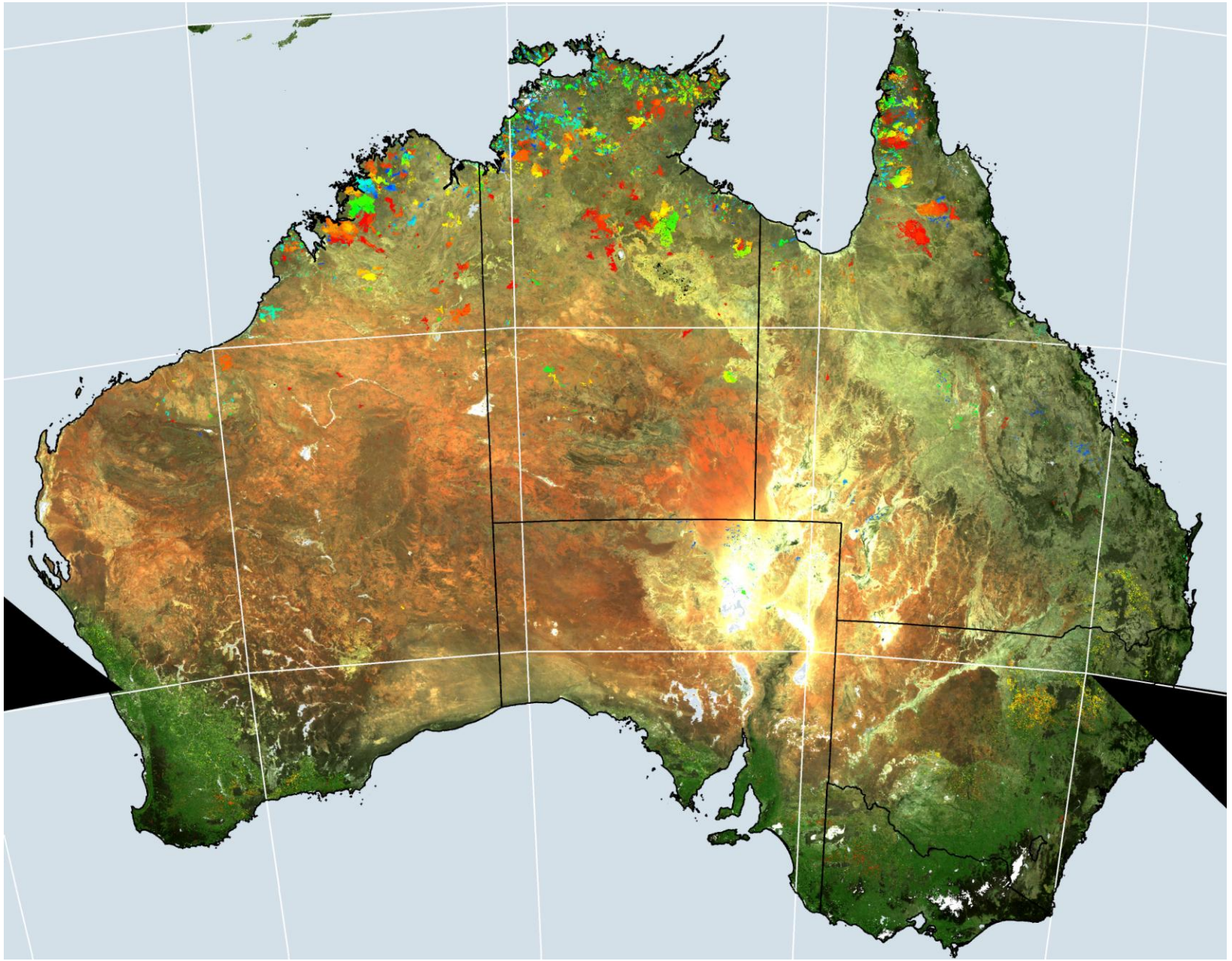
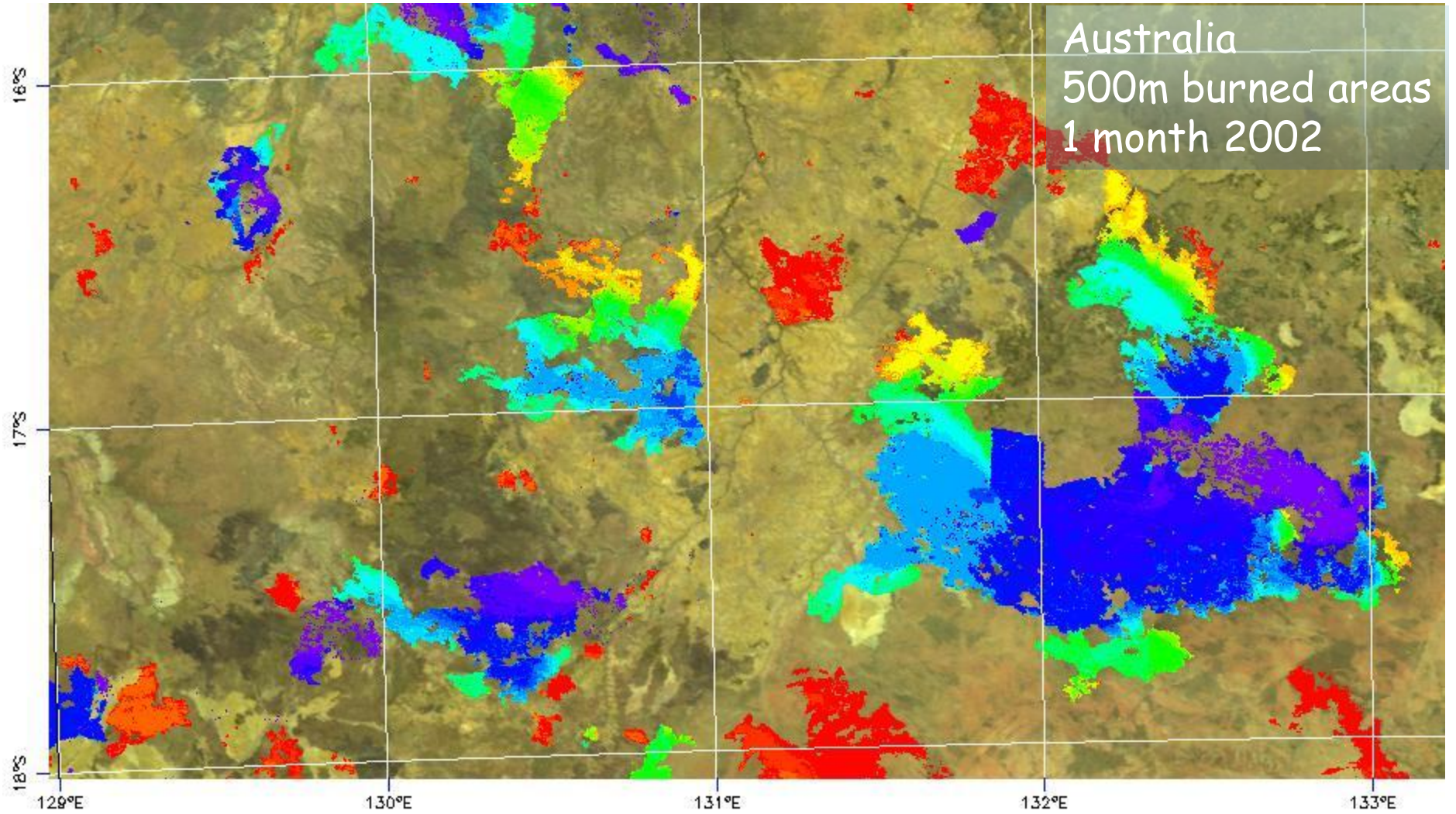
Fire Product Status

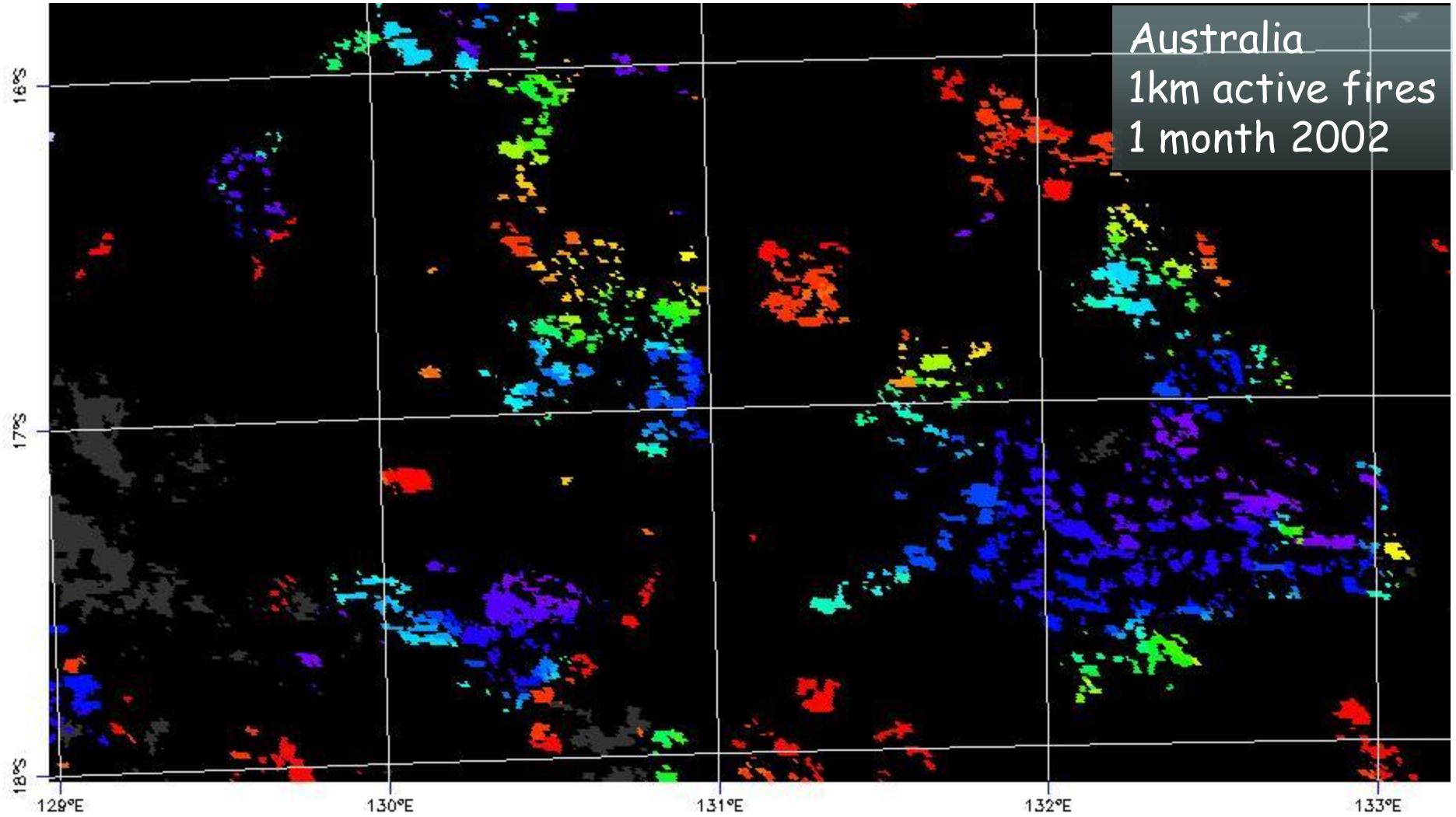
- **CMG Active Fire Code completed**
  - Multiyear SCF product being evaluated
- **Version 5 Code in process**
- **Stage 2 Active Fire Validation Underway**
  - Terra – ASTER (developed ASTER Fire Algorithm
- **Burned Area**
  - Code running at SCF regional beta products generated
  - Regional evaluation and validation underway w. GOFC/GOLD collaborators – S. Africa, Australia, Brazil, S. America, Russia, US
  - Code will run in collection 5 globally – provisional product release
- **User Outreach**
  - **Web Fire Mapper and RR System – Fire Applications**
    - Providing Web-based NRT fire locations from the Land RR System
    - Several requests to provide and enhance operational capabilities
  - **Extensive Product Outreach through GOFC GOLD Fire IT**
    - IT Meeting, Montreal – February
    - EARSEL SIG, Zaragoza – June
  - **Transition of MODIS Fire capabilities to NOAA** – continued discussions

Terra + Aqua, 500m Burned Areas, June -October, 2003

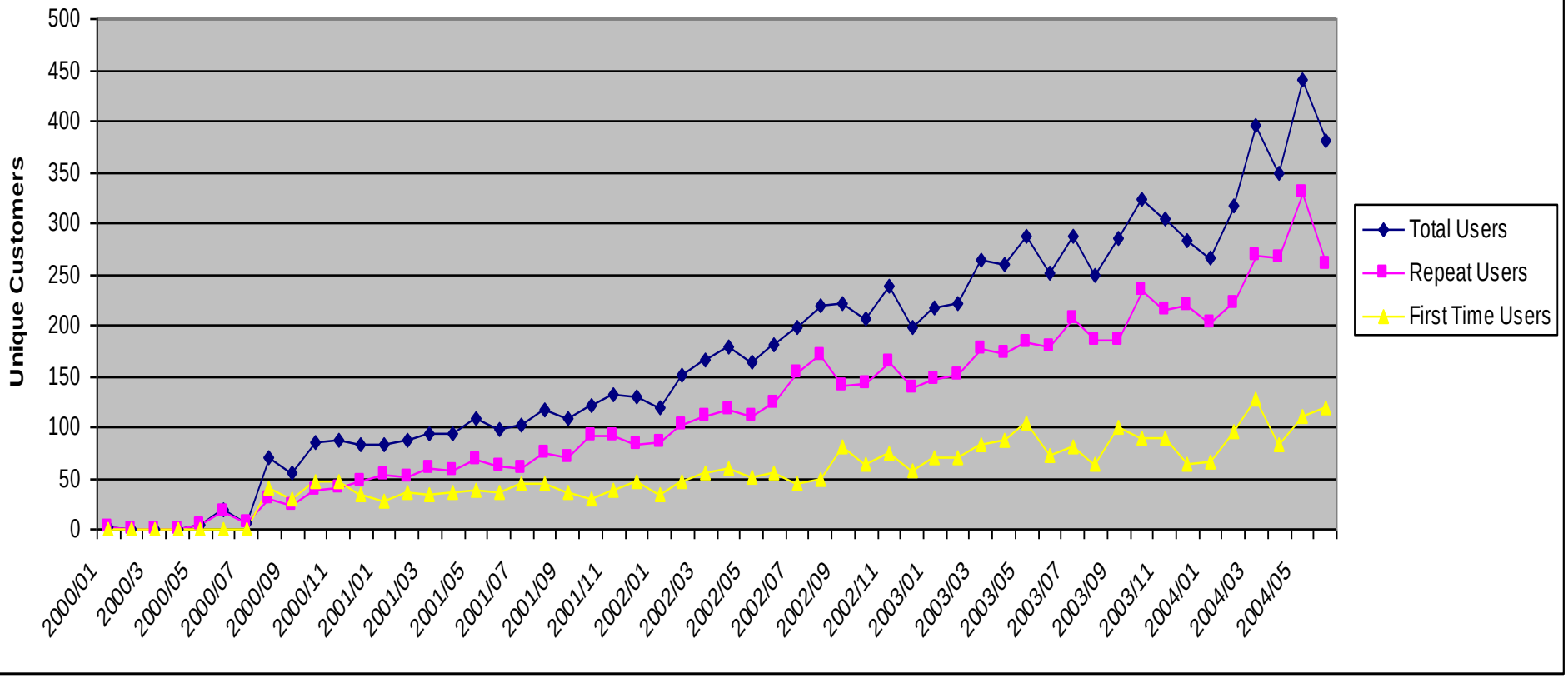




500m Burned Areas, October 1st (violet) to October 31st (red) 2002


Australia
1km active fires
1 month 2002
16°S
17°S
18°S
129°E
130°E
131°E
132°E
133°E

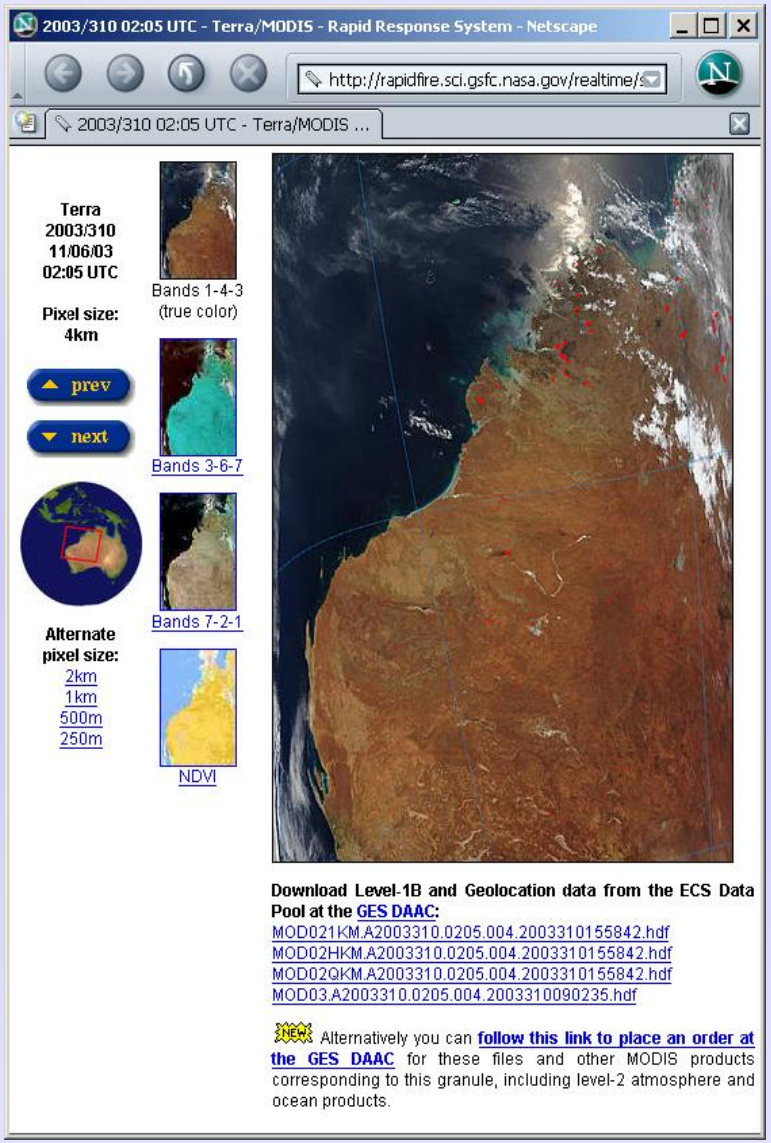
MODIS User Community Continues to Grow



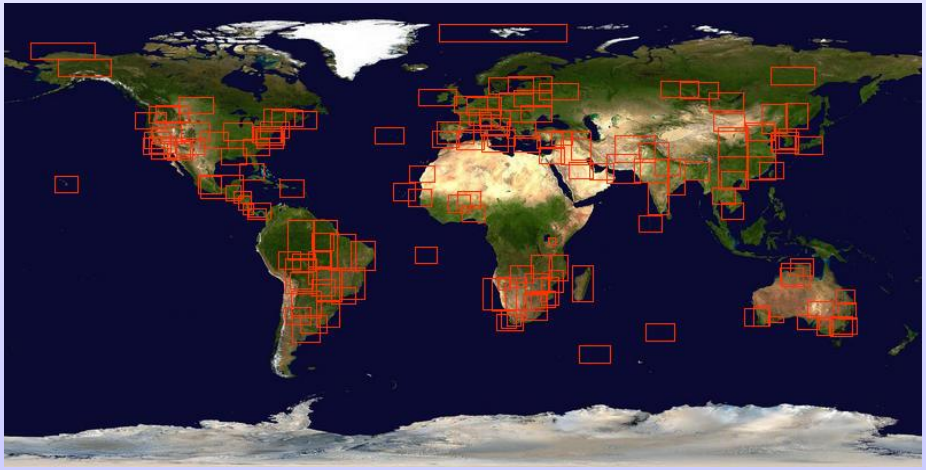
USGS

NASA

MODIS Rapid Response Distribution

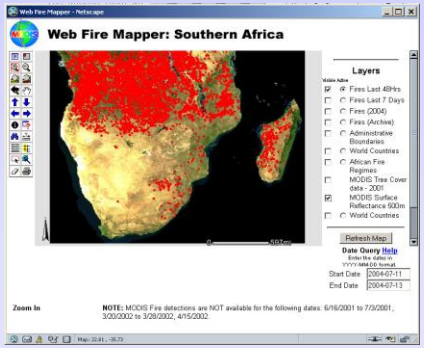


Near-real-time "browse" imagery



Automatic subsets

- Browse-and-click interface
- Thumbnail available for each image
- Multiple spatial resolutions, multiple band combinations, multiple products
- Gallery images are georeferenced ("world file" available for GIS users)
- Link to actual data at the DAAC (WHOM and Data Pool), link to ECHO client planned
- Over 160 application-specific automatic subsets



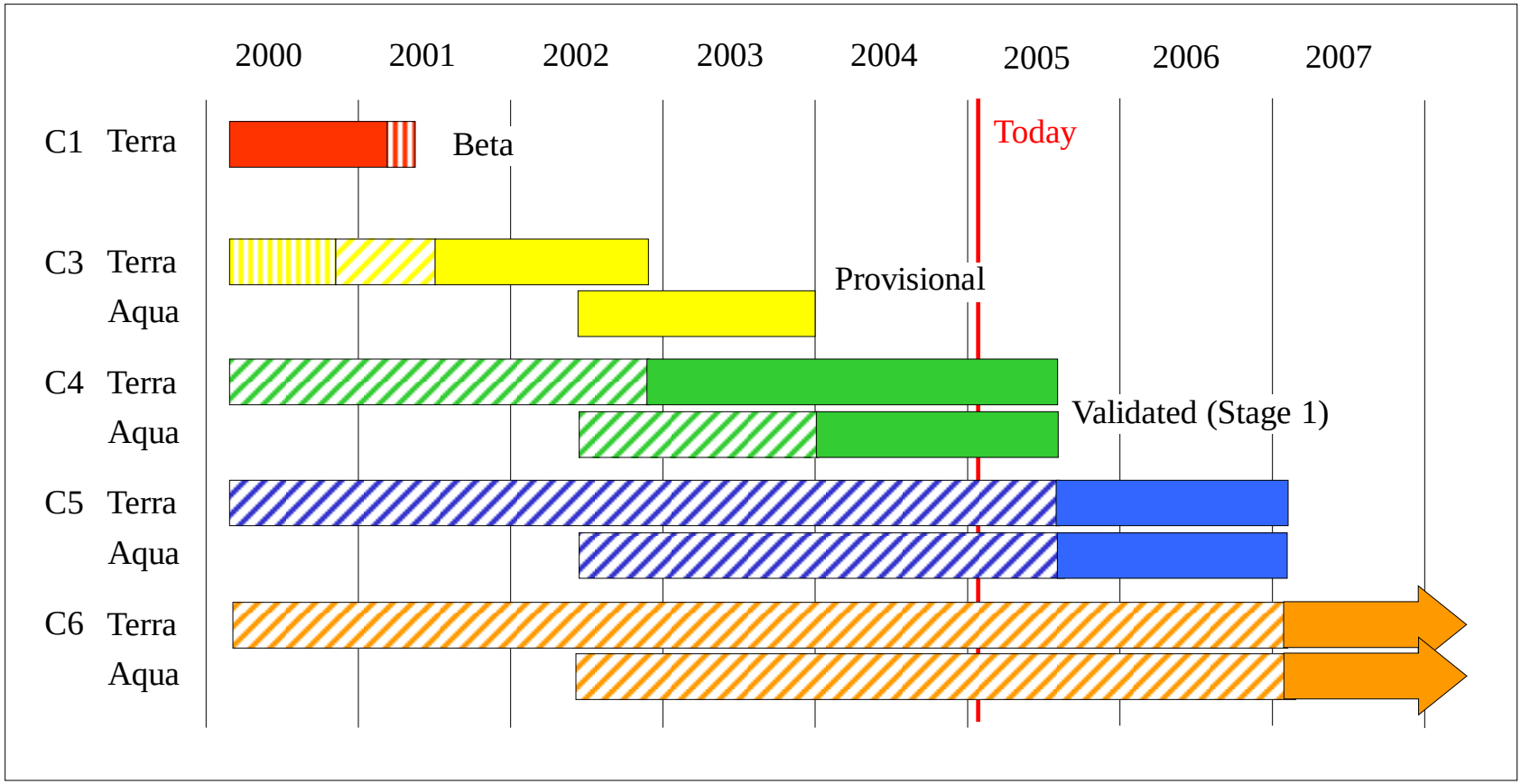
Web Fire Mapper
at Univ. of Maryland

Flash-based
interactive viewer

Standard Product
Collection 5/6 Processing Schedule

Dec. 2004	Collection 5 science testing begins
May 2005	Collection 5 data available for evaluation by community
Aug. 2005	Collection 5 processing and reprocessing starts reprocessing rates of ~7X expected
June 2006	Complete year ('03) of Terra and Aqua (and combined) products available
Sept. 2006	Complete collection 5 reprocesing Terra: 6.5 years starting Feb. '00 Aqua and Combined: 4.25 years starting July '02
Jan. 2007	Collection 6 processing starts

MODIS Land production overview



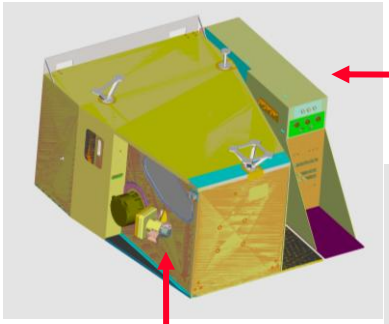
C*n* – Collection Version *n*

Forward processing

Level 1 only

Reprocessing

VIIRS Sensor Subsystems



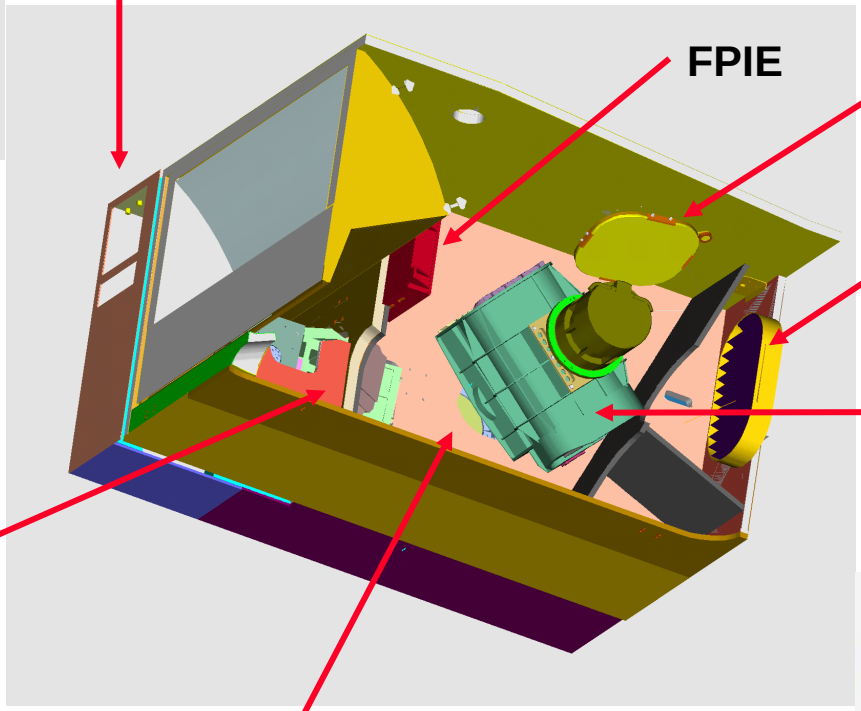
Separately Mounted Electronics Module

Solar Diffuser

FPIE

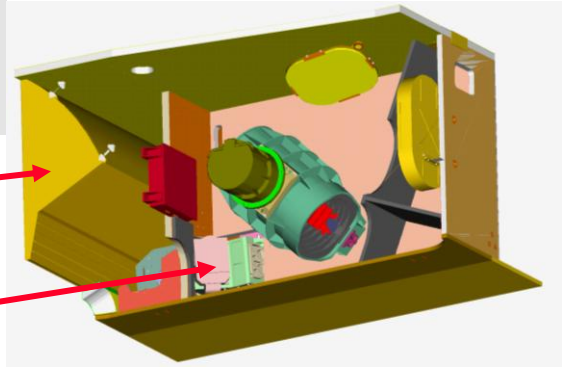
Blackbody

Solar Diffuser
Stability Monitor



3-Mirror Anastigmat
All reflective
Rotating telescope

4-Mirror Anastigmat
All Reflective
Aft Optics Imager



Cryoradiator

Half-angle Mirror

Cold FPA
Dewar Assembly

Environmental Data Records

By Discipline

- Atmos Vert Moist Prof
- Atmos Vert Temp Prof
- Imagery
- Sea Surf Temp
- Sea Surf Winds
- Soil Moisture
- Aero Opt Thickness
- Aerosol Particle Size
- **Albedo (Surface)**
- Auroral Boundary
- Auroral Imagery
- Cloud Base Height
- Cloud Cover/Layers
- Cloud Eff Particle Size
- Cloud Ice Water Path
- Cloud Liquid Water
- Cloud Opt Thickness
- Cloud Top Height
- Cloud Top Pressure
- Cloud Top Temp
- Cloud Part Size / Dist
- Dn Lwave Rad (Sfc)
- Electric Field
- Electron Density Prof
- Aero Refractive Index
- Geomagnetic Field
- Ice Surface Temp
- Energetic Ions
- In-situ Plasma Fluct
- In-situ Plasma Temp
- Downward Swave Rad
- Med Energy Particles
- Ionospheric Scint
- **Land Surface Temp**
- **Surface Type**
- Net Heat Flux
- Net Solar Rad (TOA)
- Neutral Density Profile
- Total Water Content
- **Vegetation Index**
- Ocean Color / Chlor
- Ocean Wave Char
- Ozone-Tot Col/Profile
- Precipitable Water
- Precip Type / Rate
- Pressure (Surf/Profile)
- Sea Ice Age Char
- Sea Surface Hgt/Topo
- **Snow Cover/Depth**
- Solar Irradiance
- ST- Auroral Particles
- Surface Wind Stress
- Suspended Matter
- Auroral Energy Depos
- Atmospheric
- Oceanic
- Terrestrial
- Space Environment
- Climate

NPP Land Group

Name	Lead Responsibility	Organization
Justice, Chris	Fires	University of Maryland College Park
Loveland, Thomas	Surface Type	US Geological Survey
Lyapustin, Alexei	Surface Reflectance	GEST UMBC
Privette, Jeffrey	LST, VI	NASA Goddard Space Flight Center
Ranson, Kenneth	Surface Type	NASA Goddard Space Flight Center
Schaaf, Crystal	Albedo, Surface Type	Boston University
Stamnes, Knut	Snow Cover/Depth	Stevens Institute of Technology,
Vermote, Eric	Surface Reflectance	University of Maryland College Park
Wolfe, Robert	Geolocation, SDRs	Raytheon Technical Service Company

NPP Visible IR Imaging Radiometer Suite (VIIRS)

VIIRS Instrument

- Several major issues being worked concurrently
  - Reflective band calibration suffers from excessive solar contamination
  - EDU cryoradiator is not cooling sufficiently
  - Optical module doors (hinges) failing space qualification
- Integration and ambient testing in early stages
- Schedule has become unrealistic and unreliable
  - Will not meet Apr 05 delivery as required for s/c testing
  - Will cause launch slip to ’07 timeframe

VIIRS Suite Continued

- Algorithms
  - Some delays in science code “drops” to IDPS – last delivery: 2/05 (vs. 9/04 plan)
    - Represent the ‘form stable’ algorithms for use at launch; some incomplete
    - IDPS segment converting to operational codes (IDPS Build 1.3)
  - Drop 3 deliveries represent code clean-up, LUTs based on sensor data, correcting incomplete prior-drops
  - NASA Science Team analysing NGST’s science-grade algorithms
    - Most land algorithms will need fixes to varying degrees
    - Surface Type approach is MODIS-like; spec is rigorous (88%)

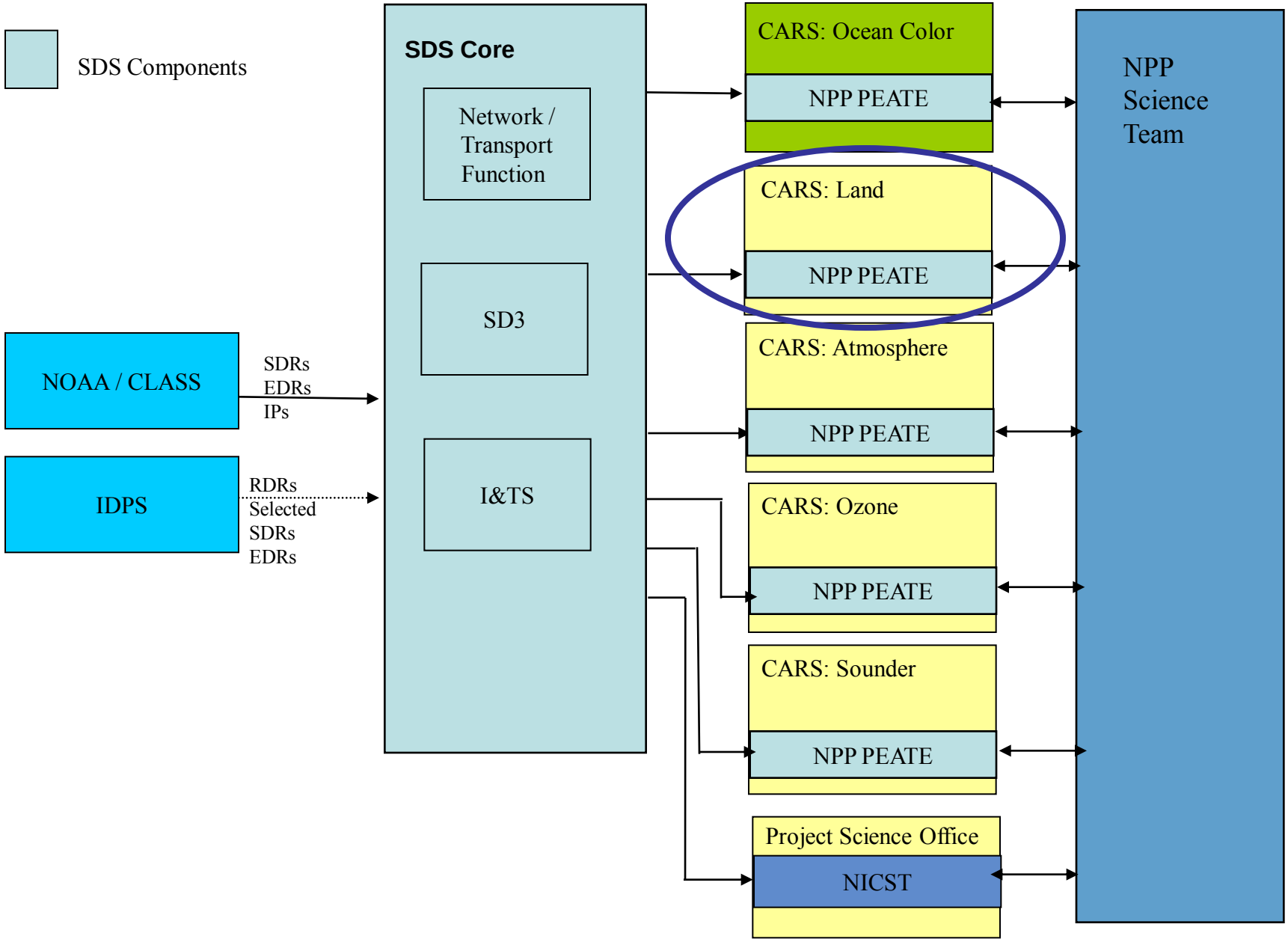
VIIRS Land Calibration Assessment

- **The MODIS experience and data have proven extremely useful in assessing VIIRS performance (e.g. crosstalk analysis)**
- **One of the key issues is to give attention to areas where VIIRS differs from MODIS (e.g. Bi-linear gain)**
- **The VIIRS Calibration ATBD is under review**
- **It is strongly recommended that the contractor develop an error budget for the calibration**
- **The drivers for land calibration are**
  - **a 2% calibration accuracy,**
  - **linearity,**
  - **polarization characterization.**
- **A lesson learned from MODIS is that an improved characterization data set (e.g. for Polarization) needs to be included**

VIRRS Suite Continued

- Data Processing Segment (IDPS)
  - Build 1.3 proceeding (Critical Design Walk-through: 12/04)
    - Concern: immature components being pushed out to Build 1.4
    - Data Quality Monitoring, QA Flag/metadata, cal/val plans developing slowly
    - “Day In The Life” test data due in 2/05

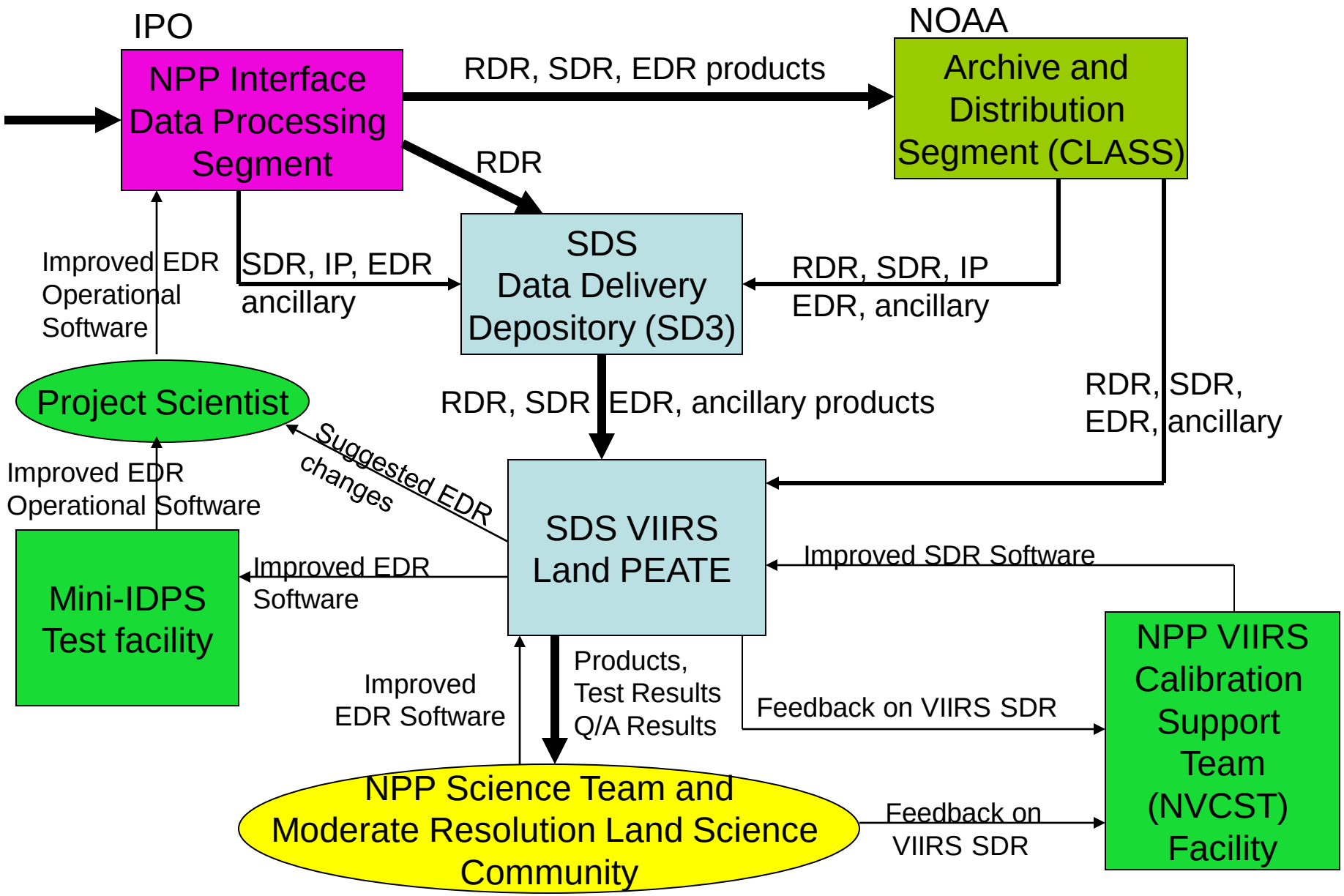
Land PEATE Interfaces with SDS, IDPS



Land PEATE

- Moderate resolution processing team at GSFC will develop and operate Land PEATE with guidance on requirements from Terrestrial Ecology Program Manager and Land discipline lead
- Land PEATE will:
  - Integrate and run science software that produces Sensor Data Records (L1B/Geoloc.), Intermediate Products(L2G/L3) , Environmental Data Records (L2) and land diagnostic products (Level 3 daily, 8-day …)
  - Integrate and run SDR, IP and EDR operational software from IDPS
  - Perform quality assessment of SDR and EDR products (LDOPE)
  - Provide suggested improvements to EDRs to Project Scientist (Gleason) Improvements may be any one of the following:
    - Suggested changes to algorithms to be implemented by NPP contractor
    - Science s/w that will be converted to operational s/w
    - Operational s/w that has improvements implemented in it
  - NPP Project Scientist will decide what improvements to submit to the Integrated Program Office for possible implementation in the operational system (IDPS)

Interfaces and data flows



Land Direct Broadcast Coordination

- Considerable interest in MODIS from the DB community on land product suites
- MODIS Software provision for Standard products and Land RR code
- DB was a secondary issue for MODIS
- DB Community interested in evolving MODIS land products, capabilities and coordination for VIIRS
- The community would benefit from a Workshop updating on MODIS code and VIIRS plans
  - Land DB Workshop proposed in DC area later in 2005