MEMORANDUM FOR: SAF/PAS
1690 Air Force Pentagon - 5D227
Washington DC 20330-1690

MAY 30 2002

FROM: Francis G. Hinnant, Col, USAF
Associate Director of Acquisition
NPOESS Integrated Program Office
8455 Colesville Rd, Suite 1450
Silver Spring, MD 20910

SUBJECT: Paper approval for: NPOESS VIIRS Land Environmental Data Records (EDRs)

Enclosed are the required ten (10) copies of the subject papers. This paper will be released at the IGARSS02 conference on June 23, 2002. It was written by, and will be presented by employees of Raytheon Electronic Systems.

The program office has reviewed the information in the attached papers and found it appropriate for public disclosure without change.

Point of contact on this matter is Capt. Ken Speidel, NPOESS IPO/ADA at 301-427-2084 (Ext. 208).

Attachment: Presentation—10 copies

NPOESS VIIRS

Land Environmental Data Records (EDRs)

Dr. Shawn W. Miller
Raytheon Santa Barbara Remote Sensing
06/23/02

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Agenda

- VIIRS Overview (Land Product Context)
- Land Product Overview
- Product Specifics:
  - Surface Reflectance Intermediate Product (IP)
  - Surface Albedo Environmental Data Record (EDR)
  - Vegetation Index EDR
  - VIIRS Vegetation Index (VVI) Secondary Products
  - Surface Type EDR
  - Soil Moisture EDR
  - Active Fires Application Related Requirement (ARR)
  - Other Intermediate Land Products
- Land Product Summary

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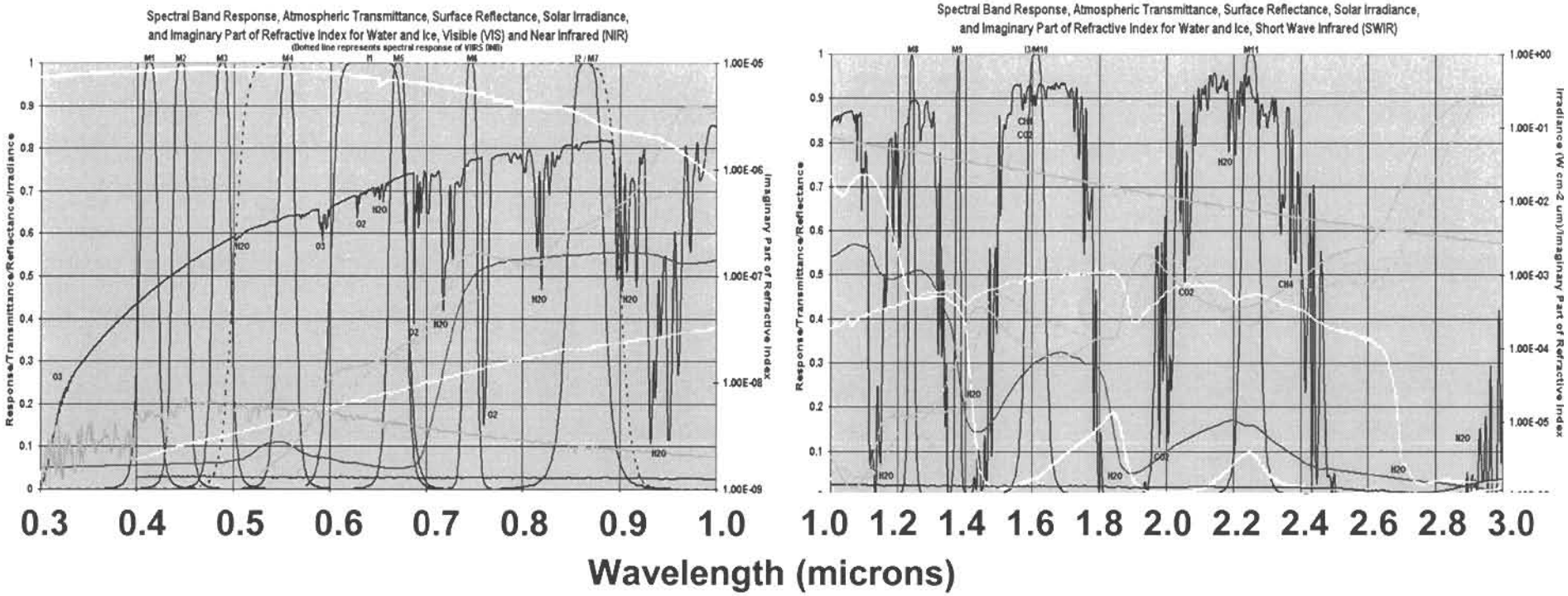
VIIRS

VIIRS Spectral Capabilities Will Continue the MODIS Heritage



VIIRS MODELED BANDPASSES SHOWN IN BLUE

VISIBLE/NEAR INFRARED OPTIMIZED FOR REMOTE SENSING OF VEGETATION

SHORT WAVE INFRARED OPTIMIZED FOR SNOW AND CLOUD DISCRIMINATION

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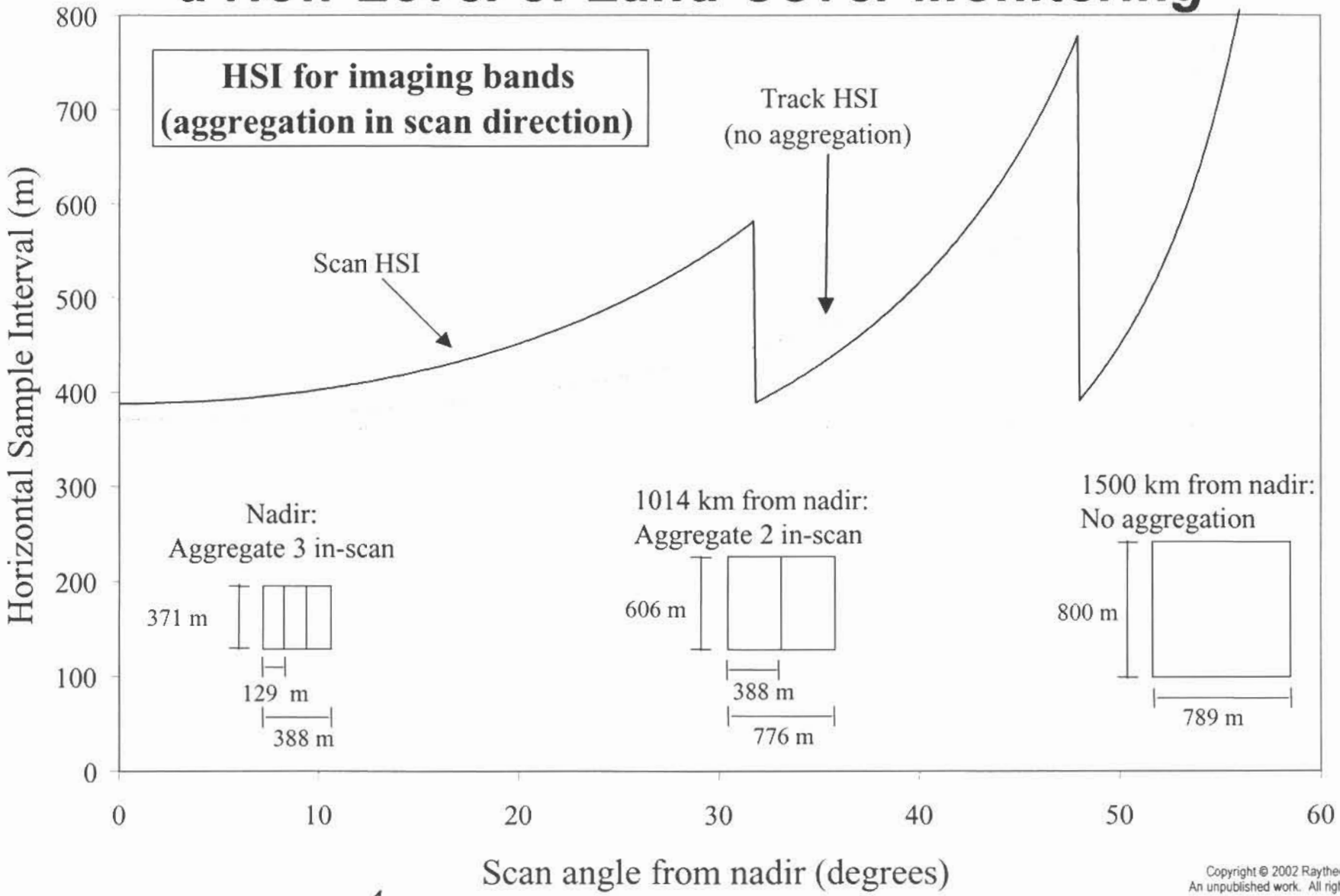
VIIRS Spatial Resolution Allows a New Level of Land Cover Monitoring



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VIIRS Land Products Address a Wide Variety of Phenomena

- Surface Reflectance IP
  - Front end to other land products, delivered in twelve bands (three at imagery resolution)
- Surface Albedo EDR
  - Output from two separate algorithms archived, including an extension of the MODIS approach
- Vegetation Index EDR, VVI Secondary Products
  - Several vegetation indices, plus FPAR and LAI
- Surface Type EDR
  - Swath-based product generated from a quarterly global map at 1-km resolution
- Soil Moisture EDR
  - Fusion of VIIRS and CMIS to produce soil moisture estimates at high spatial resolution
- Active Fires ARR
  - Includes fire detection, fire temperature/area, and burn scar detection

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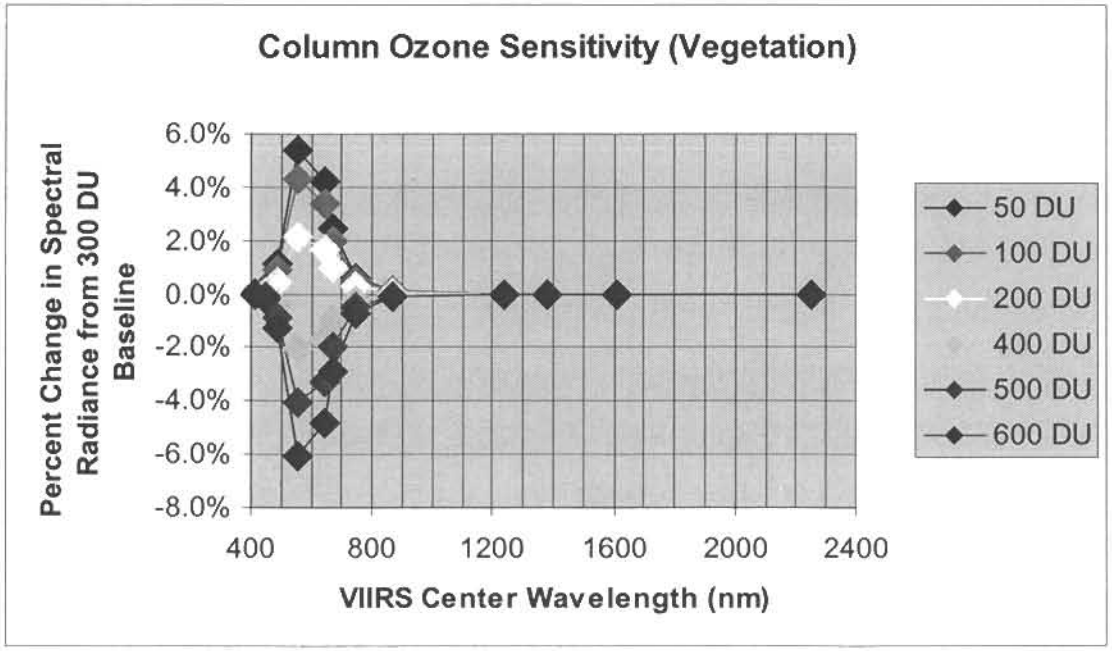
Surface Reflectance IP Based on Generic Radiative Transfer Modeling

- Adapted from the MODIS algorithm (Vermote and Vermeulen, 1999), generalized with respect to radiative transfer model
- Directional product archived for VIIRS bands ranging from 412 nm out to 2.25 microns (3 bands at imagery resolution, 9 bands at moderate resolution)

Sensitivity to various atmospheric parameters has been systematically analyzed to aid in the structuring of the central lookup table



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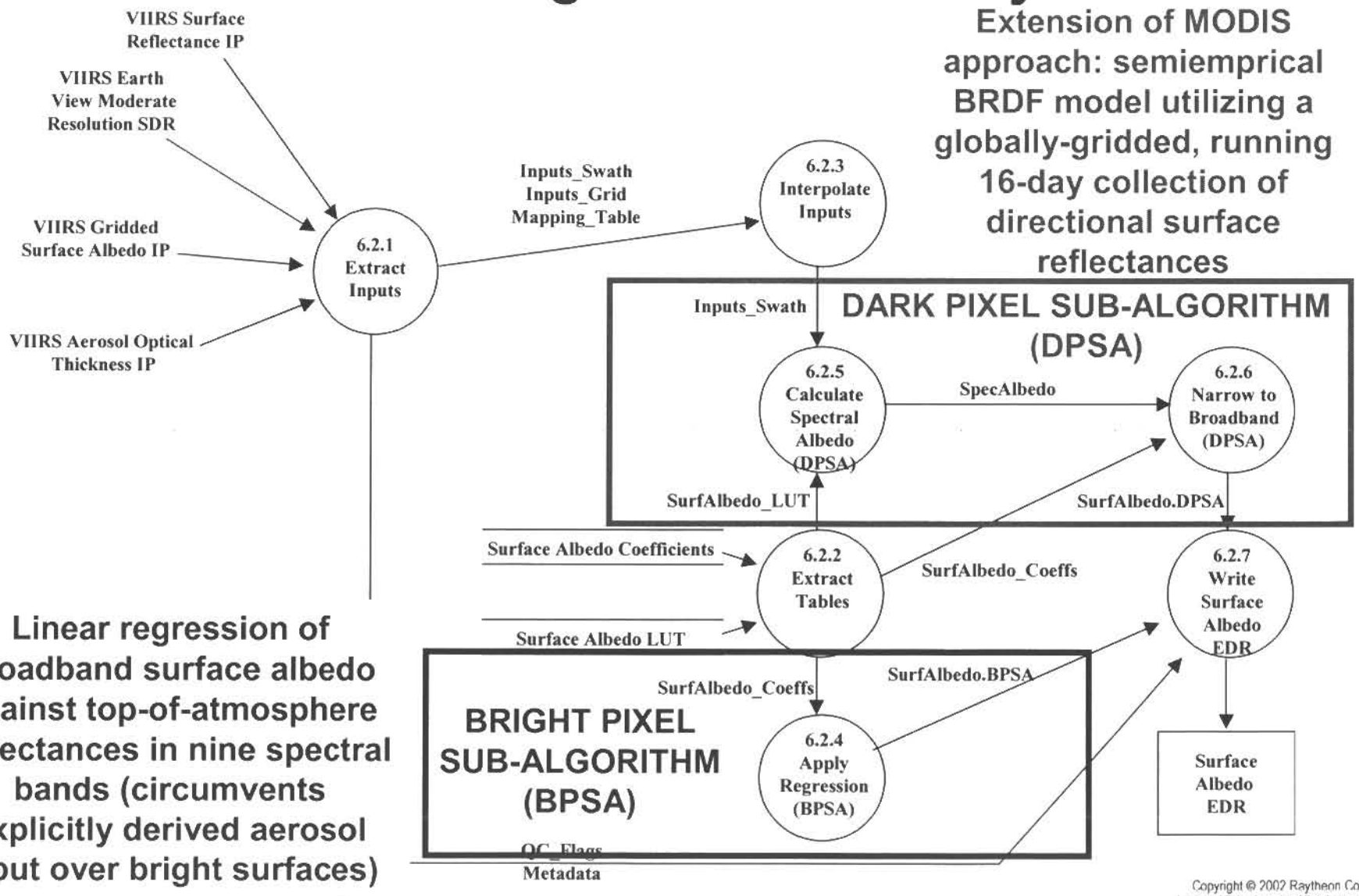
Surface Albedo EDR Reports Output of Two Algorithms Globally

Extension of MODIS approach: semiemprical BRDF model utilizing a globally-gridded, running 16-day collection of directional surface reflectances



Linear regression of broadband surface albedo against top-of-atmosphere reflectances in nine spectral bands (circumvents explicitly derived aerosol input over bright surfaces)

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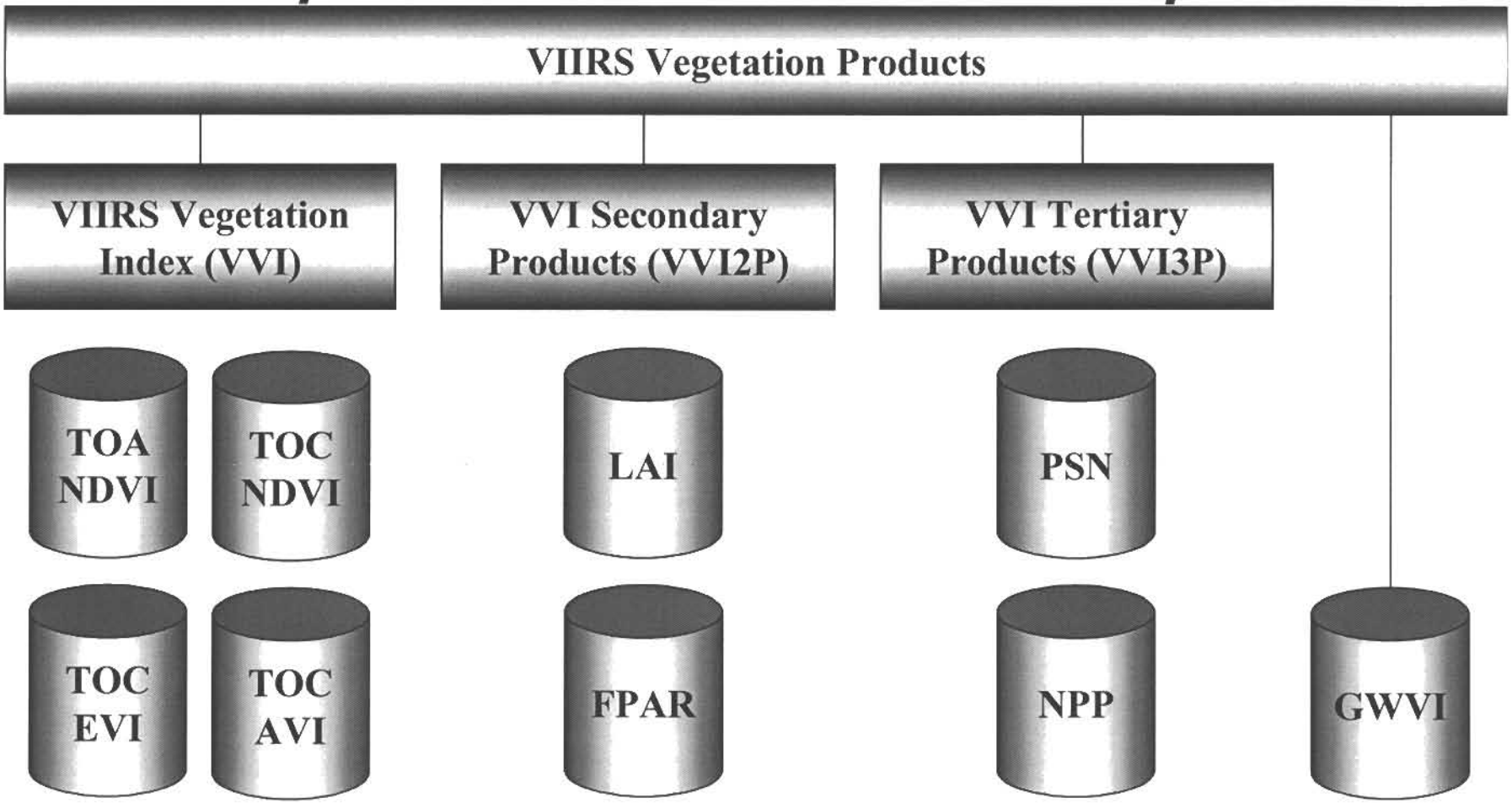
VIIRS Vegetation Products Form a Comprehensive Suite for the Biosphere



- Top-of-Atmosphere NDVI
- Top-of-Canopy NDVI, EVI
- AVI = Placeholder for future index

- Leaf Area Index
- Fraction of Absorbed Photosynthetically Active Radiation

- Net Photosynthesis
- Net Primary Production
- Gridded Weekly NDVI

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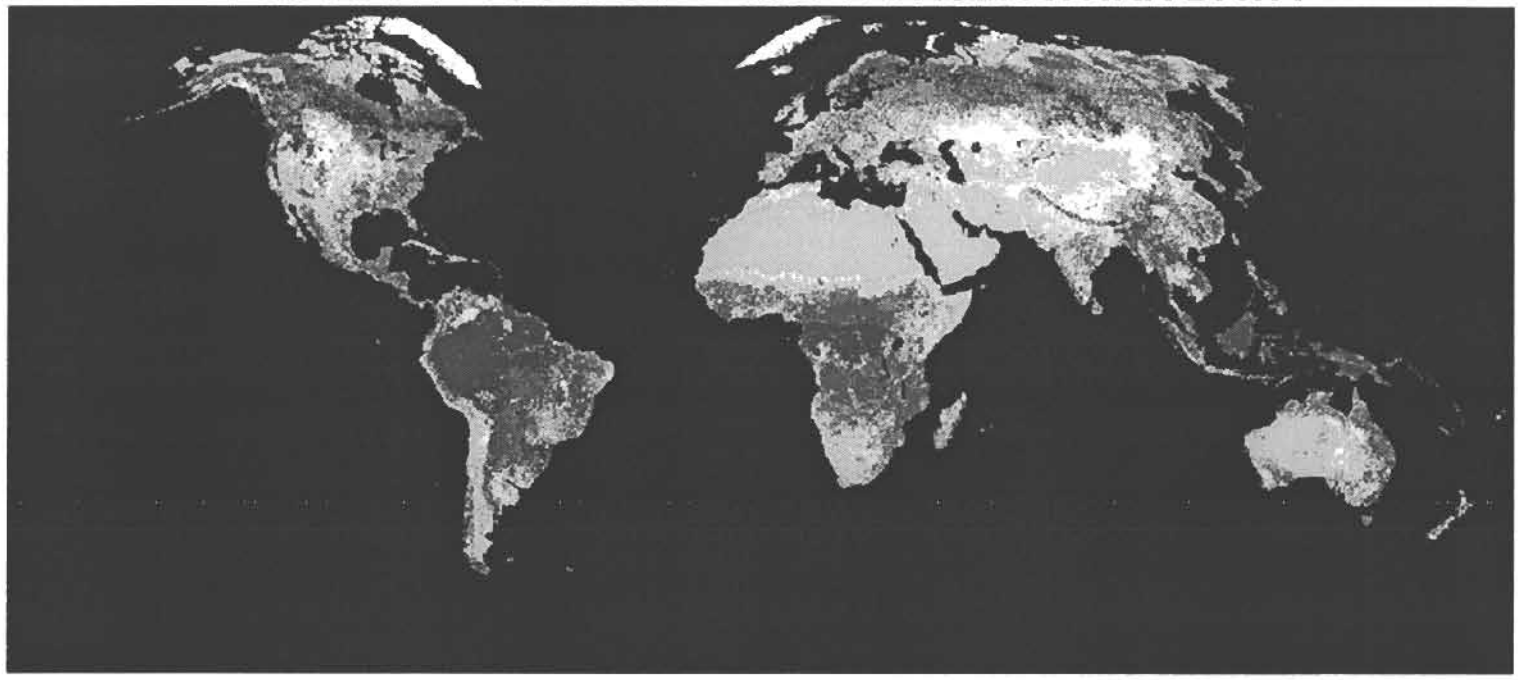
Surface Type EDR Based on Quarterly Application of a Decision Tree

PROTOTYPE OUTPUT DERIVED FROM AVHRR DATA



- Water Bodies
- Everg. Needl. For.
- Everg. Broadl. For.
- Dec. Needl. For.
- Dec. Broadl. For.
- Mixed Forests
- Closed Shrublands
- Open Shrublands
- Woody Savannas
- Savannas
- Grasslands
- Perm. Wetlands
- Croplands
- Urban/Built-up
- Nat. Veg./Crop. Mosaic
- Snow/Ice
- Barren

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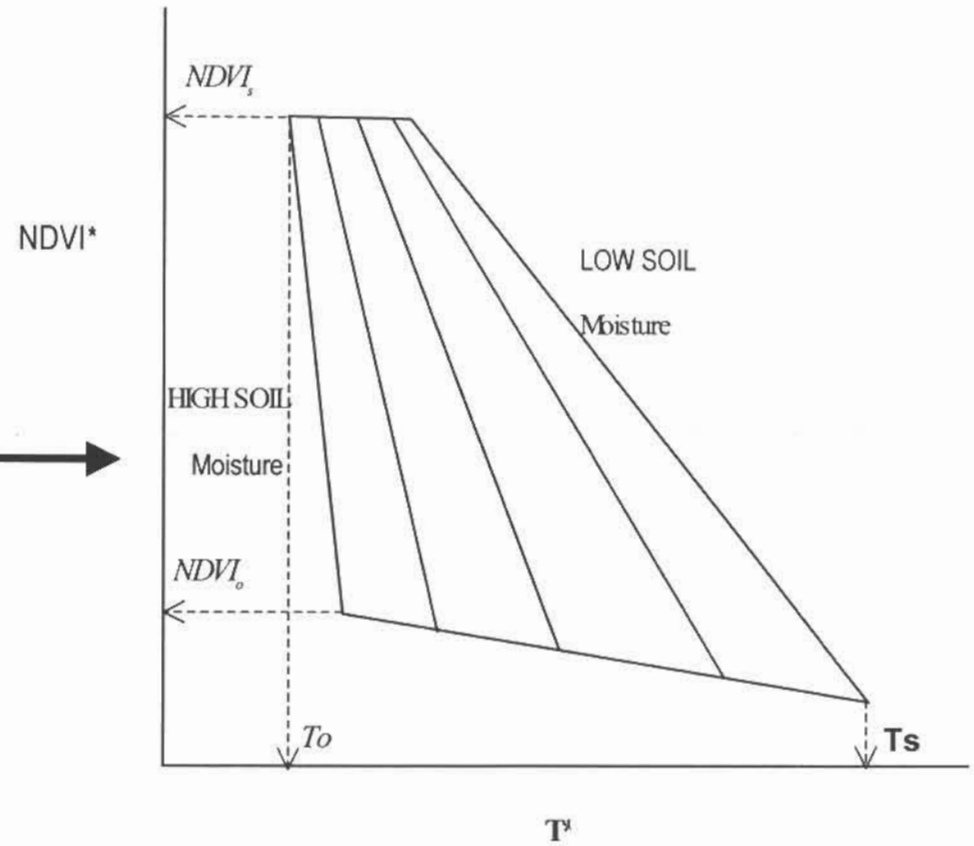
Soil Moisture Approach Fuses Microwave and Optical Remote Sensing

- Relates microwave-derived soil moisture to VIIRS-derived NDVI, albedo, and surface temperature
- Based on "universal triangle" from Carlson (1998)
- Will complement CMIS Soil Moisture product, which is a key NPOESS EDR



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Several Other Intermediate Land Products Will Be Generated

- Surface Reflectance IP extended into globally gridded products:
  - Gridded Daily, Weekly, and Monthly Surface Reflectance
  - Gridded Monthly Non-Snow Surface Reflectance
  - Gridded Weekly and Monthly Vegetation Index
  - Gridded Surface Albedo (for dark pixel algorithm)
- Surface Type IPs generated every three months:
  - Surface Types-Biomes IP, Surface Types-Olson IP, and Quarterly Surface Types IP
- Biophysical products generated on global grid
  - PSN, NPP, Weekly Vegetation Index
  - Machinery will exist for gridding LAI and FPAR as well, if this is desired by the end users

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VIIRS Land Products Integrated as a System

- Purpose of Phase II algorithm development was to convert theoretical bases into software designs and prototype code
- Land algorithms have been developed as a system
- Integration and testing has been conducted since early in Phase I; many of the results are shown in the Algorithm Theoretical Basis Documents (ATBDs, publicly available)
- VIIRS will continue and enhance the land climatologies established by AVHRR and expanded by MODIS

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