CEOS WGCV
Land Product Validation (LPV) Sub-Group: Current and Potential Roles in Future Decadal Survey Missions

Miguel O. Román\textsuperscript{1} for Joanne Nightingale\textsuperscript{1,2}, Jaime Nickeson\textsuperscript{1,2} & Gabriela Schaepman-Strub\textsuperscript{3}

\textsuperscript{(1)NASA GSFC, \textsuperscript{2}Sigma Space Corp, \textsuperscript{3}University of Zurich}

~ With input from LPV Focus Group Leads
Outline

• Re-cap: Objectives and Goals
• LPV Structure Updates
• LPV activities relevant to HyspIRI
• Cal/Val Plans for VIIRS Land Science Products
Linkages between International Programs concerned with Terrestrial Earth Observation

GEO / GEOSS
Group on Earth Observations / Global Earth Observation System of Systems
URL: http://www.earthobservations.org/
Portal: http://www.earthobservations.org/cgi_ap.shtml

SBSTA
Subsidiary Body for Scientific and Technological Advance

UNFCCC
United Nations Framework Convention on Climate Change

GCOS
Global Climate Observation System
URL: http://www.wmo.int/pages/prog/goos/index.php

GOOS
Global Ocean Observation System
URL: http://www.earthobservations.org/goos.php

GTOS
Global Terrestrial Observation System
URL: http://www.fao.org/gtos/

TOPC
Terrestrial Observation Panel for Climate
URL: http://www.wmo.int/pages/prog/goos/index.php?name=TOPC

AOPC
Atmospheric Observation Panel for Climate

OOPC
Ocean Observations Panel for Climate

TCO
Terrestrial Carbon Observations

C-GTOS
Coastal GTOS

GT-NET
Global Terrestrial Observing Network

GOFC/GOLD
Global Observations of Forest and Land Cover Dynamics
URL: http://www.fao.org/forestry/land-cf/land-cf.fr/

Land Cover
Fire
Biomass

SAR
Synthetic Aperture Radar

TMSG
Terrain Mapping

ACSG
Atmospheric Chemistry

IVOS
Infrared Visible Optical Sensors

MSSG
Microwave Sensors

LPV
Land Product Validation

Disasters
Health
Energy
Climate
Water
Weather
Ecosystems
Agriculture
Biodiversity

CDC
Capacity Building Committee

CEOS
Committee on Earth Observation Satellites
URL: http://www.ceos.org/

WGCI
Working Group on Information Systems and Services

WGCV
Working Group on Calibration and Validation

WG
Climate
WG-Edu
Virtual Constellations

Land Cover
Biophysical
Surface Radiation
Land Surface Temperature
Soil Moisture
Phenology
Snow / Ice
To foster and coordinate **quantitative validation** of higher level global land products derived from remotely sensed data, in a traceable way, and to relay results so they are relevant to users.

- To increase the **quality and efficiency** of global satellite product validation by developing and promoting international **standards and protocols** for:
  - Field sampling
  - Scaling techniques
  - Accuracy reporting
  - Data / information exchange

- To provide feedback to international structures (GEOSS) for:
  - Requirements on product accuracy and quality assurance (QA4EO)
  - Terrestrial ECV measurement standards
  - Definitions for future missions
LPV Sub-group Structure

8 Land Product Focus Groups – 2 international co-leads

Chair: Joanne Nightingale 2010 - 2013
(NASA GSFC)

Vice-Chair: Gabriela Schaepman-Strub
(University of Zurich)

Support: Jaime Nickeson
(NASA GSFC)
# Focus Groups

<table>
<thead>
<tr>
<th>Focus Group</th>
<th>North America</th>
<th>Europe / Other</th>
<th>Listserv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Cover*</td>
<td>Mark Friedl</td>
<td>Martin Herold</td>
<td>137</td>
</tr>
<tr>
<td></td>
<td>(Boston University)</td>
<td>(Wageningen University, NL)</td>
<td></td>
</tr>
<tr>
<td>Fire*</td>
<td>Luigi Boschetti</td>
<td>Kevin Tansey</td>
<td>73</td>
</tr>
<tr>
<td>(Active/Burned Area)</td>
<td>(University of Maryland)</td>
<td>(University of Leicester, UK)</td>
<td></td>
</tr>
<tr>
<td>Biophysical - LAI*</td>
<td>Richard Fernandes</td>
<td>Stephen Plummer</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>(NR Canada)</td>
<td>(Harwell, UK)</td>
<td></td>
</tr>
<tr>
<td>Biophysical - fAPAR*</td>
<td>Fred Huemmrich</td>
<td>Nadine Gobron</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>(NASA GSFC)</td>
<td>(JRC, IT)</td>
<td></td>
</tr>
<tr>
<td>Surface Radiation</td>
<td>Crystal Schaaf</td>
<td>Gabriela Schaepman</td>
<td>41</td>
</tr>
<tr>
<td>(Reflectance, BRDF, Albedo*)</td>
<td>(Boston University)</td>
<td>(University of Zurich, SW)</td>
<td></td>
</tr>
<tr>
<td>Land Surface Temperature*</td>
<td>Simon Hook</td>
<td>Jose Sobrino</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>(NASA JPL)</td>
<td>(University of Valencia, SP)</td>
<td></td>
</tr>
<tr>
<td>Soil Moisture*</td>
<td>Tom Jackson</td>
<td>Wolfgang Wagner</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>(USDA)</td>
<td>(Vienna Uni of Technology, AT)</td>
<td></td>
</tr>
<tr>
<td>Land Surface Phenology</td>
<td>Jeff Morisette</td>
<td>Jadu Dash</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>(USGS)</td>
<td>(University of Southampton, UK)</td>
<td></td>
</tr>
<tr>
<td>Snow/Ice*</td>
<td>Dorothy Hall</td>
<td>Jouni Pulliainen</td>
<td>13+</td>
</tr>
<tr>
<td></td>
<td>(NASA GSFC)</td>
<td>(Finish Instit of Meteorology, FI)</td>
<td></td>
</tr>
</tbody>
</table>
LPV Webpage: http://lpvs.gsfc.nasa.gov/

Meetings related to Soil Moisture
Upcoming Meetings

- EUNETSAT ESA Scatterometer Science Conference
  Centraltull
  Darmstadt, Bundesland Germany

  The conference will address Level 1 (backscatter) and Level 2 (soil moisture) validation and calibration activities for the METOP Advanced Scatterometer and prepare for future scatterometer missions that hold a large potential for long-term soil moisture monitoring. Also, soil moisture applications will be covered.

- SMAP CalVal Workshop #2
  Embassy Suites Hotel
  Oxnard, CA USA

  As a result of the preliminary CalVal plan and previous workshops involving the science community, activities were initiated to support the objectives of CalVal. These included field campaigns to provide specific data sets for the algorithm teams, developing tower and aircraft-based simulators, and developing and implementing methods for integrating the diverse in situ resources available for validation. As part of this workshop, results to date will be reviewed and additional requirements identified. These activities include additional field campaigns.

- Joint GEMW International Soil Moisture Working Group (ISMW) and CEOS Soil Moisture Validation (SMV) Meeting
  Embassy Suites Hotel
  Oxnard, CA USA

  The ISMW and the newly formed CEOS Soil Moisture Validation (SMV) Focus Group will hold a joint meeting to address mutual areas of interest and to formulate plans to establish and document validation protocols and data sharing. This one day meeting will be held in conjunction with the SMAP CalVal Workshop to be held in the US in the Spring of 2011.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>SMAP SSt</th>
<th>Temporal Scales: Day, Mon, 15 day, Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Spatial Coverage: CONUS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temporal Coverage: 200+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spatial Scale: 250m x 250m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temporal Scale: 7, 14 day</td>
</tr>
</tbody>
</table>

- MODS, derived from MODIS
  Contact: Cell Jekkersen
  Institution: USGS-EOSS

<table>
<thead>
<tr>
<th>Instrument</th>
<th>SMAP SSt</th>
<th>Temporal Scales: Day, Mon, 15 day, Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Spatial Coverage: Global</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temporal Coverage: 200+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spatial Scale: 1 km</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temporal Scale: 5 day</td>
</tr>
</tbody>
</table>
LPV Activities relevant to HysPIRI
## HyspIRI Products

<table>
<thead>
<tr>
<th>LPV Focus Group / Product</th>
<th>VSWIR L 2/ 3</th>
<th>VSWIR L4</th>
<th>VSWIR Global</th>
<th>TIR L4</th>
<th>SWIR / TIR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LAND COVER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fractional land cover / veg. cover</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disturbance, PFT, hazard susceptibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SURFACE RADIATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Reflectance</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Albedo</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BIOPHYSICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross / Net Primary Production</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fPAR</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAI</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water content, LUE, Pigments</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FIRE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detection of Fire events</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire fuel loads</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LAND SURFACE TEMPERATURE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LST</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissivity</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evapotranspiration</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Existing Val Methods*  *Research Required*
Official recognition of the need for long-term in-situ radiation measurements for spectral and broadband BRDF/albedo.

Stresses importance of BSRN, Fluxnet, AERONET.

Provides guidelines for data collection protocols and standardization across the flux networks.

Schaaf et al., 2008
Land Cover Focus Group

- Implementation of a global sample design and database for land cover validation independent of specific products
- Design provides a global stratified sample of LC validation sites based on climate/vegetation biomes & population data, sample sites are 5km x 5km
- “Ground truth” derived from very high resolution imagery with the assistance of local experts
OLIVE (OnLine Interactive Validation Exercise) (Baret et al.)

Web-interface tool for independent validation of biophysical land products (LAI, fAPAR and Albedo)

Will provide existing in situ data and high resolution scaled reference maps for validation, new validation datasets may be submitted

Technical specifications document undergone review by ESA and key LPV members

Operational mid-2011

User workshop scheduled for early 2012
LPV and Data Quality

- LPV starting involvement with WGCV – WGISS and ESIP Federation Information Quality Cluster (GSFC)
- IQ cluster
  - Quality of remote sensing data, terminology, standardization, IQ framework, IQ4EO white paper preparation
- Standards for “ALL remote sensing products”:
  - Metadata
  - QA flags
- Assessment of “fitness for purpose” and ways of defining this within product meta-data
- LST community via HyspIRI product planning and Barrax field campaign work are willing to be the first “test case”
Cal/Val Plans for VIIRS Land Science Products
VIIRS Land Validation Team Activities

NASA’s Role:

- To continue the scientific data record started in the EOS era.
- To coordinate algorithm development, QA, and validation activities for “Science-quality” products.
- Reprocessing will also be required to produce consistent, integrated, EOS/NPP/JPSS long term data records.

JPSS-DPA Objectives:

- To validate the VIIRS Land EDRs, IPs, and ARPs to meet operational performance requirements.

NPP (10:30 orbit)

NPP Launch
Late 2011

PRE-LAUNCH

LAUNCH

EOC

ICV

LTM

(1) Land Surface Temperature (LST)
(2) Surface Type
(3) Active Fires (ARP)
(4) Surface Reflectance
(5) Ice age
(6) Ice motion
(7) Albedo
(8) Vegetation Index
(9) Snow Cover/Depth
(10) Ice Concentration
(11) Ice Surface Temperature

EDR Validation
NPP-VIIRS Land/Cryosphere Products

Monitor Sensor Stability

Local Equatorial Crossing Time

0530
0930
1330

JPSS
METOP
DoD

Build Team
Sensor Characterization
Post-Lauch Plan Dev.
Resource ID & Development
Alg. Assessment & Verifications
Cal/Val Tool Development

Estab. Sensor Stability
SDR Validation
Key EDR Validation
Mission Integration
Product Ops Viability
EDR Validation

VIIRS Land Validation Team Activities

To validate the VIIRS Land EDRs, IPs, and ARPs to meet operational performance requirements.

NASA’s Role:

- To continue the scientific data record started in the EOS era.
- To coordinate algorithm development, QA, and validation activities for “Science-quality” products.
- Reprocessing will also be required to produce consistent, integrated, EOS/NPP/JPSS long term data records.

NPP (10:30 orbit)
Aircraft Campaigns in Support of VIIRS Cal/Val Efforts

From Sensor Data Records...

- Airborne simulators support prototyping and testing of Level 1 VIIRS Sensor Data Records (SDRs).
- Provide verification of sensor calibration and stability during ICV and LTM.

... to Global Land Products (AMS/Ikhana)

Simulated Bands:
- ETM+ B1-B4
- MODIS B27
- VIIRS M15-M16

IFOV: 2.5 mrad
FOV: 85.9°
GIFOV: 50 m

(CAR/P3-B)

Simulated Bands:
- ETM+ B1-B4
- MODIS B1,B2,B3,B5
- VIIRS I2, M3, M5, M7-8

IFOV: 17.5 mrad
FOV: 190.0°
GIFOV: 4.0-500 m

Surface Reflectance, VI, BRDF, and Albedo (see poster display)

- Development and testing of standard products (L2+); Provides critical in-situ data for multi-sensor validation and intercomparison studies.