

WORKING GROUP ON CALIBRATION & VALIDATION



**CEOS WGCV**

# **Land Product Validation Sub-Group**

Joanne Nightingale<sup>1</sup>, Jaime Nickeson<sup>1</sup> &  
Gabriela Schaepman-Strub<sup>2</sup>

(<sup>1</sup>Sigma Space Corp / NASA GSFC, <sup>2</sup>University of Zurich)

*~ With input from LPV Focus Group Leads*

# Outline

- Objectives and Goals
- LPV Structure
- Updates on LPV activities per Focus Area

# LPV Objective & Goals

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

Chair: Joanne Nightingale 2010 - 2013  
(NASA GSFC)

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

Support: Jaime Nickeson  
(NASA GSFC)

8 Land Product Focus Groups – 2 international co-leads

# Focus Groups

\* ECV


Focus Group	North America	Europe / Other	Listserv
Land Cover*	Pontus Olofsson (Boston University)	Martin Herold (Wageningen University, NL)	176
Fire* (Active/Burned Area)	Luigi Boschetti (University of Idaho)	Kevin Tansey (University of Leicester, UK)	75
Biophysical - LAI*	Richard Fernandes (NR Canada)	Stephen Plummer (Harwell, UK)	88
Biophysical - $fAPAR$ *	Arturo Sanchez-Azofeifa (University of Alberta)	Nadine Gobron (JRC, IT)	
Surface Radiation (Reflectance, BRDF, Albedo*)	Crystal Schaaf (U Mass Boston)	Gabriela Schaepman (University of Zurich, CH)	45
Land Surface Temperature & Emissivity	Simon Hook (NASA JPL)	Jose Sobrino (University of Valencia, ES)	135
Soil Moisture*	Tom Jackson (USDA)	Wolfgang Wagner (Vienna Uni of Technology, AT)	49
Land Surface Phenology	Matthew Jones (University of Montana)	Jadu Dash (University of Southampton, UK)	86
Snow/Ice*	Dorothy Hall (NASA GSFC)	Tao Che (Chinese Academy of Sciences)	71





# Role of LPV Focus Groups

- Engage community members (via listserv/website)
  - Periodic updates sent to mailing lists
  - Meeting announcements on website
- Organize at least 1 topical workshop within leadership term
  - Land Cover – June 2011
  - LAI/fPAR/OLIVE – February 2012
  - Phenology – September 2012
- Expand LPV activities, field sites, collaboration **globally**
- Lead the development and writing of “best practice” **land product validation protocols**
- Lead **product inter-comparison** activities
- Define product error definitions for ECV’s / LTDR’s for the climate modeling community



# LPV Webpage


**GODDARD SPACE FLIGHT CENTER**
[+ NASA Homepage](#)

**CEOS Working Group on Calibration and Validation**





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## Land Product Validation

**Focus Areas**

- Biophysical
- Fire/Burn Area
- Land Use
- Phenology
- Snow Cover
- Soil Moisture

### Announcing...

QA4ED Workshop on Providing Harmonised Quality Information in EO Data by 2015, 18-20 October 2011. [Download announcement.](#)

LEAPS 3rd Science Conference, 18-23 September 2011, Garmisch-Partenkirchen, Germany. Abstracts due 15 April.

CEOS WGCY 33rd plenary meeting, Moscow, Russia, 17-20 May 2011.

The LPV Soil Moisture Focus Group will hold a joint meeting May 5, 2011 in Oxnard, CA.

ISRSE 34, including special session on ground networks, 10-15 April 2011, Sydney, Australia.

### Data access

[LPV Core Sites](#)  
[Cal/Val Portal](#)

### Subscribe!

LPV subgroup focus area mailing lists.  
 Choose a group:  
  
  
[How to use these mailing lists](#)

[Link to current](#)  
**CEOS Calendar**

### Background

### Products

### Meetings

### Case Studies

### Inter-comparisons

## Meetings related to Soil Moisture

### Upcoming Meetings

- [EUMETSAT/ ESA Scatterometer Science Conference](#)

Centralstation  
 Darmstadt, Bundesland Germany  
 4/11/2011 - 4/13/2011

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 Cal/Val Workshop #2](#)

Embassy Suites Hotel  
 Oxnard, CA USA  
 5/3/2011 - 5/5/2011

As a result of the preliminary Cal/Val plan and previous workshop involving the science community, activities were initiated to support the objectives of Cal/Val. 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 GEWEX International Soil Moisture Working Group \(ISMWG\) and CEOS Soil Moisture Validation \(SMV\) Meeting](#)

Embassy Suites Hotel  
 Oxnard, CA USA  
 5/5/2011 - 5/5/2011

The ISMWG 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 Cal/Val Workshop to be held in the US in the Spring of 2011.

**Institution:** NASA-JPL

[Link to validation information](#)

**Spatial Scale:** 1 km

**Temporal Scale:** Day, Mon, Qtr, and Annual

**eMODIS**, derived from MODIS

**Contact:** [Calli Jenkerson](#)

**Institution:** USGS-EOS

**Spatial Coverage:** CONUS

**Temporal Coverage:** 2000+

**Spatial Scale:** 250m/500m/1K

**Temporal Scale:** 7, 14 day

**LAI**, derived from MODIS

**Contact:** [Ranga Myneni](#)

**Institution:** Boston University

[Link to validation information](#)

**Spatial Coverage:** Global

**Temporal Coverage:** 2000+

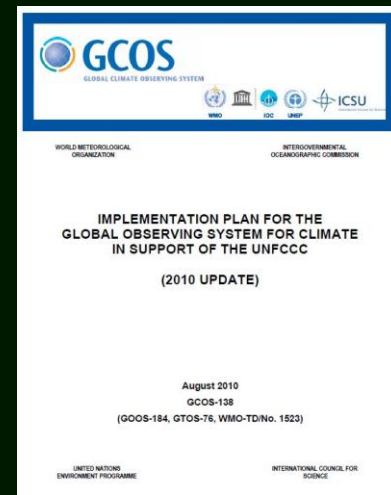
**Spatial Scale:** 1 km

**Temporal Scale:** 8-day

<b>Stage 1 Validation</b>	Product accuracy is assessed for time periods by comparison with reference data.
<b>Stage 2 Validation</b>	Product accuracy is estimated over periods by comparison with reference data. Spatial and temporal consistency has been evaluated over globally representative sites. Results are published in the peer-reviewed literature.
	Uncertainties in the product and its associated structure are well quantified from comparison with reference in situ or other suitable reference data. Uncertainties are characterized in a statistically robust way over multiple locations and time periods.

# LPV Involvement in GEOSS

- Ensuring land val community needs are addressed by GCOS, GTOS
  - CEOS response to GCOS IP
  - 138 action items / 12 relate directly to land validation: (data quality, inter-comparison, collection of insitu data)
- Providing recommendations to IGBP Integrated Observing Strategy & IPCC Assessments
  - Coordination between ground / space based observations
- As of March 2012 LPV is an official member of TOPC
  - LPV subgroup will provide guidance on publications aimed at defining ECV products and validation requirements (2013-2014 timeframe)
- Advising new satellite missions and projects on land product validation planning e.g.
  - NASA Decadal Survey – HypsIRI, SMAP
  - ESA Climate Change Initiative



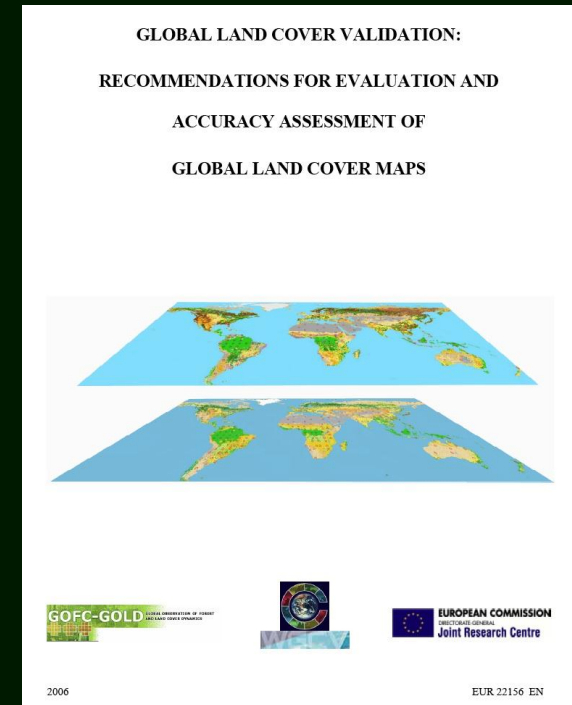


# LPV and Data Quality

- LPV involvement with WGCV – WGISS and ESIP Federation Information Quality Cluster (GSFC)
- Quality Information Standards for “ALL remote sensing products”:
  - Metadata
  - QA flags
- Assessment of “fitness for purpose” and ways of defining this within product metadata

# Land Product Protocols

- “Best practice” for land product validation
  - Current: knowledge, data, tools & methods
  - Peer-reviewed
  - CEOS endorsed/published
- Draft validation protocols:
  - Leaf Area Index
  - Land cover area change (via GOFC-GOLD)
  - Burned Area (via GOFC-Fire)
  - *Status of these provided within focus area status updates*



# Focus Group Reports

- Key activities since WGCV-34
- Planned activities / meetings

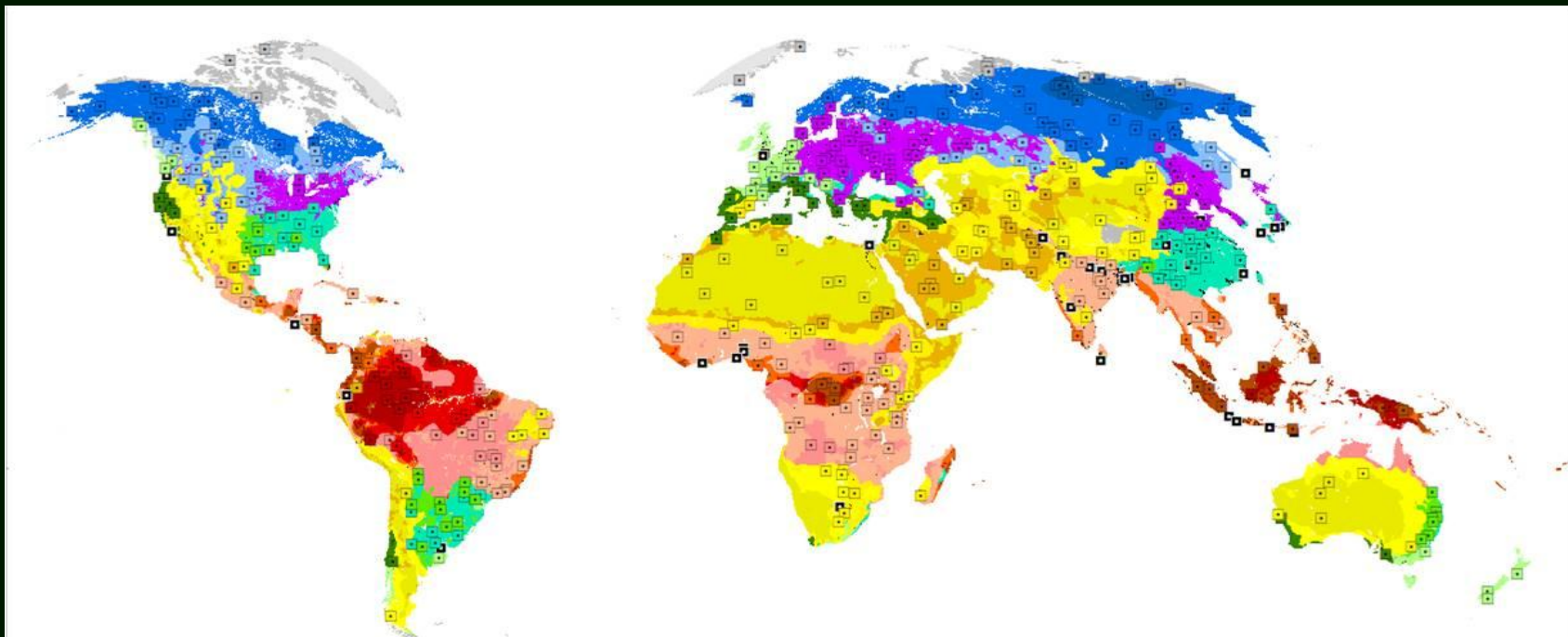
# Land Cover Focus Group

- GOFC-GOLD land cover project office is now re-established at Wageningen University (<http://www.gofcgold.wur.nl>)
- The office is providing dedicated support for the GEO global land cover task and the GEO FCT task and the Global Forest Observation Initiative (GFOI), where land validation issues are central
- Consolidation work achieved on the GlobCover validation database as part of the ESA Land Cover Climate Change Initiative
  - Work conducted in partnership with the Universite catholique de Louvain, Belgium
- The GOFC-GOLD Land Cover Implementation Team initiated a project to create a centralized and flexible validation database for global land cover map products
  - Harmonization rules are being sought for selection of the most appropriate databases. Databases will be made publicly available.

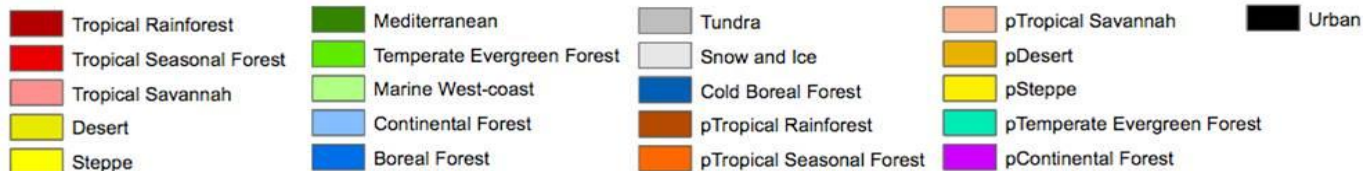
# Land Cover Focus Group

Continued progress on the very high spatial resolution satellite-based database being developed in partnership with Boston University:

- Refinement of the sample stratification
- Additional images acquired and interpreted
- Development of an online portal for the validation products



Global Validation Sites: Stratification & Geographic Sampling



# Land Cover Focus Group

## Land cover / use / area change validation protocol status

- Progress on developing best practices of validation land change and area estimates: scientific paper close to submission

## Previous meetings:

- GOFC-GOLD/CEOS WGCV LPV land cover meetings:
  - January 2012 in Boston
  - April 2012 in Frascati

## Future meetings:

- GOFC-GOLD land monitoring symposium with special session on land cover validation planned for 15-19 April 2013 in Wageningen.



# Fire Focus Group

- Activities being coordinated with US- and EU/ESA-led projects and GOFC-GOLD Fire IT
  - GEOLAND2
  - ESA CCI
  - MODIS Active Fire and Burned Area products
  - VIIRS

## Future meetings:

- EARSeL Forest Fire workshop being held in the UK in October 2013 and validation will be a discussion point.

# Fire Focus Group

- Work is ongoing for the generation of a CEOS Stage 3 burned area validation dataset as part of MODIS Validation activities
  - Aligned progress by the ESA CCI teams
- References datasets primarily consist of “Landsat Pairs” based on 3 priorities:
  1. *Ensure the accuracy of the reference data*: local partners involved in the interpretation of the high resolution data
  2. *Temporal consistency*: map the changes between two acquisitions
  3. *Spatial consistency*: differentiate between unburned areas and areas that could not be interpreted due to data quality issues, or not visible because of clouds or shadows
- **Burned Area Validation Protocol** - *still in progress*
  - Draft documentation being produced by ESA CCI and MODIS fire teams that need to be integrated
  - Documentation and reference datasets to be delivered in the future depending on funding to support the activities

# Biophysical Focus Group: LAI

## LAI Validation Protocol

- Full draft complete and sent for community review February 2012
- Community feedback (~15 people) has been collected, responses to comments and inclusion of comments into a new draft of the document are pending
- Defines internationally accepted definitions of LAI and associated quantities to ensure thematic compatibility
- Defines conversions between quantities, reviews sampling and scaling techniques, direct and indirect validation and consistency checking measures
- Provides 104 detailed recommendations for best practice to:
  - CEOS agencies
  - LAI product producers
  - Scientific research community
  - LAI product validation investigators

# Biophysical Focus Group: fPAR

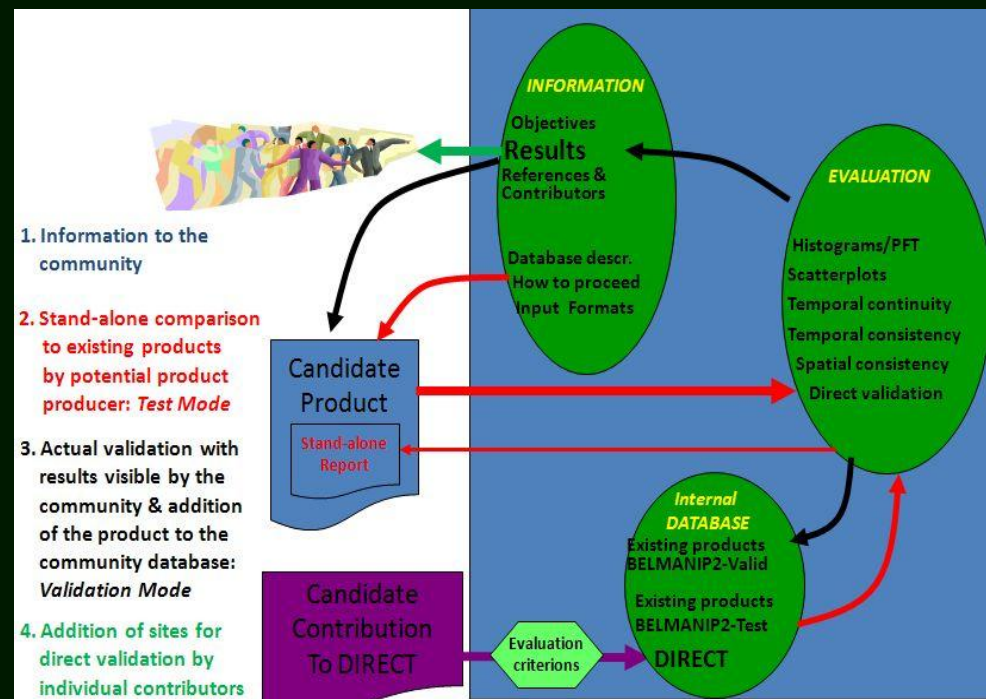
- New co-lead Dr Arturo Sanchez-Azofeifa (University of Alberta, Canada)
- Invitation sent out to the fPAR community to conduct a product spatio-temporal comparison
  - Several teams already working on fPAR product comparisons to be integrated into a LPV exercise:
    - Michele Meroni et al. "Evaluation of Agreement between Space Remote Sensing SPOT-VEGETATION fAPAR Time Series" IEEE TGARS, In press.
    - Dr Christopher Pickett-Heaps from CSIRO Marine & Atmospheric Research is currently conducting an analysis and comparison of the main FAPAR products over Australia against ground-based measurements and a land surface model.
    - Dr. Petra Dodorico from University of Zurich (Europe).

## Future meetings:

- FPAR product validation workshop to be scheduled for early 2013



- OLIVE (OnLine Interactive Validation Exercise) (Baret *et al.*)
- Web-interface tool for independent validation of biophysical land products (LAI, fAPAR and Albedo) – **on CalVal Portal!**
- Will provide existing in situ data and high resolution reference maps for validation, new validation datasets may be submitted
- Technical specifications document reviewed by ESA and key LPV members
- Operational ~ 2012
- User demonstration @ Fall AGU 2012



# Surface Radiation Focus Group

- Activities being coordinated with US- and EU-led projects
  - **GLOBALBEDO** - Processing continues and is expected to be completed by the end of the year
  - **GEOLAND 2** – Validation report has been officially released
  - **MODIS Albedo** – Collection V6 code has been delivered and is undergoing testing. Reprocessing of entire MODIS land product record will commence over the winter 2012
  - **VIIRS Albedo** – Still in pre-beta phase and undergoing testing
- Participation at the Baseline Surface Radiation Network (BSRN) Meeting in August in Potsdam. The BSRN continues to be the gold standard of reflected measurements for validation of albedo products
- Participation in the First NEON (National Ecological Observatory Network - funded by NSF) air campaign at Harvard Forest



# Soil Moisture Focus Group

- Release of 30-year soil moisture time series and associated Product Validation Plan as part of ESA's CCI programme
- GCOM-W with AMSR2 launched in May appears to be working well and getting ready for operations
- SMAP passed CDR, was assigned a launch vehicle, and date (October 20, 2014)
- Two book chapters on validation and the challenges faced by operational soil moisture providers included in a Taylor & Francis book on soil moisture and evapotranspiration (George P. Petropoulos. Ed. In prep)

# Soil Moisture Focus Group

## Previous meetings:

- SMAPVEX12 was conducted June 7-July 19, 2012 near Winnipeg, Manitoba  
<http://smap.jpl.nasa.gov/science/Validation/Campaigns/>
- Launch of Round Robin exercises for Level 2 soil moisture retrieval algorithms for ASCAT and AMSR-E

## Future meetings:

- SMAP Cal/Val Workshop Nov. 14-16, 2012 Oxnard, CA  
<http://smap.jpl.nasa.gov/science/Validation/>

# Land Surface Temperature & Emissivity

- North American ASTER Land Surface Emissivity Database (*NAALSED*) v3 is about to be released and made available through the EDC DAAC
- The new T-E separation algorithm for MODIS has been implemented and is being tested. This algorithm is similar to the ASTER algorithm and designed specifically to retrieve accurate emissivity at 1 km resolution – MOD21.
- ASTER Global Emissivity Map (ASTER-GEM) is available (incl. N America, Africa and Australia) from <http://emissivity.jpl.nasa.gov>
- A paper “A radiance-based method for estimating uncertainties in the Atmospheric Infrared Sounder (AIRS) land surface temperature product” has been accepted in Journal of Geophysical Research.
- Draft HypsIRI ATBDs for surface radiance and temperature-emissivity were made available on the HypsIRI website. These provide the fundamental basis for the algorithms being used with ASTER, MODIS and HypsIRI.
- The airborne Hyperspectral Thermal Emissions spectrometer (HyTES) had its first flights in July, 2012. HyTES has 256 spectral channels between 7.5-12 um and is ideally suited for LST&E validation.

# Land Surface Temperature & Emissivity

## Previous meetings:

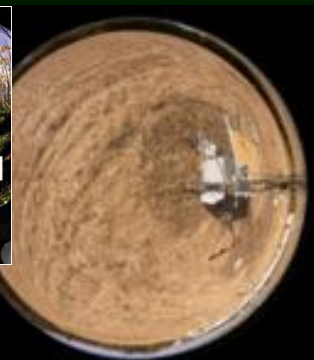
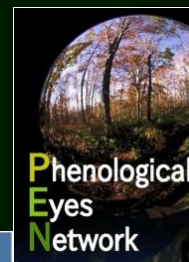
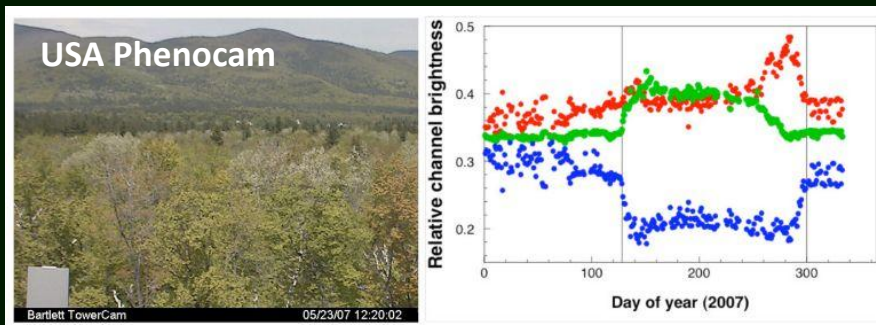
- The first Global Lake Temperature Collaboration (GLTC) was held in Lincoln, Nebraska on June 1-5, 2012. The meeting had over 40 attendees from 11 countries. More details at: <http://snr.unl.edu/GLTC/index.html>. A summary article has been accepted in AGU-EOS
- The first EarthTemp Network Meeting was held in Edinburgh, Scotland on 25-26 June. A workshop report is in progress
- The first ESA Global Temperature User Consultation Meeting was held in Edinburgh, Scotland on 27-28 June 2012 (<https://sites.google.com/site/simonpinnock/home/globtemperature>)

## Future meetings:

- The 2012 HypsIRI Science Workshop will be held in Washington DC on Oct 16-18. See: <http://hyspiri.jpl.nasa.gov> for more details.

# LSP Focus Group

- 2<sup>nd</sup> Bi-annual LSP validation meeting, Milwaukee WI (Sept 14) ~ 30 participants
- What's **new** since the last meeting?
  - Results from NACP indicate that better phenology is needed for climate models
  - Growing Global Phenology Observation and Camera Networks
  - Advances in both optical and active sensors for deriving vegetation seasonality
- What's the **same**?
  - No dedicated person/group/funding to move the effort forward
- Further discussion on selection of sites to conduct product inter-comparison and validation with field observations and near-surface sensors
  - Type A: Ground network observations and multiple resolution scaling analysis
  - Type B: Phenocams with ground network observations
- Planning to have a side-meeting at Fall AGU to discuss progress on site selection and next steps – working toward proposal to fund efforts...



# LSP Focus Group

- Discussion on Phenology “timing of changes” as an ECV variable to monitor over the long term based on recent GCP paper

???

## Global Change Biology

Global Change Biology (2012) 18, 566–584, doi: 10.1111/j.1365-2486.2011.02562.x

### Terrestrial biosphere models need better representation of vegetation phenology: results from the North American Carbon Program Site Synthesis

ANDREW D. RICHARDSON\*, RYAN S. ANDERSON†, M. ALTAFARAIN‡, ALAN G. BARR§, GIL BOHRER¶, GUANGSHENG CHEN\*\*, JING M. CHEN††, PHILIPPE CIAIS‡‡, KENNETH J. DAVIS§§, ANKUR R. DESAI¶¶, MICHAEL C. DIETZE\*\*\*, DANILO DRAGONI†††, STEVEN R. GARRITY‡‡‡, CHRISTOPHER M. GOUGH§§§, ROBERT GRANT¶¶¶, DAVID Y. HOLLINGER\*\*\*\*, HANK A. MARGOLIS††††, HARRY MCCAUGHEY‡‡‡‡, MIRCO MIGLIAVACCA§§§§, RUSSELL K. MONSON¶¶¶¶, J. WILLIAM MUNGER\*\*\*\*\*, BENJAMIN POULTER†††††, BRETT M. RACZKA§§, DANIEL M. RICCIUTO‡‡‡‡, ALOK K. SAHOO§§§§§, KEVIN SCHAEFER¶¶¶¶¶, HANQIN TIAN\*\*\*\*\*, RODRIGO VARGAS††††††, HANS VERBEECK‡‡‡‡‡, JINGFENG XIAO§§§§§§ and YONGKANG XUE¶¶¶¶¶¶



# Snow Focus Area

- New co-lead, Dr Tao Che from CAS
- New dataset:
  - Global snow water equivalent datasets from Chinese Meteorological Administration based on the FY3B MWRI brightness temperature data.  
<http://satellite.cma.gov.cn/arssen/>
- Grant:
  - Key techniques for validation of remote sensing products by an integrated experiment, granted by the Ministry of Science and Technology of the People's Republic of China, start April 2012. One of the objectives is to validate the snow cover products in mountain regions in China, and to compile a guide for the validation of snow cover and snow depth/snow water equivalent products

## Future meetings:

- International Conference on Cryosphere: Changes, Impacts and Adaptation. Sanya, China. November 10 –12, 2012

# Upcoming LPV Meetings

- **Fall AGU 2012**
  - Session IN039 on Quality Assessment of Satellite-Derived Land Surface Variables
  - San Francisco, California, Dec 3-7
    - *Side meetings for LSP and FPAR*
- **IGARSS 2013**
  - Planning for session on Advances in Observational Standards and Protocols for Terrestrial Essential Climate Variables
  - Melbourne, Australia, July 21-26

# Moving Forward...

- Continue to promote Land Validation in the GEOSS setting
- Continue to work with IGBP, IPCC, GCOS, GTOS, TOPC
- LPV Protocols— development *s/ow...* funding/resource/time constraints/coordination with other groups
- Contributing to QA4EO and ESIP Federation IQ Clusters
- Validation Field Sites / Existing Networks
  - Expanding outside of North America / Europe – future will see more collaboration with nationally funded ground observation networks such as NEON, TERN
- New Chair - 2013 at WGCV-36: Contenders for next vice-chair???

