



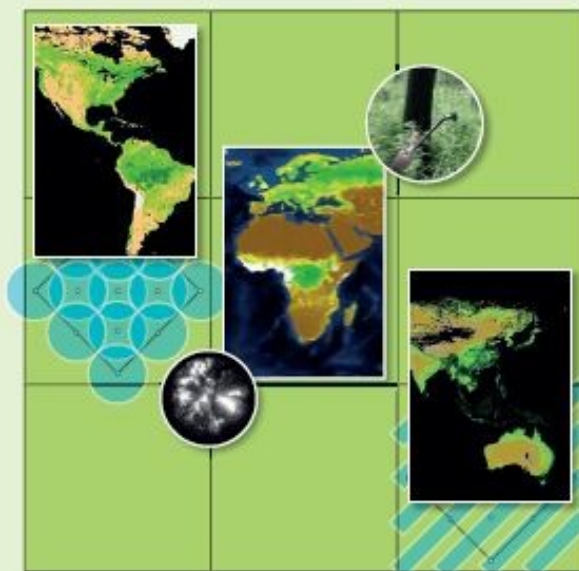
GLOBAL LEAF AREA INDEX PRODUCT VALIDATION *Good Practices*

Richard Fernandes, Stephen Plummer, Joanne Nightingale
Eds.

Contributors listed overleaf

Committee on Earth Observation Satellites
Working Group on Calibration and Validation
Land Product Validation Sub-Group

Global Leaf Area Index Product Validation Good Practices



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Editors: Richard Fernandes, Stephen Plummer, Joanne Nightingale

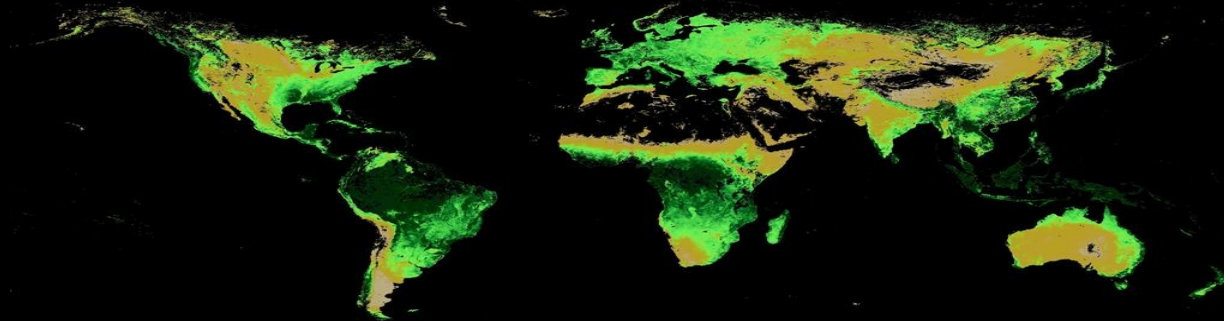
Contributors: Fred Baret, Fernando Camacho, Hongliang Fang, Sebastien Garrigues, Nadine Gobron, Matt Lang, Roselyn Lacaze, Sylvain LeBlanc, Michele Meroni, Beatriz Martinez, Tiit Nilson, Bernard Pinty, Jan Pisek, Oliver Sonnentag, Alexandre Verger, Jon Welles, Marie Weiss, Jean-Luc Widlowski, Gabriela Schaeppman-Strub, Miguel Roman, Jaime Nickeson

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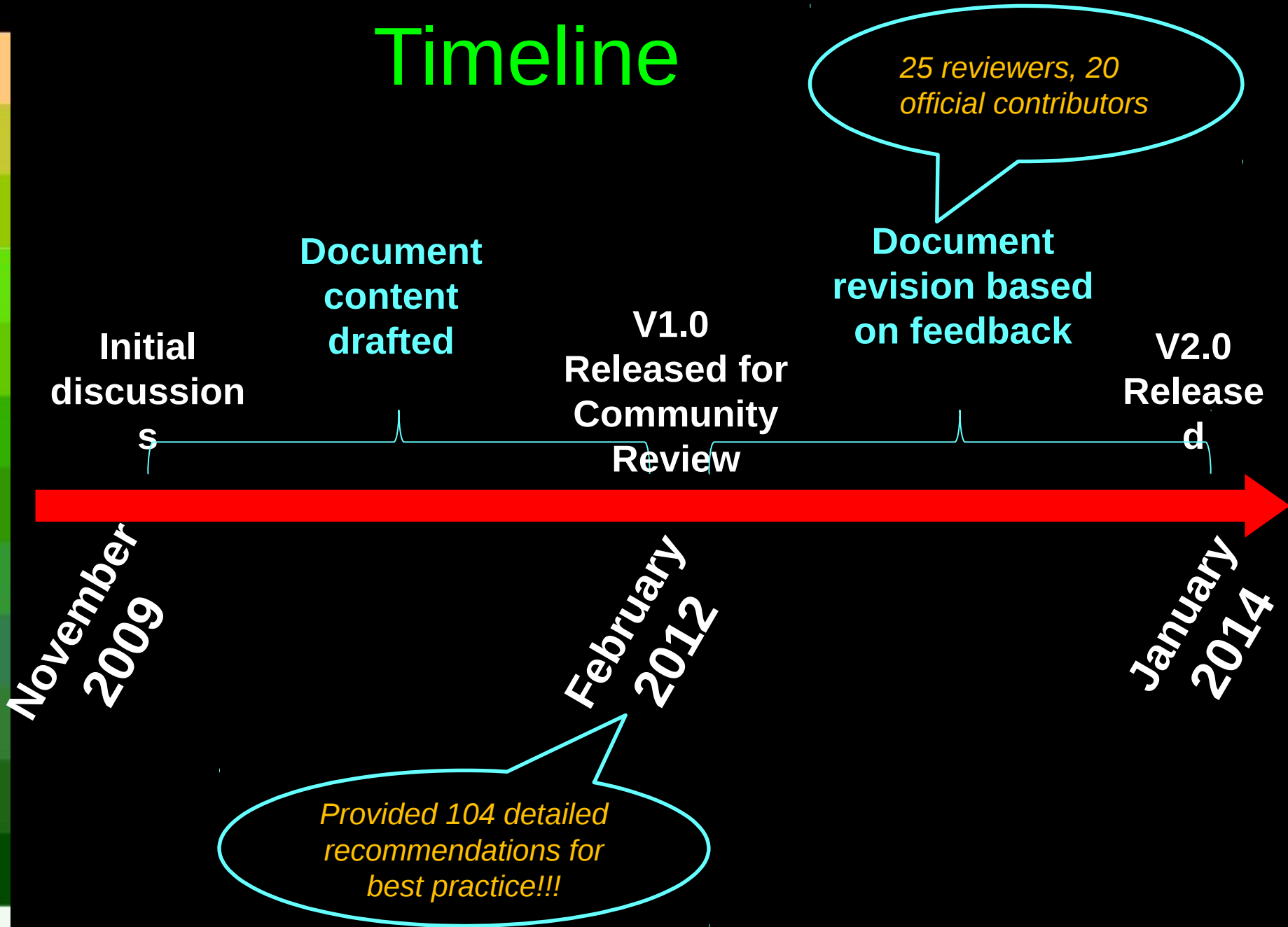
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Motivation

- CEOS Land Product Validation sub-group:
 - To increase the quality and efficiency of global satellite product validation by developing and promoting **international standards** and **best practices***
- ~ 15 satellite-derived LAI products
- Validation procedures mature enough to warrant development of internationally accepted good practices for validation

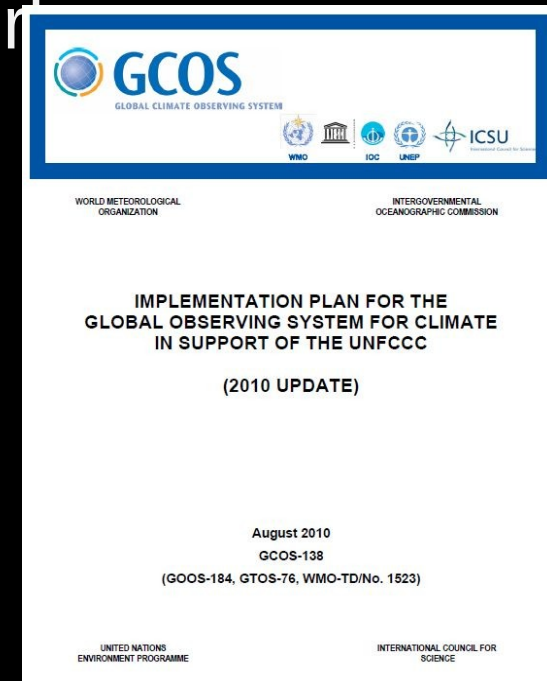


Timeline



Terms of Reference

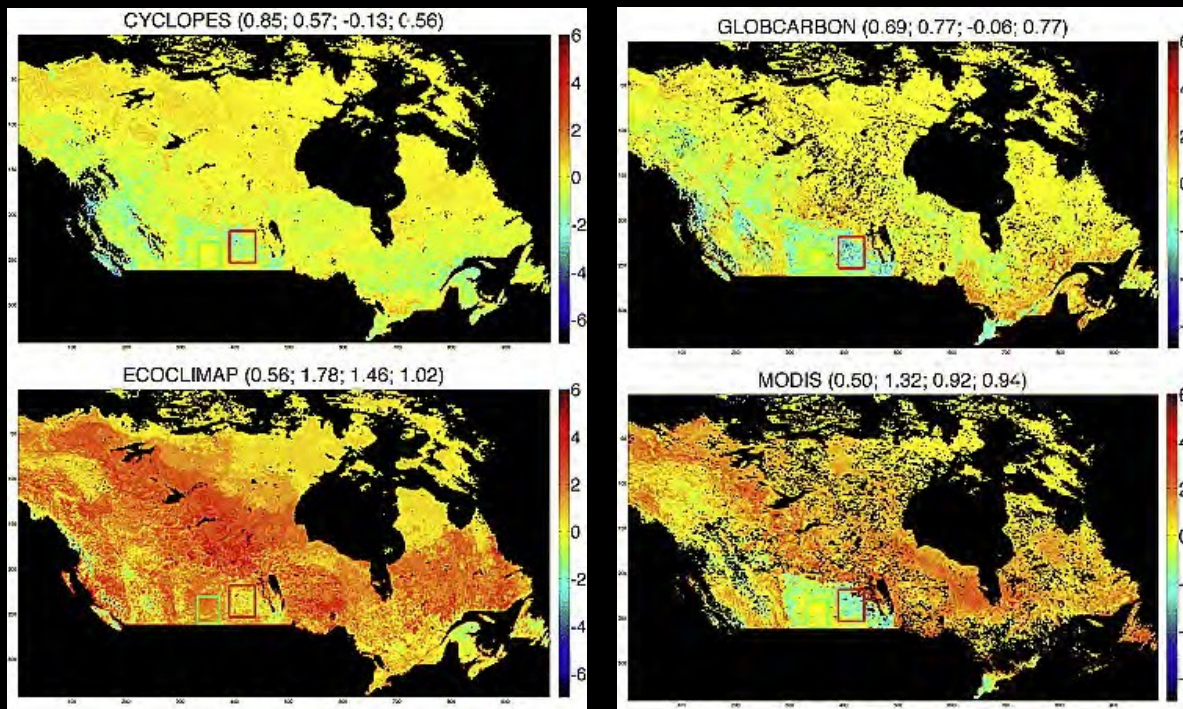
- GCOS specified need to systematically produce and validate global LAI products
- Requirement to improving both the space-based observations and the in situ network
- CEOS LPV are required to play a key coordination role and lend the expertise to address actions related to validation of global LAI measurements as identified in GCOS-138



Terms of Reference

GCOS-138 (p125):

Benchmarking and comparison of [satellite] LAI products is essential to resolve differences between products and to ensure their accuracy and reliability. The CEOS WGCV should lead this activity in collaboration with GCOS and GTOS ...



Anomalies in peak season LAI between global products and a chosen reference (over Canada and Alaska). From (Garrigues *et al.* 2008a).

Terms of Reference

Action T30 [IP-04 T30] Action: Evaluate the various LAI satellite products and benchmark them against *in situ* measurements to arrive at an agreed operational product.

Who: Parties' national and regional research centres, in cooperation with space agencies and CEOS WGCV, TOPC and GTOS.

In response to GCOS Action Item T30, the goal of this document is to identify good practices for validating global satellite LAI products.

What is covered?



- Definitions & Key terms
- Admissible in situ reference data
- Sampling and upscaling reference data
- Modelling accuracy of reference data
- Review of current products, validation methods and status
- Recommended sensitivity analyses
- Recommended CEOS approach(es) for product...
- Total measurement uncertainty
- Bias
- Precision
- Completeness

JCGM 2008

What isn't covered?



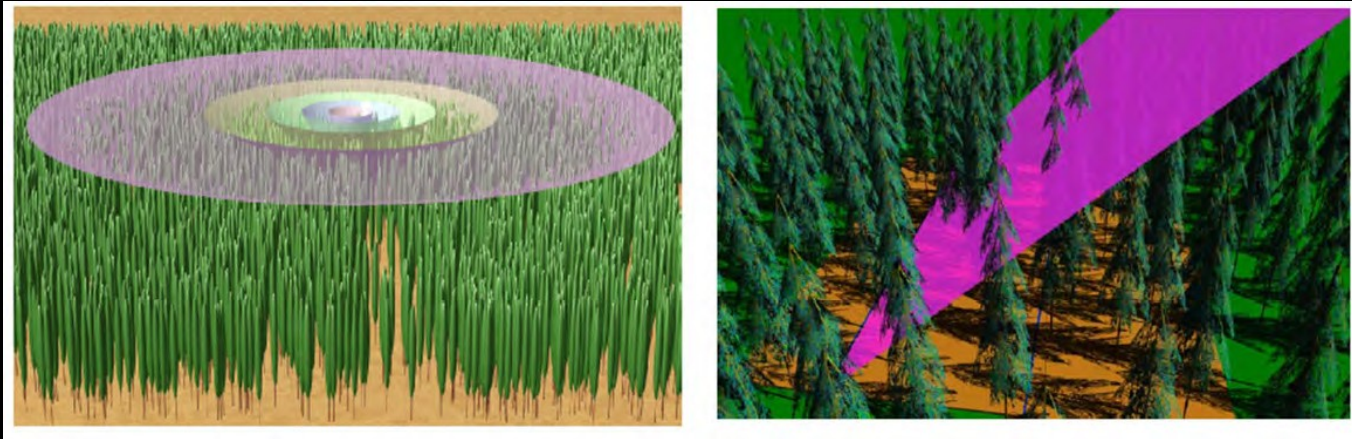
- Translating between CEOS and other definitions
- Best practice for in situ LAI measurement
- Model based verification or reference measurements or products
- Regional or non-systematic products
- Upscaling using LIDAR, hyperspectral, radar data
- Ensemble based accuracy estimates (e.g. triple collocation)
- Diagnosis of causes of bias errors

Definitions

LAI is defined as one half the total green leaf area per unit horizontal ground surface area

(GCOS-138, Chen and Black, 1992)

- Associated physical parameters
- Other key terms specific to satellite measurements

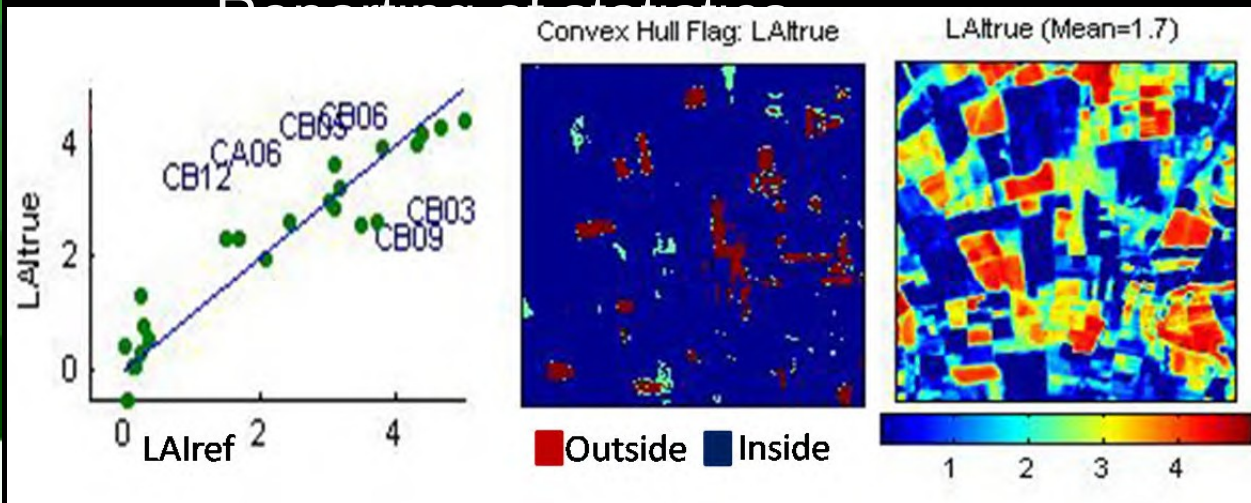


Depiction of spatial footprint of a LAI-2000 instrument as a function of zenithal view ring (left) and the TRAC instrument for a given solar illumination condition (from (Leblanc 2005c, Leblanc 2008)).

Considerations for Validation

- In situ reference LAI over an ESU
- Existing in situ LAI measurement guidelines
- Worked examples of assessing ESU LAI accuracy and precision
 - Upscaling, sampling design
 - Reference map accuracy

Descriptive statistics



Outputs of VALERI reference LAI mapping process.

Left panel shows scatter plot of predicted versus actual LAI based on robust linear regression.

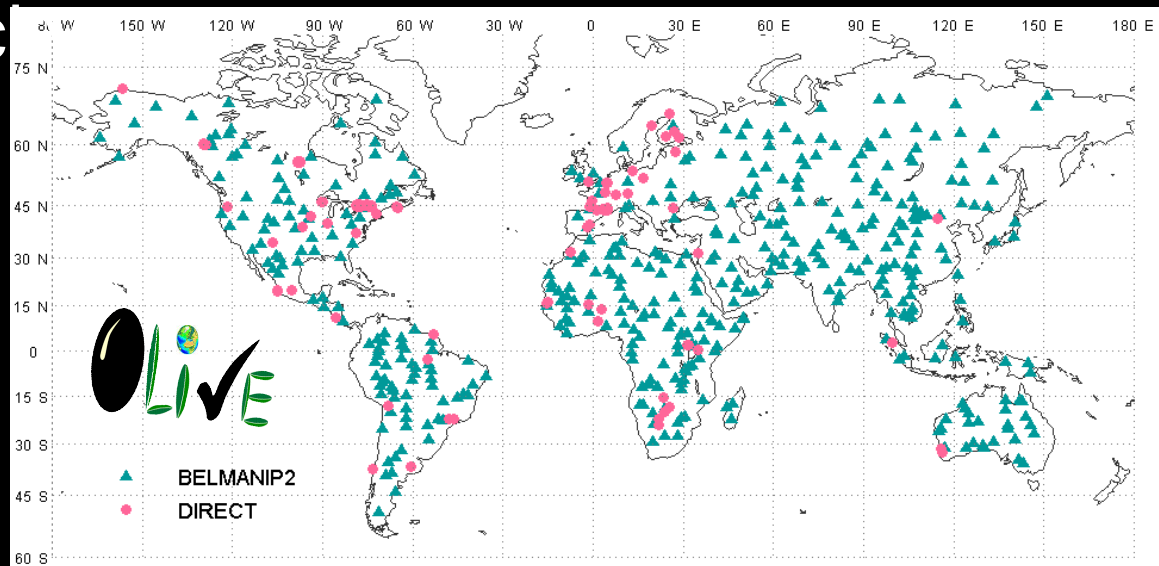
Centre panel shows mask of areas within (blue) and outside (red) spectral convex hull of ESU data.

Right panel shows final

General Strategy for Validation

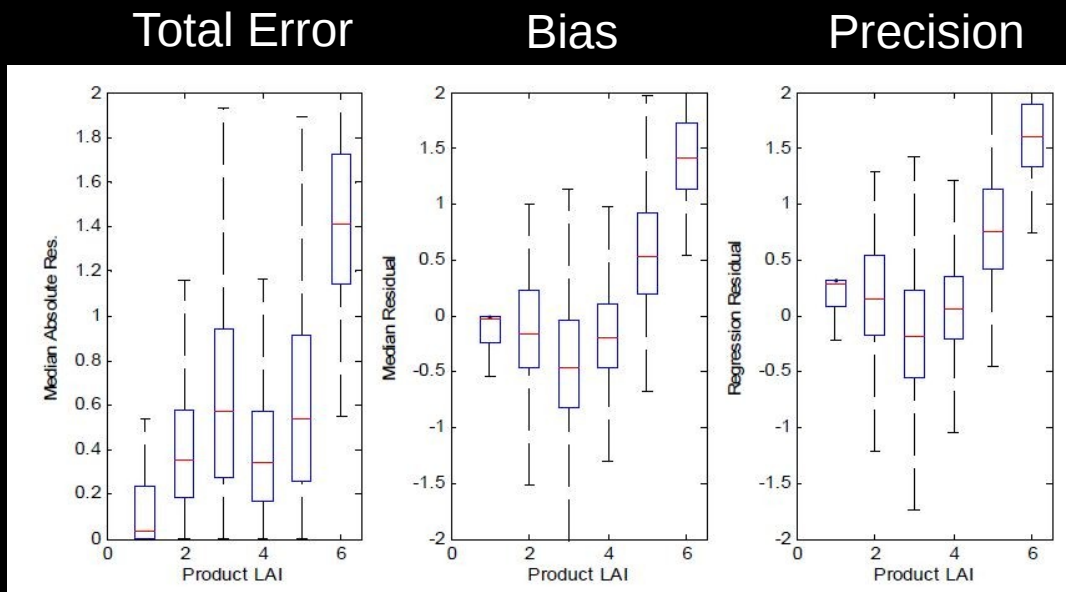
- Overview of current LAI products
- Uncertainties related to product input data & definitions
- Assessment of intra-annual precision and inter-annual stability of products
- Challenges to and status of current validation capacities

Location of reference LAI sites available for direct validation and BELMANIP2 sites for inter-comparison

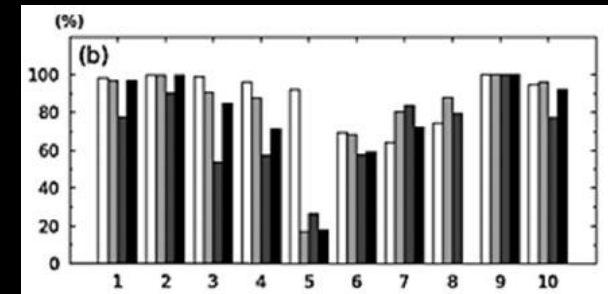
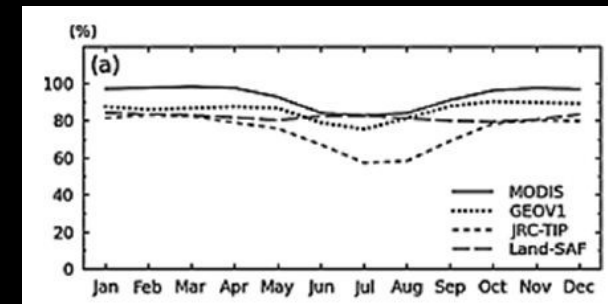


Recommended Validation Approach

- Worked examples
- Co-location and geolocation uncertainties
- Validation metrics & Statistics
 - Bias/Precision/Completeness



Completeness



42 Recommendations For...

- CEOS WGCV LPV
 - *i.e. Archiving existing LAI reference maps*
- LAI Product Producers
 - *i.e. Provision of updates of product metadata*
- Scientific Research Community
 - *An upscaling tool should be developed to model spatial prediction errors*
- LAI Product Validation
 - *Where data permits, validation statistics should be derived seasonally for individual years*

Upkeep

- Posted on LPV Biophysical webpage
<http://lpvs.gsfc.nasa.gov/>
- Includes links to supporting material:
 - Reviewer comments (*anonymous*)
 - Recommendations for future work
 - All in situ data collection “protocols”
- LPV Biophysical leads to monitor (*bi-annual*) updates of the document content based on community feedback and scientific advancement

With thanks to

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