



Leaf Area Index Inter-comparison and Validation as a Prototype Activity for WGCV/LPV

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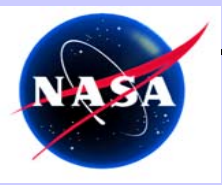
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Problematic

- Leaf Area Index :a key land surface variable for a range of land surface models
- **LAI definition:** half the total developed area of leaves per unit ground horizontal surface area (Chen and Black, 1992)
- **Multiplicity of Global Leaf Area Index products from moderate resolution sensors:**
 - single sensor products: MODIS, MERIS, POLDER/PARASOL MSG/SEVIRI,
 - multiple sensors products : CYCLOPES (AVHRR, VEGETATION, POLDER, and MERIS), GLOBCARBON (using AATSR, AVHRR, MERIS, and VEGETATION)

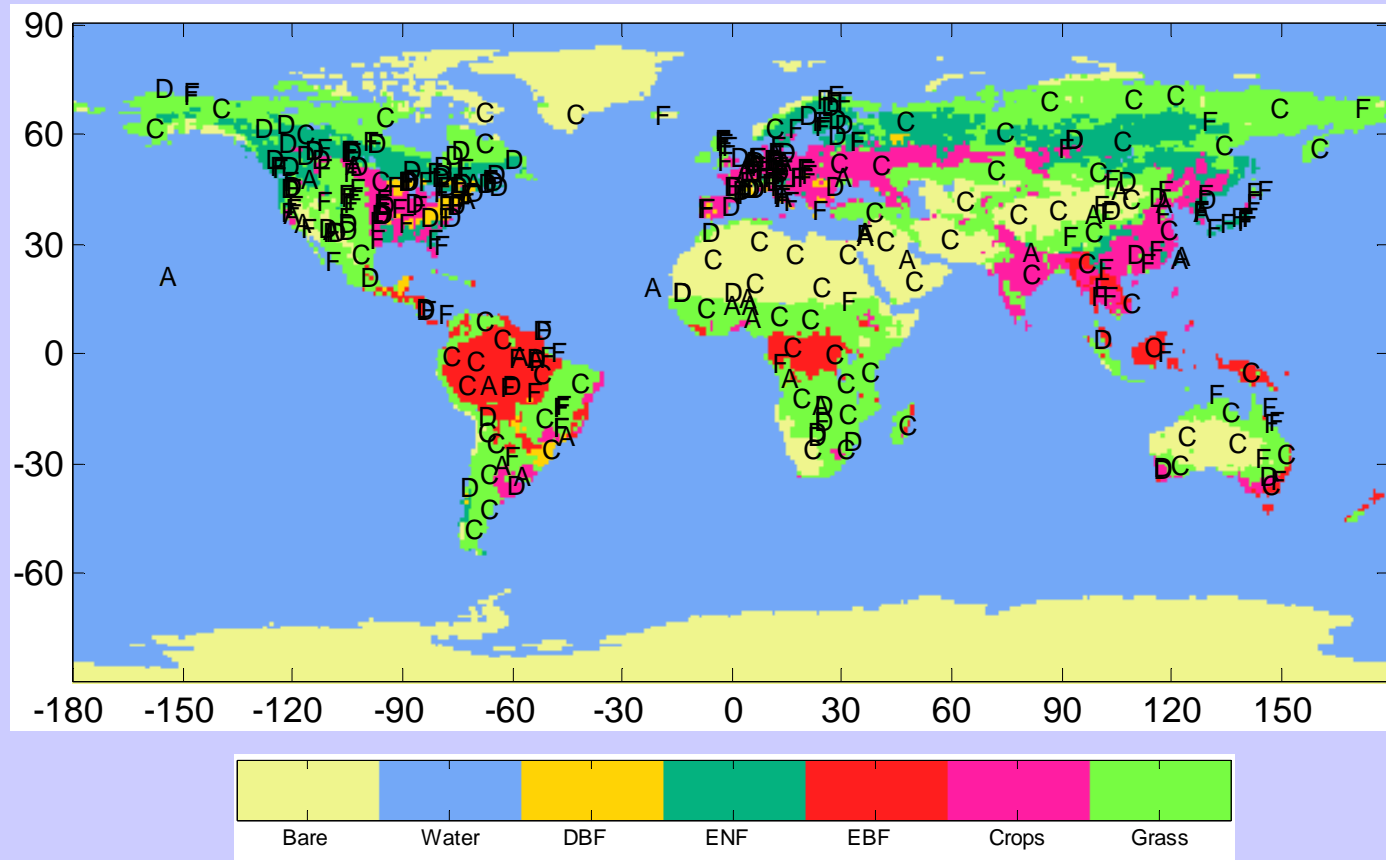


Problematic

- Understanding the uncertainty in a given product, and differences between products, is critical for their proper use
- **Direct validation**: establish the absolute accuracy of a given product
- **Product inter-comparison**: help define how multiple products can be used in combination, and how consistent time series can be constructed from different sensors
- **WGCV/LPV subgroup**: provides **international framework to share data, methods and results** relevant to validation and inter-comparison of global products (Morisette et al, 2006, IEEE TGARS special issue on land surface product validation)



BELMANIP: a global network of sites for land product validation and inter-comparison



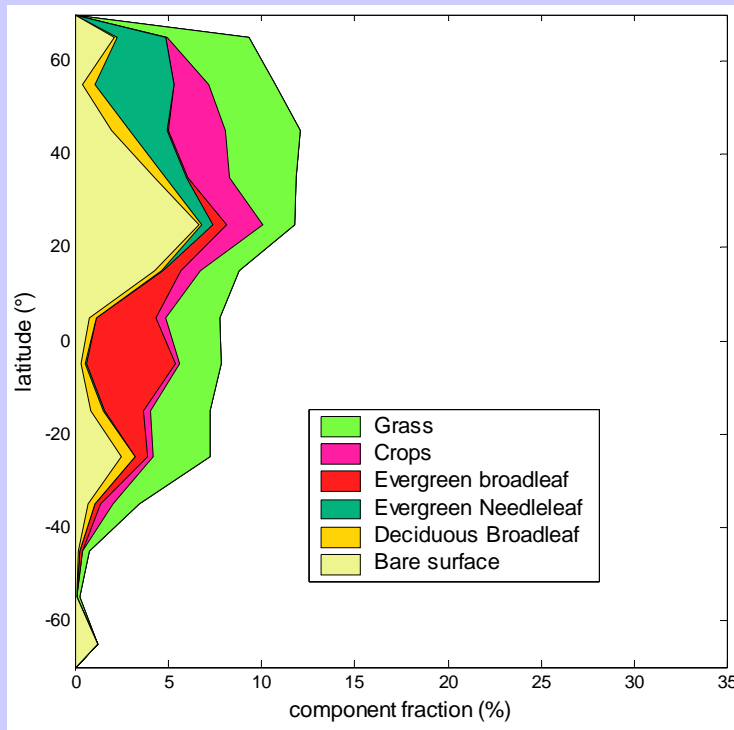
representative sampling of global land surface types :

- about 400 sites from several networks: direct validation sites (BIGFOOT, VALERI...), AERONET, FLUXNET...
- Baret, Morisette, ..., Garrigues, Nickeson, et al, in press, TGARS special issue)

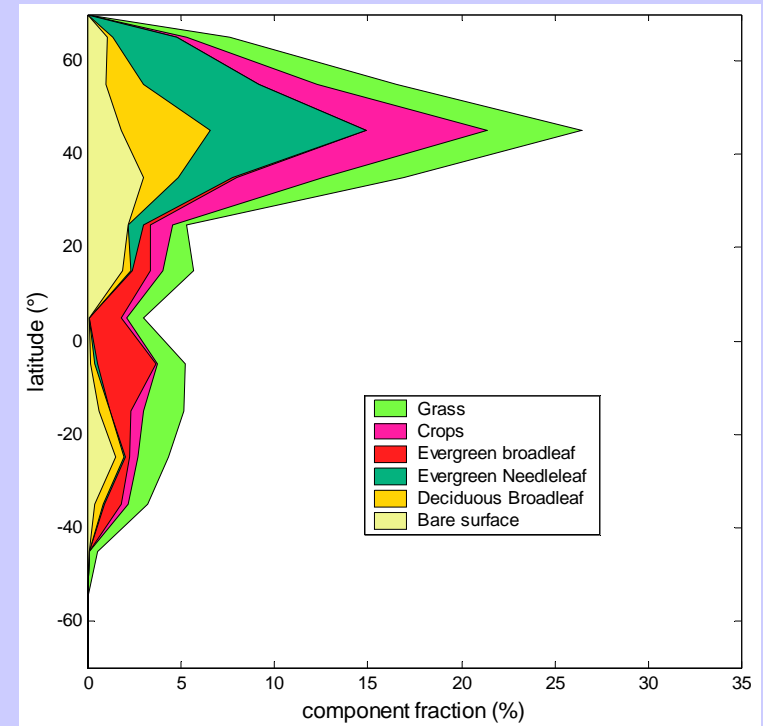


BELMANIP: improving the representativeness in land surface types

ECOCLIMAP global classification, (Masson et al, 2003)

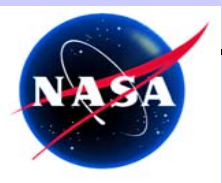


Global surface type distribution



BELMANIP surface type distribution

76 sites were added to FLUXNET, AERONET, Direct Validation sites to better sample latitude, longitude and surface types (grass, bare surface, evergreen broadleaf forest)



Validation of MODIS Leaf Area Index

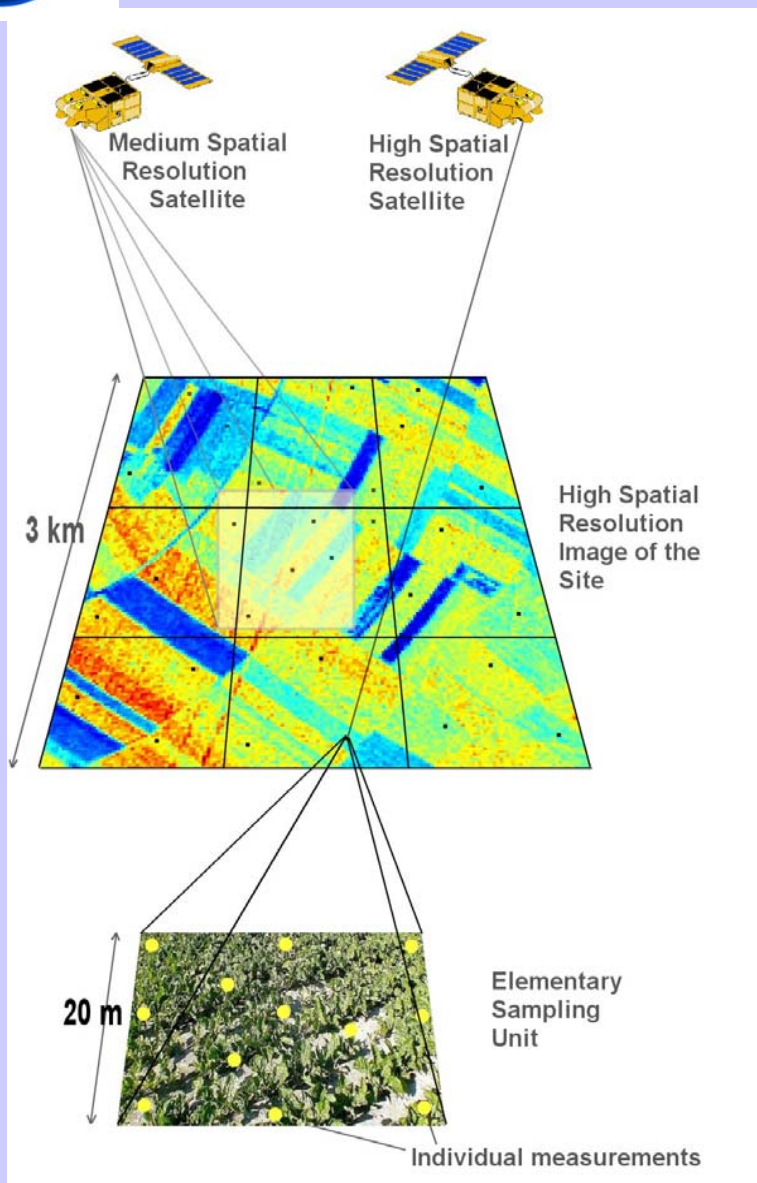
- goal: assess MODIS LAI uncertainty in a systematic and statistically robust way using BELMANIP framework (stage 2 -3 of validation process)
 - Collection 4
 - Collection 5
- direct validation conducted at BELMANIP sites at which high spatial resolution (HR) LAI maps have been generated
- using the LPV infrastructure to bring together HR LAI maps from several projects and groups:
 - North America: BIGFOOT, Boston University, EPA, CCRS, University of Alberta, SMEX02, NACP ...
 - Europe: VALERI, CARBOEUROPE, BIOTA/GLOWA-AFRICAN projects (DLR), MSG validation sites
 - Others : ?



Currently: 70 sites and potentially 90 LAI maps will be available (60 maps have been collected currently available)



Direct Validation Methodology



Medium spatial resolution LAI map

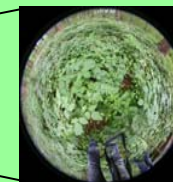
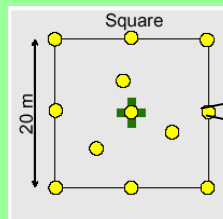
**Agregation of high spatial resolution LAI map
(image registration, convolution)**

High spatial resolution LAI map

**Spatial extension
of ESU measurements
(transfer function and cokriging)**

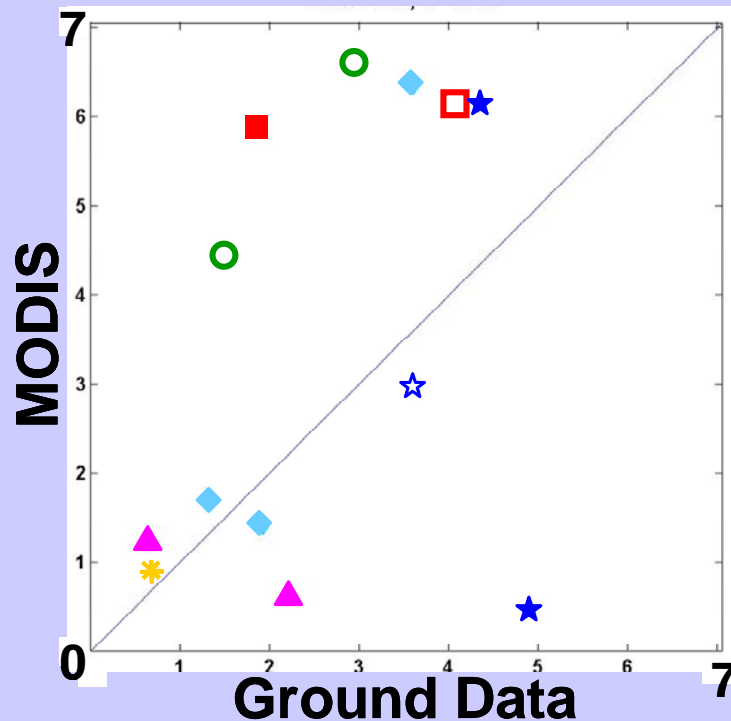
Local Ground measurements

**(12 hemispherical photographs processed using the
CAN-EYE software)**





Validation of MODIS Leaf Area Index (Collection 4) (Preliminary results)



Preliminary results over some VALERI sites
(Lacaze and Weiss, GLOBCARBON user workshop, 2006)



Inter-comparison of Several Global LAI Products

Products	Spa Res	Temp Res	Temp Period	Projection	Contact
MODIS	1km	8d	2000-pres	Sinusoidal	Myneni, BU
CYCLOPES (VEGETATION)	1km	10d	1998-2003	Plate Carree	Baret,INRA Lacaze, Medias- France
GLOBCARBON (VEGETATION, ATSR)	10km	1month	1998-2003	Plate Carree	Plummer, ESA
POLDER/PARASOL	7km	10d	Jun 2005-pres	Sinusoidal	Lacaze, Medias- France
CCRS Product over Canada (VEGETATION)	1km	10d	1998-pres	Lambert conformal Conical, NAD83	Fernandes,CCRS
MSG/SEVIRI	3-12k	daily	Aug 2005-pres	MSG	Camacho, Valencia U
ECOCLIMAP	1km	1 month	Climato	UTM	Masson CNRM-Meteo France
MERIS TOA	1km	10d	2003	UTM	Baret, INRA Weiss, Noveltis



LAI inter-comparison

- international collaboration: Medias-France, INRA, GLOBCARBON, CCRS, BU...
- established a protocol to carry out this task:
 - defining relevant metrics for inter-comparison of LAI products
 - defining consistent cartographic projection to facilitate the inter-comparison
 - several steps according to the characteristics of the products
 - 1/ GLOBCARBON, MODIS, CCRS, CYCLOPES, 10km , monthly
 - 2/ CYCLOPES, MODIS (Collection 5) 1km, 8/10 days
 - 3/ adding new products : MSG and PARASOL



Inter-comparison of GLOBCARBON, CYCLOPES, MODIS and ECOCLIMAP at 10km spatial resolution, monthly

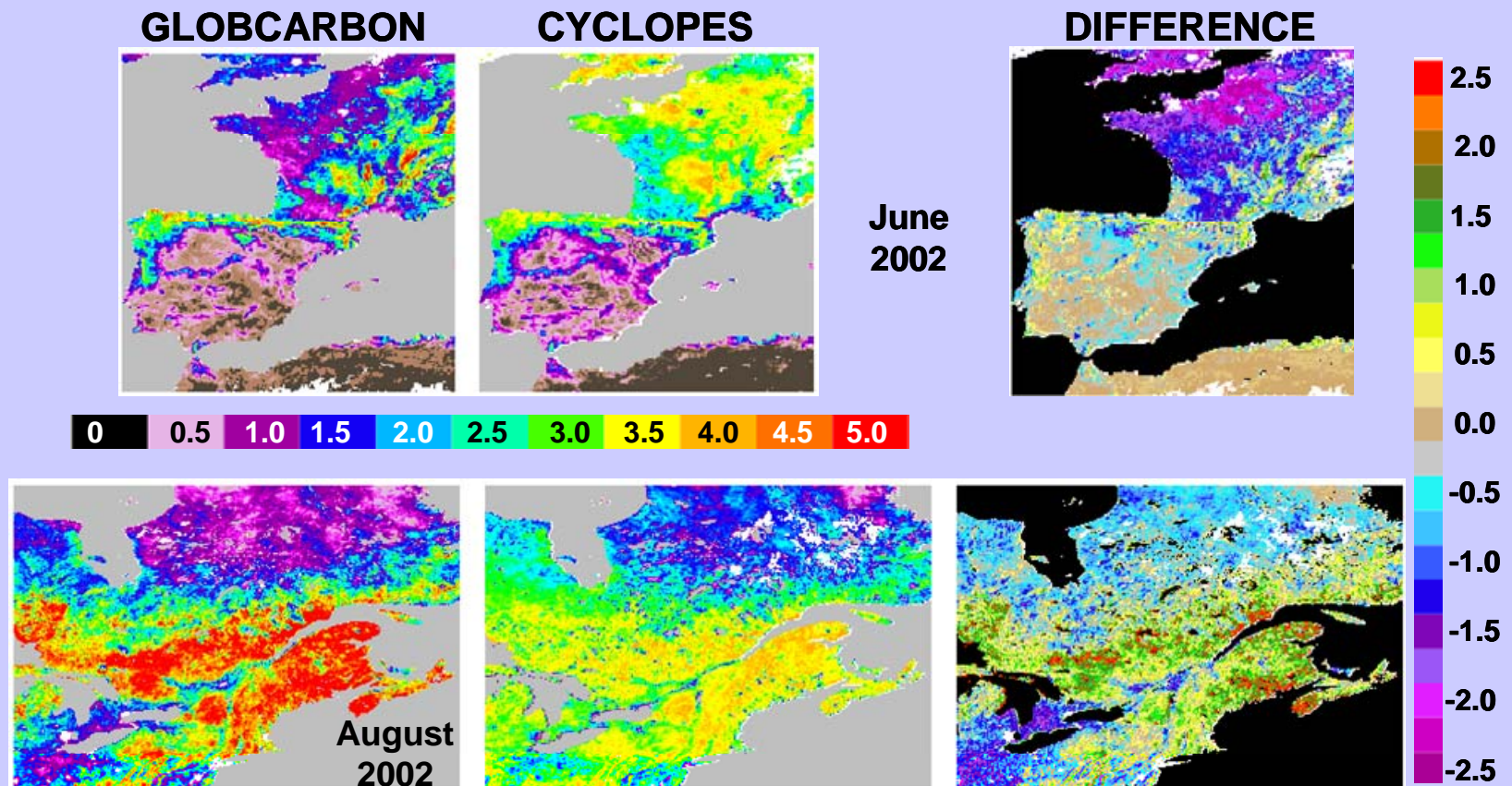
Product	Algorithm	Type of LAI
GLOBCARBON	Semi-empirical relationship (SR,RSR VI, BRDF Correction)	True LAI (clumping correction)
CYCLOPES	Radiative Transfer Inversion by neural network	Effective LAI
MODIS	Radiative Transfer Inversion by LUT	True LAI (Clumping and Woody elements correction)
ECOCLIMAP	Climatology from global classification. global climate distribution and NOAA AVHRR time series	True LAI



Inter-comparison of GLOBCARBON, CYCLOPES, MODIS and CCRS LAI products

(Preliminary results, Lacaze and Weiss, 2006)

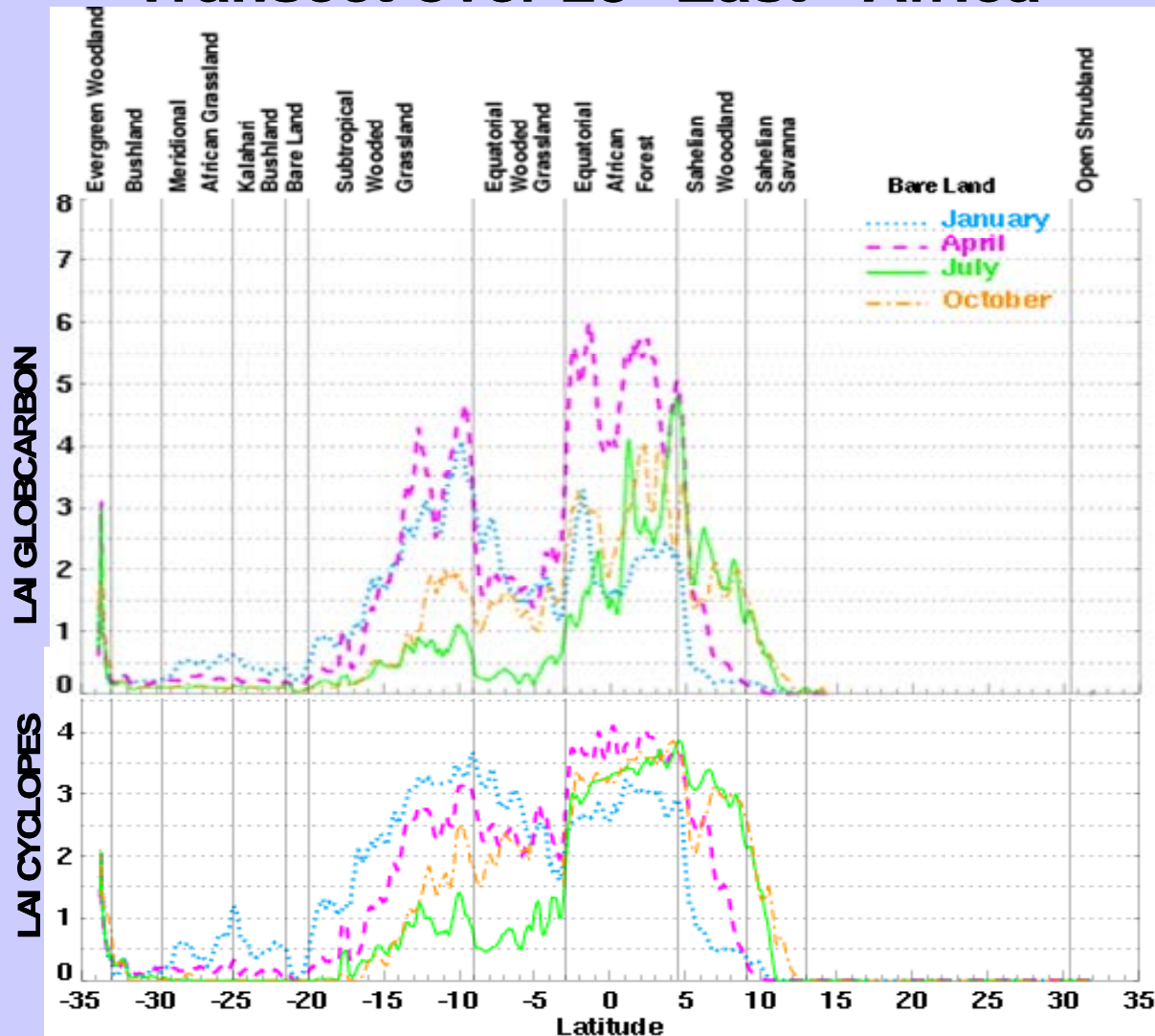
Difference (GLOBCARBON – CYCLOPES) at local scale





Inter-comparison of GLOBCARBON, CYCLOPES, MODIS and CCRS LAI Products

Transect over 25° East - Africa

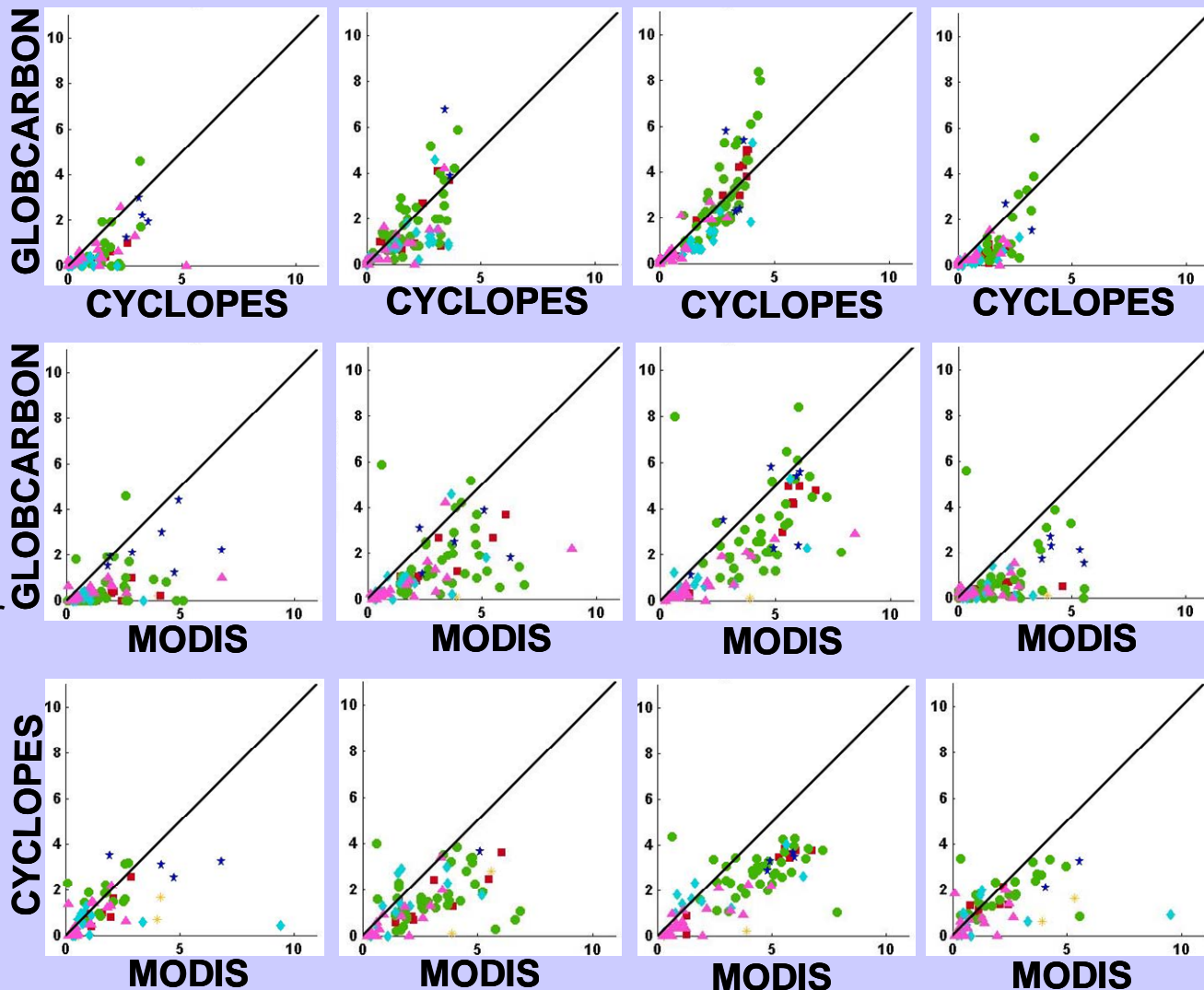


Unrealistic seasonal variations over forest for GLOBCARBON



Inter-comparison of GLOBCARBON, CYCLOPES, MODIS and CCRS LAI products

Scatter plots over FLUXNET sites

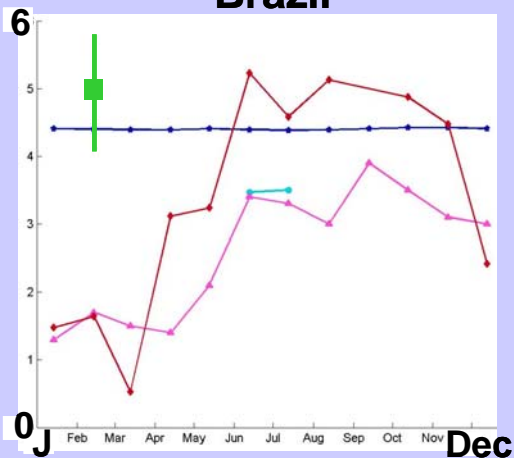


-GLOBCARBON closer to CYCLOPES than to MODIS
 - CYCLOPES closer to MODIS than GLOBCARBON

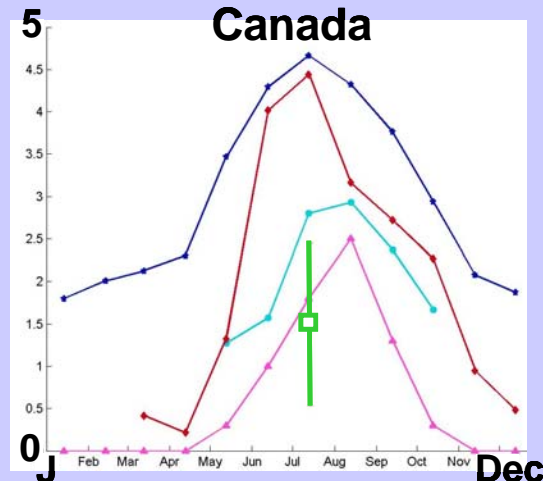


Inter-comparison of GLOBCARBON, CYCLOPES, MODIS and CCRS LAI products

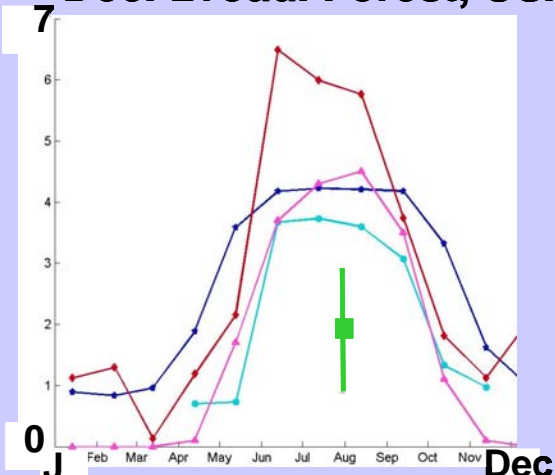
Ever. Broad. Forest, Brazil



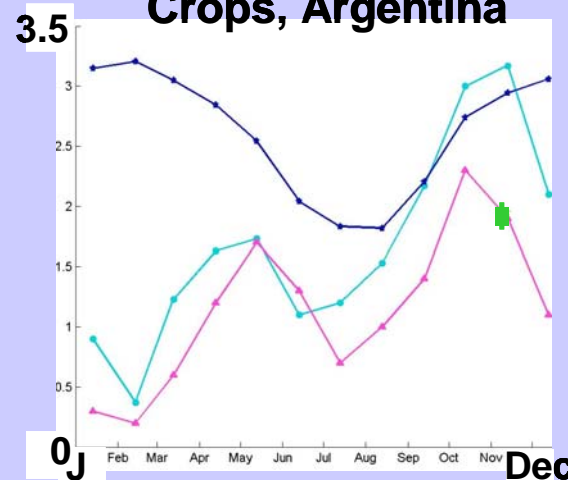
Ever. Needle. Forest, Canada



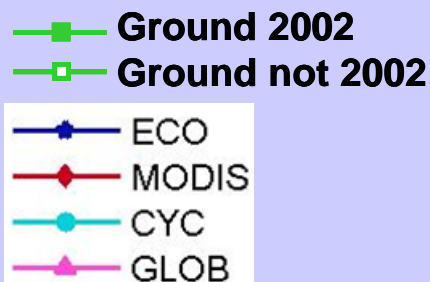
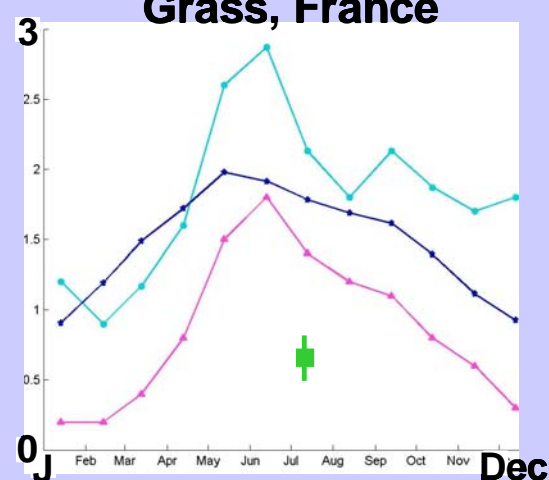
Dec. Broad. Forest, USA

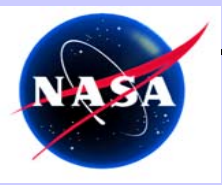


Crops, Argentina



Grass, France





Conclusions and Prospectives

Conclusions

- importance of international collaboration between networks
- utility of CEOS/LPV infrastructure and GEOSS integration to help with this task



Conclusions and Prospectives

-Next steps:

- refine validation results with a larger number of HR LAI maps for MODIS collection 4 and collection5
- refine inter-comparison results at 10km, monthly
- integrating other products or new version of products
- Vegetation products Workshop (Missoula, Montana, aug 06)
- Joint paper

-Prospectives:

- working with users (surface modeling)
 - model sensitivity analysis to the type of products
 - work with CEOP network (data and method sharing)
- application of this framework to other products:
 - albedo intercomparison work defined at the EGU 2005 albedo topic workshop)
 - vegetation index (Montana 2006 LPV workshop)



Inter-comparison of GLOBCARBON, CYCLOPES, MODIS and CCRS LAI Products

Transect over 30° East - Europe

GLOBCARBON:
 - Lower LAI
 - strong seasonal variations

CYCLOPES:
 - stable over Taiga
 - Unrealistic hivernal LAI

