Towards an operational production of
surface albedo in the GMES Land Monitoring Core Service

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- **Context**
  - Global Monitoring for Environment and Security (GMES)
  - Land Monitoring Core Service (LMCS)
- **The Geoland-2 project**
  - Figures and facts
  - Functional view
- **BioPar Core Mapping Service**
  - Structure
  - Objectives
  - Portfolio
- **BioPar albedo products**
  - GEO Albedo
  - VGT Albedo
- **Quality Assessment Plan**
  - Inter-comparison
  - Direct Validation
- **Summary**

e.g. man-made and climate induced changes in Europe

Water – 20% of all surface water sources seriously threatened by pollution

Soil Erosion – 17% of total European land area affected, economic loss around 85 €per ha

Biodiversity – 335 species highly endangered in Europe

Agriculture – intensification leads to water stress, soil erosion and biodiversity decline

Urban Settlements and transport networks growing - leads to soil sealing and fragmentation of landscape

Man-made impact & climate variability – require adaptation
Directives & Regulations – requesting geo-spatial monitoring
GMES – supporting reporting & management tasks

- **Global Monitoring for Environment and Security** (**GMES**) aims to provide, on a sustained basis, **reliable and timely geo-information services** related to environmental and security issues in support of public policy makers' needs

- **GMES** is an EU-led initiative, in which ESA implements the space component and the European Commission manages actions for developing services, relying on both in-situ and space-borne remote sensing data.

- **GMES basic architecture**
    - Infrastructures: In-situ and Space data
    - Core Mapping Services : Generic products
    - Down-stream services: End-users applications

- **"Fast Track" Services**
    - Marine Monitoring
    - Emergencies Response
    - **Land Monitoring Core Service**
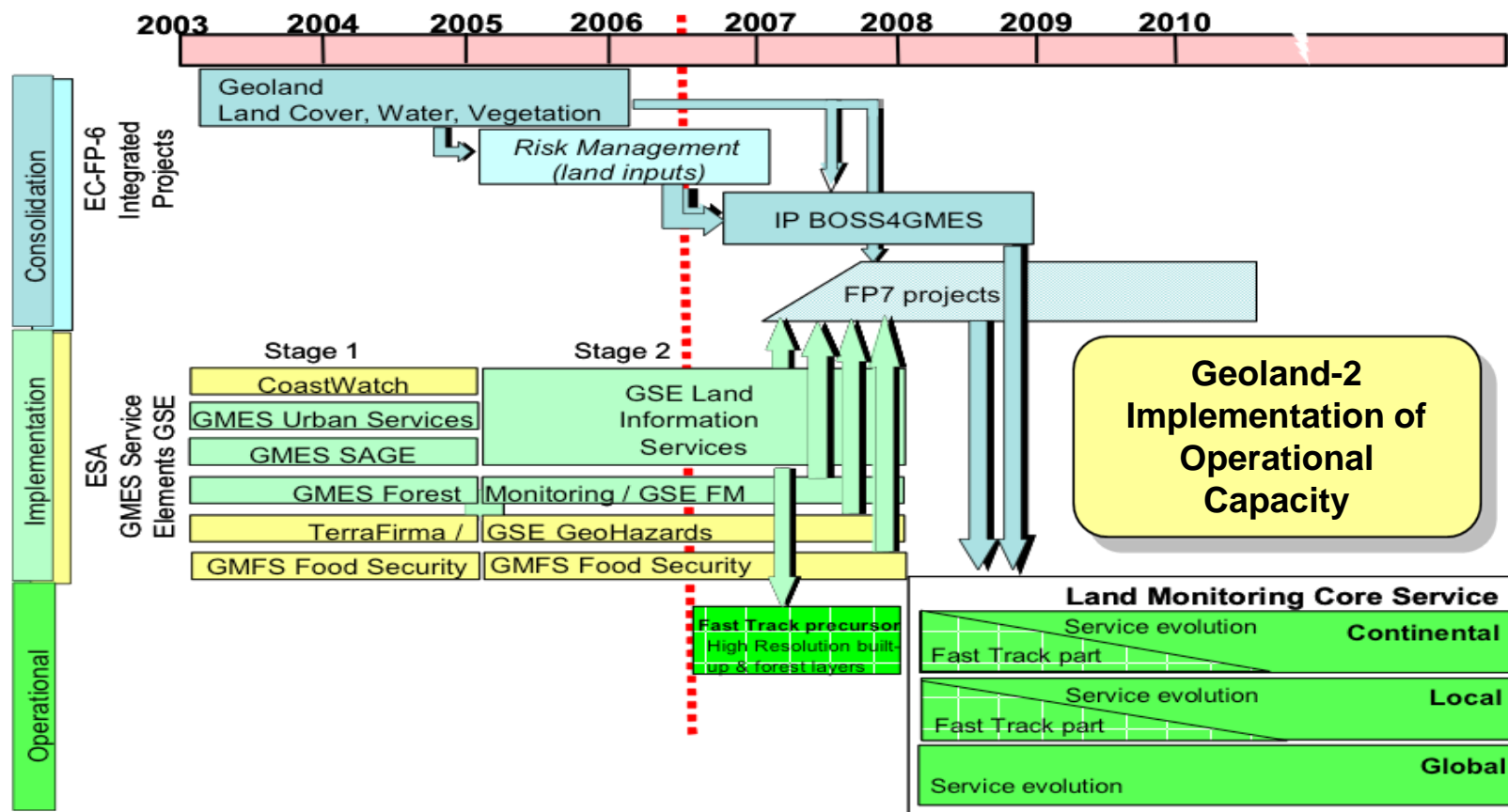
Revised version following the comments from the GAC Delegations

- ■ **LMCS complements existing operational European services EUMETSAT / SAF Land, JRC / MARS Food, JRC/ ACP Observatory**
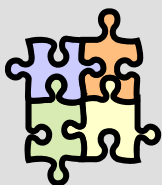
FP7 Project funded by European Commission

Implementing the Land Monitoring Core Service -
contributing to GEO, interacting with INSPIRE & SEIS

- To prepare, validate, and demonstrate pre-operational service chains and products of the LMCS

- To propose the specific functional organisation of LMCS

50 partners
- 171 collaborating user organisations
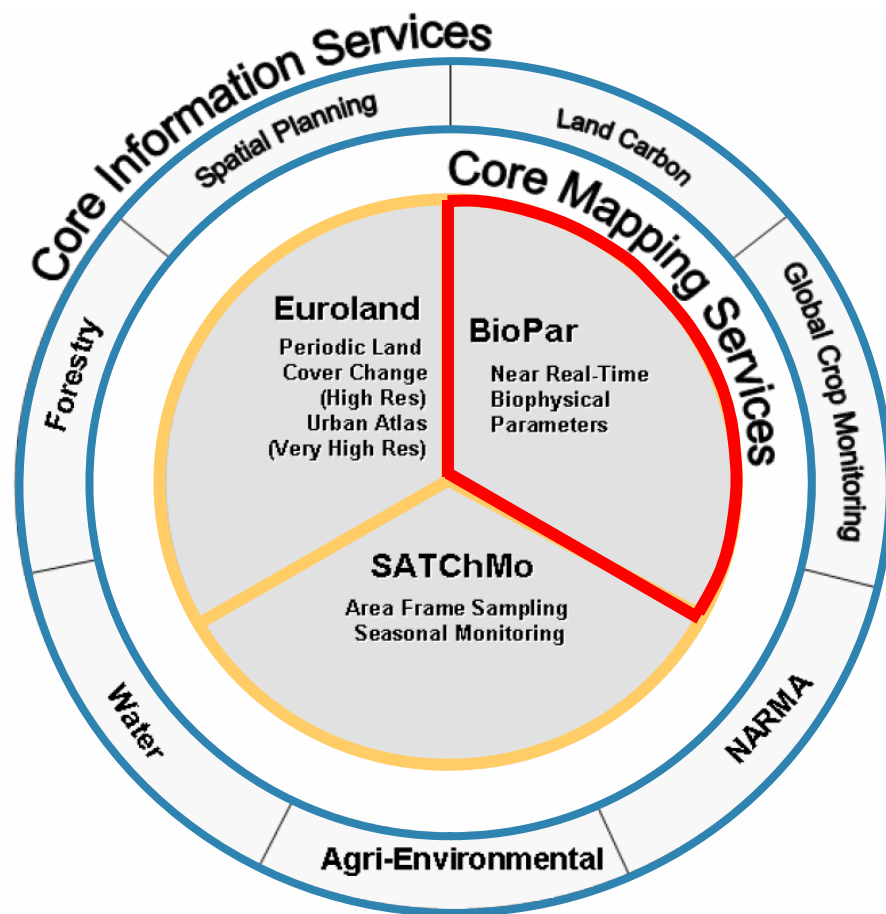(81 directly committed to geoland2)

32.5 Mio.€ volume – 4 years duration

22.4 Mio. € European Commission grant (FP7)

11 thematic tasks – 1 coordination office

3 stakeholder platforms (users, science, service providers)

3 Core Mapping Services
- Euroland (Land Cover)
- SATChMo (Seasonal Monitoring)
- **BioPar (Biophysical Products)**

7 Core Information Services
- **Land Carbon**
- **Natural Resource Monitoring in Africa (NARMA)**
- **Global Crop Monitoring**
- **Forest**
- **Agri-Environment**
- **Water**
- **Spatial Planning**

- **Set-up an operational system, fully validated, developed according to industry standard, and that meets users' needs.**
  - Taking benefit of previous R&D projects to complement (SAF Land) or to extend (VGT4Africa) operational services
  - Building a strong **user base** (user-driven service**)**
  - Moving from off-line processing to **Near Real Time**
  - Integration global-regional-local to build a service providing bio-geophysical parameters **at any scale** of interest
- **Ensuring Service Continuity**
  - Developing sensor-independent algorithms
  - Design back-up processing line (in case of failure of nominal sensor)
  - Guarantee the compatibility between historic and current products
  - Adapting the present method to the next generation of sensors
- **Improving Quality Assessment**
  - Combining technical, scientific, utility and external assessments

BioPar CMS Portfolio
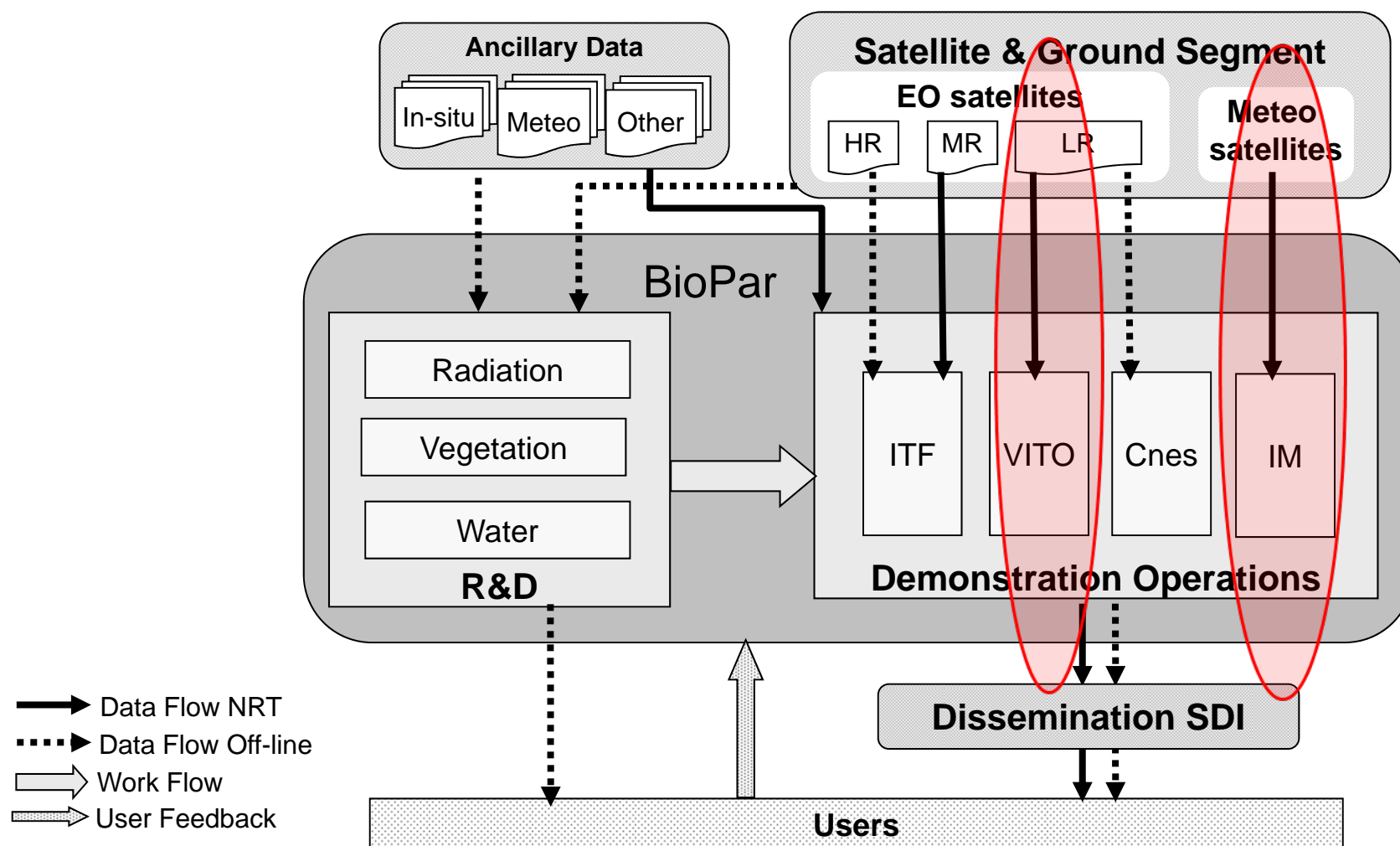
Product	NRT / Off-line	Spatial Resolution	Spatial coverage	Temporal Resolution	Sensor (back-up)
Land Surface Temperature	NRT	~ 5 km	Global	3 hours	ΣGEO + AVHRR
Downwelling Shortwave Radiation, Downwelling Longwave Radiation	NRT	~ 5 km	Global	3 hours	ΣGEO + AVHRR
Surface Albedo - GEO	NRT	~ 5 km	Global	10-days	ΣGEO + AVHRR
Surface Albedo - VGT	NRT	1 km	Global	10-days	VGT
LAI, fCover, fAPAR, DMP, NDVI, Phenology	NRT	1 km	Global	10-days	VGT (MODIS)
Burnt areas + seasonality	NRT	1 km	Global	Daily	VGT
MERIS FR biophysical products	NRT	300 m	Test Areas	10-days	MERIS
HR biophysical products	Off-line	< 50m	Pilot Areas	2-3 months	SPOT
Time series of vegetation products	Off-line	4 km	Global	10-days	AVHRR + VGT
Water Bodies + seasonality	NRT	1 km	Africa	10-days	VGT
Soil Moisture + Freeze/Thaw	NRT	25 km	Global	Daily	ASCAT
Time series of soil moisture products	Off-line	25 km	Global	Dailly	ERS1&2 Scatt

Albedo from ΣGEO + AVHRR data

- **Product content**:
    - Directional-hemispherical ("**black-sky**") albedo, Bi-hemispherical ("**white-sky**") albedo, **spectral** (VIS, NIR, SWIR) and **broadband** (0.3-4.0 μm)
    - **Error** estimate and **quality flag**.
- **Input:**
    - Geostationary Satellite (METEOSAT, GOES, MTSAT) + AVHRR data
- **Product Characteristic:**
    - NRT**,** global at 5-km,10-days, 5% accuracy (expected).
- **Added value**:
    - Global product taking benefit of the higher frequency of geostationary satellite sensors and polar satellites for high latitudes
- **Processing chain**: adaptation of algorithms developed for EUMETSAT data
    - Global Albedo developed at EUMETSAT
- **R&D Challenge**:
    - Fusion of GEO products and AVHRR product
    - Fusion at the product (albedo) level taking into account error bars
- **R&D and Production:** Portuguese Meteorological Institute
    - V1 (ΣGEO) expected in 2010 ; V2 (ΣGEO + AVHRR) expected in 2012

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  - Directional-hemispherical ("**black-sky**") albedo, Bi-hemispherical ("**white-sky**") albedo, **spectral** (VIS, NIR, SWIR) and **broadband** (0.3-4.0 μm)
  - **Error** estimate and **quality flag**.
- **Input:** SPOT / VEGETATION data
- **Charact.:** Global, 1 km spat. res., 10-days temp. res., 5% accuracy (tbd)
- **Added value:** consistency with historic products
- **Methodology:** Processing chain developed in the FP5/CYCLOPES project at METEO-FRANCE
  - Atmospheric correction, cloud-screening
  - Inversion of kernel-driven BRDF model (Roujean et al., (1992))
  - Angular integration to retrieve spectral albedo
  - Broadband conversion

- **V0 (CYCLOPES) validated and user accepted in Geoland**

- **Production Center: VITO (Belgium)**
  - Operational production starting in 2010

0.12   0.25
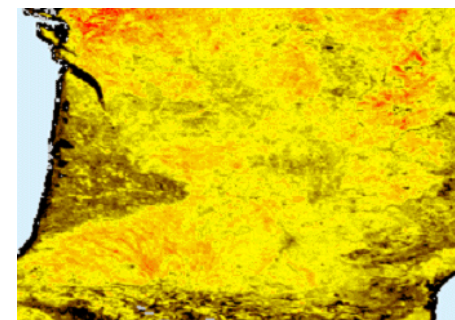
VGT albedo over France

- **Procedure**
  - 1- Technical validation at production centres (IM, VITO)
  - 2- Scientific validation by independent team (EOLAB)
  - 3- Utility assessment by user (CIS)
  - 4- Review by external experts (tbd)

- **Scientifc Validation Plan follows CEOS LPV guidelines**

  - Inter-comparison with operational products (MODIS Albedo)
    Spatial consistency
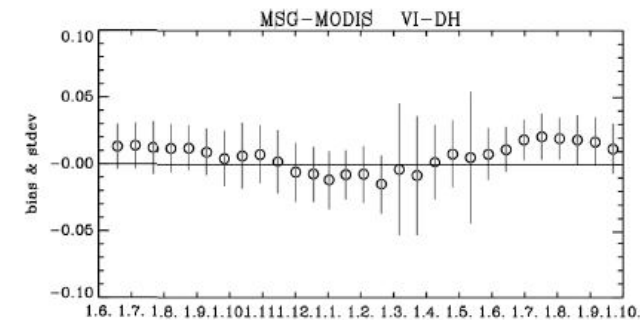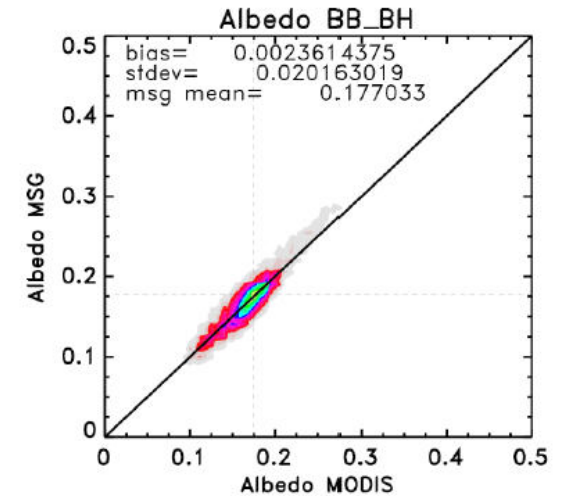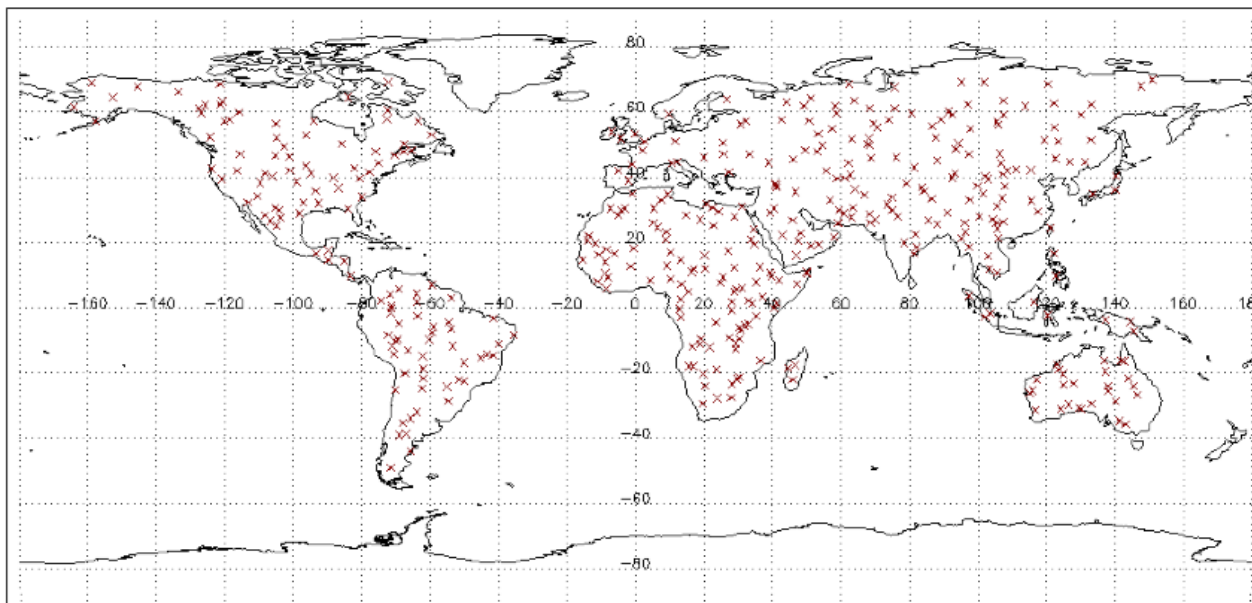   1- Overall evaluation of products (maps, difference maps)
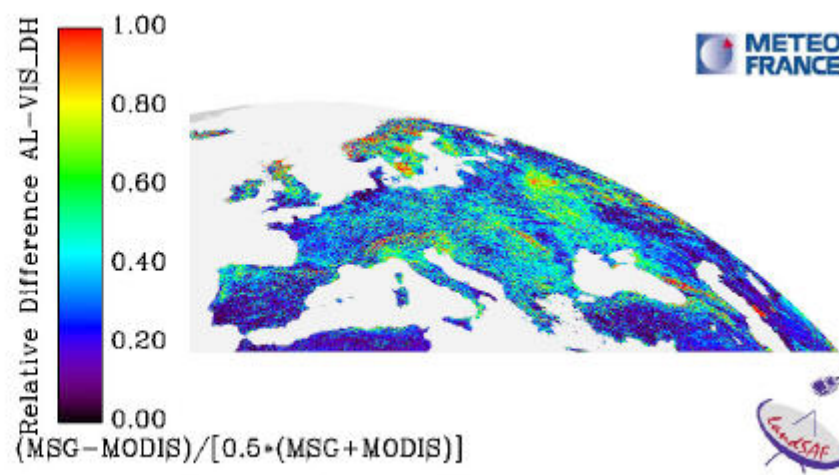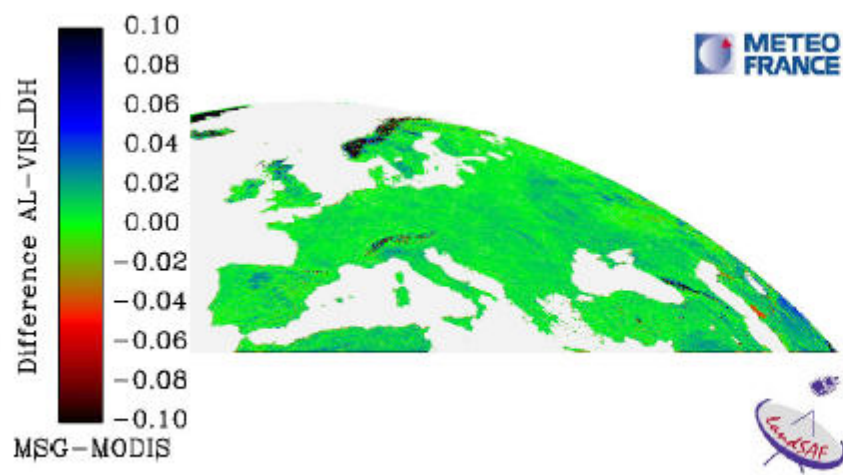
Spatial consistency

2- Statistical analysis (RMSE, bias, r)

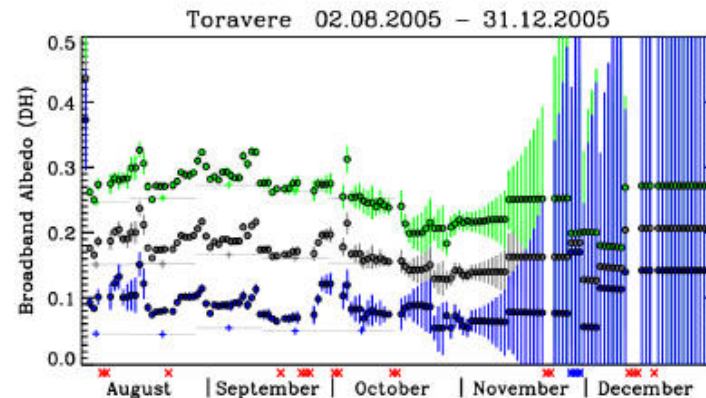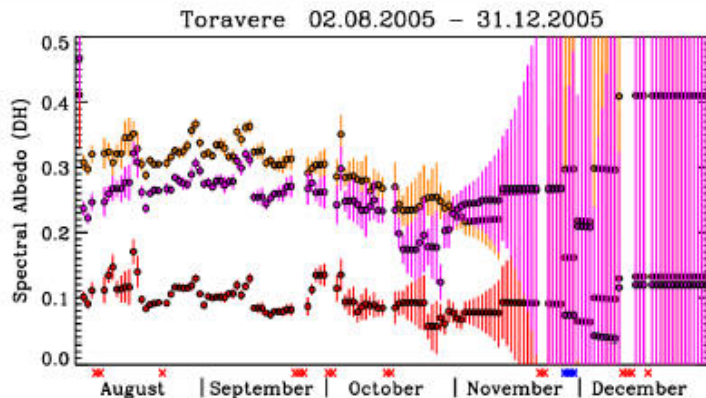BELMANIP-2 list of site is proposed for the statistical analysis of spatial consistency

Albedo BB_BH

bias=   0.0023614375
stdev=   0.020163019
msg mean=   0.177033

MSG-MODIS   VI-DH

Figures from LSA SAF
Albedo Validation Report
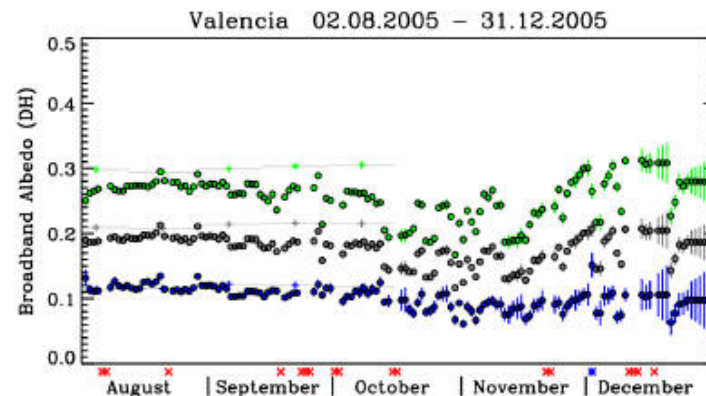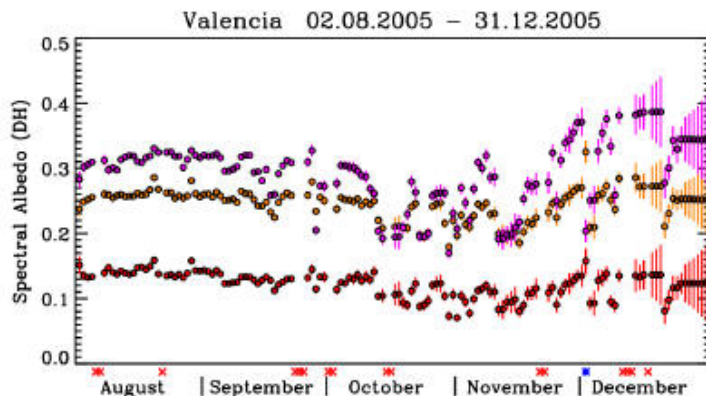
BELMANIP-2 distribution of sites over the globe

Temporal consistency

Latitude 58.2⁰

Latitude 39.1⁰

Figures from LSA SAF Albedo Validation Report

- **Direct Validation**
  - Accuracy and Temporal realism of BioPar albedo products will be assessed against in-situ measurements (blue-sky albedo)

  - Baseline Surface Radiation Network (BSRN), including SURFRAD and ARM sites, AMMA sites or data from field-airborne experiments will be used when coincident.

Accuracy
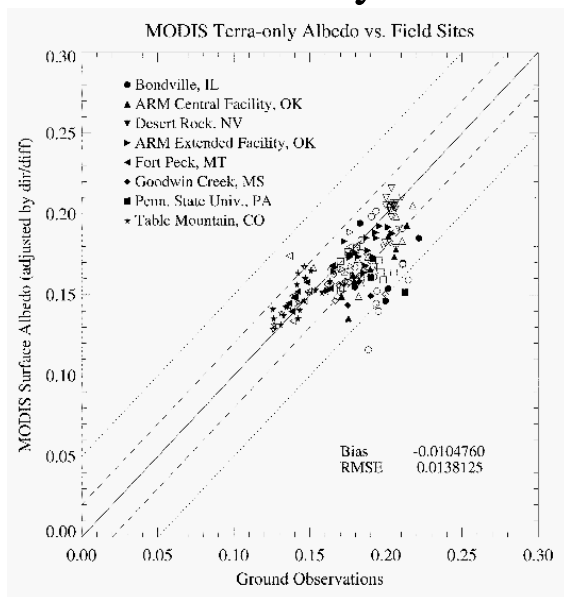
Temporal Realism
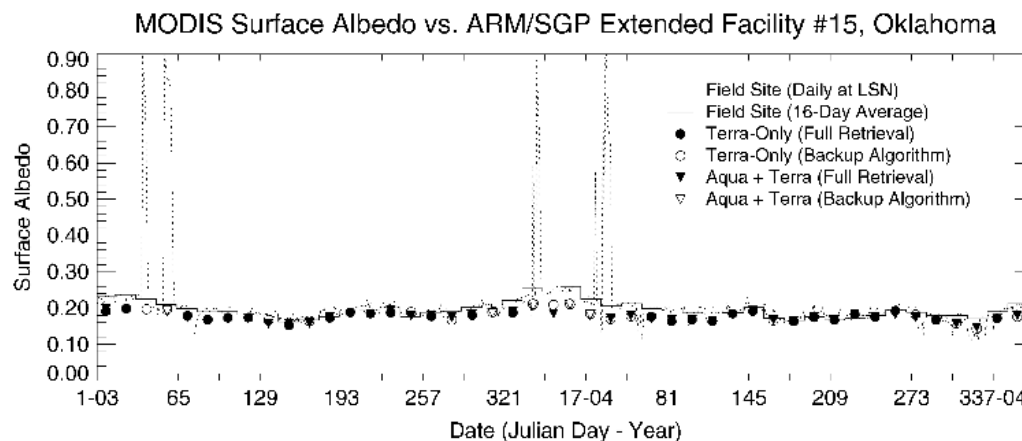
Figures from Salomon, Schaaf et al., (2006). IEEE.

- Land Monitoring Core Services is the GMES Fast Track Services dedicated to land surface products
- FP7 Geoland-2 aims at implementing the operational capabilities of GMES LMCS during the period 2008-2012.
- BioPar Core Mapping Service will be in charge of biogeophysical variables (radiation, vegetation, water) production in Near Real Time and off-line mode

- **Two global surface albedo products will be generated starting in 2010**
  - ALBEDO VGT based on CYCLOPES processing chain (kernel-driven aproach)
  - ALBEDO GEO+AVHRR based on fusion of geostationary and polar orbiting satellite sensor data
    - The processing chain will be developed based on existing processing chains (EUMETSAT).
    - Fusion of GEO + AVHRR products weighted by their uncertainties
  - Special atention will be paid to the accuracy assessment : Technical, Scientifical, by Users and external experts.

- Operational monitoring of surface albedo in the LMCS is expected from 2012 onwards ▪

More information at

www.land.eu

www.gmes-geoland.info

Thank you very much for your attention !