geoland and the Biogeophysical Parameter Core Service (CSP)

Marc Leroy
HALO Workshop
November 16, 2004
geoland - Overview

- **FP-6 Aeronautics & Space Integrated Project - GMES addressing ‘Land Cover & Vegetation’**

- **Complementing on-going activities**

- **Co-funded by European Commission, 6th Framework Programme**

- **Resources**
  - 20 M€ budget, 10 M€ EC-contribution
  - 165 Person-years

- **Partnership**
  - 46 user organisations
  - 56 consortium members

- **Duration: 3 years**
GMES priorities addressed by geoland

- A- Land Cover Change in Europe
- B- Environmental Stress in Europe
- C- Global Vegetation Monitoring

Policies / Directives / Conventions

- Habitats
- ESDP, ESPON
- Natura 2000
- Wetland Directive
- Water Framework Directive
- Soil Thematic Strategy
- Sustainable Development
- Fight against Poverty
- Global Change
- Kyoto
- Global Environment Protection

Service Portfolio

Core Services
- upstream exploitation of synergies

Observatories
- downstream customization
Ambition

- geoland aims at a comprehensive coverage of land cover & vegetation related GMES issues

- geoland wants to
  - integrate existing heritage & link to other related GMES activities
  - develop & demonstrate pre-operational services on Europe areas and for larger international test-areas
  - develop a vision for an operational service infrastructure
Information chain

Data
Reduction

TBytes
EO data
other data

Core Services

GBytes

Observatories

MBytes

End Users

Added
Value

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FP-6 IP geoland: Specific Links to ESA Activities
FP-6 IP geoland: Links to other Activities

Co-ordination

Operational Scenario
- Operational Scenarios Dev.
- Data Procurement
- Service Infrastructure Dev.

Regional Monitoring

Global Monitoring

Core Services

Observatories
- Nature Protection
- Spatial Planning
- Water & Soil
- Natural Carbon Fluxes
- Food Security & Crop Monitoring
- Land Cover & Forest Change

Directives Implementation

Policy Support

FP-6 SSAs
- HALO
- GOSIS
- NAVOBS

FP5/CYCLOPES
- Land SAF / EUMETSAT
- STREP EAGLE

STREP INTEGRAL

FP5/EOLA
- EION2000
- BIOPRESS
- Megacities, Moland

FP5/SIBERIA
- • FP5/ELDAS

FP-5/EO
- N2000+
- BIOPR
- ESP
- S
- Megacities, Moland
- FP5/SIBERIA

FP-5/CYCLOPES
- Land SAF / EUMETSAT
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                          - ESP
                          - S
                          - Megacities, Moland

FP-5/EO
                            - • FP5/ELDAS
geoland Products Overview

Intermediate Products
• Inputs to models, services
• E.g. land cover, bio-physical parameters, seasonal vegetation parameters

Final Products
• Provided to users
• Different downstream service integration levels ranging from parameters to complex environmental assessments
Operational Scenario: GMES Infrastructure

VHR
- 0.5 – 2.5 m
- Urban Coverage
- Optical (VIS, NIR)
- SAR (multi-pol, X-Band)

HR
- 10 – 30 m
- National/Regional
- Optical (VIS, NIR, SWIR, TIR)
- Hyperspectral??
- SAR (multi-pol., L-Band, P-Band)

MR
- 100 – 500 m
- Continental
- Optical
- SAR ?

LF
- 1 km – 2.5 km
- Continental, Global
- Optical
- Passive Microwave
- Active Microwave

Sustainable availability of standard sensor series

Co-ordinated multi-sensor tasking to optimise use of limited space resources

Up-stream exploitation of Synergies (Core Services)
Down-stream customisation (Observatories)

SDI Interface (network of databases/catalogues)
Core Services
Observatory Networks
(Ordering Interface, Dissemination)
Consortium Members

46
Users
(18 consortium members, 28 letters of commitment)

56
Consortium Members

15
Nations

Core Users
- UNEP-DEWA
- FAO
- PUMA
- IGOS
- PIK
- JRC

Service Providers
- UNI Trieste
- APAT
- CNR-IREA

Others
- NAGREF-FRI
- MAICh

International

- IKT
- ICI
- ETC-TE
- TragaTec
- ICC

- CEH
- LMU

- Infoterra Ltd.
- ECMWF

- IFEN
- Medias-France
- Astrium SAS
- Spotimage
- Météo-France
- Noveltis

- INRA
- LCSE

- EARS
- NEO
- KNMI
- Alterra

- NCC
- NR

- SEPA
- CAB
- Metria
- SLU

- LWF
- Infoterra GmbH
- Astrium GmbH
- Delphi IMM GmbH
- Hugin GmbH
- RSS

- DLR / DFD
- IMK
- Uni Bonn
- FELIS

- D
- F
- NL
- S
- RU
- PL
- A
- GR
- I

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Regional Observatories & Core Service

- Core Service Land Cover (CSL)
  - *Products*: Nested range of local, national, continental land cover products
  - *Users*: Regional observatories + additional regional & national agencies

- Observatory Nature Protection (ONP)
  - *Goal*: Operationalisation of EO data for habitat monitoring and nature conservation
  - *Products*: Change indicators in protected areas (mountains, protected forests, wetlands)
  - *Users*: National agencies, national parks administrators

- Observatory Water & Soil (OWS)
  - *Water products*: Water quality assessment
    - water pollution maps, irrigation volume maps, nutrient leakage maps
  - *Soil Products*: Erosion & pollution risks
  - *Users*: National & local environmental agencies, agriculture agencies

- Observatory Spatial Planning (OSP)
  - *Goal*: Urban & regional planning tools and dynamic models (policy impact scenarios)
  - *Products*: spatial planning indicators, urban growth, landscape transformation scenarios
  - *Users*: National & local governments, ESPON Coor. Unit, DG Regio
Global Observatories & Core Service

- **Core Service Bio-Physical Parameters (CSP)**
  - *Products*: Biogeophysical parameters: leaf area index, albedo, fires, soil moisture, temperature, precipitation, evapotranspiration, downwelling radiation
  - *Users*: Global Observatories + International Science community

- **Observatory Natural Carbon Fluxes (ONC)**
  - *Goal*: Global assimilation of remote sensing for monitoring water & carbon fluxes on land
  - *Products*: CO2 & water flux, biomass, carbon storage, leaf area index
  - *Users*: Int'l organisations in charge of assessing the Carbon Balance and consulting political decision makers (IGBP, IGOS-P, PIK, GCP)

- **Observatory Food Security & Crop Monitoring (OFM)**
  - *Goal*: Input to Food Security Services and trade policies
  - *Products*: Crop Production Assessment for Europe, Central Asia, China
  - *Users*: FAO, DG Agri, DG Aid Co

- **Observatory Land Cover & Forest Change (OLF)**
  - *Products*: decadal-seasonal Indicators for change and degradation of land cover & forests
  - *Users*: International partners of the EU that implement their own environmental monitoring system (FAO, UNEP)
  - *Additional Users*: decision makers for services with responsibilities in policy orientation, project management and environmental reporting in the regions covered by the observatory (DG Aid Co, PUMA, IKI)
Test areas

GMES Service: Crop Monitoring
Core Users: FAO, DG-AGRI, AidCo, DG-DEV

Observatory
Food Security & Crop Monitoring

GMES Service: Vegetation Growth, Vegetation Stress, Land Cover Change, Fire Patterns, Burnt Surfaces
Core Users: UNEP-DEWA, PUMA, IKI

Observatory
Global Landcover & Forest Change

GMES Service: Carbon Fluxes
Core Users: IGBP, IGOS, PIK

GMES Service: Natural Carbon Fluxes

Core Test Sites
Expansion Test Sites
The Biogeophysical Parameter Core Service (CSP)

Core Services

- Generic Land Cover
- Observatories
  - Nature Protection
    - Habitat Directive
    - Wetlands
  - Spatial Planning
    - ESPON
  - Water & Soil
    - Water Framework Directive
    - Soil Protection Initiative
  - Natural Carbon Fluxes
  - Global Change (Kyoto)
- Bio-physical Parameters
- Directives Implementation
- Policy Support

- Operational Scenario
  - Co-ordination
  - Regional Monitoring
  - Global Monitoring
  - Food Security & Crop Monitoring
  - Land Cover & Forest Change
  - Global Environment Protection
  - Sustainable Development
  - Fight against Poverty

- Nature Protection
  - Habitat Directive
  - Wetlands
  - ESPON
  - Water Framework Directive
  - Soil Protection Initiative

- Global Change (Kyoto)
  - Sustainable Development
  - Fight against Poverty

- ESPON
  - Water Framework Directive
  - Soil Protection Initiative

- Soil Protection Initiative
  - Sustainable Development
  - Fight against Poverty

- Water Framework Directive
  - Sustainable Development
  - Fight against Poverty

- Global Environment Protection
  - Sustainable Development
  - Fight against Poverty
CSP Objectives

- To set up a network visible at European level to serve the future GMES services in biogeophysical parameters

- To demonstrate pre-operational capabilities of production of a series of biogeophysical parameters
  - vegetation
    - LAI, fAPAR, fCover, burnt areas
  - radiative budget
    - temperature, albedo, shortwave & longwave flux
  - hydrology
    - soil moisture, water bodies, precipitation

for:
  - global observatories
  - international science community

- To define & propose an operational scenario for the future
# Service Portfolio (1/2)

<table>
<thead>
<tr>
<th>Products</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>Time Res.</th>
<th>Space Res.</th>
<th>Sensor</th>
<th>Users</th>
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<td>LAI, fAPAR, fCover</td>
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<td>GLOBAL, 2002 - 2003</td>
<td>GLOBAL, 1998 - 2003</td>
<td>10 days</td>
<td>1 km</td>
<td>VGT</td>
<td>ONC OLF OEFM</td>
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<td>EUROPE + AFRICA, 1993 - 2003</td>
<td>ASIA, 1999 - 2003</td>
<td>1 day to 1 year</td>
<td>5 km sub-satellite</td>
<td>Meteosat</td>
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<td>AFRICA + Boreal EURASIA, 2002-2003</td>
<td>AFRICA + Boreal EURASIA, 1998 - 2003</td>
<td>3 months</td>
<td>1 km</td>
<td>VGT</td>
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<td>EUROPE + AFRICA, 3 months 2000</td>
<td>GLOBAL, whole 2000</td>
<td>4 to 10 times per day</td>
<td>50 km</td>
<td>Meteosat + GMS</td>
<td>ONC OEFM</td>
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<td>EUROPE + AFRICA, 1993 - 2003</td>
<td>ASIA, 1999 - 2003</td>
<td>10 days</td>
<td>5 km sub-satellite</td>
<td>Meteosat</td>
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<td>EUROPE + AFRICA, 2000</td>
<td>EUROPE + AFRICA, 1997 - 2003</td>
<td>4 times per day</td>
<td>50 km</td>
<td>Meteosat + AVHRR</td>
<td>ONC OEFM</td>
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<td>EUROPE + AFRICA, 1993 - 2003</td>
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<td>5 km sub-satellite</td>
<td>Meteosat</td>
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</tbody>
</table>

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*The date of delivery is indicated by the left border of the coloured cell.*
### Service Portfolio (2/2)

<table>
<thead>
<tr>
<th>Products</th>
<th>Time Res.</th>
<th>Space Res.</th>
<th>Sensor</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Temperature</td>
<td>½ hour</td>
<td>10 km</td>
<td>Meteosat (IR)</td>
<td>ONC OFM</td>
</tr>
<tr>
<td></td>
<td>10 days</td>
<td>5 km</td>
<td>Meteosat</td>
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<td>1 month</td>
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<td></td>
<td>daily</td>
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<tr>
<td>Soil Moisture</td>
<td>7-10 days</td>
<td>50 km (grid-25 km)</td>
<td>ERS</td>
<td>ONC OFM</td>
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<td>1 month</td>
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<td>1 week</td>
<td>100 km</td>
<td>AMSR</td>
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<td>Precipitation</td>
<td>1 day</td>
<td>1°</td>
<td>Multi-sensor</td>
<td>OFM</td>
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<tr>
<td>Evapotranspiration</td>
<td>1 day to 1 year</td>
<td>5 km sub-satellite</td>
<td>Meteosat</td>
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<tr>
<td>Burnt Areas</td>
<td>10 days</td>
<td>5 km sub-satellite</td>
<td>Meteosat</td>
<td>OFM OLF</td>
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<tr>
<td>Water Bodies</td>
<td>1 month</td>
<td>1 km</td>
<td>VGT</td>
<td>OLF</td>
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</tbody>
</table>

*The date of delivery is indicated by the left border of the coloured cell.*
Product status

- All CSP products existed already at some stage of development at the beginning of geoland

- However, methodological improvements have been undertaken within geoland

  - Novel methods developed for
    - shortwave radiation
    - temperature
    - soil moisture (passive)
    - precipitation

  - For all product lines, strong emphasis on customization
Vegetation & albedo

Fraction of Vegetation Cover, 15 June 1997, POLDER

Albedo, 13 August 2000, VEGETATION

geland added value:
integration, customization

0.12 0.25
Shortwave Radiation

Shortwave Radiation (W/m²)

Quality Assurance flag

geoland added value: global fields through merging of polar & geostationary satellites
Example of LSA SAF DSLF output product for MSG full disk 12.02.2003 - 12 UTC: (a) DSLF (W m\(^{-2}\)); (b) QC information.
Surface Temperature

Land Surface Temperature indicators, representatives of August 1996, METEOSAT

geoland added value: novel approach to adapt to space & time constraints of users
Evapotranspiration

Relative evapotranspiration (%) May 2002

Difference with 5yr average (%)

Relative evapotranspiration is the ratio evapotranspiration / net radiation
Fires

Burned areas

Burns scars detected in Mongolia on 11/5/2000, left: ATSR image (RED, NIR, SWIR) and right: burn scar map

geoland added value: improve space & time resolution
Soil Moisture (1/2)

Left. Longterm mean soil moisture as derived from SMMR (1978 –1987)

Right. Anomaly for a particular day

geoland added value: novel approach for soil moisture
Soil Moisture (2/2)

Global monthly Soil Water Index derived from ERS / Scatterometer (1992-2000)

geoland added value: intercomparison, customization
Precipitation

left. GPCP-1DD multi-satellite estimates of precipitation (mm) for July 01, 2000.

right. GPCC bias corrected rain gauge measurements (mm) from about 6000 synoptic stations, July 01, 2000.

geoland added value: merge multisatellite product with data from rain gauge network.
CSP Operational scenario considerations

- The Eumetsat / SAF model seems adequate
  - operational time series of satellite data over the long term
  - established networks Research & Service Providers

- Land SAF
  - products adapted to real time operational meteorology needs
  - centered on the operational application of meteorological sensors: MSG, EPS

- CSP
  - products adapted to GMES Services needs
    - Food safety
    - Carbon flux
    - Land & Forest degradation
  - emphasis on differed time products (i.e. historical series)
  - multisensor character
CSP Preoperational organisation

Role of Coordination
- define Service Portfolio
- synthetize needs
  - customization of existing products
  - design of new products
- coordinate with R&D network
- list product catalog
- coordinates quality assessment
- provide access to products through Web inerface

Research

Service Providers
IM Portugal, VITO, EARS

Coordination
MEDIAS-France

Precursors of GMES Services
ONC
OLF
OFM