LAND SURFACE ALBEDO FROM MSG GEOSTATIONARY SATELLITE
(METHOD FOR RETRIEVAL, VALIDATION, AND APPLICATION FOR WEATHER FORECAST)

OUTLINE

- Land SAF project

- Surface Albedo Products
  - method for retrieval
  - evaluation
  - application for weather forecast

- Perspectives
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Land-SAF CHRONOGRAM

Development Phase: Sep 1999

Initial Operations Phase: Feb 2005

Continuous Development & Operations Phase Mar 2007
OPERATIONAL SYSTEM

[Diagram of energy budget processes involving various data inputs and system components, with a URL for LSA SAF website: http://landsaf.meteo.pt]
THE Land-SAF CONSORTIUM (2009)

- Instituto de Meteorologia (IM), Portugal
- Meteo-France (MF), France
- Royal Meteorological Institute (RMI), Belgium
- Finnish Meteorological Institute (FMI), Finland
- IMK, University of Karlsruhe
- IDL, University of Lisbon
- UV, University of Valencia

- Organisation principles
  - Algorithms developed at one of the participating Institutes
  - Algorithms handed over to IM for integration and production
# THE PRODUCTS

<table>
<thead>
<tr>
<th>Product</th>
<th>Acronym</th>
<th>Type</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Albedo</td>
<td>AL</td>
<td>OP</td>
<td>MF</td>
</tr>
<tr>
<td>Bi-directional Reflectance Distribution Function</td>
<td>BRDF</td>
<td>OP-Int</td>
<td>MF</td>
</tr>
<tr>
<td>Land Surface Temperature</td>
<td>LST</td>
<td>OP</td>
<td>IM</td>
</tr>
<tr>
<td>Thermal Surface Parameter</td>
<td>TSP</td>
<td>POC-Int</td>
<td>IMK</td>
</tr>
<tr>
<td>Emissivity</td>
<td>EM</td>
<td>OP-Int</td>
<td>ICAT</td>
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<tr>
<td>Downwelling Surface Short-wave Fluxes</td>
<td>DSSF</td>
<td>OP</td>
<td>MF</td>
</tr>
<tr>
<td>Downwelling Surface Long-wave Fluxes</td>
<td>DSLF</td>
<td>OP</td>
<td>IM</td>
</tr>
<tr>
<td>Snow Cover</td>
<td>SC</td>
<td>OP</td>
<td>SMHI</td>
</tr>
<tr>
<td>Evapotranspiration</td>
<td>ET</td>
<td>OP</td>
<td>RMI</td>
</tr>
<tr>
<td>Fractional Vegetation Cover</td>
<td>FVC</td>
<td>OP</td>
<td>UV</td>
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<tr>
<td>Leaf Area Index</td>
<td>LAI</td>
<td>OP</td>
<td>UV</td>
</tr>
<tr>
<td>Risk Fire Manager</td>
<td>RFM</td>
<td>DEM</td>
<td>IDL</td>
</tr>
<tr>
<td>Fire Radiative Power &amp; Energy</td>
<td>FRP&amp;FRE</td>
<td>OP</td>
<td></td>
</tr>
<tr>
<td>Fraction of Absorbed Photosynthetic Active Radiation</td>
<td>fAPAR</td>
<td>OP</td>
<td>UV</td>
</tr>
</tbody>
</table>
SNOW COVER

2006/02/19 - 00:00 UTC

Totally | Partial | Free | Unclass | Sea
LONG-WAVE RADIANCE
FRACTIONAL VEGETATION COVER
fAPAR
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**PRODUCT CHARACTERISTICS (AL)**

- **Spatial Resolution:** 3km at the Sub-Satellite Point
- **Projection:** native MSG/SEVIRI Projection
- **Production Frequency:** Daily
- **Effective Temporal Resolution:** 5 Days
- **Format:** HDF5
- **Timeliness:** 3 hours

**Dissemination:** EUMETSAT broadcast system (EUMETCast), and project website (http://landsaf.meteo.pt)

- **Spectral Albedo (6):** 0.6µm, 0.8µm, and 1.6µm (DH&BH)
- **BroadBand Albedo (4):** VIS-DH ([0.4µm, 0.7µm]), NIR-DH ([0.7µm, 4.0µm]), SW-DH ([0.3µm, 4.0µm]), SW-BH ([0.3µm, 4.0µm])
METHOD FOR RETRIEVAL

TOA Reflectance Factor

Geometry

Atmospheric Correction

Atmosphere

TOC Reflectance Factor

Geometry

BRDF Model Inversion

Previous Model Estimate

Model Parameters $k, C_k$

Geometry

Integration

Albedo

AL1 for each slot $\Delta t=15$ min

AL2 for each day $\Delta t=1$ day
ALBEDO INPUT DATA

- MSG Data: 0.6µm, 0.8µm, 1.6µm
- Solar and View Angles
- Land/Sea Mask
- Cloud Mask (SAF-NWC software)
- Total Column Water Vapour, and Pressure (ECMWF)
- Ozone Content (Climatology)
- Aerosol Optical Thickness (Climatology)
COMPARISON WITH MODIS ALBEDO (1/2)

16-day average MSG Albedo -
MODIS albedo projected on SEVIRI grid

over Europe (from 2005-06-01 to 2006-10-01)

- [0.4µm, 0.7µm]
- [0.7µm, 4µm]
- [0.3µm, 4µm]

10-25 of June 2006
COMPARISON WITH MODIS ALBEDO (2/2)

12-27 of July 2006
ALBEDO TIME SERIES (snowfall episodes)

Toravere 01.09.2005 – 30.06.2006

- Modis SW-BH albedo
- MSG albedo
- Ground measurements (boreal forest)

Mehrstedt 01.09.2005 – 30.06.2006

- Ground measurements (mixed shrub/tree)
The temporal evolution of the albedo estimate is related to the evolution of surface properties (typically rainfall). The spurious fluctuations appear to be caused by aerosol effects.
SUMMARY OF PERFORMANCES (AL)

Accuracy

Over mid-latitude region:

bias: 5% in relative units for SW and NIR broadband albedo (except for snow/ice pixels) – bellow 0.01 in absolute unit

20% for VIS broadband albedo (potentially due to the use of different BRDF models and aerosol products)

stdev: 0.015 for VIS and 0.030 for NIR and SW (or BB)

Over brightening surfaces (North Africa): no degradation in relative units

Publications:


APPLICATION FOR WEATHER FORECAST

Weather forecast model: ALADIN (~9.5km)
Two experiments: with ALADIN albedo and with Land SAF albedo analysis
Run every day at 00h: 20070201->20070731 (54h forecast)

Surface albedo 15022007 00UTC+12 LandSAF-reference

2m temperature 15022007 00UTC+12 LandSAF-reference

Conclusion of Score Study: weather model has a significant cold bias in winter. Satellite data permit to reduce this bias.

(J. Cedilnik, D. Carrer, J.-L. Roujean and J.-F. Mahfouf, “Analysis of satellite derived surface albedo for numerical weather prediction”, to submit)
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OPEN ISSUES AND FURTHER DEVELOPMENTS

• **2009-2012:**  
  1/ **tuning of algorithms**  
  2/ **high latitude coverage:** extension achieved due to the merging of MSG and MetOp data.  
  3/ **to strengthen validation:** over Africa & snow covered areas  
  4/ **use in NWP models:**  
    - radiative forcing (DSSF & DSLF).  
    - surface analysis (albedo).  
  5/ **aerosols:**  
    - operational algorithm under development.  

  *(Carrer et al., submitted)*

• **Until 2019:**  
  => a perennial operational production with MTG and MetOp-2.
LAND SURFACE ANALYSIS
SATELLITE APPLICATIONS FACILITY

Home

The scope of Land Surface Analysis Satellite Applications Facility (LSA SAF) is to increase benefit from EUMETSAT Satellite (MSG and EPS) data related to:

- Land
- Land-Atmosphere interaction
- Biospheric Applications

The LSA SAF performs:

- R&D Programs
- Operational Activities
  - Generation
  - Archiving
  - Dissemination

of land surface related products.

Latest News:

- Information LSA SAF outage see more...
- Information Possible difficulties in accessing the Landsat.metoe.fr see more...
- Information LSA SAF outage see more...
- Information New algorithm versions see more...
- Information LSA SAF outage see more...

Product Development Status:

**MSG System**

<table>
<thead>
<tr>
<th>LST</th>
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<td>IAPAR</td>
<td>FRP</td>
<td>MXE</td>
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**EPS System**

Caption

- Internal
- Development
- Demo
- Pre-Operat.
- Operat.

LSA SAF is an initiative of:

![EUMETSAT]

LSA SAF consortium in CDOF (2007-2012):

- IM
- MF
- FMI
- IMK
- UV
- FMI
- IDL

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LandEnergyBudget -March 18-20, 2009
MANY THANKS