A SCOPE-CM Initiative: Surface Albedo from the Geostationary Constellation

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SCOPE-CM

- SCOPE-CM: Sustained, Co-Ordinated Processing of Environmental Satellite Data for Climate Monitoring
- Aims to provide an international basis for the provision of high quality long-term data sets of ECVs
- Established in 2008 by: CMA, EUMETSAT, JMA, NOAA

Further information: www.wmo.int/pages/prog/sat/SCOPE-CM.html
PHASE 1: Establish the network through pilot projects:
- AVHRR based data set of cloud and aerosol properties
- SSM/I: total column water vapor, precipitation, liquid water path
- Atmospheric Motion Vectors (AMV) and clear sky radiance
- Upper tropospheric humidity
- Surface albedo, clouds and aerosols from geostationary satellites

PHASE 2: CDR Generation, more ECVs processed, partnership extended

PHASE 3: Sustained generation of ECVs
Surface albedo = fraction of incoming solar radiation reflected by the land surface

A sensitive indicator of environmental changes

Identified as an Essential Climate Variable (ECV) by the Global Climate Observing System (GCOS)
GSA Algorithm

- Based on approach proposed by Pinty et al (2000)
- From geostationary, any single pixel is observed with the same viewing geometry, but with illumination angles that change during the course of the day
- GSA assumes: temporal sampling throughout the day is an instantaneous angular sampling of the TOA radiance field
GSA Algorithm -- inputs

- **Inputs:**
  - Radiance measurements (GOES visible band)
  - Geolocation grid (latitude/longitude values)
  - NWP data (ozone, water vapor)
  - Cloud mask (optional)

- **Excluded measurements:**
  - Solar zenith angle > 70°
  - View zenith angle > 70°
  - Cloudy conditions
    - Filtered by recursive technique

(Figure from NASA-LARC)
GSA Algorithm -- outputs

- Outputs:
  - Optimized set of daily model parameters characterizing the surface Bidirectional Reflectance Factor (BRF), which can be used to generate:
    - Directional-hemispherical reflectance (DHR; aka Black sky albedo) for any solar angle
    - Bi-hemispherical reflectance (BHR; aka White sky albedo) under isotropic illumination conditions
  - Associated solution probability and estimated parameter errors
  - 10-day composite product
GSA Pilot Project

- Spatial and temporal coverage from NOAA, EUMETSAT, JMA

Image credit: K. Knapp

Image credit: A. Lattanzio
GSA Pilot Project

- Each code installation has 2 components:
  - Core: identical
  - Extern: unique; handles schedule, VIS image, cloud mask, NWP data

<table>
<thead>
<tr>
<th></th>
<th>GOES-W</th>
<th>GOES-E</th>
<th>MET-000</th>
<th>MET-063</th>
<th>GMS5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration</td>
<td>ISCCP (w/ AVHRR)</td>
<td>ISCCP (w/ AVHRR)</td>
<td>SCC (bright desert targets)</td>
<td>SCC (bright desert targets)</td>
<td>In-house (w/ MODIS)</td>
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<tr>
<td>NWP data</td>
<td>NCEP</td>
<td>NCEP</td>
<td>ECMWF</td>
<td>ECMWF</td>
<td>JRA-25 (TCWV) TOMS (TCO3)</td>
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<tr>
<td>Image sampling</td>
<td>Varying (~90 images/day)</td>
<td>Varying (~90 images/day)</td>
<td>Full disk: ½ hourly</td>
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<td>Full disk: hourly</td>
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At NCDC:
- Algorithm ported to NCDC and upgraded to work in a Linux 64-bit environment
- Code created to import GOES format images and export netCDF4 products
- Incorporated NCEP ancillary data inputs for ozone and water vapor, improved GOES calibration
- Designed optimal (parallelized) algorithm configuration given variable GOES scan schedule
- Staging of 2000-2003 GOES-8,10,12 data to parallel computing cluster system completed
January 1-10, 2000

June 29-July 8, 2000
GSA Pilot Project – L3 proof of concept

- Black sky albedo
- Top: 1-10 May 2001, GSA broadband (0.3-3.0 μm) with prob. > 80%
- Bottom: 1-16 May 2001, MODIS (MCD43C3) broadband (0.3-5.0 μm) with quality: 75% albedo values from full inversion

Image credit: A. Lattanzio
GSA -- future work

- At NCDC:
  - Complete processing 2000-2003 for GOES-E and GOES-W
  - Validation of level-2 product with polar-orbiting and in situ data
  - Process entire historical record of GOES data (1978-present)

- SCOPE-CM network:
  - Generate level-3 global product
    - Calibration consistency between satellites
    - Homogeneous NWP model reanalysis data
    - Spatial/temporal consistency between products
For more details, please see an upcoming publication: