Multisensors remote sensing of cloud properties from POLDER2/Adeos2 and MODIS/Terra

J. Riedi, C. Oudard, JM. Nicolas, F. Parol and L. Labonnote,

Laboratoire d'Optique Atmosphérique
Université des Sciences et Technologies de Lille
Multisensors remote sensing of cloud properties from POLDER2/Adeos2 and MODIS/Terra

Context and Rationale

Methodology

Current activities

Potential Synergy

Perspectives
Context and Rationale
Objectives:
Define and implement new scientific algorithms based on combination of MODIS and POLDER level 1 data in order to
– (i) improve retrieval of existing parameters
– (ii) allow for retrieval of new parameters

Basic interference considerations tell us that both constructive and destructive interferences are possible

HOW SHOULD WE PROCEED TO MAKE SURE THAT 2 > 1?

MODIS/Terra and POLDER/Adeos II in flight between February and October 2003
Terra and AdeosII were in very good coordination every 3 days during one orbit
83 orbit swath available to prepare the A-Train data analysis and test ideas
Instrumental Background : MODIS

- NASA, Terra & Aqua
  - launched 1999, 2002
  - 705 km polar orbits, descending (10:30 a.m.) & ascending (1:30 p.m.)

- Sensor Characteristics
  - 36 spectral bands ranging from 0.41 to 14.385 µm
  - cross-track scan mirror with 2330 km swath width
  - Spatial resolutions:
    - 250 m (bands 1 - 2)
    - 500 m (bands 3 - 7)
    - 1000 m (bands 8 - 36)
  - 2% reflectance calibration accuracy
  - onboard solar diffuser & solar diffuser stability monitor
Instrumental Background : POLDER

- CNES/LOA instrument, Adeos I & Adeos II Platform
  - launched 1996, 2003
  - ~ 800 km polar orbits, descending (10:30 a.m.)

- Sensor Characteristics
  - 9 spectral bands ranging from 0.443 to 0.910 µm
  - 3 polarised channels
  - Wide FOV CCD Camera with 2400 km swath width
  - +/- 43 degrees along track
  - +/- 51 degrees cross track
  - Multidirectional observations (up to 14 directions)
  - Spatial resolution : 6x7 km
  - No onboard calibration system - Inflight vicarious calibration :
    - 2-3% absolute calibration accuracy
    - 1% interband – 0.1% interpixel over clouds
Methodology

Questions:

What are the possible synergies between the different instruments of the Atrain and particularly between POLDER / MODIS?
How do we combine these measurements to allow combined retrievals?

Strategy:

Comparison of products retrieved independently by each instrument

Conducting sensitivity studies based on simulation

Direct analysis of combined level 1 data (ie: look at real world data)
- Processing line development for efficient colocation of all data
- Performing intercalibration of sensors to get compatible reflectances
Current Activities: Processing environment

Provide users with an hyper-pixel structure containing both multispectral, multispatial and multidirectionnal observation together with all necessary ancillary data.

Provide an easy to access, visualize and process data structure.
Current Activities: Processing environment

POLDER-MODIS - 01/06/2003 – Pacific
Current Activities: Intercalibration

Modis Band 2  Polder 865 nm  5 degrees diff.  2 degrees diff.

Geometry selection
Current Activities: Intercalibration

Reflectances POLDER-MODIS

POLDER 865 nm

MODIS Band 2
Current Activities : Intercalibration
Current Activities: Intercalibration

865 nm

670 nm

443 nm

910 nm
Current Activities : Intercalibration

Paired scattergram for 665nm and 865nm for the POLDER and MODIS simultaneous overpasses of the Terra satellite (IGM).
Potential Synergy: Cloud phase

MODIS VIS/SWIR composite (band 2, 6 and 7)
Higher absorption by ice in SWIR bands produces red colors in composite
Potential Synergy: Cloud phase

POLDER True color (total radiances / Top) and False color (polarized radiances / Bottom)

Spherical (liquid) particles produce high polarisation around 140 degree
Potential Synergy: Cloud phase

Spherical (liquid) particles produce high polarisation around 140 degrees
Potential Synergy: Cloud detection over snow/ice

Combination of polarisation and SWIR measurements enable better discrimination of clouds against snow/ice surface.
Potential Synergy: Cloud detection in glint region

Multiangle observations enable straightforward cloud detection under glint conditions
Potential Synergy

Cloud layers height
Deriving multiple cloud top pressure (O2, Rayleigh, CO2 slicing, H2O) to detect multilayer clouds and better describe vertical structure

Improved cloud retrievals
Using Size retrieval from MODIS to improve multidirectional OT retrievals from POLDER

Cloud Heterogeneities
Using MODIS 250m information to understand angular behavior in POLDER measurements and separate 3D effect from subpixel heterogeneities
Summary

An efficient module for merging MODIS and POLDER data has been created

Intercalibration of the sensors is greatly simplified and detectors evolution can be monitored

Improved knowledge of the POLDER sensor is also possible

Various potential synergy for cloud remote sensing are clearly identified

Future work

Implement new algorithms for joint analysis

Provide users with POLDER/MODIS joint dataset and new products

Parasol-Modis/Aqua soon available ...

Next Generation POLDER to follow.