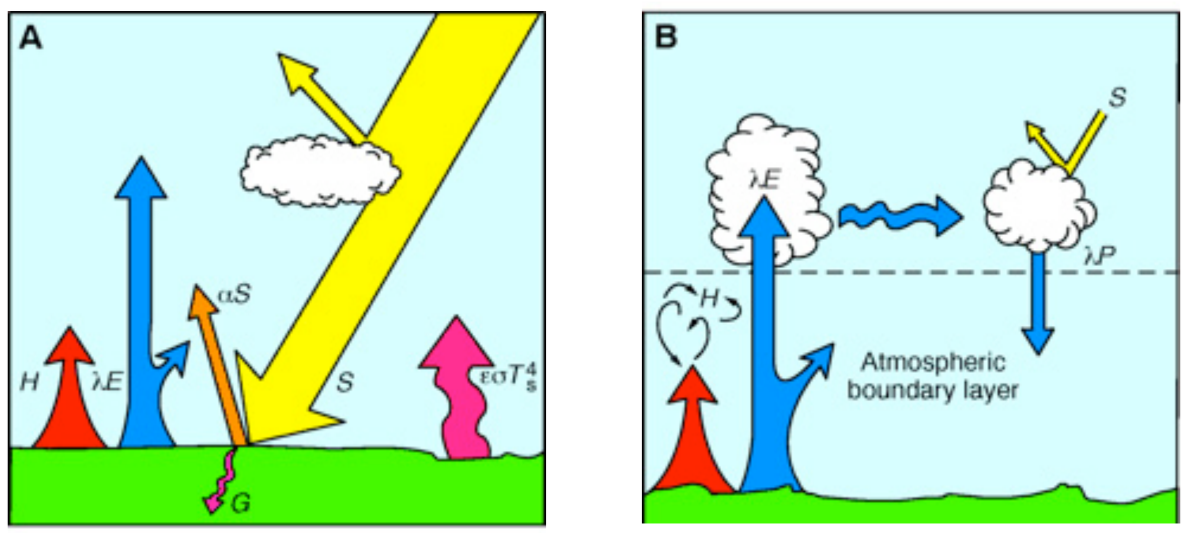
JOINT RESEARCH CENTRE
EUROPEAN COMMISSION

Making Surface Albedo Compatible with the Needs of Land Surface Models

Institute for Environment and Sustainability

Ref: Sellers et al. (1997) Science, 275, 502-509

Land Surface interactions



Surface radiation budget Atmospheric heat fluxes

Surface Albedo: various meanings

BHR : Bi-Hemispherical Reflectance is the ratio between the upward and the downward radiant fluxes, that is, accounting for the downwelling diffuse intensities from the sky.

Depends on both surface and atmospheric radiative properties and …the Sun angle.

DHR: Directional Hemispherical Reflectance is the ratio between the upward flux and the downward collimated flux coming thus from one single direction.

Need for inter-comparison exercises

- Identify the product values showing appropriate QA
- Achieve the needed transformations (e.g., BHRs, spectral conversions) to ensure inter-comparison of physical quantities having same meaning

Ref: Pinty et al. (2005) Journal of the Atmospheric Sciences

Surface Albedo: some caveats

• If the downwelling diffuse intensities from the sky is assumed fully **isotropic** then the BHR is equal to the integral of the DHR over all incoming directions and,

the BHR becomes a BHRiso called White Sky albedo by MODIS and depends on surface radiative properties only and …the Sun angle.

•The DHR boils down to a single integral of BRF on all the outgoing directions, called Black Sky albedo by MODIS where

the BRF, a Bidirectional Reflectance Factor expressing the probability for radiation coming from one particular direction to be scattered in a specific outgoing direction

All quantities can be defined monochromatic or broadband

• MISR delivers DHRs and BHRs as flux ratios but under ambient conditions and for the Sun illumination conditions at time of observations

and all information needed to reconstruct the DHRs at any other Sun angle as well as the BHRiso

• EUMETSAT delivers DHRs for a fixed Sun angle

and all information needed to reconstruct the DHRs at any other Sun angle as well as the BHRiso

MODIS delivers DHRs and BHR*iso*

to reconstruct the BHRs may require substantial investments or some level of assumption

The albedo products may also differ with respect the spectral bands of integration they refer to.

Assuming that the field of downwelling diffuse intensity reaching the surface is PERFECTLY isotropic yields a *BLUE SKY ALBEDO* produced operationally by MODIS

Surface level

Sun angle

ratio of direct to total downward flux

$$BHR^*(z_0,\mu_0;\tau,\rho_{sfc}) = DHR(z_0,\mu_0;\rho_{sfc})\times f^{\downarrow dir}(z_0,\mu_0;\tau) + BHR_{iso}(z_0,\mu_0;\rho_{sfc})\times f^{\downarrow diff}(z_0,\mu_0;\tau,\rho_{sfc})$$

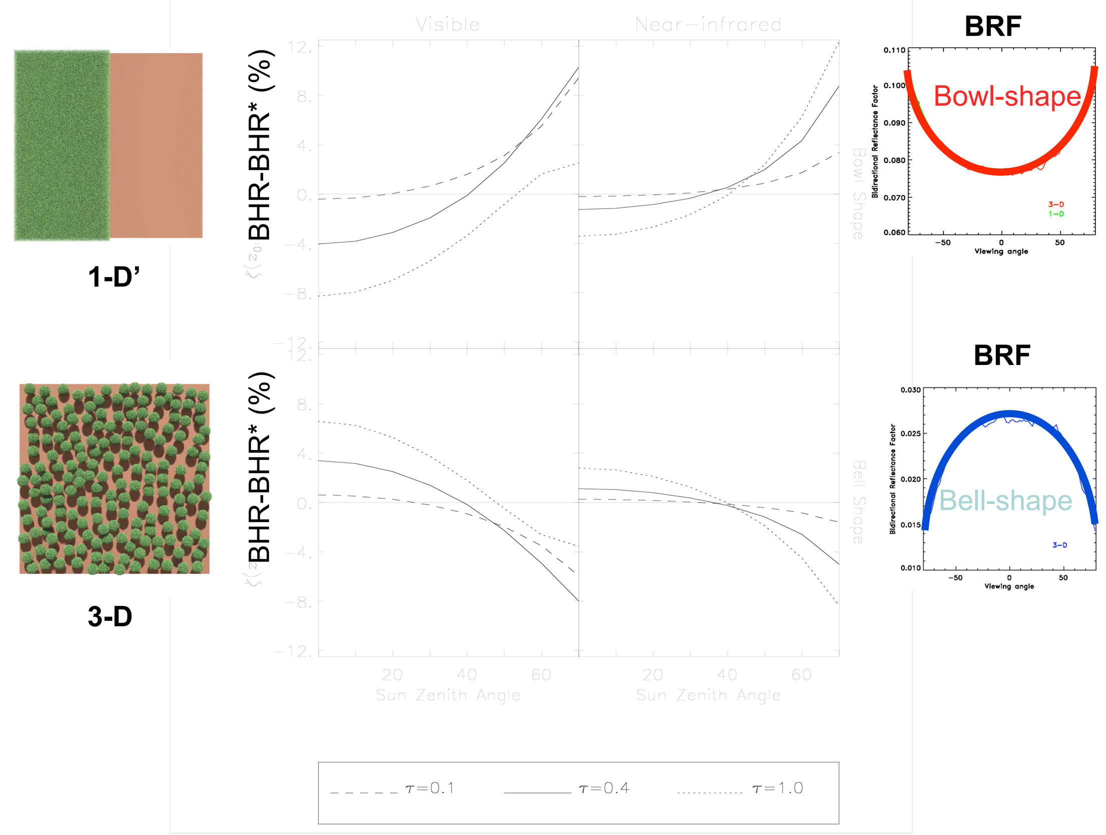
Atmospheric optical depth (type of atmosphere)

Surface BRF (amplitude and shape)

ratio of diffuse to total downward flux

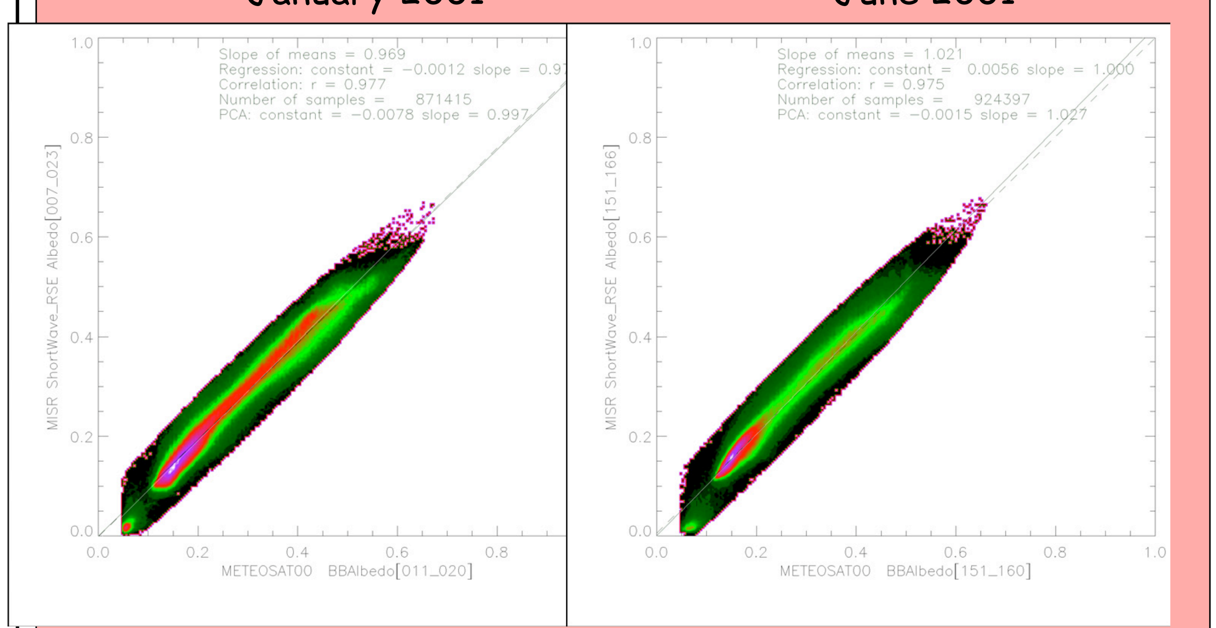
with $f^{\downarrow dir}(z_0,\mu_0;\tau)+f^{\downarrow diff}(z_0,\mu_0;\tau,\rho_{sfc})=1$

All quantities can be defined monochromatic or broadband

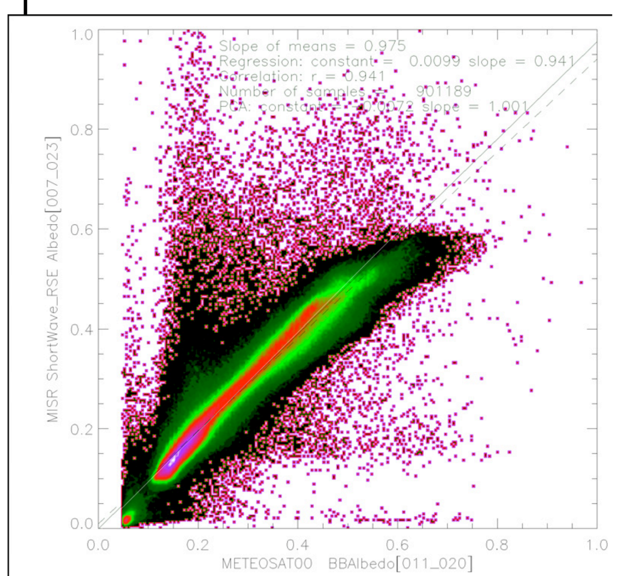


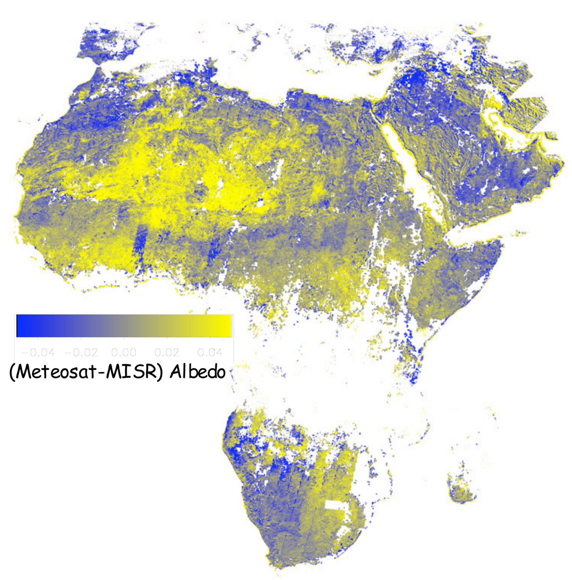
MISR versus Meteosat

January 2001 June 2001

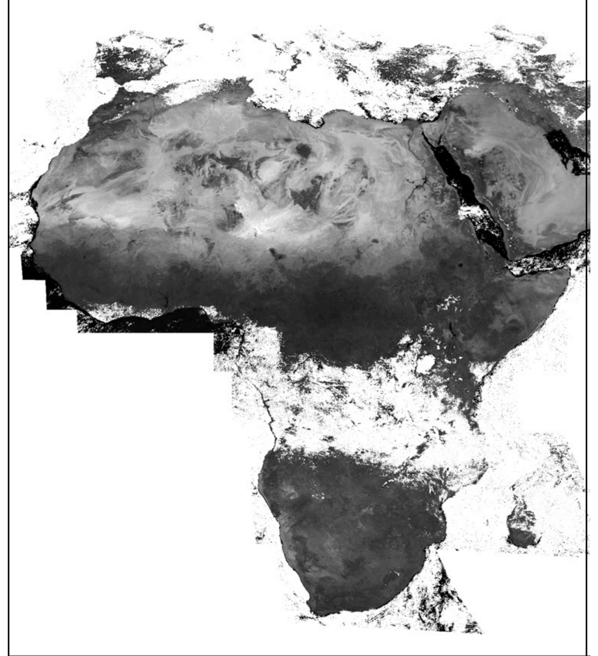


After the spectral conversion to an ideal 0.3-3.0µm band

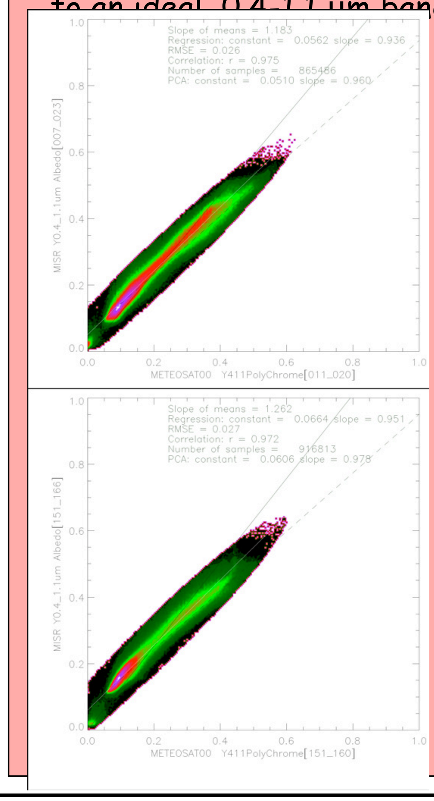




MSA product year 2001, 11-20



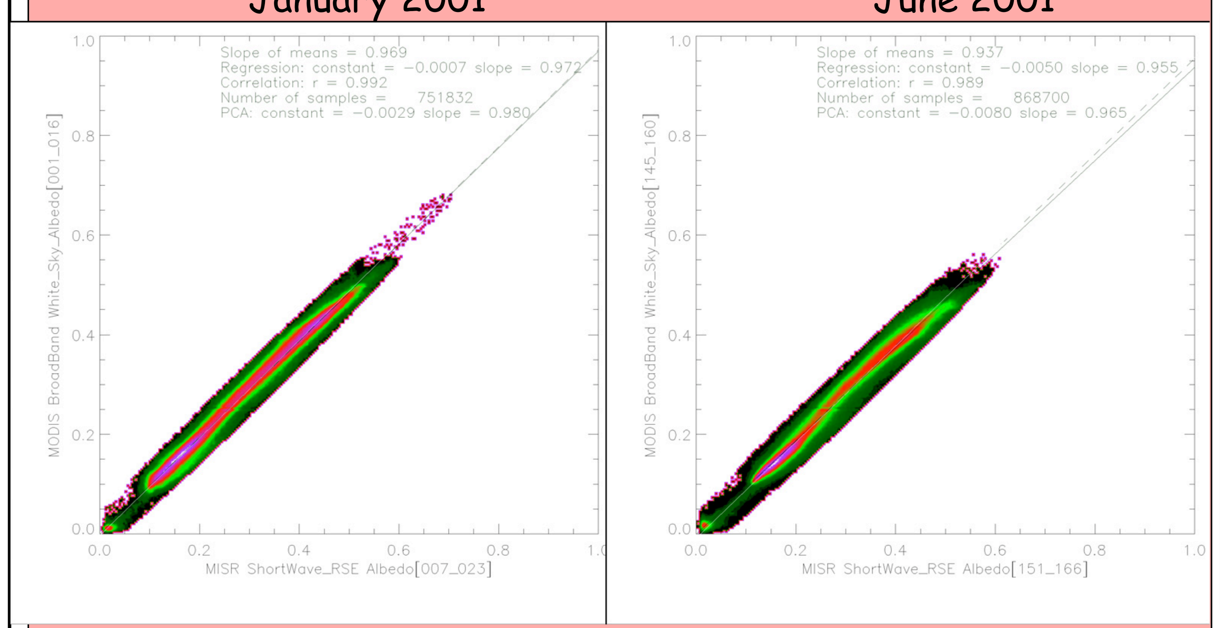
After the spectral conversion to an ideal 0.4-1.1 µm band



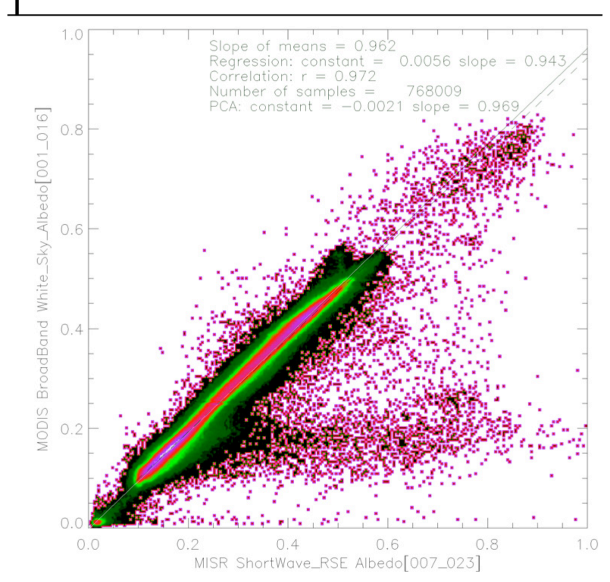
MISR versus MODIS

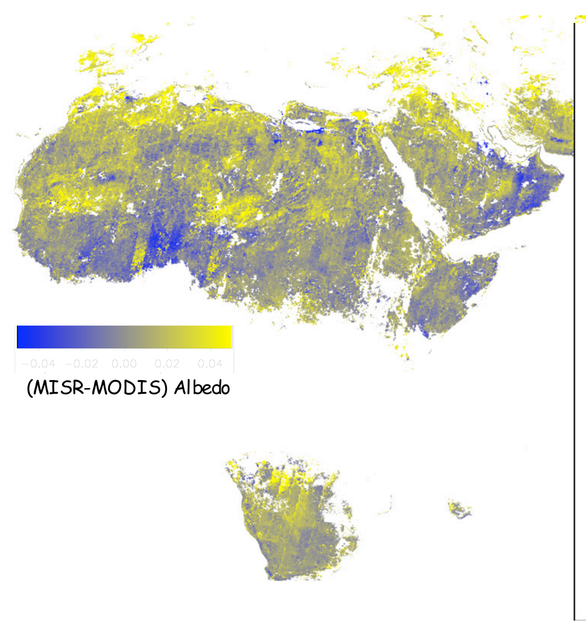
High QA values only

January 2001 June 2001

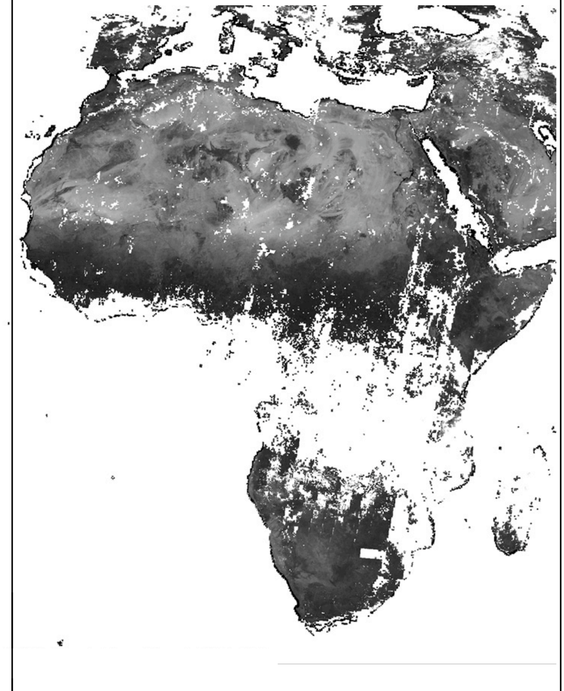


After the spectral conversion to an ideal 0.3-3.0µm band

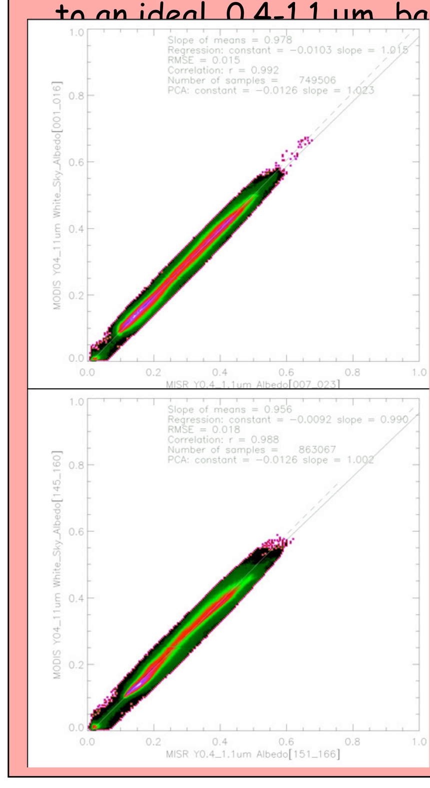




MISR product year 2001, 7-23



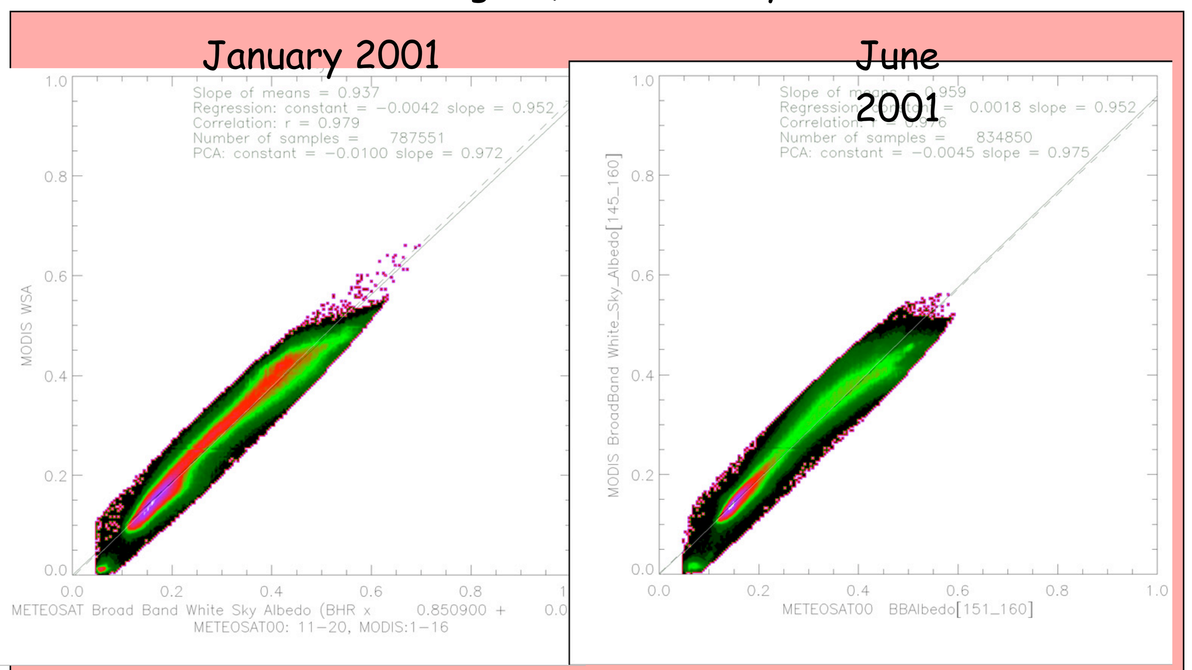
After the spectral conversion to an ideal 0.4-1.1 µm band



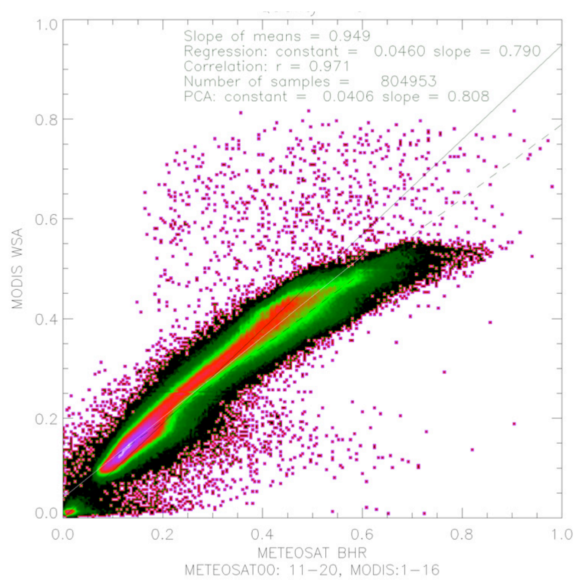
MODIS versus Meteosat

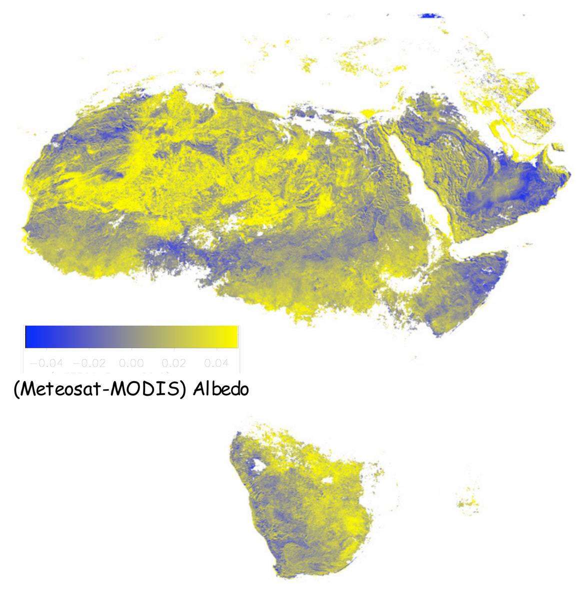
High QA values only

January 2001 June 2001

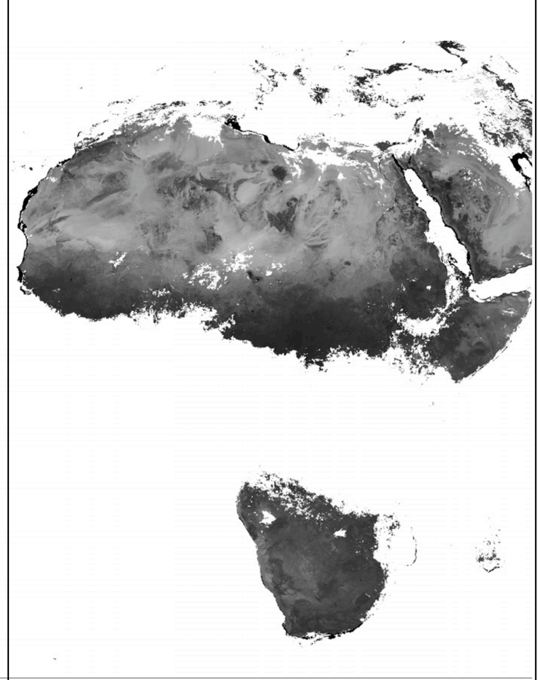


After the spectral conversion to an ideal 0.3-3.0µm band





MODIS product year 2001, 1-16



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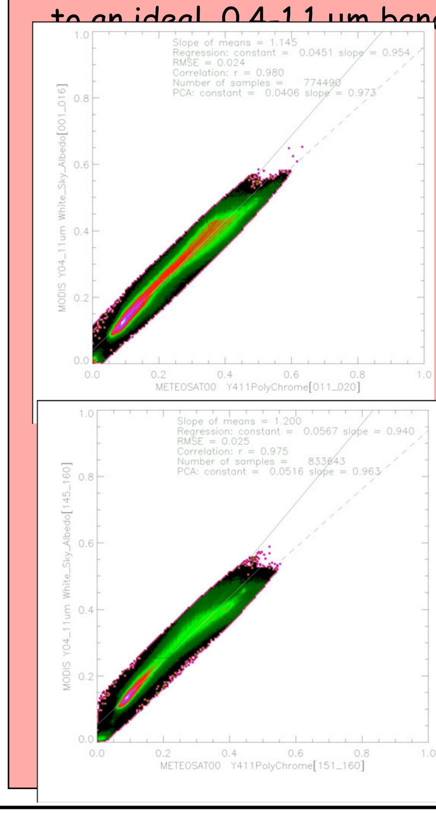

Authors : B. Pinty [1], M. Taberner [1], A. Lattanzio [2], S. Liang [3], J.V. Martonchik [4], M. M. Verstraete [1], R. E. Dickinson [5], N. Gobron [1], J-L. Widlowski [1], Y. Govaerts [6] and C. Barker Schaaf [7]

(1) Institute for Environment and Sustainability of EC-JRC, TP 440, GVM, 21020 Ispra (VA) Italy
(2) Makalumedia gmbh, Robert-Bosch Strasse 7, 64296 Darmstadt, Germany
(3) University of Maryland, Department of Geography, 2181 LeFrak Hall, College Park, MD 20742, USA
(4) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA
(5) SEAC, Georgia Institute of Technology, 311 Ferst Drive, Atlanta, GA 30332 USA
(6) EUMETSAT, Darmstadt, D-64295, Germany
(7) Department of Geography, Boston University, 675 Commonwealth Avenue, Boston, MA 02215 USA

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