Progress and Plans for MODIS validation and new algorithm development

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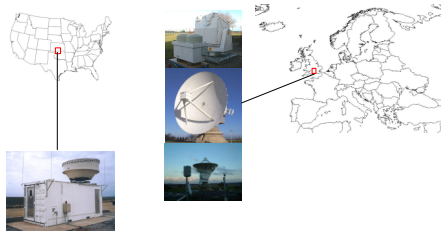
Objectives for next 3 years

- Develop automated algorithms for the extraction of geophysical parameters from MODIS using geomatic engineering, image understanding (IU) techniques and 3D radiative transfer theory
- Develop extensions of existing MOD43 global BRDF/Albedo product to take topography into explicit account
- Develop new products for the climate modelling community based on fusion of MODIS and SRTM near-global topography
- Develop fused MODIS-MISR products to exploit the complementarity between their spectral and angular aspects (clouds, aerosols, surface BRDF/albedo)
- Develop fused MODIS-DMSP products to explore the anthrogenic components of global change
- Develop global validation strategies using independent data-sets as well as inter-comparison between different sensors on the same EO platform.
- Publish individual validation case studies on the web to provide a detailed reference for product users.

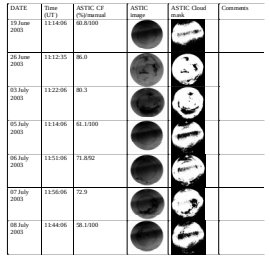
Validation of Cloud and Water Vapour Properties from the NASA Terra MODIS and MISR instruments (EU-CLOUDMAP2)



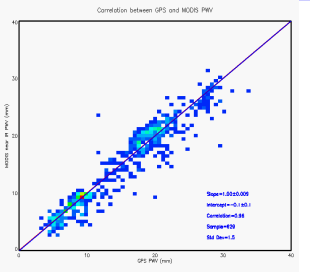
Long time series inter-comparisons of cloud-top heights and cloud fractions from ground-based active and passive instruments at ARM-SGP, OK and Chilbolton Radar Observatory, UK

Cloud situation	Date and location	MERIS and Radar CTH (km)			MISR, MODIS and Radar CTH (km)			
		Time of overpass (UT)	MERIS	Radar	Time of overpass (UT)	MISR	MODIS	Radar
Low continuous	2003-02-15, SGP	16:58	1.9	2.0	17:30	2.2	3.8	2.1
Low broken	2003-05-11, CFARR	10:42	CTHs too variable		11:10	1.0	3.6	1.1
	2003-06-12, CFARR	10:35	1.7	1.6	11:10	1.5	3.9	2.0
Low multi-layer	2003-05-27, CFARR	10:37	1.2	2.5/1.4*	11:10	1.2	2.3	2.5/1.4*
Mid-level continuous	2003-06-07, SGP	16:39	4.3	4.6	17:30	4.5	5.1	4.7
Mid-level broken	2003-06-09, SGP	17:15	4.9	6.2	17:15	5.4	7.1	6.2
High multi-layer	2003-05-15, SGP	17:01	5.0	11.7	17:25	9.0	10.6	11.6
	2003-05-31, SGP	16:58	5.5	12.4	17:25	9.0/5.3*	10.6	11.8

All cases per cloud situation: good agreement between MISR, radar and MERIS for single level (non-broken) clouds (#: large box indicates high cloud whilst smaller boxes indicate mid-level cloud)

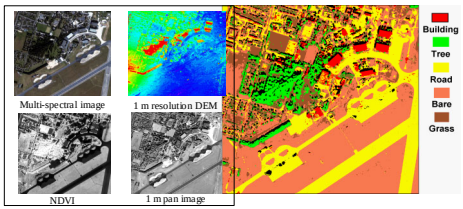


Good agreement between thermal IR all-sky camera and MODIS cloud fractions



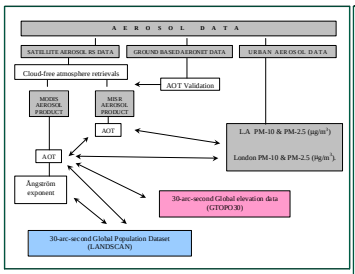
Excellent agreement between MOD05 and GPS Precipitable Water Vapour

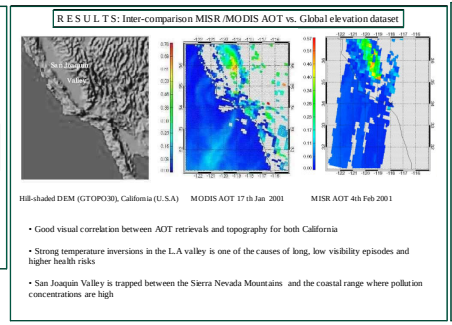
Automated building detection from 1m IKONOS

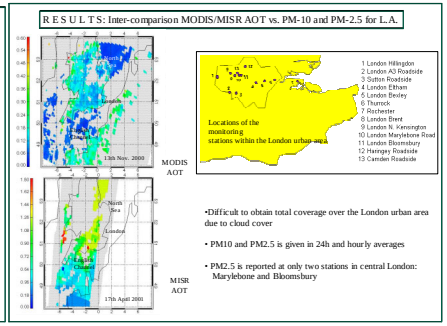


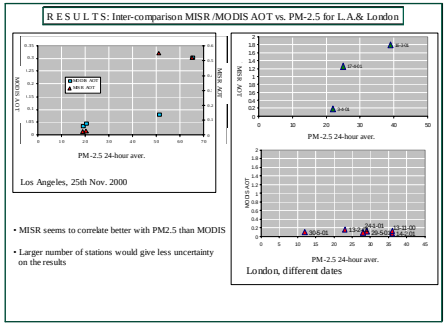
Reliable tree and building detection using the fusion of multi-spectral and Digital Surface Model information and both supervised and unsupervised classification. 3D radiative transfer can then be applied to the 3D landscape objects to understand better the spectral and angular signatures seen by MODIS

Validation of Aerosol Properties from the NASA Terra MODIS and MISR instruments with street-level urban pollution



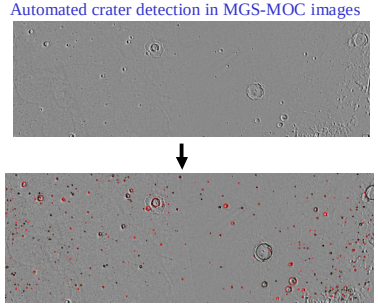






Example Application of IU techniques to Mars

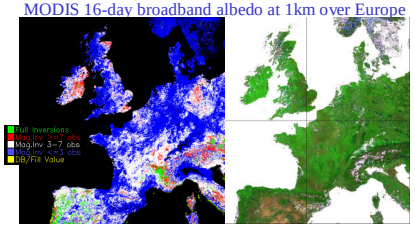
Automated crater detection in MGS-MOC images



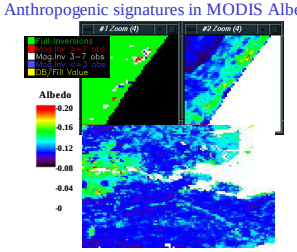
Such automated high-level feature extraction based on image understanding techniques will be applied to MODIS products to try to extract climate change signatures

Land Surface Albedo Properties from MODIS instrument

MODIS 16-day broadband albedo at 1km over Europe



Anthropogenic signatures in MODIS Albedo



Sample publications (2000-2004)

Barnsley, M.J., P.D. Hobson, A.H. Hyman, W. Lucht, J.P. Muller, and A.H. Strahler, Characterizing the spatial variability of broadband albedo in a semidesert environment for MODIS validation, *Remote Sensing of Environment*, *74* (1), 58-68, 2000.

Doll, C.N.H., J.P. Muller, and C.D. Elvidge, Night-time imagery as a tool for global mapping of socioeconomic parameters and greenhouse gas emissions, *Ambio*, *29* (3), 157-162, 2000.

Li, Z.H., J.P. Muller, and P. Cross, Comparison of precipitable water vapor derived from radiosonde, GPS, and Moderate-Resolution Imaging Spectroradiometer measurements, *Journal of Geophysical Research-Atmospheres*, *108* (D20), art. no.-4651, 2003.

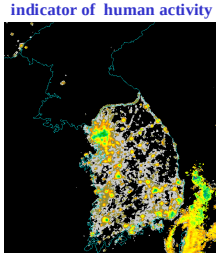
Muller, J.P., A. Mandanayake, C. Moroney, R. Davies, D.J. Diner, and S. Paradise, MISR stereoscopic image matchers: Techniques and results, *Ieee Transactions on Geoscience and Remote Sensing*, *40* (7), 1547-1559, 2002.

Naud, C., J.P. Muller, and E.E. Clothiaux, Comparison of cloud top heights derived from MISR stereo and MODIS CO2-slicing, *Geophysical Research Letters*, *29* (16), art. no.-1795, 2002.

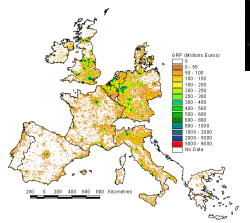
Naud, C., J.P. Muller, M. Haeffelin, Y. Morille, and A. Delaval, Assessment of MISR and MODIS cloud top heights through intercomparison with a back-scattering lidar at SIRTA, *Geophysical Research Letters*, *31* (4), art. no.-L04114, 2004.

Anthropogenic activities from the DMSP OLS instrument

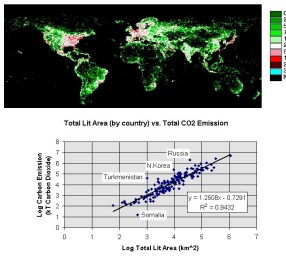
Night-time Lights as an indicator of human activity



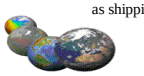
Mapping economic activity from night-time lights



Mapping CO_2 from night-time lights



Excellent at identifying human activities in developed parts of the world Also highlights human activity at sea such as shipping fleets and off-shore gas fields. Clear economic component when analysing the data



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