SCM-project description

1. Project name: **Multiplatform surface albedo demonstrator from polar-orbiting satellites**

2. Project (proposal) leader (name, affiliation, address):
Terhikki Manninen, Finnish Meteorological Institute, P.O. Box 503, FI-00101, Finland

3. Team composition (participating organisations and eventually stakeholders):
Finnish Meteorological Institute (Dr. Terhikki Manninen and Mr. Aku Riihelä),
NOAA (Dr. Jeffrey Key),
University of Massachusetts Boston (Prof. Crystal Schaaf),
EUMETSAT (Mr. Alessio Lattanzio, SCISYS Deutschland GmbH)

4. Identification of satellite CDR capability (geophysical parameters, satellite sensor record (inter)-calibration, processing chains, algorithms):
The goal of this pilot project is to derive a roadmap for estimation of surface albedo using data from several satellite instruments thus benefiting from increased temporal sampling. The method is demonstrated using AVHRR and MODIS images. The quality aims at the GCOS requirements (1, 2, 3).

The following outlines the initially agreed-on approach (Figure 1); alternative methods will be studied during the project, and may be implemented if deemed necessary.

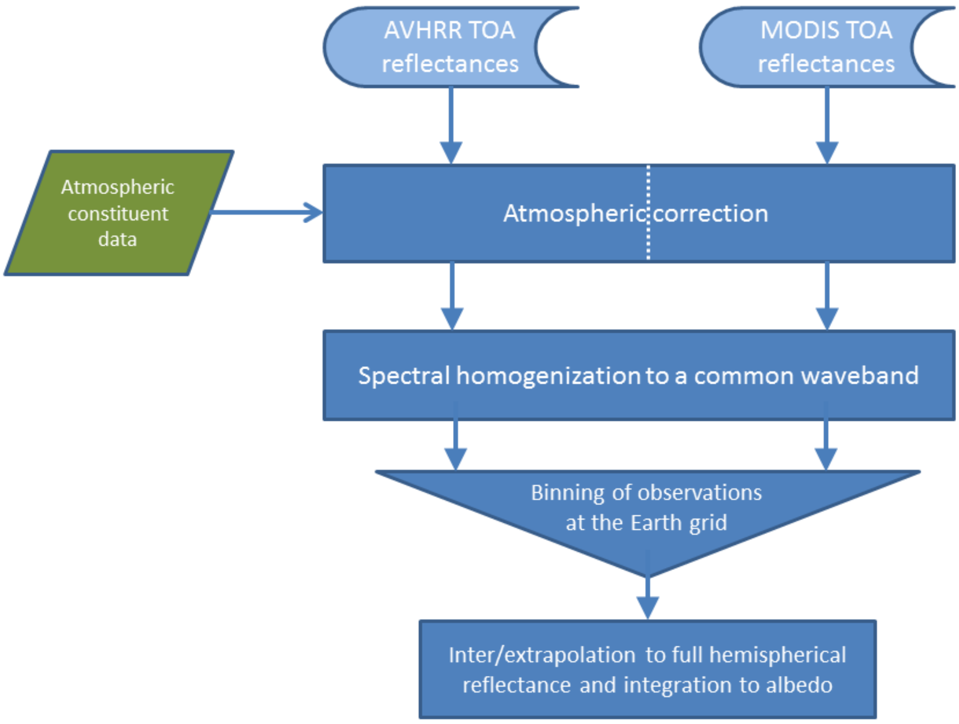

Figure Error! No text of specified style in document.**: Proposed technical approach for MODIS & AVHRR data processing towards a combined albedo retrieval. Note that the framework allows for other instrument data to be added as long as the atmospheric correction and spectral homogenization steps are considered appropriately. For a more detailed description of the processing steps, see text below.**

The steps of the multiplatform albedo retrieval are:

1. Implement atmospheric corrections for each instrument, having similar atmospheric constituents in all correction algorithms.

2. Convert spectral surface reflectances to equal waveband surface reflectance.
    a. At least Photosynthetically Active Radiation (PAR) waveband albedo and full broadband albedo will be produced.
    b. Simultaneous Nadir Overpass (SNO) analysis of the common-band reflectances used to verify the success of common atmospheric correction and spectral homogenization.
3. Perform binning of common-band surface reflectances at the Earth grid, analyze and correct for spatial footprint difference effects.
    a. Testing of various methods (Variable-Pixel Linear Reconstruction ("drizzling") and wavelet-based decomposition of image signals, simple averaging).
    b. Compensation for sun zenith angle variation in the images to be combined.
4. Inter/extrapolate to full BRDF and integrate over viewing hemisphere to retrieve surface albedo.
    a. Fitting of a kernel-based BRDF model into the data.
    b. Five-day temporal resolution targeted,10 days product as backup.

The input data for this method will consist of MODIS and AVHRR TOA reflectances in this project, with an aim to include other instrument data, e.g. from geostationary satellites, in potential follow-ups projects. AVHRR-GAC data utilizing latest radiance calibrations are available at NOAA and MODIS data are available at NASA Land Products Data Active Archive Center (LPDAAC) and the NASA/Goddard DAAC.. The proposed characteristics of the combined albedo product are defined in section 7.

In addition to the albedo product, the project will also develop and maintain the database of binned directional surface reflectance data for added benefit to the Earth science community.

5. Justification of the project including a very brief summary of the related work from the literature, and an assessment of the feasibility of the proposed activity

Justification:
Utilizing only a single instrument family for albedo retrieval limits the total amount of available data per time period per terrestrial scene. Better tracking of sudden changes in surface albedo (for example because of snow falls) is improved when the number of sensors is increased. We propose a SCOPE-CM pilot project to combine multiplatform surface observations from optical imagers to improve both the accuracy and temporal resolution of surface albedo retrievals. In this pilot project phase, we will strive to combine AVHRR and MODIS data, although the developed methodology is intended to be flexible enough to support later inclusion of other polar imager data (e.g. MERIS, VIIRS, MISR, Fengyun, etc.) and further on geostationary satellite data. AVHRR is chosen, because it has the longest time series. MODIS is chosen, because it is a modern instrument with good radiometric accuracy and wavelength range. Our initial focus is on imagers onboard polar-orbiting satellites, whose strengths are in high data acquisition rates over the high latitudes of Earth. This benefit will be leveraged to enhance the quality of albedo retrievals over the polar and boreal regions, which are of paramount importance from the climate change point of view.

Related work:
1. NASA/Goddard has an ongoing project called Land Long Term Data Record (LTDR), which aims at combining AVHRR and MODIS data to generate a Fundamental Climate Data Record (TCDR) of daily surface reflectances, with albedo generated as a side product. We plan to contact the LTDR team to share expertise and potentially also utilize their products in this demonstrator if appropriate.
2. The ESA Globalbedo project utilizes a multisensor approach to deriving global albedo from European satellite instruments (MERIS and SPOT VGT) as well as MODIS BRDF. Contact to the Globalbedo team exists already through C. Schaaf. Again, sharing of experiences between the projects is welcomed and shall be sought after.

3. Within the EUMETSAT SAF project network, CM-SAF has produced a global surface albedo time series 1982-2009 based on AVHRR data including sea ice areas and topography correction. This starting SCM-project is also a EUMETSAT-CM-SAF contribution to SCOPE-CM.
4. Within the EUMETSAT SAF project network, Land-SAF also has extensive experience on land surface albedo retrievals and the development of directional reflectance models. The project team is already in contact with Dr. J-L Roujean of Meteo-France, and will consult him on BRDF modeling as needed.
5. There is also a new SCOPE-CM project on generation of surface albedo from geostationary imagers on multiple platforms (Meteosat, GOES, etc.) proposed that is a continuation of an earlier SCOPE-CM pilot poject. In the long term, the possibility of combining multiplatform geostationary (GEO-Ring) and polar orbiter data for a consistent global albedo retrieval should be considered, as such an approach would leverage the strengths of both GEO (high sampling of low latitudes) and LEO (the highest data acquisition rates over polar regions) imagers in a mutually supportive fashion. Alessio Lattanzio, the EUMETSAT/CF scientist involved with this project, will provide the link between the two projects with the aim to elaborate a common strategy for combining data from geostationary and polar orbiting satellites.

Assessment of feasibility:
The team has long experience in albedo product development for AVHRR (NOAA, FMI) and MODIS (UMB) and uniting data from several satellites for albedo retrieval (EUMETSAT). The co-operation is anticipated to result in a good multi-instrument polar albedo demonstration product.

6. Current and targeted Maturity Level (see Maturity Matrix Model)
The maturity level of the current **single sensor** albedo products of the partners is estimated to be in the range 2 (AVHRR) - 4 (MODIS). The targeted maturity level of the **new combined** polar multi-platform albedo product is 1-2.

7. Expected results, challenges and potential contributions of the project
The expected result is a demonstration albedo data record derived from MODIS and AVHRR including a limited validation. The project considers the processing arrangements and will develop a roadmap how to combine various polar satellite instrument data to produce a homogeneous surface albedo data set with higher maturity. During the project a demonstration albedo data set is processed to test the logistics and validate the results using two satellite instruments: MODIS and AVHRR.

The proposed demonstration albedo product from this project is defined as follows:

Parameter	Definition
Time Period	One full year during the 2000s. A suitable candidate could be 2007 (TBD).
Spatial Coverage	Global
Temporal Resolution	Primary goal is to produce a 5-day mean albedo. Back-up solution of a 10-day mean considered if reflectance sampling is insufficient at shorter scale.
Product Grid	Equal-spaced lat/lon grid with a cell size of 0.05 degrees. This grid is commonly used in satellite-based albedo products (MODIS, Globalbedo) and is therefore considered to be familiar to potential users. Separate equal-area grids considered for the polar regions to match current CM SAF gridding.
Spectral Coverage	Three products currently envisaged: (1) Photosynthetically Active Radiation (PAR) albedo (0.4-0.7 µm) (2) PAR-complementary waveband albedo (0.7-4 µm) (3) Broadband (black-sky) albedo (0.4-4 µm) Final selection of the wavebands is subject to analysis of available narrow-to-broadband algorithms and/or development of new ones appropriate for the combined MODIS-AVHRR retrieval.

The following scientific (s) and technical (t) challenges are expected:

s1. The different spectral surface reflectance observations need to be extrapolated in a way that ensures convergence to common broadband wavebands, in our case the following bands are planned: PAR (0.4-0.7 µm), PAR-complementary (0.7-4 µm), and full shortwave broadband albedo (0.4-4 µm).

s2. A multi-resolution method to intelligently combine observations with variable spatial and temporal resolution is required.

s3. Keeping the atmospheric correction method stable so that the oldest images can be analyzed and yet the newest images benefit from the improved radiometric accuracy and higher number of images available of today and the future.

s4. Observations made during low Sun elevation conditions dominating the retrievals at the poles, particularly for snow/ice. Possibilities to extend the applicable range of observations in our albedo retrievals will be studied.

s5. In rugged terrain the topography correction has to be paid attention to. FMI has developed and applied a correction algorithm in its CM SAF albedo products from AVHRR. This algorithm serves as a baseline in refining this correction further.

t1. Designing the processing chain so that it is easily extended to take in data from other satellites (such as geostationary) requires extra attention.

8. Expected project duration and tentative schedule

2.5 years, 1.9.2013 – 28.2.2016

Task	Start date	Finish date
Definition of processing approach, identification and distribution of specific tasks among partners.	1.1.2014	1.9.2014
Development of procedures to combine AVHRR and MODIS data at surface reflectance level	1.9.2014	1.5.2015
Simulations and limited-scale test studies on combination of MODIS and AVHRR at surface reflectance level	1.5.2015	1.12.2015
Development of a processing chain to support large-scale production of the demonstrator data set	1.12.2016	1.6.2016
Production of the deliverable demonstrator data set and documentation	1.6.2016	31.12.2016

9. Funding situation (current grants, expected funding proposals)

In the CM-SAF project a total 31 person months are allocated for FMI to SCOPE-CM related activities, such as co-ordination. NOAA funding for the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin-Madison will be pursued. It is anticipated that CIMSS support will be roughly equivalent to 10% of one researcher’s work hours, i.e. 1-2 man-months per year. Partners will provide their own processing facilities for small-scale method development and testing. EUMETSAT will provide the link to the SCOPE-CM geostationary surface albedo project with minor resources (1 man month max over the whole project life). The person resource allocation of UMB will probably be similar to that.

10. Needed and available processing capacities

NOAA/CIMSS has available computing facilities and a readiness to commit them to this project. As primary data repositories for this project are in the U.S., processing of the product at NOAA is seen to be the most efficient approach. Partners will provide their own processing facilities for small-scale method development and testing.

11. Expectations and intentions to sustain the addressed CDR capabilities

It is expected that at the end of the SCM-project there is a clear logistic plan (tested in the project using two satellites), how the surface albedo and PAR should be generated when using several instruments from different satellites. The plan is to after the SCM-project invite more albedo specialists to join the team bringing along new satellite data and knowledge, so that the basic concept of processing the CDR developed and demonstrated in the SCM-project will then be extended to start real continuous processing of the albedo data record. Wide international co-operation will be the basis of the work.

12. References

1. GCOS – 154 , SYSTEMATIC OBSERVATION REQUIREMENTS FOR SATELLITE-BASED DATA PRODUCTS FOR CLIMATE, 2011 Update, Supplemental details to the satellite-based component of the "Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2010 Update)", World Meteorological Organization, 2011, 127 p.

2. Gobron, N. and Verstraete, M.M., 2009, "FAPAR, Fraction of Absorbed Photosynthetically Active Radiation (FAPAR)", Assessment of the status of the development of the standards for the Terrestrial Essential Climate Variables, T10, Global Terrestrial Observing System, Rome 2009,14 p.

3. Schaaf, C.B., Cihlar, J., Belward, A., Dutton, E. and Verstraete, M.M., Albedo, 2009, "ALBEDO, Albedo and reflectance anisotropy", Assessment of the status of the development of the standards for the Terrestrial Essential Climate Variables, T8, Global Terrestrial Observing System, Rome 2009,10 p.

13. The work plan for the first year is in Annex A

14. Curriculum vitae of the key investigators are in the following attachments and the list of key partners equals the team composition.

Annex A: Work plan for the first year

Tasks during the period 1.1.2014 … 1.9.2014

Official start of the project 1.1.2014.
Generation of the technical plan of the processing:

1. List of the basic facts to be taken into account in planning the processing chain (AVHRR and MODIS)
- How the AVHRR and MODIS data are archived and how the archives are accessed
- What is the AVHRR and MODIS data format and procession level in the archives
- What is the status of the georectification of the archived AVHRR and MODIS data
- What is the status of the topography correction of the archived AVHRR and MODIS data
- What codes related to albedo processing chain already exist and in what language
- What is the computer configuration to be used (operation language, computer configuration, work space available, remote controlling possibility, restrictions related to computer safety)
- What kind of meta data is needed and where are they stored
- How much is needed data transfer and can it be carried out once, or is there need for external data use in the processing chain (automatic scripts picking up data from elsewhere)
- What is the estimated need of computer resources

2. Lessons learnt from previous processing chains
- Interview of NOAA, UBM and EUMETSAT by FMI concerning
    - NOAA/AVHRR albedo processing / science
    - MODIS albedo processing /science
    - EUMETSAT geo-ring albedo processing/science and experience of SCOPE-CM pilot project
- Interview of DWD by FMI concerning
    - CLARA-SAL processing
- Self-assessment of CLARA-SAL processing/science by FMI

3. Logistic plan of the processing
- schema of data flow and analysis of crucial points

4. Identification of specific tasks among partners:
- Agreement of work distribution (processing, science, analysis etc.)

Tasks during 1.9.2014 …1.5.2015

(Development of procedures to combine AVHRR and MODIS data at surface reflectance level):
1. Beginning of radiation analysis with respect to
- reflectance spectra of diverse targets
- relationship of responses of various channels
- broadband conversion of various band inputs
- effect of different resolution
- effect of land cover heterogeneity
- effect of atmosphere in various channels
- effect of time difference
- effect of difference in sun and viewing angles

2. Beginning of study of mathematical alternatives of data uniting
- statistical methods (for example wavelets, Variable-Pixel Linear Reconstruction etc.)

CV January 15, 2013: Terhikki Manninen

A. Personal data

Nationality: Finnish
Current employer, beginning January 1, 2003: Finnish Meteorological Institute
Current position, beginning January 1, 2008: Head of the Surface Remote Sensing group, Senior Research Scientist

B. Education:

M. Sc. in Physics (distinction), Helsinki University of Technology, 1981
(Low temperature physics, ”Platinum-NMR –thermometer in precision measurements”, in Finnish)
Lic. Tech. in Physics, Helsinki University of Technology, 1986
(Semiconductor physics, ”Mathematical modelling of epitaxial growth of silicon, in Finnish)
Dr. Tech. in Physics, (Helsinki University of Technology, 1996
(Remote sensing, “Microwave Surface Backscattering and Surface Roughness of Baltic Sea Ice”)
Language proficiency: Finnish (native), English (good), Swedish (good), Germany (modest), French (modest)

C. Previous positions and mobility:

1977-1978, Helsinki University of Technology, Department of Mechanics, Part time assistant
1978-1981, Helsinki University of Technology, Low Temperature Laboratory, research assistant
1981 – 1986, Vaisala Oy, Department of Microsensors, process research and development
1986 - December, 1994, Finnish Institute of Marine Research, Department of Physical Oceanography, research scientist
January 1995 – December 2002, VTT (Technical Research Centre of Finland), Senior research scientist
January 2003-, Finnish Meteorological Institute, Senior research scientist, 2006-2007, Deputy Head of the Satellite Applications group

D. Professional activities and achievements

Expert and reviewer tasks:

- Evaluation of Norwegian Research Council proposals 2011 and 2012
- Regular reviewer in several international journals, such as IEEE Transactions on Geoscience and Remote Sensing, Remote Sensing of Environment, Journal of Geophysical Research, Geoscience and Remote Sensing Letters, Remote Sensing, Photogrammetric Engineering and Remote Sensing.

Supervision of thesis:

Completed 3 B.Sc. and 2 M.Sc. thesis and ongoing 2 PhD thesis.

International research funding:

- Projects funded/financially supported by ESA, EC and EUMETSAT since 1990's.
- Currently participating in the CM-SAF (EUMETSAT), GEO-HR (ESA) and CORE-CLIMAX (EC) projects

Other international scientific activity:

- Participation in the Scientific Advisory group of ENVISAT/ASAR 2001 – 2002
- Member of the steering group of the project Satellite Application Facility on Climate Monitoring (EUMETSAT) 2006-2007.
- Participation in the VALERI network 2003-
- Organization of the SNORTEX campaigns 2008, 2009 and 2010 in Sodankylä together with Météo-France.
- Participation in the NEESPI network 2009 –
- Participation in the COST ES0903 network 2009-

Number of publications:

- About 40 peer reviewed papers in international journals, altogether about 110 publications.

Citation statistics:

- The Web of Science h-index is now 11 (only remote sensing publications).

CURRICULUM VITAE

28.1.2013

CONTACT INFORMATION

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EDUCATION

09/ 08 –	**Study towards D. Sc. (space technology) at Aalto University, Finland.** Title of thesis: Remote sensing and validation of snow and sea ice albedo". Completion is expected in 2013.
06/09 – 09/09	**International Space University, Space Studies Program 2009** Graduate-level summer school for young space technology professionals, held at NASA Ames, CA, USA. I served as the chief editor of a 30-person team project for the final report and executive summary. Final grade: 88.2% (excellent)
09/00 – 02/07	**M. Sc. (Tech) at the Helsinki University of Technology, Dept. of Electrical Engineering and Communications** Major: Space Technology, Minor: Electronics and Measurement Technology 290 study credits (ECTS equivalent). Overall Grade: Very Good (3.52 / 5.00)

WORK EXPERIENCE (2 MOST RECENT)

02/06 – Present	**Researcher at Finnish Meteorological Institute, Earth Observation Division.** My first duties were in completing my Master's Thesis study on similarities of SAR backscatter and optical observations for forest albedo measurements. After graduation, I assumed responsibility in developing and validating the surface albedo product of CM SAF project of EUMETSAT, as well as representing FMI in the Technical Board of CM SAF. During summer 2010, I coordinated a three-person research expedition to Summit Camp, Greenland Ice Sheet.
06/02 – 09/04	**Research assistant at the Laboratory of Space Technology at HUT.** My work included testing and further development of a prototype L-band radiometer. and participation in characterisation measurements for the CAS subsystem of ESA's SMOS satellite mission. I was responsible for the design and implementation of the electronic test bench for the vacuum chamber tests. The tests were carried out as planned and the test bench performed satisfactorily.

OTHER INTERNATIONAL EXPERIENCE

10/04 – 09/05	**Kanazawa University, Japan.** Exchange studies, mainly in Japanese language and culture. I also collaborated with the remote sensing research group of Prof. Ken-Ichiro Muramoto.

PROFESSIONAL SKILLS

Development of surface albedo retrieval algorithms
Spectrometer and pyranometer measurements
Snow sampling for physical parameters
Validation strategies for optical
Technical documentation
Editing, work coordination, organization of field measurement campaigns

PUBLICATIONS

Author in six peer-reviewed publications (first author in two).

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a. Experience

Professor 2011-Present
Environmental, Earth and Ocean Sciences, University of Massachusetts Boston, Boston MA
Research Professor 2008-Present
Research Associate Professor 2000-2008
Research Assistant Professor 1996-2000
Center for Remote Sensing, Dept. of Earth & Environment, Boston University, Boston MA
Research Meteorologist 1986-1996
Satellite Branch, Geophysics Directorate, USAF Phillips Laboratory, Hanscom AFB MA
Atmospheric Research Officer USAF 1982-1986
Cloud Physics Branch, USAF Geophysics Laboratory (AFGL), Hanscom AFB MA

b. Academic Qualifications

DOCTOR of PHILOSOPHY Geography (Remote Sensing) 1994, Boston University, Boston, MA
MASTER OF SCIENCE Meteorology 1982 Massachusetts Institute of Technology, Cambridge MA
BACHELOR OF SCIENCE Interdisciplinary Sciences (Meteorology) 1982 MIT, Cambridge MA
MASTER OF LIBERAL ARTS Archaeology 1988 Harvard University Univ. Extension, Cambridge MA

c. Synergistic Research Activities

MODerate resolution Imaging Spectroradiometer (MODIS) on board NASA's Aqua and Terra Earth Observing System Platforms: Science Team Member and Principal Investigator for the MODIS BRDF/Albedo Product, 2004-present.
Visible/Infrared Imager/Radiometer Suite (VIIRS) on board the NOAA/NASA Joint Polar-orbiting Satellite System (JPSS) /Suomi National Polar-orbiting Partnership (NPP): Science Team Member & Principal Investigator for VIIRS Albedo Environmental Data Records, 2004-present.
Landsat Data Continuity Mission (LDCM) Science Team Member for Albedo, 2012-present.
Oak Ridge National Laboratory (ORNL) Biogeochemical DAAC Advisory Board 2004–2009.
USGS EROS Land Processes DAAC (LPDAAC) Advisory Board 2010-present.
Co-chair CEOS/WGCV/LPV Committee on Earth Observing Systems, Working Group on Calibration & Validation Land Product Validation Subgroup on Radiation 2002-present.

d. Publications

Schaaf, C., J. Liu, F. Gao and A. Strahler, MODIS Albedo and Reflectance Anisotropy Products from Aqua and Terra, In *Land Remote Sensing and Global Environmental Change: NASA's Earth Observing System and Science of ASTER and MODIS*, Remote Sens. Digital Image Process. Series, Vol 11, B. Ramachandran, C. Justice, M. Abrams, Eds., Springer-Verlag, 873pp. 2011.
Schaaf, C. B., F. Gao, A. H. Strahler, W. Lucht, X. Li, T. Tsang, N. C. Strugnell, X. Zhang, Y. Jin, J.-P. Muller, P. Lewis, M. Barnsley, P. Hobson, M. Disney, G. Roberts, M. Dunderdale, C. Doll, R. d'Entremont, B. Hu, S. Liang, J. L. Privette andD. Roy, First Operational BRDF, Albedo and Nadir Reflectance Products from MODIS, Remote Sens. Environ., 83, 135-148, 2002.
Schaaf, C., J. Cihlar, A. Belward, E. Dutton, and M. Verstraete, Albedo and Reflectance Anisotropy, ECV-T8: GTOS Assessment of the status of the development of standards for the Terrestrial Essential Climate Variables, ed., R. Sessa, Global Terrestrial Observing System (GTOS), FAO, Rome, 2009.
Zhang, X., M. A. Friedl, C. B. Schaaf, Global vegetation phenology from Moderate Resolution Imaging Spectroradiometer (MODIS): Evaluation of global patterns and comparison with in situ measurements ,J. Geophys. Res., 111, G04017,doi:10.1029/2006JG000217, 2006.
Shuai, Y., J. Masek, F. Gao, C. Schaaf, An algorithm for the retrieval of 30-m snow-free albedo from Landsat surface reflectance and MODIS BRDF, Remote Sens. Environ.,115, 2204-2216, 2011.

Jeffrey R. Key

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Professional Positions

Supervisory Physical Scientist, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, Madison, WI, 2003-present. **Branch Chief**, Advanced Satellite Products Branch. **Physical Scientist**, 1999-2002. **Acting Team Leader**, 4/2001-12/2002.

Associate Professor, Department of Geography, Boston University, 1995-1999.

Education

Ph.D., 1988, University of Colorado, Boulder, Dept. of Geography (Climatology)
M.A., 1982, Northern Michigan University, Dept. of Geography (Resource Analysis)
B.S., 1979, Northern Michigan University, Dept. of Geography (Environ. Conserv.)

Recent Professional Activities

WMO Executive Council Panel of Experts on Polar Observations, Research and Services, U.S. representative (one of three), 2009-present; WMO Gloal Cryosphere Watch co-lead, 2008-present; WMO Space Task Group on the International Polar Year (IPY), NOAA representative, 2007-present.

Grants

Summary: PI, Co-PI, or Co-I on 50 grants totaling over $20M since 1990.

Field Work

McMurdo, Antarctica (2004), SHEBA (Beaufort Sea, summer 1998), Greenland ice sheet (summer 1995), BASE (Beaufort Sea, fall 1994), SIMMS 92 and SIMMS 93 (near Resolute, N.W.T., spring 1992 and 1993), LeadEx/AGASP IV (Beaufort Sea, spring 1992).

Teaching

Taught courses in remote sensing, meteorology, statistics, geography, and computer science at Boston University, the University of Colorado, the University of Alaska, and Northern Michigan University (15 different courses, 33 sections).

Recent Publications

Summary: Author/co-author on 97 refereed papers and other refereed publications, 4 book chapters, 77 conference proceedings papers and newsletter articles, and 21 workshop, technical, and data reports.

Full vita is available at http://stratus.ssec.wisc.edu/jkey.

Alessio Lattanzio

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Mr. Lattanzio has a master degree in Physics and has been worked in the field of remote sensing since 1998. He has been involved in albedo retrieval with geostationary satellite since 2002. Mr. Lattanzio is currently a member of the Climate Team in EUMETSAT and he is involved in different projects concerning the generation of Climate Data Records (CDRs)

For details: http://www.linkedin.com/in/alessiolattanzio

Publication in the field of albedo retrieval:

- Govaerts, Y. M., A. Lattanzio, B. Pinty, and J. Schmetz, 2004: Consistent surface albedo retrieval from two adjacent geostationary satellites, Geophys. Res. Lett., 31, L15201, doi:10.1029/2004GL020418.

- Govaerts Y.M., Lattanzio A., 2007: Retrieval error estimation of surface albedo derived from geostationary large band satellite observations: Application to Meteosat-2 and -7 data. Journal of Geophysical Research, 112, D05102, doi:10.1029/2006JD007313.
- Govaerts Y.M., Lattanzio A. , 2007: Surface Albedo Response to Sahel Precipitation Changes, EOS Volume 88 Number 3 Pag.25, 26 2007

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- Lattanzio A., Goevarts Y.M., Pinty B., 2006: Consistency of surface anisotropy characterization with Meteosat observations doi:10.1016/j.asr.2006.02.049

- Lattanzio A.;Schulz J. ; Matthews J.; Okuyama A.; Theodore B.; Bates J.J. ; Knapp K.R. ; Kosaka Y.; Schüller L.. Land Surface Albedo from Geostationary Satellites: a multi-agency collaboration within SCOPE-CM, 2013. Bulletin of the American Meteorological Society - DOI:10.1175/BAMS-D-11-00230.1

- Schaaf, C. L., J. Martonchik, B. Pinty, Y. Govaerts, F. Gao, A. Lattanzio, J. Liu, A. H. Strahler, and M. Taberner , 2008: Retrieval of Surface Albedo from Satellite Sensors: Chapter 9, in Advances in Land Remote Sensing: System, Modeling, Inversion and Application", (2008) S. Liang (Ed.), Springer, page 219-243 .