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GCOS AOPC/TOPC Joint Working Group on Land-Surface/Atmosphere Issues (WG-LSA)

First meeting:
European Commission Joint Research Centre, Ispra (VA), Italy
14-15 February 2007

GCOS TECHNICAL PAPER

GCOS – TP 1

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Meeting report and recommendations

The Working Group on Land-Surface/Atmosphere issues (WG-LSA) was instituted jointly by the Atmospheric and the Terrestrial Observation Panels for Climate (AOPC and TOPC, respectively) of the Global Climate Observing System (GCOS). This working group is co-chaired by Michel M. Verstraete (JRC, member of both AOPC and TOPC) and by Jo Schmetz (EUMETSAT, member of AOPC), and has an initial mandate of up to three years. The working group's terms of reference are provided in Annex 1.

The WG-LSA held its first meeting at the Institute for Environment and Sustainability (IES) of the European Commission Joint Research Centre (JRC) in Ispra (VA), Italy, from 14 to 15 February 2007. A list of working group members and other contributors to the discussions, as well as the agenda of the meeting are appended as Annexes 2 and 3, respectively.

In line with its terms of reference, the WG-LSA reviewed the scientific issues arising from the need to ensure the physical consistency of atmospheric and land surface Essential Climate Variables (ECVs) derived from operational Earth Observation measurements (both in situ and from remote sensing techniques) and discussed some of the key implications of potential incoherencies or discrepancies between these products. This document summarizes the presentations made, reports on the working group discussions and proposes recommendations for consideration by the AOPC and TOPC panels of GCOS.

1. Summary of the presentations

- Stephan Bojinski (GCOS Secretariat), with contributions from Michael Rast (GEO Secretariat), provided an overview of the GCOS process, its interactions with other international bodies (UNFCCC, GEO, etc), and the roles of AOPC and TOPC in the evaluation and improvement of Earth Observation systems for climate applications. The terms of reference and charge of the working group were briefly presented in this context. The Second Adequacy Report (WMO/TD No. 1143, GCOS-82, 2003), the GCOS Implementation Plan (WMO/TD No. 1219, GCOS-92, 2004) and the Supplement to this IP specific to satellite-based products (WMO/TD No. 1338, GCOS-107, 2006) were distributed at the meeting.

- Bernard Pinty (JRC) described various land surface reflectance concepts, including the directional hemispherical reflectance (DHR) or 'black sky albedo', the bi-hemispherical reflectance (BHR), the isotropic bi-hemispherical reflectance (BHRiso) or 'white sky albedo', and the 'Blue sky albedo'. He highlighted the fact that different Space Agencies and Data Providers generate and distribute products representing different physical quantities, often under the generic label of albedo, making it difficult for users to understand which product to use and for specialists to carry out benchmarks and comparisons. Also, the products generated currently may not necessarily address the specific needs of particular users, e.g., climate modellers.

- Pedro Viterbo (Land-SAF) described the role of data assimilation in Numerical Weather Prediction (NWP) models, its impact on the forecast improvements, and the difficulties associated with the ingestion of land surface products in existing schemes. He outlined current and planned model developments, and highlighted opportunities for assimilating both albedo and aerosol products, either for weather forecasting or for reanalysis purposes. He also described some of the products currently being offered by the EUMETSAT Land-SAF and underscored the general trend towards assimilating 'top of atmosphere' radiances rather than products.

- Sam Pullen (UK Met Office) described the land surface parameterization scheme implemented at the UK Met Office and outlined both current requirements for data and plans for improvements in modelling and in data assimilation. She described, in particular, the sensitivity of model predictions to land surface albedo, snow cover and soil moisture.

- Bernard Pinty (JRC) exposed recent developments in modelling the transfer of radiation at or near the land surface (specifically in vegetation canopies) and discussed the advantages and drawbacks of approaches based on an explicit versus implicit representation of surface 3D heterogeneity. He also discussed an updated 1D/two-stream approach that is directly compatible with the schemes currently employed by typical weather and climate models. The difference between 'true' variable values, as estimated by direct measurements in the field and/or remote sensing measurements, and the 'effective' variable values that are in fact required by 1D models was highlighted.

- Jean-Luc Widlowski (JRC) described the RAdiation transfer Model Inter-comparison (RAMI) exercise, initiated in 1999, which has recently completed its third phase. This community-based initiative has resulted in significant improvements in the participating radiation transfer models, some of which are used to retrieve remote sensing products. He pointed to the RAMI On-line Model Checker (ROMC) that has recently been made available on-line (http://romc.jrc.it/) and allows individual modellers to evaluate the performance of their models in comparison to an ensemble of well-established state of the art models. He also described on-going plans for the RAMI4PILPS initiative, recently endorsed by GEWEX, which will further extend these concepts and allow comparisons of radiation schemes designed for use in GCM land surface parameterizations and Soil-Vegetation-Atmosphere Transfer (SVAT) models.

- Jo Schmetz (EUMETSAT) presented the Global Space-based Inter-Calibration System (GSICS) project, a key international initiative to ensure the consistent calibration of sensors in orbit around the Earth. This effort underpins and complements the benchmarking efforts to evaluate the models used in the exploitation of remote sensing data and the resulting Earth Observation products.

- Crystal Schaaf (Boston University), with input from Eric Vermote (University of Maryland), described the processing steps leading to the characterization of atmospheric and surface properties within the NASA Terra/Aqua MODIS ground segments. The critical role of the surface measurement networks (such as AERONET and BSRN) in assessing the quality of the products was highlighted, and the specific interest in surface anisotropy (in addition to the various reflectance and albedo products) was underscored.

- John Martonchik (NASA JPL) similarly described the retrieval of aerosol and land products within the NASA Terra MISR ground segment. The advantages of multiangular measurements to characterize the phase function of aerosols and the anisotropy of land surfaces, as well as to correctly estimate the various reflectance products (specifically HDRF, BRF and DHR), over both ocean and land areas (including bright areas), were highlighted. He also discussed the sensitivity of surface products to changes in atmospheric characterizations, and showed regional and global maps as examples of Level 3 products currently available from the MISR team.

- Yves Govaerts (EUMETSAT) explained in detail how aerosol and surface properties are jointly retrieved from an analysis of observations acquired by the Meteosat Second Generation platform. He demonstrated the role of a priori information on the retrievals and the advantages of an optimal estimation approach, which capitalizes on the current physical understanding of the processes at work.

- Bernard Pinty (JRC) then described the results of a comparison between MISR, MODIS and Meteosat broadband albedo products, as retrieved from the respective operational ground segments. Although derived on the basis of different models and assumptions, as well as using widely different sensors, these products show rather good overall agreement. Differences of the order of 5% are observed between MODIS and MISR, while those between MISR and Meteosat remain less than 10%. Algorithms and products are continually being improved, and such comparisons are in fact instrumental in the process of increasing the accuracy of these geophysical products.

- John Martonchik (NASA JPL) presented a contribution prepared by Raph Kahn (also NASA JPL) on the inter-comparison of aerosol products in specific sites during field campaigns, in the presence of ample in situ measurements. Such detailed comparisons are essential to understand the processes at work and the reasons for any apparent inconsistencies, and therefore to guarantee the performance and accuracy of remote sensing products in the long run. These meticulous exercises are, however, often rather involved and time-consuming to implement, in particular because of the high spatial variability and limited life time of atmospheric aerosols and because of the associated

logistic difficulties. The importance of collecting ancillary data on the measurement protocols and observation conditions was highlighted to ensure a correct interpretation.

- Although unable to attend the meeting, Didier Tanré (Université de Lille) had sent materials describing the POLDER instrument (currently operational on the PARASOL mission) and the associated ground segment. These materials were presented and discussed by the group in the light of comparable findings from other teams. The specific advantage of polarimetric measurements was highlighted.

- Julian Wilson (JRC) described the Global Atmospheric Watch (GAW) World Data Centre for Aerosols (WDCA), a repository of surface or in situ aerosol measurements (including surface-based remote sensing). He reviewed the status of the various contributing networks and stations, the nature of the aerosol information contained in the database, as well as results of comparisons between products obtained simultaneously by different instruments at the same site.

- Bernard Pinty (JRC) presented an innovative approach to the exploitation of remote sensing flux products in climate models using advanced techniques such as adjoint models in the inversion process This approach is particularly computer efficient to ensure the consistency and coherency between models and measurements, and compatible with the techniques routinely used in data assimilation applications such as numerical weather forecasting, reanalysis and climate modelling.

2. Summary of the main working group discussions

2.1 Summary of the scientific issues at the core of this working group's concerns

- An accurate characterization of aerosol properties (e.g., optical thickness, particle type and composition, scattering phase function) on the basis of remote sensing measurements (both space- or ground-based) in the solar spectral domain, over continental regions, cannot be achieved without taking into account some of the reflective (spectral and directional) properties of the underlying land surfaces. This is a direct consequence of the transparency of the atmosphere and of the presence of multiple scattering between the atmosphere and the underlying surface.

- Conversely, the accurate retrieval of land surface properties, and in particular of the soil and vegetation canopy characteristics such as directional reflectances and anisotropy, Leaf Area Index (LAI), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), etc, can't be achieved accurately without taking into account the scattering and absorption of light by gases and particulate matter in the atmosphere.

- These facts are well-known in and acknowledged by the scientific research community, yet the retrieval of atmospheric and surface properties in operational contexts does not always implement a fully coupled inversion scheme: if the atmosphere is characterized on the basis of a priori information about the surface, or if the properties of the surface are

retrieved assuming some predefined atmospheric state, without the possibility for feedback, a bias in aerosol characterization may result in erroneous surface properties, or conversely.

- The correct interpretation of long-term trends in environmental properties (surface and atmosphere) thus requires ensuring that all radiative effects and interactions are properly taken into account. For instance, the prolonged drought in Africa north of the Equator in the seventies led to a progressive drying up of these regions and to the enhanced mobilization of aerosols. The reliability of findings about such processes critically depends on the inherent quality but also the radiative coherency between the atmospheric and surface retrieval algorithms. Whether these work sequentially (iteratively) or simultaneously, it is critical both to ensure the coherency between the retrieved properties and to document the errors associated with each product, making sure that they are internally consistent, for instance by verifying that the satellite measurements can be adequately simulated on the basis of the assumed state of the geophysical system. This leaves open the question of how accurate and consistent should the various products be: sensitivity studies should be carried out to establish the minimum standards of quality, or at least the likely impact of a given level of inconsistency.

- In addition, the WG-LSA noted that models of radiation transfer that are used to retrieve advanced geophysical products from remote sensing observations are generally very different from, and often incompatible with, those that are implemented in General Circulation Models or Global Climate Models (GCMs). This is particularly noticeable with regard to the 3D structure and spatial heterogeneity, processes, amount of detail, accuracy, scale of resolution of the simulated area and dimensionality of radiation transfer models in vegetation canopies. These differences may hinder the effective assimilation of Earth Observation products in climate models.

- The WG-LSA also expressed concern about the fact that atmospheric and surface products (both radiative fluxes and geophysical properties) generated by different instrument teams may or may not be entirely compatible between themselves, as each retrieval algorithm uses different assumptions and forward models. On one hand, different models can result in the estimation of similar fluxes but assuming different state variables. On the other hand, there is currently no harmonization with respect to the number, types and properties of atmospheric aerosols that are (or should be) considered in these retrievals. While it may be possible to use flux products from different sources together, mixing and merging geophysical variables (ECVs) generated by different instrument ground segments themselves may not be currently advisable.

- In summary, differences between similarly-named products, inconsistencies between atmospheric and surface products, or incompatibilities between the assumptions used to derive these products and those made to build climate models may hinder the effective assimilation of Earth Observation products in such models: The blind assimilation of such products could result in the introduction of systematic biases or noise in weather and climate models, and ultimately hinder or prevent the full exploitation of these products in weather forecasting and climate projections.

- The WG-LSA noted that the GCOS Implementation Plan is not always clear as to which of the many reflectance and albedo concepts is considered an ECV, and does not currently discuss in any great detail the need for coherency between the various atmospheric and surface ECVs, or the possible implications associated with such a lack of consistency. Such considerations in future versions of this and related documents would help raise the awareness of Satellite Operators and Data Providers and lead to better or more usable products.

2.2 Additional important issues that have a direct bearing on the points mentioned above

- The WG-LSA reviewed some of the international calibration, assessment or evaluation activities that are currently undertaken to ensure the quality of the raw radiometric measurements, to benchmark radiation transfer models in plant canopies, as well as to compare Earth Observation products. Experience gained from these activities may be of direct relevance in other related fields, and should be expanded to address, for instance, the benchmarking of coupled surface and atmospheric radiation transfer models.

- The WG-LSA stressed the importance and relevance of surface radiation measurement networks to guarantee the quality and accuracy of remote sensing products. The working group was particularly concerned about the lack of institutional long-term funding for networks such as AERONET and BSRN, and noted the efforts of the GCOS Secretariat to help find a solution in the latter case. In fact, the need for well-instrumented high quality field (in situ) observation stations is likely to increase in the future, as regular improvements in models and retrieval procedures will require finer and more accurate measurements to test their performance. These efforts to observe in detail geophysical variables in situ should be reinforced, with particular attention to the maintenance of long-term reference station, proper data acquisition, coordinated management and dissemination, harmonization of measurement protocols, etc.

- The WG-LSA was also very concerned about the apparent high risk of significant future gaps in the satellite records of MODIS- and MISR-like instruments and their associated products. It was noted, in particular, that the suite of instruments on METOP and scheduled for NPOESS do not always match the capabilities and performance of currently flying research instruments. This, together with the simplified algorithms often implemented in the ground segments of operational systems, will compromise both the immediate benefits to real time operations and the long term consistency of products for climate studies.

- This data continuity issue is of particular concern because the operational assimilation of satellite remote sensing products in a GCM requires substantial investments on the part of the modelling groups. Assignments of human and material resources to such tasks can't generally be justified if there is no guarantee concerning long term availability of the concerned Earth Observation products.

- The WG-LSA noted that some of the difficulties associated with potential incoherencies and incompatibilities between products identified above might be alleviated when models are upgraded to assimilate the so-called 'top of atmosphere' radiances, as opposed to derived products. However, some doubts were expressed about the feasibility or even the soundness of adopting this technique exclusively or to ingest data from all sensors. This is because considerable computational resources may be spent on extracting detailed information from remote sensing data, using dedicated radiation transfer models that may be too costly to include in climate models.

- The WG-LSA was informed of the fact that the difficulties associated with a lack of standardization of aerosol properties identified above are also encountered by the oceanographic community. The GCOS may thus consider, in the future, extending the remit of the working group by including the joint, simultaneous retrieval of atmospheric and oceanic properties, as well as coherency and consistency of aerosol products across the Case-I (open ocean), Case-II (coastal waters) and land surface conditions.

3. Recommendations

On the basis of these findings, the WG-LSA made recommendations in the following categories:

3.1 GCOS issues

- GCOS may want to consider including the scientific considerations expressed above in the preparations for the next versions of the Assessment Report and Implementation Plan, to ensure sharper definitions of the various ECVs, better overall integration and, above all, a higher degree of consistency between the land surface and atmospheric ECVs. In particular, it may be appropriate to group the ECVs in sets of inter-dependent variables that need to be retrieved jointly, and to deal with all these variables simultaneously, in a consistent, coherent and integrated manner.

- The WG-LSA noted that small differences or slight biases between currently available products (such as the MISR, MODIS and Meteosat land surface albedos) may need to be investigated further in order to track their sources to differences in instrument calibration, to the models and assumptions used, or to software errors. The cost of such activities, however, should be justified by clear needs expressed by the end-user community and precise statements as to the expected level of consistency between these products. GCOS could take a lead role in stimulating activities to establish these needs.

- The WG-LSA recognized that many of the issues raised in this context may require further research and development projects, as well as continuing support for observation or benchmarking activities, and in particular for surface-based networks. The working group recommended that GCOS raise these issues in high level consultations with the GEO/GEOSS, GMES and CEOS initiatives, to coordinate actions and to ensure that appropriate support may ultimately be provided for these actions.

3.2 Model and product benchmarking activities

- The WG-LSA recommended continuing support for the maintenance—and enhancement wherever necessary—of radiation transfer model benchmarking activities (building, for instance, on the I3RC and RAMI initiatives), perhaps including coupled atmospheric and surface models in the future. Previous efforts have shown to be effective in improving the quality, reliability, accuracy and relevance of radiation transfer models in vegetation canopies, and to enable the generation of better and more reliable Earth Observation products required for climate research and forecasting. Such exercises provide a convenient framework to acquire improved insight into the problems associated with product retrieval. The WG-LSA further encourages the scientific community to participate in such exercises.

- The WG-LSA also recommended the continuation—and strengthening wherever necessary—of inter-comparison activities between similar Earth Observation products (e.g., land surface albedos, aerosol properties) generated by different Space Agencies or Data Providers, with a view to explaining existing differences, working towards more coherent and compatible products, documenting their accuracy and improving their suitability for climate research as well as for re-analysis activities.

- The WG-LSA considered the albedo inter-comparison study led and presented by Bernard Pinty and collaborators an important pioneering effort, in particular with respect to the carefully defined methodology, the participation of three major albedo products and the large sample selected for evaluation. In view of the importance of this effort and the significance of the results, the WG-LSA recommended the swift preparation of a report for external publication.

3.3 Assimilation of Earth Observation products (ECVs) in global and regional models used for climate and numerical weather forecasting

- The WG-LSA recommended the development and implementation of more advanced radiation transfer models in GCMs to better simulate relevant processes at and near the land surface. These models should be identical or equivalent to those used in the retrieval of Earth Observation products to guarantee the proper assimilation of such products in the GCMs. Special attention should be given to the modelling of effective variables, which result in the correct representation of the relevant processes but may differ from the values measured in situ, and to the characterization of the uncertainties associated with the Earth Observations products, as this information is essential for the purpose of assimilation.

- The WG-LSA noted the importance of data assimilation techniques for the purpose of characterizing the current climate and its variability in the past via atmospheric reanalysis efforts, where a given model and data assimilation system are used to analyse the time-dependent observations over a period of several decades. Reanalysis ensures production

of a complete set of physically consistent variables, with regular and complete coverage in space and time, ensuring energy, angular momentum, and mass conservation. While data assimilation is now systematically exploited in Numerical Weather Prediction (NWP) applications, only a few such systems (notably at ECMWF) have been specifically developed for the purpose of reanalysis. Close contacts between reanalysis and NWP groups should be maintained to facilitate the assimilation of Earth Observation products in both groups, especially with regards to the definition and implementation of radiation schemes in land surface parameterizations.

- The WG-LSA recognized that current state-of-the-art remote sensing products over land surfaces are not being fully used by the NWP and, to a certain extent, the climate model community. Realising the human resources constraints of NWP and the pressure for increasing forecast quality, the WG-LSA recommends a stepwise approach towards a more advanced use of remote sensing products.

- Currently, the characterisation of surface radiative properties in the NWP centres is lagging behind that of some climate models. The WG-LSA recommends that NWP, reanalysis and climate modelling groups move towards a higher level of consistency between the radiation transfer schemes used in retrievals (inverse mode) and those used in land surface parameterizations, using the same state variables in both cases.

- The WG-LSA discussed the feasibility and implications of direct assimilation of 'top of atmosphere' radiances in GCMs as compared to the assimilation of a derived product. In some cases (e.g., assimilation of SEVIRI radiances) intensive computations are often done anyway and the addition of aerosol effects in the RT model may not lead to a large increase in computing resources. In other cases (e.g., OMI radiances in shorter wavelength ranges), the forward RT models currently implemented may not yet be able to assimilate such radiances (and they are not likely to be available in the near future). Products may therefore be a more cost effective way to exploit the available information. The pragmatic choices may also depend on the error characteristics of the retrieved product and its dependence on a first guess. Given the difficulties of representing the full suite of complex atmospheric and surface processes in radiative forward models, it appears prudent to pursue both paths (assimilation of radiances wherever possible and of aerosol and surface products in parallel).

- The WG-LSA recommended ensuring the consistency between the chemical composition aerosol models used for aerosol transport purposes, and the radiative descriptions of these aerosols for the purpose of retrievals from remote sensing.

- National and international institutions involved in climate modelling are encouraged to implement quantitative experiments to document the sensitivity of climate simulations to (1) the use of global or regional land surface products (as opposed to pre-set or standard conditions), (2) changes in the spatial and/or temporal distribution of key surface geophysical variables (such as albedo) or to changes in the accuracy of these products, (3) changes in the parameterization of radiation transfer and other relevant surface processes. These results should be published and communicated to GCOS and the

providers of Earth Observation products, as they provide a major driver for setting (or improving) the user requirements in terms of quality and accuracy.

3.4 Data continuity, data reprocessing and future plans of Earth Observation

- Following the MODIS, MISR and Meteosat land surface albedo inter-comparison described above, the WG-LSA concluded there is a very good basis for establishing a long-term high-accuracy global data record of surface albedo for climate applications. However, concern was raised about the continuity of the relevant space-based capabilities, in particular with respect to possible future gaps in MODIS- and/or MISR-like observing capabilities. The WG-LSA reiterated the relevance of the 'Key recommendations' expressed in GCOS-107, WMO/TD No. 1338, p.iii in this regard. The WG-LSA further noted the difficulty of monitoring highly dynamic processes such as the detection of snow cover, the estimation of snow mass, and the assessment of snow melt, as understanding these processes requires both accurate and frequent measurements.

- The WG-LSA encourages Space Agencies to proceed with the reprocessing of their archive data (both from geostationary and polar orbiting platforms) with a view to generate long-term records of satellite land surface parameters and aerosol. Emphasis should be placed on making the long-term data sets consistent to be useful for studies of climate variability and trends. The feasibility of generating a near-global albedo product on the basis of applying the same basic algorithm to the historical geostationary satellite record has already been demonstrated. This and similar efforts should be further supported to take advantage of the long term records available from all historical satellite archive data.

- Space Agencies that retrieve aerosol and surface products should consider initiating (whenever necessary), reviewing and harmonizing their approaches with a view to generating extensive, comprehensive aerosol and surface product inter-comparisons, both amongst themselves and with in-situ networks (such as AERONET and BSRN, in the case of aerosols).

- Recognizing that Space Agencies and other Data Providers offer a natural home for the operational calibration, validation and intercomparison of their products (subsection 3.2), and that climate and numerical weather forecasting centres are ideally placed to establish the sensitivity of their respective models to existing remote sensing products (subsection 3.3), the WG-LSA estimated that the scientific community could benefit from developing, in collaboration with those institutions, an integrated system capable of assimilating a wide range of atmospheric and land surface data sources for research purposes. Building on state of the art knowledge of radiative transfer theory and product retrieval methods, such an R&D system could provide guidance on best practices to address the coherency and consistency issues raised earlier and to explore new ways of assimilating proposed or future remote sensing products in weather and climate models, or innovative approaches to evaluate the accuracy of specific remote sensing products that would ultimately benefit the entire community.

4. Future activities

- The WG-LSA welcomes the constructive comments of the AOPC, TOPC and GCOS Secretariat on these findings and will adjust forthcoming activities accordingly.

- In the future, and if this is deemed appropriate, the WG-LSA may consider extending its discussions to (1) better define the sets of ECVs that should be treated as a group, (2) addressing similar concerns with respect to other geophysical variables (e.g., surface roughness, canopy structure), or (3) include the OOPC, for instance to address the issue of ensuring the consistency of aerosol products across the ocean/land boundary.

- The WG-LSA also agreed that specific R&D activities might be very useful to support its work, including establishing the sensitivity of GCM results on the nature and accuracy of the atmospheric (especially aerosol) and surface (in particular albedo) properties, though specific funding would be required to actually conduct these experiments.

5. Acknowledgments

The WG-LSA thanks the European Commission's Joint Research Centre, and in particular the SOLO Action of the Global Environment Monitoring Unit in the Institute for Environment and Sustainability for the hospitality and local arrangements, as well as Ludivine Del Grande (IES GEM Unit) for her professional secretarial and administrative support.

Annex 1

Terms of Reference, Membership and Initial Plans for a GCOS AOPC/TOPC Joint Working Group on Land-Surface/Atmosphere Issues (WG-LSA)

Michel M. Verstraete (1) and Jo Schmetz (2)
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Both TOPC and AOPC activities have focused on the identification and prioritization of Essential Climate Variables (ECVs) in their respective thematic fields, the specification of the observational means required to derive these products operationally, and associated scientific issues (algorithms, benchmarks, quality assessments, compatibility and inter-operability, coordination of in situ, airborne and space measurements, archiving, data rescue, etc). The ECV products are intended to be Thematic Climate Data Records, i.e., of sufficient accuracy and consistency to serve climate process research and climate monitoring. To this end it is also important that ECVs are consistent between themselves. This problem has been identified by TOPC and AOPC with regard to ECV products whose retrieval is mutually dependent, surface albedo and atmospheric aerosol load for example. It is thus important that both GCOS Panels harmonize their recommendations to ensure the scientific consistency of these products, especially when they are exploited simultaneously. The purpose of the WG-LSA is to provide coordination and advice on how to achieve these objectives, in a manner consistent with and in direct support of the overarching goals of GCOS as described in the Implementation Plan and other applicable documents.

General terms of reference

The WG-LSA will

- Promote the development of methods and tools to accurately retrieve both surface and atmospheric properties in a radiatively consistent manner, as well as the benchmarking of the relevant algorithms to retrieve these ECVs.
- Demonstrate the benefit of generating the products in a mutually consistent manner through an inter-comparison of time series of global ECV products, including their quality control and assessment.
- Consider and recommend to TOPC and AOPC other activities that would be of interest to both the terrestrial and atmospheric communities, in particular with respect to emerging or potential ECVs, as well as other products and processes that could be of relevance to fill gaps in the current Implementation Plan or to address climate change issues.
- Report to TOPC and AOPC on the progress achieved on a yearly basis with short papers or contributions to the respective annual meetings.

The WG-LSA is established for an initial period of three years. This period shall be concluded with a summary report to both TOPC and AOPC documenting the achievements and advising on future activities, including a new work plan if required.

WG-LSA charge, initial activities and membership

The WG-LSA will initially be led and co-chaired by Michel M. Verstraete (TOPC and AOPC) and Jo Schmetz (AOPC), who will develop and coordinate strategies and work plans to carry out the tasks mentioned above. Specific tasks will be addressed by the WG-LSA with the help of a small number of experts.

Following the recommendation of TOPC and AOPC, the WG-LSA will focus its attention initially on the specific, well-defined problem of estimating Land Surface Albedo (LSA) and the aerosol load in a radiatively consistent manner over periods of time extending from the recent years (when advanced satellites are available) to decades exploiting archived satellite data..

Specifically the WG-LSA will

- Review the state of the art in land surface albedo estimation from space measurements.
- Benchmark existing products (continuation and extension of the initial effort to compare Meteosat, MODIS, and MISR LSA products), both in space and time, and propose ways and means to merge such products to generate truly global products with adequate coverage in Polar Regions.
- Investigate the compatibility between albedo products derived from bi-directional reflectance observations acquired by sensors on geostationary and polar-orbiting platforms.
- Evaluate the factors affecting the quality of LSA products and in particular their dependency on related atmospheric products (e.g., clouds and aerosols).
- Investigate the drawbacks, limitations and obstacles that have prevented the effective use of these albedo products in GCMs and recommend ways to address these issues.
- Promote sensitivity studies and other appropriate projects aimed at documenting the role and impact of LSA products in climate models, with a view to establishing precise requirements on the characteristics of this product.

Drawing on existing activities, the WG-LSA co-Chairs plan to assemble about a dozen experts at an initial workshop. Attendance will be by invitation only. The co-Chairs of the WG-LSA shall deliver a first progress report to the next meetings of AOPC and TOPC (nominally taking place in the spring of 2007).

Annex 2

AOPC/TOPC Joint Working Group on Land-Surface/Atmosphere Issues (WG-LSA)

First meeting:
European Commission Joint Research Centre, Ispra (VA), Italy
14-15 February 2007

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Annex 3

AOPC/TOPC Joint Working Group on Land-Surface/Atmosphere Issues (WG-LSA)

EC Joint Research Centre, Ispra (VA), Italy
14-15 February 2007

Agenda

Wednesday 14 February

08:50-09:00 Michel Verstraete and Jo Schmetz: Welcome and opening of the meeting

09:00-09:30 Stephan Bojinski: The perspective of GCOS, WMO and GEO/GEOSS, CGMS (background, international organizations and relations, scope and objectives of the meeting, expected outcome)

09:30-09:50 Bernard Pinty: Overview of albedo definitions in the remote sensing and climate modelling communities

Session 1. Modelling land surface processes and coupling with the atmosphere: the point of view of users

09:50-10:30 Pedro Viterbo: Using land surface remote sensing products at ECMWF (possibly also which land surface products are generated at the Land-SAF and how those are anticipated to be exploited operationally)

10:30-11:10 Samantha Pullen: Land surface specification and modelling at the Met Office (UK)

11:10-11:40 Coffee break

11:40-12:20 Bernard Pinty: Revisiting the representation of radiation transfer in climate models (direct models)

12:20-12:40 Jean-Luc Widlowski: Model inter-comparisons and RAMI4PILPS

12:40-13:00 Jo Schmetz: Global Space-based Inter-Calibration System (GSICS)

13:00-14:30 Lunch break

Session 2. Algorithms and product retrievals: the point of view of data providers

14:30-15:10 Crystal Schaaf and Eric Vermote: Retrieving Surface Reflectance, Anisotropy and Albedo Land Products from MODIS

15:10-15:50 John Martonchik: Retrieving aerosol and land products from MISR

15:50-16:20 Coffee break

16:20-17:00 Yves Govaerts: Simultaneous aerosol and surface albedo retrieval from MSG/SEVIRI observations using an Optimal Estimation Approach

17:00-17:40 Bernard Pinty: Operational albedo product inter-comparison

17:40-18:20 John Martonchik: Atmospheric aerosol products inter-comparison

18:20-18:40 Didier Tanré: Presentation of his slides (in absentia) and discussion

20:00-22:30 Dinner at the restaurant of Hotel Pavone, Angera

Thursday 15 February

Session 3. Bridging gaps and moving forward

09:00-09:40 Julian Wilson: The World Data Centre for Aerosols

09:40-10:20 Bernard Pinty: Opportunities and perspectives on exploiting remote sensing data in climate models (inverse mode)

10:20-10:50 Coffee break

10:50-12:30 Discussions and drafting of recommendations

12:30-14:30 Lunch break

14:30-16:30 Finalization of recommendations (and actions, if any)

16:30-17:00 Conclusions, future work and priorities, next meeting, AOB