User questionnaire for Land SAF products

INTRODUCTION

In Annex is present an overall view of the SAFs and in particular of the Land SAF. More information can be found in the EUMETSAT web site (www.eumetsat.de) or directly asked to the Land SAF consortium.

Within the SAF, the following products will be derived and made available:

BASIC PARAMETERS			
SW Radiation		**LW Radiation**	
Bi-directional Reflectance Distribution Function (BRDF) Surface Broadband Albedo (AL)		Land Surface Temperature (LST)	
SURFACE RADIATION BUDGET			
SW Radiation Budget		**LW Radiation Budget**	
Downwelling Surface Short-wave Fluxes (DSSF)		Downwelling Surface Long-wave Fluxes (DSLF)	
BIOPHYSICAL PARAMETERS			
Soil Moisture (SM)	Snow Cover (SC)	Evapotranspiration (ET)	Vegetation Indices (VI)

In order to generate products, which fit your needs, we kindly ask you to answer the following questionnaire if you are interested in satellite derived land surface products. In particular it will help very much if you are able to tell us what are the limits that will make these products usable by you now (accuracy, geographic coverage area, projection, etc.) or in the next 5/10 years. It will help very much if you can tell what are the Vegetation Parameters (VP) you would like to use (Fraction of Green Vegetation - FGV, Fraction of Absorbed Photosynthetic Active Radiation f_{APAR}, Leaf Area Index – LAI, etc.)

We are also very much interested to get information about the priorities in the products. As an example, the following table reflects the priorities and needs of ECMWF in the near future.

Please, complete this form with your requirements. **Please, leave open areas where you feel the questionnaire is not applicable or is not relevant**. Feel free to make all your comments or remarks. We will try to make a good use of them.

Please, return your answers to Fernando.Cabecinha@meteo.pt or Luis.Pessanha@meteo.pt

Products	Priority	Benefits for NWP
Albedo	1	Validation of NWP results. Broadband albedo is the relevant quantity here. Current NWP is not sensitive to changes of albedo below 0.1; therefore the most important information is the contrast snow/no snow.
Snow Cover	1	Validation of NWP results. Possible use as a proxy for initial conditions of snow mass in NWP data assimilation.
LST	1	Validation of NWP results. Confronting the comparison of model and satellite LST with model and satellite brightness temperatures on relevant IR channels.
DSSF	2	Validation of NWP results. Possible use as a forcing field for a global soil moisture analysis.
DSLF	2	Validation of NWP results. Possible use as a forcing field for a global soil moisture analysis.
SM	3	If useful and “comparable” with NWP product, utilize as validation material for NWP. Assuming success, it would be possible to consider it as input of soil data assimilation towards the end of the Land SAF.
ET	3	If useful and “comparable” with NWP product, utilize as validation material for NWP.
VP, LAI, …	4	Although, at current level of sophistication of NWP, no use can be made of VPs, it is possible that they will become useful quantities, later in the Land SAF development phase, when the ECMWF model becomes more mature to incorporate them.

Activities in the observation and characterization of land surface processes are especially relevant in several fields of applications. You will find some part in this questionnaire where you can identify the applications for major themes such as: weather and climate modeling, natural hazard forecasting and monitoring, ecosystem monitoring and hydrology.

The strategy on the definition of the Land SAF shall be to develop a set of biophysical product parameters that may constitute an appropriate input to a wide variety of different user models giving to the meteorological community priority in their definition. In particular the NWP models shall be assign by the Land SAF as the first priority in the product design. Nevertheless several other areas had been also considered as appropriate.

Some extra efforts from the users side will certainly be required in order to make use of the Land SAF product parameters in developing specific end products. Nevertheless, it should be emphasized that, for some applications, Land SAF parameters are already at a level that can be considered almost as an end user product. Some other users might also be interested in some of the parameters as inputs to specific models. Try to present an indication of yours estimated extra-effort required based on parameters to be provided by the Land SAF consortium.

QUESTIONNAIRE

Product priorities and use

Products	Priority	Near real time	Validation	Coverage	Modeling	Economies/Benefits for your project
Albedo		Yes / No	Yes / No		Yes / No	
Snow Cover		Yes / No	Yes / No		Yes / No	
LST		Yes / No	Yes / No		Yes / No	
DSSF		Yes / No	Yes / No		Yes / No	
DSLF		Yes / No	Yes / No		Yes / No	
SM		Yes / No	Yes / No		Yes / No	
ET		Yes / No	Yes / No		Yes / No	
VP, LAI, …		Yes / No	Yes / No		Yes / No	

Priority: Please enter a value in the range of 1 (high), 2 (moderate), 3 (poor), 4 (no need)
Near real time: Distribution within 2 hours after satellite pass
Validation: Can you contribute to validation.
Coverage: Please enter your general priority
MSG for high temporal coverage up to 55 N and S Africa and Europe
EPS for 6 hourly global coverage.
Modeling: Do you intend to use the product in NWP model?

Products	Distributed within 2 hours (NRT)	Sensor	Comments (Contribution to decision making process)
Albedo	Yes / No	MSG	
Snow Cover	Yes / No	MSG/EPS/Both	
LST	Yes / No	MSG/EPS/Both	
DSSF	Yes / No	MSG/EPS/Both	
DSLF	Yes / No	MSG/EPS/Both	
SM	Yes / No	MSG/EPS/Both	
ET	Yes / No	MSG/EPS/Both	
VI, LAI, …	Yes / No	MSG/EPS/Both	

Product characteristics

BASIC PARAMETERS

	Product acronym	Temporal resolution	Spatial resolution	Projection	Location Accuracy	Measurement Accuracy	Geographic coverage area	Observation
SW Radiation	BRDF							
	AL							
LW Radiation	LST							

SURFACE RADIATION BUDGET

	Product acronym	Product delivery	Resolution	Projection	Location Accuracy	Measurement Accuracy	Geographic coverage area	Observations
SW Radiation Budget	DSSF							
LW Radiation Budget	DSLF							

BIOPHYSICAL PARAMETERS

	Product acronym	Product delivery	Resolution	Projection	Location Accuracy	Measurement Accuracy	Geographic coverage area	Observations
Soil Moisture	SM							
Snow Cover	SC							
Evapotranspiration	ET							
Vegetation Parameters	SVI							
	LAI							
	Other							

Temporal and spatial resolution: The resolution of the product should be specified – not the resolution of the data from which the product is derived

Products use

Only products that are produced by the Land SAF are listed. The main objective is to identify and to define requirements for applications and to establish procedures and protocols for data acquisition and model selection in order to deliver products consistent with the user's needs and improve applications of Land SAF products. Some products are required indirectly by an application or are intermediate for other products. If you thing that you can do, mark with an '**r**' if that variable or product is required for that application and '**i**' if that product is most likely going to be used as intermediate.

Applications and Land SAF products

Themes, applications and users	SAF products	AL	BRDF	DSSF	DSLF	LST	SM	SC	ET	LAI	SVI	Other
Weather and climate modeling	Nowcasting											
	Numerical Weather Prediction											
	Climate											
	Other											
Natural hazard forecasting and monitoring	Air pollution monitoring											
	Fire hazard monitoring											
	Storms, snow, ice, heat hazards											
	Drought monitoring											
	Famine Early warning system											
	Desertification											
	Insect migration (e.g. locust)											
	Volcanoes											
	Flood monitoring											
	Green house gas exchange											
	Other											
Agriculture and Foresty	Vegetation dynamics seasonal interannual											
	Classification											
	Canopy structure											
	Irrigation											
	Crop yield											
	Crop and pest and diseases											
	Other											
Hydrology	Water management											
	Run-off											
	Other											

Please fill as appropriate (see next table as an example)

Agriculture	Land Surface Temperature Soil Moisture Evapotranspiration Biophysical Parameters	High Low Low Low to middle

Potential users, Land SAF products and extra-effort to develop a final product

Potential users market	Land SAF products	User extra-effort
Agriculture		
Forestry		
Natural hazard management		
Terrestrial transports safety		
Other:		

Provided that the final satellite product above meets the specifications in the table (shown by validation results), how would you estimate the potential benefits for improvements of your model? Please, submit your views in the tables on the next pages and your name etc.

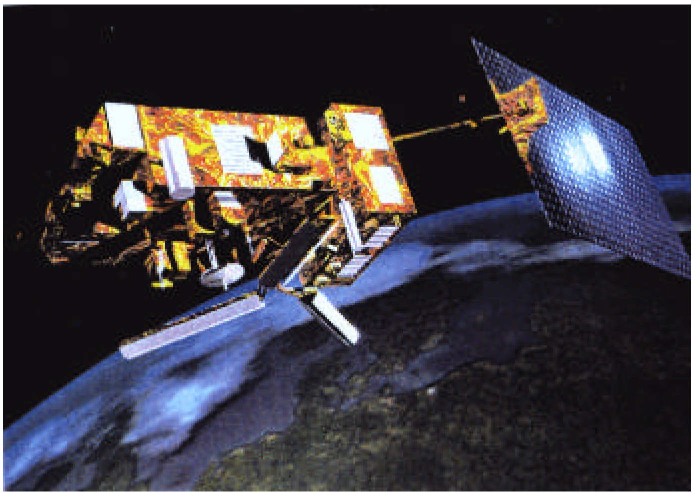
Name(s)	Institution	Position	Field of work	e-mail

Other comments

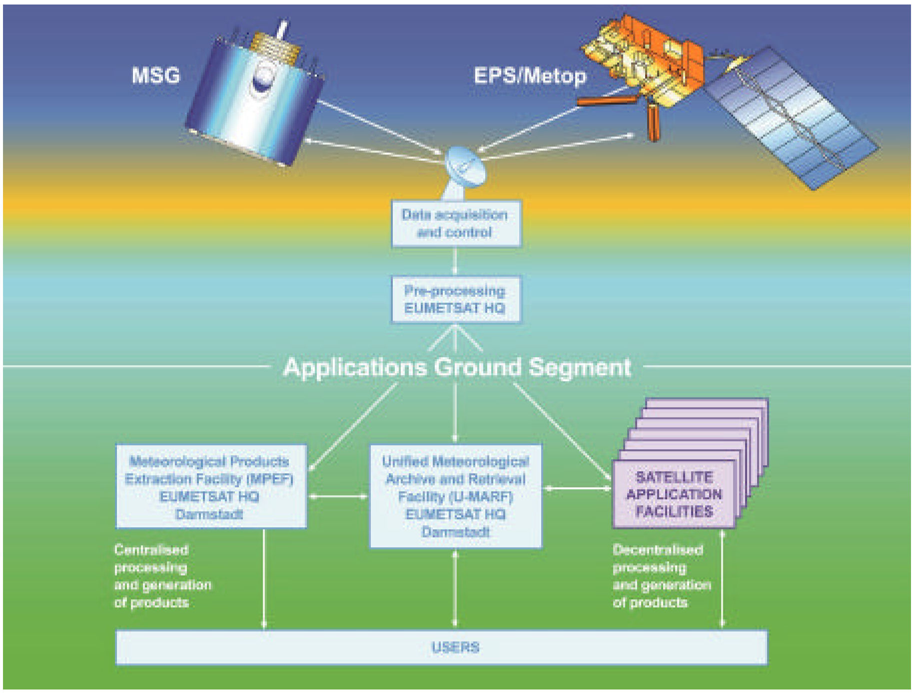
Please, return to Fernando.Cabecinha@meteo.pt or Luis.Pessanha@meteo.pt as soon as possible.

ANNEX

SATELLITE APPLICATION FACILITIES



The SAF concept
SAF product generation and applications



The SAF concept has been developed with the aim of coordinating the operational exploitation of future meteorological satellites within EUMETSAT Member States.

The SAFs are hosted by various National Weather Services

The SAFs carry out dedicated satellite data processing according to their specific field of application.

SAF Network: Objective

Providing services to operational and other users, e.g.:
- Real time/off line products
- User software packages
- Data management and related user services
- Co-ordination of & support to research and development

Focus: operational meteorology & climate monitoring in line with the new Convention under ratification

Development of the SAF Network

7 SAFs are already approved by the EUMETSAT Council

3 funded from MSG Programme budget

SAF on support to Nowcasting and Very Short Range Forecasting
Hosted by the Spanish NMS (INM) in Madrid and involving the participation of France, Austria, Sweden

SAF on Ocean and Sea Ice
Hosted by Météo-France in Lannion and involving the participation of The Netherlands, Sweden, Denmark and Norway

SAF on Ozone Monitoring
Hosted by the Finnish NMS (FMI), in Helsinki and involving the participation of Finland, Germany, The Netherlands, Greece and Denmark

1 funded from MTP Programme budget

SAF on Climate Monitoring
Hosted by the German NMS (DWD) in Offenbach and involving the participation of Finland, Sweden, The Netherlands and Belgium

3 funded from EPS Programme budget

SAF on Numerical Weather Prediction
Hosted by the UK NMS (UKMO) in Bracknell and involving the participation of France, The Netherlands and ECMWF

SAF on GRAS Meteorology
Hosted by the Danish NMS (DMI) in Copenhagen and involving the participation of Denmark, UK and Spain

SAF on Land Surface Analysis
Hosted by the Portuguese NMS (IMN) in Lisbon and involving the participation of Portugal, Italy, Belgium, Germany, France, Spain, Sweden and Greece

METEOSAT Second Generation (MSG) (SEVIRI spectral channels characteristics)
SEVIRI – Spinning Enhanced Visible and Infrared Imager

Bands	Centre	Sub-Satellite sampling	99% energy band (? m)	Imaging frequency
HRV	0.75	1 Km	Similar to Meteosat	15min
VIS 0.6	0.635	3 Km	0.56 - 0.71	15min
VIS 0.8	0.81	3 Km	0.74 - 0.88	15min
IR 1.6	1.64	3 Km	1.50 - 1.78	15min
IR 3.9	3.92	3 Km	3.48 - 4.36	15min
IR 8.7	8.70	3 Km	8.30 - 9.10	15min
IR 10.8	10.8	3 Km	9.80 - 11.80	15min
IR 12.0	12.0	3 Km	11.00 - 13.00	15min
WV 6.2	6.25	3 Km	5.35 - 7.15	15min
WV 7.3	7.35	3 Km	6.85 – 7.85	15min
IR 9.7	9.66	3 Km	9.38 – 9.94	15min
IR 13.4	13.40	3 Km	12.40 – 14.40	15min

EUMETSAT Platform System (EPS) AVHRR/3 Channel Characteristics

Channel	Central wavelength (? m)	Half Power Points (? m)	Sub-Satellite sampling	Equivalent MSG channel
1	0.630	0.580 - 0.680	3 Km	VIS 0.6
2	0.862	0.725 – 1.00	3 Km	VIS 0.8
3a	1.61	1.580 - 1.640	3 Km	IR 1.6
3b	3.74	3.550 - 3.930	3 Km	IR 3.7
4	10.8	10.30 - 11.30	3 Km	IR 10.8
5	12.00	11.50 - 12.50	3 Km	IR 12.0

Land SAF product description table

Layer	Acronym	Name
SW Radiation	BRDF	Scattered radiance field
	AL	Surface Albedo
	AE*	Aerosol
LW Radiation	LST	Land Surface Temperature
	EM*	Surface Emissivity
	TSP*	Thermal Surface Parameters
SW Radiation Budget	DSSF	Downwelling Surface Short-Wave Fluxes
LW Radiation Budget	DSLF	Downwelling Surface Long-Wave Fluxes
Biophysical parameters	SM	Soil Moisture
	SC	Snow Cover
	ET	Evapotranspiration
	NDVI**	Normalised Differential Vegetation Index
	SVI	SEVIRI Vegetation Index
	LAI	Leaf Area Index
	Other	

* Internal product
** Product not calculated/distributed/obsolete

Layer IA Products

The parameters to be derived are the **Scattered Radiance** (BRDF), the **Surface Albedo** (AL), and the internal product **Aerosol** (AE).

The **Scattered Radiance** field is defined by means of Bi-directional Reflectance Distribution Functions (BRDFs). It is likely that important directional effects will be observed on both MSG and AVHRR-3 measurements, making necessary a correction of directional effects on the measurements based upon the use of a BRDF model. The model application will also allow to normalise the data sets, thereby insuring consistency in the derived products from day to day. MSG and METOP systems will finally offer a complementary vision on the anisotropic properties of the surface in respect to onboard multi-angular instruments.

The **Surface Albedo** should be a corrected reflectance from effects of the atmosphere and the response function of the sensor should be removed, giving a square band directional reflectance (directional albedo) or a bi-hemispherical reflectance (mean or diffuse albedo). It can be anticipated that the frequent diurnal sampling from the geostationary satellites will contribute to improve the surface albedo estimate based on the application of a BRDF model.

The **Aerosols** (internal product) are characterised by their radiative properties, namely the optical thickness and phase function. A good knowledge of aerosol phase function, including effects of non-sphericity is required, especially in case of retrieval in maritime environment and mainly for mineral dust. This product will be calculated to be internally used but will be not disseminated unless good quality can be proved.

Layer IB Products

The parameters to be derived are the **Land Surface Temperature** (LST) and two internal products **Surface Emissivity** (EM) and **Thermal Surface Parameters** (TSP).

Land surface temperature strongly depends on surface Emissivity, which in turn is moisture and wavelength dependent and is sensitive to surface type; Emissivity also depends on the viewing angle and due to surface slope such effects may be strong.

The LST is highly variable from place to place and changes of local conditions may also cause a diurnal variation of this parameter. On the other hand, local surface Emissivity is generally a function of moisture and wavelength as well as of the viewing angle of the satellite sensor. In order to derive LST and Emissivity, window channels in the TIR are used, but the presence of the atmosphere introduces a bias in the measured data, making the need of an accurate atmospheric correction.

Isolated values of LST for a certain pixel at a certain time must not be taken as a final product. Diurnal and inter-annual changes of thermal parameters, as well as characteristics of their horizontal distribution must also be extracted in order to describe the thermal surface characteristics.

Layer IIA and IIB Products

Short (DSSF) **and Long-wave Fluxes** (DSLF) are of primary importance once they control the net radiation budget at the surface. They cannot be directly retrieved from spaceborne observations but have to be inferred from other sources of information. The methods to infer surface fluxes from satellite data are empirical/statistical and physical methods

Layer IIIA Product

The parameter to be derived is **Soil Moisture** (SM) defined as the fraction of water contained in a specified layer depth of the soil.

Layer IIIB Product

The parameter to be derived is the **Snow Cover** (SC)**.**
Because of the difficulty of making field measurements in snow cover, especially in remote and mountainous regions, remote sensing is attractive as a means of measuring snow cover properties. The possibilities for detecting snow properties are largely determined by the wavelength being recorded by the remote-sensing instrument. VIS and NIR wavelength mainly provide information about the surface of the snow, since they do not penetrate far into the snow pack.

Layer IIIC Product

The parameter to be derived is the **Evapotranspiration** (ET), i.e. the flux of water vapour emitted by the surface and diffused into the atmosphere. ET is involved in the water cycle and in the energy balance at the surface. ET cannot be observed directly by remote sensing and must be deduced by indirect means from, e.g., the net radiation budget, the radiative temperature and other ancillary data.

Layer IIID Product

The level and the state of vegetation covering the Earth surface play a primary role in global scale processes. Vegetation can heavily influence climate in terms of energy balance and, at the same time, it represents a sensitive indicator of the effects of climate change and anthropic pressure.

Remote sensing techniques have been developed and tested to derive indicators related to vegetation biophysical parameters. Spectral information provided by remote sensed data will be processed to produce some vegetation indices that are commonly used to derive some vegetation biophysical parameters.

The vegetation indices that will be calculated are the **SEVIRI Vegetation Index** (SVI), the **Leaf Area Index** (LAI) and others to be defined depending of users requests. The **Normalised Differential Vegetation Index** (NDVI), which is be adopted in many cases by many users in different projects as reference to extract information about vegetation density, can be easily calculated if proved to be useful. Nevertheless the other vegetation indices are assumed to be much more better and up-to-date products.