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EUMETSAT STRATEGY - CONTRIBUTION TO CLIMATE AND OCEAN MONITORING

In response to CGMS recommendation 35.06 and PA05 and for information

Working Paper Abstract

The purpose of this document is to inform CGMS on the current activities and future plans of EUMETSAT to reach the objectives laid down in the "EUMETSAT Strategy: 2030", approved by EUMETSAT Member States in July 2006, in the specific domains of climate monitoring and operational oceanography.

In Climate Monitoring, the document first reviews the activities of EUMETSAT in international initiatives and then presents the direct EUMETSAT contribution through EUMETSAT programmes and EUMETSAT Satellite Application Facilities (SAFs).

On operational oceanography, the document presents the relevance of current EUMETSAT programmes (MSG, EPS, Jason-2) and the specific contribution of the EUMETSAT Ocean and Sea Ice (OSI) SAF. It then elaborates on a set of planned EUMETSAT activities related to the development of a Jason follow-on programme, on the operations of the Kopernikus (former GMES) Sentinel-3 oceanography mission by EUMETSAT and on the access to third parties data, relevant for the oceanographic community, by EUMETSAT.

Action/Recommendation proposed:

CGMS is invited to take note of this document.

EUMETSAT Strategy - Contribution to climate and ocean monitoring

1 INTRODUCTION

The long-term EUMETSAT strategy approved at the 59th EUMETSAT Council in July 2006 notes that "*The vision of EUMETSAT is to be the leading operational satellite agency for European Earth Observation Programmes that are consistent with its Convention.*"

EUMETSAT will do so "*through the establishment and operation of suitable satellite systems and dissemination schemes, and by adopting a gradual and progressive approach in maintaining and developing the existing services and enhancements to meet new requirements. Whilst maintaining the priority of operational meteorological and climate services, the development of new services in the environment should cover the oceans, atmosphere, land and biosphere, and natural disasters to the extent that they interact with, drive or are driven by meteorology and climate.*"

The purpose of this document is to inform CGMS on the current activities and future plans of EUMETAST to reach these objectives in the specific domains of climate monitoring and operational oceanography.

2 ROLE OF EUMETSAT IN CLIMATE MONITORING

EUMETSAT is mainly contributing to climate Monitoring activities through its programmes and through participation in international initiatives.

EUMETSAT's contribution is presented in the following sections.

2.1 Promoting EUMETSAT activities on climate monitoring through International Cooperation and Initiatives

In this section, EUMETSAT's involvement in current international programmes and initiatives is briefly introduced. The involvement includes extraction and provision of data (ISCCP and GPCP), initiation and membership in activities within the WMO framework (R/SSC-CM and GSICS) as well as membership in CEOS and GEO.

2.1.1 Regional / Specialized Satellite Centres – Climate Monitoring R/SSC-CM

The aim of the WMO Global Network of Regional / Specialized Satellite Centres for Climate Monitoring (R/SSC-CM) is to address the requirements of GCOS in a cost-effective, coordinated manner, capitalising upon the existing expertise and infrastructures. The overall objective is the continuous and sustained provision of high-quality Essential Climate Variables satellite products on a global scale.

The Implementation Plan for the R/SSC-CM was finalized by EUMETSAT in November 2007 and agreed with the initial participating organizations: EUMETSAT,

the China Meteorological Administration (CMA), National Oceanic and Atmospheric Administration (NOAA), Japan Meteorological Agency (JMA), the Committee on Earth Observation Satellites (CEOS), the United States Geological Survey (USGS), the WMO Space Programme, and GCOS.

EUMETSAT's contribution to the R/SSC-CM Network includes the committed activities of the CM-SAF and other SAFs as well as the activities of its Central Facilities in Darmstadt. Furthermore, EUMETSAT acts as the interim R/SSC-CM Secretariat. In a planning meeting which took place in April 2008, the participating organisations agreed on five areas of interest to focus the initial activities onto:

1. AVHRR based data set of cloud and aerosol properties
2. SSM/I total column water vapour, precipitation and liquid water path
3. Surface albedo, clouds and aerosols from geostationary satellites
4. Atmospheric motion vectors and clear sky radiances
5. Upper tropospheric humidity.

The first Executive Panel Meeting will take place in January 2009.

2.1.2 Global Space-Based Intercalibration System GSICS

The WMO Global Space-Based Intercalibration System (GSICS) has been established by leading satellite operating agencies with the overarching goal of creating an operational system that monitors and evaluates the calibration of the global meteorological satellite observing system in a coherent and systematic manner. EUMETSAT is one of the founding members of GSICS and very actively pursues the realisation of such an operational system. Implementation plans are reviewed and updated by the GSICS Executive Panel and the implementation activities are now underway. The operational EUMETSAT intercalibration activities have concentrated on the calibration of the EUMETSAT geostationary satellites (Meteosat First and Second Generation, MVIRI and SEVIRI instruments, respectively). So far this has been based on intercalibration with the HIRS instruments on NOAA satellites. A major recent step has been the intercalibration with the IASI instrument on Metop; IASI is considered as a reference for the thermal infrared inter-calibration because of the excellent on-board calibration. It is also noteworthy that a longer term (> 1 month) comparison with Meteosat First Generation (M-7) has been done, which is important for a re-calibration of first generation Meteosat satellites; this is in turn important for the re-processing in support of re-analysis activities at NWP centres.

2.1.3 International Satellite Cloud Climatology Project ISCCP

Since 1986 EUMETSAT has supported the International Satellite Cloud Climatology Project (ISCCP) as part of the world climate research project (WCRP) by providing data from the first and second generation Meteosat satellites. This project routinely extracts sampled images from geostationary satellites on a 3-hourly basis to enable the detection of global cloud coverage and associated changes of these quantities. It also performs a satellite intercalibration, or rather a normalisation, to AVHRR radiances which can be considered the first "satellite intercalibration" ever.

2.1.4 Global Precipitation Climatology Project GPCP

Similarly to EUMETSAT's contribution to the ISCCP project, EUMETSAT has, since 1987, extracted from its Meteosat image data so called precipitation indices on a routine basis as a contribution to the Global Precipitation Climatology Project (GPCP). This is also an activity which contributes to the World Climate Research Project as a contribution in the context of GEWEX (Global Energy and Water Cycle Experiment).

2.1.5 Committee on Earth Observation Satellites CEOS

In the context of the Committee on Earth Observation Satellites (CEOS), strategic positions are generally prepared first at the working/organisational level (Societal Benefit Area Teams, Constellations and Working Groups, CEOS SEC) before becoming progressively endorsed at the various policy-making levels (mainly CEOS Strategic Implementation Team SIT and CEOS Plenary).

EUMETSAT's representation in all the relevant CEOS fora means that it is well-positioned to push its climate monitoring agenda within CEOS. In particular, EUMETSAT's involvement in the recently formed CEOS Climate SBA team (Coordinator: Mitch Goldberg from NOAA) together with its participation in the OST and ACC Constellations are anticipated to be the primary vehicles to pursue EUMETSAT's positions and plans at the CEOS working level.

2.1.6 Group on Earth Observation (GEO)

In the domain of climate monitoring, EUMETSAT has one direct and one indirect relationship with the Group on Earth Observations (GEO):

- as a GEO Participating Organisation and
- as an active member of CEOS which is charged with fulfilling GEO's climate SBA tasks concerned with satellite observations.

2.2 Other EUMETSAT activities in relation with Climate Monitoring

This section gives a brief overview of the current activities of EUMETSAT related to climate monitoring. The related activities and plans are reported in two categories: EUMETSAT Programmes and the Network of Satellite Application Facilities.

2.2.1 EUMETSAT Programmes

2.2.1.1 Meteosat (1st and 2nd Generation)

The Meteosat programme is the well-established European contribution to the ring of operational geostationary satellites. The first Meteosat satellite was launched more than 30 years ago by ESA in 1977. In 1995 EUMETSAT took over the operations of the Meteosat satellites. Nowadays EUMETSAT still operates one Meteosat satellite of the first generation (Meteosat-7) and two (Meteosat-8 and Meteosat-9) of the second generation. The latter has much higher capabilities in terms of temporal repeat cycle

(15 minutes compared to 30 minutes of the first generation) and twelve spectral bands as compared to only three spectral bands for the first generation Meteosats. The larger number of spectral bands enables a better observation of important climate variables, especially those undergoing diurnal cycles. An additional improvement of vital importance to climate observations is the improved on-board calibration of the thermal IR channels of the Meteosat Second Generation Satellites.

2.2.1.2 EUMETSAT Polar System EPS

With the launch of Metop-A in October 2006 EUMETSAT operates a polar orbiting satellite system with a long-term operational perspective. Through its innovative payload, the Metop satellites can provide information on a large number of key climate variables over at least 14 years of operations on a global scale.

The hyper spectral sounding Infrared Atmospheric Sounding Interferometer (IASI) allows the retrieval of temperature and moisture profiles at high accuracy (1K, 15 %, respectively) over 1km layers. IASI also allows the observation of trace gases relevant for the greenhouse effect and for atmospheric chemistry. The Global Ozone Monitoring Experiment -2 (GOME-2) will continue the capability to measure Ozone profiles and related trace gases with high accuracy. An instrument like the GNSS Radio-occultation Atmospheric Sounder (GRAS) also provides information on temperature and humidity profiles, with the advantage that no adaptation of calibration between subsequent satellites is required for the creation of a long-term dataset.
From the other instruments on Metop (AVHRR, ATOVS, ASCAT) long-term climate records can be derived as well, especially with regard to AVHRR and ATOVS which provide continuity of climate records from NOAA satellites.

In summary, the measurements of EPS/Metop System provide a wealth of new and continued climate monitoring information.

2.2.1.3 Jason

OSTM/Jason-2 will provide essential observational data on the mean sea level ECV. IPCC reports on acceleration of global mean sea level rise beyond 1993 are essentially based on satellite altimetry. Polar orbiting satellite altimetry missions are unique instruments for addressing the spatial requirements on mean sea level observations. A particular goal of OSTM/Jason-2 is to extend the existing mean sea level ECV data-set beyond TOPEX/Poseidon and Jason-1 to complete the first two decades of high-precision altimetry observations. For the future, NOAA and EUMETSAT lead the CEOS study to establish the basis for an Ocean Surface Topography Constellation that satisfies the threshold requirements for the sea level ECV (and also those of the sea state ECV). These studies will also include considerations to improve the spatial resolution and to extend observations over lakes and rivers for the lakes ECV.

2.2.1.4 Meteosat Third Generation MTG

The uniqueness of geostationary measurements and their high temporal frequency provide the capability to observe sub-synoptic atmospheric and surface events,

particularly precipitating cloud systems and to characterize the diurnal cycles of the atmosphere-surface system. Characterization of the annual cycle and diurnal cycles is crucial for an understanding of the physical processes determining the status of the climate system and its potential change. The extended observation capabilities of MTG which are expected to provide hyper-spectral sounding and lightning data in addition to an improved imager will deliver unprecedented information which will provide new insights into the forcing and feedback mechanisms that determine the energy and water cycle of the climate system.

2.2.1.5 Post-EPS

The continuation of observing Essential Climate Variables (ECVs) from satellites hinges upon the observations from operational meteorological satellites in a polar orbit, because such satellites provide the required continuity in time and the global coverage. The Post-EPS satellite series (i.e. the series planned after Metop) will provide such continuity for atmospheric ECVs as well as for some terrestrial and oceanic ECVs. Currently, the Post-EPS preparation is in Phase-0; high-level user requirements, including climate, have been established. It is also important that the current work towards a Joint Polar System with NOAA provides the basis for truly concerted observing systems and their deployment in a coordinated fashion. It is expected that Post-EPS, as part of a Joint Polar System with NOAA, will address and cover all ECVs currently measured with better quality and will potentially go beyond the fulfilment of these requirements by providing additional monitoring capabilities (e.g. on aerosol, clouds, trace gases, wind fields and also improved observations for a better understanding of the climate processes).

2.2.1.6 Reprocessing of EUMETSAT Archive Data

EUMETSAT has continuous activities related to the reprocessing of its image data and Meteorological Products from the first and second generation of its Meteosat satellites. Past activities included the reprocessing of Meteosat-2 image data for the ECMWF ERA-40 Re-analysis and the reprocessing of Meteosat-3 to Meteosat-7 image data for the ECMWF ERA-Interim Re-analysis for the years 1989 to 2000. This data set included image data from the Meteosat-3 Atlantic Data Coverage and the Meteosat-3 Extended Atlantic Data Coverage.

The reprocessed data for the ERA-40 and ERA-Interim Re-analysis are used also by JMA Re-analysis. Several months of Multi-Sensor Precipitation Estimates (MPE) from Meteosat-7 have been reprocessed.

A current activity is the processing of the Meteosat Surface Albedo (MSA) product using Meteosat First Generation imagery. About 60% of the archive has been processed for the zero degree mission. The algorithm derives the surface albedo within the VIS band accounting for the surface anisotropy and the performed advanced atmospheric corrections. These data need to be analysed to determine the temporal consistency of the time series based on six different Meteosat first generation radiometers. A prerequisite for this is the currently ongoing re-calibration of the Meteosat first generation VIS channel using stable desert targets.

Reprocessing of Atmospheric Motion Vectors (AMV) is a current activity as well. Reprocessed winds have a demonstrably positive impact on the quality of the reanalysis.

2.2.2 Satellite Application Facilities Network (SAFs)

2.2.2.1 Climate Monitoring SAF

The Satellite Application Facility on Climate Monitoring (CM-SAF) operationally retrieves geophysical parameters from meteorological satellites that are considered suitable for climate monitoring. With its current list of products (cloud parameters, surface and top of atmosphere radiation fluxes, surface albedo as well as atmospheric humidity and temperature), the CM-SAF already covers part of the variables that are classified as „GCOS Essential Climate Variables“.(http://www.cmsaf.eu)

The establishment of high quality long term series with known error characteristics and high temporal stability is a significant committed activity of the CM-SAF in its Continuous Development and Operations Phase (CDOP) which started 2007 and will be completed in 2012. The following datasets are planned to be generated within the CDOP:

Cloud and surface radiation flux products from NOAA/AVHRR GAG dataset Patmos-X, global coverage, 1982-2002 in collaboration with NOAA,
Cloud, top of atmosphere, surface radiation and humidity products from homogeneous radiance data set (VIS+IR) from SEVIRI+GERB, 2004-2010,
Temperature and humidity products from ATOVS (1998-2010), IASI (2006-2010), GRAS (2006-2010), and GOME-2 (2006-2010) with contributions from the GRAS SAF and O3M SAF,
Free Troposphere Humidity (FTH) from Meteosat 2-10, 1983-2011 in collaboration with LMD, France and EUMETSAT central facility,
Surface radiation fluxes from Meteosat, 1983-2004 (associated activity to FTH),
Total column water vapour content and liquid water path over ocean from SSM/I and SSMIS, 1987-2011,
Turbulent Heat Fluxes over ocean from SSM/I, SSMIS and AVHRR, 1987-2011,
Precipitation and Evaporation over ocean from SSM/I, SSMIS and AVHRR1987-2011.

2.2.2.2 Ocean and Sea Ice SAF

The Ocean and Sea Ice SAF generates in near-real time a set of products with high relevance for climate monitoring, such as Sea Surface Radiation parameters, Sea Surface Temperature and Sea Ice Coverage and Characteristics.

The OSI SAF is currently developing a reprocessing environment for the sea ice algorithms in order to generate a re-analysis of global (Arctic and Antarctic) sea ice from 1987/1995 to 2005 from SSM/I data. (http://www.osi-saf.org/)

2.2.2.3 Other SAFs

GRAS SAF: Through its precision and stability, the Radio Occultation Technique provides an excellent opportunity for the monitoring of atmospheric profiles for climate monitoring purposes. The GRAS SAF is dedicated to the operational derivation of such parameters in Near Real Time and offline, as well as the provision of climate data derived from the initial products. The GRAS SAF is also involved in a federated activity with the CM SAF, targeting the generation of the long-term homogeneous water vapour data set. (http://www.grassaf.org)

LSA SAF: The Satellite Application Facility on Land Surface Analysis generates, disseminates and archives on an operational basis a set of parameters involved in the surface radiation budget, snow and vegetation cover. The LSA SAF addresses a wide user community including climate modelling and seasonal forecast and as such is a provider of products and services for international programmes. (http://landsaf.meteo.pt)

O3M SAF: The SAF on Ozone and Atmospheric Chemistry Monitoring produces, archives, validates and disseminates ozone and atmospheric chemistry products to support the services of the EUMETSAT Member States in weather forecasting as well as monitoring of ozone depletion, air quality and surface UV radiation. The O3M SAF is also involved in a federated activity with the CM SAF and the GRAS SAF to produce long term data sets of atmospheric water vapour derived from GOME-1 and GOME-2 data. (http://o3msaf.fmi.fi)

H-SAF: The SAF on Support to Operational Hydrology and Water Management will generate and archive high-quality data sets and products for operational hydrological applications. The retrieval of products will use data from microwave and infrared instruments and will aim at reaching the best possible accuracy from satellite systems available now or in the near future. The H-SAF, currently in its Development and Validation Phase, is focusing on the generation of products, that are considered essential climate variables covering precipitation, soil moisture and snow parameters. The planned start of the dissemination of the first operational products is currently in 2010.

NWP SAF: The continuous improvement of the Fast Radiative Transfer Code RTTOV and adaptation to new instruments is a major task of the NWP SAF and is recognized as a significant contribution to the reanalysis activities at ECMWF. (http://www.metoffice.gov.uk/research/interproj/nwpsaf/).

NWC SAF: The development of retrieval software, its continuous validation and improvement is provides the scientific community with valuable tools for generating climate products from EUMETSAT data. A large part of the CM-SAF processing is based on NWC SAF developments.

3 ROLE OF EUMETSAT IN OPERATIONAL OCEANOGRAPHY

3.1 Relevance of operational delivery of space data in support of operational Oceanography

Measurements of oceanic physical parameters such as surface wind, temperature, salinity, sea ice cover and sea surface waves and height, as well as the related modelling of momentum, energy and fresh water exchanges at the ocean/atmosphere interface are very important to operational weather forecasting, not only for the short, medium-range and seasonal-to-inter-annual time scales but also for monitoring and modelling over climate time-scales.

Ocean satellite measurements are particularly indispensable and have proven to be a unique source of valuable information. In general, the vastness, remoteness and roughness of the global ocean are impediments for a cost-effective exploitation of in-situ ocean observational networks. Over the last decades various space-borne missions (e.g. AVHRR, scatterometers, SSMI, T/P-JASON) have demonstrated that remotely sensed observations of sea surface temperatures (SST), ocean vector winds (OVW), sea surface heights (SSH) and significant wave heights (SWH) can be most successfully integrated into weather, ocean weather, wave and climate model systems.

This success has strongly contributed to the development of seasonal and inter-annual climate predictions, and to the study of climate variability in general. It was also a prerequisite for the ocean community to commence with operational services. Clearly the success of the satellite missions, and the services that have been enabled, are considered indispensable and need to be maintained and enhanced for future operational meteorological, marine and climate applications and services.

On the daily and hourly time scales, marine weather forecasting intensively uses the ocean satellite measurements to monitor the latest meteorological developments. For example, altimeter SWH products and scatterometer OVWs are used by operational prediction centres to issue wind and high sea warnings both near the coast and on the open ocean. Mapped SST and SSH products are used to monitor hourly changes the ocean heat potential which strongly influences the magnitude of tropical storms.

On the medium-range and seasonal timescales, mapping and modelling of the upper ocean plays a central role in the forecasting capacity as it is the ocean which provides the memory of the coupled system which enables the extension the temporal range. Seasonal forecast centres assimilate on a daily basis the high resolution maps of e.g. satellite SSTs and SSHs. Near Real Time observations on both sides of the ocean-atmosphere interface are needed to determine and constrain the ocean-atmosphere interactions. Moreover, an accurate detection of individual events is also essential as they can cause rapid changes. An example is the role of westerly wind bursts as observed by scatterometers in the onset of an El Niño.

On the inter-annual and decadal time scales, the rate of change in mean SSH (sea level rise) is an important indicator of climate change. The mass budget of the ocean is primarily controlled by exchanges of water with the continents, which many sources and sinks are very difficult to accurately monitor individually. Changes in the heat content of the ocean (in response to global warming) also play an important role in sea level by altering the volume of the ocean. The integrated effect is directly measured by radar altimeters. In fact, only satellite altimeters can provide the global spatial and temporal coverage needed to determine sea level trends over decadal

time scales. This is of the greatest interest to scientists and policy makers concerned about the impacts of global warming. Therefore, it is important to extend the current accurate altimeter Climate Data Record on mean SSH. Moreover, reproducing the altimeter time series forms an extremely important validation test for climate models.

The ocean forecasting and monitoring activities on the different timescales are overlapping and will converge in there needs for high-resolution ocean observations with the increase of model resolutions. In the future, for accurate ocean energy budgets it will become important to map even the sub-mesoscale variability which is a regime in itself in the energy cascade towards the final viscous dissipation. Only high-resolution measurements systems can bring the key information on the sub-mesoscale statistics.

The operational availability of all these information in the future would help National Meteorological Services of EUMETSAT Member States in the fulfilment of their mandatory tasks.

3.2 Current EUMETSAT involvement in support of operational oceanography

3.2.1 Current and future EUMETSAT programmes

The EUMETSAT MSG and EPS programmes are already contributing to the global ocean observing system. For example, the SEVIRI on MSG and AVHRR on METOP measurements are essential input for the NRT high-resolution mappings of SST and the derivation of radiative heat fluxes. Scatterometers like Seawinds and ASCAT on METOP, provide in NRT essential details on the momentum forcing (surface winds) and basic parameters (friction) for the determination of the turbulent air-sea fluxes. Currently, NWP models cannot provide the same resolution even with the assimilation of the scatterometer data. There are strong relationships between sea surface temperature (SST) and surface wind stress, especially in regions of strong SST gradients. In addition, radar altimeters are the key instruments to map and monitor the associated mesoscale motions and unique in providing Upper Ocean integrated heat content. Hence, there is a lot of synergy in the combined use of the instruments.

Future EUMETSAT mandatory programmes (MTG and post-EPS) would increasingly contribute to the delivery of useful data for operational oceanography.

3.2.2 SAF on Ocean and Sea Ice Monitoring

EUMETSAT, through its current mandatory programmes (Meteosat, MSG and EPS), is already involved in a number of missions delivering key data for operational and science oceanography users.

In response to the requirements from the meteorological and climate community, EUMETSAT Member States have made a major effort by establishing the Ocean and Sea Ice Monitoring SAF (OSI SAF). This SAF develops and delivers Near Real Time products of Sea Surface Temperature, radiative heat fluxes, Ocean Vector Winds and Sea Ice based on data from MSG and EPS satellites, as well as third party missions.

These products are disseminated in near real time via EUMETCast, or ftp, to the various Regional and Global Data Assembly Centres (RDAC's and GDAC's) of the Operational Oceanography community and also to the end users. Several products are already in an operational or pre-operational state.

The OSI SAF started its continuous Development and Operations Phase (CDOP) in March 2007.

3.2.3 Jason-2 Ocean Surface Topography Mission

The Jason-2 Ocean Surface Topography Missions was launched on 20 June 2008. This programme is developed in partnership between EUMETSAT, CNES, NASA and NOAA. In this mission, EUMETSAT is ensuring operational and timely delivery of the Jason-2 wind speed and significant wave height observations which are key requisites for sea state services, bringing the essential Sea Surface Height (SSH) data for detecting the ocean mesoscale eddies, sea level variability and sea level rise. These products will be delivered through EUMETCast and via the GTS network.

Many operational meteorological entities do, or will, rely on the services provided through the OSI SAF and Jason-2. The "ECMWF Strategy 2006 – 2015" states that ECMWF does not have the capacity to develop its own sea-surface temperature and sea-ice analyses, despite the fact that these parameters are of paramount importance for the quality of forecasts at lead times from the medium-range to the seasonal range. The "ECMWF Strategy 2006 – 2015" explicitly refers to the OSI SAF as the source of data for the provision of relevant boundary conditions for forecast models.

3.2.4 Cooperation with NOAA

The exchange of geostationary data with NOAA is referred to under the "Agreement between EUMETSAT and NOAA on Access to Images and Meteorological Data Distribution Material from the EUMETSAT Geostationary Satellites". Access by EUMETSAT to the U.S. polar data is covered by the Initial Joint Polar System (IJPS), the Joint Transition Activities (JTA) Agreements and related letters.

The above Agreements secure the operational access by EUMETSAT to data generated by U.S. satellites from the GOES, POES and DMSP series. They also cover the access to future NPOESS satellite data, and discussions are underway to extend this to the NPOESS Preparatory Programme (NPP) mission.

Therefore, EUMETSAT is currently is a position to operationally deliver relevant data from the U.S. to the Operational Oceanography User Community.

3.3 Future EUMETSAT involvement in support of operational oceanography

EUMETSAT is currently exploring different areas which might increase its involvement in support to operational oceanography activities.

3.3.1 Jason Follow-on mission

The perspective of the continuity of the operational altimetry service beyond Jason-2 was discussed by the EUMETSAT Members States in the frame of the definition of the Programme Proposal. The results of these discussions are summarised in the text of the Programme Proposal adopted by the Potential Participating Member Sates as follows:

"The long-term objective (post 2010) is to have a single global altimetry system covering both the non-synchronous and the sun synchronous orbits, with common technology being used to the extent possible. This would be achieved with contributions from at least the US and Europe. Such a system would only be achieved if Europe maintains its commitment to OSTM mission and translates it into a true operational system."

On different occasions, users have expressed the need for the continuation of a Jason-type mission, including:

- The recommendations of the Symposium on 15 Years of Progress in Altimetry, held in Venice on 13 to 18 March 2006;
- The conclusions of the Post-EPS Application Expert Group;
- The conclusions of the World Climate Research Programme Workshop held on 6 June 2006 in Paris;
- The report of the Working Group on Space Infrastructure for the Kopernikus (former GMES) Marine Core Services published in September 2006.

There is therefore a strong case for developing an operational Jason Follow-on mission. As European operational agency of choice, EUMETSAT should play a leading role in the development of this mission, together with its U.S. counterpart (NOAA) and with the active support from the necessary Research and Development agencies.

Activities are on-going to prepare for this programme.

In addition, EUMETSAT and NOAA – as operational agencies co-chairing the *CEOS Ocean Surface Topography Constellation* – organised a *Strategic Workshop in Assmannshausen* in January 2008. The objective of the workshop was to seek guidance and advice from the User community concerning the response to the Venice recommendations.

This workshop formulated a Strategic Plan and Roadmap for establishing and strengthening international collaboration in satellite altimetry from the present until ca. 2022. The outcomes of the Strategic Workshop provides guidance in steering the international efforts in order to ensure systematic and sustained satellite altimetry data provision over the period of the next 15 years. NOAA and EUMETSAT have undertaken actions to ensure that a 15-year plan is developed by the end of 2008.

To this purpose, EUMETSAT has recently initiated a study which will put together the high-level Mission Requirements document corresponding to the planned constellation of altimeters. This document will encompass both the requirements for the high accuracy altimetry mission and for the complementary high inclination missions. It will cover both scientific and operational applications with the user needs

being expressed in terms of single or multi satellite products as well as the associated coverage, latency, sampling, filtering etc. It will also address the error budget for the main measurements and corrections, the orbits selection and optimization, the overlap requirements between missions and the overall reliability objectives.

3.3.2 ESA Kopernikus (former GMES) Sentinel-3 mission

ESA and EUMETSAT have jointly agreed on a set of working assumptions which define EUMETSAT's role as operator of ESA Kopernikus (former GMES) Sentinel-3 satellite.

This mission, devoted to provision of operational oceanographic services has been baselined within the European initiative Kopernikus (former GMES).

Sentinel-3 will provide crucial data for information services to the European Union and its Member States as part of Kopernikus (former GMES). The services to be fed data cover areas such as climate change, sustainable development, environmental policies, European civil protection, development aid, humanitarian aid and the European Common Foreign & Security Policy.

The Sentinel-3 mission will produce a consistent, long-term set of remotely-sensed marine and land data for (operational) ocean state analysis, forecasting and service provision. A comprehensive measurement system facilitating global ocean and land observation is required in order to provide data for advanced numerical forecasting models.

Sentinel-3 will determine parameters such as sea surface topography, sea/land surface temperature, ocean colour and land colour with high-end accuracy and reliability. For this purpose, it carries an advanced radar altimeter and a multi-channel optical imaging instrument.

To achieve near-global coverage and meet all scientific requirements, Sentinel-3 will be placed in a high-inclination, sun-synchronous polar orbit. Near-realtime data processing and delivery will allow operational services to continuously profit from the mission.

In its role as operator of Sentinel-3 oceanography mission, EUMETSAT will:

- Generate and disseminate all Sentinel-3 products routinely required by the EC Kopernikus (former GMES) Marine Core Service and its related downstream services;

- Serve the offline requests of the Operational Oceanography User Community for Sentinel-3 products (using a distributed network of centres of expertise);

- Monitor and control the spacecraft and flight operations segment;

- Acquire payload data, in a mode consistent with the overall Kopernikus (former GMES) ground segment design which is under ESA's responsibility.

3.3.3 Third Party Data

An essential further role for EUMETSAT will be to ensure that the Operational Oceanography User Community has operational access to satellite data provided by third parties. Indeed, reliable, operational access to such satellite data streams is a fundamental assumption for the Kopernikus (former GMES) Marine Core Service.

This access could be facilitated through the Cooperation Agreements that EUMETSAT currently has in place. The cooperation with the United States has already been mentioned. In addition, EUMETSAT has recently enhanced its Cooperation Agreements with China, India, Korea and Russia to cover oceanography.

In the framework of the Cooperation Agreement with ISRO (India), discussions have taken place to assess the possibility of accessing information from the planned CNES/ISRO AltiKa mission - AltiKa aims at demonstrating the performance of an altimetry payload package that is compatible with a micro satellite. Based on the synergy with Jason-2, a possible contribution from EUMETSAT for this mission could also be to process and distribute the Near Real Time products. EUMETSAT is also seeking to get access to the Indian Oceansat data, for operational redistribution to its users.

With China, EUMETSAT is also seeking to get access to data from the HY-series of satellites operated by the Chinese State Oceanographic Administration (CSOA), but no significant results have been achieved until now.

4 CONCLUSIONS

CGMS is invited to take note of this document.