CGMS

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# USE OF SATELLITE DATA IN WMO CLIMATE ASSESSMENTS

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WMO has been active in assessing global and regional climate since the initiation of the World Climate Programme in 1979. The WMO annual Statement on the Status of the Global Climate has been published since 1993 in the 6 official languages. More recently WMO published a report on the climate during the decade 2001-2010. The interest in these publications has been increasing with time; including the interest of international agencies, policy makers, governments and the general public at large. A need for data completeness and quality is therefore of a paramount importance to maintain a high standard of these assessments.

In this regard, there is a growing need for satellite products that should complement the poorly documented areas and topics that are currently based mainly on in-situ data. It is of particular importance for WMO to further enhance its climate assessments using long term homogenized data sets on tropical cyclones, satellite based data to contribute to global temperature anomalies and trends, precipitation anomalies and climatology, estimated arctic sea ice volume, monthly northern hemisphere snow cover and anomalies.

Other products such as snow depth estimate and forest fire index, based on combined in-situ and satellite data could be also envisioned as a contribution to regional climate watch demonstration projects.

## Action/Recommendation proposed:

Action: CGMS Members who are willing to contribute satellite-based products to the annual WMO climate assessment shall nominate a point of contact to liaise with the future CCl Task Team on the Use of Satellite Data for Climate Monitoring in order to jointly define the specifications of these products, including validation and verification issues. (September 2014)

Recommendation: CGMS Members are encouraged to support regional climate watch demonstration projects.

# Use of Satellite data in WMO climate assessment

## 1 INTRODUCTION

Climate assessment is part of WMO international role in the coordination and implementation of the World Climate Programme activities and its contribution to the implementation of the Global Framework for Climate Services (GFCS). WMO has been issuing an annual Statement on the Status of Global Climate in the six official languages as an authoritative peer-reviewed source of climate information including yearly global temperature assessment, regional temperature and precipitation features and the assessment of extreme weather and climate events of the year. Recently WMO published a more extended climate assessment for the 10 year period 2001-2010. These assessments and others are based on Essential Climate Variables; for some of which the assessment is based entirely or partly on satellite data and products. The purpose of this document is three folds: 1) to summarize the current status of the use of Satellite data and products in the WMO climate assessments, details can be found in the links provided in the text, 2) to provide prospects for enhancing the content of the WMO climate assessment based on suggested satellite based products and 3) to provide few recommendations on key joint activities with the WMO Commission for Climatology (CCl).

## 2 CURRENT USE OF SATELLITE DATA IN WMO CLIMATE ASSESSMENTS

Satellite data and products are routinely used to cover such climate variables, for which no appropriate in-situ observations exist or poorly covered, such as soil moisture, sea ice extent, sea level rise, tropical cyclone activity assessment and stratospheric ozone over Antarctica. Satellite data are also used occasionally to complement in-situ data, e.g. for precipitation analyses, derived drought monitoring, snow cover extent etc. Furthermore satellite data are implicitly used in the reanalysis data that WMO uses routinely for assessing the state of the climate.

Examples of WMO climate assessments, which includes in-situ and satellite based products comprise the annual WMO Statement on the Status of the Global Climate as well as special assessments regarding remarkable climate anomalies (cf. http://www.wmo.int/pages/prog/wcp/wcdmp/CA_2.php), and the newly introduced Decadal Report (cf. http://library.wmo.int/pmb_ged/wmo_1119_en.pdf).

Special climate reports are also produced to assess large scale extreme events, an example is the assessment of the extreme conditions during late boreal winter 2011/2012 which resulted in high socio-economic damages and hundreds of fatalities in many nations in Europe http://www.wmo.int/pages/prog/wcp/wcdmp/documents/Coldspell2012.pdf. A multitude of further assessments are produced by WMO Members, covering national, regional and global scales. http://www.wmo.int/pages/prog/wcp/wcdmp/index_en.php (see section on Climate Monitoring Products)

## 3 PROSPECTS OF FUTURE USE OF SATELLITE DATA IN WMO CLIMATE ASSESSMENTS

There is great potential in using more satellite data in WMO climate assessments. In principle, this can be done in two parallel ways: (1) Introduce 'classic' satellite-derived variables in climate assessments, such as radiation, cloud parameters, water vapour etc.; and (2) Use more satellite data to complement in-situ data over oceans, deserts and mountainous areas. Related suggestions are outlined in the sections below.

The 16th Session of the WMO Commission for Climatology (CCl-16, 3-8 July 2014, Heidelberg, Germany) is expected to establish a Task Team on the Use of Satellite Data for Climate Monitoring. The team will address the current situation and future prospects of using satellite data to improve climate monitoring and assessment activities.

## 4 CRITERIA FOR EXTENDING THE USE OF SATELLITE DATA IN WMO CLIMATE ASSESSMENTS

### *General aspects*

A key approach for assessing the state of the climate is to put specific periods of observation (day, month, season , year, decade etc) into broader context (30 years or longer). Accordingly, time series data of sufficient length and quality are needed to constitute a 'climatology' of the variable. Atop, most statistical analysis methods require homogeneous data time series. Therefore, well documented, quality-controlled and consistent data sets are needed, including appropriate discovery and observation metadata.

At global and regional levels the compilation of WMO annual, decadal and special climate reports requires more data sets than those currently available from in-situ observing systems. Data sets on tropical cyclones, ice sheet and sea ice are gaining more interest for close and timely monitoring. Consistently estimated monthly rainfall anomalies, relative to 1981-2010 reference period, in scarce data regions, in Africa, South East Asia, Southern America and the Caribbean region will add value to the current WMO climate assessments in particular in flood and drought prone areas.

At national level, capacity building is needed, based on easily accessible satellite data sets in user friendly formats, to fully familiarise the National Meteorological and Hydrological Services (NMHSs) around the world with the specific characteristics of satellite data and products. The more WMO Members are able to process satellite data, the more such data will be used in climate assessments. Relevant existing capacity building activities showed some success already. It turned out, however, that significant efforts are needed to fully integrate satellite data into NMHSs routine climate monitoring and assessment activities.

### *Recommended products*

The following products are suggested to be implemented, with enhanced contribution from the satellite community:

- Long term homogenized data sets on tropical storms and cyclones based on WMO definition of tropical cyclone ocean basins and tropical cyclone categories;

- Air temperature products and sea surface temperatures with an assessment of uncertainties;

- Weekly, monthly, seasonal and annual precipitation products and climatology. The products can be based on Standardized Precipitation Index (SPI) definition provided at grid points over land. Products should be given with an assessment of uncertainty to the extent possible;

- Estimated arctic sea ice volume at the end of growing and melting season, March and September respectively;

- Monthly northern hemisphere snow cover and anomalies with respect to 1981-2010 reference period with provision of assessed uncertainties.

## 5 CLIMATE WATCH DEMONSTRATION PROJECTS

Other products such as snow depth estimates at weekly, monthly and/or seasonal time scale and forest fire index, derived from combined in-situ and satellite data, could also be considered to enhance the WMO Climate Watch System (CWS) (http://www.wmo.int/pages/publications/showcase/documents/CWS_EN_v1.pdf). This could include for instance a forest fire index based on in-situ observed temperature and humidity on one hand and satellite derived soil moisture.

Efforts are being carried out in the Greater Mediterranean Region to develop high quality long term data sets (http://www.omm.urv.cat/MEDARE/rationale-background.html) to support demonstration projects aiming to develop such new climate products that would support short term climate monitoring and climate watch related activities.

## 6 ACTIONS AND/OR RECOMMENDATIONS FOR CONSIDERATION BY CGMS

Joint efforts involving the WMO Commission for Climatology and space agency experts can significantly extend the use of satellite data in WMO climate monitoring and assessment activities with the benefit of improving our understanding of the climate system and its processes as well as providing operational climate products and services.

The following action and recommendation are proposed:

Action: CGMS Members who are willing to contribute satellite-based products to the annual WMO climate assessment shall nominate a point of contact to liaise with the future CCl Task Team on the Use of Satellite Data for Climate Monitoring in order to jointly define the specifications of these products, including validation and verification issues.

Recommendation: CGMS Members are encouraged to support regional climate watch demonstration projects.