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SATELLITE PRODUCTS IN SUPPORT OF THE SWFDP FOR THE LAKE VICTORIA BASIN REGION

The paper provides information on the Severe Weather Forecasting Demonstration Project (SWFDP) developments in Eastern Africa and describes its needs for satellite products for the Lake Victoria Basin region, which will improve severe weather forecasting in this region, and thereby will support various socio-economic sectors and application areas, including hydrology (e.g. in flood monitoring and forecasting) and water resources, agriculture and fisheries, and maritime safety, in addition to the general public.

Particular interest is expressed for cloud products, rainfall estimation, wind speed and direction over the lake basin region, soil moisture in the lake basin region, lake bathymetry, lake surface temperature, lake water level, and wave height and direction in the lake.

Recommendation proposed:

CGMS is invited to note the SWFDP needs for satellite products for the Lake Victoria Basin region.

SATELLITE PRODUCTS IN SUPPORT OF THE SWFDP NEEDS FOR THE LAKE VICTORIA BASIN REGION

1 INTRODUCTION

The Lake Victoria Basin

Lake Victoria is the world's second largest freshwater lake by surface area. It stretches 412 km from north to south between latitudes 0°30'N and 3°12'S, and 355 km from west to east between longitudes 31°37' and 34°53'E. The lake is situated at an altitude of 1,134 m above sea level. It has a volume of 2,760 km³ and an average depth of 40 m. The maximum depth is 80 m. Lake Victoria is the largest lake in Africa, with a surface area of 68,800 km² and a catchment area of 193,000 km² (Kayombo and Jorgensen, 2004). The Lake surface is shared between Kenya (6%), Uganda (43%) and Tanzania (51%), while its basin includes parts of Burundi and Rwanda. The lake is the source of the White Nile and thus, is an important asset for all countries within the Nile Basin. (Kizza et al, 2009).



Figure 1 – Lake Victoria Basin (Kizza et al, 2009).

The population of the lake basin is about 30 million, which constitutes about one third of the population of Kenya, Tanzania and Uganda. The lake basin provides resources for the livelihoods of the population living in the basin. The lake is used as source of food, energy, drinking and irrigation water, shelter, for transport, and as a repository for human, agricultural and industrial waste. The lake basin resources also provide amenities for cultural activities as well as for leisure. Over 70% of the population within the catchment area of the three riparian countries is engaged in agricultural production mostly as small scale farmers for crops such as sugar, tea, coffee, maize,

cotton, horticultural products, and livestock keeping. Lake Victoria supports the most productive freshwater fishery in the world with annual fish yields in excess of 300,000 tons worth USD 600 million annually. The rate of population growth of the riparian municipalities of the three countries stands at above 6% per annum and is among the highest in the world (Kayombo and Jorgensen, 2004).

Lake Victoria Climate and Weather

The general climate of Lake Victoria Basin ranges from a modified equatorial type with substantial rainfall occurring throughout the year, particularly over the lake and its vicinity, to a semiarid type characterized by intermittent droughts over some areas located even within short distances from the lakeshore.

Lake Victoria provides an environment conducive for complex interactions and integrations between regionally induced and large-scale circulation systems. The diurnal, seasonal and inter-annual variability of the basin climate (and East Africa generally) results from a complex interaction between the Inter-Tropical Convergence Zone (ITCZ), El Niño/Southern Oscillation (ENSO), Quasi-biennial Oscillation (QBO), large scale monsoonal winds, meso-scale circulations and extra-tropical weather systems.

Lake Victoria is large and diverse thus it produces regional-weather dynamics that are superimposed upon and interact with large-scale patterns. As a result, even diurnal circulations are impacted by large-scale forcing such as the lake surface temperature.

The wind and pressure patterns that govern the region's climate include three principal air streams namely; the Congo airstream with westerly and south-westerly winds, the southeast monsoon and the northeast monsoon. The north-south migration of the ITCZ results in a predominantly bimodal seasonal rainfall and wind distribution for the basin; the March-May rainfall period ("long rains") and the October-December rainfall period ("short rains"). El Niño years are usual associated with above normal rainfall amounts in the "short rainfall season" in most of the region. Meso-scale circulations due to orography, lake surface temperature and other factors have also been shown to significantly amplify the rainfall over the lake compared to surrounding land. The diurnal cycle is dominated by land/lake breeze circulations (Anyab. *et al.*, 2006).

2 SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP) IN EASTERN AFRICA

The Lake's unique weather dynamics – strong winds, heavy precipitation, high occurrence of hailstorms and severe thunderstorms – has led to loss of life and property, and threatens the safety of marine and air navigation over the lake and the basin around the lake. Forecasting the rapid onset of localized severe thunderstorms, heavy precipitation and strong winds over and around Lake Victoria, especially in absence of weather radar coverage, requires specialized expertise, real-time data and products. The National Meteorological and Hydrological Services (NMSs) of the countries bordering the lake (Tanzania, Kenya and Uganda) play a key role in monitoring and forecasting such rapidly developing and localized phenomena.

This is a central component of an end-to-end system for an operational service, including improving the delivery of timely warning and alerting services.

Understanding the present limitations of the NMHSs in the Lake Victoria Region to carry out severe weather forecasting and deliver warnings to the various socio-economic sectors, and the growing demand for these services, including amongst others, critical end users such as local fishing and farming communities, humanitarian and food relief agencies, lake transport sector and the disaster management community, there was an urgent need for a Severe Weather Forecasting Demonstration Project (SWFDP) to assess and plan for an end-to-end system for improved service delivery, including warning and alerting services, for the region. Details on the SWFDP concept and framework are provided in CGMS-39 WMO-WP-05 on the Update on SWFDP.

Following the recommendation by the WMO Fifteenth Congress (May 2007), and the proposal by the Steering Group for the SWFDP (February 2010), a Technical/Planning workshop was held in Nairobi, Kenya (October 2010), to consider the development of a SWFDP for Eastern Africa, which should focus on severe weather forecasting and warning services for the benefit of the general public and socio-economic sectors, in particular agriculture and fisheries. Following the outcomes of this workshop, a Regional Subproject Management Team (RSMT) has been established to develop and execute a Regional Subproject Implementation Plan (RSIP) for the field phase of the project, which is available on the WMO Web site at http://www.wmo.int/pages/prog/www/CBS-Reports/documents/RSIP_SWFDP-EA.pdf (WMO, 2011). The beneficiaries are countries in Eastern Africa, bordering on Lake Victoria (United Republic of Tanzania, Kenya and Uganda) and other surrounding countries, including Rwanda, Burundi and Ethiopia. The SWFDP – Eastern Africa is also in an early stage of implementation.

The Regional Specialized Meteorological Centre (RSMC) Nairobi is carrying out the functions of the lead regional forecasting support centre for the project. It is responsible for synthesizing all available and relevant products and information, and making the best use of all these products for diagnosing the convective systems, in order to provide daily severe weather forecasting guidance (day-1 to day-5) for the entire project footprint to NMHSs in Eastern Africa region. It is also responsible for developing and managing the Project Web Portal. The NMHSs continue to be responsible for the warning services to key users (including general public, and agriculture and fishery communities).

In addition to severe weather forecasting and warning services for the benefit of the general public and socio-economic sectors, in particular agriculture, for the entire project footprint, the SWFDP – Eastern Africa includes a specific component addressing severe weather forecasting and warning services over the Lake Victoria, addressing marine meteorological aspects for the safety and protection of fishers, living in nearshore communities and operating daily in small vessels in the nearshore.

Within the framework of the SWFDP – Eastern Africa, training is annually provided to forecasters and end-users, and therefore very short-range forecasting tools (how to use and interpret them) would be introduced in the training programme for these events.

3 SWFDP SATELLITE PRODUCT NEEDS FOR THE LAKE VICTORIA BASIN

Thanks to joint the establishment by EUMETSAT and WMO of the RA I (Africa) Dissemination Expert Group and its on-going review of the EUMETCast-Africa dissemination baseline, the six participating NMHSs in the SWFDP – Eastern Africa are informed of the relevant satellite data and products available for their region.

While noting that these are products that cover the Lake Victoria region, there are typically few data over the Lake Victoria Basin region, either due to the resolution of the products or any other constraint. In this context, the SWFDP needs for improved satellite products for the Lake Victoria Basin region include:

- (a) Diurnal cycle and propagation of convective activity and cloudiness over the Lake – identification of convective cells;
- (b) Rainfall estimation for the Lake Basin region;
- (c) Wind Speed and Direction over the Lake Basin region;
- (d) Soil Moisture in the Lake Basin region;
- (e) Lake Bathymetry;
- (f) Lake Surface Temperature;
- (g) Lake Water Level; and,
- (h) Wave Height and Direction in the Lake.

These products will improve severe weather forecasting in the Lake Victoria Basin region, and will support various socio-economic sectors and application areas, including hydrology (e.g. in flood monitoring and forecasting) and water resources, agriculture and fisheries, and maritime safety, in addition to the general public.

In addition, verification of these products over the Lake Victoria Basin region could be further improved and this could be performed within the framework of the SWFDP – Eastern Africa.

Finally, noting that there are some developments in products for coastal areas, the CGMS Satellite Operators could consider expanding them to cover lake regions.

4 CONCLUSIONS AND ACTIONS PROPOSED

CGMS is invited to note the SWFDP needs for satellite products for the Lake Victoria Basin region.

CGMS Satellite Operators are invited to advise on satellite products that could be made available in response to the needs of the SWFDP – Eastern Africa, to facilitate the timely provision of such satellite-related information by the relevant satellite operators to RSMC Nairobi and the NMHSs participating in the SWFDP – Eastern Africa, and to consider the SWFDP needs for the Lake Victoria Basin region in future product development activities.

5 REFERENCES

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