

**QUARTERLY REPORT OF THE SEVERE WEATHER FORECASTS**  
**RSMC- NAIROBI**  
**PERIOD: 1<sup>st</sup> October to 31<sup>st</sup> December, 2018**

## **1. HIGHLIGHTS OVER THE PERIOD**

The guidance Products during the review period (1<sup>st</sup> October to 31<sup>st</sup> December, 2018) were based on a skilful evaluation of both Regional and Global model outputs for the domain area of the project, Satellite imagery at the hour of issue and, expert interpretation that takes into consideration interactions with the local features. The criteria for generating the guidance products included:

- Heavy rain:  $\geq 50$  mm/24hr;
- Strong winds:  $\geq 25$  Kts;
- Ocean/lake large waves:  $\geq 2$ m;

During the period, the Regional Specialized Meteorological Centre (RSMC), Nairobi prepared daily Guidance products valid 0900z and issued uplink at 0900z consisting of 2 bulletins:

The first bulletin focused on Short-Range Forecasts (day-1 and day-2) while the second addressed the medium-range forecasts (day-3, day- 4 and day-5).

For each day there was a table giving the probability of occurrence of severe weather and background maps indicating expected areas for heavy rainfall, strong winds and severe wave height over the Eastern Africa region, with the day-1 map overlaid on a current satellite image.

## **2. OVERVIEW OF PRODUCTS**

### ***2.1 Usefulness of RSMC Daily Severe Weather Forecasting Guidance***

Daily RSMC guidance helped NMHSs of the member countries' forecasters increase skill and confidence in the preparation of forecast products. The improved tools and forecasting techniques increased efficiency in production of quality daily forecasts thus leading to confidence of products by the users.

### ***2.2 Usefulness of SWFDP NWP/EPS Products and Guidance Products***

The skilful guidance products posted on the web portal were useful. The Weather Research and Forecasting Model (WRF) regional models, European Centre for Medium Range Weather Forecasting (ECMWF), National Centre for Environmental Prediction (NCEP), United Kingdom Global Model (UKGM) ensemble and deterministic products and video teleconference discussions were extensively utilized thus enabling detections of the severe weather events in advance.

Accessibility of large scale medium range deterministic and probabilistic forecasts given by the Global Centres, high resolution refinements and details in the model fields given by the Limited Area Models and

the chronological evolution of the model parameters through the EPSgrams in longer lead times improved efficiency of the production and issuance of forecasts/warnings. These enabled evaluation of the extent of the spread of the predicted events objectively using ensemble forecasting technique, and hence accelerated technology transfer of Numerical Weather Prediction / Ensemble Prediction System (NWP/EPS) tools used.

### **3. PROJECT EVALUATION AGAINST SWFDP GOALS**

Forecasting products and tools from Global and Regional Centres under one RSMC portal improved the accuracy and timely dissemination of severe weather forecasts/warnings/advisories. Interactive site improved the interaction with Disaster Management and Civil Protection authorities (DMCPAs), the media, and other sectoral users, before, during and after severe weather events.

The major weakness during the period was scarcity of observation data in real time from member countries, while southern Sudan, Burundi and Ethiopia have not been participating on daily video teleconference severe weather discussions as well as slow/interrupted internet connectivity. These factors occasionally affected effective severe weather productions and timely uploading of the guidance products.

### **4. EVALUATION OF SEVERE WEATHER FORECASTS AND WARNINGS**

- Feedback from the NMHS of the member countries of the project through the seminars/workshops and online were commendable hence the users were making use of the forecasts and warnings issued.
- Improved forecasts and warnings were fully utilized for developing necessary precautions and minimise the risks.
- The difficulty in getting feedback was due to the inconsistency by stakeholders to respond to feedback mechanism especially from centres who are currently not participating in the discussions.
- Alternative contacts through emails, social media (Skype/twitter/whatsapp) as well as functional website and web portal facilitated quick access of guidance forecasts/warnings/advisories that enabled the stakeholders to disseminate the information out quickly.
- Forecasts/warnings/advisories were timely disseminated during the period.

## **5. SUMMARY OF ACHIEVEMENTS AND CHALLENGES DURING 1<sup>st</sup> October to 31<sup>st</sup> December, 2018.**

### **5.1 Achievements**

- During the period of review, the RSMC-Nairobi led daily Skype video teleconferencing of weather discussions.
- The feedback and archiving mechanism on RSMC web portal facilitated the interaction with other NMHSs, Disaster Management and Civil Protection authorities, media and other users.
- Guidance forecasts and warnings issued during the period concerning heavy rains, strong winds and large waves over the region were used to develop mitigation strategies that minimized fatalities of adverse weather.
- Weather advisory and flood watch alerts based on Guidance forecast products linked on website <http://meteo.go.ke> homepage.
- A total number of 92 guidance products of severe weather forecasts for day 1 to 5 covering the region were issued, uploaded and archived before 0900z every day during the period.
- Daily video teleconferences of severe weather discussions totalling 78 were held during the period despite network connectivity and the workforce for daily guidance forecasts.
- From daily verifications of the previous day's guidance forecasts issued after reaching a consensus, the level of accuracy was averagely good during the period. Satellite information and South Africa 24hrs rainfall estimator were used for verification to supplement data from sparse station networks in the SWFDP Eastern Africa regions.
- Also general information concerning weather discussions were relayed to relevant participants/NMHS through various medium of communications on time. There was one case study of heavy rainfall from Kenya during the period of review.

### **5.2 Challenges**

The major challenges during the period included:

- Insufficient data in real time for validations of previous forecasts issued.
- Frequent power interruptions affecting communication systems; internet connections, servers, smooth regional model runs, the productions, participation of weather discussions, uploading and dissemination of forecasts/warnings on time.
- Inadequate forecasting systems; multi viewing screens for successive forecasting ingredients and model outputs. (Consortium of Small Scale Modelling (COSMO) was down during the period).
- No direct communication facilities to SWFDP member countries for follow up of severe events and data for verification purposes.
- No alternative internet connections (modem and airtime)
- No observational data and non-participation on daily weather discussion by southern Sudan

## 6.0 Verification of severe weather forecasts events

Contingence tables were used to verify occurrence of severe weather forecasts events to evaluate hits, false alarms, misses and correct negatives for the purpose of monitoring the quality of forecasts, improvement and to compare the consistency of different forecast systems.

The dichotomous tables below summarize the verification results of severe weather events for the period of review.

**Table 1: Severe rainfall contingency table**

<i>Severe rainfall forecasts</i>	<i>Event observed</i>		
	<i>Yes</i>	<i>No</i>	<i>Marginal total</i>
<i>Yes</i>	<b>20</b> (Hit)	<b>6</b> (False Alarm)	<b>26</b>
<i>No</i>	<b>2</b> (misses)	<b>64</b> (Correct Negative)	<b>66</b>
<i>Marginal total</i>	<b>22</b>	<b>70</b>	<b>92</b>

$$POD = \frac{\text{hits}}{\text{hits} + \text{misses}}$$

### 6.1 Probability of Detection (POD)

**6.1.1** Probability of detection of severe rainfall events during the period of review was  $20/22*100 = 90.9\%$

**Table 2: Strong winds contingency table**

<i>Severe strong winds forecasts</i>	<i>Event observed</i>		
	<i>Yes</i>	<i>No</i>	<i>Marginal total</i>
<i>Yes</i>	<b>56</b>	<b>21</b>	<b>77</b>
<i>No</i>	<b>3</b>	<b>12</b>	<b>6</b>
<i>Marginal total</i>	<b>59</b>	<b>33</b>	<b>92</b>

**6.1.2** Probability of detection of severe strong winds during the period of review was  $56/59*100 = 94.9\%$

## 6.2 Skype video teleconference of severe weather discussions by representatives from Tanzania, Rwanda, and Kenya

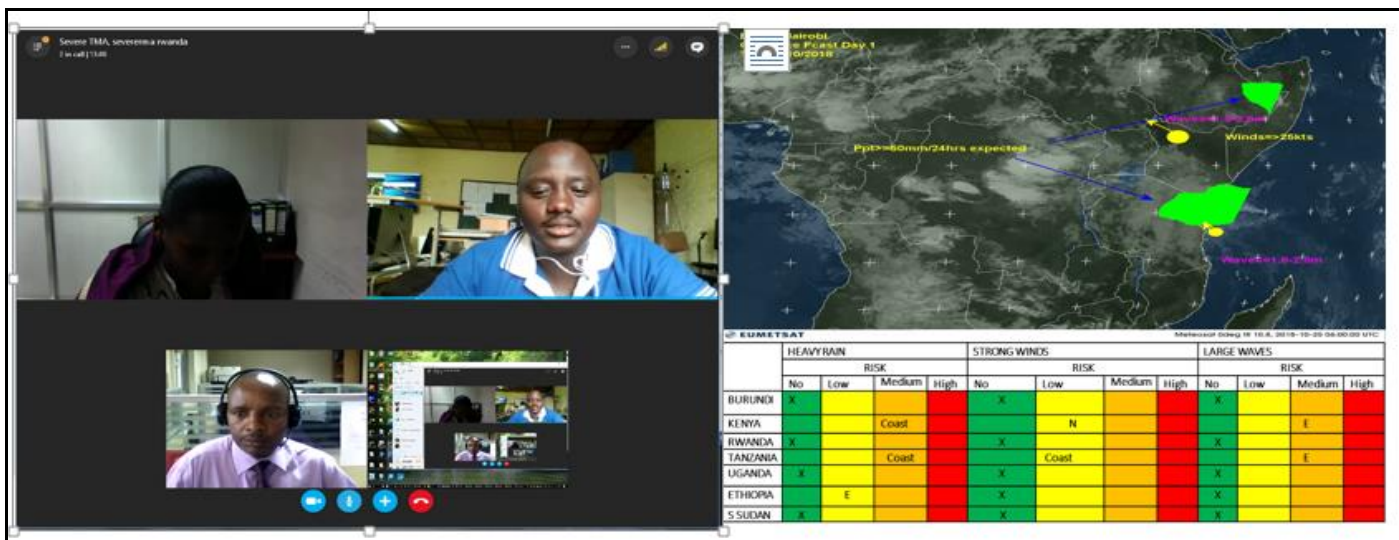


Figure 1: Verification of Previous day severe weather guidance forecasts issued.

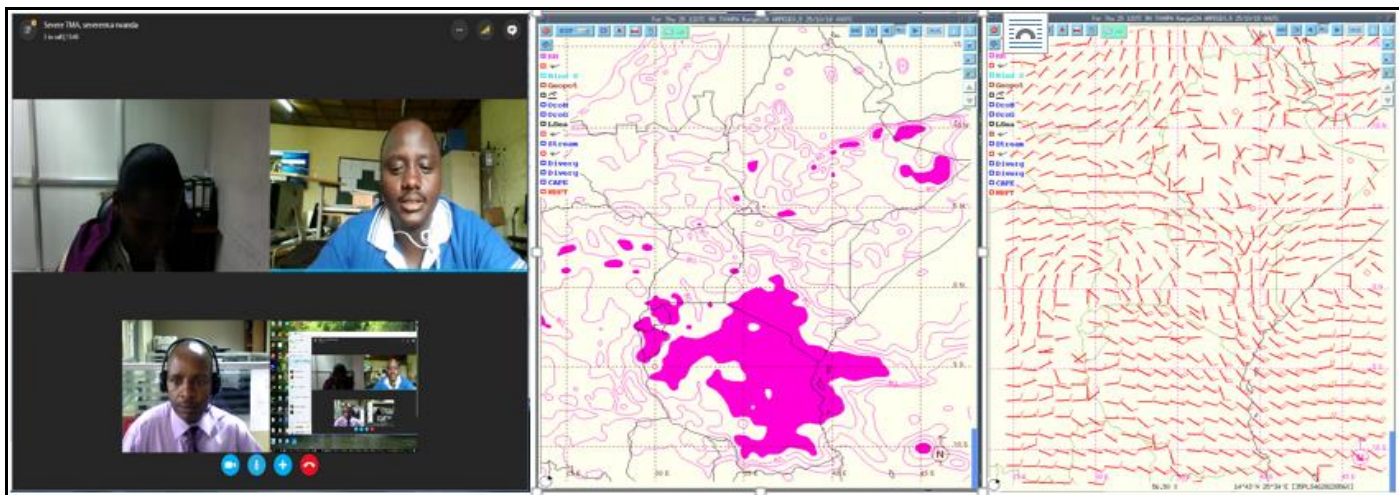


Figure 2: Discussion of mesoscale systems that affect weather over the region

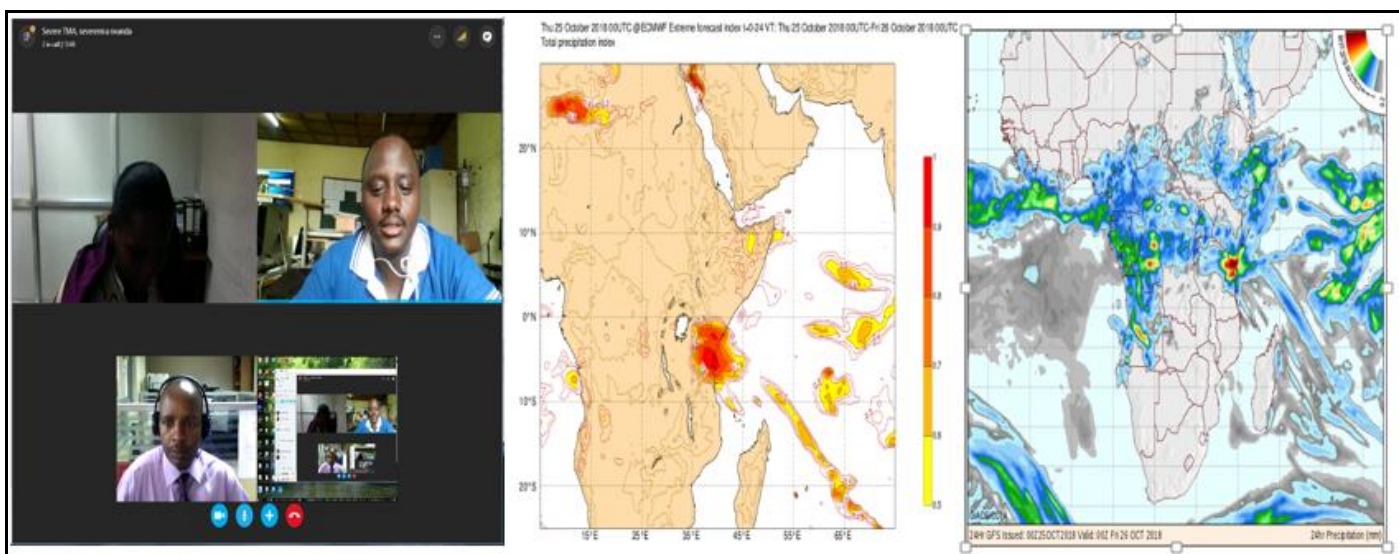


Figure 3: Discussions of NWP severe weather guidance products.



## 7.0 CASE STUDY SEVERE RAINFALL OVER COASTAL REGION OF KENYA ON 25<sup>TH</sup> OCTOBER, 2018

### 7.1 General synoptic system for October.

During October 2018, The SST anomaly patterns was slightly warmer than average SSTs in the central to western Equatorial Indian Ocean (adjacent to the East African coast) coupled with the cooler than average SSTs in the eastern Equatorial Indian Ocean (adjacent to Australia). This constituted a slightly positive Indian Ocean Dipole (IOD) that favored rainfall in the country

The Meridional (North-south) arm of the Inter-Tropical Convergence Zone (ITCZ) was well over the western parts of the country occasionally extending to central Highlands and Nairobi. The Zonal (east-west) arm of the ITCZ was diffused over Kenya.

### 7.2 Observations on 26<sup>th</sup> October, 2018 at 0600Z

On 26<sup>th</sup> October, 2018 at 0600Z, several stations over Coastal region recorded very heavy rainfall in 24hrs as shown in table 1 and Figure 1 below.

Date	Region	Station	Rainfall
26/10/2018 at 0600z	Coastal region	Mombasa port	194mm
		Kwale Vet.	158mm
		Vanga FTC	103.5mm
		Mtwapa Met	93.5mm
		Kilimasi.	93.4mm
		KARLO Matuga	59.4mm

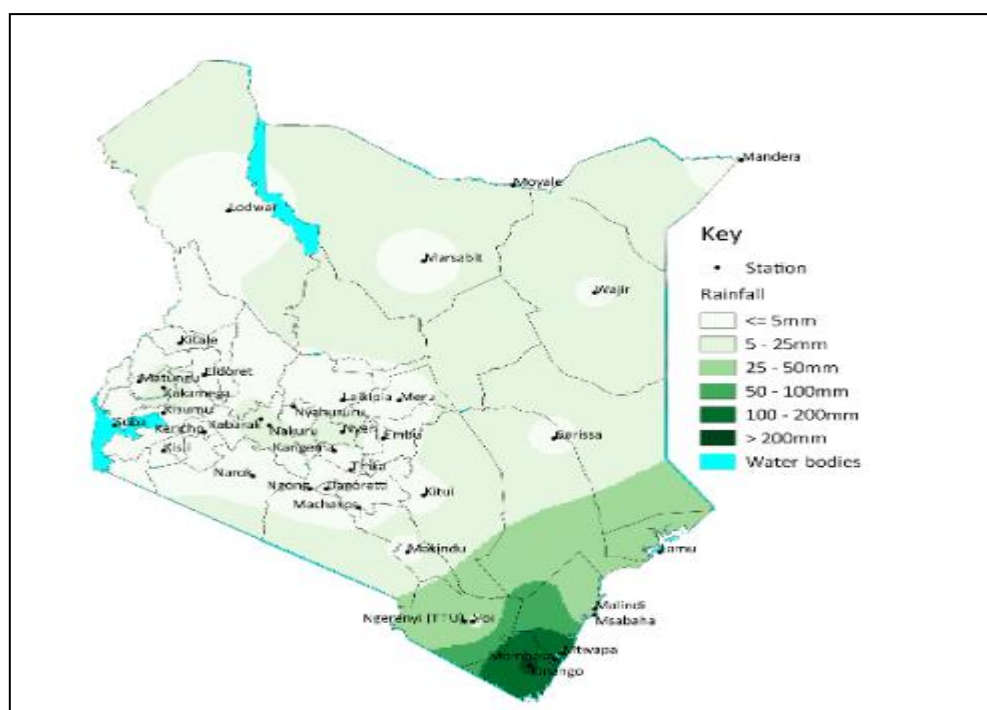


Figure 1: Total Rainfall reported in twenty-four-hour period, from 25<sup>th</sup> October 0600Z 2018 to 26<sup>th</sup> October 0600UTC 2018.

### 7.3 MODEL FORECASTS

All models predicted the heavy rainfall of above 50mm over Coastal region of Kenya on 25<sup>th</sup> October, 2018.

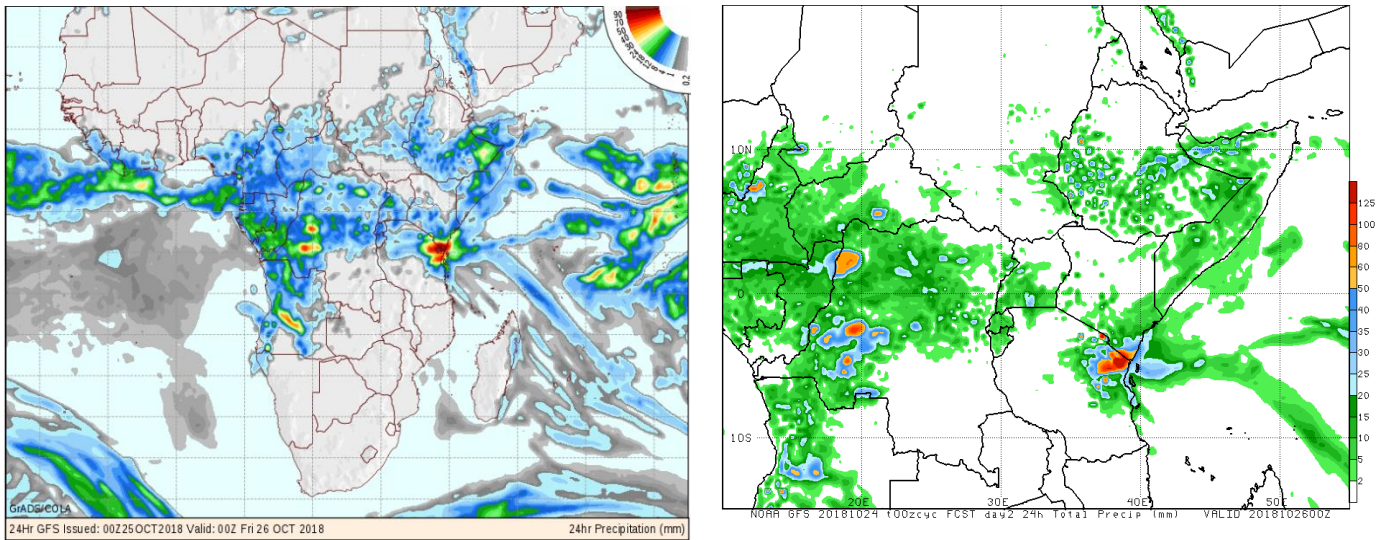


Figure 2: GFS-COLA (Left panel) and GFS-NOAA (Right panel) 24 hours rainfall accumulation from 25<sup>th</sup> October 00Z to 26<sup>th</sup> October 00Z 2018

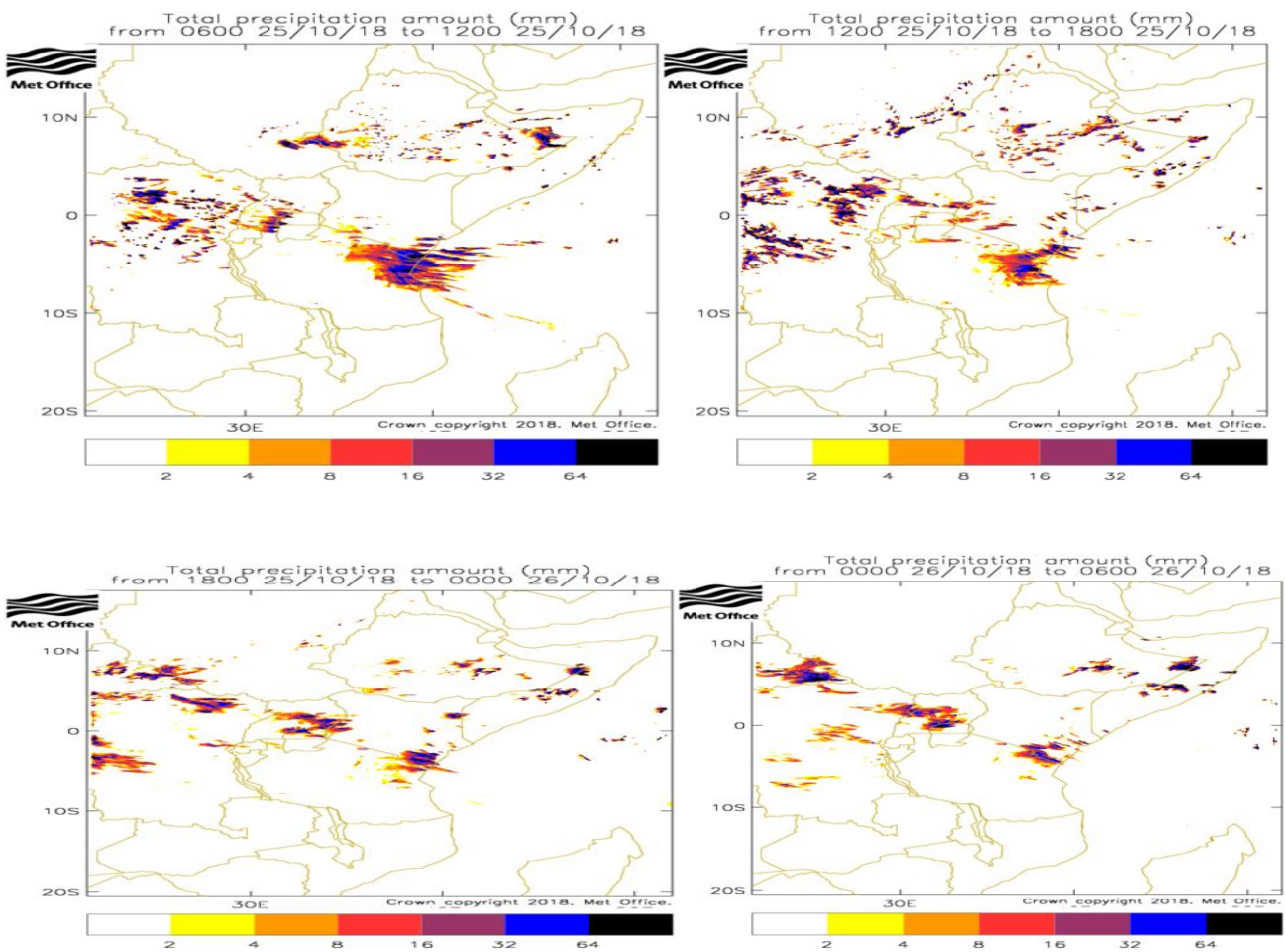
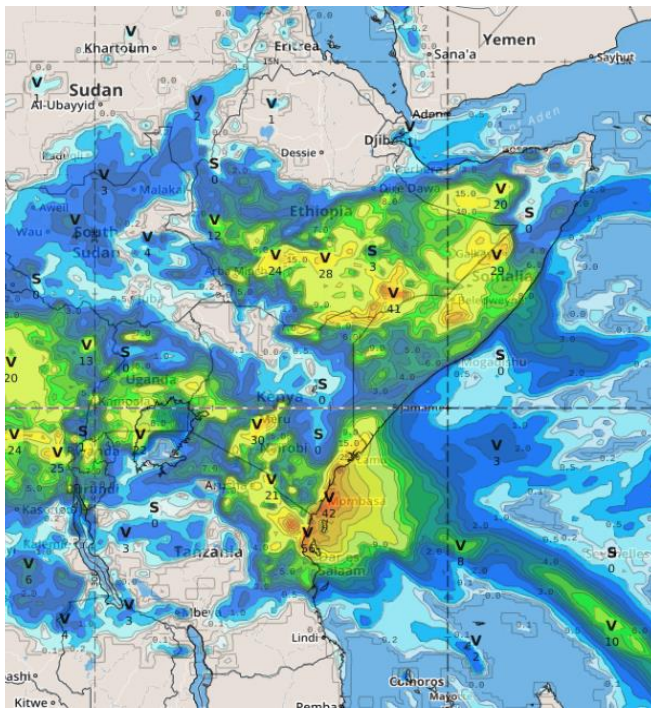


Figure 4: UK MET office 6 hourly rainfall accumulation for 25<sup>th</sup> October, 2018





Thursday 25 October 2018 0000 UTC ECMWF t+24 VT: Friday 26 October 2018 0000 UTC  
 MSLP (hPa) and Probability of Precip exceeding 50mm/24h since last 24 h (%)

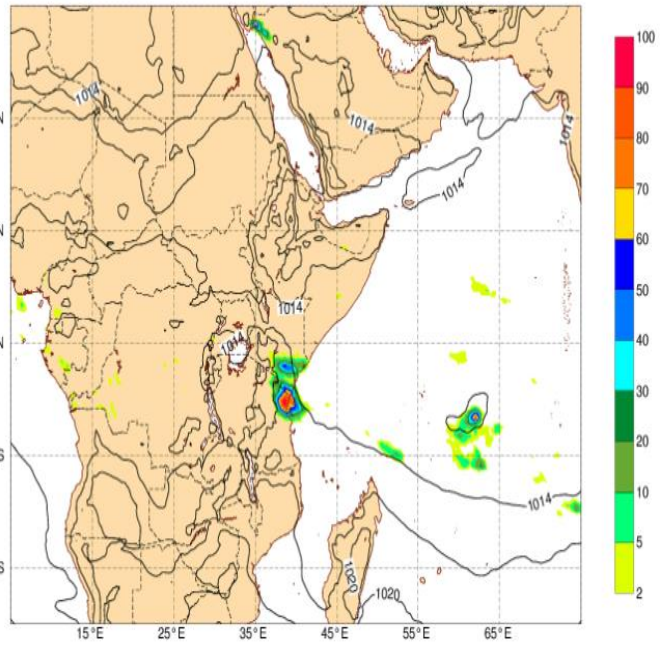
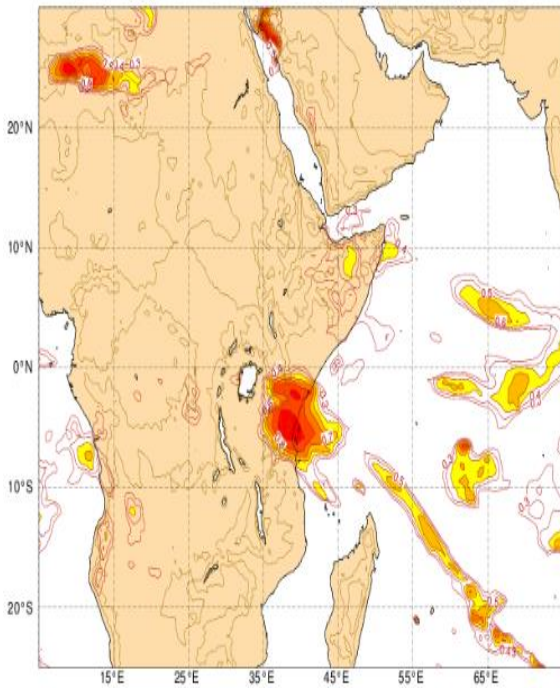


Figure 5: UK MET (Left panel) and ECMWF probability of exceeding 50mm/24hrs (Right panel) 24 hours rainfall accumulation on 25<sup>th</sup> October, 2018

Thu 25 October 2018 00UTC @ECMWF Extreme forecast index t-0-24 VT: Thu 25 October 2018 00UTC-Fri 26 October 2018 00UTC  
 Total precipitation index



Thu 25 October 2018 00UTC @ECMWF Extreme forecast index t+24-48 VT: Fri 26 October 2018 00UTC-Sat 27 October 2018 00UTC  
 Total precipitation index

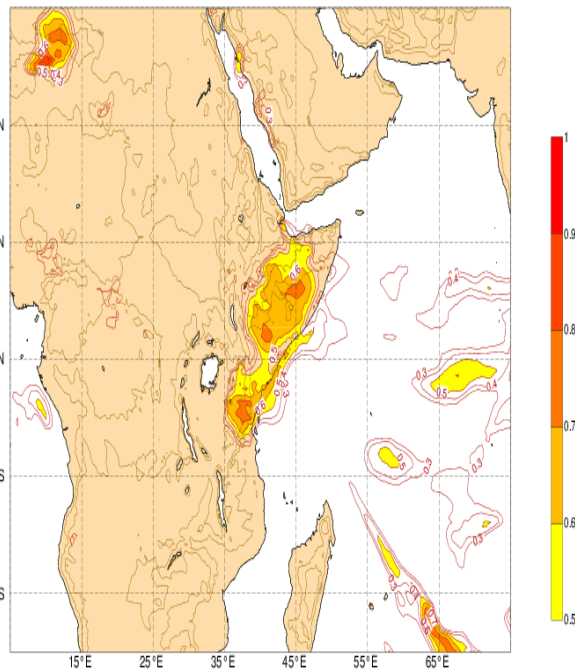
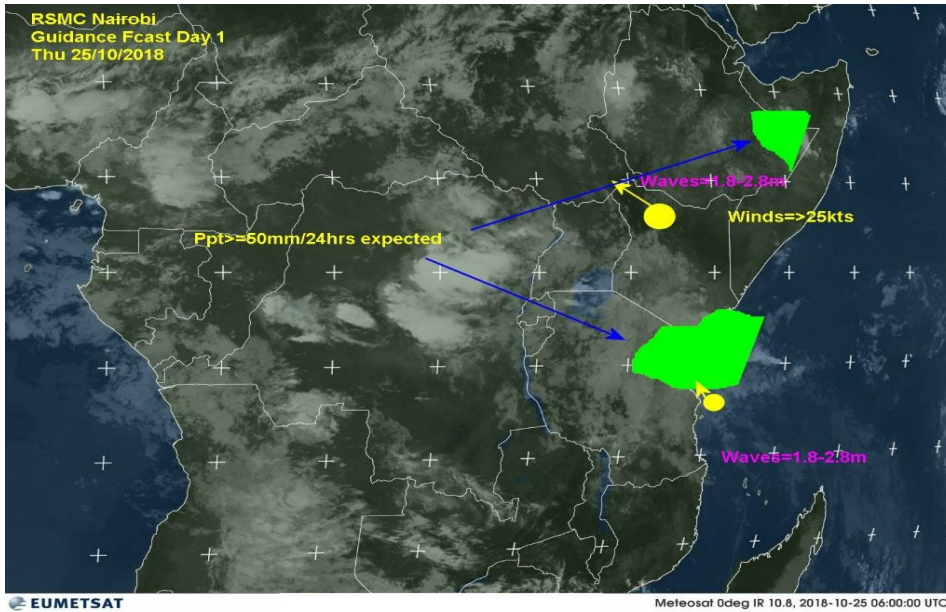


Figure 6: ECMWF Extreme forecast index for 25<sup>th</sup> and 26<sup>th</sup> October (Left and Right panels respectively)



## Severe weather forecasts Issued on 25<sup>th</sup> October 2018

### (i) Imagery/Picture



### (ii) Risk Table

	HEAVY RAIN				STRONG WINDS				LARGE WAVES			
	RISK				RISK				RISK			
	No	Low	Medium	High	No	Low	Medium	High	No	Low	Medium	High
BURUNDI	X				X				X			
KENYA			Coast			N					E	
RWANDA	X				X				X			
TANZANIA			Coast			Coast					E	
UGANDA	X				X				X			
ETHIOPIA		E			X				X			
S SUDAN	X				X				X			

### (iii) Text description of an event

Day	Parameter	Severe Weather Expected	Degree of Confidence
Day 1: Thursday 25 <sup>th</sup> October, 2018	Rainfall	Heavy rainfall of more than 50mm/24hrs is expected over the coastal regions of Kenya and Tanzania and eastern parts of Ethiopia	High
Day 2: Friday 26 <sup>th</sup> October, 2018	Rainfall	Heavy rainfall of more than 50mm/24hrs is expected over Coastal regions of Kenya and North Coastal Tanzania.	High



## Heavy Rain Advisory

<b>Message Type:</b>	Heavy Rainfall
<b>Message Update No.:</b>	One
<b>Advisory No.:</b>	10/2018
<b>Date of Issue:</b>	23 <sup>rd</sup> October, 2018 0700UTC
<b>Validity:</b>	From 24 <sup>th</sup> to 26 <sup>th</sup> October 2018
<b>Urgency:</b>	Expected
<b>Severity:</b>	Moderate
<b>Certainty:</b>	Moderate Probability of occurrence (33% to 66% Chance)
<b>Message Description:</b>	Heavy rainfall of more than 30mm in 24 hours is expected on 24 <sup>th</sup> Wednesday October, 2018 over the coastal region of Kenya. The rainfall is expected to intensify to more than 40mm in 24hrs on Thursday 25 <sup>th</sup> October 2018, along the south coast. On Friday 26 <sup>th</sup> October 2018, the rainfall intensity expected along the coast will decrease to 30mm in 24 hours. These heavy rains will be accompanied by strong winds and large waves.
<b>Area(s) of Concern:</b>	Counties expected to be affected include; Kwale, Mombasa, Kilifi Tana River and Lamu.
<b>Instructions:</b>	Residents in all the mentioned areas are advised to be on the lookout for flashfloods. People should avoid driving, wading or walking through any fast moving waters. The heavy rains and strong winds off shore may result in storm surge along the coast, hence fishermen and all in the Marine industry should be on high alert. Continue listening to local media as updates will be provided if conditions change significantly. Further advisories will be issued as we follow upon the progress of this weather event.
<b>Message Addressed to:</b>	Office of the president, Kenya Red Cross, Kenya Maritime Authority, Kenya Ports Authority, National Disaster Operations Centre, Media, County Directors of Meteorological Services (CDMs) of Mombasa, Kilifi, Lamu, Tana-River Counties.
<b>Originator:</b>	Director, Kenya Meteorological Department.

## IMPACTS

There were reports from the media showing negative cases of heavy rainfall during the period that caused destruction of property and socio economic activities.

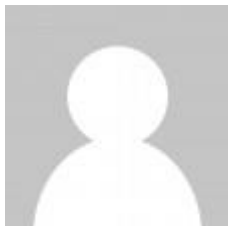
# Floods, damages as heavy rains pound Mombasa – PHOTOS

October 25, 2018 10:30 am

2 Min Read



A flooded street in Mombasa town following heavy rains on October 25, 2018. PHOTOS | WACHIRA MWANGI



NATION TEAM

Share This!

A nightlong downpour has flooded parts of Mombasa city. Heavy rains pounding the coastal city have caused flooding and poor visibility. The rains that started on Wednesday night caused traffic snarl-ups as motorists struggled to steer vehicles through flooded roads.



Some of Mombasa residents had to wade through flooded sections of the roads.



PHOTO | WACHIRA MWANGI

At the ferry, there was a traffic snarl up as the motorists carefully steered their cars through the waters.

### **STRANDED**

Some pedestrians remained stranded at the ferry waiting bay as they waited for the rains to subside.

Those who braved the pounding rain got to work wet. Floodwaters filled major streets and avenues in the city.

Residents of Kaa Chonjo, Tudor woke up to blocked sewage lines and flooded houses following the heavy rains.



PHOTO | WACHIRA MWANGI

The men rushed to unblock the biggest sewer in the area that drains into the ocean while women and children used anything to scoop water from their houses.