



Strengthening Climate Information and EWS in Tanzania for Climate Resilient Development and Adaptation to climate change Project in Tanzania

Presented by: Hamza A. Kabelwa, PhD (TMA)

Prepared by

**Abbas Kitogo (UNDP-TZ), Alfei Daniel (PC) and Diana Kimbute
(MoWI)**

**REGIONAL WORKSHOP ON TOWARDS SUSTAINABILITY FOR CLIMATE INFORMATION SERVICES: ACHIEVEMENTS,
IMPACTS, LESSONS LEARNED AND NEXT STEPS",
29 NOVEMBER - 1 DECEMBER, 2017 LUSAKA, ZAMBIA**



Outlines

- Project background
- Achievements
- Impacts
- Lessons Learned
- Next Steps





Project background



- Project Work to strengthen the weather, climate and hydrological monitoring capabilities, early warning systems and available information for responding to extreme weather and planning adaptation to climate change.
- Enhancing Capacity of Tanzania Meteorological Agency and Ministry of water and Irrigation to monitor (and forecast) droughts and floods
- Improving the National Meteorological and Hydrological systems in Tanzania to monitor, assess and disseminate of hydro-climate information
- Improving the effective use of hydro-meteorological and environmental information for making early warnings and long-term development plans
- The project is funded by Global Environment Facility, UNDP and Tanzania Government
- The Implementer is *the Prime Minister's Office* and work together with other Government Institutions

Target Authorities/
Institutions/ Agencies:
Prime Minister's office,
Tanzania
Meteorological agency,
Ministry of Water and
Irrigation, Ministry of
Agriculture, Ministry of
Livestock and
Fisheries, Pangani
Basin Water Board and
Ruvuma and Southern
Coast Basin Water
Board.

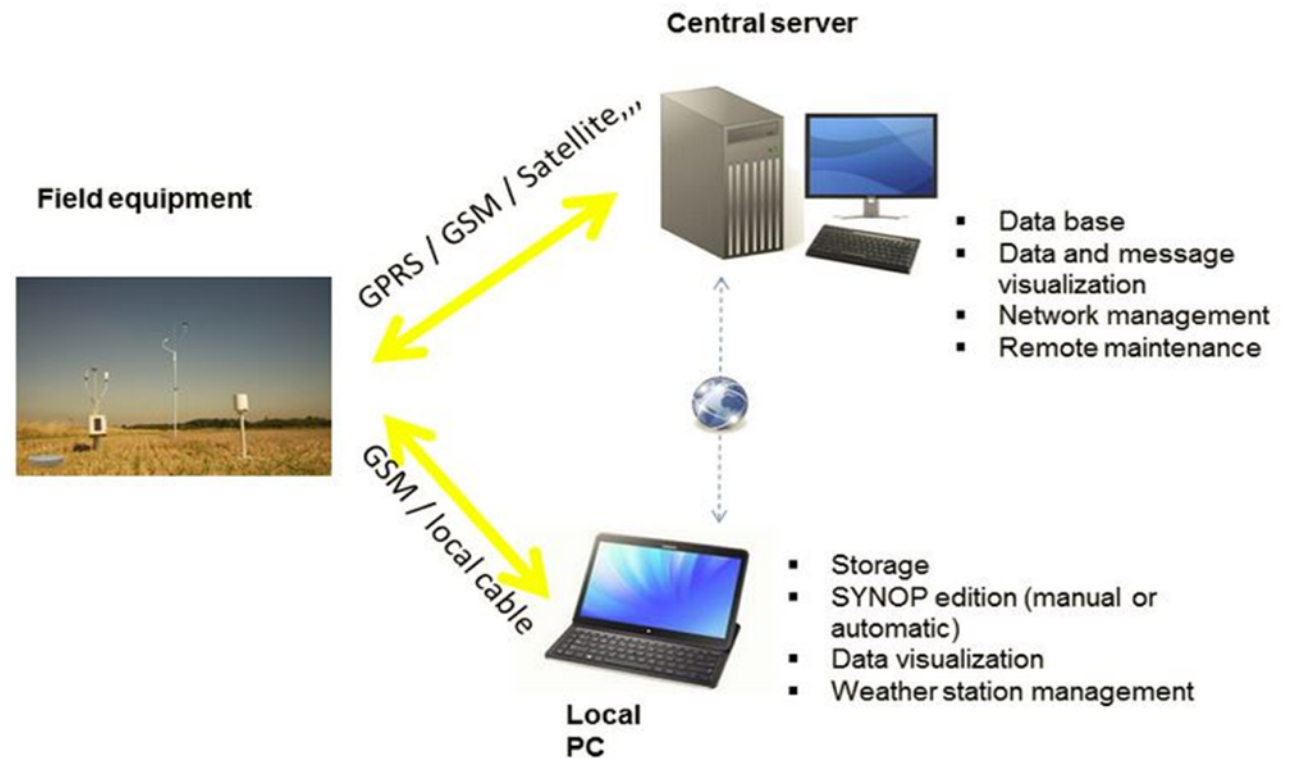


ACHIEVEMENTS

1.0 Transfer of technologies for weather, climate, hydrological and environmental monitoring infrastructure

Output 1.1: 36 additional automated stations generate hourly climate data

Installation of 36 automatic weather stations across the country



Distribution of stations





Output 1.1: 36 Cont...



Empowered lives.
Resilient nations.





Output 1.1: 36 additional automated stations generate hourly climate data



- The project procured 2 field laptops for calibration and 4 savers for data transmission
- Eight stations were connected with national fiber optic cable for improving meteorological operations and data transmission
- Six Meteorological Engineers from Tanzania Meteorological Agency and 2 hydrologists from Ministry of Water and Irrigation were trained for maintaining of new installed AWSs, repairing, calibration of AWS sensors and telecommunications for maximising data processing and interpretation for socio-economic services
- TMA 11 modelling experts were trained on data Assimilation for enhancing capacity on Numerical Weather Prediction for improving the service delivery



Training on data Assimilation NWP WRF



Empowered lives.
Resilient nations.





Output 1.2 Real time hydrological and water flow data available at Pangani and Ruvuma basins

- 10 hydrological stations and 5 AWS were installed in Pangani Basin.
- 10 AWS and 5 Hydrological stations were installed in Ruvuma and Southern coast Basins.
- Configuration were made to ensure the real time data are transmitted to the servers at Ministry Of Water and Irrigation and TMA
- 14 Hydrologist on calibration, maintaining and installation of stations in the two basins were trained

The stations transmit data using GPRS/Satellite to the main server after every one hour



River staff gauge installed in of the river in Pangani Basin



The case with the data logger



Automatic weather stations (Davis type)



Output 1.3 Flood forecasting models, flood forecast management systems and flood risk maps are developed for each major river within Pangani and Ruvuma and Sothorn Coast Basi

CIEWS - Integrated Water Resource Management System (CIEWS-IWRMS) implementation progress for Tanzania



- The MoWI of Tanzania desires to procure Real Time Hydrological Software Solutions for Integrated Water Resource Management.
- As primary beneficiary, the MoWI will operate the IWRMS and is in charge of providing a suitable IT environment for the system.
- The IWRMS doesn't consist of Meteorological Software Solutions which are operated by TMA, but TMA weather observed and forecast data are required as IWRMS input data.
- The stakeholders involved in the IWRMS project are:
 - MoWI (including PBWB & RSCWB) as primary beneficiary of the IWRMS project.
 - PMO-DMD as Implementing partner of the CIEWS project.
 - TMA as weather data provider (MoU established between MoWI and TMA for data exchange)
 - In-country consultant in charge of the implementation of the **National Database for Climate and Hydrology (NDCH)**. The NDCH is partly implemented and will provide input data for the IWRMS.
- Note: The NDCH is a keystone of the Tanzanian Water Information System which acts as a single data source for all ministries and relevant sector users.



Output 1.3 Flood forecasting models, flood forecast management systems and flood risk maps are developed for each major river within Pangani and Ruvuma and Sothern Coast Basin Cont...

installation and the operationalization of the IWRMS. As a first start, the IWRMS will be implemented for 2 pilot basin area

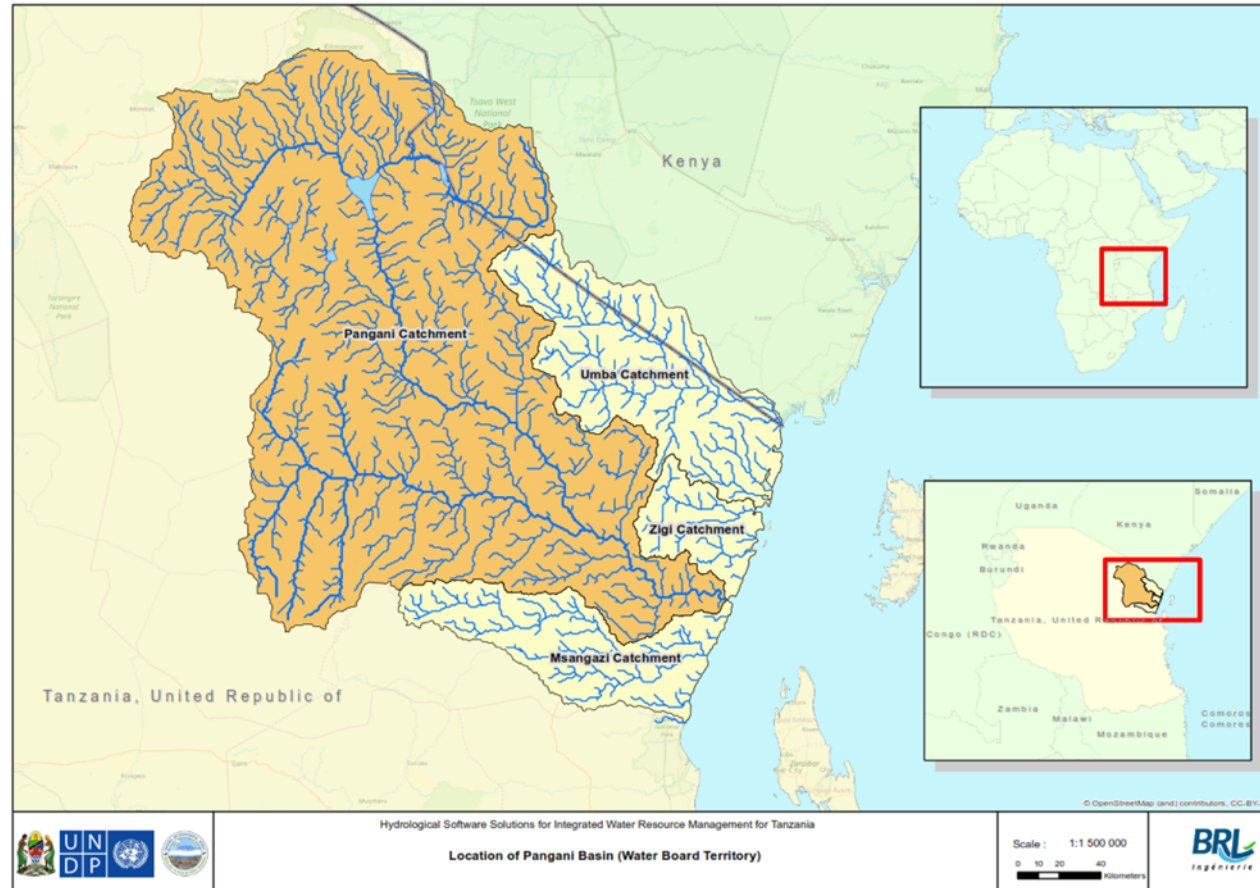
- The **Ruvuma & Southern Coast** basin area:
 - Transboundary river basin with Mozambique (MoU established)
 - Total area: 152 200 km²
 - Tanzanian aera: 105 500 km²
- The **Pangani river** basin area:
 - Transboundary river basin with Kenya (MoU established)
 - Total area: 56 300 km²
 - Tanzanian aera: 53 500 km²



In the future, the project scale could be extended to the whole country (9 basins)



Output 1.3 Flood forecasting models, flood forecast management systems and flood risk maps are developed for each major river within Pangani and Ruvuma and Sothern Coast Basin
Contl...

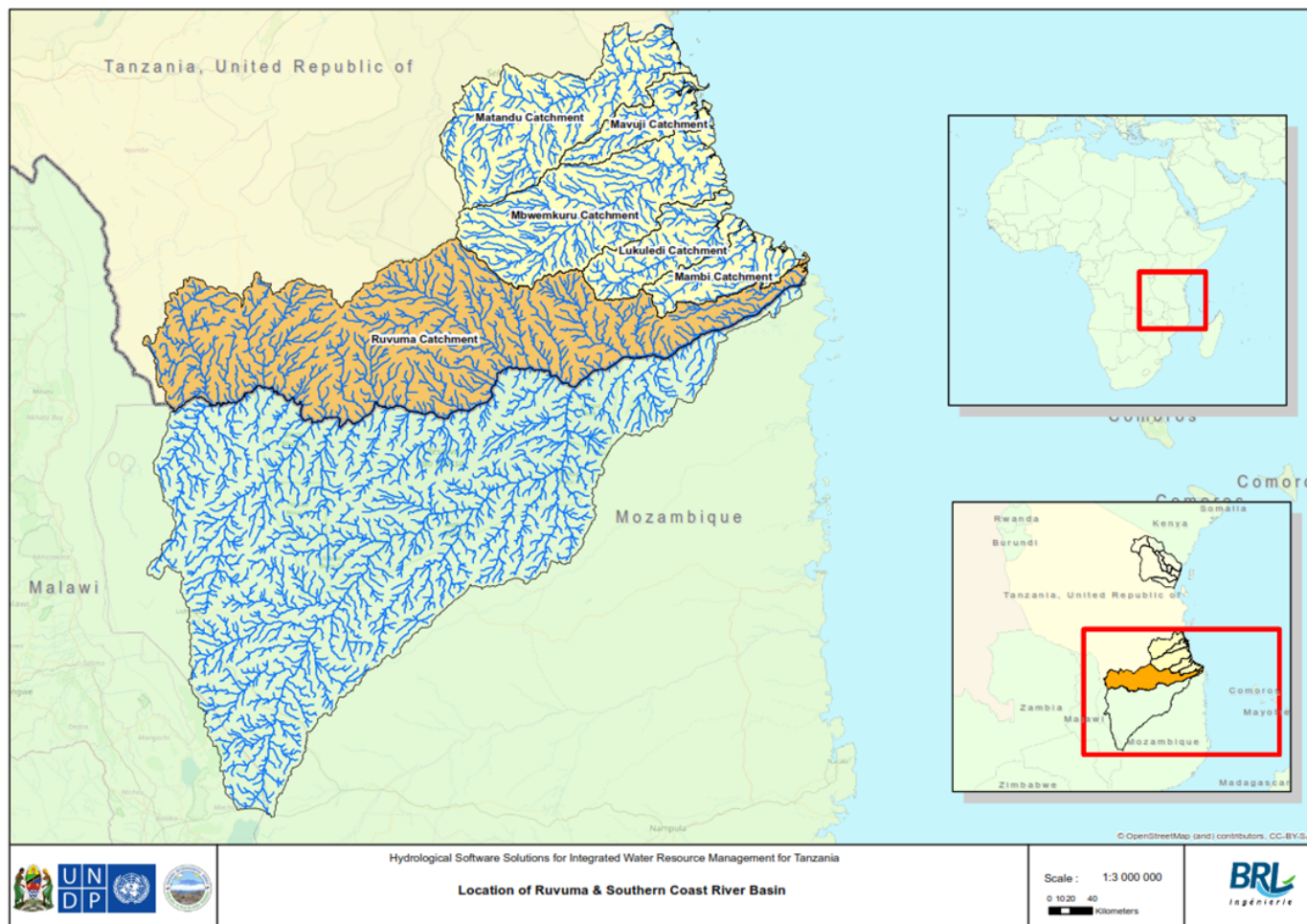


STUDY AREA – PANGANI RIVER BASIN

Pangani River Basin, plus the Uмба, Zigi-Mkulumuzi Coastal and Msangazi river catchments



Output 1.3 Flood forecasting models, flood forecast management systems and flood risk maps are developed for each major river within Pangani and Ruvuma and Sothern Coast Basin Contl...



**STUDY AREA –
RUVUMA RIVER AND
SOUTHER COAST
BASIN**

Ruvuma River Basin, plus the Lukuledi, Likuyu, Mbwemkuru and Matandu river valleys



Output 1.3 Flood forecasting models, flood forecast management systems and flood risk maps are developed for each major river within Pangani and Ruvuma and Sothern Coast Basin
Contl...

END-USERS

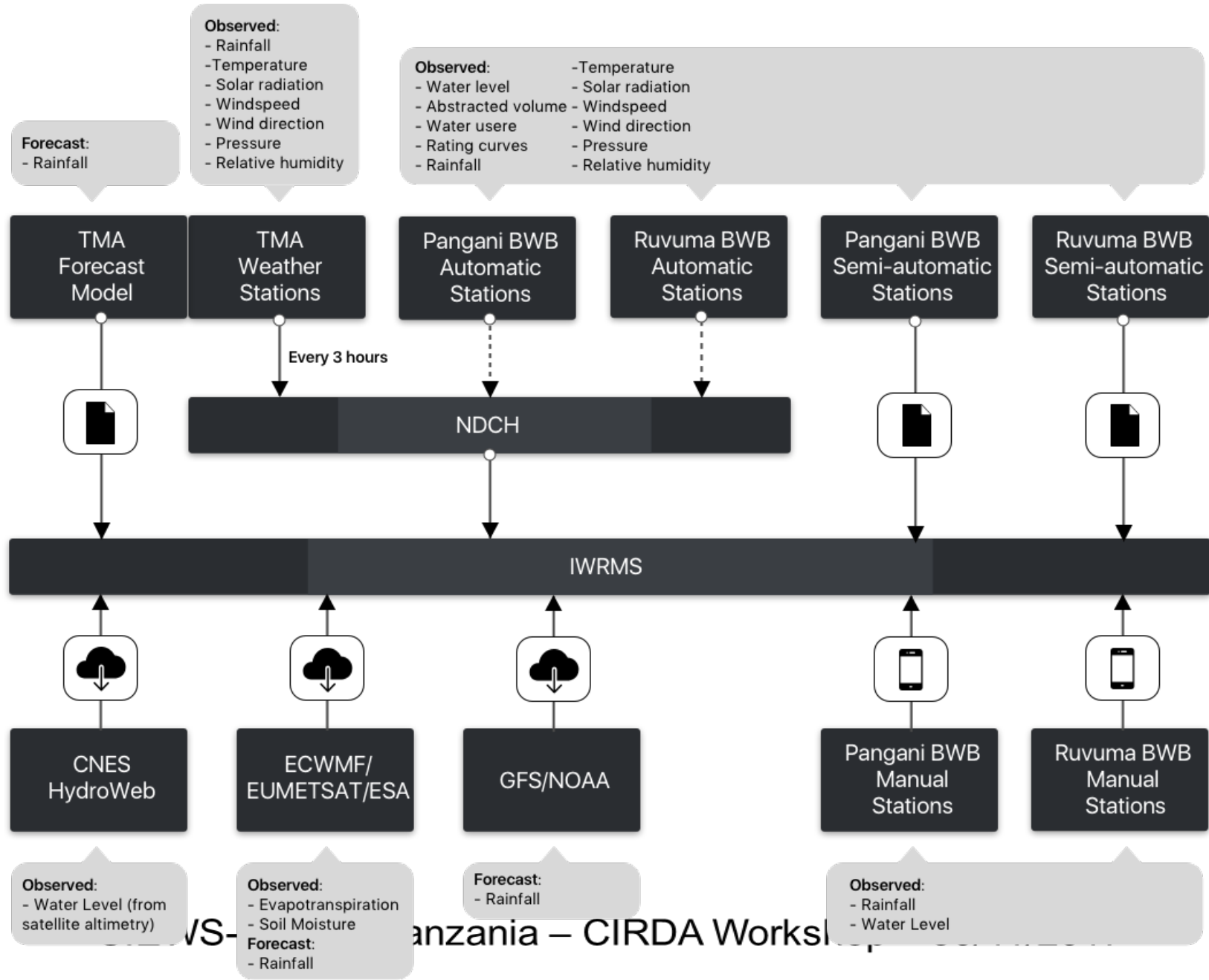
The system is a **aid-decision tool** that will be **mainly used by the specialists of MoWI, BWBs, TMA and PMO-DMD.**

The system will **deliver a forecast hydrological risk** warning based on modelling and computation. The specialists interpret the outputs of the system. Then if needed mitigation actions can be undertaken in the basins that will encounter floods or droughts.

Nevertheless, the system can **deliver a real time information** (or nowcasting) to the general public in a visual way using colored symbol (associated to risk level) located on basins maps (but no figure numbers).



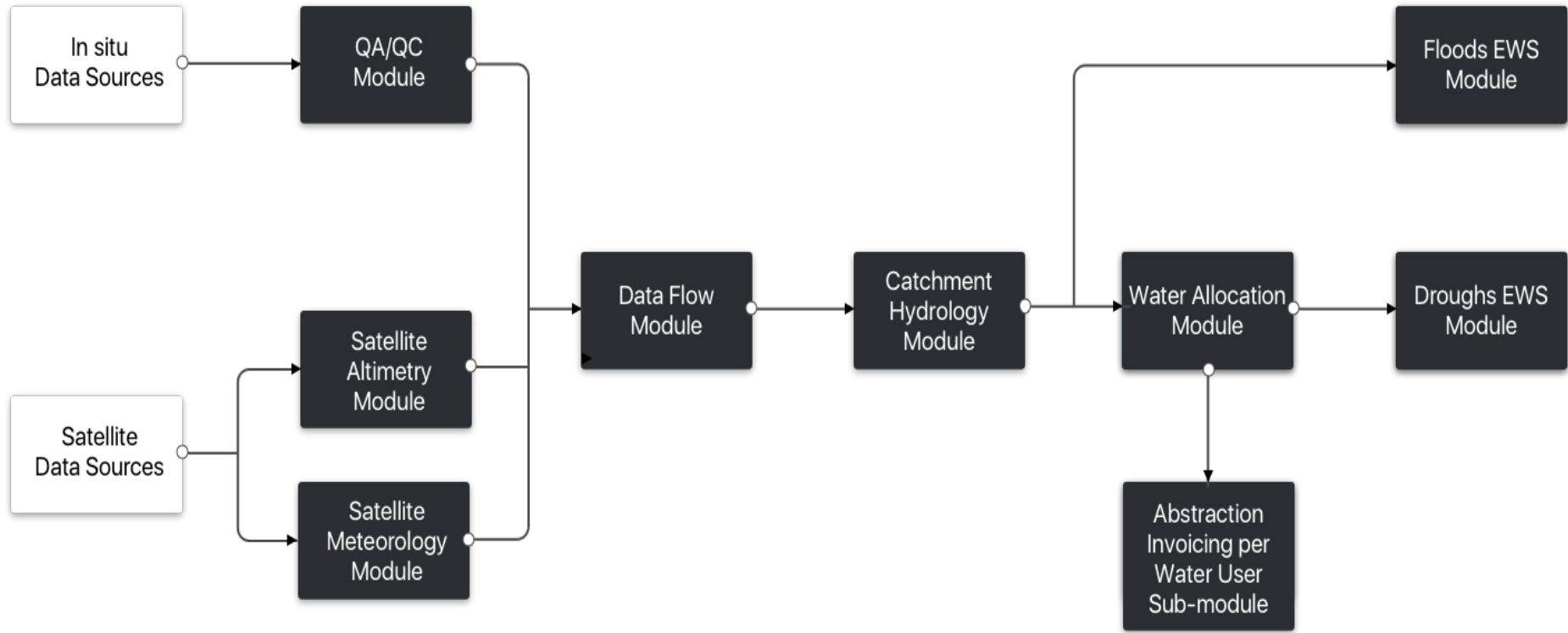
IDENTIFICATION OF DATA SOURCES





Output 1.3 Flood forecasting models, flood forecast management systems and flood risk maps are developed for each major river within Pangani and Ruvuma and Sothorn Coast Basin Contl...

DESIGN OF THE FUNCTIONAL ARCHITECTURE



Output 1.3 Flood forecasting models, flood forecast management systems and flood risk maps are developed for each major river within Pangani and Ruvuma and Sothern Coast Basin
Contl...

PHASING AND WORKPLAN														
Activities	June 2017	July 2017	Aug. 2017	Sep. 2017	Oct. 2017	Nov. 2017	Dec. 2017	Jan. 2018	Feb. 2018	Mar. 2018	Apr. 2018	May 2018	June 2018	July 2018
IWRMS System Design	■	■	■	■										
IWRMS Implementation & installation					■	■	■	■	■	■				
IWRMS Operator Training										■	■	■	■	
IWRMS Operational Service										■	■	■	■	■

BRLi provided the **system design report** in **October 2017**.

In **June 2018**, the MoWI and both Basin Water Boards (Pangani & Ruvuma SC) will have an **operational prototype** version of the application at least.

FIRST OVERVIEW OF THE IWRMS

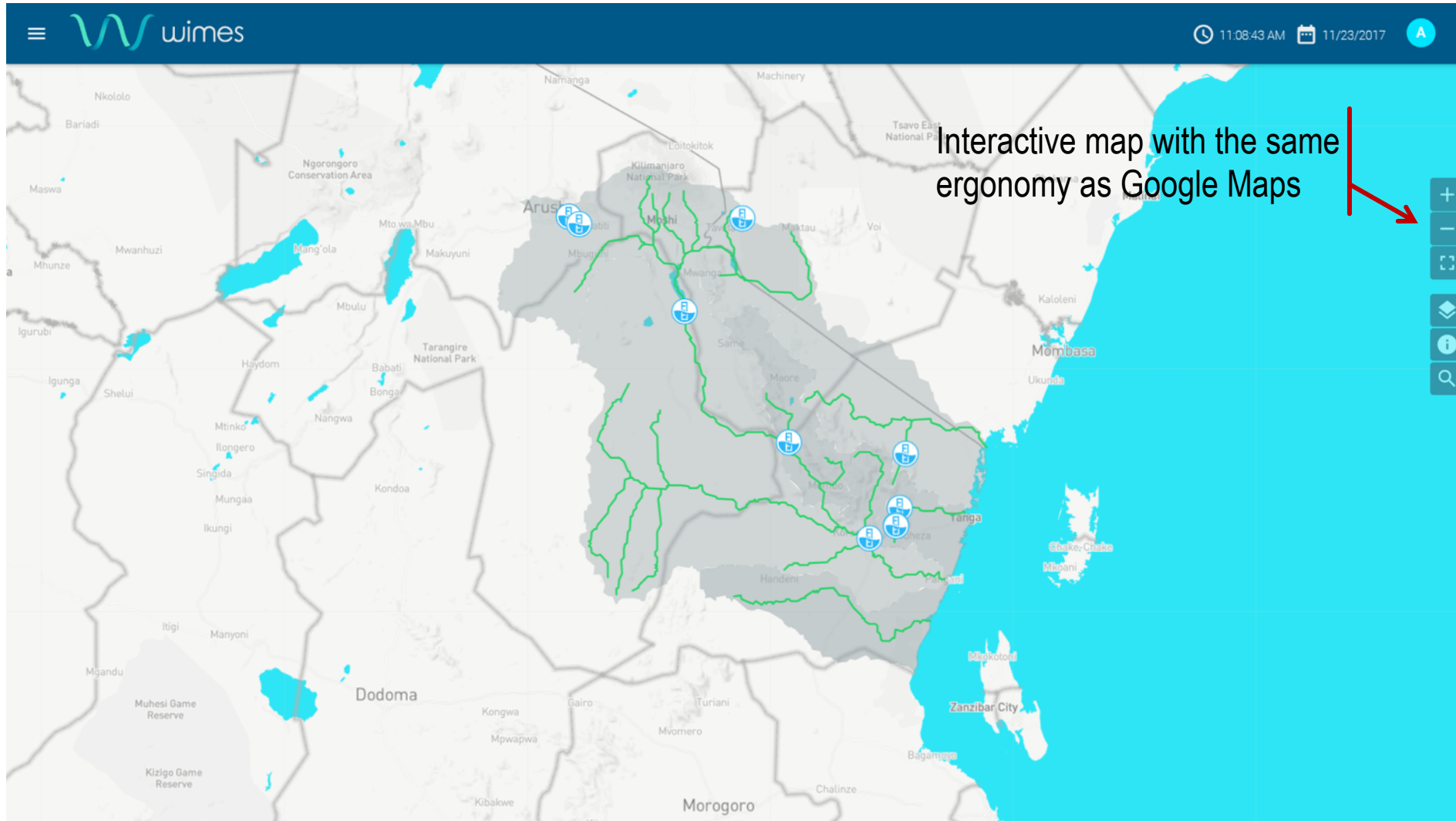


The screenshot shows the login interface for the wimes system. At the top, the 'wimes' logo is displayed on the left, and a small UK flag is on the right. The main content area is a light gray rectangle containing a white login form. The form has two input fields: 'E-mail' and 'Password'. Below these fields is a blue button labeled 'LOGIN'. A red arrow points from the text 'Secured access with different profiles of end-users' to the 'LOGIN' button.

FIRST OVERVIEW OF THE IWRMS

The screenshot shows the top navigation bar of the 'wimes' application. On the left is a menu icon and the 'wimes' logo. On the right, it displays the time '11:02:57 AM', the date '11/23/2017', and a user profile icon with the letter 'A'. Below the navigation bar is a teal header bar containing a circular profile picture with the initials 'Ad' and the text 'Admin admin@brt.fr'. The main content area features a 'Language/Time Zone' settings card. This card has a title bar with an upward arrow and two dropdown menus: 'Language' set to 'en' and 'Time zone' set to 'UTC (+00:00)'. A vertical red line is drawn to the right of these dropdowns, with two red arrows pointing from the line to the dropdown menus. To the right of this line, the text reads: 'Usability enhanced thanks to the selection of the language and the time zone by the user'. Below the settings card are two more sections: 'Main information' and 'Password', each with a downward arrow on the right side.

FIRST OVERVIEW OF THE IWRMS



FIRST OVERVIEW OF THE IWRMS

The screenshot displays the WIMES (Water Information Management and Reporting System) web interface. The main map shows the geographical outline of Tanzania with a network of green lines representing rivers and catchments. Several blue circular icons with 'R' and 'L' are placed along the river network, indicating the locations of various water level and rainfall stations. The interface includes a top navigation bar with the WIMES logo and a hamburger menu icon. On the right side, there is a 'Layers' panel with a close button (X) and a 'Background' section. The 'Layers' panel lists various data layers with corresponding icons and toggle switches. The 'Background' section shows four preview thumbnails for different map styles: RHR, Satellite, High visibility, and In progress.

Layers / background management system

Layers

- River Water Level Stations (Manual)
- River Water Level Stations (Semi-Automatic)
- River Water Level Stations (Automatic)
- Lake Water Level Stations (Manual)
- Lake Water Level Stations (Semi-Automatic)
- Rainfall Stations (Manual)
- Rainfall Stations (Automatic)
- Groundwater Level Stations (Manual)
- Groundwater Level Stations (Automatic)
- Weather Stations (Automatic)
- Catchments
- Main rivers

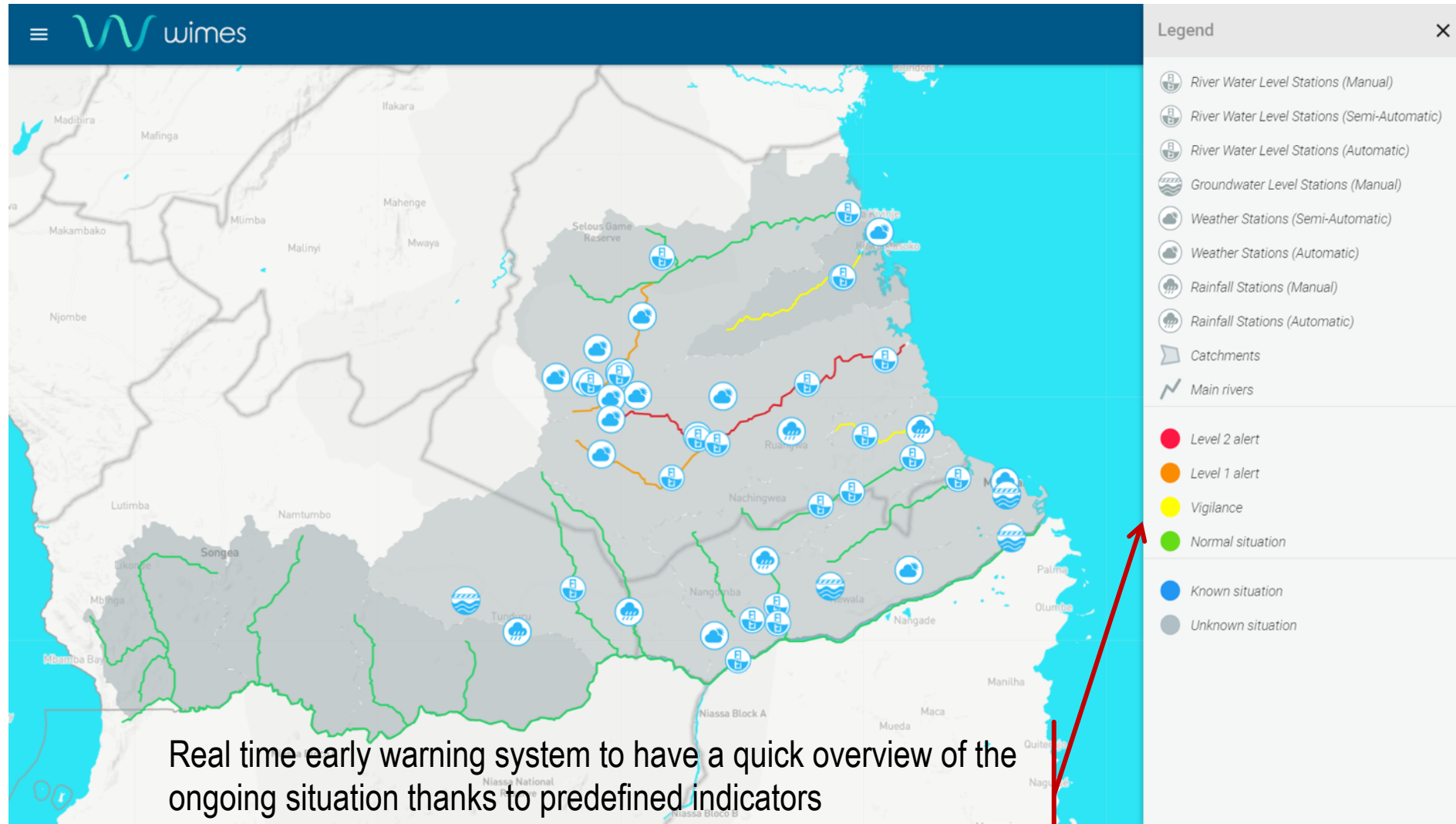
Background

- RHR
- Satellite
- High visibility
- In progress

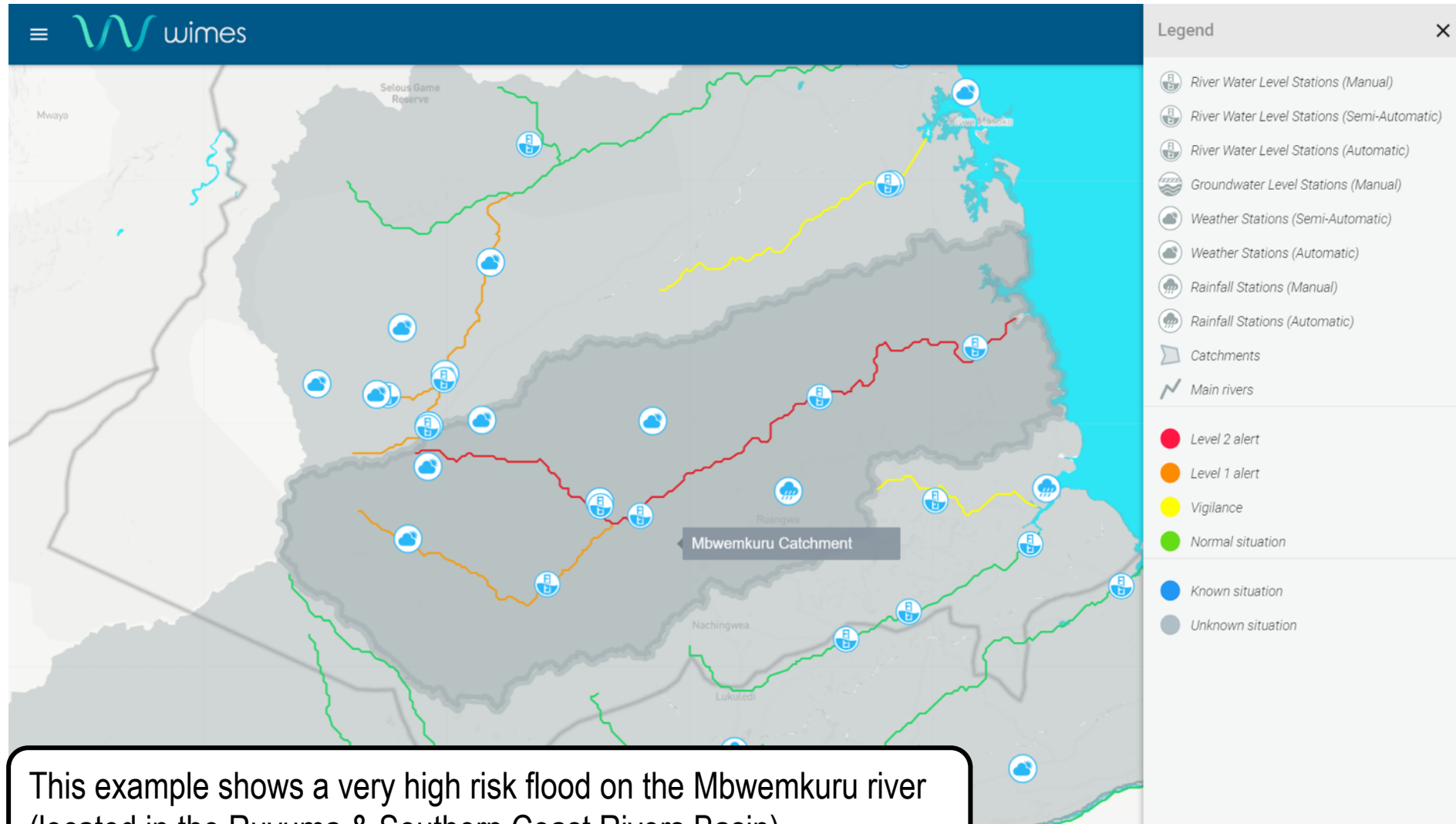
FIRST OVERVIEW OF THE IWRMS

The screenshot displays the BRL Ingénierie web application interface. On the left, a sidebar menu contains the following items: 'Pangani Map', 'Ruvuma Map' (highlighted with a grey background), 'About', 'Loader', and 'Content Management'. A yellow arrow points from the text 'A menu to change the map or to up/download data (csv or shp files)' to the 'Ruvuma Map' option. The main area shows a map of Tanzania with a network of green lines representing rivers and numerous blue circular icons with white symbols (a cloud, a water drop, and a gear) overlaid on the map. The top right corner of the interface shows the time '11:15:16 AM', the date '11/23/2017', and a user profile icon 'A'. The bottom left corner of the screenshot shows the URL 'https://wimes-tanzania.brl.fr/#/ruvuma'.

FIRST OVERVIEW OF THE IWRMS



FIRST OVERVIEW OF THE IWRMS



This example shows a very high risk flood on the Mbwemkuru river (located in the Ruvuma & Southern Coast Rivers Basin).

Each basin has its own specificities in terms of data sources, environment IT and especially end-users needs. That's why it is crucial to implement the system with a **customized solution** covering all the issues to address, from data acquisition to aid decision.

The **involvement of the end-users**, from the design to the training session, is a key to success for the system to meet their needs and for the end-users to be able to use it in normal period and in times of crisis to manage floods and droughts risks.

WIMES by BRLi is an open, modular, upgradable, scalable solution which aims to:

- Produce a tailored system fitting with the specific requirements of end-users,
- And involve end-users during the implementation.





Output 1.4 Hydrological and climate data collected from various monitoring systems is integrated into a harmonized database that is accessible to sectoral users



- Supported the data rescuing, digitization and archiving of historical data relevant for the project pilot districts including procurement of Necessary equipment.
- Equipment procured by project include iMac computers, scanners, printers, Cameras, furniture, software and printers printers,
- Data rescued included daily Rainfall, Maximum and Minimum Temperatures, Dry and Wet Bulb Temperatures





Output 1.4...cont'n

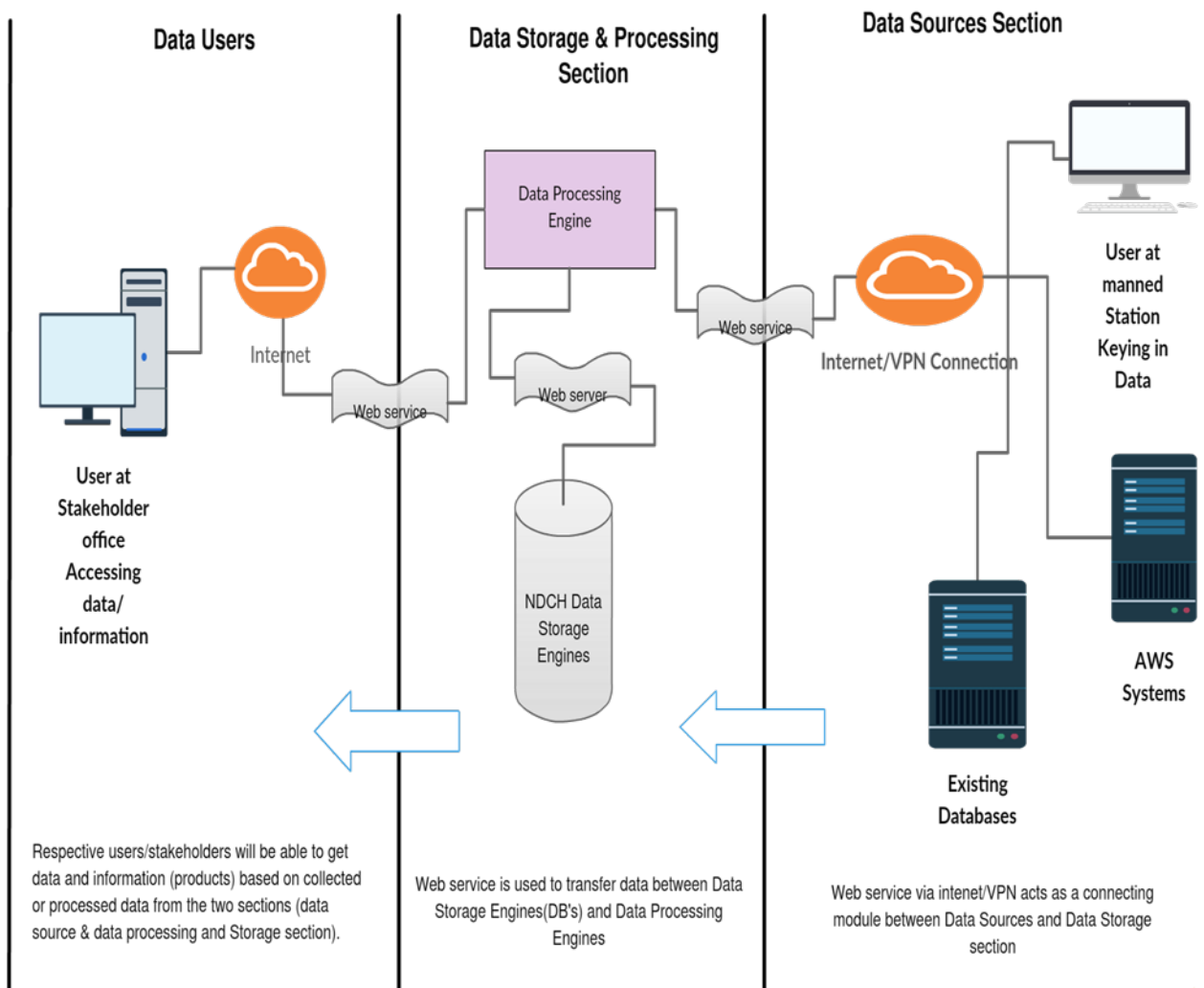
- National Database for Climate and Hydrology (NDCH)
 - The project has created a secure web based database for climate/hydro information that is relevant to the institution partners which has created a national network and sharing platform
- This has created a long term central storage of unified, clean and integrated climate/hydro information that is relevant and meaning full to be shared among the partner institutions
- Developed Standard Operating Procedure for the collection of observational data to support data collection



Partner institutions include : Prime Minister's Office as the coordinator for Disaster and risks Management, Ministry Of Water and Irrigation, Tanzania Meteorological Agency, Ministry Of Agriculture, Ministry of Livestock and Fisheries



Technologies used - Architecture



The database has been organized based on the below giant items which can be managed at different levels;

- Stakeholder
- Station
- Data sources
- Users
- Weather Elements



Accessing and using the Database



Login Screen

Home Page

The screenshot shows a web browser window with the URL `tma.meteo.go.tz/ndch/web`. The page features the coat of arms of Tanzania at the top, followed by the text "The United Republic of Tanzania". Below this is a "Welcome to NDCH" message with the instruction "Please Login to start your session". There are input fields for "Username" and "Password", and a "Login" button. At the bottom, a copyright notice reads "Copyright © 2016 - 2017 PMO - DMD. All rights reserved."

The screenshot shows the NDCH System home page. The browser window title is "Welcome to NDCH System" and the URL is `tma.meteo.go.tz/ndch/web/index.php`. The page has a dark blue header with "NDCH System" and a "Logout(admin)" link. A left sidebar contains navigation options: Home, Station Data, VAISALA Data, SEBA Data, Setup, and System Security. The main content area includes a "Welcome" message, an "Introduction" section with a list of features, and two tables: "TOP 3 VAISALA REPORTING STATIONS" and "TOP 3 SEBA REPORTING STATIONS".

TOP 3 VAISALA REPORTING STATIONS

NAME	CODE	TYPE	OWNER	More
MSOGA		3	2	View Station
MBAMBABAY		2	1	View Station
MAKETE		2	1	View Station

TOP 3 SEBA REPORTING STATIONS

NAME	CODE	TYPE	OWNER	More
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2.0 Climate information integrated into development plans and early warning systems

Output 2.1 Standard Operating Procedures for droughts and floods specifying EW codes, communications channels, roles and responsibilities and emergency procedures

- Completed hazard analysis of the two project pilot districts.
- Developed District Rural Vulnerability Capacity Assessments reports for all project pilot districts
- Developed Emergency preparedness and Response Plans
- Developed the Standard Operating Procedures (SOP) for managing drought and floods

Output 2.2 An operational emergency operations unit that coordinates EW emission and DR activities for the country, based on SOPs

- The project has established a 24/7 Emergency Operation Unit (EOU) which function as a centralized location for collecting, analyzing, prioritizing, monitoring, disseminate information, coordination and control of emergency management at the national level
- Procured the necessary equipment to support the unit. This included Computers and communication facilities.
- Developed the Standard Operating Procedure (SOP) to support the operation of EOC.
- Trained the stakeholders involved in Disaster Risks and Management of the function of the developed SOP

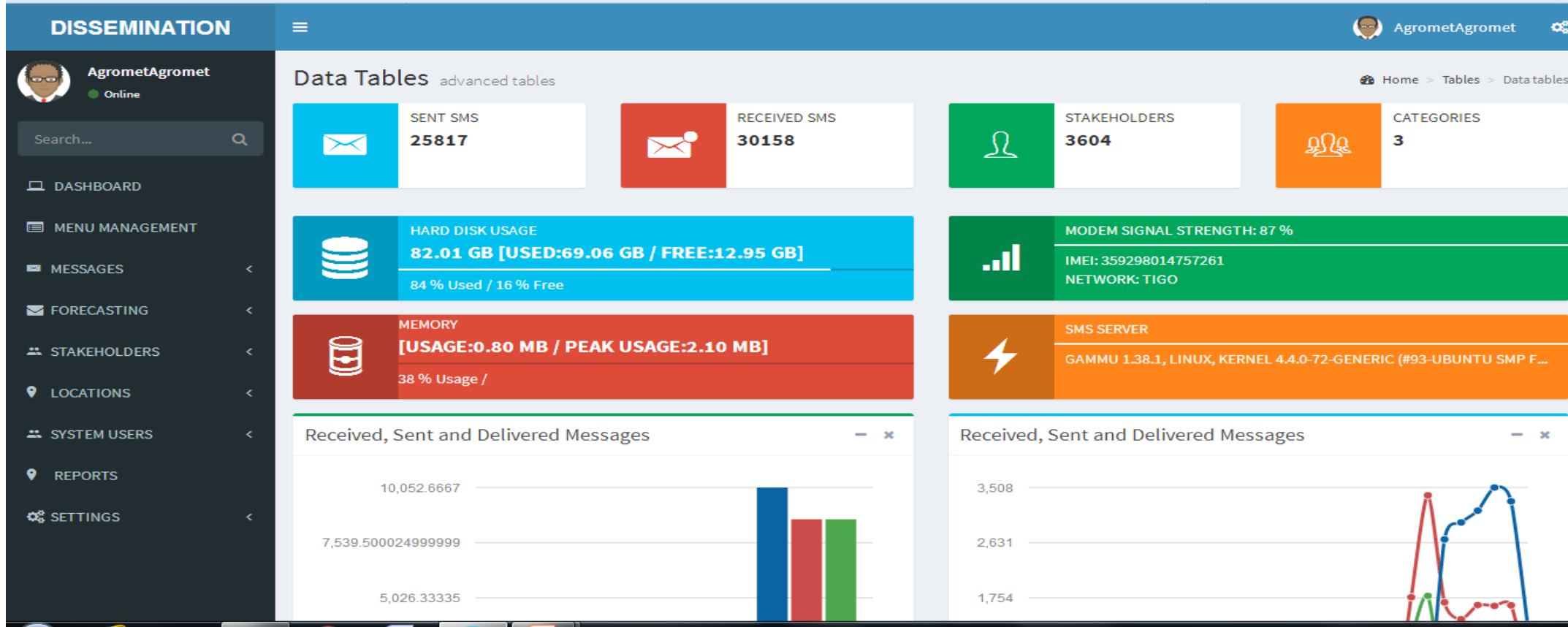
Output 2.3 One EWS simulation and adaptation planning exercise deployed in each districts generates lessons learned for upscaling and replicating

- Developed the guidelines to guide local Early Warning Systems simulation (EWS)
- Facilitated the tabletop simulation exercises in the piloted districts much emphasize was the management of droughts and floods. This created awareness and understanding of communities, Disaster Management Committees and District councils on the early warning systems and procedures to be taken
- Tested the communication pathways on the Management of Floods and drought from National to local level

Output 2.4 A crowdsourced hazard feedback platform is installed

- Established a platform of community volunteers in the pilot districts for climate information sharing and providing feedbacks on climate hazards to the end users (Community, District councils, disaster management committees etc).
- Connected 810 smallholder farmers from the pilot districts with the farmers SMS system administered by TMA for receiving weather forecast and farmers advisories.
- Trained communities on pilot districts on the importance of climate information to social economics
- The training was extended to local media, CBOs and NGOs active in the project regions.

WEATHER INFORMATION DISSEMINATION SYSTEM (FarmSMS)



Agromet and Remote Sensing
Tanzania Meteorological Agency



Communicating weather information through web based FarmSMS



Output 2.6 Climate Change and Climate Hazards included in local development plans and land use plans in Liwale and Meru districts

- The work is going on updating local landuse plans, district strategic development plans and district budget plans in light of emerging climate information, flood forecasts and economic scenarios for the pilot districts.
- The work is going on developing policy belief and collecting lessons for upscaling. This is covering the impacts of climate change on local development, summaries of climate scenarios, flood forecast and changes in the local development plans and budgets.
- Note: *These products are for decision makers and providing guidance to the planning cycles*

Output 2.7 A plan for the sustainable financing for the operation and maintenance hydro-met network is developed and nationally approved

- The following works is still going on:
 - (a) Work with TCRA on enhancing participation of cellphone operators in the EWS through regulatory reform
 - (b) Developing annual costs and benefits of maintenance of the hydro- monitoring network, including cost recovery, data services and public-private partnerships to support integration into national budget
 - (c) Developing a private sector engagement strategy for weather and climate service users, including clients like agriculture, tourism, insurance, mining, transport (ports), and partners like cell phone operators, extension services, markets



IMPACTS



Transfer of technologies for weather, climate, hydrological and environmental monitoring infrastructure



- The project has achieved the target of 75% of national territory covered by automated network.
 - The weather forecast accuracy has improved significantly
 - Perception of the public on weather services has increased – the public is very sensitive to weather information and warnings issued by TMA
 - Number of automated weather stations (AWS) have increased from 12 to 48
 - Hydrological services has improved substantially
 - Number of stations 15 hydrological stations and 15 AWS in Ruvuma, Pangani and Southern Coast Basins, this has increased the availability of Real-time data available at the basin level.

Note: The stations transmits hourly data using GPRS /Satellite and ensuring data are available for forecasting



Transfer of technologies for weather, climate, hydrological and environmental monitoring infrastructure.



- The project has established a National Integrated Database for Climate and Hydrology information. This has increased significantly chances and availability of data to the users
- The MoU for enhancing collaboration in the management and operations of hydro-meteorological stations including data sharing between TMA and Ministry of Water and Irrigation has been established
- Telecommunication infrastructure has improved

The database is providing a central, unified and coordinated information sharing platform for the stakeholders in the climate monitoring systems



Transfer of technologies for weather, climate, hydrological and environmental monitoring infrastructure.



- Meteorological Engineers and Technicians are able to do installation, calibration and maintenance of the telecommunications network.
- Modelling experts at TMA are capable to install and run Data Assimilation in WRF and generate products for use by Forecasters
 - AWSs that installed are used in Data Assimilation for improving the accuracy of the forecasts.





NWP facilities



- TMA cluster computer has the following configurations:
 - i. 16 - computation nodes; each with 2-socket, 8-core Sand Bridge Intel e5530 2.6 GHz processors, 32GB DDR3-1333 Memory, (2) 146GB 10K RPM SAS, interconnected via Infiniband (Total 192 Cores)
 - ii. 1- Master cluster node /Head node (dual-socket, quad-core Intel E5-2609 2.4 GHz, 32GB DDR3-1333 memory, 2 x 146GB 15K RPM SAS HDD) to manage;
 - iii.
 - iv. 1-IBM DS3500 Storage subsystem with 25.2 TB of storage (Raw) using 42 x 600 GB SAS 10K RPM drives.



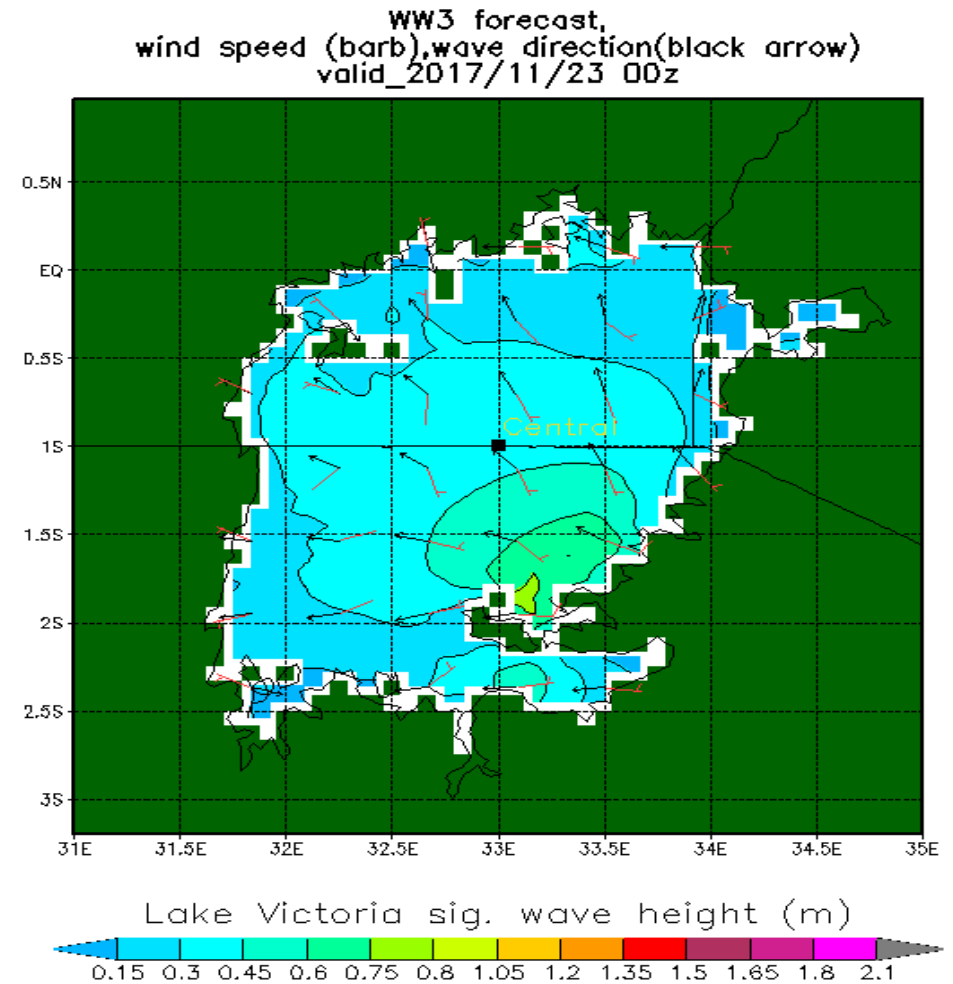
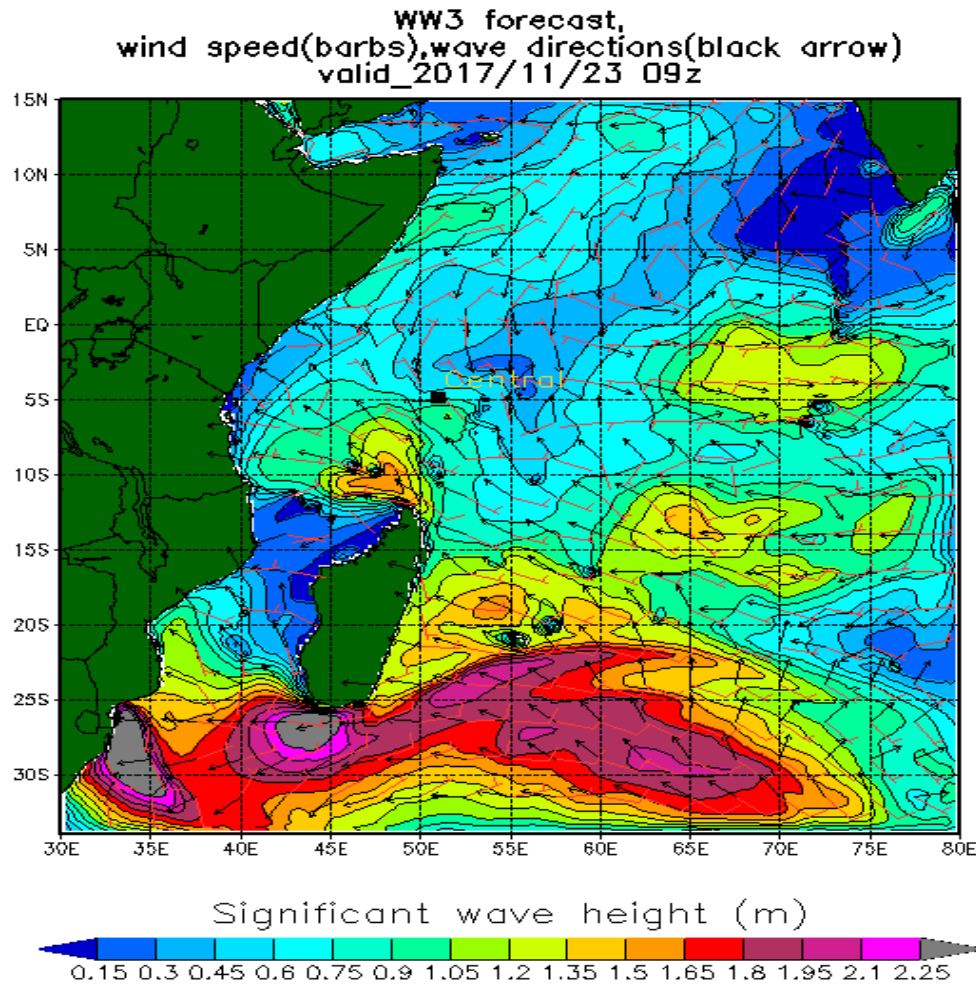
Data assimilation, objective analysis and initialization



- TMA is currently doing data assimilation in testing basis.
- The model under the data assimilation tests are WRFDA (3D-Var).
- The surface observations of 41 AWS data were used for WRFDA processes
- The model simulations was done for 48 hours in a cluster computer with 48 processors and it took half an hour to finish for East Africa domain
- The quick comparison indicated an improved forecast by WRF model with data assimilation.
- The test WRFDA sample products can be accessed on TMA website:



Operational wave model products

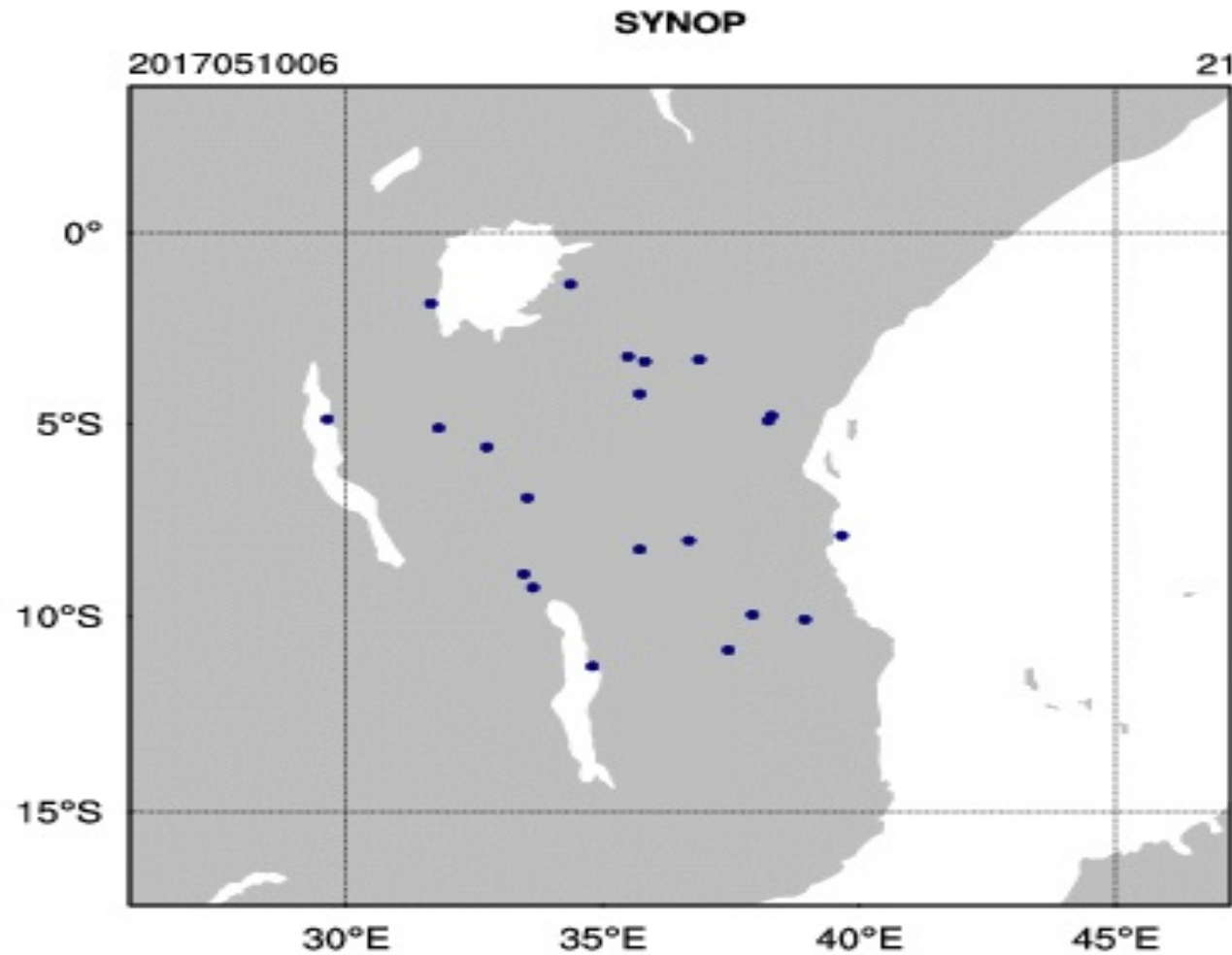




AWS observations used in WRF-3DVAR process



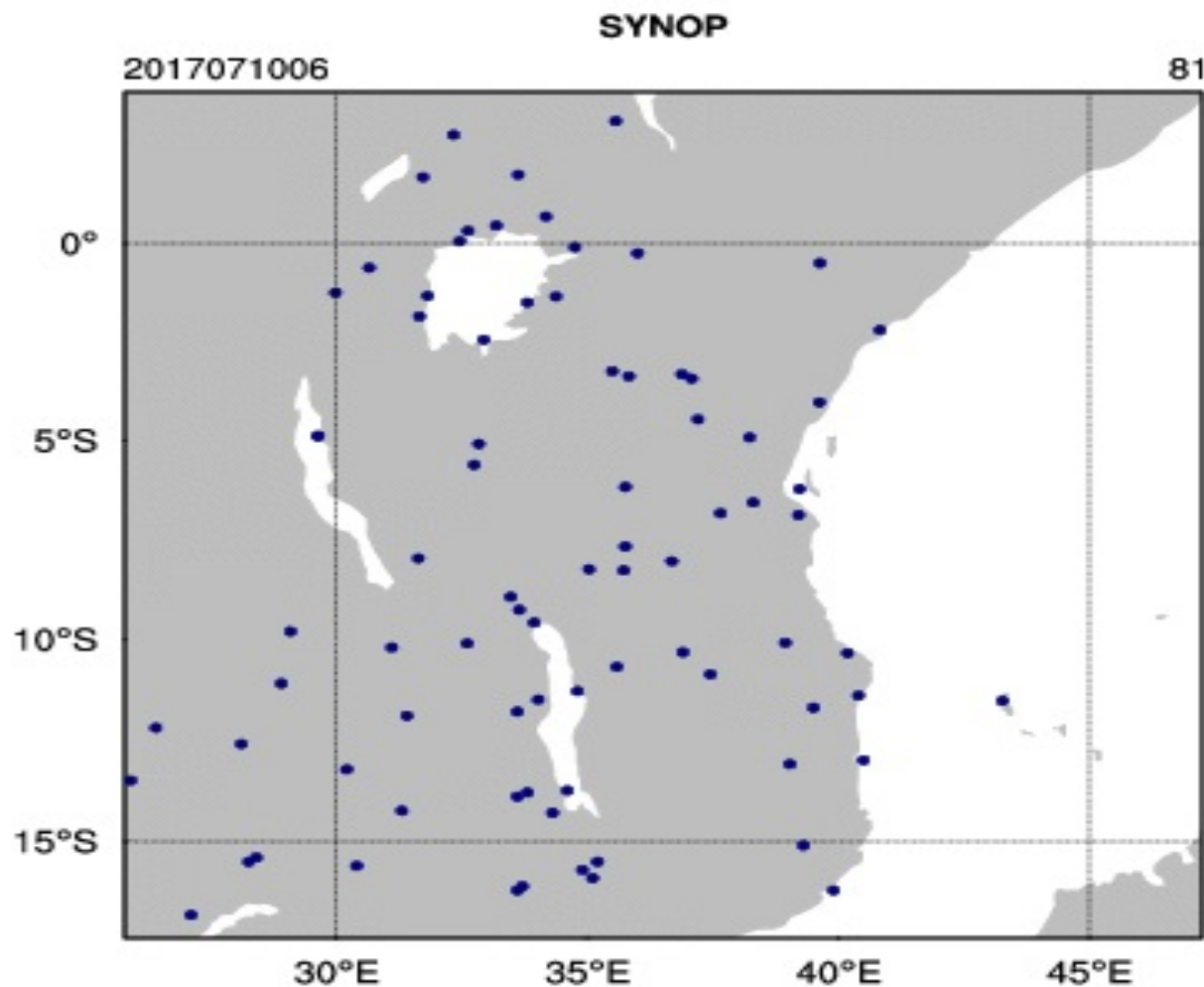
- Synoptic stations only 21 stations were assimilated





AWS and Manual observations used in WRF-3DVAR process

Regional Stations: Total of 81 stations (AWS and manual) were assimilated

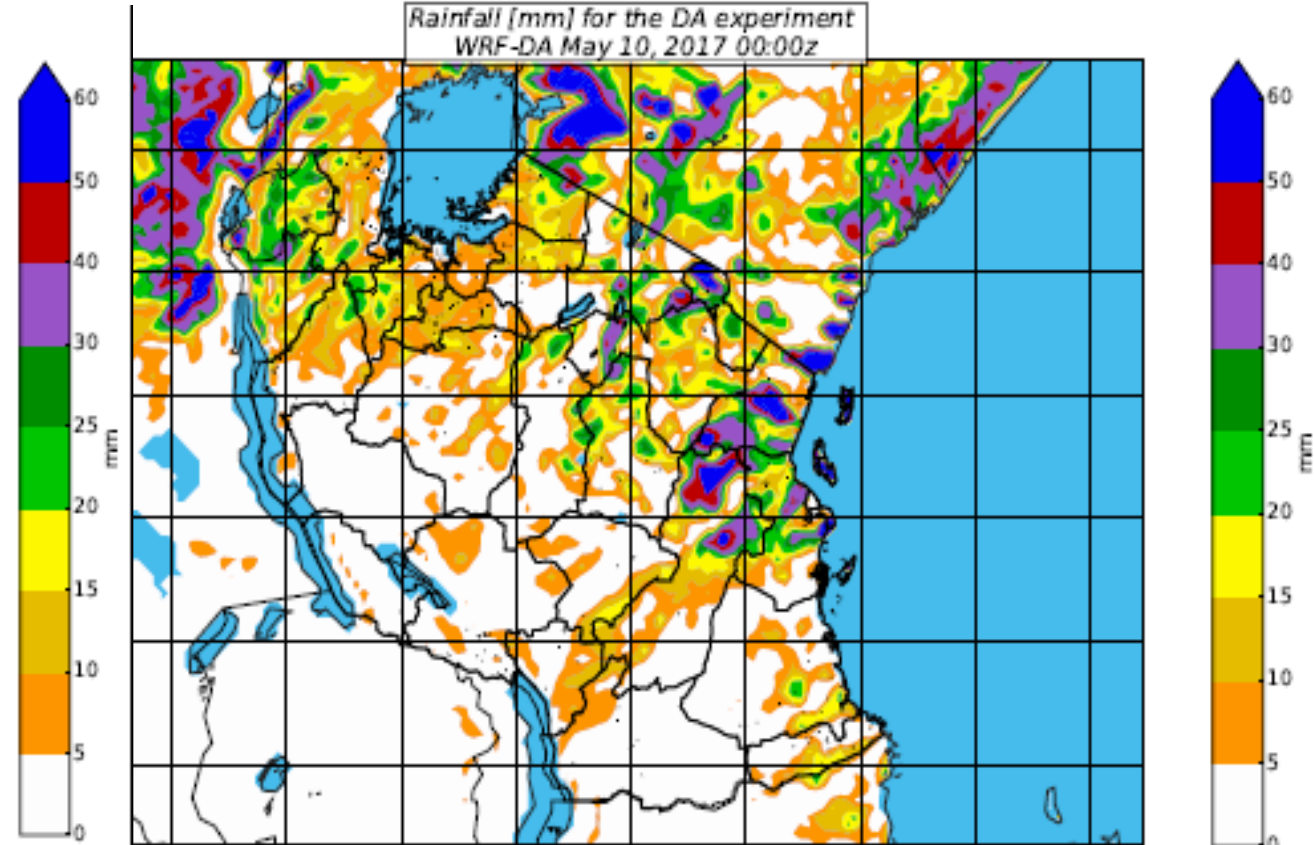
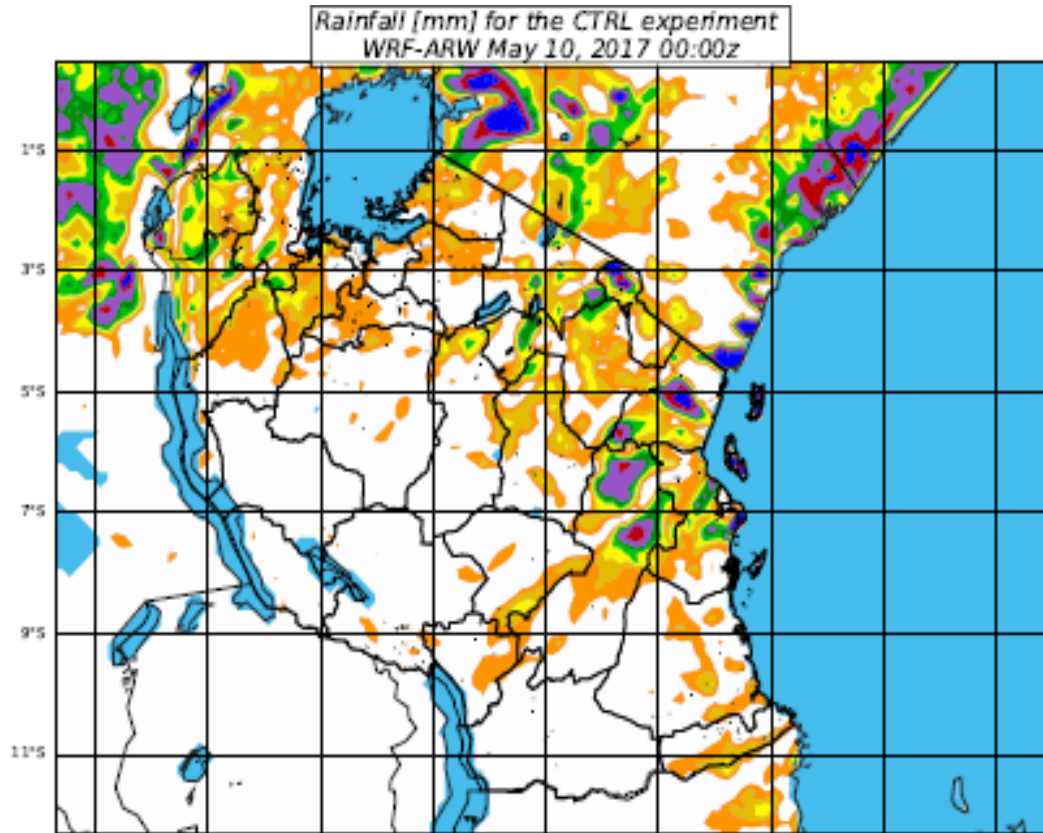




WRFDA (3DVar) Sample products



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Resilient nations.





TANZANIA METEOROLOGICAL AGENCY

REGIONAL FORECASTING SUPPORT CENTRE (RFSC) LAKE VICTORIA BASIN



WRF PRODUCTS FOR LAKE VICTORIA REGION ISSUED BY TMA

[MSLP](#) [Precipitation](#) [Relative Humidity](#) [Winds](#) [10m winds](#) [SkewT](#)

Tanzania Meteorological Agency
Ubungu Plaza (3rd Floor)
P.O.Box 3056 (Dar es Salaam - Tanzania)
Phone (+255 (0) 22 2460706-8)
Fax (+255 (0) 22 2460735/700)
E-mail:met@meteo.go.tz

LAKE VICTORIA PRODUCTS

Short-range (1-2 Days)- GUIDELINES

Forecast

- [TMA met Products](#)
- [Marine Products](#)
- [Uk met office \(Password Hint\)](#)

- [Map Day 1](#)
- [Map Day 2](#)

- [Day 2](#)
- [Tropical Rainfall Measuring Mission \(TRMM\)](#)

[Risk Table](#)

[Discussion](#)

Agrometeorology Products

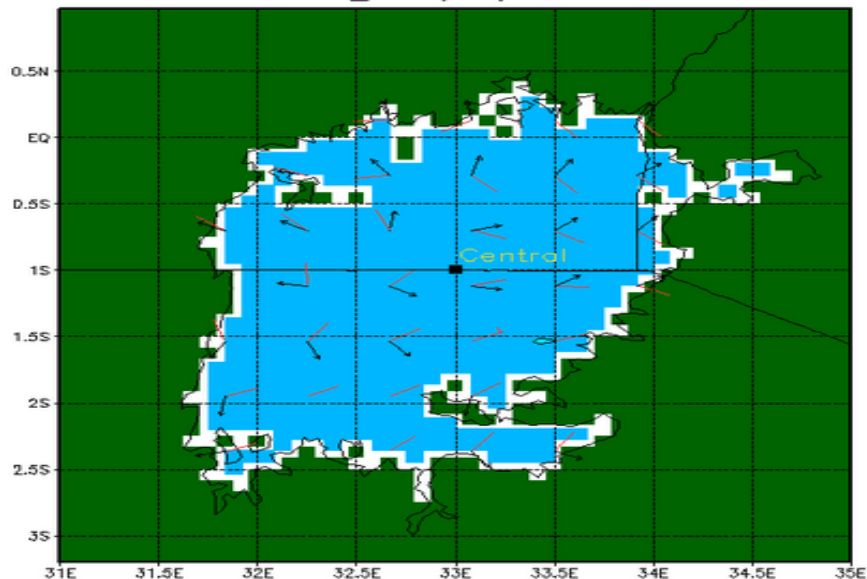
- [2 Days](#)
- [Dekadal](#)

Real Time Radar and Satellite Imagery

- [RADAR](#)
- [SATELLITE](#)

Click here to view [SWFDP Archive Products](#)

WW3 forecast,
wave speed (barb), wave direction (black arrow)
valid_2015/11/14 04z



Lake Victoria sig. wave height (m)





Climate information integrated into development plans and early warning systems



Empowered lives.
Resilient nations.

- **More residents in the targeted areas benefited from improved climate information, drought or early warnings.**
- End users from the pilot districts receive agrometeorological information for social economic activities such as crop farming and livestock keeping
- Developed Districts emergence and response plan and standard operating procedures for managing floods and droughts for the pilot districts. These are key documents in the normal district planning cycle
- Established an Emergence Operation Unit (EOU) which function as a centralized location for collecting, analyzing, prioritizing, monitoring, disseminate information, coordination and control of emergency management at the national level
- Created awareness to local government officials and communities on the procedures to be employed when the situations demand to take appropriate actions and response in saving properties and lives

The EOC is enabling the Disaster Management Department officials to make timely and effective decisions in climate and non-climate hazards. The EOC is assisting to identify potential disaster that may require a national response



Lessons Learned



Lessons Learned



- Strengthening climate information monitoring systems is very important in saving life and properties
- Involvement of relevant stakeholders in the implementations of the CIEWS project has increased significantly working relationship among the sectoral users.
 - For example Tanzania Meteorological Agency and Ministry of water has signed an MOU for enhancing collaboration in the management and operations of hydro-meteorological stations including data sharing.
- Tanzania Meteorological Agency as the National entity responsible for providing meteorological services in the country has to review its climate information strategies to ensure data collected from other stations in the country are included in the national climate monitoring system. This will improve the forecasting and accuracy including providing localized weather forecast.
- Poor communication facilities for data collection and exchange has been one of the factor that has limited access of data in the country.



Lessons Learned ...cont'n



- TMA has to consider Cost recovery for services intended for commercial purposes through engagement of private partnerships
- Establishing a mechanism of ensuring climate information awareness and outreach programs to community is critical for sustainable development
- Information sharing mechanism has to be strengthened through the development of the district disaster communication strategy that will details the requirement of the SOPs for various climate related hazards.
- The District Disaster Management Committees in collaboration with Disaster Management Department should establish SOPs for engagement with the key disaster stakeholders for climate related hazards.
- Involvement of Mobile Network Providers in improving the weather and hydrological services will promote the cost recovery strategies and provide the sustainable means of transmitting the weather/climate data in the country



Next Steps



Next Steps



- Ensuring the initiated project intervention are sustainable by ensuring the government is taking over and costs are included in the national budget.



- To develop cost recovery strategy to strengthening the meteorological and Hydrological services in the country
- Upscaling the CIEWS Project – Potential funding from GCF and Adaptation Fund
- Data processing by doing Data Assimilation using Radar Data
- **Engagement of more community radios in dissemination of weather and climate services in rural areas**