FLOOD EARLY WARNING SYSTEM FOR THE NZOIA RIVER BASIN

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KMD

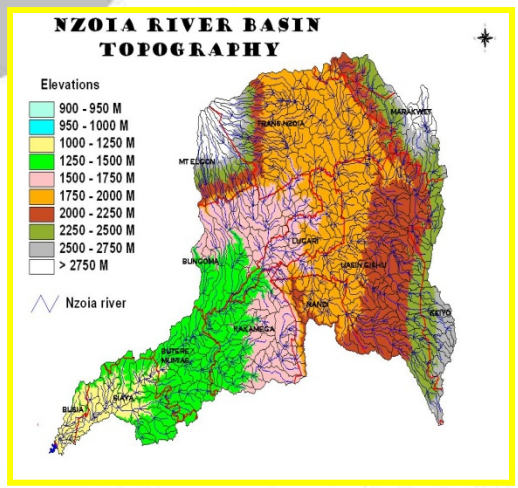
THE NZOIA RIVER SYSTEM

CHERANGANY HILLS

MT. ELGON

FLOOD PLAIN

LAKE VICTORIA



FLOODING SCENARIOS

FLOOD HAZARD

- FREQUENT FLOODS
- DYKE PROTECTION FAILURE

- Economic and social impacts of floods on the Nzoia Basin

- ✓ Structural damage to buildings, roads, communication lines, and land degradation
- ✓ Deaths of people and animals from drowning and injuries
- ✓ Displacement from homes.
- ✓ Possible outbreaks of diseases like malaria, cholera, dysentery etc due to presence of mosquitoes and contamination of water sources by the floodwaters.

- ✓ Contamination of wells and ground water which is a major source of drinking water by most rural communities
- ✓ Loss of harvests and crops in farms, loss of food stocks, supplies and produce from farms.
- ✓ Mental and physical stress (e.g. anxiety, depression, loss of security, domestic problems)
- ✓ Increased conflicts over water resources
- ✓ Nutrition problems/food insecurity- lack of food as the floods destroy food reserves

Integrated Flood Management Approach

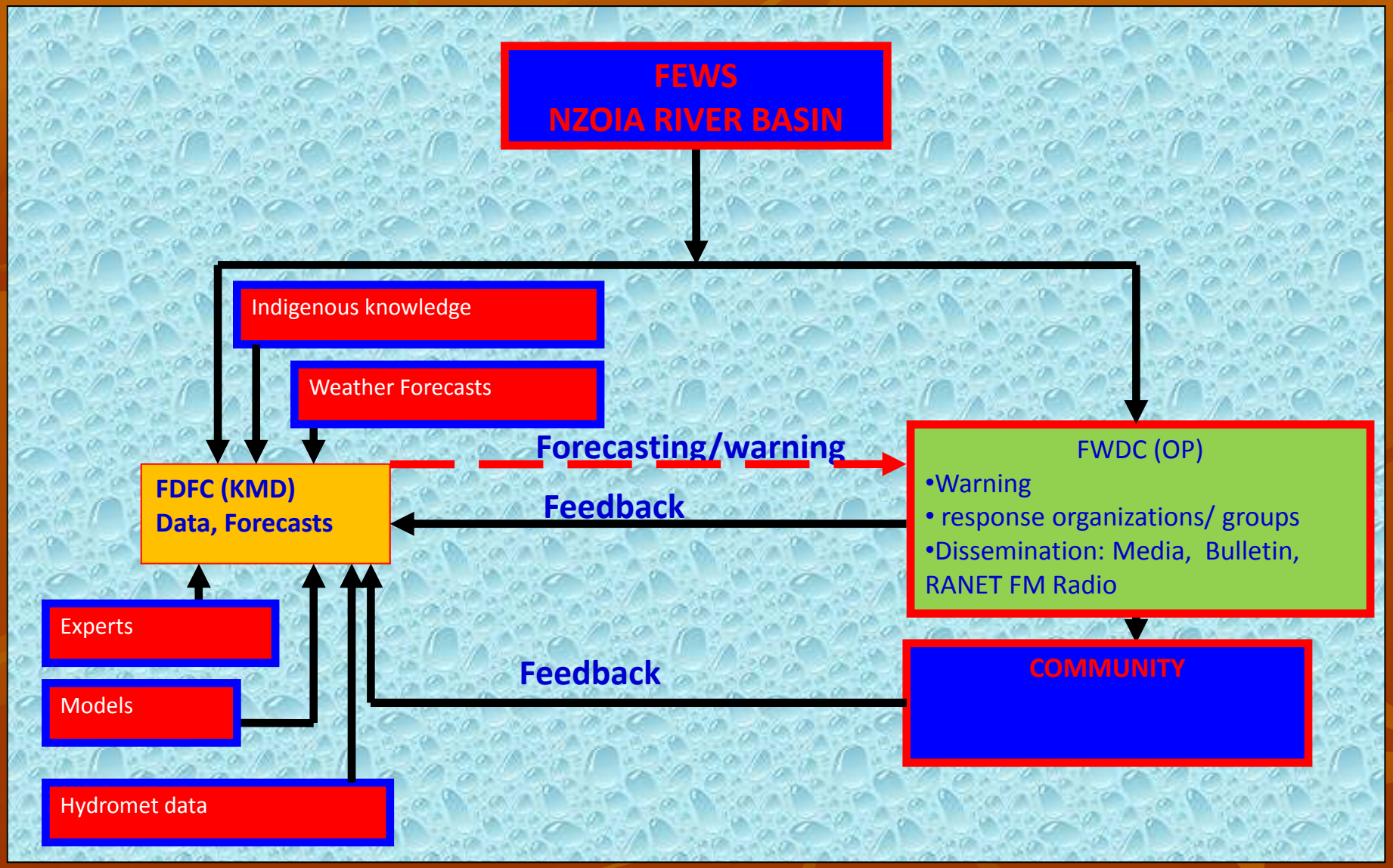
- The Western Kenya Flood Management Project was informed by the report on "Strategy for Flood Management for Lake Victoria Basin", jointly prepared by WMO/APFM and Kenya Government – Min of Water & Irrigation, KMD. A component of the Western Kenya Community Driven Development and Flood Mitigation Project (WKCDD&FMP
- Report recommended the Integrated Flood Management Approach
- Structural: dykes, river training, check dams-control of siltation, multi-purpose dams (design stage)-hydropower, irrigation, fishing
- Non-structural: Catchment management (reforestation, agricultural practices, conservation of riparian areas), community awareness and education, early warning system, clearing of channel (vegetation, sediment deposits), dyke management, poverty reduction
- Participatory: community, inter-sectoral, inter-ministerial, CBOs, religious Organizations.

FLOOD EARLY WARNING SYSTEM

Components of a flood forecasting & Warning System

1. ***Hydro-Met Networks:*** ***Weather and River Gauging Stations***
2. ***Data acquisition, processing and analysis system:***
   1&2: Real-time Flood Monitoring System-data collection: observation and rapid communication system, processing, analysis, data base management system (dbms)
3. ***Forecasting and Warning Centre:*** ***models, software, hardware, expertise***
4. ***Forecast dissemination:*** ***email, press, TV, Radio, telephone, Internet website***
5. ***Response plan***
6. ***Forecast review and development***: feedback, improvement of forecasts/warning (reach, timeliness, accuracy)

NZOIA RIVER BASIN FLOOD EWS



THE FLOOD DIAGNOSTICS AND FORECASTING CENTRE (FDFC)

The Flood Early Warning System :

(i) Set up a telemetric flood monitoring network to collect, in real-time, meteorological (e.g. flood producing storms) and river flow/flood information

(ii) Established a National Flood Early Warning Centre (NFEWC now FDFC) at which,

- (i) data will be acquired in real-time,
- (ii) data will be integrated using models to generate flood forecasts and warnings to inform decisions in flood management.

(iii) The center should

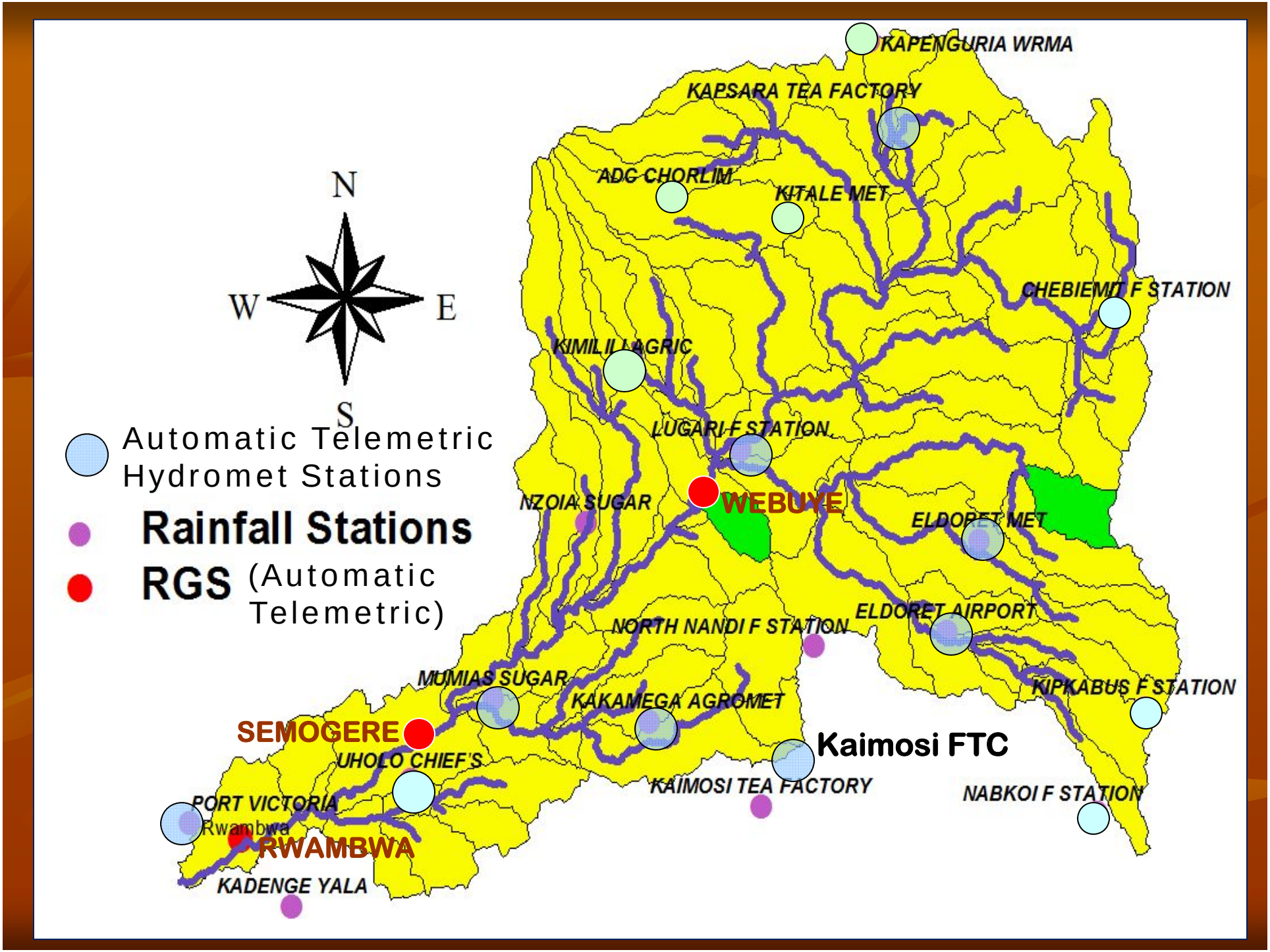
- operate 24 hours a day for 7 days a week all the year round
- have advanced telecommunications facilities to ensure access to data sources, including remote sensing technologies (e.g. satellite and radar);
- have personnel skilled in hydrology/ hydrometeorology.

iv) FDFC is located at Kenya Meteorological Department HQs: To ensure rapid access to real-time meteorological data/ Information- forecasts (QPFs), Satellite imagery, others

OPERATIONS AT THE FLOOD DIAGNOSTICS AND FORECASTING CENTRE

1. **Data acquisition**
   - Meteorological Network
   i) 35 Synoptic stations (distributed nationally, 3 are within the Nzoia Basin)
   ii) 16 Automatic Hydromet Systems & 3 Rainfall Stations within or close to the basin
   - River Gauging Network: 3 Radar Water Level Stations: Rwambwa Bridge, Semogere and Webuye;

     Method: GPRS Telemetry and Use telephone calls
   - Quantitative Precipitation Forecasts (QPF) from National Meteorological (Forecasting) Centre (NMC)
   - Satellite images - NMC


KAPENGURIA WRMA
KAPSARA TEA FACTORY
ADC CHORLIM
KITALE MET
CHEBIEMIT F STATION
KIMILILI AGRIC
LUGARI F STATION
WEBUYE
NZOIA SUGAR
ELDORET MET
ELDORET AIRPORT
NORTH NANDI F STATION
MUMIAS SUGAR
KAKAMEGA AGROMET
KIPKABUS F STATION
SEMOGERE
Kaimosi FTC
UHOLO CHIEF'S
KAIMOSI TEA FACTORY
NABKOI F STATION
PORT VICTORIA
Rwambwa
RWAMBWA
KADENGE YALA
N
W
E
S
Automatic Telemetric Hydromet Stations
Rainfall Stations
RGS (Automatic Telemetric)

REMOTE UNIT/ HYDROMET SYSTEM

Solar Panel

SUTRON 9210 Data Logger

GSM Modem

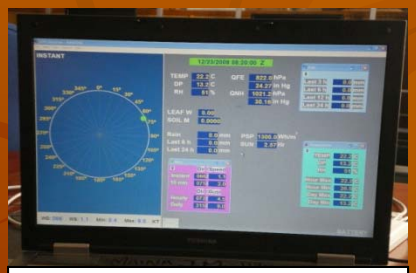
AT/RH
RG/TB
WS/WD
PYRO
BARO

GSM NETWORK

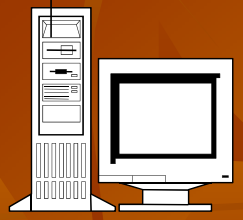
X-Connect will poll the 9210 and update the Synoptic User Interface with the newest data. Connection use radio.

GSM Network (900/1800MHz)

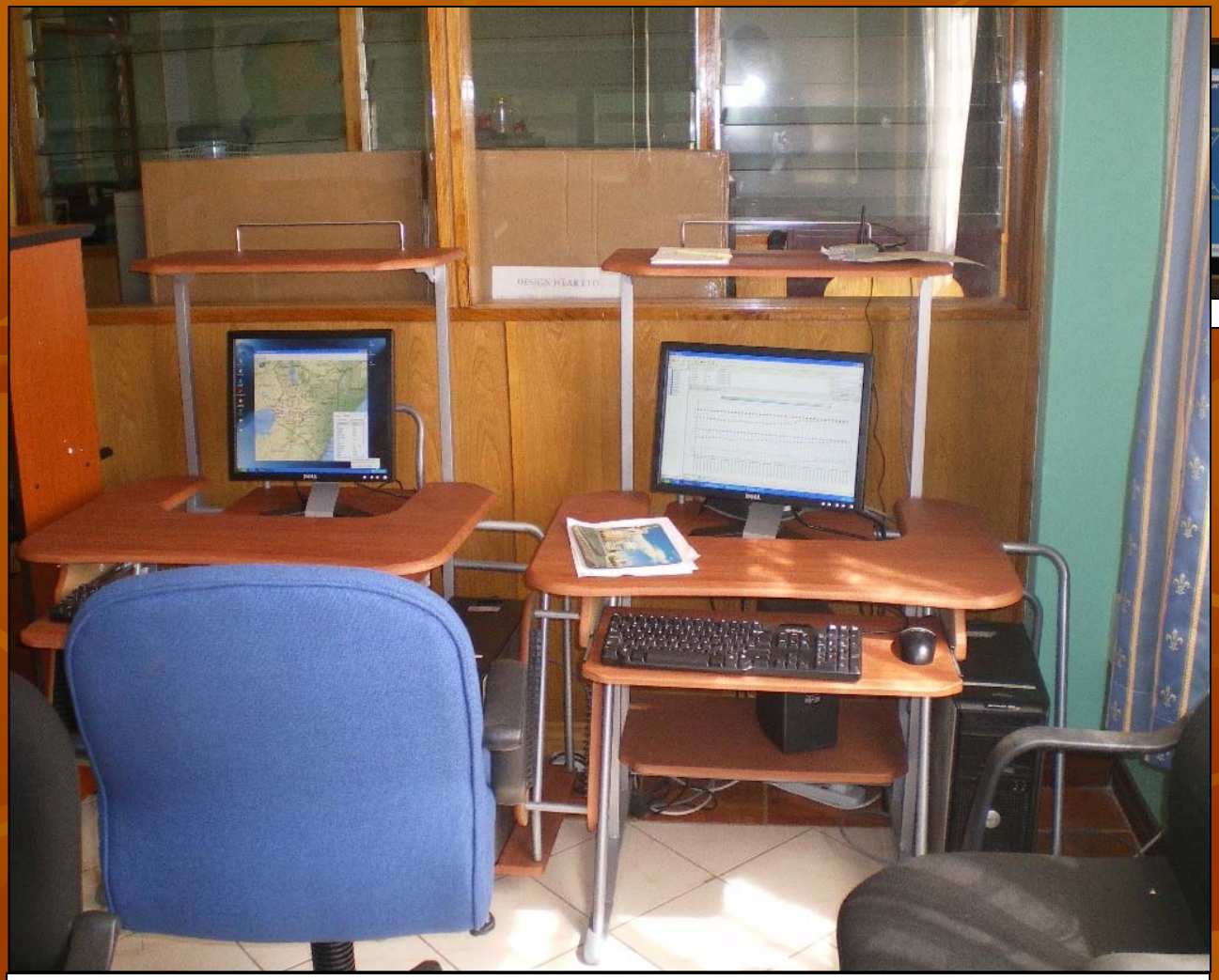
HYDROMET CENTRAL BASE SYSTEM

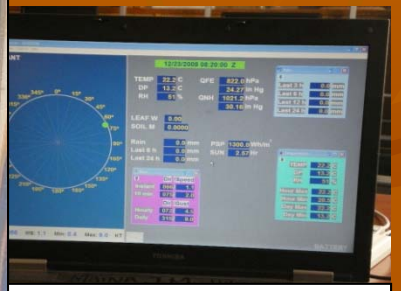


GSM Modem



BASE STATION COMPUTER





HYDROMET AND
RGS
BASE STATIONS

OPERATIONS OF FDFC (contd)

2. Data processing and analysis

i. Data entry (into database) and validation -Rainfall and water level

ii) Spatial analysis of rainfall data

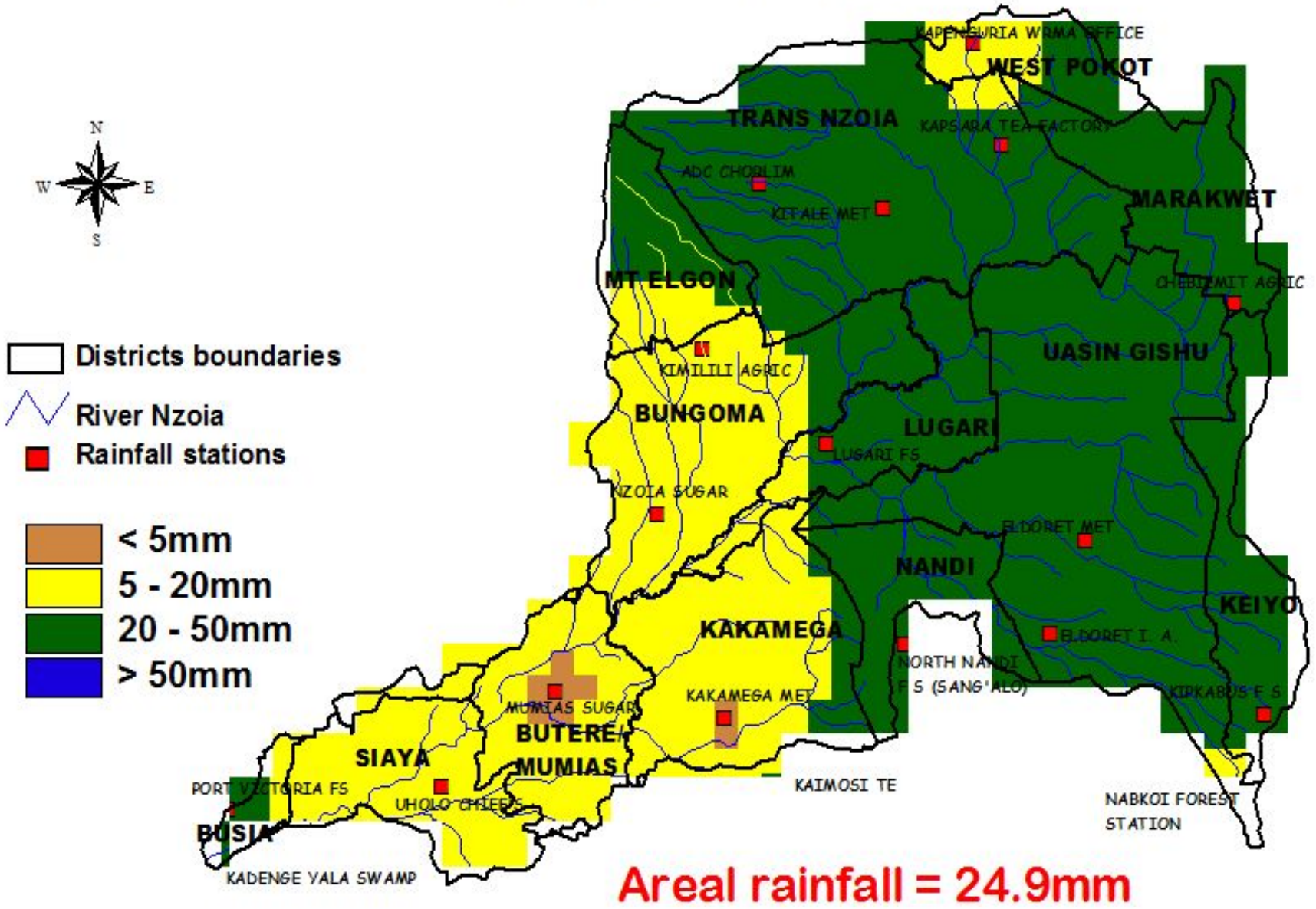
iii) Estimation of areal rainfall (i.e. spatially averaged rainfall over Nzoia river basin)

iv) Computation of river flow from rating curve

v) Compilation of **model data input** files: areal rainfall, flow, evaporation, QPF

vi) Data storage/archival for subsequent use

Rainfall distribution over Nzoia basin
06 November 2008



Areal rainfall = 24.9mm

OPERATIONS OF FDFC (contd)

3. Streamflow/River level Forecasting

i. Model in Use

- The SMAR Model with Updating. SMAR means Soil Moisture Accounting Routine

  SMAR is a Component of the Galway Flow Forecasting System (GFFS).
- Model was calibrated using rainfall, flow and evaporation data for 2000 to 2007 period
- KMD provided the MET data while the Water Resources Management Authority-WRMA & Ministry of Water and Irrigation provided flow data, rating equations

- **Other Models: GeoSFM, MIKE Flood Watch**

ii. Update input data files-

- ✓ Rain,
- ✓ Discharge,
- ✓ Evaporation,
- ✓ QPF (Quantitative precipitation Forecasts)

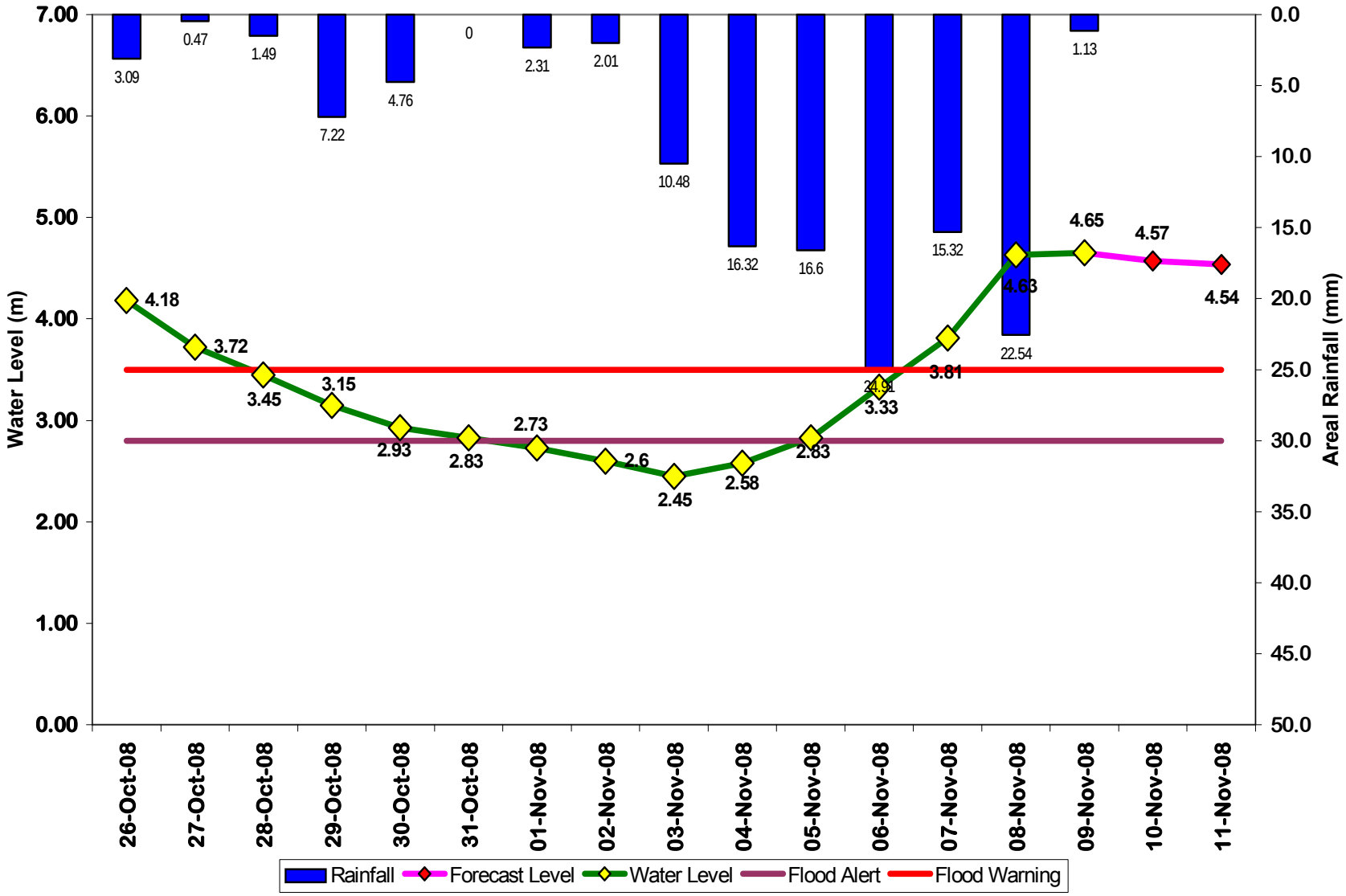
iii. Run model to obtain forecast flows

iv. Convert forecast flows to water levels

v. Prepare forecast chart

vi. Determine whether to issue flood warning or not

Forecast chart



OPERATIONS OF FDFC (contd)

4. Products presentation

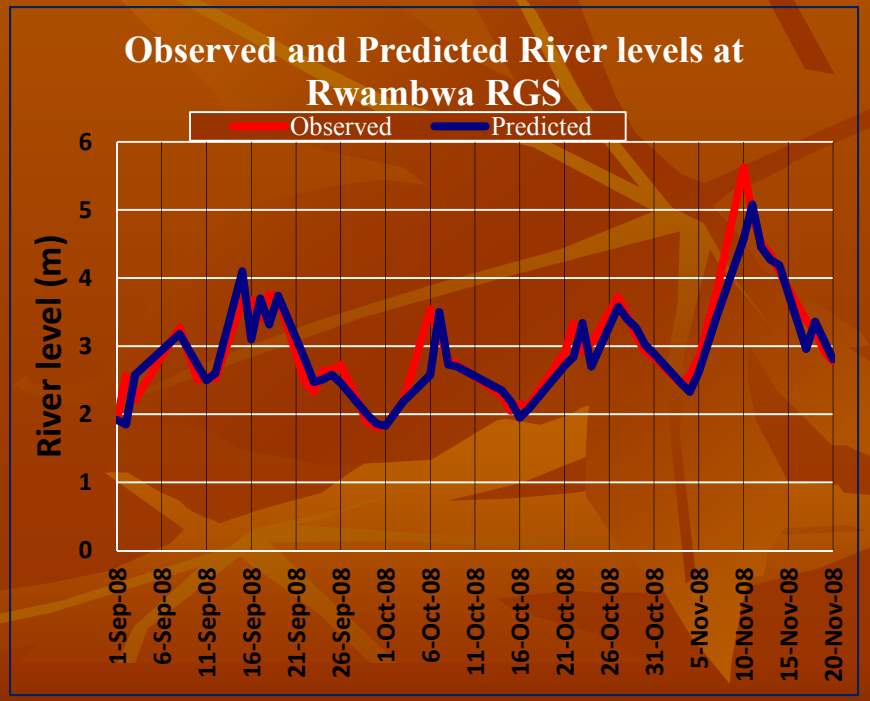
- Main and regular Products
  - ✓ Daily Flood Watch Update
    - Summary: weather forecast, observed and forecast water levels, flood risk category (colour coded)
    - Flood risk indicators in detail:
      - Rainfall distribution, areal rainfall amount and forecast
      - Water level forecast chart
  - ✓ Monthly Flood Diagnostics Bulletin
    - Summary
    - Hydrometeorological Analysis and Modeling
    - Impacts during the month
    - Rainfall Forecast, expected impacts and advisory

5. Dissemination of products/ Warnings to the Flood Warning and Dissemination Centre

Methods

- ✓ Email
- ✓ Road
- ❖ Other methods?

6. Forecast review and development



FLOOD WARNING AND DISSEMINATION CENTRE(FWDC)

USERS

- Budalang'i community
- Public
- Emergency management e.g NOC, RED CROSS: logistics, response, evacuation, relief, shelter, medics
- Private sector, media
- Government Agencies
- Civil Society – NGOs, CBOs
- Others- UNOCHA, FEWS NET

METHODS

- Mailing lists: email, fax
- Internet website
- Weather Radio – RANET
- Hotlines including mobile sms

FORMS OF WARNING MESSAGES

✓Daily Flood Watch Updates: Colour Code:

✓Green-No Flood Risk

✓Amber: Medium Risk

✓RED: High risk

✓Monthly Bulletins

Role of the Community in EWS

- ✓ **Observers**: Observe rainfall and water level
- ✓ **Communication Network**: Relay data and information to FDFC and FWDC
- ✓ **Provide Indigenous Knowledge**: integration into forecasting and early warning.
- ✓ Provide **flood information/data**
- ✓ Provide **impacts information** during floods
- ✓ Provide security for flood monitoring equipment
- ✓ Disseminate warnings in local languages e.g through the Bulala RANET FM Community Radio Station
- ✓ Community disaster and response plans
- ✓ RESPONSE TO WARNINGS

ISSUES THAT NEED CONSIDERATION

- QPFs are made available in a suitable format
- Build Capacity at the FDFC in analysis (especially ArcGIS)
- Use of various flood forecasting models
- Staffing levels necessary for 24/7 operation
- Sustainability of FDFC/FWDC
- Integration of Remote Sensing data sources - radar, satellite

THANK YOU FOR YOUR TIME

Modeling using GFFS

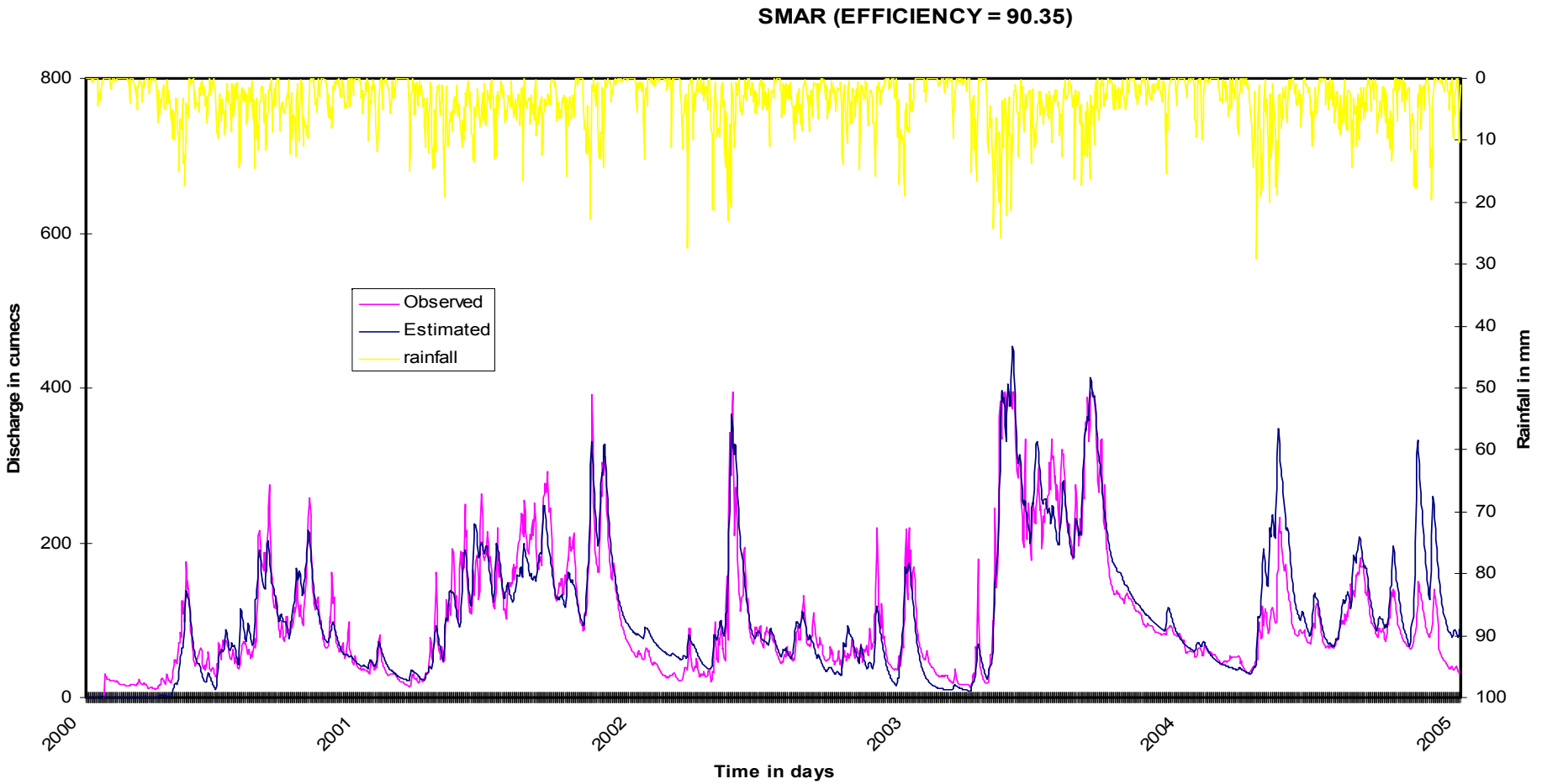
Data
Collection
Analysis
Correction
Process

→

Model
Set Up

→

Calibration
Validation

→

Model
Implementation
Flood forecasting
Flood mitigation
Flood mapping