



Limpopo Early Warning Flood Forecasting System

01 March 2017



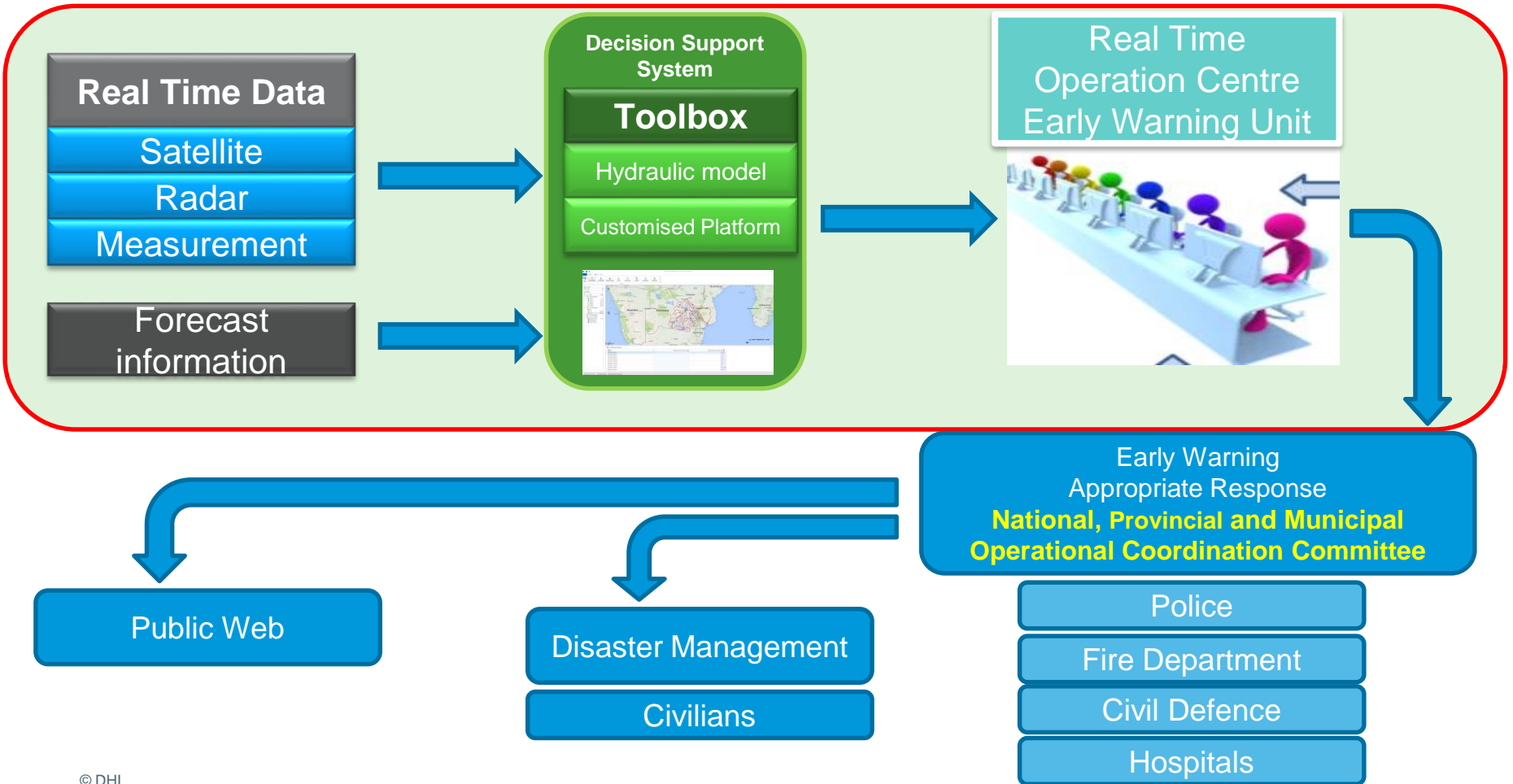
Agenda

- EWFF System Architecture
 - Mike Customised Platform
- Flood Forecasting
 - Lead Time
 - Accuracy of Prediction
- Limpopo EWFFS
 - Real time data
 - Hydraulic Modelling
 - Scenario Manager
 - Reporting
 - Verification and Validation



01. Early Warning Flood Forecasting System Architecture

EWFF System Overview





Mike customised Platform

...get the full benefit of real-time **monitoring** and early warning systems

...manage, organise and analyse large amounts of **data**



...optimise **operations** and planning

...make wise and robust water management **decisions**

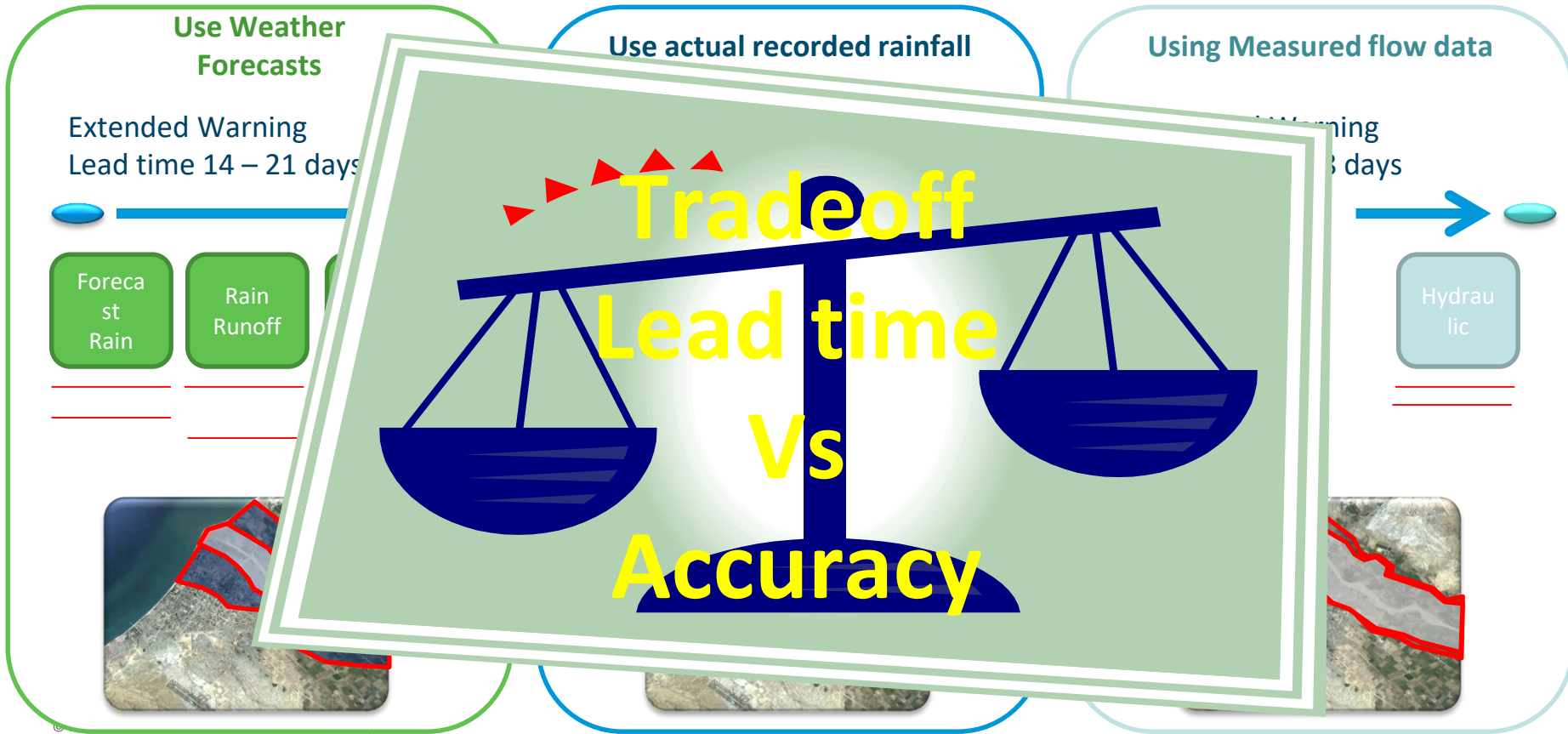


Flood Forecasting

- Flood events are generally managed by continuously monitoring waterbodies and assessing their potential for flooding in real-time.
- Where flooding is likely, those potentially affected (the public and businesses), and those protecting them (emergency services and local government) are warned, and warning recipients then act to reduce losses.
- It is typically represented as a process with component activities of Detection, Forecasting, Warning and Response



Lead time and Accuracy of prediction





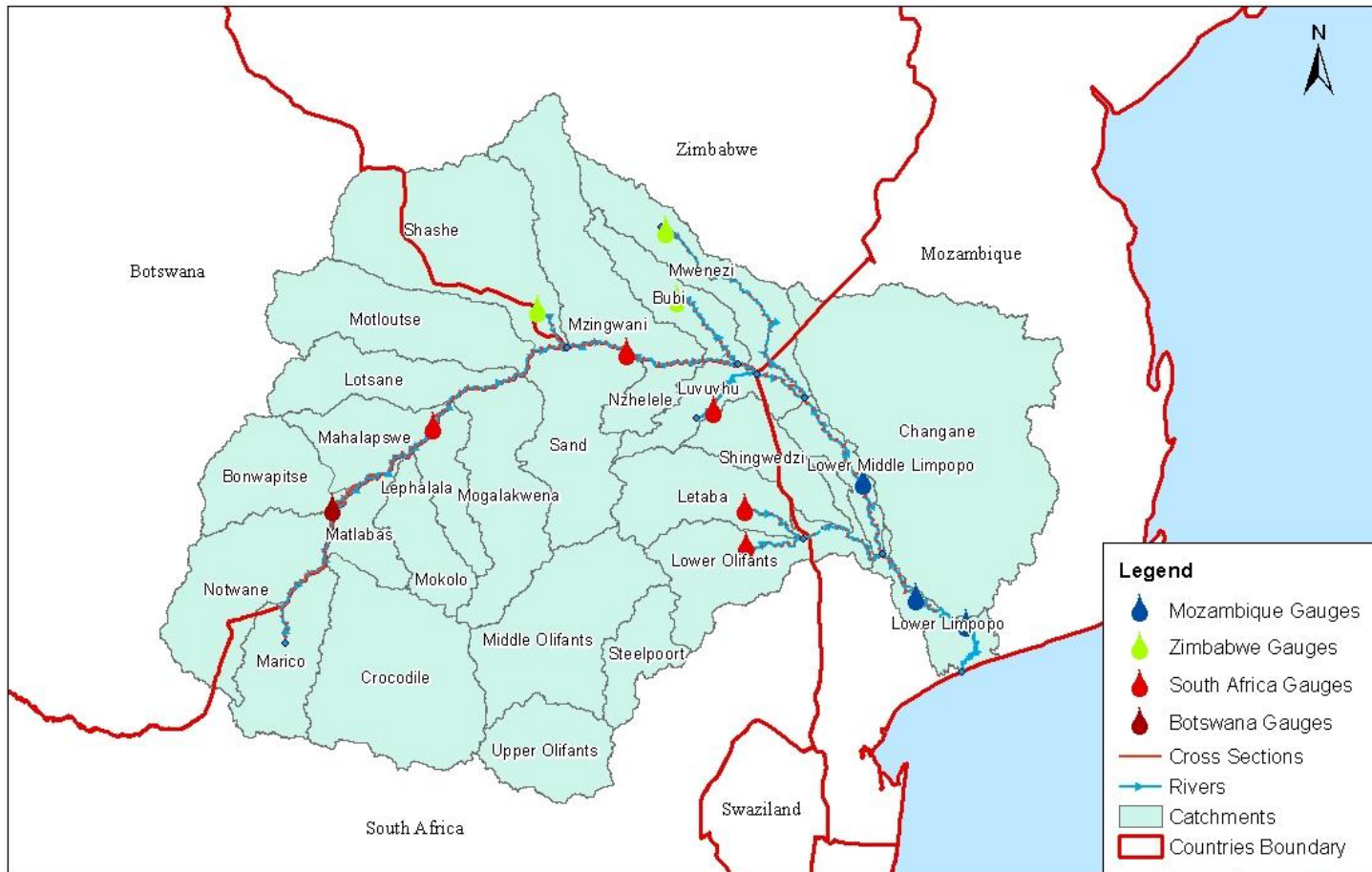
Limpopo EWFFS

- Objectives

- Establish a system to transmit near real-time data from critical flood flow monitoring points in the lower Limpopo in each LIMCOM Member State to a central server, and
- establish a flood routing model to determine the likely extent and timing of floods
- establish an early warning system that detect, and forecasting the likelihood of flood and send warning on time for stakeholders to act on time on perceived flood danger



Limpopo EWFFS



Legend

- Mozambique Gauges
- Zimbabwe Gauges
- South Africa Gauges
- Botswana Gauges
- Cross Sections
- Rivers
- Catchments
- Countries Boundary

Limpopo Early Warning Flood Forecasting

| | | | | | |
|-------------------------------------------------------|-----------------|------------------------|--------------------------------------|-----------------------------------------------|----------------------|
| Project Limpopo Early Warning Flood Forecasting | Client CRIDF | Date August 2015 | Compiled by DHI - South Africa | Projection Transverse Mercator to 29 | Scale 1:5 000 000 |
|-------------------------------------------------------|-----------------|------------------------|--------------------------------------|-----------------------------------------------|----------------------|





Real time data acquisition

- Real time data acquisition
 - Real Time Flow rates for selected gauges are stored in the MIKE Customised data base
 - link to the south Africa DWS real-time sites established
 - The GPRS system for the selected gauges have not been installed, once it is installed the data will be available in the platform
 - Real-time data are captured through the “script and job manager” of MIKE Customised and stored in a database



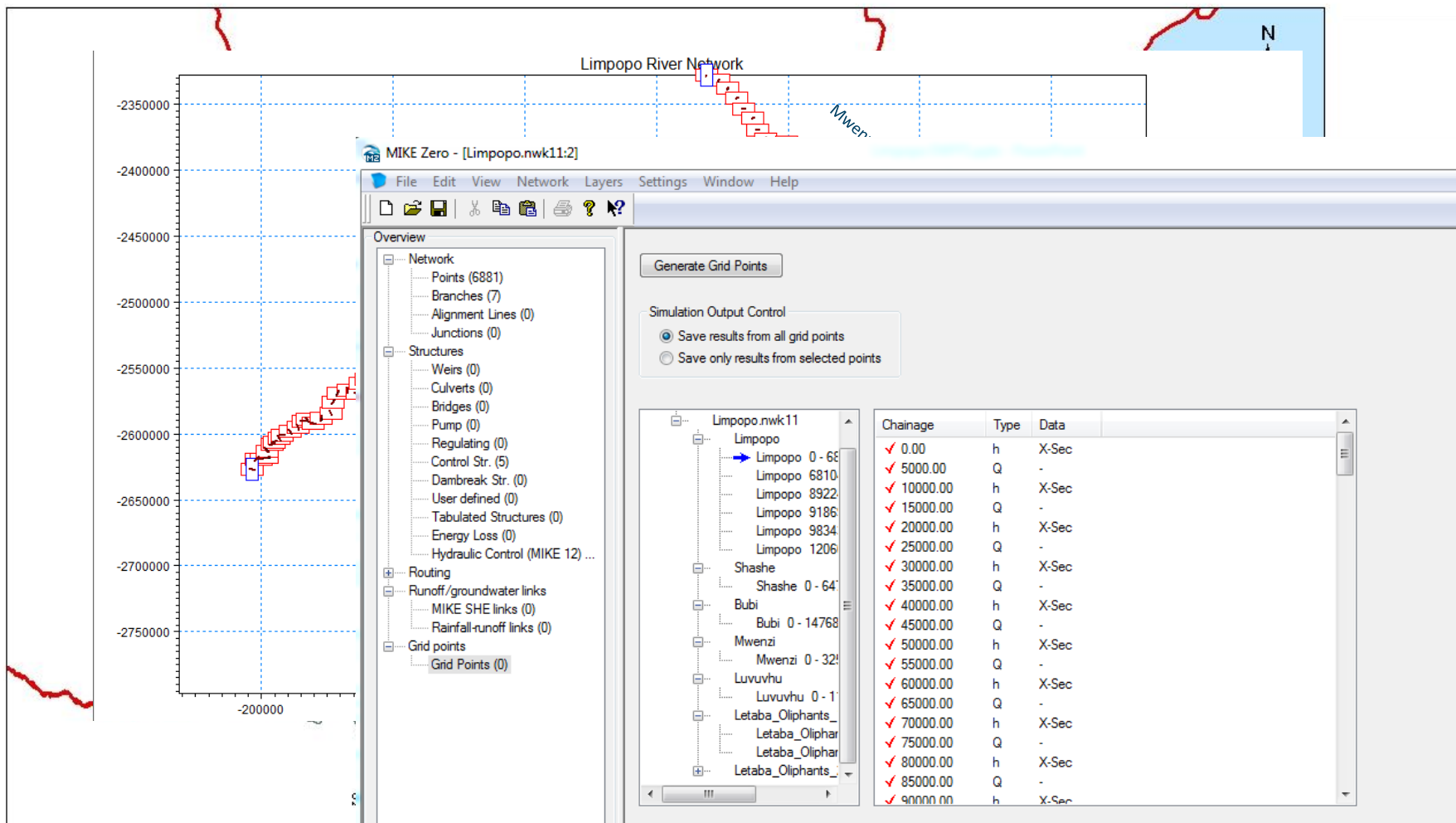


Hydraulic Modelling

- Hydraulic Modelling
 - A MIKE 11 hydraulic model was setup for Limpopo catchment
 - to route flow from upstream to downstream
 - predict the transition of water in time and space in a one dimensional direction
 - If the model is run on near real time, the model predicts downstream flood extent with certain lead time
 - Cross sections for the catchment were derived from a 90 m resolution ASTER SRTM DEM, every 10 km distance
 - However, the DEM don't represents the river cross-section very accurately
 - External boundary conditions are required at all model boundaries,
 - i.e. all upstream and downstream ends of model branches which are not connected at a junction.
 - The selected gauges in activity D02 were used as boundary files in the MIKE 11 setup, except for AH006, AH009 and E33 which was used as data assimilation points.



Hydraulic Modelling



Limpopo Early Warning Flood Forecasting

Project
Limpopo Early Warning
Flood Forecasting

Client
CRIDF

Date
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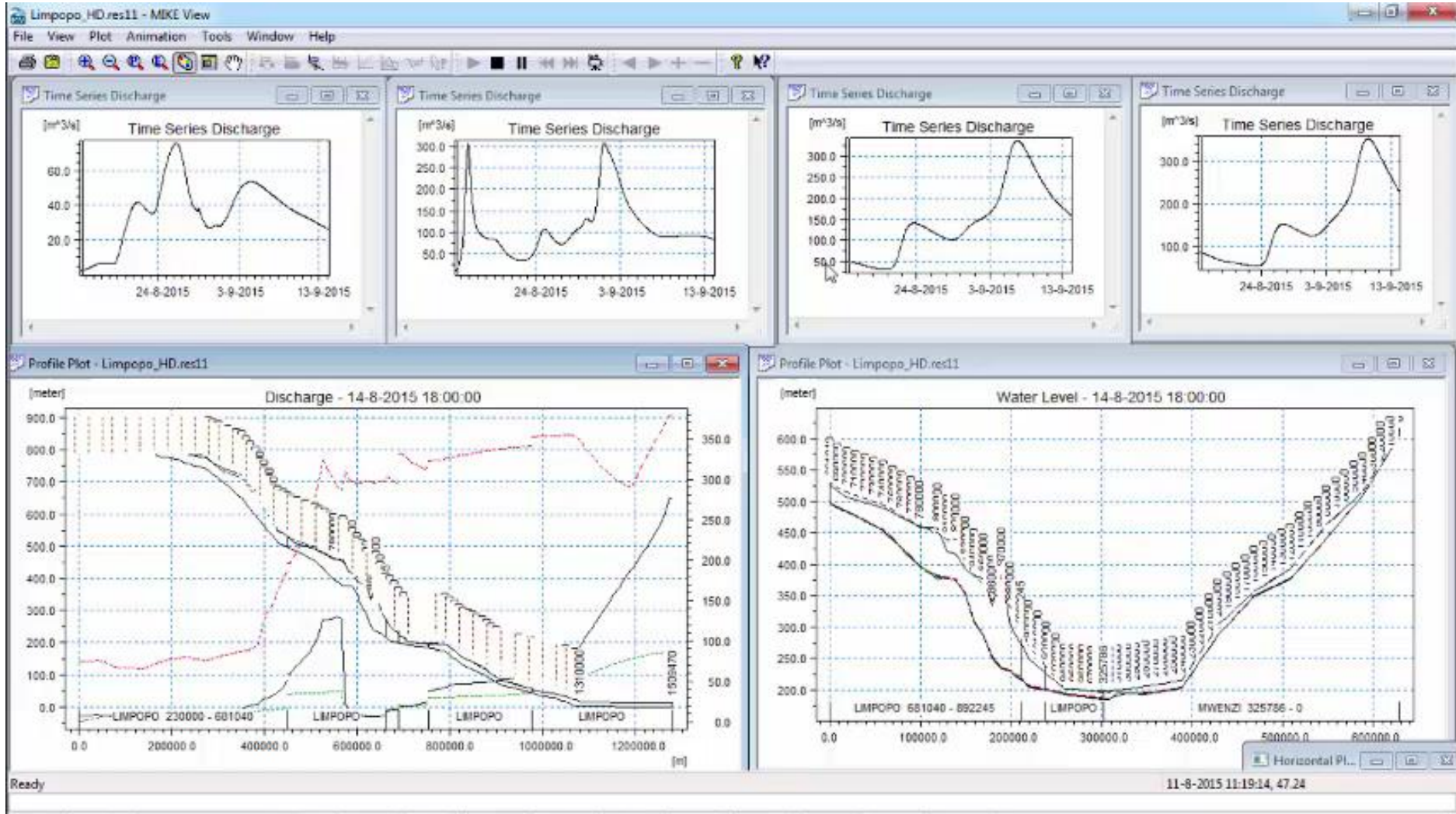
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CRIDF



Limpopo EWFFS



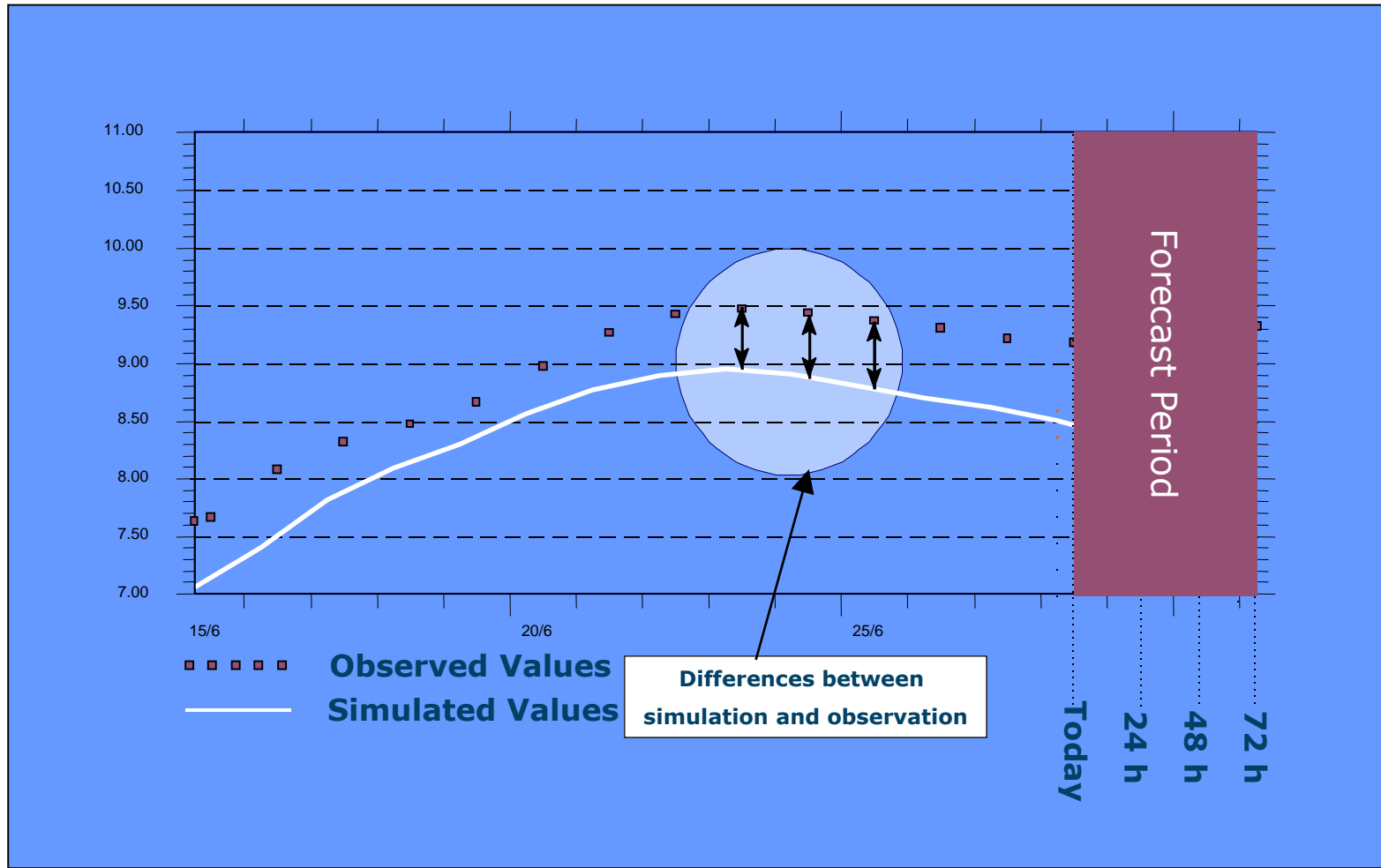


Data Assimilation

- Data assimilation
 - Data assimilation is a technique for combining any measurements of the state of the system with the model dynamics in order to improve the knowledge of the system
 - In this Limpopo MIKE 11 setup, data assimilation were performed at four points namely at AH006, A7H008, E32 (on the Limpopo mainstream) and at Massingir Dam on the Oliphants tributary

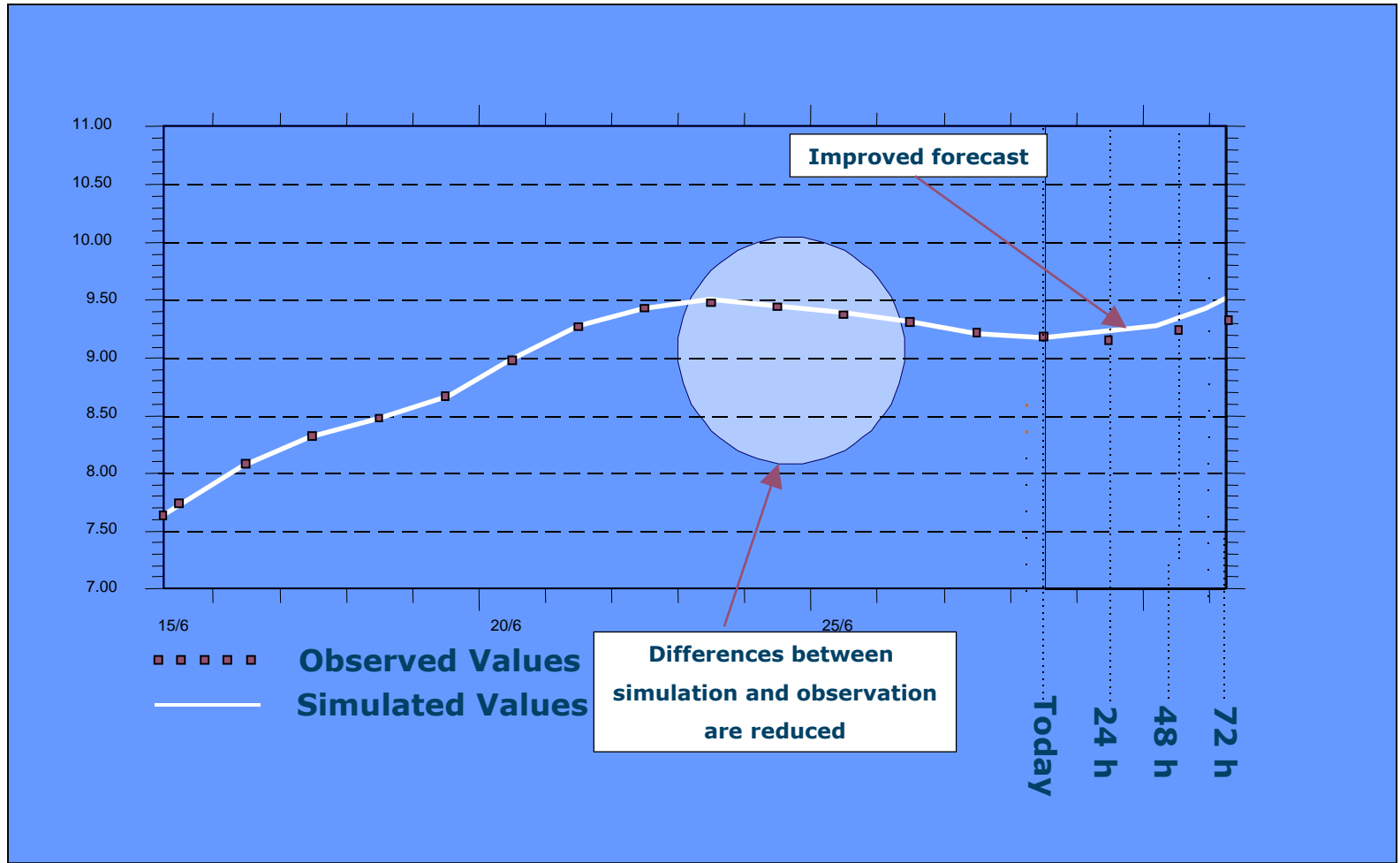


Simulation Without Updating





Simulation With Updating





Scenario Manager

The screenshot displays the Scenario Manager interface for the LimpopoFFEWS model. The main window shows a map of the Limpopo river system with various simulation points and boundaries. The left sidebar shows a tree view of the model structure, including scenarios and simulation runs. The bottom panel shows a table of model components.

| Name | Count | Type |
|-------------------|-------|--------------------|
| Calculation point | 485 | Model Object Group |
| Branch | 7 | Model Object Group |
| Boundary | 19 | Model Object Group |
| Cross section | 219 | Model Object Group |
| Structure | 5 | Model Object Group |
| MIKE 11 | 1 | Model Object Group |
| MZAdapter | 1 | Other Output Data |
| Limpopo-SIMSTAT | 1 | Other Output Data |
| Limpopo | 1 | Other Output Data |

Tools Explorer:

- ModelSetup Tools
- Stored Sequence
- Other Tools
- Data tools
 - Change-log query
 - Data Export Tool
 - Data Import Tool
 - Document Query Tool
 - Event-log query
 - Feature Class Query Tool
 - Metadata Schema Import
 - Master Query Tool
 - Script Execute Tool
 - Script Query Tool
 - Spreadsheet Query Tool
 - Timeseries Query Tool
- Gauges
- Rating curve tool
- Stored Sequence

Properties:

Model - LimpopoFFEWS

General Properties

| Description | Value |
|-------------|--------------|
| Model name | LimpopoFFEWS |
| Model tool | MIKE 11 |

Simulation times

| Property | Value |
|------------|----------|
| End Time | 8/1/1997 |
| Start Time | 1/1/1997 |

Model name: The name of the selected model.

11 setup, and
equipment
series are



Thresholds

General Thresholds are decision-making elements incorporated in a FWS to evaluate predicted or real-time hydrographs

- Gauge thresholds are defined based on
 - a flow frequency analysis of the historical observed data or
 - user defined
- Is the predicted discharge higher than a predefined critical threshold? If the answer is, an Alert/alarm is raised

The screenshot displays two windows from the 'SA Flow gauges' application. The main window, titled 'SA Flow gauges', contains a 'Threshold Definitions' table with columns for Image, Name, Color, Symbol, Size, Document Image Path, Resource Image Path, and Alert. The 'Red' threshold is selected. To the right of the table are buttons for 'New', 'Remove', 'Move up', 'Move down', and 'Messages'. The 'E 33 (Observed Flow)' window shows a table with columns for 'I...' (Image), 'Threshold', and 'Observed Flow [m³/s]'. The 'Red' threshold is highlighted, corresponding to an observed flow of 400 m³/s.

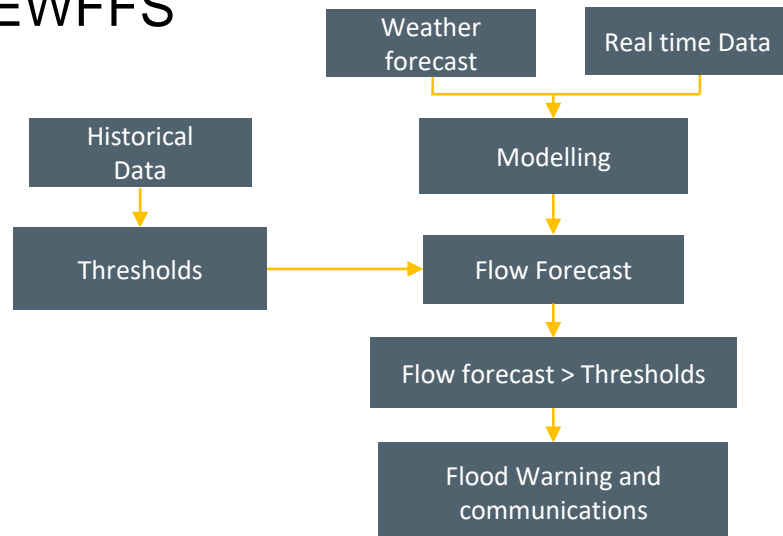
| Image | Name | Color | Symbol | Size | Document Image Path | Resource Image Path | Alert |
|-------|---------|------------|--------|------|---------------------|---------------------|-------------------------------------|
| | default | Grey | Circle | 10 | | ForecastS... | <input type="checkbox"/> |
| | Low | Light Blue | Circle | 10 | | ForecastS... | <input type="checkbox"/> |
| | Normal | Dark Blue | Circle | 10 | | ForecastS... | <input type="checkbox"/> |
| | Yellow | Yellow | Circle | 10 | | ForecastS... | <input type="checkbox"/> |
| | Orange | Orange | Circle | 10 | | ForecastS... | <input checked="" type="checkbox"/> |
| | Red | Red | Circle | 10 | | ForecastS... | <input checked="" type="checkbox"/> |

| I... | Threshold | Observed Flow [m³/s] |
|------|-----------|----------------------|
| | default | 0 |
| | Low | 30 |
| | Normal | 70 |
| | Yellow | 150 |
| | Orange | 300 |
| | Red | 400 |



Alerts/Flood warning Thresholds

- Alerts or Flood warning thresholds
 - Flood warning thresholds define river or gauge conditions at which decisions are taken to issue flood warnings.
 - Flood warning thresholds are set to achievable reasonable lead time before the flood is reached where it is perceived to cause damage
 - When flood warning thresholds are transgressed an alert or alarm is raised in EWFFS



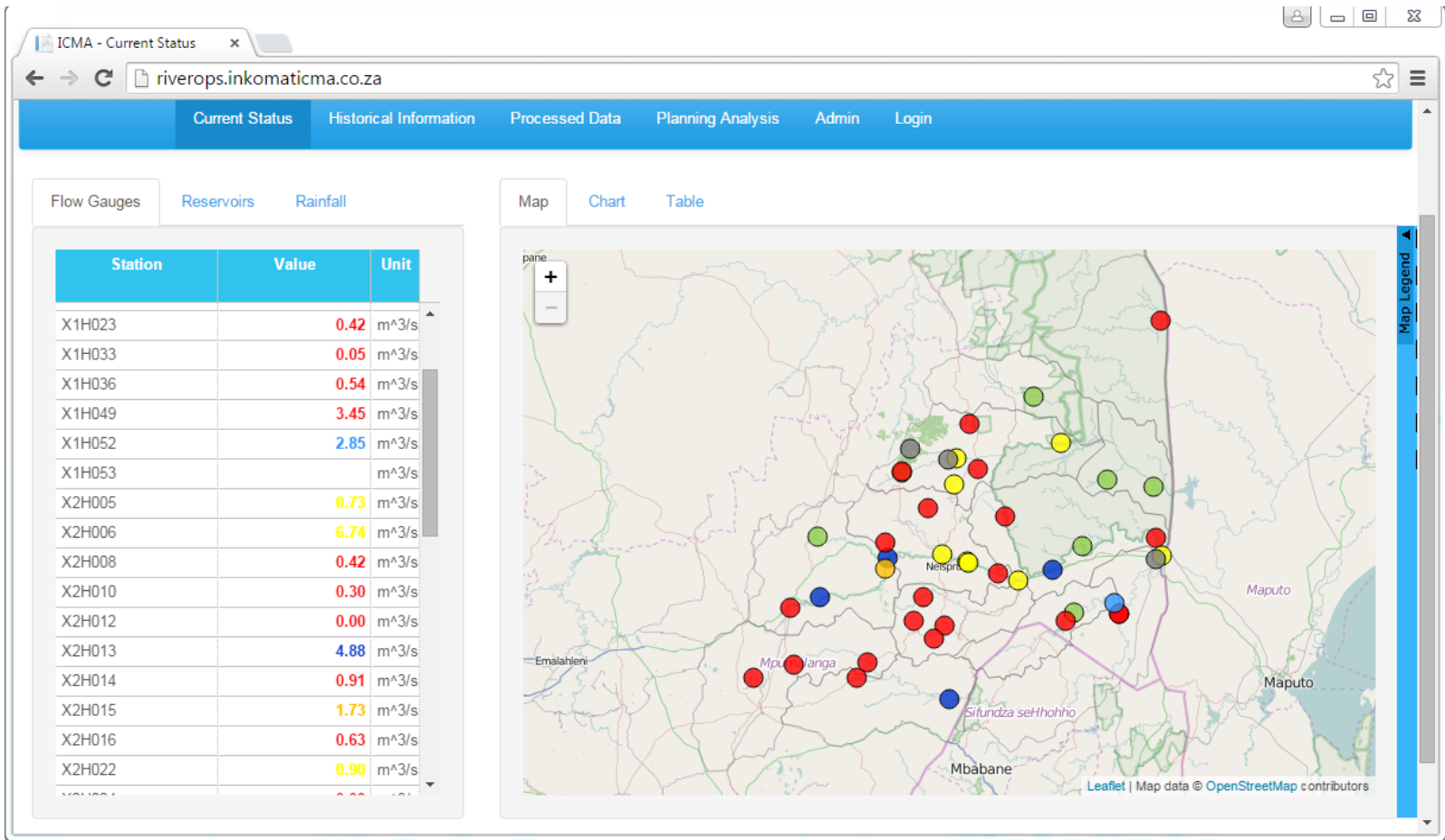


Reporting Facilities

- User interface and Reporting facilities
 - Desktop Real time User Interface – accessible by the Administrator/Operator of the system
 - Website
 - Email
 - Every daily email will be send that shows real time data information of catchment/s
 - [Example of daily email](#)
 - SMS
 - alert SMS are send to selected contacts to warn the perceived danger of flood once thresholds are transgressed (Expensive, Whats App?)



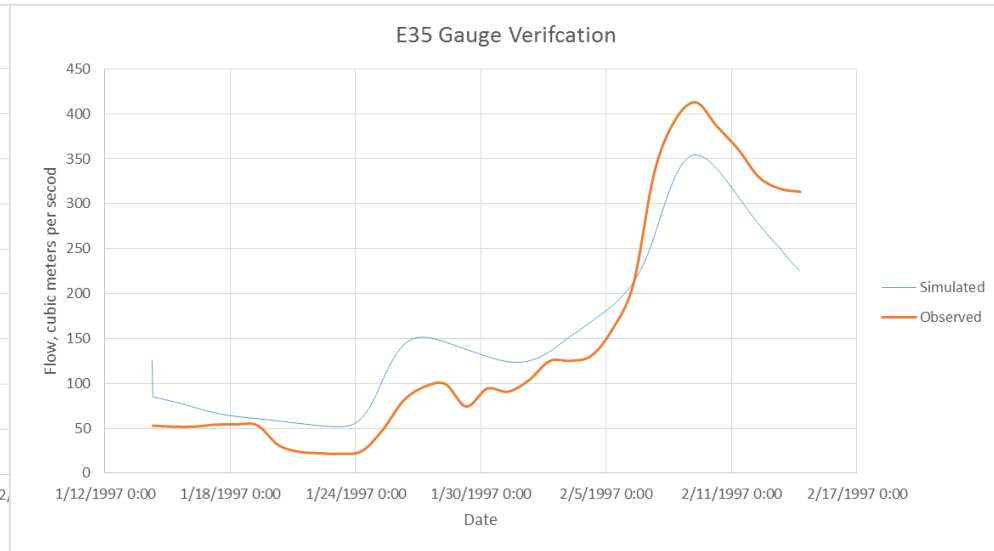
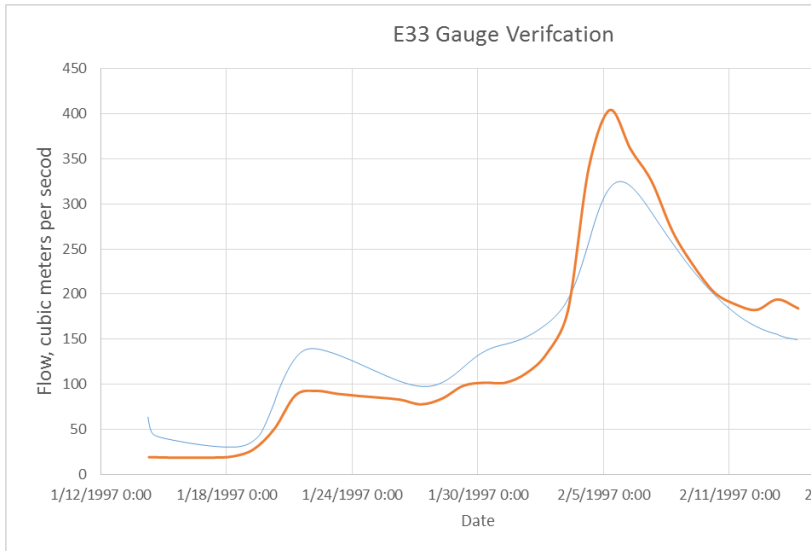
Limpopo EWFFS





Verification

- Hindcast Mode
 - Is a Validation and Verification process of the hydraulic modelling







Thank you