CTCN assistance in Thailand

Strengthening Bangkok's Early Warning System to respond to climate induced flooding

Deliverable 2.4 Design, configuration and deployment of web-based early warning system

Draft 24 August 2017

This report has been prepared under the DHI Business Management System certified by Bureau Veritas to comply with ISO 9001 (Quality Management)

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1 Introduction

An urban flood early warning system, applied for a limited, but representative catchment within the Bangkok Metro area has been developed. The system integrates the existing data-monitoring network with flood simulations. The result is an automated, operational warning system providing information on flood risk zones (extent and duration) by means of web/mobile platforms.

The document describes the state of the early warnings system installed and configured in the period March 2017 – August 2017. The report focuses on the web-reporting functionality and features. The data management parts are described in more details in Activity 2.3 and the associated report.

The dedicated software, deployed and configured in this activity, has been a part of the training session in December 2016 (Activity 3.2) and the workshop at DHI, DK attended by BMA in August 2017 (Activity 3.1).

BMA and DHI have initiated a dialogue process on how to secure maintenance and updates of the demonstration when the TA ends. The concept being discussed is a Maintenance Agreement between BMA and DHI. DHI has offered to waive all costs associated with the necessary software licenses.

2 Early warning system components and system data flow

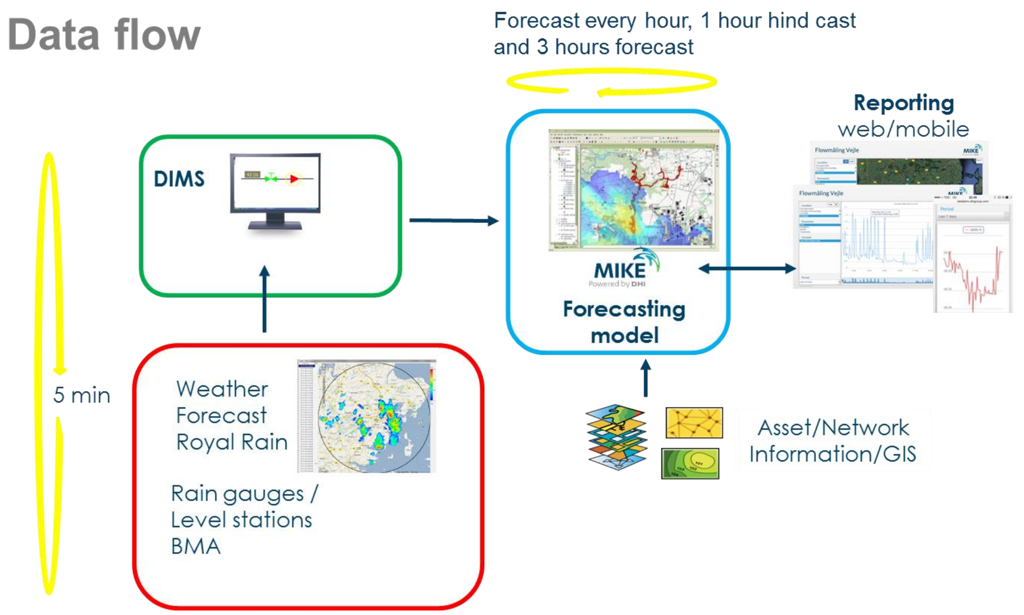

Figure 2-1 Data flow in - and system components of - the early warnings system. The system applies the two DHI software packages DIMS.CORE and MIKE OPERATIONS.

DIMS.CORE is the data repository for the early warning system. This component collects data from the BMA citywide operated SCADA system together with radar-based rainfall forecasts provided by Royal Rain. SCADA data are collected every 5 minutes, while Radar data are collected every half hour. DIMS-CORE is linked to MIKE OPERATIONS, which is a combination of a standardised out-of-the-box software product and a flexible and open software framework. The BMA installation is configured to launch flood simulation every hour. MIKE OPERATIONS builds on the MIKE Workbench data management framework. Not only does MIKE OPERATIONS offer online modelling capabilities, but it is also a versatile data management system.

The MIKE OPERATIONS features are made available through three complementary applications:

- MIKE OPERATIONS Desktop – a user-friendly desktop client, designed for users who need a quick overview of the operational system status and who need to test operational alternatives.
- MIKE OPERATIONS WEB – a web-client with a look-and-feel feature similar to the MIKE OPERATIONS Desktop but with a subset of the functionality and a focus on data sharing.
- MIKE Workbench – an advanced desktop client, designed for expert users who apply data analysis and process tools interactively and are able to configure automated workflows, scripts and custom-made data reports.

Presently, the online system is hosted by DHI servers, and BMA has access to flood warning reporting though the MIKE OPERATION WEB interface. If BMA decides to expand the demonstration system to a city wide-system, the hardware/software installations will be migrated to Bangkok. The decision, if to go system-wide, depends on different aspects, including financing options. The latter will be discussed in Activity 5.

Hardware and data collection are described in details in Activity 2.3 and the corresponding report.

2.1 Flood Reporting

Flood simulation and reporting is done by the flexible MIKE OPERATION desktop application and the corresponding web application. Main features of the configured reporting tool are described below.

MIKE OPERATIONS has an IDE-style user interface (UI) where all windows reside under a single parent window, referred to as the Shell. The Shell contains dockable and collapsible child windows, tabbed windows and splitters for the resizing of child windows. There are several types of docking windows (Views) available as follows: Time Series View, Thresholds, System Status, Table View, Chart View, Document View and Legend. Each of these Views can be docked at different locations around the map, which always remains open.

The map window of MIKE OPERATIONS (see Figure 2-1) is the focal point of MIKE OPERATIONS. The map contains the following functionality:

- Zoom Slider, which allows the user to zoom in and out on the map
- Time Slider, which is used for going back and forward in time. The ‘Play’ button is for playing the entire period automatically. The Time of Forecast (ToF) is shown above the Time Slider. In brackets, the actual selected time relative to Time of Forecast appears.

A google map is used as the background map in this version of MIKE OPERATION.

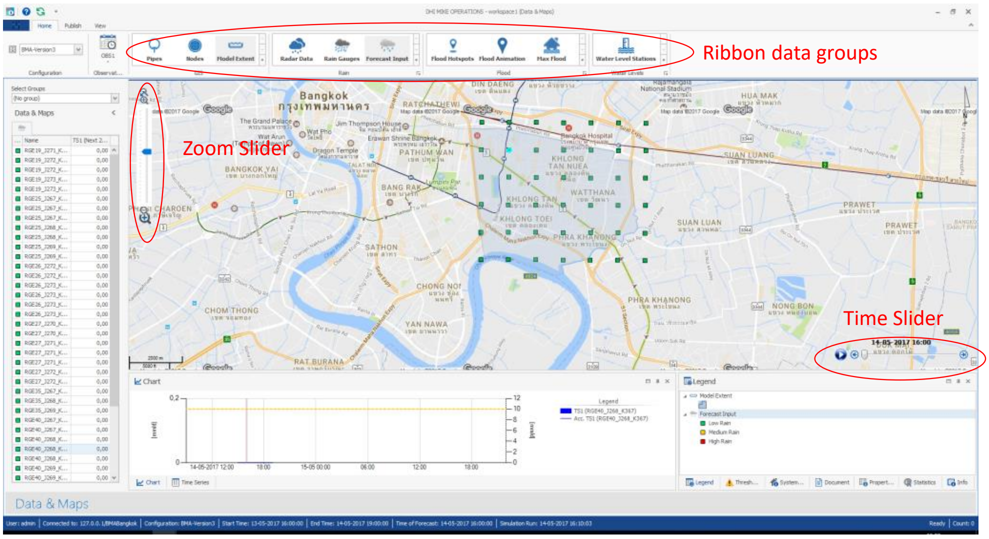

Figure 2-1 Map view of Mike Operation

The ribbon above the map contains access to the most important functionality in MIKE OPERATIONS. The ribbon is divided into four groups. The four groups are:

- GIS, which contains three different data types: extended of the flood model, pipes network included in the flood model and manholes included in the flood model. These layers are static.
- Rain, which contains access to three different time series: radar forecast, rain gauge measurements and the processed time series applied in the flood simulations. All data types in this group are dynamic feature layers (see below).
- Flood, which contains access to time series of flood level (flood spots), flood map animation for the latest flood simulation and map of maximum floods. The flood level is a dynamic feature layer. All these data types are extracted from flood simulation.
- Water levels, which contain access to time series of measured water levels in the canals bounding the model.

Selection of time series can be carried out in two ways, either by selecting on the map or by selecting in the navigation pane, see Figure 2-2. As a standard, selected time series are plotted at the bottom of the user interface.

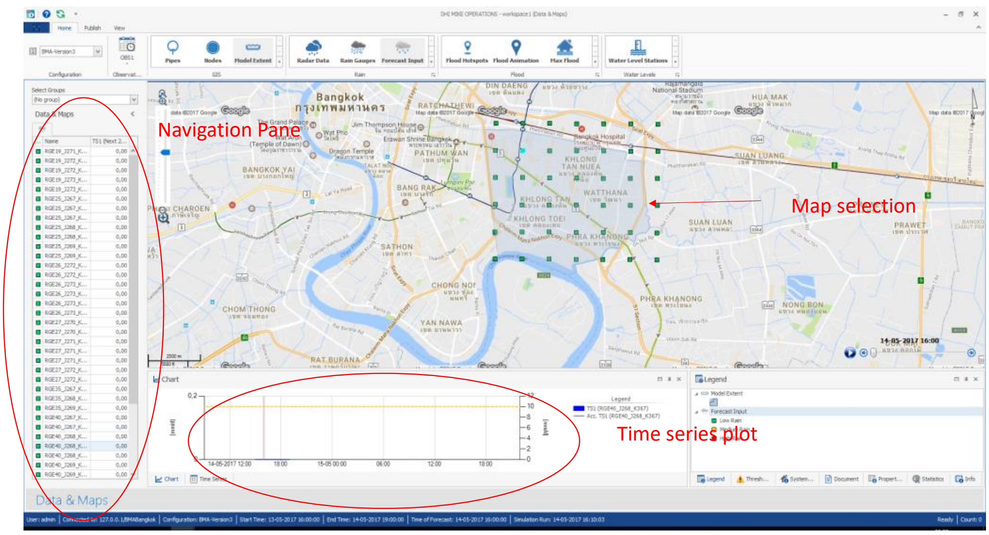

Figure 2-2 Map view with forecast input and model extend selected.

As mentioned above, many layers are dynamic feature layers. In these layers, elements are coloured from a threshold setup. In the example shown in Figure 2-3, the selected feature shows the location of the rainfall time series applied in the flood simulation. Elements (the square) of this map change colour according to the actual value or maximum time value of the complete time series during the chosen observation period. It will be green if the value is below a certain threshold value, yellow if the value is above the threshold value but still below a second threshold value and red if it is above the last threshold value. These feature layers provide operators with a quick overview. In general, the system is presently configured with three threshold levels:

- Normal (feature elements are green)
- Warning (feature elements are yellow)
- Alarm (feature elements are red)

The threshold level is also visualized in time series plots.

The system is presently configured with two observation periods:

- The latest 24 hours and 3 hours forecast
- The period of a selected forecast

These observation periods define the extent of for example time series plot.

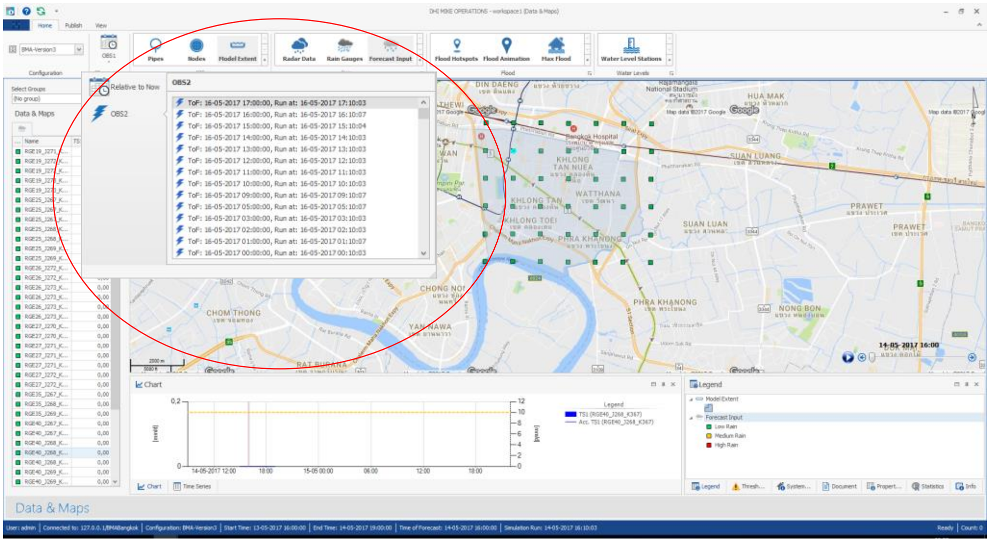

Figure 2-3 Forecast selection

The user can select among stored forecast simulations and evaluate historical events, see Figure 2-3. Presently, however, the system is configured with auto clean-up procedures, which delete forecast simulation results that are older than 2 weeks.

The web interface includes the same main functions as the desktop application, see Figure 2-4.

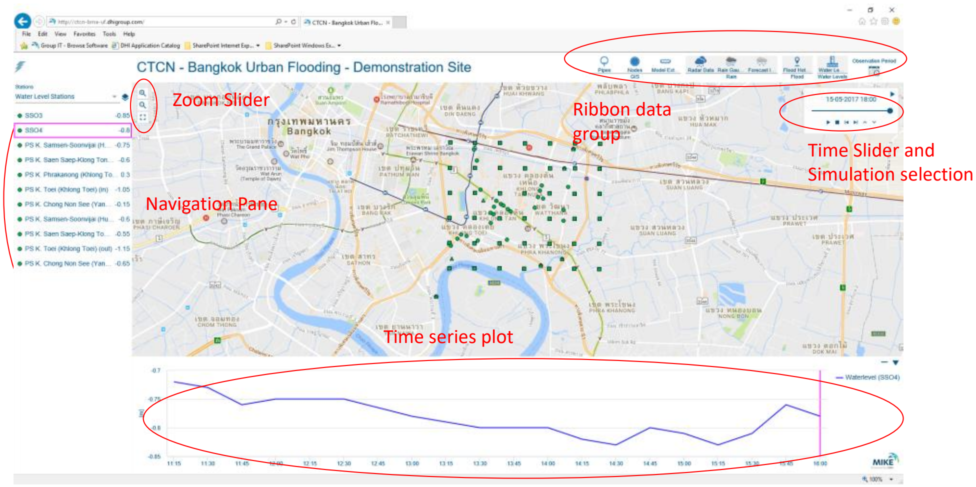

Figure 2-4 Example of web interface.

The web-interface, as well as the desktop views, are translated to Thai language. Figure 2-4 shows the water level variations in one of the main canals over a 24 h period on the 23-24 August 2017.

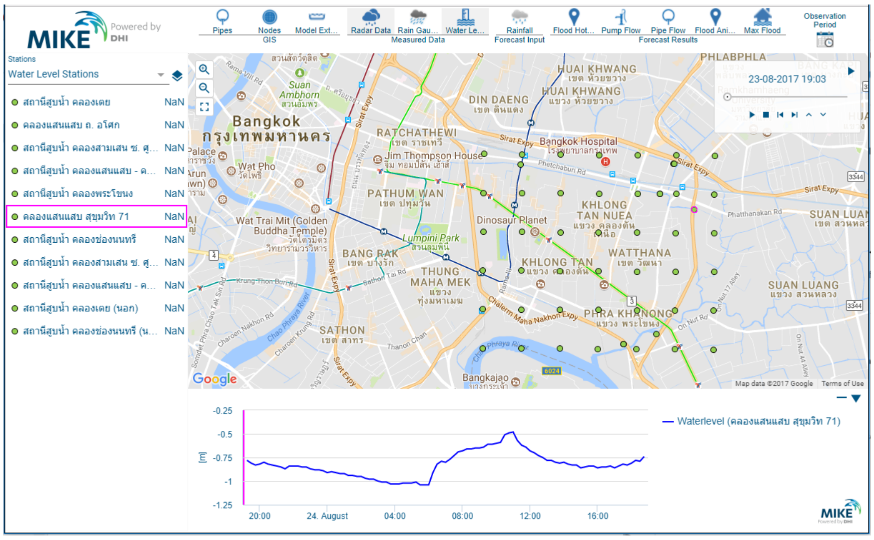

Figure 2-5 Example of web interface, Thai language

XXXXXXXXXXX THIS SECTION TO BE EXPANDED WITH MORE TEXT AND ILLUSTRATIONS WHEN WE HAVE HAD SOME FLOOD EVENTS XXXXXXXXXXXXX

3 Conclusion and recommendations

The technical assistance resulted in additional skills and competences to the staff of BMA, and an early warning system that can be expanded to a city-wide warning system has been developed.

A part of the configuration work, has been to identify points of special interest, and include flood hot spots and other critical locations. These points have been added to a separate layer in the GIS, allowing for quick access to forecasted information about water/flood levels.

XXXX 1-2 MORE CONCLUSIONS TO BE ADDED WHEN WE HAVE CAPTURED SOME HIGH RAINFALL EVENTS CAUSING FLOODING XXXX

4 References

References are published and made available to BMA as a part of the project. The references are integral parts of the software applied in the TA.

/1/ DIM.CORE DHI manual

/2/ MIKE OPERATION documentation