Serious gaming in training for crisis response

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ABSTRACT

In this practitioner report, we present the experiences with the use of the serious game Water Coach in a national training for crisis response professionals in the Netherlands. This paper describes the set-up of the training and its learning objectives. We explain the usability of the Water Coach in such a training and the extended functionalities that were required. Finally, the evaluation of the training, in which we focus on the added value of a serious game in the training for crisis response, is presented.

Keywords

Training, serious gaming, early warning systems, flooding, crisis organizations, learning objectives.

INTRODUCTION

At ISCRAM 2011, we presented the newly developed serious game for operational systems called the Water Coach (De Kleermaeker, Zijderveld and Thonus, 2011). At ISCRAM 2012 we present the use of the Water Coach in a large scale, three day long, Dutch national training exercise for the employees of the Water Management Centre for the Netherlands (WMCN).

Water Coach as presented at ISCRAM 2011

The purpose of the Water Coach (formerly known as FEWS game) is to submit a correct and timely storm surge level forecast, by using all available information correctly and combine information with knowledge and experience. It exists of two parts: the water coach engine and a copy of the operational Delft-FEWS forecast system. FEWS is an acronym for Flood Early Warning System. The water coach engine holds the scenarios, controls the game time, distributes additional information such as weather forecasts, logs the actions of the student and allows the game to be paused. The (copy of the) Delft-FEWS system contains the regional information, including hydrodynamic models and measurement stations, which makes the training very realistic.

NATIONAL TRAINING EXERCISE

The WMCN provides the daily communication regarding the status of the Dutch water systems. This includes information on expected water levels (ship maneuvering) and (bathing) water quality. The WMCN is also responsible for the early warning system in case of extreme events such as floods, droughts and water contamination. In such cases the WMCN informs and advises the national and regional water managers on the expected state of the water system. In this way, the WMCN helps them to cope with any water situation.

At the WMCN all professionals involved in forecasting and provision of warnings concerning the water systems work together as a team of teams. The preparation of the water reports requires intensive communication and collaboration between the involved teams. All of this generally takes place under a high time pressure. Since extreme water events occur very infrequently in the Netherlands, professionals cannot operate in a real situation as often as needed to train and maintain their skills (process and technical).

In November of 2011 the WMCN performed a large scale exercise to train the communication between all teams involved. The objective was to reach a consistent water communication concerning a scenario with both high water levels on the main rivers and a storm at sea. This realistic scenario requires optimal interaction between all teams,

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because not only does this scenario create a flood risk at two locations (along the inland rivers and along the coast), these risks also influence each other. The national response to such a complex crisis requires intensive communication between many teams. The training focused on the process of cooperation between teams in a crisis situation, i.e. working together to be able to act quickly and appropriately in a complex situation under (time) pressure. Complete, correct, and timely information is essential and communication thereof should be in line with the pre-defined procedures. During this exercise newly defined procedures were tested.
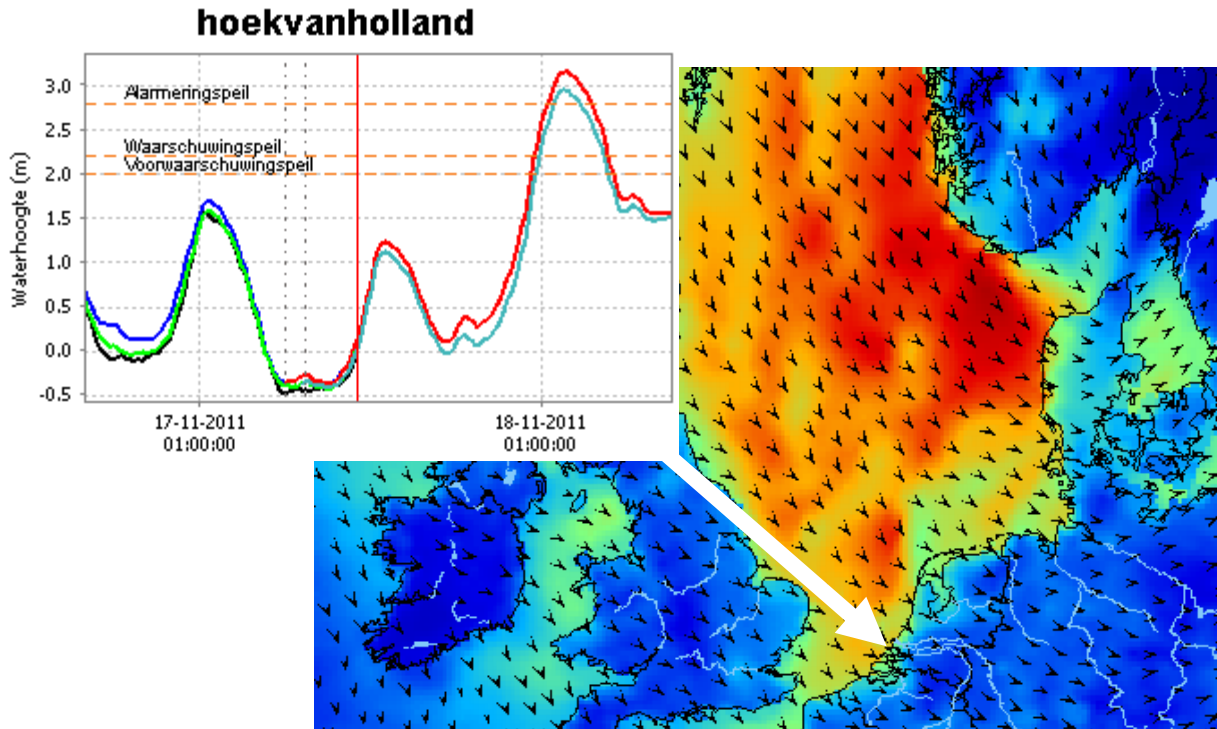

Figure 1. Data analysis in FEWS-North Sea
Overlay (top): Time series of the forecast water levels [m] by 2 models (colored) with measured levels (black) for Hoek van Holland (location along the Dutch coast). Red vertical line is "now", orange horizontal lines are warning levels. Bottom right: 2D display of the forecast wind speed [m/s] on the North Sea. The arrow points at Hoek van Holland.

WATER COACH

The crisis response professionals work with different Delft-FEWS applications for setting up their operational forecasts. The Water Coach is a serious game used to train operational forecasters in generating a forecast. With the Water Coach, we replicate the actual Delft-FEWS operational environment as much as possible. This means that the trainee can access meteorological and hydrodynamic model results and measurements relevant for the exercise scenario within the familiar operational environment. The only difference is that the Water Coach generally works with pre-simulated model runs. During the exercise, the trainee does not have to prepare and run the models, to avoid the long simulation times.

The scenario consists of all data related to the weather and water situation. For each scenario, several scripts (i.e. storylines) can be generated, to facilitate the different learning objectives, using the same scenario. A script describes everything that is not data, e.g. a new weather forecast or a news bulletin concerning a sunken ship.

The Water Coach assists the trainee to reach the following learning objectives, i.e. to demonstrate the ability to:

- Collect, analyze, and interpret data, and to formulate and support conclusions. This concerns the results of both hydrodynamic and meteorological models and measurements (see figure 1);

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- Identify the strengths and limitations of models as predictors of real-world behaviors. This concerns both the meteorological and hydrodynamic models. The model results are evaluated based on measurements and expert judgment;

- Apply appropriate software tools to analyze the relevant data;

- Communicate effectively about forecasts with a specific audience, both orally and in writing;

- Work effectively under time pressure and/or while unexpected events occur (e.g. technical problems).

For the national exercise, the Water Coach as presented on ISCRAM 2011 has been extended with several functionalities.

The options to manipulate the in-game time have been extended. The script has been made more interactive, allowing the trainee to influence the information he/she receives. The archiving functionality in FEWS has been improved to more easily archive and retrieve data from actual events. This is big step forwards as generating scenarios with a consistent weather and water situation is very tricky. It is much easier to tweak real historical events. The possibility to run (light and quick) models locally during the game has been added.

Feedback is an important part of the learning process. The coach does not give a score, but relies on feedback given by a senior hydrologist in an evaluation afterwards. To assist this we've added functionality to compare the in-game forecast with the real forecast made during the actual event or by previous players of the same scenario. Also, it is now possible to log even more in-game actions of the trainee.
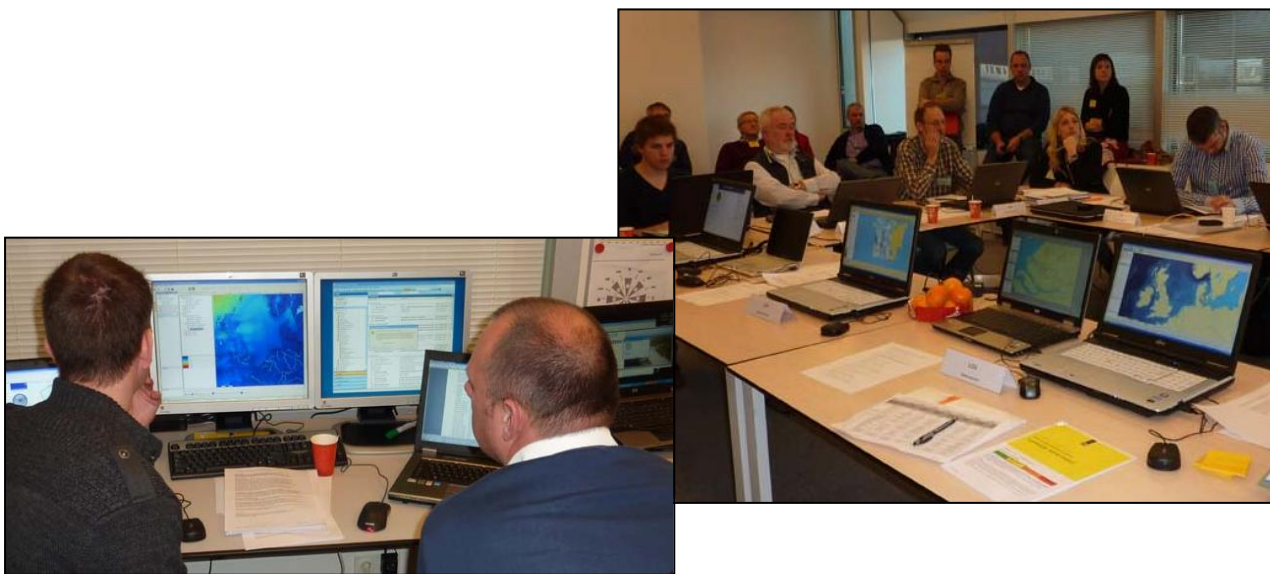

Figure 2. The national training for crisis response in November of 2011.
On the left a single crisis response team works with the Water Coach for FEWS North Sea.
On the right all teams work together as one team to create a uniform communication.

TRAINING SCENARIO

The scenario for the WMCN exercise was based on the combination of two events from the past: a historic storm surge at sea, combined with high water levels at the main rivers. This scenario impacted three different regions: the North Sea, the inland river system and the river delta (see figure 3). For each region, a separate and specialized FEWS application is used by the operational forecasters of the WMCN.

For the WNCN exercise the Water Coach has been used with all three FEWS-applications, based on one common, fictional scenario which was the result of combining 2 historical events:

- Rivers: high water levels on the river as occurred in January 2011, ignoring the storm surge;

- North Sea: storm surge at sea as occurred in November 2007, ignoring the high water levels;

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- River delta: a combination of both historical events. The forecasts were generated based on a fictional forcing, consisting of a combination of both events. The meteorological forcing is based solely on the situation of November 2007.
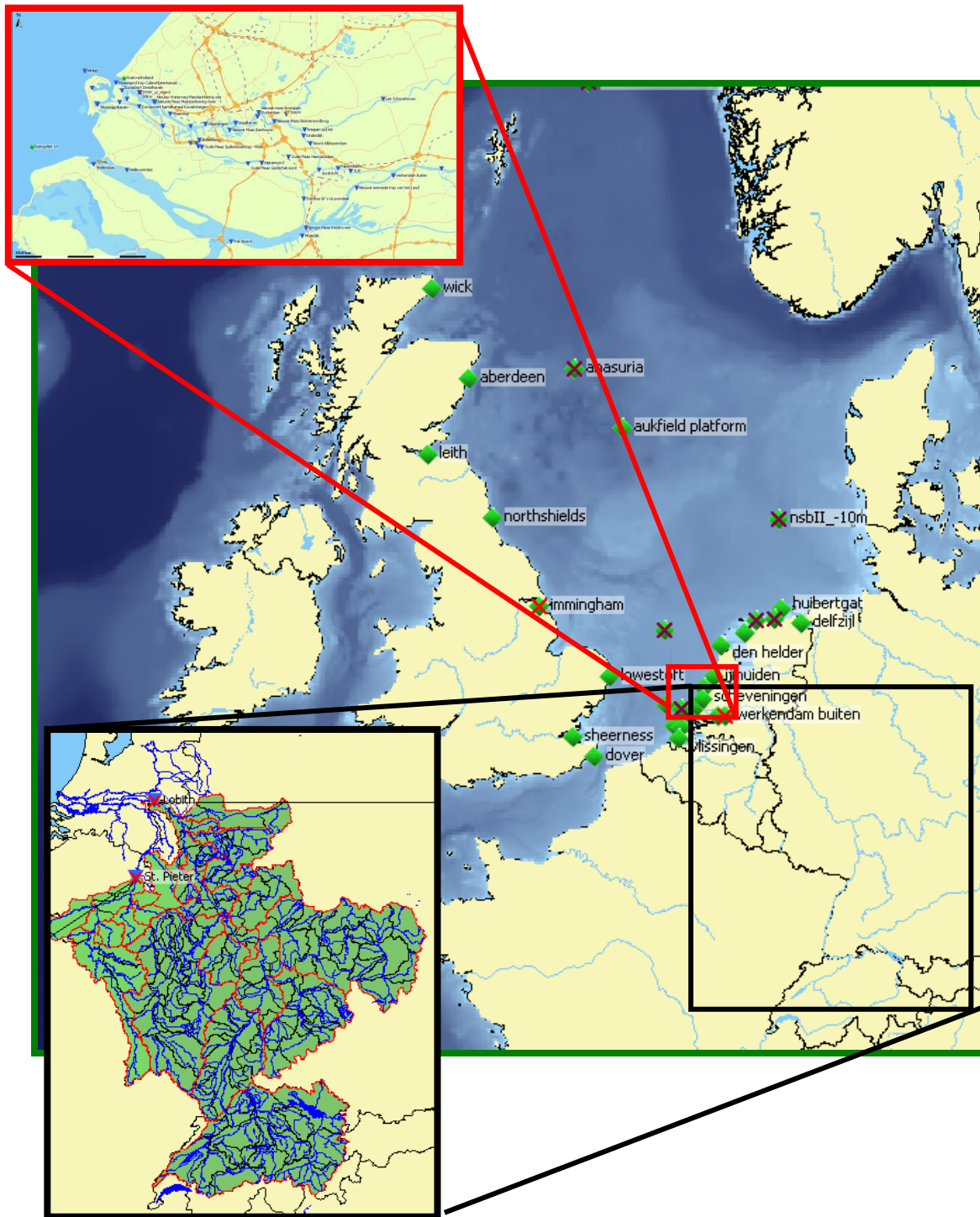

Figure 3. Three FEWS applications were used with the Water Coach: for the North Sea (FEWS North Sea, large map in background, green box), for the inland rivers (FEWS Rivers, bottom overlay, black box) and for the overlapping area in between (FEWS River Delta, top overlay, red box).

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EVALUATION

The evaluation of the training was based on three parts: a short survey for the trainees directly after the training, first impression reviews in a group discussion and observations made using the TARCK-it method

- In the survey the trainees could indicate how much they had learned on 4 topics: Cooperation between teams, procedures, communicate effectively about the forecasted water levels, transfers between teams. All teams indicated that the training at least refreshed their existing knowledge. On the topics *cooperation* and *procedure*, both of which were explicit learning goals of the training, the trainees indicated they acquired new knowledge.

- Each block of the training was completed with a round table discussion, in which the observers and trainees could share their first impressions. This resulted in a very open discussion, in which especially aspects concerning cooperation were discussed.

- With the TARCK-it method, observers scored the teams using a check list, which consisted of checks for each OODA phase based on five aspects, being Timely, Accurate, Relevance, Complete and Cost effective. The OODA methodology distinguishes between four phases: Observe, Orient, Decide and Act (OODA). By measuring the performance on the above five aspects, overall grades were deduced for the performance of each team during every phase of the OODA loop.

Evaluation of the Water Coach

The main learning goals focused on cooperation between teams. To train this, a scenario-based simulation was essential. This allowed all teams to work together in a realistic storyline, working towards the common goal of a timely and accurate communication on the condition of the water system.

The Water Coach has proven to be a very suitable and powerful tool to support such a (national) exercise. Moreover, because the Water Coach is an add-on to the daily used operational FEWS applications, the trainees find it is easy to use due to the familiar look-and-feel. They can find all necessary information without loosing precious time in searching. All parties have the required meteorological and hydrodynamic information available in one system, both the model results as well as the measurements. In the past this used to be problematic during an exercise on this scale, due to inconsistencies and inflexibilities in the operational tools available. Because the Water Coach facilitates the collection and analysis of the information, the trainees could now focus primarily on the cooperation and communication with the other teams, which was the main focus of the training.

FUTURE WORK

Due to the positive experiences, the WMCN wishes to make use of the Water Coach for more if not all of the trainings involving the generation of forecasts. For this we will need to develop some additional functionality, of which the most important one is to make it possible to use the Water Coach on-line. This means that several trainees should be able to log-in from different location to the same Water Coach, while looking at the same data (i.e. the same database). If any player performs a local run, this additional information should be accessible to all players. Furthermore, the Ministry of Infrastructure and Environment wishes to continue the Water Coach in the national trainings. For this, more Water Coach games will be developed for other FEWS applications.

REFERENCE

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