

FLOOD SURVEILLANCE AND EARLY WARNING IN PHU THO PROVINCE VIETNAM

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ABSTRACT

This paper is about a collaboration between Pacific Disaster Center (US) and Vietnam's Central Committee for Flood and Storm Control (CCFSC) and Disaster Management Center (DMC). As part of an overall programme for capacity development within Vietnam's disaster management community, especially at the national and provincial level, Pacific Disaster Center (PDC), the Central Committee for Flood and Storm Control (CCFSC) and the Ministry of Agriculture and Rural Development's Disaster Management Center (DMC) have collaborated to better understand and enhance the current state of disaster management in Vietnam in terms of:

- *monitoring and observation systems/networks;*
- *analysis and decision support system (DSS) capabilities; and,*
- *warning and notification dissemination.*

Towards these goals, a pilot project was undertaken to automate flood-related information feeds and incorporate them into a flexible, easy-to-implement decision support application. Additionally, flood inundation model outputs and data sets detailing critical assets and infrastructure were prepared and included in the Web-based application.

More specifically, a map-based user interface for the decision support application based on PDC's Natural Hazards and Vulnerabilities Atlas and on the DSS deployed to Thailand's National Disaster Warning Center was developed and deployed using Open Source Map Server technology. The flood-prone Phu Tho province, northeast and upstream of Hanoi, along the Red River, was selected as representative of both the need for such disaster management tools and the capacity, especially in terms of Information and Communications Technology (ICT), to field such tools.

The technical scope of the pilot project in Phu Tho included:

- *assessing ICT capabilities and needs,*
- *review and enhancement of GIS hazard data,*
- *development of hazard products applications, and*
- *sharing results and findings in a seminar.*

The project was initiated in December 2006-January 2007 with an ICT survey of DMC and of the Phu Tho Province Dyke Management and Flood and Storm Control Office. Subsequent activities included the Open Source Map Viewer and Map Server development, GIS database development focusing on flood hazards and at-risk infrastructure and populations in Phu Tho Province, and flood modelling and consequence assessment for various dyke breach scenarios along the Red River.

The project concluded with an International Seminar on 'Best Practices' in Disaster Management: Disaster Risk Assessment and Early Warning Systems in November 2007, which featured panel sessions and skill development seminars in risk assessment, flood modelling, and Web-based crisis management software. Experts from Vietnam and at least six other countries made presentations contributing to the "Best Practices" theme. Following the international workshop and skills development event, representatives from Phu Tho Province participated in a day-long training session on the use of the Map Viewer.

This paper describes the recently concluded pilot project and discusses next steps towards implementation of a nationwide system in all of Vietnam.

1. INTRODUCTION

Pacific Disaster Center, in collaboration with Vietnam's Central Committee Flood and Storm Control (CCFSC), Department of Dyke Management & Flood and Storm Control (DDMFSC), and its Disaster Management Center (DMC), has undertaken a pilot project aimed at better understanding, illustrating, and enhancing the current state of disaster management in Vietnam in terms of: monitoring and observation systems and networks; analysis and decision support system (DSS) capabilities; and warning and notification dissemination and computer-based decision support systems.

This project grew out of a then three-year engagement with the Government of Vietnam. The initial phase, the pilot project, was designed to be limited to riverine flood threats in Phu Tho Province, with the development of a national, all-hazards "Vietnam Disaster Center" (VDC) as the longer term goal.

The objectives of this first set of activities included to raise awareness of the need for co-ordinated disaster management in Vietnam, to clarify to stakeholders the benefits of co-ordinated disaster management, to validate the concept of an all-hazards approach to disaster management, and to generate exemplar products to provide insight into issues ranging from disaster management to data sharing and access. This project is broken into five main tasks. Each is described in a section below.

2. TASK 1: PROJECT DEFINITION AND PILOT AREA SELECTION

Although VDC is envisioned to be a multi-hazard facility, representatives from DDMFSC and CCFSC expressed their desire to limit the scope of the initial collaborative effort to flooding, one of the most prevalent and destructive hazards in Vietnam, to help ensure that the project could be successfully completed within a twelve-month timeframe. To further focus this effort, PDC and DDMFSC staff agreed to select a representative "pilot" site to refine and validate assessment methodologies and applications. Through various discussions between PDC and Vietnam stakeholders, a pilot project focusing on flooding in Phu Tho Province, located in the hazard-prone northern region of Vietnam, was defined. Phu Tho province is located within the floodplain of the Red River approximately 50 miles upstream from Hanoi. This floodplain plays a critical "safety valve" role in the flood mitigation strategy for protecting Hanoi from severe flooding, although at the potential expense of homes, crop land and livestock within the affected retention basins. These retention basins would be intentionally flooded by breaching levees along the Red River in case of extreme flooding. A better understanding of the resultant flooding, the impact on people and infrastructure, and considerations of appropriate warning mechanisms thus became the focus of a pilot project to assess capacities and gaps.

Following an initial kick-off meeting in Hanoi (December 2006), PDC worked with DMC staff to identify other stakeholders in Vietnam's DM community, including the Hydro-Meteorological (HydroMet) Service and affiliated universities including the Hanoi-based Water Resources University. These stakeholders helped PDC throughout the course of the pilot project to identify and secure data resources which would be used for subsequent flood modelling and impact assessment tasks. Additionally, PDC and DMC Staff travelled to Phu Tho province to meet with the Provincial DDMFSC representatives, review their capabilities and procedures, and to baseline the ICT systems. The Provincial DDMFSC representatives were very excited by and encouraging of the PDC/DMC project. They provided an overview

of their capabilities, which primarily included facsimile-based communication with the central DDMFSC (in Hanoi) and central and regional offices of the HydroMet service. Most urgent warnings from the provincial office are hand delivered to district and village offices and officials.

3. TASK 2: PRELIMINARY DATA GATHERING AND MONITORING AND WARNING CAPACITY SURVEY

Once the Phu Tho study area was established, PDC worked with DDMFSC to conduct the ICT survey and to clarify the availability of data. PDC project members travelled to Vietnam in the Spring of 2007 for this purpose and to inventory and collect data as well as to document flood monitoring and warning capabilities at both the National level and within the selected study site.

Assessment of ICT: PDC conducted an assessment of the information and communication technologies in order to characterise the current state of ICT equipment and personnel, and to understand any potential shortfalls. The assessment was conducted by using a questionnaire to interview DDMFSC's ICT personnel in Hanoi as well as their colleagues at the Provincial office in Phu Tho. Generally the DDMFSC IT environment was found to have the basic components (servers, networks, internet connectivity, PDC) necessary for early warning and decision support. However, there were limited provisions for redundancy (i.e., spare servers and components) and the computing environment was not robust (i.e., server room not on separate electrical and air conditioning services, limited back-up and off-site data storage, etc.) Recommendations were made to DDMFSC to meet the minimum requirements for "enterprise-class, high availability computing."

Data Inventory and Gathering: During this visit, PDC staff also conducted an inventory of data resources at DDMFSC. The team learned that Geographic Information Systems (GIS) data were available from DDMFSC including baseline infrastructure/boundaries, elevation, population, critical infrastructure, communication and transport networks, land cover, and data on river systems, including historical flooding, dykes and other flood control devices, textual historical data on flood frequency and severity, and real-time data from hydro-met and river gauge stations.

Additionally, PDC project staff visited the Phu Tho province office in June, 2007, and collected the priority datasets, including critical facilities such as medical clinics, schools, government buildings, communications and transport facilities, for further analysis in the flood impact study.

Survey Flood Monitoring and Warning Capabilities: PDC and DDMFSC surveyed the availability and suitability of meteorological monitoring equipment, hazard assessment tools, warning dissemination systems and practices serving the study site and at the national level. PDC found that the Hydro-Meteorological Service of Vietnam (HMSV) has two networks of real-time hydrological and meteorological monitoring equipment for Vietnam; one for measuring rainfall, and another composed of gauging stations along several large rivers in Vietnam, including the Red River. The monitoring equipment collects and transmits vital information such as rainfall amount and river elevation data. These data are made accessible by HMSV to various agencies in Vietnam such as DDMFSC/DMC. Combined with predefined thresholds for flooding, these real-time data are used to create rudimentary map products that visualise potential flood areas for DDMFSC staff and serve as a basis for

warning dissemination. They are not well integrated with other geospatial data, nor does it appear that automated warnings are generated based on these data (*i.e.*, any warning requires manual review and assessment of these data).

4. TASK 3: HAZARD ASSESSMENT PRODUCT DEFINITION

In the Phu Tho study area, PDC and DMC focused on a flood hazard area between the Red River and the Black River. This hazard area is the designated site for intentional flooding by forced breaching of levees at predetermined sites along the rivers, which takes place when water levels exceed an official threshold. The forced breaching is intended to safeguard Hanoi from flooding, albeit at the expense of the local community.

PDC staff worked with DMC staff to document the breach locations and the estimated flood volume and flow rates for the purpose of creating a modelled simulation of the flood using statistical modelling software and GIS analytical tools. This simulation, shown in Figure 1, was shared at the final workshop.

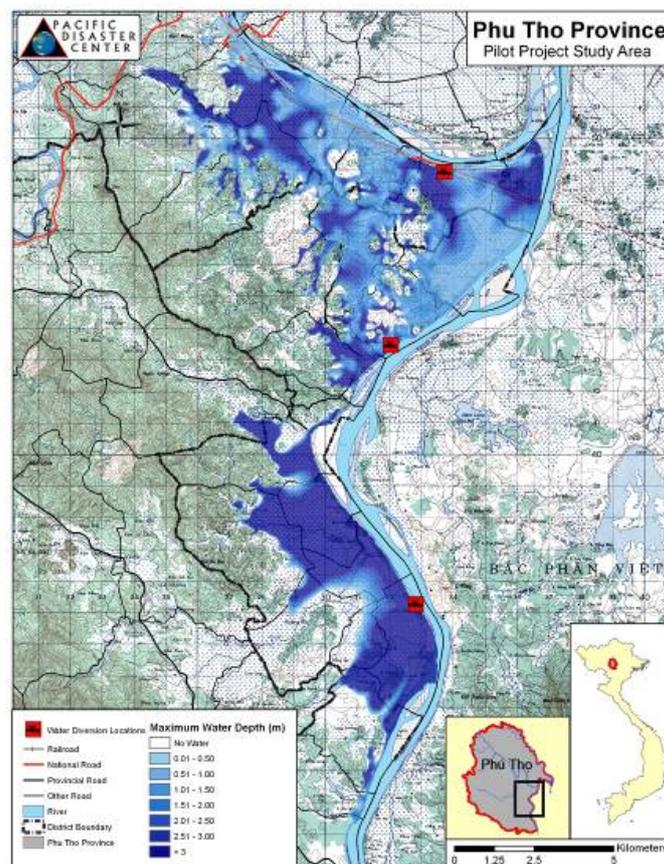


Figure 1: Flood Extent and Depth Model Output for Phu Tho Province Study Area.

PDC and DMC staff next collaborated to develop prototype flood-hazard warning products depicting critical facilities in this area which would be susceptible to flooding based on parameters supplied by DMC. These products, including maps and tables, were used to evaluate potential impacts caused by releasing water into the flood retention area by computing which facilities would be impacted, by how much water, and at what time. Table 1 shows these data for several selected facilities. This information is valuable for evacuation planning and other mitigation efforts including relocation of critical services to

non-flood prone areas. These products are also useful for increasing public awareness of flood risk, an important step in the risk reduction process.

Infrastructure Type	Commune	Distance to Nearest Breach Location (km) *	Time to First Arrival (hours)	Name of Nearest Breach Location	Maximum Water Depth (m)	Latitude	Longitude
Pumping Station	X. DỄU D-NG	0.87	2.57	Thuong Nong	3.44	21.2476	105.3134
School	X. DỄU D-NG	2.11	8.98	Thuong Nong	1.02	21.2453	105.3008
School	X. DỄU D-NG	1.90	8.34	Thuong Nong	1.00	21.2415	105.3031
Clinic	X. DỄ NỄU	5.79	46.20	Thuong Nong	0.11	21.2425	105.2653
Commune Office with Police	X. DỄ NỄU	5.89	42.35	Thuong Nong	0.54	21.2409	105.2644
Post Office	X. DỄ NỄU	5.78	42.99	Thuong Nong	1.83	21.2413	105.2655

Table 1: An Analysis of flood depths and time to first arrival for several facilities within the Phu Tho Province Study Area.

5. TASK 4: MONITORING AND WARNING CAPABILITY ENHANCEMENT

Working with DMC staff, PDC designed and implemented a process and associated software applications to automatically capture, parse and database these data streams, and to further automate the process of creating alerts/warnings based on their values and pre-determined alerting levels.

Specifically, PDC established a secure file transfer protocol (SFTP) feed to gather, from the Vietnam Hydro-Met stations, data on rainfall and observations of river water levels. These data are automatically retrieved, processed and ingested into PDC’s Enterprise Geospatial Database (EGDb) at regular intervals. The water level values are compared to pre-defined alert levels in order to determine the appropriate alert level for each station. An interactive Multi-Source Map Viewer application, also known as the “Viet Nam Hazards and Vulnerability Atlas,” which uses open communications standards for GIS data and map requests, is dynamically updated to show the alert level at each station. The Viet Nam Hazards and Vulnerability Atlas is shown in Figure 2.

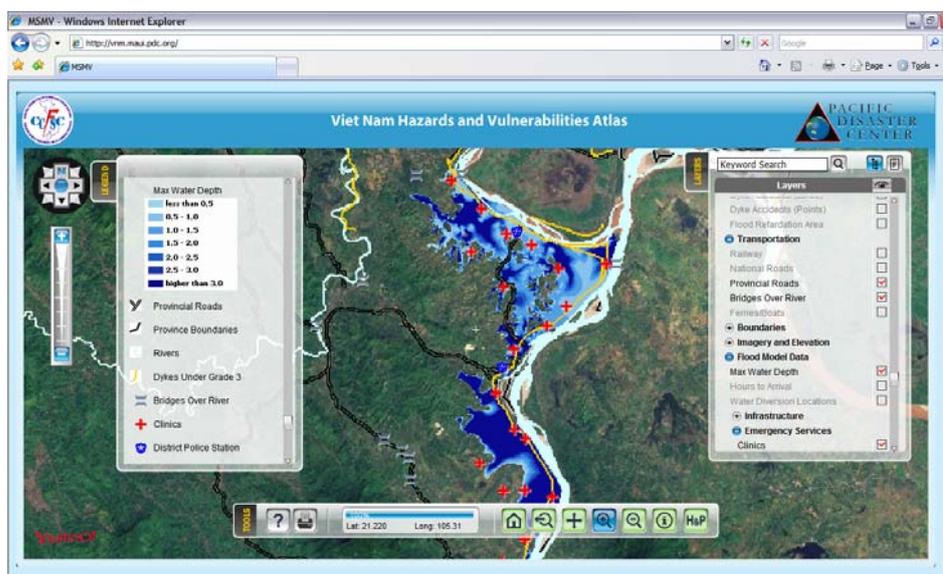


Figure 2: Viet Nam Hazards and Vulnerability Atlas

6. TASK 5: INTERNATIONAL WORKSHOP ON 'BEST PRACTICES'

At the conclusion of the Pilot Project, PDC and DMC organised and participated in an International Seminar on 'Best Practices' in Disaster Management: Disaster Risk Assessment and Early Warning Systems in Hanoi on November 6–7. Vice Minister Nguyen Ngoc Thuat of the Ministry of Agriculture and Rural Development greeted the conferees with opening remarks. Other presenters included City Planning and Development Officer Thomas Aguilar from Marikina City, Philippines; Director of Disaster Prevention and Civil Defense Division Chul-Do Kim from Busan City, Republic of Korea; Dr Smith Dharmasaroja, Chairman of the Committee of the National Disaster Warning Administration, Thailand; Dr Wei Sen Li, Deputy Executive Secretary, National Science & Technology Center for Disaster Reduction, Taiwan; Mr Chuck Dolejs *et al.* representing ESI911; and Mr Christopher Nielsen representing Danish Hydraulic Institute (DHI). PDC Chief Information Officer Chris Chiesa and Hazard Mitigation Specialist Sharon Mielbrecht provided presentations, and the Vietnamese speakers and presenters included top officials of the Central Committee on Flood and Storm Control (CCFSC), Ministry of Agriculture and Rural Development (MARD), Department of Dyke Management and Flood and Storm Control (DDMFSC), Disaster Management Committee (DMC), and Hydro-Meteorological Service of Vietnam (HMSV).

The second day of the conference featured skills development sessions in flood modeling, and risk and vulnerability assessment methodologies, led by DHI and PDC respectively. Finally, representatives from CCFSC and Phu Tho Province participated in a day-long training session on the use of the Map Viewer on the third day of this event. The training marked the practical launch of the Vietnam Hazards Atlas in the open-source/multi-source map viewer.

8. NEXT STEPS TOWARDS ALL-HAZARD DISASTER MANAGEMENT

The United States Trade and Development Agency (USTDA) has expressed interest in “next step” activities that PDC has conceptualised in co-operation with CCFSC/DDMFSC/DMC. After a series of discussions with USTDA, PDC has prepared a proposal outlining an expansion of the pilot project to include flood monitoring in central Vietnam and development of a national architecture for all-hazards disaster management.

PDC looks forward to a long and productive engagement with Vietnam, working in partnership to strengthen the country’s disaster management capacity.