ASIA FLOOD NETWORK: USAID/OFDA FLOOD MITIGATION AND PREPAREDNESS PROGRAM IN ASIA

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Floods are among the most devastating natural disasters affecting more people in the world than any other natural disaster. Between 1995 and 2004, floods affected over one billion people and claimed over 40,000 lives (OFDA/CRED, 2005), more damage than any other natural disaster. In addition to humanitarian assistance, USAID/OFDA provides support for programs to mitigate the adverse impacts of floods in Asia and other regions through strengthening flood forecasting and warning capacity of regional and national agencies.

An early warning system and preparedness plan are vital tools in reducing loss of life and socio-economic impacts of floods. A flood early warning system should provide sufficient lead time to prepare for and respond to extreme hydrometeorological events. USAID/OFDA and its partners have been providing 24-hour satellite estimates and short-term forecasts of rainfall over the Mekong River basin and surrounding areas to the Mekong River Commission (MRC) since 2001 in support of MRC's flood forecasting in the basin. The support for rainfall estimates and forecasts lead to implementation of the USAID/OFDA-sponsored Asia Flood Network (AFN) in 2003. The AFN and MRC's Flood Management and Mitigation Program *Component # 1: Establishment of a Regional Flood Management Centre* seek to achieve a common goal of reducing vulnerability and adverse impacts of floods while taking advantage of positive effects of floods. This presentation and the corresponding poster presentations illustrate an integrated approach to flood mitigation and management, crucial to reducing vulnerability to floods and other hydrometeorological extremes.

The Asia Flood Network aims to strengthen the capacity of national hydrometeorological institutions in climate, weather, and hydrological forecasting to reduce vulnerability and hydrometeorological hazards of populations at risk. AFN has been jointly implemented by USAID/OFDA, USGS, NOAA, and other USG partners to:

- Enhance rainfall estimations and forecasts for flood, river and flash-flood forecasting, and drought monitoring;
- Strengthen national and regional capacity in hydrometeorological forecasting and warnings;
- Advance hydrologic and hydraulic modelling of watershed and river deltas where hydrometeorological data are scarce;
- Encourage hydrometeorological data and information sharing, which is vital in program implementation; and
- Strengthen dissemination of forecasts and warnings to users and populations at risk.

As illustrated in Figure 1, the mitigation of and preparedness for floods can be defined as an end-to-end process including: (1) data collection and monitoring; (2) hydrometeorological forecasting; (3) planning, preparedness, decision making, and coordination; (3) dissemination of information to people at risk; and (4) actions taken by population at risk to lessen the impacts of potential hazards. Each component in this process is critical to reducing the impacts of floods, and failure of one component will lead to failure of the entire process. State of the art technology and a perfect forecast will not save lives if the populations at risk are not informed in a timely fashion , do not have plans and policies in place, or simply do not know what to do. Similarly, even a well prepared community will be highly vulnerable to hazards if they don't have access to forecasts which gives them the lead time to take necessary actions. Therefore, an integrated approach to disaster mitigation and preparedness is critical in reducing the impacts of floods and other natural disasters.

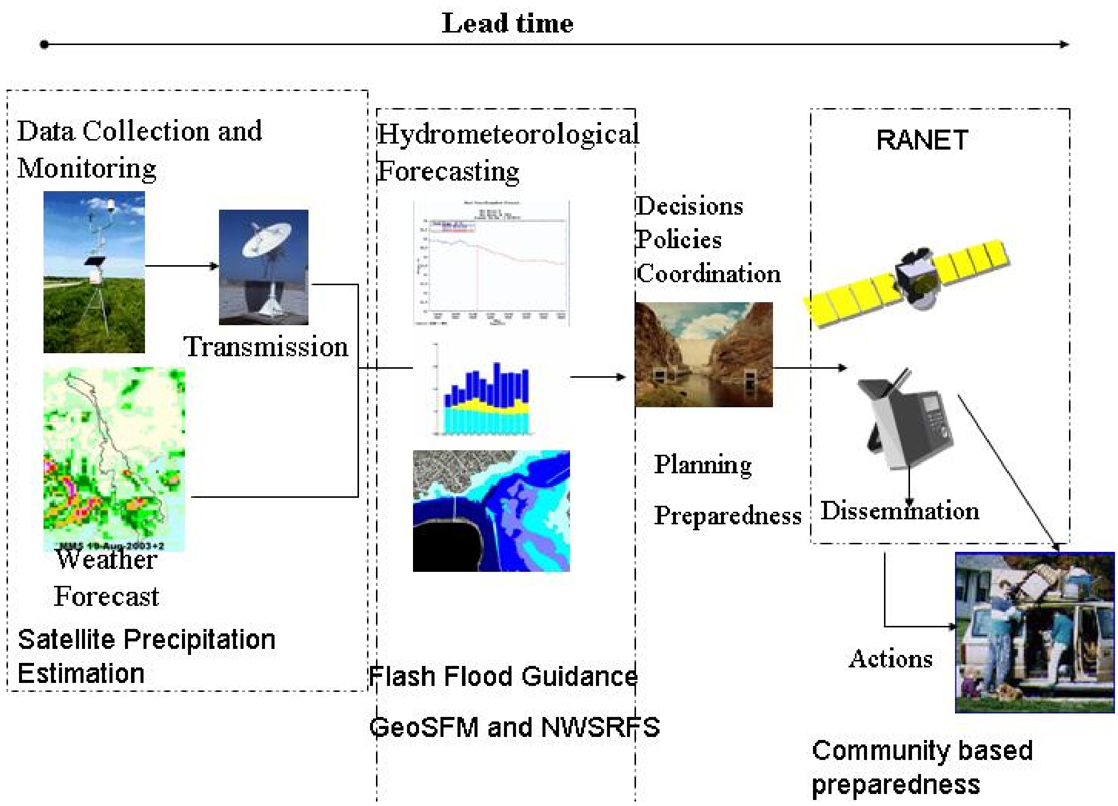

Figure 1 **An end-to-end flood mitigation process.**

In cooperation with NOAA and USGS, USAID/OFDA has been collaborating with MRC and International Centre for Integrated Mountain Development (ICIMOD) in Asia to identify and fill gaps in end-to-end flood forecasting and early warning. The programs complement current USAID/OFDA-funded community based early warning activities in the region. In this presentation and the poster sessions, AFN activities will be presented by addressing the end-to-end process of mitigation.

<u>Data Collection and Monitoring</u>

Monitoring extreme hydrometeorological events is the first step towards understanding what could potentially happen in the future and to choose from possible alternatives. Collection of hydrometeorological data, such as rainfall, temperature, and streamflow, is essential in simulating the natural phenomena. Ground observation networks are commonly used in collecting rainfall and other meteorological data. However, in many countries, satellite-based precipitation estimation may be the only source of rainfall data due to scarcity of hydrometeorological networks, long delays in data transmission, and absence of data sharing in many trans-boundary river basins. A combined satellite- and surface-based rainfall estimation (RFE) technique to enhance the knowledge of collecting precipitation was developed at the NOAA Climate Prediction Centre in 2001. The RFE brings value-added information to rain-gauge interpolations and is primarily intended to serve a flash flood monitoring role as a near real time rainfall dataset. The estimation complements real-time stream gage, rain gage, and independent satellite-based information.

The dataset also provides an excellent opportunity for the monitoring of seasonal moisture, especially when comparing to historical averages of anomaly and normal rainfall. Through AFN, USAID/OFDA, in partnership with Mekong River Commission and the International Centre for Integrated Mountain Development, conducted workshops on the use of RFE technology to strengthen capacity of National Meteorological and Hydrological Services and regional organizations in Asia. Under AFN, NOAA and USGS have been cooperating with MRC and ICIMOD on the use of satellite precipitation estimation to forecast and monitor flooding, flash floods, and droughts. In 2005, MRC and ICIMOD hosted training workshops on the use of RFE. AFN plans to transfer the technology to MRC and ICIMOD in 2006, which will enable regional partners to integrate local rain gage data, validate remote sensing data, improve accuracy for the region, and reduce the time lag of data transmission. In their poster session, Dr. Love and Mr. Wolvovsky from Climate Prediction Centre (NOAA/CPC) will illustrate the technology and other detailed information on the RFE (see Figure 2).

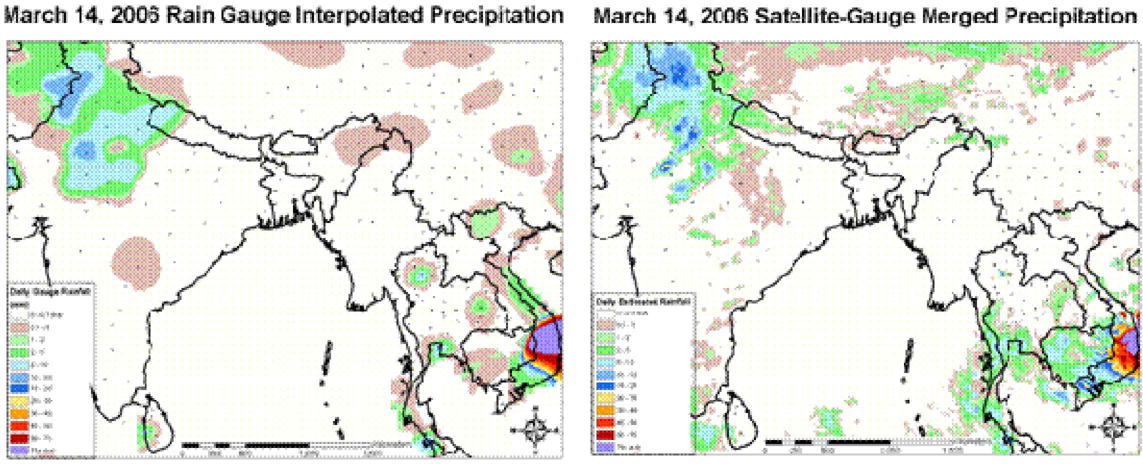

Figure 2. Rain gage versus satellite/gage merged precipitation estimates. (See poster session, T. Love and E. Wolvovsky.)

Although floods have significant impact in the region, droughts have also been prevalent in recent years throughout the region. RFE has been used in Africa and Central America to monitor potential droughts. Through his poster presentation, Dr. Husak will demonstrate the applications of RFE on potential drought monitoring in Asia. The work conducted by Dr. Husak and his colleagues demonstrate a process that uses spatially and temporally over-sampled RFE data to estimate distribution parameters for each pixel in a given interval. These distribution parameters can then be used in the development of a Standardized Precipitation Index (SPI), which measures the significance of an event by comparing it with the probability distribution. SPI is commonly used to monitor the performance of rainfall compared to a historical average of hydrological extremes such as droughts and floods.

Hydrometeorological Forecasting

Building capacities to forecast hydrometeorological parameters, such as rainfall, temperature, and river flow, is critical to providing sufficient lead time for warnings about potentially dangerous river and weather conditions. Modelling hydrological and meteorological processes is essential to response planning, not only for early warnings but also for ongoing management of water resources, agricultural planning, flood mitigation, navigation, scenario-based risk-evaluation, and environmental impact-assessments. Rainfall forecasts and potential evaporation data used in flood and river forecasting in Asia have been made available to MRC and ICIMOD through CPC.

The main causes of flooding in the Mekong, Ganges-Brahmaputra, Meghna river basins are either due to flash floods or river flooding. Due to its rapid-onset, limited warning procedures and emergency actions, the high velocity of water flows, and the associated debris flows, flash floods are the main cause of weather related deaths in many countries. Under AFN, MRC and ICIMOD also hosted flash flood guidance workshops in 2005. As an outcome of the MRC workshop, USAID/OFDA, USG partners, and MRC agreed to transfer technology for flash flood guidance, which was developed for seven Central American countries after Hurricane Mitch devastated the region. Mr. Jubach will provide a brief illustration of this Flash Flood Guidance system. He will also illustrate the capabilities of the Central America Flash Flood Guidance system and the potential implementation of a regional flash flood early warning system for the Lower Mekong River Basin.

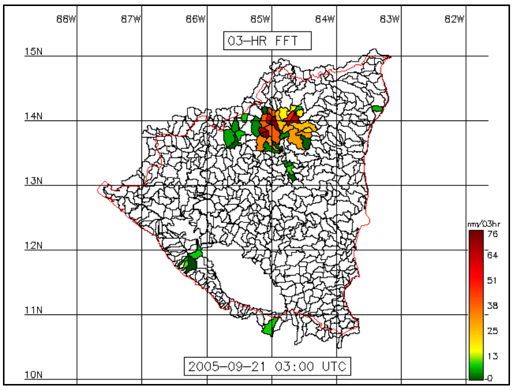

Figure 3: Example of Central America Flash Flood Guidance System product: flash flood threat. (See poster session, B. Jubach.)

The USGS Geospatial Streamflow Model (GeoSFM) application began as a project of USAID's Famine Early Warning Systems Network (FEWS NET). GeoSFM was designed to utilize NOAA satellite rainfall estimates, rainfall forecast data from the U.S. Air Force, and potential evapotranspiration data combined with Geographic Information System (GIS) data to provide data and parameter estimates for streamflow forecast models. After the AFN Satellite Precipitation Workshop, MRC and other participating representatives selected the Nam Ou and Se Done river basins in Lao PDR as the test basins. These two basins were selected because they contribute large flows to the Mekong and, therefore, have a significant impact on the Mekong River main stem forecasts. The GeoSFM is a physically based catchment-scale (semi-distributed) hydrologic model consisting of a GIS-based pre-processing module and a rainfall-runoff component. The rainfall-runoff component of the GeoSFM is a physically based hydrologic model with few parameter and variable input data requirements. This component of the GeoSFM has three main sub-modules, namely: water balance, catchment routing, and distributed channel routing. Dr. Artan will present in details how these basins were calibrated using GeoSFM and technical characteristics of the model.

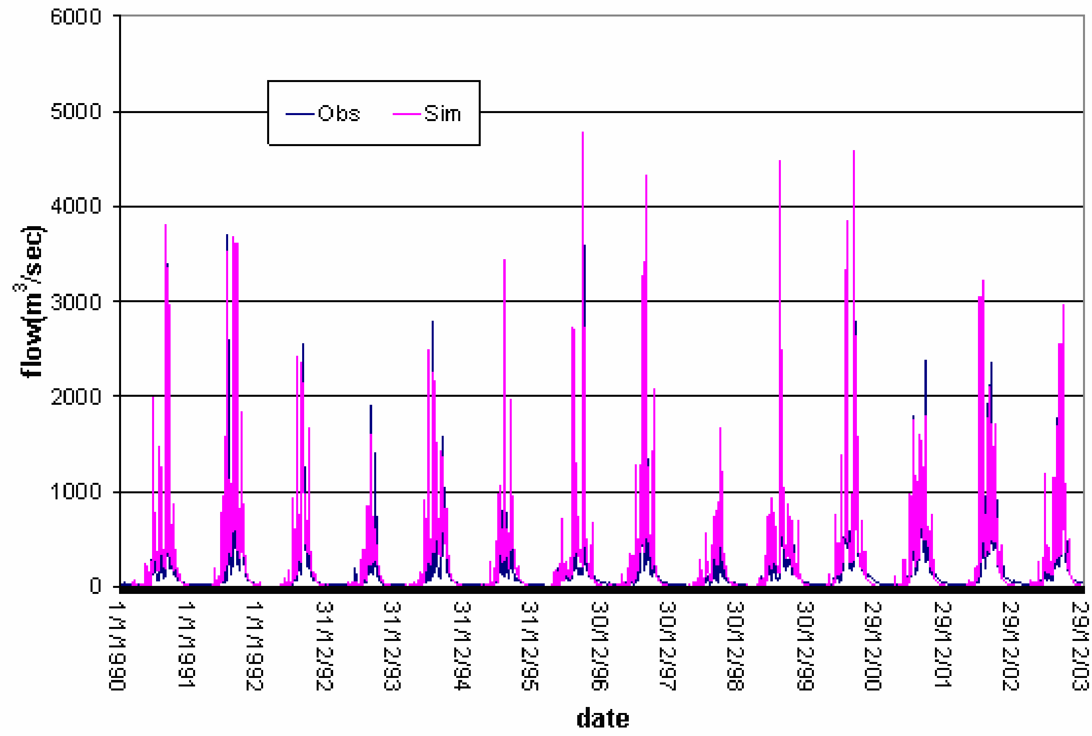

Figure 4: **Observed and simulated hydrographs from calibrated GeoSFM for the Se Done River at Souvanna Khili station. (See poster session G. Artan and G. Husak.)**

The National Weather Service River Forecast System (NWSRFS) is a fully functional operational river and flood forecasting system that is used in the U.S. to issue warnings, manage water resources, and guide navigation. The system has been implemented in a wide range of climates in both the U.S. and around the world as part of NWS technology transfer projects. NOAA, USGS, and USAID/OFDA are in the process of developing a hybrid NOAA-USGS system that would integrate independent developments from the two science agencies and apply them to the developing world. The Hybrid Flood Forecast System is well suited for application in data-sparse areas such as the Mekong River Basin. Dr. Day will illustrate the technical advantages of the system as illustrated in Figure 5.

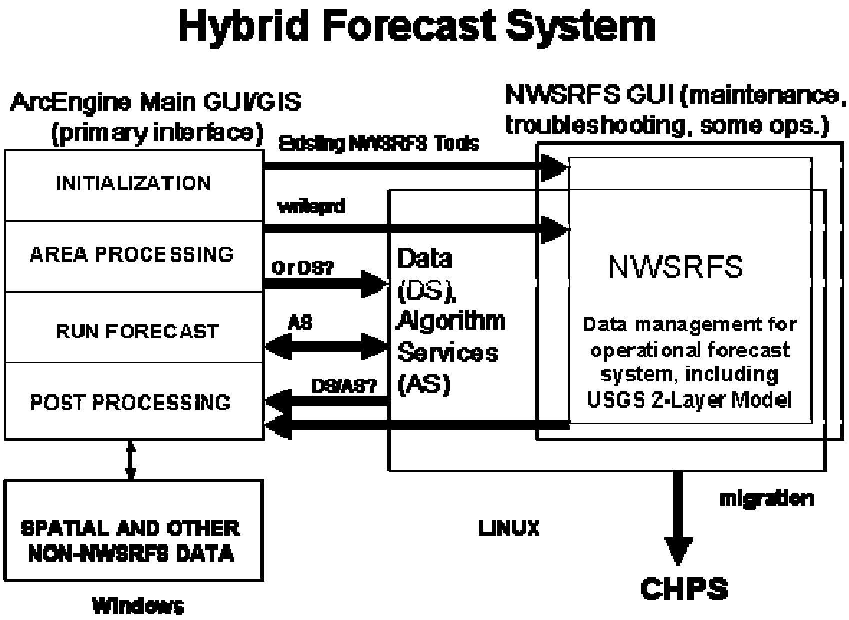

Figure 5: Hybrid NWSRFS and GeoSFM system. (See poster session, J. Day.)

Planning, Preparedness, Decision Making, and Coordination

For successful flood mitigation, decision makers must implement necessary measures such as planning for extreme events, developing policies for disaster management, warning affected populations, and providing coordinated and effective responses to disasters.

Dissemination of Information to People at Risk

State of the art technology and perfect forecasts alone can not save lives and property unless forecasts and warnings reach the populations at risk with sufficient lead time to take appropriate measures to reduce the impact of disasters. MRC and NOAA hold a workshop on implementing the Radio and Internet (RANET) technology in the lower Mekong River basin in 2005. RANET, used globally to improve dissemination of information to people in remote areas, is an international collaboration to improve access to weather, climate, and related development information for populations in remote and resource poor areas. The technology assists in day-to-day resource decisions and preparation against natural hazards. RANET identifies appropriate, low-cost communications technologies—primarily based on radio and internet standards—that can be used to augment existing communication systems in developing countries. A key tenant of the RANET program is local ownership and management. RANET depends on four critical components (see Figure 6) to move information from capital cities to rural communities. As a result of the workshop, NOAA and MRC received pilot project proposals from riparian countries. MRC riparian countries participated in the global RANET workshop recently and plan to implement pilot projects in 2006.

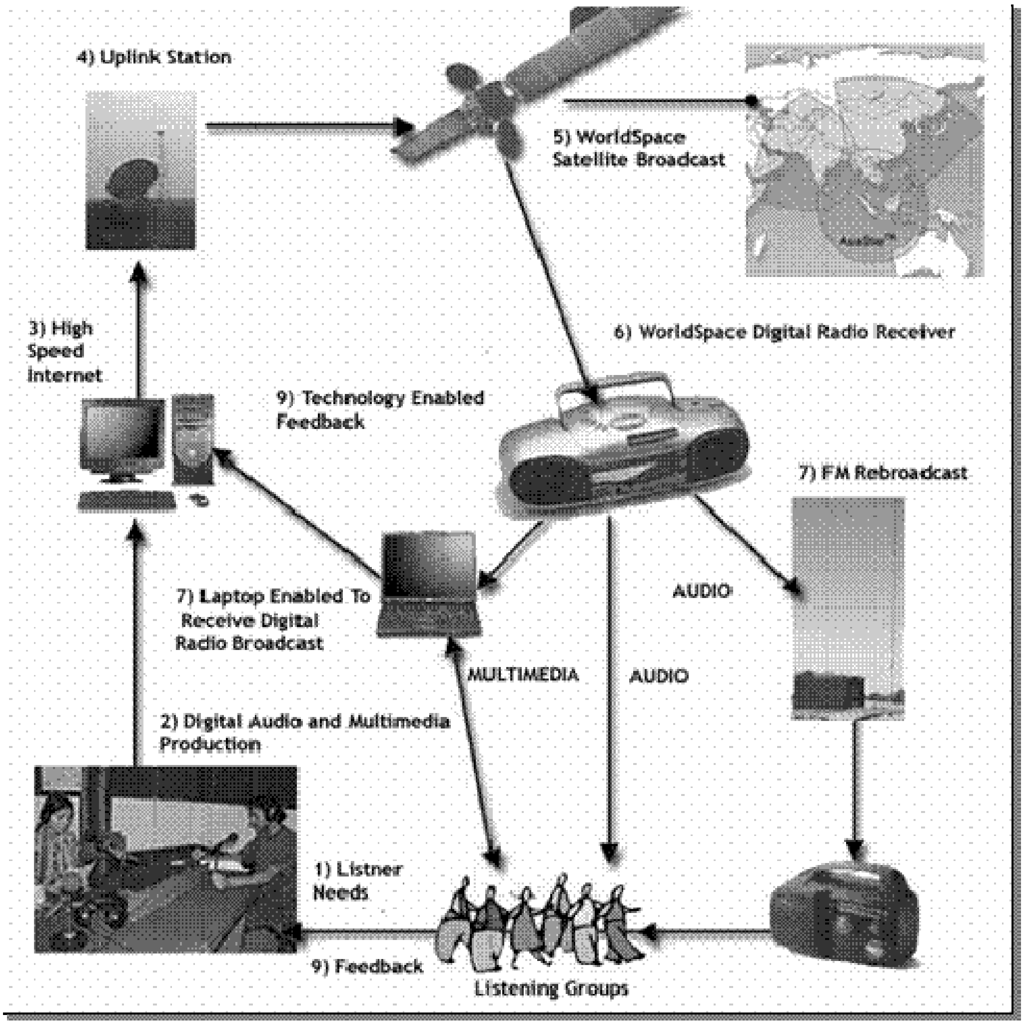

Figure 6 RANET Components.

<u>Actions Taken by Population at Risk to Lessen the Impacts of Potential Hazards</u>

USAID/OFDA has been supporting community-based preparedness and early warning projects in the region to raise community awareness and capacity to reduce vulnerability to extreme floods. USAID/OFDA and MRC have been implementing a community-based flood preparedness project in Cambodia in partnership with American Red Cross, Action Contra la Faim, and the Cambodian Red Cross. Another example is the community-based flood information system that has been implemented in Bangladesh by Riverside Technology, Inc., the Center for Environment and Geographic Information Services (CEGIS), and the Bangladesh Disaster Preparedness Center (BDPC). (See poster session by Dr. Martin et al.)