



HYDRO AND AGRO INFORMATICS INSTITUTE
MINISTRY OF SCIENCE AND TECHNOLOGY



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HAIT

SCIENCE & TECHNOLOGY
for better Agricultural &
Water Resource Management



HYDRO AND AGRO INFORMATICS INSTITUTE



HAI



Background

Thailand has long encountered a variety of water-related problems such as water scarcity, flooding, and water pollution in every region, which interfere with the economic and social growth of the country. With agriculture being the backbone of Thailand's economy, the proper management of water resource is undeniably critical.

HAI was originally established in 1998 by the initiative of His Majesty King Bhumibol Adulyadej, with support from the Massachusetts Institute of Technology (MIT) and working closely with the Office of the Royal Development Projects Board (RDPB) and Thailand Research Fund (TRF), to help develop a coherent plan to improve water resource management in Thailand. This collaboration set up the process of data gathering and forming research and development networks among various organizations to collectively contribute in all aspects of water resource management.

1998

"Thailand Water Resources Management Network" was initiated by H.M. The King



2000

Awarded for the Patent of "The Process of Data Display and Map for Geography Resources Management"



2002

- Developed Terabyte Server for large scale data repository and data backup
- Started the Agro Informatics Network Project



2003

Collaborated with the National Agriculture Research Organization (NARO)-Japan on Telemetry Research (Field Server)



Vision

Aiming at developing and applying science and technology knowledge for agricultural and water resource management in order to cope with climate change ; and expanding the accomplishment through the design and development of strong and effective networking.

2004

16 January 2004
Hydro and Agro Informatics Institute (HAI) was established under NSTDA , Ministry of Sciences and Technology



Collaboration on Community Water Resource Management (CWRM) with private sectors such as Coca - Cola, SOG and PTT



2006



2008

27 December 2008
The Royal Decree on the establishment of Hydro and Agro Informatics Institute (Public Organization) B.E. 2551 was promulgated.

2009

1 January 2009
The Royal Decree on the establishment of Hydro and Agro Informatics Institute (Public Organization) B.E. 2551 was in effective.



Missions

1. Conducting research and development of science and technology, including collecting, synthesizing, and analyzing data in respect to agricultural and water resource management;
2. Disseminating the research and development outcomes to other agencies for the efficient improvement of agricultural and water resource management;
3. Promoting research and development collaborations, nationally and internationally;
4. Expanding the services and disseminating the research and development outcomes, accessibly and effectively, for the benefit of others



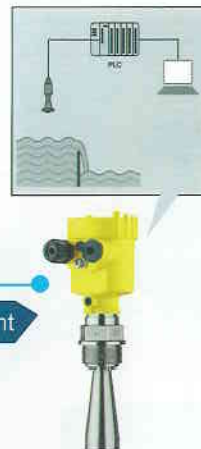
Automatic Weather and Water Level Monitoring System

Since 2004, HAI has developed a telemetering system to monitor weather and water levels from remote stations. Our station consists of several sensors measuring water level, precipitation, temperature, humidity, atmospheric pressure, and solar radiation and automatically links all data through the transmission system (3G, GPRS, etc) of Local Network providers and Satellite Communication System. HAI telemetering station has a compact design but still can deliver accurate measurements and is powered by a solar panel. Currently, over 700 stations are deployed and operated 24/7 countrywide and the data are displayed at www.thaiwater.net. These measured data are being used to support the water situation analysis necessary for effective water and disaster management and flood warning system.

Data Logger
Weather Sensors
Rain Gauge
Solar Panel



Water Level Measurement



Weather and water level telemetering station with K-Band Radar system

Recently HAI upgraded our water level sensor to be the K-Band Radar beam measuring the change of water level based on beam reflection from water surface with high accuracy ± 2 mm.

Mobile Surveying Technology



Unmanned Aerial Vehicle: UAV

Collaborated with the Institute of Field Robotics (FIBO), King Mongkut's University of Technology Thonburi

- » Operates on a flight route programmed before take off
- » Installs equipment for surveying from bird's-eye view e.g. Digital cameras and GPS, etc
- » Data obtained can be used for high resolution mapping



Land Mobile Unit or Mobile Integrated Geospatial Intelligence System

Collaborated with the Institut Cartogràfic de Catalunya (ICC), Spain

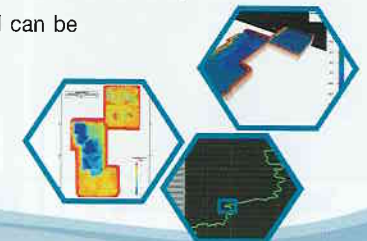
- » Uses Mobile Mapping System (MMS) in making topographic map by applying coordinates and the direction of movement (Orientation) and topographic surveying system (Sensor) for object finding purposes
- » Quick surveying and making the topographic map with high accuracy of mean sea level reference



Autonomous Robot Boat for Environmental Data Acquisition

Collaborated with Department of Science Service (DSS), and Rajamangala University of Technology Thanyaburi (RMUTT)

- » The robotic system can carry surveying or data acquisition instruments for tasks such as river profiling, hydrological data acquisition, and water quality measurements
- » helps alleviate the normally strenuous and risky tasks of field survey work
- » Increases capability of performance, the data obtained can be investigated in real-time with capability of capturing dynamical behavior of data

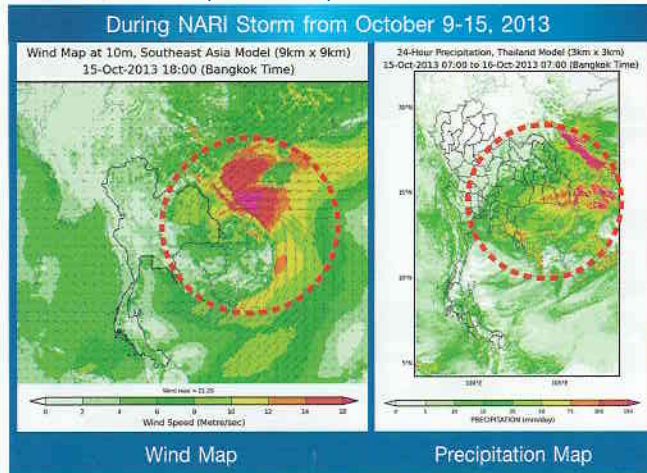




Development of Weather Forecast System

WRF (Weather Research and Forecasting Model)

Wind and Precipitation Map Forecast from WRF Model

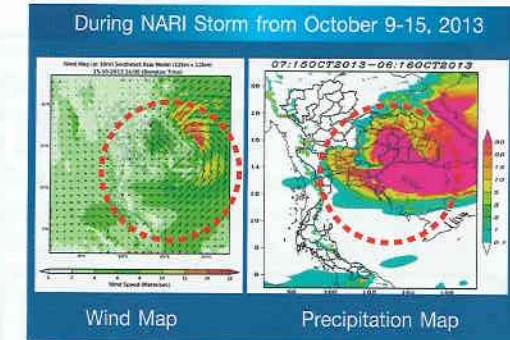


HAIL customized the Weather Research and Forecasting Model (WRF) for Thailand and generates wind, rain, and weather maps that can forecast 3 days ahead with $3 \times 3 \text{ km}^2$ resolutions and 7 days ahead with $9 \times 9 \text{ km}^2$ resolutions. The data is processed twice a day, and then sent to related agencies and the public via website www.thaiwater.net.

RAMS (Regional Atmospheric Modeling System)

The collaboration of HAIL, Electricity Generating Authority of Thailand (EGAT), National Electronics and Computer Technology Center (NECTEC), Faculty of Science-Chulalongkorn University and the Institute of Atmospheric Physics (IAP)-Chinese Academy of Sciences (CAS) together developed the RAMS (Regional Atmospheric Modeling System) that can run weather forecasts 3 days ahead at $3 \times 3 \text{ km}^2$ resolutions and $12 \times 12 \text{ km}^2$ resolutions. Currently, it is in the process of developing the RAMS data display system, which consists of wind, rain and temperature maps at different height levels hourly and daily, for the Thailand wind database development. This will help develop the potential of wind power, storm and rainfall monitoring and water management planning.

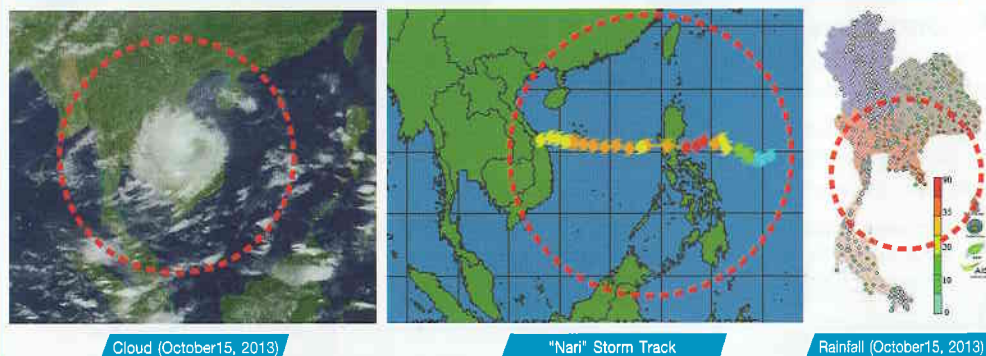
Wind and Precipitation Map Forecast from RAMS Model



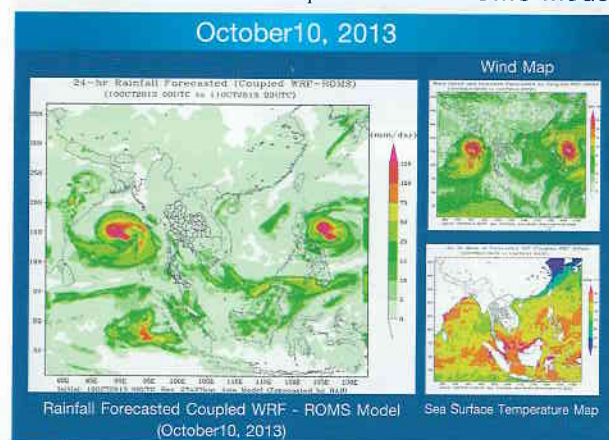
2-way Coupled Models for Precipitation Prediction

HAIL developed the model for precipitation forecast by using the Weather Research and Forecasting Model (WRF) together with Regional Ocean Modeling System (ROMS) for short-term precipitation in Thailand and Indo-China countries, based on the Earth System Modeling Framework (ESMF) that improve forecast accuracy both spatially and quantitatively.

The Weather (October15, 2013)



Rainfall Forecasted Coupled WRF - ROMS Model



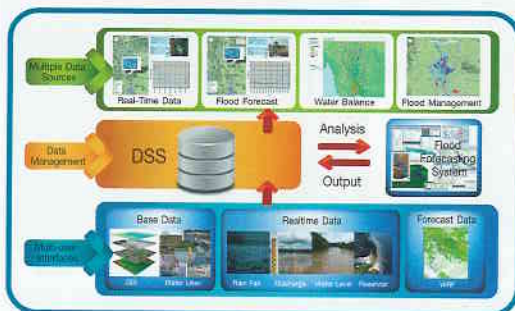
The Weather (October10, 2013)





Towards A Development of A Decision Support System for Flood Management in Chao Phraya River Basin, Thailand

The Model and decision support system for analyzing flow and flood forecast in The Chao Phraya River Basin are the upgraded systems of effective collection and analysis of data application. The system has linked the rainfall forecast data and hydrological measurement data to the Waterway Network Model System and Flood Forecast System. All data are analyzed, monitored and used to forecast the water situation in Chao Phraya River Basin, 7 days in advance. This forecast is accurate, approx. 60-80%, and could be applied in different scenarios for long-term flood management plan.



Integrated Flood Forecasting System



The Structure Represents The Linkage of Streamflow Forecast Data for Flood Management



Display the system via Website

System Structure consists of :

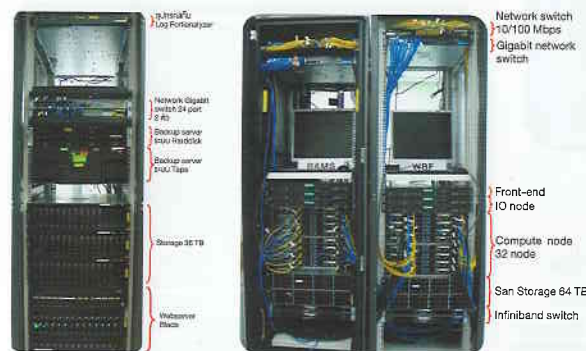
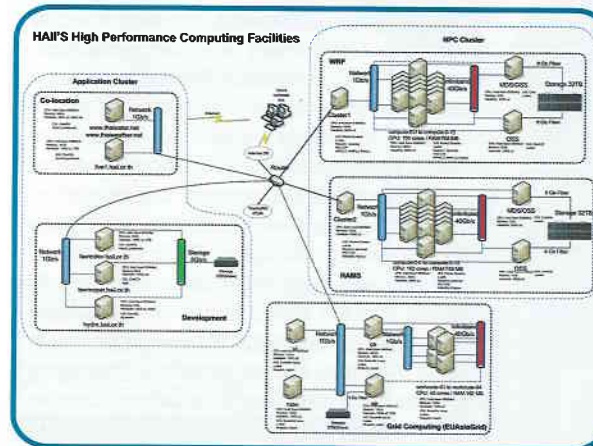
- » Model System: link the rainfall-runoff forecast data to the water resource management model in order to calculate and get the data of water balance which used for water resource management. All the models are linked to database and real-time automated measurement data with DHI Solution Software Program on Client server computer network, which is a decision support system.
- » The decision support system (DSS): links data base, real-time measurement data, rainfall forecast data, the linkage between calibrated model system, input data format, analysis processing, and presentation in assigned format.



High Performance Computing



Computing Network System Chart



HAI's High Performance Computing (HPC) Network System was developed based on Cluster Computing technology that connects computing clusters via high-speed network. Job distribution among the computing clients increases the processing efficiency; and with the optimized parallel processing, the system can perform as well as, if not better than, the Supercomputer. Currently, Terabyte Server and HPC are in-use in Clustering format to process the flood and weather models; store big sets of data such as Thailand telemetering data, geo-informatics data, and the data collected from relative agencies on Hydroinformatics Data Warehouse; and provide data exchange service with other agencies using web service. HAI has also developed HPC in Grid Computing format that links with EU-Asia Grid network to increase cluster system efficiency in supporting various scientific researches.

Currently, HAI operates on its 32 nodes, 384 cores, 1 TB RAM and 32 TB storage system. It can process complex applications in short periods of time, such as WRF Model (Weather Research Forecasting), RAMS Model (Regional Atmospheric Modeling System), and ROMS Model (The Regional Ocean Modeling System). These models are processed daily at the resolution of regional and provincial levels. The model with higher resolution is now under development.



National Hydroinformatics and Climate Data Center : NHC



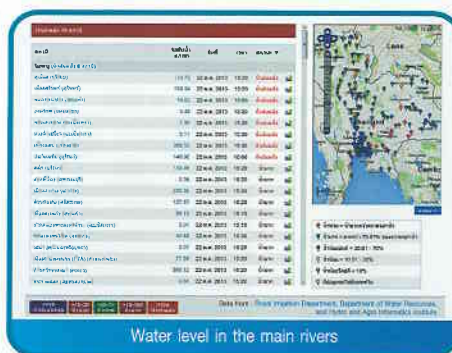
NHC Diagram

The database has the standard format and the international standard of system development process. The data sets are categorized as follows:

1 Water Data

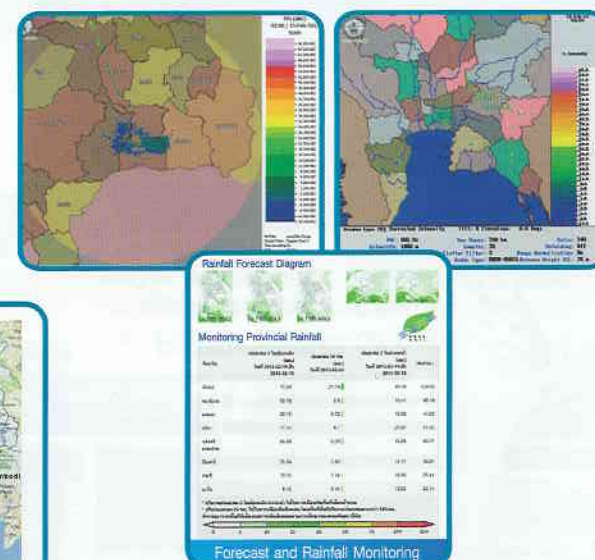
to monitor water situation throughout the country. The information is represented in various formats appropriate for actual use. They comprise the water levels of dams, main rivers, canals, sea, as well as water level images from Closed Circuit Television (CCTV).

National Hydroinformatics and Climate Data Center collects and integrates information from 12 water resources and weather related agencies, i.e., Royal Irrigation Department, Thai Meteorological Department, Department of Water Resources, Department of Groundwater Resources, Marine Department, Hydrographic Department (Royal Thai Navy), Electricity Generating Authority of Thailand, Bangkok Metropolitan Administration, Land Development Department, Department of Mineral Resources, Geo-Informatics and Space Technology Development Agency (Public Organization), and Hydro and Agro Informatics Institute. All collective data are stored in the same database and available for exchange between agencies in order to maximize mutual benefits in managing water resources, controlling all situations, disaster warning, and minimizing life and property loss in a timely manner.



2 Weather Data

to monitor the situation of rainfall, temperature, storms and rainfall forecasts. These are data from the real-time telemetering stations throughout the country, data from RADAR weather stations and 3-7 days rainfall forecasts.





NHC Mobile Application

NHC Mobile Application

Thai water and Thai weather at your fingertips

NHC Mobile Application is Thailand's water and weather information service freely available to the public for 24 hour monitoring of water and weather situation. The application, available on iOS and Android, provides information on rainfall, weather, water level in main waterways, storm tracking, storm severity level, reservoir storage as well as 7-day weather forecast.



Available on both
iOS and Android



Free
Download



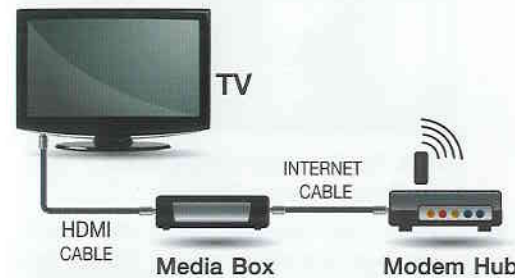
Free download
by searching
"NHC Thailand"



"National Hydroinformatics and Climate Data Center (NHC)"
Integrating and exchanging information from 12 relevant agencies



Automated weather and water monitoring system (Media Box)



Connection:

Through the internet via LAN or wireless system from the modem router which converts the internet signal before connecting to media box equipment.

Media Box displays weather information, 3-7 days rainfall forecast from WRF Model, 24 hour cumulative rainfall from telemetering stations, satellite images from MTSAT-2 satellite and storm direction and storm tracking diagram of the Pacific Ocean. Other supporting data such as water storage level in the dams, water level in the main canals and rivers, and sea level information are also provided.

Ability to monitor water situation and promptly respond to disaster is necessary and crucial to the safety of life and property. Hydro and Agro Informatics Institute (HAI) has developed an automated weather and water monitoring system or Media Box, using RSS News Feed technology, which allows the local administration and local people to conveniently access weather data and weather forecast data. The Media Box is easily installed, a reasonable price and suited for communities and local administrations.



Media Box equipment set
consists of the main unit, remote control, adaptor, AV cable and HDMI cable to connect to TV.



Science and Technology for Community Water Resource Management



The application of satellite images and GPS receivers

enables community people to understand the overall images of the local area, and systematically plan for appropriate community resource management. The technologies can be used to create local water charts, which are a tool to appropriately develop existing or additional water infrastructure, land use allocation, nature study trails for head watershed conservation, mangrove and coastal resources management and etc.



Data Management

The application of scientific data can benefit local management and agricultural planning. The data of water level, water quantity, and agricultural product marketing, can appropriately produce agricultural products yearlong that are suitable with current market trends and local water resources. Moreover, the use of satellite images and GPS receivers also enables a community to survey and understand their overall area and create a suitable planning structure.

HAI cooperatively works with community and Local Administration in order to apply science, technology, and information systems as tools to support community water resource management. Science and technology such as water and weather data, maps, satellite images, and GPS receivers, can support communities to effectively develop water structures for agriculture, water for consumption, and prevent problems of flood and drought. As a result of the project, best practices of community water resource management are created and aimed to expand their success to other communities.



Data Application Usage from Telemetering Station

The community can use data from a telemetering station installed nearby to monitor rainfall and temperature changes that can affect agricultural products. For example, using data from a telemetering station to monitor rainfall and temperature which affect the natural efflorescence of longan.



Automated weather and water monitoring system (Media Box)

Local Administrations and communities can easily access data of current weather and forecasts which are beneficial for local water resource management, prevention, and surveillance.

Community Water Resource Management Network : Science and Technology Usage

