Integrated Flood Analysis System (IFAS)

ICHARM has developed the Integrated Flood Analysis System (IFAS) based on the distributed hydrological run-off model (multiple-layer tank model) of the Public Works Research Institute under the concept of addressing issues in developing flood forecasting models, particularly in developing countries.

ICHARM has also provided a number of training courses on IFAS to broaden the number of users and implemented flood forecasting systems (early warning systems) in individual rivers through projects in order to contribute more to the mitigation of water disasters in the world.

In developing IFAS, ICHARM considered the following issues commonly faced by developing countries:

(1) No observation data such as rainfall, water levels, and flow rates have been accumulated, and no real-time observation networks have been in place. Consequently, there are no sufficient data available for developing and operating a model.

(2) Commercial runoff models are often costly, requiring a budget for development and operation.

(3) To ensure simple, effective use of the system by users in public offices, the models installed in IFAS should be equipped with an interface to enable easy input and output and visual functions to display simulation results.

(4) The models should not be a black box. They should be mechanically simple, and equipped with functions to adjust parameters, which allow users flexibility in system operation by calibrating parameters according to characteristics of individual river basins.

(5) To develop and operate models effectively, the capacity of engineers should also be developed and thus training is indispensable.

To meet these challenges, ICHARM determined the concept of IFAS development and operation based on the following considerations:

(1) A distributed hydrological model, capable of estimating the spatial distribution of model parameters from global data, should be the primary choice to be installed in IFAS, since the application of such a model to IFAS has become possible with the advent of powerful computers. Although its resolution and accuracy are still limited at present, the model should be set up and operated in a way to maximize its capacity by using global data and near-real time satellite-based rainfall data. In addition, the model should be designed to improve simulation accuracy by using ground data when available since they are more accurate than satellite data.

(2) Free software should be developed to allow free downloading of executable files from the website.

(3) Graphical User Interface (GUI) should be equipped to enable easy input and output operations. In addition, by using a geographical information system (GIS), the system should be capable of the creation and display of graphic charts showing spatial and temporal distributions of flow rates, rainfall, parameters, river channel networks, and terrain.

(4) The parameters will be provided in default values, but should be manually adjustable. Land-use classification and the definition of river channels should also be customizable.

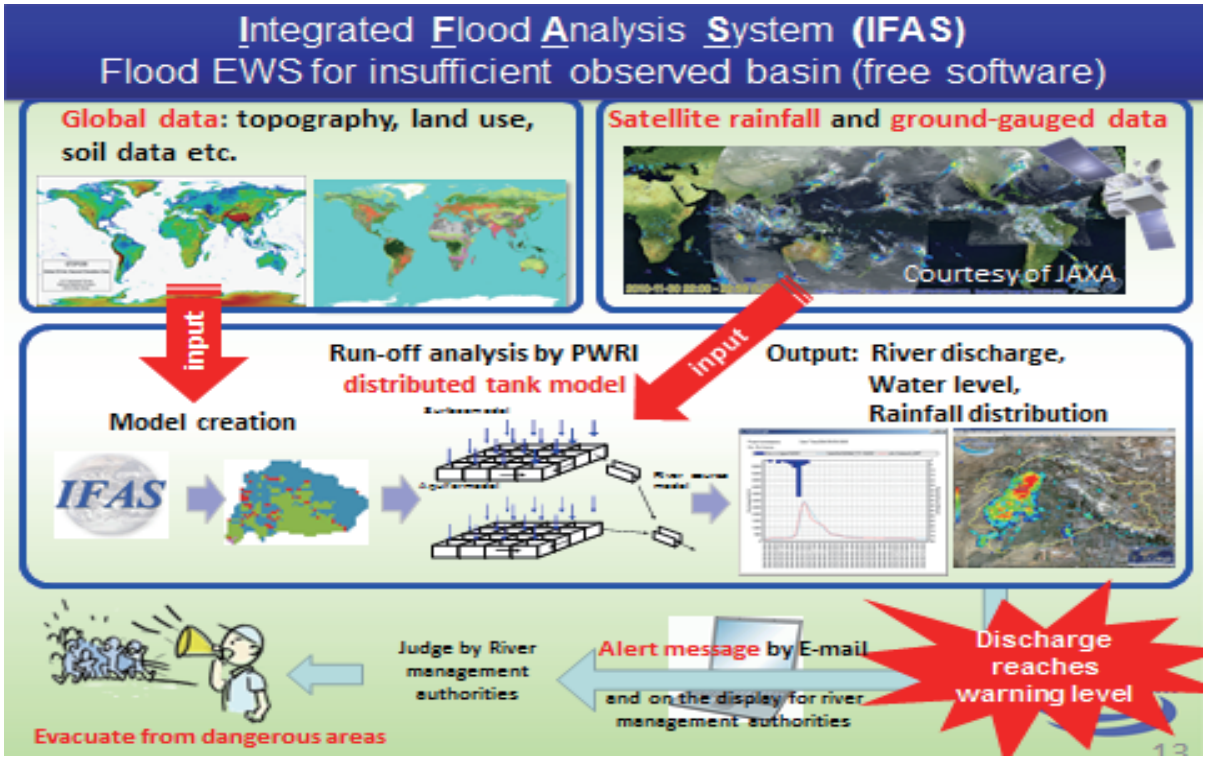

Figure 1 IFAS structure

(5) An instruction manual should be prepared and extensive training courses should be provided in cooperation with JICA.

The distributed hydrological runoff model, the main engine of IFAS, is based on the model developed by the Public Works Research Institute since the 1980s (the three layer tank model for flood and drought analysis ver.1 and two layer tank model for flood analysis ver.2, both using the kinematic wave model for river channel flow). To add GUI functions to this model, a joint study with nine private consultant firms was conducted for three years between 2005 and 2007. Thereafter, ICHARM continued the improvement and expansion of its functions, and in 2008 established a runoff simulation system that was able to download satellite precipitation data (See Figure 1).

IFAS has been used in the Solo River in Indonesia since 2009 and the Cagayan River in the Philippines since 2012 under the ADB project (TA7276) to simulate flood runoff, and eventually the complete system was installed in the basins. In 2011, ICHARM released IFAS (ver. 1.3β) on the website (http://www.icharm.pwri.go.jp/research/ifas/index.html), which incorporated an automatic warning function (Auto-IFAS) to automatically simulate and alert at a preset flow rate (water level). Since 2012, IFAS has been introduced as the Indus-IFAS, a UNESCO project of the Indus River basin flood analysis system in Pakistan. In 2014, with improved operability, IFAS (ver2.0) was released. In 2016, as an achievement of the SATREPS project, IFAS-based flood forecasting models were developed in the Kelantan River and the Dungun River in Malaysia. Currently, ICHARM is working on the development of a snow melt calculation module and the optimization of parameters. On the other hand, as IFAS is equipped with a function to set flow rates in dam operation, various simulations are possible. Ground rainfall data, if not available, can be substituted by data from radars or satellites. Satellite-based observation data have bias and require correction. Recently, a near-real time correction method using ground rainfall data has been proposed and is expected to improve simulation accuracy even in regions without sufficient ground data.

Although the structure of IFAS's flow calculation model is user-friendly both mechanically and operationally, ICHARM provides IFAS training workshops in Japan in cooperation with JICA and regional training seminars in ASEAN and Arab countries. More than 1,100 participants of 53 countries (Photo 1, 2) have so far participated. Intensive training programs through individual projects are also conducted. In Japan, in cooperation with the Ministry of Land, Infrastructure, Transport and Tourism, ICHARM has validated the flood forecasting model of IFAS for accuracy in typical river basins. It also held workshops at the Japan Society of Civil Engineers and the Japan Society of Hydrology Water Resources, and develops element models for Common MP (a Japanese version of the water-related simulation software shared platform).

ICHARM will continue improving the capacity and operability of IFAS and providing support for engineers and practitioners to sharpen the skill for more effective operation of the system.

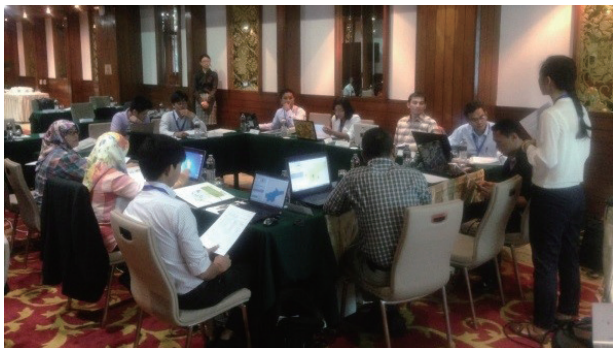

Photo 1 IFAS training (for ASEAN, Jakarta, 2014)

Photo 2 IFAS training work by Bengawan Solo River Basin Agency (2-4 March, 2010)