Construction of the Online Synthesis System for Sustainability and Resilience (OSS-SR) to realize consilience for basin-wide consensus building and facilitator training

a) Background

In recent years, ongoing climate change and increasing social and economic complexity have caused water-related risks such as floods and landslides to emerge as compound risks. Countries are being called on to advance disaster risk management in an integrated manner with climate change adaptation and sustainable development goals (SDGs), and since the adoption of the Sendai Framework for Disaster Risk Reduction (2015–2030), the priorities of mainstreaming disaster risk management and build-back-better reconstruction have been reaffirmed. Against this backdrop, the Science Council of Japan issued a recommendation in 2020, titled "Building a sustainable global society by strengthening disaster resilience: Developing an "Online Synthesis System (OSS)" and fostering "Facilitators" to realize consilience," which emphasized the need for an information infrastructure to support interdisciplinary and transdisciplinary collaboration that responds to on-the-ground challenges. The recommendation called for: (i) the development of an OSS for integrating knowledge to advance disaster risk management and sustainable development, (ii) the training of facilitators, (iii) the development of multi-perspective scenarios that integrate considerations of disaster risk management, the environment, and development, and the implementation of concrete actions, and (iv) support for OSS development, facilitator training, and the formulation of cooperative scenarios and actions at national and regional levels.1)

OSS-SR is a practical knowledge-integration platform that supports consensus building among diverse stakeholders, such as government bodies, researchers, residents, and businesses, by enabling assessment of disaster risks, visualization of future impacts, and comparative evaluation of countermeasure options at the basin scale, while also providing training materials and an exercise environment to support facilitator development. ICHARM has positioned "OSS-SR development" and "facilitator training" as its main research activities, and, in collaboration with the University of Tokyo's Earth Environment Data Commons, has been developing OSS-SR on the Data Integration and Analysis System (DIAS).

Figure 1 provides an overview of OSS-SR.

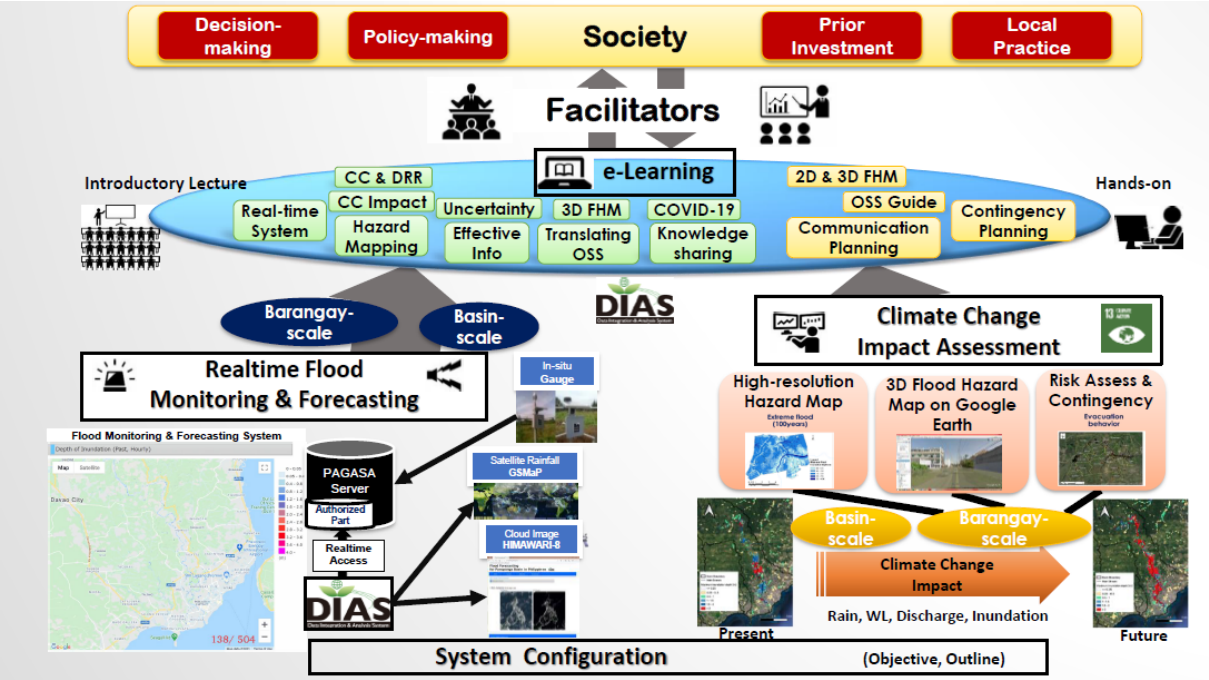


Figure 1 Overview of OSS-SR

b) OSS-SR application cases

(1) Sri Lanka: the Kalu and Mahaweli River basins

In Sri Lanka, floods recur under the influence of the northeast and southwest monsoons and cyclones, and urbanization and land-use changes have further complicated the risk structure.

Under the International Flood Initiative (IFI) platform framework, a locally-tailored OSS-SR was developed for the country's river basins to provide real-time flood monitoring, forecasting, and information sharing with relevant agencies. For the Kalu River basin (2,766 km²) and the Mahaweli River basin (10,400 km²), the developed OSS-SR automatically updates 72-hour flood forecasts every hour in real time at a 500 m spatial resolution by integrating multiple data sources into the Water and Energy Budget-Based Rainfall-Runoff-Inundation (WEB-RRI) model. These data sources include 1) ground-observed rainfall; 2) cloud and water-vapor distributions from Himawari-8; 3) rainfall distributions based on satellite rainfall estimates (GSMaP NOW); 4) GSMaP NRT rainfall distributions corrected in real time using ground-observed rainfall data; 5) river water levels and flood inundation extents produced by inputting the corrected GSMaP NRT into WEB-RRI; 6) 72-hour rainfall forecasts; and 7) rainfall forecasts.

The OSS-SR is used among national organizations, including the Ministry of Irrigation (IR), the Disaster Management Centre (DMC), the National Building Research Organisation (NBRO), and the Meteorological Department (Met Office).

Figure 2 shows an overview of the OSS-SR developed for the Kalu River.

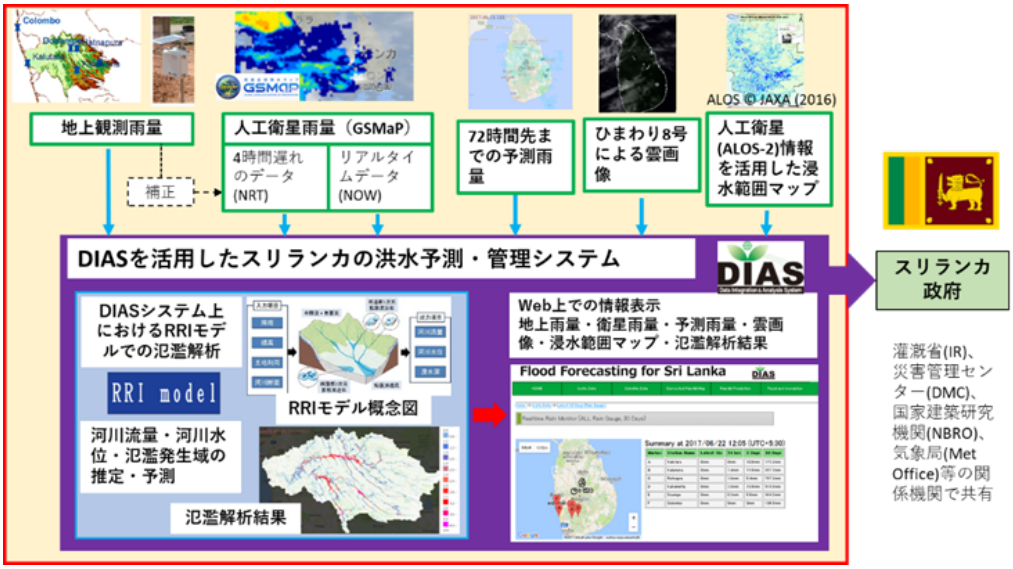


Figure 2　Overview of the OSS-SR for the Kelani River

(2)　Philippines: the Pampanga River basin

The Pampanga River basin in central Luzon, Philippines, is prone to widespread flooding during typhoons, causing major damage to both agricultural and urban areas. Under the SATREPS Philippine project, OSS-SR has been used for real-time monitoring of rainfall and inundation and for basin-scale flood-risk visualization, including flood-inundation maps that incorporate probabilistic future rainfall projections accounting for climate change; these outputs are shared with relevant agencies.

The Pampanga version of OSS-SR automatically updates multiple datasets every hour in real time at a 500-m spatial resolution. These datasets include: 1) ground-observed rainfall; 2) cloud and water-vapor distributions from Himawari-8; 3) rainfall distribution based on satellite rainfall estimates (GSMaP NOW); 4) river water levels and flood inundation extents produced by running the Rainfall-Runoff-Inundation (RRI) model with ground-observed rainfall data; 5) river water levels and flood inundation extents produced by running RRI with statistically-corrected GSMaP. The system also provides hindcast simulations of past flood events due to Typhoon Ulysses in November 2020, Typhoon Nesat in September 2011, and Typhoon Noru in September 2022, as well as information on inundation under future-climate scenarios in case of 25-, 50-, and 100-year rainfall events.

In addition, e-learning materials and the OSS-SR platform for capacity development have been shared under the HyDEPP-SATREPS project with the University of the Philippines (Los Baños, Diliman, and Mindanao campuses), PAGASA, DPWH, DOST, LLDA, MMDA, and other stakeholders.

Figure 3 shows an overview of the OSS-SR developed for the Pampanga River.

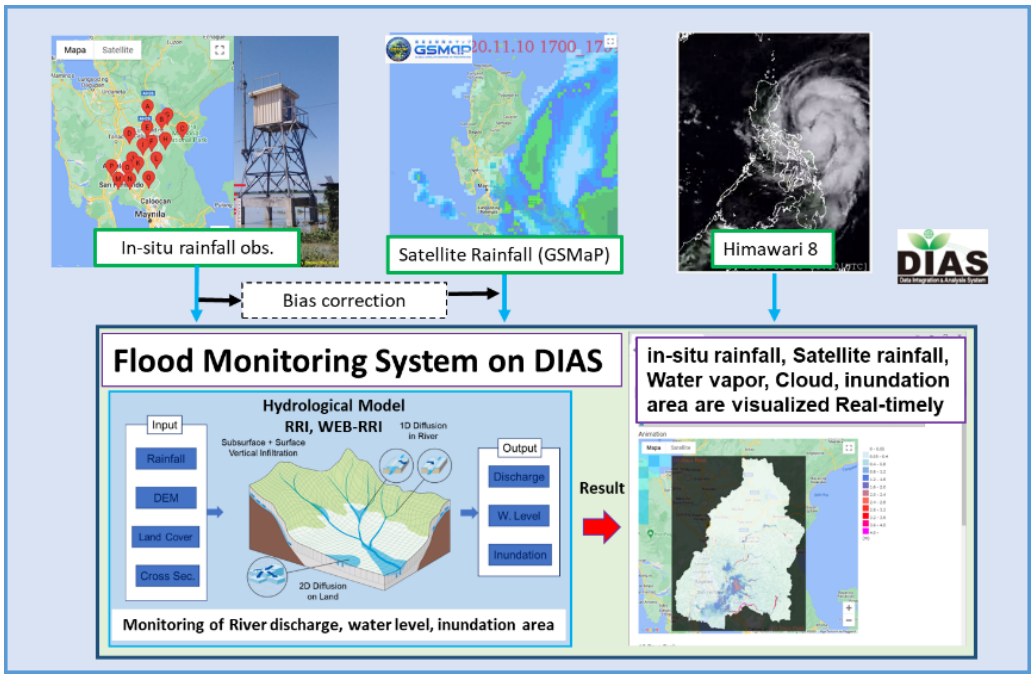


Figure 3 Overview of the OSS-SR for the Pampanga River

(3) Philippines: the Davao River basin

The Davao River basin on Mindanao Island, Philippines, faces heightened flood and landslide risks due to steep terrain and rapid urbanization. Under the IFI framework, four multi-stakeholder platform meetings were held with all relevant agencies, including PAGASA, DOST, DPWH, and the University of the Philippines. In collaboration with these local stakeholders, ICHARM conducted various activities, including developing a real-time flood-monitoring and forecasting system using OSS-SR, assessing climate-change impacts, and implementing facilitator training via e-learning.

The Davao version of OSS-SR automatically computes basin-scale river water levels and flood-inundation extents every hour in real time at a 500-m spatial resolution by inputting the following datasets into the WEB-RRI model: 1) cloud and water-vapor distributions from Himawari-8; 2) rainfall distributions based on satellite rainfall estimates (GSMaP NOW); and 3) statistically corrected GSMaP. For flood hotspots (barangays: Ma-A and Mandug), the system updates river water levels and inundation extents – produced by running RRI with corrected GSMaP – every hour in real time at a 40-m spatial resolution. It also provides information on inundation under future-climate scenarios in case of 25-, 50-, and 100-year rainfall events, and offers e-learning materials for capacity development.

ICHARM carries out these projects through strong local institutional engagement. For example, the Davao Regional Development Council adopted Resolution No. 42, formalizing collaboration with ICHARM on OSS-SR development and facilitator training.

Figure 4 shows an overview of the OSS-SR developed for the Davao River basin.

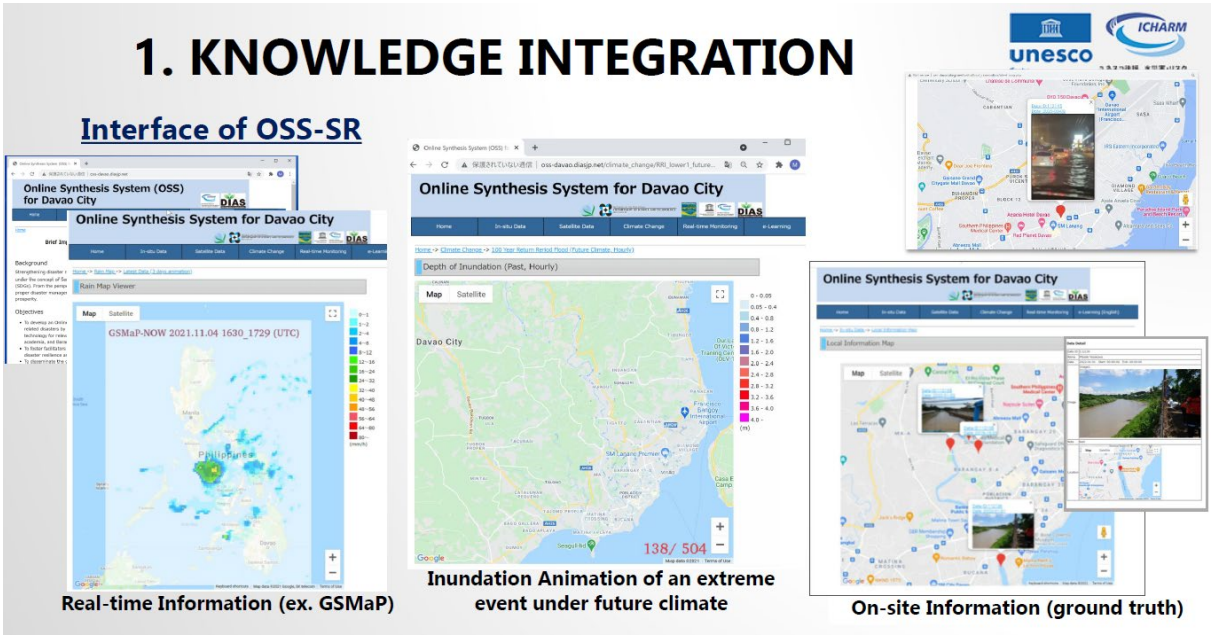


Figure 4 Overview of the OSS-SR for the Davao River basin

(4) West Africa: the Niger and Volta River basins

In West Africa, flood risk is rising while observed data remain sparse in many areas. Under the UNESCO WaDIRE Africa project, OSS-SR is used for real-time monitoring of rainfall and inundation, with outputs shared among related agencies. For the Niger River basin (2,118,000 km²) and the Volta River basin (400,000 km²), the system automatically computes the following in real time every hour: 1) rainfall distributions based on satellite rainfall (GSMaP NOW); 2) rainfall distributions based on statistically corrected GSMaP NRT; and 3) basin- and hotspot-scale river water levels and flood-inundation extents by running the WEB-RRI model with corrected GSMaP. Spatial resolution is 4 km for the Niger River basin, 2 km for the Volta River basin, and 450 m for flood hotspots. The system also provides simulations and maximum inundation depths for historical events at two flood hotspots (the July 2018 flood at Bamako on the Niger River and the October 1970 flood at Mango on the Volta River).

In addition, ICHARM prepared and provided e-learning materials, which are shared among 11 West African countries and relevant organizations such as AGRHYMET, NBA, and VBA.

Figure 5 shows an overview of the OSS-SR developed for the Niger and Volta River basins.

c) Spillover Effects and Future Prospects

The development of OSS-SR provides a framework that integrates cutting-edge scientific insights with diverse forms of locally grounded knowledge, linking “information” to “decision-making” and ultimately to “action” through tools such as flood early-warning systems. This framework enables not only effective disaster response but also proactive preparedness and problem-solving.

Moreover, when combined with capacity-development mechanisms such as e-learning, OSS-SR helps bridge the gap between scientific and technological expertise and local stakeholders and communities for whom such

knowledge is not easily accessible or understandable. It does so by offering expert advice that draws, in a transdisciplinary manner, on both scientific knowledge and the traditional and experiential knowledge accumulated within communities.

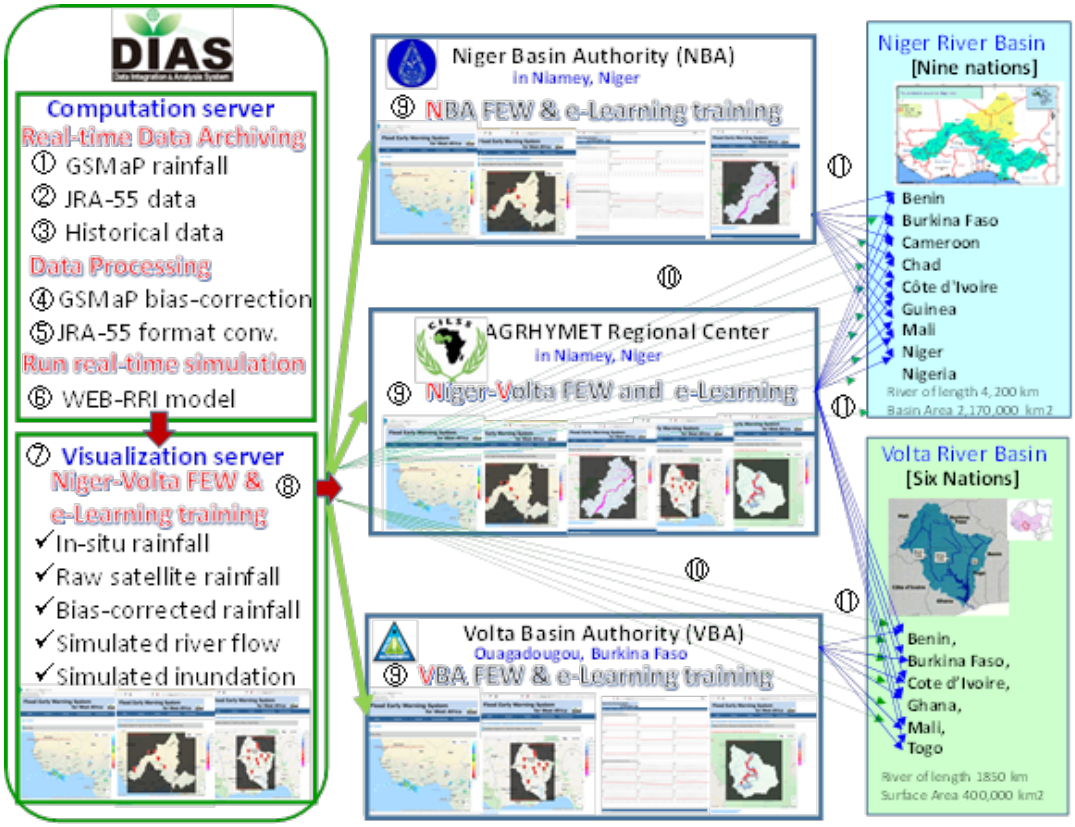


Figure 5 Overview of the OSS-SR for the Niger and Volta River basins.

One of the most significant spillover effects of this initiative is its strong contribution to cultivating "facilitators" – individuals who serve as catalysts for dialogue among stakeholders with different roles and areas of expertise, helping them jointly identify pathways toward problem-solving.

These approaches build on the achievements accumulated through demonstration studies ICHARM conducted using DIAS and have since been implemented in various projects and policies. They have been applied to the UNESCO Kenya Project, the Ghana Project, and the SATREPS Philippines Project. In Davao, the Philippines, the Regional Development Council adopted Resolution No. 42, endorsing collaboration with ICHARM on these approaches. Together, these cases demonstrate that OSS-SR's contribution extends beyond the research domain and into real-world policy decision-making and on-the-ground practice, with proven effectiveness.

Looking ahead, ICHARM will continue to draw on the knowledge and experience gained thus far to further promote the deployment of OSS-SR tailored to regional contexts – particularly in Asia and Africa – along with the development of facilitators. Through these efforts, we aim to make an even greater contribution to enhancing disaster resilience and realizing a more sustainable society.

<Reference>

1) the Science Council of Japan recommendation (2020) “Building a sustainable global society by strengthening disaster resilience: Developing an “Online Synthesis System (OSS)” and fostering “Facilitators” to realize consilience
https://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-24-t298-1en.pdf

2）ICARM Activity Report：
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