



Development of a new satellite rainfall product HiDRED (Himawari Data Rainfall Estimation using Deep learning) and a fundamental study on its applicability to hydrological models

Kansei Fujimoto¹ and Taichi Tebakari²

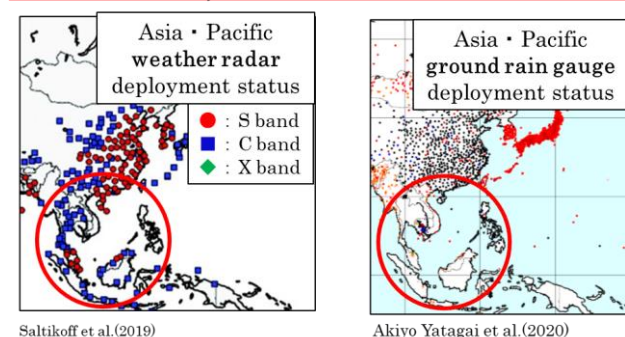
1.Graduate school of Science and Engineering, Chuo University, Japan 2.Department of Civil and Environmental Engineering, Chuo University, Japan

E-mail : a18.7asf@g.chuo-u.ac.jp



Background

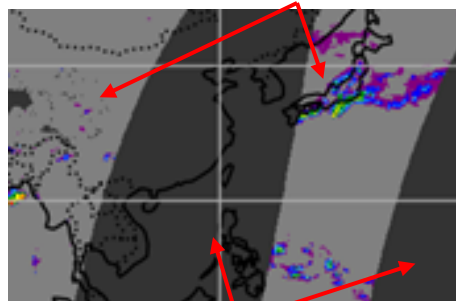
Lack of Meteorological observation networks



Satellite-based precipitation estimates offer a potential solution in ungauged basins.

Previous study

Passive microwave precipitation



Main challenges

- Errors in microwave precipitation estimates
- Spatial discontinuities caused by spatial interpolation

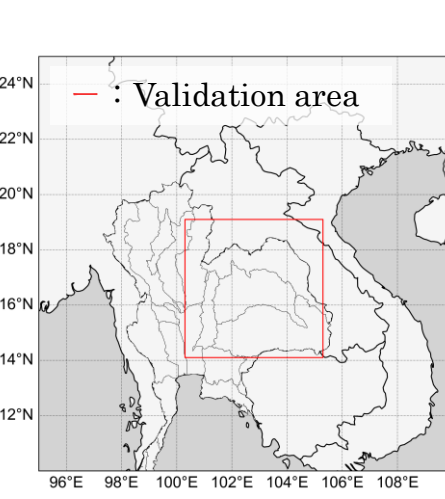
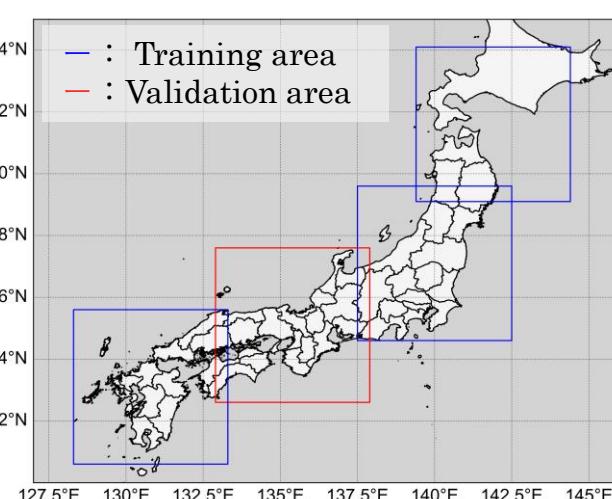
Interpolation using IR image

Objective

To generate high-resolution, **spatially continuous precipitation data** using deep learning trained on **weather radar observations**.

Methodology

Approach



Data

input data (IR image)

Observation data of Himawari-8,9

Brightness temperature

FD gridded data version 02 (CERes)

Spatial resolution : 2km Observation frequency : 10min

input data (PWM precipitation)

Rainfall data from PMW satellite

Precipitation

GSMaP MVKv08(JAXA)

Spatial resolution : 10km Observation frequency : 1hour

input data (Elevation)

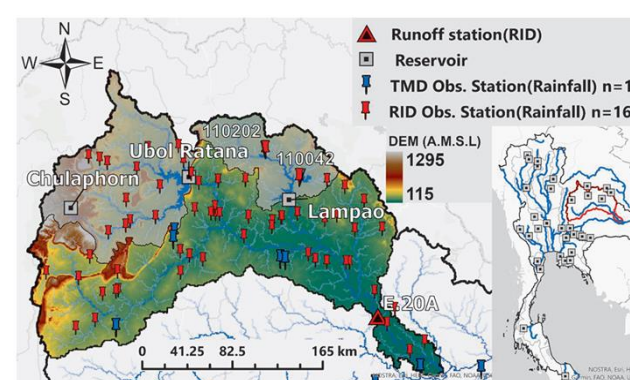
Geographical information data

Elevation

MERIT DEM (U Tokyo)

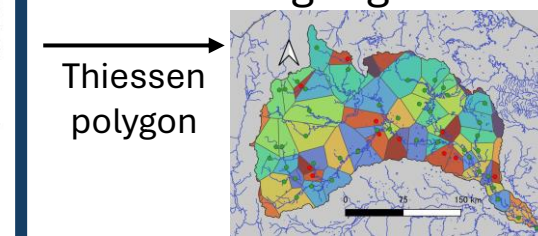
Results

Target area



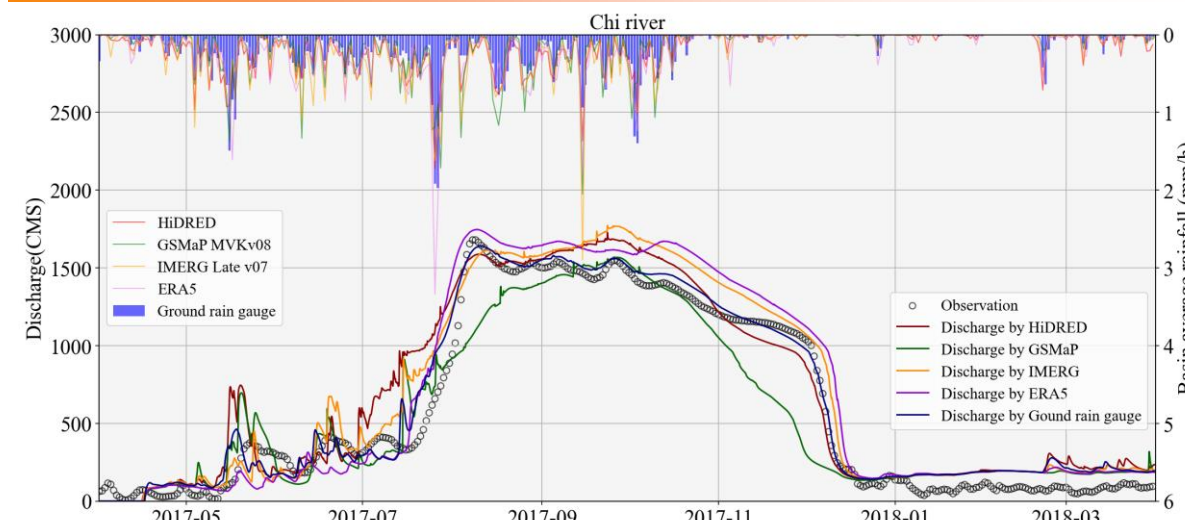
Chi river in Thailand
Basin area : 48,880km²
Number of gauges : 180

Ground rain gauge



The study area was divided into five sub-catchments to evaluate rainfall estimates. To assess the accuracy at the basin scale, runoff simulations were performed.

Discharge evaluation

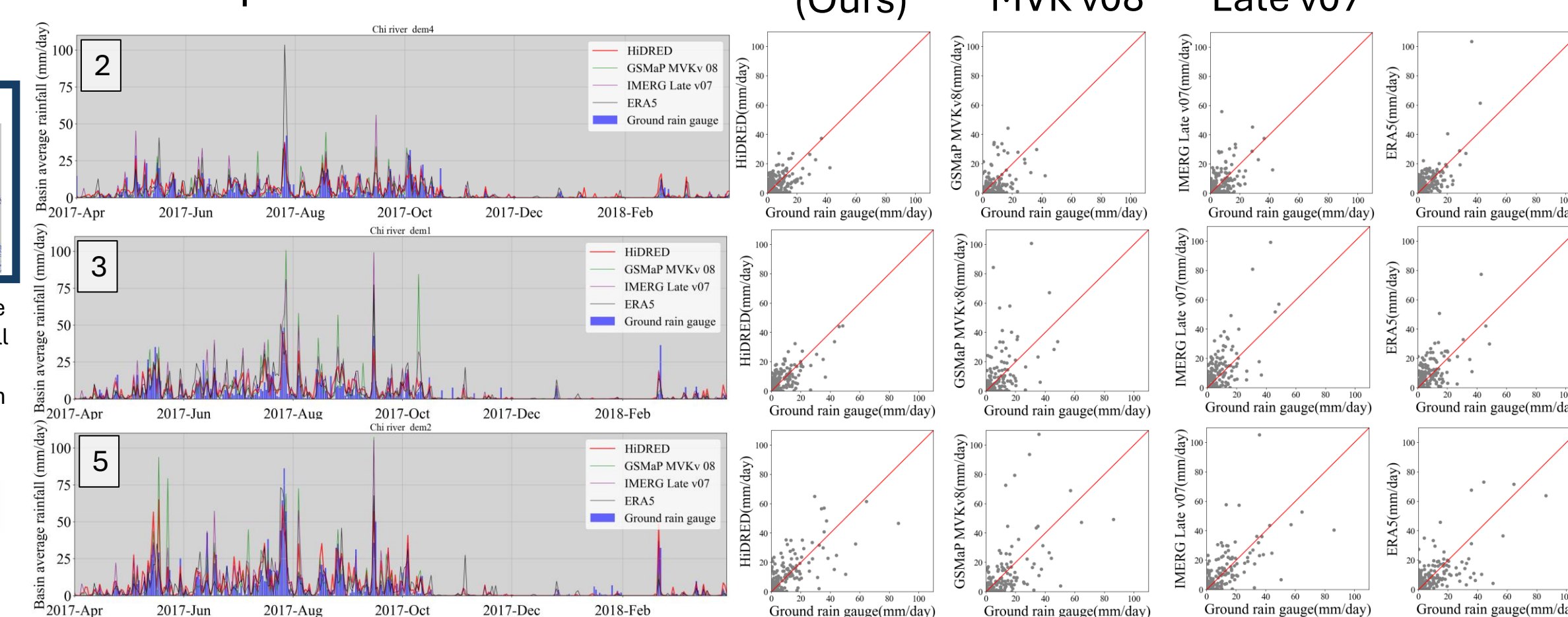


This rainfall-runoff model is calibrated by ground rain gauge rainfall. The dam release volume is also considered in the calculation.

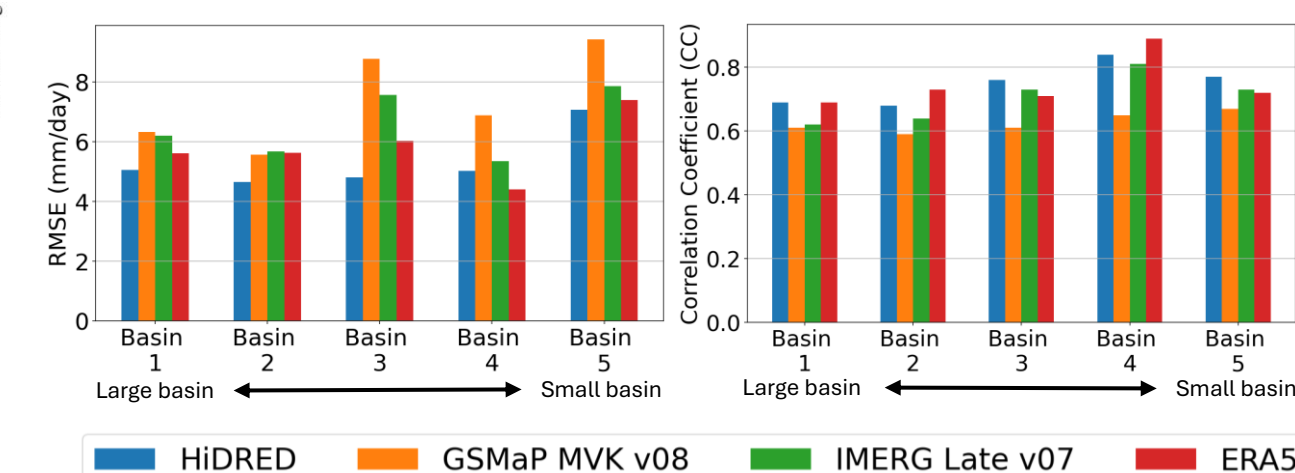
- Among the satellite-based rainfall products, HiDRED and IMERG showed good performance in the runoff analysis.
- The Nash-Sutcliffe Efficiency (NSE) values were 0.903 for HiDRED, 0.873 for GSMaP, 0.926 for IMERG, and 0.914 for ERA5.

Rainfall evaluation

Period : April 2017 to March 2018



Comparison of the RMSE and correlation coefficient for daily precipitation.



- HiDRED outperformed both GSMaP and IMERG in all sub-catchments.
- As shown in the bar plots, while ERA5 demonstrated superior performance in the larger catchments (Catchments 1 and 2), HiDRED exhibited the highest accuracy in the smaller catchments, with lower error metrics compared to other products.
- The scatter plots reveal that HiDRED maintains a close agreement with the reference data, without notable overestimation or underestimation.

Conclusion

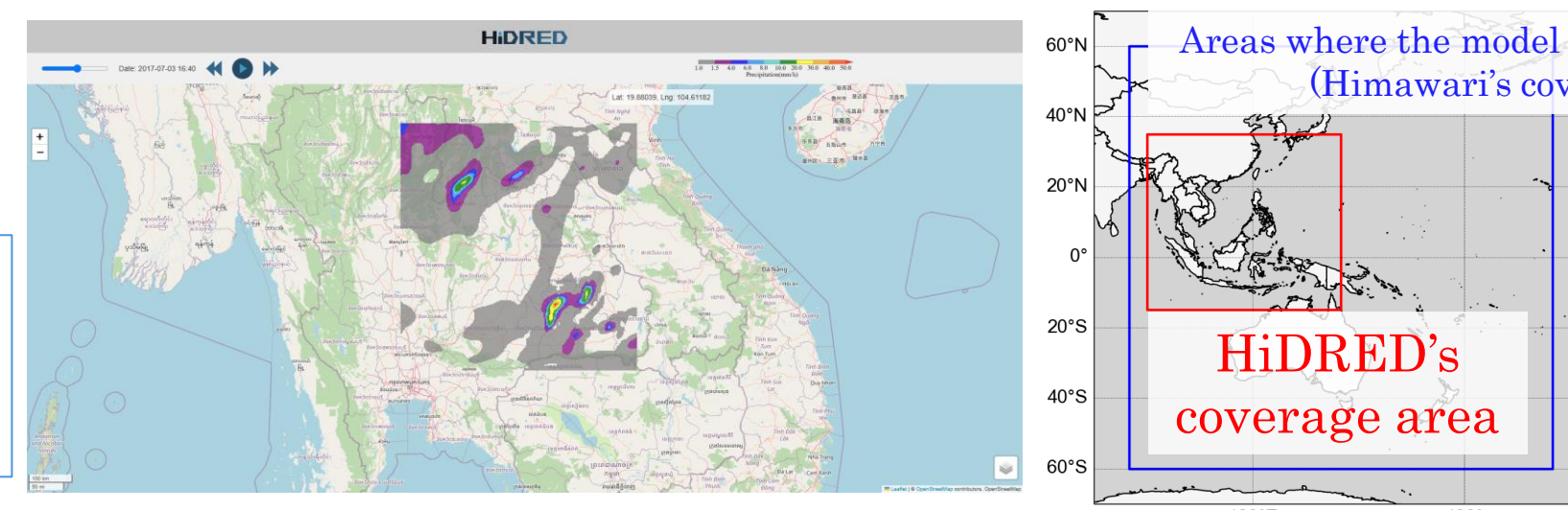
- The deep learning model trained in Japan demonstrated the potential for application in other regions.
- In smaller basins, it outperformed ERA5 in terms of accuracy.

Social implementation

HiDRED

(Web app)

Time resolution : 10min
Spatial resolution : 2km
Period : July 2015~present



This product is intended for future use by governmental agencies in Southeast Asia, with the aim of supporting disaster risk reduction and dam operation management.

