MERGED SATELLITE AND GROUND-BASED PRECIPITATION PRODUCTS FOR EVALUATION OF VERY HIGH-RESOLUTION RCM SIMULATIONS OVER CAMBODIA

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I. Introduction

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- Rainfall data are a crucial input for hydrological modelling and water resource planning and management studies
- In Cambodia, the number of rain gauges is still small, and they are unevenly distributed
- Moreover, missing rainfall data at some stations and the lack of long-term rainfall data are challenging issues, mainly for climate change studies
- In this case, satellite and ground-based rainfall products play a significant role as the alternative rainfall data sources in providing dense and long-term rainfall data.

II. Objectives

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1) To evaluate the performance of APHRODITE and PERSIANN-CDR by comparing with observed rainfall over Cambodia

2) To compare these rainfall products with simulated rainfall from a very high-resolution regional climate model (NHRCM) which is developed by the Meteorological Research Institute (MRI) of the Japan Meteorological Agency (JMA).

III. Methodology

Research Framework

1. AHRODITE & PERSIANN-CDR vs Gauge

Rainfall Data Collection
(gauge, APHRODITE, PERSIANN)
(Monthly rainfall from 2001 to 2007)

↓

Quality Check
(missing data, outlier)

↓

Rainfall Interpolation
(Interpolate gauged rainfall using IDW)

↓

Extreme Rainfall Indices
(Rx1d, Rx5d, R99p)

↓

Compare Rainfall and Rainfall Extreme Indices
(CC, RMSE, Bias, Scatter plot, CDF)

2. NHRCM vs AHRODITE & PERSIANN-CDR

Rainfall Data Collection
(NHRCM, APHRODITE, PERSIANN)
(Monthly, May to October from 1983 to 1992

↓

Quality Check
(missing data, outlier)

↓

Rainfall Interpolation
(Interpolate NHRCM rainfall using IDW)

↓

Compare Rainfall
(CC, RMSE, Bias, Scatter plot)

Note: Year 2002 was excluded from the first comparison because of some errors found in APHRODITE.
June 1984 was excluded from the second comparison because of missing rainfall in PERSIANN-CDR.

APHRODITE and PERSIANN-CDR

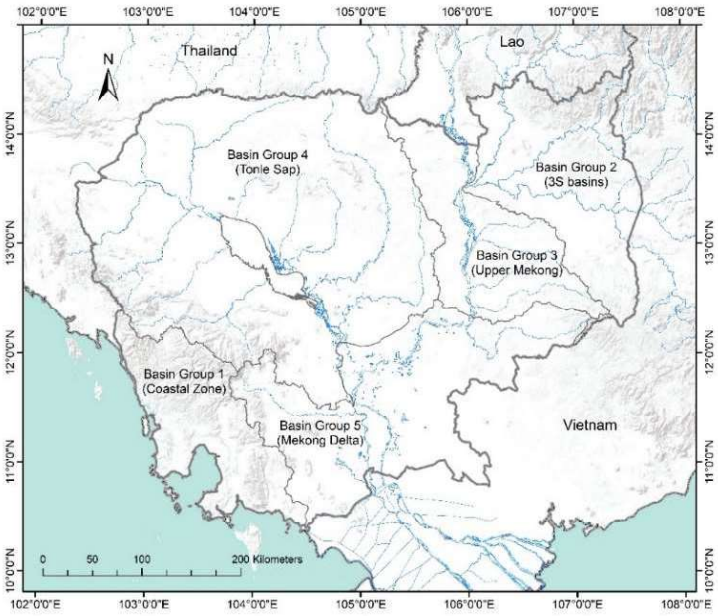
Feature	APHRODITE	PERSIANN-CDR
Spatial Resolution	0.25°	0.25°
Timescale	Daily	Daily
Data availability	1951-2007	1983-present
Coverage	Asia	Near-global (60°S-60°N)

APHRODITE: Asian Precipitation – Highly-Resolved Observational Data Integration Towards Evaluation of Water Resources

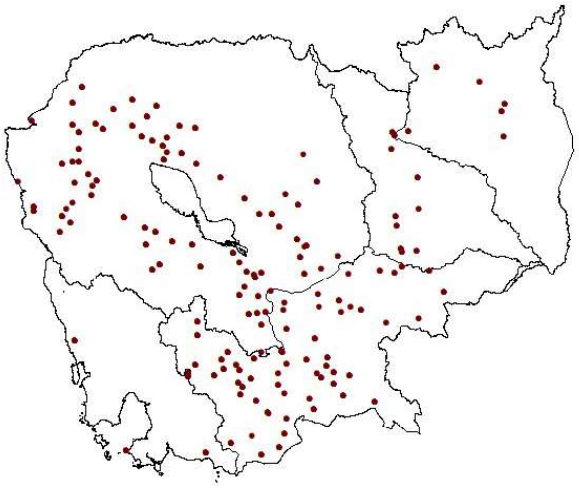
PERSIANN-CDR: Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks - Climate Data Record

Study Area: Cambodia

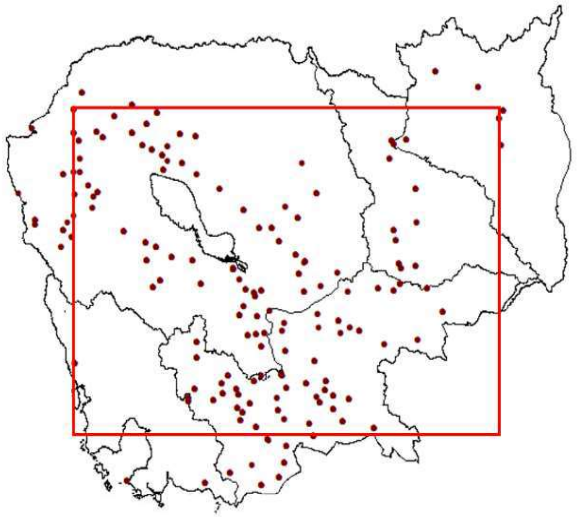
- Total area: 181 035 km^2
- Average Rainfall: range from 1400 mm in the central lowland region and may reach 4000 mm in coastal zone and highland area.
- Average temperature: 28 °C



Study Area: Cambodia



Rainfall stations in Cambodia



Selected area for rainfall comparison

Data source: Ministry of Water Resources and Meteorology (MOWRAM)

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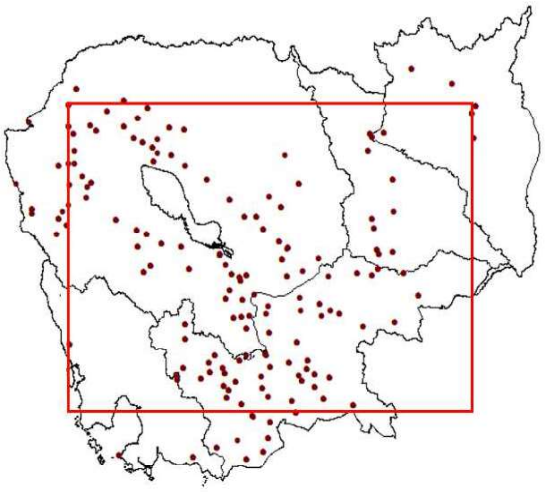
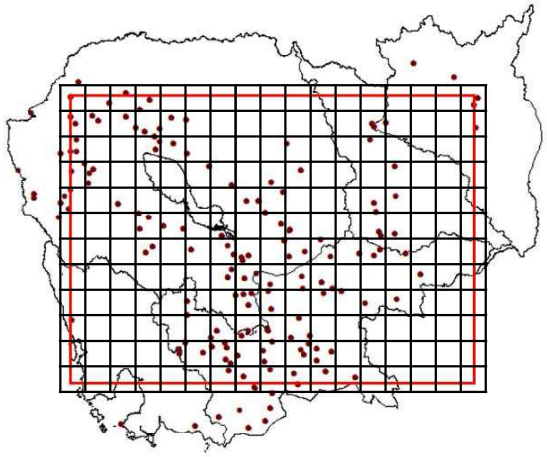
Rainfall Interpolation





The observed rainfall is interpolated using Inverse Distance Weighting Method (IDW) with grid size and center point in accordance to each gridded rainfall products.

Extreme Rainfall Indices

Indices	Name	Definition	Unit
R99p	Extreme wet day	Annual total rainfall when rainfall > 99th percentile	mm
Rx1d	Daily maximum rainfall amount	Annual maximum 1-day rainfall	mm
Rx5d	5-day maximum rainfall amount	Annual maximum 5-day rainfall	mm

Statistical Indicators for rainfall comparison

$$CC = \frac{\sum_{i=1}^{n}(x_i - \bar{x}).(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 . \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(X_{obs,i} - X_{model,i})^2}{n}}$$

$$BIAS = \frac{\sum_{i=1}^{n}(X_{model,i} - X_{obs,i})}{\sum_{i=1}^{n} X_{obs,i}} \times 100$$

Where

$X_{obs,i}$ is the observed value and at time i

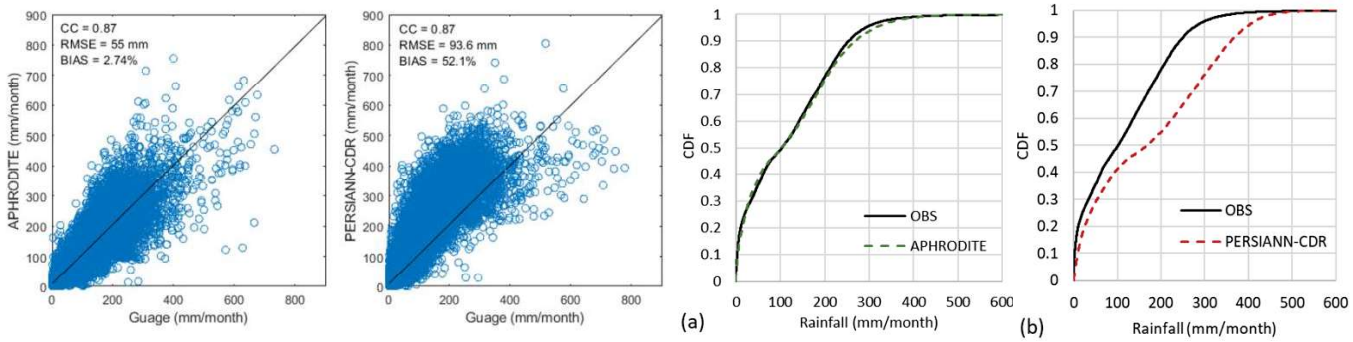
$X_{model,i}$ is the predicted value at time i

n is the total number of data.

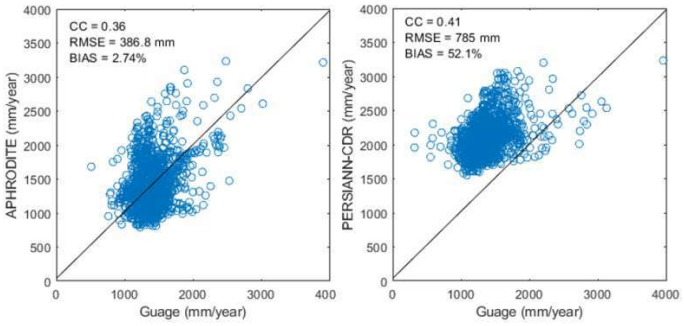
IV. Results and Discussion

Accuracy of Rainfall Products

Monthly rainfall

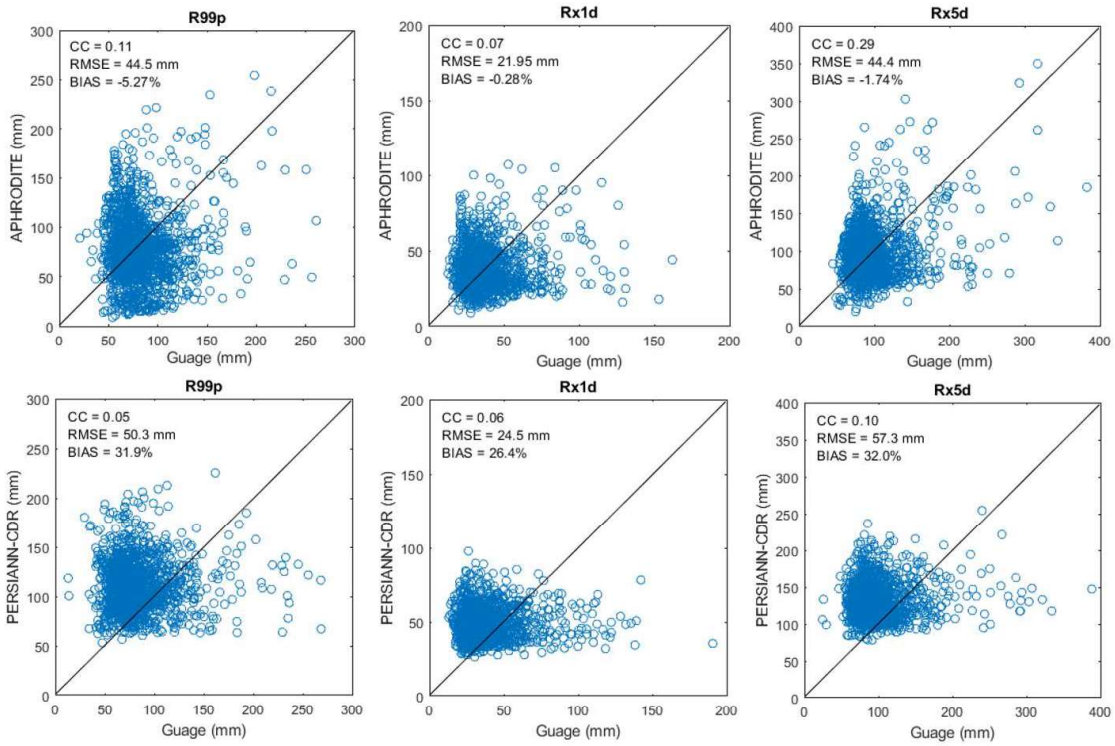


Annual rainfall



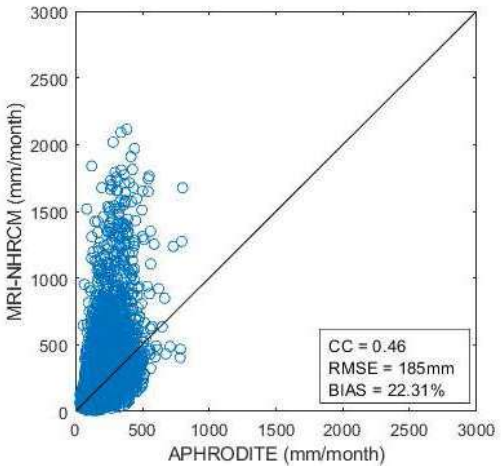
- Both rainfall products have high monthly correlation with observed rainfall
- APHRODITE has smaller error than PERSIANN-CDR for both timescales
- PERSIANN-CDR highly overestimates observed rainfall.

Accuracy of Rainfall Products in capturing extreme rainfall

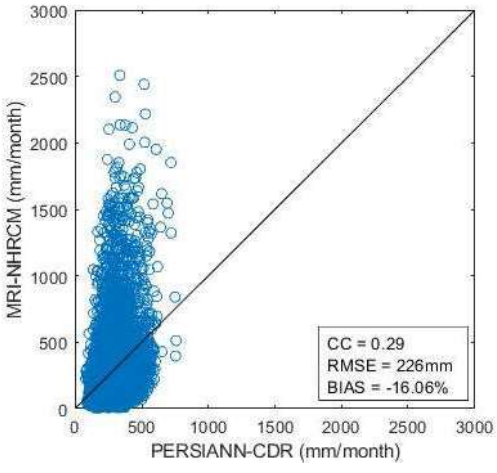


Performance of MRI-NHRCM Rainfall

MRI-NHRCM vs APHRODITE

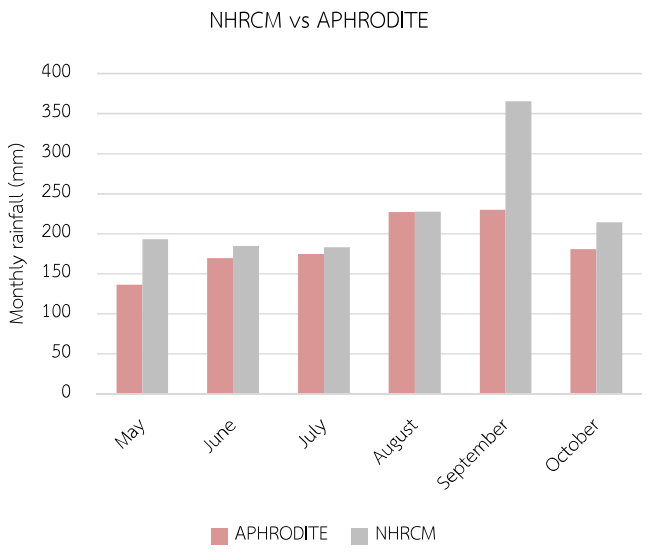


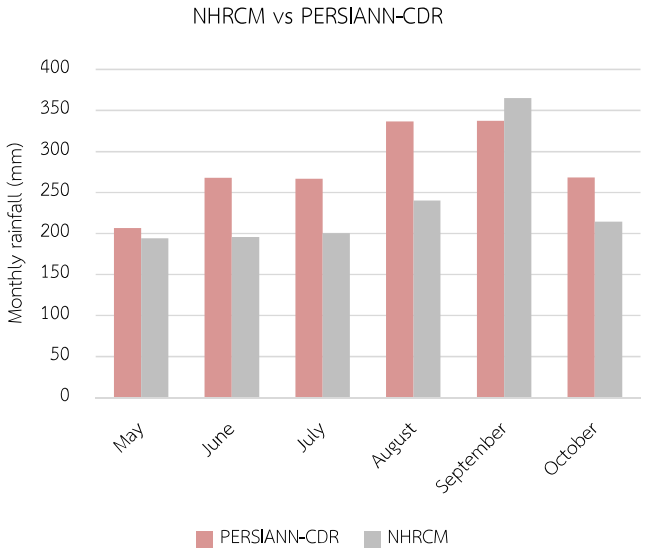
MRI-NHRCM vs PERSIANN-CDR



- MRI-NHRCM has small monthly correlation with both rainfall products
- MRI-NHRCM overestimates APHRODITE and underestimates PERSIANN-CDR

Performance of MRI-NHRCM Rainfall





V. Conclusions

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- Overall, PERSIANN-CDR and APHRODITE have a good monthly correlation with observed rainfall; however, APHRODITE seems to perform better for both monthly and annual timescales
- The poor performance of PERSIANN-CDR is a result of overestimation, probably by the satellite technique, especially at a high rainfall intensity
- APHRODITE and PERSIANN-CDR are unable to capture the extreme rainfall accurately as indicated by poor correlation and high RMSE, but APHRODITE performs slightly better than PERSIANN-CDR.
- The performance of the simulated rainfall from NHRCM is quite low due to very high monthly rainfall values in some grids which caused the error to be large.

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V. Conclusions

- This study implies that APHRODITE can be used over the selected study area when monthly and annual rainfalls are required for example in the assessment of water balance/water budget
- For PERSIANN-CDR, biased correction is needed since it highly overestimates observed rainfall.
- Simulated rainfall from NHRCM comprises high error, and thus it requires more investigations.

Thank you!

Q&A