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Towards more accurate riverine flood forecasting over the Lower Mekong Basin

Miguel Laverde (ADPC), Chinaporn Meechaiya (ADPC),
Arjen Haag (Deltares), Martijn Kwant (Deltares)

CONNECTING SPACE TO VILLAGE

SERVIR Hub Network



A photograph of a woman and a young child in a blue boat on a body of water. The woman is wearing a pink hat and a purple long-sleeved shirt, and is smiling while holding a wooden pole. The child is sitting next to her, looking towards the camera. The boat has a red canopy.

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Intergovernmental
organization

Building Capacity for Resilience

Consortium:

 Spatial Informatics Group
Bangkok, Thailand

 **SEI** Stockholm
Environment
Institute

Deltares
Enabling Delta Life 



WEATHER AND CLIMATE



WATER RESOURCES AND DISASTERS

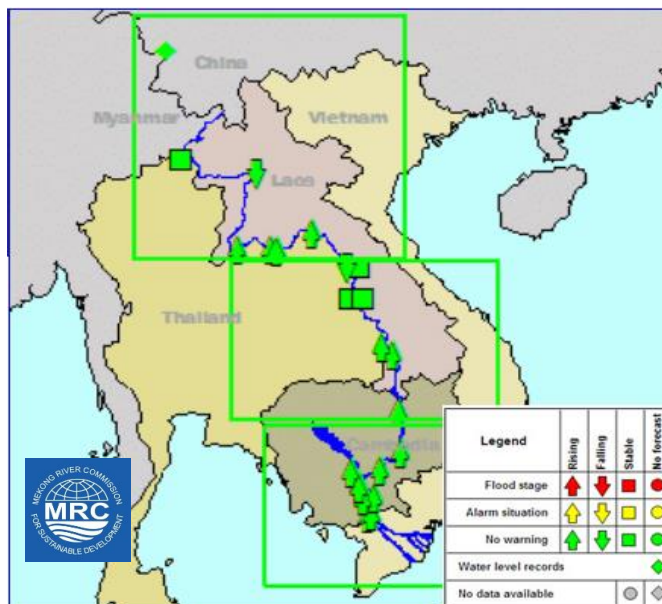


LAND COVER / LAND USE AND ECOSYSTEMS



AGRICULTURE AND FOOD SECURITY

Supporting a better riverine and flash flood forecasting for Lower Mekong Region



- The **MRC Flood Early Warning System (MRC-FEWS)** is a modular hydrological- hydraulic model created to provide short and medium-term early warnings flood updates for each member countries.
 - Dry season: weekly forecast
 - Flood season: Daily forecast



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Objectives:

- Improve the accuracy of the NRT satellite-based rainfall product for **Short-term** flood riverine forecast.
- Incorporate the state of the art bias corrected CHIRPS-GEFS for **Medium-term** flood riverine forecast.



Short-term riverine forecast:

Operational bias correction
tool for the MRC FEWS system

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Characteristics:

- Python based tool (Open access)
- Working with multiple bias correction methods
- Adjusted to work with MRC daily information
- Working operationally or date range based
- Evaluate the performance based on R, RMSE and BIAS



Available

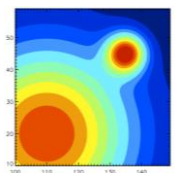
<https://github.com/Servir-Mekong/GPM-BICO>

Bias correction schemes:

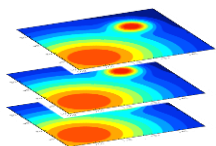
Performance of GPM-BICO



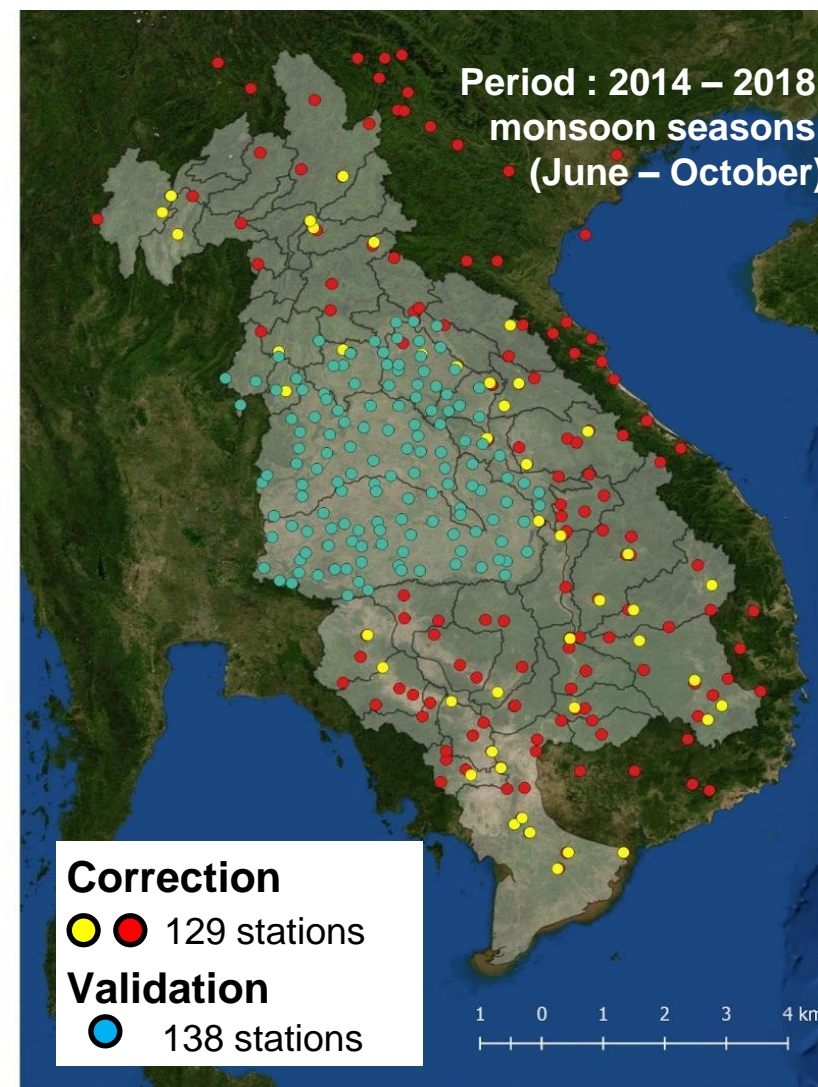
1. **Uniform Distribution Transformation (DT)** (Bower, 2004)



2. **Spatial Bias corrector (SB):** (Immerzeel (2010))

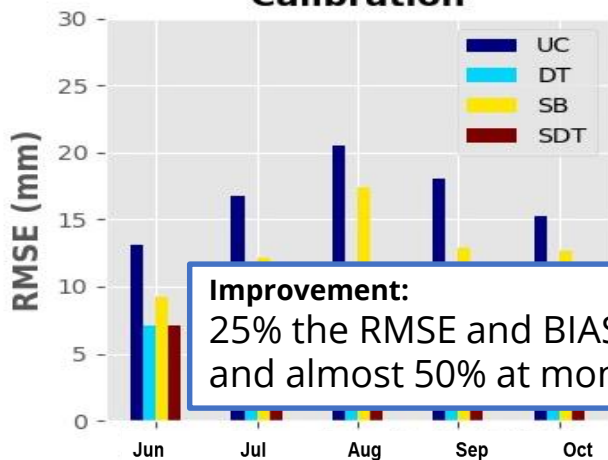


3. **Spatiotemporal Distribution Transformation**
4. **Gamma Quantile Mapping (V 1.3)**

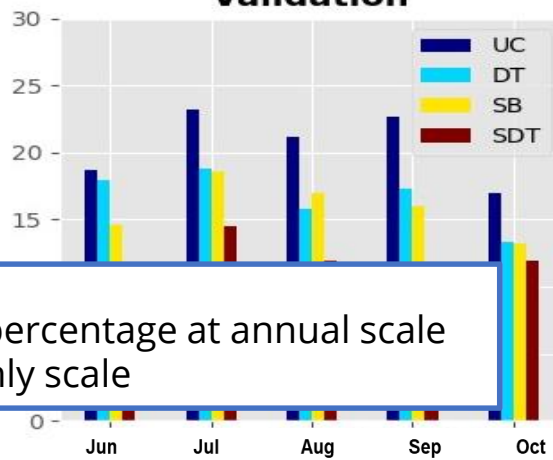


Results:

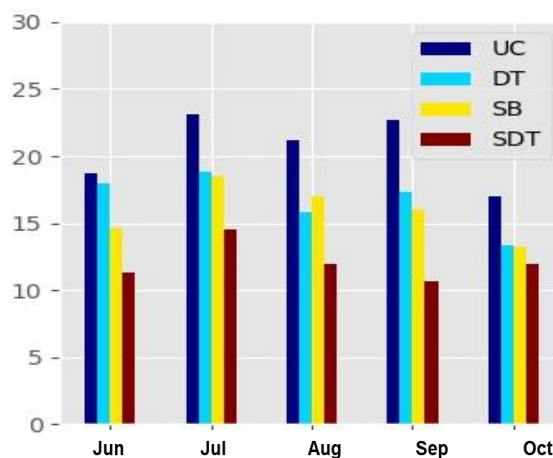
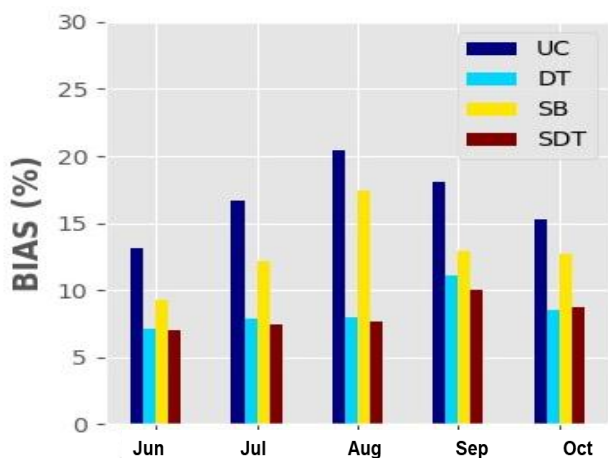
Calibration



Validation

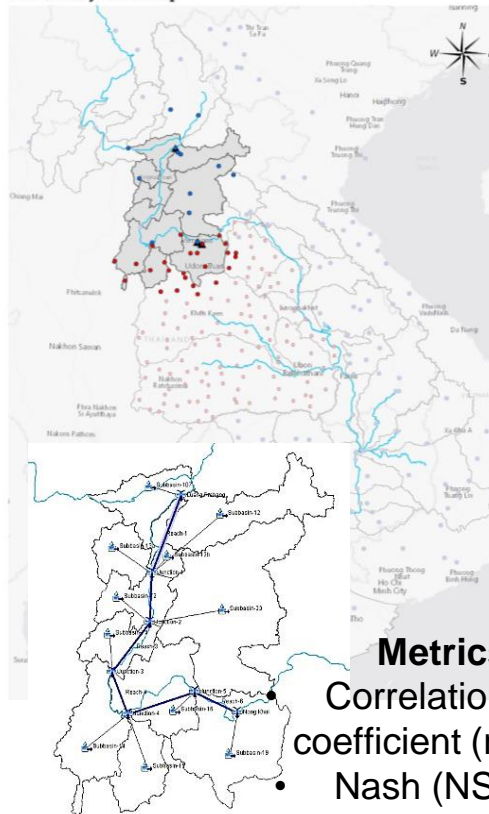


Improvement:
25% the RMSE and BIAS percentage at annual scale
and almost 50% at monthly scale



Hydrological impact

Pilot study area map



Metrics
Correlation coefficient (r)
Nash (NS)



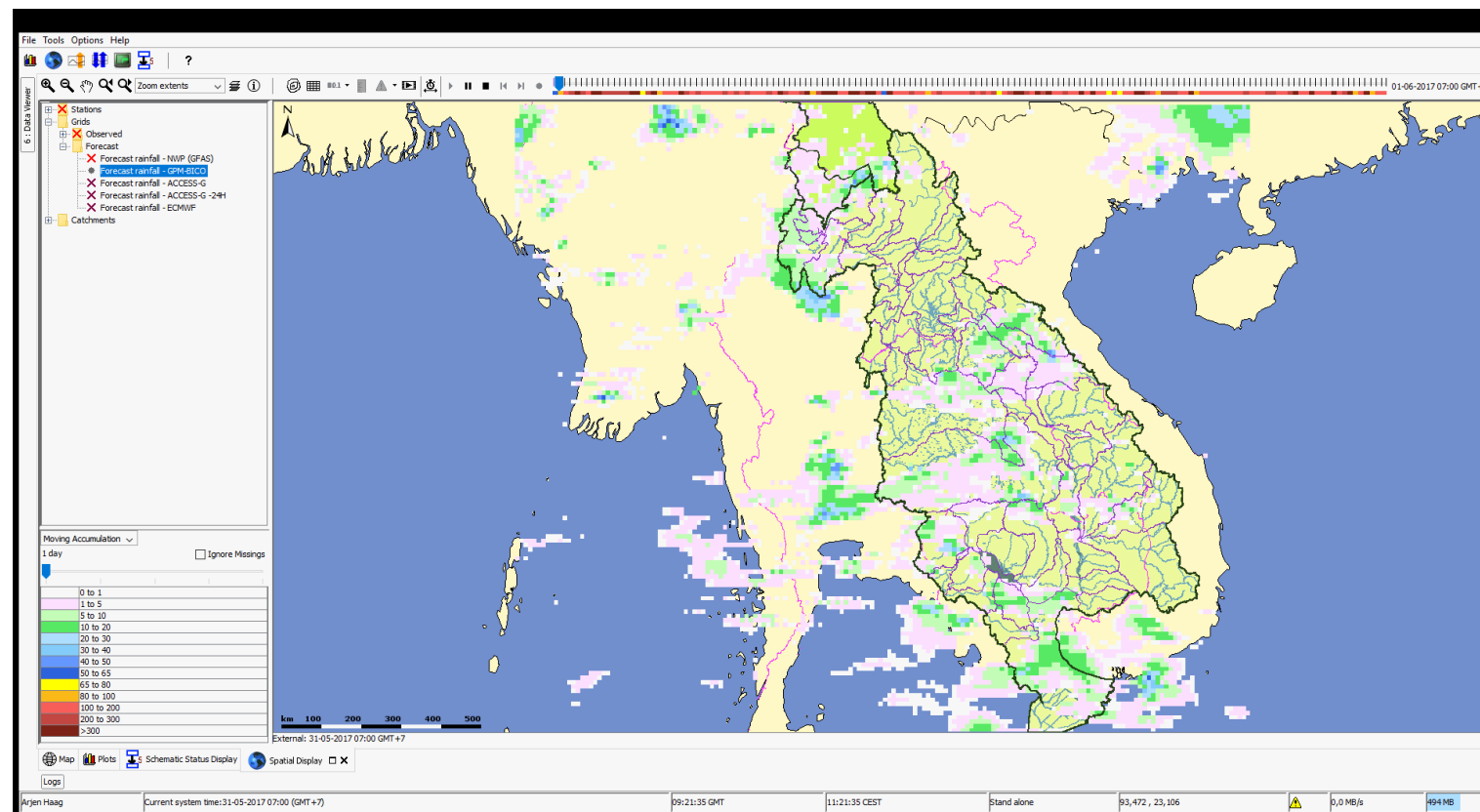
GPM-BICO into FEWS:

Technical training GPM-BICO

The Regional Flood Management and Mitigation Centre (RFMMC)



27 May 2019,
Phnom Penh,
Cambodia

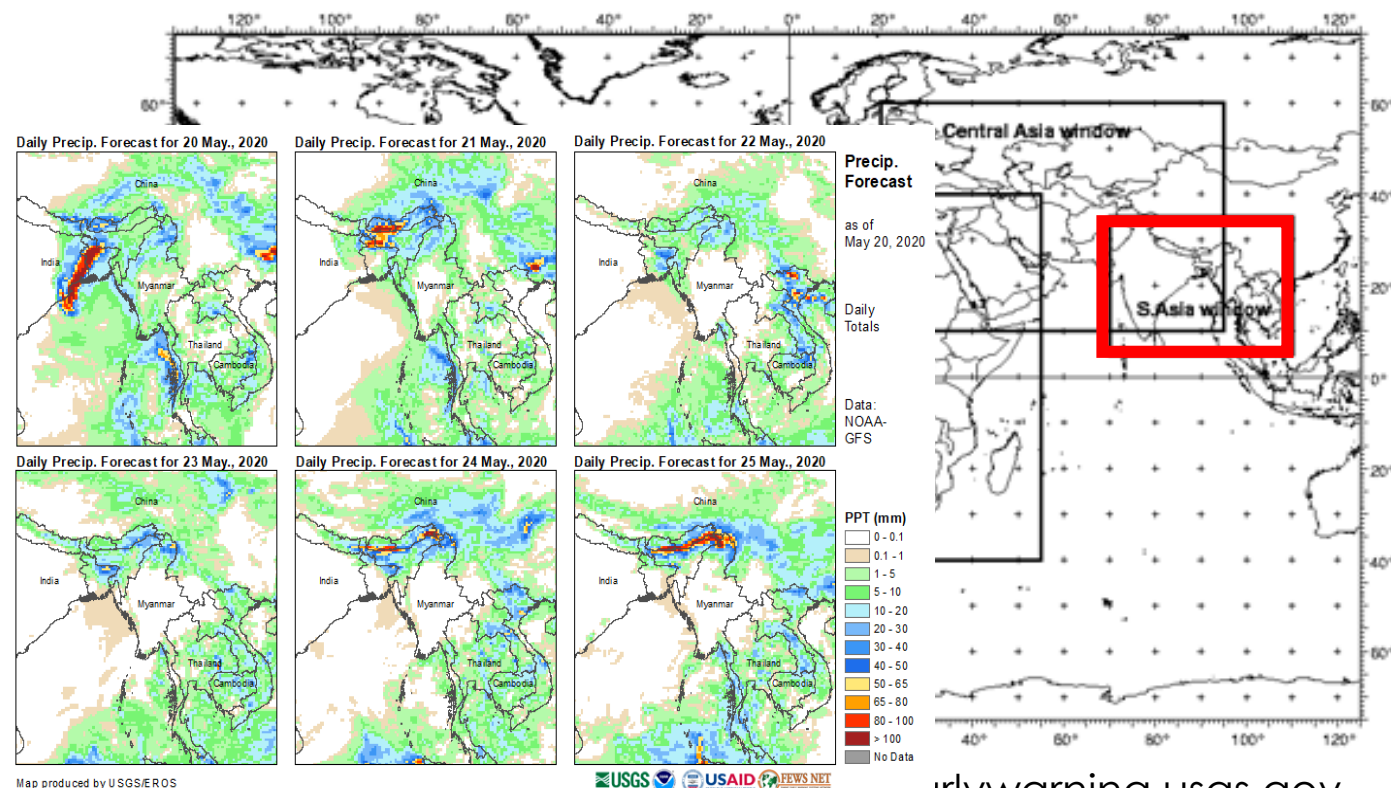


Medium-term riverine forecast:

NOAA Daily GFS Forecast Data

The Global Forecast System (GFS) precipitation data are provided on a daily basis by the NOAA Climate Prediction Center.

- 7 day forecasts of precipitation
- 0.25 degree resolution



Map produced by USGS/EROS

USGS USAID FEWS NET

earlywarning.usgs.gov



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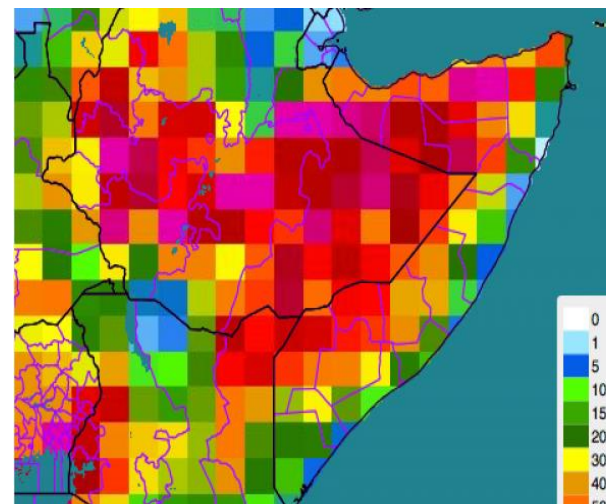
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State of the art bias corrected rainfall forecast product: CHIRPS-GEFS

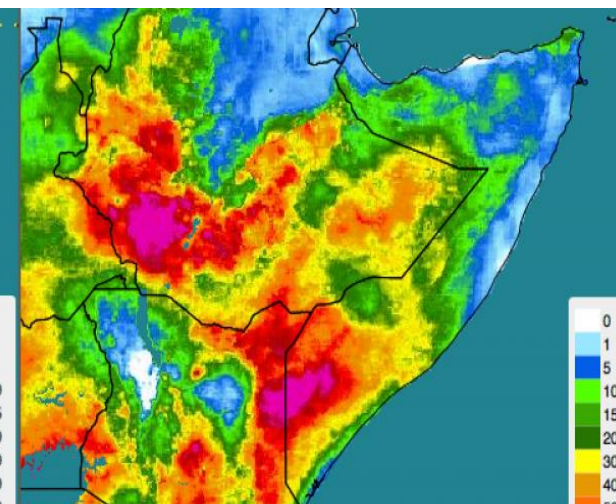
Bias-corrected and downscaled version of NCEP Global Ensemble Forecast System precipitation forecasts.

**Daily 5-day, 10-day, 15-day
Forecasts
5 km resolution**

GEFS



CHIRPS-GEFS



Source
<https://nasaharvest.org>



Climate
Hazards
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CHIRPS-GEFS version 2.0



National Oceanic and
Atmospheric Administration
U.S. Department of Commerce

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NOAA upgrades Global Ensemble Forecast System

Foundation for weather forecast models gets a big boost from the
FV3

Weather | modeling

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<https://www.chc.ucsb.edu/data/chirps-gefs>

Daily simulations 15 days rainfall forecast
(Before 5 days latency)

**October 1st, 2020 to present are
currently available**

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CHIRPS-GEFS in SERVIR-MEKONG

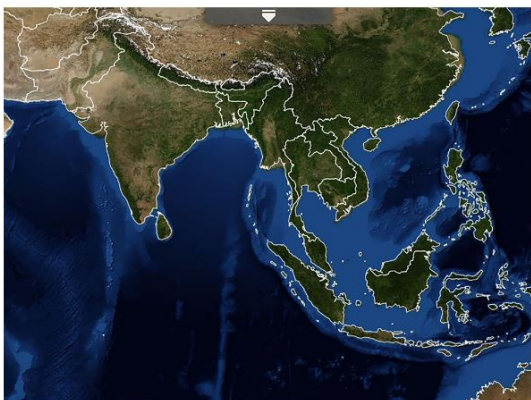
DECISION SUPPORT TOOLS
Home » Decision Support Tools

ClimateSERV

This tool allows development practitioners, scientists/researchers, and government decision-makers to visualize and download historical rainfall data, vegetation condition data, and 180-day forecasts of rainfall and temperature to improve understanding of, and make improved decisions for, issues related to agriculture and water availability.

Share    

Launch ClimateSERV LAUNCH TOOL



LAUNCH TOOL

Subscribe to tool updates
email address... Submit
Privacy and usage policy

Geographic Region
Global

Developer(s)
SERVIR Science Coordination Office


Contributors/Partners

- FEWS NET
- NMME

Users

- IGAD (Intergovernmental Authority on Development) Climate Prediction Center
- Ministries of Agriculture, Ethiopia and Kenya
- Water and Land Information Management, Somalia
- Kenya Meteorological Department


Earth Observations and

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climateserv 0.0.12

✓ Latest version

Released: Feb 5, 2020

`pip install climateserv` 

This is a package to access the ClimateSERV API[(https://climateserv.servirglobal.net/)]

Navigation

- ☰ Project description
- 🕒 Release history
- 📄 Download files

Project description

ClimateServ API Access

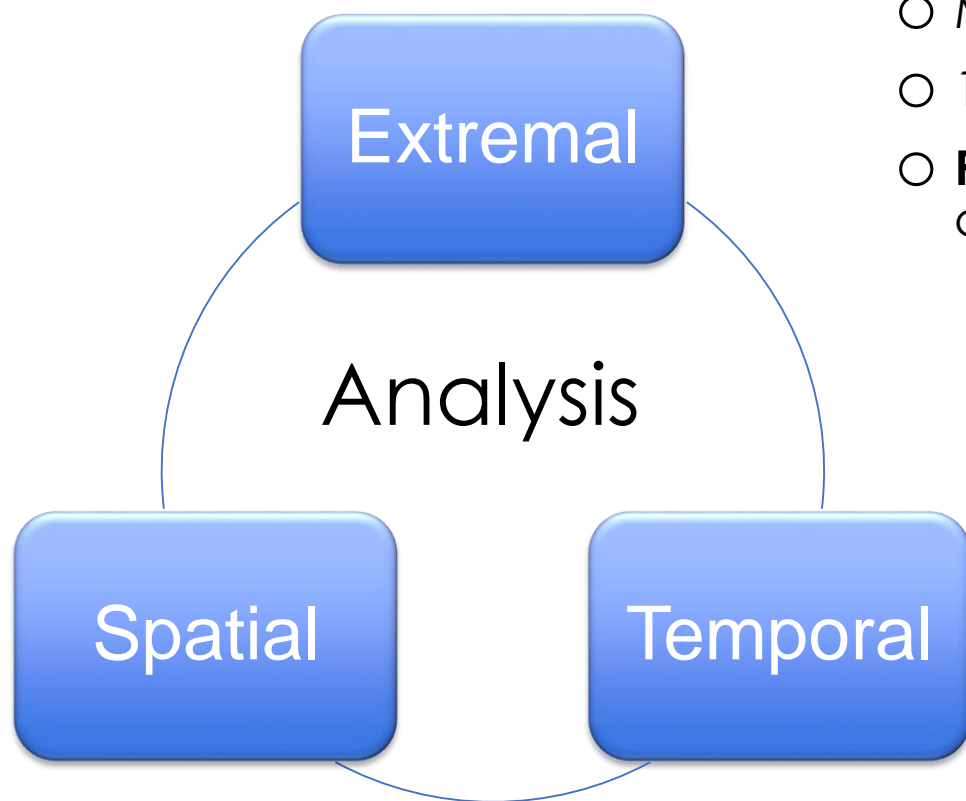
This is a simple package to access the [ClimateSERV API](https://climateserv.servirglobal.net/) you can install using pip:

- pip install climateserv

Available in:
<https://climateserv.servirglobal.net/>



Performance of CHIRPS-GEFS and GFS



- Monsoon seasons **2017-2019** (Jun to October)
- 1 – 6 days forecast (0.25 degrees)
- **Reference data** GPM-IMERG Final version bias corrected

ERROR METRICS

Standard metrics

- Root Mean Square Error
- Bias
- Correlation coefficient

Categorical metrics

- POD
- FAR
- CSI

Temporal analysis

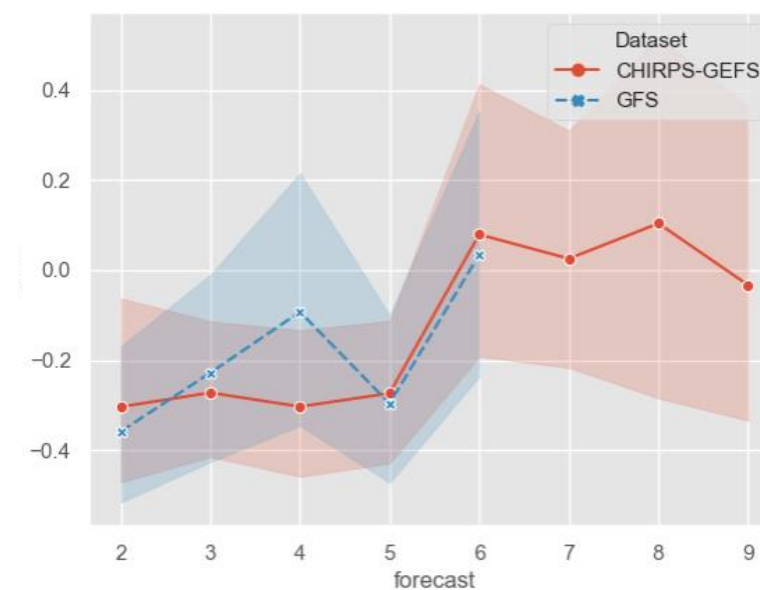
RMSE



Correlation coefficient

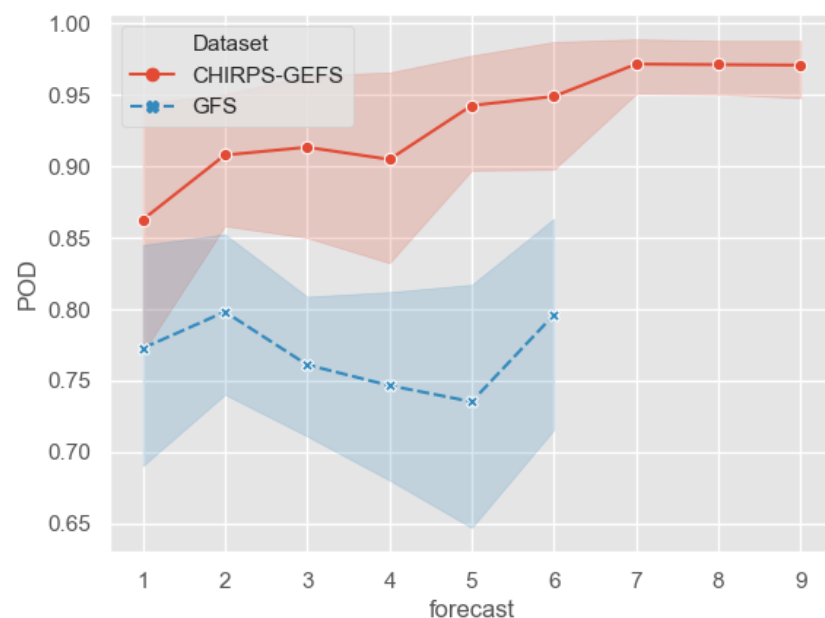


BIAS

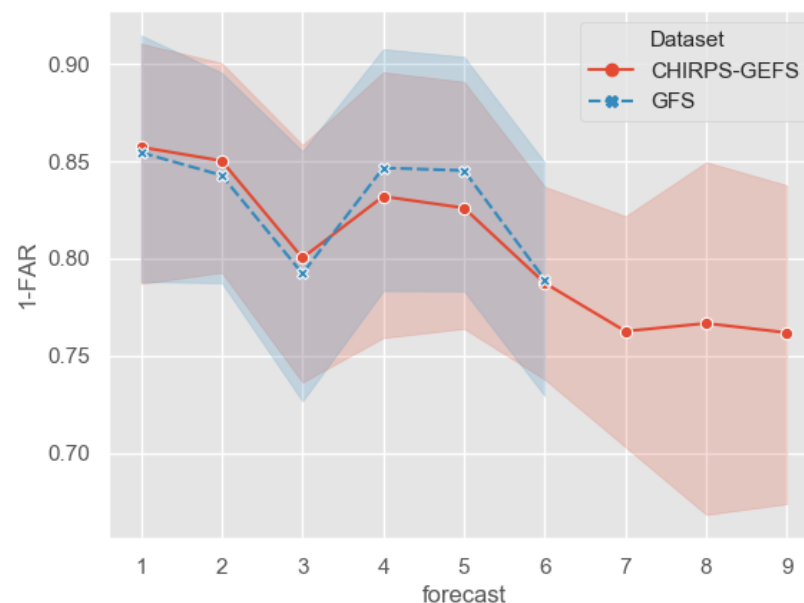


Temporal analysis

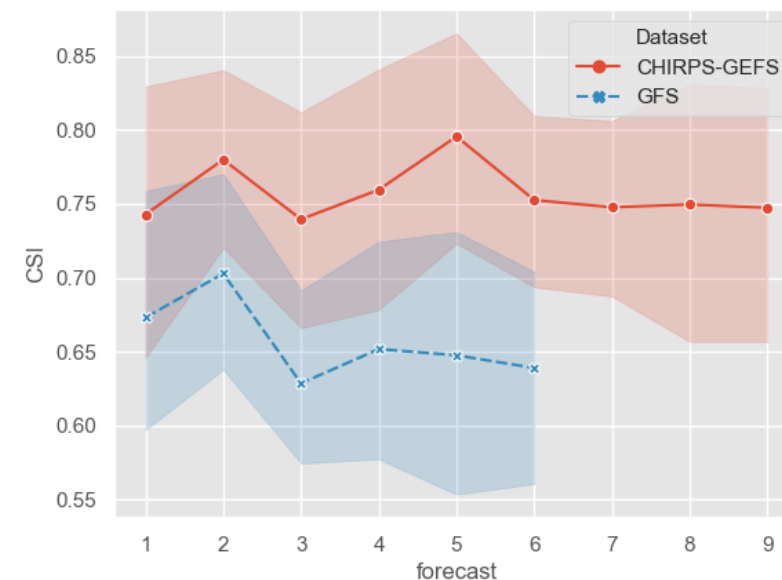
POD



1 - FAR



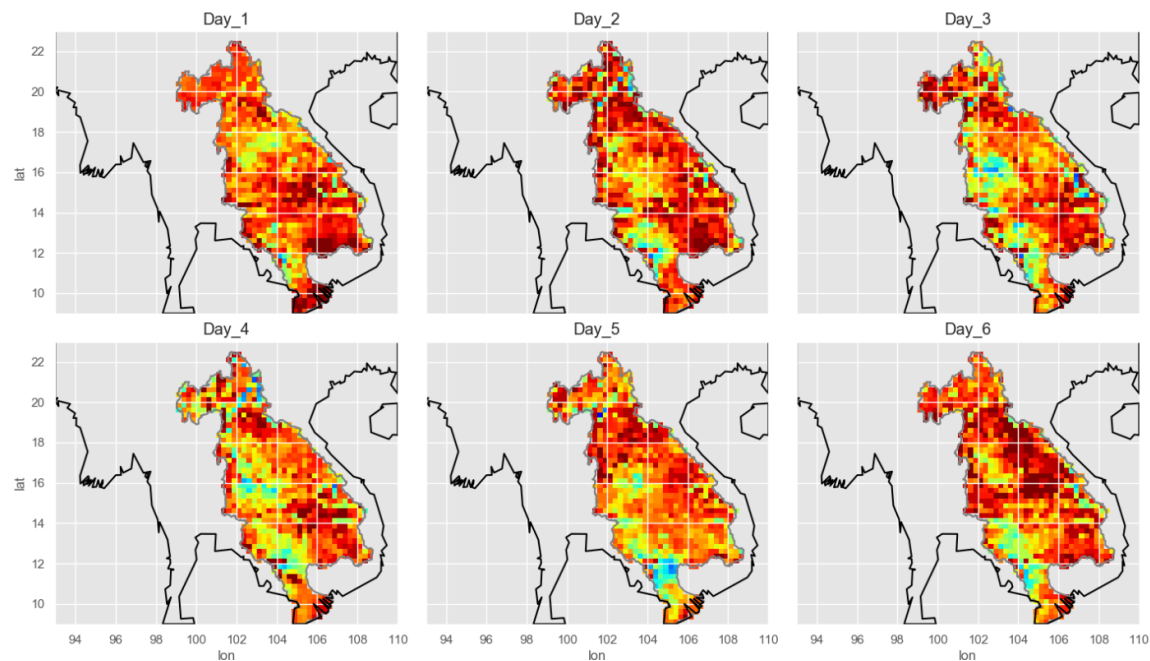
CSI



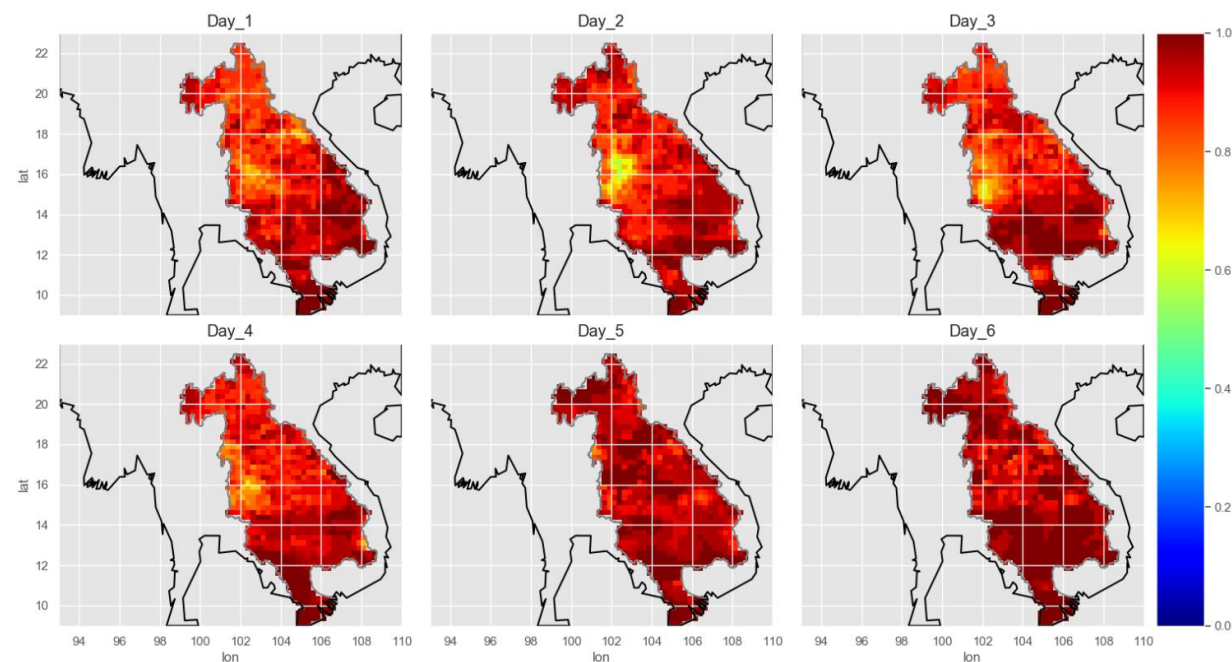
Spatial analysis

POD

GFS



CHIRPS-GEFS

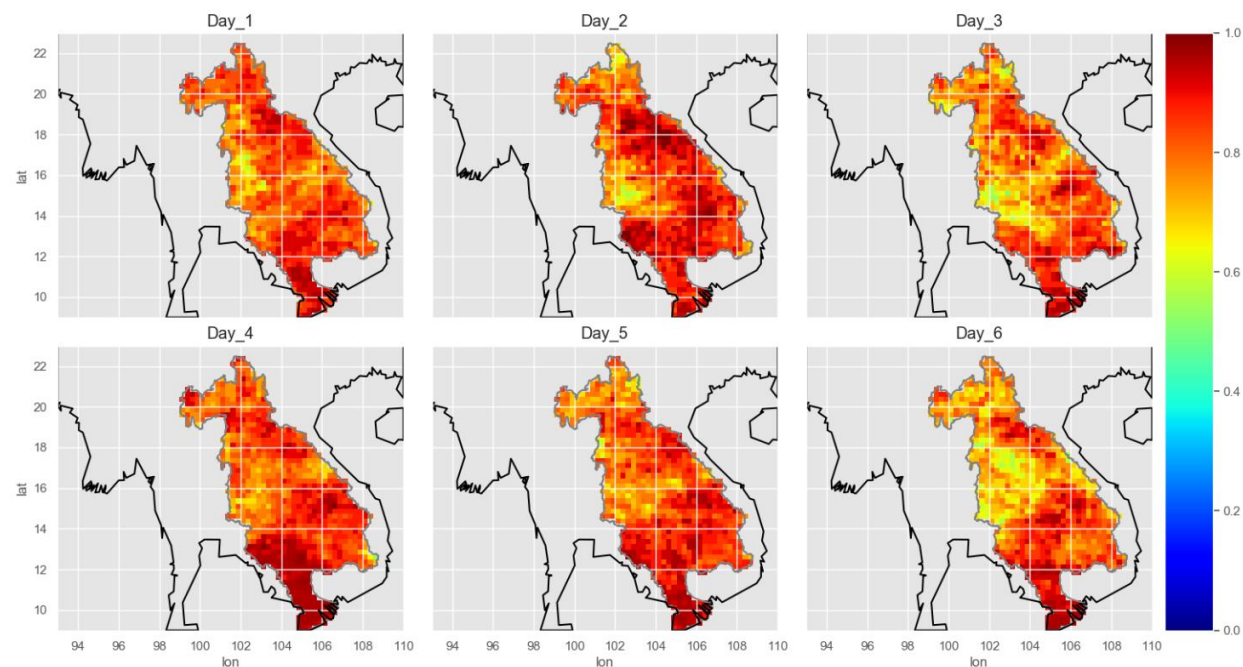
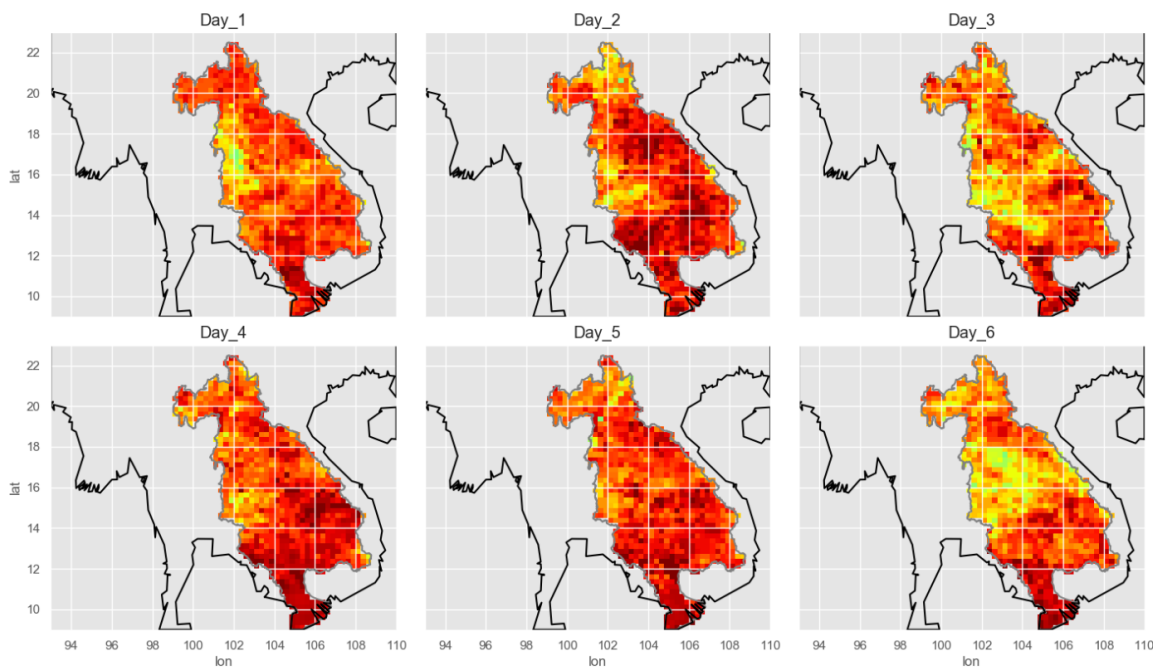


Spatial analysis

1-FAR

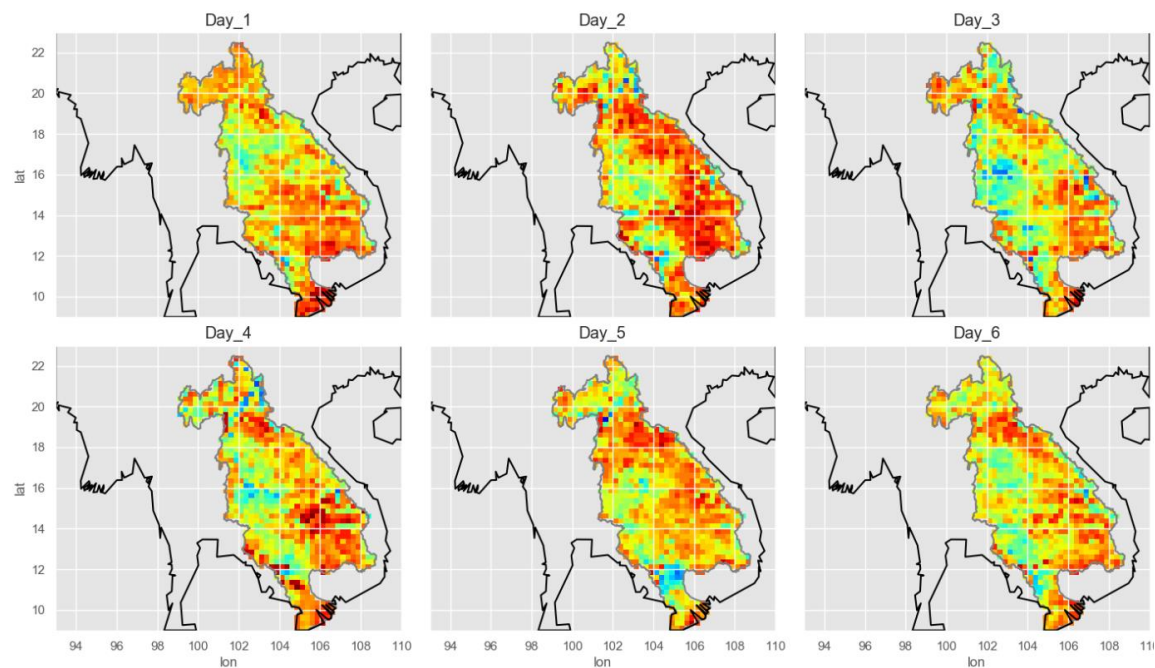
GFS

CHIRPS-GEFS

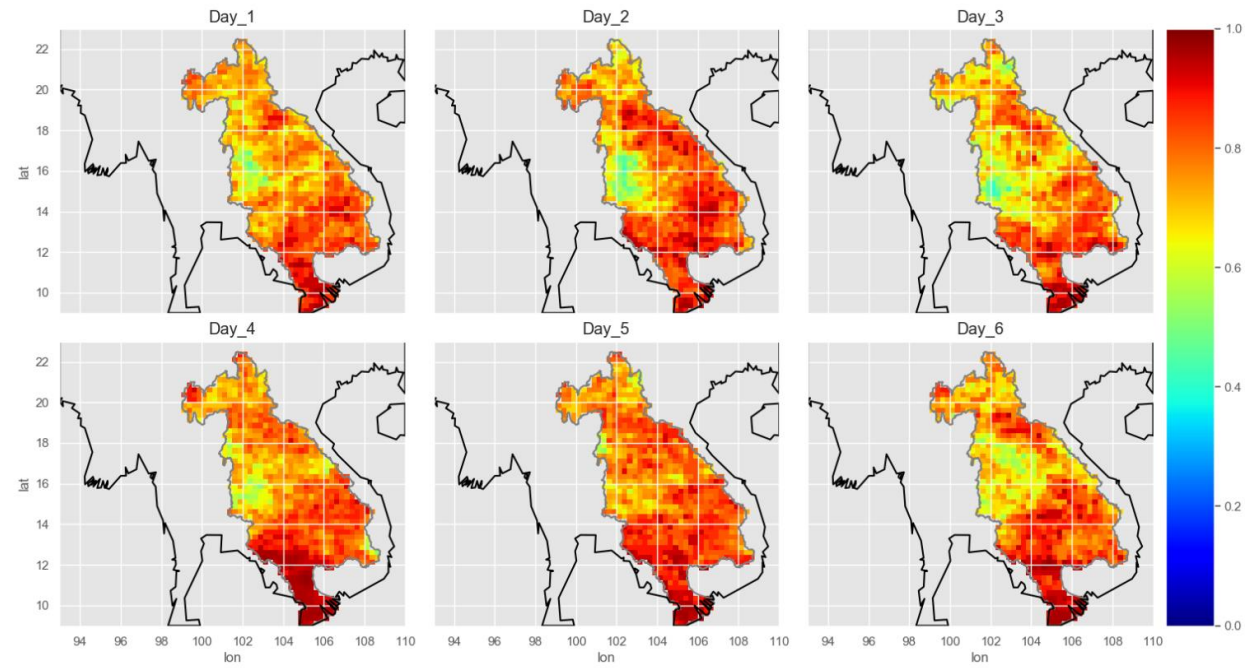


Spatial analysis CSI

GFS

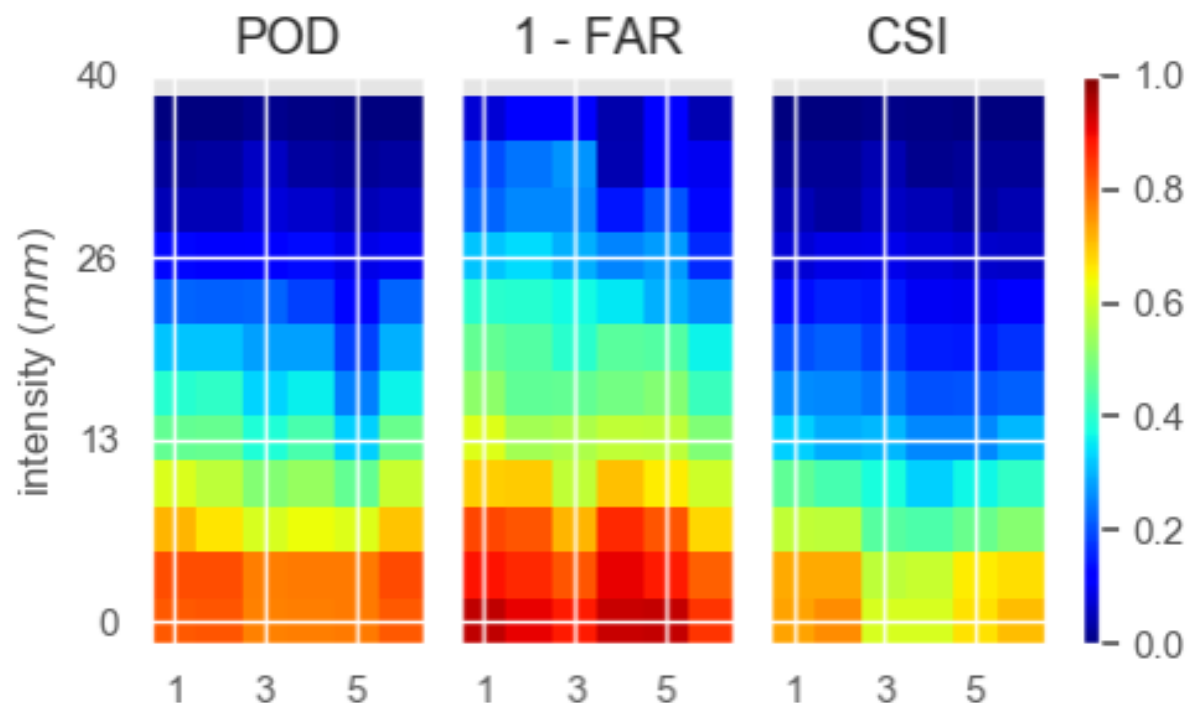


CHIRPS-GEFS

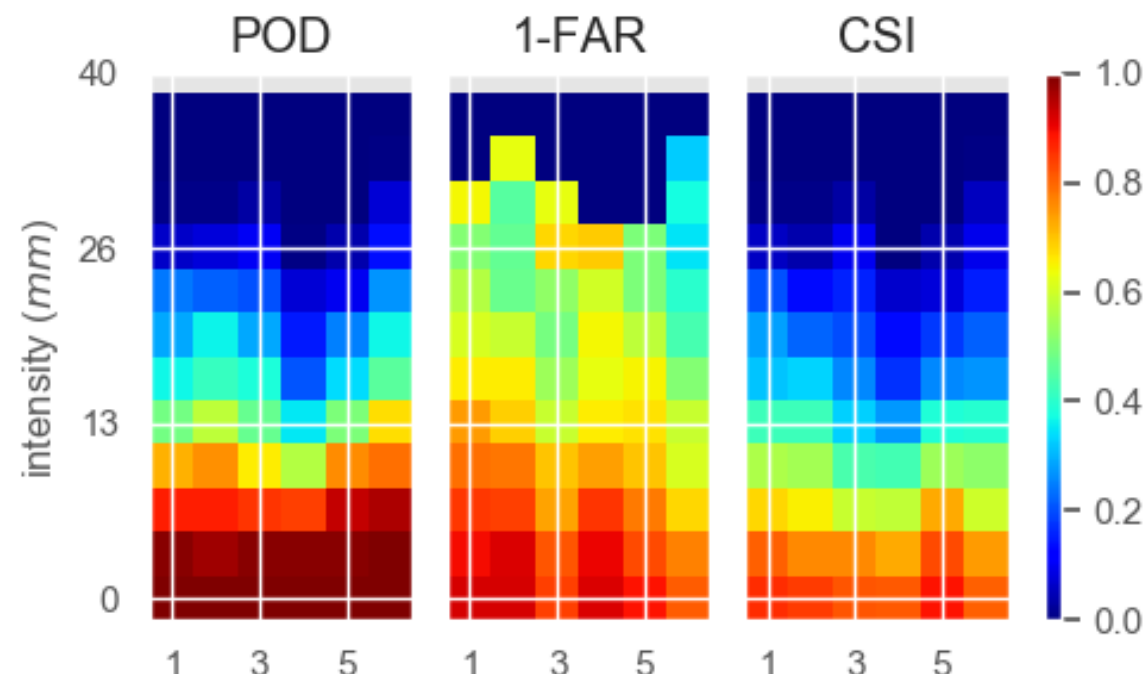


Results: Extremal

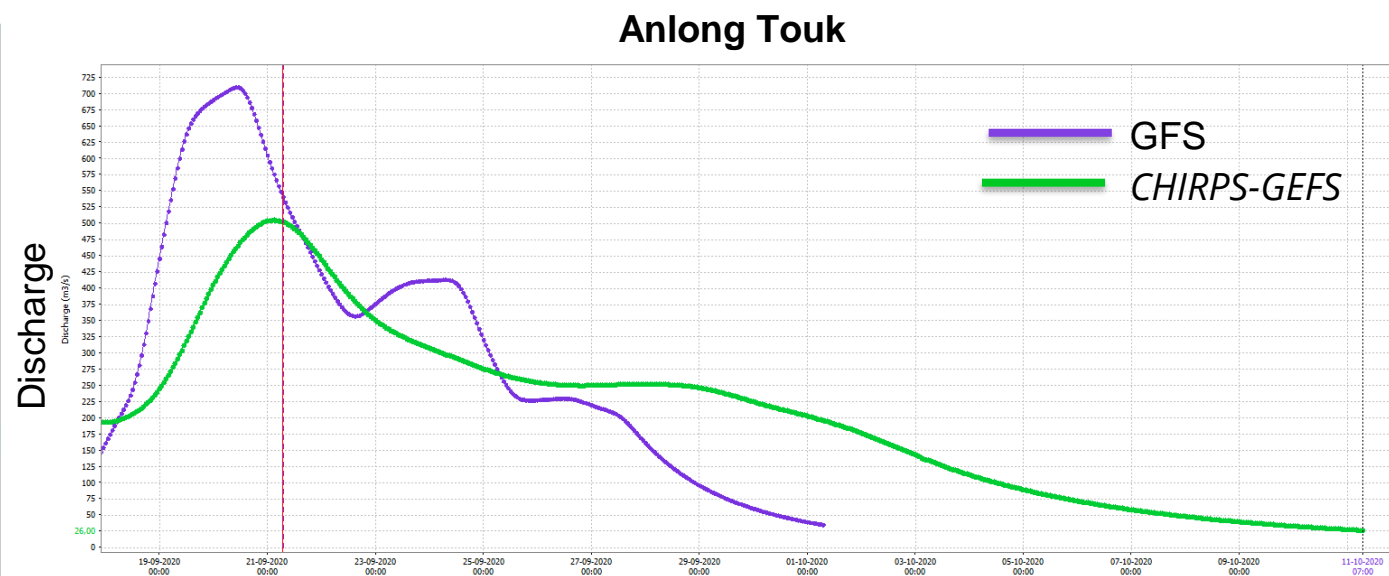
GFS



CHIRPS-GEFS



CHIRPS-GEFS into FEWS





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Summary

- SERVIR-Mekong supports MRC in accessing the latest technology for near-real-time (NRT) monitoring and rainfall forecast prediction for the FEWS system
- Results for bias correction GPM-BICO tool showed a reduction up to 50% of the bias and RMSE errors in NRT IMERG data. Results in the hydrological model suggested that this reduction considerably improved the streamflow forecast.
- CHIRPS-GEFS rainfall forecast provides a high resolution daily forecast information up to 15 days with 5 km spatial resolution
- In comparison with the GFS, CHIRPS-GEFS displayed the lowest temporal and spatial error with a longer forecast during monsoon seasons
- This encouraged MRC to implement GPM-BICO and CHIRPS-GEFS into their Flood Forecasting System in an operational setting to improve the lead time and accuracy of riverine Flood Early Warning in the Lower Mekong Basin.



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Connecting Space to Village in the Lower Mekong Region

SERVIR-Mekong is a geospatial data-for-development program that responds to the needs of Lower Mekong countries. [Learn more](#)



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LAND COVER / LAND USE
AND ECOSYSTEMS



WEATHER AND CLIMATE



WATER RESOURCES AND
DISASTERS

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Decision Support Tools

These high quality user-tailored decision support tools and applications have been developed to address on-the-ground issues, empowering decision-makers to act locally on climate-sensitive challenges such as disasters, agriculture, water management, ecosystem protection and land use.



Live

**Regional Land Cover
Monitoring System**



Live

Surface Water Mapping Tool

Surface water distribution changes



Live

**Regional Drought and Crop
Yield Information System**



Live

**Satellite Radar-derived
Virtual Rain and Stream
Gauge Data Service**



Live

Eco-Dash

Changes to vegetation can have a significant impact on health, resilience.



Live

ClimateSERV

This tool allows development practitioners, scientists/researchers



Live

Reservoir Mapping Tool



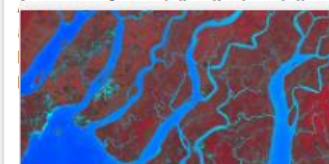
Live

Historical Flood Analysis Tool



Live

**Gender Equality Monitoring
(GEM) Platform**



Live

Dancing Rivers



In Production

**Supporting Water Resources
Management (SWARM)**



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SERVIR-Mekong x +

github.com/Servir-Mekong/

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Bangkok, thailand http://servir.adpc.net dsaah@sig-gis.com

Repositories 36 Packages People 33 Teams 2 Projects

Find a repository... Type: All Language: All New

ClimateSERV_CHIRPS-GEFS

Automatic extraction of CHIRPS-GEFS rainfall forecast data using ClimateSERV

Python 0 1 0 0 Updated 5 days ago

AirQuality

Air Quality Study for Mekong Region

JavaScript MIT 0 0 8 Updated 5 days ago

sentinel-1-pipeline

Sentinel 1 pipeline using SNAP GPT 7.0

Python MIT 0 1 1 Updated 5 days ago

Top languages

- Python JavaScript
- Jupyter Notebook HTML

Most used topics

remote-sensing earth-engine flood near-real-time surface-water

People 33 >

<https://github.com/Servir-Mekong/>

SERVIR MEKONG

www.servir.adpc.net

miguel.Barajas@adpc.net

chinaporn.m@adpc.net

arjen.Haag@deltares.nl

martijn.kwant@deltares.nl



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