Effect of land use and land cover dynamics on streamflow by using SWAT model in Chindwin Basin, Myanmar

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Introduction: Case study, Chindwin Basin, Myanmar

Problem Statement

The Republic of the Union of Myanmar is prone to a wide range of disasters caused by various natural and human-made hazards

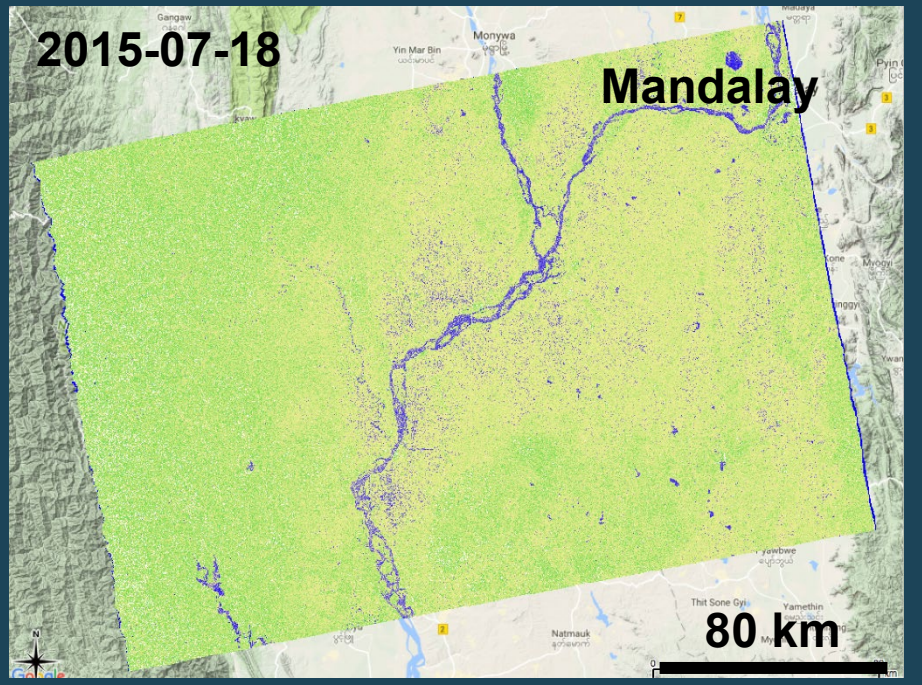
Floods in Myanmar, July and August 2015.
Photo: Myanmar Red Cross

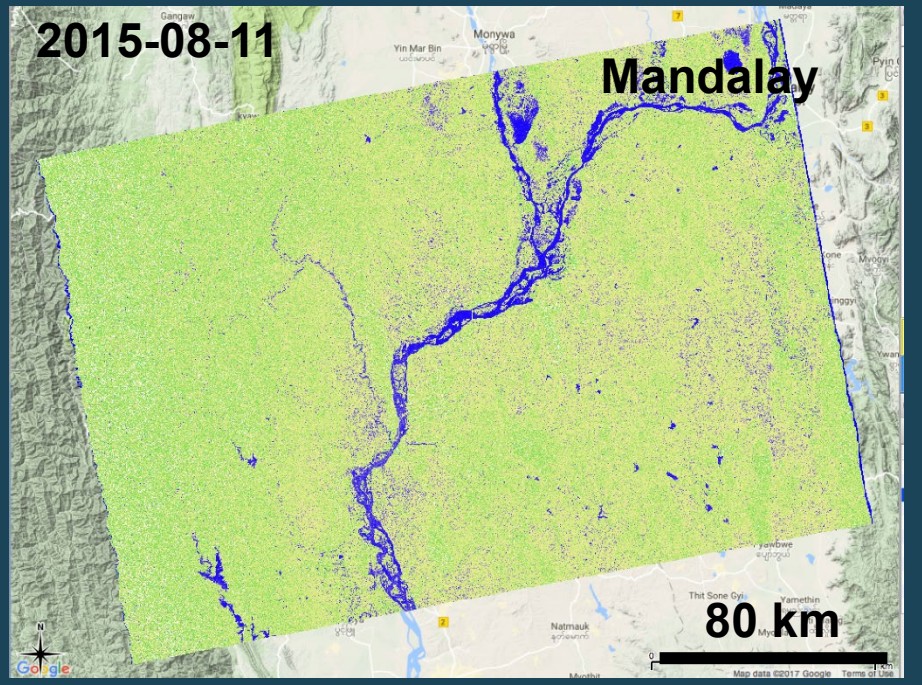
50% of the total number of disasters in Myanmar was related to floods

Floods have affected **75%** people between 1980-2015

Estimated damage cost (86%)

(AHA Centre, 2015)





Contains modified Copernicus Sentinel-1A data (2015), processed by ESA.

Flood in Myanmar 2015

Problem Statement

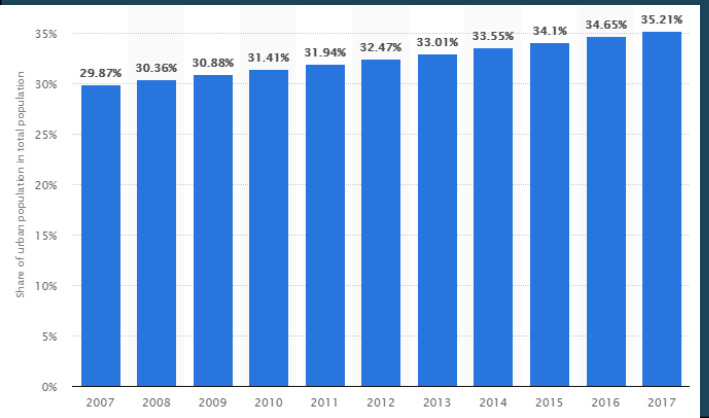
Land cover is changing

Problem Statement

Deforestation

Urbanization

https://ecosystemsunited.com/2017/03/19/all-about-urbanization/



Myanmar: urbanization from 2007 to 2017

Myanmar **third-worst** for deforestation rate, *says UN*

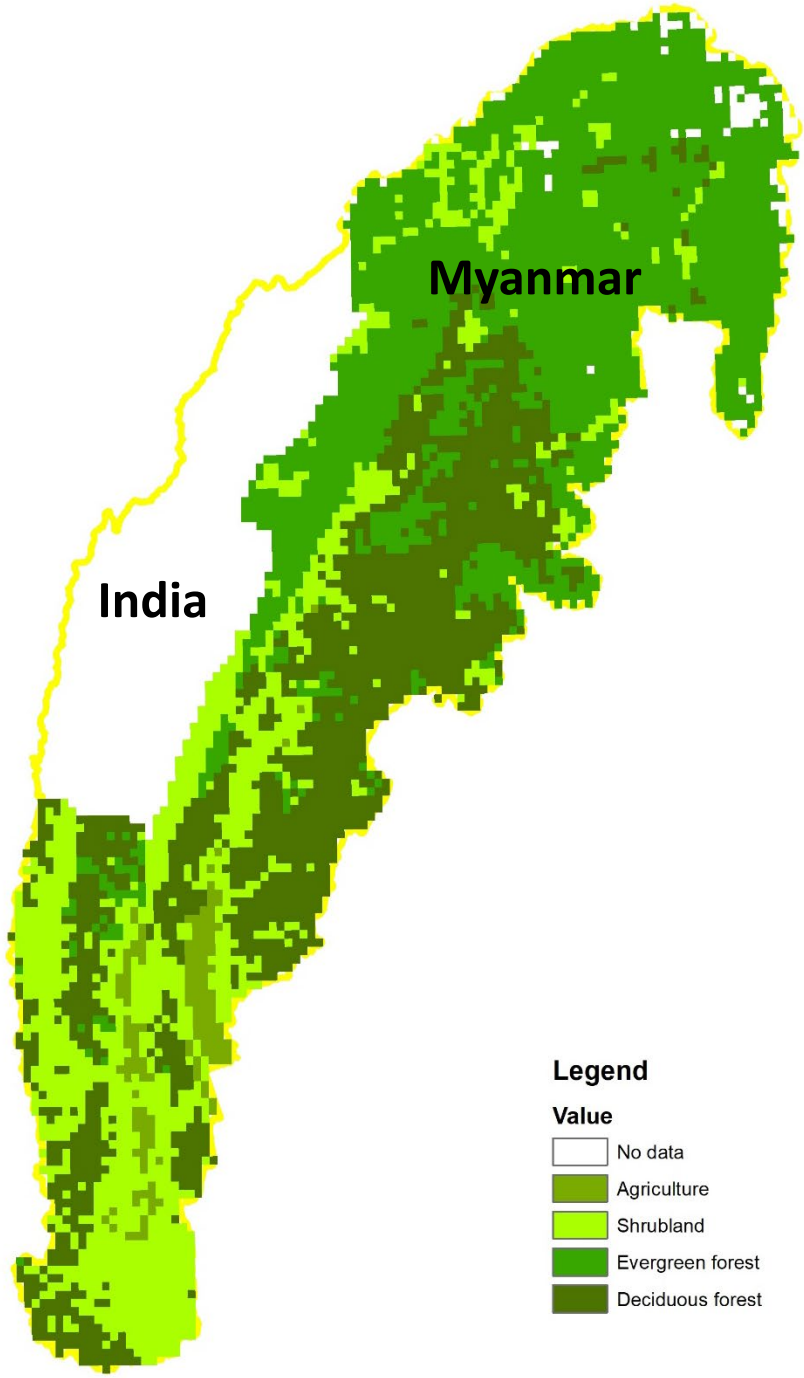
Land cover is changing

Problem Statement

Chindwin basin, Myanmar

Current Land Cover
free available in Myanmar

UNEP 2000, 1km.



Introduction: Problem statement and Objectives

Problem statement

- **Lack** of data in the region

- How well higher resolution land cover data affect on stream flow and help to improve flood risk management in Myanmar

Main Objective

"To understand the effects of higher resolution land cover data on stream flow to improve flood risk management in Myanmar.

Sub-Objectives

1

- Analyzing Sensitivity of Hydrological model with 3 different Global LC products

UNEP/GLOBCOVER/RLCMS

2

- Analyzing uncertainty of Streams flows from 3 different Global LC products

UNEP/GLOBCOVER/RLCMS

Introduction: https://servir.adpc.net/ SERVIR-Mekong

SERVIR GLOBAL

CONNECTING SPACE TO VILLAGE

WHAT IS SERVIR?

- Partnership between USAID and NASA
- Establishes long-term regional hubs to get geo-spatial information and tools to decision makers
- Identifies, addresses and resolves data and information challenges
- Focuses on climate change and implications on land use, agriculture, biodiversity, disasters, forests, health, water and weather

AGRICULTURE AND FOOD SECURITY

LAND COVER / LAND USE AND ECOSYSTEMS

WEATHER AND CLIMATE

WATER RESOURCES AND DISASTERS

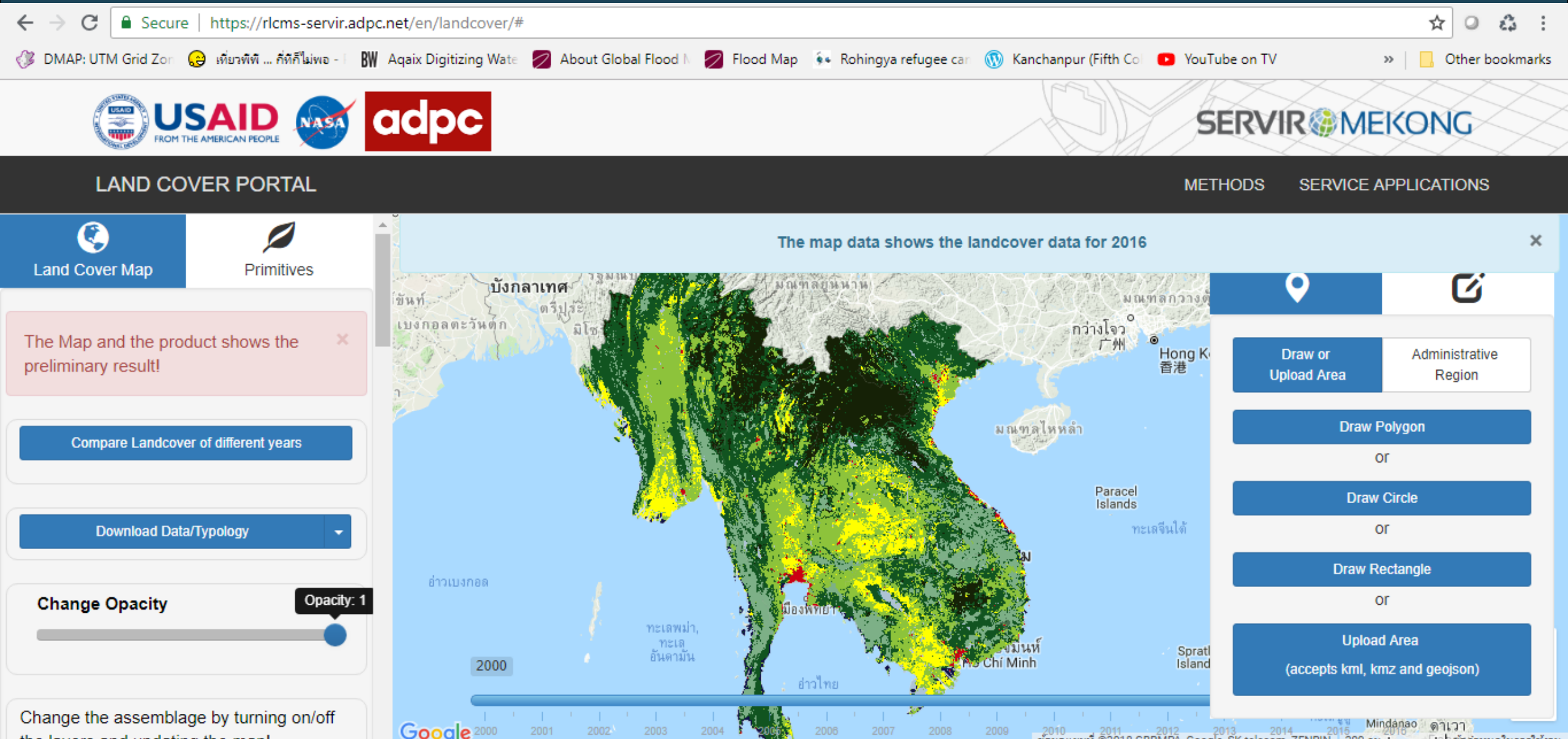
Introduction:

It is now live!

What is RLCMS Tool?

https://rlcms-servir.adpc.net/en/landcover/#

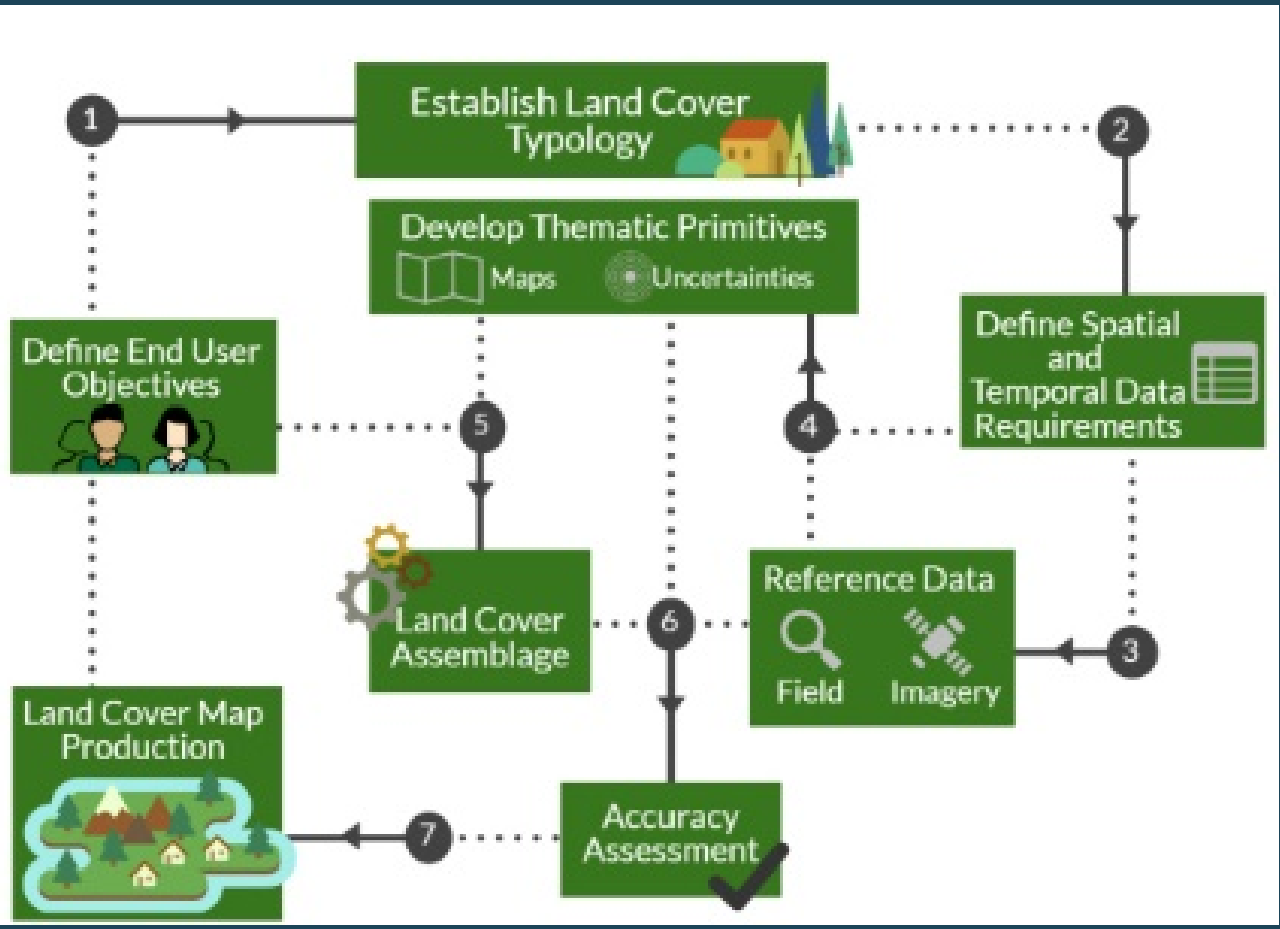
REGIONAL LAND COVER MONITORING SYSTEM



Introduction: It is now live! What is RLCMS Tool?

https://rlcms-servir.adpc.net/en/landcover/#

REGIONAL LAND COVER MONITORING SYSTEM METHODOLOGY



- A robust system that isdeveloped **collaboratively**
- Produces **consistent products** at **regular intervals**
- Serves the expressed **needs of multiple users** in the region
- Uses **transparent, well documented, open source approach**
- Includes **quality control/quality assurance methods** that integrates information from multiple sources

CODE REPOSITORIES

- Regional Land Cover Monitoring System Google Earth Engine code repository (Requires Earth Engine Authentication)

Go to Google Git repository | View code in Google Earth Engine

Don't have an Earth Engine account yet?

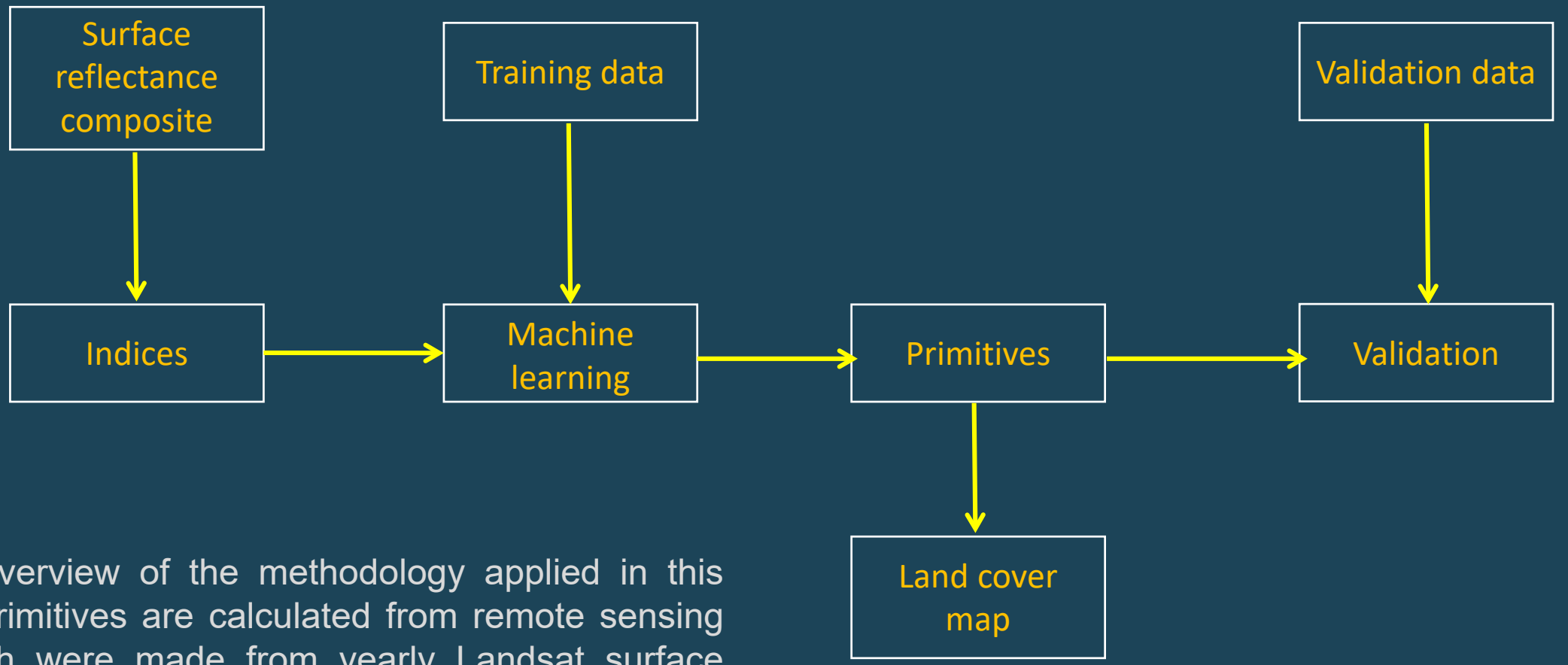
Sign up now

- SERVIR-Mekong Land Cover Portal Code Repository in GitHub

Go to Land Cover Portal Repository GitHub | Go to Land Cover Monitoring Repository GitHub

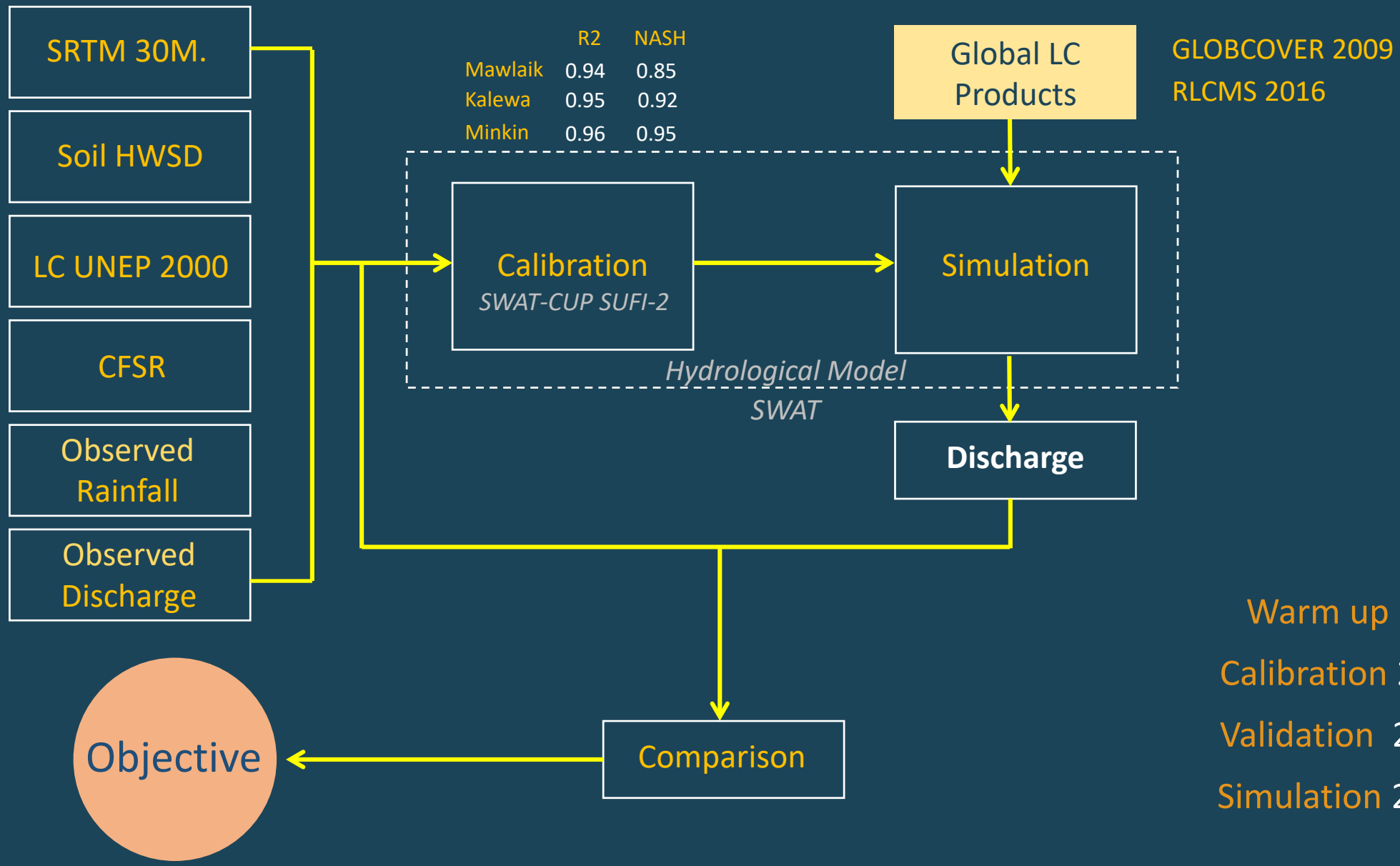
Methodology developing RLCMS Tool

https://rlcms-servir.adpc.net/en/landcover/#



Schematic overview of the methodology applied in this study. The primitives are calculated from remote sensing indices which were made from yearly Landsat surface reflectance composites. Primitives were calculated obtained using machine learning.

Methodology: SWAT



Warm up 1998-2003

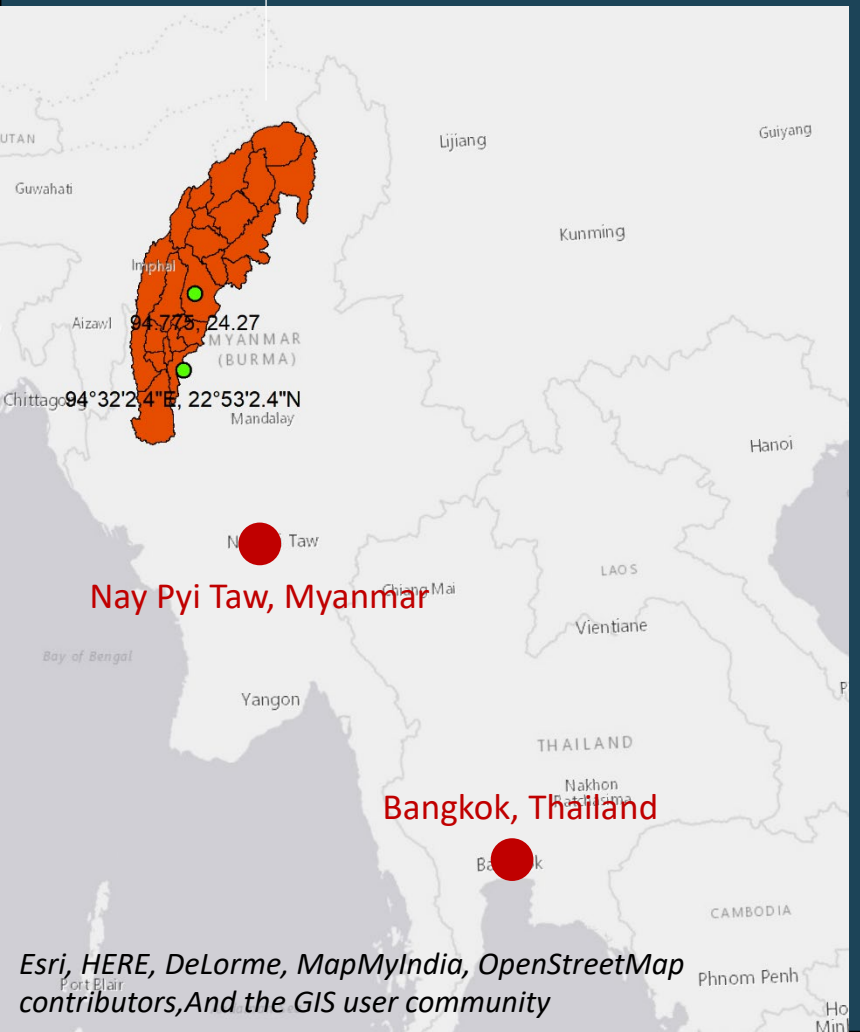
Calibration 2004-2009

Validation 2010-2014

Simulation 2015

Methodology: Case study, Chindwin Basin, Myanmar

Chindwin basin, Myanmar

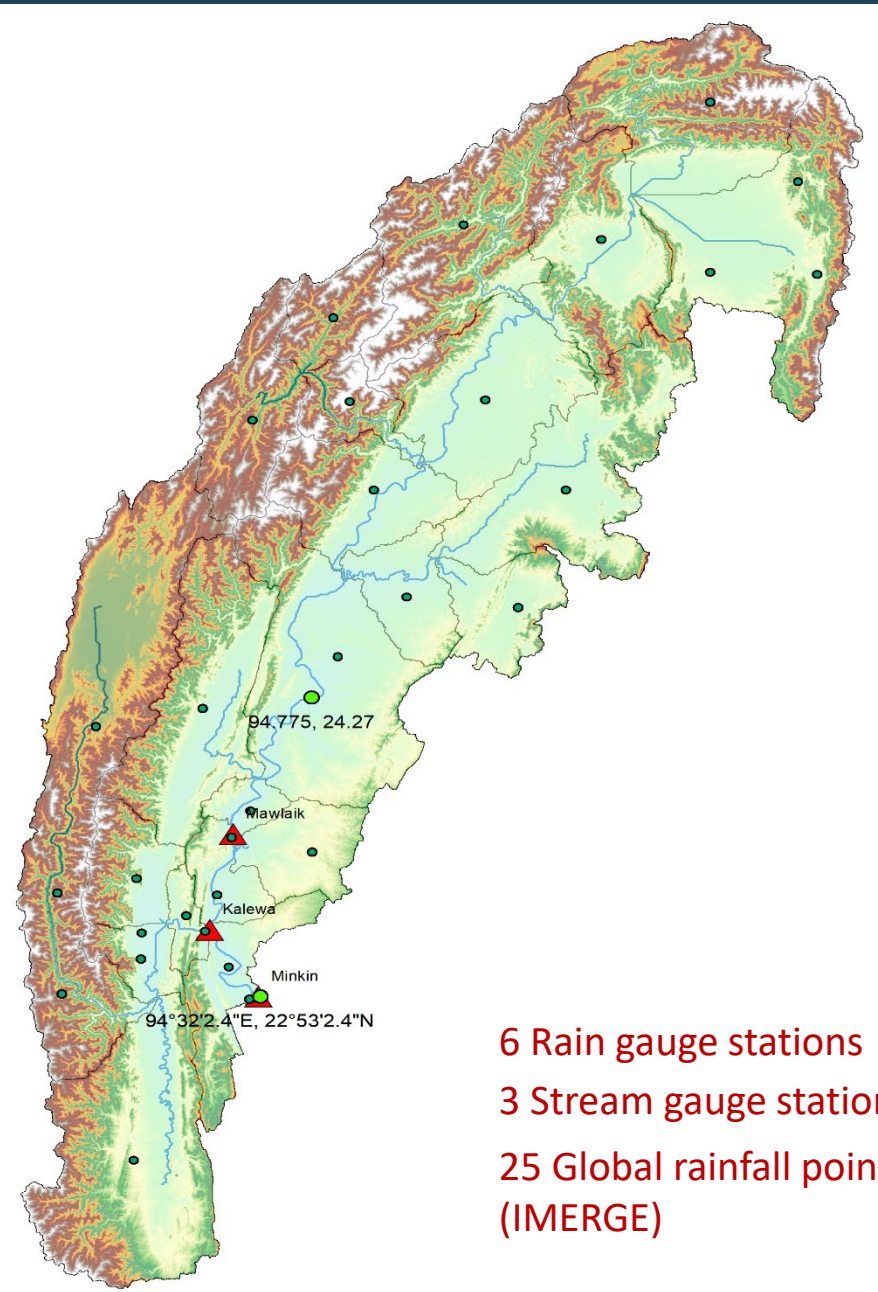


Chindwin is the largest tributary of Myanmar's chief river the Irrawaddy

Catchment area: 114,000 km2, length: 900 km.

Big flood in 2015

Hydrological context



6 Rain gauge stations

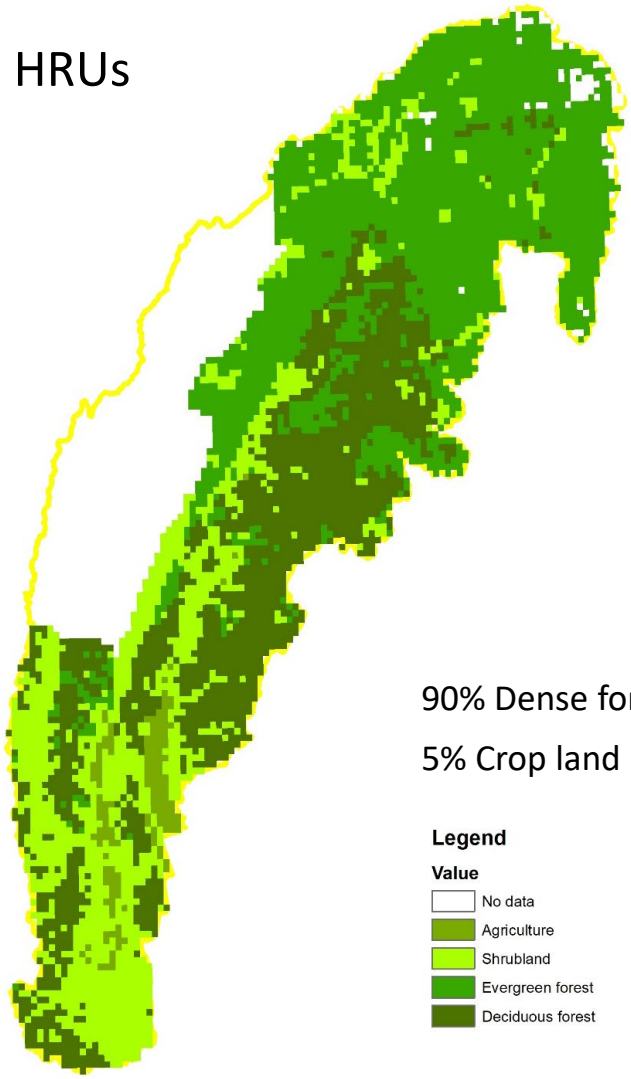
3 Stream gauge stations

25 Global rainfall points (IMERGE)

Methodology: Land cover comparison in Chindwin basin

UNEP, 1KM, 5 Classes, 2000

7 HRUs

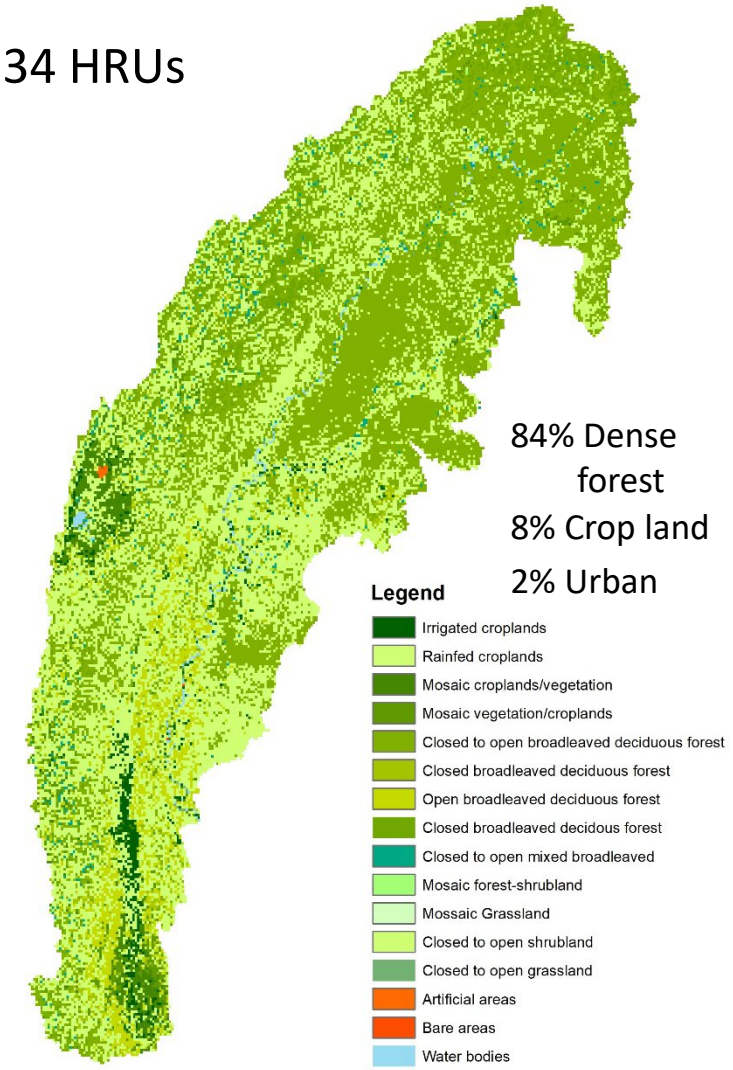


90% Dense forest

5% Crop land

GLOBCOVER, 400M., 16 Classes, 2009

34 HRUs



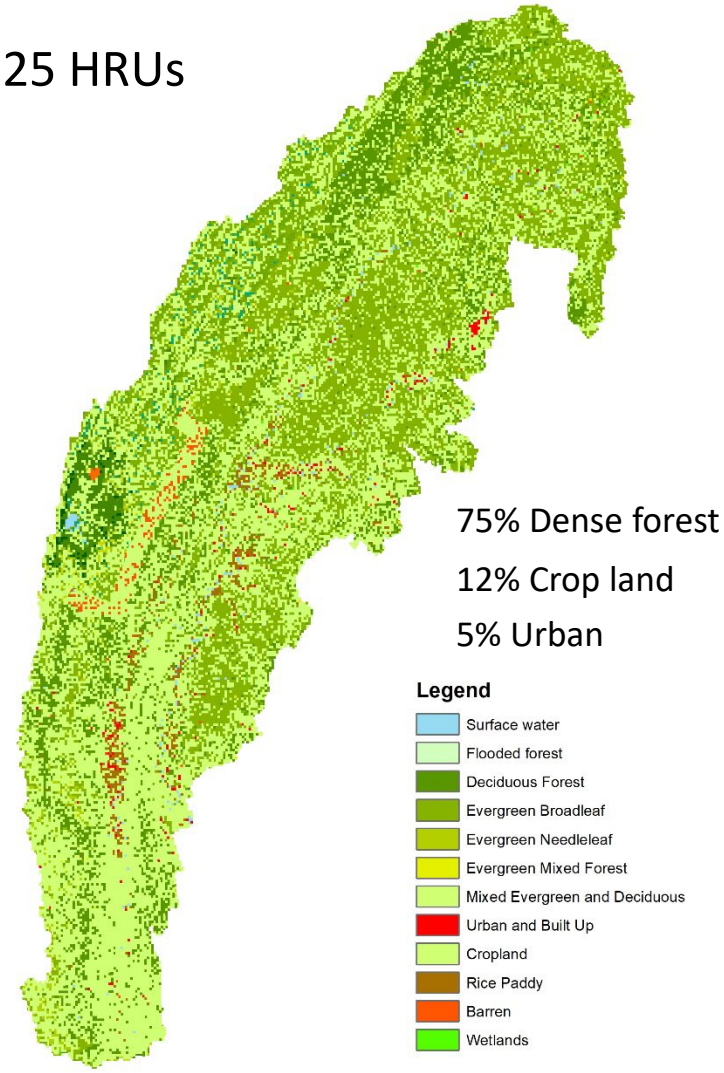
84% Dense forest

8% Crop land

2% Urban

RLCMS, 30M., 12 Classes, 2016

25 HRUs

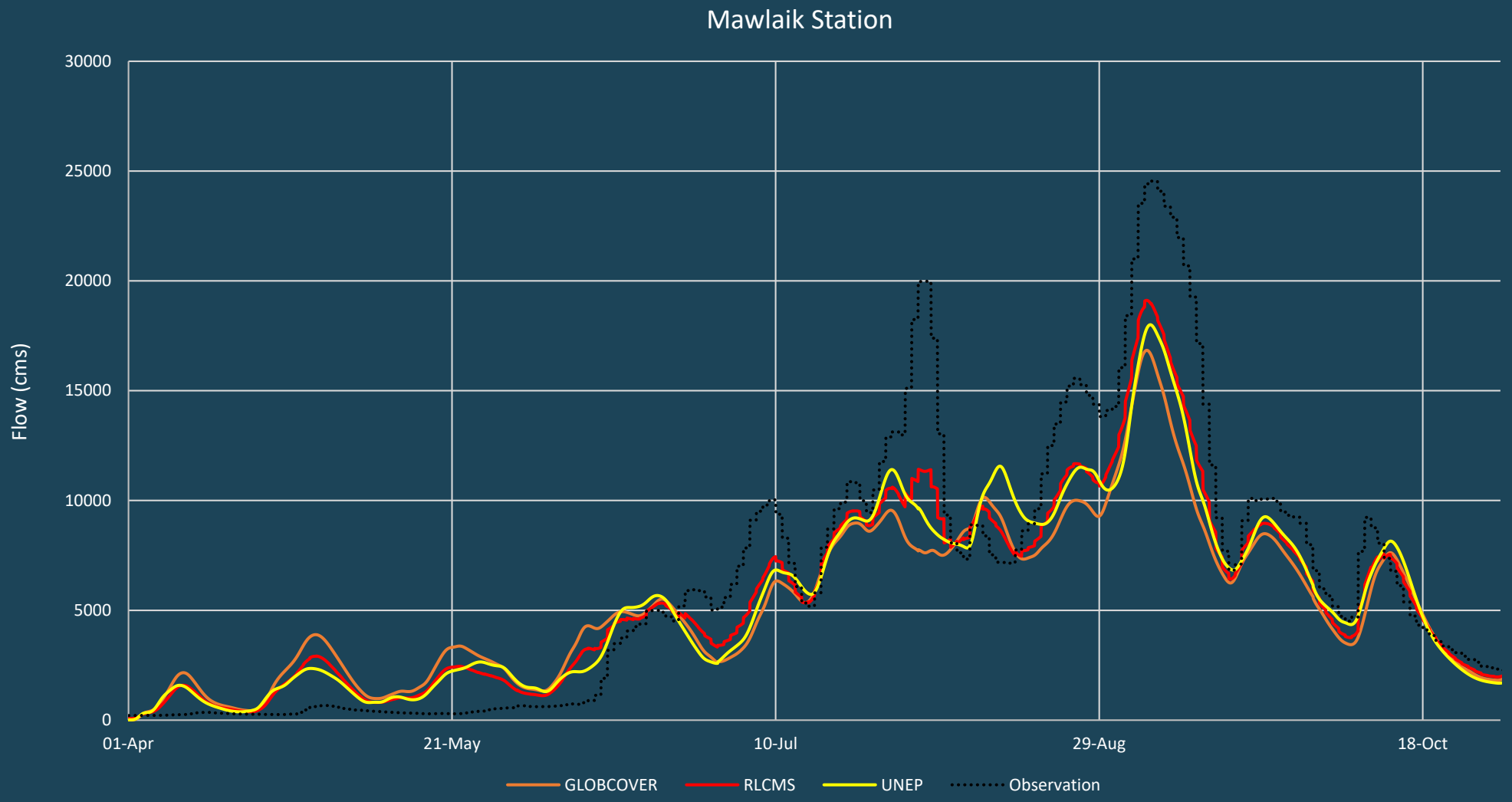


75% Dense forest

12% Crop land

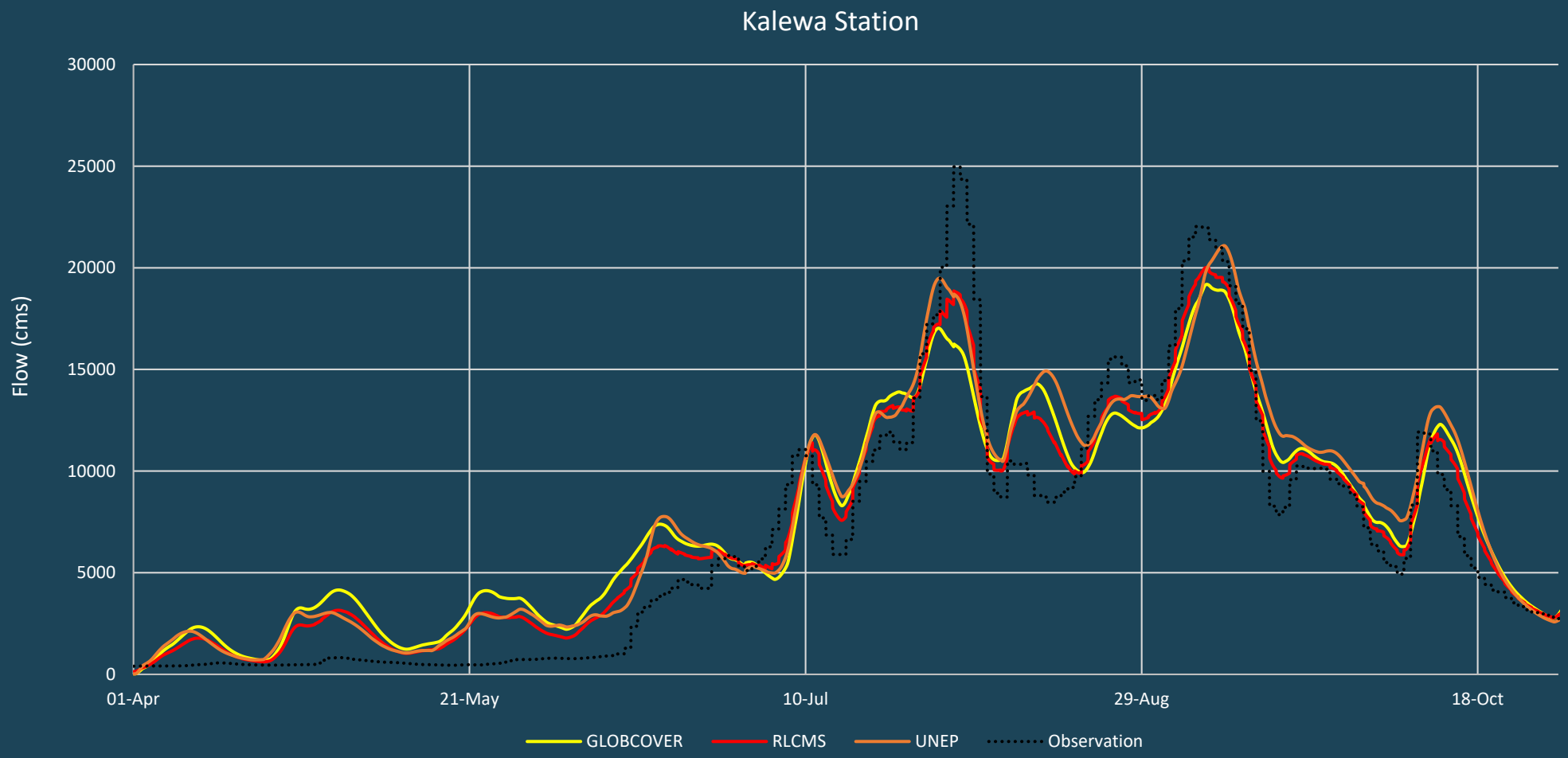
5% Urban

Results: Sensitivity of Hydrological model due to 3 different Global LC products at Mawlaik station in 2015



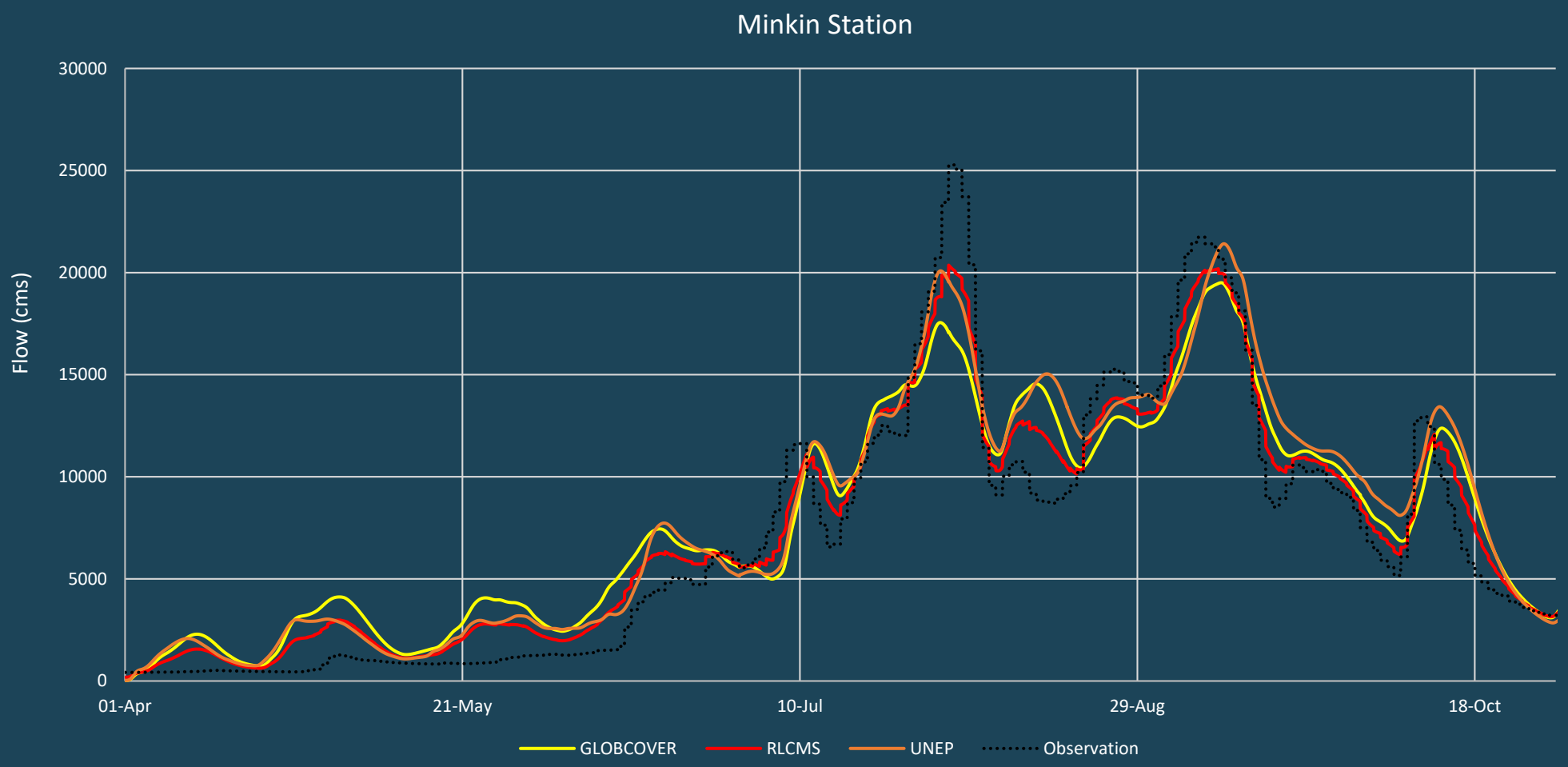
	R2	NASH
GLOBCOVER	0.79	0.63
RLCMS	0.84	0.75
UNEP	0.71	0.60

Results: Sensitivity of Hydrological model due to 3 different Global LC products at Kalewa station in 2015



	R2	NASH
GLOBCOVER	0.75	0.69
RLCMS	0.81	0.72
UNEP	0.79	0.68

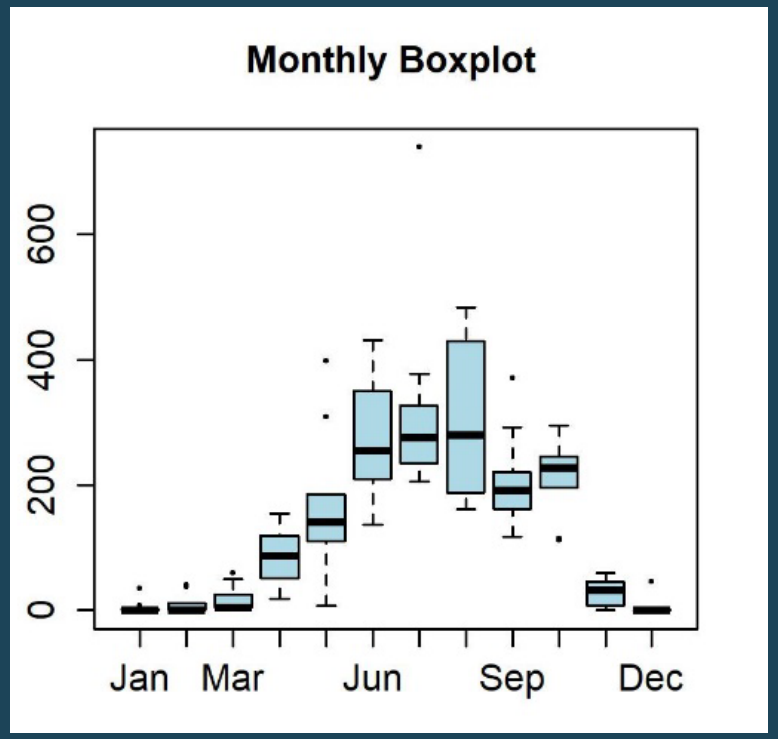
Results: Sensitivity of Hydrological model due to 3 different Global LC products at Minkin station in 2015



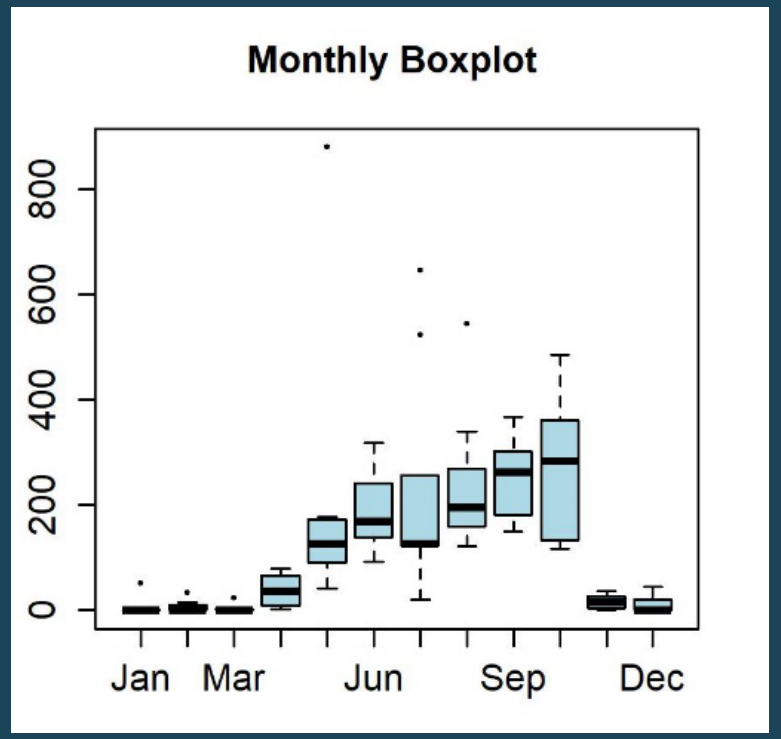
	R2	NASH
GLOBCOVER	0.79	0.72
RLCMS	0.83	0.79
UNEP	0.72	0.68

Results:

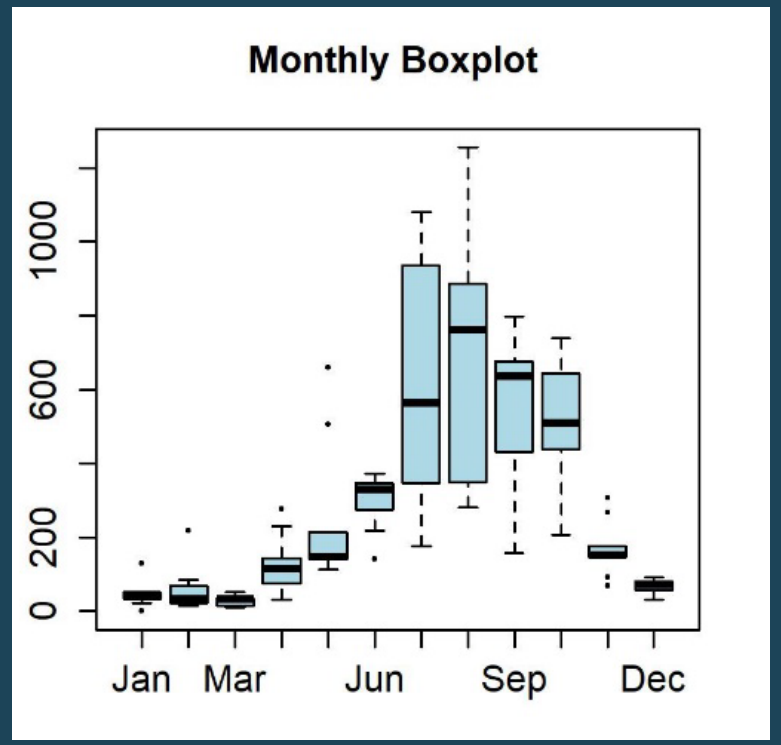
Uncertainty of stream flows due to 3 different Global LC products at sub basin no. 18 (Kalay city) in 2015



GLOBCOVER



RLCMS



UNEP

Conclusion: Summary

RLCMS

perform well in the context of Chindwin basin and could help in transboundary river basin

UNEP

perform worst in the context of Chindwin basin By giving over estimate rainfall. However, it can capture peak well in Mawlaik station

GLOBCOVER

perform slightly less than RLCMS but much better than UNEP in the context of Chindwin basin.

Uncertainty

RLCMS gave less uncertainty on stream flows comparing with GLOBCOVER and UNEP

"Land cover change is sensitive to the stream flows in the case of Chindwin basin"

"Higher resolution land cover data and up to date could help and improve flood risk management and Basin Planning in the area that lack of data"

Conclusion: Limitations/further study

1

6 observed Rainfall station mostly are located in the lower Chinwin basin

Exploring more observed rainfall data at the upper Chindwin basin to improve the model results

2

There is no dam operation and human intervention included in this study due to lack of data and difficulty of data exchange

3

As of data available in different time scale, the study could not compare by using the LC in the same time scale.

4

The Global rainfall products/inputs should do bias correction to improve the model results

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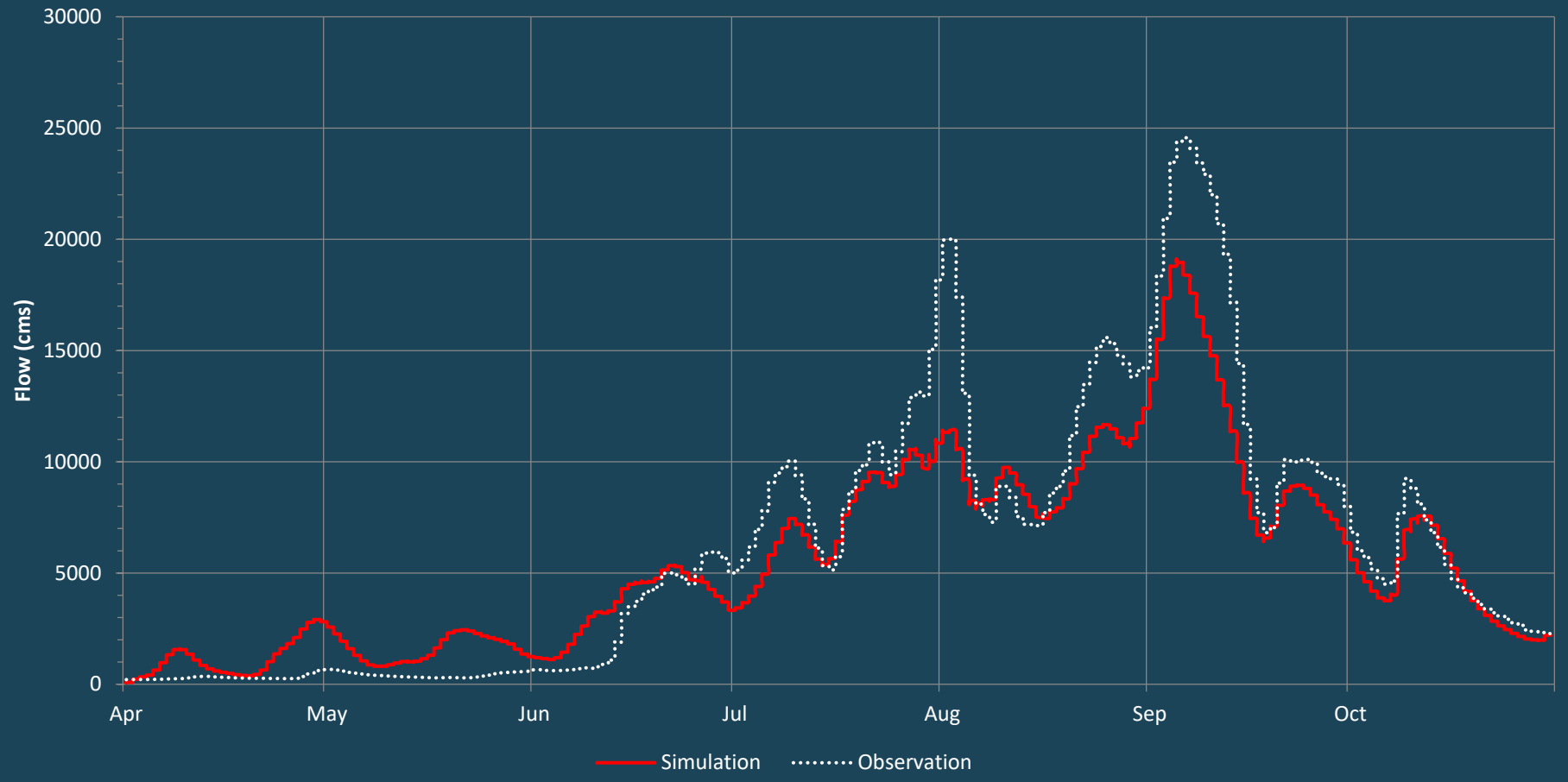
THANK YOU

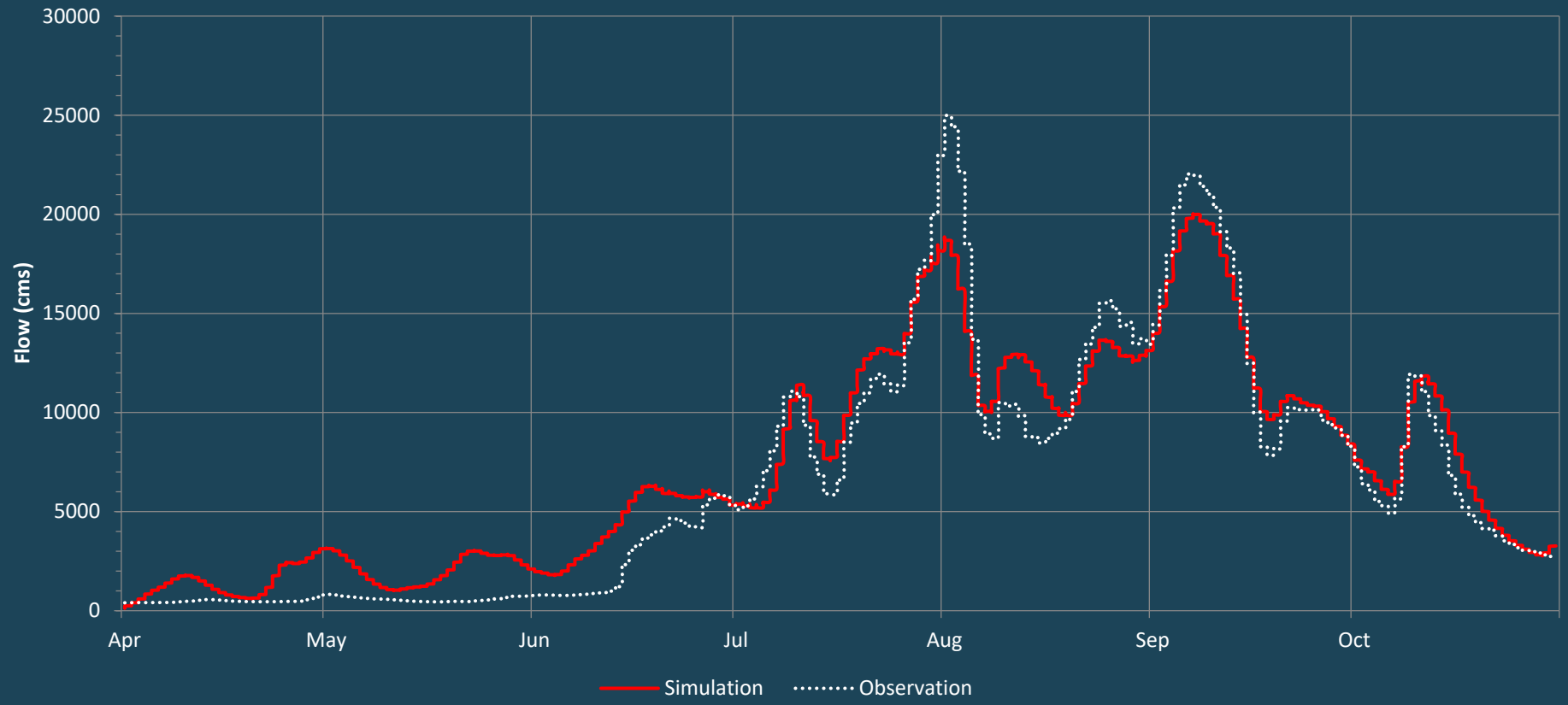
SEI STOCKHOLM ENVIRONMENT INSTITUTE Spatial Informatics Group Deltares Enabling Delta Life

Results: Hydrological model calibration at Mawlaik station



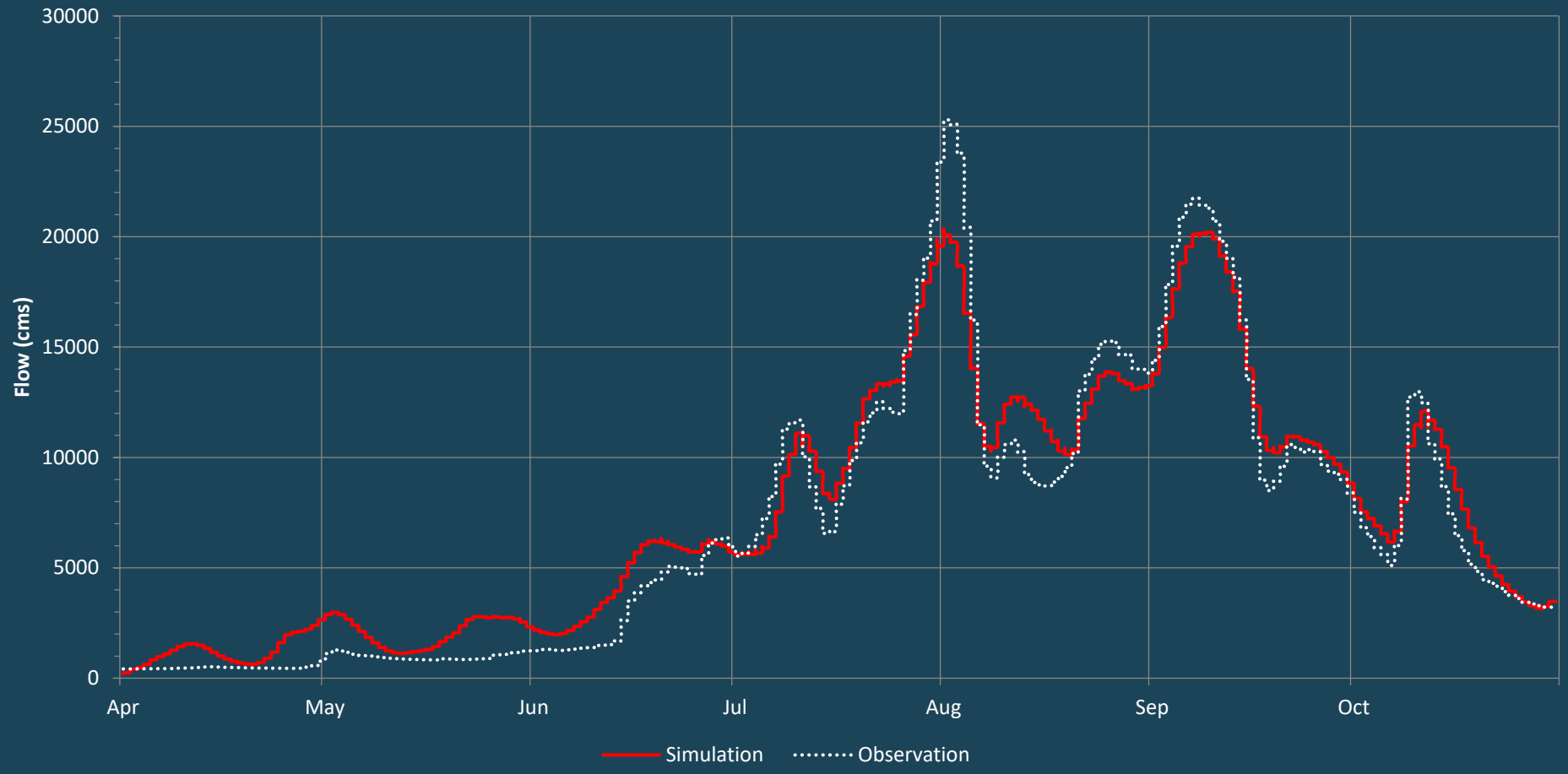
	R2	NASH
Observation	0.94	0.85

Results: Hydrological model calibration at Kalewa station



	R2	NASH
Observation	0.95	0.92

Results: Hydrological model calibration at Minkin station



	R2	NASH
Observation	0.96	0.95