# Simulation of sub-basin sediment yields and river runoffs into Davao Gulf, Philippines

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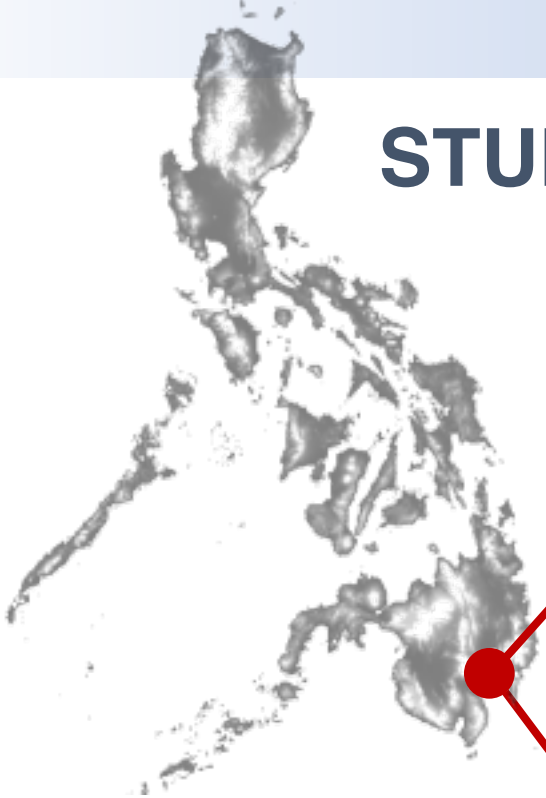
Strengthening Marine Protected Areas to Conserve Marine Key Biodiversity Areas in the Philippines

## OBJECTIVE

Identify catchment areas with high sediment yield.

# STUDY SITE



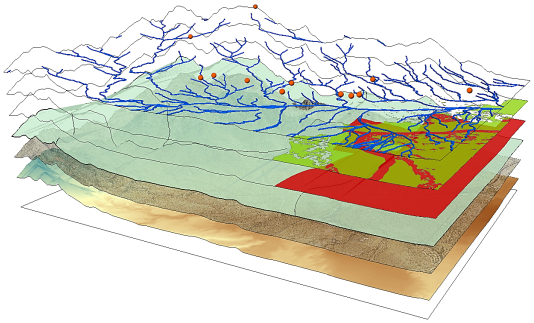

- high fish production
- a priority conservation area of the Sulu-Sulawesi Marine Ecoregion

# SWAT Soil & Water Assessment Tool

- a spatially semi-distributed and time continuous hydrological model

## Inputs

geospatial data



weather data

- DEM (NASA SRTM, 30m)
- land use (PhilGIS, 1km)
- soil type (BSWM, 1km)

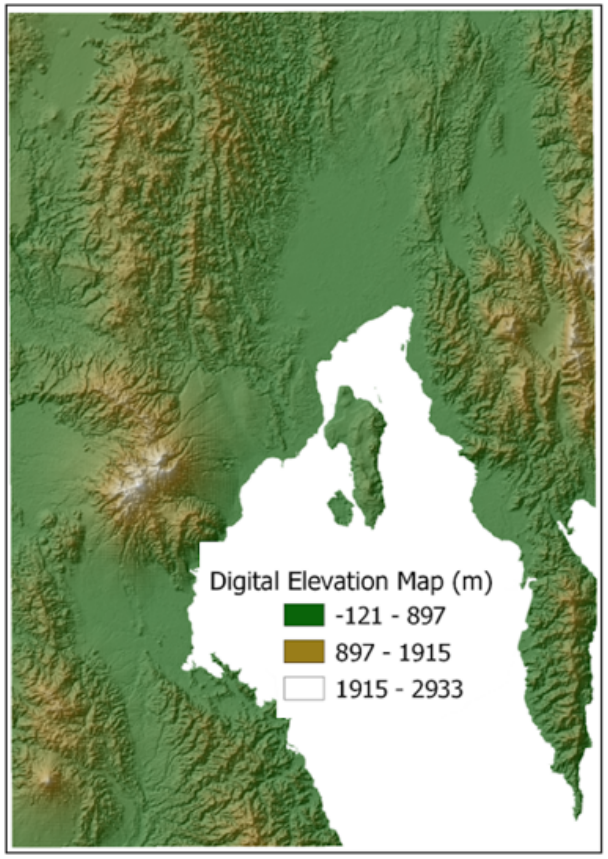
- precipitation (TRMM, 0.25° x 0.25°)
- relative humidity (NASA LaRC)
- wind speed (NASA LaRC)
- solar radiation (NASA LaRC)
- temperature (NASA LaRC)

## Outputs

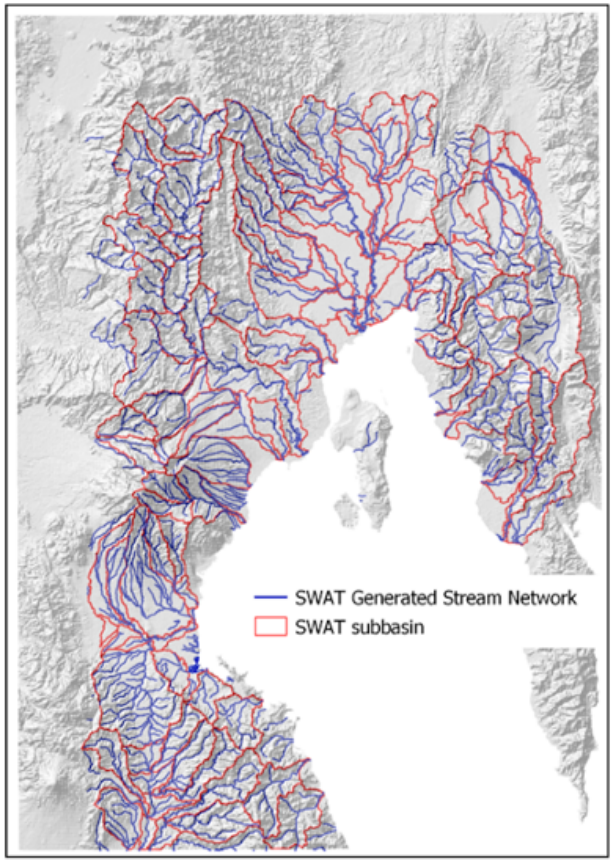
- generated stream networks
- subbasins
- HRUs
- sediment yield

**model run:**
Jan 1998 - Aug 2018
(spin-up period: 3 years)

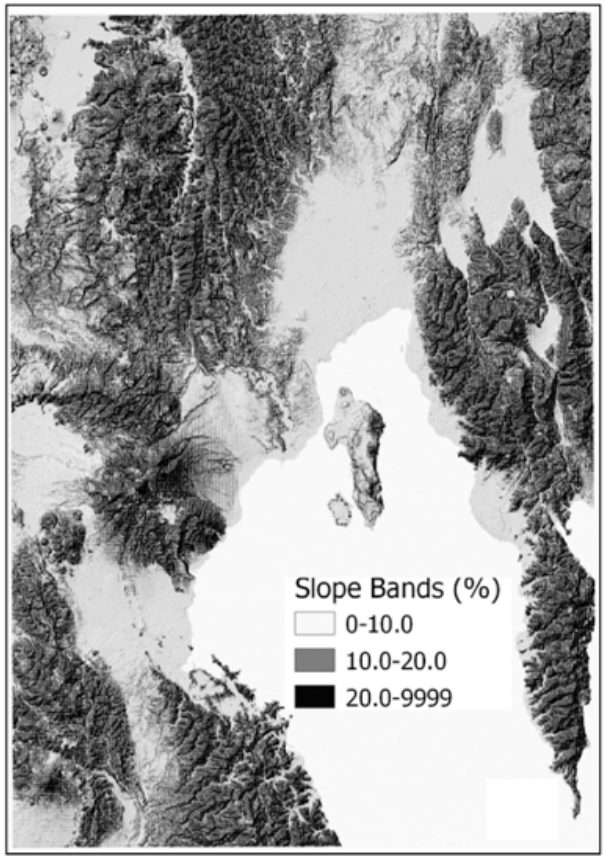
# Geospatial data




topographic map

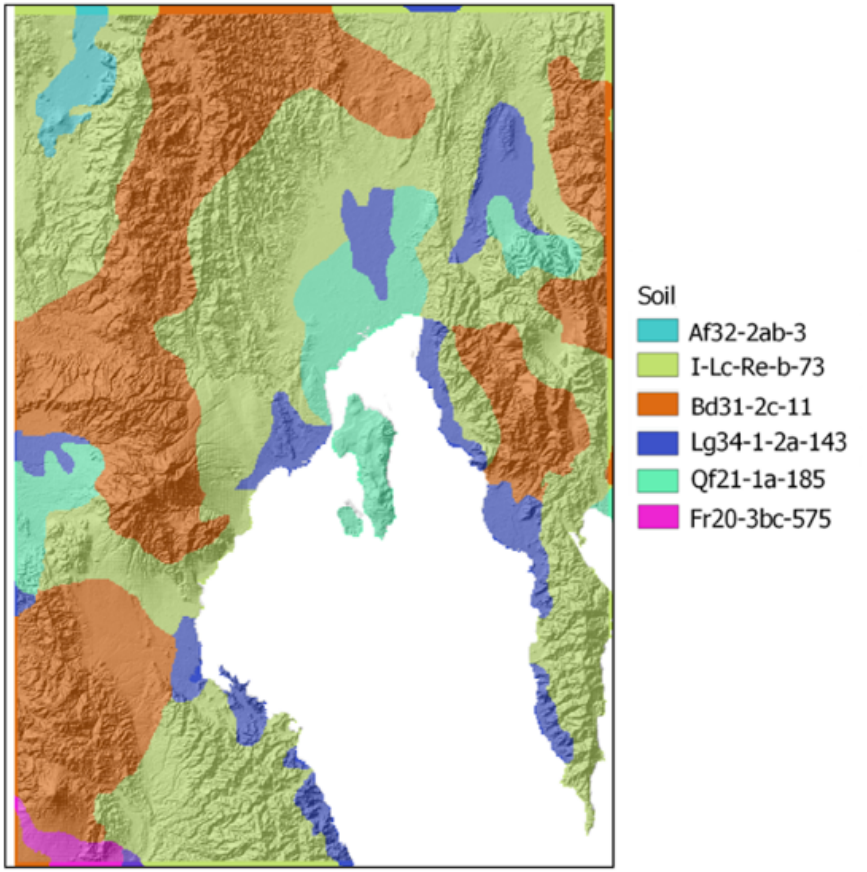



stream network
and subbasins

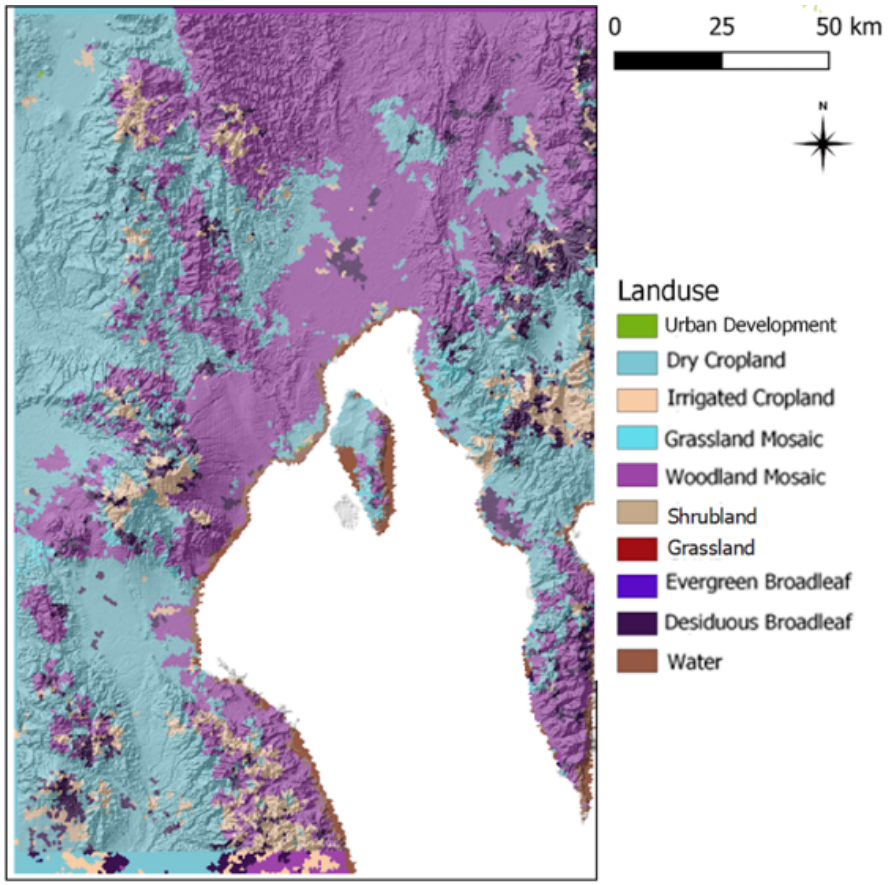



slope map

# Geospatial data

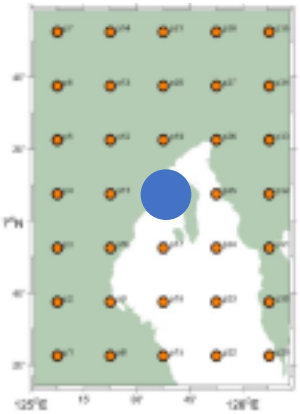



soil map

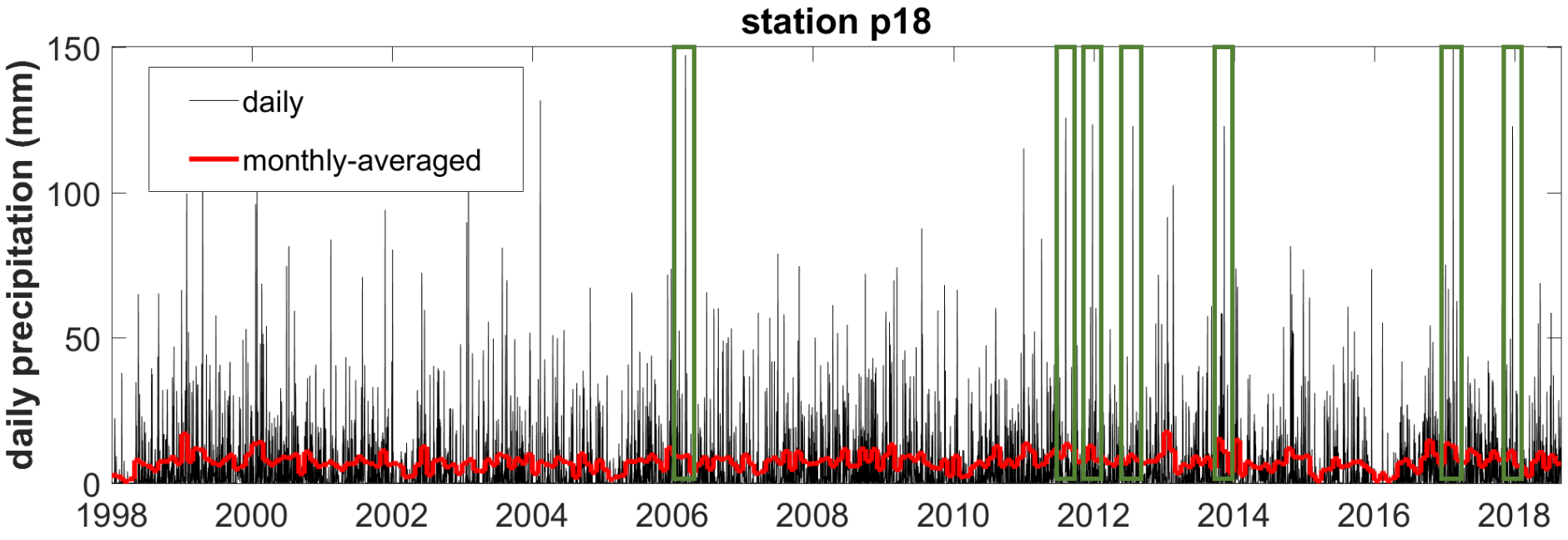



land use map

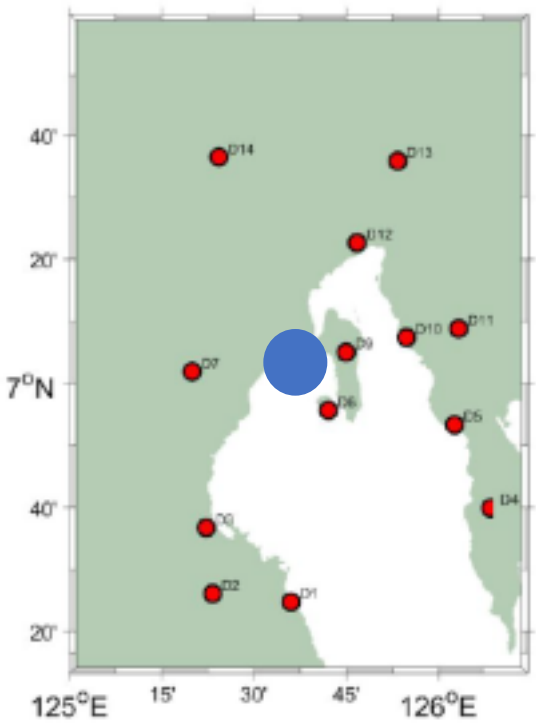
# Weather data

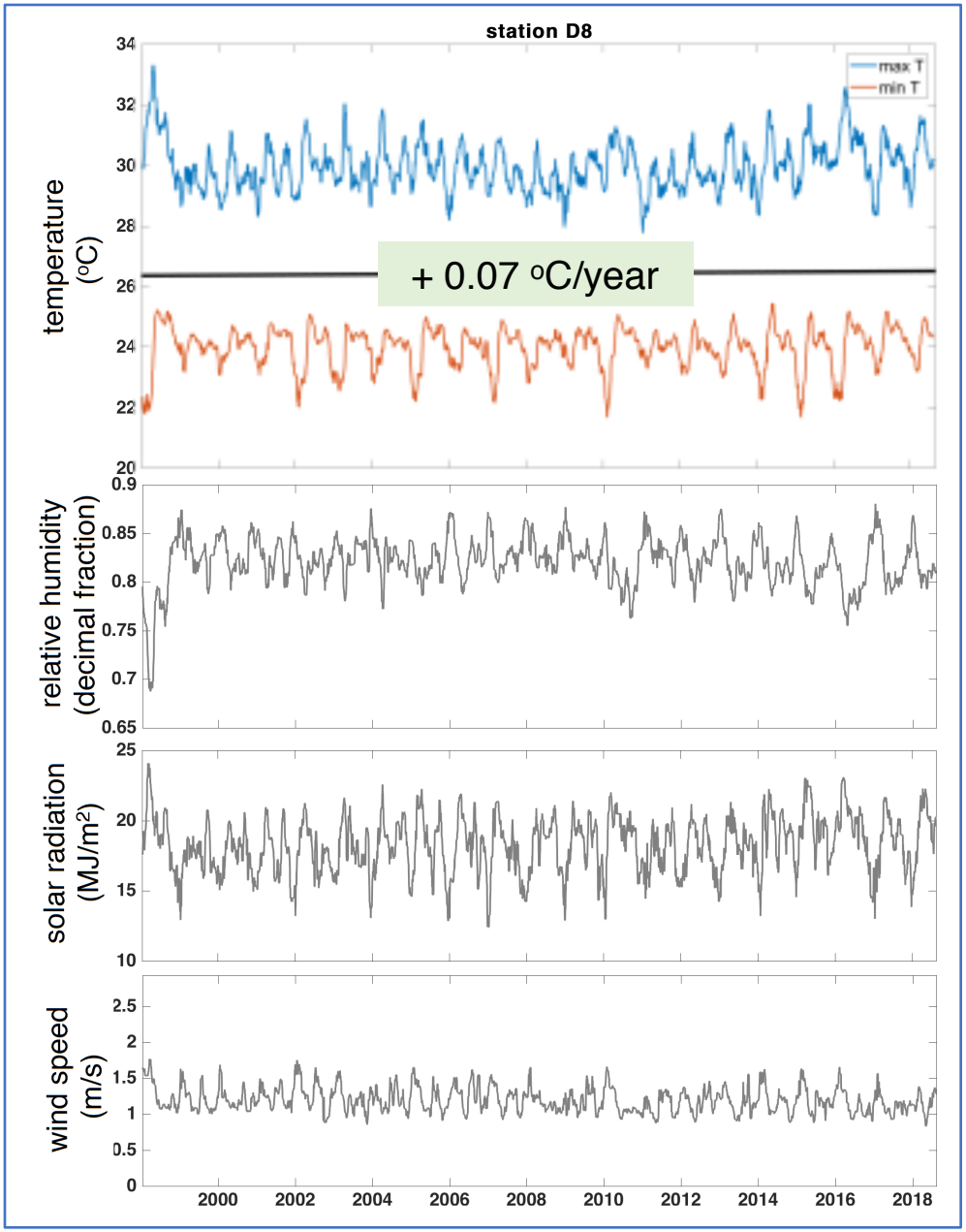


**Episodic high precipitation events** are not captured by the **monthly-averaged data (red line)**.



# Weather data



coefficient of determination

$$R^2 = \frac{\left[\sum_{i=1}^{n} (Q_m - \overline{Q}_m)(Q_s - \overline{Q}_s)\right]^2}{\sum_{i=1}^{n} (Q_m - \overline{Q}_m)^2 \sum_{i=1}^{n} (Q_s - \overline{Q}_s)^2}$$

Nash-Sutcliffe model efficiency

$$NSE = 1 - \frac{\sum_{i=1}^{n} (Q_m - Q_s)^2}{\sum_{i=1}^{n} (Q_m - \overline{Q}_m)^2}$$

percentage deviation

$$PBIAS = \frac{\sum_{i=1}^{n} (Q_m - Q_s)}{\sum_{i=1}^{n} Q_m} x100$$

Pearson correlation coefficient

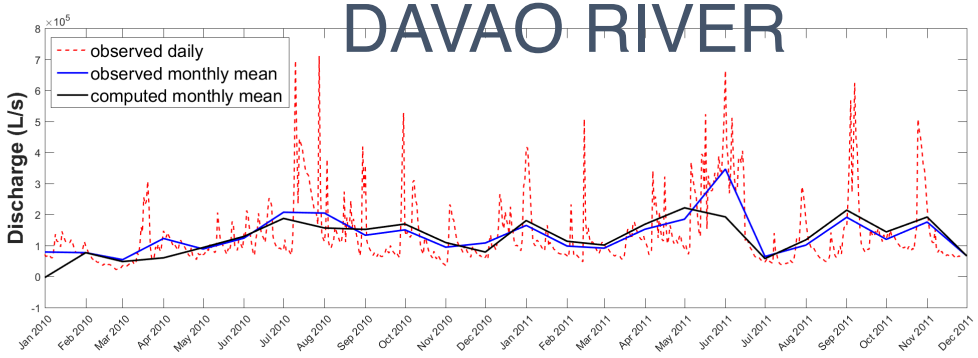
$$r = \frac{n \sum_{i=1}^{n} Q_{mi} Q_{si} - \sum_{i=1}^{n} Q_{mi} \sum_{i=1}^{n} Q_{si}}{\sqrt{n \sum_{i=1}^{n} Q_{mi}^2 - (\sum_{i=1}^{n} Q_{mi})^2} \sqrt{n \sum_{i=1}^{n} Q_{mi}^2 - (\sum_{i=1}^{n} Q_{mi})^2}}$$

Satisfactory:

- $R^2 > 0.6$
- NSE > 0.5
- PBIAS < ±25
- 1 > r > 0

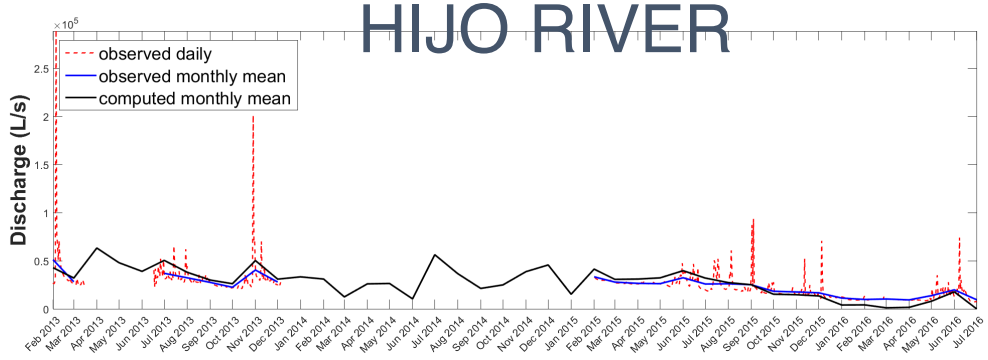
*(Luan et al., 2018)*

## DAVAO RIVER




$R^2$ = 0.6142 NSE = 0.6090
PBIAS = 2.8711 r = 0.7837

## HIJO RIVER

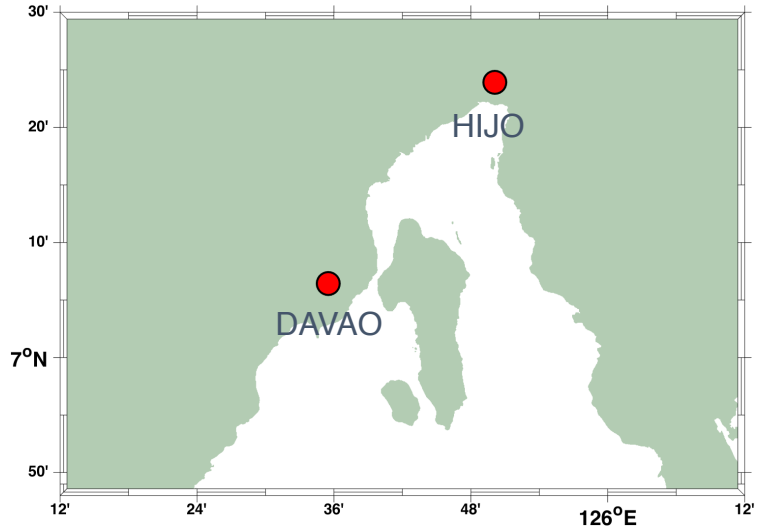


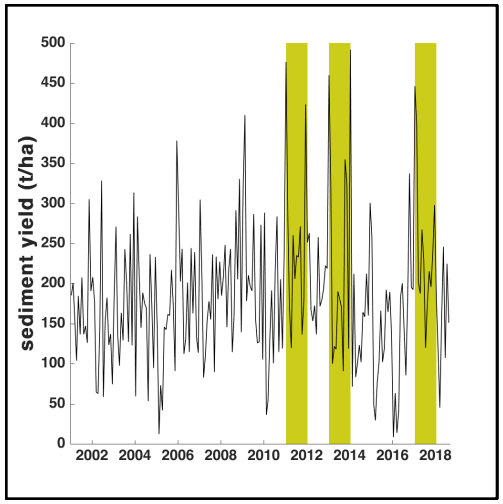

$R^2$ = 0.8945 NSE = 0.6194
PBIAS = -2.1630 r = 0.9458

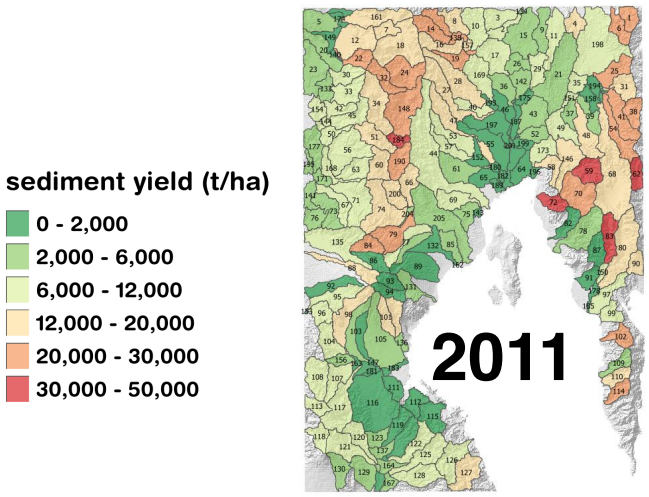
Satisfactory:

- $R^2 > 0.6$
- NSE > 0.5
- PBIAS < ±25
- 1 > r > 0

*(Luan et al., 2018)*

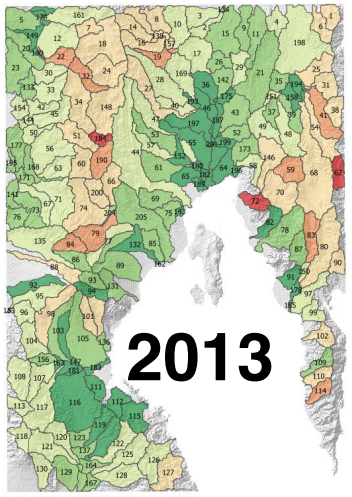


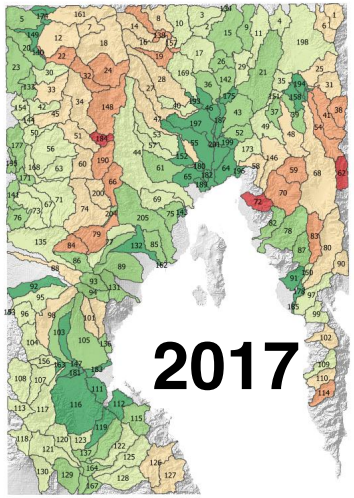


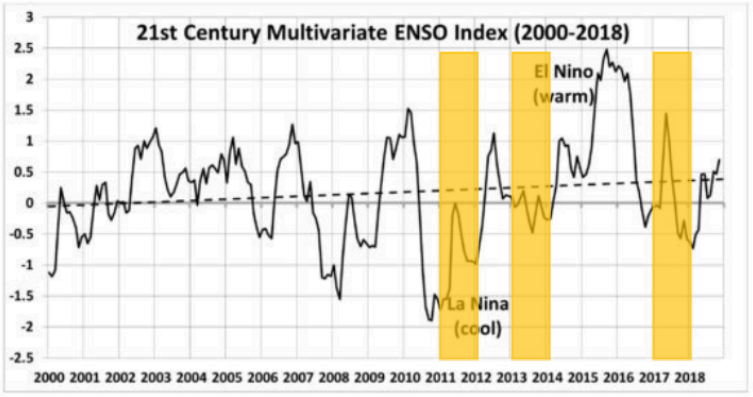










*Spencer, 2019*

INQUIRER.NET

## Up to 25 dead in Davao flashflood, officials say

By: Dennis Jay Santos, Jeffrey M. Tupas - @inquirerdotnet

Agence France-Presse, Inquirer Mindanao, Radyo Inquirer 990AM / 06:50 PM June 29, 2011

A man carries the body of Catherine Valderosa, 3, one of three children in the Valderosa Family, swept away by the flashfloods overnight in Davao city, in southern Philippines, which killed at least 25 people Wednesday June 29, 2011. AP

DAVAO – Up to 25 people were killed and up to 15 others were missing as a flashflood triggered by heavy rains devastated a riverside community in the Philippines, rescuers said Wednesday.

RAPPLER — Be a Rappler PLUS Member

## Over 25,000 affected by Davao flooding

At least 13 barangays suffered flooding and classes will be suspended on Monday

Karlos Manlupig

Published 7:54 PM, January 20, 2013
Updated 11:12 AM, January 21, 2013

DAVAO CITY, Philippines - More than 25,000 residents in Davao City were affected by flooding after a major river overflowed on Saturday night, January 19, submerging houses near the riverbanks.

RAPPLER — Be a Rappler PLUS Member

## Over 31,000 affected by flooding in Davao City

The City Information Office urges donors to either drop their donations at the City Hall or directly give them to victims in coordination with evacuation center managers to ensure orderly distribution of relief goods

Mick Basa

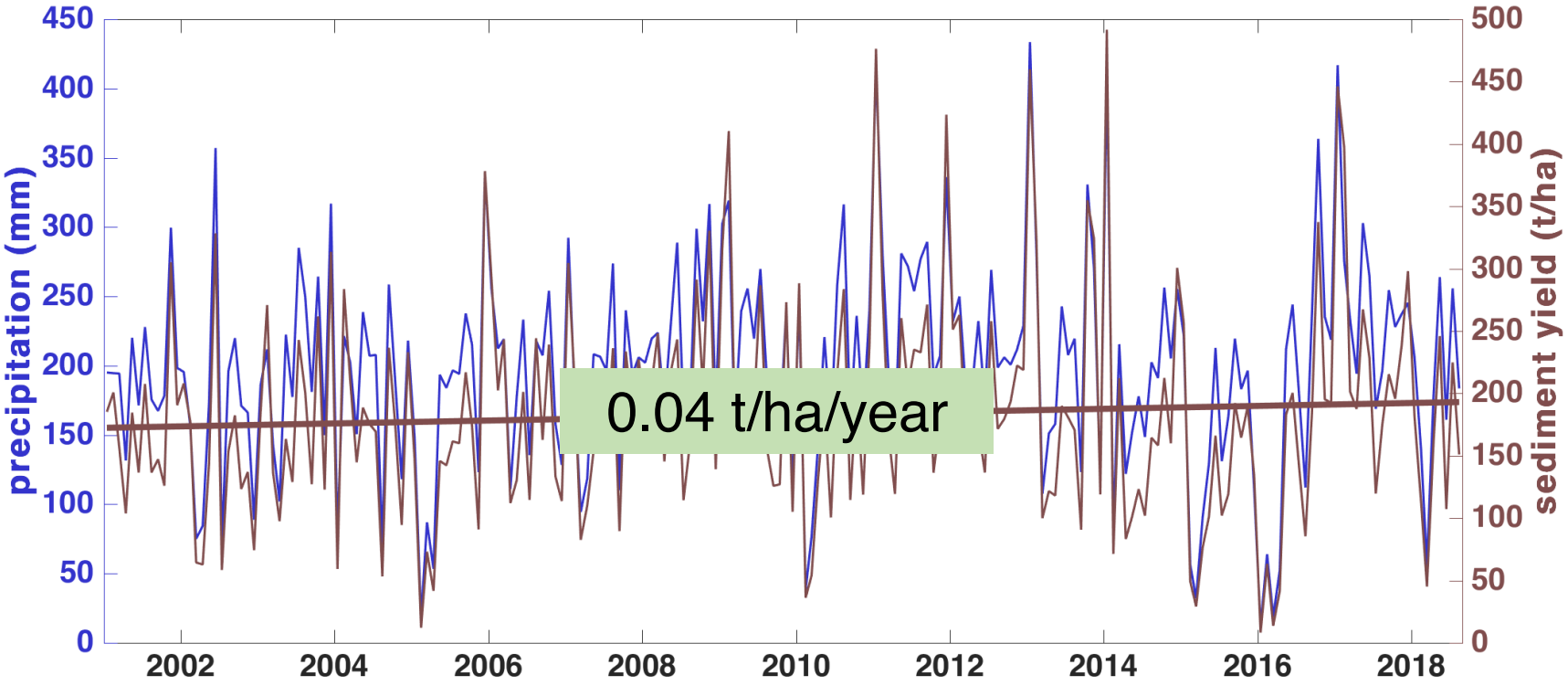
Published 1:15 AM, December 23, 2017
Updated 2:18 PM, December 23, 2017

DAVAO FLOODING. Homes in a barangay in Davao City are submerged in flood waters on Friday night, December 22, 2017. Photo by Mick Basa

DAVAO CITY, Philippines (2nd UPDATE) – At least 6, 614 families or 31, 375 individuals have been affected by flooding in Davao City, the City Information Office said on Saturday, December 23.

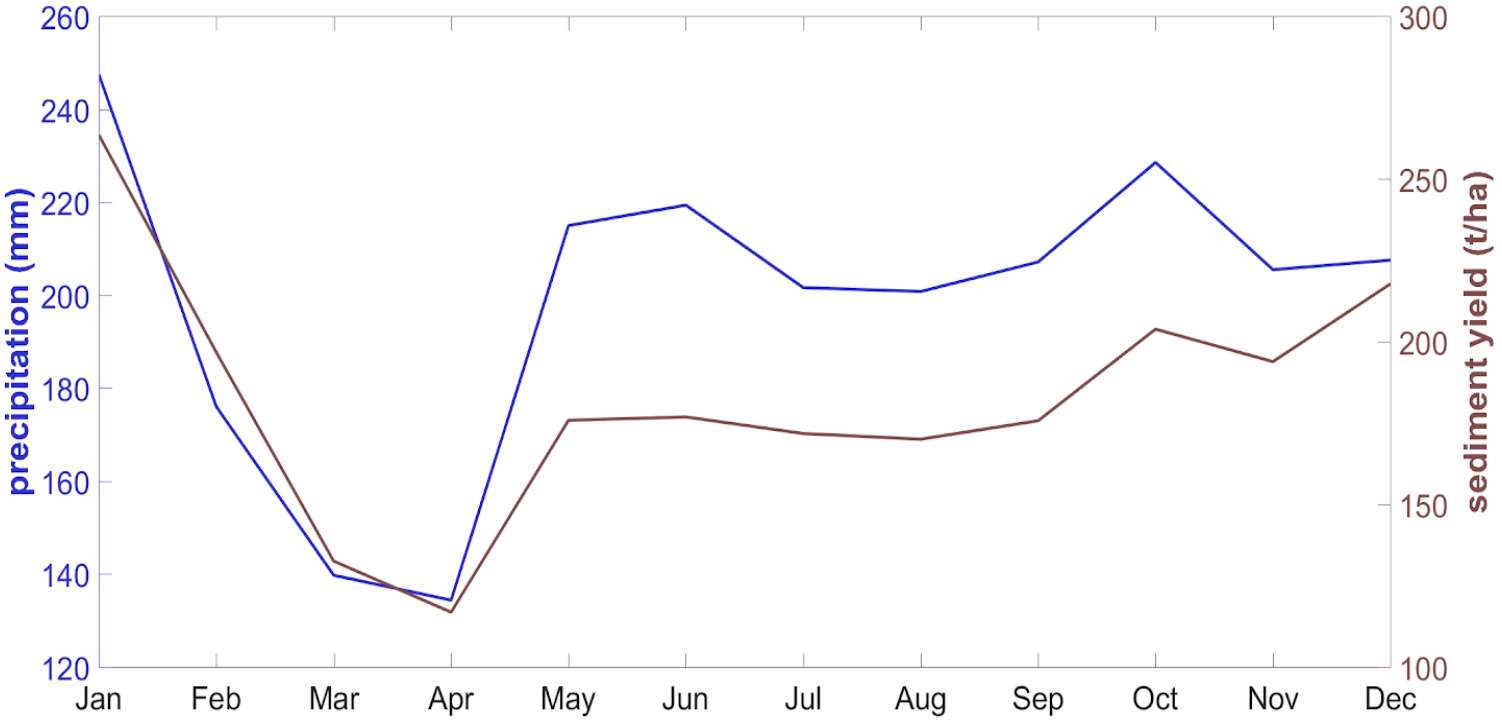
# monthly precipitation and sediment yield

(January 2001 to August 2018)

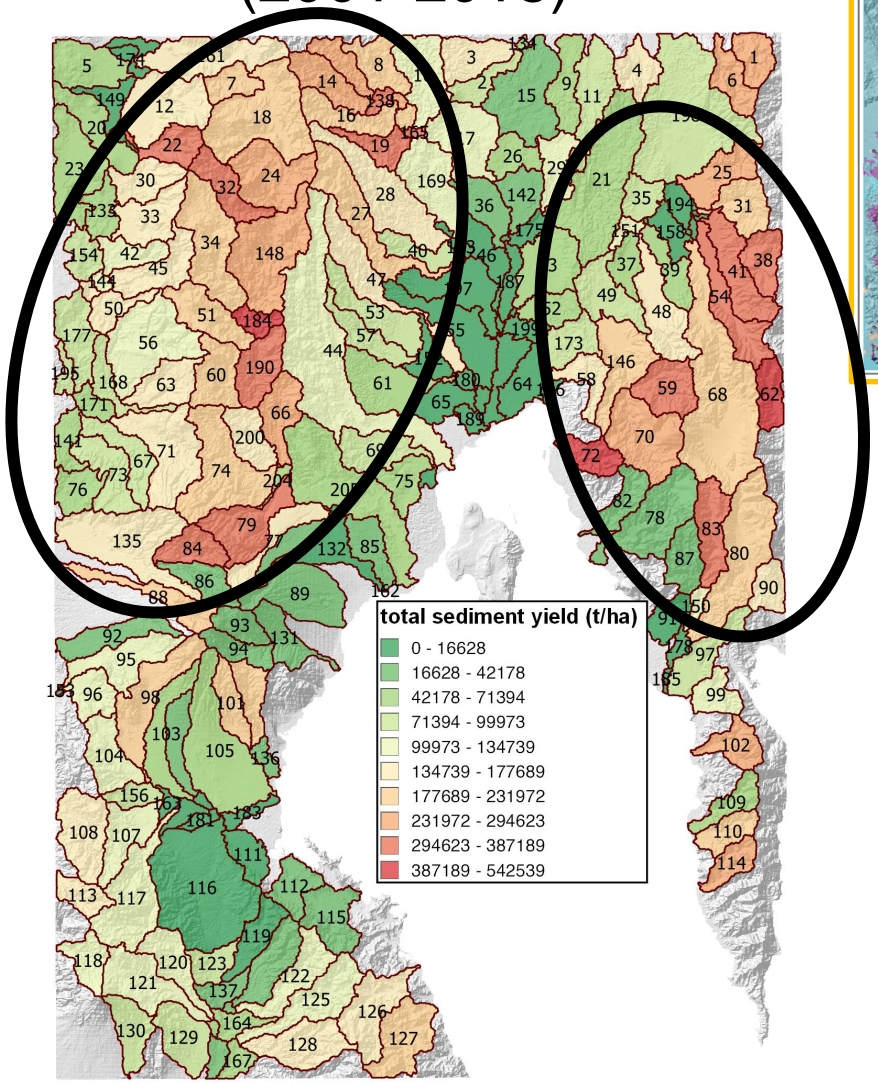


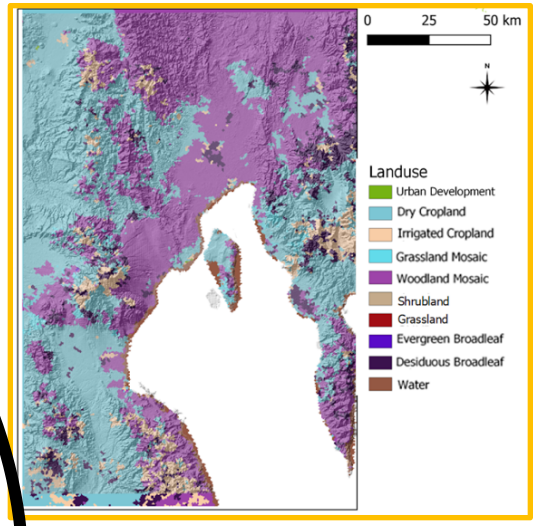
## monthly averaged precipitation and sediment yield

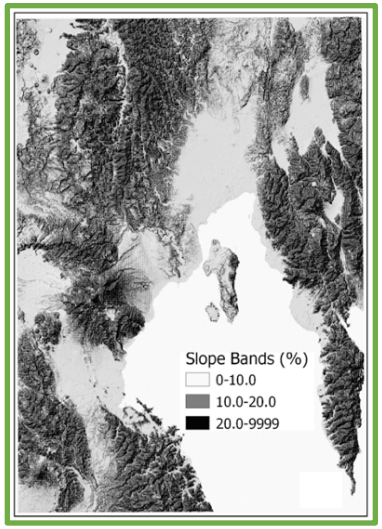
(January 2001 to August 2018)



# total sediment yield (2001-2018)




- elevated sediment yield mostly comes from the **northwest and northeast subbasins**
- **irrigated croplands** have higher sediment yield compared to **woodlands** and **dry croplands**.
- **steeper topography** tends to have higher sediment yield

- Sediment yield is greatly dictated by precipitation events, topography, and land use.

- This study can be used as science-based reference in addressing sedimentation and crafting local Comprehensive Land Use Plan (CLUP).

- Calibrate with observed data.
- Incorporate land use changes.
- Apply to other areas in the Philippines.
- Use hydrodynamic model to study how the sediments discharged into the sea are dispersed.


Strengthening Marine Protected Areas to Conserve Marine Key Biodiversity Areas in the Philippines