

# Parameterization of physical and climatic characteristics in the Amazon basin for hydrological simulation with SWAT model

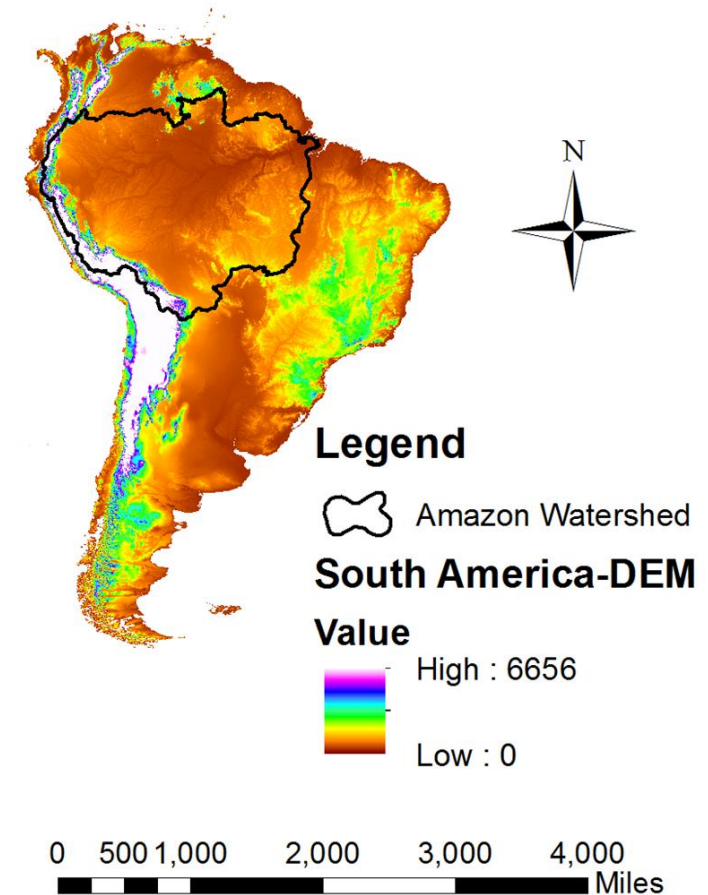
## Team Work:

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Pernambuco Federal University, Doctoral Student in Geography - UFPE  
Rio de Janeiro Federal University (COPPE/UFRJ)

# STUDY AREA: Amazon basin

- Largest watershed in the world
- Approximately **6,100,000 km<sup>2</sup>**
- Occupying territories:
  - Brazil, Peru, Ecuador, Bolivia, Colombia, Venezuela and Guyana
- Covers about **one third of the South American** continent.



# Motivation

- **The Amazon region** → great interest to scientific community due environmental services provided by its dense forest on:
  - Climate regulation,
  - Carbon balance,
  - Water supply,
  - biodiversity.
- **Challenge** → considered poorly monitored:
  - Huge area;
  - Logistics difficult;
  - Tidal influence;
  - River level influence.
- **Soil & Water Assessment Tool - SWAT** → good alternative to estimate the water balance parameters (ex. Streamflow) in different locations and specially for river stretches that are inaccessible or difficult to reach.

# Difficulty

- Don't exist a ready database in South American continent to use on SWAT-Model;

- Difficult to find and prepare:

- Soil data;
- Weather data;
- Land use.

- MDE

Hard to find and  
to prepare.

# Time Period

- **Daily data:** from 1/1/1985 to 12/1/2012

244 TOTAL

- **Precipitation** → 204 rainfall gage stations from National Water Agency – ANA (Brasil)  
40 rainfall gage stations from National Meteorological Institute – INMET

- **Relative Humidity**
- **Solar Radiation**
- **Wind Speed**
- **Temperature (Máx, Mín)**

40 weather stations  
National Meteorological Institute - INMET (Brazil)

Data Produced by:



- Home
- Overview
- Data Sources
- Data Set Development
- Quality Assessment
- Data Availability
- Data Formats
- Notes for Users
- References
- Disclaimer
- Resources:
  - [DATA DOWNLOAD](#)
  - [LEAFLET](#)
  - [DOCUMENTATION](#)
- Acrobat® Reader is needed to view and print a PDF.

In Partnership with:



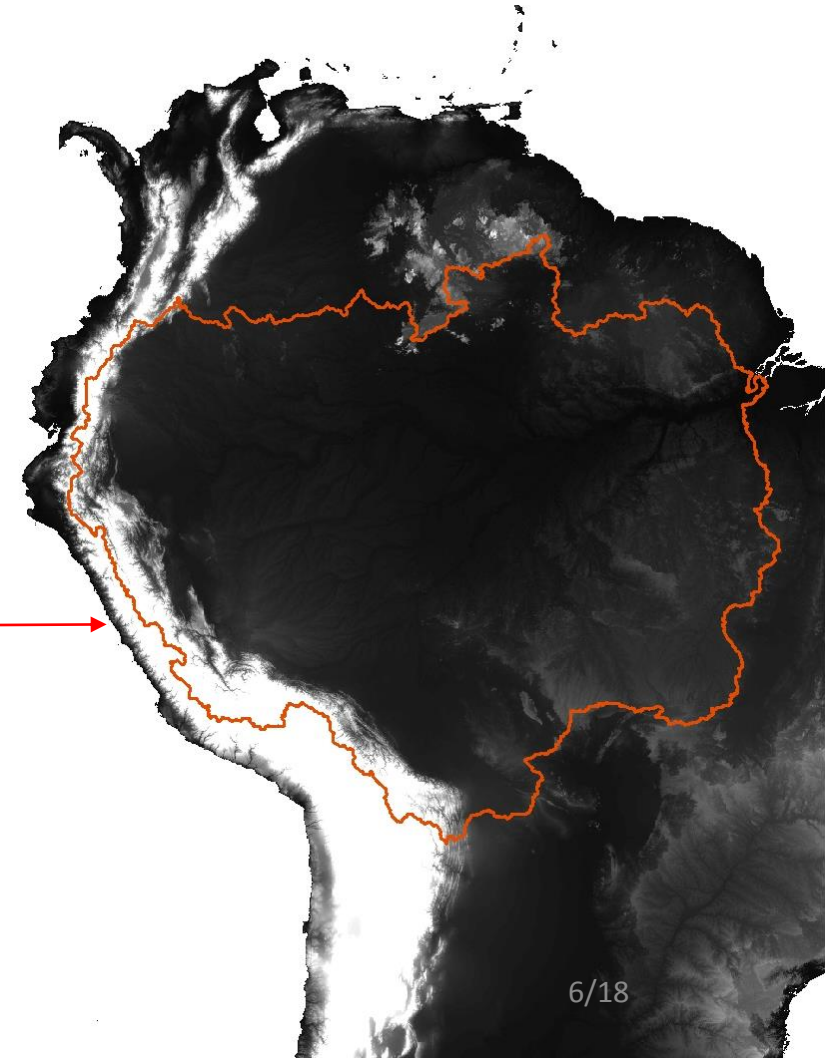
## Data Downloads

### Available Datasets:

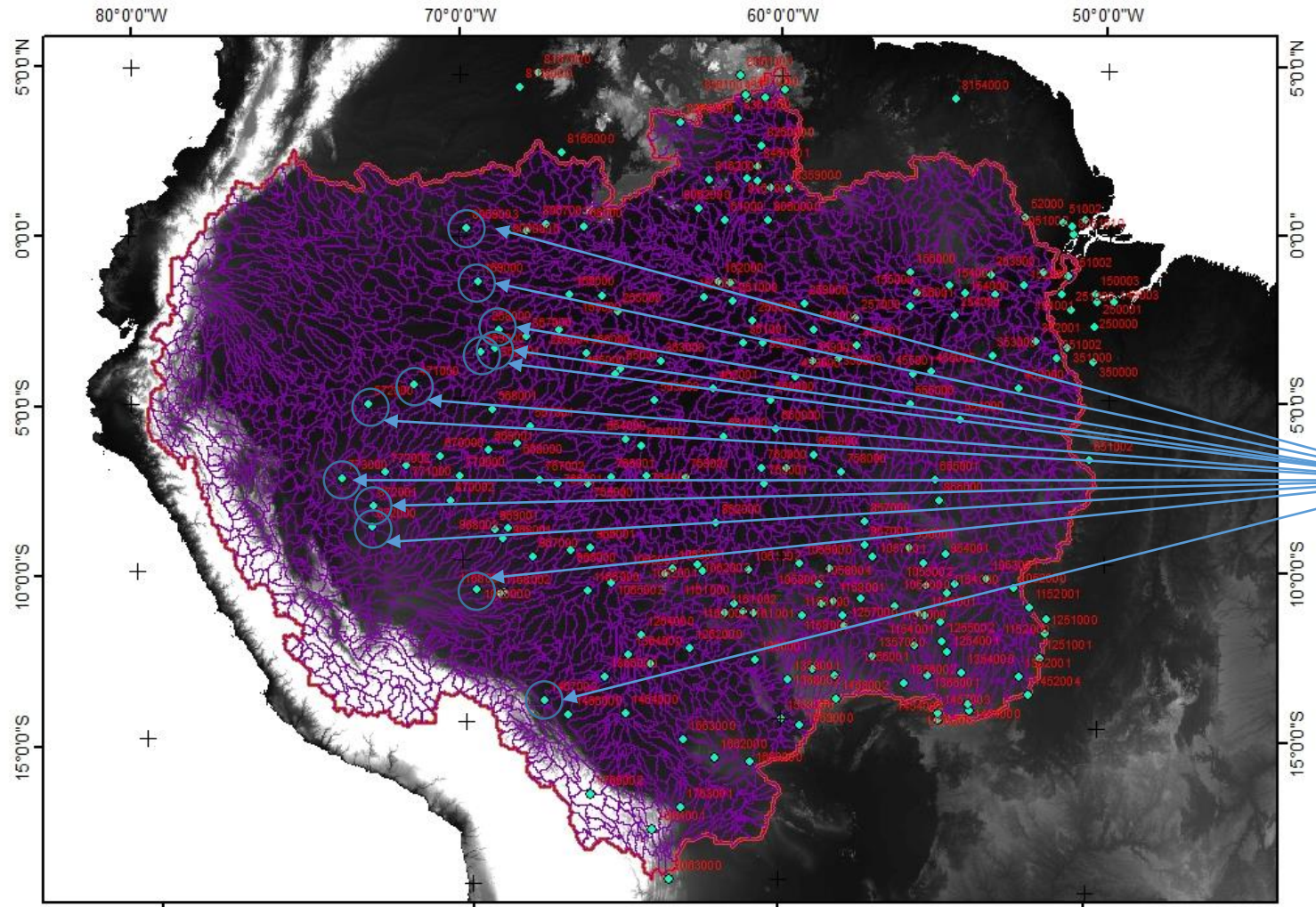
- [3sec GRID: Void-filled DEM](#)
- [3sec GRID: Conditioned DEM](#)
- [3sec GRID: Flow Direction](#)
- [3sec BIL: Void-filled DEM](#)
- [3sec BIL: Conditioned DEM](#)
- [3sec BIL: Flow Direction](#)
- [15sec GRID: Conditioned DEM](#)
- [15sec GRID: Flow Accumulation](#)
- [15sec GRID: Flow Direction](#)
- [15sec BIL: Conditioned DEM](#)
- [15sec BIL: Flow Accumulation](#)
- [15sec BIL: Flow Direction](#)
- [15sec SHAPE: River Network](#)
- [15sec SHAPE: Drainage Basins \(Beta\)](#)
- [30sec GRID: Conditioned DEM](#)
- [30sec GRID: Flow Accumulation](#)
- [30sec GRID: Flow Direction](#)
- [30sec BIL: Conditioned DEM](#)
- [30sec BIL: Flow Accumulation](#)
- [30sec BIL: Flow Direction](#)
- [30sec SHAPE: River Network](#)

30 arc seconds (approximately 1 kilometer)

# Digital Elevation Model (DEM)



# Rainfall Gage Stations Location





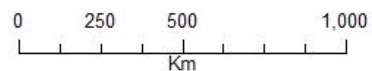
## Precipitation

Estimate of precipitation  
Less distance between center of watershed to gage station

Precipitation's Representation from Border Stations

### Legend

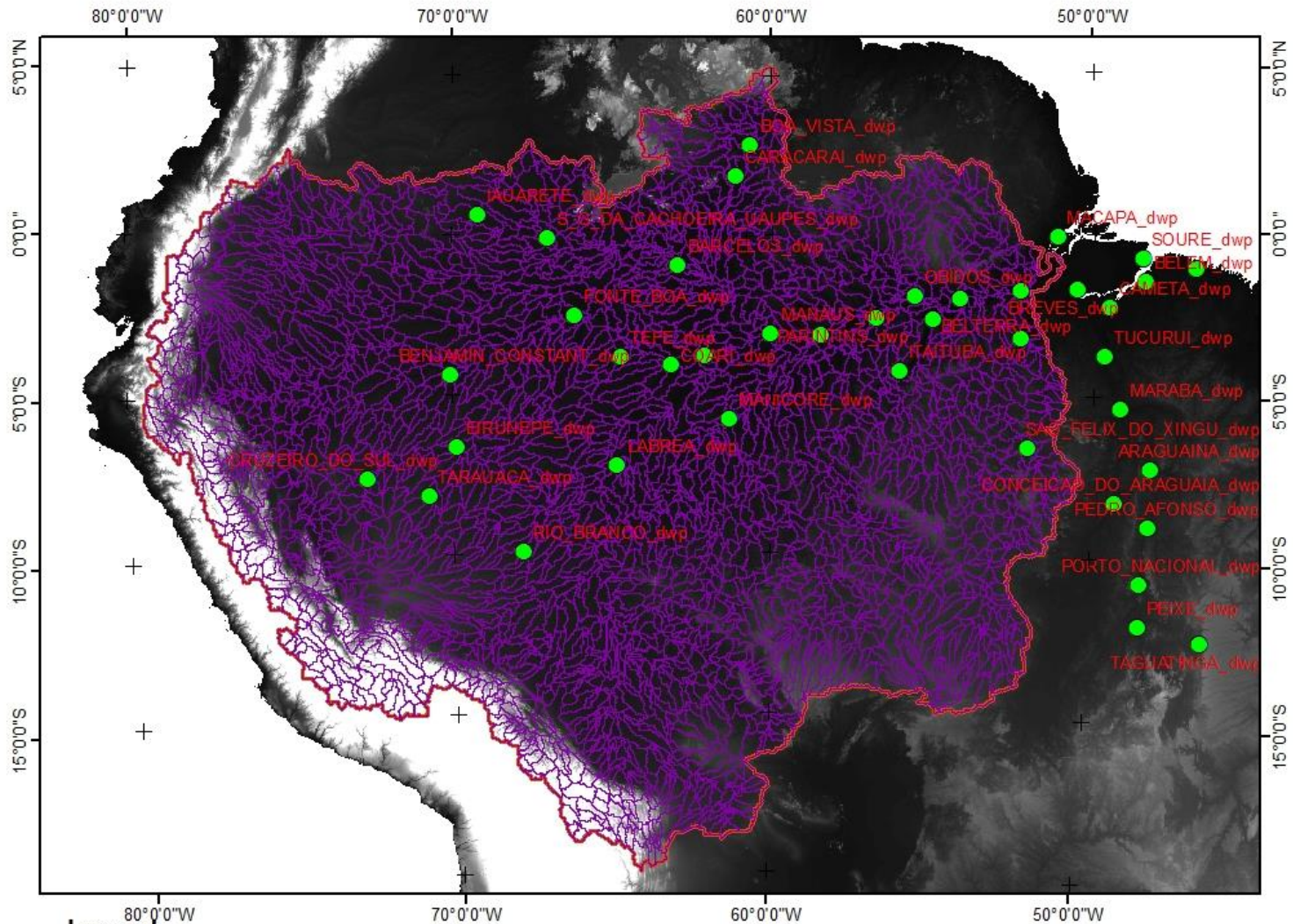
-  Rainfall Gage Stations (ANA)
-  Watershed



By: RIBEIRO, C.B.M. (2014)  
(Universidade Federal de Juiz de Fora ESA-UFJF)

2014 International SWAT Conference  
July 30 - August 1 - Conference in Porto de Galinhas

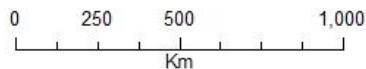
# Weather Stations Location



*Precipitation*  
*Relative Humidity*  
*Solar Radiation*  
*Wind Speed*  
*Temperature (Máx,Mín)*

**Legend**

- Weather Stations - INMET
- Watershed



By: RIBEIRO, C.B.M. (2014)  
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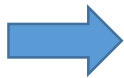
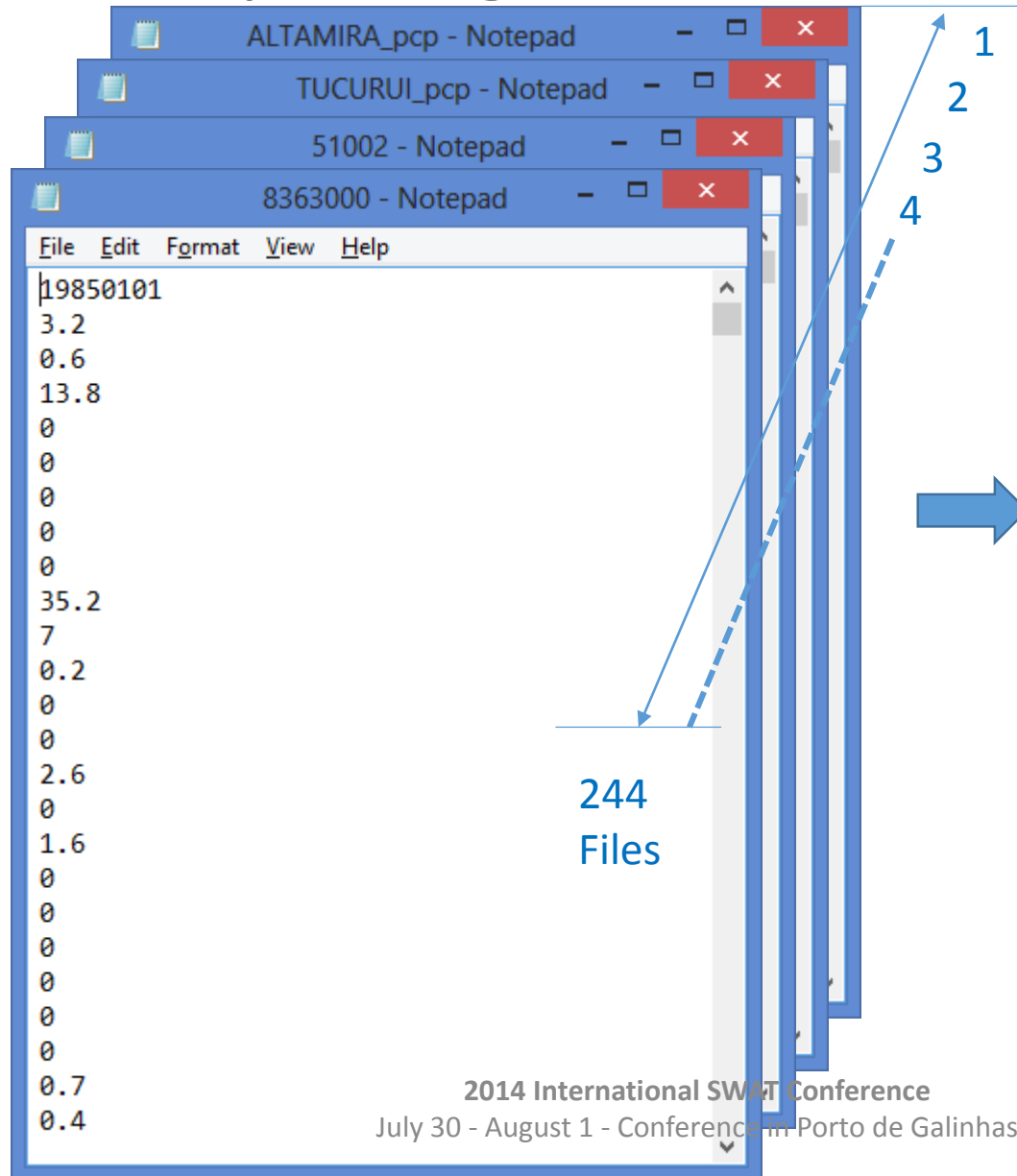
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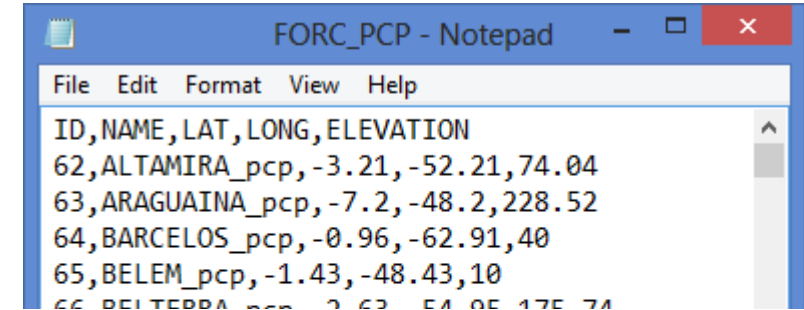
# Preparing Rainfall Database

Initial Format

**ANA  
and  
INMET**

244  
Files

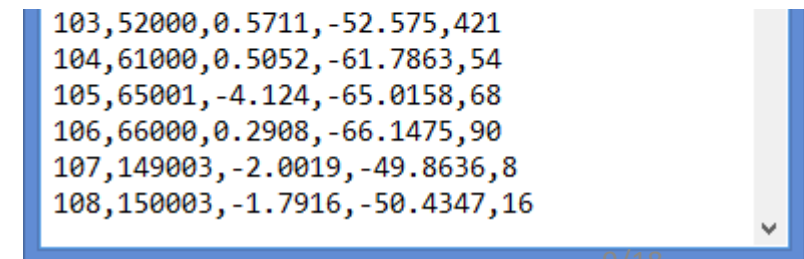
**SAME:**

*Relative Humidity*

*Solar Radiation*

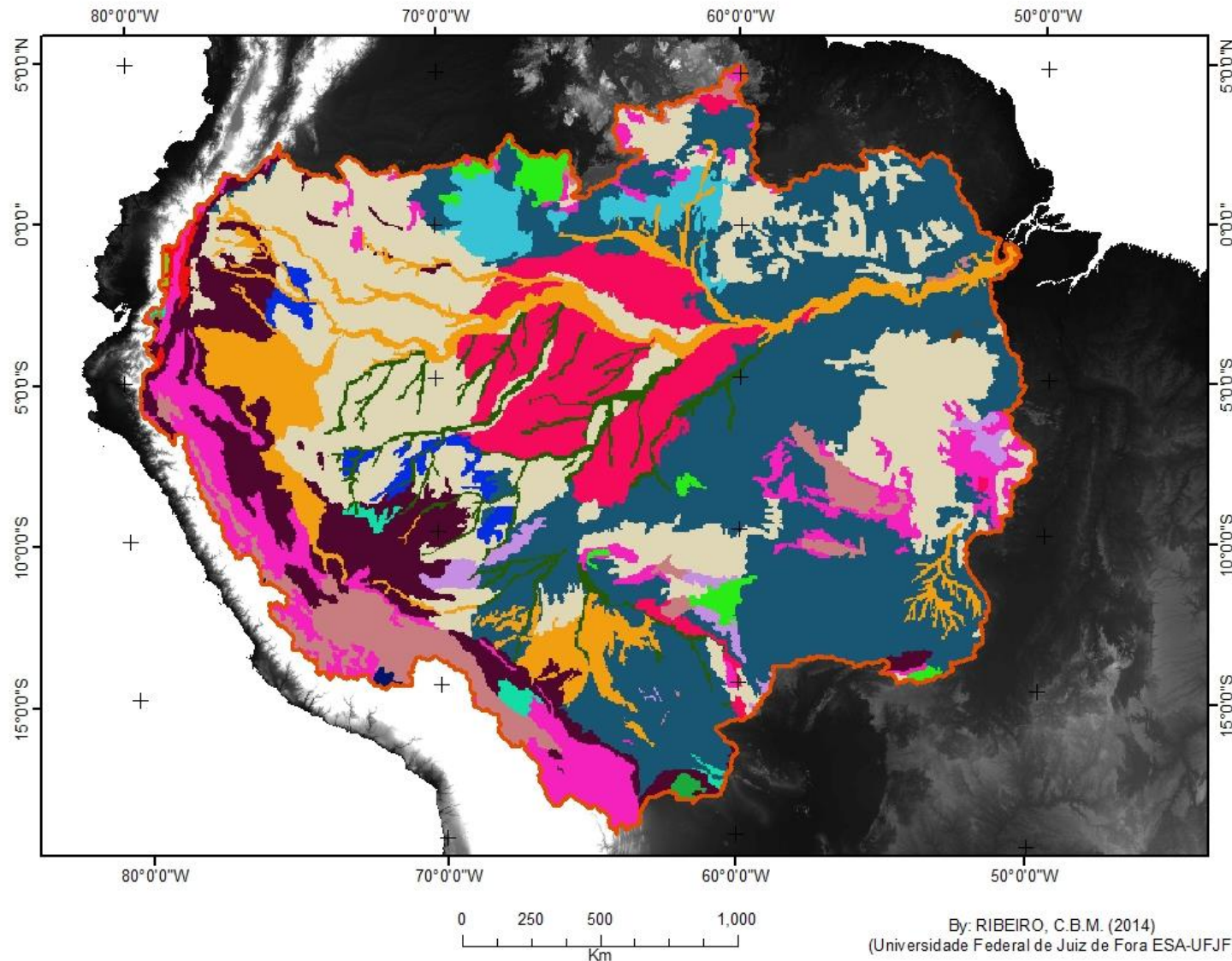
*Wind Speed*

*Temperature (Máx, Mín)*





# Soil



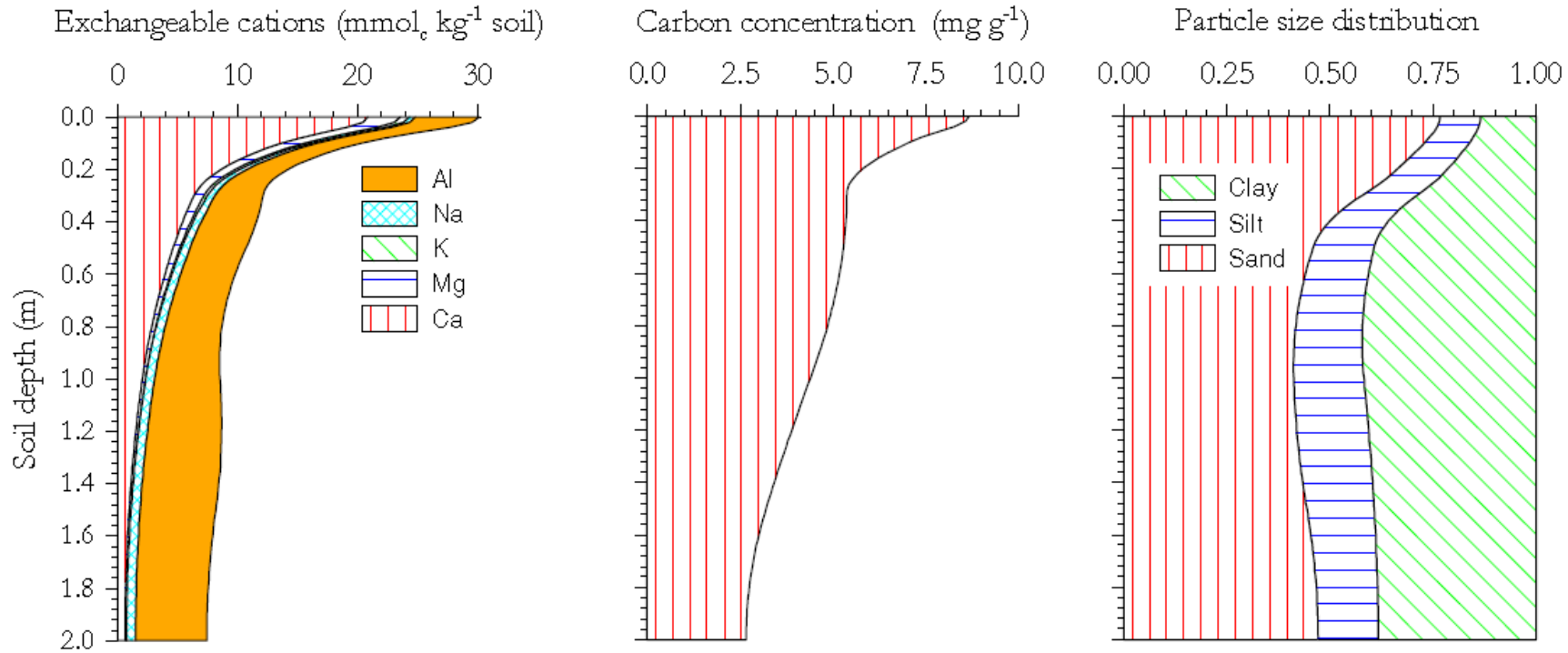
ISRIC (World Soil Information) → MAP

-  ACRISOLS
-  ALISOLS
-  ANDOSOLS
-  ARENOSOLS
-  CAMBISOLS
-  FLUVIOSOLS
-  FERRALSOLS
-  GLEYSOLS
-  LEPTOSOLS
-  LUVISOLS
-  LIXISOLS
-  NITISOLS
-  PHAEOZEMS
-  PLANOSOLS
-  PLINTHOSOLS
-  PODZOL
-  REGOSOLS
-  SOLONETZ
-  VERTISOLS

2014 International SWAT  
 Conference  
 July 30 - August 1 - Conference in  
 Porto de Galinhas

## Chemical, physical and morphologic characteristics of main group soils of Amazonia

**Exemple:** Profiles of exchangeable cations, soil carbon and texture for a Vetic Acrisol (Hyperdystric) at Mato Grosso state, Brazil.



*Quezada et al. (2009)*

# Soil – Pedo Transfer Function (PTF)

Soi ID → Map → ISRIC  
 Layers Number  
 Hydrologic Group  
 Organic Matter → Concentration  
 Texture (Clay, Silt and Sand) %

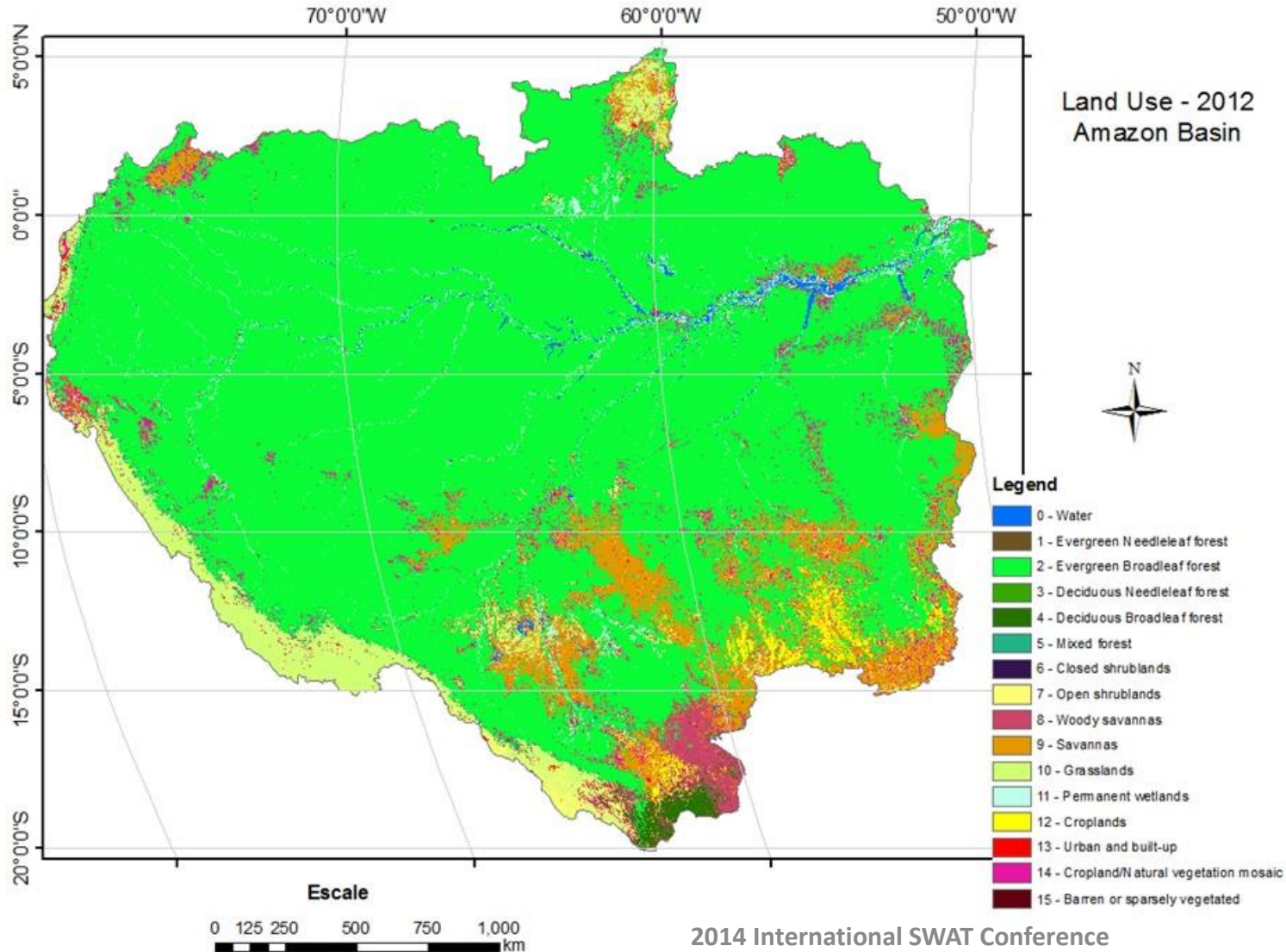
*Saxton & Rawls (2006)*



MUID	SNAM	NLAYERS	HYDGRP	SOL_ZMX	ANION_EXCL	SOL_CRK	TEXTURE	SOL_Z1	SOL_BD1	SOL_AWC1	SOL_K1	SOL_CBN1	CLAY1	SILT1	SAND1	ROCK1	SOL_ALB1	USLE_K1	SOL_EC1	SOL_Z2
11	Ferralsols	8	C	2000.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	82.0000	14.0000	4.0000	0.0000	0.1415	0.1383	1.0000	200.0000
28	Plinthosols	8	D	1800.0000	0.5000	0.5000	SIL	10.0000	1.3744	0.1768	6.5873	2.0000	27.0000	58.0000	15.0000	0.0000	0.1516	0.1768	1.0000	200.0000
1	Acrisols	8	C	2000.0000	0.5000	0.5000	SL	10.0000	1.5860	0.0659	35.9867	0.8100	14.0000	10.0000	76.0000	0.0000	0.3437	0.1269	1.0000	200.0000
29	Podzols	2	C	1000.0000	0.5000	0.5000	SL	10.0000	1.0614	0.0489	1.4619	2.1000	4.0000	41.0000	55.0000	0.0000	0.0096	0.1455	1.0000	1000.0000
4	Arenosols	8	A	2000.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	2.0000	4.0000	94.0000	0.0000	0.2815	0.0712	1.0000	200.0000
2	Alisols	8	D	1800.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	33.0000	23.0000	44.0000	0.0000	0.2453	0.1304	1.0000	200.0000
20	Leptosols	2	D	1000.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	12.0000	16.0000	72.0000	0.0000	0.0923	0.1180	1.0000	1000.0000
30	Regosols	2	D	1000.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	8.0000	9.0000	83.0000	0.0000	0.2914	0.1018	1.0000	1000.0000
8	Cambisols	8	C	1700.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	10.0000	20.0000	40.0000	0.0000	0.2138	0.1168	1.0000	200.0000
22	Lixisols	7	B	1280.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	7.0000	19.0000	74.0000	0.0000	0.2274	0.1357	1.0000	200.0000
14	Gleysols	2	D	1000.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	9.0000	79.0000	12.0000	0.0000	0.0799	0.2597	1.0000	1000.0000
3	Andosols	7	A	1300.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	28.0000	34.0000	38.0000	0.0000	0.0000	0.1256	1.0000	200.0000
10	Fluvisols	6	C	1000.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	30.0000	34.0000	36.0000	0.0000	0.0136	0.1245	1.0000	200.0000
21	Luvissols	2	D	1000.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	25.0000	45.0000	30.0000	0.0000	0.0844	0.1344	1.0000	1000.0000
24	Nitisols	8	B	1700.0000	0.5000	0.5000	C	10.0000	1.0614	0.0489	1.4619	2.1000	38.0000	25.0000	37.0000	0.0000	0.0383	0.1138	1.0000	200.0000
26	Phaeozems	2	C	1000.0000	0.5000	0.5000	SL	300.0000	1.5713	0.1018	40.4602	0.8800	9.0000	31.0000	60.0000	0.0000	0.3275	0.1737	1.0000	1000.0000
27	Planosols	2	D	1000.0000	0.5000	0.5000	SL	300.0000	1.5687	0.1022	16.0632	0.9700	19.0000	24.0000	57.0000	0.0000	0.3078	0.1551	1.0000	1000.0000
33	Solonetz	2	D	1000.0000	0.5000	0.5000	SCL	300.0000	1.6042	0.0790	8.9678	0.6600	26.0000	5.0000	69.0000	0.0000	0.3810	0.1081	1.0000	1000.0000
36	Vertisols	2	D	1000.0000	0.5000	0.5000	C	300.0000	1.3837	0.1274	1.0565	1.3400	46.0000	25.0000	29.0000	0.0000	0.2387	0.1240	1.0000	1000.0000

All Layers → Parameters

# Land Use



MODIS – MCD12Q1  
Land Cover (T1) – 500 m

Friedl et al. (2010)

# Physical and Biological characteristics

## USGS Global Land Cover Characterization (GLCC) database

Land Cover/Plant Growth Database Edit

Crop types

- Barren
- Barren\_1
- Bell Pepper
- Bermudagrass
- Big Bluestem
- Broccoli
- Cabbage
- Cantaloupe
- Carrot
- Cashews
- Cauliflower
- Celery
- CLOSE SHUBLAND R
- Coconut
- Coffee
- Com
- Com Silage
- Cowpeas
- Crested Wheatgrass
- CROPLAND/GRASSLAND MOS
- CROPLAND/WOODLAND MOS
- Cucumber
- DECIDUOUS BROADLEAF FO
- DECIDUOUS NEEDLELEAF FO
- DRYLAND CROPLAND AND P
- Durum Wheat
- Eastern Gamagrass
- Eggplant
- Eragrostis Tef
- EVERGREEN BROADLEAF FO**
- EVERGREEN NEEDLELEAF FC
- Field Peas
- Flax
- Forest-Deciduous
- Forest-Deciduous\_1
- Forest-Evergreen
- Forest-Evergreen\_1
- Forest-Mixed
- Forest-Mixed\_1
- Forest-Mixed\_2
- Forest-Mixed\_3
- Garden or Canning Peas
- Grain Sorghum
- Graigue
- GRASSLAND
- Green Beans
- Hay

Crop type Parameters

Crop Name: EVERGREEN BROADLEAF FOREST      CPNM (4 character): FOEB

IDC: Trees       Crop is fertilized      Op Schedule: AGRR

BIO_E [(kg/ha)/(MJ/m2)]: 15	HVSTI [(kg/ha)/(kg/ha)]: 0.759999990	BLAI (m2/m2): 5
FRGRW1 (fraction): 0.150000005	LAIMX1 (fraction): 0.699999988	CHTMX (m): 10      RDMX (m): 3.5
FRGRW2 (fraction): 0.25	LAIMX2 (fraction): 0.990000009	DLAI (heat units/heat units): 0.990000009
T_OPT (C): 30	T_BASE (C): 0	CNYLD(kg N/kg seed): 0.001500000      CPYLD(kg P/kg): 0.000300000
BN1 (kg N/kg biomass): 0.006000000	BN2 (kg N/kg biomass): 0.002000000	BN3 (kg N/kg biomass): 0.001500000
BP1 (kg P/kg biomass): 0.000699999	BP2 (kg P/kg biomass): 0.000399999	BP3 (kg P/kg biomass): 0.000300000
WSYF [(kg/ha)/(kg/ha)]: 0.600000023	USLE_C: 0.001000000	GSI (m/s): 0.002000000      VPDFR (kPa): 4
FRGMAX (fraction): 0.75	WAVP (rate): 8	CO2HI (uL/L): 660      BIOEHI (ratio): 16
RSDCO_PL (fraction): 0.050000000	ALAI_MIN (m2/m2): 0.75	BIO_LEAF (fraction): 0.300000011
MAT_YRS (years): 0	BMX_TREES (tons/ha): 0	EXT_COEF: 0      BM_DIEOFF: 0.1

Hydrological Parameters

OV\_N: Manning's N (roughness): 0.10000001490      LU

SCS Runoff Curve Numbers: A: 25      B: 55      C: 70      D: 77      LU

Add New

Save Edits

Cancel Edits

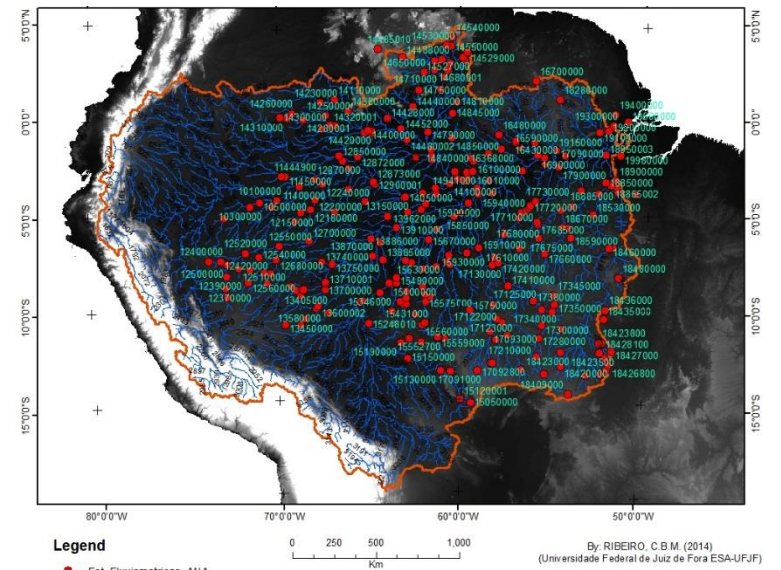
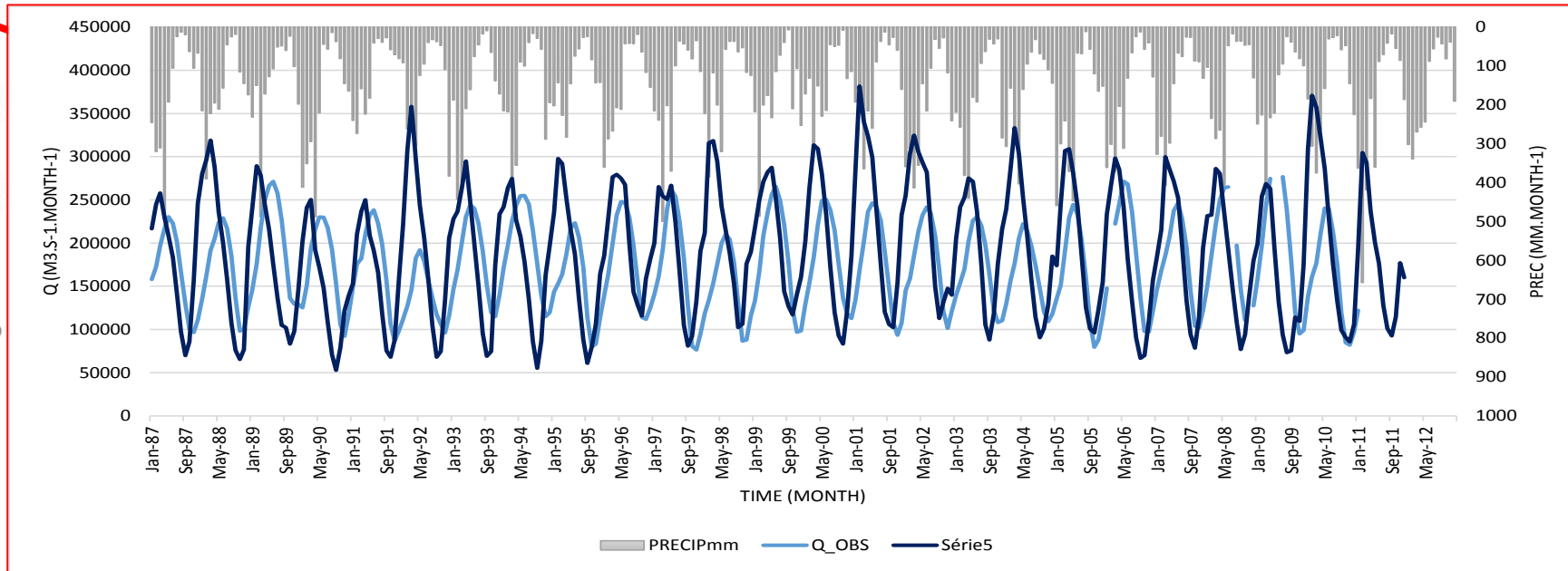
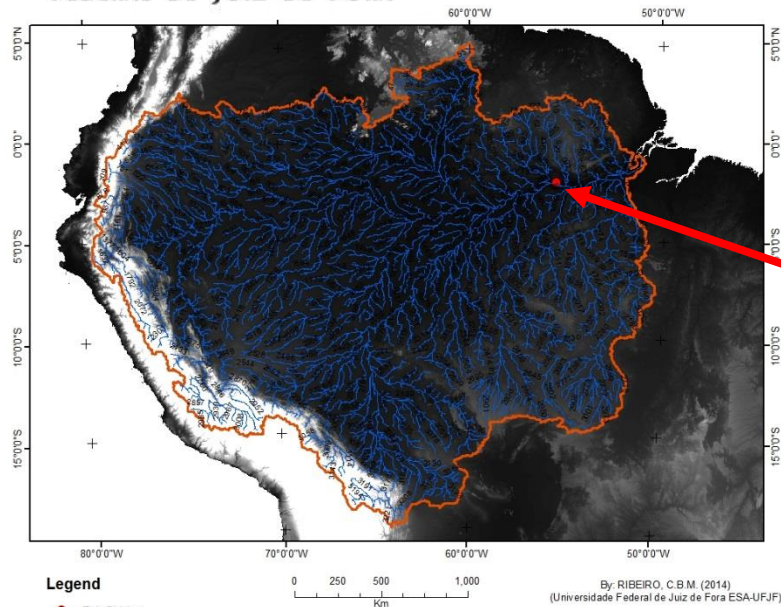
Delete

Default

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# Preliminary Results

Obidos Gage Station → StreamFlow Monthly Data





# Acknowledgments:



- We would like to acknowledge the financial support provided by CNPq, Brazilian National Council for Scientific and Technological Development for conducting this research work.
- We also would like to express our **special thanks** for the cooperation with this study to:
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  - Danielle Bressiani and Josimar Gurgel
  - Vadose Zone Reserarch Group – VZGR at Texas A&M University.

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