Recent progress in modeling surface hydrology across the Amazon Basin using a Variable Infiltration Capacity approach

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(Presenting)

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Why daddy, why?!?

- LBA – Understand how Amazon works
- Hydrology – indispensable for the functioning of the ecosystem
- Transport means for biogeochemical cycles
  - Water carries “stuff”
    - Deforestation impacts on water cycle
    - Changes on the biogeochemical cycles
- Tooooooo complex. Use of hydrological modeling and coupling with biogeochemical models to better understand functioning of the ecosystem and how it’s affected.
Study Area
Study Area
Hydrology Model – VIC

- **Variable Infiltration Capacity**
- For each cell:
  - Meteorological forcings (precip., max. & min. temperature and wind)
  - Vegetation distribution (%forest, %pasture ...)
  - Average soil properties
  - VARIABLE INFILTRATION CURVE, empirical model that describes soil saturation related to soil moisture (calibration)
- Results -> Routing Model
Variable Infiltration Capacity (VIC) Macroscale Hydrologic Model

Cell Energy and Moisture Fluxes

Grid Cell Vegetation Coverage

Variable Infiltration Curve

\[ i = i_b [1 - (1 - A)^{1/n}] \]

Infiltration Capacity

Baseflow Curve

\[ Q_d = W_o + W_i \]

\[ W_f = W_o + W_i \]

\[ 0 \leq A \leq 1 \]

\[ W_o \]

\[ W_i \]

\[ 1 \]

\[ 0 \]

\[ Q \]

\[ R \]

\[ B \]

\[ E \]

\[ G \]

\[ P \]

\[ L \]

\[ S \]

\[ R_e \]

\[ R_s \]

Canopy

Layer 0

Layer 1

Layer 2

Fractional Area

Layer 2 Soil Moisture, \( W_2 \)

Baseflow, \( B \)

\( Q_d \)

\( W_{Dm} \)

\( W_{Dm} \)

\( W_m \)

\( W_n \)

\( W_k \)
Model calibration

- Soil depth: 3 layers, down to 3 meters
- Variable Infiltration Capacity curve adjustment
- Regional vegetation parameters: LAI, albedo, root depth and distribution, etc
Initial results

Amazon evaporation (mm)

January 1995
March 1995
May 1995
July 1995
September 1995
November 1995
Initial results
Amazon soil moisture

Jan 93
Initial results

Amazon soil moisture

January 1994

April 1994

July 1994

October 1994
Initial results
Amazon soil moisture

April 94
January 95
August 94
September 95
Initial results

Ji-Paraná: Modeled discharge

[Graph showing modeled and observed discharge over time]

Tabajara Station
Initial results

Ji-Paraná: Modeled discharge

1994 and 1995

- 1994: $y = 0.4336x - 4.8721$, $R^2 = 0.5072$

- 1995: $y = 0.7323x - 165.94$, $R^2 = 0.7753$
Initial results

Ji-Paraná: Evapotranspiration
Ji-Paraná: Physical template

Legend
- Landcover:
  - Crops
  - Forest
  - Mining
  - Pasture
  - Regrowth
  - Savanna
  - Urbanization
  - Water

Texture Class (Embrapa Classification):
- Sandy
- Medium
- Medium Clay
- Clay
Initial results
Ji-Paraná: Soil Moisture
Next steps…

- Improve calibration
- Update vegetation library (MODIS LAI and Albedo)
- Extend time period
- Improve visualization and analysis tools for the results
- Couple with Biogeochemical Model
Acknowledgments