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United Nations
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GRAPHIC

Assessing the impacts of climate change and human activities on groundwater recharge in tropical basins

Clique para editar o estilo do subtítulo mestre

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13/07/11

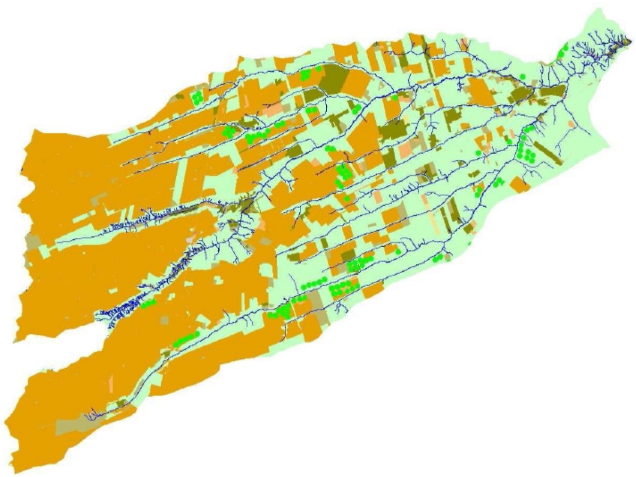
Outline

- Issues in GW recharge in tropical basins
- Impacts of climate variability and climate change on GW recharge in the Femeas river basin (Brazil)
- Impacts of human activities on GW recharge in the Pipiripau river basin (Brazil)
- Discussion

Issues in GW Recharge in the Tropics

- GW recharge: key process in river basins
- GW recharge affected by climate variability & land use / management
- Scarcity of data limits comprehensive (modeling) analyses in the tropics
- However, adequate information is required for decision-making, mitigation, adaptation

The Femeas River Basin

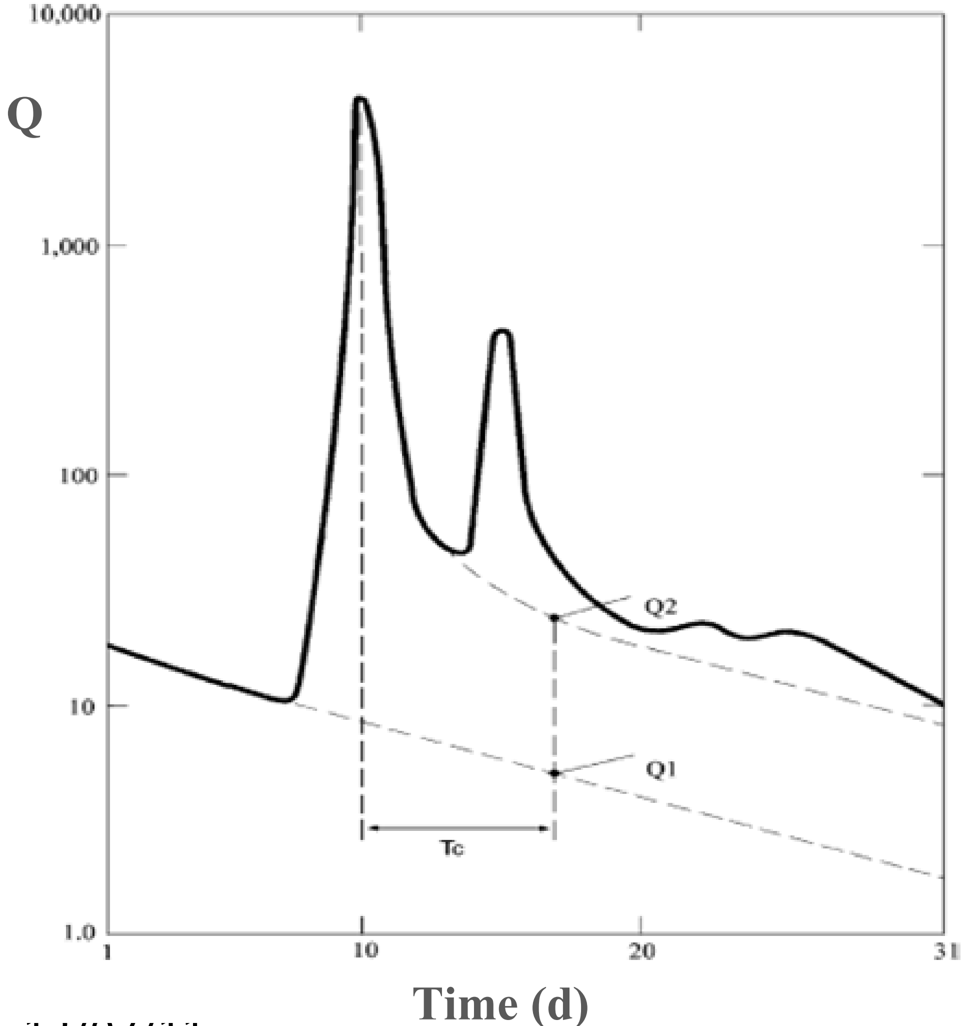


- Area: 6,300 km2
- Geology: Sandstone / Limestone
- Soils: Yellow oxisols
- Altitude: 600-900 m
- Ave. slope: 0.5%
- Ks = 15.2 cm/h
- Tr = 1,500 m2/d
- S = 2.0 x 10-4

The Femeas River Basin: Methods

- P, T & Q historical data: 1977-2006
- Future climate scenarios: A2 & B2 (2080)
- Climate Model: ETA (RCM) with 50 km grid
- Detection of climate trends: graphical analysis, bias correction (RCM), T-test for trends/jumps
- Historical GW recharge: Hydrograph recession-curve displacement method
- Future GW recharge: Empirical relationship between historical P & R
- Impact on GW recharge: % variation

The Femeas River Basin: Methods



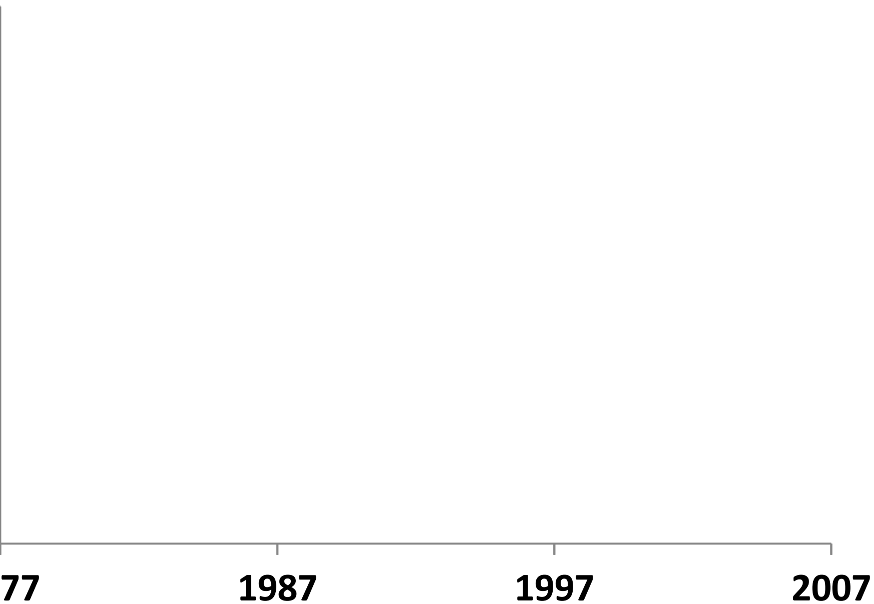
$$R = \frac{2(Q_2 - Q_1)K}{2.303}$$

$$K = \frac{0.933 \cdot d^2 S}{T_r}$$

$$T_c = \frac{0.2 \cdot d^2 S}{T_r} = 0.214 \cdot K$$

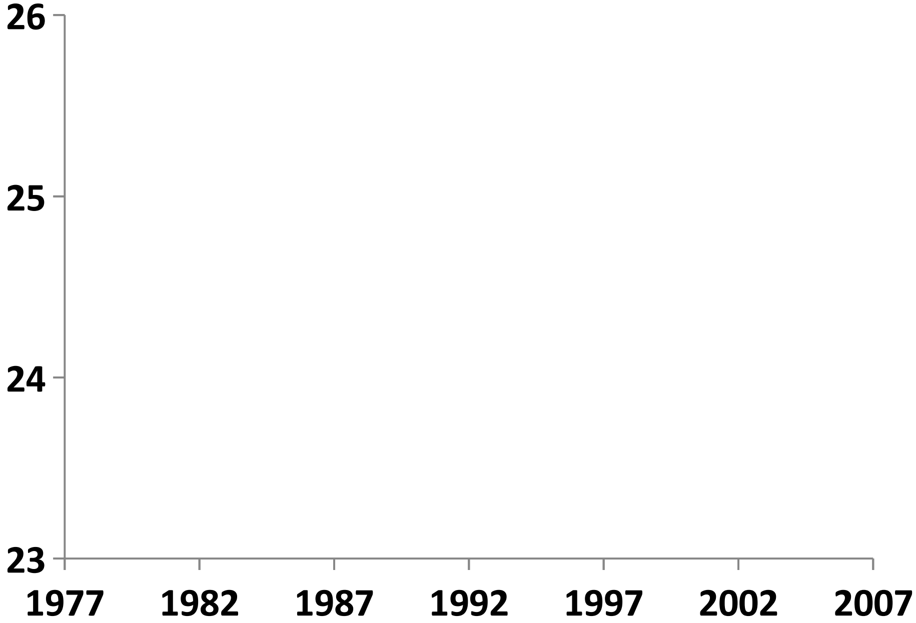
(Rorabaugh, 1964; Rutledge & Daniel, 1994)

Femeas R. Basin: Climate Variability (77-06)



Precip. (mm/yr)

Decreasing trend (α =95%)

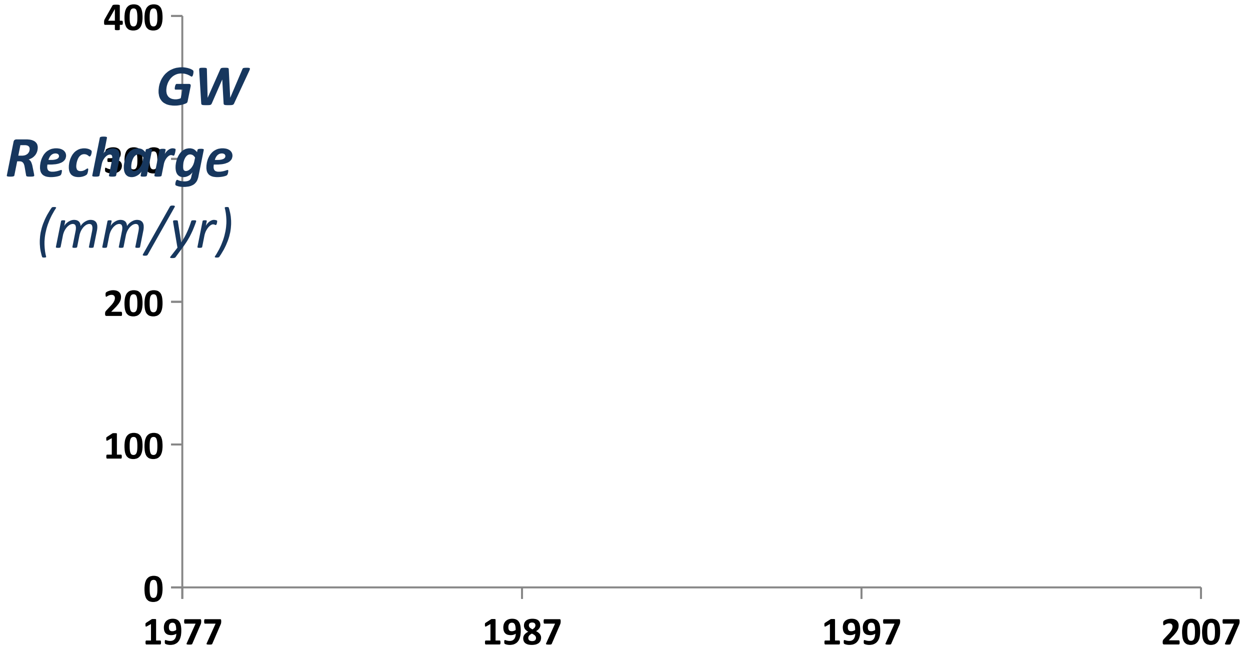


Ave. T (oC)

Increasing trend (α

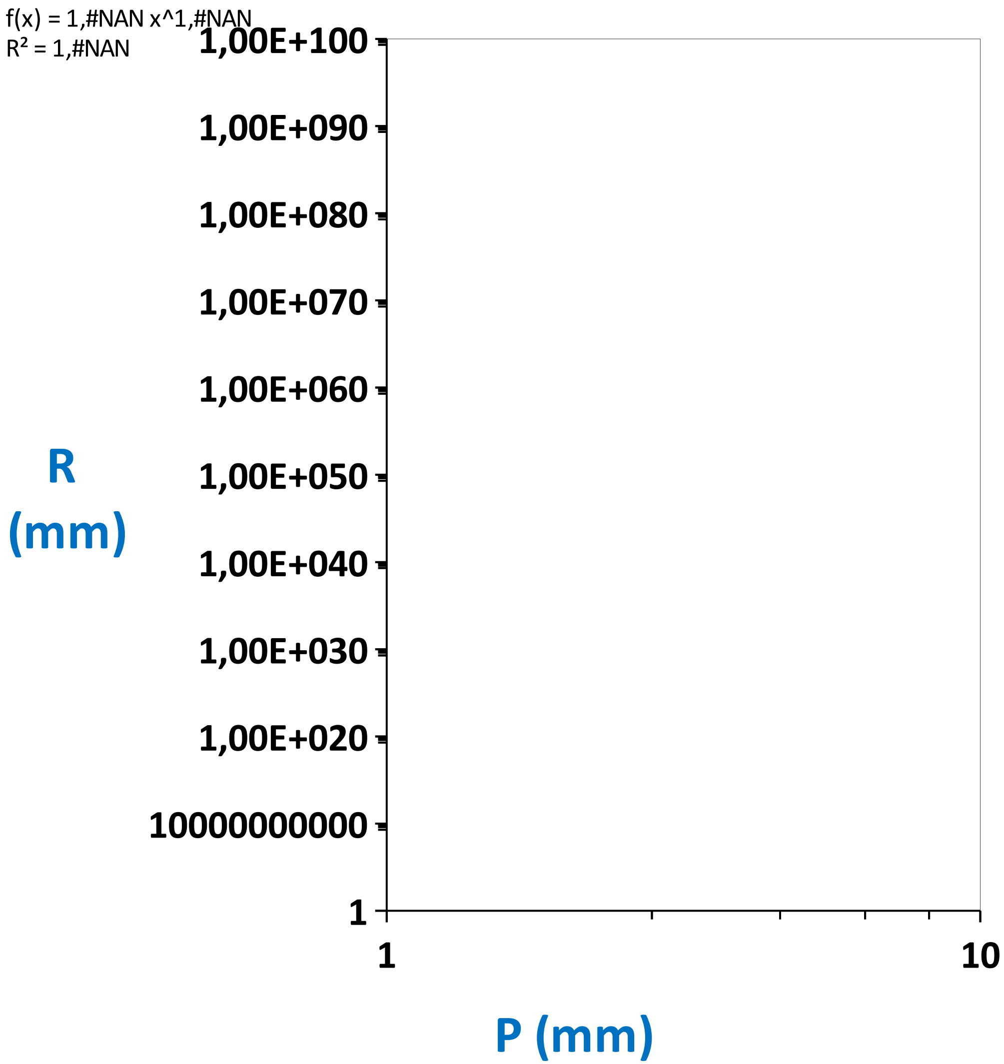
=99%)

<u>Femeas R. Basin:</u> Variability in GW Recharge (77-06)

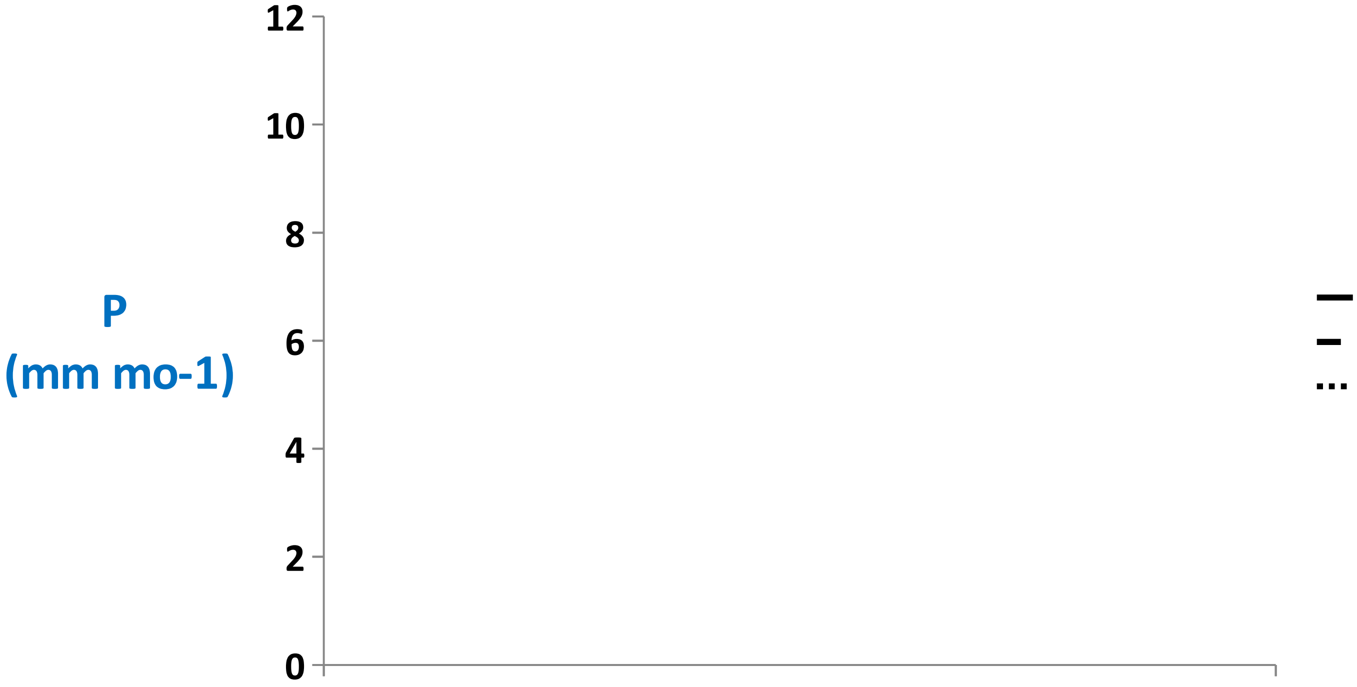


Stationary series

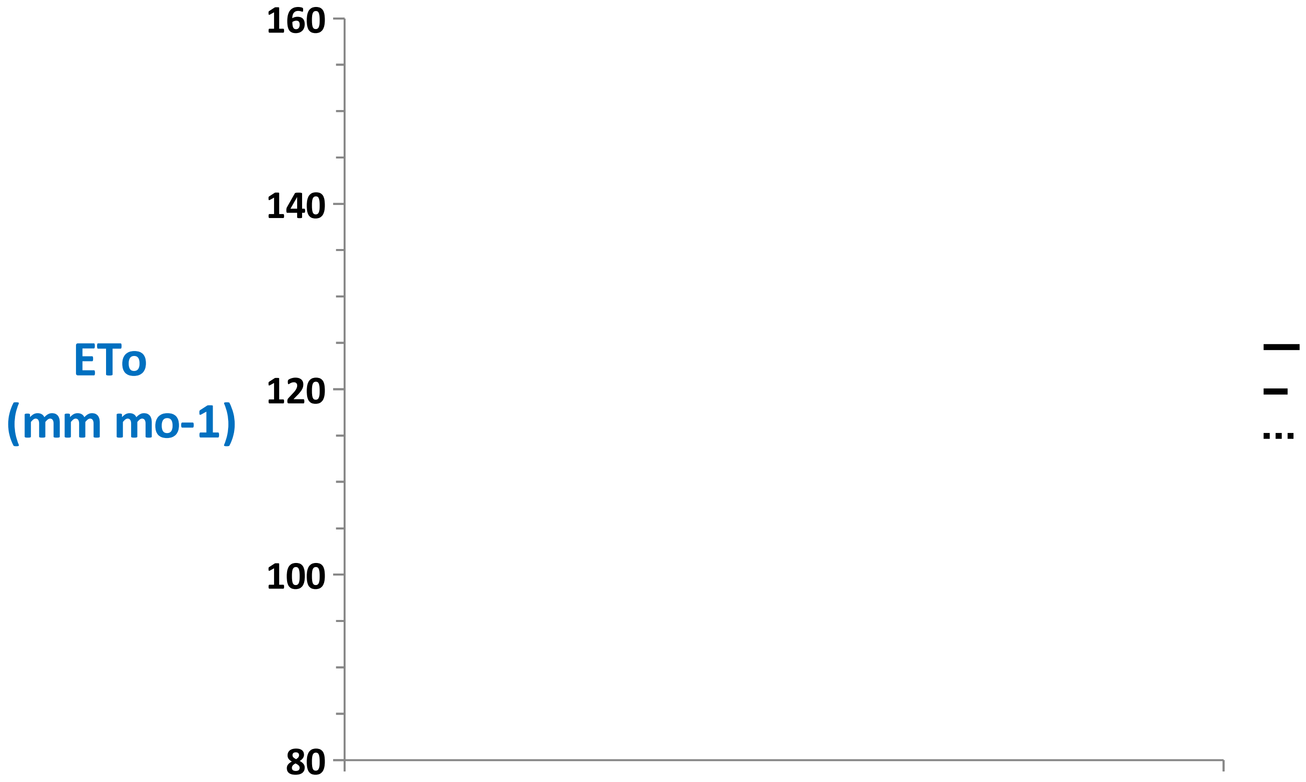
Femeas R. Basin: Monthly P & R (77-06)



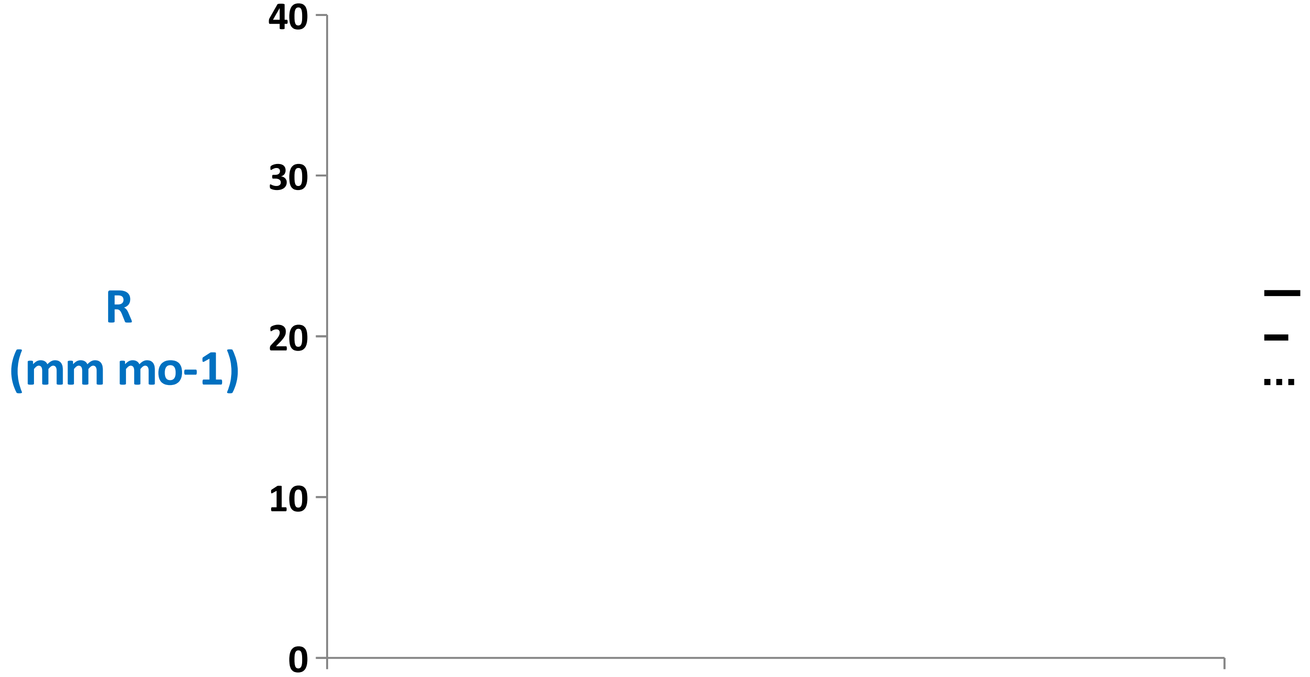
Femeas R. Basin: Climate Change (P)



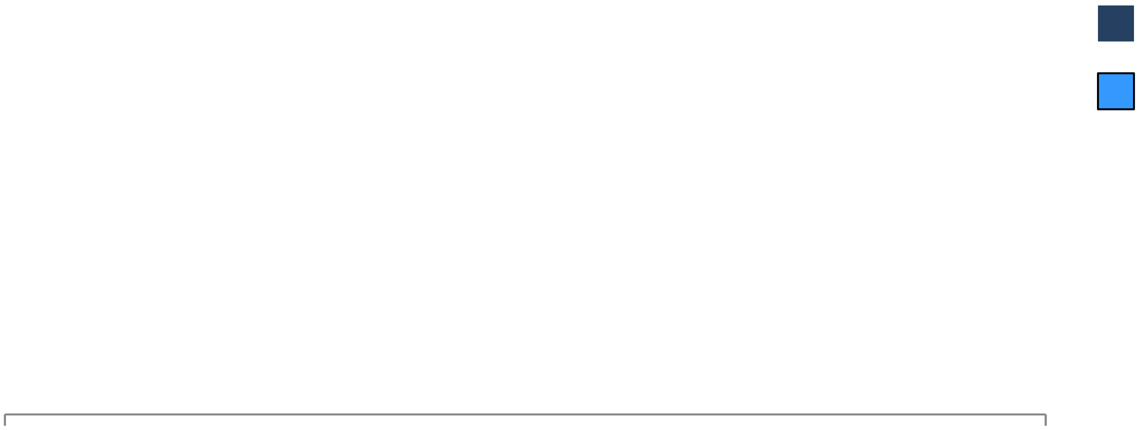
Femeas R. Basin: Climate Change Impact (ETo)

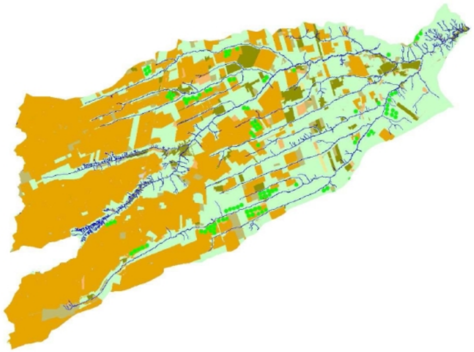


Femeas R. Basin: Climate Change Impact (R)



Femeas R. Basin: Annual P & R

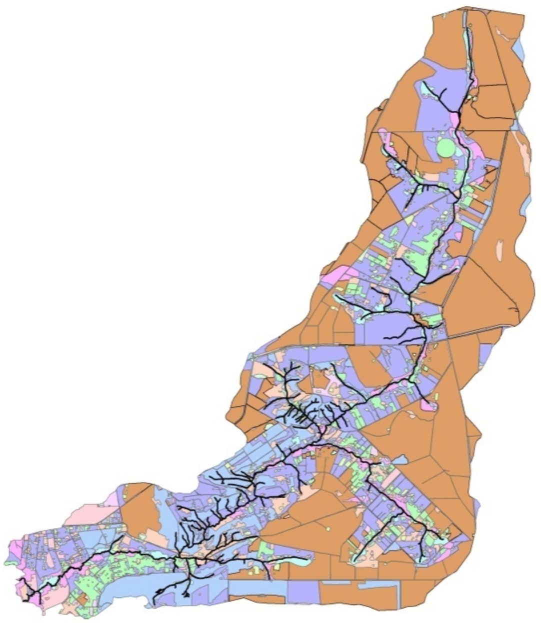




Femeas Basin: Conclusions

- Despite significant climate (P) variability in 77-06, GW recharge was stationary in period
- Ave. reduction of 26% in P (2080) would reduce GW recharge in 8%
- High aquifer transmissivity & storage attenuation factors?

The Pipiripau River Basin



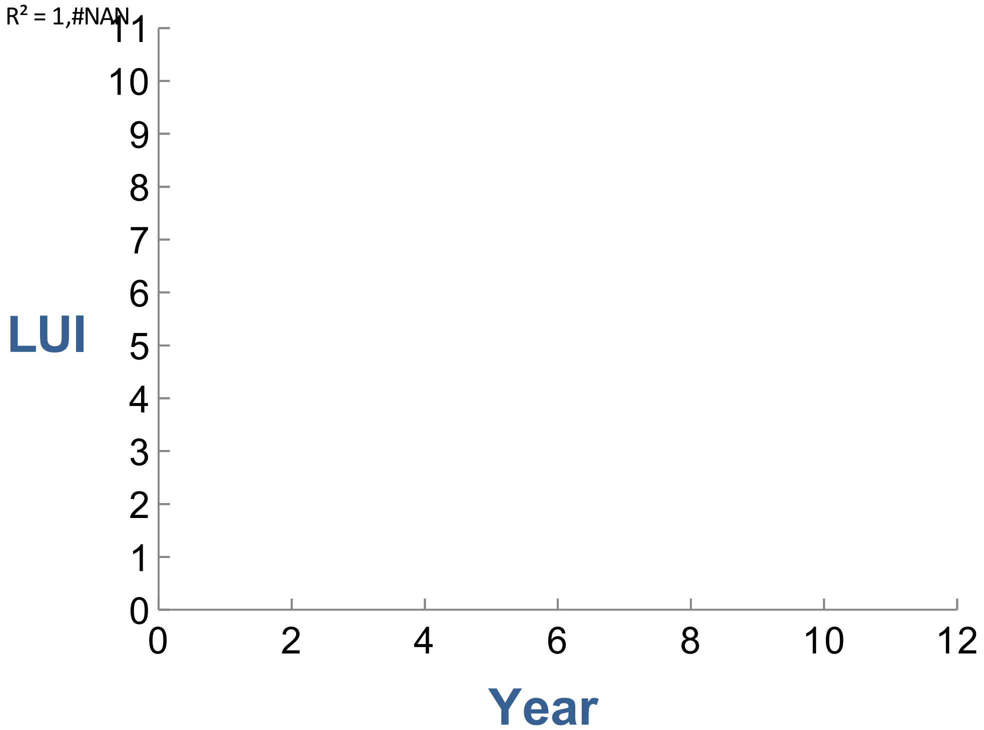
- Area: 235 km2
- Geology: sandy metarhythmites
- Soils: red oxisols
- Altitude: 900-1,100 m
- Ave. slope: 5.5 %
- Ks = 0.01 cm/h
- Land uses: agriculture, pasture, savannah

The Pipiripau R. Basin: Methods

- Runoff & base flow estimated by digital filter (Nathan & McMahon, 1990)
- Assumption: GW recharge = GW discharge
- Calibrated CN (NRCS, 1972)
- Land-use intensity index (Ometto et al., 2000)
- Empirical relationship between qb & CN/P
- Prospective basin land use & mgt

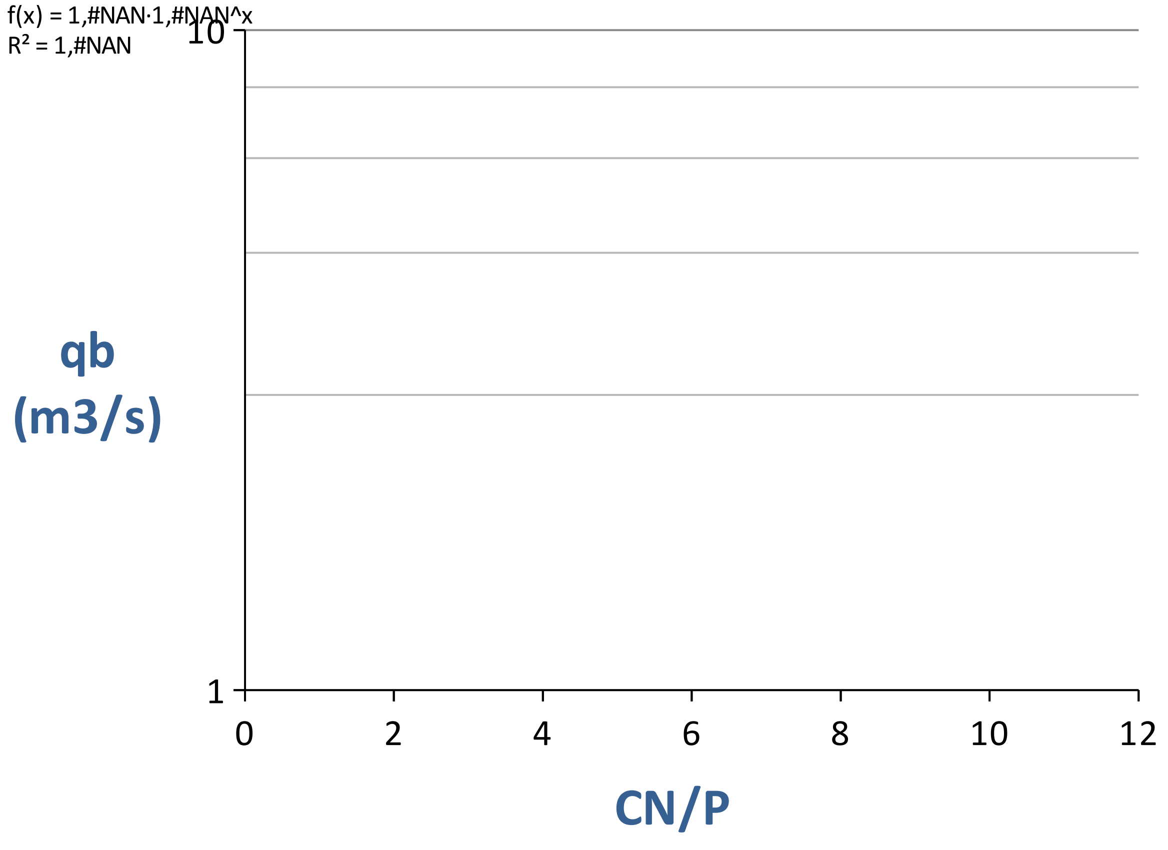
The Pipiripau River Basin: Filtered qb

The Pipiripau R. Basin: Land-use Dynamics



The Pipiripau R. Basin: Days w/ direct R.O.

The Pipiripau R. Basin: qb x CN/P



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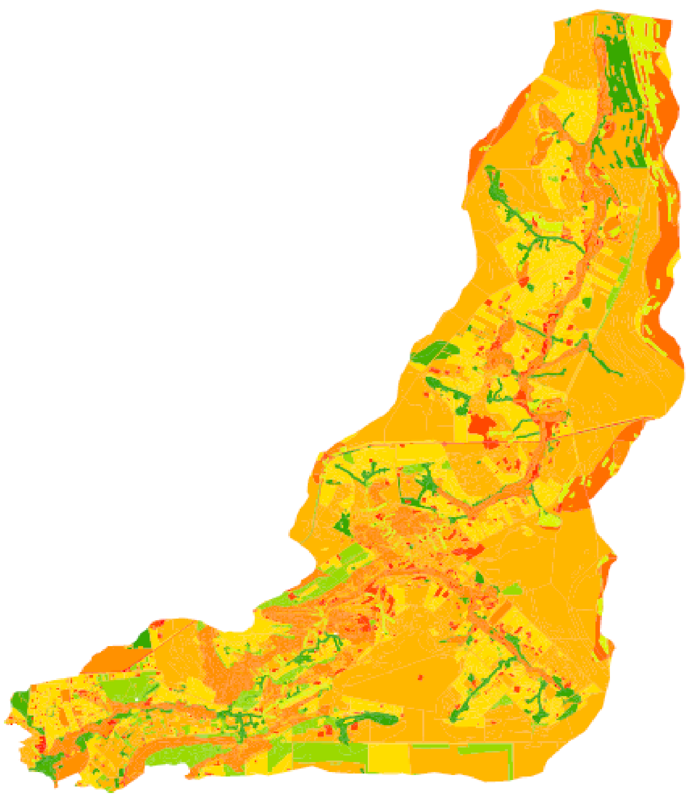
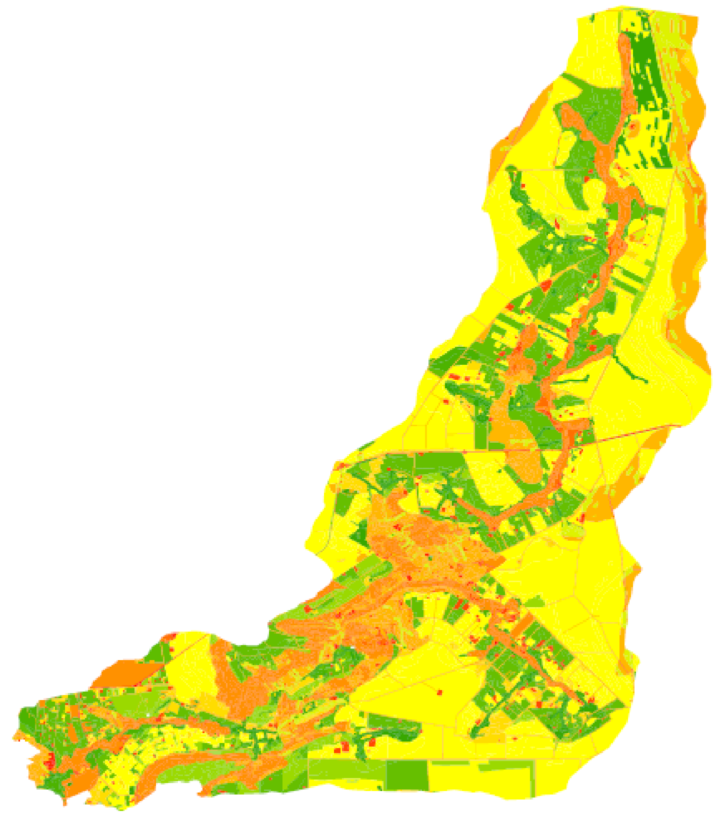
The Pipiripau R. Basin: CN before & after BMP



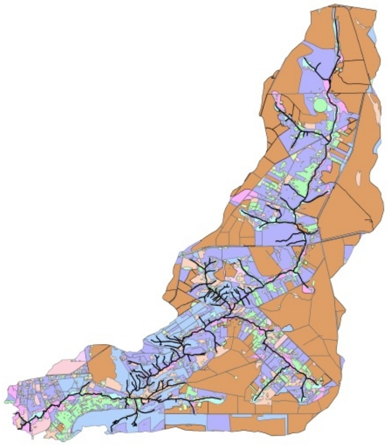


Before: CN = 71.4

After: CN = 59.8

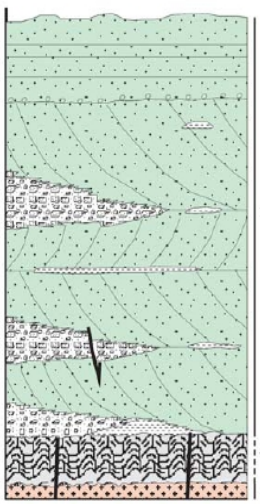
The Pipiripau R. Basin: qb before & after BMP

<u>The Pipiripau R. Basin:</u> Conclusions



- LUI increased by 340% in 40 yrs.
- Runoff increased, qb decreased in period
- Empirical relationship obtained between qb & CN/P
- If BMPs are implemented in basin, mean qb would be increased by 32%, reducing water-use conflicts

General Conclusions



- Analyses of P & q data provided useful recharge information in two tropical basins
- Empirical relationships & assumptions were used to estimate R in prospective scenarios
- A similar approach could be used in other tropical basins / aquifers
- Examples presented are potential GRAPHIC case-studies

Gracias

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