Influence of reorganization of the tropical hydrologic cycle on Atlantic salinity and meridional overturning at the end of the last interglacial

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Image credit NASA
The Amazon river system
The Amazon & Orinoco river systems
South American precipitation seasonality

Percent of annual precipitation

Figure: Silva and Kousky 2012
South American precipitation seasonality

Figure: Silva and Kousky 2012
Core locations

- 12°N
- 5°N
- Orinoco
- Lowland (Negro)
- Andes (Solimões, Madeira)
- Amazon
- NBC retroflection
- NECC
- NBC: North Brazil Current
- NECC: North Equatorial Counter Current

Color bar:
- DRY: -1.4
- In(Al/Si): -1 to -1.4
- WET: -1.2 to 0
- DJF rainfall: 0 to 400 (mm)
Core reconstructions
Model environment & simulations

We use two equilibrated simulations: 125ka and 115ka

We use boundary conditions including insolation and greenhouse gases
CCSM3 annual net precipitation anomalies
Runoff model & data

<table>
<thead>
<tr>
<th>River</th>
<th>115 ka</th>
<th>125 ka</th>
</tr>
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<tbody>
<tr>
<td>Amazon</td>
<td>3560 km³/yr</td>
<td>3070 km³/yr</td>
</tr>
<tr>
<td>Madeira &amp; Marañón</td>
<td>1720 km³/yr</td>
<td>1460 km³/yr</td>
</tr>
<tr>
<td></td>
<td>(48%)</td>
<td>(41%)</td>
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Runoff model & data

125 ka to 115 ka Change in POP Oceanic Transport
Vertically Integrated Currents

Core at 12°N

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(10%)

(14%)
South American Runoff

125ka to 115ka Change in Surface Runoff

125ka to 115ka Change in Freshwater Flux

km³/yr

kg/m²/y
Fixed Runoff Experiment

115ky insolation & GHG

Fully Coupled

Exception: Virtual freshwater flux from South America is fixed:

-115ky or 125ky runoff

-Monthly means (smoothed)

-115ky runoff > 125ky runoff
Fixed Runoff Experiment: Atlantic Upper Ocean Salinity

Salinity difference (115 less 125)

ppt
Fixed Runoff Experiment:
Atlantic Upper Ocean Temperature
Fixed Runoff Experiments: Winter Mixed Layer Depth
Summary

We found the model & core reconstructions to be in agreement with regards to the transition from 125ka to 115ka including:

- Increase in highland precipitation in Amazon basin
- Decrease in Orinoco basin precipitation
- Increase in North Brazil Current Retroflection

Enhanced precipitation over South America at 115ka relative to 125ka leads to changes in the Atlantic including:

- Lower Salinity in deep water formation regions
- Lower Temperature in deep water formation regions
- Weakening of deep water formation
- Northward shift in deepwater formation region