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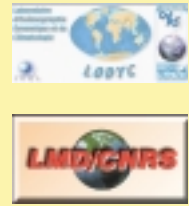
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A 50-year simulation of Amazon discharge by ORCHIDEE

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Objective:

Validation of discharge values simulated by the IPSL (Institut Pierre Simon Laplace) land surface model ORCHIDEE (Organising Carbon and Hydrology in Dynamics EcosystEms), using observed discharge values in various Amazon tributaries and in the Amazon in Óbidos, the last gauged station before the ocean.

Data and methods:

- Construction of NCC, a 53 year (1948-2000) atmospheric forcing data, as an input for ORCHIDEE (Ngo-Duc et al. 2005). NCC was built based on the NCEP/NCAR reanalysis (Kistler et al. 2001) constrained by the CRU data (New et al. 2000). It has a 6-hourly time step and a spatial resolution of $1^\circ \times 1^\circ$.
- WHYBAM data base (www.mpl.ird.fr/hybam): observed discharge data from HYBAM project (Hydrogeodynamics of the Amazon basin). Period: 1967-2003 (1903-2003 for Óbidos)
- Nash Sutcliffe test (Nash and Sutcliffe 1970), Root Mean Square Error (RMSE), correlations. The Nash Sutcliffe test compares the performance of a model with the use of the mean observed discharge. When Nash-Sutcliffe = 1, the simulation is perfect. When Nash-Sutcliffe = 0, the simulation is poor; the error is the same than that resulting from the use of mean discharge values.
- Nash-Sutcliffe = $1 - (\sum(Q_s - Q_o)^2 / \sum(Q_o - Q_o \text{ mean})^2)$, RMSE = $(\sum(Q_s - Q_o)^2 / N)^{1/2}$
 Q_s =simulated discharge, Q_o = observed discharge, N = nb observations.

Error on annual discharge:

- Strong overestimation in eastern Amazon (Xingu-Jari), in northern Amazon (Branco), In southern tributaries: Jurua, Puru
- Weak overestimation in the Madeira (+ 30 %).
- Weak under estimation in big western tributaries (median Solimões, Negro) (-20%).

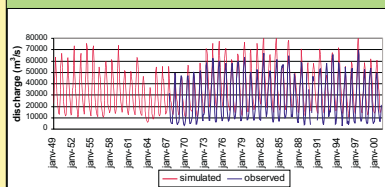
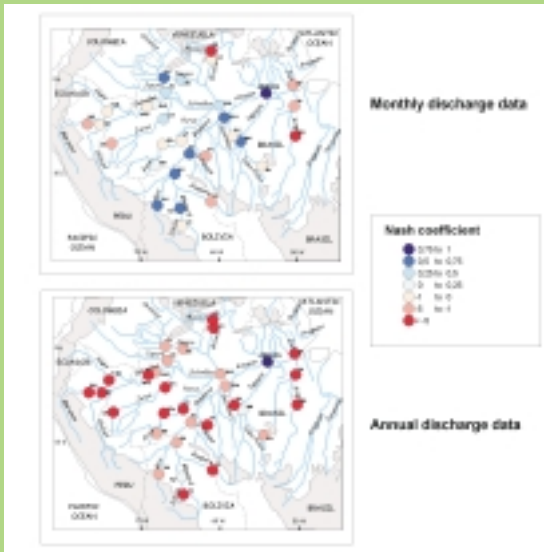


Good simulation in the southwestern Madeira basin

Nash Sutcliffe coefficient:

Using monthly data:

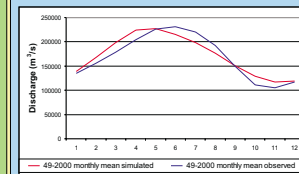
- Good simulation along the Beni-Mamoré-Madeira
 - Rather good simulation in the downstream Solimões and Negro
- Using annual data, the simulations are not good.



Simulated and observed monthly discharge in Fazenda Vista Alegre (Madeira). R^2 is 0,73 between monthly data, 0, 61 between annual data. The change at the beginning of the 70's is reproduced.

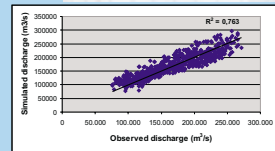
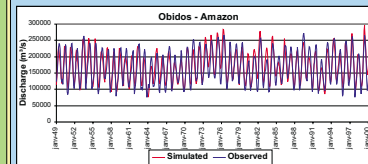
Good simulation in Óbidos

- 800 km from the Atlantic ($1^\circ 56' S$ $55^\circ 30' W$)
- 4 677 000 km² (3/4 of the Amazon basin)
- Mean annual discharge: 170 000 m³/s (1903-2003)



Simulation of the annual cycle:

- The simulated high flow occurs sooner (April-May) than the observed high flow (June) and it is slightly not high enough (-7 to -10%)
- As a consequence, the decrease of the flood is too slow.
- The timing of the low-flow water is good.
- Low flow and rising flow are slightly too high.



Nash-Sutcliffe

- On monthly data: 0,80
- On annual data: 0,81
- Mean annual error: + 2%
- RMSE on monthly data = 13%

Reproduction of the long-term Amazon variability (Callède et al. 2004), with a rupture at the beginning of the 1970'.

CONCLUSION and perspectives:

- Good simulation of the water fluxes in Óbidos and along the Madeira, but overestimation in the southern tributaries and underestimation in the western basins.
- Good simulation of the interannual and multi-decadal variability, especially along the Madeira.
- Some discrepancies between the observed and simulated annual cycles.
- The accuracy of CRU rainfall in the Amazon basin needs further analysis. The introduction of HYBAM rainfall in ORCHIDEE is ongoing.
- The behaviour of the routing scheme within ORCHIDEE, and especially the parameterisation of floodplains, needs further analysis.

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