Conjoint Analysis of the Surface and Atmospheric Water Balances of the Andes-Amazon System

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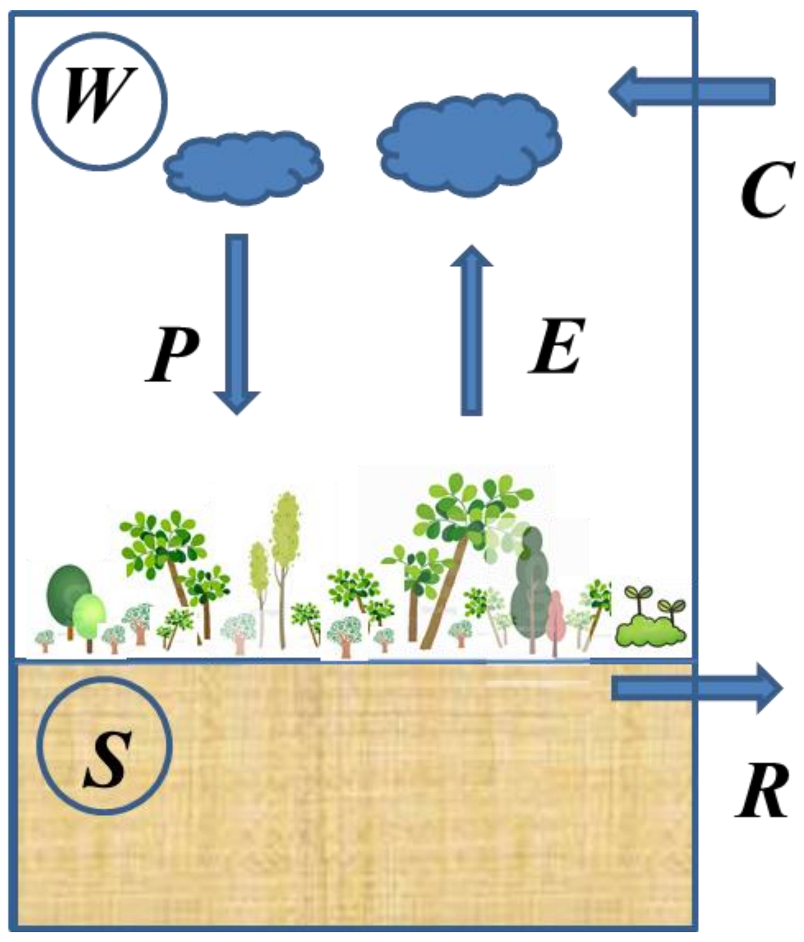
1. Introduction and theoretical background



Water balance equations

$$\frac{\partial S(t)}{\partial t} = P(t) - E(t) - R(t) \quad (1)$$

$$\frac{\partial W(t)}{\partial t} = -P(t) + E(t) + C(t) \quad (2)$$

$$\langle R \rangle = \langle P \rangle - \langle E \rangle \quad (3)$$

$$\langle C \rangle = \langle P \rangle - \langle E \rangle \quad (4)$$

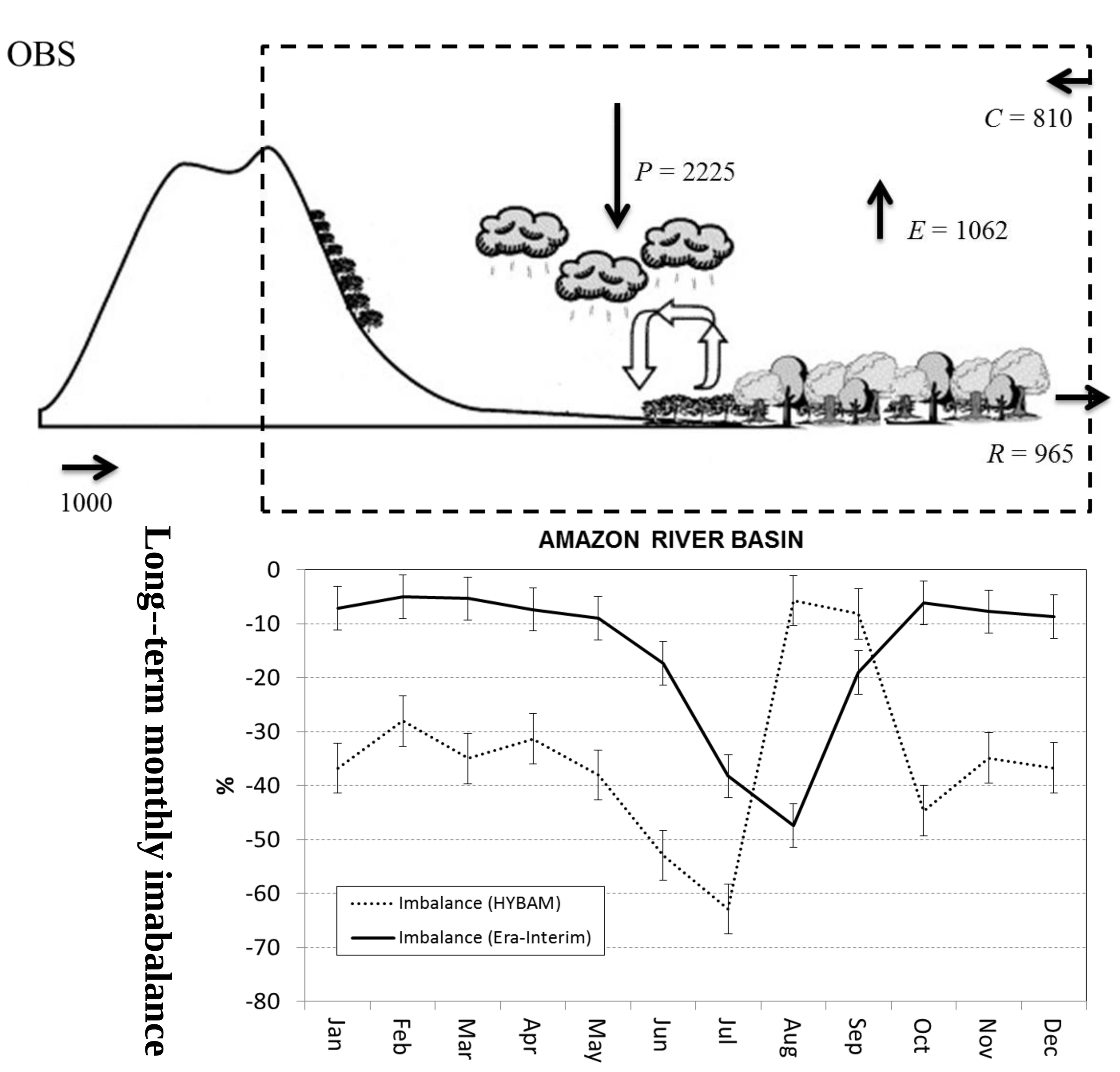
Water imbalance equations

$$I = \frac{C}{R} - 1 \quad (5)$$

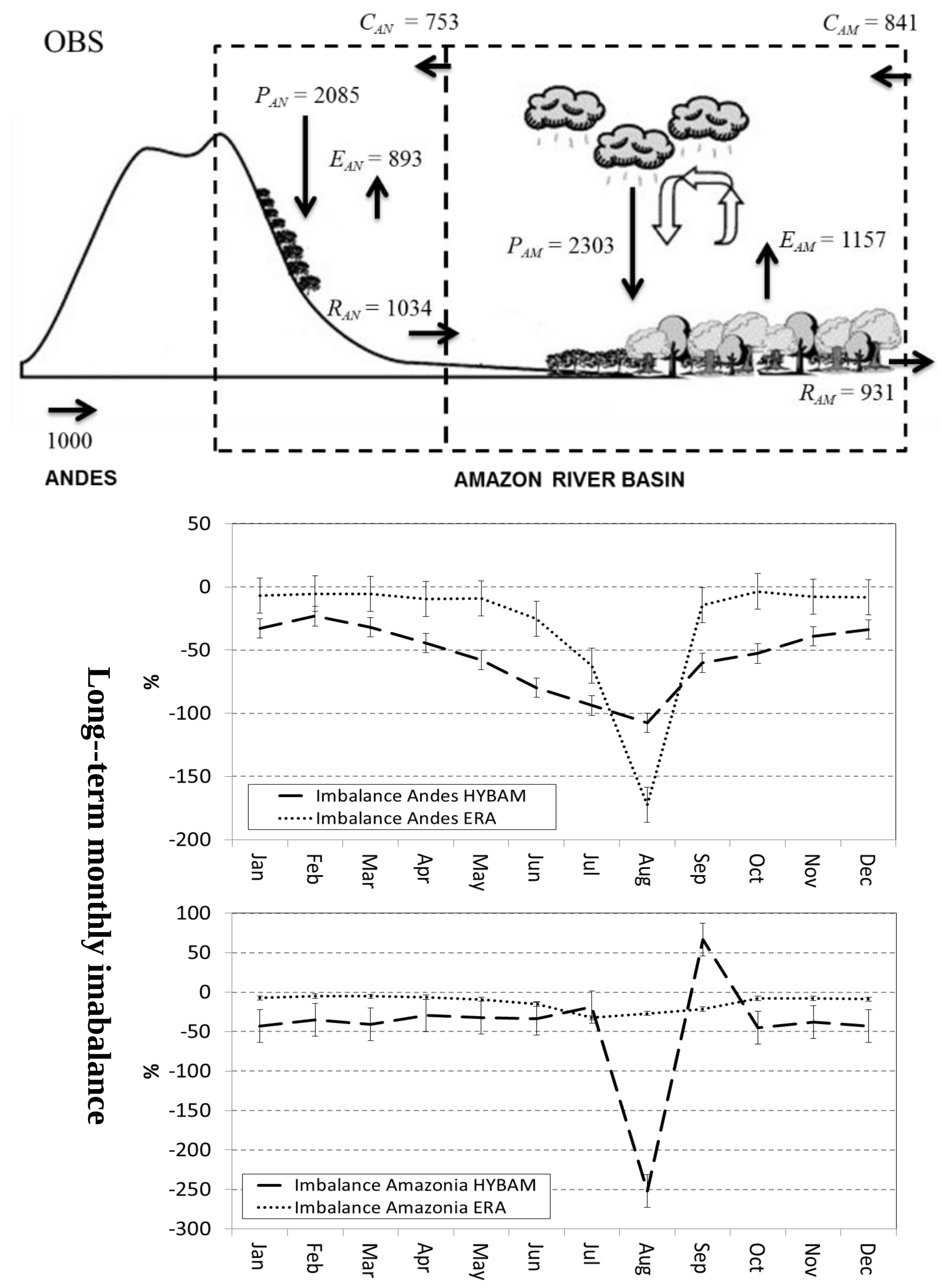
$$CI(t) = \frac{C(t) - \frac{\partial W(t)}{\partial t}}{R(t) + \frac{\partial S(t)}{\partial t}} - 1 \quad (6)$$

	Source	S. resolution	Time span	Reference
P	GPCC	1.0°x1.0°	1901-2010	[Schneider et al., 2014]
	Era-Interim	0.75°x0.75°	1979-2014	[Dee et al., 2011]
	ORCHIDEE	1.0°x1.0°	1970-2008	[Krinner et al., 2005]
	MPI	0.5°x0.5°	1982-2008	[Jung et al., 2010]
E	MODIS	1.0°x1.0°	2000-2010	[Mu et al., 2011; Nadzri and Hashim, 2014]
	GLEAM	0.25°x0.25°	1979-2014	[Miralles et al., 2011]
	Era-Interim	0.75°x0.75°	1979-2014	[Dee et al., 2011]
R	SO-HYBAM	drainage area	1982-2008	http: //www.ore − hybam.org/
	Era-Interim	0.75°x0.75°	1979-2014	[Dee et al., 2011]
C	Era-Interim	0.75°x0.75°	1979-2014	[Dee et al., 2011]

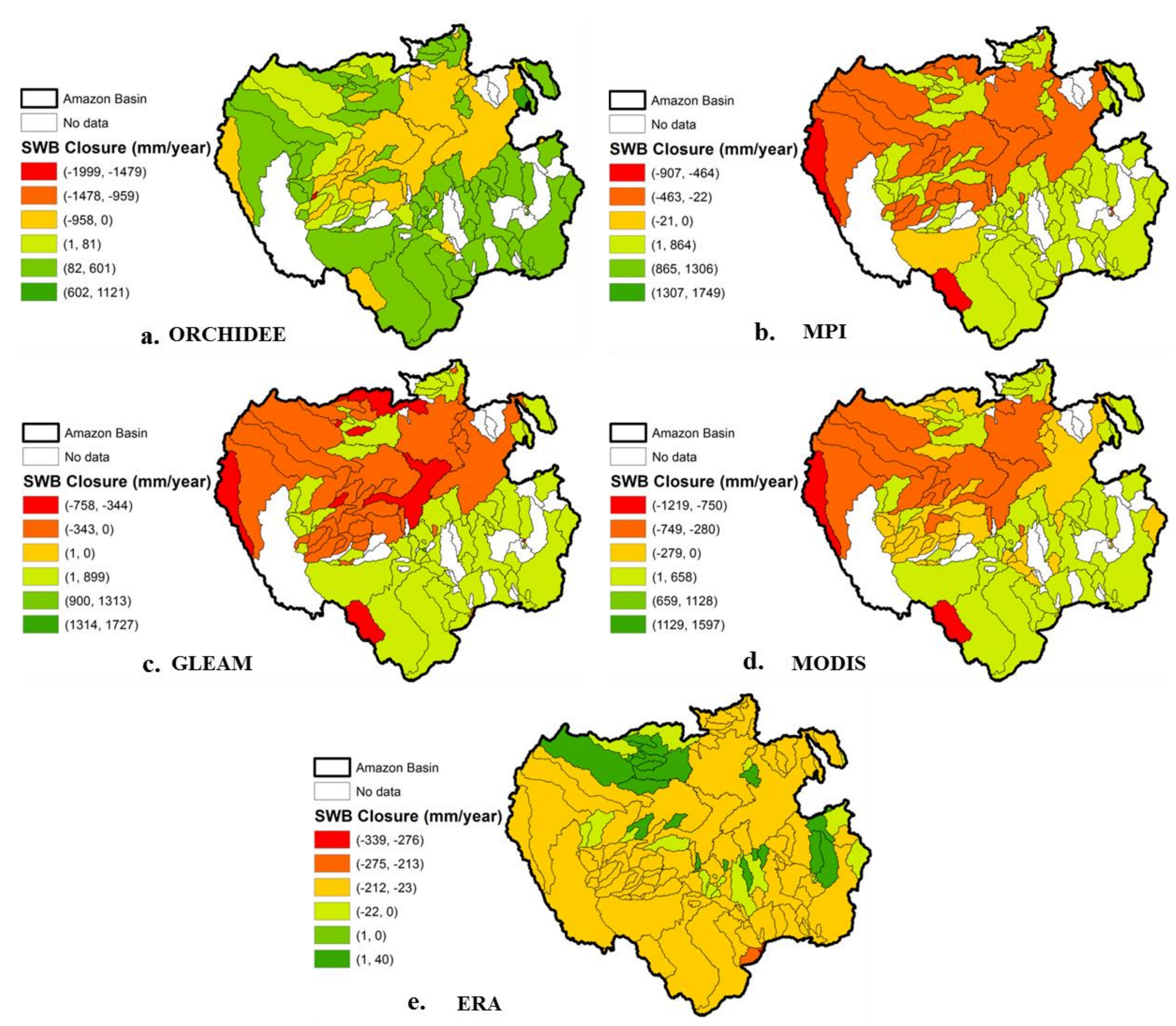
2. Water balances and imbalances for each spatial scale



- Surface balance *P-E-R* = 8% of *P*
- Atmospheric balance *P-E-C* = 16% of *P*
- Long-term monthly means of imbalance always negative (*R*>*C*), higher imbalances in the dry season
- Higher values of *P* and *R* for unit area in the Andean region of the Amazon River basin



Closure of surface water balance in each sub-catchment



- Sub-catchment results using observations show different signs of closure depending on north-south hydrological gradient of the Amazon River basin.
- 55% of sub-catchments are in balance for the results with observations and 92% for results with reanalysis.

3. Concluding remarks

- There is no such thing as balance in the sub-catchment analysis of surface and atmospheric water budgets
- The imbalance between the two water budgets (14%-16%) is driven by higher values of runoff and by an abrupt change in runoff when changing from dry to wet seasons in the Amazon
- The separated analysis performed to the Andes and low-lying Amazonia subsystems unveils two shortcomings of the available data, namely a poor quality of the representation of surface processes in the reanalysis models (including precipitation and evapotranspiration), and the limitations that high altitudes and scarcity of information induce in capturing the dynamics of hydrological processes over the Andean region.
- Our results confirm the paramount importance of a joint analysis between the atmospheric and surface water budgets at the river basin level, in order to achieve a complete understanding of the hydrologic dynamics.
- The results of the present study highlight the importance of the Andean region for the hydrological integrity of the entire Amazon River basin.

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5. References

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