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

Alejandro Builes-Jaramillo (1,2) and Germán Poveda (1)

(1) Universidad Nacional de Colombia, Sede Medellín, Department of Geosciences and Environment, Facultad de Minas, Carrera 80 x Calle 65, Medellín, Colombia, (2) Institución Universitaria Colegio Mayor de Antioquia, Facultad de Arquitectura e Ingeniería, Carrera 78 65 - 46, Edificio patrimonial. Medellín, Colombia (luis.builes@colmayor.edu.co)

Acknowledging the interrelation between the two branches of the hydrological cycle, we perform a comprehensive analysis of the long-term mean surface and atmospheric water balances in the Amazon-Andes River basins system. We estimate the closure of the water budgets based on the long-term approximation of the water balance equations, and estimate the imbalance between both atmospheric and surface budgets. The analysis was performed with observational and reanalysis datasets for the entire basin, for several sub-catchments inside the entire Amazon River basin and for two physical and geographical distinctive subsystems of the basin, namely upper Andean the low-lying Amazon River basin. Our results evidence that for the entire Amazon River basin the surface water balance can be considered to be in balance (P= 2225 mm.yr^{-1}, ET= 1062 mm.yr^{-1}, R= 965 mm.yr^{-1}), whereas for the separated subsystems it not so clear, showing high discrepancies between observations and reanalysis datasets. In turn, the atmospheric budget does not close regardless of datasets or geographical disaggregation. Our results indicate that the amount of imbalance of the atmospheric branch of the water balance depends on the evaporation data source used.

The imbalance calculated as *I=(C/R)-1*, where C is net moisture convergence (C= -∇Q where ∇Q is the net vertically integrated moisture divergence) and R the runoff,represents the difference between the two branches of the hydrological cycle. For the entire Amazon River basin we found a consistent negative imbalance driven by higher values of runoff, and when calculated for monthly time scales the imbalance is characterized by a high dependence on the Amazon dry season. 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.