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Distributed Macro-scale Hydrological Modeling in Rainforest Catchments in Amazonia using the HAND Model

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Climate change can significantly affect planetary functions, in part through direct interferences in the hydrological cycle (IPCC, 2007). Climate model results show that the world's water reserves experience large-scale variations, with a global tendency towards an increase in demand and a reduction in the ability to supply the demand (IPCC, 2007). That difficult scenario is compounded by the challenge of hydrological modeling in ungauged basins, which is necessary to find relationships and parameters that can be transferred from one basin (gauged) to others (ungauged). In this work we used the hydrological distributed model MGB-IPH (the Portuguese acronym for the Large Basins Model – Institute of Hydraulic Research. Collischonn, 2001; Collischonn et al, 2011) developed for applications in macro-scale basins (area > 10,000 km2). The model uses the Grouped Response Unit (GRU) approach, which consists of grouping all areas with similar combinations of soil and land use, so that the cell contains a limited number of different GRUs. Thus, the water balance is calculated for each GRU and at each cell, and the estimated stream flow rates in each GRU are summed and then propagated to the drainage network. For this study the GRU were replaced by Hydrological Response Units (HRU) that were obtained using the new drainage-normalized terrain model HAND (Height Above the Nearest Drainage; Nobre et al, 2011). The HAND model normalizes DEMs according to distributed vertical distances, through the flow path network, relative to the reference level in the drainage channel. This terrain model is the basis for obtaining hydrological relevant maps of soil water environments. The Digital Elevation Model (DEM) data were obtained from the Shuttle Radar Topography Mission (SRTM) data. Thus, the HRU are generated grouping these soil water environments and land uses. The model was calibrated for the Purus river basin (376,000.00 km^2, seven stream gauging stations), subbasin of the Amazon Basin, Brazil. The calibration period extended from January 1975 to December 1985. The parameters obtained were used to simulate the stream flows in the Tocantins- Araguaia river basin (918,822 km^2, seven stream gauging stations). The results showed the robustness of this approach; allowing to obtain a simplified parameterization, with strong physical basis, for prediction in ungauged basins. This type of approach and the parameters obtained through this can be used to improve surface schemes (LSM's) used in numerical models of weather and climate, and will increase the capacity of climate models to predict soil water and its connections to the land-atmosphere interactions.