SWOT FOR SOUTH AMERICA (PIs Fabrice Papa (IRD-LEGOS, France) and Daniel Moreira Medeiros (CPRM, Brazil):

Earth has a limited amount of water that recycles itself in what is called the 'Water Cycle'. Climate, weather, the environment and human activities are profoundly affected by the variability and changes in this continuous and interconnected cycle. Therefore, observing, monitoring and predicting the key variables governing the global water cycle is essential to our understanding of the Earth's climate and its changes, and to accurately forecast our weather, predict floods and droughts, and improve water resources management. However, although improved description of the components of the global water cycle is now recognized as being of major importance, the flux of water and the spatial distribution and variability of freshwater storage on continents are still poorly known. This is particularly true for the components governing the terrestrial branch of the global water cycle in large river basins of South America such as the Amazon River Basin or Andean lakes. These regions are particularly crucial to global climate and biodiversity, but they remain still poorly monitored at large-scale, limiting our understanding of their role in flooding hazard, carbon production, sediment transport and nutrient exchange. Moreover they are currently facing climate extreme events in the last twenty years with major droughts and floods that affected, for instance, large areas of the Amazon basin in recent years. Despite the advent of hydrology-oriented Earth observations missions over the past decades, the dynamic of the components of surface terrestrial water balance, in particular the water storage (in lakes, rivers, wetlands and subsurface) and the water fluxes (run off and discharge) are still not properly monitored, at least at basin and continental scale. It leaves thus major questions opened over the South American continent: what is the seasonal amount of water filling and emptying the Amazon floodplains, its interannual variability and its behavior during exceptional drought/flooding events? What are the variations of freshwater storage in Andean lakes and their link to climate variability? What is the "true" Amazon River discharge, knowing it is very difficult to estimate due to the tidal signature in water levels? Which processes govern the water extremes in the lower Amazon? These questions will take new dimensions with the future launch in 2022 of the US-French Surface Water and Ocean Topography (SWOT) mission, as its Synthetic Aperture Radar (SAR) in an interferometry mode will offer for the first time to the scientific community satellite-derived high spatial resolution and temporal sampling observations of the continental surface waters. In this favorable context, what can be done meanwhile, with the current satellite observations to work towards answering these crucial scientific questions and to prepare the SWOT mission?

In order to foster the challenges and opportunities resulting from this incoming capacity, the French Space Agency (CNES), along with the Institut de Recherche pour le Développement (IRD), and several institutes in South America (mainly Universities and Federal Agencies) joined forces to initiate a South America SWOT Science Team. The group also initiates a series of conference devoted to SWOT and the Water cycle in South America, named "South America Water from Space" (in Rio de Janeiro in April 2015 and 2017, in Santiago, Chile, in March 2018, and in Manaus, State of Amazonas-Brazil, on November 4-7 2019, just 2 years before the launch of SWOT, welcoming more than 100 participants from most of South American countries, France and the US, https://hydrologyfromspace.org/).

The current project aims at maintaining those efforts and the dynamics in the new SWOT Science Team 2020-2023 with a new group named "SWOT for South America", involving strong collaborations in Brazil, Chile, Argentina, Colombia and French Guiana. Our project is based on an integrated proposal organized into 5 interconnected WP covering several thematic dealing with the Water Cycle, hydrology in the SWOT context. The proposal is lead by two main PI, Fabrice Papa (IRD, LEGOS, France) and Daniel Moreira (CPRM, Rio, Brazil). Each WP has 2 PIs, one from France and one from South America. Other Co-I are also involved in each task. The proposed WPs are as follow:

1) WP1 on the estuary of the Amazon: PIs: Fabien Durand (IRD-LEGOS) and Otto Rotunno Filho (UFRJ-Brazil)
2) WP2 on water storage variability in surface and sub-surface of South America with focus on the Amazon basin and its link to climate: PIs: Fabrice Papa (IRD-LEGOS) and Javier Tomasella (CEMADEN, Brazil)
3) WP3 on lakes storage and climate variability in SA: Jean-Francois Cretaux (CNESLEGOS) and Rodrigo Abarca del Rio (Uni-Concepcion, Chile)

4) WP4 on floodplains hydrology and dynamics at high resolution: Marie-Paule Bonnet (IRD-ESPACEDEV) and Jefferson Ferreira (Mamirauá Inst. for Sustai Dev., Brazil)
5) WP5 dealing with the Cal/Val of SWOT and its science applications for Altimetry missions in South American rivers: Adrien Paris (CLS) and Juan Gabriel Leon (Uni.Colombia at Cali, Colombia)

The integrated scientific objectives of the WPs of the present proposal are therefore to develop, combine, and analyze together a wide variety of observations from remote sensing techniques, in-situ measurements and modeling in order conduct activites pre- and post-launch of SWOT:

1) Improve our understanding of floods extent and water level dynamics in the wetlands and in the estuary of the Amazon River at high spatial resolution (WP1, WP2 and WP4)

2) Analyze the seasonal and interannual dynamic of Amazon water storage (surface and subsurface) and the different processes at play at different spatial/temporal scale to better characterize extreme events such as flood and droughts over the basin (WP2 and WP4)

3) Better estimate the water stored in lakes and in rivers/wetlands of South America and better understand their links with climate variability (WP2, WP3, WP4).

4) Prepare the future SWOT era in terms of cal/val with field trips and develop analysis, and algorithms using current altimetry missions (WP1-3-5).

5) Provide the community with important benchmark products (over lakes, rivers, wetlands, and estuary) to future evaluation of SWOT observations in the Amazon basin and over South America (WP1-2-3-4-5)

Our proposal will contribute to several following key points identified in the 2019 SWOT ROSES TOSCA for hydrology including 1) River, Lake and Wetland Science (WP1-2-3-4); 2) SWOT Algorithm and Data Products (WP2-3-5); 3) Key areas in Calibration and Validation (WP1-3-5).

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