Temporal Variability of Streamflow in Uruguay River Basin, Southern Brazil from 1980 to 2018

Aydoğan Avcıoğlu1, Rosalie Vandromme1, Thomas Grangeon1, Landemaine Valentin1, Olivier Evrard2, Anthony Foucher2, Amaury Bardelle2, Néverton Scariot3, Daniel Allasia4, Jean Minella5, Vinícius B. P. Chagas6, Marcos Tassano7, and Olivier Cerdan1

1 BRGM, 3 avenue Claude Guillemin, 45060 Orléans, France

2 Laboratoire des Sciences et de l'Environnement, UMR 8212 (CEA/CNRS/ UVSQ-IPSL), Université Paris-Saclay, Gif-sur- Yvette Cedex, France

3 Universidade Federal de Santa Maria

4 Environmental Sanitary Department, Universidade Federal de Santa Maria

5 Department of Soils, Universidade Federal de Santa Maria

6 Department of Sanitary and Environmental Engineering, Federal University of Santa Catarina, Florianopolis, Brazil

7 Laboratorio de Radioquímica, Centro de Investigaciones Nucleares, Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay

Climate-related and anthropogenic disturbances can alter hydrological processes, often resulting in modified streamflow characteristics, and sediment fluxes, as well as impacts on hydro morphology, flooding processes, and aquatic ecology. Southern Brazil, and particularly the northern section of the Uruguay River Basin, has experienced notable human pressures (i.e., deforestation, urbanization, expanding of agricultural fields, etc.) across the landscape over the last 38 years. However, knowledge of the spatiotemporal interaction between landscape disturbances and streamflow is still required in these regions. Therefore, in this study, our goal is to determine which disturbances—natural or human—have a greater influence on changes in streamflow and to quantify spatio-temporal associations between variations in streamflow trends over the past 38 years and natural (precipitation, temperature, soil moisture, etc.) and human (deforestation, soybean production, dam construction, population density, roads, etc.) disturbances. Here, we use the daily streamflow observations over 38 years (for the period from 1980 to 2018) provided by the National Water Agency (ANA) of Brazil from 78 hydrometric stations, which encompass almost one-third of the Uruguay River basin as a contribution area. The climate-based and anthropogenic spatio-temporal data sets have been compiled as potential explanatory data sets of the different trend patterns in the streamflow. We used the Mann-Kendall and Sen’s Slope test to quantify the streamflow trends over the study area and drew bivariate maps to identify the spatio-temporal drivers of the streamflow changes. The findings indicated that streamflow data shows two distinct periods, 1) an increasing trend between 1980 and 1999 and then 2) a declining trend between 2000 and 2018, while climate conditions (i.e., precipitation) have remained relatively constant in contrast to human disturbances. Given that bivariate maps also demonstrate a linear spatio-temporal association with streamflow trends, especially after 2000, we may primarily attribute this trend change to increased dam construction, agricultural practice changes, deforestation associated with agriculture, and wildfire-related tree loss. The preliminary results indicate that human disturbances influence streamflow trends more than natural disturbances in Southern Brazil.

**Keywords:** Decadal-scale streamflow analysis, Trend Analysis, Natural and Anthropogenic Disturbances, Southern Brazil