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Impact of strong El Niño events on river discharge in South America

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The impact of the El Niño Southern Oscillation (ENSO) on rivers are well known, but most existing studies involving streamflow data are severely limited by data coverage. Time series of gauging stations fade in and out over time, which makes hydrological large scale and long time analysis or studies of rarely occurring extreme events challenging. Here, we use a machine learning approach to infer missing streamflow data based on temporal correlations of stations with missing values to others with data. By using 346 stations, from the "Global Streamflow Indices and Metadata archive" (GSIM), that initially cover the 40 year timespan in conjunction with Gaussian processes we were able to extend our data by estimating missing data for an additional 646 stations, allowing us to include a total of 992 stations. We then investigate the impact of the 6 strongest El Niño (EN) events on rivers in South America between 1960 and 2000. Our analysis shows a strong correlation between ENSO events and extreme river dynamics in the southeast of Brazil, Carribean South America and parts of the Amazon basin. Furthermore we see a peak in the number of stations showing maximum river discharge all over Brazil during the EN of 1982/83 which has been linked to severe floods in the east of Brazil, parts of Uruguay and Paraguay. However EN events in other years with similar intensity did not evoke floods with such magnitude and therefore the additional drivers of the 1982/83 floods need further investigation. By using machine learning methods to infer data for gauging stations with missing data we were able to extend our data by almost three-fold, revealing a possible heavier and spatially larger impact of the 1982/83 EN on South America's hydrology than indicated in literature.