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Spatio-temporal dynamics of reservoir (de-)commissioning in Ceará, NE Brazil

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The North East of Brazil is characterized by a high spatial, seasonal and inter-annual variability of rainfall. The climate is semiarid with pronounced wet and dry seasons. In the federal state of Ceará, water supply for the dry season is ensured by the construction of reservoirs of various sizes. However, most of these reservoirs were built without documentation by the water management authorities. Thus, there is no complete state-wide inventory of reservoirs in Ceará. Using the satellite based global surface water dataset (GSW), this study aimed at investigating (i) the location, (ii) size, (iii) commissioning and decommissioning year as well as (iv) spatio-temporal dynamics of reservoirs in Ceará for the period 1984 - 2018.

Based on the maximum water extent of the GSW dataset, 17 919 reservoirs larger than 90 x 90 m were detected in Ceará (ii), which could be confirmed with an accuracy of 87 % for a validation dataset including 157 reservoirs regularly monitored by the State Agency for Meteorology and Water Resources in Ceará (FUNCEME). Thereby, reservoirs with a maximum water extent < 2.05 ha (category 1) form the largest and reservoirs with a maximum water extent > 50 ha (category 6) the smallest share in number of all detected reservoirs (i). In turn, reservoirs of category 6 contribute most to the water storage capacity while category 1 reservoirs contribute least. For the estimation of (de-)commissioning years (iii), the GSW monthly water history dataset was used. The years of commissioning and decommissioning were determined as the first and last year, respectively, of water being detected. The calculated commissioning years were validated against the FUNCEME dataset, whereas to date there is no validation data to confirm the decommissioning of reservoirs. The analysis of spatio-temporal dynamics of reservoir commissioning and decommissioning (iv) indicate a spatially variable increase of reservoirs until approximately 2010, followed by an intensive decrease until 2015 (analysis of extended study period currently ongoing).

Deviations in terms of commissioning years are mainly small and can be attributed to uncertainties inherent to satellite observations. Up to 2010, the detected spatio-temporal variability can be largely attributed to droughts which occurred in most parts of the state in several years and particularly severe since 2012. However, the maximum rate of large strategic reservoir

construction by the public sector (for which records exist) decreased since the 1990's, which is attributed to a shift in the adaptation strategy to water scarcity, from structural measures (construction of dams) to governance measures (water management and control). From the data presented here, it seems that this trend likewise occurred on the level of small reservoirs for which no records existed so far.