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Evaluating the dynamic hydrological connectivity of a coastal wetland: an application of connectivity response unit (CRU) approach on Chilika Lagoon, Odisha, India

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Chilika is a large brackish water lagoon in the eastern coast of India and received the distinction of a Ramsar wetland in 1971. It was put under 'The Montreux Record' in 1993 because of large scale degradation, but the remarkable restoration activities led to regaining its Ramsar status in 2002. The Chilika receives an influx of saline water from the Bay of Bengal and that of freshwater from the terrestrial systems from its catchment as well as from a distributary channel of Mahanadi River. Having these two very different types of water influx is a characteristic feature of this wetland which defines its biophysical as well as hydrogeomorphic attributes. There are at least three connectivity-related factors controlling the physical attributes of Chilika Lagoon – its connectivity with the sea, the lagoon-catchment connectivity, and lagoon-river connectivity. In the present work, we have assessed the lagoon-catchment hydrological connectivity for 30 years (1990-2020) by calculating connectivity indices (IC) annually. Using the Connectivity Response Unit (CRU) approach, we evaluated the dynamic hydrological connectivity of the lagoon with its catchment as well. The ICs are calculated as a function of topographic and land-cover factors. Since grasslands and shrubs are the primary land-cover in the catchment, we used NDVI to model the vegetation-induced impedance to the hydrological connectivity. The algebraic sum (IC_sum) of the IC values of each pixel of the catchment in a given year was used to compare the overall connectivity at the inter-annual scale. Since connectivity increases with increasing IC values, a higher IC_sum represents a relatively higher hydrological connectivity. The IC_sum is showing a strong decreasing trend with time, which implies that the overall hydrological connectivity of the lagoon with its catchment is decreasing since the 1990s. Further, the CRU assessment has demarcated the specific regions of the catchment which are showing dynamicity in the hydrological connectivity. As expected, the CRUs with high connectivity potential are in proximity to the lagoon. Nevertheless, there are large patches of CRUs with increasing connectivity in the distal parts of the catchment as well. A total of 13.5% area of the catchment is showing either high or increasing connectivity pattern, however, an overwhelming 67.6% of the catchment is exhibiting either low or decreasing connectivity pattern. In 14% area of the catchment, the connectivity was high in the past, but it is diminishing with time, whereas in 20% of the catchment, the low connectivity is intensifying. The changing lagoon-catchment hydrological connectivity is expected to impact the biophysical and hydrogeomorphic characteristics of the Chilika wetland by impacting the freshwater inflows in a brackish water lagoon such as the Chilika, and therefore, this is an

important management consideration for the wetland.