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Analysis of hydrologic alternations in the rapidly changing environment in the Pearl River Delta, South China

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Hydrologic regimes fluctuate in response to climatic variations and human influences. Over the past three decades, the Pearl River Delta (PRD) has been the fastest developing region in China. Human activities mainly associated with urbanization and industrialization in the region have been rapidly changing the environment, making the PRD crisscross river network an ideal area for studying human-induced hydrologic alternations. In this study, we first used linear regression method to systematically evaluate the long-term variations of extreme water levels defined as exceeding/falling below certain thresholds (mean$\pm$std) across the delta. It was found that the low water level has been significantly dropping in the upper PRD while the opposite situation has occurred in the lower PRD. Secondly, we used Mann-Kendall trend test and Kriging interpolation method to detect the spatial and temporal patterns of the trends of the extreme high and low water levels related to different magnitudes of streamflow. The results indicate that the high (low) water level along the Pearl River estuary has been increasing and the inner delta region is characterized by decreasing high (low) water level in high and normal streamflow periods, but by increasing high (low) water level in the low stream periods. This phenomenon can be attributed to more significant impact of tidal process on water level in dry season than in flood season. Finally, we applied Beyes model and Lepage test to detect change point(s) of water level time series and analyzed the associated statistical properties of high/low water levels in summer (Jun, Jul, Aug) and winter (Dec, Jan, Feb). With respect to winter mean low

water level, 14 out of 19 stations had two change points. The first abrupt change occurred around 1980 and the second abrupt change in the early 1990s. As for summer mean high water level, 12 out of 19 stations have only one change point. The timing of change points of summer mean high water level is similar to that of winter mean low water level. Identification and analysis of the causes for the hydrologic alternations in terms of water level will help us understand the impacts of human activities and thus provide important scientific evidence for managing the water environment in the PRD region.