Coupling Shoreline Changes with Ground Water Monitoring Data to Interpret Changes of Hydrogeological Properties in Confined Aquifers on Littoral Zones in Taiwan

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Not only the mean-sea-level rising induced by the global climate warning but also the extreme climate events, such as typhoons and storms, which frequently occurred and accompanied with the global climate warning always seriously impacted the coastal environments in Taiwan. Taiwan, an island country located at southwestern Pacific Ocean, has a cost line of 1,335 km long. And 55% proportion of the coast line remains natural. In recent 5 years, the maximum daily accumulated rainfall over 1,000 mm brought by regular typhoons always generated huge disasters and massive sediments in a broad flood-prone area on littoral zones in Taiwan. The sediments were transported from the Cainozoic zone in the central Taiwan and caused significant changes of downstream shorelines. Therefore, the continuous and regular monitoring of shoreline changes is essential for the environment protection and the disaster management in Taiwan.

The two dimensional Morlet wavelet analysis was used to detect edges on Synthetic Aperture Radar (SAR) images. And a clock tracing algorithm and an active contour model were integrated for the final shorelines auto-delineation in the study. The SAR image that is climate unaffected and is free of visible light can provide reliable information in unfavorable climate conditions. The Morlet wavelet function has the smallest window size and is directional. Therefore, the Morlet wavelet function is more flexible and efficient in extracting specific information from image signals. The shoreline changes were studied with an interval of 5 years in a period of 20 years from 1990 to 2010. All shoreline changes were mapped compared to the baseline map in 1990.

A groundwater monitoring network system (GMNS) was established and has been maintained since 1992 on littoral zones surrounding Taiwan. The network consists of 327 hydrogeological wells for constructing hydrogeological profiles and 137evently distributed stations for deriving hydrological parameters, including hydraulic conductivity and specific storage coefficient, from the pumping test in every year. The correlations between the changes of the hydrological parameters in the near-surface confined aquifer and the distance changes between well stations and the shoreline with a zero mean sea level were then examined and the results were statistically significant. And the influences of shoreline changes on hydrogeological properties in confined aquifers were discussed accompanied with the field survey of the near-surface hydrogeological structures.

This study proposed a framework to indirectly interpret the variations of near-surface structures induced by natural disturbances on shorelines. And the application of the framework on water resource management and shoreline management were also specified.

Keywords: shoreline, SAR, aquifer, hydrogeology, water resources