Evolution of hydrological cycle under ENSO effect and global warming context in Taiwan

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Taiwan island is divided by the tropic of cancer into tropic and temperate climate regimes' areas. Its topographical feature is mostly dominated by high, steep mountain ranges and small, narrow coastal plains. Accordingly, its water regime mainly depends upon the typhoon and droughts may occur regardless high annual precipitation. This study utilizes the 5th generation of European Centre for Medium-Range Weather Forecasts (ECMWF) reanalysis (ERA5) dataset targeting at deeper knowledge of the relationships between climate drivers (soil moisture, soil temperature, evaporation and precipitation) and climate change indicators (here are temperature increasing and drought frequency). Ensemble empirical mode decomposition and other statistical methods were applied to enumerate the trends, the frequent oscillations and the stochastic variations of climate factors. The analysis helps evaluating the mutual effects of these factors to the above-mentioned climate change signals. The results prove the strong and significant correlation and the increasing tendency of air and soil temperature over whole Taiwan island. In contrast, precipitation shows tendency of significant decreasing in the last 15 years, while evaporation is generally stable, although a slightly increasing trend is observed, especially in the agricultural area recently. Generally, soil moisture content reduces in all parts of Taiwan, accompanying with the decrease of precipitation. Ensemble empirical mode decomposition well captures the signals of seasonal, interseasonal, annual, interannual, semidecadal, decadal and interdecadal oscillations in soil moisture content (and others parameters) long term observations. Some components of the decomposition are concurrent with the drought, ENSO and sun cycle signals. These signals' amplitudes indicate the magnitude of natural processes' effect on climate drivers. They also reveal the response of climate drivers upon long-term climate change signals. Besides, the segmented trends of soil moisture in some pixels imply the vulnerability of soil moisture regime with the occurrences of climate change events and its feedback. In conclusion, soil temperature and soil moisture, coupling with evaporation, strongly relate to the weather parameters (air temperature, precipitation). They are affected by and also impact the climate system, driven by climate oscillation and contribute to the climate change indicators such as drought.

Keywords:climate change, ensemble empirical mode decomposition, European Centre for Medium-Range Weather Forecasts reanalysis, soil moisture, soil temperature