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Long-term radon variations at a hot spring in China

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Radon concentration is monitored continuously in mainland China by China Earthquake Administration (CEA) for the purpose of earthquake prediction. An almost gap-free radon record of nearly 40 years (from April 1976 to December 2015) of monitoring of water-dissolved radon at the hot spring site of BangLazhang (BLZ), Southwestern China is analysed. The length of the time series allows the investigation of long-term periodicities of radon. Ancillary observation data, i.e. water temperature, spring discharge rate, barometric pressure, combined with regional rainfall, galactic cosmic ray (as a proxy for solar activity) and regional seismicity are complemented for the same period to identify potentially influencing factors controlling the changes of radon. The long-term variations in radon concentration and ancillary observation data are studied by using the continuous Wavelet Power Spectrum (WPS), Wavelet Coherence (WTC), and Partial Wavelet Coherence (PWC) methods. The results of WPSs and WTCs show that the long-periodic radon concentration is characterized by a significant decadal cycle, matching well with the concurrent periodicity in water temperature, spring discharge rate, and galactic cosmic ray. The analysis of PWCs among radon, discharge rate, water temperature, and galactic cosmic ray reveals that the 11-year solar cycle might influence radon, water temperature, and spring discharge, though a direct physical link between the solar activity and the monitored parameters seems unlikely. Moreover, PWCs of radon, discharge rate and water temperature suggests that water temperature variations explain most of the coherent variability of radon and the discharge rate. Possible mechanisms are discussed. We tentatively propose that the multi-year periodic variations in radon concentration are mainly explained by variations of water temperature and/or spring discharge, which are modified and inter-modulated by earthquakes and decadal variations of unknown origin.