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Multi-parametric measurements in water wells for detection and assessment of geodynamic processes

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We collect and analyze a multi-parametric set of lithospheric-hydrologic variables in order to study their inter-correlations and their association with geodynamic processes along the Dead Sea Fault Zone (DSFZ). Currently, most available data, studies, and reports seem to miss such extensive datasets, and studies regarding the various correlations are scarce. As result, the controlling factors of reported anomalies preceding geodynamic events remain elusive and questionable. Geodynamics explores materials movement throughout the earth as a response to a stress field by utilizes physics, chemistry, geophysics and models. Displacements on faults is a substantial fraction of the strain occurring in the upper crust. Therefore, strain measurement at the earth's surface can provide important information on that fundamental geodynamic process. However, resulting from fault creep surface strains are generally very small and direct measurements are challenging. Physicochemical properties of confined groundwater along with bedrock gas emissions may provide a means of obtaining quantitative data on the earth's strain. Numerous worldwide studies reported the anomalous behavior of physicochemical properties of groundwater and bedrock gas emissions preceding earthquake events and several models have been proposed to account for those observed variations including earth dilatation and the physio-electric reaction of silicates to strain. However, long periods of continuous measurements are rare and multi-parameters monitoring is even further exceptional. As consequence, precursory signs for earthquake prediction, or forecasting, are still debatable and studies have been criticized for being anecdotal or fragmentary. Hence, we utilize an innovative approach for monitoring and analysis of a multi-parametric continuous and synchronized dataset of groundwater physicochemical properties and bedrock gas emissions to study geodynamic process along the DSFZ. For that purpose, a monitoring station has been constructed in a well located close to the main fault of the DSFZ, Israel. The collected data set include groundwater level, temperature an electrical conductivity as well as Rn-222, CO_2 and temperature at different altitudes within the well above groundwater level. Above ground temperature, barometric pressure measured locally and full range of meteorological data set is attainable from a nearby meteorological station. The data set is analyzed using signal processing algorithms and statistical analysis both in time and frequency domains in order to suggest possible links between the different measured parameters. Understanding those links allow filtering of non-geodynamic influences from the measured signal and minimize false correlations of anomalies with geodynamic processes.