Using Independent Components Analysis to diminish the response of groundwater in borehole strainmeter

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With designed feather, borehole strainmeter can not only record minor signals of tectonic movements, but also broad environmental signs such as barometry, rainfall and groundwater. Among these external factor, groundwater will influence the observation of borehole strainmeter mostly. According to essential observation, groundwater will cause much bigger response than the target tectonic strain change. We use co-sited piezometer to record pore pressure of groundwater in the rock formation in order to obtain the relationship of stain change and pore pressure. But there still exist some puzzle that can not be solved. First, due to instrument limitation, we could not set the pore pressure transducer in the same aquifer as strainmeter did. In this case, the response due to pore pressure change might be not fully correct. Furthermore, through pore-pressure transducers were set in most observatory, problem of electricity and connectivity will cause the record lack and lost. Therefore, it is necessary to find out a better and more stable method to diminish the groundwater response of strainmeter data.Strain transducer with different orientation can observe the groundwater response in different scale. If we can extract out groundwater signal from each independent strain transducer and estimate its original source. That will significantly rise signal strength and lower noise level. The case belongs some kind of blind-signal-separation (BSS) problem. The procedure of BSS extract or rebuild signal that can't be observed directly in many mixed sources and Independent-Component–Analysis (ICA) is one method adopted broadly. ICA is an analysis to find out parts which have statistics independence and non-Gaussian factor in complex signals. We use FastICA developed by to figure out the groundwater response strain in original strain data, and try to diminish it to rise the signal strength. We preceded strain data previously, then using ICA to separate data into serval independent components. Among them, we found one is highly correlated to groundwater result. It has not only good correlation in long-term trend, but also in short-term fluctuations. It can minimize the groundwater response in borehole strainmeter data effectively.