Observations of the effect of earth tides on groundwater fluxes variations at the scale of a borehole

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For a long time, characterization of aquifers has been mainly based on the monitoring of groundwater heads variations. This approach allowed to demonstrate that pressure changes induced by earth tides have a significant and measurable impact on groundwater heads monitored in confined aquifers. Nowadays efficient methods provide a direct estimation of groundwater fluxes. This is the case of the Finite Volume Point Dilution Method (FVPDM), a single-well tracer experiment that allows continuously monitoring and quantifying groundwater flux variations over time. Yet, the potential effect of earth tides on local groundwater flow has never been investigated. In this context, FVPDM tests have been performed in a confined aquifer in order to monitor groundwater fluxes over several tidal cycles. Results show significant groundwater flux variations over time (around 20% of the flux value), clearly correlated with pressure changes induced by earth tides. Subsurface heterogeneities could explain the fact that earth tides induce groundwater flow variations. Indeed, groundwater heads variations induced by earth tides depend on the local specific storage (in confined conditions) of aquifer. Any spatial variation of this parameter could induce variations of the hydraulic gradient and thus of groundwater fluxes. Therefore, these preliminary observations seem to open new perspectives for subsurface characterization by showing how groundwater flow variations measured in confined aquifer and induced by earth tides can be used as a marker of subsurface heterogeneities.