Asymmetric quantification of Stream water Groundwater interaction based on Stream Aquifer Flow Exchange (SAFE) method

The interaction between stream water and groundwater is an important component of the hydrologic cycle. The quantification of the water that flows from/to the streams to aquifers is critical for management of conjunctive use of surface and groundwater. Commonly, the quantification is achieved with the use of integrated surface-groundwater simulation models such as Modflow, IWFM etc. In these models the seepage (stream water loss to groundwater) is estimated as a function of the head difference between the stream and groundwater head and the “leackage coefficient” which is an empirical parameter estimated via calibration.

In this study we use the Stream Aquifer Flow Exchange (SAFE) method which replaces the calibrated “leackage coefficient” with a dimensionless conductance. So far, the SAFE method, has been developed for grid based numerical simulation codes i.e. finite difference numerical models. In our work we demonstrate the applicability of the SAFE method for both structured and unstructured grids.

Traditional approaches cannot make distinction between left and right seepage due to different pumping/recharging. Here the SAFE method was modified to quantify independently the seepage on either side of the stream.

In this study, first we demonstrate the SAFE methodology on a hypothetical example and provide a sensitivity analysis of the method. Next the method is applied to a real world example to quantify the seepage on the Central Valley basin, California which consist of a large interconnected network of rivers, canals sloughs etc.