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Model development for a stream-aquifer interaction through the Hyporheic Zone with the effect of riverbed clogging using Open-GeoSys

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Stream-aquifer interaction, in recent research works, has gained tremendous interest. Most of the work focusing on the river restoration and river ecology management consider this interaction as a crucial factor. These interactions occur through a transitional zone known as Hyporheic Zone (HZ). HZ is a zone encompassing physical, chemical and biological aspects of the river and the underlying aquifer. Owing to its multifarious ecological significance, modelling of HZ has become an important research interest.

Stream-aquifer interaction modelling requires complete understanding of the interrelated, spatio-temporally varying processes. HZ flows are sensitive to river bed topography, river geomorphology, internal factors like heterogeneity in hydraulic conductivity, processes like erosion and clogging. In model development for HZ, these processes and factors play a vital role in the implementation of boundary conditions. However, there are several processes which directly or indirectly obstruct the hyporheic flow. Clogging of the riverbed is identified as one of the major factors, impairing the stream-aquifer interaction. The process of clogging is time-dependent and spatially scattered.

In this study, an attempt has been made to develop a 2-dimensional HZ model using OpenGeoSys 6 (OGS6). The ongoing setup involves two physical surfaces representing riverbed and the underlying aquifer. Constant head boundaries on the top (river) and on the sides (lateral GW) has been applied, keeping bottom boundary as a no-flow boundary. Initial results suggest that this combination of boundary condition is best suited for modelling the effect of clogging in HZ flow. As a future work, it is proposed to work upon the effect of the combinations of these boundary conditions on HZ flows. It is also, proposed to incorporate the effect of clogging in HZ model development and further incorporation of model complexities. The final aim of the study is the development of HZ model which could incorporate clogging and other riverbed complexities.

Keywords: HZ, clogging, interaction, OGS