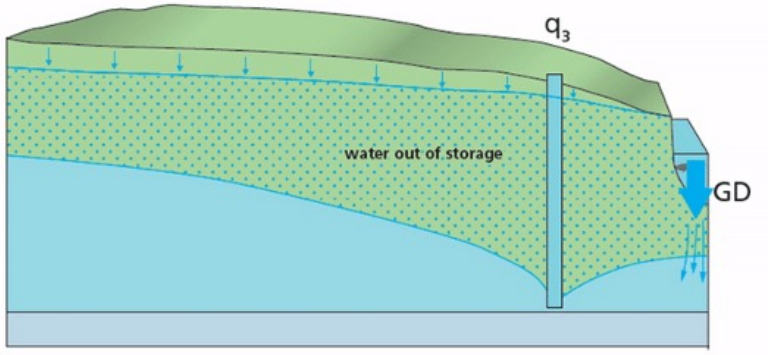
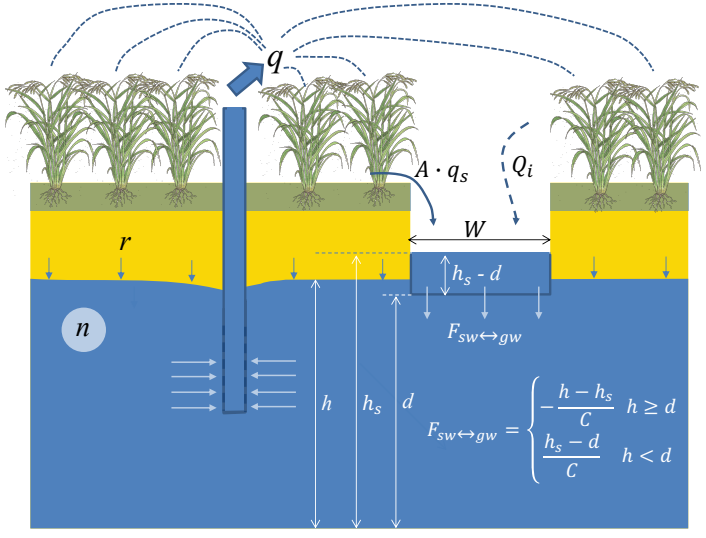
A conceptual analytical framework to assess the large-scale effects of groundwater withdrawal on groundwater storage and surface water flow

Marc F.P. Bierkens[1,2], Edwin H. Sutanudjaja[1], and Niko Wanders[1] ([1]Utrecht University, [2]Deltares)

Groundwater-surface water interaction and pumping



Lumped conceptual model groundwater-surface water interaction and pumping



Lumped conceptual model -> Piece-wise linear model

Groundwater balance

$$n\frac{dh}{dt} = r + F_{gw\leftrightarrow sw}(h) - q$$

Surface water balance

$$Q = Wv(h_s - d) = Q_i + q_s A + F_{gw\leftrightarrow sw}(h)A$$

GW-SW interaction term

$$F_{gw\leftrightarrow sw}(h) = \begin{cases} -\frac{h-h_s}{c} & h \geq d \\ \frac{h_s-d}{c} & h < d \end{cases}$$

See HESSD for details, some validation and reviewer feedback

Global results using PCR-GLOBWB parameters and inputs

Total depletion rate: 158 km^3 yr^{-1}
PCR-GLOBWB 2: 171 km^3 yr^{-1}