COMSOL CONFERENCE ROTTERDAM2013

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Aquifer Physics Modes for Hydrogeological Modeling

– an Application of the COMSOL Physics Builder

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Introduction

Although there are porous media and subsurface flow modes available in a toolbox of COMSOL Multiphysics, for hydrogeological modeling some common requirements can not be easily accessed in the graphical user interface. Most crucially, there is no distinction between confined and unconfined situations for permeable layers, i.e. aquifers. Using the Physics Builder for such distinctions *aquifer physics modes* are constructed that enable hydrogeologists to work with COMSOL Multiphysics as they are used to from other specialized software for hydrogeological modeling.

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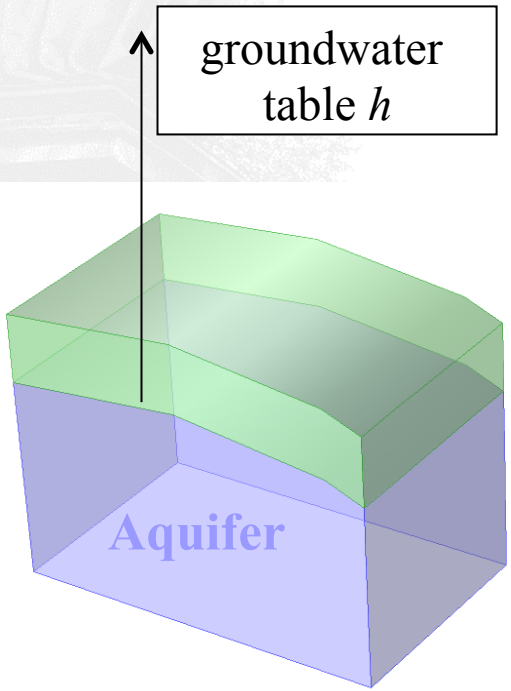
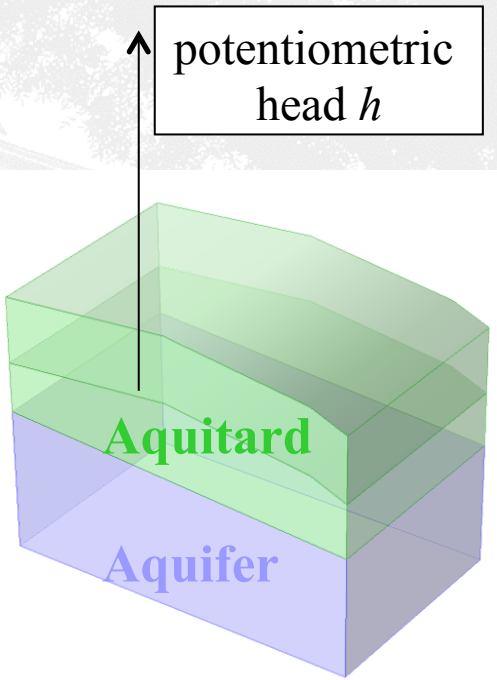
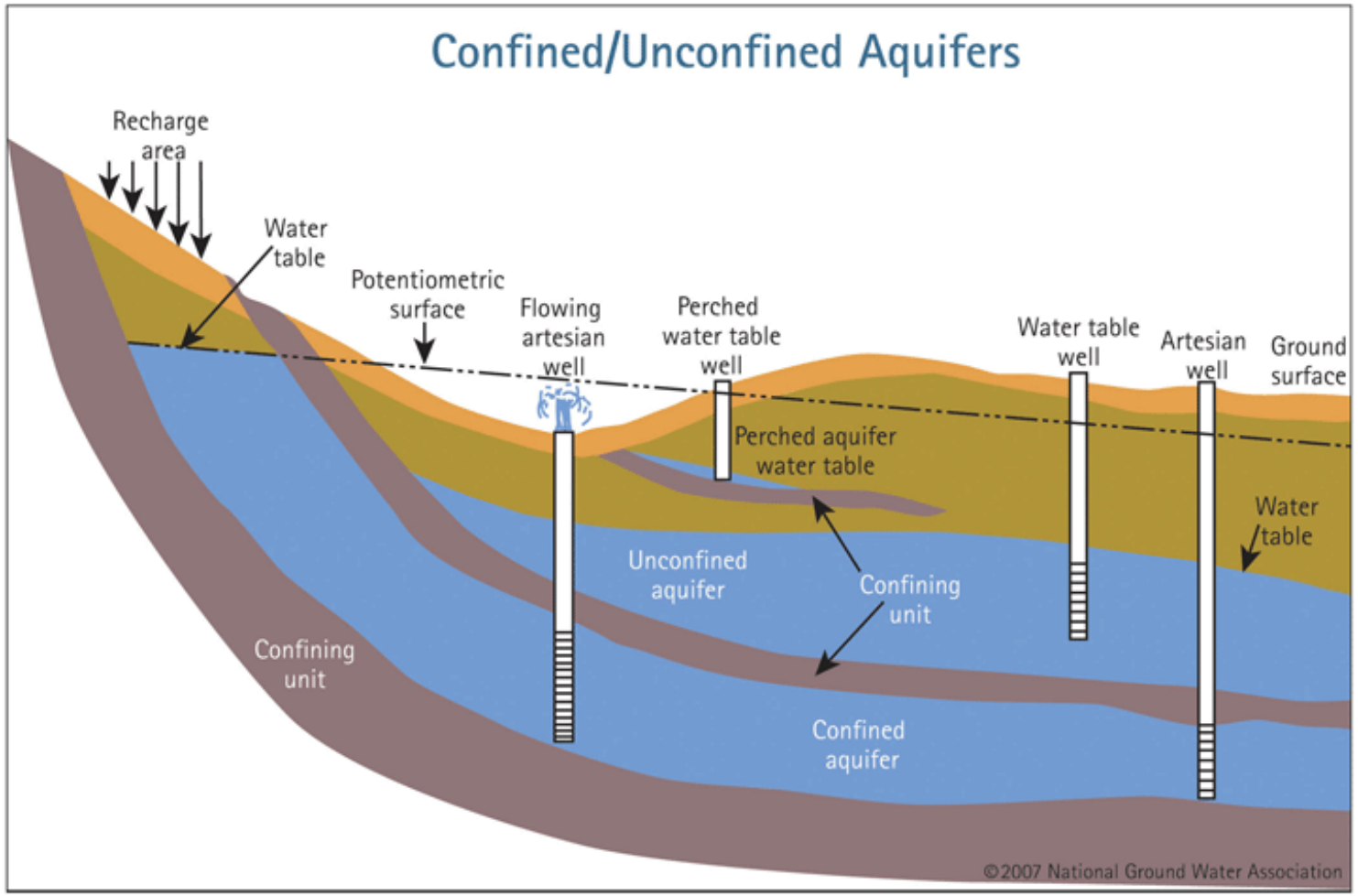
Aquifers & Aquitards





An **aquifer** is an underground layer of water-bearing permeable porous unconsolidated materials

Confined / Unconfined



Differential Equations (1D / 2D)

confaq mode

$$S\frac{\partial h}{\partial t} = \nabla \mathrm{g} KH\nabla h + q$$

unconfaq mode

$$S\frac{\partial h}{\partial t} = \nabla \mathrm{g} Kh\nabla h + q$$

$$\left.\begin{array}{l} \\ \\ \end{array}\right\} \text{for} \begin{cases} \text{confined} \\ \text{unconfined} \end{cases}$$

aq mode

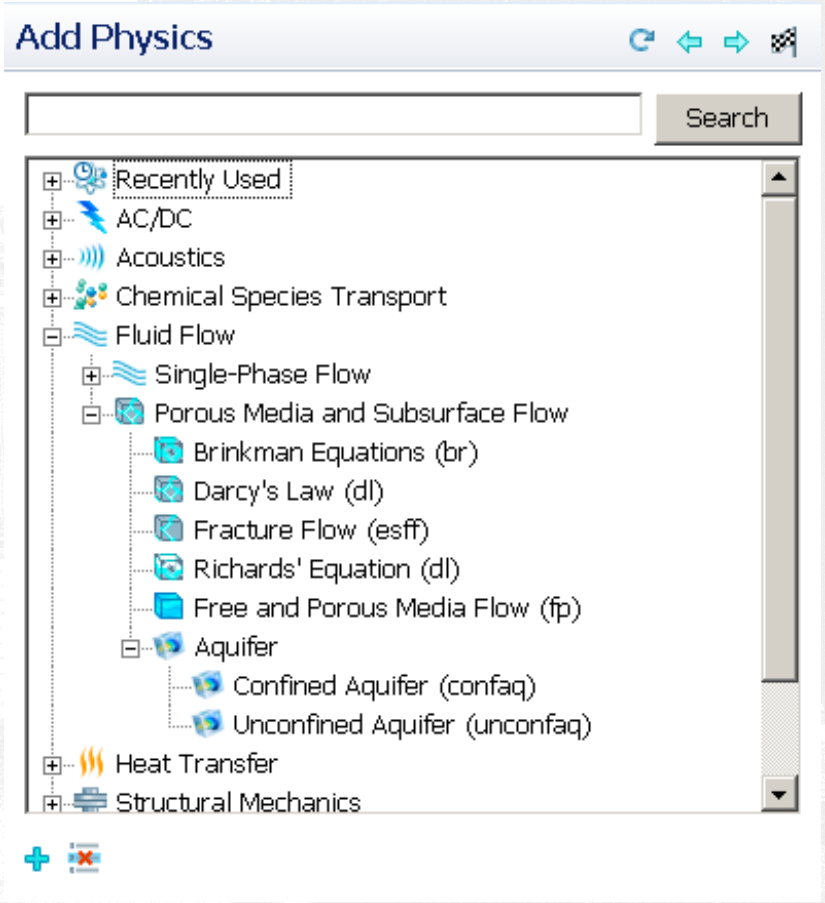
$$S\frac{\partial h}{\partial t} = \nabla \mathrm{g} \nabla \varphi + q$$

with

$$\varphi = \begin{cases} K \cdot H \cdot h \\ \tfrac{1}{2} K \cdot h^2 \end{cases} \text{for} \begin{cases} \text{confined} \\ \text{unconfined} \end{cases}$$

Aquifer Modes

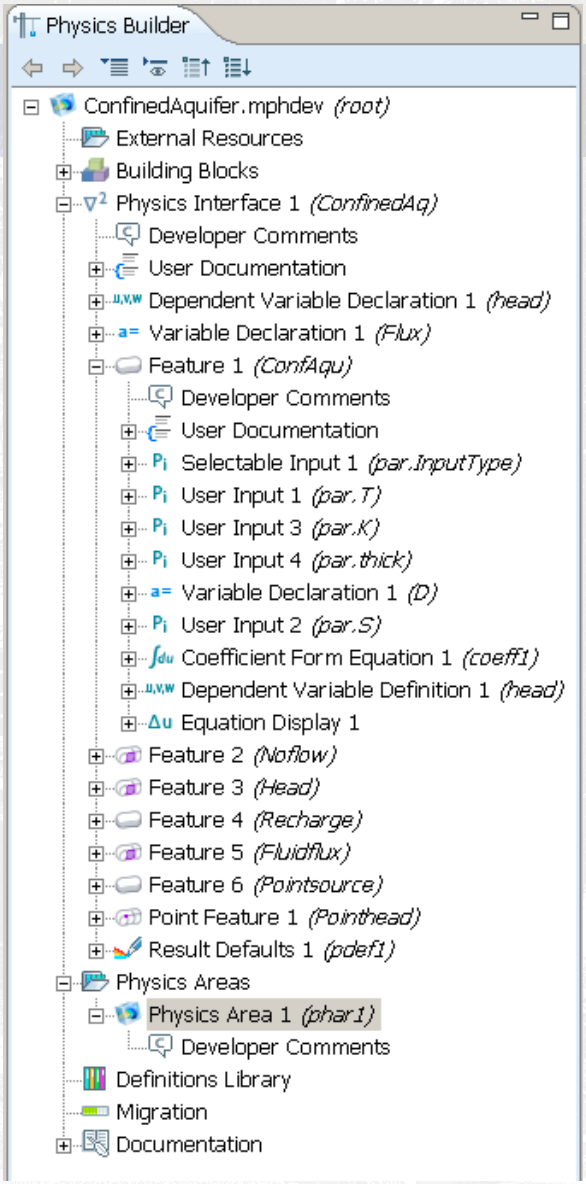
COMSOL Multiphysics offers the option to work with own modes, in addition to the pre-constructed modes, delivered with the software!



COMSOL Physics Builder

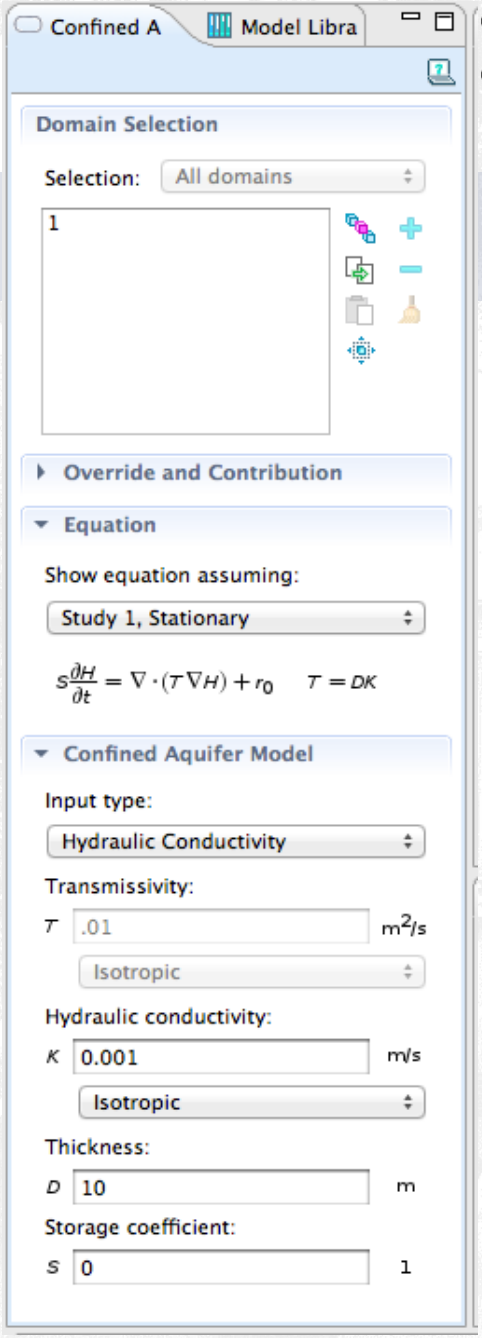
Features determine the way the mode is seen by the user and which options are available.

See Physics Builder tree and six features that have been implemented for the confined aquifer mode



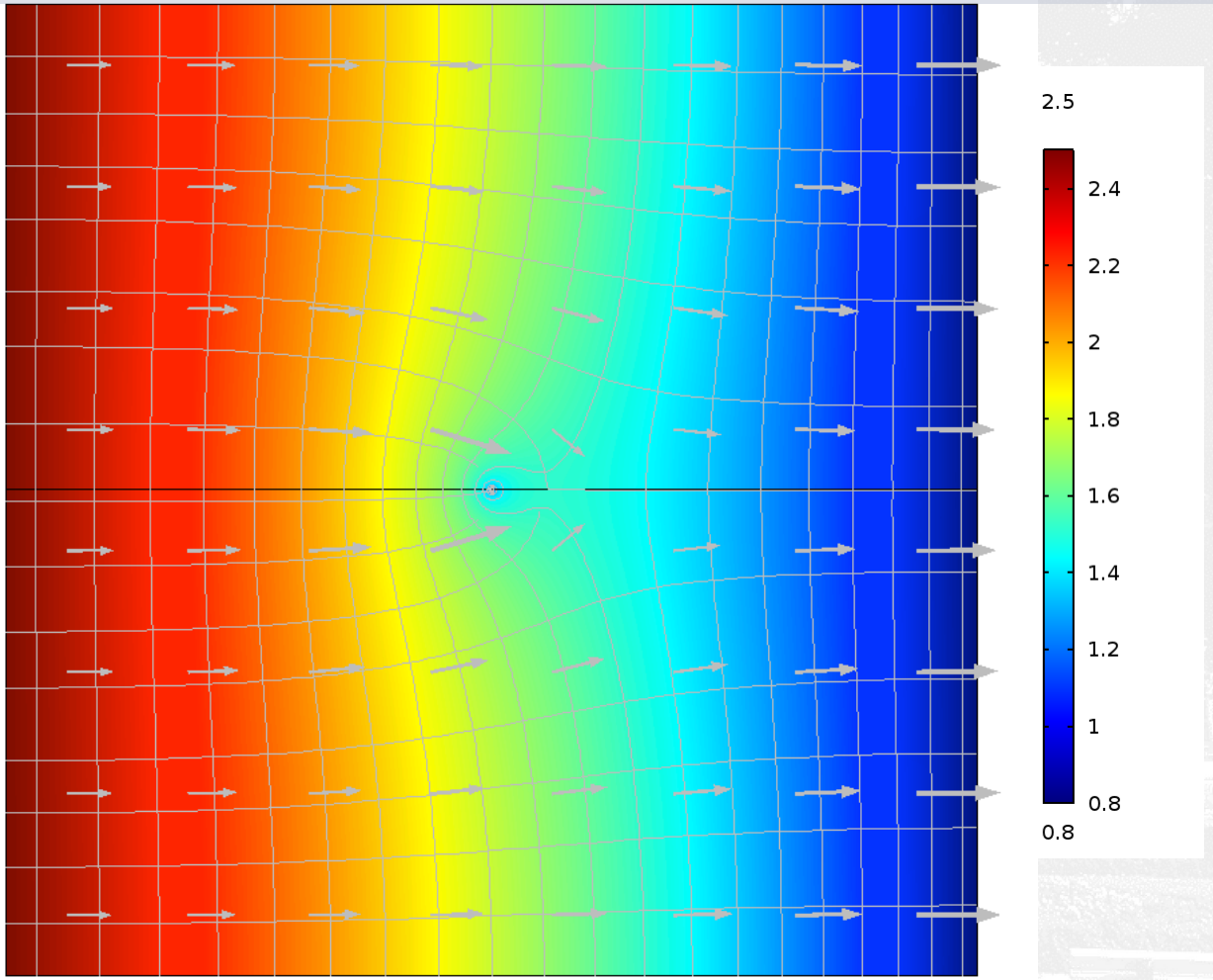
Parameter Input

Example

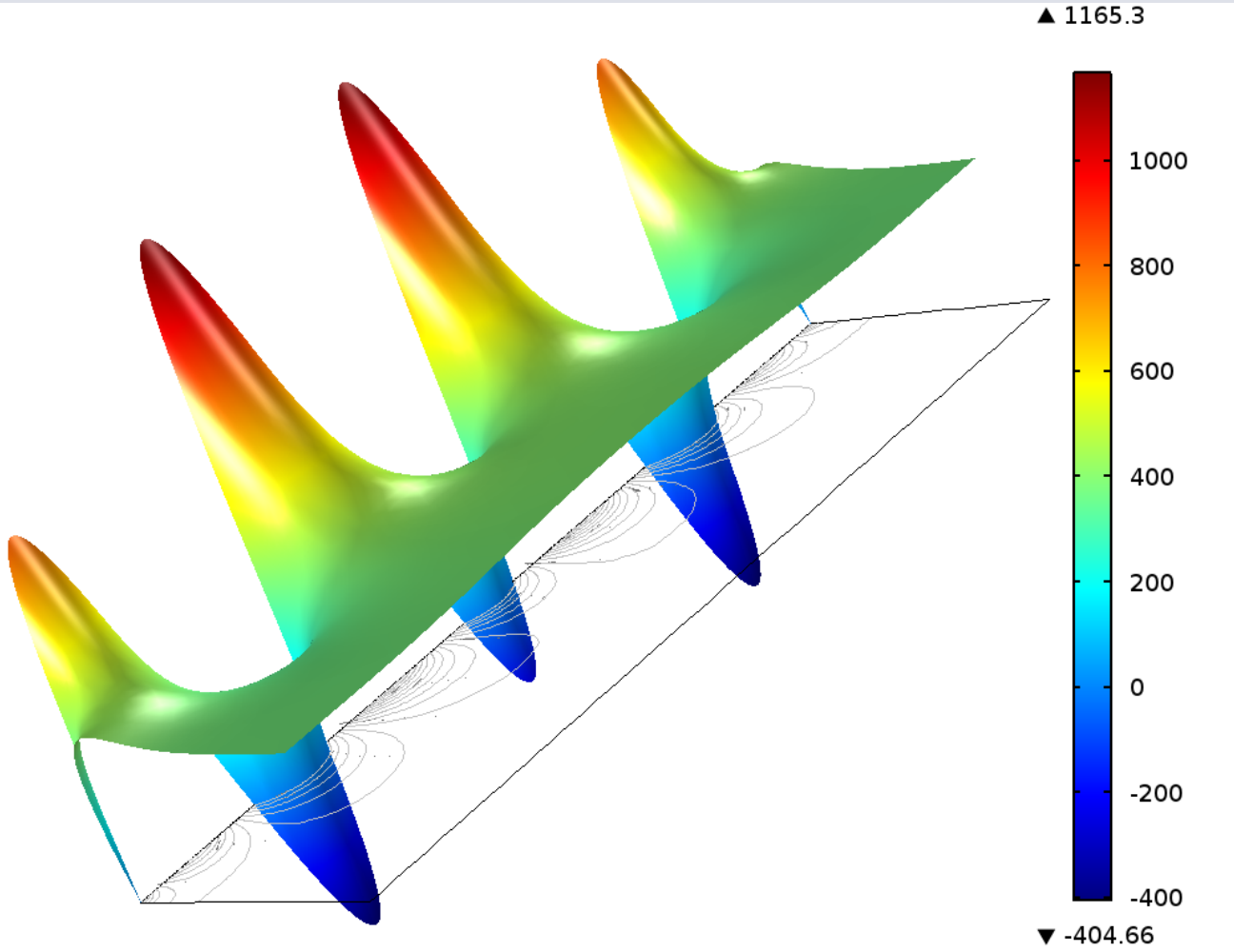


Parameter input for the confined aquifer mode, as seen by the user.

Example 1: Pumping Well in 1D Flow Field



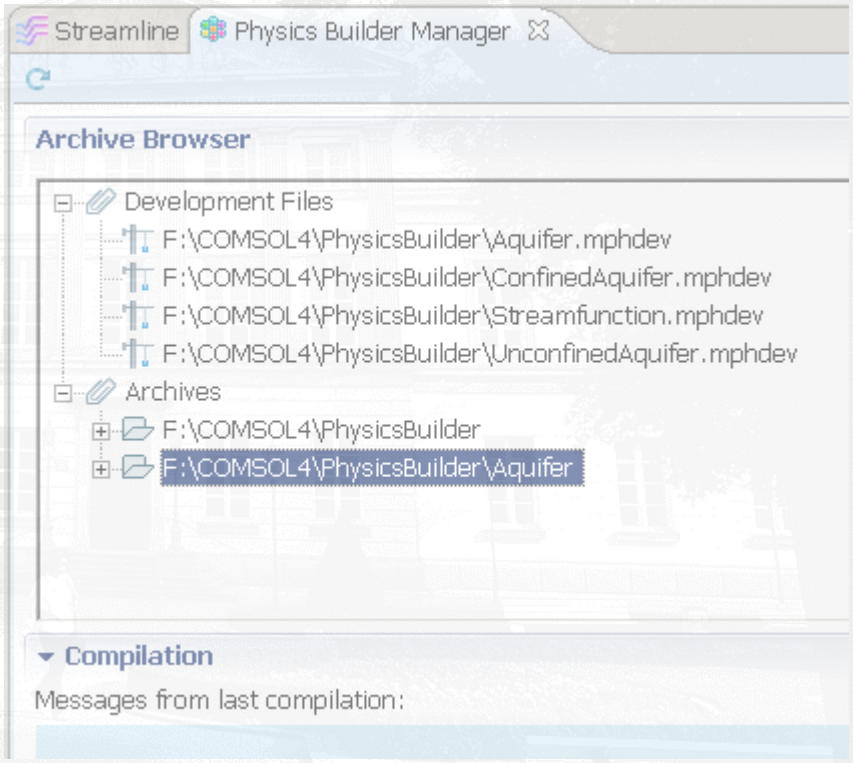
Example 2: Groundwater Flow in Sedimentary Basins



Distribution

New physics modes are stored under the *.mphdev* extension.

Using the *Physics Builder Manager* the modes can be compiled into an archive, which then can be distributed for use to anyone interested.



Availability

see website: *www.geo-sol.de*