TH2 and TH3 parameter sheet – complementary information

(11th May 2015)

This complementary document sums up the decisions made for TH2 and TH3 during the last Paris meeting (9-10 April 2015) and during following discussions.

The present version 1) adds two plots consisting of a post processing of TH2_PM1 and TH3_PM2 results, 2) adds new performance measures for TH3, 3) changes the list of head gradients to be considered for TH3. These points are detailed below:

1. **TH2**: Participants are requested to **post-process** their TH2_PM1 PMs (Performance Measure) (evolution of minimum temperature). The data required for each head gradient case is the threshold time defined as the time for minimum temperature to reach 0°C. These threshold times should be plotted as a function of head gradient values (requested head gradient values are 0%, 3%, 9%, 15% as well as any optional additional one).
2. **TH3**: The **0% head gradient** is discarded from the list of required head gradients for all PM associated with the TH3 case. Instead the **6% head gradient** case is suggested. Participants should finally run 3%, 6%, 9% and 15% for all TH3 performance measures.
3. **TH3**: Participants are requested to **post-process** their TH3_PM1 performance measure consisting of the evolution of the equivalent hydraulic conductivity. The data required for each head gradient case is the threshold time defined as the time for equivalent hydraulic conductivity to get lower than 0.1% of its initial value. This is of course valid for the lower values of head gradient (3%, 6% as well as any optional additional one).
4. **TH3**: A **new performance measure** is introduced for TH3 corresponding to punctual temperature “monitoring” at two points labeled TH3_Pt1 and TH3_Pt2. This was missing in our first proposal and should bring some more discriminating information for the inter-comparison:
    a. Spatial positioning: TH3_Pt1 and TH3_Pt2 are placed on Fig. 1 below representing the upper half of the modelled domain (frame in green) with the boundary limit (in blue) between the 5°C and the -5°C initial conditions. TH3_Pt1 is in consequence in the middle of the total studied domain. TH3_Pt2 is symmetrical to TH3_Pt1 with respect to this former boundary ($d_1 = d_2 =$ 0.0901 m).
    b. Performance measure: TH3_PM4_Pt1 consists of the temperature evolution at point TH3_Pt1, similarly TH3_PM4_Pt2 consists of the temperature evolution at point TH3_Pt2.

c. The head gradients to be considered are the same as the ones for the other TH3 Performance measures: 3%, 6%, 9% and 15%.

5. The **format** requested for the performance measure results is an ascii file with two columns separated by ";" solely. The first column is time in seconds, the second the value of the performance measure in the international system units. Each performance measure should lead to a separate file for each head gradient value. Suggestion for the file names: TH_i_PM_j_GH_k for PM1, PM2, PM3. For PM3, TH_i_PM_j_Pt1_GH_k and TH_i_PM_j_Pt2_GH_k
6. The **mathematical expressions for the performance measures** are provided below when necessary (all notations are from the parameter sheets already provided on the web site):
   a. ***TH2_PM1***: minimum domain temperature in °C.
      i. ***TH2_PM1_Evol*** provides threshold times in seconds as a function of head gradients
   b. ***TH2_PM2***: the total heat flux exiting the system as a function of time. The upper and lower flow boundaries being imposed zero heat flux, PM2 expresses as
      $\int_{Right\ Boundary}\left(\rho_w C_w T U_x - \lambda_{eq}\frac{dT}{dx}\right)dy - \int_{Left\ Boundary}\left(\rho_w C_w T U_x - \lambda_{eq}\frac{dT}{dx}\right)dy$ with *U* being the Darcy velocity $U = K_w \nabla(p+z)$
   c. ***TH2_PM3***: total liquid water volume (m^3)

   d. ***TH3_PM1***: equivalent total hydraulic conductivity (m/s) as a function of time. This equivalent hydraulic conductivity is computed for each time step as the integrated Darcy flux (Q) at the right boundary divided by the imposed head gradient: $K_{eq} = \frac{Q}{\Delta H/_L}$, *Q* itself results from a steady state simulation of flow conducted for each time step considering a permeability field actualized with the temperature field $K(T(t))$and the imposed head conditions.
      i. ***TH3_PM1_Evol*** provides threshold times in seconds as a function of head gradients
   e. ***TH3_PM2***: total heat flux entering the system through upper and lower boundaries (purely conductive)
   f. ***TH3_PM3***: evolution of total heat expressed as
      $\iint (\rho_w C_w \epsilon S_w + \rho_i C_i \epsilon (1 - S_w) + \ \rho_S C_S (1-\epsilon))\ T\ dxdy$
   g. ***TH3_PM4_Pt1*** *and* ***TH2_PM4_Pt2:*** evolution of temperature in °C at point locations TH3_Pt1 and TH3_Pt2 (refer to Fig. 1).

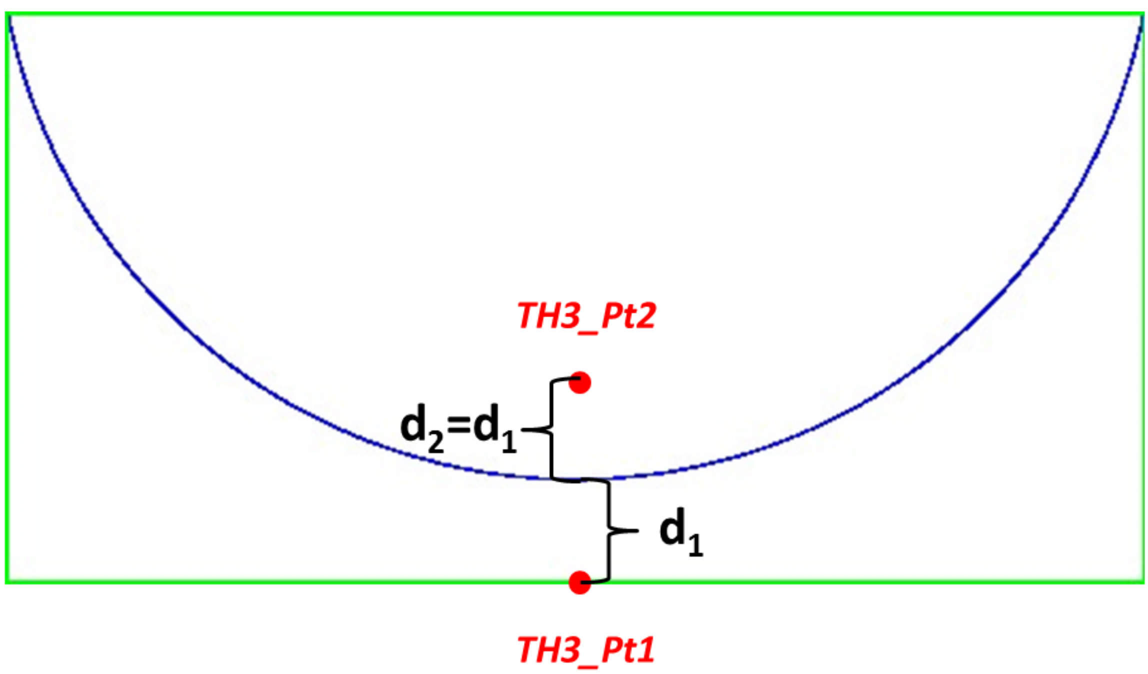

Fig. 1: TH3 case upper half geometry providing point locations of the new performance measures