BENCHMARK TESTS

BATHMANN&AL

1. Simply Synthetics

1.1. **ConcentrationDiffusionOnly.** Some small changes on the project file were necessary, in order to really get the case where the steady state concentration distribution is linear from 1 to 0. Necessary changes were: no storage and no dependency of density on concentration.

1.2. **ConcentrationDiffusionAndStorage.** Some small changes on the project file were necessary, in order to really get the case where the density is constant in space. Necessary changes were: storage into density model, no dependency of density on concentration.

1.3. **DiffusionAndStorageAndAdvection.** As expected the results of the old and the new HC-Process differ in this benchmark. Since the new implementation takes into account density variations which directly lead to variations in darcy velocity and hydrostatic pressure, which where not taken into account previously (See upper row of Figure 7). The pressure in the high concentration domain (left) is slightly increased relative to the domain without component concentration. As a result the Darcy velocity is slightly higher within the boundary region. Accordingly, the concentration front is a bit broader and more components are transported than with the Boussinesq approximation applied.
The reference files have been updated.

1.4. **DiffusionAndStorageAndGravityAndDispersionHalf.** The old benchmark does not work anymore, since the huge differences in concentration led to huge differences in density. Including gravitational force, this leads to non convergent behaviour of the solver, since the system got more compley with non boussinesq approximations. Accordingly a new, similar Benchmark has been added and is showing the behavior which we want to check with this Benchmark.

1.5. **DiffusionAndStorageAndAdvectionAndDispersion.** We see the same effects as in the "DiffusionAndStorageAndAdvection" test scenario. Other differences are not obvious. Accordingly the reference files have been updated.

1.6. **DiffusionAndStorageAndAdvectionAndDecay.** We see the same effects as in the "DiffusionAndStorageAndAdvection" test scenario. Other differences are not obvious. Accordingly the reference files have been updated.

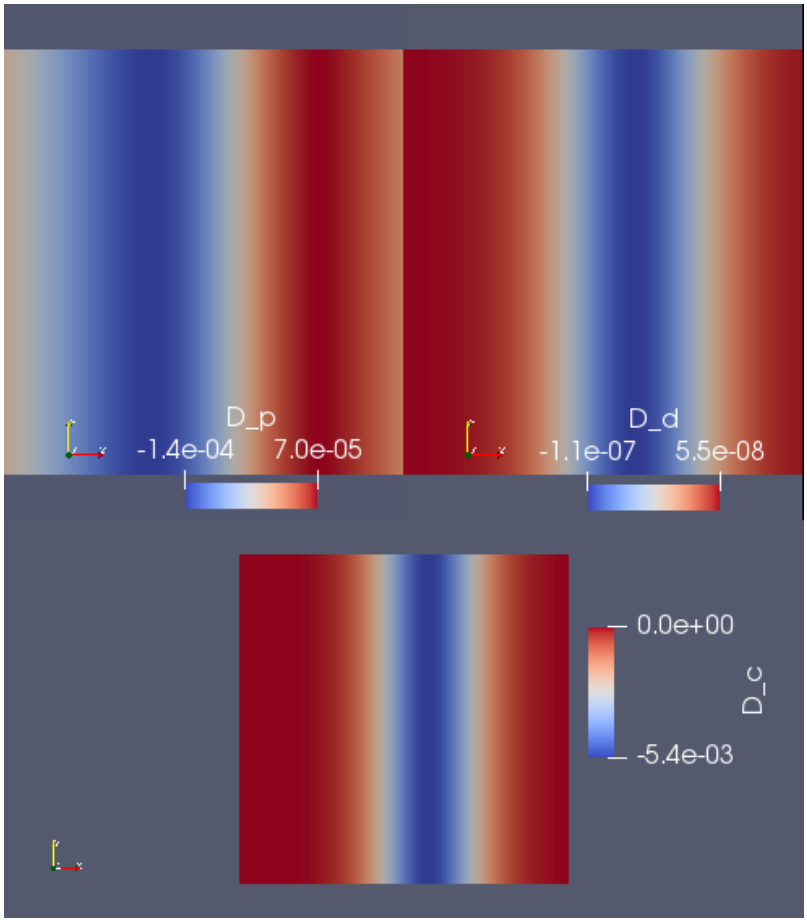

FIGURE 1. Results of DiffusionAndSotrageAndAdvection benchmark. Here, the non boussinesq effects are clearly visible as described within the test.

1.7. **DiffusionAndStorageAndAdvectionAndDispersionHalf.** We see the same effects as in the "DiffusionAndStorageAndAdvection" test scenario. Other differences are not obvious. Accordingly the reference files have been updated.