

Fall School 2018: Numerical Methods in Integrated Hydrosystem Modelling

From the 8th to the 12th of October, the fall school on *Numerical Methods in Integrated Hydrosystem Modelling* took place, gathering not only the new students from the third cohort of RTG 1829 “Integrated Hydrosystem Modelling”, but also senior RTG students, external PhD students and supervisors. The fall school was an intensive week of learning how useful and practical numerical methods are. With a mix of lectures and exercises the participants got an insight to what is behind the scenes of numerical hydrosystem models in a motivating learning environment. The increased awareness for numerical errors helps to differentiate between real model results and artefacts created by numerical schemes.

On the first day, Olaf Cirpka introduced us to the mystery behind Matlab ode-solvers. We got to write some simple, but effective ode-solvers based on the most basic numerical methods for ordinal differential equations such as the explicit and implicit Euler methods. We learned how useful ode-solvers are, and how and when to use them.

The second day was opened with Tobias Weber’s first ever lecture on the topic Richards’ equation. Here, he presented his work on pedo-transfer functions which will be published soon. Later on, Daniel Erdal with his particular survey-based teaching method, explained to us the Finite Volumes method and its application for solving the Richards’ equation. We wrote as well our own one-dimensional vertical unsaturated-zone code in Matlab.

Wednesday was the day of the Finite Element method. Olaf Cirpka derived some of the main principles behind it and pointed out the main differences to the finite volumes method for solving partial differential equations. In the afternoon, a hike in the Black Forest not only was an occasion to see regional geology but also for socializing and exchange among the students.

On Thursday, we put our hands on exercises. Michael Finkel, Emilio Sánchez-Léon and Daniel Erdal presented the 3-D control-volume finite element groundwater model HydroGeoSphere which together with the complementary AlgoMesh (mesh generator software) and Tecplot (visualization and analysis software) are important parts of integrated hydrosystem models in the CAMPOS project and for some of the projects of the new RTG cohort.

Friday was the day of the PhD students. The new RTG students and some of the external researchers presented their current or past work and gave an overview what their projects are all about. Even though most of us have just started, it is clear how motivated all are to start and succeed with their projects.



Participants and lecturers of the fall school 2018 during a hike in the Black Forest around Freudenstadt.

Program

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| October 8 | Solving Ordinary Differential Equations: <i>What the hell do the Matlab ode-solvers do for you?</i> | <i>Olaf Cirpka</i> |
| October 9 | Solving the Richards Equation by Finite Volumes: <i>Unveiling the secrets of unsaturated-flow modelling</i> | <i>Daniel Erdal, Tobias Weber</i> |
| October 10 | The Finite Element Method for Flow and Transport: <i>Ooh, triangles!</i> Afternoon Hike | <i>Olaf Cirpka</i> |
| October 11 | The Joy of Using HydroGeoSphere: <i>Hands-on Exercises</i> | <i>Daniel Erdal, Michael Finkel, Emilio Sánchez</i> |
| October 12 | The Fascination of Doctoral Research: <i>Presentations by the students</i> | |