High Performance Computing of Coupling 2D and 3D Numerical Modelling of Flood Propagation and its High Performance Interface and Visualisation

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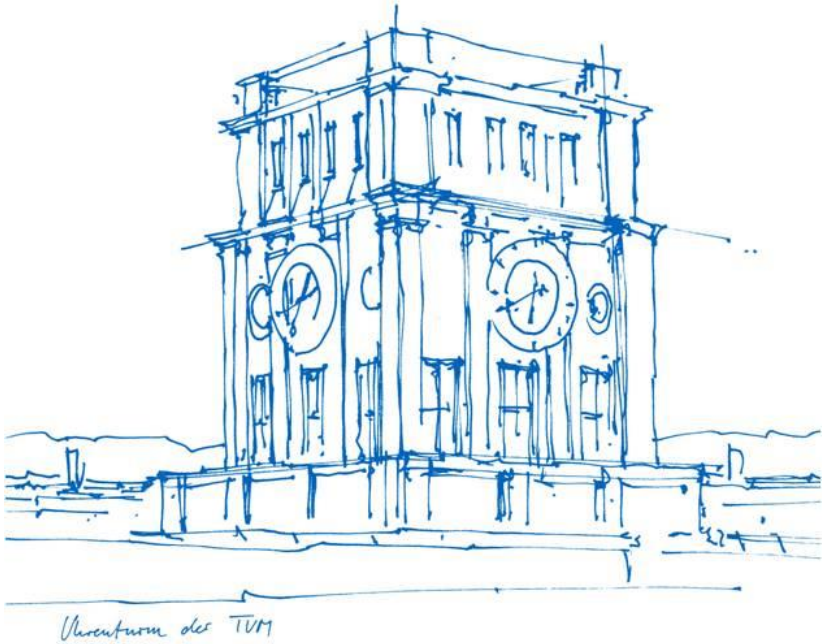
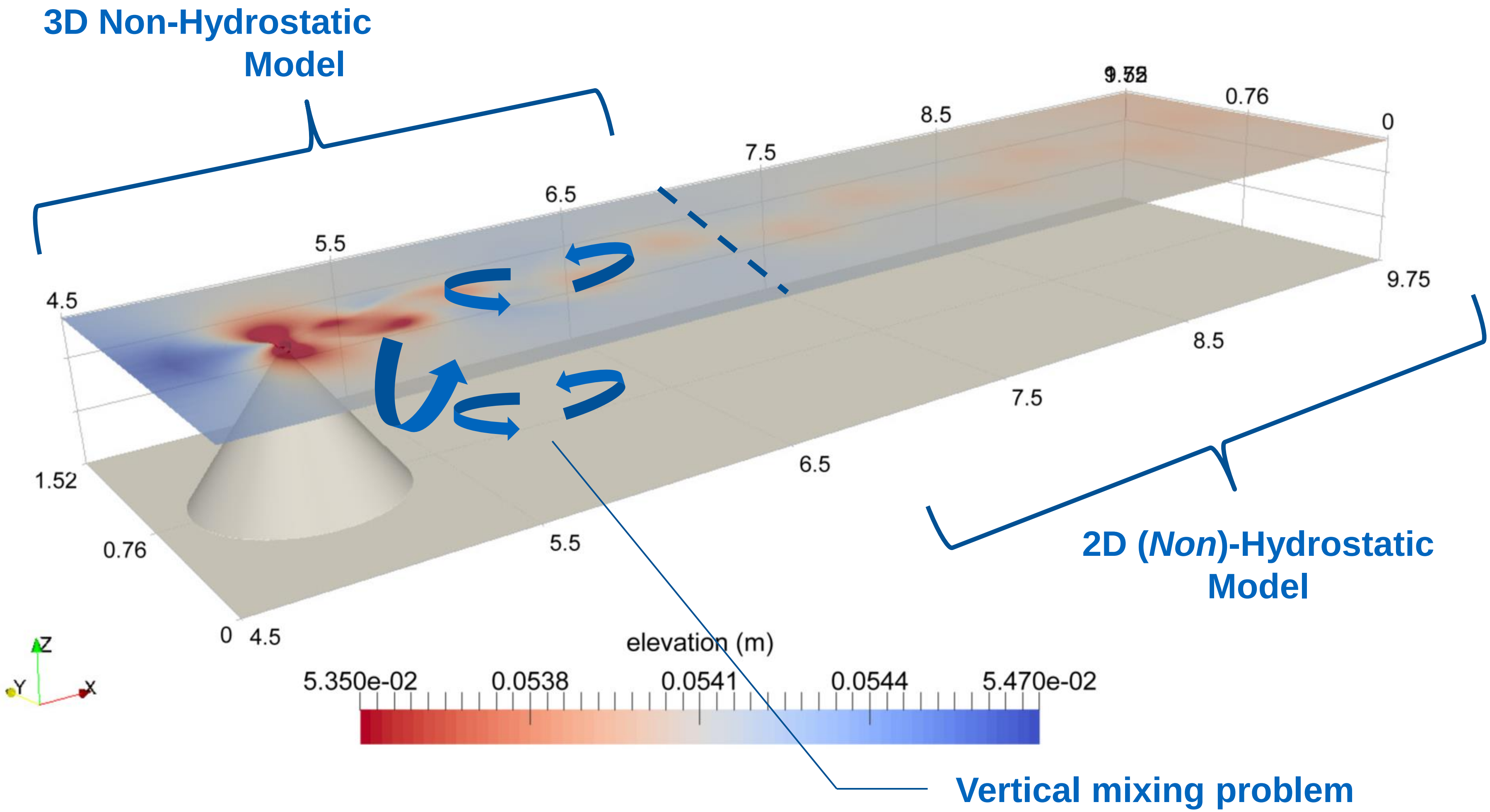
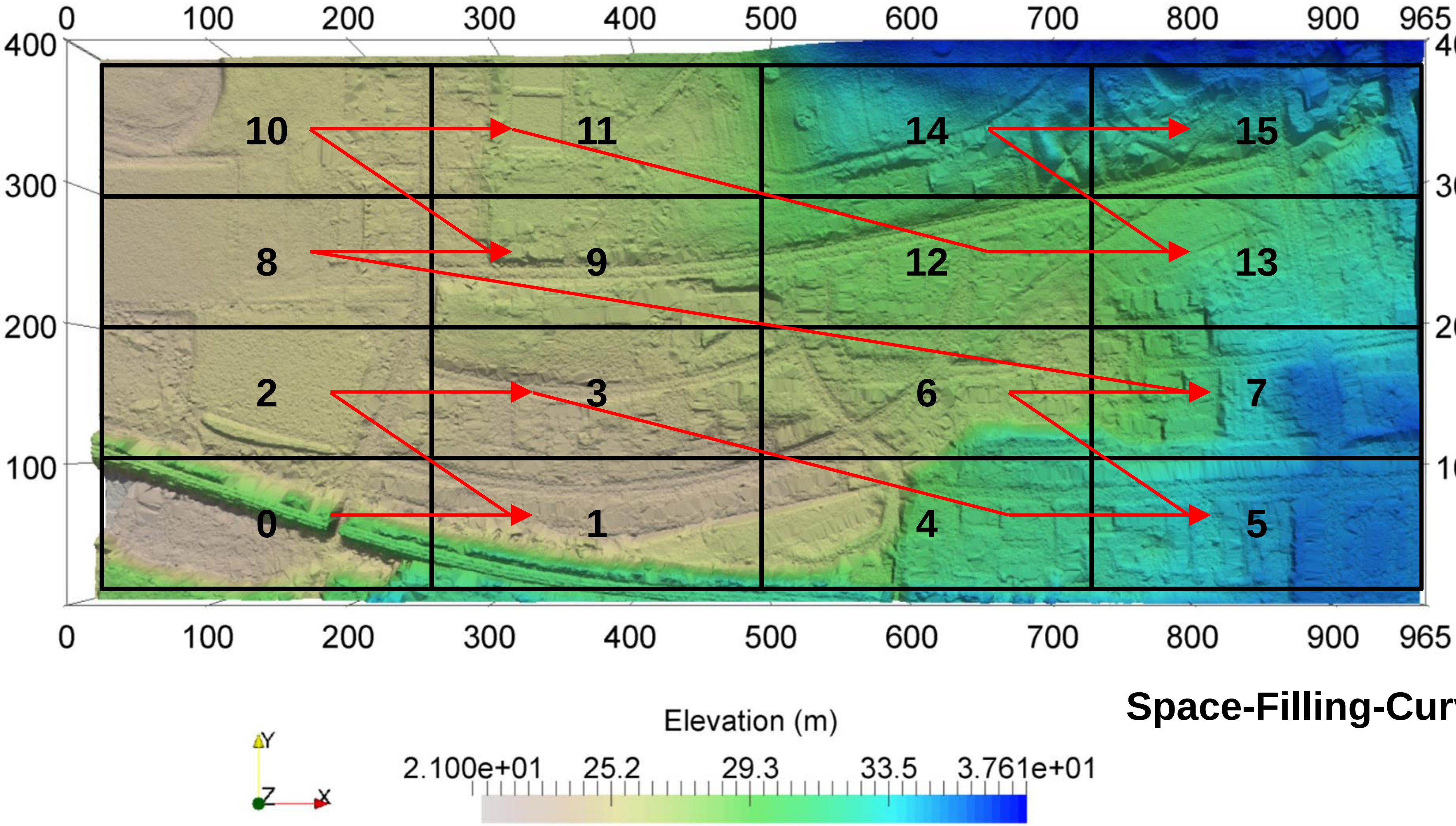


International HPC Summer School 2018

Illustration: example of 2D & 3D flow problems



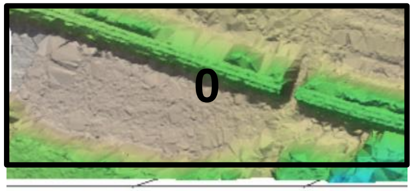
Domain decomposition: between nodes – MPI



Space-Filling-Curve

* (High resolution) real topography in Glasgow, UK

Domain decomposition: inside a node – OpenMP



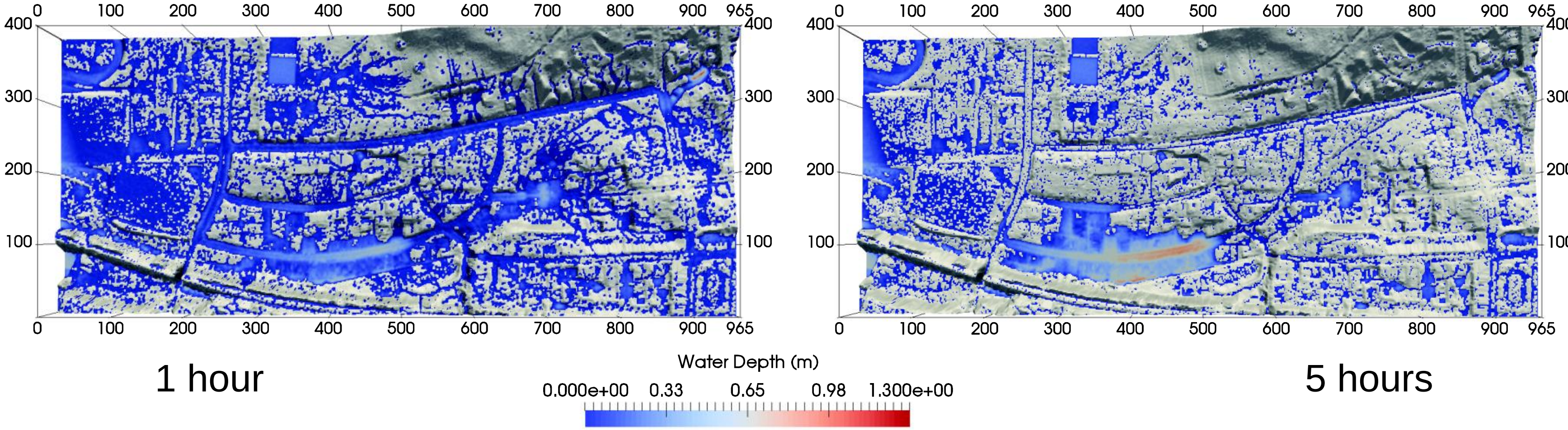
- A cell-edge reordering strategy is proposed
  - Helping ease the compiler to exploit the instruction pipelining and parallelisation

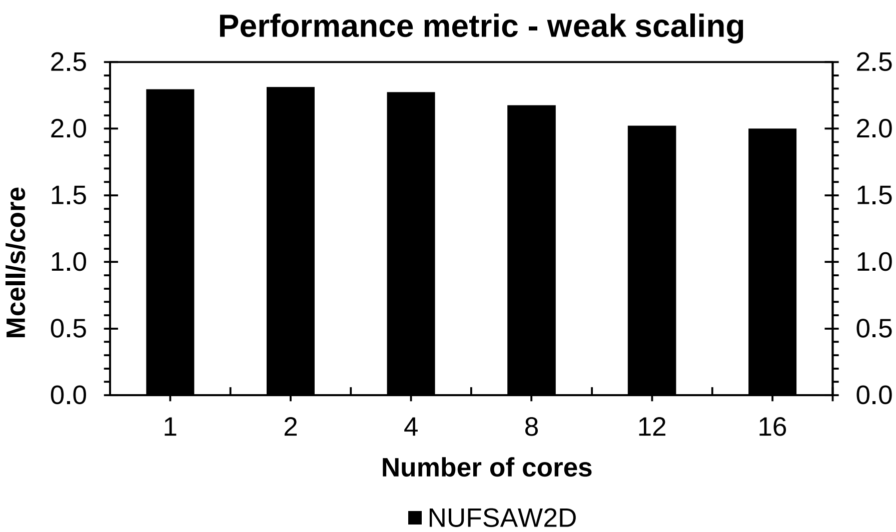
Ginting et al. (2018)[2] – *accepted*

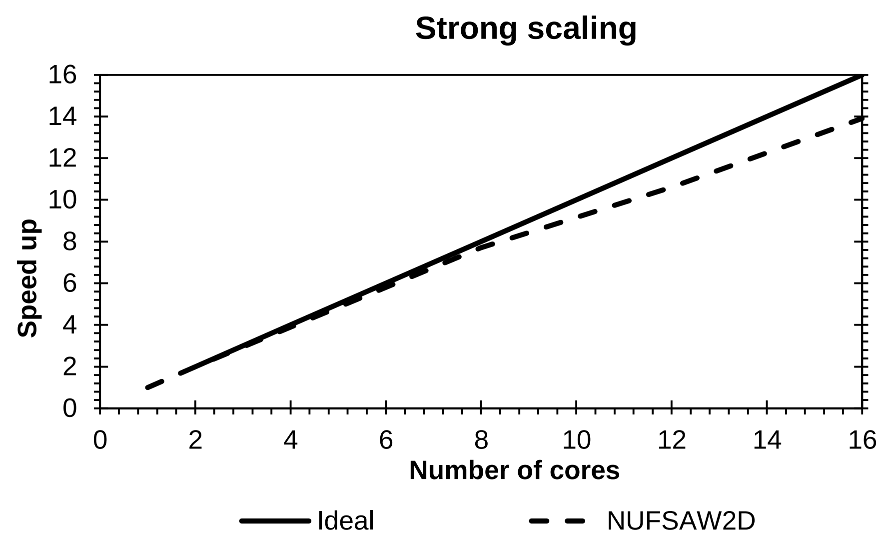
- A weighted dynamic load balancing due to wet-dry problems is proposed

Ginting & Mundani (2018)[1] – under review

Results







up to 3.6 million cells or 7.2 million edges

My in-house code
"NUFSAW2D"

My in-house code
"NUFSAW3D"
in progress

Numerical
sim**U**lation of
Free surface
Sh
Allow
Water

- written in Fortran
- cell-centred finite volume method
  - 2nd order spatial MUSCL method
  - Roe, HLLC, central-upwind, and artificial viscosity schemes
  - turbulence model depth-averaged κ – ε & algebraic stress models
- 1st Euler time stepping or 2nd, 3rd, 4th order Runge-Kutta scheme
- hybrid parallelisation technique: OpenMP + MPI

References

1. B.M. Ginting, R.-P. Mundani, Parallel Flood Simulations for Wet-Dry Problems Using Dynamic Load Balancing Concept, 2018. *submitted* to Journal of Computing in Civil Engineering.
2. B.M. Ginting, R.-P. Mundani, E. Rank, Parallel Simulations of Shallow Water Solvers for Modelling Overland Flows, 2018. *accepted* in 13th International Conferences on Hydroinformatics.
3. B.M. Ginting, R.-P. Mundani, Artificial Viscosity Technique: A Riemann-solver-free method for 2D Urban Flood Modelling on Complex Topography, 2018. in: Advances in Hydroinformatics, Springer Water. https://doi.org/10.1007/978-981-10-7218-5_4
4. B.M. Ginting, A Two-dimensional Artificial Viscosity Technique for Modelling Discontinuity in Shallow Water Flows, 2017. Applied Mathematical Modelling. http://dx.doi.org/10.1016/j.apm.2017.01.013