Gravimetry for monitoring water movements: the Classical Karst as a natural laboratory

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Motivation/Objectives

1) The Classical Karst area

- Reka river sinks in the Škocjan caves, flows underground and emerges at Timavo springs (fig. 1).
- In Škocjan area the water paths are shallow and well known.
- Downstream the water dynamics become more unclear.
- We focus on the Škocjan area to test the sensitivity of the gravity method because here the geometry of the cave is well known and the water level variations due to flood events are continuously monitored [3].

2) Škocjan cave: a) Hydrology

- SWMM [5] is a software that models the unsteady flow in conduits and pipes by numerically solving the Saint-Venant equations.
- We used the SWMM software to produce a 4D hydraulic model of the water variations inside the cave.
- We simulate the karst system of the Škocjan caves with 4 conduits (fig. 5).
- We injected the water hydrograph at the node J4. The input is the discharge timeseries from Cerkvenik Mlin.

3) Gravity variations due to floods

- We calculated the gravity variations discretising the 4D simulated water variations with prisms.
- We estimated the effect for the considered events in two locations: one above the Martelova Dvorana and the other in the info center (fig. 2).

4) Conclusions/perspectives

- Simulations showed that gravimetry could be useful to track water movements in the Classical Karst area.
- The Škocjan cave could be an interesting test site to verify the sensitivity of the method. The biggest events should be recorded also in the info center that is about 250m far from the caves.
- Additional effects not yet modelled should be considered when a continuous gravity meter is placed in the Classical Karst area, in particular:
  1. Tectonic movements that deform the Karst plateau
  2. Newtonian and loading effects due to the Marine Tides of the Adriatic sea

References and Acknowledgments