Introduction
Hydrology
- Concept of connectivity has gained popularity
- Clear agreement exists on its definition & quantification

Neuro-Sciences
- Clear conceptualization of connectivity
- Clear approaches to quantify connectivity

Case Study
- 20 ha experimental catchment, Pre-Alps, Switzerland
- Steep terrain (average slope 35%)
- Low-permeability soils (Gleysol)
- 2200 mm precipitation, recurrent rainstorms
- 34 groundwater and 1 streamflow time series
- 5 min time interval (August 2013 to May 2014)

Conductivity
- Structural: Functional micro connectivity, in hydraulic and brain neurosciences
- Functional: Long-distance connectivity, in hydraulic and brain neurosciences

Rationale and Objectives
- Similarities in the terminology of connectivity in hydrology and the brain neurosciences (Figure 1).
- Idea: Connectivity measures used in brain neurosciences can potentially capture properties of hydrologic connectivity (Table 2).

1) Application of brain connectivity measures in hydrology
2) Feasibility study and recommendations for future research

Functional & Effective Connectivity
- Influence map quantifying spatial connectivity. Cell value expresses the percentage of flow from a source pixel (red) to a downstream pixel using a multi-flow direction routing algorithm.

Structural Connectivity
- Point-to-point and point-to-stream connectivity can then be explored for structural connectivity metrics

Conclusions
- The application of brain connectivity measures in hydrology is promising when constrained by structural connectivity measures.
- Not one “best” connectivity measure but individual measures capture different characteristics of hydrological connectivity.
- Some point-to-point connections were functionally or effectively connected despite the absence of a structural connection.
- Challenge to transfer connectivity thresholds from the neuroscience to hydrology (1) connectivity values drawn with thin lines are constrained to connect to a point, (2) thickness indicates the strength of connectivity, (3) not all streams connected, (4) stream network differs, (5) not all links (or connections) are the same (Table 2).

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Brain Connectivity Measures
- Table 3. Theoretical study of brain connectivity measures to capture specific properties of the hydrologic system. Hydrologic connectivity: "the specific property can be captured by the specific variable or system variable". Connectivity refers to the property of the system which is defined using hydrologic connectivity (Table 2).

Figure 1: Overview of connectivity concepts in hydrology and the brain neurosciences.

Figure 2: Structural connectivity for point-to-stream connectivity. Cell value expresses the percentage of flow from a source pixel (red) to a downstream pixel using a multi-flow direction routing algorithm.

Figure 3: Functional effective connectivity for a point to a point and for a point to a stream. Effective connectivity is the total connectivity flow from the source point (red) to the target point (cyan). Effective connectivity of structural connectivity (no flow path) is illustrated for a kinematic flow direction routing algorithm.

Figure 4: Structural connectivity for point to point. Cell value expresses the percentage of flow from a source pixel (red) to a downstream pixel using a multi-flow direction routing algorithm.