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A method for mapping topsoil field-saturated hydraulic conductivity $K_{fs}$ in the Cévennes-Vivarais region using infiltration tests conducted with different techniques

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1. CONTEXT AND OBJECTIVES

Context:
Flash floods are natural hazards that affect the Mediterranean region. They are caused by intense rainfall events but catchment characteristics, and particularly topsoil field-saturated hydraulic conductivity $K_{fs}$, are also influential on the hydrological response. For distributed hydrological models, maps of $K_{fs}$ are useful, as $K_{fs}$ impacts Hortonian runoff, but they are difficult to obtain from point measurements.

Objectives:
- Propose a method to map $K_{fs}$ from GIS data with application to the Cévennes-Vivarais region where infiltration measurements obtained with different methods were available (Fig. 1).
- Propose a method to pool available infiltration measurements obtained with various techniques in the region for regionalization.

2. STUDY AREA AND DATA

Study catchment and available data (Fig. 1 and 2):
- Infiltration measurements performed using
  - Guelph permeameter (GP) and Double Ring infiltration devices (DR) between 2002 and 2008 in the Gardon and Avène catchments
  - Single Ring (SR) infiltration measurements in the Claudiène catchment (2012) and Yzeron catchment (2008, blue rectangle in Fig. 1)
  - Tension Disk Infiltrometers (TI)

A two steps method for pooling $K_{fs}$ data from various methods:
- Pooling of GP and DR data by geology * land use (Desprats et al., 2010, Fig. 4) and conversion of GP data to equivalent DR data
- Pooling SR and DR + TI data (Fig. 5) to get a final set of homogenized equivalent DR + TI data set

3. POOLING INFILTRATION MEASUREMENTS

- Raw data show significant difference in distribution among methods (Fig. 3) so pooling the data requires specific treatments

4. METHODS

5. MAPPING TOPSOIL $K_{fs}$

Mapping method:
- Field data analysis show that geology and land use are significant explaining factors of $K_{fs}$ and one value is assigned by geology * land use class (Fig. 6).
- Geology and land use were used to produce a map of $K_{fs}$ (Fig. 7a) that is compared to a map derived from Rawls and Brakensiek (1985, RB85) pedotransfer function (Fig. 7b) based on a pedology map with associated soil data base including information about soil texture.

Comparison of maps:
- A pattern more governed by land use resolution (30 m) for Fig. 7a and more related to the pedology map for Fig. 7b.
- Lower range and lower absolute values with RB85 pedotransfer function.
- RB85 values not representative of field in situ measurements (Braud et al., 2017).

6. CONCLUSIONS AND PERSPECTIVES

- A method was proposed to pool infiltration measurements of $K_{fs}$ obtained with different techniques.
- Geology and land use were found to be discriminant factors explaining the variability of $K_{fs}$.
- Geology and land use can be used to map $K_{fs}$.
- Perspective: use the map in a distributed hydrological model to assess if flash flood simulation is improved as compared to the use of pedotransfer functions.

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References: