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Compared hydrodynamic behaviour in sedimentary and crystalline sahelian contexts at the point, parcel and small catchment scales

Moussa Malam Abdou (1,2), Jean-Pierre Vandervaere (1), Ibrahim Bouzou Moussa (2), Oumarou Faran Maiga (2), and Luc Descroix (1)

(1) UJF-Grenoble 1 /CNRS / G-INP / IRD, LTHE UMR 5564, Grenoble, F-38041, France, (2) Dept. de géographie, Université Abdou Moumouni de Niamey, BP 418 Niamey , Niger

A runoff increase has been observed in the Sahel since the beginning of the Drought in the last 1960s (Albergel 1987; Mahe et al. 2003; Mahé et al. 2005; Mahé et Paturel 2009). It impacts differently the two main geological substracts as it is shown in the south West Niger, probably due to different hydrodynamical processes. A rise in the number and volume of ponds is observed in endorheic, mostly sedimentary terrains, leading to a groundwater level increase (Leblanc et al., 2008). On the other hand, flooding and inundations are increasing in exorheic, crystalline, areas (Amogu et al., 2010; Descroix et al., 2012).
Thus, geological context potentially have a great impact on water balances at the regional scale. Can these regional trends be supported by local observations?
In the West African Sahel, studies carried out at the experimental plots scale showed that the superficial hydrodynamics is mostly controlled by soil surface features (Casenave and Valentin, 1992). Only few studies focused on the impact of the geological context on hydrological processes, including the lithology and its possible consequences onto soil surface features proportions. However, knowledge of these patterns distribution should lead to improve the basins hydrological behaviour understanding.
The main purpose of this study is to characterize the soil surface features and hydrodynamical functioning at the point, the plot and the catchment scales in both crystalline and sedimentary areas.
Our observations allowed differentiating the processes according to the scale: i) at the point scale: values of hydraulic conductivity (Ks) were similar for a given surface feature in both sedimentary and crystalline terrains; ii) at the plot scale: runoff coefficients were similar from one domain to another for a given class of soil surface feature, except for cultivated plots where they were significantly different; iii) at the catchment scale: runoff coefficients were higher on crystalline basement.

A few points are to be highlighted: i) runoff coefficients were different in basement than those observed in sedimentary terrain, due to agricultural practices; ii) runoff was higher on crystalline basement due to both the extension of outcropping few altered granite and “gravel-crusts” features, on the one hand, and little infiltration in the gullies, on the other hand.
This was consistent with previous foundings on basement by Descloitres et al. (2003) who observed a low infiltration under the gullies.
Finally, this work could constitute a first attempt of regionalisation of the soil water holding capacity in the Sahel.