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HYDROCLIMATIC MONITORING IN CHRONIC HUMANITARIAN CRISIS AREA - SOUTHWESTERN MADAGASCAR

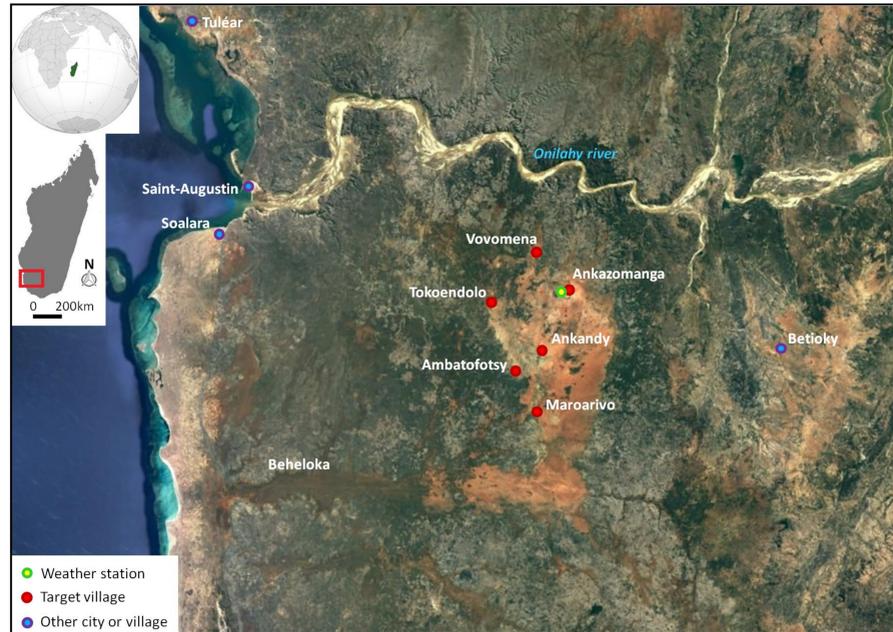
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BACKGROUND

Southwestern Madagascar is a semi-arid region and a hot-spot of global change (which encompasses climate change, land use change, the alteration of the water cycle and of biogeochemical cycles, and biodiversity loss). Since 2016, El Niño conditions have resulted in **reduced rainfall**. Widespread charcoal production increases deforestation, which in turn and combined with overgrazing, amplifies the desertification process. **Groundwater, the only source of water supply, is difficult to exploit** due to a complex hydrogeological environment. Numerous water points in the area are not perennial, and the population lives with **almost permanent water stress**. In the dry season, the humanitarian situation becomes critical and limited access to water results in extremely poor hygiene practices and very high pressure on functioning water points. Fifty percent of the population of southern Madagascar (850,000 people) required humanitarian assistance in 2016.



OBJECTIVES

Action Against Hunger (AAH) and the University of Avignon have established, in collaboration with Malagasy institutions and universities, a **hydroclimatic observatory** in a remote area in the southern part of Madagascar. This observatory, operational since 2014, includes 6 piezometers and 1 weather station on the Mahafaly Plateau. The purpose of this observatory is to **identify potential relationships**

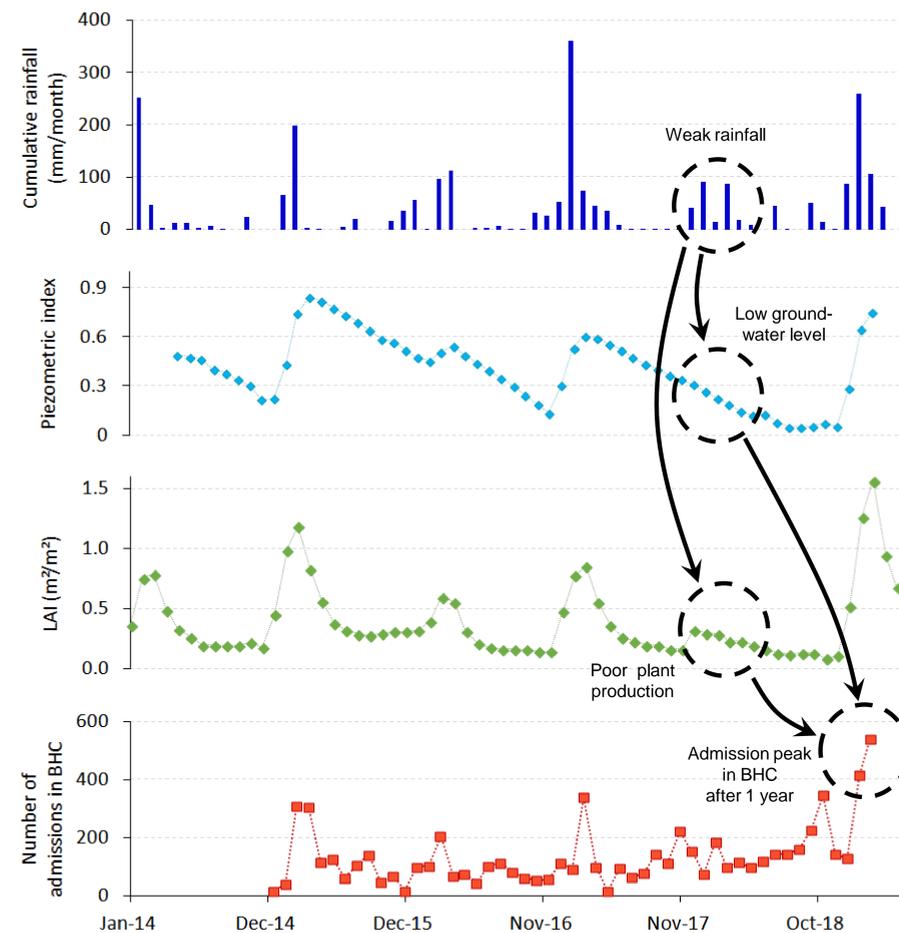
between climate change, groundwater variations, water use, plant production and humanitarian health and nutrition indicators. A better understanding of the relationship between these parameters will lead to a better understanding of the origin of humanitarian crises.



METHODOLOGY

We assessed the humanitarian situation by comparing patterns between monthly rainfall and groundwater data (piezometric index) calculated with the results of AAH hydroclimatic observatory, agricultural production (leaf area index) from remote sensing data, and health data (monthly admissions to basic health centers (BHCs)) provided by the Malagasy Ministry of Health.

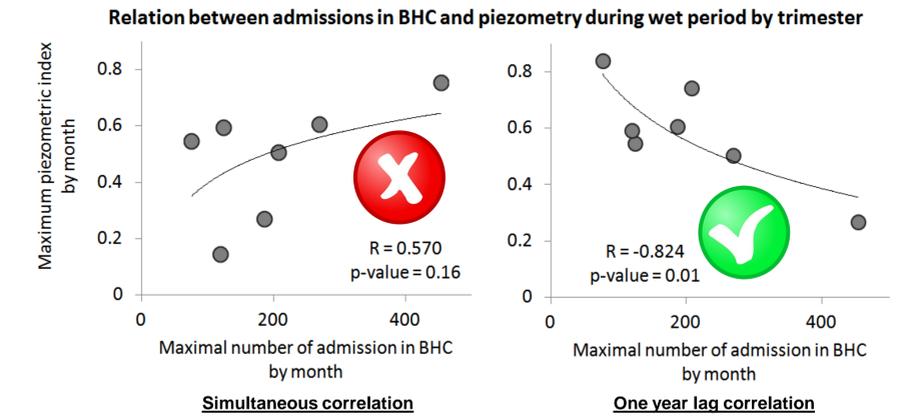
RESULTS



Five years of observatory data allowed a better understanding of aquifer recharge conditions. Preliminary results highlighted: a) a **strong inter-annual heterogeneity** of aquifer recharge. We notice that some years like 2014-2015, aquifers are well recharged while some years like 2017-2018 there is almost no recharge; b) the recharge process is strongly influenced by rainfall pattern. Consequently, there is a high **dependency of groundwater recharge on extreme weather events** (i.e. cyclones and tropical storms); and c) a **relationship between the hydroclimatic monitoring and key humanitarian indicators** (i.e. admissions to health centers). Indeed, rain has a strong impact on piezometry and crop production. These last parameters are decisive for access to water and food with direct repercussions on the health of populations.

When we look at the temporal graphs (left), a first quick analysis could lead us to believe that increased precipitation is associated with a higher number of health center admissions, which isn't very logical in a semi-arid context.

Instead, the correlograms (below) indicate that the **peaks in health center admissions are related to the hydroclimatic conditions of the previous year: the severity of the drought period** (low piezometric index) is linked to peaks in health center admissions during the following lean season.



LIMITATIONS

The results of this study were obtained over a limited geographic area. The AAH observation network has been extended to other areas of southern Madagascar. These future results will lead to more robust statistical analyzes.

In addition, reasons for health center admissions have not been analyzed. Future analyses will include reasons for admission, and hopefully allow to associate environmental trends with specific health conditions such as diarrheal disease and undernutrition.

LESSONS LEARNED

The consequences of a poor rainy season (2018) on groundwater levels and plant production are immediate. However, the **consequences on the humanitarian situation occur 9 months to 1 year later**. National governments, local institutions and NGOs should take this result into account in order to **better anticipate and adapt their responses to humanitarian crises**.

