Spatial econometrics and spatial clustering to explore the conflict potential of water in the Lake Chad Basin

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The role of water resources in conflict is a popular but scientifically controversial and debated issue (Barnaby 2009; Dell'Angelo, D'Odorico, and Rulli 2018; Kallis and Zografos 2014; Katz 2011; Selby and Hoffmann 2014). Exploring the connections between water and conflict in a robust manner poses many constraints and thus often results in high uncertainty (Dell'Angelo et al. 2018). However, interest has been rising on the importance of water resources in intra-state conflicts (Mach et al. 2019; Rodríguez-Labajos and Martínez-Alier 2015), as rebel groups allegedly take advantage of environmental stress especially in settings that are highly dependent on agriculture (Nett and Rüttinger 2016; von Uexkull and Buhaug 2021).

The Lake Chad Basin is one of these settings, where unequal water availability impacts the people's livelihoods exacerbating ethnical rivalries. Non-state armed groups in the region are suspected to profit from this to extend their radius of action. We address these claims for this region, in the period from 2000 to 2015. Starting from WATNEEDS (Chiarelli et al. 2020), a physically based, spatially distributed, dynamic, crop-specific agro-hydrological model at a monthly time scale and 5 arc minutes spatial resolution, we obtain high-quality blue water and green water availability maps. These are combined with data on human water demand and population density to build different water availability and water scarcity indicators, each representative of a different type of socio-hydrological interaction. We then test the yearly occurrence of conflict events in the study area against a set of covariates, using spatial econometric regression models on a 50 km resolution square grid. Covariates include urbanization, co-presence of politically relevant ethnic groups, human development, availability of arable land, and water scarcity periods length. The time spillover and spatial autocorrelation of conflict are also tested. We then evaluate the conflict potential of different combinations of water availability indicators by comparing their spatial clustering in conflict locations and in a randomly selected control sample, also in relation to the distributions of the spatial econometric model covariates.

Our results, in line with previous studies (Ide et al. 2020; Von Uexkull et al. 2016), show that there is no statistically robust signal that water scarcity directly drives violent conflict. In particular, the self-feeding and diffusive mechanisms of conflict, highlighted by the conflict time spillover and spatial autocorrelation, prove to be the most important drivers of conflict. However, the spatial clustering of water availability indicators is able to identifies multiple connections between water availability and conflict, often operating in different, even opposite ways, depending on the specific conflict dynamic. This points to the fact that the relation between water resources and conflict is an integral, inextricable, part of a more articulated hydro-social framework (Selby and Hoffmann 2014). In this sense, our study provides new biophysically and statistically sound information and methods for understanding resource conflicts, in case study that is relevant both from the scientific and the policy point of view (Daoust and Selby 2021). By relaxing the assumption that environmental factors work as separate conflict drivers, we are able to focus on complex socio-hydrological processes and to present quantitative results as a support rather than an alternative to qualitative studies, aiming to close the gap between the biophysical understanding of environmental stress and the qualitative knowledge on social tension phenomena.

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