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Inspecting the link between climate and human displacement with Explainable AI and Causal inference

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On average, more than 21 million forced human displacements were reported as result of weather-related events between 2008 and 2020 worldwide. This is a major concern due to the increment trend in intensity and frequency of weather hazards. Breaking down the figures, the impact is more severe in low-middle income countries, where most of the natural hazards take place and adaptation strategies are lacking. Implementing efficient and operational policy responses requires a quantitative analysis of the nexus between climate-induced displacement. So far the study of this phenomenon has been often limited to qualitative assessments or to correlation measures from regression linear models, not accounting for the inherent complexity of the problem. The multicausal nature of human mobility and data availability present significant research challenges. We apply two methodological approaches that use machine-learning to close these gaps, namely addressing both rapid-onset (e.g. floods) and slow-onset (e.g. droughts) disaster types. The former uses the Internal Displacement Monitoring Centre (IDMC) global database of displacements triggered by floods and storms at disaster level, socioeconomic (RWI Meta Data4Good, Global Human Modification Layer, Education Expenditure), and Earth-Observation variables: meteorological (CHIRPS, ERA5) and environmental (NASA ASTER SRTM DEM, MODIS NDVI vegetation index). Explainable AI techniques enable to open the black box of random forest models and were applied at the global scale: Shapley values are used to investigate the contributions of the main drivers thereby quantitatively addressing the climate-displacement nexus. Results are consistent with the hazard, exposure and vulnerability concept discussed in literature and findings reveal that socioeconomic factors greatly mediate displacement magnitudes. The slow-onset study is being explored at the local scale at district level, currently focused on the effects of droughts on displaced populations in Somalia using UNCHR PRMN displacement dataset, remote sensing variables (CHIRPS, MODIS LST), conflict (ACLED) and market prices time-series (FSNAU, WFP VAM Unit). Beyond correlations analysis, causation alongside time-lag effects for the drivers of drought-induced displacement are assessed using the PCMCI algorithm. Results in specific districts indicate that decreases in vegetation in conjunction with cattle price drops are driving drought displacement, revealing these factors are in need for targeted intervention. Albeit the same method applied to other districts in Somalia returns no causal link among considered variables, taking these findings into account, we are able to propose district-wise recommendations on how to improve the quality of the data: eg. field data collection

guidelines, what other data input is required, and where sampling efforts should be directed.