ANALYTICAL UNITS BASED ON NATURAL SYSTEMS IN UNDERSTANDING ENVIRONMENTAL FACTORS ASSOCIATED WITH DISEASE: A CASE-STUDY OF PEDIATRIC DIARRHEA IN BRAZIL

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Background and Aims: Over two million children die annually due to disease attributed to enteric disease. The importance of an improved understanding of environmental factors associated with this disease has been widely recognized. An important factor is the geographic extent and framework of the unit of analysis. In this study we evaluate a geospatial method for identifying spatio-temporal patterns in mortality attributed to pediatric diarrhea in Brazil based on the natural system, hydrologic regime, rather than political census units.
Methods: We analyze trends in peak timing of pediatric mortality (MPT) attributed to diarrheal disease in Brazil. We evaluate multi-scale analytical units including: (1) Country-wide municipal level mortality data aggregated to Census Micro Regions (CMR) and to a grid of 20 Km^2 raster cells generated by geostatistical modeling; (2) Within eight officially designated Hydrographic Regions of Brazil based on results from the geostatistical models; and (3) Along longitudinal "vectors" of 1 km raster cells defining the stream network (hydrologic regime) within each Hydrographic Region.
Results: We found evidence of a country-level trend west to east of increasing MPT over an annual cycle. However, when we examined the model results across the Hydrographic Regions, we discovered greater geographic heterogeneity in MPT. At the spatial scale of the stream network within the Hydrographic Regions, trends were generally consistent and no longer predominantly east to west, but oriented in the direction of flow of the major river draining the basin.
Conclusions: We found the geographic orientation of trend in MPT to be highly dependent on the geographic extent and derivation of the analytical unit. We demonstrate that a unit based on natural boundaries, e.g., stream segments or watershed boundaries, resulted in more consistent and robust prediction of trends in MPT attributed to diarrhea.