The use of remote sensing data for assessing seasonality of enteric infections

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Introduction

Worldwide waterborne diseases add substantially to global morbidity and mortality. Diarrheal diseases continue to be one of the leading causes of mortality worldwide. Annually there are 4 billion cases of diarrhea, 2.2 million resulted in deaths, 80% of them occur in the first two years of life and 18% of deaths are in children under 5 years of age (WHO 2008). In resource poor settings 88% diarrheal infections are thought to be due to unsafe water, inadequate sanitation, and poor hygiene (WHO 2008). Despite great efforts to provide clean drinking water and to regulate, both the quality and use of, recreational water the burden caused by waterborne infection in developed countries should not be neglected. Enteric infections are thought to be driven by numerous social and environmental factors, drinking water quality, hygiene and sanitation. However, the relative contribution of demographic, behavioral and environmental drivers with respect to their causal pathways is poorly understood. This gap in knowledge jeopardizes the development of sustainable preventive strategies that will be effective under potentially critical conditions, including the response to an increase of extreme weather events worldwide due to climate change.

Seasonal fluctuations in infectious diseases are well documented and many prominent theories attempt to explain the nature of such fluctuations. The core of seasonality is thought to be related to temporal oscillations in the governing transmission cycles of pathogenic agents and host susceptibility. It has been shown for example, that cryptosporidiosis rates increase in seasons when precipitation and temperature reach their extremes. In tropical climates the incidence of cryptosporidiosis increases during the warm, rainy season (Adegbola et al. 1994; Newman et al. 1999; Perch et al. 2001) and in temperate climates it is shown to be high in the spring and fall. (Naumova et al. 2000; Naumova et al. 2005; Shepherd et al. 1988) However, the consistency of such behavior on a global scale has not been investigated due to limited data on cryptosporidiosis collected over a long time period with reasonable temporal resolution and the difficulty in assessing local information on meteorological parameters in remote areas. Despite growing attention to disease seasonality, especially in enteric infections, a solid theoretical underpinning and relevant analytical tools are limited. Seasonal factors operate at many levels, creating temporal and geographic shifts in human behavior, animal husbandry, exposure concentration, and vector diversity and abundance.

The extent to which human, animal and environmental factors contribute to the spread of infectious agents remains unclear. Waterborne diseases, particularly cryptosporidiosis and giardiasis, are associated with zoonotic transmission (Hunter and Thompson 2005). Domestic livestock, especially cattle, are major reservoirs for these protozoa. Both protozoa have prolonged survival times in water and are resistant to chemical and physical agents (Brandonisio 2006). Outbreaks of infections with zoonotic nature have been shown to be associated with