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A real-time dengue early warning driven by seasonal climate forecasts.

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The impact of mass global travel on communicable diseases have been widely discussed and the need for global cooperation is accepted by most health authorities. However, when the disease is vector-borne, the scenario is not yet well understood. Imposing travel restrictions to affected countries, or creating unnecessary alarm would exclude many parts of the world from hosting international events, such as the World Cup or the Olympics. In this study, we addressed the potential for a dengue fever epidemic during the 2014 FIFA World Cup, using the first real-time probabilistic forecast of dengue risk for the 553 microregions of Brazil, with risk level warnings for the twelve host cities. We produced the probabilistic dengue forecasts using a novel spatio-temporal modelling framework, driven by real-time seasonal climate forecasts and the observed epidemiological situation in Brazil at the forecast issue date. This precursory information allowed dengue warnings to be released three months ahead. By evaluating the past performance of the forecasting system, optimum trigger alert thresholds were determined for medium and high risk dengue scenarios. Our forecasts for June 2014 revealed that dengue risk was likely to be low in the host cities Brasília, Cuiabá, Curitiba, Porto Alegre and São Paulo. Medium risk was assigned to Rio de Janeiro, Belo Horizonte, Salvador and Manaus. High risk alerts were triggered for the north east cities of Recife (p(high)=19%), Fortaleza (p(high)=46%) and Natal (p(high)=48%). For these high risk areas, in particular Natal, the forecasting system showed to have performed well for previous years (June 2000-2013). This timely dengue early warning provided the opportunity for the ministry of health and local authorities to implement appropriate, city-specific mitigation and control actions ahead of the World Cup. To our knowledge, this is the first example of a real-time climate service for public health, ahead of a major global event.