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The use of aerosol remote sensing data sets for health impacts studies

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The meningitis epidemics are a huge public health problem in Africa. Each year, during the dry season (February-April), 25 to 250 thousands of cases are observed (WHO) in the 10-15°N "meningitis belt". On average, there is 10% of mortality, and 10 to 20% of survivors present important neurological repercussions. Social factors (number of people per house, exposure to smoke, immunity, population dynamics, ...) are of prime importance. Nevertheless, climate and environmental factors have recently proved to also play an important role. The desert aerosols ("dust") as well as drought conditions (low relative humidity, high air temperature) would tend to destabilize the ORL mucous membranes (especially pharynx) and enable bacteria (mainly Neisseria meningitidis serogroup A and W135), which numerous healthy holder accommodate, to pass in blood.
The "Impacts of Dust Aerosols and Climate on Meningitis Epidemics in the Sahel" (ADCEM) project is supported by the French "Climate-Environment-Society" Scientific Interest Group (GIS) and part of the French AMMA "health impacts" working group. The ADCEM project's aim is to analyse the relationships between dust, climate and meningitis in order to contribute to develop a forecasting tool of the epidemics risks in Western Africa.
Remote sensing is a crucial tool to better understand and monitor desert dust aerosols : the aerosol Absorption Index (AI) derived from TOMS and OMI data sets in the UV are available daily since the end of the 70's at a spatial resolution of 1° (1979-2005) and 0.25° (2005-today) respectively. This paper questions the possibility of using such aerosol data sets to analyse the meningitis health impacts in Burkina Faso, Mali and Niger, which are among the most concerned countries in Western Africa.
Existing studies use the aerosol optical thickness (AOT) as a proxy of the aerosol quantity in the atmosphere. We considered AERONET AOT as well as TEOM concentrations measurements as ground-based "truth" to validate the AI products from OMI for the recent period 2004-2009. The results show a good agreement between AI and AOT at a daily time-step (correlation coefficients of 0.60 in Burkina Faso, 0.65 in Niger and 0.56/0.68, 2 stations in Mali). The results are improved at a weekly time-step (0.81 in Burkina Faso, 0.87 in Niger and 0.84/0.86 in Mali). The OMI product is also able to reasonably well reproduce the dust seasonal cycle. As a result, the AI product at a 0.25° spatial resolution can be possibly used for health impact studies in Burkina Faso, Mali and Niger, especially at a weekly time-step, which is the time-step of the available WHO epidemiological data sets.