



Monitoring suspended particulate matter in West Africa: toward health hazard assessment

Elodie Robert, Manuela Grippa, Jean-Michel Martinez, Cindy Gosset, Sylvain Pinet, and Laurent Kergoat
GET (CNRS/IRD/Université de Toulouse/CNES), Toulouse, France (elodie.robert@get.omp.eu)

Suspended particulate matter (SPM) can carry bacteria and foster their development. Therefore, it can be considered a vector of microbiological contaminants, which cause diarrheal diseases, and can be used as a proxy for fecal bacteria. Few studies have focused on SPM in rural Africa, where many cases of intestinal parasitic infections are due to the consumption of unsafe water from ponds, lakes and rivers. Diarrheal diseases are indeed the second cause of infant mortality in sub-Saharan Africa. Furthermore, in this region, environmental survey is minimal or inexistent. Monitoring water SPM therefore represents a challenge for health improvement.

SPM is well suited to monitoring by remote sensing since it impacts water color. Because it varies in space and time and because relatively small water bodies are critical for societies in rural areas, monitoring SPM requires the use of high temporal and spatial resolution sensors like Landsat 7 and 8, Sentinel-2 as well as SPOT5-TAKE5 data.

We propose a method to monitor water quality using in-situ and remote sensing data. It is tested at different sites for which in-situ SPM measurements have been collected. Water samples are routinely taken at two sites (semi-arid climate) within the AMMA-CATCH observatory : the Agoufou lake in northern Mali, and the Niger River at Niamey in Niger. A third site is monitored : the Bagré reservoir in Burkina (sub-humid climate).

These data are used to evaluate different indexes to derive SPM from the reflectance in the visible and infrared bands of high resolution optical sensors (LANDSAT, SPOT5-Take5, SENTINEL2). The temporal evolution of the SPM of ponds, lakes and rivers is well captured at the seasonal and interannual scales by the NIR reflectance.

The Agoufou lake displays a marked temporal variability and also the highest values of SPM (as high as 4200 mg/l). SPM increases from the first rains in June with toward a maximum observed in July and August and then declines from October onward. There is a second peak in the dry season due to particle resuspension, occurring most except the driest years.

The Niger River in Niamey displays a rapid increase in SPM between mid-June and late August associated to the 'red' flood, with a maximum in late July-early August and then a sharp decline associated with the black flood.

The Bagre Lake displays a significant trend of SPM over 2000-2015. Within a year, sediment transport is observed from upstream to downstream between June and September.

The high SPM values observed at these sites indicates clear risks for human health. Beyond health hazard, it is essential to address health vulnerabilities. Focusing on the Burkina site, we analyzed epidemiological data and we comment the results of the first exploratory interviews.

Satellite data provide valuable information on exposure of populations, and Sentinel-2 images offer a unique opportunity for tele-epidemiology related to inland water bodies in West Africa.