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Use of isotopic spike from Tropical Storm to understand water exchange on large scale: study case of Rafael Storm in the Lesser Antilles archipelago, October 2012.

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Aim The tracking of the rainfall from Tropical Storm Raphael of mid October 2012 was used to better understand how the eco-hydrology and the water cycle function in wet areas, such as mangrove growing in salty ponds on a number of tropical islands.

Location Guadeloupe and Saint Martin Islands in the Leeward Islands archipelago, Lesser Antilles.

Methods Compared to normal tropical rainfall, tropical storms display distinct depleted heavy stable water isotopes which can be used as isotopic spikes to understand these special rainfall inflows. Rainfall, groundwater, river and pond water were sampled before, during and after the storm.

Results In Guadeloupe where the tropical storm started, the rainfall isotopic signal reached values of $d^{18}O$= -9 to -8 ‰ on October 12-14^{th} 2012, whereas the normal range is $d^{18}O$= -4 to -2 ‰ as measured from 2009 to 2012. It was possible to detect such a depleted signal in the groundwater and in the mangrove forest during the days after the storm event.

Main conclusions The use of such natural isotopic spikes provides an opportunity to obtain a dynamic and time reference on a large scale for the study of the hydro-ecosystems and the effects on the impacted tropical islands. A few days after the cyclone, the isotopic spikes were found in river, groundwater and mangrove water pools with values up to $d^{18}O$= -8.6 ‰ . For the water basins on the windward side, the downhill salty pond water was almost completely renewed. By contrast, only 20 to 50 % of the water in the ponds located on the leeward side was renewed. No specific elevation in the d-excess values was noted, certainly due to the relatively long distance from the eye of the storm (180 to 300 km), which meant that there was no spray water evaporative process.