

Characterizing heavy rainfall events associated with major floods in Haiti

Haïti Géosciences 2021

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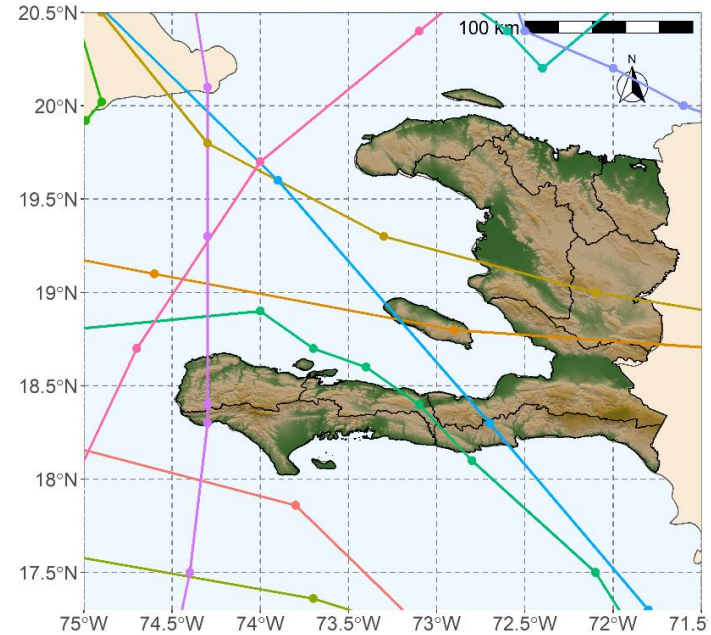
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Study area and problematic

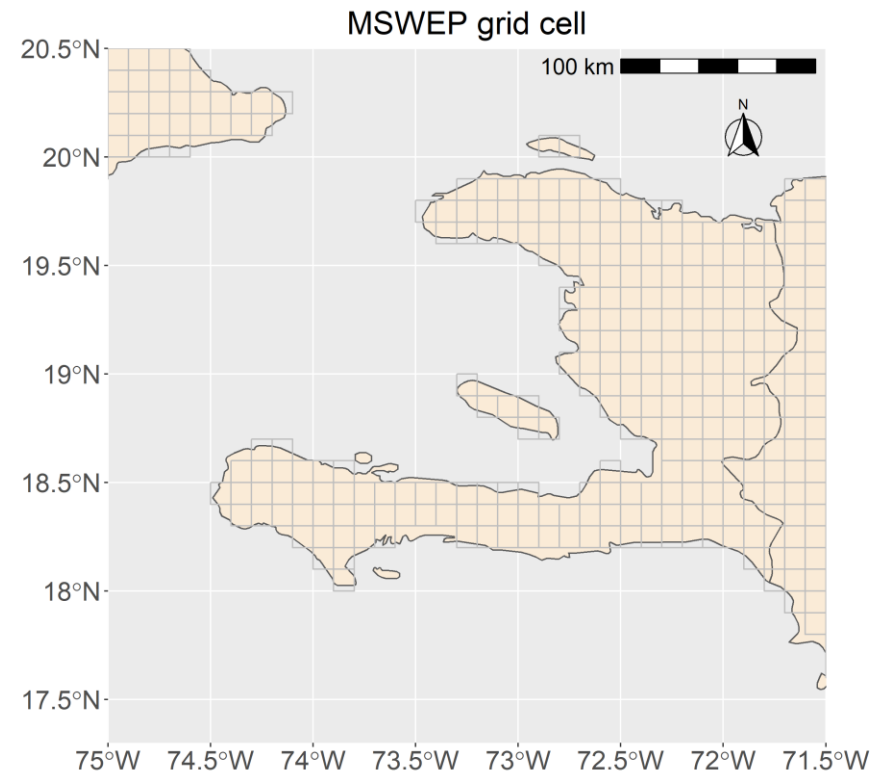
- Haiti → in hurricane's path → country very exposed to hydrometeorological hazards.
- Haitian cities : in flood plains + weak economic situation → high vulnerability to these hazards.
- Lack of reference data → difficulty in characterizing the associated hazards
- But, the BRGM has listed the major floods of the last decades (Terrier et al., 2017).
- What are the characteristics of the rainfall causing these floods?
- To answer this question, we use the MSWEP gridded rainfall data (Beck et al. 2017).



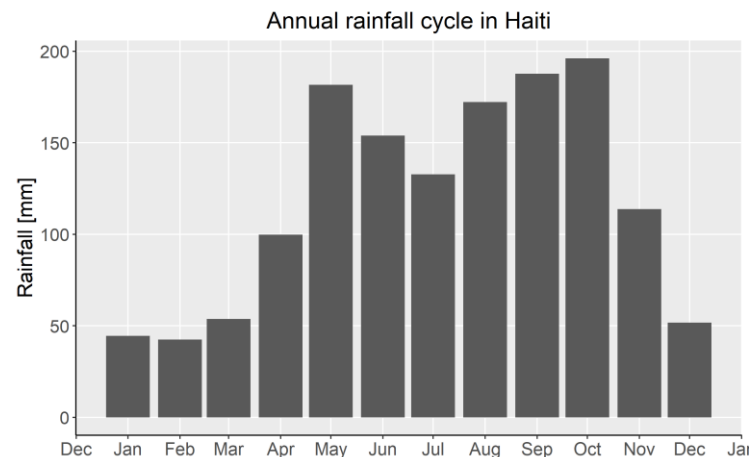
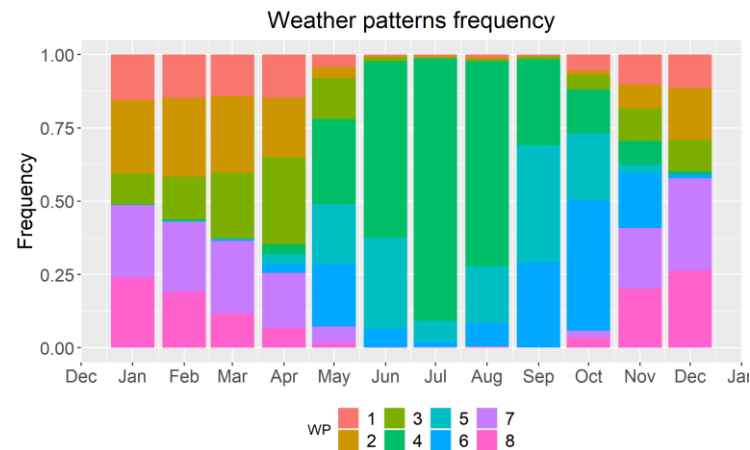
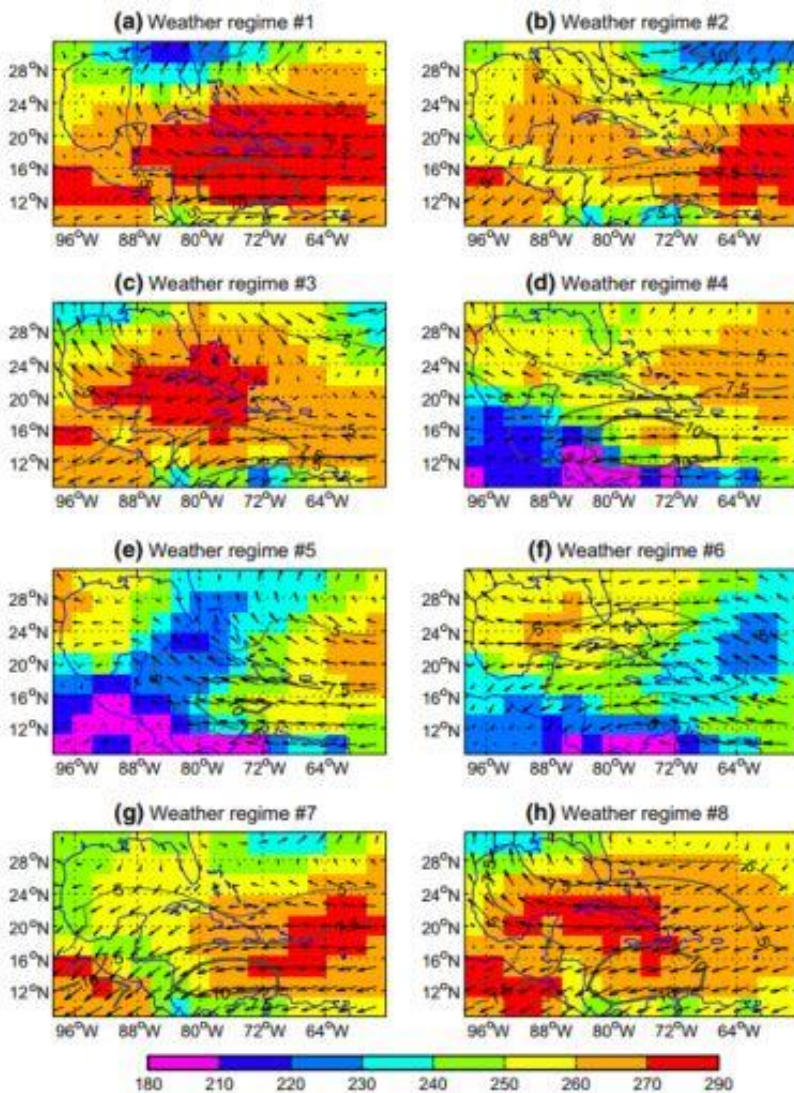
<https://lemediateurhaiti.com/haiti-inondation-la-ville-des-gonaives-sous-les-eaux/>

Data used

- 13 major floods during hurricanes periods (June to November) + 20 major non-hurricanes floods across Haiti from 1979 to 2017 catalogued by BRGM (Terrier et al., 2017).
- Dates and paths of the 13 major hurricanes during 1980 to 2016 ([NOAA](#))
- Eight Caribbean weather patterns (shown on the next slide ; Moron *et al.* 2016).
- MSWEP rainfall data, available from 1979 to 2017 for a spatio-temporal resolution $0.1^\circ(11 \text{ km}) / 3 \text{ h}$ (Beck *et al.* 2017).



Caribbean Weather Patterns (Moron *et al.* 2016)

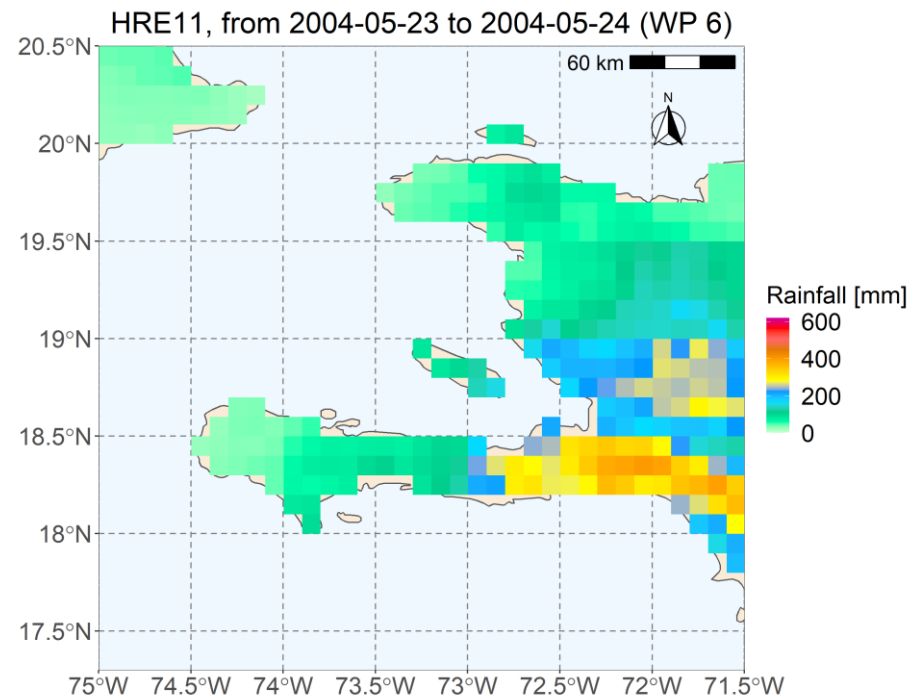
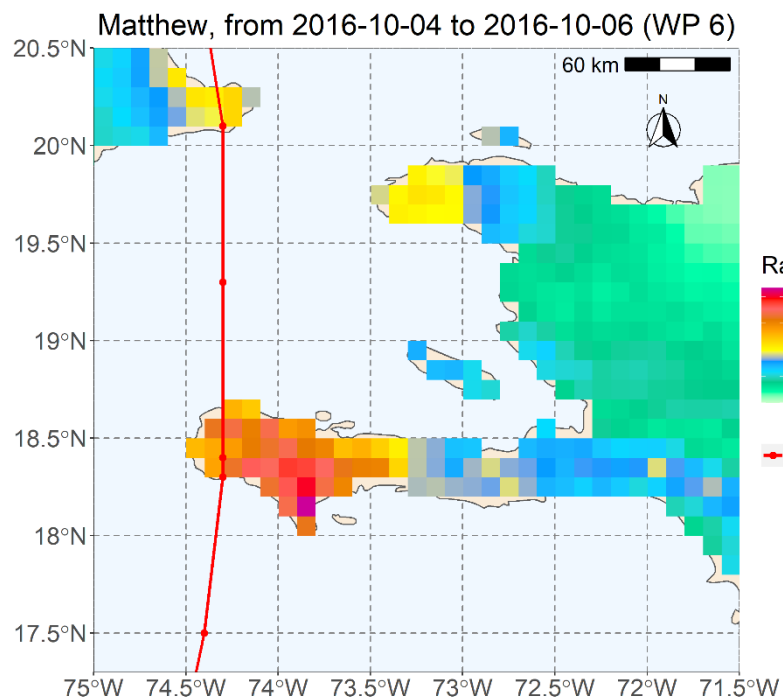


- WP 1-3 et 7-8 → low rainfall (décembre - avril)
- WP 4-6 → heavy rainfall (mai – juin et août – nov)
- WP 4 → less heavy rainfall (juin – août)

Methodology

- Qualitative assessment of the capacity of MSWEP to identify heavy rainfall events generating the major floods catalogued by BRGM as :
 - ❖ Hurricane paths compared to MSWEP rainfall maps during hurricane season
 - ❖ Non-hurricane flooded areas compared to MSWEP rainfall maps
- Characterizing heavy rainfall events associated with major floods by studying their cumulative rainfall, spatial extent and associated atmospheric weather patterns.

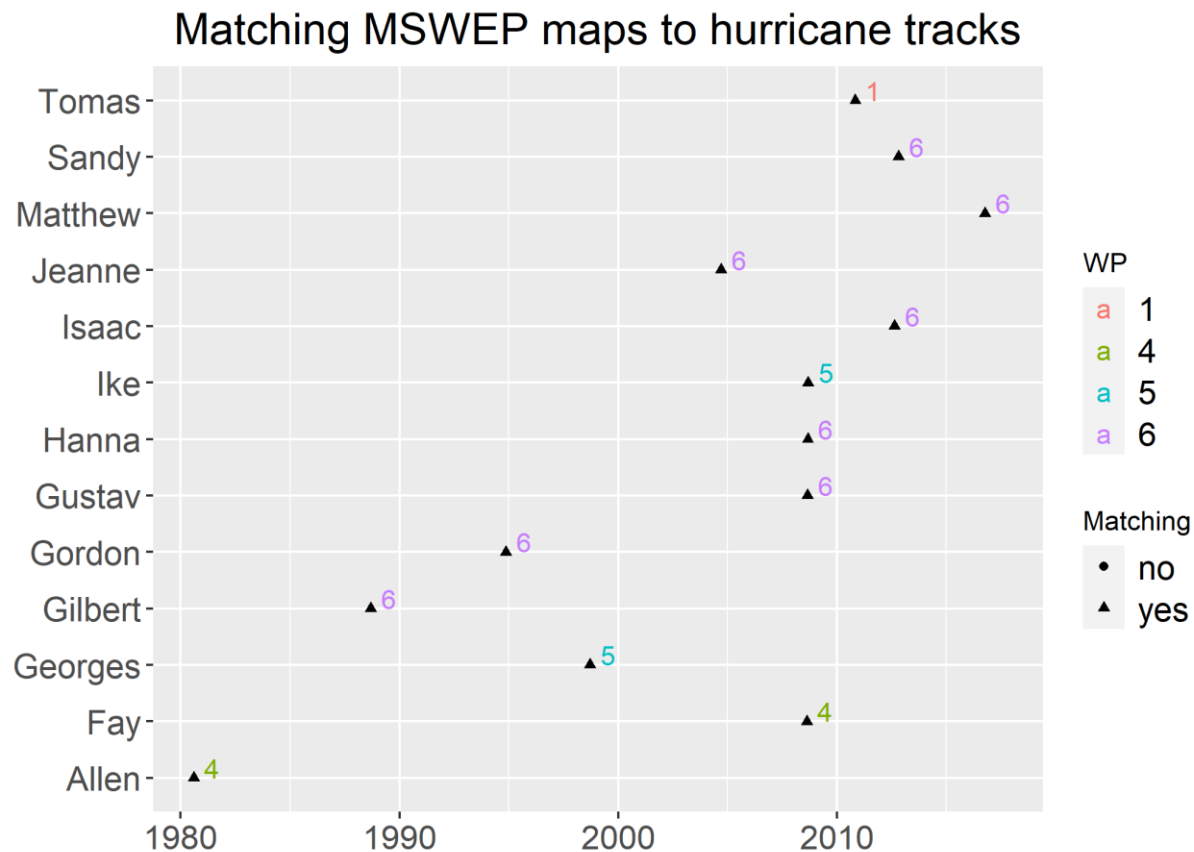
MSWEP rainfall maps compared to the BRGM catalog for the two highest rainfall events



- The MSWEP rainfall map during Matthew corresponds with the path of the hurricane.
- The MSWEP rainfall map during the May 24-25, 2004 floods in Southeast Haiti corresponds with the flooded area.

MSWEP rainfall maps compared to the BRGM catalog during hurricane

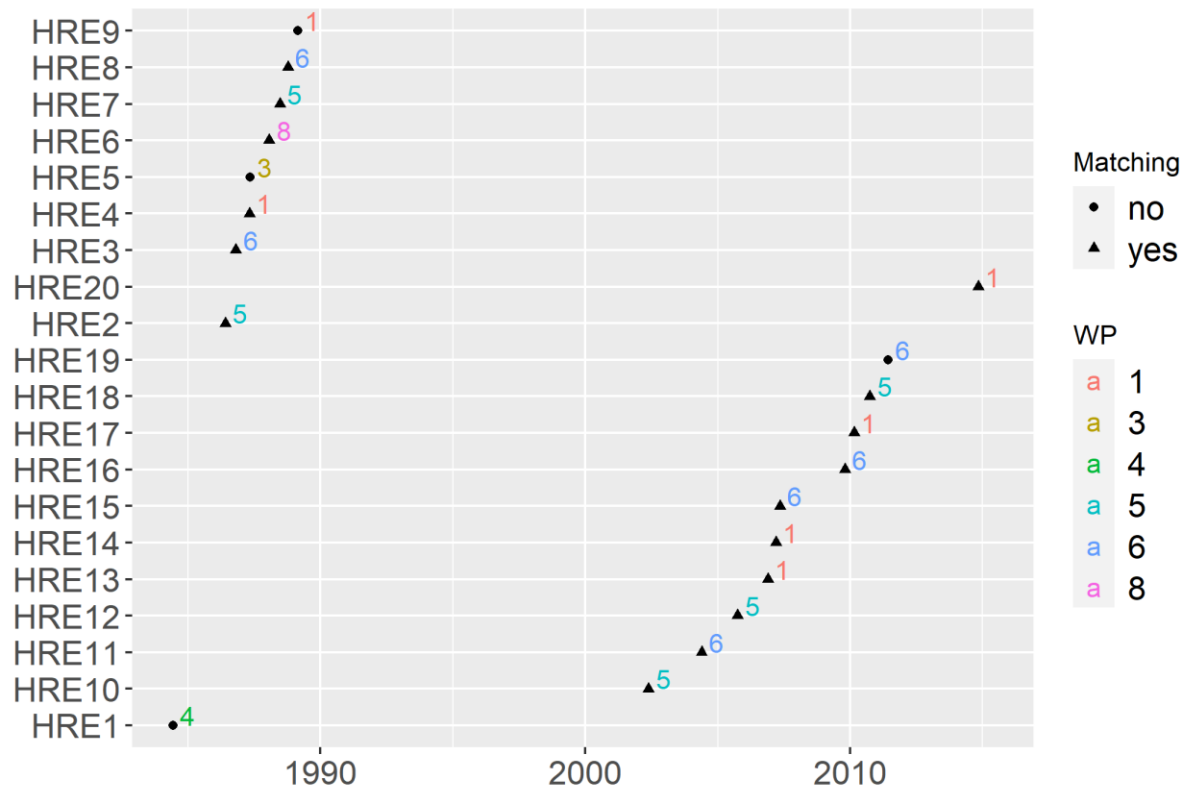
- The MSWEP rainfall maps correspond with the paths of the 13 hurricanes
- WP 6 = 60% of hurricanes
- WP 4 -5 = 30% of hurricanes
- WP 1 = 10 % of hurricanes



MSWEP rainfall maps compared to BRGM non-hurricane floods

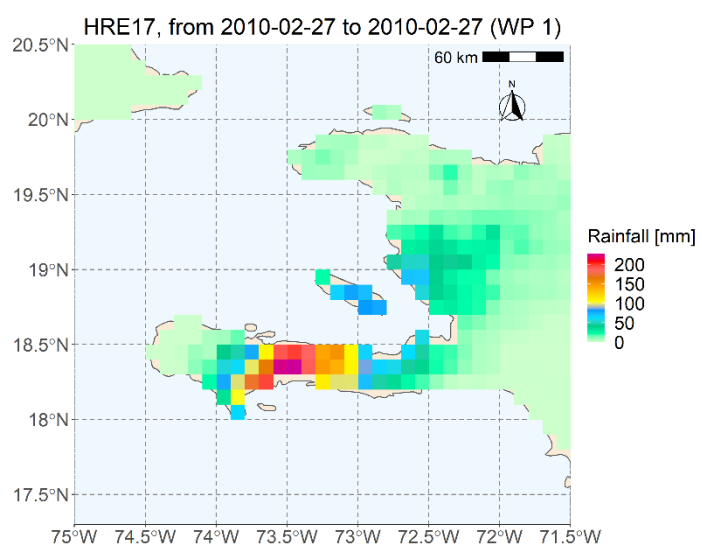
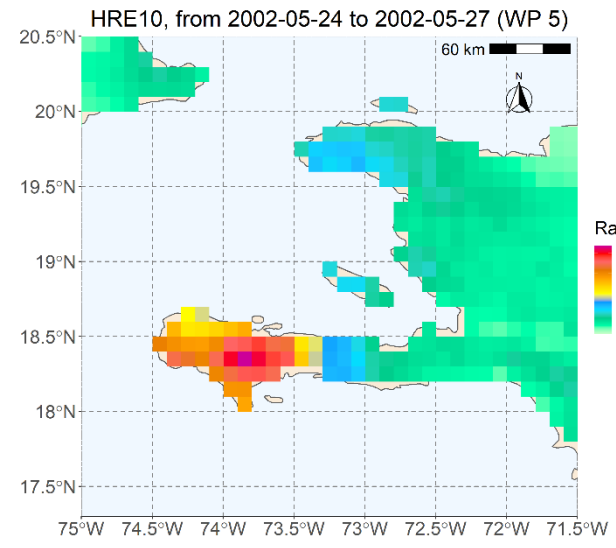
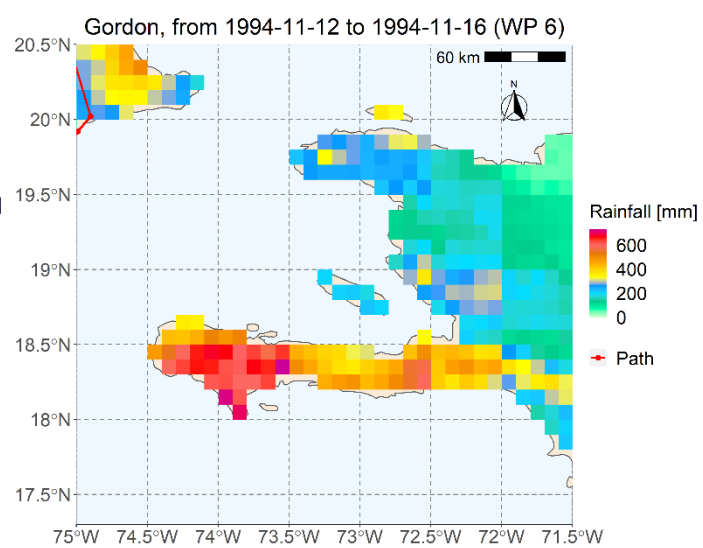
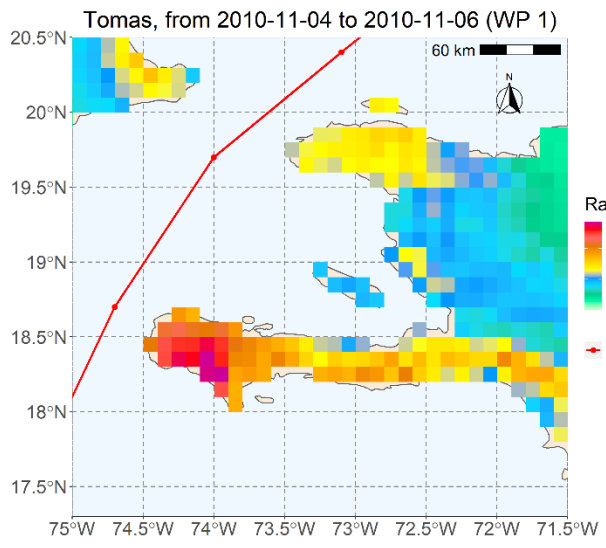
- 80% of major non-hurricane floods are captured by MSWEP
- WP 1, 5 and 6 = 85% of non-hurricane floods
- WP 2, 4 and 8 = 25% des inondations hors cyclone

Matching MSWEP Maps to non-hurricane flooded areas

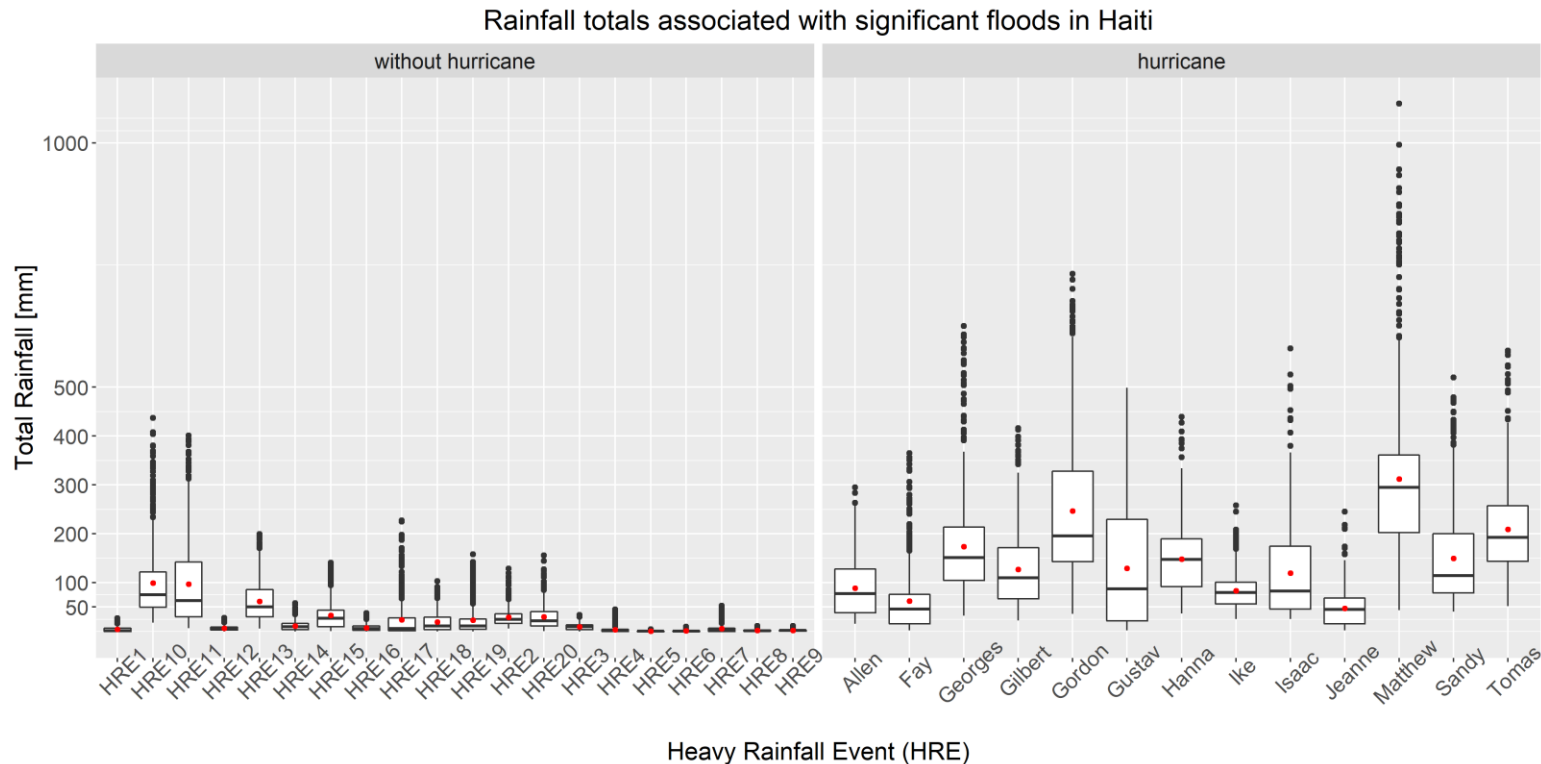


Rainfall characterization associated with major floods in Haiti with MSWEP rainfall data

- Cumulative rainfall during hurricanes (top) and without hurricanes (bottom)
- Rainfall during hurricane are higher and more widespread spatially.
- Rainfall is systematically higher in the southern peninsula of Haiti



Rainfall characterization associated with major floods in Haiti with MSWEP rainfall data



- Rainfall totals around 100 to 300 mm for hurricanes, has a return period of 5 years (Bathelemy et al., 2021b), and generally less than 50 mm without a hurricane.
- Note that MSWEP underestimates heavy rainfall quantiles over the Greater Antilles by ~10% (Bathelemy et al., 2021a).
- Rainfall during cyclones extends over the whole country while rainfall without hurricanes are relatively more localized.

Conclusions and perspectives

- MSWEP rainfall data represent rainfall fields associated with the 23 major floods listed by BRGM
- Rainfall events generating major floods during hurricane season have a return period of 5 years and less for non-hurricane floods → this highlights vulnerability of Haitian territory to flooding hazard
- In perspective, we can analyze all the heavy rainfall events in the MSWEP data to create a complete catalog and complete the BRGM list.
- We can go further, and discuss the accumulation, duration, spatial and temporal variability of heavy rainfall events in Haiti or in the Greater Antilles.

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