Waterborne Hazard Forecast: Haiti – Potential Cholera Hotspots

26AUG2021

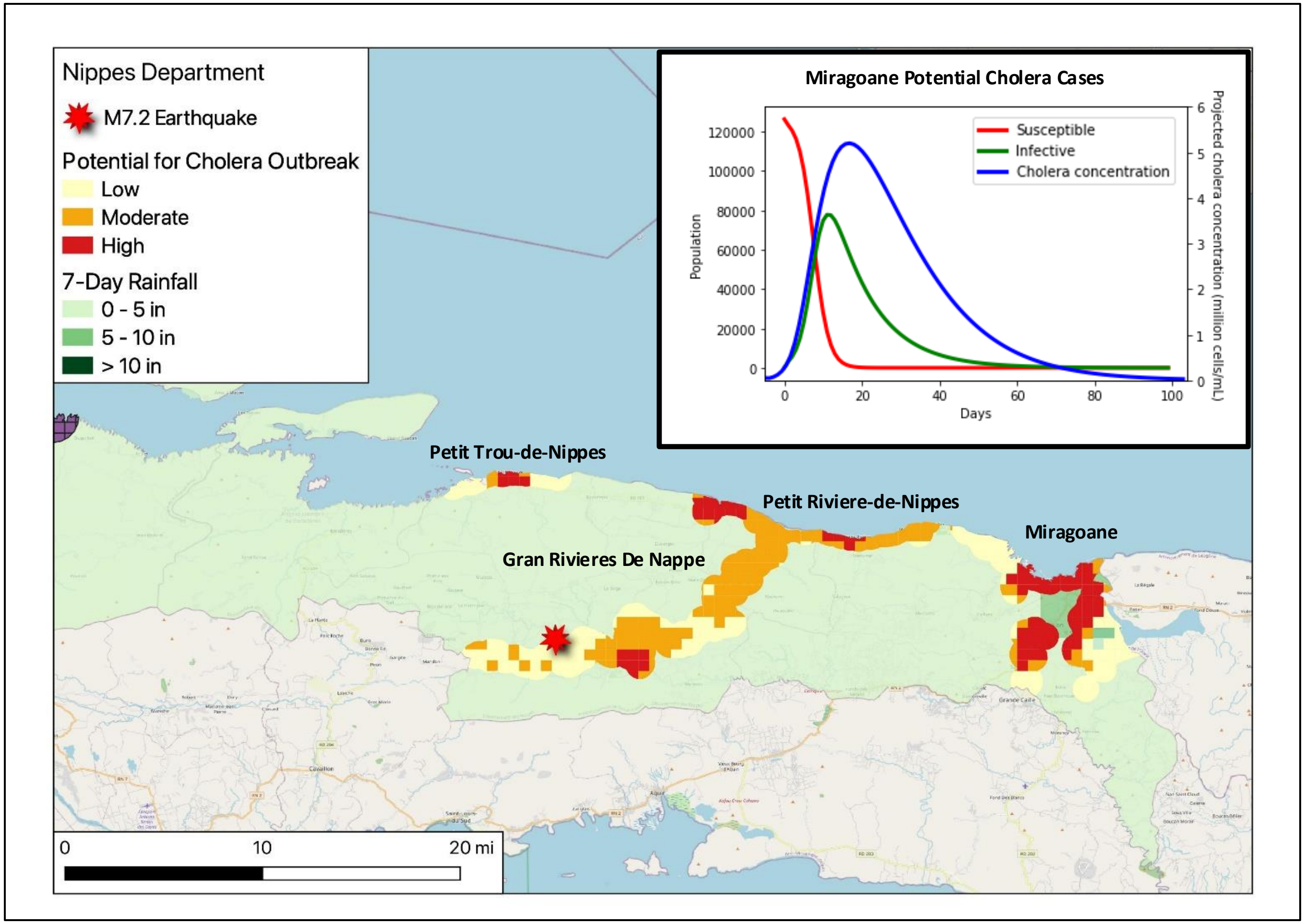
Background/Methodology/Assumptions

- Infrastructure damage from the 14AUG magnitude 7.2 earthquake in Haiti and subsequent flooding from tropical storm Grace have impacted drinking water quality increasing the potential for cholera outbreaks.
- Hotspot regions were identified within the administrative departments of Nippes, Sud, and Grand'Anse impacted by the earthquake and heavy rains.
- Lakes, river, and coastal region intersections with high population areas were used to identify areas with high probability of cholera outbreak.
- Terra ASTER Global Digital Elevation Model and HOTOSM Waterways dataset were used to define water-impacted regions.
- The WorldPop 1km-gridded population density was used to determine the total population within the identified areas [https://www.worldpop.org/] .
- Post-earthquake NASA GPM 7-day rainfall accumulation was used for flooding impact [https://gpm.nasa.gov/].
- An SIWR model was used to forecast cholera peak infectivity as a function of population.
- Population within 1km - 2km of the potentially impacted waters was used as the baseline population for calculating cases.
- Impacted regions were ranked based on population density, rainfall accumulation, and time to peak infectivity.

Background/Methodology/Assumptions

- SIWR model assumptions:
  - Entire population is susceptible, no adjustment for vaccination
  - 1% initial infection rate.
  - Recovery rate = 0.09 d^{-1}.
  - Exposure to cholera is from contaminated water only, with a 50% contact rate to contaminated water.
  - Concentration level resulting in 50% chance of infection was constant:
    - 1 million cholera cells/mL
  - All infected individuals contribute 10 cells/mL to total bacterial population.
    - Higher per capita contributions shorten the time to peak infectivity and increase the fraction of the population impacted at peak infectivity.
  - No distinction is made between symptomatic and asymptomatic in the infectivity projections.
  - Severity of impacts is not included.
  - Waterbodies are not volume adjusted and assumed to be uniformly mixed.
  - An average temperature 28 Celsius assumed for all regions.
  - Hyper-infectivity was not included in the analysis.

Department of Nippes – 1km



Miragoane:

- Two regions have high risk for cholera outbreak: coastal, due to potential inundation from Tropical Storm Grace, and inland, due to population density and rainfall.
- The fastest rate of infection is projected in the first 11 days.
- A significant percentage of the population could be infected without intervention (>60%) at the peak infection rate.
- Three other locations show a slightly lower potential rate of infection and onset of maximum infection

Gran Rivieres De Nappe:

- 12-day peak for infection
- Peak potential Infectivity: 59%

Petit Trou-de-Nippes:

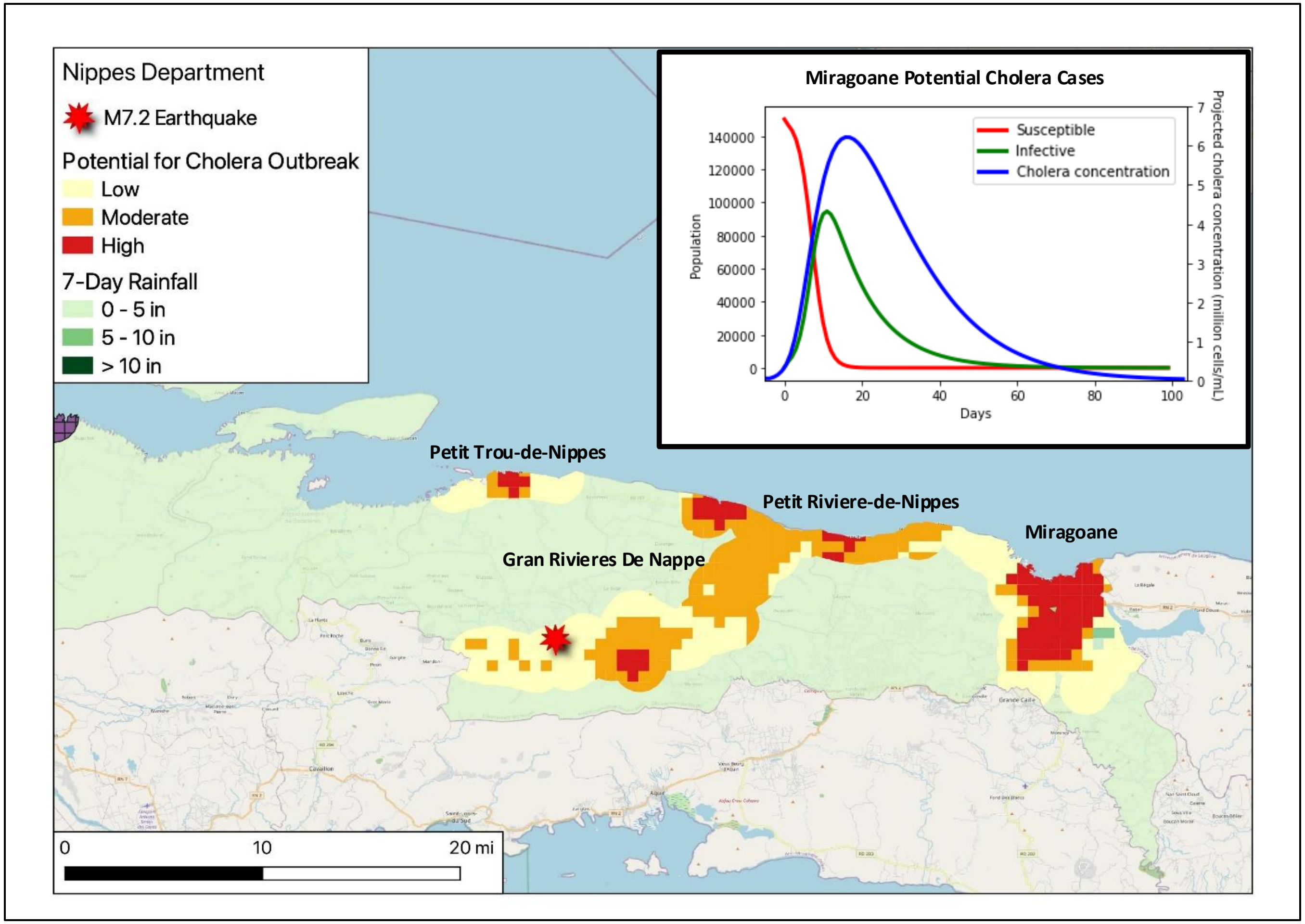
- 21-day peak
- Peak potential Infectivity: 40%

Petit Riviere-de-Nippes:

- 21-day peak
- Peak potential Infectivity: 39%

A total of 251,484 people live within 1km of these waterbodies

Department of Nippes – 2km



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- Two regions have high risk for cholera outbreak: coastal, due to potential inundation from Tropical Storm Grace, and inland, due to population density and rainfall.
- The fastest rate of infection is projected in the first 11 days.
- A significant percentage of the population could be infected without intervention (63%) at the peak infection rate.
- Three other locations show a slightly lower potential rate of infection and onset of maximum infection.

Gran Rivieres De Nappe:

- 11-day peak for infection
- Peak potential Infectivity: 61%

Petit Trou-de-Nippes:

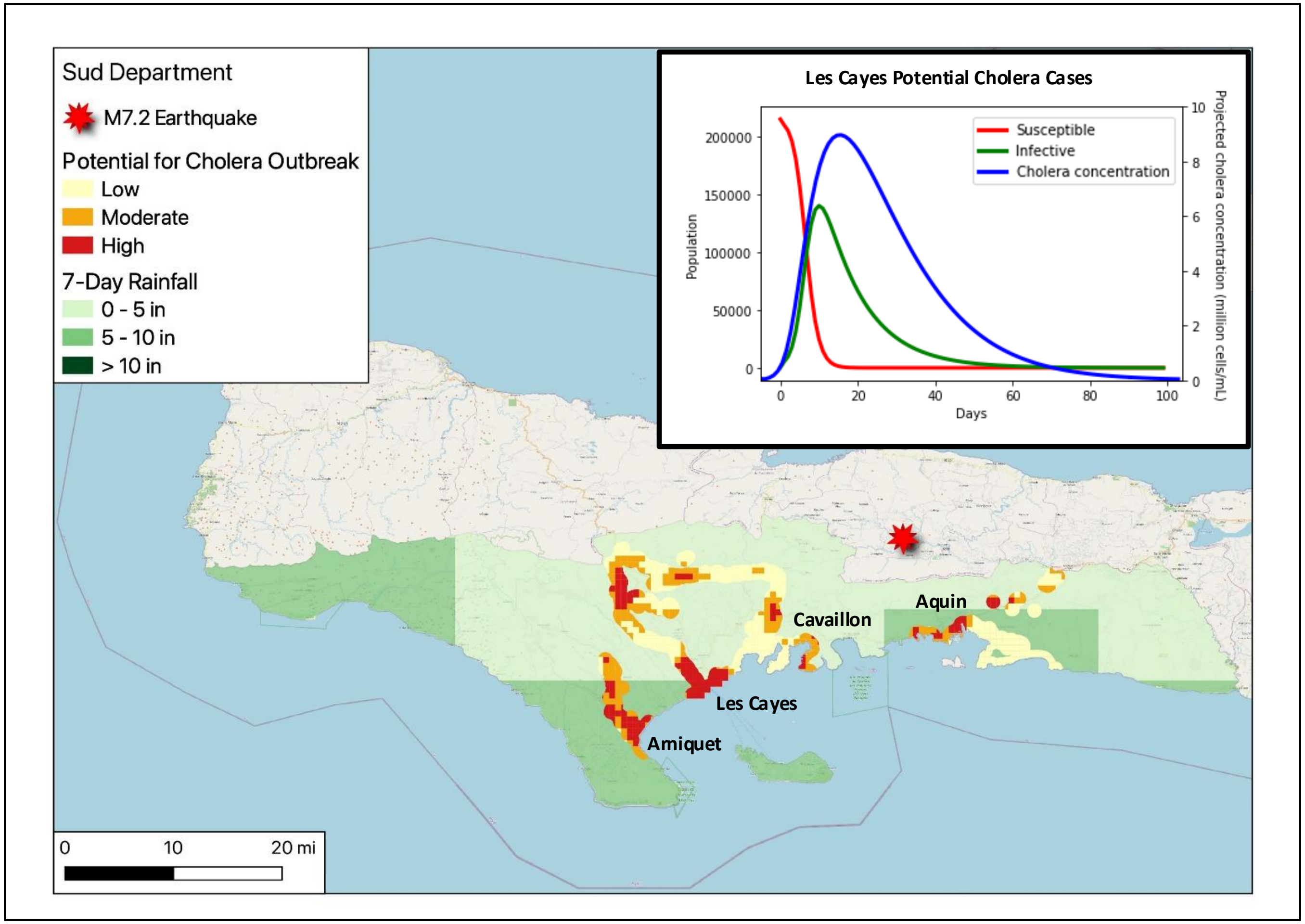
- 19-day peak
- Peak potential Infectivity: 44%

Petit Riviere-de-Nippes:

- 18-day peak
- Peak potential Infectivity: 46%

A total of 326,149 people live within 2km of these waterbodies

Department of Sud – 1km



Les Cayes:

- Two regions have high risk for cholera outbreak: coastal, due to potential inundation from Tropical Storm Grace, and inland, due to population density and rainfall.
- The fastest rate of infection is projected in the first 11 days.
- A significant percentage of the population could be infected without intervention (>60%) at the peak infection rate.

•Three other locations show a slightly lower potential rate of infection and onset of maximum infection.

Cavaillon:

- 12-day peak for infection
- Peak potential Infectivity: 59%

Arniquet:

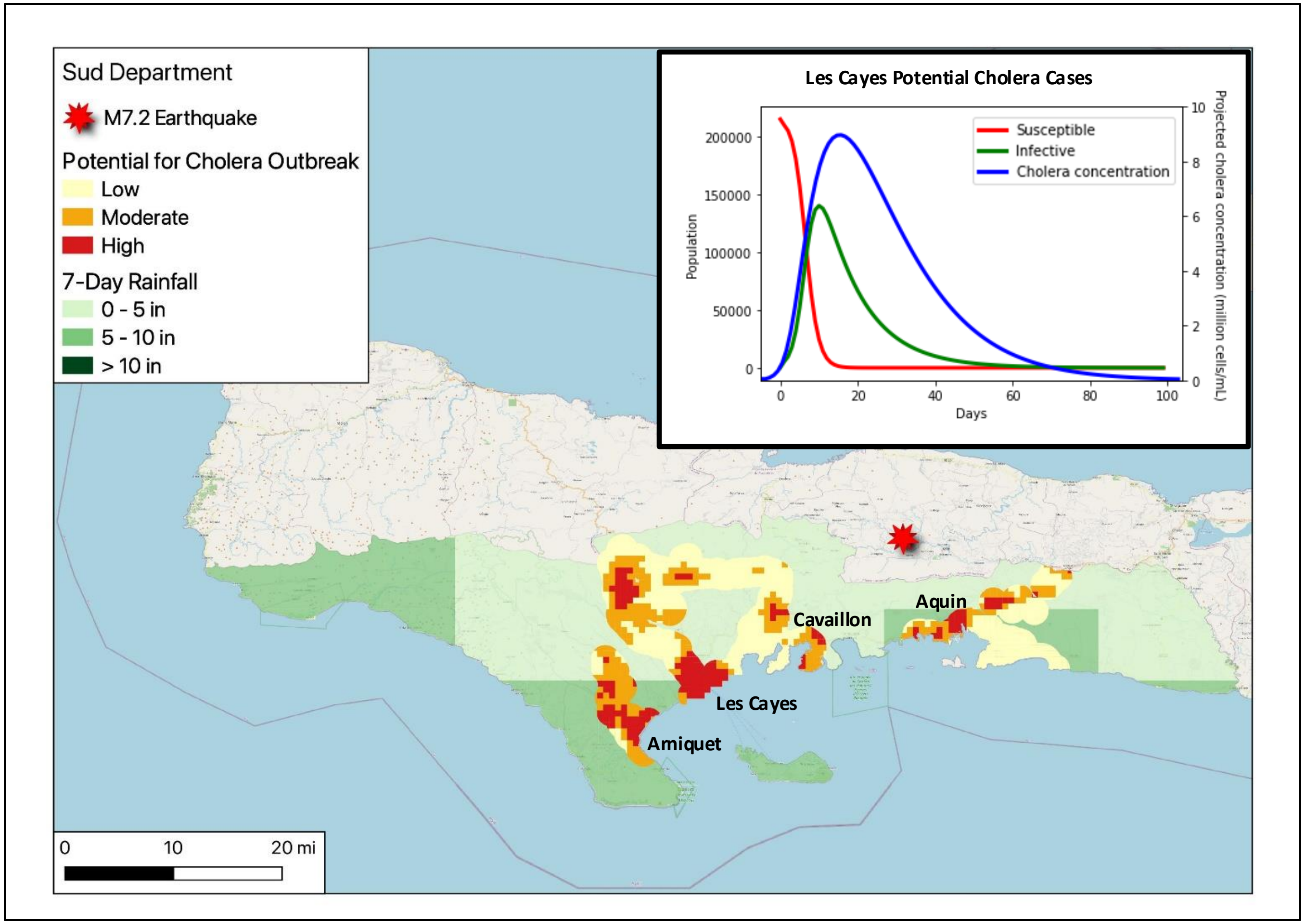
- 14-day peak
- Peak potential Infectivity: 56%

Aquin:

- 14-day peak
- Peak potential Infectivity: 55%

A total of 385,771 people live within 1km of these waterbodies

Department of Sud – 2km



Les Cayes:
- Two regions have high risk for cholera outbreak: coastal, due to potential inundation from Tropical Storm Grace, and inland, due to population density and rainfall.
- The fastest rate of infection is projected in the first 10 days.
- A significant percentage of the population could be infected without intervention (65%) at the peak infection rate.
- Three other locations show a slightly lower potential rate of infection and onset of maximum infection.

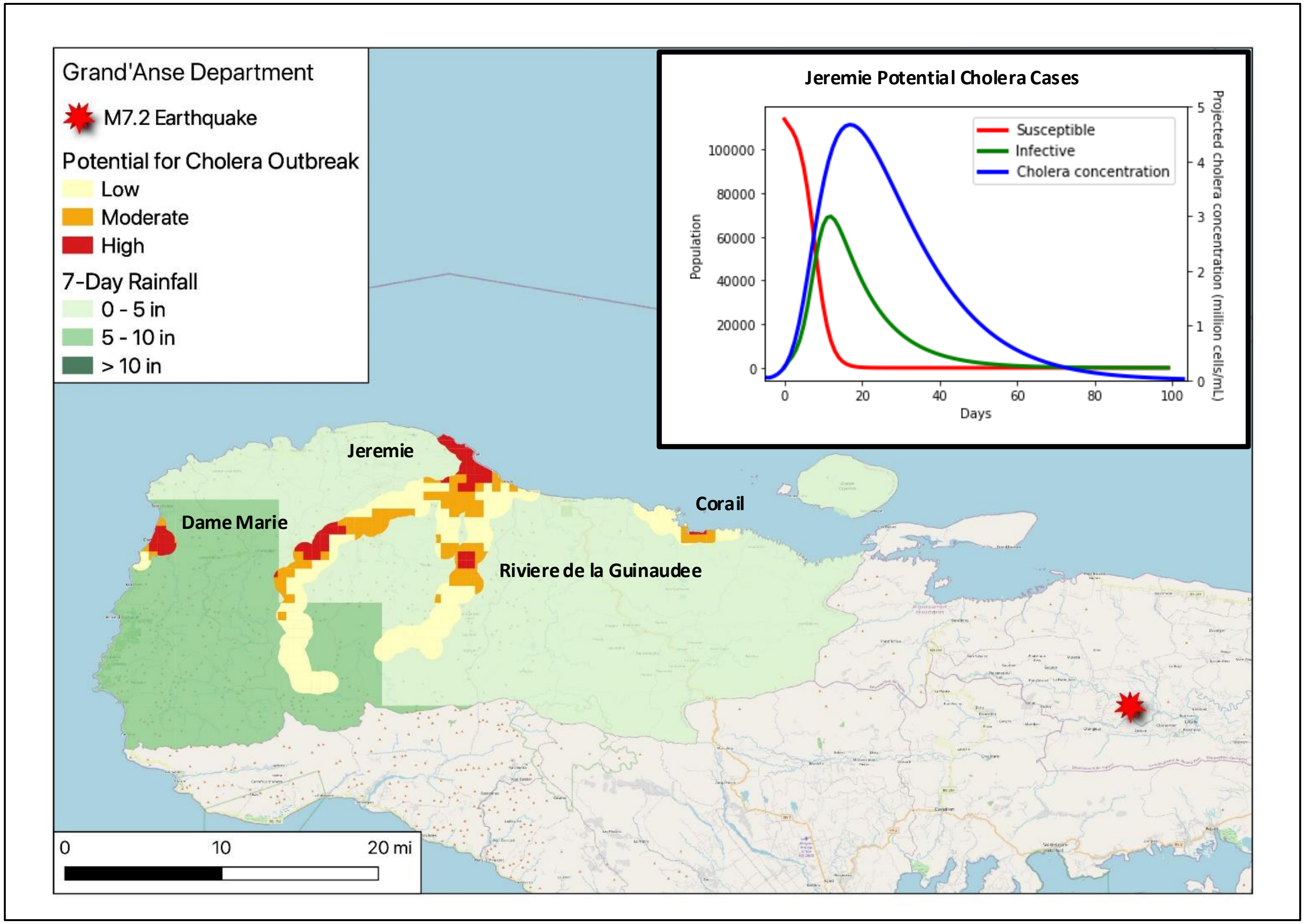
Cavaillon:
- 11-day peak for infection
- Peak potential Infectivity: 62%

Arniquet:
- 12-day peak
- Peak potential Infectivity: 59%

Aquin:
- 13-day peak
- Peak potential Infectivity: 58%

A total of 529,781 people live within 2km of these waterbodies

Department of Grand'Anse – 1km



Jeremie:

- Two regions have high risk for cholera outbreak: coastal, due to potential inundation from Tropical Storm Grace, and inland, due to population density and rainfall.
- The fastest rate of infection is projected in the first 12 days.
- A significant percentage of the population could be infected without intervention (61%) at the peak infection rate.
- Three other locations show a slightly lower potential rate of infection and onset of maximum infection.

Corail:

- 24-day peak for infection
- Peak potential Infectivity: 33%

Dame Marie:

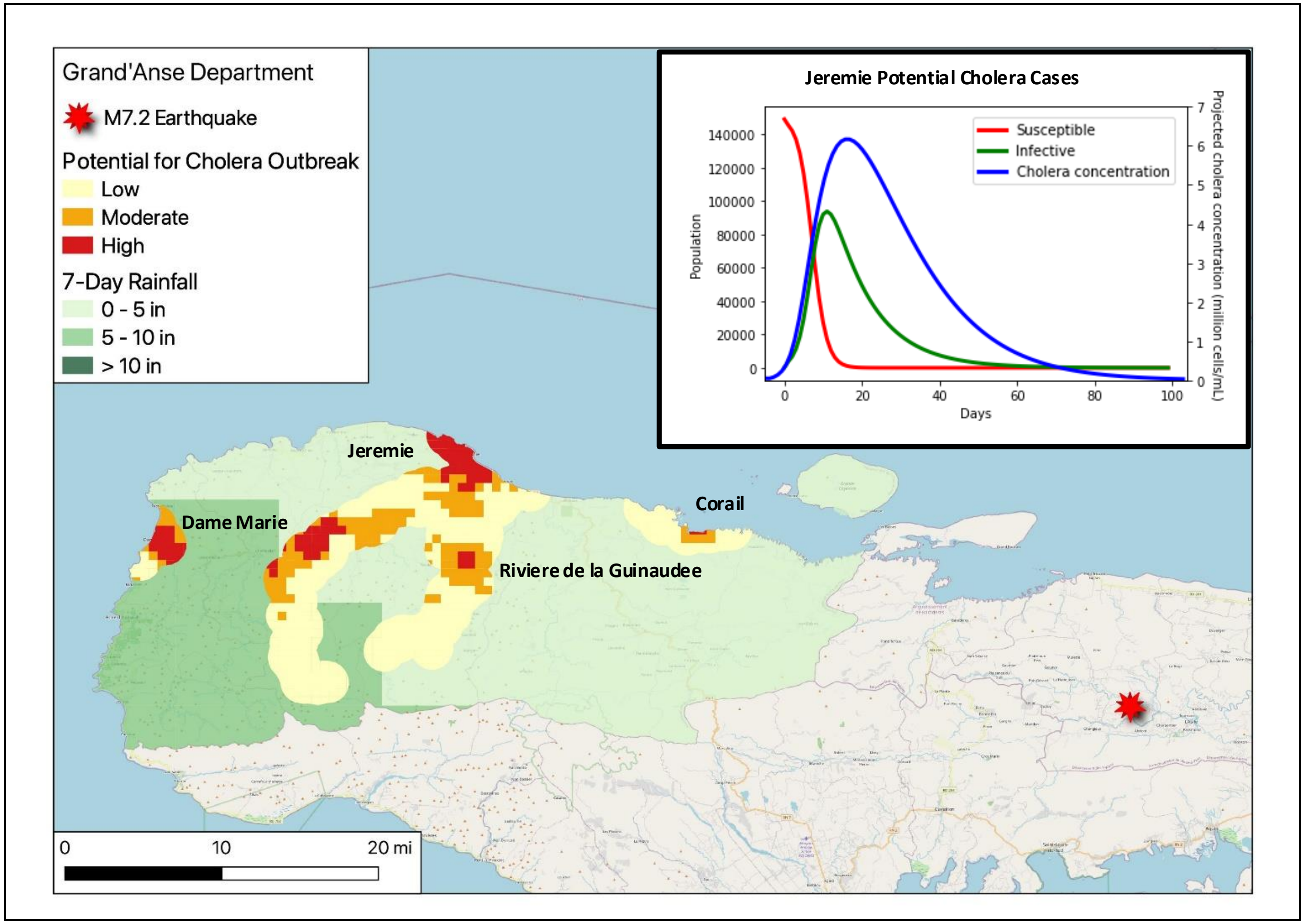
- 19-day peak
- Peak potential Infectivity: 44%

Riviere de la Guinaudee:

- 14-day peak
- Peak potential Infectivity: 55%

A total of 204,205 people live within 1km of these waterbodies

Department of Grand’Anse – 2km



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- A significant percentage of the population could be infected without intervention (>63%) at the peak infection rate.
- Three other locations show a slightly lower potential rate of infection and onset of maximum infection.

Corail:

- 21-day peak for infection
- Peak potential Infectivity: 39%

Dame Marie:

- 17-day peak
- Peak potential Infectivity: 49%

Riviere de la Guinaudee:

- 13-day peak
- Peak potential Infectivity: 58%

A total of 281,130 people live within 2km of these waterbodies