

EMERGENCE OF HIGH-TIDE FLOODING IN FRENCH GUIANA DUE TO SEA-LEVEL RISE.

R. Thiéblemont¹, Le Cozannet¹, D. Idier¹, M. D'Anna¹, G& A. Bel Madani², A.B.A. Slangen³ & F. Longueville¹

¹BRGM, French Geological Survey, Orléans, France.

²Météo-France, Toulouse, France.

³NIOZ, Yerseke, The Netherlands.

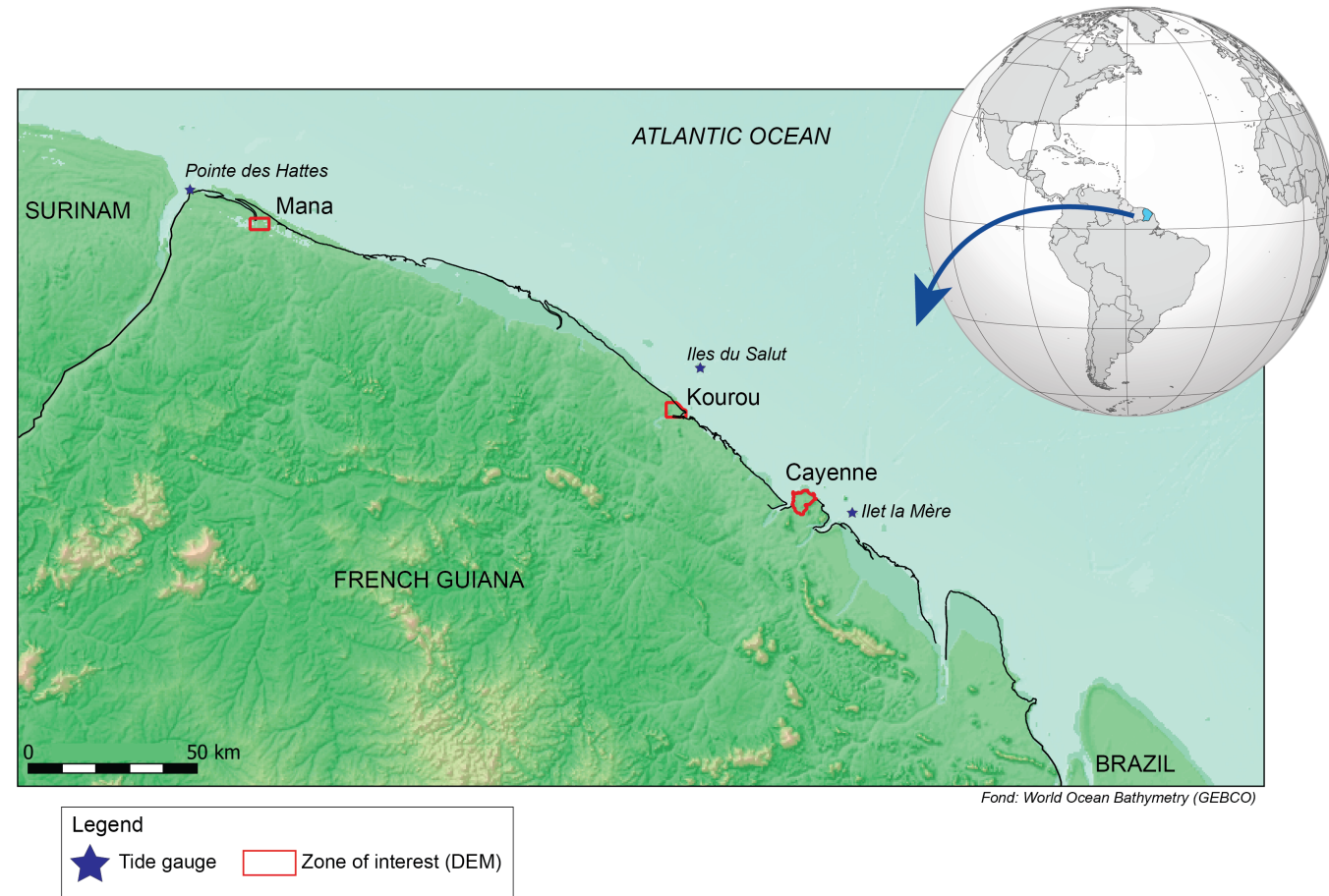
r.thieblemont@brgm.fr

Introduction

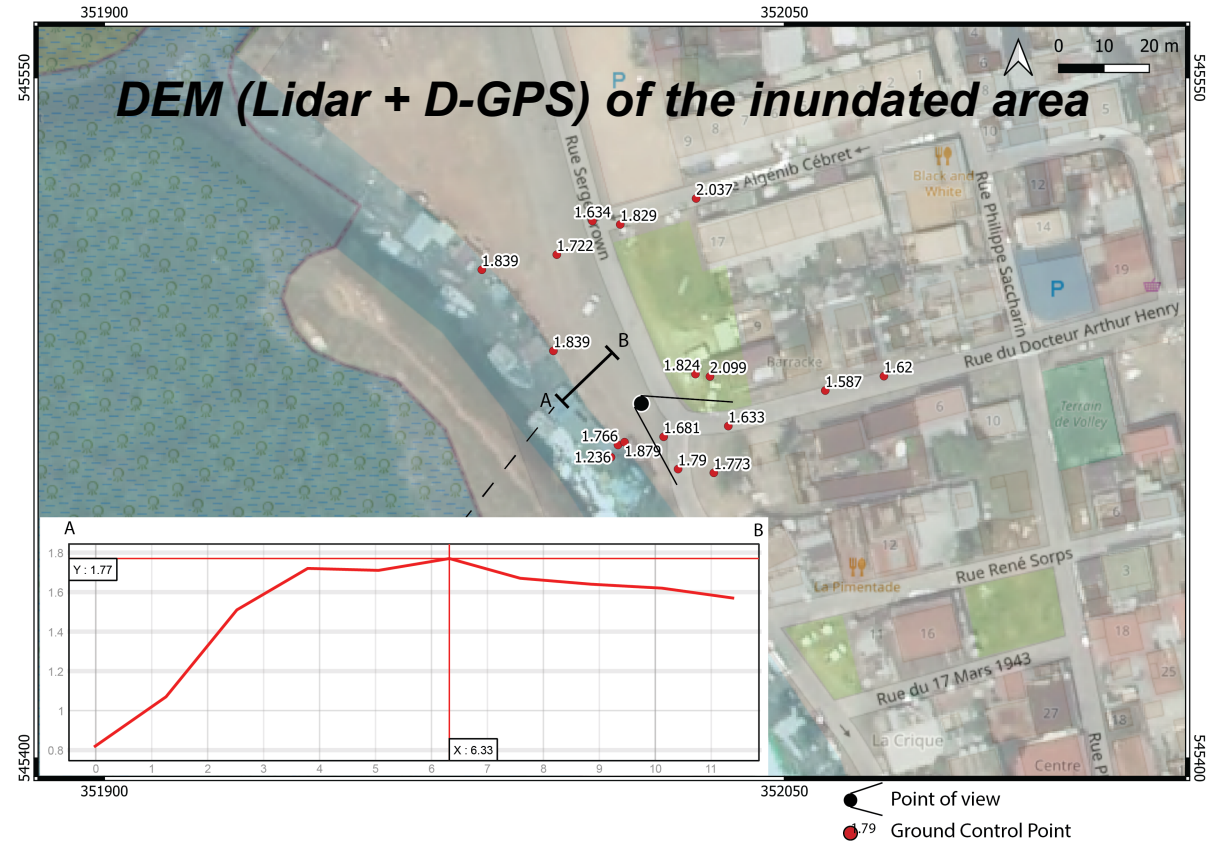
- Chronic flooding at high tide is an early impact of ongoing sea-level rise due to climate change (Fox-Kemper et al., 2022).
- Many coastal regions are already experiencing chronic flooding, often associated with land subsidence context: e.g. US (Moftakhari et al., 2015), Venice (Zanchettin et al., 2020), ...
- French Guiana recently started experiencing high-tide calm weather inundations in several coastal urban zones;



Here, we analyze historical events and make projections of this chronic flooding



Analysis of a recent high-tide flooding event in Cayenne



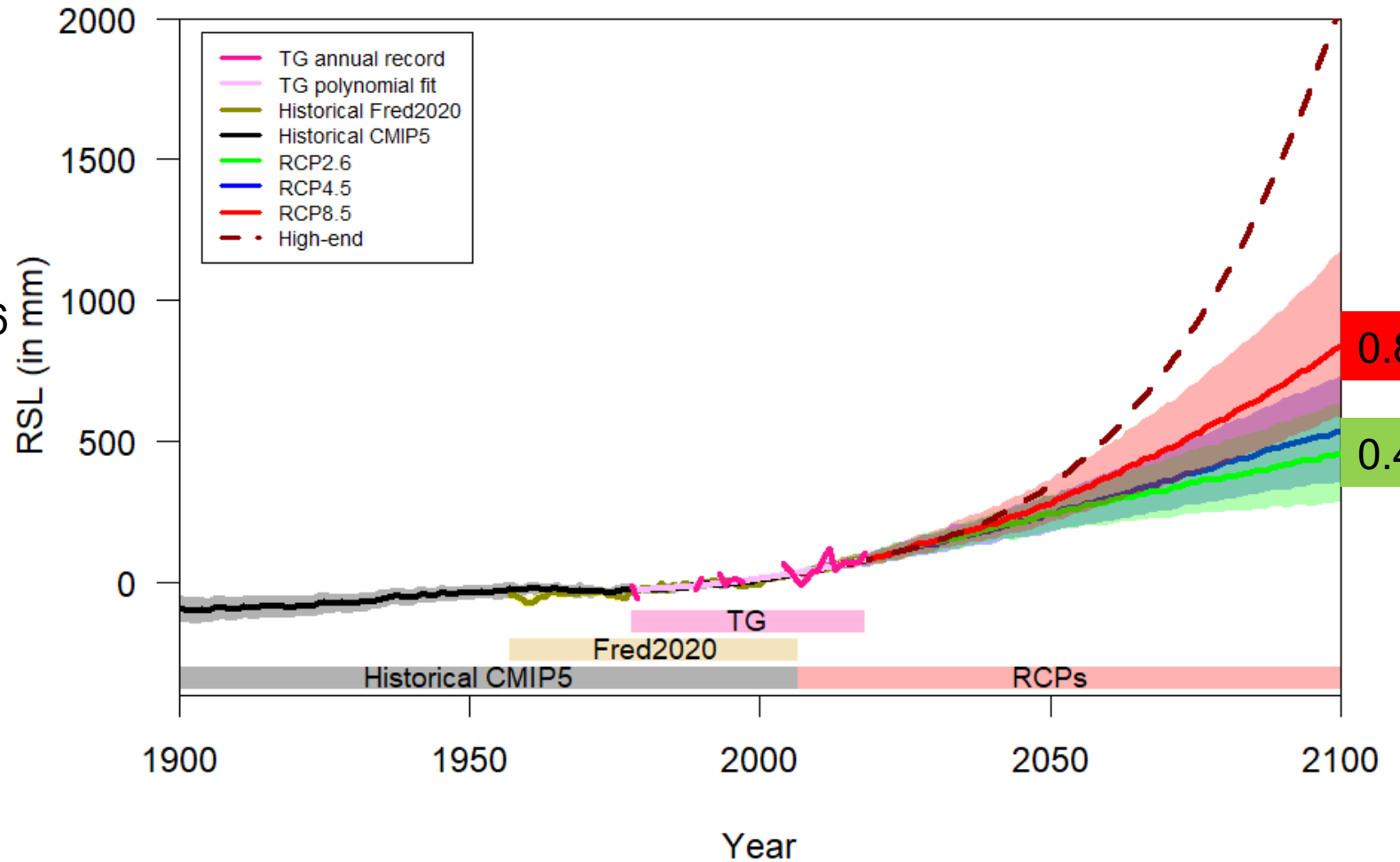
- On that day, the hourly maximum water level recorded @TG was exceptionally high (and without storm);
- TG records reveal that such a high level has been exceeded from 2012 and was not observed before

Can we reconstruct this event statistically ?

Relative Sea-Level in French Guiana

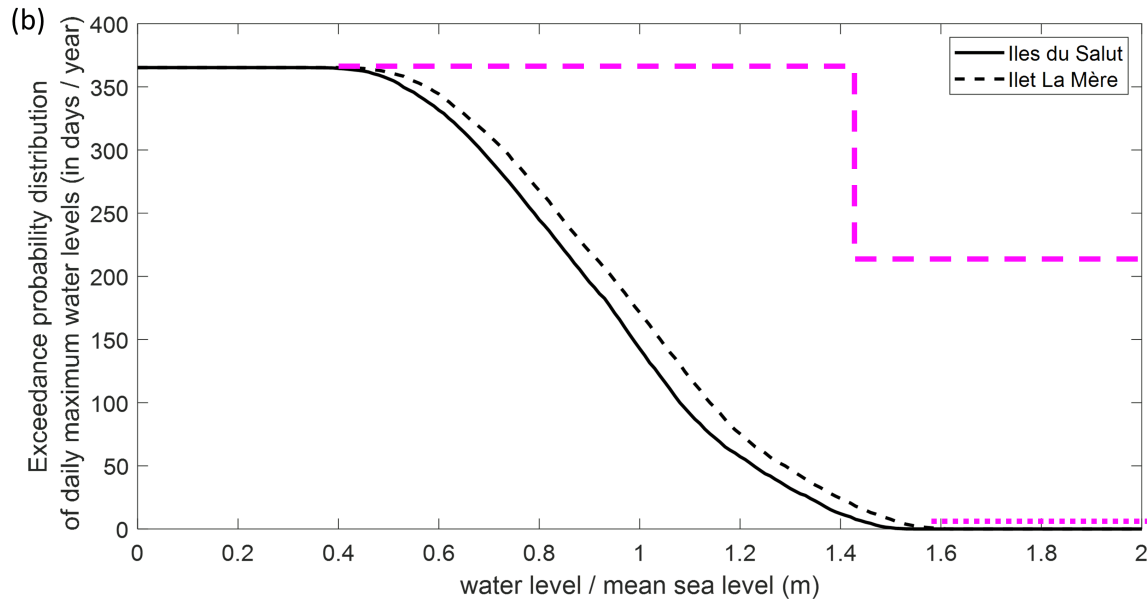
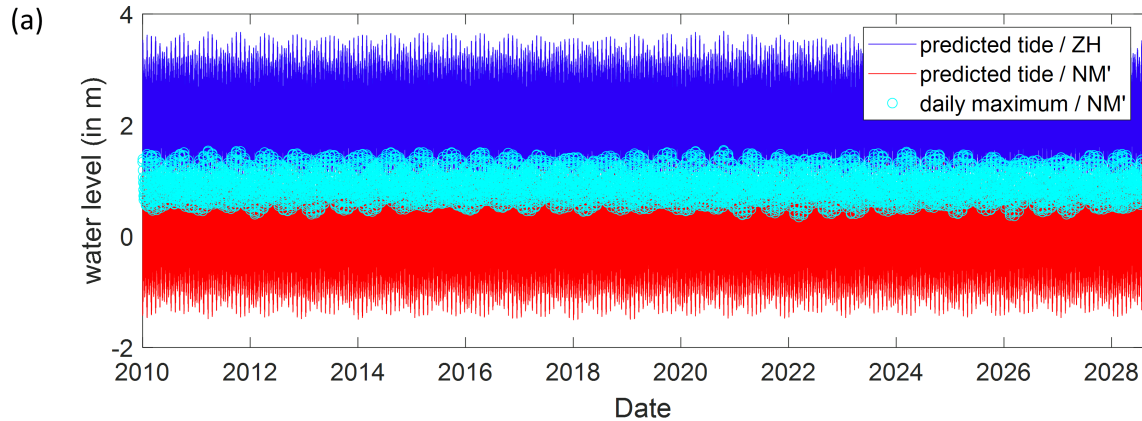
Relative sea level at TG 'Ilet La Mère' (wrt 1986-2005)

- CMIP5-based RSL historical reconstructions are well aligned with the longest TG record (Ilet la Mere; 1978-present);
- In 2100, RSL projections reach 0.46 m (RCP2.6, median) and 0.84 m (RCP8.5, median)
- One cannot exclude 2 m by 2100 in the event of ice-sheet collapse (High-end, *Thiéblemont et al.*, 2019)
- No significant local vertical land motion

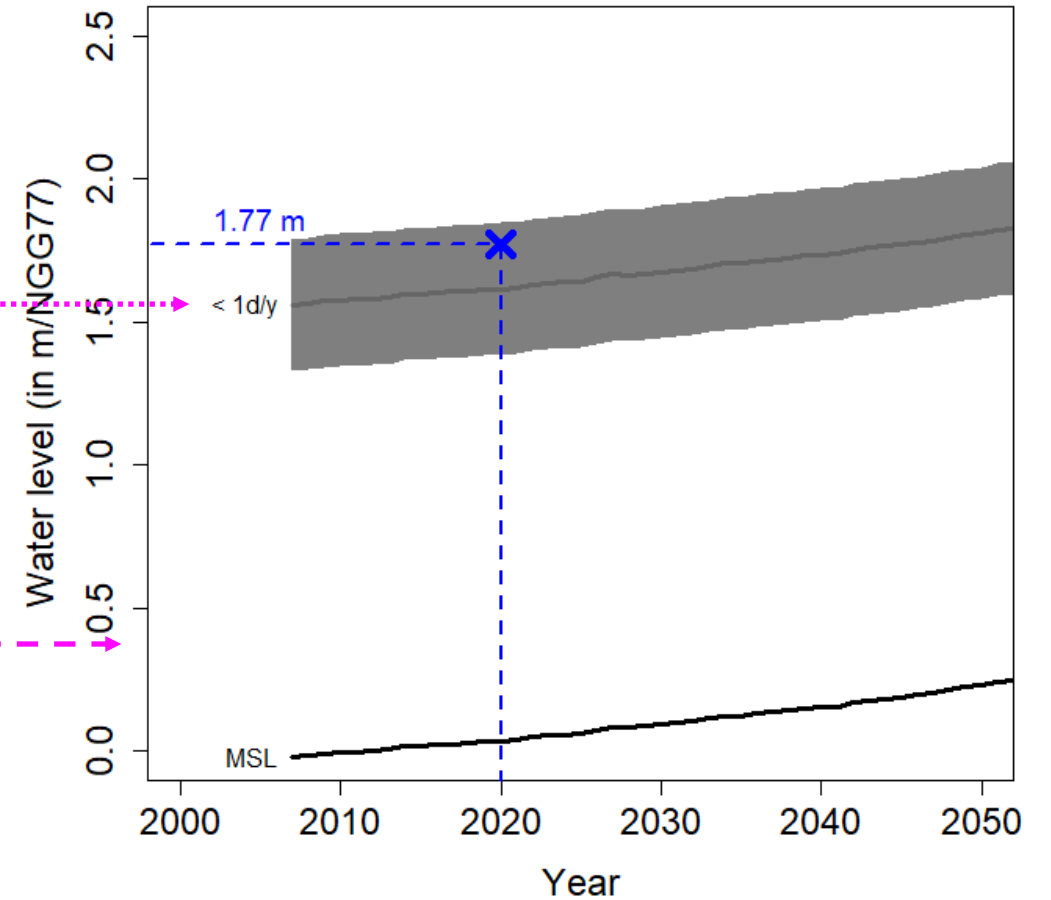


Probability curves of daily max. water level exceedance

Predicted tides (Ilet La Mère @Cayenne) wrt MSL



Projections of daily max. water level exceedance (RCP8.5, median)

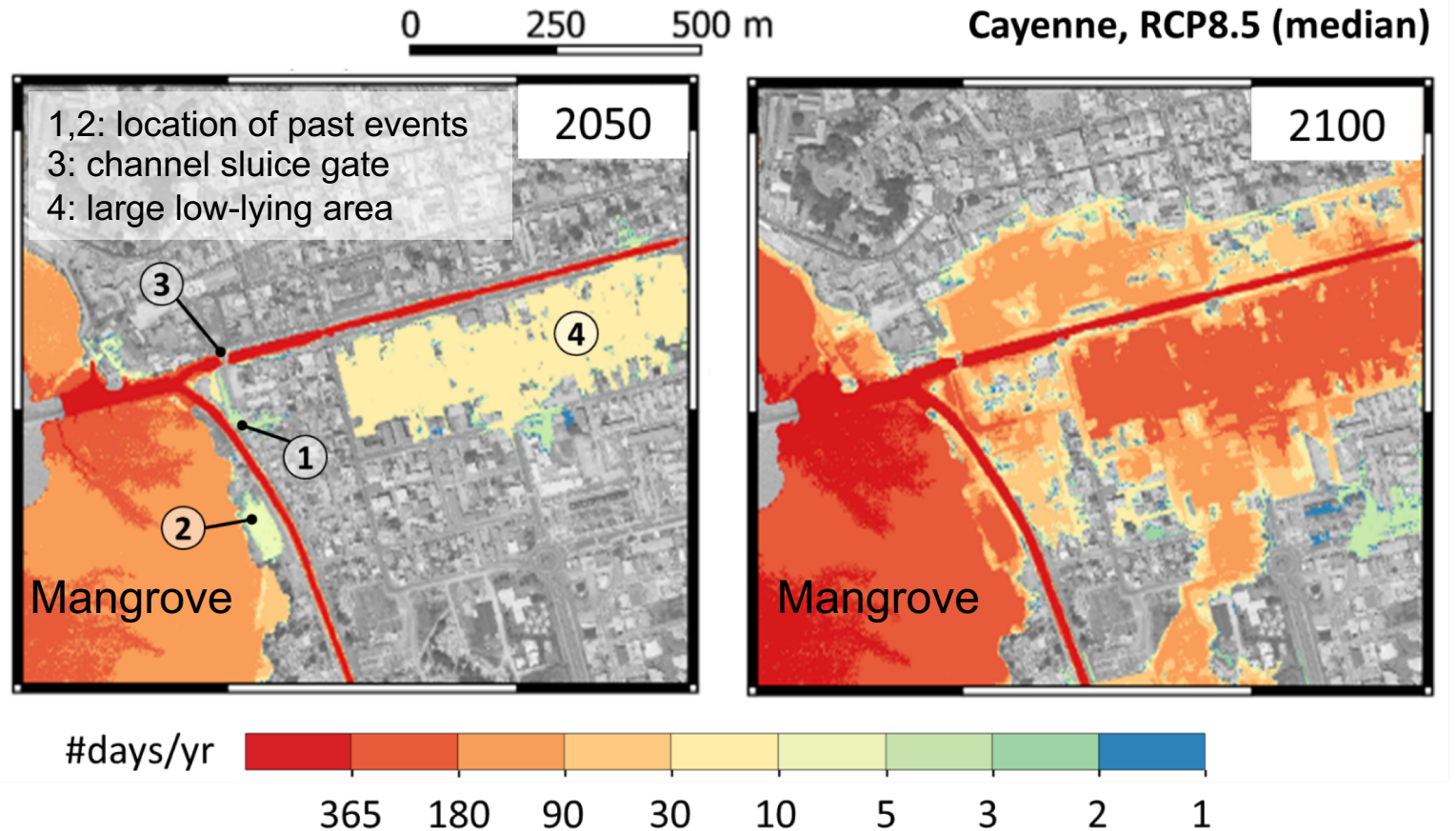


The critical level causing nuisance flooding in Cayenne can be exceeded since late 2000's

Mapping urban zones exposed to chronic flooding - Cayenne

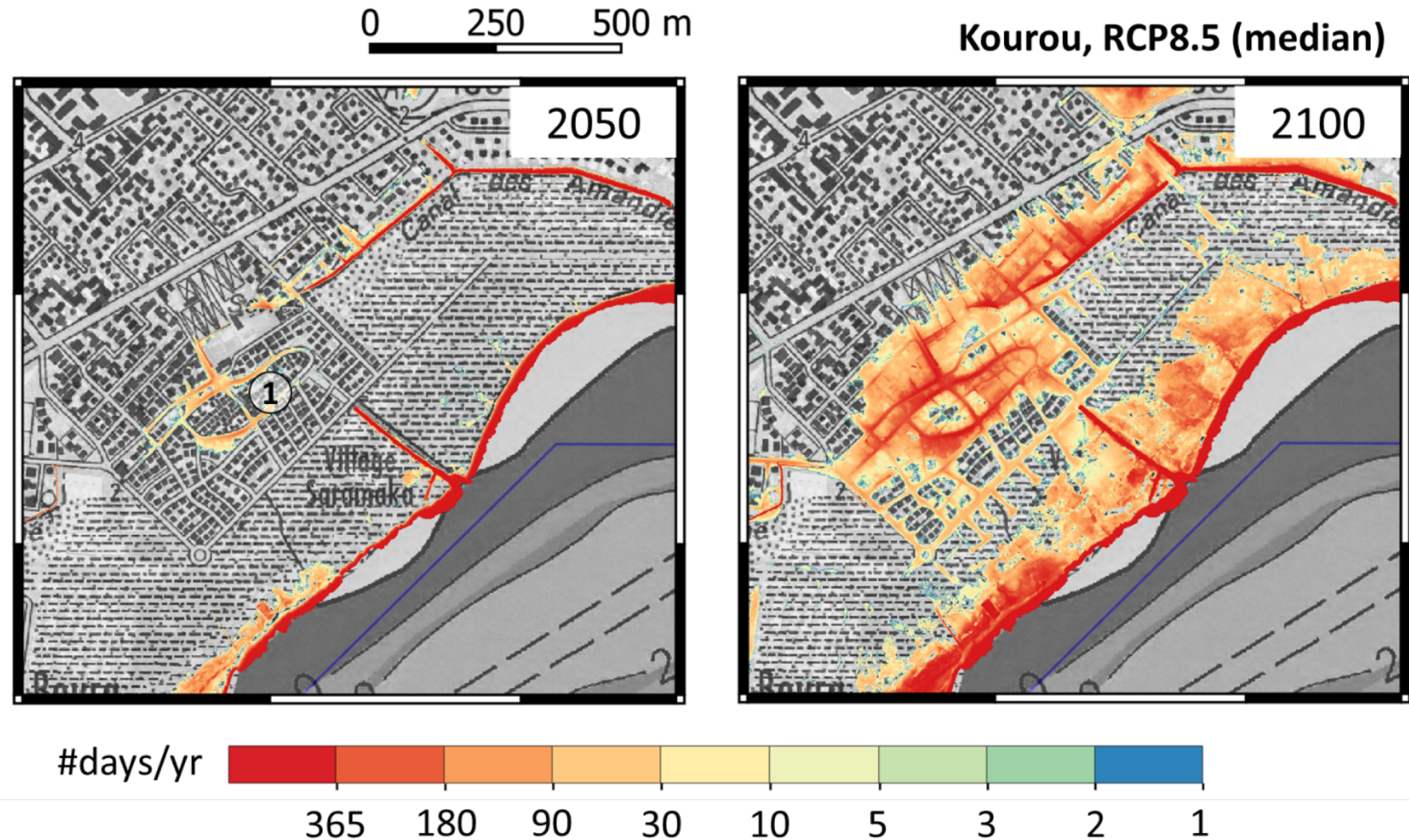
- Location of chronic flooding events recorded recently are well captured (1,2);
- Surface hydraulic connections are included;
- A large low-lying area (4) is protected by a sluice gate (which however revealed some failures over a recent maintenance check);
- By 2100, very large urban zones will be exposed (even under RCP2.6) and the sluice gate will no longer be an effective protection measure.

Map of low-lying areas projected to be exposed to chronic flooding (expressed in annual frequency of exposure)



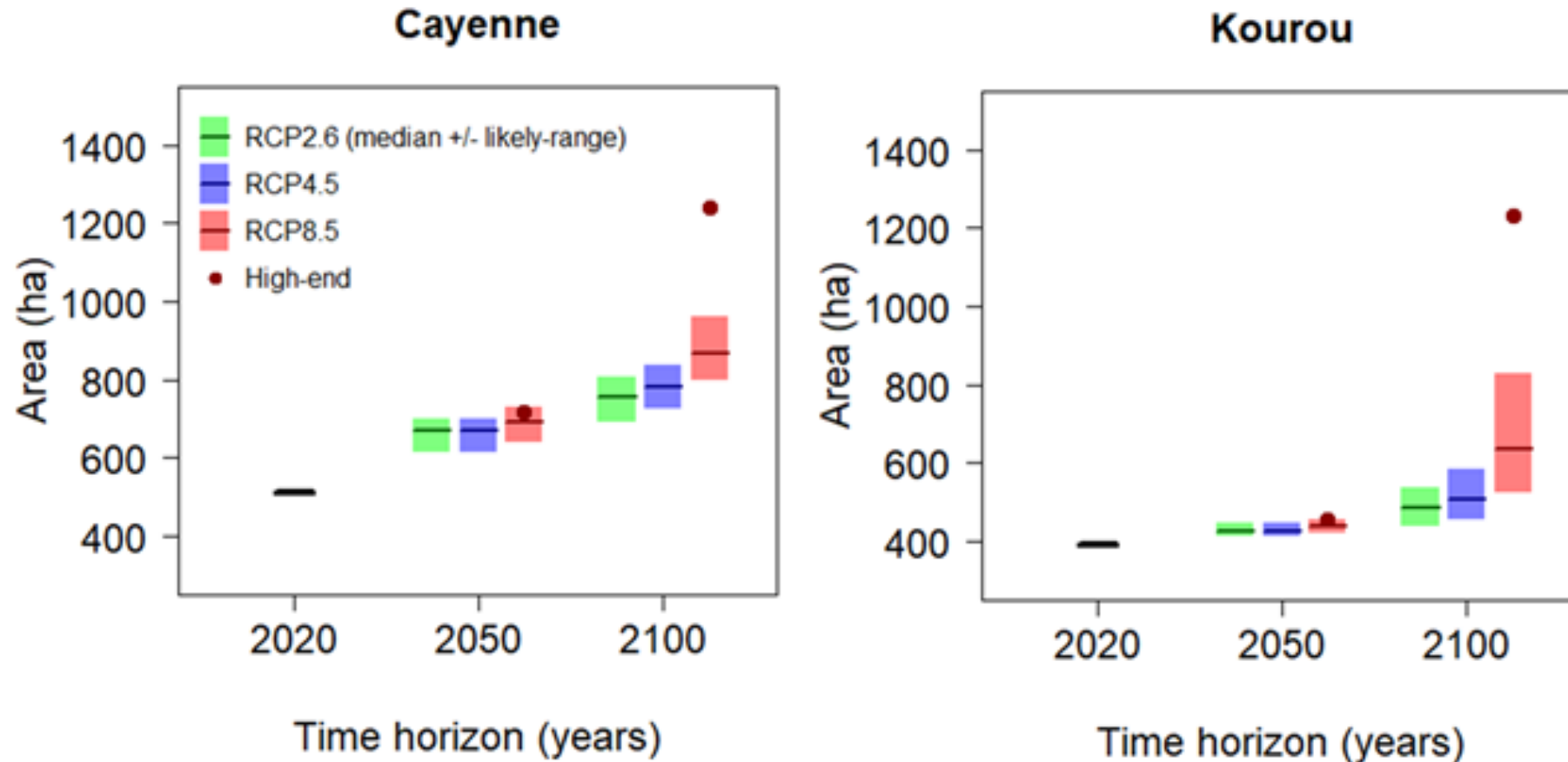
Mapping urban zones exposed to chronic flooding - Kourou

- Location of chronic flooding events recorded recently are well captured (1);
- Surface hydraulic connections are not considered here.



Evolution of chronic flooding exposure in urban areas

Change in spatial extent (in ha) exposed at least 1 day/yr to chronic flooding

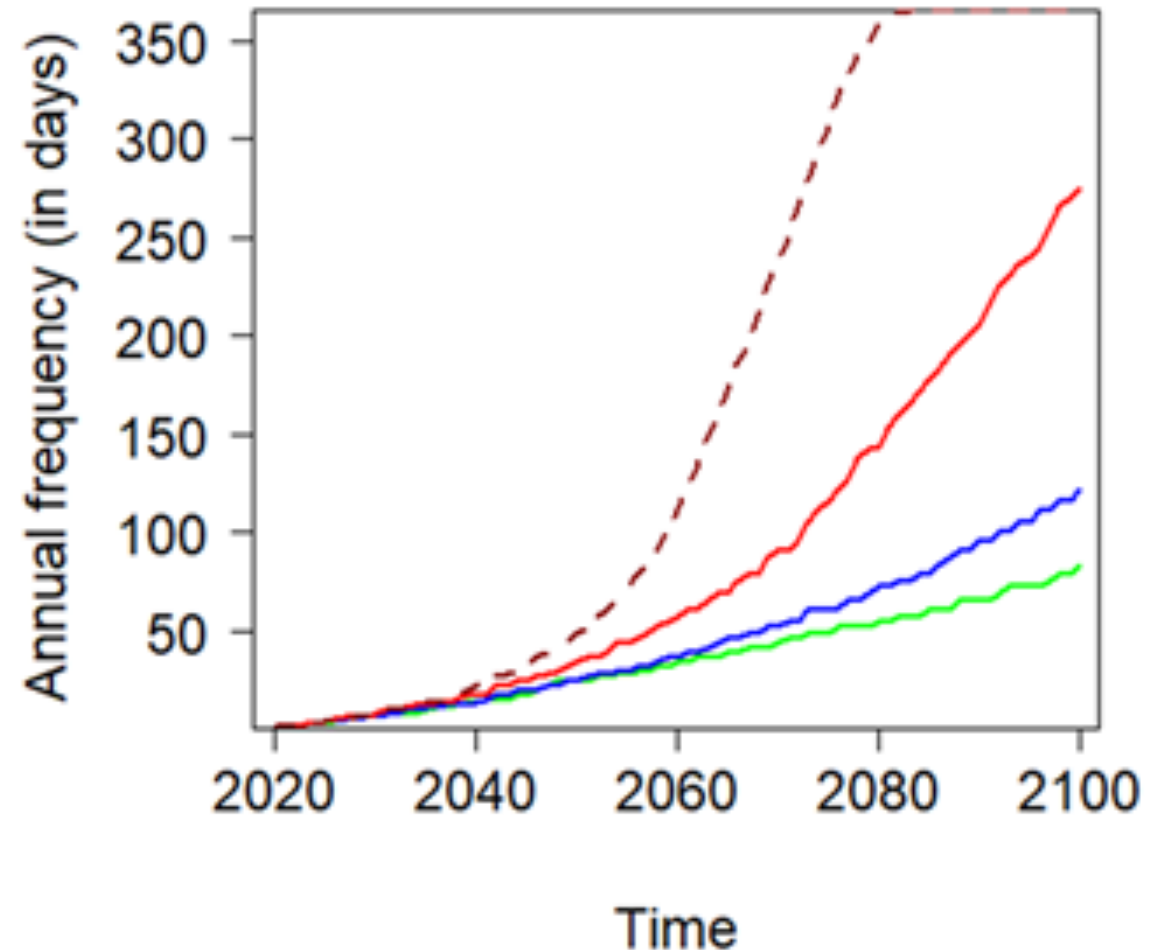


The rates of exposure increase to chronic flooding throughout the 21st century differs from one urban zone to another (due to topography)

Evolution of chronic flooding exposure in urban areas (2)

- As a consequence of SLR, the annual maximum water level of year 2020 would be exceeded ~10 days/year in 2040, independently of the scenario (median estimates);
- By the end of the century, the annual maximum water level of year 2020 would be exceeded ~2-3 months per year under the median RCP2.6 against almost every day under a median RCP8.5;

Change in annual occurrence of the 1 day/year chronic flooding level in 2020



Summary

- French Guiana experienced increasing chronic flooding events over the recent years;
- We analyze a well documented chronic flooding event in Cayenne in October 2020;
- Our probabilistic assessment of daily maximum water levels superimposed on SLR shows that this event can be reproduced and is a consequence of SLR;
- Frequency and extent of high-tide flooding events will increase in urban areas of French Guiana, but not everywhere concomitantly and depending on scenarios...
- ... and therefore imply tailored adaptation strategies design locally.



RÉPUBLIQUE
FRANÇAISE

*Liberté
Égalité
Fraternité*



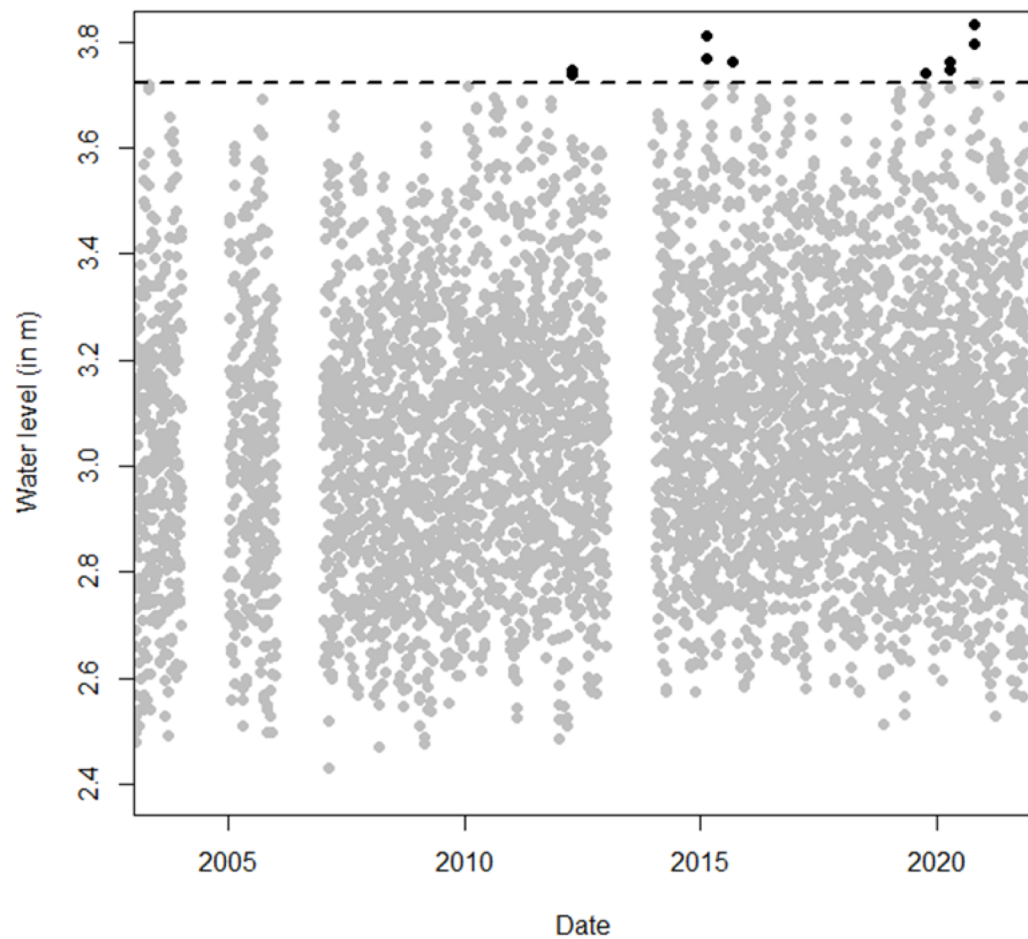
Géosciences pour une Terre durable

brgm

THANK YOU !

r.thieblemont@brgm.fr

Daily max water level @Ile Royale TG



Daily max water level @Ile Royale TG w/o SLR since 2003

