

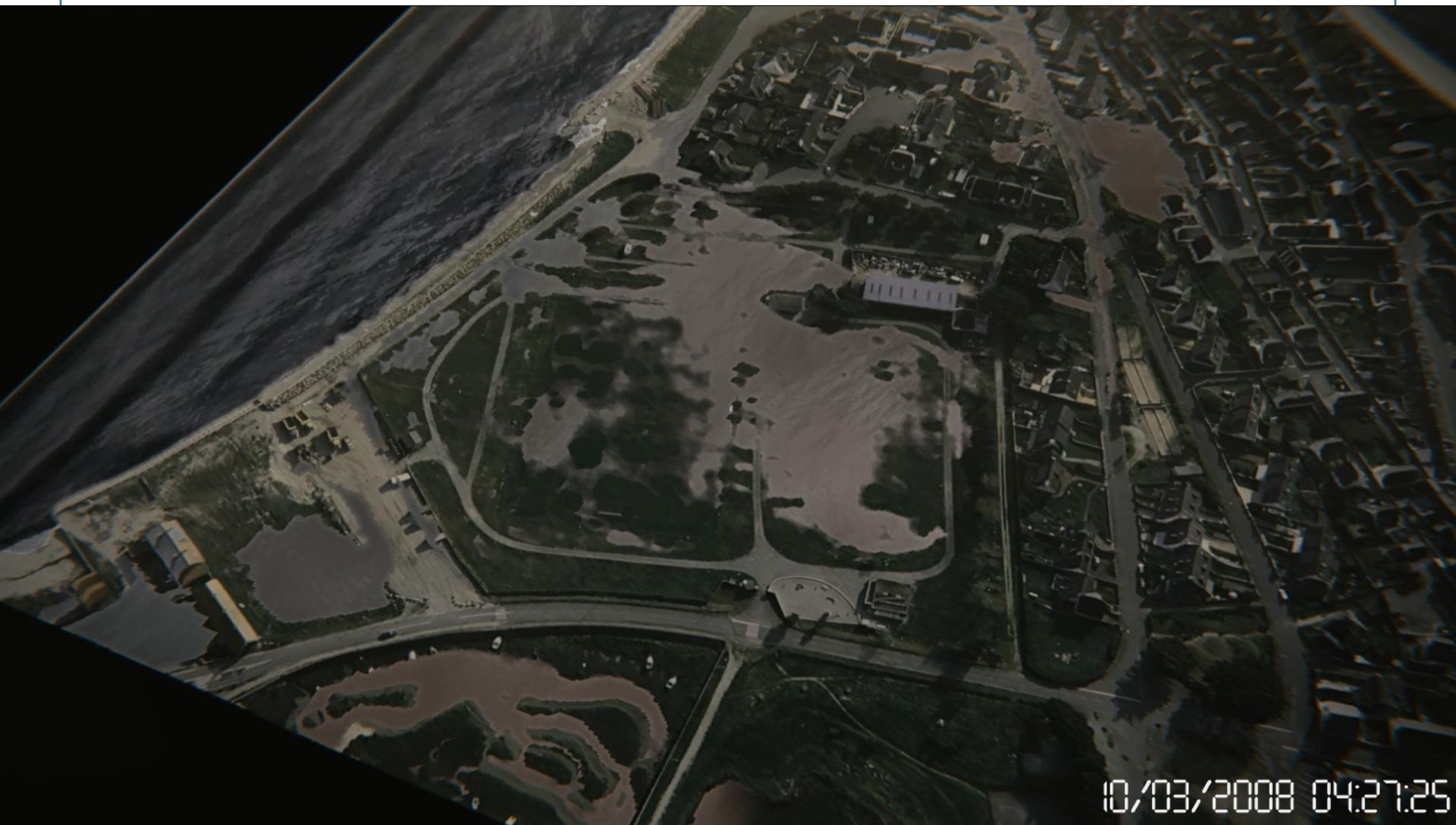
Impacts of sea-level rise on coastal erosion and flooding

Gonéri Le Cozannet, BRGM

*Déborah Idier, Carlos Oliveros, Manuel Garcin,
Rodrigo Pedreros, Sylvestre Le Roy, Heloise Muller,
Jeremy Rohmer, Jean-Charles Manceau,
Thomas Bulteau, Cyril Mallet, Daniel Raucoules*

TEMPETE JOHANNA à GAVRES (Morbihan)

Simulation de la submersion
causée par les franchissements
de vagues lors de la marée haute
du 10/03/2008 au matin



10/03/2008 04:27:25



Etude réalisée par le BRGM pour le compte de la Direction Générale de la Prévention des Risques (DGPR) du Ministère de l'Écologie dans le cadre du projet "Méthodologie et prototype d'outil de visualisation 3D réaliste de modélisations de submersions marines"

Equipes BRGM :

Direction Risques et Prévention – Unité Risques Côtiers et Changement Climatique et
Direction des Systèmes d'Information – Unité Applications et Expertise Technologique

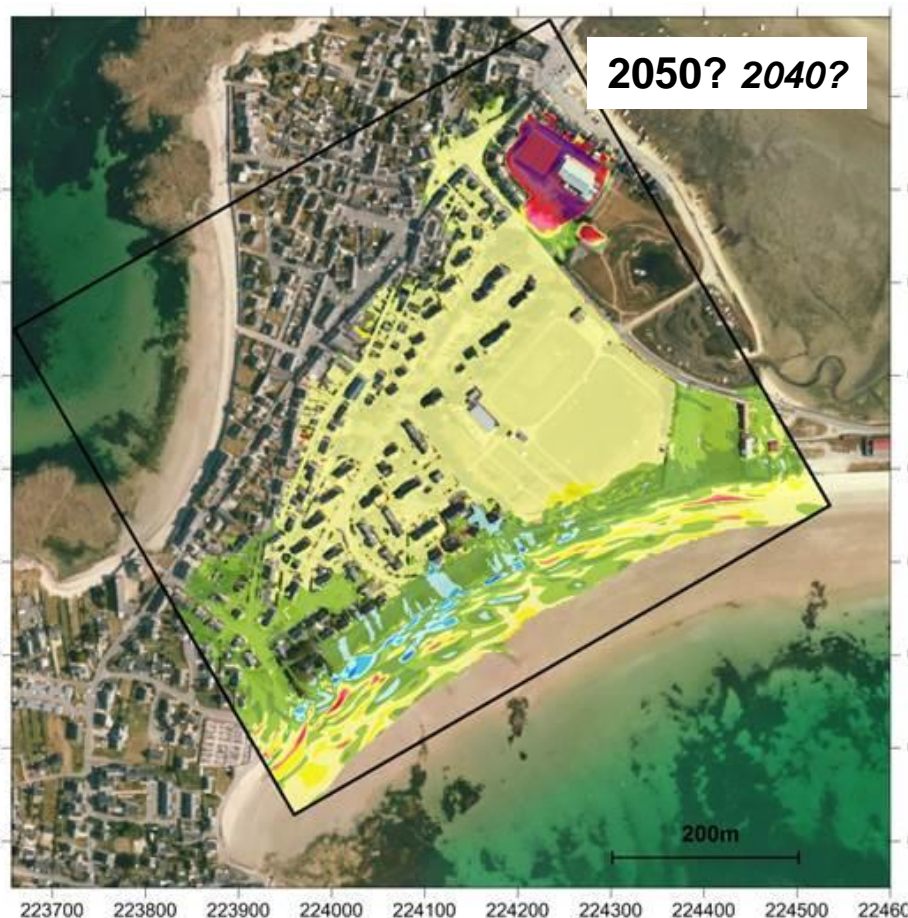
Réalisation images de synthèse 3D : Jean-Gabriel LOQUET.

Données issues de la modélisation (modèle SURF-WB) de la submersion marine à Gâvres (56) lors de la tempête Johanna (10 mars 2008) réalisées dans le cadre du projet JOHANNA : Analyse des dommages au bâti liés à la submersion marine lors des tempêtes.

Etude réalisée dans le cadre d'une convention de recherche financée par la Fondation MAIF et le BRGM en partenariat avec le laboratoire LETG de l'UBO (D'après Le Roy, S., Pedreros, R., André, C., Paris, F., Lecacheux, S., Marche, F., and Vinchon, C.: Coastal flooding of urban areas by overtopping: dynamic modelling application to the Johanna storm (2008) in Gâvres (France), Nat. Hazards Earth Syst. Sci. Discuss., 2, 4947-4985, doi:10.5194/nhessd-2-4947-2014, 2014.)

Sensitivity to « only » 10 and 20cm sea-level rise

Sea-level +10cm



Sea-level +20cm



Increase in maximum water level for a storm surge identical to the 2008 event with 10/20cm sea-level rise

1m

20 10 0 -10 -20 cm



Without adaptation, sea-level rise will amplify coastal flooding hazards

- > Higher water levels during events
- > Increased current velocity
- > More frequent flooding events
- > Data and research needs:
 - local very high resolution bathymetric and topographic data
 - impacts of nearshore sedimentary processes and human adaptation



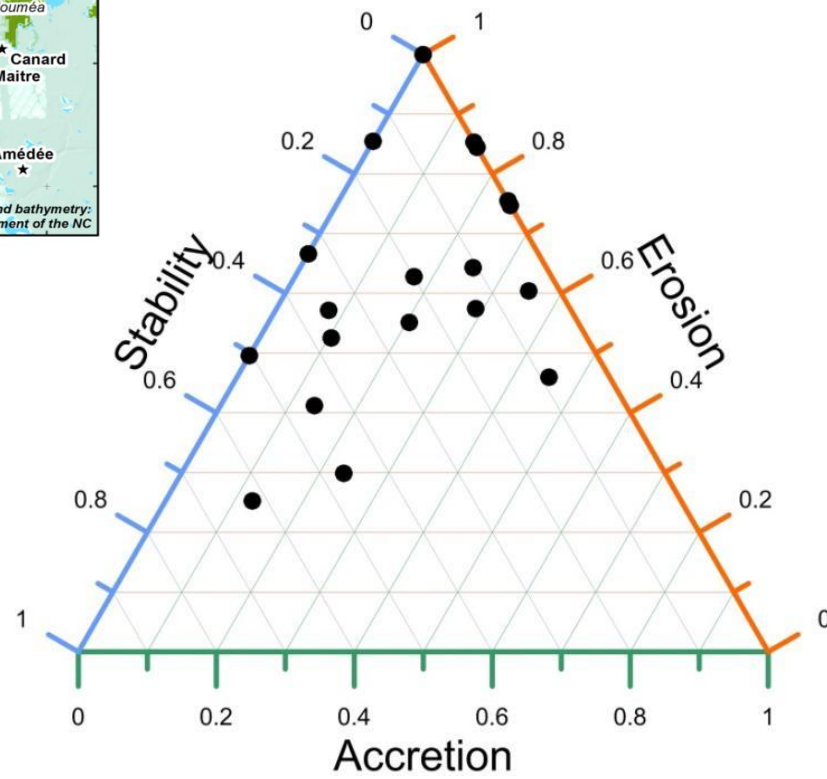
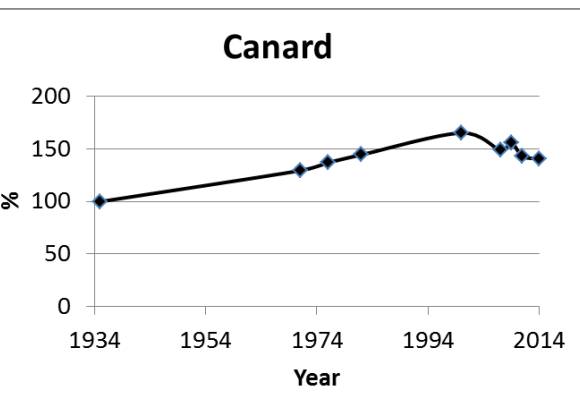
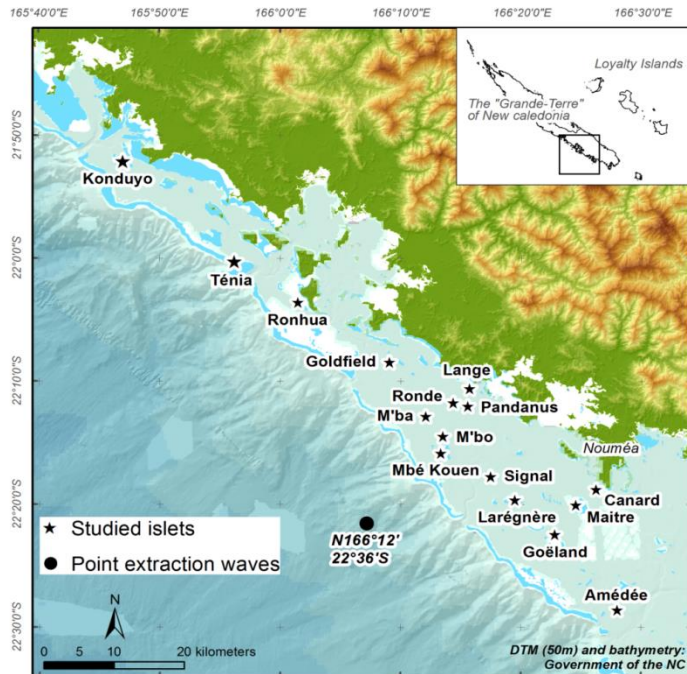
Shoreline changes: superimposed effects

- > Extreme events
- > Seasonnal variability
- > Interannual variability
- > Multidecadal trends



Can we observe impacts of sea-level rise on shoreline changes already?

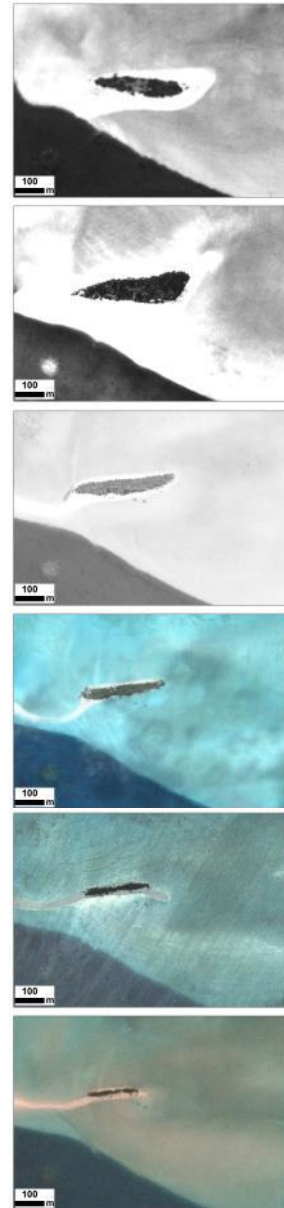
Detection and attribution of climate change impacts



1954

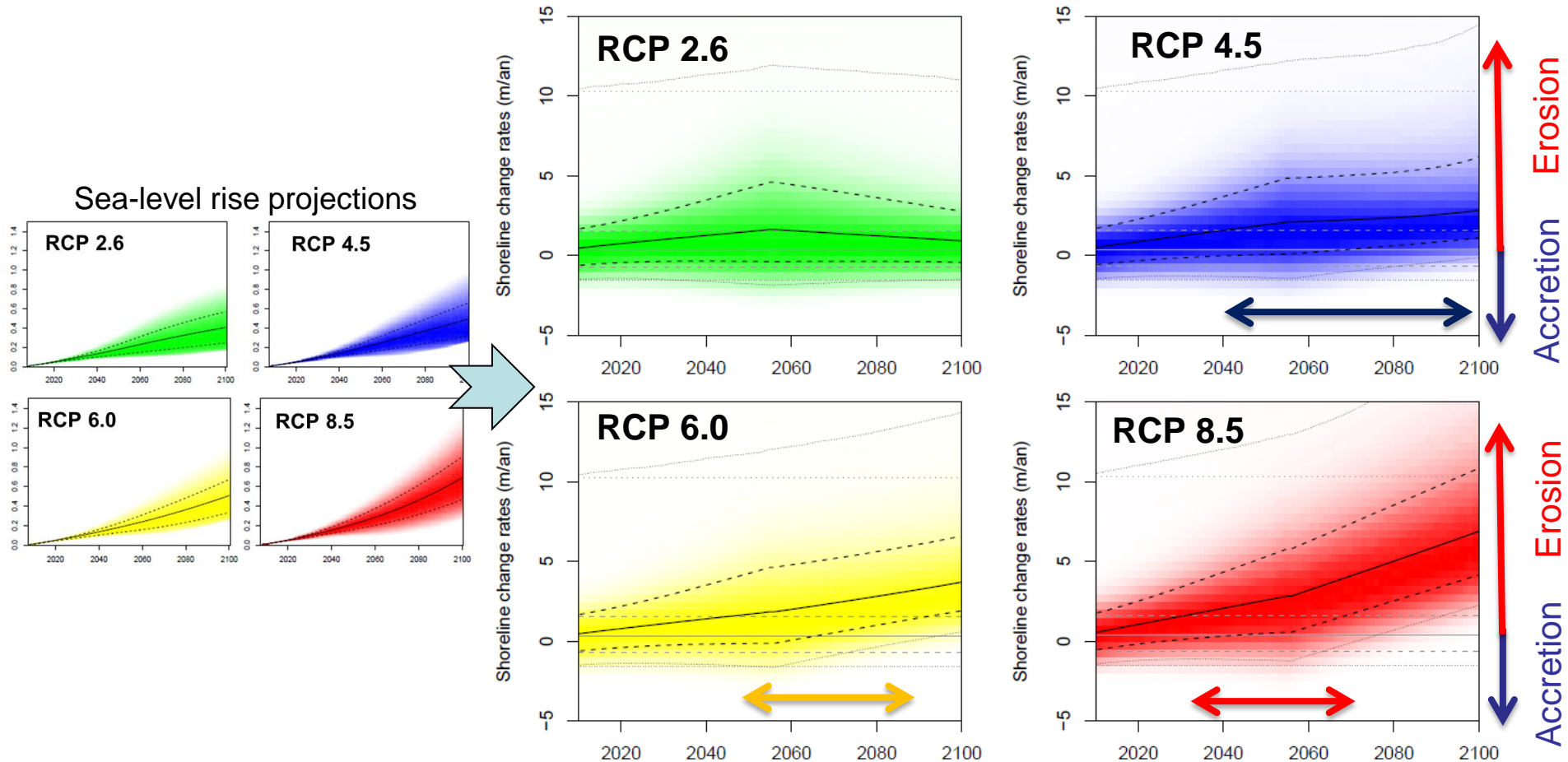


2013



**It is still too early to observe shoreline retreat driven by sea-level rise
⇒ When could a signal emerge?**

Low-energy beaches without coastal works

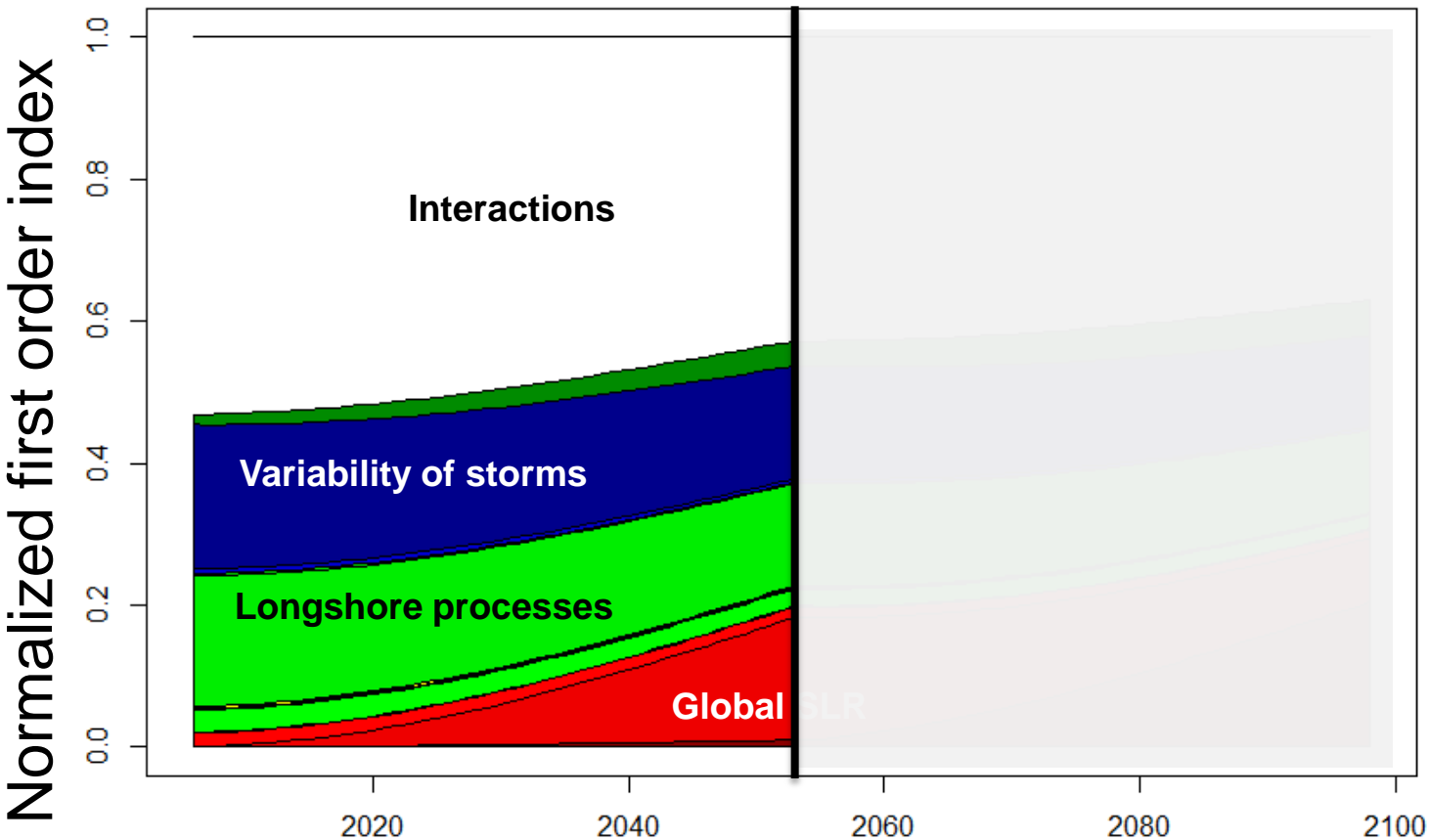


- > Limited confidence in the coastal impact model
- > Large uncertainties

Ranking observation & research priorities

Global sensitivity analysis – decomposition of variance (Sobol', 2001; Saltelli et al., 2008)

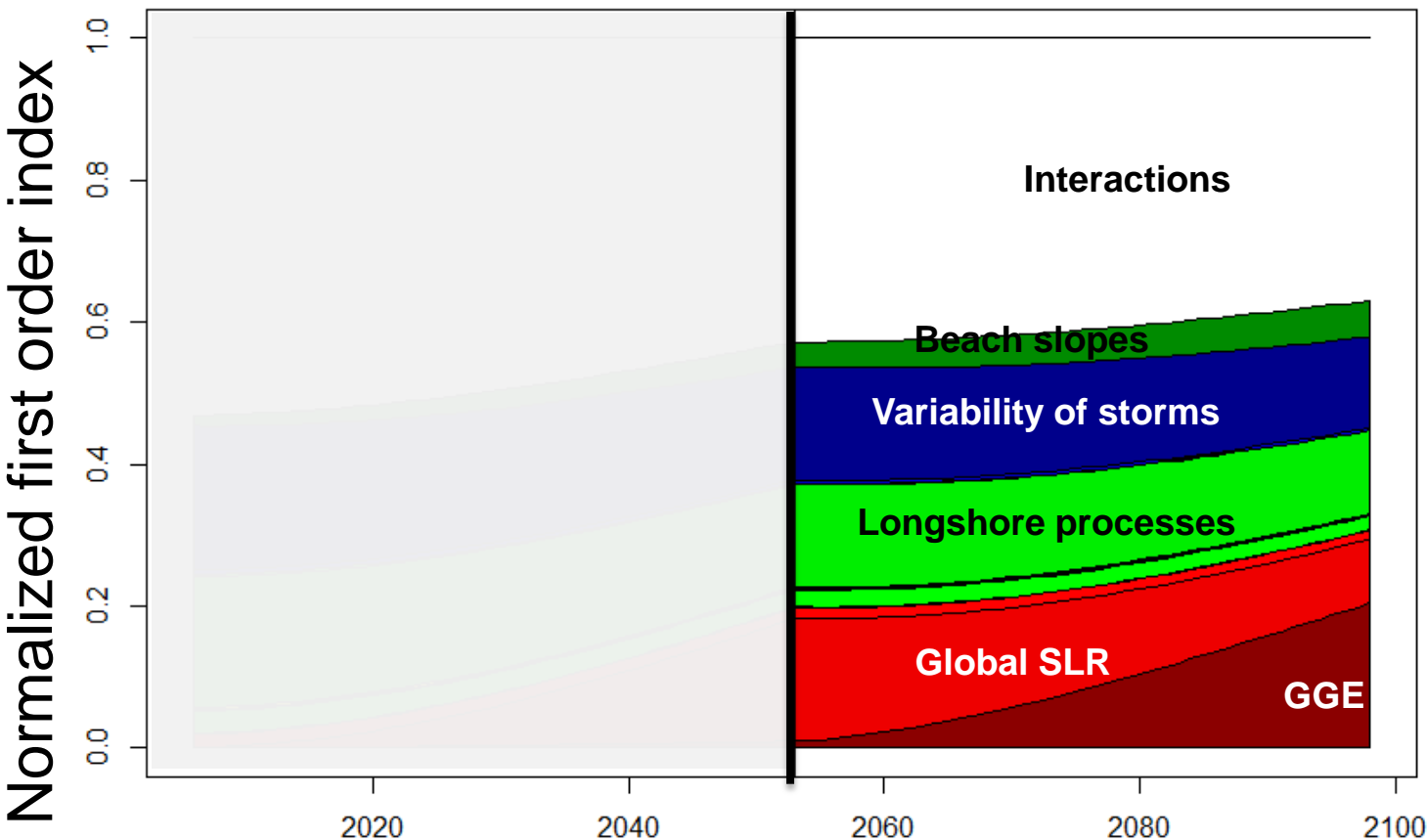
⇒ 1st part of the 21st century: growing importance of uncertainties due to global sea-level rise



Ranking observation & research priorities

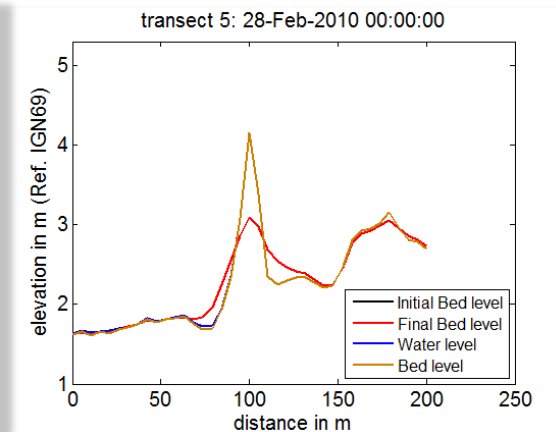
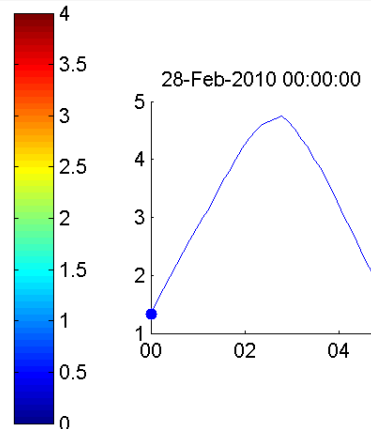
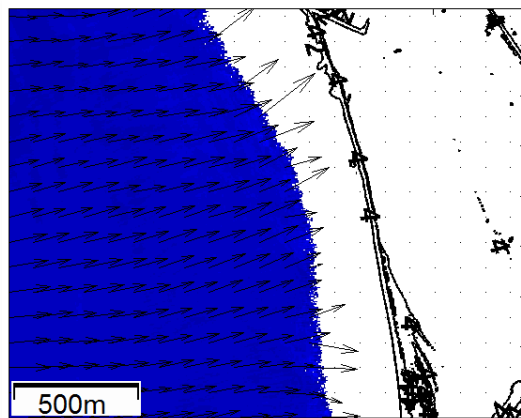
Global sensitivity analysis – decomposition of variance (Sobol', 2001; Saltelli et al., 2008)

- ⇒ 1st part of the 21st century: growing importance of uncertainties due to global sea-level rise
- ⇒ 2nd part of the 21st century: growing importance of uncertainties due to greenhouse gaz emissions

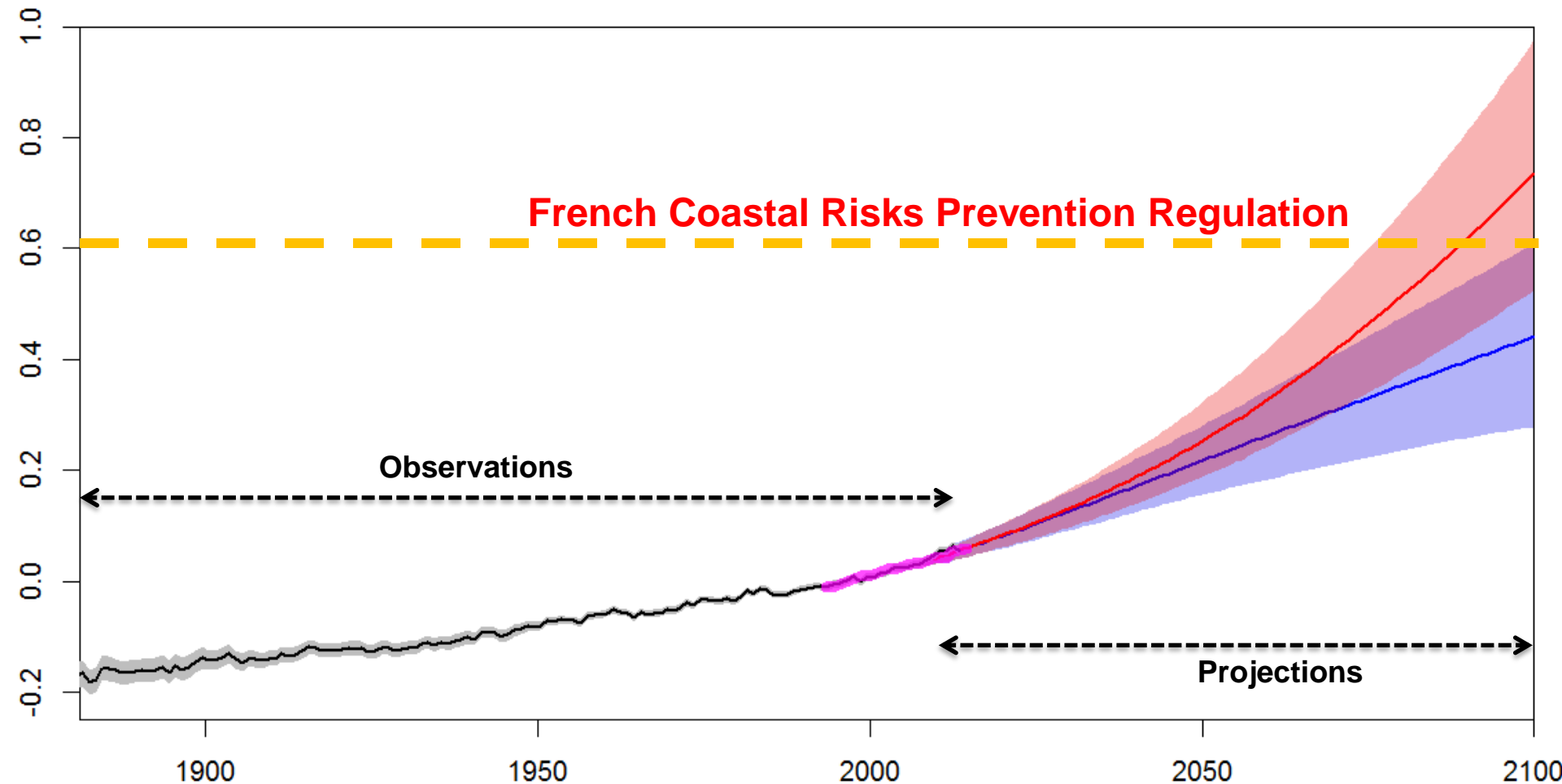


Sea-level rise will exacerbate coastal erosion

- > But there are large uncertainties
- > Observation and research needs:
 - shoreline change observations (high resolution in space and time)
 - improved coastal evolution models applicable at multidecenal time scale

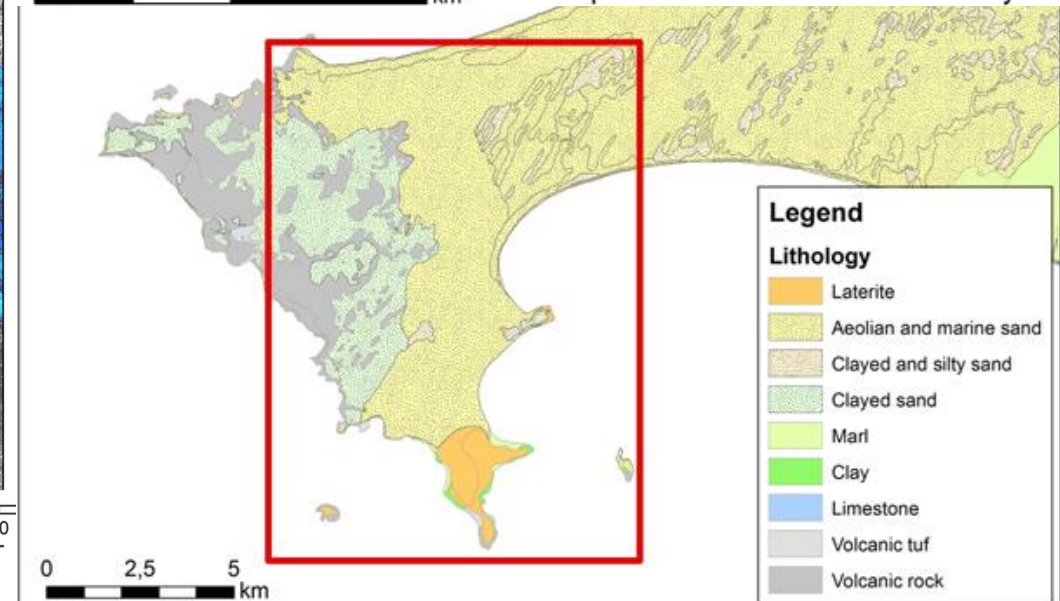
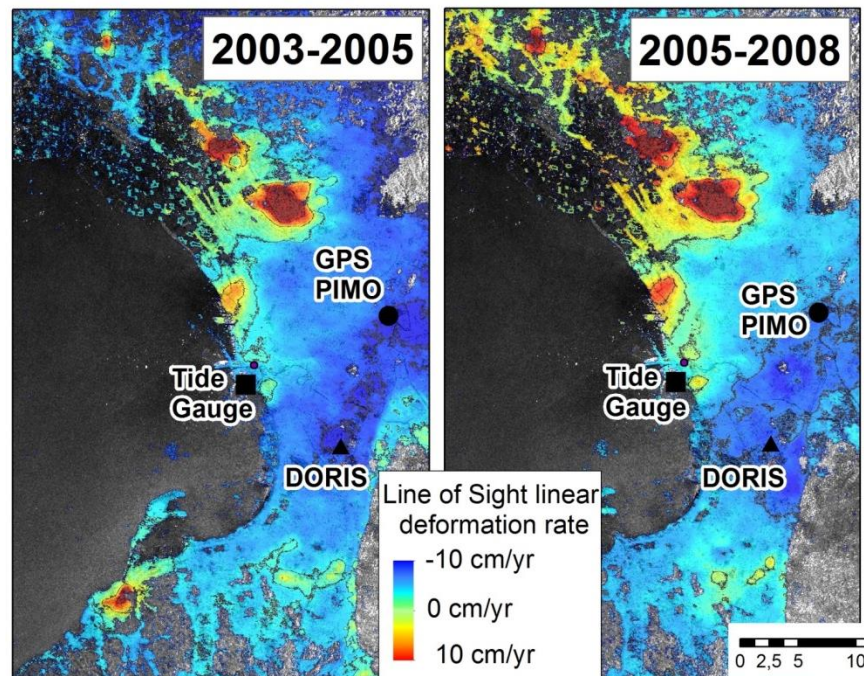
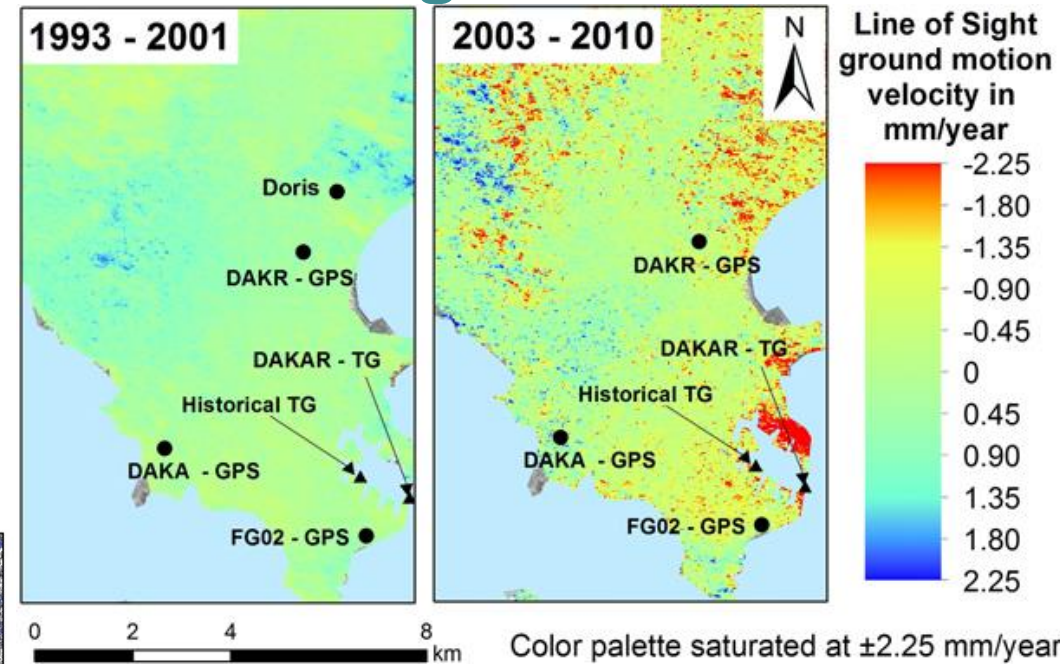


What sea-level rise projections do we need?



Coastal users need sea-level projections considering local coastal vertical ground motions

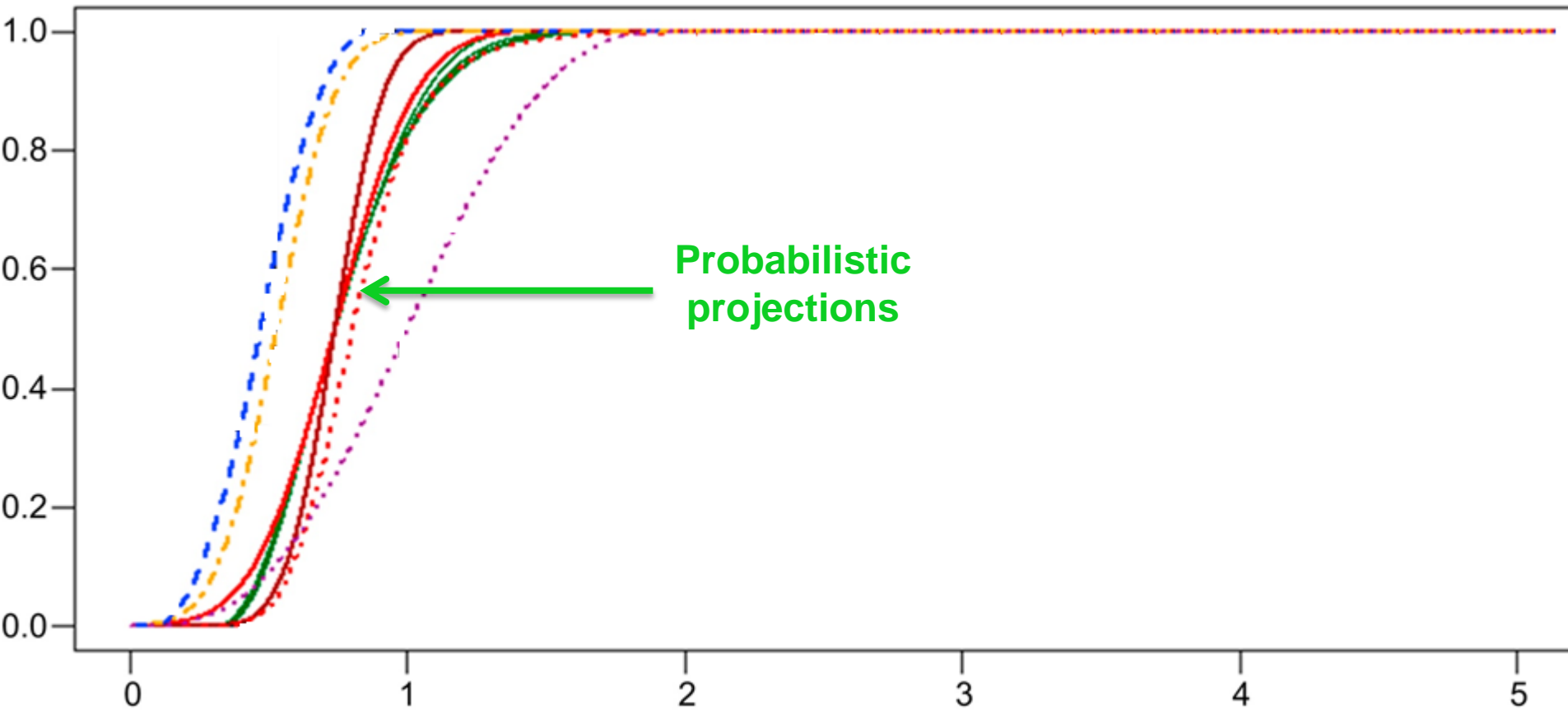
- > Examples with high spatial and temporal variability of vertical ground motions
- > Need for geodetic observations



Coastal users need sea-level projections considering their uncertainties

- Example: probabilistic projections

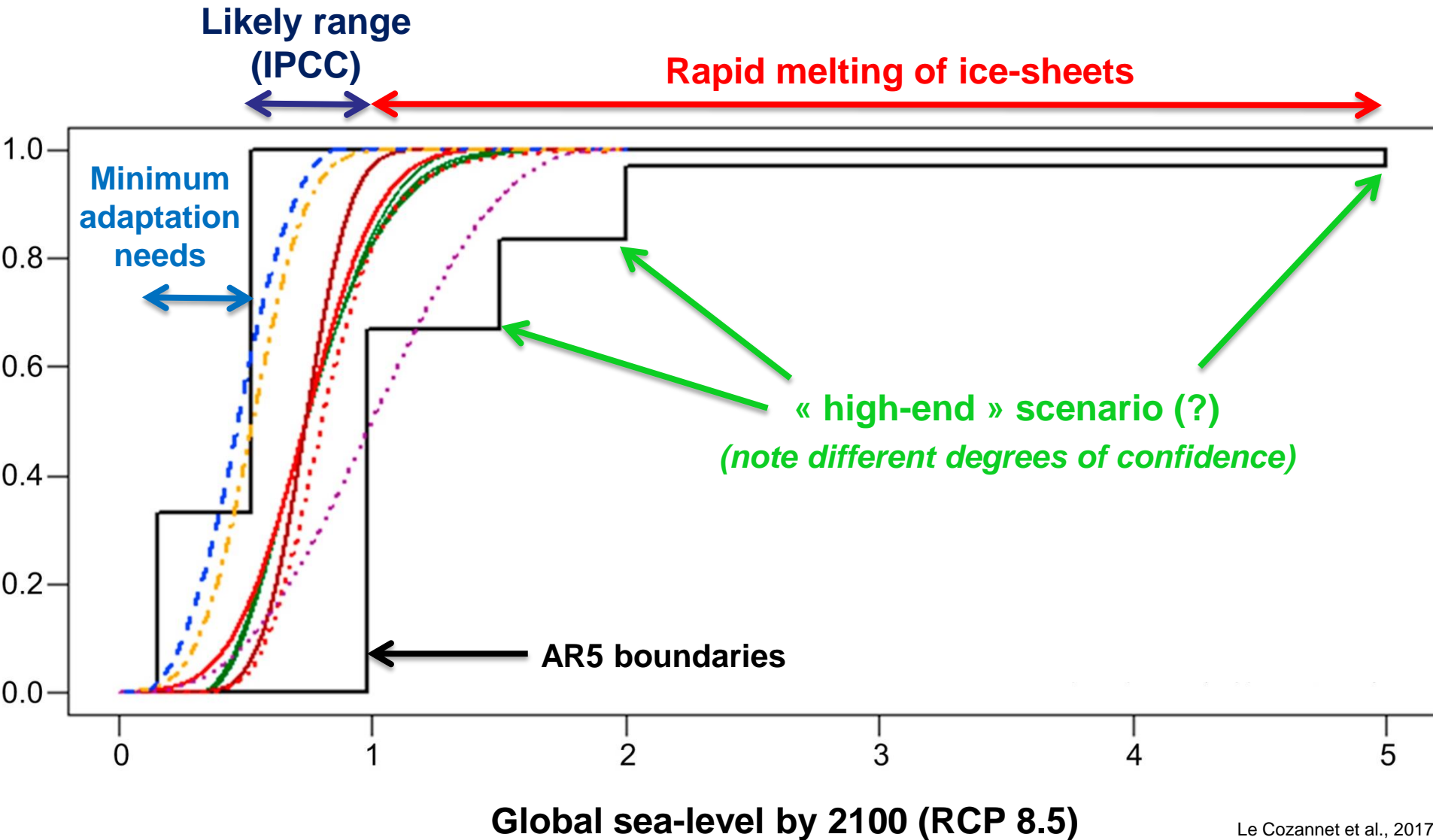
Cumulative distribution functions



Global sea-level by 2100 (RCP 8.5)

Coastal users need sea-level projections considering their uncertainties

- Risk averse users may consider extra-probabilistic theories of uncertainties



Coastal climate services for adaptation will require:

- sea-level and coastal observations
- sea-level projections aligned to coastal user's needs
- improved coastal biophysical impacts models
- applied mathematics to represent and propagate uncertainties

Please note:

<http://www.sealevel2017.org/>



INTERNATIONAL WCRP/IOC CONFERENCE 2017
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New York City, NY
www.sealevel2017.org



Thank you for your attention

g.lecozannet@brgm.fr

Background articles:

Le Roy et al. (2015) - Hydrodynamic modelling

<http://www.nat-hazards-earth-syst-sci.net/15/2497/2015/nhess-15-2497-2015.html>

Garcin et al. (2016) - New Caledonian Islets

<http://www.sciencedirect.com/science/article/pii/S0278434316301583>

Le Cozannet et al. (2016) - Observability of the Bruun effect

<http://journal.frontiersin.org/article/10.3389/fmars.2016.00049/full>

Muller et al. (2016) - Storm impact on dunes

<http://www.jcronline.org/doi/abs/10.2112/JCOASTRES-D-15-00102?code=cerf-site>

Le Cozannet et al. (2015) - Dakar Subsidence

<http://iopscience.iop.org/article/10.1088/1748-9326/10/8/084016/meta>

Raucoules et al. (2013) - Manila subsidence

<http://www.sciencedirect.com/science/article/pii/S0034425713002794>

Le Cozannet et al. (2017) - Sea-level possibilistic projections

<http://iopscience.iop.org/article/10.1088/1748-9326/aa5528/meta>

Coastal observatories:

Aquitaine coastal observatory: <http://littoral.aquitaine.fr/>

New Caledonian Coastal Observatory: <https://dimenc.gouv.nc/geologie/observatoire-du-littoral-de-nouvelle-caledonie-oblic>