Photo: Global News

SurgeMIP

ADVANCING COASTAL FLOODING SCIENCE: COORDINATING MODEL INTERCOMPARISON AND SURGE CLIMATE PROJECTION EFFORTS

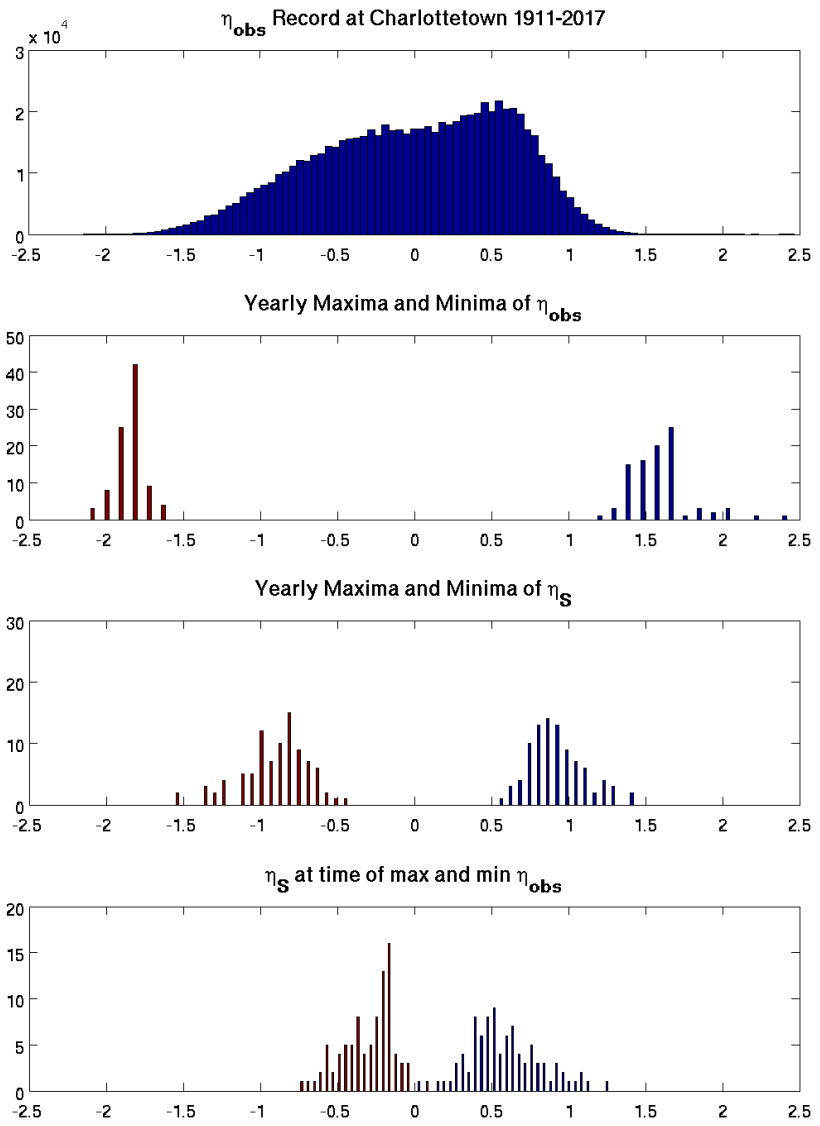
Natacha B. Bernier, M. Hemer, N. Mori and the SurgeMIP Community

WHAT IS IN SEA LEVEL RECORDS

- Extreme surges are rarely the ones leading to extreme total water levels
- We must forecast surges at all times, not only when large storms are expected.

WHAT IS OFTEN NOT IN SEA LEVEL RECORDS

- Sufficient coverage
- Wave effects
- Compounded effects



WHY IS SEA-LEVEL RISE AN ISSUE?

1775 Hurricane

1869 Saxby Gale

1976 Ground Hog Day Storm

2000 PEI Storm

2003 Hurricane Juan

2010 December storm

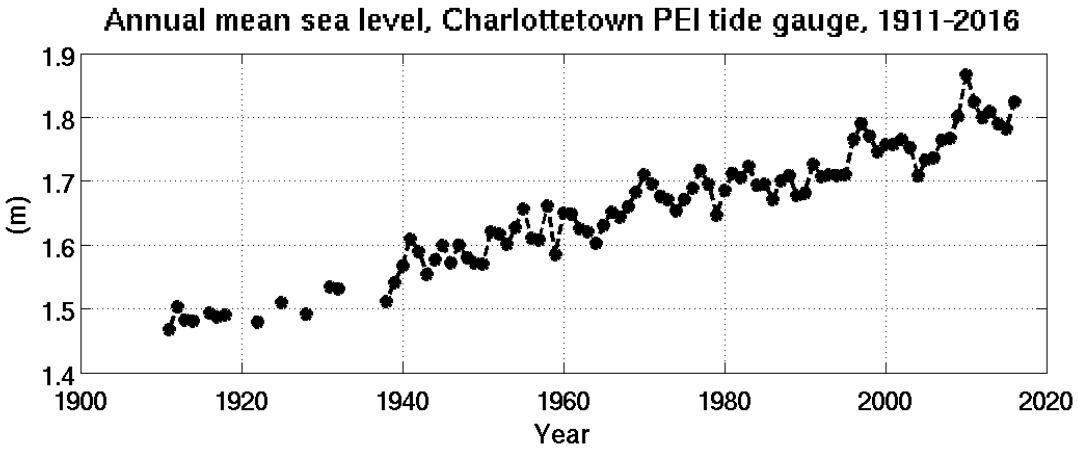
2016-2017 Qc and NL Winter Storms

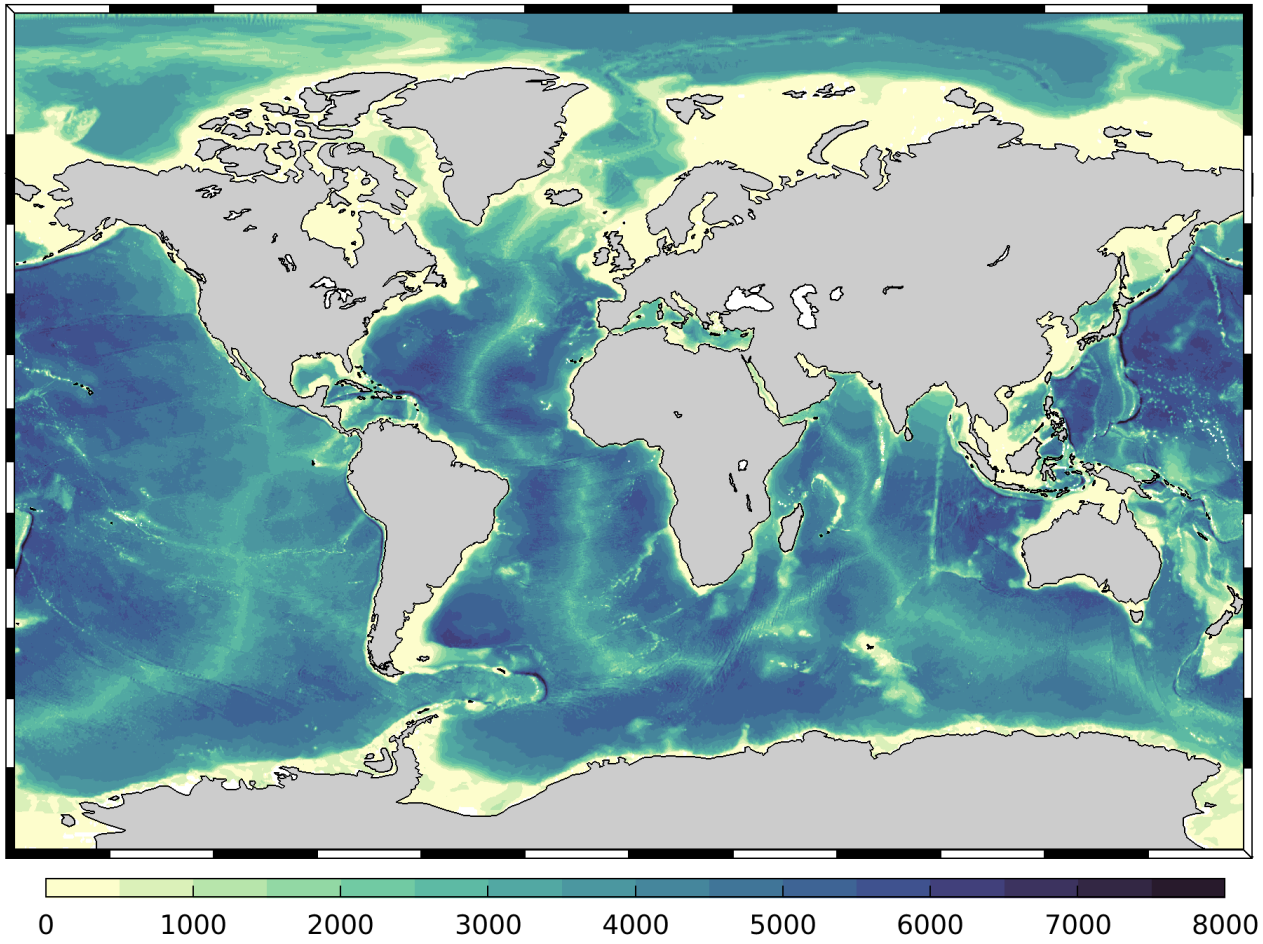
2022 Fiona

Storm surges during these events varied between 1 and 2m – under extreme conditions they can exceed 8m

In many areas a 60cm surge occuring at or near high tide is sufficient to cause flooding

With sea-level rise jumping the gap to the critical level becomes easier





- World's coastlines are exposed to powerful storms such as hurricanes, typhoons, medicane, polar outbreaks, nor'easters.
- Low-lying areas are exposed to floods, some cliffs and melting permafrost prone to erosion.
- Population exposed to surge hazard is increasing
- Mean sea level is rising
- Powerful storms are increasing

WHO SHOULD CARE ABOUT STORM SURGES?

MOTIVATION

- **Public and private sectors require more accurate forecasts with longer lead times worldwide (e.g., for activation of emergency measures including evacuations).**
- **CIFI bring much needed information to those in need, but they are costly, and reaching all in need is too slow.**
- **Can we reach more (all) faster?**
- **Can we contribute to the UN Early Warning For All Initiative through the provision of numerical guidance that is skillful in all ocean basins?**
- **Can we provide guidance for adaptation worldwide?**
- **Can we coordinate efforts to provide projections that sample scenarios?**
- **Can we produce informative and actionable data at the community level worldwide?**

WHERE DO WE START?

Guidance over the next hours to weeks

- Deterministic, ensemble, surge only or coupled systems available worldwide – most focussed over team's region of interest.
- Recently developed global systems.

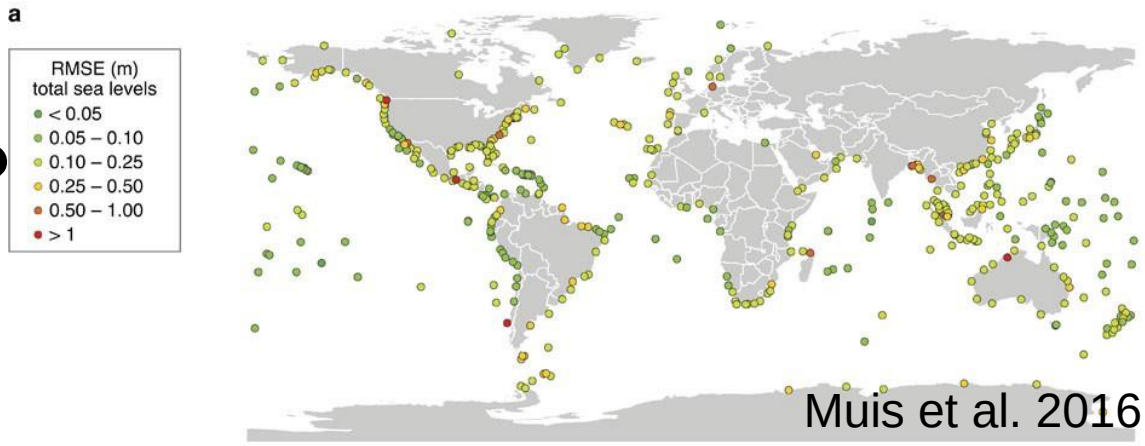
Guidance over the next years to century

- Globally coordinated projections based on data and or reanalysis.
- Emergence of projections driven with data from scenario base climate projections.

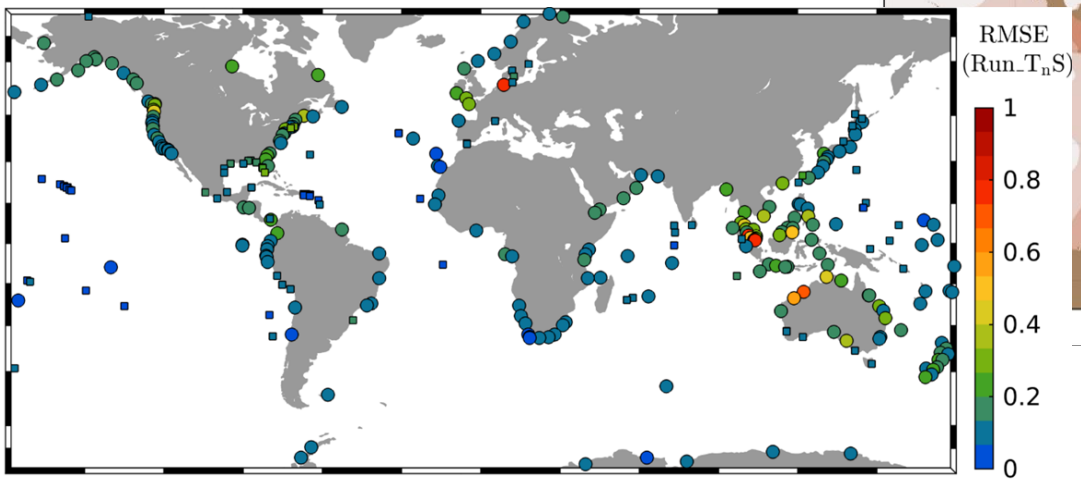
WHERE DO WE STAND TODAY?

- A few global systems - verified over different time periods and tide gauges.

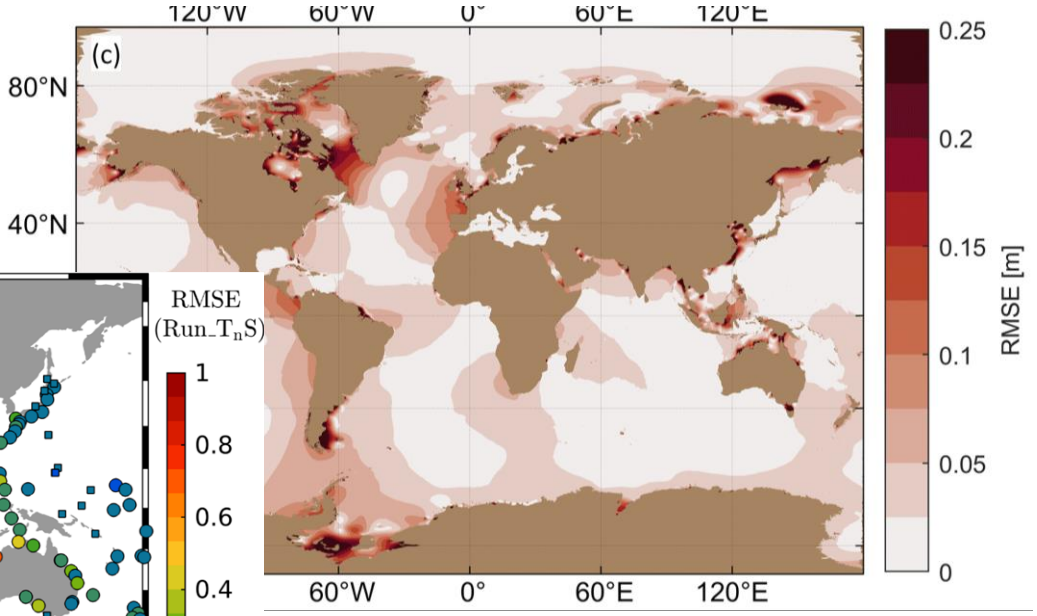
- Rich diversity of regional models that often do not overlap



Muis et al. 2016

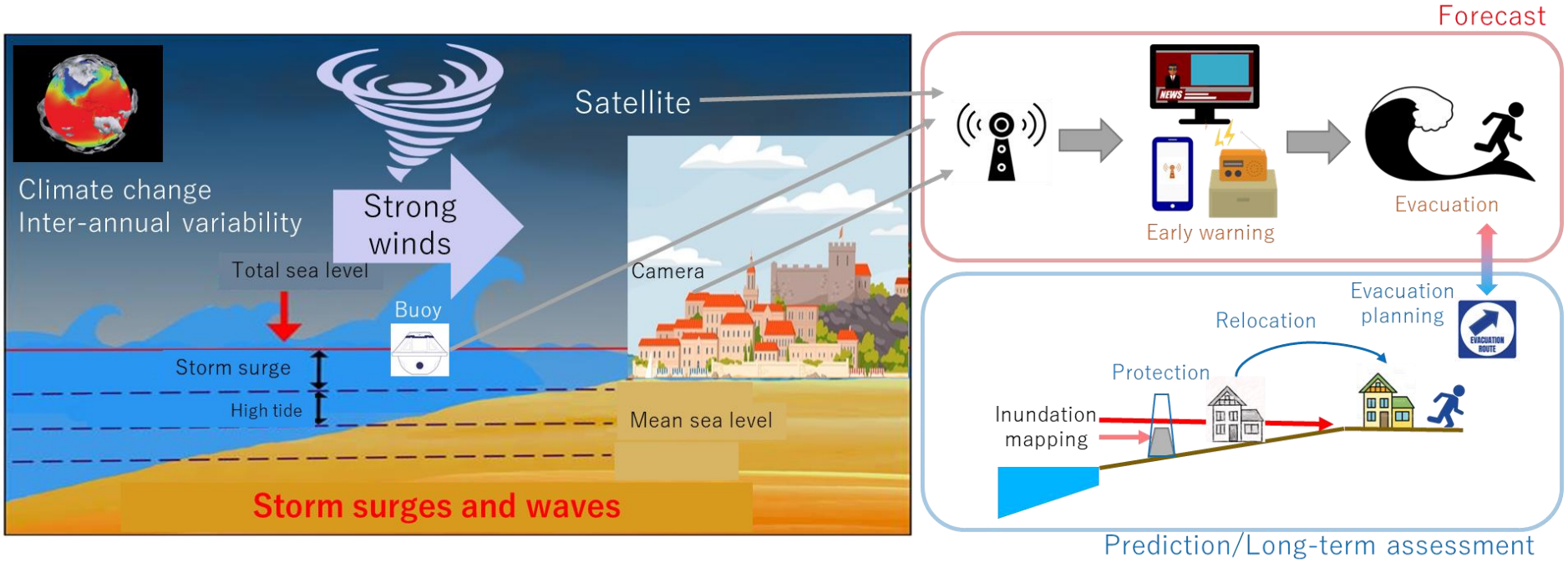


Wang et al. 2021



Pringle et al. 2021

CAN OUR DATA SUPPORT THE DEVELOPMENT OF SERVICES?

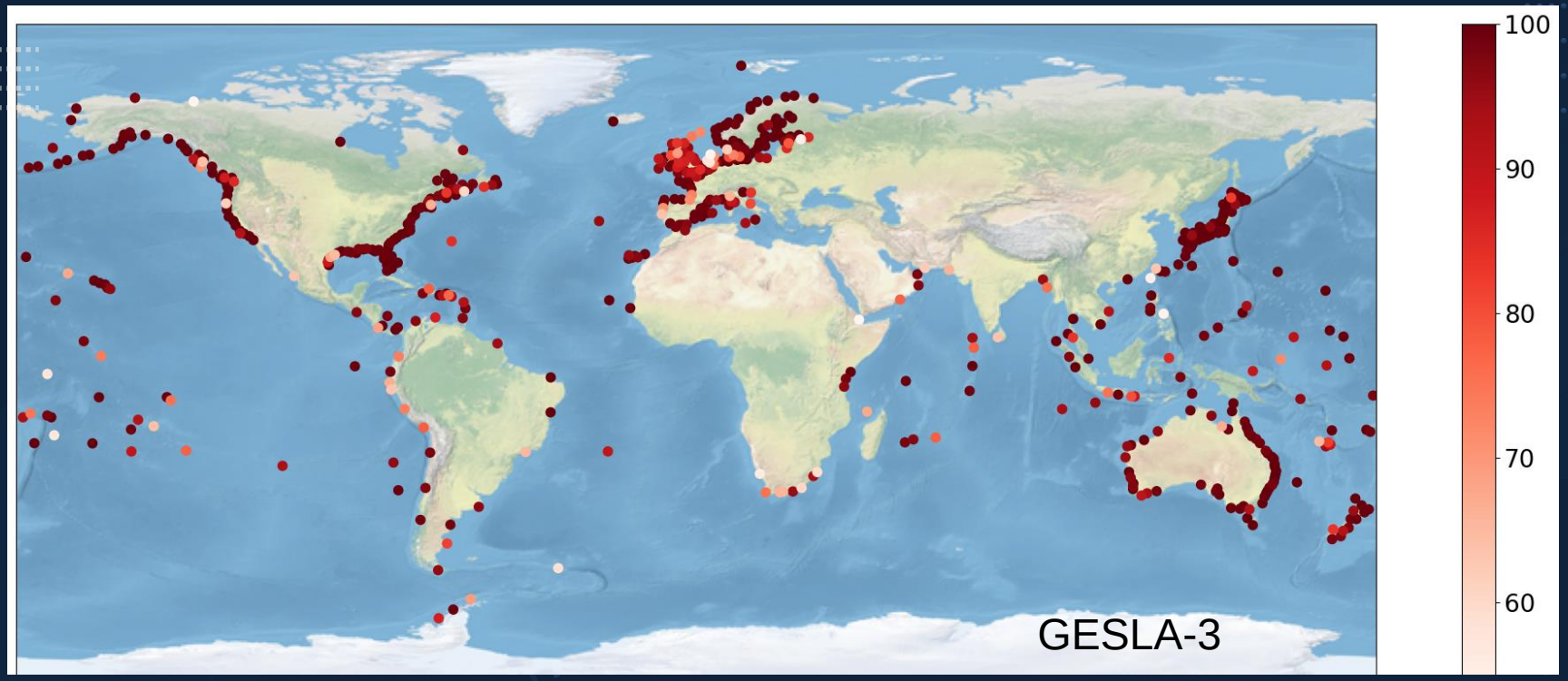


Example of applications of storm surge forecast to early warning and long-term assessment efforts.

CAN GLOBAL SYSTEMS PRODUCE RELIABLE DATA FOR EARLY WARNING SYSTEMS?

- In developing global systems, we have made slightly different choices (e.g., numerical or statistical (soon inferenced), barotropic vs baroclinic, ice or no ice effects, with or without tides). Can we learn from our differences, identify gaps and areas that require additional efforts, verify that beyond acceptable bulk statistics these system are able to reproduce extreme events, etc...
  - We have all verified our systems making different choices (verification period, data used for validation, statistics, etc).
  - Time to get organized and intercompare: First step is to start with global systems (then follow with regional systems).

- Following online meetings the following choices were made:
  - Period of intercomparison: 2013-1018
  - Forcing: ERA5



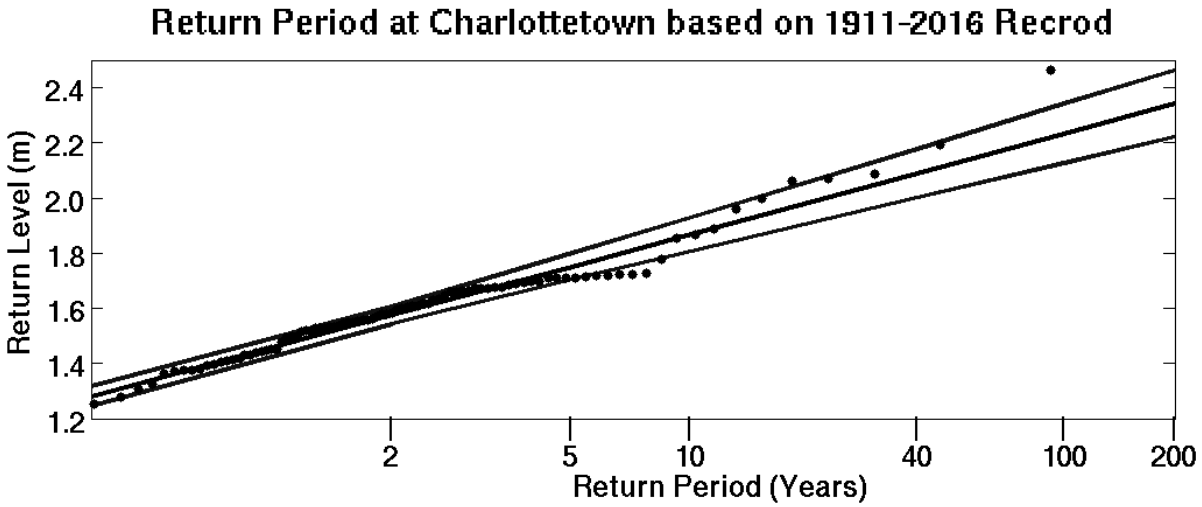
INTERCOMPARISON: NEXT STEPS

- Data exchanged at 500 gauges distributed worldwide – careful selection applied to include areas that could most benefit from a global ‘CIFI’.
- Hindcasts and observations run through the same piece of code to minimize external differences.
- Preliminary results to be discussed over the coming weeks to months

HOW CAN WE HELP ADAPTATION FOR CHANGING CLIMATE?

Data driven approach:

- With long observation records or a reanalysis, we can estimate the return period of extreme events.



- More complex modeling and advanced statistics can take into account non-stationarity (e.g., SLR, changes storminess) and joint probabilities.

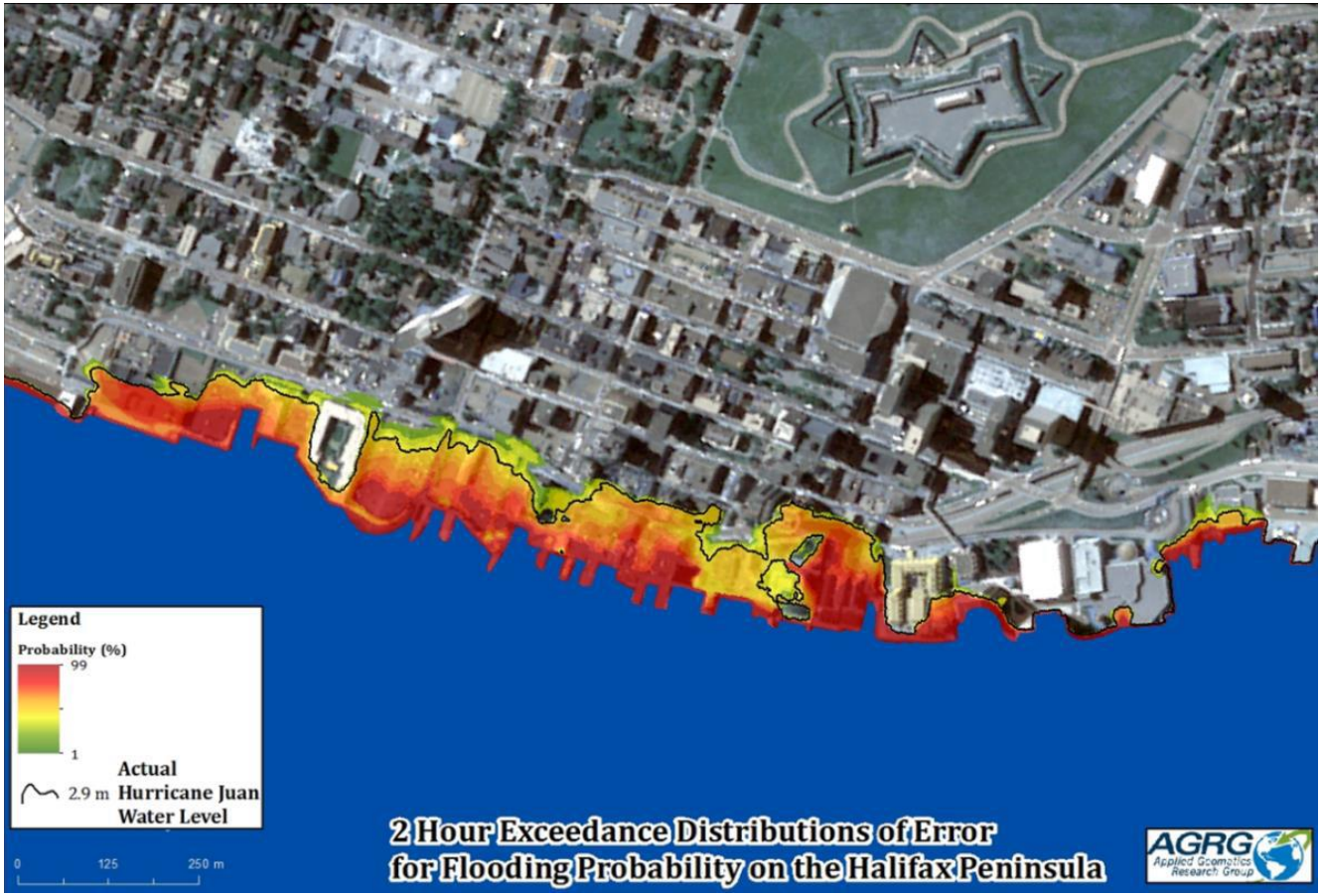
HOW CAN WE HELP ADAPTATION FOR CHANGING CLIMATE?

- Can we better sample the uncertainty moving forward?

- Once you have a good surge model – you need sufficient resolution in both the surge model (circa 1/10deg) and forcing fields (at least 50-60 km with developed storms) to capture large storms and extremes.
  - Climate model resolutions are fast improving and storms are becoming better resolved.
- Extreme sea-levels, surge and wave, are important (e.g., IPCC AR6). Seeking to step up this community's contribution for AR7

- Can we coordinate our efforts and work toward a SurgeMIP?

CLIP: WHAT DO WE NEED MOVING FORWARD?



- Can we produce data local stakeholders can rely on to get to their community level?
- Can we produce reliable guidance that considers both sea-level rise and extremes storms over the lifetime of most infrastructure?
- Can we provide useful information to AR7

SURGEMIP/CLIP

Want to get involved?

F2F meeting

This afternoon

2pm Rm 202

Email Natacha.Bernier@ec.gc.ca

- Want to contribute to next topics and activities, SurgeMIP, AI, ensemble, compound effects, …

WHO ARE WE?

Natacha B. Bernier, Mark Hemer, Mori Nobuhito, Christian M. Appendini, Oyvind Breivik, Mercè Casas-Prat, Trang M. Duong, Ivan D. Haigh, Tom Howard, Maielen Irazoki, Oleksandr Huizy, Jennifer Irish, Ebru Kirezci, Jun-Whan Lee, Kathy McInnes, Elke Meyer, Marta Marcos, Reza Marsooli, Ariadna Martin Oliva, Melisa Menendez, Saeed Moghimi, Sanne Muis, Julian O'Grady, Jeff A. Polton, William J. Pringle, Roshanka Ranasinghe, Michael Getachew Tadesse, Val Swail, Shimura Tomoya, Martin Veerlan, Evangelos Voukouvalas, Thomas Wahl, Pengcheng Wang, Ralf Weisse, Joannes J. Westerink, Joanne Williams, Ian Young, Y. Joseph Zhang… and you?