Reflection of WCRP Sea Level Conference in Singapore

CLIVAR-GOOS: From Global to Coastal, Trieste, August 2022

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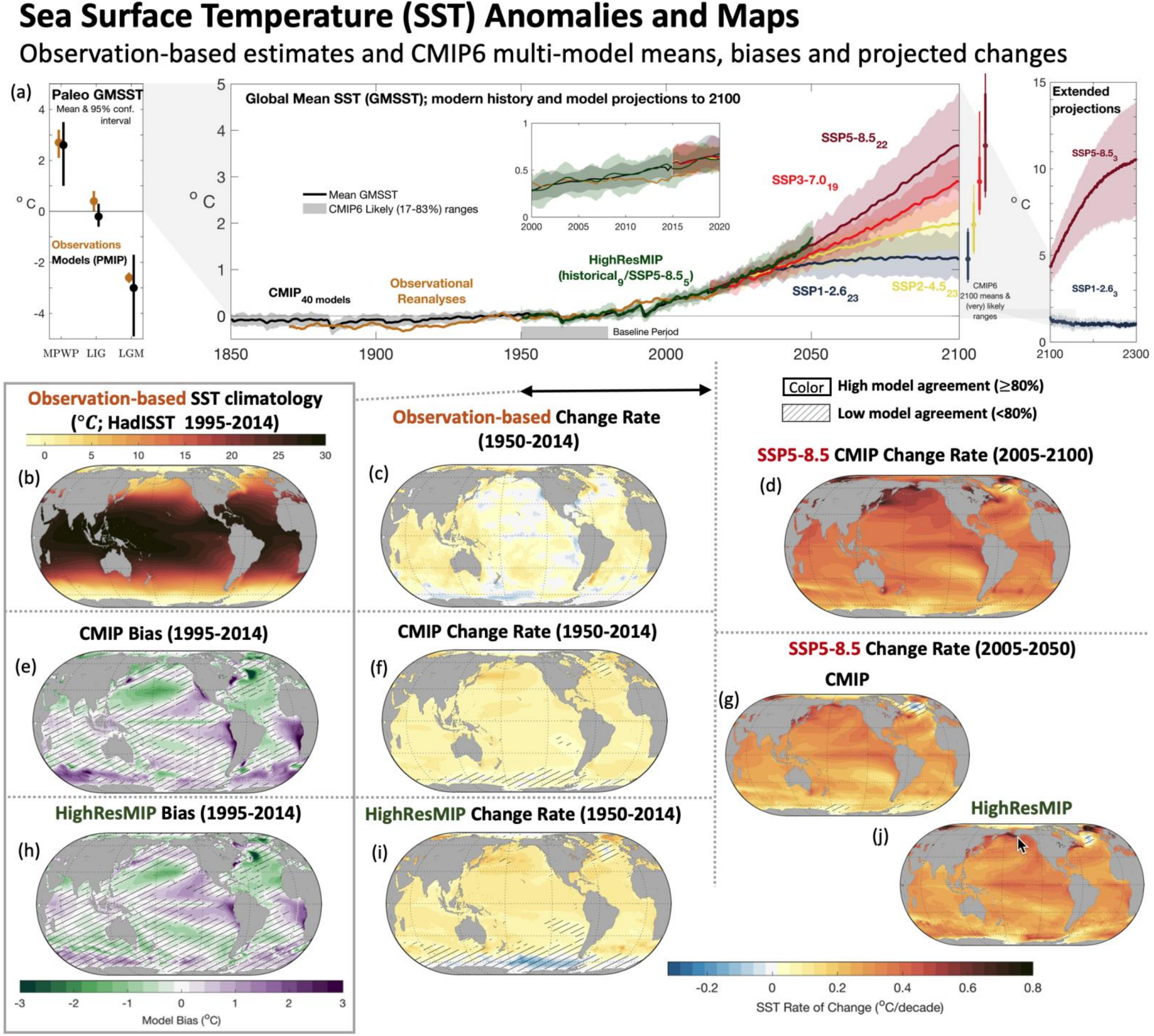
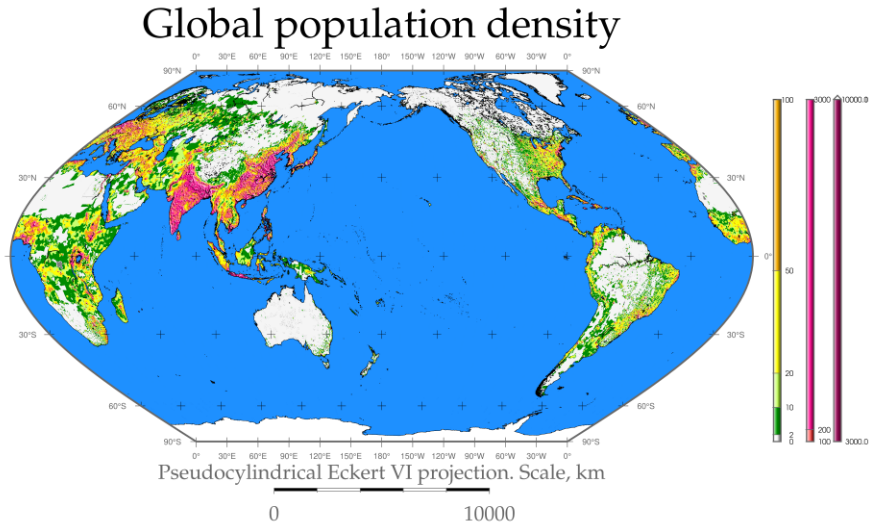
The World continues to Warm

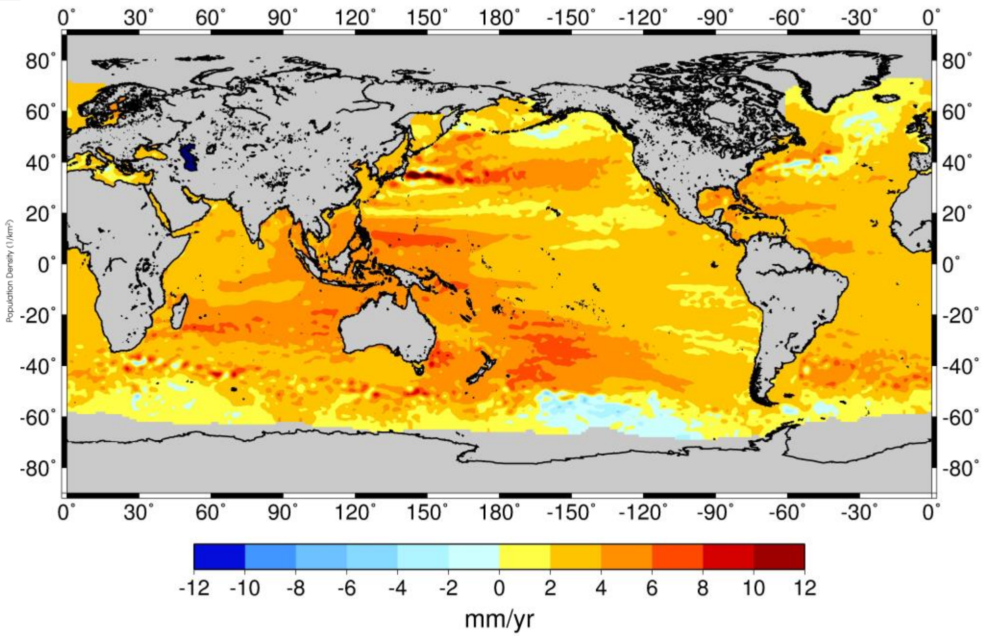
- ✓ CO_2 emissions keep rising and limiting global warming to 1.5° is not likely.
- ✓ The past six years have been the warmest years on record and temperature continue to rise.
- ✓ Associated variations show strong regional pattern and year to year variations.

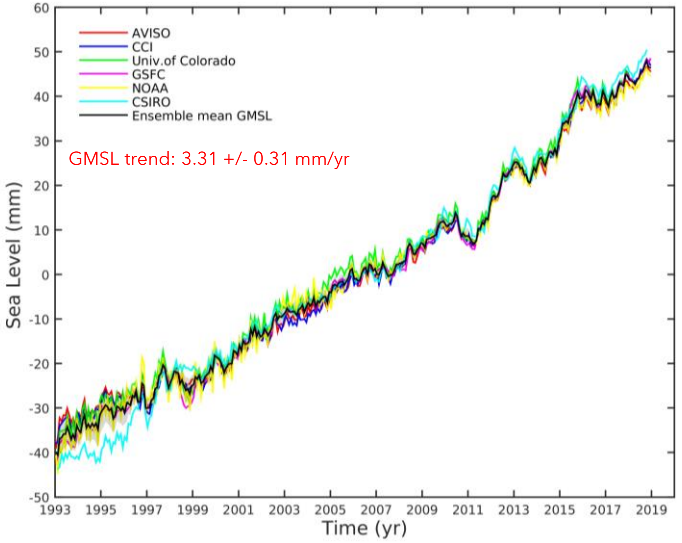


After AR6

RISING SEA LEVEL







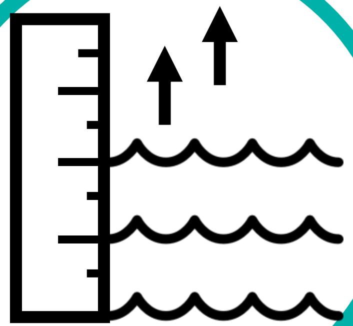
With rising global temperatures, sea level is rising, threatening many people around the global coastlines.

Trend in sea-level rise is accelerating, especially through the accelerating loss of polar ice masses.

Requires efforts in mitigation and adaptation.

Research Questions

Importance of past sea level record



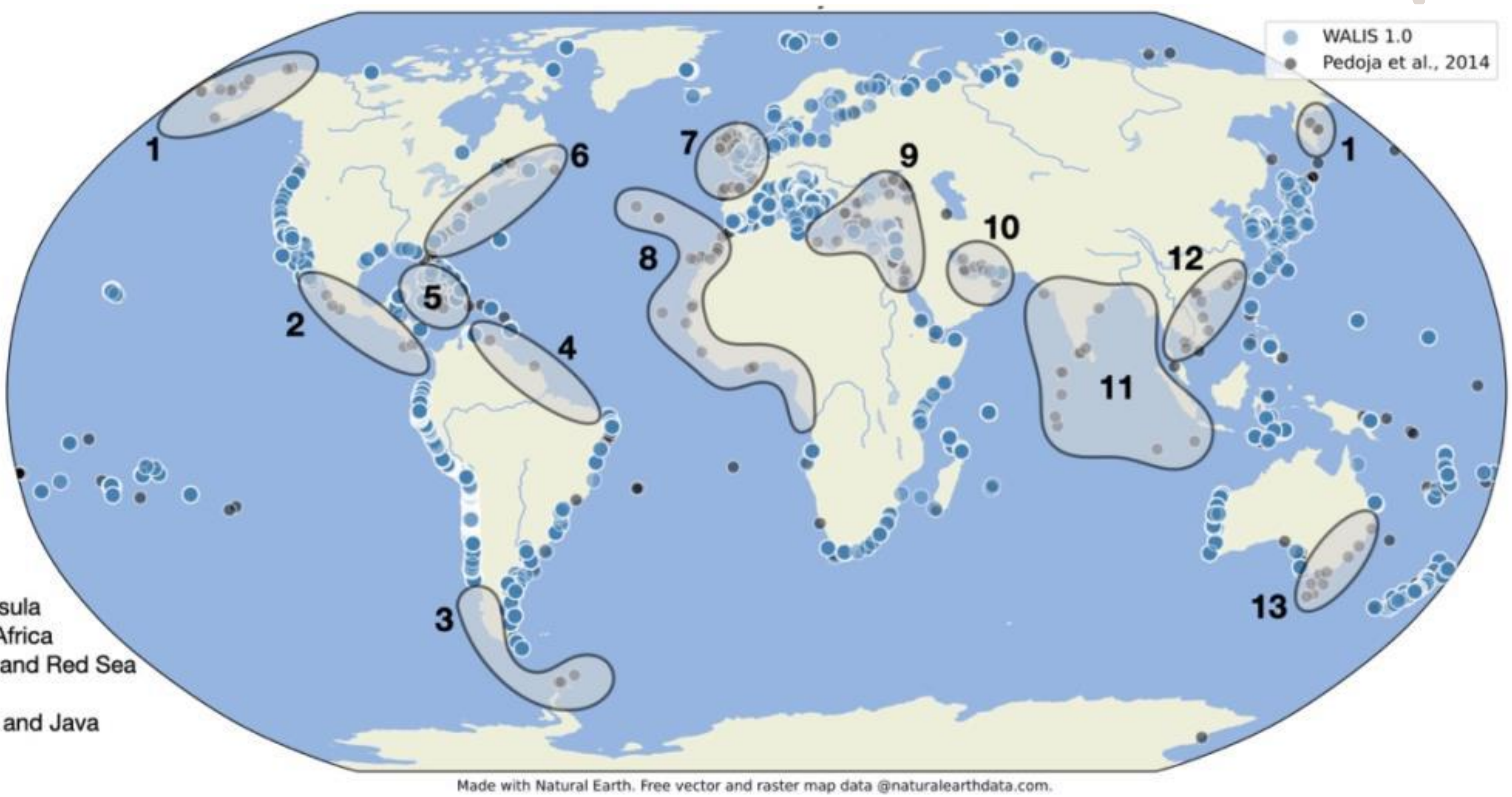
Extending short term instrumental records

Projections of future sea level

DATA GAP: URGENT NEED OF MORE SEA-LEVEL RECORDS?

Main geographic data gaps
WALIS 1.0

1. Alaska, Chukotka and Kamčatka
2. South of Baja California
3. South Pacific and Antactica
4. North Brazil to Honduras
5. Jamaica and Cuba
6. US Atlantic coast (MIS 5e)
7. Ireland and Atlantic coasts of Iberian Peninsula
8. Azores, Canary Islands and North-Central Africa
9. Black Sea, parts of Eastern Mediterranean and Red Sea
10. Gulf of Oman and Persian Gulf (MIS 5e)
11. India, Chagos-Laccadives ridge, Sumatra and Java
12. South China Sea
13. South and Southeast Australia

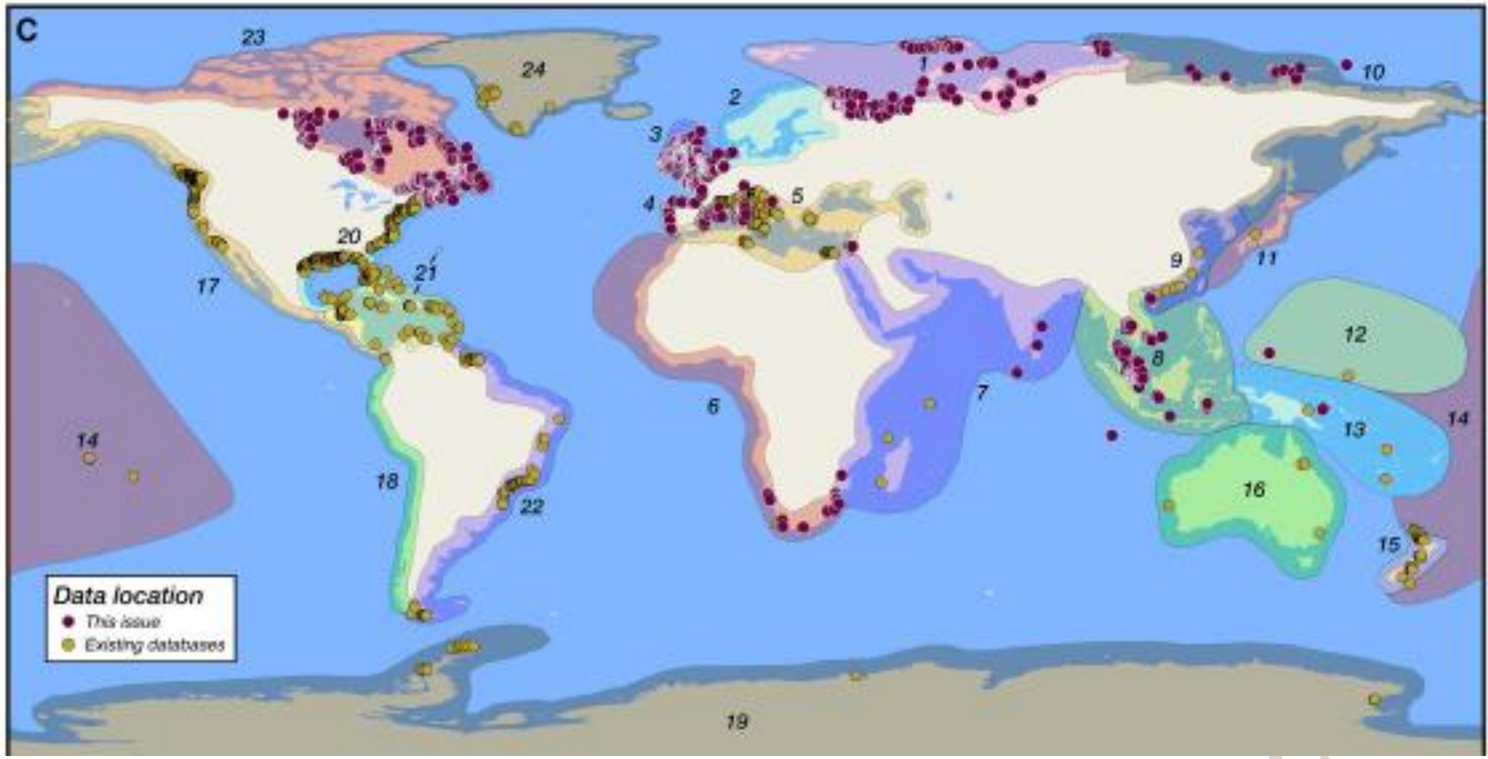


Location of sea-level proxies included in WALIS 1.0, divided by category. Rovere et al., (2022).

GLOBAL DISTRIBUTION OF RELATIVE SEA-LEVEL (RSL) DATA

RSL records spanning the Last Glacial Maximum (LGM) to present exhibit temporal and spatial variability that arises mainly from the interaction of eustatic (land ice volume and thermal expansion) and isostatic (ice and water loading and unloading) factors.

RSL= ESL + GIA + Static equilibrium + Tectonics + Local



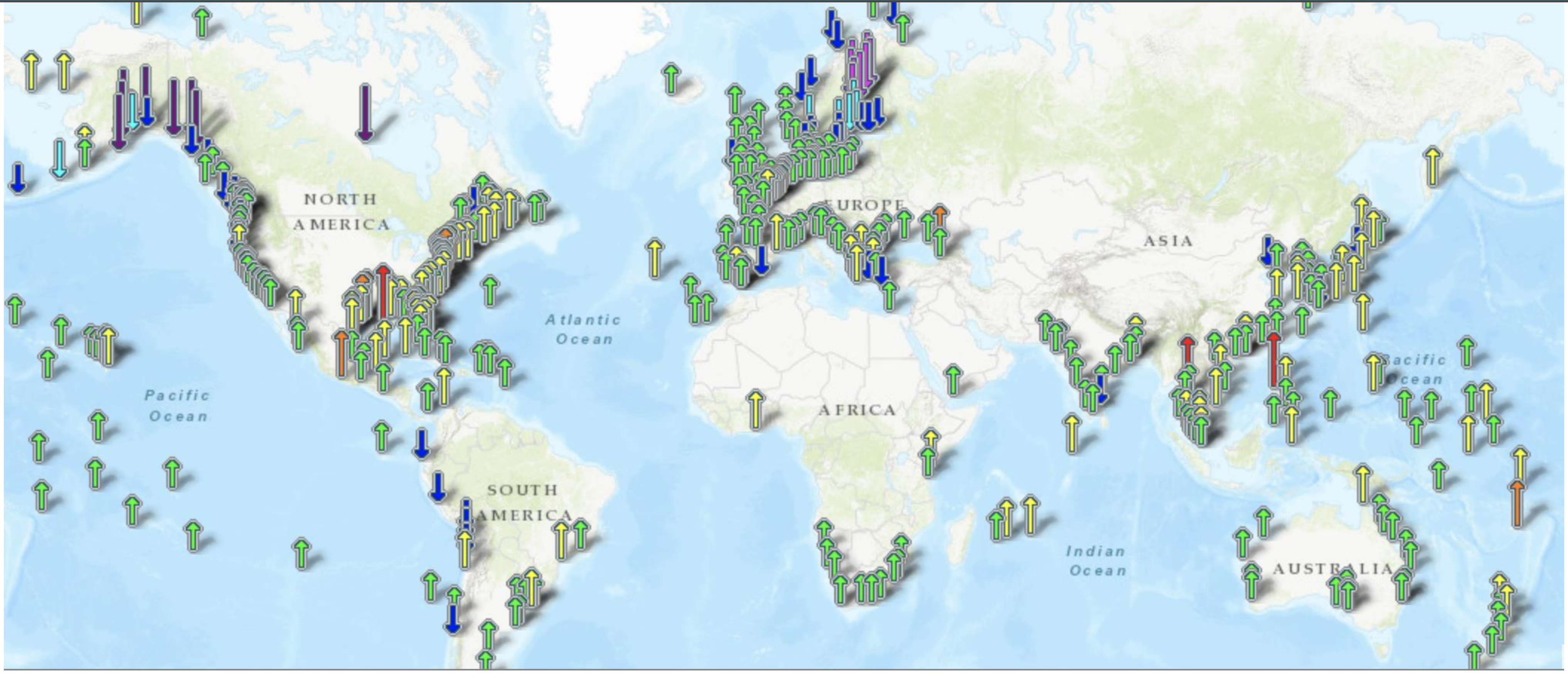
Khan et al. (2019) Quatenary Science Reviews

The eustatic (ESL) term refers to melting (or growth) of land-based ice (barysteric contribution) and ocean water density changes from temperature and salinity variations (steric contribution).

Glacial isostatic adjustment (GIA) is the response of the solid Earth and gravity field to ice mass redistribution during a glacial cycle.

'static equilibrium' RSL changes associated with gravitational, deformational, and rotational processes in response to exchanges of mass between the cryosphere and the ocean.

There Is Still .... A Long Way To Go !!!



Average sea level change trend according to monitoring data

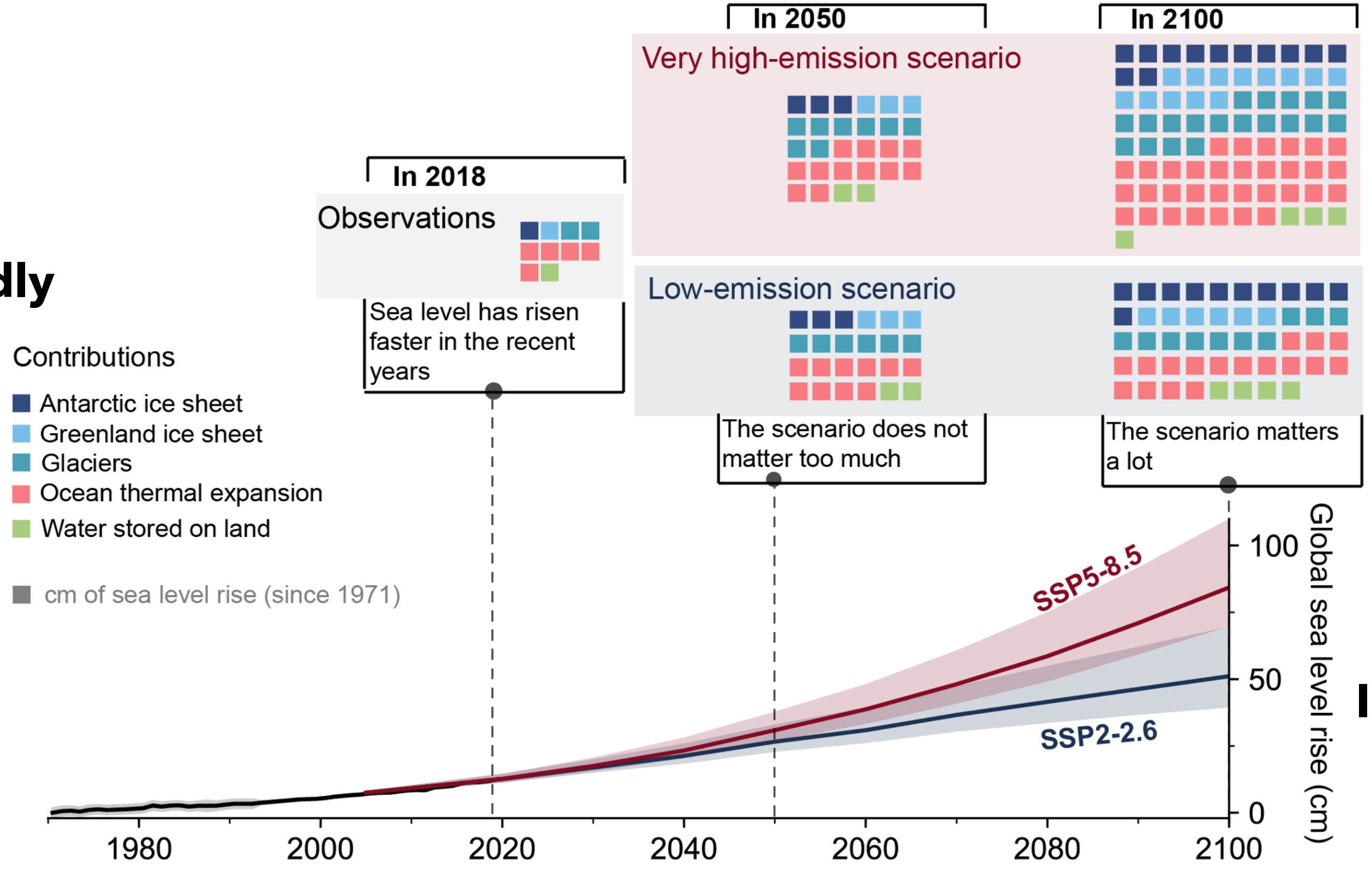
- 1901 - 2015: the average global sea level increased by 16 cm (12-21 cm) with an average increase of 1.5mm/year (1.1-1.9 mm/year)
- 1993 - 2015: the average global sea level increased by 3.16mm/year (2.8-3.5 mm/year)
- 2006 - 2015: the average global sea level increased by 3.6mm/year (3.1-4.1 mm/year)

https://tidesandcurrents.noaa.gov/sltrends/sltrends.html

GLOBAL SEA LEVEL WILL RISE

BUT WE NEED BETTER CLIMATE SCIENCE TO INFORM US ON THE RATE OF FUTURE SLR

2100 marks a turning point in sea level projection when:
(1) Emissions scenarios diverge
(2) Uncertainty (primarily from Antartica) begins to grow rapidly



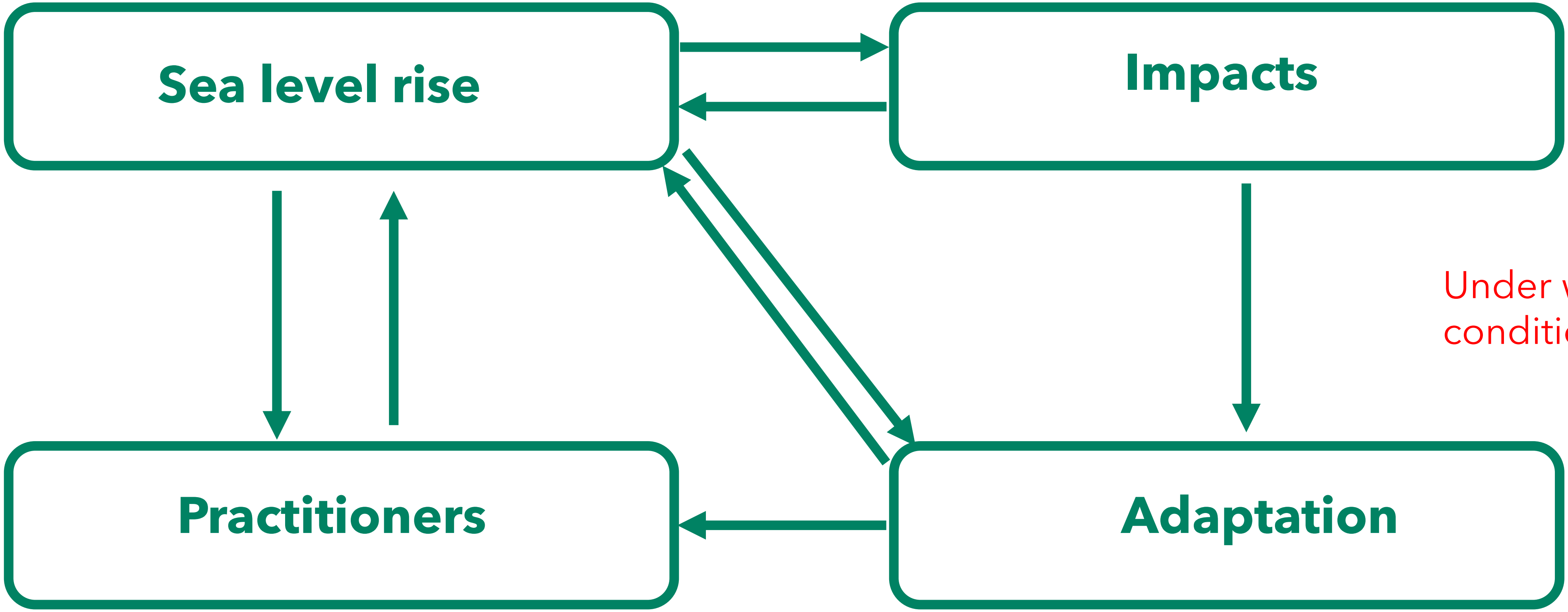
IPCC ARG, WG1

Emissions scenarios influence little sea level rise of the coming decades but has a huge effect on sea level at the end of the century.

Sea level rise beyond 2100 can be significant!

Understanding sea level rise (and its consequences) requires input from many areas of expertise

Tipping points?
Timeseries
Near and long-term



Under what conditions?

When?
How much/fast?
Certainties and uncertainties?

2022 CONFERENCE OUTCOME (1/2)

The following major themes and priorities for sea-level science over the next decade were identified:

a) Thresholds, stability and rates of loss of the Antarctica ice sheet and the Greenland ice sheet.

b) Understanding the commitment to sea-level rise over decades and centuries under different emission pathways and the implications for coastal adaptation and mitigation

c) How important is the feedback from the response of the Earth crust to the retreat of the ice?

d) How can we better understand the relation between large-scale open ocean sea level change and coastal sea level changes in order to translate the open ocean signal to what actually happens at the coast?

e) How can we incorporate long- and mid-term sea-level projections into hydrodynamic models to constrain coastal extreme sea level projections and explore coastal sea level impacts?

f) How can we set-up regional and global sea-level budget studies and a linked consistent Earth energy budget to be repeated on a recurring basis?

g) How can we better connect science leadership to practitioner efforts to ensure sea level science is well-connected to resilience efforts at a local and national level? As adaptation actions increasingly impact society, can the science and practitioner communities build coproduction approaches that improve science translation to support decision making?

2022 CONFERENCE OUTCOME (2/2)

The following major themes and priorities for transforming sea-level science information over the next decade were identified:

a) How can sea-level projections be best used with the range of decision analysis methods to develop effective, efficient and equitable adaptation solutions?

b) How can we maximize the value of sea-level science and projection ranges (including low-end and high-end estimates) for adaptation planning and close the gap between sea-level science and practitioner needs?

c) How can we capture the non-climate components of relative sea-level change that are essential for climate risk and adaptation assessment, and develop appropriate scenarios, including various sources of human-induced subsidence.

d) How should coastal climate services evolve and scale as coastal adaptation action accelerates?

e) How can we anticipate and model cascading and compounding effects caused by sea-level rise alongside other contributors to coastal flooding such as storm surge, wave action, fluvial flooding, and vertical land motion?

Thank You for your attention.