Global Glacier Mass Loss estimated from GRACE and GRACE-FO Satellite Observations (2002-2019)

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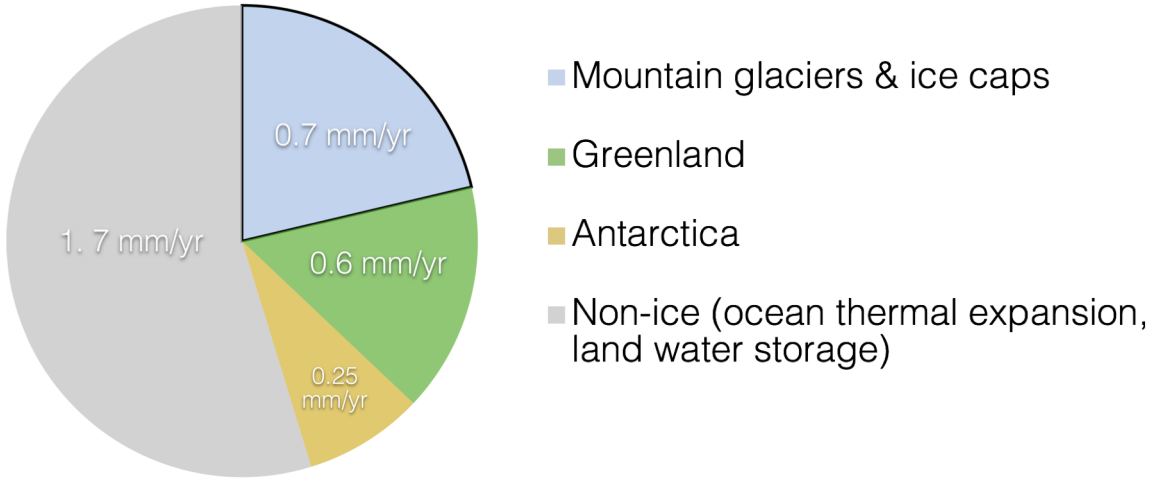
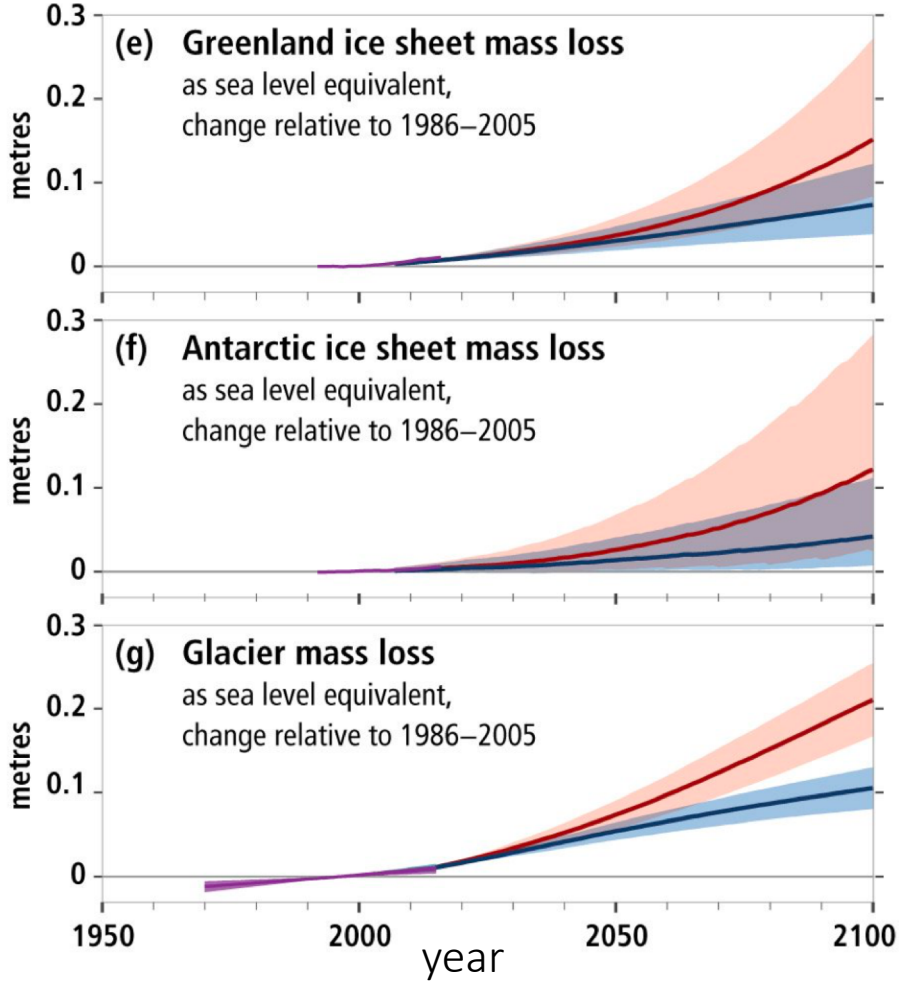
Background

Sea level change 1993-2016 (Cazenave, 2018)



SROCC Projections 2100

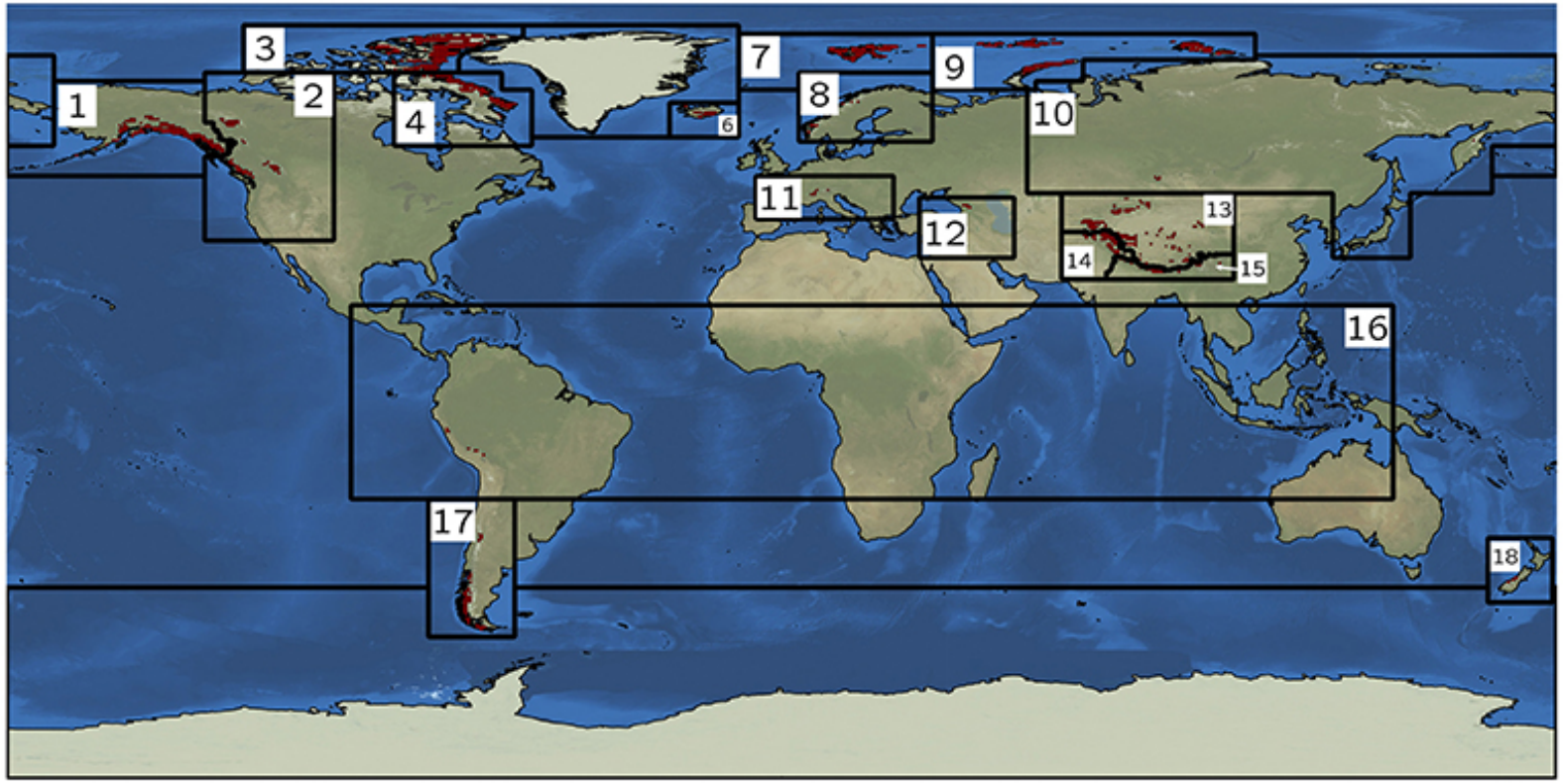


Historically, mountain glaciers have been the largest land-based contributors to sea level rise and are projected to continue to play a key role in the future

Regions

Mass balance was computed for 17 RGI* glacier regions, based on changes in the gravitational field observed by GRACE (2002-2017) and GRACE-FO (2018-present)

1. Alaska
2. Western Canada & US
3. Arctic Canada North
4. Arctic Canada South
6. Iceland
7. Svalbard
8. Scandinavia
9. Arctic Russia



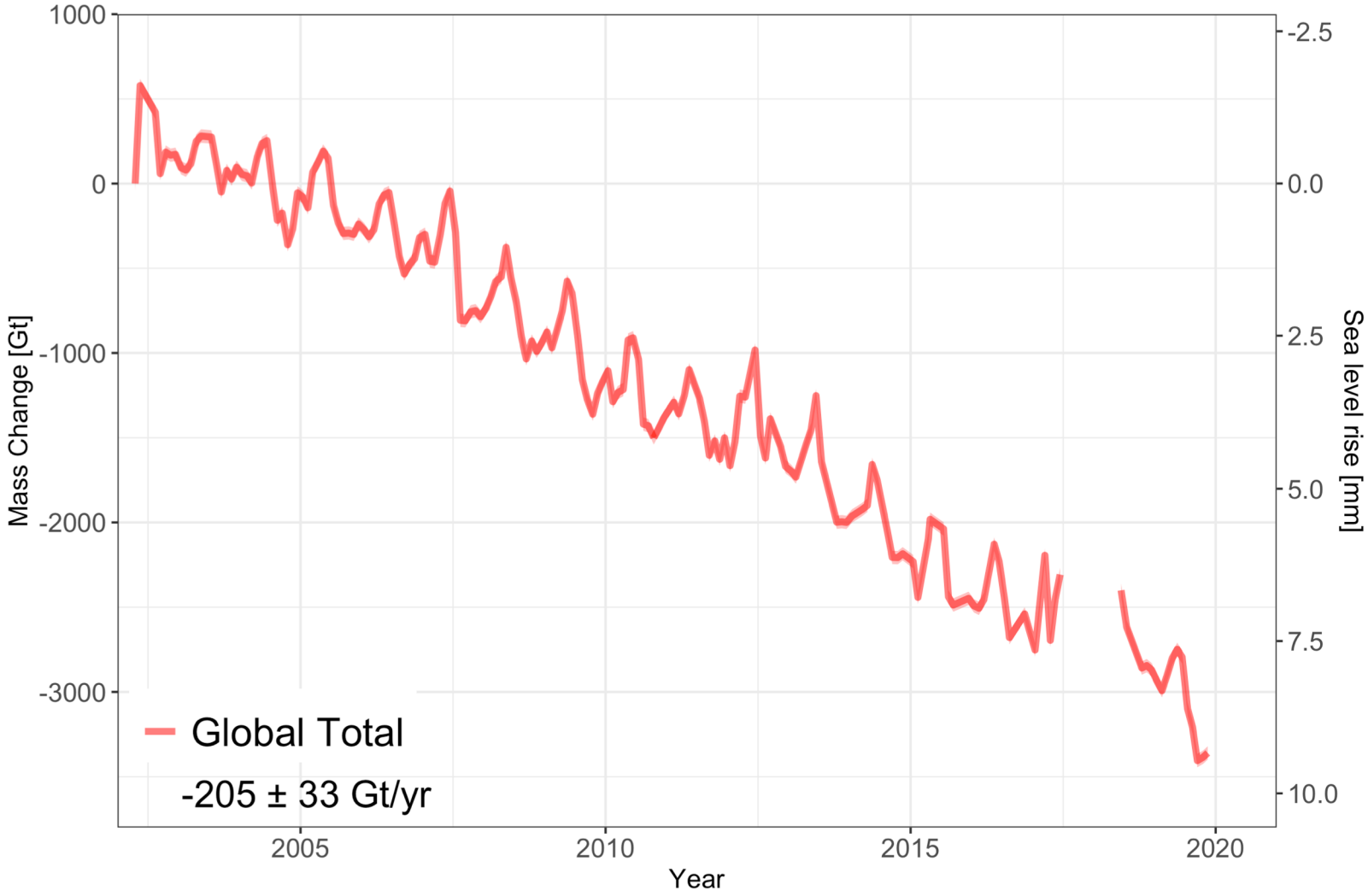
10. North Asia
11. Central Europe
12. Caucasus
13. Central Asia
14. South Asia West
15. South Asia West
16. Low Latitudes
17. Southern Andes

*RGI = Randolph Glacier Inventory (https://doi.org/10.7265/N5-RGI-60)

Results (interested in method? See last slide)

Mass balance of the global glacier population has been *consistently negative* over the observational period (Apr 2002 – Dec 2019)

Exceptional mass loss of approximately 500 km^3 water equivalent in 2019



Results

Most of the 2019 mass loss can be attributed to the Arctic glaciers:

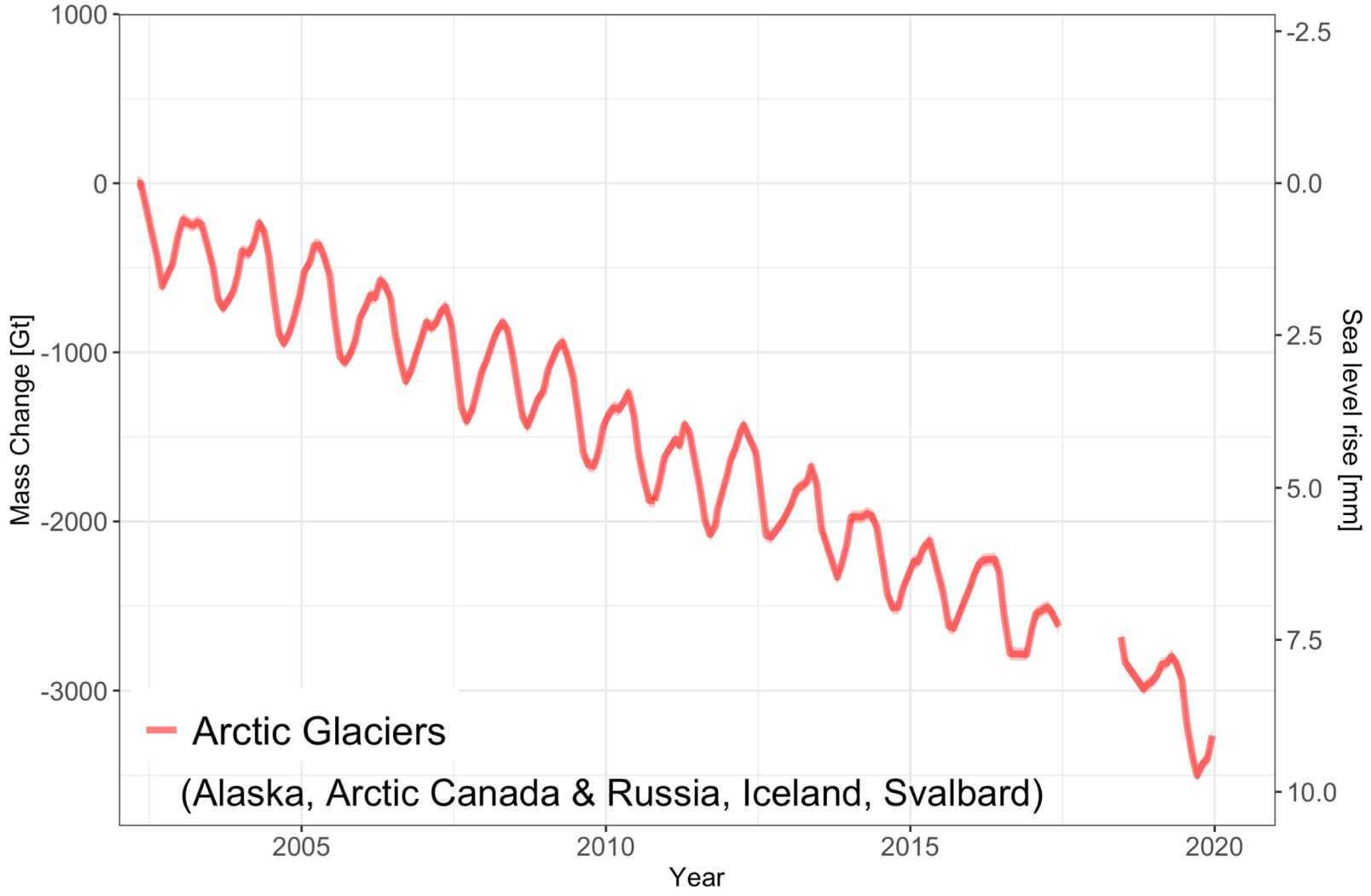
exceptional summer melt (~700 km^3)

+

below-average winter gain (~200 km^3)

=

~ 510 km^3 mass loss



Results

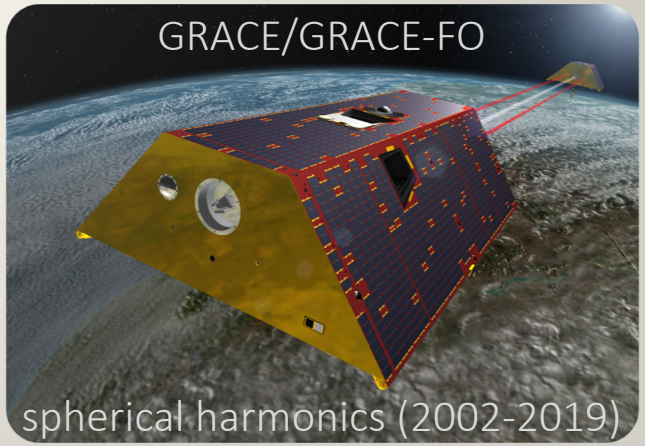
Alaska largest net contributor strongest

Strongest relative losses observed in Southern Andes (but with large uncertainties)

RGI region	Area [km²]	Annual mass change [Gt yr⁻¹]	Specific mass balance [kg m⁻² yr⁻¹]
01. Alaska	86725	**-64.3 ± 13.2**	-740 ± 150
02. Western Canada and US	14524	-5.5 ± 18.3	-380 ± 1260
03. Arctic Canada North	105111	-30.6 ± 3.3	-290 ± 30
04. Arctic Canada South	40888	-32.5 ± 7.7	-790 ± 190
06. Iceland	11060	-9 ± 2	-820 ± 180
07. Svalbard	33959	-12.1 ± 2.1	-360 ± 60
08. Scandinavia	2949	-0.9 ± 8.4	-310 ± 2830
09. Arctic Russia	51592	-13.5 ± 2.9	-260 ± 60
10. North Asia	2410	2.3 ± 4.5	940 ± 1880
11. Central Europe	2092	0.2 ± 0.9	80 ± 440
12. Caucasus	1307	-0.8 ± 2.9	-650 ± 2230
13+14+15. HMA	97606	-12.4 ± 16.1	-130 ± 170
16. Low Latitudes	2341	2.7 ± 5.2	1130 ± 2220
17. Southern Andes	29429	-27.9 ± 10.8	**-950 ± 370**
18. New Zealand	1162	-0.3 ± 1.1	-260 ± 910

Workflow

(for details, see Wouters et al., Frontiers, 2019)



Add degree 1 coefficients
+
replace C_{20} and C_{30}

Combine 4 sets of spherical harmonics into one solution
(error-weighted average)

Mass inversion in 17 glacier regions

Correction for Glacial Isostatic Adjustment and non-glacial hydrological signals (e.g. seasonal snow)

Time series & error weighted trend estimates

Questions or comments?

Catch me in the chat, or email to:

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