30552 - Satellite Geodesy

Consolidating Sea Level Acceleration Estimates from Satellite Altimetry

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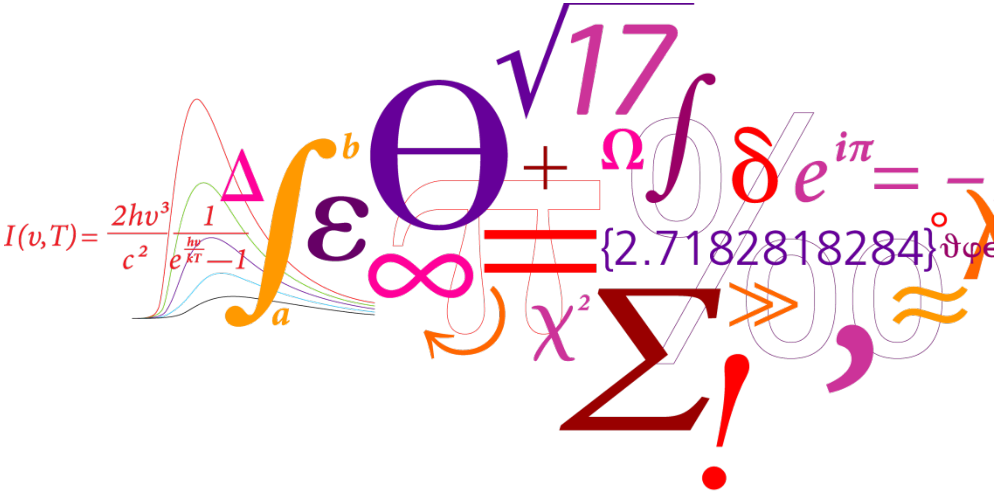


Introduction / background

- The TOPEX/Jason-1/Jason-2/Jason-3 derived GMSL indicate sea level acceleration of 0.084mm/y^2 within +/- 66° from 25 years of data.

- The TOPEX Side A/B switch in 1999 questions the magnitude of GMSL acceleration
- (Beckley et al., 2017; Watson et al., 2015)

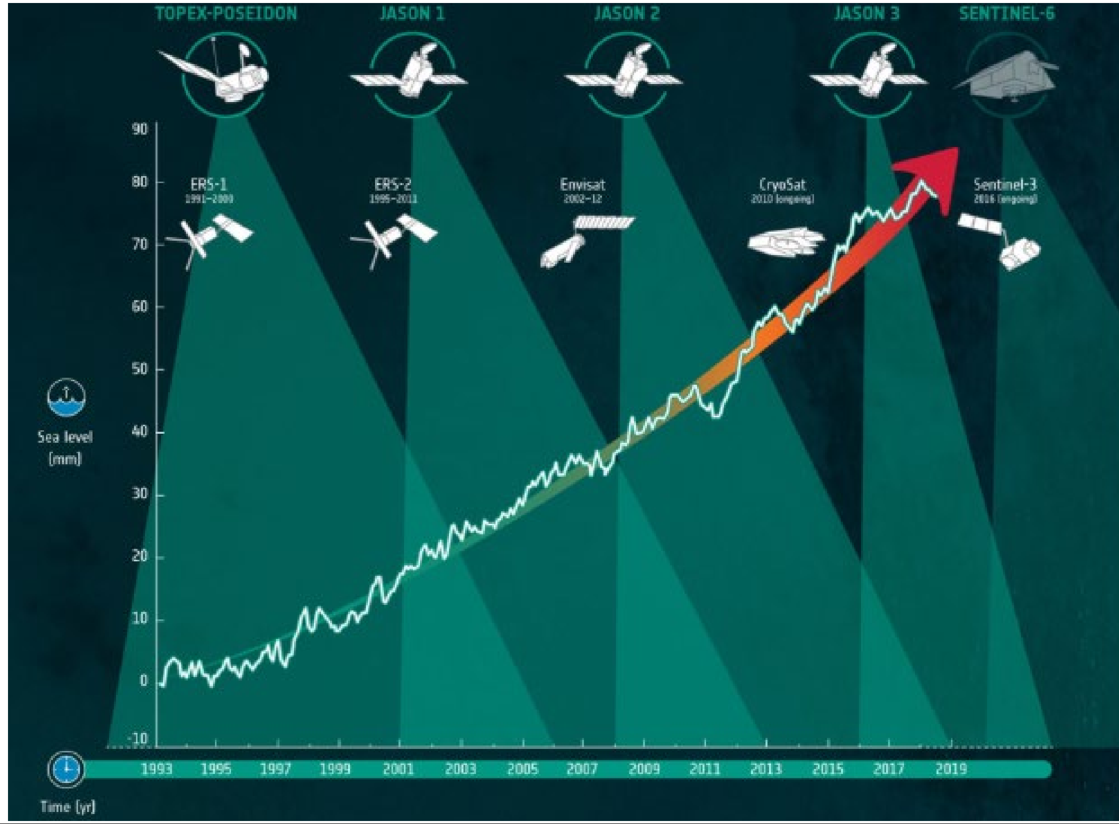
- ERS/Envisat/Cryosat offers alternate GMSL record consolidating GMSL acceleration.

- ERS/Envisat/Cryosat enables extended timeseries to 28.5 years within the 82°

- ERS-1 launched few month after the largest Volcanic eruption of century (Pinatubo)

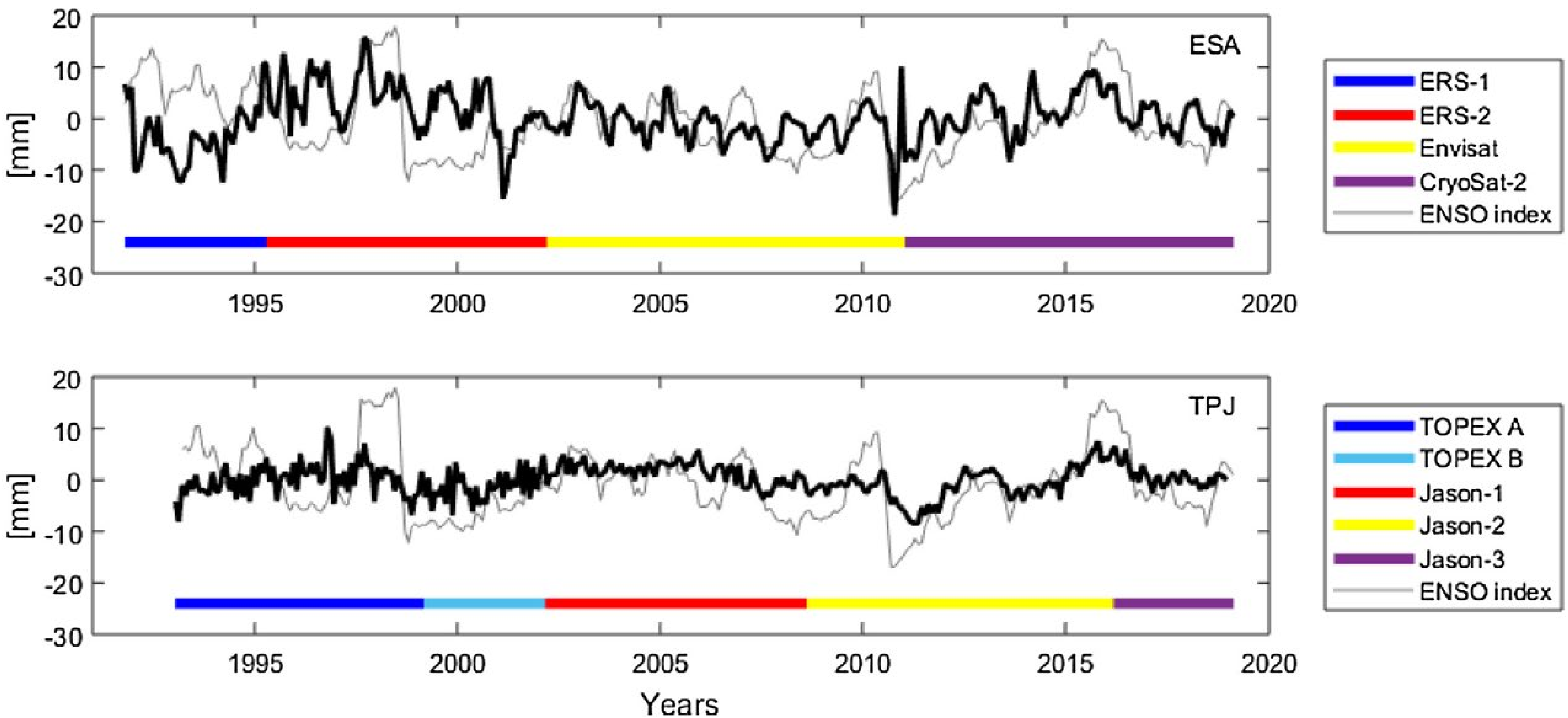
- Data from RADS used in this investigation

Two independent dataset used:

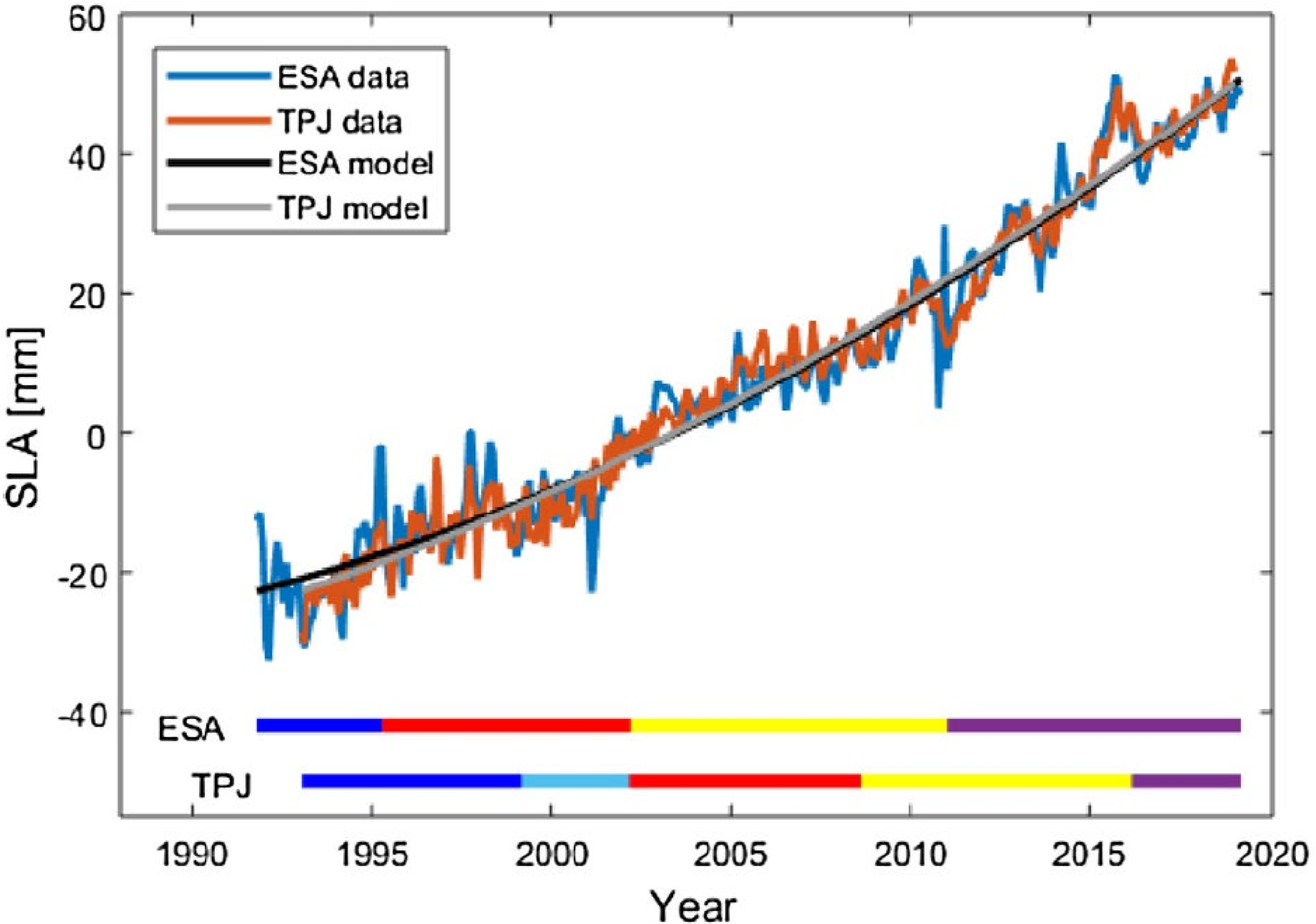


	Satellitemission	Phase	Start date	End date
TPJ	TOPEX/Poseidon	Side A	10/1995	02/1999
		Side B	02/1999	01/2002
(1993-2019)	Jason-1		01/2002	06/2008
	Jason-2		07/2008	01/2016
	Jason-3		02/2016	01/2019
	ERS-1	AB	09/1991	04/1992
		C	04/1992	12/1993
ESA		D	12/1993	04/1994
		EF	04/1994	03/1995
(1991-2019)		G	03/1995	07/1995
	ERS-2		08/1995	02/2002
	Envisat		03/2002	09/2010
	CryoSat-2		10/2010	01/2019

Increased noise on ESA dataset



Global Monthly Residuals after removing linear + quadratic + annual signal


ESA data
TPJ data
ESA model
TPJ model
SLA [mm]
60
40
20
0
-20
-40
ESA
TPJ
1990
1995
2000
2005
2010
2015
2020
Year

GMSL acceleration

Using FULL timeseries and spatial coverage

	1991.7–2019.0 without Pinatubo correction [mm/yr^2]	1991.7–2019.0 with Pinatubo correction [mm/yr^2]
TPJ (from 1993.0)	0.080 ± 0.008	0.105 ± 0.008
ESA $\pm$ 66°	0.084 ± 0.010	0.095 ± 0.010
ESA $\pm$ 82°	0.095 ± 0.009	0.105 ± 0.010

Using limited timeseries for comparison with previous.

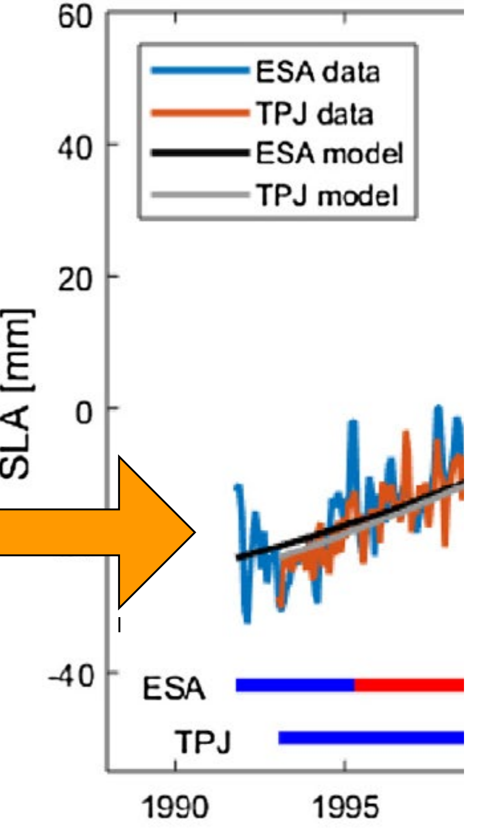
	1993.0–2017.0 [mm/yr^2]	1993.0–2018.21 [mm/yr^2]
WCRP (2018)	–	0.10
Nerem et al. (2018)	0.097 ± 0.011	–
TPJ	0.082 ± 0.010	0.079 ± 0.009
ESA	0.093 ± 0.014	0.086 ± 0.012

Climate change driven sea level acceleration.

- Converting observed GMSL to climate change
- driven GMSL acceleration requires corrections for
- Pinatubo eruption in 1991 and ENSO
- (Nerem et al., 2017).

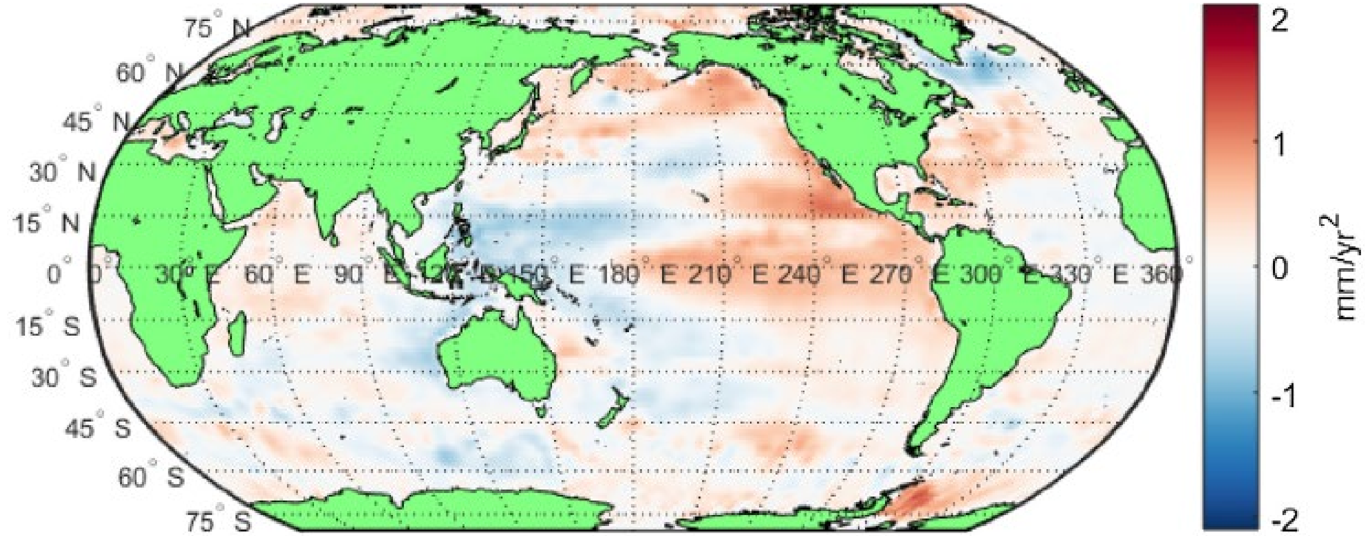
- We find both within the error or 0.01 mm/y^2

- Pinatubo erupted 2 month before launch of ERS-1.
- ERS-1 shows sea level drop of 6 mm within first years.
- Drop in agreement with models of expected GMSL drop
- (Fausullo et al., 2016)

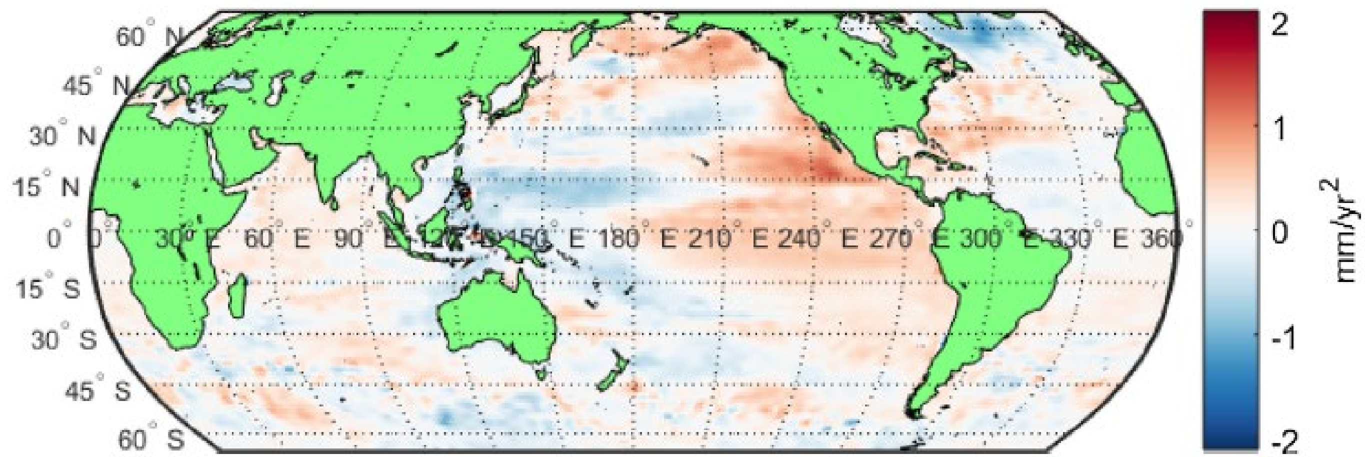


Sea level acceleration from full timeseries

- **TPJ**

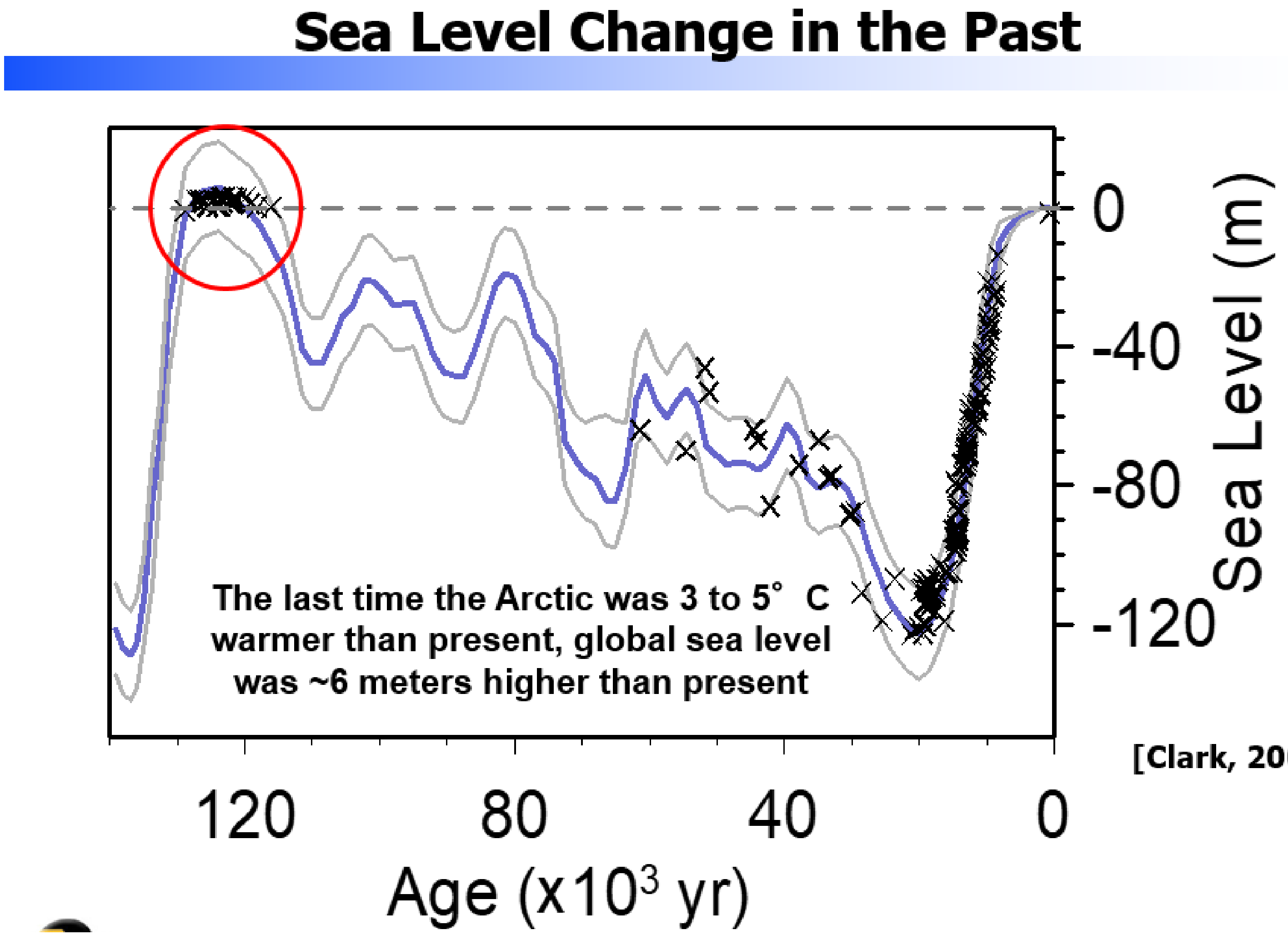


- **ESA**



Interesting negative sea level acceleration found south of Greenland.

Past sea level



[Clark, 2009]

Summary

Global (+/- 66°) GMSL from TPJ sequel of satellites consolidated using ESA sequel of satellites (ERS1/ERS2/ENVISAT/CRYOSAT-2).

ESA offers extended time series in both time and space.

Both indicate same GMSL acceleration of 0.08 mm/y^2 +/- 0.008 mm/y^2
Within +/- 66 and period 1993-2018.

ESA indicate slightly higher GMSL acceleration of 0.095 mm/y^2 +/- 0.009 mm/y^2 if period and region is extended.

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