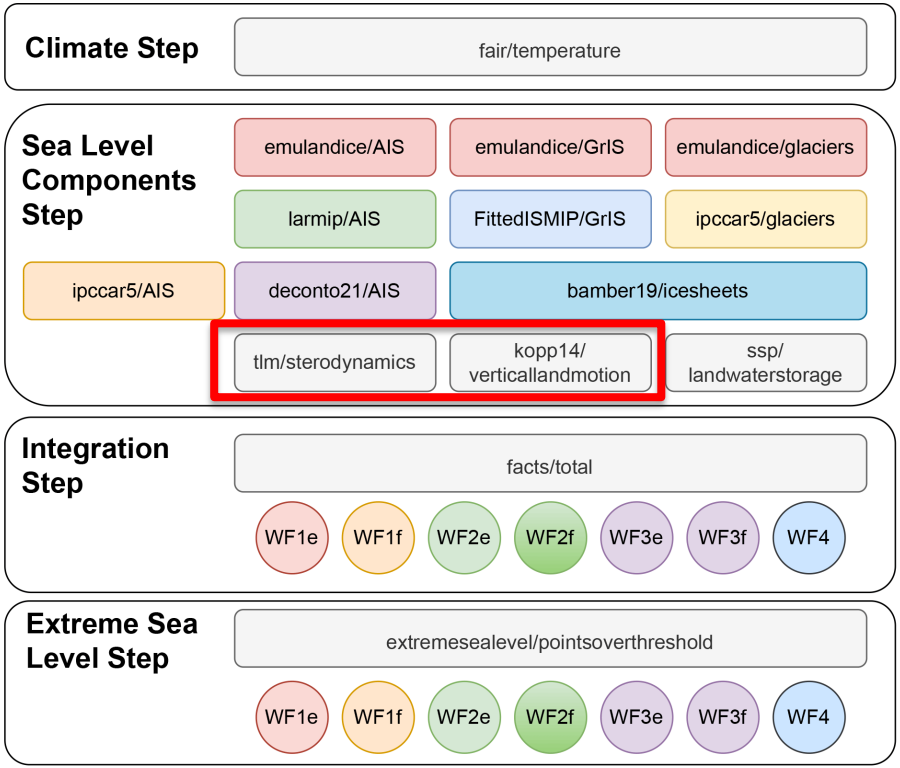
Group Meeting

Yunlong Pan

Outline

- Tlm/sterodynamics
  - Methodology
- Kopp14/verticallandmotion
  - Dataset(constant rate)
- NeuralGCM (Flooding)
- https://coast.noaa.gov/slr/



Tlm/sterodynamics

- <<The Framework for Assessing Changes To Sea-level (FACTS) v1.0: a platform for characterizing parametric and structural uncertainty in future global, relative, and extreme sea-level change>>
  - https://gmd.copernicus.org/articles/16/7461/2023/
  - 21 Dec 2023
- Dataset, Code: https://zenodo.org/records/6419954

Workflow	GrIS	AIS	Glaciers	Land water	Sterodynamic	VLM
Medium-confidence workflows						
1e	emulandice	emulandice	emulandice	ssp	tlm	kopp14
1f	FittedISMIP	ipccar5	ipccar5 (GMIP2)	ssp	tlm	kopp14
2e	emulandice	larmip	emulandice	ssp	tlm	kopp14
2f	FittedISMIP	larmip	ipccar5 (GMIP2)	ssp	tlm	kopp14
Low-confidence workflows						
3e	emulandice	deconto21	emulandice	ssp	tlm	kopp14
3f	FittedISMIP	deconto21	ipccar5 (GMIP2)	ssp	tlm	kopp14
4	bamber19	bamber19	ipccar5 (GMIP2)	ssp	tlm	kopp14

Tlm/sterodynamics: Methodology

Result Review:

Ex:oceandynamics_ssp370

https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool

			sea_level_change
quantiles	years	locations	
0.0	2020	1	-143.0
		2	-123.0
		3	-139.0
		5	-142.0
		7	-118.0
...	...	...	...
1.0	2300	1018003550	NaN
		1018003560	NaN
		1018003570	NaN
		1018003580	NaN
		1018003590	NaN

205387570 rows × 1 columns

Tlm/sterodynamics:

Methodology:

1.Simulation

2. Find μ and σ to get the t-distribution

3. z, σ, k, y, s, r, t

4. multi-model

Workflow	GrIS	AIS	Glaciers	Land water	Sterodynamic	VLM
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4	bamber19	bamber19	ipccar5 (GMIP2)	ssp	tlm	kopp14

Tlm/sterodynamics:

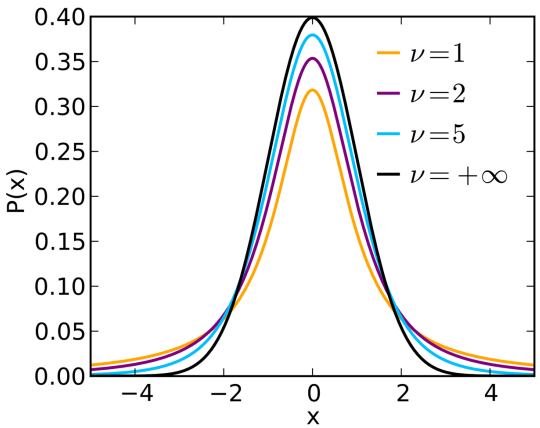
Methodology:

1. Simulation

Given a time and location,

the sea level change value ~ t-distribution

Ex:t-distribution



			sea_level_change
quantiles	years	locations	
0.0	2020	1	-143.0
		2	-123.0
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...	...	...	...
1.0	2300	1018003550	NaN
		1018003560	NaN
		1018003570	NaN
		1018003580	NaN
		1018003590	NaN

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Tlm/sterodynamics:

Methodology:

2. Find $\mu$and σ to get the t-distribution :

$$\overline{z_t}(r) + \sigma_t(r) k_t(r) \frac{y_t - \overline{y_t}}{s_t}$$

$$\sigma_t(r) 1 - k_t(r)^2,$$

			sea_level_change
quantiles	years	locations	
0.0	2020	1	-143.0
		2	-123.0
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https://gmd.copernicus.org/articles/16/7461/2023/

Tlm/sterodynamics:

Methodology:

3. z, σ, k, y, s, r, t

$$\overline{z_t}(r) + \sigma_t(r) k_t(r) \frac{y_t - \overline{y_t}}{s_t}$$

time t and location r

$\overline{z_t(r)}$ is the multi-model mean ocean dynamic sea level at time t and location r,

Note: z is independent of temperature

$\overline{y_t}$ is the multi-model mean of global mean thermosteric sea-level rise

Note: y is associate with temperature

Tlm/sterodynamics:

Methodology:

4. multi-model

Table A3 CMIP6 models used for calibrating the thermal expansion coefficients of Fox-Kemper et al. (2021a) (TE, left column) and for projecting ocean dynamic sea-level change and the IB effect (zos+psl, right column) in the tlm/sterodynamics module.

Model	TE	zos+psl
ACCESS-CM2	x	x
ACCESS-ESM1-5	x	x
BCC-CSM2-MR		x
BCC-ESM1		x
CAMS-CSM1-0		x
CanESM5	x	x
CanESM5-CanOE		x
CAS-ESM2-0		x
CESM2		x
CESM2-FV2		x
CESM2-WACCM		x
CESM2-WACCM-FV2		x
CIESM		x
CMCC-CM2-SR5		x
CNRM-CM6-1	x	x
CNRM-CM6-1-HR	x	x
CNRM-ESM2-1	x	x
EC-Earth3	x	x
EC-Earth3-Veg	x	x
EC-Earth3-Veg-LR		x
FIO-ESM-2-0		x
GISS-E2-1-G		x
GISS-E2-1-G-CC		x
HadGEM3-GC31-LL	x	x
HadGEM3-GC31-MM		x
INM-CM4-8		x
INM-CM5-0	x	x
IPSL-CM6A-LR	x	x
MIROC6	x	x
MIROC-ES2L		x
MPI-ESM-1-2-HAM		x
MPI-ESM1-2-HR	x	x
MPI-ESM1-2-LR	x	x
MRI-ESM2-0	x	x
NorCPM1		x
NorESM2-LM	x	x
NorESM2-MM	x	x
UKESM1-0-LL	x	

Tlm/sterodynamics:

Methodology:

3. z, σ, k, y, s, r, t

$$\overline{z_t}(r) + \sigma_t(r) k_t(r) \frac{y_t - \overline{y_t}}{s_t}$$

$k_t(r)$ is the correlation between global mean thermosteric sea-level rise and $z_t(r)$

The commonality is the assumption that the distribution of ocean dynamic sea level at a given point may be constrained by information about global mean thermosteric sea-level rise (“may” is an operative word here – it is also possible for the scaling factor or correlation coefficient to be zero).

Tlm/sterodynamics:

Methodology:

1.Simulation

2. Find $\mu$and σ to get the t-distribution

3. z, σ, k, y, s, r, t

4. multi-model

Workflow	GrIS	AIS	Glaciers	Land water	Sterodynamic	VLM
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4	bamber19	bamber19	ipccar5 (GMIP2)	ssp	tlm	kopp14

Kopp14/verticallandmotion

<<Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites>>

https://agupubs.onlinelibrary.wiley.com/doi/10.1002/2014EF000239

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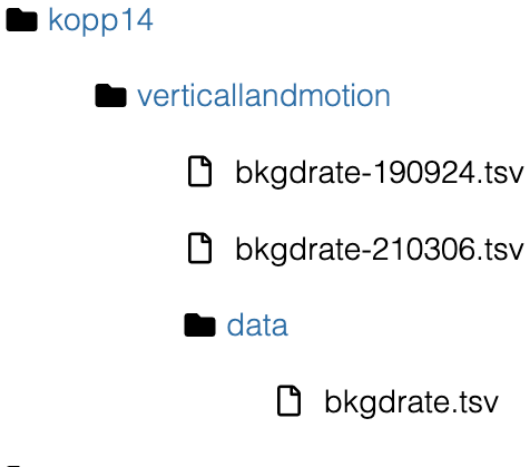
Kopp14/verticallandmotion

Dataset: https://zenodo.org/records/6419954



Kopp14/verticallandmotion

Dataset: https://zenodo.org/records/6419954

```
print(df.shape)
```
[3] ✓ 0.0s

```
(66190, 6)
```

▷ Initialize Reactive Jupyter | Sync all Stale code

```
df[0:1030]
```
[8] ✓ 0.0s

	site	ID	lat	long	bkgd rate	std
0	BREST	1	48.38	-4.49	-0.15	0.08
1	SWINOUJSCIE	2	53.92	14.23	-0.29	0.09
2	SHEERNESS	3	51.45	0.74	0.35	0.09
3	HOLYHEAD	5	53.31	-4.62	0.04	0.15
4	CUXHAVEN 2	7	53.87	8.72	0.69	0.09
...	...	...	...	...	...	...
1025	MAYPORT	2326	30.40	-81.43	0.92	0.15
1026	REDWOOD CITY	2329	37.51	-122.21	0.48	0.44
1027	PORT CHICAGO	2330	38.05	-122.04	0.53	0.23
1028	SUVA-B	2356	-18.13	178.43	0.08	0.58
1029	SYDNEY PORT JACKSON	2358	-33.83	151.26	-0.63	0.10

1030 rows × 6 columns

Kopp14/verticallandmotion

Dataset: https://zenodo.org/records/6419954

```
print(df.shape)
```

✓ 0.0s

```
(66190, 6)
```

▷ Initialize Reactive Jupyter | Sync all Stale code

```
df[1030:]
```

✓ 0.0s

	site	ID	lat	long	bkgd rate	std
1030	grid_90.0_0.0	1000000000	90.0	0.0	1.48	1.40
1031	grid_90.0_1.0	1000000010	90.0	1.0	1.47	1.40
1032	grid_90.0_2.0	1000000020	90.0	2.0	1.47	1.40
1033	grid_90.0_3.0	1000000030	90.0	3.0	1.47	1.40
1034	grid_90.0_4.0	1000000040	90.0	4.0	1.47	1.40
...	...	...	...	...	...	...
66185	grid_-90.0_355.0	1018003550	-90.0	-5.0	-2.45	1.09
66186	grid_-90.0_356.0	1018003560	-90.0	-4.0	-2.46	1.09
66187	grid_-90.0_357.0	1018003570	-90.0	-3.0	-2.46	1.09
66188	grid_-90.0_358.0	1018003580	-90.0	-2.0	-2.47	1.09
66189	grid_-90.0_359.0	1018003590	-90.0	-1.0	-2.47	1.09

65160 rows × 6 columns

Summary

- Fair/temperature
- Emulandice/AIS, GrIS, glaciers
- Tlm/sterodynamics
- Kopp14/verticallandmotion

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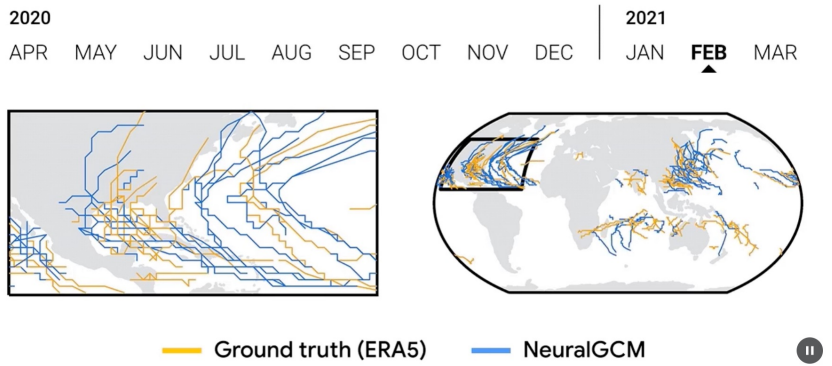
NeuralGCM (flooding)

- <<Neural general circulation models for weather and climate>>
- *22 July 2024*
- http://research.google/blog/fast-accurate-climate-modeling-with-neuralgcm/
- https://www.nature.com/articles/s41586-024-07744-y
- https://github.com/google-research/neuralgcm

NeuralGCM

- Tropical Storm prediction (Earth's atmosphere)
- Open source
- fast

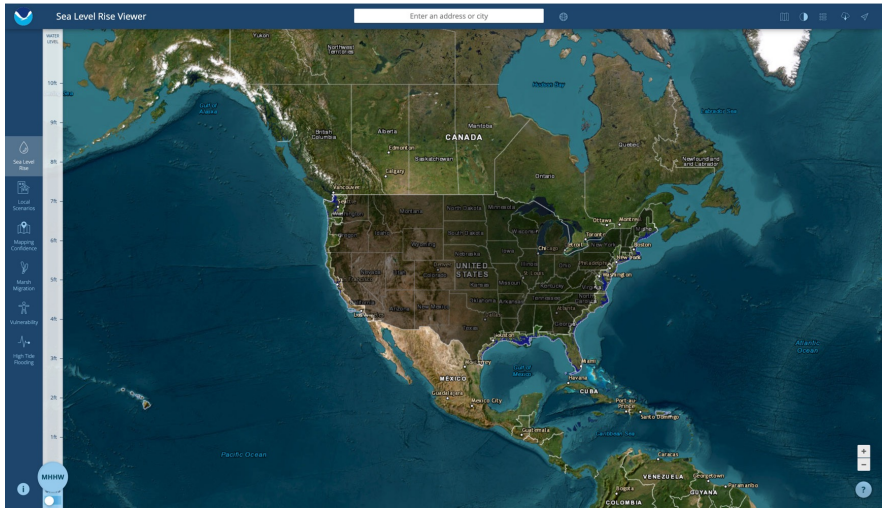


NeuralGCM predicted tropical cyclone tracks across the globe for 2020. The predicted storms matched the number and intensity of actual cyclones from that year as seen in the ECMWF reanalysis v5 (ERA5) dataset.

Sea Level Rise Viewer tool

- US
- Keep updated

- Data source
- Projection method



Discussion