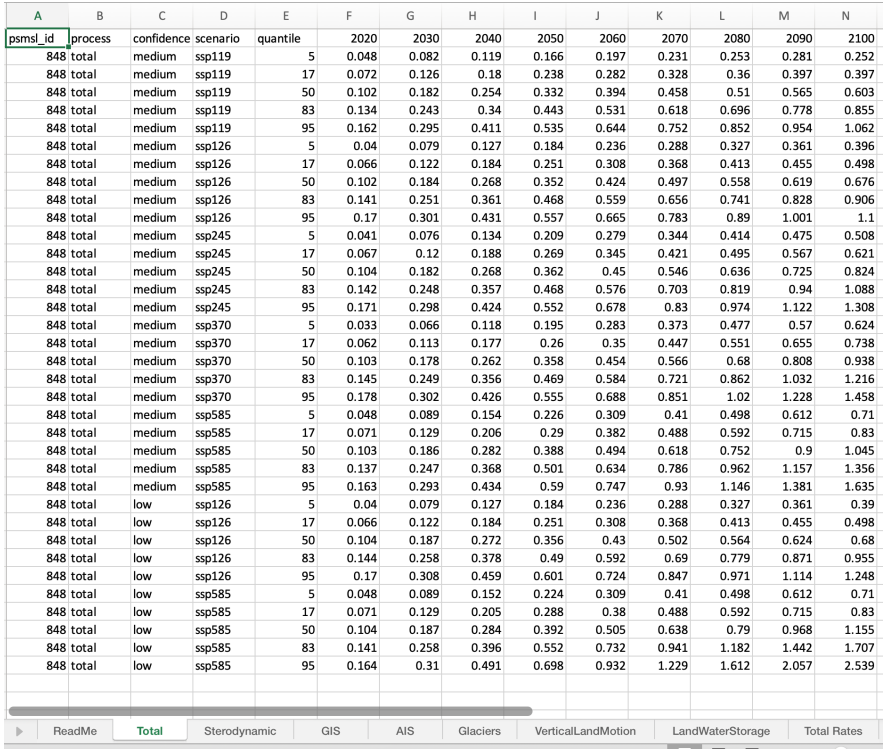
Group Meeting

Yunlong Pan

Outline

- Sea level tool
  - https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool
  - Paper
  - Methods
  - Dataset
  - Limits
- Discussion



psmsl_id	process	confidence	scenario	quantile	2020	2030	2040	2050	2060	2070	2080	2090	2100
848	total	medium	ssp119	5	0.048	0.082	0.119	0.166	0.197	0.231	0.253	0.281	0.252
848	total	medium	ssp119	17	0.072	0.126	0.18	0.238	0.282	0.328	0.36	0.397	0.397
848	total	medium	ssp119	50	0.102	0.182	0.254	0.332	0.394	0.458	0.51	0.565	0.603
848	total	medium	ssp119	83	0.134	0.243	0.34	0.443	0.531	0.618	0.696	0.778	0.855
848	total	medium	ssp119	95	0.162	0.295	0.411	0.535	0.644	0.752	0.852	0.954	1.062
848	total	medium	ssp126	5	0.04	0.079	0.127	0.184	0.236	0.288	0.327	0.361	0.396
848	total	medium	ssp126	17	0.066	0.122	0.184	0.251	0.308	0.368	0.413	0.455	0.498
848	total	medium	ssp126	50	0.102	0.184	0.268	0.352	0.424	0.497	0.558	0.619	0.676
848	total	medium	ssp126	83	0.141	0.251	0.361	0.468	0.559	0.656	0.741	0.828	0.906
848	total	medium	ssp126	95	0.17	0.301	0.431	0.557	0.665	0.783	0.89	1.001	1.1
848	total	medium	ssp245	5	0.041	0.076	0.134	0.209	0.279	0.344	0.414	0.475	0.508
848	total	medium	ssp245	17	0.067	0.12	0.188	0.269	0.345	0.421	0.495	0.567	0.621
848	total	medium	ssp245	50	0.104	0.182	0.268	0.362	0.45	0.546	0.636	0.725	0.824
848	total	medium	ssp245	83	0.142	0.248	0.357	0.468	0.576	0.703	0.819	0.94	1.088
848	total	medium	ssp245	95	0.171	0.298	0.424	0.552	0.678	0.83	0.974	1.122	1.308
848	total	medium	ssp370	5	0.033	0.066	0.118	0.195	0.283	0.373	0.477	0.57	0.624
848	total	medium	ssp370	17	0.062	0.113	0.177	0.26	0.35	0.447	0.551	0.655	0.738
848	total	medium	ssp370	50	0.103	0.178	0.262	0.358	0.454	0.566	0.68	0.808	0.938
848	total	medium	ssp370	83	0.145	0.249	0.356	0.469	0.584	0.721	0.862	1.032	1.216
848	total	medium	ssp370	95	0.178	0.302	0.426	0.555	0.688	0.851	1.02	1.228	1.458
848	total	medium	ssp585	5	0.048	0.089	0.154	0.226	0.309	0.41	0.498	0.612	0.71
848	total	medium	ssp585	17	0.071	0.129	0.206	0.29	0.382	0.488	0.592	0.715	0.83
848	total	medium	ssp585	50	0.103	0.186	0.282	0.388	0.494	0.618	0.752	0.9	1.045
848	total	medium	ssp585	83	0.137	0.247	0.368	0.501	0.634	0.786	0.962	1.157	1.356
848	total	medium	ssp585	95	0.163	0.293	0.434	0.59	0.747	0.93	1.146	1.381	1.635
848	total	low	ssp126	5	0.04	0.079	0.127	0.184	0.236	0.288	0.327	0.361	0.39
848	total	low	ssp126	17	0.066	0.122	0.184	0.251	0.308	0.368	0.413	0.455	0.498
848	total	low	ssp126	50	0.104	0.187	0.272	0.356	0.43	0.502	0.564	0.624	0.68
848	total	low	ssp126	83	0.144	0.258	0.378	0.49	0.592	0.69	0.779	0.871	0.955
848	total	low	ssp126	95	0.17	0.308	0.459	0.601	0.724	0.847	0.971	1.114	1.248
848	total	low	ssp585	5	0.048	0.089	0.152	0.224	0.309	0.41	0.498	0.612	0.71
848	total	low	ssp585	17	0.071	0.129	0.205	0.288	0.38	0.488	0.592	0.715	0.83
848	total	low	ssp585	50	0.104	0.187	0.284	0.392	0.505	0.638	0.79	0.968	1.155
848	total	low	ssp585	83	0.141	0.258	0.396	0.552	0.732	0.941	1.182	1.442	1.707
848	total	low	ssp585	95	0.164	0.31	0.491	0.698	0.932	1.229	1.612	2.057	2.539

ReadMe | Total | Sterodynamic | GIS | AIS | Glaciers | VerticalLandMotion | LandWaterStorage | Total Rates

IPCC AR6 Sea Level Projections: Paper

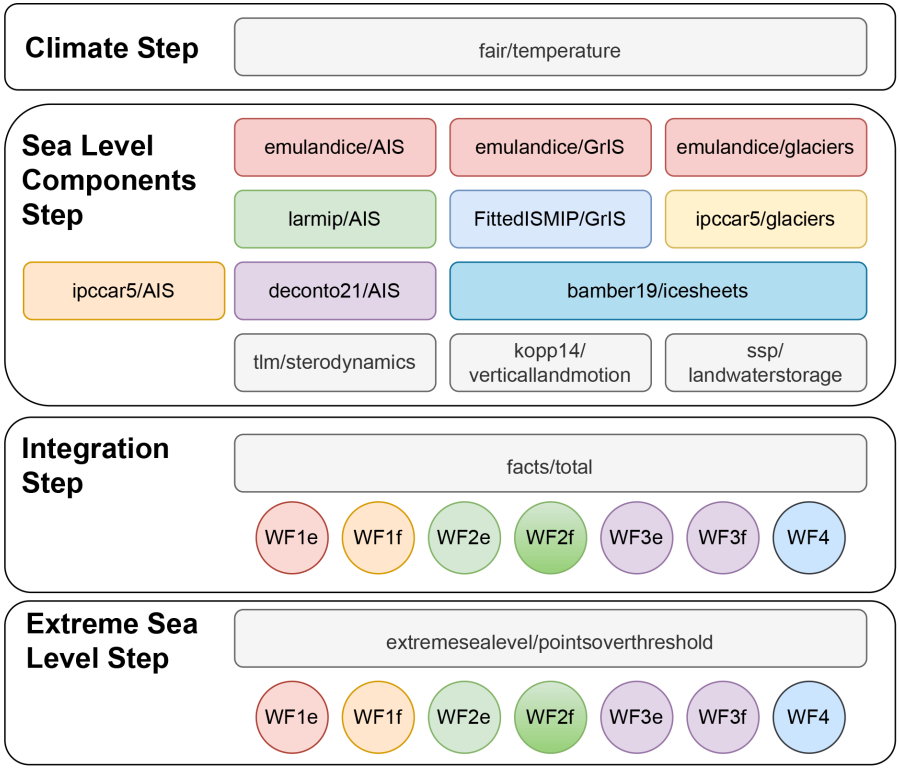
<<The Framework for Assessing Changes To Sea-level (FACTS) v1.0: a platform for characterizing parametric and structural uncertainty in future global, relative, and extreme sea-level change>>

https://gmd.copernicus.org/articles/16/7461/2023/

21 Dec 2023

Methods

- Fair
- Emulandice
- larmip
- ipccar5
- deconto21
- bamber19
- Tlim
- Kopp14
- ssp



Methods

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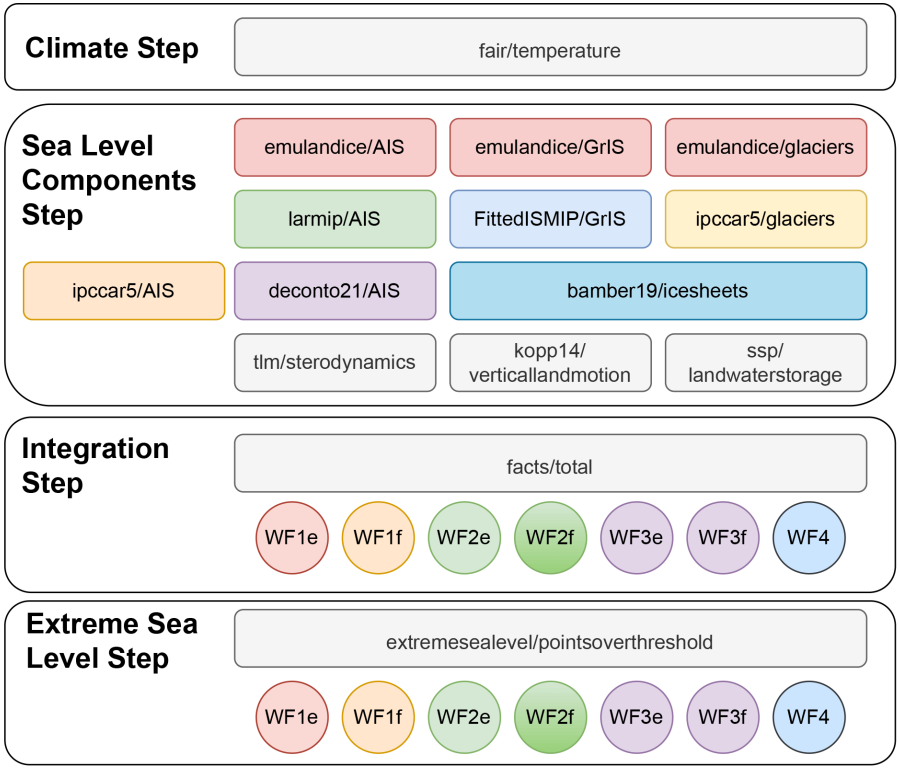

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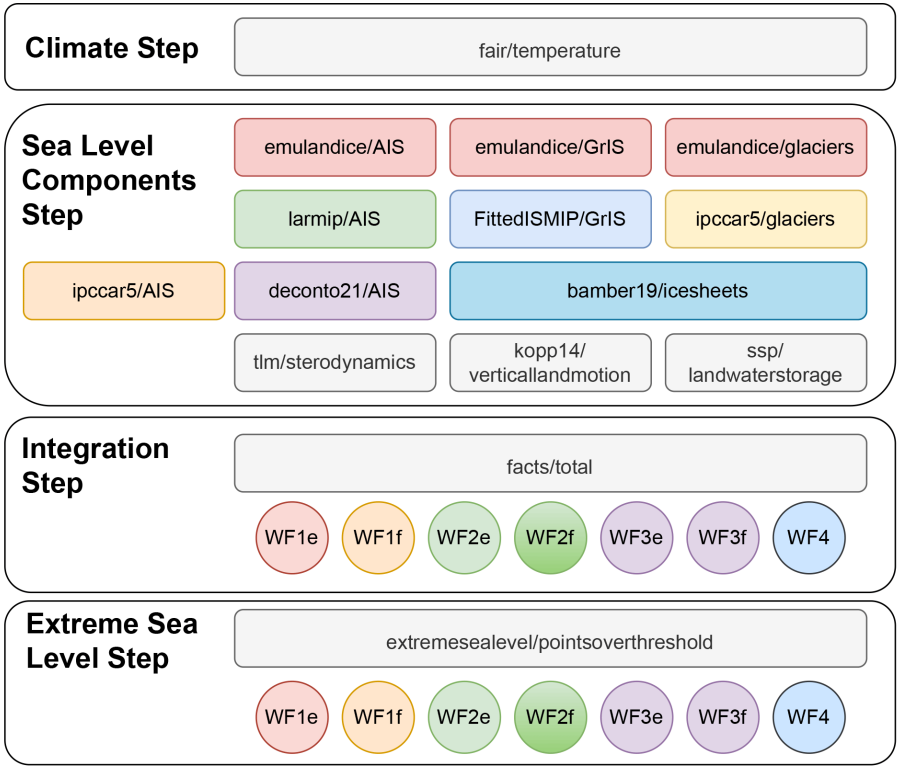
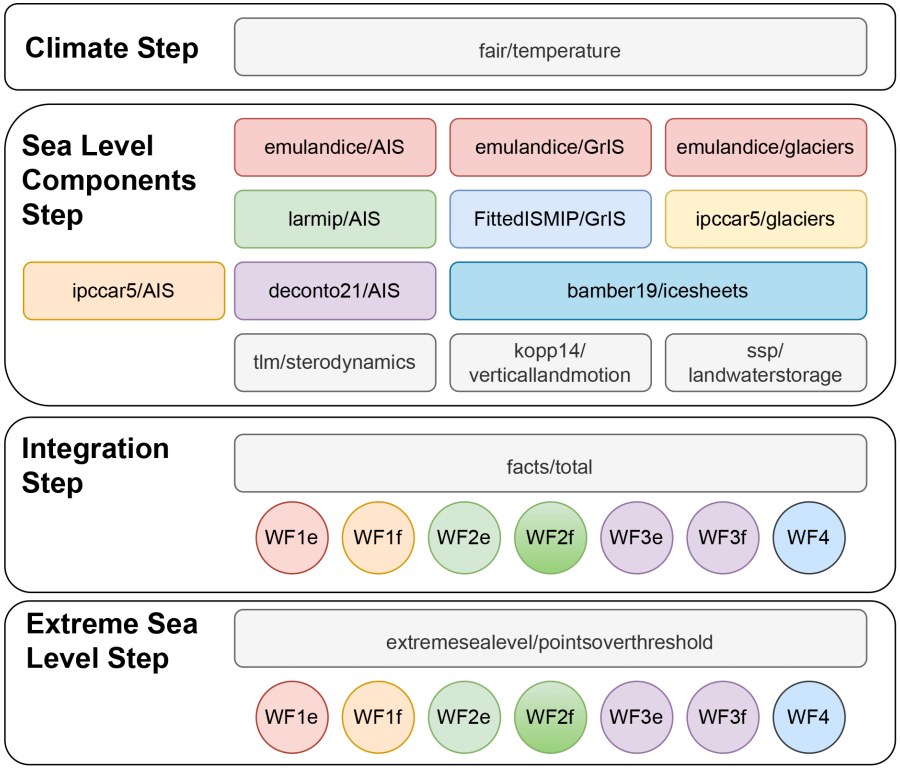


Methods

2.3.3 Totaling module

The `facts/total` module handles the aggregation of sea-level component probability distributions into probability distributions for total GMSL and RSL change. This module takes as an input a configuration file pointing to the output files that constitute different workflows (see Sect. 2.4).

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



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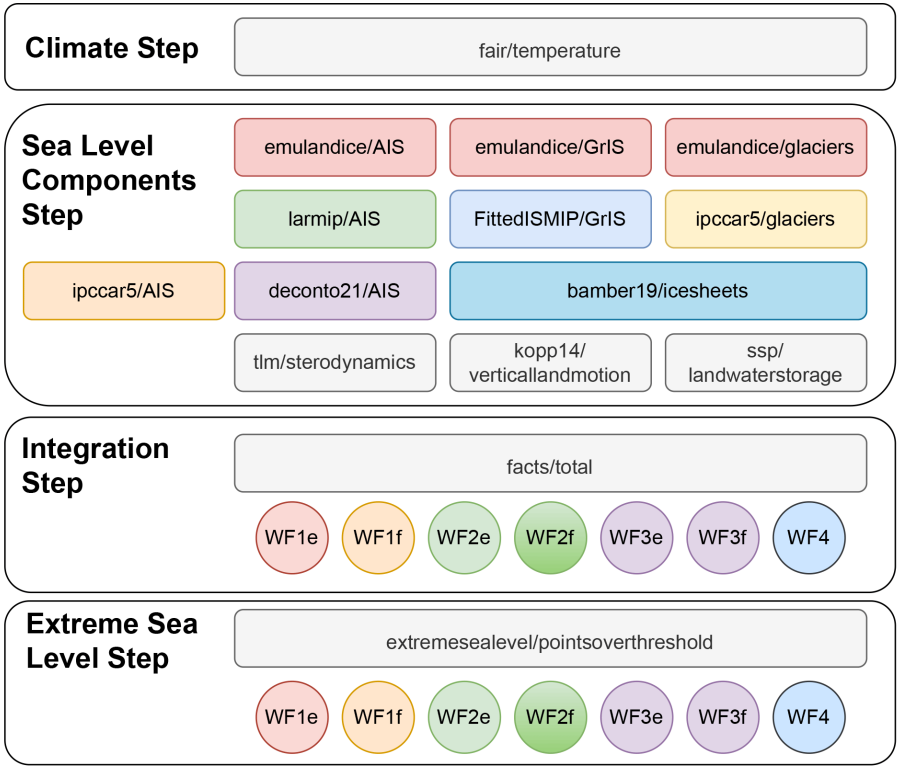

tlm/sterodynamics

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

Appendix A: The `tlm/sterodynamics` methodology

The ocean dynamic sea-level projection method used by the `tlm/sterodynamics` module is a modification of that described in Kopp et al. (2014). Whereas in Kopp et al. (2014) global mean thermosteric sea-level rise projections are derived directly from a GCM ensemble, in `tlm/sterodynamics` they are generated from the two-layer model, as described in Fox-Kemper et al. (2021b).

As in Kopp et al. (2014), ocean dynamic sea level is assumed to have a degree of correlation with global mean thermosteric sea-level rise, with the correlation assessed on a grid cell basis. In the case of `tlm/sterodynamics`, the correlation is calculated based on the CMIP6 ensemble for a particular (specified) SSP scenario. Given a sample of 19-year-average global mean thermosteric sea-level rise y at a particular point in time t, 19-year-average ocean dynamic sea level z is taken as distributed following a t distribution with a conditional mean of

$$\overline{z_t}(r) + \sigma_t(r) k_t(r) \frac{y_t - \overline{y_t}}{s_t} \tag{A1}$$

and a conditional standard deviation proportional to

$$\sigma_t(r) 1 - k_t(r)^2, \tag{A2}$$

where $z_t(r)$ is the multi-model mean ocean dynamic sea level at time t and location r, $\sigma_t(r)$ is the multi-model standard deviation, $k_t(r)$ is the correlation between global mean thermosteric sea-level rise and $z_t(r)$, $\bar{y}_t$ is the multi-model mean of global mean thermosteric sea-level rise, and s_t is the standard deviation across models of global mean thermosteric sea-level rise. The standard deviation is inflated relative to that of the ensemble to account for the expert judgment that the 5th–95th percentile of the ensemble may have as much as a 33 % chance of being exceeded on either end (i.e., the 5th–95th percentile range is treated as a likely range). Though the parameters of this regression model are refit for each time point, correlation across time is preserved (perhaps excessively) in sampling by drawing (via Latin hypercube sampling) a single quantile of the variance characterized by the conditional standard deviation to use at all time points for a given time series sample. In sampling the t distribution, the number of degrees of freedom is taken as the number of GCMs providing ocean dynamic sea-level projections for a particular grid cell in the scenario used for calibration.

In some ways, the approach is similar to that of a linear-regression-based scaling of ocean dynamic sea level on global mean thermosteric sea-level rise, as in Palmer et al. (2020). 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).

4.2 Directions for improvement

- Enhanced Climate Information Integration
- Refined Vertical Land Motion (VLM) Approaches
- Addressing Uncertainty in Glacial Isostatic Adjustment (GIA)
- Enhanced Extreme Sea Level (ESL) Projections
- Dynamic Contemporary Geophysical and Regional Deformation (GRD) Processes
- Higher-Frequency Variability in Sea-Level Projections
- Transformation into a Community Project

Discussion