

# Group meeting

6/19/24

Yunlong Pan

# Outline

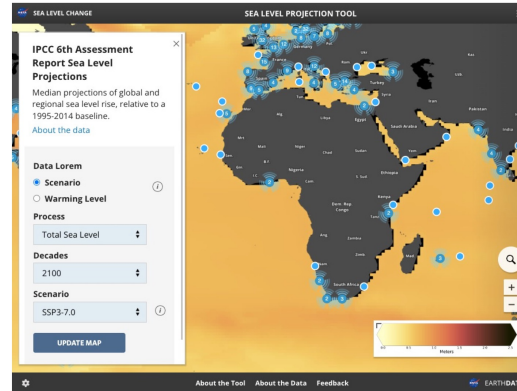
- Email
  - Regional climate change projections Web tools
  - Criteria and methods
  - Search for future predictions with LLM
- ChatIAMs
  - Review
  - Demo app (New)

# Regional climate change projections Web tools

- [https://sealevel.nasa.gov/data\\_tools/17](https://sealevel.nasa.gov/data_tools/17)



## IPCC AR6 Sea Level Projection Tool



LAUNCH

Under a warming climate, sea levels around the world have been rising and are projected to continue rising in the future. The projections of future sea level rise are critical for coastal planners and policymakers trying to understand and account for sea-level impacts on their communities. Understanding the science, determining which projections to use, and having

### Platform Recommendations

- Mac OS: Safari, Firefox
- Mac iOS: Safari
- Windows: Chrome, Edge
- Android: Chrome

### Featured Resources



Video: Tracking 30 Years of Sea Level Rise



Video: Global Ocean Tides

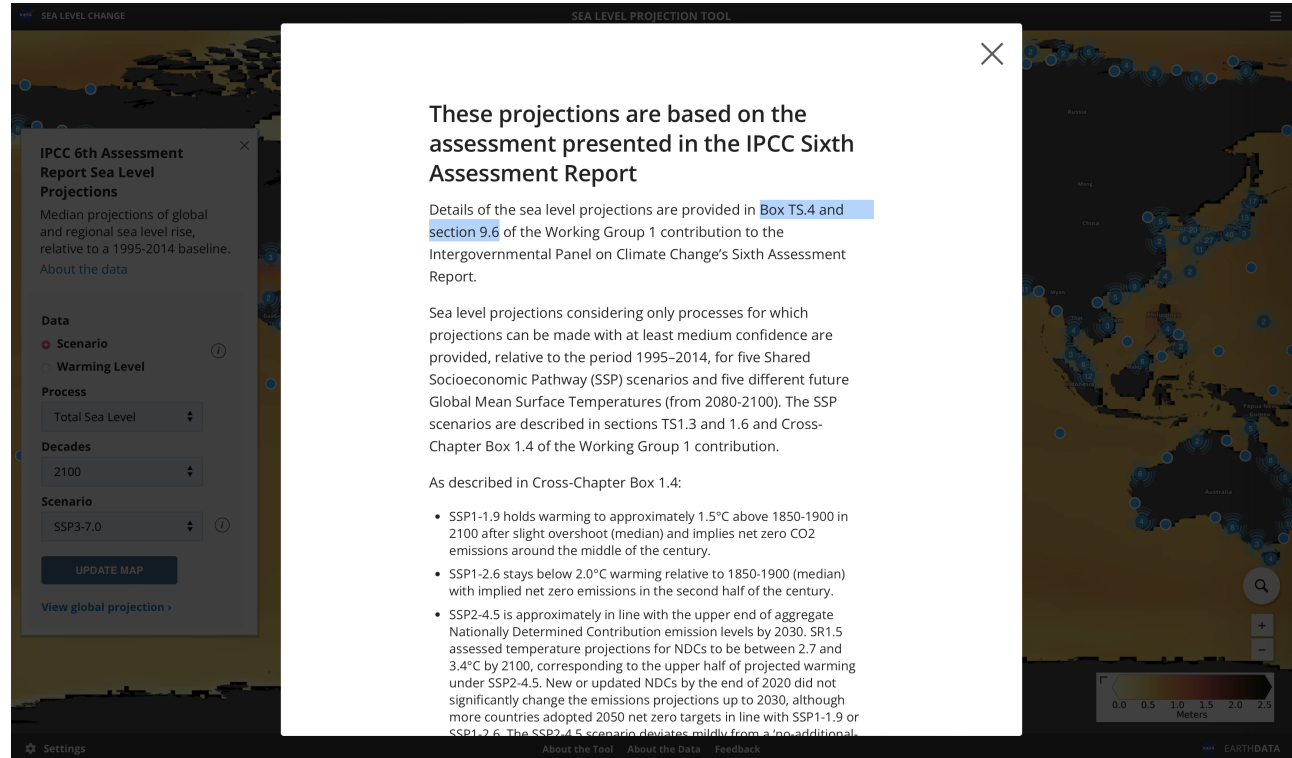


Video: Ocean Flow Vignettes

[more resources](#)

# Criteria and methods

- <https://www.ipcc.ch/report/ar6/wg1/>



# Criteria and methods

- Dataset (IPCC AR6 Sea Level Projections)  
<https://zenodo.org/records/6382554>
- Guide (to the IPCC AR6 Sea Level Projections)  
<https://github.com/Rutgers-ESSP/IPCC-AR6-Sea-Level-Projections>
- Framework for Assessing Changes To Sea-level (FACTS)  
<https://github.com/radical-collaboration/facts>

# Search for future predictions with LLM

Ex: SEA  
LEVEL  
PROJECTION  
for PORT  
JEFFERSON

Demo app  
(Next week)

A1	psmsl_id																		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	psmsl_id	process	confidence	scenario	quantile	2020	2030	2040	2050	2060	2070	2080	2090	2100	2110	2120	2130	2140	2150
2	848 total	medium	ssp119	5	0.048	0.082	0.119	0.166	0.197	0.231	0.253	0.281	0.252	0.259	0.279	0.296	0.311	0.327	
3	848 total	medium	ssp119	17	0.072	0.126	0.18	0.238	0.282	0.328	0.36	0.397	0.418	0.453	0.485	0.517	0.547		
4	848 total	medium	ssp119	50	0.102	0.182	0.254	0.332	0.394	0.458	0.51	0.565	0.603	0.66	0.722	0.781	0.838	0.895	
5	848 total	medium	ssp119	83	0.134	0.243	0.34	0.443	0.531	0.618	0.696	0.778	0.855	0.955	1.048	1.139	1.228	1.317	
6	848 total	medium	ssp119	95	0.162	0.295	0.411	0.535	0.644	0.752	0.852	0.954	1.062	1.18	1.297	1.414	1.529	1.642	
7	848 total	medium	ssp126	5	0.04	0.079	0.127	0.184	0.236	0.288	0.327	0.361	0.396	0.396	0.421	0.445	0.467	0.488	
8	848 total	medium	ssp126	17	0.066	0.122	0.184	0.251	0.308	0.368	0.413	0.455	0.498	0.512	0.547	0.58	0.611	0.641	
9	848 total	medium	ssp126	50	0.102	0.184	0.268	0.352	0.424	0.497	0.558	0.619	0.676	0.73	0.788	0.844	0.9	0.953	
10	848 total	medium	ssp126	83	0.141	0.251	0.361	0.468	0.559	0.656	0.741	0.828	0.906	1.01	1.099	1.188	1.274	1.361	
11	848 total	medium	ssp126	95	0.17	0.301	0.431	0.557	0.665	0.783	0.89	1.001	1.1	1.222	1.333	1.444	1.557	1.669	
12	848 total	medium	ssp245	5	0.041	0.076	0.134	0.209	0.279	0.344	0.414	0.475	0.508	0.516	0.569	0.621	0.672	0.722	
13	848 total	medium	ssp245	17	0.067	0.12	0.188	0.269	0.345	0.421	0.495	0.567	0.621	0.648	0.715	0.78	0.844	0.906	
14	848 total	medium	ssp245	50	0.104	0.182	0.268	0.362	0.45	0.546	0.636	0.725	0.824	0.906	1.004	1.1	1.194	1.289	
15	848 total	medium	ssp245	83	0.142	0.248	0.357	0.468	0.576	0.703	0.819	0.94	1.088	1.236	1.377	1.515	1.654	1.792	
16	848 total	medium	ssp245	95	0.171	0.298	0.424	0.552	0.678	0.83	0.974	1.122	1.308	1.49	1.666	1.839	2.011	2.182	
17	848 total	medium	ssp370	5	0.033	0.066	0.118	0.195	0.283	0.373	0.477	0.57	0.624	0.633	0.71	0.786	0.861	0.934	
18	848 total	medium	ssp370	17	0.062	0.113	0.177	0.26	0.35	0.447	0.551	0.655	0.738	0.763	0.854	0.946	1.035	1.12	
19	848 total	medium	ssp370	50	0.103	0.178	0.262	0.358	0.454	0.566	0.68	0.808	0.938	1.03	1.158	1.285	1.41	1.532	
20	848 total	medium	ssp370	83	0.145	0.249	0.356	0.469	0.584	0.721	0.862	1.032	1.216	1.374	1.55	1.728	1.903	2.078	
21	848 total	medium	ssp370	95	0.178	0.302	0.426	0.555	0.688	0.851	1.02	1.228	1.458	1.657	1.875	2.092	2.31	2.526	
22	848 total	medium	ssp585	5	0.048	0.089	0.154	0.226	0.309	0.41	0.498	0.612	0.71	0.708	0.794	0.877	0.958	1.033	
23	848 total	medium	ssp585	17	0.071	0.129	0.206	0.29	0.382	0.488	0.592	0.715	0.83	0.853	0.956	1.054	1.148	1.238	
24	848 total	medium	ssp585	50	0.103	0.186	0.282	0.388	0.494	0.618	0.752	0.9	1.045	1.15	1.294	1.432	1.566	1.695	
25	848 total	medium	ssp585	83	0.137	0.247	0.368	0.501	0.634	0.786	0.962	1.157	1.356	1.557	1.76	1.961	2.157	2.349	
26	848 total	medium	ssp585	95	0.163	0.293	0.434	0.59	0.747	0.93	1.146	1.381	1.635	1.875	2.126	2.377	2.623	2.868	
27	848 total	low	ssp126	5	0.04	0.079	0.127	0.184	0.236	0.288	0.327	0.361	0.39	0.396	0.421	0.445	0.467	0.488	
28	848 total	low	ssp126	17	0.066	0.122	0.184	0.251	0.308	0.368	0.413	0.455	0.498	0.512	0.547	0.58	0.611	0.641	
29	848 total	low	ssp126	50	0.104	0.187	0.272	0.356	0.43	0.502	0.564	0.624	0.68	0.743	0.806	0.869	0.933	0.998	
30	848 total	low	ssp126	83	0.144	0.258	0.378	0.49	0.592	0.69	0.779	0.871	0.955	1.055	1.157	1.267	1.383	1.498	
31	848 total	low	ssp126	95	0.17	0.308	0.459	0.601	0.724	0.847	0.971	1.114	1.248	1.392	1.529	1.675	1.826	1.982	
32	848 total	low	ssp585	5	0.048	0.089	0.152	0.224	0.309	0.41	0.498	0.612	0.71	0.708	0.794	0.877	0.958	1.033	
33	848 total	low	ssp585	17	0.071	0.129	0.205	0.288	0.38	0.488	0.592	0.715	0.83	0.853	0.956	1.054	1.148	1.238	
34	848 total	low	ssp585	50	0.104	0.187	0.284	0.392	0.505	0.638	0.79	0.968	1.155	1.342	1.569	1.821	2.1	2.408	
35	848 total	low	ssp585	83	0.141	0.258	0.396	0.552	0.732	0.941	1.182	1.442	1.707	2.002	2.589	3.396	4.474	5.655	
36	848 total	low	ssp585	95	0.164	0.31	0.491	0.698	0.932	1.229	1.612	2.057	2.539	3.083	3.708	4.392	5.119	6.376	
Total																			
Sterodynamic																			
GIS																			
AIS																			
Glaciers																			
VerticalLandMotion																			
LandWaterStorage																			
Total Rates																			
+																			
Ready																			

# ChatIAMs

- **Paper Draft** <https://www.overleaf.com/1225397724nhhpgfjszczg#a93b66>
  - Introduction
  - Background
  - Method
  - Experiment **level1 (Simple Q&A)**
  - Experiment level2
  - Experiment **level3 (General Q&A)**
  - Discussion
  - Conclusion
- **Demo app** <https://github.com/yl1127/ChatIAMs/tree/main>

# Level 3(General Q&A)

## 7 questions:

- 1. What is the best estimate of the equilibrium climate sensitivity?
- 2. Is it possible the Arctic will become ice free at some points before 2050?
- 3. How likely will the world see runaway ice loss from the Antarctic ice sheets by 2100?
- 4. To what extent has climate change impacted ice sheets in both polar regions?
- 5. Will coastal New York see the impact of Greenland ice sheet melting by 2100?
- 6. What will be the likely changes to weather and climate extremes in coastal New York around 2050 if the world take no action to reduce greenhouse gas emissions?
- 7. What are the primary evidence and how robust is it that human activities caused the observed global warming since the pre-industrial period?



# Level 3(General Q&A)

Result:

Questions	tool_calls	IAMs
Q1	No	
Q2	No	
Q3	No	
Q4	No	
Q5	No	
Q6	Yes	{"variable":"Surface Air Temperature Change","year":"2050","scenario":"ssp585"}
Q7	No	

# Level 3(General Q&A)

- Q6:What will be the likely changes to weather and climate extremes in coastal New York around 2050 if the world take no action to reduce greenhouse gas emissions?
- IAMs :

	model	quantile	variable	unit	scenario	2050
99	REMIND-MAGPIE	0.005	Surface Air Temperature Change	K	ssp585	2.09478
199	REMIND-MAGPIE	0.025	Surface Air Temperature Change	K	ssp585	2.11271
299	REMIND-MAGPIE	0.5	Surface Air Temperature Change	K	ssp585	2.38907
399	REMIND-MAGPIE	0.975	Surface Air Temperature Change	K	ssp585	2.64485
499	REMIND-MAGPIE	0.995	Surface Air Temperature Change	K	ssp585	2.66145

# Level 3(General Q&A)

- Q6 answers:

Initialize Reactive Jupyter | Sync all Stale code

display(Markdown(get\_chatians(Q6)))

✓ 10.4s Python

```
[{'role': 'user', 'content': 'What will be the likely changes to weather and climate extremes in coastal New York around 2050 under these conditions:'}]
```

If no action is taken to reduce greenhouse gas emissions, the climate model projections under the high-emission scenario SSP5-8.5 suggest significant increases in surface air temperatures for coastal New York by around 2050. The median estimate indicates an increase of approximately 2.39°C above the baseline temperature levels.

Here are some likely changes to weather and climate extremes in coastal New York around 2050 under these conditions:

- Increased Temperature Extremes:**
  - More frequent and intense heatwaves, with higher maximum temperatures.
  - Warmer night-time temperatures, reducing the occurrence of cool nights.
- Sea-Level Rise:**
  - Rising sea levels will contribute to more frequent and severe coastal flooding, especially during high tides and storm surges.
  - Increased risk of coastal erosion and loss of land due to higher sea levels coupled with storm events.
- More Intense Storms:**
  - Potential for more intense tropical cyclones (hurricanes) with higher wind speeds and more heavy rainfall, although the frequency of these storms can vary.
  - Greater likelihood of damaging storm surges due to a combination of sea-level rise and intense storm activity.
- Increased Precipitation Extremes:**
  - More frequent and severe heavy rainfall events, leading to a higher risk of flash flooding and urban flooding.
  - Possible changes in seasonal precipitation patterns, potentially causing prolonged periods of both drought and intense rainfall.
- Changes in Ocean Conditions:**
  - Ocean warming and acidification can impact coastal ecosystems, fisheries, and biodiversity.
  - More frequent and widespread harmful algal blooms, affecting water quality and marine life.

Adapting to these changes will require significant efforts in updating infrastructure, improving emergency response systems, and planning for resilient coastal development.

+ Code

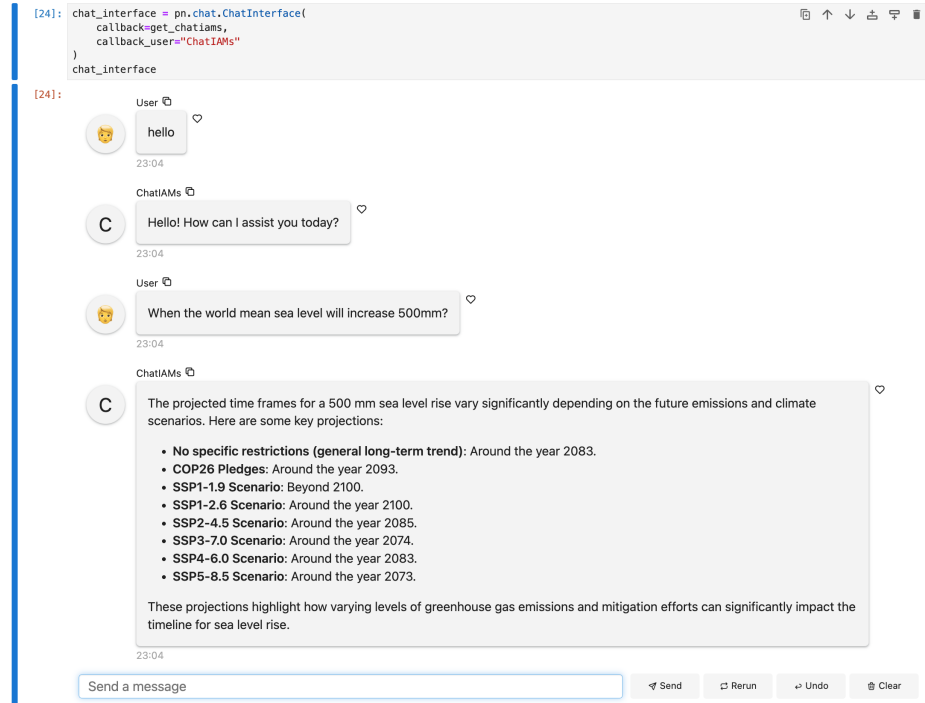
+ Markdown

# Possible powerful climate models

- GraphCast: <https://deepmind.google/discover/blog/graphcast-ai-model-for-faster-and-more-accurate-global-weather-forecasting/>
- Aurora: <https://www.microsoft.com/en-us/research/blog/introducing-aurora-the-first-large-scale-foundation-model-of-the-atmosphere/>
- ClimaX: <https://arxiv.org/abs/2301.10343>


# Demo app (Old)

- Jupyter notebook
- [https://github.com/yl1127/Academic-projects/blob/main/yl\\_Climate\\_LLM/yl\\_ChatsIAMS\\_0612.ipynb](https://github.com/yl1127/Academic-projects/blob/main/yl_Climate_LLM/yl_ChatsIAMS_0612.ipynb)




```
[24]: chat_interface = pn.chat.ChatInterface(
      callback_get_chatsians,
      callback_user="ChatIAMS"
    )
      chat_interface
```


[24]:

User  hello


23:04

ChatIAMS  Hello! How can I assist you today?

23:04

User  When the world mean sea level will increase 500mm?





23:04

ChatIAMS  The projected time frames for a 500 mm sea level rise vary significantly depending on the future emissions and climate scenarios. Here are some key projections:

- No specific restrictions (general long-term trend): Around the year 2083.
- COP26 Pledges: Around the year 2093.
- SSP1-1.9 Scenario: Beyond 2100.
- SSP1-2.6 Scenario: Around the year 2100.
- SSP2-4.5 Scenario: Around the year 2085.
- SSP3-7.0 Scenario: Around the year 2074.
- SSP4-6.0 Scenario: Around the year 2083.
- SSP5-8.5 Scenario: Around the year 2073.

These projections highlight how varying levels of greenhouse gas emissions and mitigation efforts can significantly impact the timeline for sea level rise.

23:04

Send a message    

# Demo app (Docker)



## ChatIAMS

A chatbot enhanced by Climate IAMS from IPCC

What's the Surface Air Temperature Change under ssp 119 in 2078?

Under the SSP1-1.9 scenario in the year 2078, the projected global mean Surface Air Temperature change is as follows:

- Median (50th percentile): 1.591343 K (Kelvin)
- 5th percentile: 1.353024122 K
- 25th percentile: 1.367541008 K
- 75th percentile: 1.8050365 K
- 95th percentile: 1.8188977 K

These values are based on the IMAGE model. Is there anything else you'd like to know?






How's the ssp 245

- <https://github.com/y1127/ChatIAMS/tree/main>

# Demo

- <https://github.com/yl1127/ChatIAMs/tree/main>
- Q6: What will be the likely changes to weather and climate extremes in coastal New York around 2050 if the world take no action to reduce greenhouse gas emissions?

# Plan

- Application:
  -  LLM (ChatGPT-4o)
  -  Climate models (IAMs)
  -  function\_call (OpenAI Assistant API) 50% -> 90%
  -  Web application (Text-> Text, documents(PDF, CSV), image(PNG), audio(mp3))
- Research
  -  Experiments



# Discussion