Our Coastal Futures

A pathway for a sustainable coastal zone from a theoreticians perspective

Robert Weiss

Department of Geoscience, Virginia Tech

5 December 2019

Twitter: @VTCoastal

An Applied Mathematician, an Engineer, and a Geoscientist are asked what is $1 + 1 \ldots$

An Applied Mathematician, an Engineer, and a Geoscientist are asked what is 1 + 1 …

Applied Mathematician: 2 (two)

An Applied Mathematician, an Engineer, and a Geoscientist are asked what is $1 + 1 \ldots$

Applied Mathematician: 2 (two);
Engineer: 2.00 ± 0.32

An Applied Mathematician, an Engineer, and a Geoscientist are asked what is $1 + 1 \ldots$

Applied Mathematician: 2 (two);
Engineer: 2.00 ± 0.32;
Geoscientist: **What do you want it to be?**


futureearth coasts
land-ocean interactions in the coastal zone

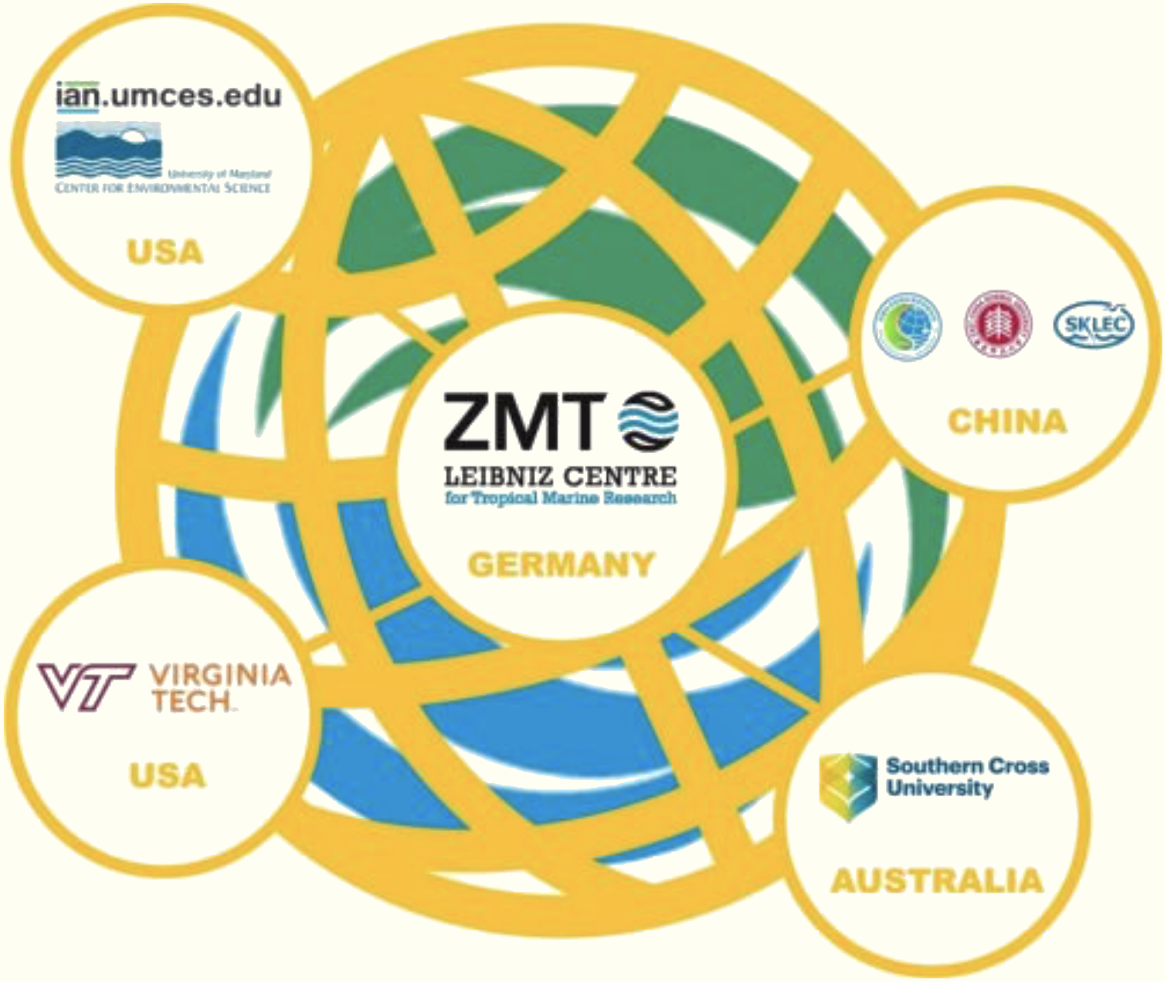
futureearth coasts

land-ocean interactions in the coastal zone

- Supporting sustainability and adaptation to global change in the coastal zone
- Formerly known as LOICZ
- Part of **Future Earth** family

futureearth coasts

land-ocean interactions in the coastal zone



futureearth coasts

land-ocean interactions in the coastal zone

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts

A new regional approach to:

A. Enable regional stakeholders and institutions to develop a common understanding of their coasts and future prospects
B. Co-design robust strategies to chart desired coastal futures;
C. Co-produce innovative coastal sustainability initiatives and pathways to achieve these desired outcomes, and realise the Sustainable Development Goals.

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts

Benefits:

1. It enables regional coastal stakeholders and governing institutions to chart a course away from unsustainable practices towards desired sustainable coastal futures.
2. It provides access to Future Earth Coasts' global network of scientific expertise, portfolio of best practices, and the resources needed to improve management of our shared coastal zones.
3. It offers an independent forum that can be tailor-made for each region, given existing realities and institutional arrangements.

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts

Benefits (cont):

4. It builds on and integrates scientific, local and indigenous knowledge.
5. It builds shared understanding about coastal issues, problems, opportunities and potential pathways to sustainability.
6. It considers alternative coastal futures and then develops strategies that can be implemented sequentially, reviewed, and modified over time.
7. It helps to build the capability of the people and institutions that guide how we use coastal resources and sustain our coasts.

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts

Step 1

Step1: Bring regional coastal stakeholders together to agree on a way forward

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts

Step 1

Step 2

Step1: Bring regional coastal stakeholders together to agree on a way forward

Step2: Build shared understanding about the coast and identify plausible coastal futures

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts

Step 1 | Step 2 | Step 3

Step1: Bring regional coastal stakeholders together to agree on a way forward

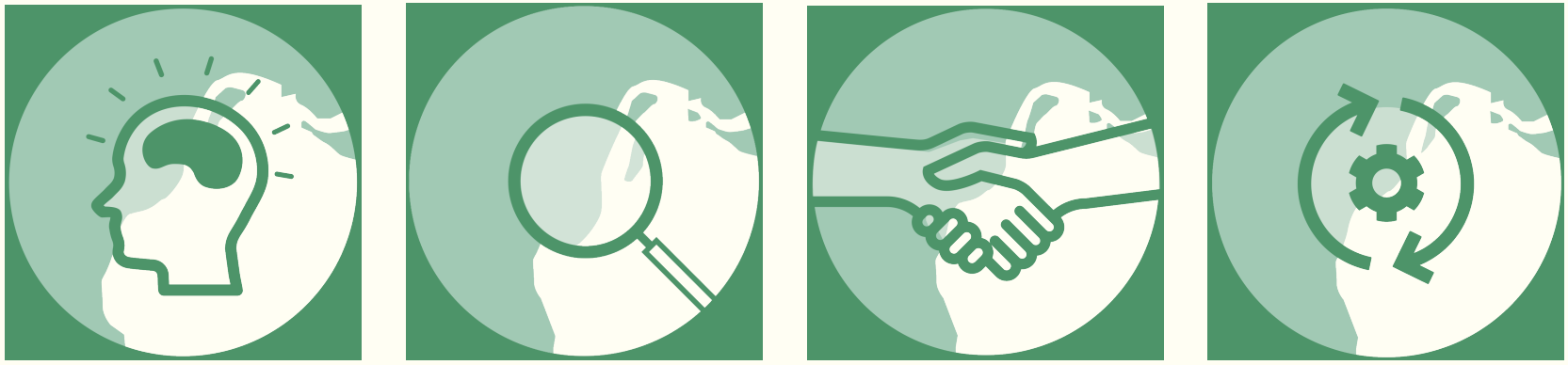
Step2: Build shared understanding about the coast and identify plausible coastal futures

Step3: Co-design robust coastal sustainability strategies

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts

Step 1 | Step 2 | Step 3 | Step 4



Step1: Bring regional coastal stakeholders together to agree on a way forward

Step2: Build shared understanding about the coast and identify plausible coastal futures

Step3: Co-design robust coastal sustainability strategies

Step4: Co-produce innovative coastal sustainability interventions and enable transition pathways

Step 2: Build shared understanding about the coast and identify plausible coastal futures

Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

Example: Barrier Island - Marsh - Lagoon System

Step 2: Build shared understanding about the coast and identify plausible coastal futures

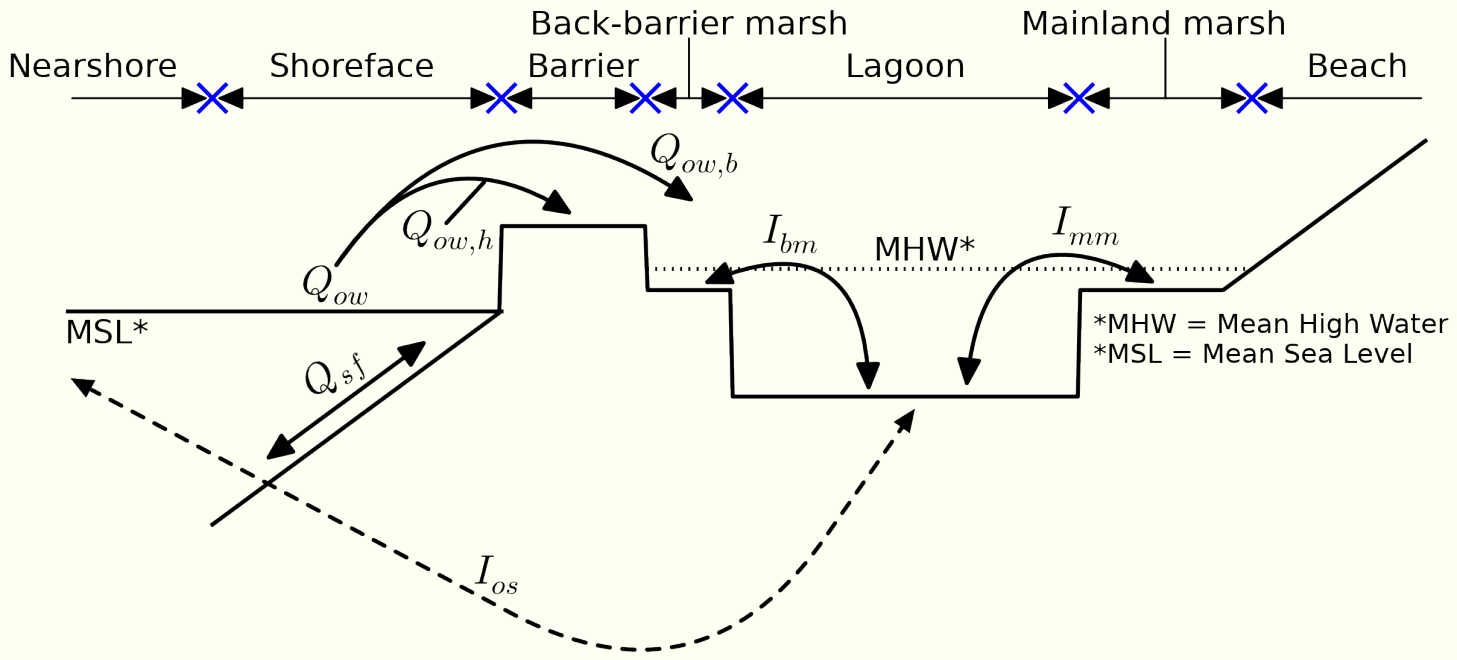
How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

Example: Barrier Island - Marsh - Lagoon System

Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

Example: Barrier Island - Marsh - Lagoon System



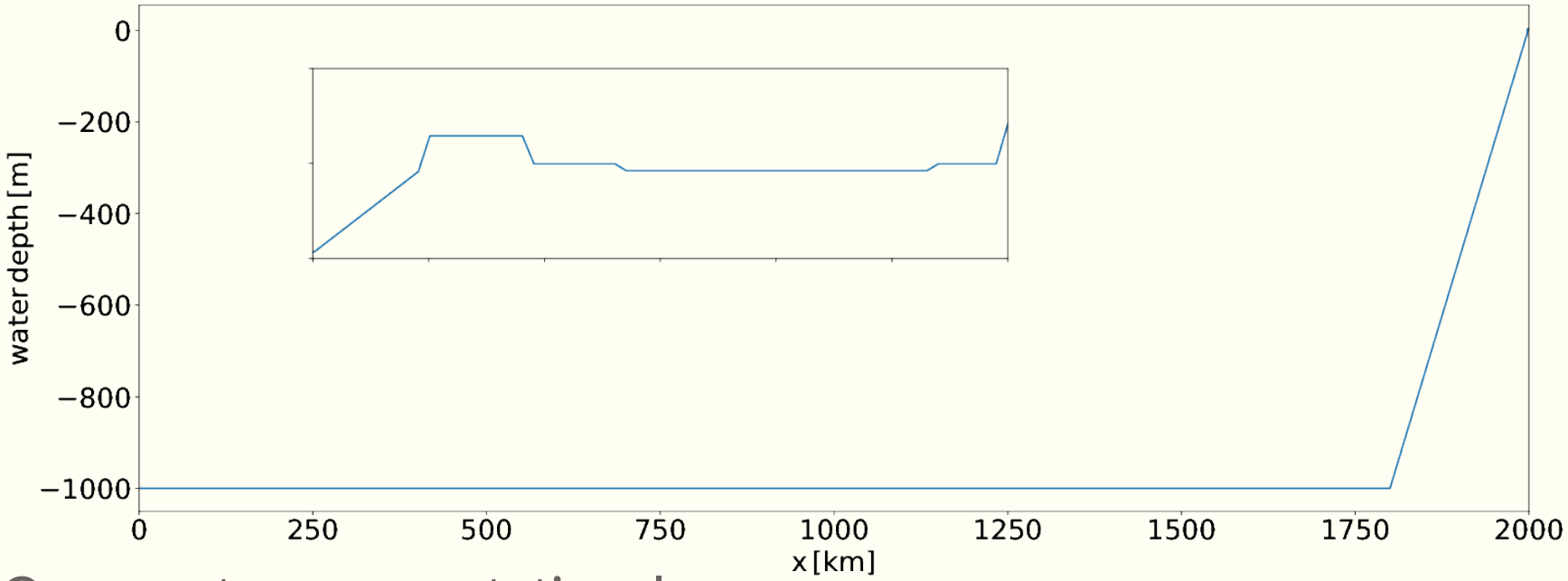
Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

Climate Change Impacts:

- **Sea-level change**
- Tidal Characteristics
- Wind Speeds
- Deep and Shallow-Sea Water Temperatures
- Storm Overwash
- Shoreface erosion
- …
- …

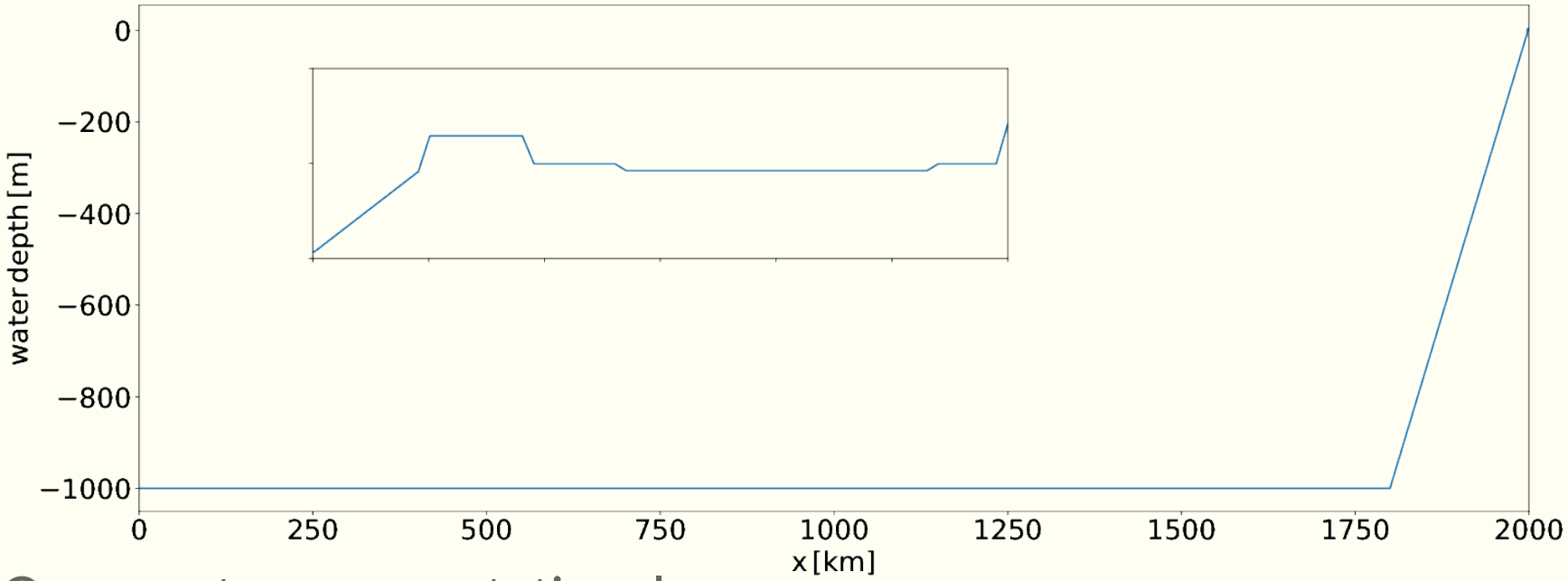
Setup



Comment on computational resources:

- EQ range: 7.0 - 9.0
- $\Delta M = 0.2$, $N_{EQ} = 11$
- EQ depths: 10
- N realizations: 1000
- Years: 3
- RCP scenarios: 3
- Total N_{CC} scenarios: 7
- T_R per tsunami: 2 mins
- Files per run: 10
- T_R to analyze 1 file: 1 s

Setup

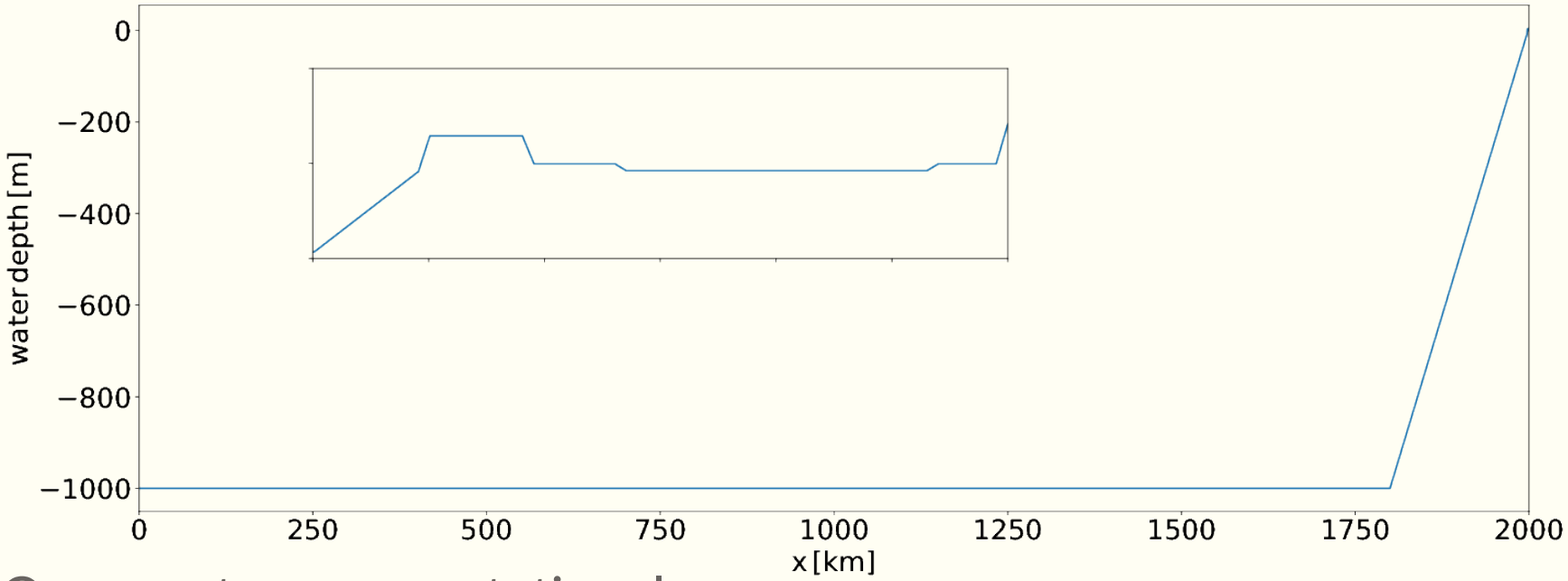


Comment on computational resources:

- EQ range: 7.0 - 9.0
- $\Delta M = 0.2$, $N_{EQ} = 11$
- EQ depths: 10
- N realizations: 1000
- Years: 3
- RCP scenarios: 3
- Total N_{CC} scenarios: 7
- T_R per tsunami: 2 mins
- Files per run: 10
- T_R to analyze 1 file: 1 s

Compute time (single CPU): 48,125 days $\approx$ 131.8 yrs

Setup



Comment on computational resources:

- EQ range: 7.0 - 9.0
- $\Delta M = 0.2$, $N_{EQ} = 11$
- EQ depths: 10
- N realizations: 1000
- Years: 3
- RCP scenarios: 3
- Total N_{CC} scenarios: 7
- T_R per tsunami: 2 mins
- Files per run: 10
- T_R to analyze 1 file: 1 s

Compute time (single CPU): 48,125 days $\approx$ 131.8 yrs

Data analysis (single CPU): 57,750 hrs $\approx$ 6.6 yrs

Example Results: RCP 8.5

Year	Type	50	17-83	5-95	1-99
2025	Ia	5.68	5.66 - 5.71	5.64 - 5.74	5.63 - 5.76
	Ib	7.61	6.02 - 9.14	4.56 - 11.25	4.03 - 13.96
	IIa	5.72	5.67 - 5.79	5.64 - 5.84	5.62 - 5.86
	IIb	7.56	5.97 - 9.14	4.45 - 11.18	4.03 - 14.38
2050	Ia	5.82	5.76 - 5.90	5.73 - 5.97	5.70 - 6.06
	Ib	7.99	6.46 - 10.57	5.05 - 12.26	4.02 - 25.63
	IIa	6.01	5.87 - 6.22	5.81 - 6.31	5.75 - 6.38
	IIb	8.31	6.57 - 10.84	5.08 - 13.72	4.12 - 26.70
2100	Ia	6.25	6.03 - 6.52	5.93 - 6.75	5.82 - 7.08
	Ib	8.61	6.79 - 11.33	5.48 - 16.74	4.13 - 28.22
	IIa	7.35	6.91 - 8.11	6.74 - 8.40	6.60 - 8.61
	IIb	9.28	6.98 - 11.77	5.46 - 26.76	4.42 - 29.65

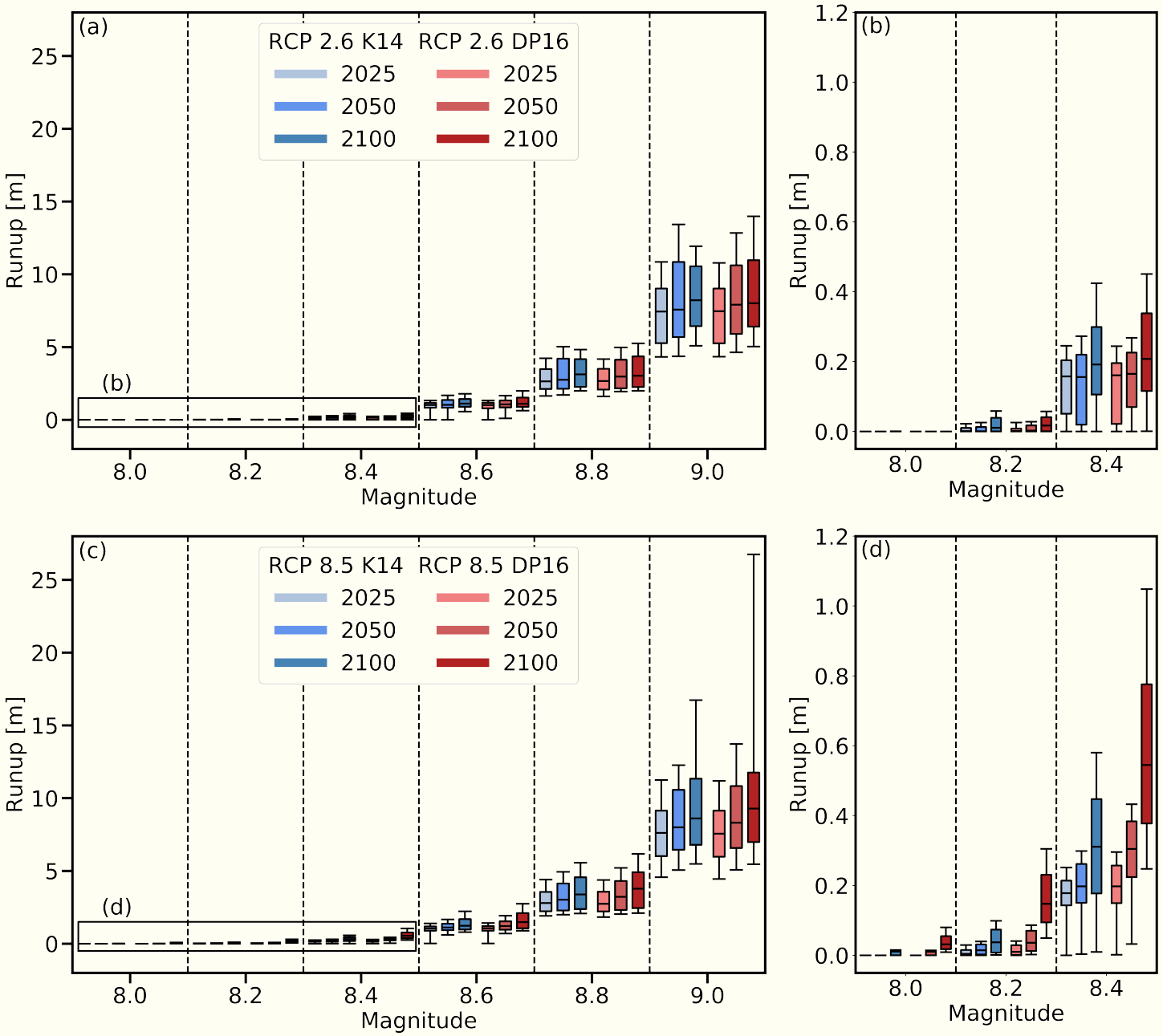
Example Results: RCP 8.5

Year	Type	50	17-83	5-95	1-99
2025	Ia	5.68	5.66 - 5.71	5.64 - 5.74	5.63 - 5.76
	Ib	7.61	6.02 - 9.14	4.56 - 11.25	4.03 - 13.96
	IIa	5.72	5.67 - 5.79	5.64 - 5.84	5.62 - 5.86
	IIb	7.56	5.97 - 9.14	4.45 - 11.18	4.03 - 14.38
2050	Ia	5.82	5.76 - 5.90	5.73 - 5.97	5.70 - 6.06
	Ib	7.99	6.46 - 10.57	5.05 - 12.26	4.02 - 25.63
	IIa	6.01	5.87 - 6.22	5.81 - 6.31	5.75 - 6.38
	IIb	8.31	6.57 - 10.84	5.08 - 13.72	4.12 - 26.70
2100	Ia	6.25	6.03 - 6.52	5.93 - 6.75	5.82 - 7.08
	Ib	8.61	6.79 - 11.33	5.48 - 16.74	4.13 - 28.22
	IIa	7.35	6.91 - 8.11	6.74 - 8.40	6.60 - 8.61
	IIb	9.28	6.98 - 11.77	5.46 - 26.76	4.42 - 29.65

Example Results: RCP 8.5

Year	Type	50	17-83	5-95	1-99
2025	Ia	5.68	5.66 - 5.71	5.64 - 5.74	5.63 - 5.76
	Ib	7.61	6.02 - 9.14	4.56 - 11.25	4.03 - 13.96
	IIa	5.72	5.67 - 5.79	5.64 - 5.84	5.62 - 5.86
	IIb	7.56	5.97 - 9.14	4.45 - 11.18	4.03 - 14.38
2050	Ia	5.82	5.76 - 5.90	5.73 - 5.97	5.70 - 6.06
	Ib	7.99	6.46 - 10.57	5.05 - 12.26	4.02 - 25.63
	IIa	6.01	5.87 - 6.22	5.81 - 6.31	5.75 - 6.38
	IIb	8.31	6.57 - 10.84	5.08 - 13.72	4.12 - 26.70
2100	Ia	6.25	6.03 - 6.52	5.93 - 6.75	5.82 - 7.08
	Ib	8.61	6.79 - 11.33	5.48 - 16.74	4.13 - 28.22
	IIa	7.35	6.91 - 8.11	6.74 - 8.40	6.60 - 8.61
	IIb	9.28	6.98 - 11.77	5.46 - 26.76	4.42 - 29.65

Example Results: RCP 2.6 vs RCP 8.5



Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

Where does Earth-Observing come in?

Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

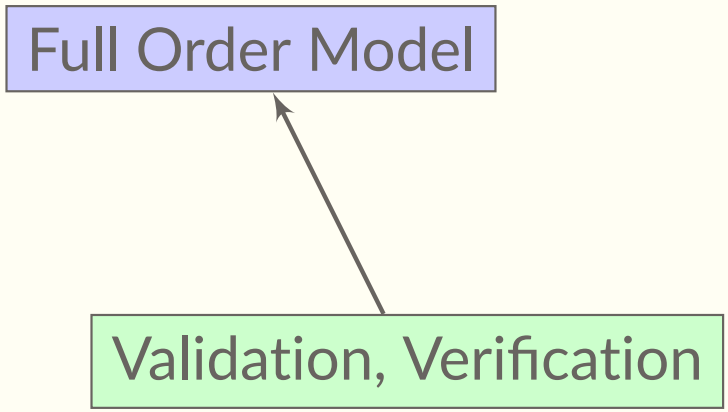
Where does Earth-Observing come in?

Full Order Model

Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

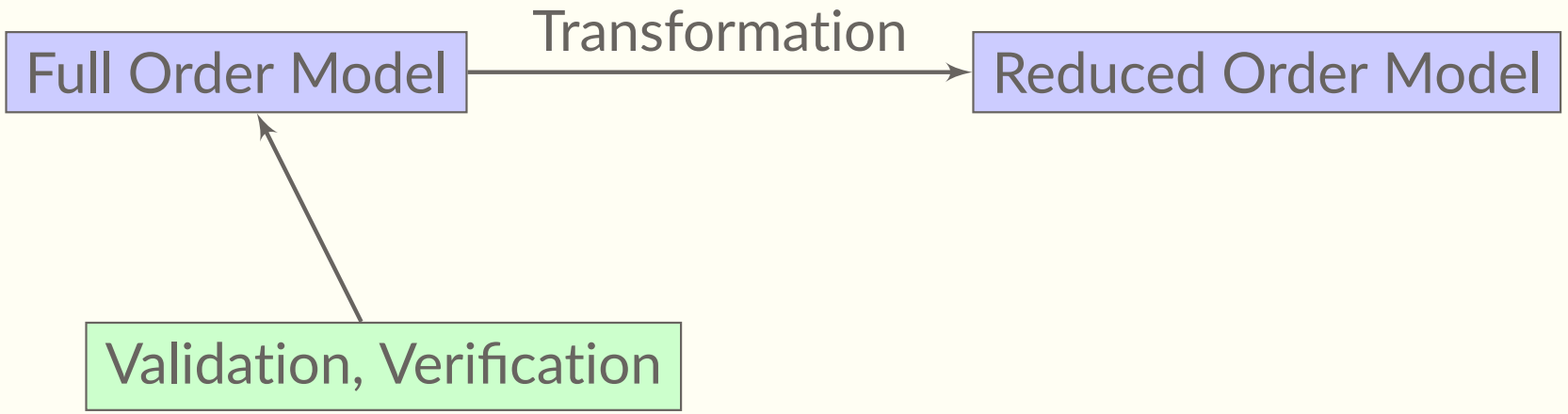
Where does Earth-Observing come in?



Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

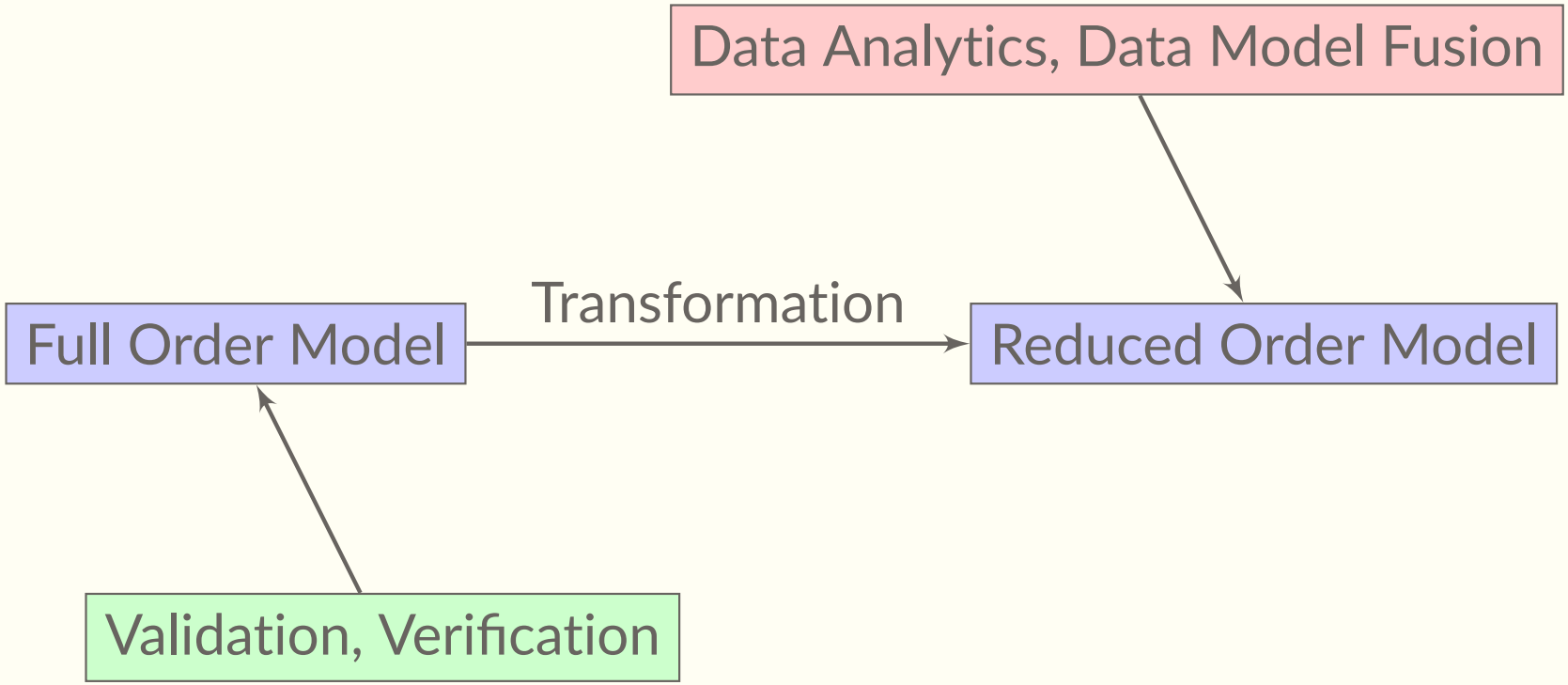
Where does Earth-Observing come in?



Step 2: Build shared understanding about the coast and identify plausible coastal futures

How do climate change impacts, such as sea-level rise, alter the effects of coastal hazards?

Where does Earth-Observing come in?



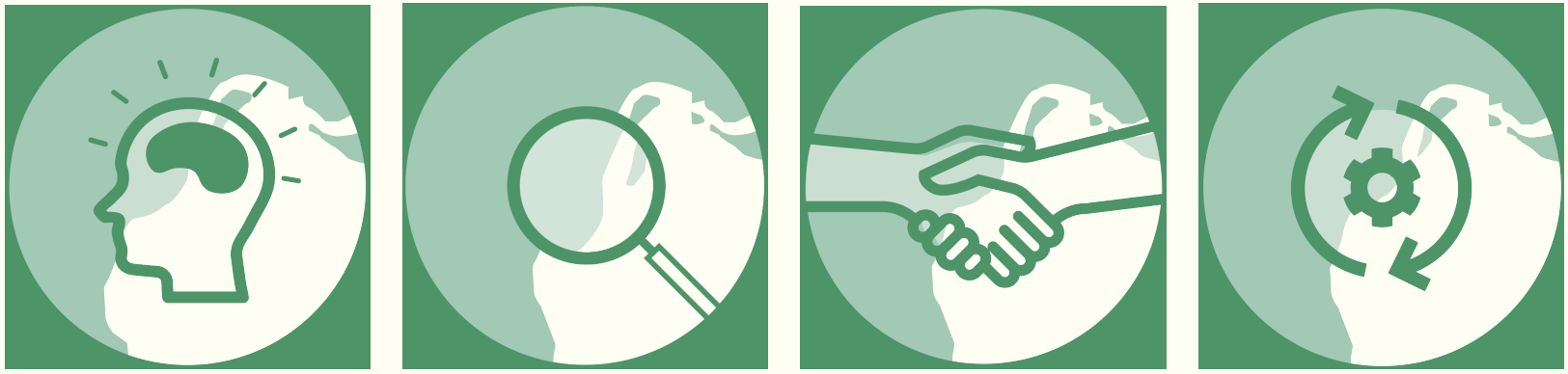
An Applied Mathematician, an Engineer, and a Geoscientist are asked what is $1 + 1 \ldots$

Applied Mathematician: 2 (two);
Engineer: 2.00 ± 0.32;
Geoscientist: **What do you want it to be?**

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts

Step 1 | Step 2 | Step 3 | Step 4



Step1: Bring regional coastal stakeholders together to agree on a way forward

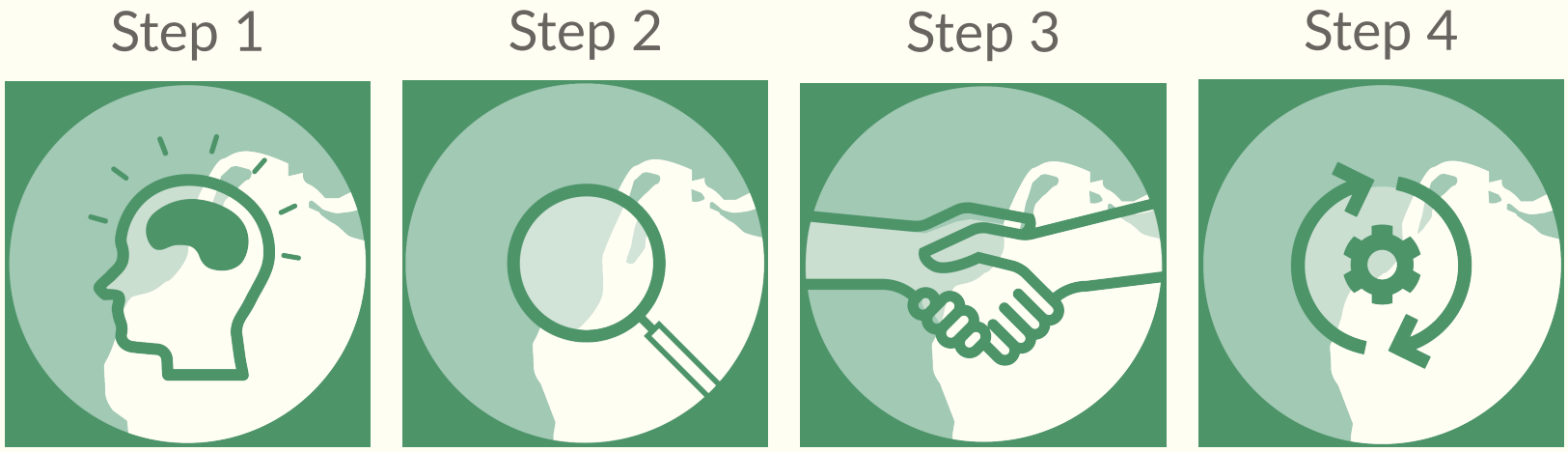
Step2: Build shared understanding about the coast and identify plausible coastal futures

Step3: Co-design robust coastal sustainability strategies

Step4: Co-produce innovative coastal sustainability interventions and enable transition pathways

OUR COASTAL FUTURES

A Strategy for the Sustainable Development of the World's Coasts



Our Coastal Futures is an opportunity for Science, Research, and Development to build stronger connections between disciplines, challenge established scientific paradigms, and change the perception of science as a whole.