

**Professor Davor Vidas**

CIL Distinguished Visiting Scholar

**THE LAW OF THE SEA  
AND SEA LEVEL RISE:  
between the Holocene  
and the Anthropocene**

**22 February 2023, Wednesday**

**4:00PM – 5:30PM**

**NUS Bukit Timah Campus**

**Block B, Level 5, Seminar Room 5-3**

# Geological Time Scale



## INTERNATIONAL STRATIGRAPHIC CHART

International Commission on Stratigraphy



Epoch	System	Series	Stage	Age (Ma)	GSSP		
Phanerozoic	Cenozoic	Quaternary	Holocene				
			Pleistocene	Upper	0.0117	▶	
				"Ionian"	0.126		
			Pliocene	Calabrian	0.781		
				Gelasian	1.805		
		Piacenzian		2.588			
		Paleogene	Neogene	Zanclean	3.600		
				Miocene	5.332		
				Eocene	Messinian	7.246	
					Tortonian	11.608	
	Serravallian				13.82		
	Paleocene		Langhian	15.97			
			Burdigalian	20.43			
			Aquitanian	23.03			
			Chattian	28.4 ± 0.1			
			Rupelian	33.9 ± 0.1			
	Mesozoic	Cretaceous	Upper	Präriabonian	37.2 ± 0.1		
				Bartonian	40.4 ± 0.2		
				Lutetian	48.5 ± 0.2		
			Lower	Ypresian	55.8 ± 0.2		
Thanetian				58.7 ± 0.2			
Paleozoic		Permian	Selandian	- 61.1			
			Damian	65.5 ± 0.3			
			Maastriichtian	70.6 ± 0.6			
			Campanian	83.5 ± 0.7			
			Santonian	85.8 ± 0.7			

Epoch	System	Series	Stage	Age (Ma)	GSSP	
Phanerozoic	Mesozoic	Jurassic	Upper	Tithonian	145.5 ± 4.0	
				Kimmeridgian	150.8 ± 4.0	
			Oxfordian	- 155.6		
			Middle	Callovian	161.2 ± 4.0	
				Bathonian	164.7 ± 4.0	
		Bajocian		167.7 ± 3.5		
		Lower	Aalenian	171.6 ± 3.0		
			Toarcian	175.6 ± 2.0		
			Plesbachian	183.0 ± 1.5		
			Sinemurian	189.6 ± 1.5		
	Hettangian		196.5 ± 1.0			
	Paleozoic	Triassic	Upper	Rhaetian	199.6 ± 0.6	
				Norian	203.6 ± 1.5	
				Camian	216.5 ± 2.0	
			Middle	Ladinian	- 228.7	
				Anisian	237.0 ± 2.0	
		Lower	Cenomanian	- 245.9		
			Induan	- 249.5		
			Lopingian	251.0 ± 0.4		
		Paleozoic	Permian	Wuchiapingian	253.8 ± 0.7	
Changhsingian				260.4 ± 0.7		
Capitanian	265.8 ± 0.7					
Wordian	268.0 ± 0.7					
Roadian	270.6 ± 0.7					
Carboniferous	Carboniferous		Kungurian	275.6 ± 0.7		
			Artinskian	284.4 ± 0.7		
			Sakmarian	294.6 ± 0.8		
	Pennsylvanian		Asselian	299.0 ± 0.8		
			Gzhelian	303.4 ± 0.9		
Paleozoic	Carboniferous	Upper	Kasimovian	307.2 ± 1.0		
			Moscovian	311.7 ± 1.1		
		Lower	Bashkirian	318.1 ± 1.3		
			Serpukhovian	328.3 ± 1.6		
			Visean	345.3 ± 2.1		
Paleozoic	Cambrian	Series 3	Tournaisian	359.2 ± 2.5		
			Fortunian	542.0 ± 1.0		
			Stage 2	- 521 *		
			Stage 3	- 515 *		
			Stage 4	- 510 *		
		Ordovician	Drumian	- 506.5		
			Guzhangian	- 503		
			Fabian	- 499		
			Stage 9	- 492 *		
			Stage 10	- 488.3 ± 1.7		

Epoch	System	Series	Stage	Age (Ma)	GSSP		
Phanerozoic	Paleozoic	Silurian	Upper	Ludlow	418.7 ± 2.7		
				Wenlock	422.9 ± 2.5		
			Lower	Llandovery	426.2 ± 2.4		
				Aeronian	428.2 ± 2.3		
				Rhuddanian	436.0 ± 1.9		
		Devonian	Upper	Himantian	443.7 ± 1.5		
				Katian	445.6 ± 1.5		
				Sandbian	455.8 ± 1.6		
			Middle	Dartmouthian	460.9 ± 1.6		
				Dapianian	468.1 ± 1.8		
	Paleozoic	Cambrian	Lower	Floian	471.8 ± 1.6		
				Tremadocian	478.6 ± 1.7		
			Upper	Stage 10	488.3 ± 1.7		
				Stage 9	- 492 *		
				Stage 8	- 496 *		
	Paleozoic	Cambrian	Series 2	Terreneuvian	- 528 *		
				Fortunian	542.0 ± 1.0		
				Stage 2	- 521 *		
				Stage 3	- 515 *		
				Stage 4	- 510 *		
Proterozoic			Archean	Upper	Ediacaran	542	▶
					Cryogenian	- 635	
				Lower	Tonian	850	
					Stenian	1000	
					Ectasian	1200	

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Subdivisions of the global geologic record are formally defined by their lower boundary. Each unit of the Phanerozoic (~542 Ma to Present) and the base of Ediacaran are defined by a basal Global Boundary Stratotype Section and Point (GSSP), whereas Precambrian units are formally subdivided by absolute age (Global Standard Stratigraphic Age, GSSA). Details of each GSSP are posted on the ICS website ([www.stratigraphy.org](http://www.stratigraphy.org)).

Numerical ages of the unit boundaries in the Phanerozoic are subject to revision. Some stages within the Cambrian will be formally named upon international agreement on their GSSP limits. Most sub-Series boundaries (e.g., Middle and Upper Aptian) are not formally defined.

Colors are according to the Commission for the Geological Map of the World ([www.cgmw.org](http://www.cgmw.org)).

The listed numerical ages are from 'A Geologic Time Scale 2004', by F.M. Gradstein, J.G. Ogg, A.G. Smith, et al. (2004; Cambridge University Press) and 'The Concise Geologic Time Scale' by J.G. Ogg, G. Ogg and F.M. Gradstein (2006).

This chart was drafted by Gabi Ogg, Intra Cambrian unit ages with \* are informal, and awaiting ratified definitions. Copyright © 2009 International Commission on Stratigraphy

# Intergovernmental Panel on Climate Change: Periodization of Future Projections (in AR6)

***Near-term***: until 2040

***Mid-term***: from 2041 to 2060

***Long-term***: beyond (2081-2100)

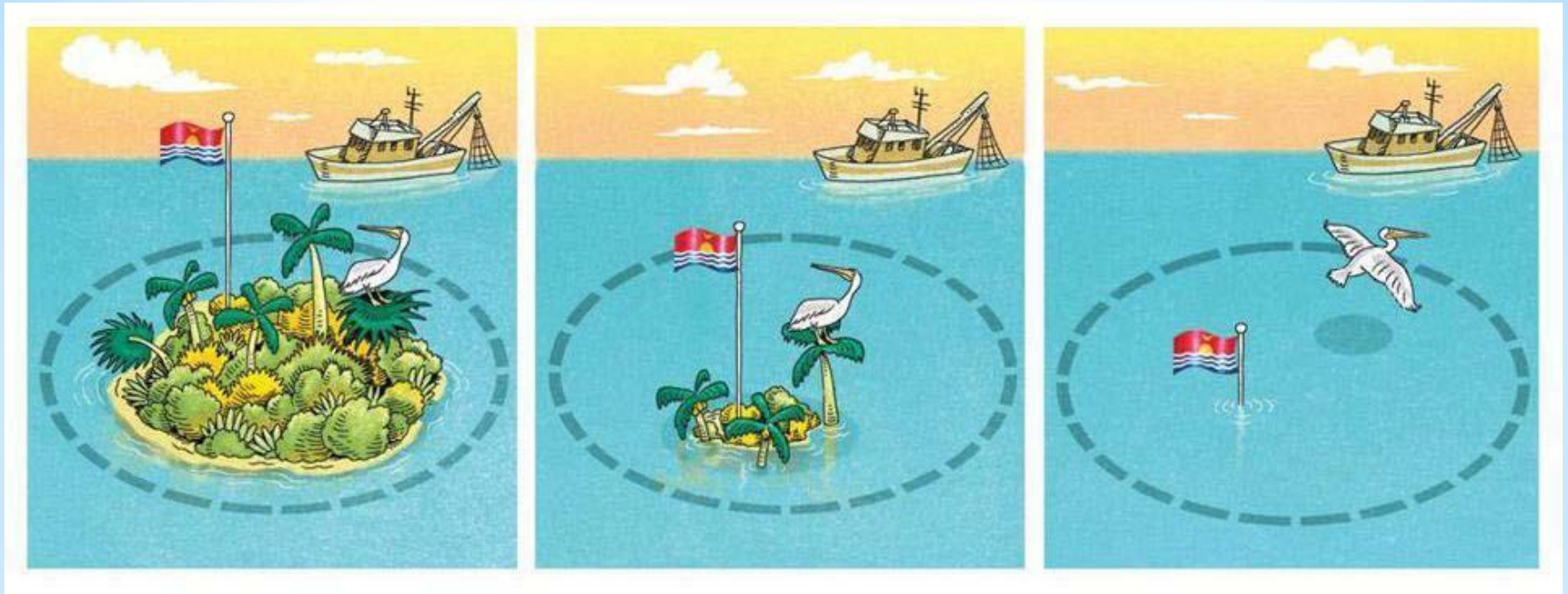
KD Burke, JW Williams, MA Chandler, AM Haywood,  
DJ Lunt and BL Otto-Bliesner:

“Pliocene and Eocene provide best analogs for  
near-future climates”

*Proceedings of the National Academy of Sciences*  
(PNAS), 2018, Vol. 115, No. 52, pp. 13288-13293.

\*“The normal baseline is ambulatory, ***moving seaward*** to reflect changes to the coast caused by accretion, land rise, and the construction of human-made structures associated with harbour systems, coastal protection and land reclamation projects, ***and also landward*** to reflect changes caused by erosion and sea level rise.”

\* **Finding of the ILA  
Baselines Committee in  
Sofia Report of 2012**



# \* WHY IT IS IMPORTANT ...

Illustration by Wesley Bedrosian, in Latif Nasser, *When island nations drown, who owns their seas?* The Boston Globe, October 19, 2014.

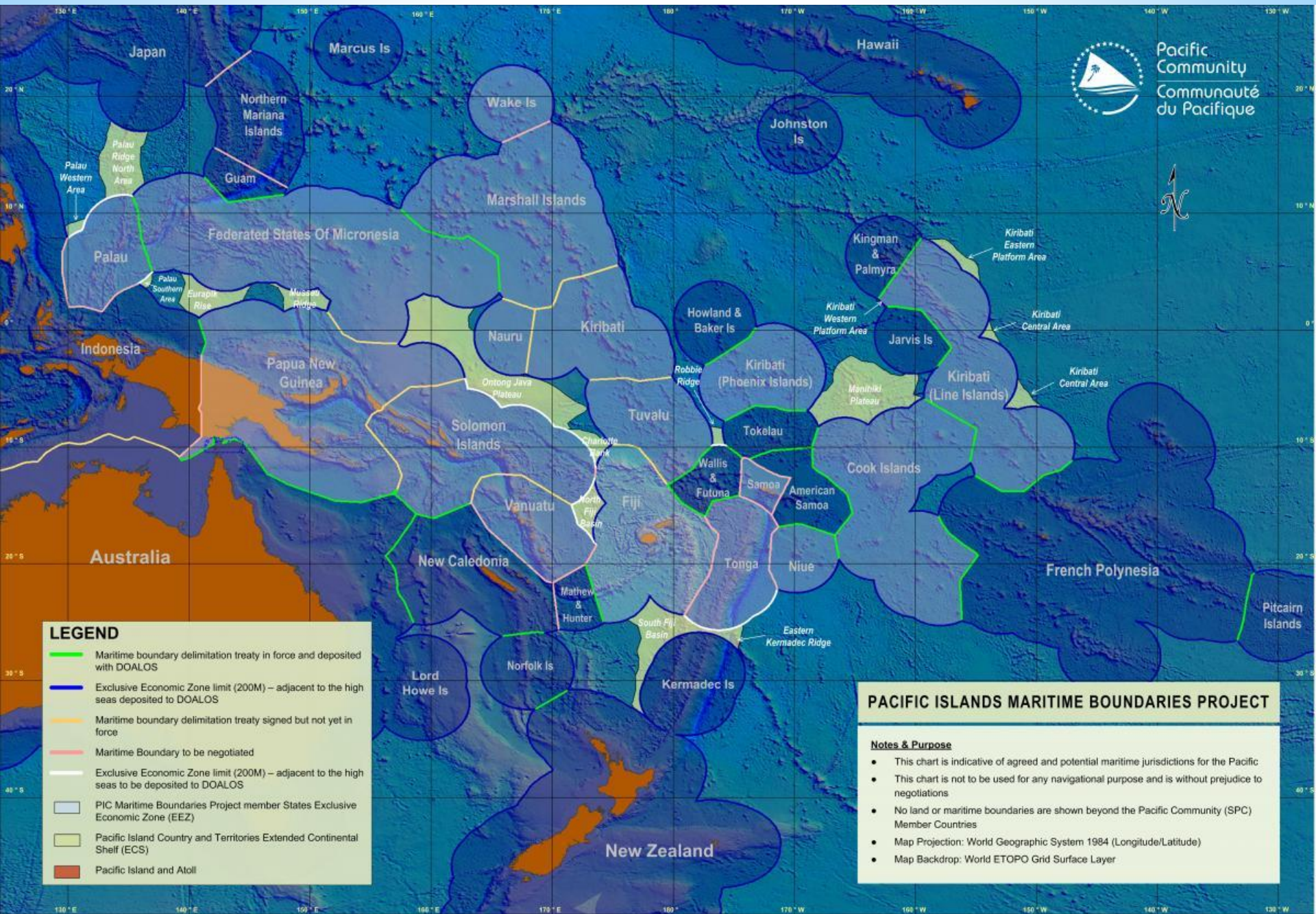
# \* 38 UN Member States are SIDS

1. Antigua and Barbuda	14. Guyana	27. Singapore
2. Bahamas	15. <b>Haiti*</b>	28. St. Kitts and Nevis
3. Bahrain	16. Jamaica	29. St. Lucia
4. Barbados	17. <b>Kiribati*</b>	30. St. Vincent and the Grenadines
5. Belize	18. Maldives	31. Seychelles
6. Cabo Verde	19. Marshall Islands	32. <b>Solomon Islands*</b>
7. <b>Comoros*</b>	20. Federated States of Micronesia	33. Suriname
8. Cuba	21. Mauritius	34. <b>Timor-Leste*</b>
9. Dominica	22. Nauru	35. Tonga
10. Dominican Republic	23. Palau	36. Trinidad and Tobago
11. Fiji	24. Papua New Guinea	37. <b>Tuvalu*</b>
12. Grenada	25. Samoa	38. Vanuatu
13. <b>Guinea-Bissau*</b>	26. <b>São Tomé &amp; Príncipe*</b>	

1. American Samoa	8. Cook Islands	15. New Caledonia
2. Anguilla	9. Curacao	16. Niue
3. Aruba	10. French Polynesia	17. Puerto Rico
4. Bermuda	11. Guadeloupe	18. Sint Maarten
5. British Virgin Islands	12. Guam	19. Turks and Caicos Islands
6. Cayman Islands	13. Martinique	20. U.S. Virgin Islands
7. Commonwealth of Northern Marianas	14. Montserrat	

**\* 20 non-UN Members are associate members of regional commissions**





**LEGEND**

- Maritime boundary delimitation treaty in force and deposited with DOALOS
- Exclusive Economic Zone limit (200M) – adjacent to the high seas deposited to DOALOS
- Maritime boundary delimitation treaty signed but not yet in force
- Maritime Boundary to be negotiated
- Exclusive Economic Zone limit (200M) – adjacent to the high seas to be deposited to DOALOS
- PIC Maritime Boundaries Project member States Exclusive Economic Zone (EEZ)
- Pacific Island Country and Territories Extended Continental Shelf (ECS)
- Pacific Island and Atoll

**PACIFIC ISLANDS MARITIME BOUNDARIES PROJECT**

- Notes & Purpose**
- This chart is indicative of agreed and potential maritime jurisdictions for the Pacific.
  - This chart is not to be used for any navigational purpose and is without prejudice to negotiations.
  - No land or maritime boundaries are shown beyond the Pacific Community (SPC) Member Countries.
  - Map Projection: World Geographic System 1984 (Longitude/Latitude)
  - Map Backdrop: World ETOPO Grid Surface Layer

- \* '...this new committee 'should **take into account the spirit of modern law of the sea** in which the interests of differently situated states are balanced'
- \* '... should also **recall the aims of the [LOS] Convention**: to strengthen peace, security, cooperation, and friendly relations among nations in conformity with the principles of justice and equal rights; to take account of the interests and needs of humankind as a whole; and to promote the economic and social advancement of all peoples of the world considering the special interests and needs of developing countries.'

\* **From the ILA Baselines  
Committee Sofia Report**

‘[T]he Committee has presented evidence of the emergence of State practice, particularly in the South Pacific region, indicating that small island States intend to maintain the baselines and limits of their current maritime zones established in accordance with the 1982 Law of the Sea Convention for the future, notwithstanding physical coastline changes brought about by sea level rise.’

**\* ILA Resolution 5/2018:  
on the evidence of State practice**

- \* An *initial* phase from about **2010 to 2018**: early evidence of State practice in the South Pacific: regional policy documents and national legislation.
- \* A *watershed* phase in the course of **2019 and 2020**: main trends, but also some mixed approaches, can be identified. Increasing number of examples from other regions, such as the Caribbean and the Indian Ocean.
- \* A phase of *consolidation*, **from 2021**: achieved the current level of clarity and specificity. States from several different regions expressed support, including in the Sixth Committee.

\* **Three phases of development of State practice specific to sea level rise**

***Co-ordinated texts of Declarations adopted by PIF and AOSIS (August and September 2021):***

- (1)** the [LOS] Convention imposes no affirmative obligation to keep baselines and outer limits of maritime zones under review nor to update charts or lists of geographical coordinates once deposited with the Secretary-General of the United Nations.
- (2)** maritime zones, as established and notified to the Secretary-General of the [UN] in accordance with the Convention, and the rights and entitlements that flow from them, shall continue to apply, without reduction, notwithstanding any physical changes connected to climate change-related sea-level rise.

Romania (UN, 2021):

'our legislation could be interpreted as favouring an ambulatory system of baselines, though *a connection with the specific case of sea-level rise is difficult to make...*'

Ireland (UN, 2022):

'our practice [of ambulatory baselines] has *not* been formulated expressly *in contemplation of sea-level rise*' .'

**\* Statements in the Sixth Committee**  
**UNGA**

'Under existing international law, as reflected in the [Law of the Sea] Convention, coastal ***baselines are generally ambulatory***, meaning that if the low-water line along the coast shifts (either landward or seaward), such shifts may impact the outer limits of the coastal State's maritime zones.'

\* **Statement by the USA in the Sixth Committee UNGA in 2021**

The United States would like to note that it has **announced a new policy** on sea-level rise and maritime zones.

Under this policy, which ***recognizes that new trends are developing*** in the practices and views of States ***on the need for stable maritime zones in the face of sea-level rise***, the United States will work with other countries toward the goal of lawfully establishing and maintaining baselines and maritime zone limits ***and will not challenge such*** baselines and maritime zone limits that are not subsequently updated despite sea-level rise caused by climate change.

\* **Statement by the USA in the Sixth Committee UNGA in 2022**



'Germany commits to support the process and work together with others to preserve their maritime zones and the rights and entitlements that flow from them in a manner consistent with the Convention, including *through a contemporary reading and interpretation of its intents and purposes*, rather than through the development of new customary rules.'

'Through such contemporary reading and interpretation, Germany *finds that the UNCLOS allows for freezing* of once duly established, published and deposited baselines and outer limits of maritime zones in accordance with the Convention.'

**\* Germany  
(statements/submissions in the  
UN, 2021 and 2022)**

## For more on this theme, if interested in further reading:

- *Davor Vidas and David Freestone: “Legal Certainty and Stability in the Face of Sea Level Rise: Trends in the Development of State Practice and International Law Scholarship on Maritime Limits and Boundaries”, **The International Journal of Marine and Coastal Law**, Vol. 37, No. 4, 2022, pp. 673–725 (published online 6 October 2022);*
- *Davor Vidas and David Freestone: “The Impacts of Sea Level Rise and the Law of the Sea Convention: Facilitating Legal Certainty and Stability of Maritime Zones and Boundaries”, **International Law Studies**, Vol. 99, 2022, pp. 944–964 (published 1 December 2022).*