Sea Level Rise and Impacts on Baselines

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Sea Level Rise and Impacts on Baselines

- Climate change and impacts on coasts
- Importance of Relative Sea-level Rise
- Differing impacts on diverse coastlines/ecosystems
- Baselines and maritime claims
- Limits vs. boundaries
- Baselines vs. basepoints
- Evolving approaches
Sea Level Rise: Primary Drivers

• Ocean warming:
  ▪ Oceans = the Earth’s primary heat sink
  ▪ Thermal expansion – as oceans warm, they expand
  ▪ Estimated to account for 33-55% of global mean sea level rise in 21st century
  ▪ Projections greater than AR4 thanks to improved modelling of grounded ice contributions
  ▪ Five years after the IPCC’s Fifth Assessment Report (2013) = warmest on record for the oceans

• Contributions from the cryosphere
  ▪ Grounded ice – Greenland (6-7m of SLR) and Antarctica (58m of SLR)
  ▪ Climate change ‘wild cards’
Sea Level Rise: Additional Drivers

• Atmospheric-oceanic interactions, e.g. El Niño Southern Oscillation (ENSO)
• Deformations of Earth’s crust
  ▪ Isostatic rebound
  ▪ Tectonic movements
  ▪ Subsidence
• Anthropogenic causes
• IPCC AR5: Sea level changes likely to feature “a strong regional pattern, with some places experiencing significant deviations of local and regional sea level change from the global mean change.”
Sea Level Rise

• Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (2013):
  ▪ Multiple scenarios – up to 0.98m rise by 2100
  ▪ Compared to mean rise of 0.19m in 20th Century
  ▪ Projections greater than AR4 thanks to improved modelling of grounded ice contributions

• Increasing rate of rise projected
  ▪ From 1.7 mm/yr (1901-2010)
  ▪ To 3.2 mm/yr (1993-2010)
Sea-level rise projections

- Precise scale of rise uncertain
Relative Sea Level

• Sea level influenced by:
  ▪ Ocean warming (expansion)
  ▪ Glacio-eustatic processes influencing volume of water in the oceans
  ▪ Processes influencing the shape of land and oceans
  ▪ Anthropogenic impacts

• Significant spatial and temporal variability
  ▪ Tidal complexity/variability
  ▪ Influence of oceanic-atmospheric interactions (e.g. El Niño Southern Oscillation)

• **Relative** sea level critical
  ▪ Feedbacks between sea level rise and the shape of land/coast
Increasingly Contested Coasts

- Longstanding trends in population movements: rural/urban, inland/coastal
- Increasing concentration of population/development in the coastal zone
  - 44% of global population within 150km of the coast
- Result: Increasing ‘coastal squeeze’
- Coastal landscapes under pressure and increasingly contested
“Normal” Baselines

1958 Convention on the Territorial Sea and the Contiguous Zone, Article 3

LOSC, Article 5

Article 5 of the LOSC states:
Except where otherwise provided in this Convention, the normal baseline for measuring the breadth of the territorial sea is the low-water line along the coast as marked on large-scale charts officially recognised by the coastal State.

In effect a State’s default baseline
Key issue what is meant by the term “low-water line”
The most widely used type of baselines used globally
Normal baselines apply to much of the Arctic coastline
Potential Impacts of Sea Level Rise

Seaward impacts:
Changes to baselines and maritime limits

Landward impacts:
Coastal areas less habitable
Coastal Impacts

- Threat of inundation to low-lying inhabited land
- Impacts on population, property, infrastructure
- Impacts on coastal ecosystems and valuable habitats
  - Ecosystem services under threat
Ambulatory Baselines and Shifting Limits

• Coastlines dynamic and move over time
  ▪ Deposition along the shore
  ▪ Erosion leading to shoreline retreating inland

Normal baselines therefore potentially “ambulatory” – unstable and subject to sometimes rapid change

Implications for:
  Extent and limits of maritime claims
  Enforcement issues
  Delimitation of maritime boundaries

Exacerbated by sea level rise?
Ambulatory Baselines and Shifting Limits

Animation by Arsana & Schofield, 2012

State A
Uneven Impacts:
Baselines, basepoints and maritime limits
Sea Level and Insular Features:
A need for Reclassification of Insular Features?

Source: TALOS Manual (5th edition)
Caveats

- Beware of ‘bathtub modelling’!
  - If sea level rises it does not necessarily simply ‘march up the contours’
  - Dynamic and complex interactions between sea level and the coast/coastal ecosystems
  - Coasts change/adapt both vertically and horizontally with sea level
  - Stability in baseline features such as reefs
- Basepoints versus baselines
- Outer limits of EEZ less susceptible to change
Scenario 1: Vegetation Encroachment

Scenario 2: Accretion & other processes

Source: Courtesy of Dr Kerrylee Rogers
Resilient Reefs?

- Healthy coral reefs able to grow c.11mm/year
- Reefs and reef islands remarkably persistent
- BUT Oceans:
  - Warmer
  - Increasingly acidic
  - Deoxygenated
  - Under pressure from human activities
- Ability of reefs to adapt and keep pace with projected rates of sea level rise increasingly compromised
- IPCC 2018 Special Report on *Global Warming of 1.5°C* projects 90% of reefs gone and 99% if warming at 2°C
Changing Island Location

- While the reef edge may be stable, the location and size of islands on reefs may change.
- Webb and Kench: survey of 27 atoll islands in central Pacific – 86% the same size or larger.
- Sea level rise a factor plus:
  - Ocean acidification
  - Human impacts

Changing Island Location

- Example:
  - Funafuti Atoll, Tulvalu (1897-2010)
- Islands on reef exhibit significant change and mobility
- 31.3% increase in land area

Source: Paul Kench, University of Auckland
Remote Sensing: McDonald Island

Aerial photo – 1 March 1980

QuickBird image - 9 April 2003
Multi-pan merge (0.37m pixels)
Impacts of Changing Baselines on Existing Maritime Boundaries?
Response Options

- Protection?
  - A ‘bulwark’ policy featuring sea defences is far-fetched given **lengths** of coasts involved, **remote** locations and therefore **cost**
  - Hard structures notorious for causing unanticipated and unwelcome ‘knock’ on impacts elsewhere on the coast

- Use straight baselines?
- Fix limits and boundaries?
  - Freeze baselines?
  - Fix territorial sea limit?
  - Fix EEZ limits?
  - Fix all limits?
  - Delimit maritime boundaries
  - Emerging State practice
Straight Baselines

- Cater for complex coastal geography
- Deeply indent or cut into coasts or a fringe of islands in the immediate vicinity of the coast
- Aim to avoid mosaic of territorial sea and non-territorial sea areas

Problems:
- Excessive claims
- Still need to be tied back to the coast

Fixing Limits?

That part of the outer limit of Australia’s continental shelf proclaimed on 24 May 2012
1. Freezing Baselines

- Frozen Baseline
- Expanded Internal Waters
- Territorial Sea
- Sea level rises
- Exclusive Economic Zone
- Outer Limit
- High Sea

Arsana & Schofield, 2017
2. Freezing Outer limits: TS

Sea level rises
Exclusive Economic Zone

Frozen
Baseline Outer Limit

Frozen
Outer Limit

Internal Waters
Territorial Sea
expanded

Arsana & Schofield, 2017
2. Freezing Outer limits: EEZ

Sea level rises

Internal Waters

Territorial Sea

Exclusive Economic Zone

Frozen Outer Limit

Arsana & Schofield, 2017
Emerging Practice from the Pacific

Marshall Islands Declaration, 2016: Comprehensive definition of:

• Baselines
• Closing lines
• Outer limits of all maritime zones
• Deposited with UN
• Declaration 451 pages long!
• Instructive for Arctic States?
Emerging State Practice: Taputapuātea Declaration

- July 2015 by seven leaders of Polynesian States and Territories. The Signatories ... “acknowledge, under the United Nations Convention on the Law of the Sea (UNCLOS), the importance of the Exclusive Economic Zones of the Polynesian Island States and Territories, whose area is calculated according to emerged lands and permanently establish the baselines in accordance with the UNCLOS, without taking into account sea level rise."

- Signed by the leaders of French Polynesia, Niue, Cook Islands, Samoa, Tokelau, Tonga and Tuvalu.
Emerging State Practice: Delap Commitment

• March 2018 by eight Pacific Island leaders representing the Parties to the Nauru Agreement signed the Delap Commitment on Securing Our common Wealth of Oceans: Reshaping the future to Take Control of the Fisheries. The Signatories agreed to “pursue legal recognition of the defined baselines established under the United Nations Convention on the Law of the Sea to remain in perpetuity irrespective of the impacts of sea level rise.”

• Signed by the leaders of the Marshall Islands, Nauru, Kiribati, Tuvalu, FSM, Solomon Islands, Palau and PNG.
Emerging State Practice:

- Unilateral fixing of baselines, limits and boundaries:
  - e.g. March 2016 Republic of the Marshall Islands Maritime Zones Declaration Act (Declaration = 451 pages long!)
  - To provide maritime jurisdictional clarity and certainty.
  - BUT once established these ‘lines in the sea’ defining baselines, limits and boundaries **will not move in the future** in keeping with the Pacific Oceanscape regional Action 1B “to Ensure the Impact of Climate Change and Sea-Level Rise does not result in reduced jurisdiction of PICTS”
Source: Geoscience Division, Secretariat of the Pacific Community (SPC)
Should have just stayed a fish!