Sea Level Rise Primer

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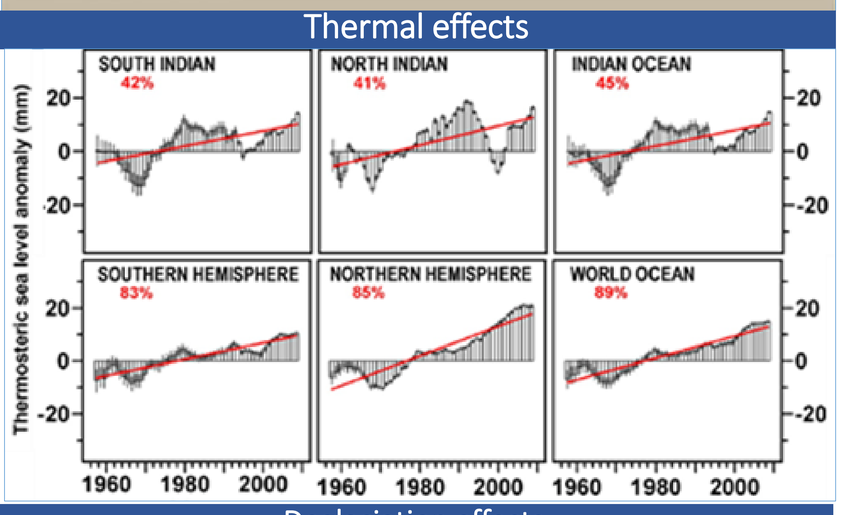
Understanding sea level rise

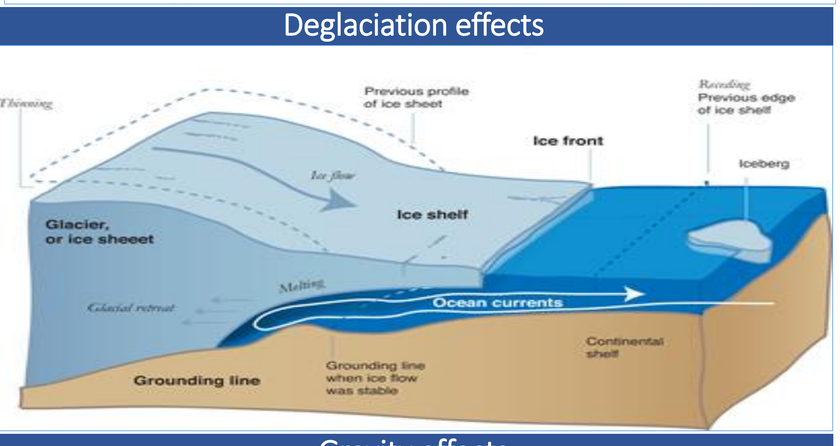
Increasing concentrations of carbon dioxide and other greenhouse gases in the atmosphere are trapping heat and the climate has begun to respond. One of the major and certain consequences is rising sea level, a process that has already begun. Prior to the 1990s, sea level was largely recorded by tide gauges fixed to coastal structures grounded in the solid Earth, showing over the last 2 centuries a rise of just over 1 millimeter per year. Beginning in the 1990s, satellites have provided near-global altimetry coverage of the ocean. Since then, both satellites and tide gauges have indicated a rise of about 3.2 millimeters per year. Taking into consideration all sea level observations, the IPCC concludes that the seas are not only rising, but accelerating. Understanding the underlying causes of sea level rise that has been observed over the past decades is an important point of departure for the Sea Level Rise Primer. There are a wide variety of processes that cause sea level to change on time scales ranging from hours to millennia, and spatial scales ranging from regional to global. These are illustrated in the Figures below.

Major processes contributing to sea level rise

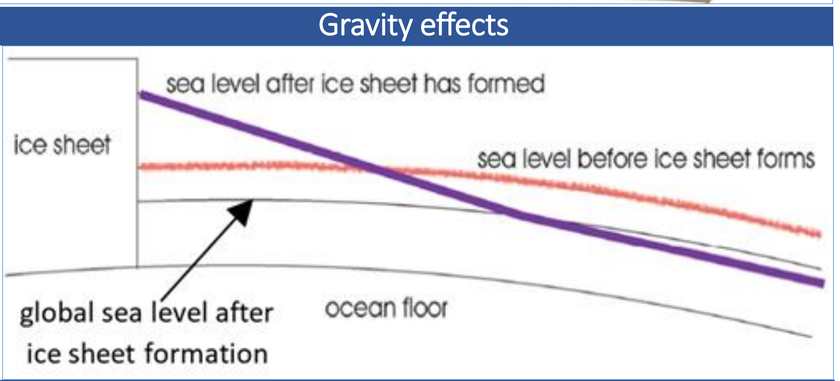
Thermal effects



Deglaciation effects



Gravity effects



Summary of effects

Contributor to sea level rise	Sea level rise (mm/year)	Share (%)
Thermal effects	1.1	34%
Deglaciation effects (Antarctica, Greenland)	0.6	19%
Deglaciation effects (other glaciers)	0.9	27%
Gravity and other effects	0.6	12%
"Unexplained"	0.3	8%
Observed global mean sea level rise	3.2	100%

Sea level and coastal zones in UAE

Sea level would cause permanent flooding of low-lying areas. Coastal areas with sufficient elevation to avoid inundation would be threatened by erosion or shoreline retreat. When combined with storm surge, sea level rise could sharply eroding unprotected shorelines. Gradual and instantaneous sea level rise will also lead to seawater intrusion processes in coastal aquifer systems.

Most of the Arabian Gulf region's inhabitants are coastal dwellers and a dominant share of economic activity occurs in inundation-vulnerable, urban centers. These areas represent valuable commercial property and are particularly vulnerable to SLR impacts because of their low elevation above sea level. Expanding coastal tourism patterns are likely to continue, further exacerbating coastal zone vulnerability to climate change.

The UAE's exposure to sea-level rise impacts, given current and projected socioeconomic conditions, is significant. Sea level rise will potentially impact the entire extent of the UAE's natural and built environment along the coast.

UAE coastal environment

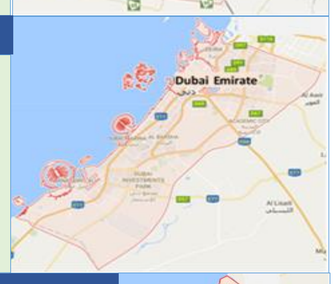
The UAE adjoins both the Arabian Gulf and the Gulf of Oman. The entire coastline is about 1,318 km. This does not include the coastline of the many offshore islands.

Abu Dhabi

Vulnerable infrastructure: The E 11 Coastal Highway; refinery complex of Ruwais; city of Abu Dhabi itself with its building infrastructure such as office and residential high-rises, schools, desalination and electrical generation plants, shopping malls and hospitals.

Dubai

Vulnerable infrastructure: Port Rashid and Port Jebel Ali, Dubai Drydocks, the iconic Burj Al Arab Hotel, Dubai Federal Hospital and numerous hotels/resorts are located directly on the waterfront. The Dubai International Airport is located about 3 km away from the coastline.



Sharjah

Vulnerable infrastructure: Sharjah front both the Arabian Gulf and the Gulf of Oman. Resorts and hotels line the shores of Sharjah as well as important cultural sites, including Central Suq, Sharjah Art Museum and Heritage Area, the Islamic Arts and Culture building and Crystal Plaza. Port Khalid and the Dubai – Sharjah Highway runs within proximity of three lagoons. Al Hamriyah has its port, power station and free zone authority near the coast.

Ajman

Vulnerable infrastructure: Transport routes are less than 200 meters from coast. To the north lies the southern arm of the Khor comprising port facilities and ancillary industries, including warehousing areas. The southern shore has large resorts and residential, office and retail buildings.

Umm Al Qwain

Vulnerable infrastructure: Residential, commercial and tourist properties cover the peninsula while the E-11 highway passes within a kilometer of the shoreline in several places.

Ras Al Khaimah

Vulnerable infrastructure: The coast of Ras Al Khaimah is heavily developed putting government buildings, schools, residences, commercial developments and resorts that will be at risk from future sea level rise.

Fujairah

Vulnerable infrastructure: large oil storage and exporting facilities, warehousing and industrial developments; power and desalination plant on the coast at north end.

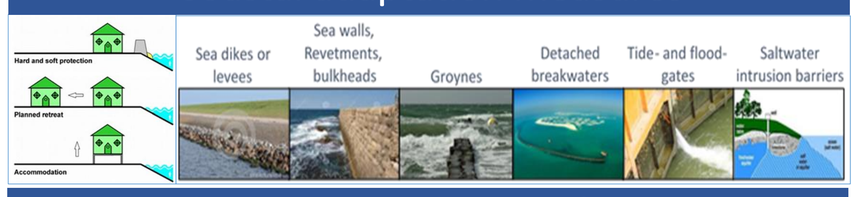
Framework for decisionmaking

This section of the Primer offers a tool-kit for coastal decision-makers charged with making future plans under the threat of sea level rise. The tool-kit is structured into three subsections. The first subsection presents an overview of commonly employed adaptation measures and policies. The second subsection presents an overview of the adaptation process and illustrates this with a couple of adaptation frameworks as used in several regional settings. The third subsection then zooms into one step of the adaptation process, the adaptation options appraisal, and presents decision making frameworks relevant for the appraisal of coastal adaptation options.

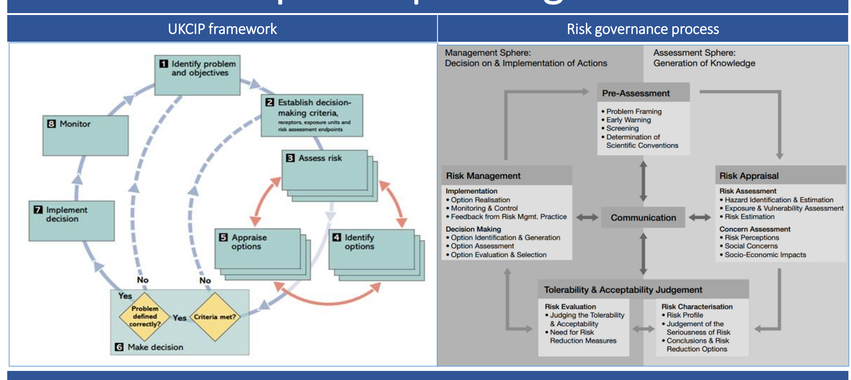
Online resources

A user-friendly online tool has been developed to provide access to the Primer as well as other resources such as adaptation case studies, annotated bibliographies and a discussion forum. The tool is available at http://www.ccr-group.org/slr

Coastal adaptation measures



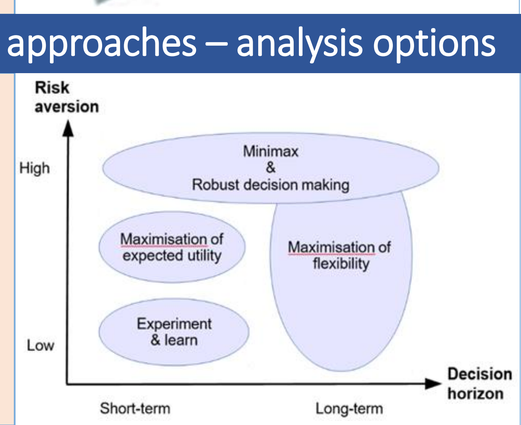
Coastal adaptation planning frameworks



Risk management approaches – decision criteria

Risk management approaches – analysis options

- Maximization of expected utility
- Minimization of losses
- Robustness of options under all scenarios
- Flexibility of options under all scenarios
- Adaptation pathways

Risk management approaches – analysis options

- Low-medium risk & short-term decisions
- Very low risk & very short-term decisions
- Long-term adaptation
- High risk