

## CONCEPTUAL OVERVIEW

### Sea Level Rise Primer

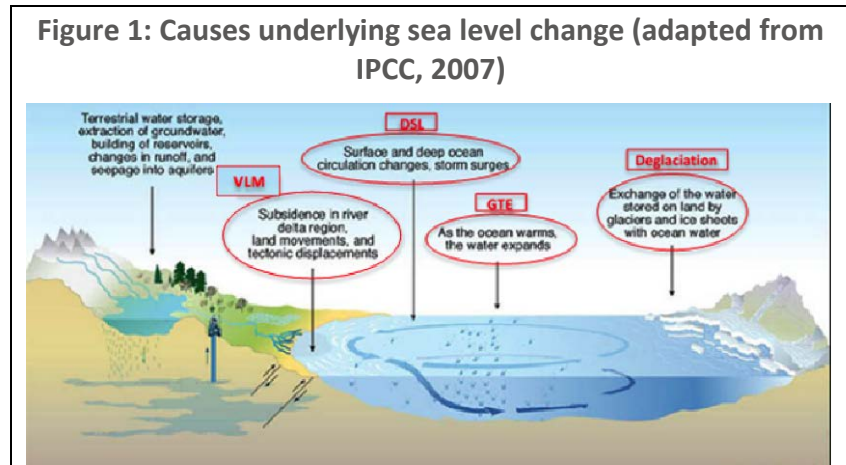
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**With rising sea levels will come new challenges for planners and decision-makers in the UAE.** Sea level rise will mean that tides, waves and storm surges can reach further inland than before, resulting in flooding, erosion, receding shorelines and the deterioration of groundwater quality. The vulnerability of particular coastal areas to rising seas depends on many factors including shoreline elevation, the topography of the land and the seabed, the presence of natural barriers, and other local characteristics. Other impacts of climate change, such as changing wind and rainfall patterns, will also come into play, such as more intense rainfall coinciding with storm surges, amplifying the impacts of rising seas.

**As with all other countries that have an extensive coastline, the UAE is confronted with the need to prepare for sea level rise.** The task of planning for sea level rise is challenging on many levels. On the one hand, it is a scientifically complex challenge, with current general circulation models unable to integrate well the ice-air-ocean interactions under increasing concentrations of greenhouse gases (GHGs) in the atmosphere. On the other hand, both the magnitude as well as the actual timing of impacts remains uncertain. Hence, a fundamental understanding of the nature of climate-driven sea level rise is essential for assessing the viability of risk management approaches.

**The overall goal of the Sea Level Rise Primer is to support decision-making pertinent to sea level rise in the UAE and the GCC region.** The Primer aims to be a helpful interface between sea level rise, a topic that is highly technical and multi-faceted, and decision-makers and other stakeholders in the UAE and the Arabian Gulf region who are interested in coastal development and protection. The focus is on three (3) key areas: increasing the scientific understanding of what sea level rise is and how it is predicted; identifying how sea level rise will impact specific areas in the UAE; and laying out a range of planning tools and options to plan for sea level rise. In sum, this Primer can be considered a toolkit for action for confronting sea level rise. It is also important to note what this Primer does not cover – it does not predict the increase in sea level in the Arabian Gulf nor does it include any analysis of the magnitude of the impacts of sea level rise scenarios for coastal areas in the UAE.

**Understanding the underlying causes of observed sea level rise over the past decades is an important point of departure for the 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. The major causes are illustrated in Figure 1. As air temperatures rise, water in the sea is also becoming warmer and expanding (i.e., about 34% from thermal global expansion, or GTE); mountain glaciers are retreating while polar ice sheets on Greenland and Antarctica are shrinking (i.e., about 46% from deglaciation effects); there are shifts in the mass distribution on land and oceans (i.e., about 12% from gravity effects, including DSL); and a number of other local effects are at work (i.e., about 8% other effects; including VSL).



**Accurate predictions of future sea-level rise is also a key input to planning.** The Greenland and Antarctic ice sheets, with the potential to raise sea level nearly 70 meters if completely melted, dominate uncertainties in projected sea-level change. Interpreting past changes in sea and projecting future changes requires sophisticated numerical modeling using coupled ice-atmosphere-ocean general circulation models. While substantial advances have been made, these models currently poorly represent the complex interactions between the atmosphere, the cryosphere, and the ocean environment. The Sea-Ice Model Intercomparison Project (SIMIP) aims to better understand how sea ice works and evolves in the coupled climate system of the planet. The results of SIMIP will be incorporated into the next IPCC Assessment Report, AR6, expected to be released by 2021.

**Future sea level rise represents a major threat to infrastructure including roads, telecommunication systems, buildings, and industrial facilities, all of which are important elements of the current and planned built environment.** The UAE and Gulf states may be more vulnerable to sea level rise than most regions of the world due to particularly high concentrations of population and economic activity in coastal zones. The Primer provides an overview of the regional coastal environment, focused on the Arabian Gulf, plus a brief overview of the major infrastructural elements that exist within each emirate in the UAE.

**The last 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 particular step of the adaptation process, the adaptation options appraisal, and presents decision-making frameworks relevant for the appraisal of coastal adaptation options. The Primer ends with a discussion of how to choose a suitable decision framework for adapting to sea level rise risks, relative to short- to long-term planning goals.