



Introduction to Coastal Environments

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Overview

- **Definition of Coastal Environments**
- **The Coastal Zone**
- **The Importance of Coastal Environments**
- **Threats to Coastal Environments**
- **Mitigating Threats to Coastal Environments**
- **The Coastal Environment of Kuwait**
- **Discussion (*throughout*)**

Definition of Coastal Environments

Coastal Environments - Definition

- An environment in which the coast is a significant part or element
- Will vary from place to place depending upon the extent to which it affects or is (directly) affected by coastal processes and the management issue concerned.
- Includes at least three distinct but interrelated parts:
 - Coastal marine area
 - Active coastal zone; and
 - Land backdrop.

Coastal Environments - Definition

(contd.)

- **The coastal environment includes (at least):**
 - The **coastal marine area**: the water, plants, animals, and the atmosphere above it;
 - All **tidal waters** and the **foreshore** whether above or below mean high water springs, dunes, beaches, areas of coastal vegetation and coastal associated animals, areas subject to coastal erosion or flooding, salt marshes, sea cliffs, and coastal wetlands, including estuaries.

The Coastal Zone

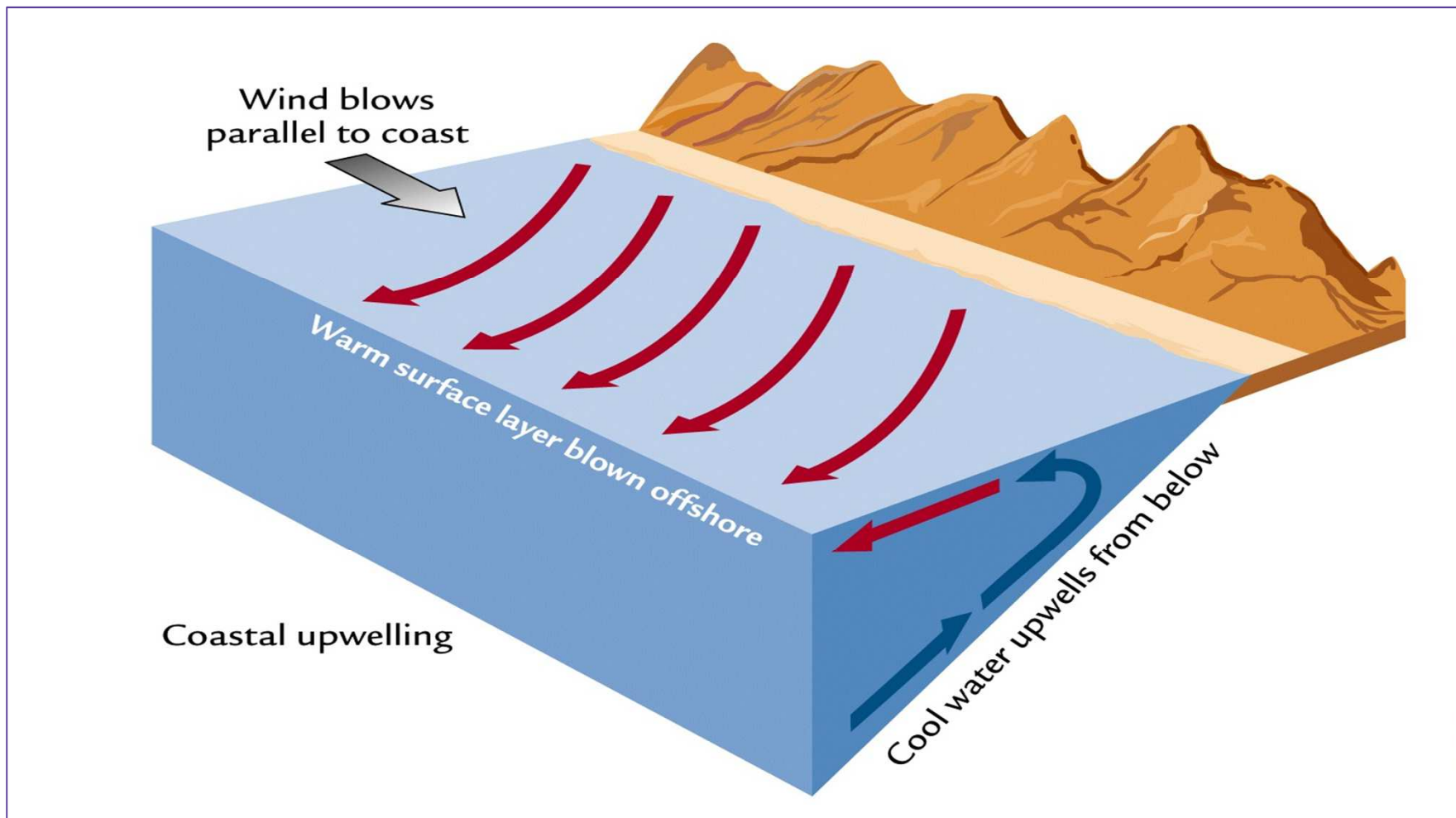
Coastal Zone

- Can be defined as “the spatial zone where interaction of the sea and land processes occurs”
- Include many types of environment, such as:
 - Upwelling areas
 - Coral reefs
 - Coastal shelf
 - Estuaries
 - Salt marshes
 - Mangroves
 - Tidal flats
 - Marine sabkhas

Upwelling Areas

- **Involve wind-driven motion of dense, cooler, and usually nutrient-rich water towards the ocean surface, replacing the warmer, usually nutrient-depleted surface water**

Upwelling



Coral Reefs

- **Underwater natural structures made from calcium carbonate secreted by corals**
- **Amongst the most impressive, diverse and productive on Earth**

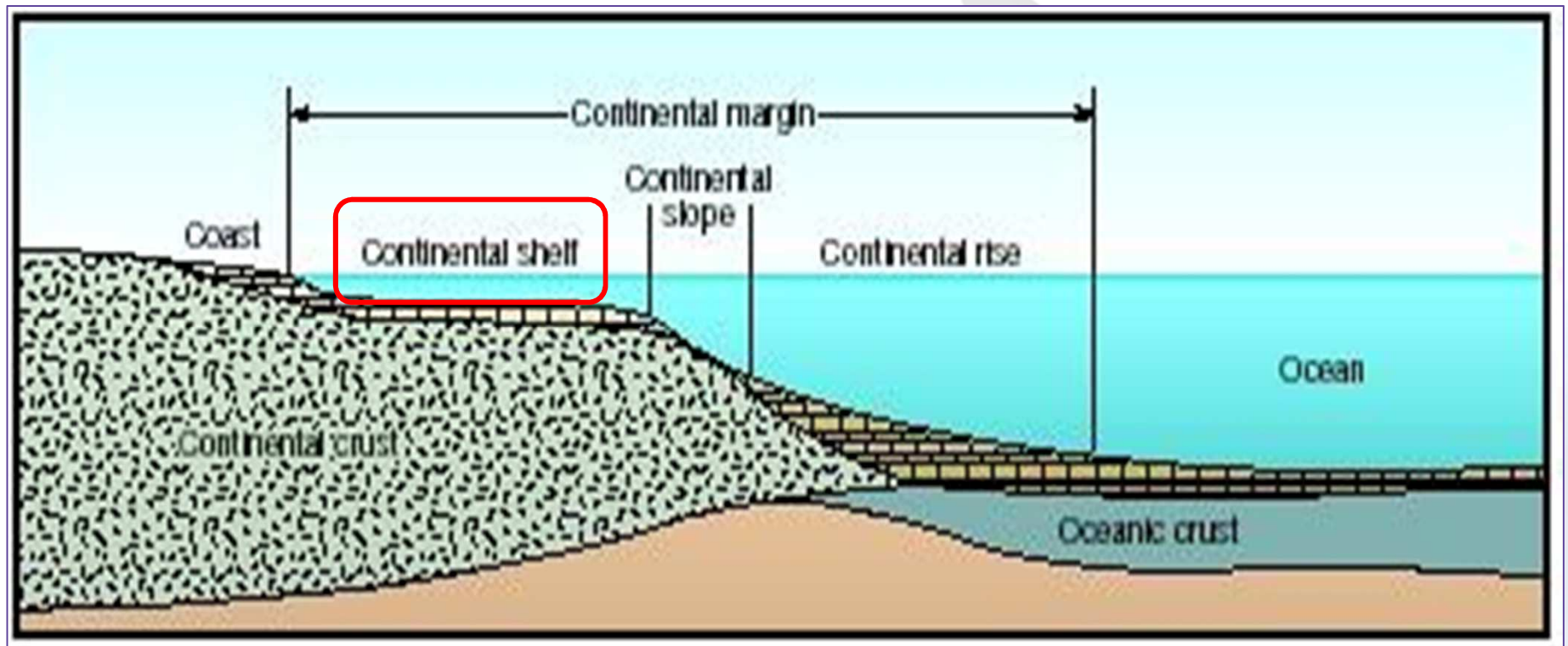
Coral Reefs



Coastal Shelf

- Also referred to as “continental shelf”
- Characterized by shallow (200-m depth) water
- Shallow depth allows re-suspension of nutrients due to storms → promotes high biological activity

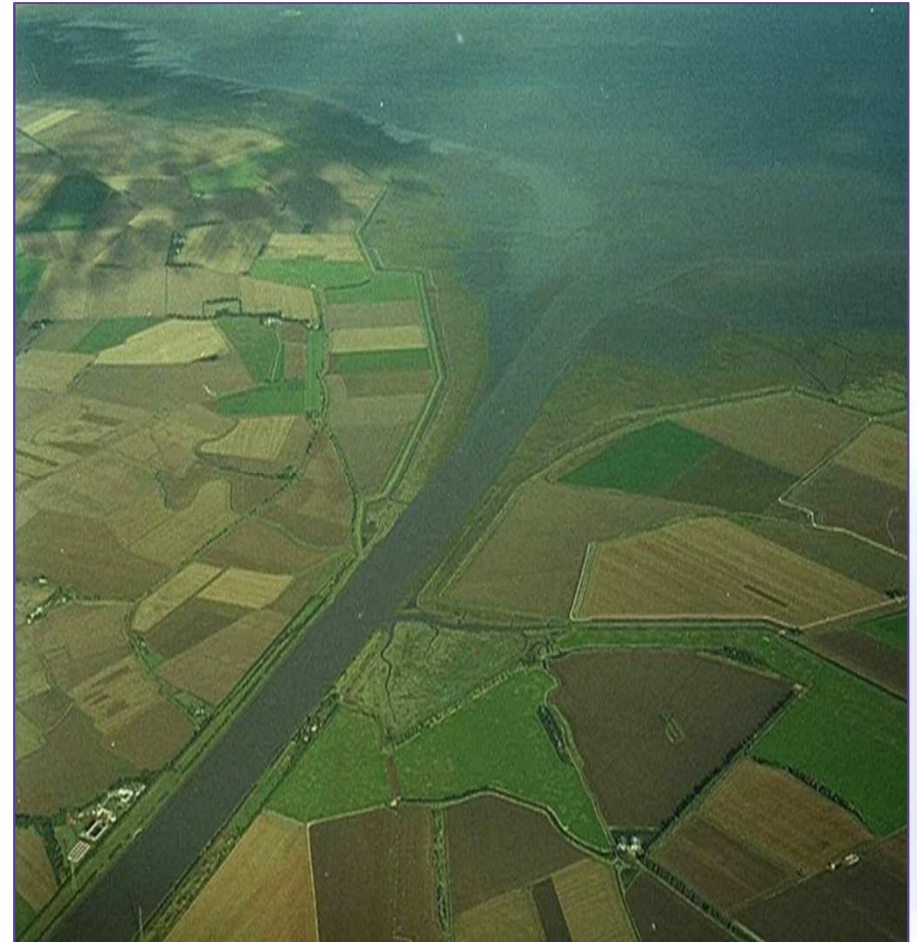
Coastal Shelf



Estuaries

- Form where freshwater from rivers and streams flows into the ocean → mixing with salty sea water
- Act as a natural buffer between the land and ocean, absorbing flood waters and dissipating storm surges.
- They often exhibit vertical stratification → outward-flowing freshwater rests on a layer of denser salt water along the bottom

Estuaries



Salt Marshes

- **Low coastal grassland frequently overflowed by the tide**
- **Highly productive ecosystems**
- **Serve as nursery grounds for diverse fish and shellfish**
- **Provide habitat for birds and other wildlife**
- **Also trap sediments and nutrients**

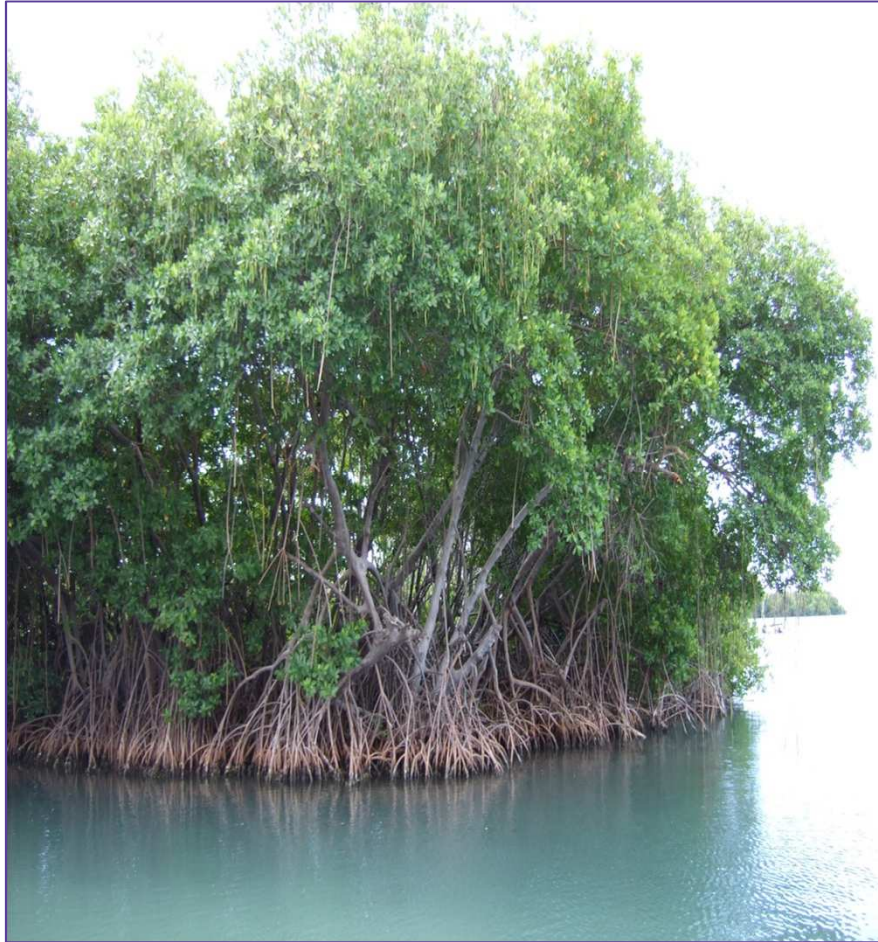
Salt Marshes



Mangroves

- Not a taxonomic category, but a diverse group of salt-tolerant plants.
- Composed of mangrove trees
- Mangrove trees have specially adapted aerial & salt-filtering roots and salt-excreting leaves → occupy the saline wetlands where other plant life cannot survive
- Provide protection from long waves (“shock absorber”)
- Absorb more carbon dioxide per unit area than ocean phytoplankton

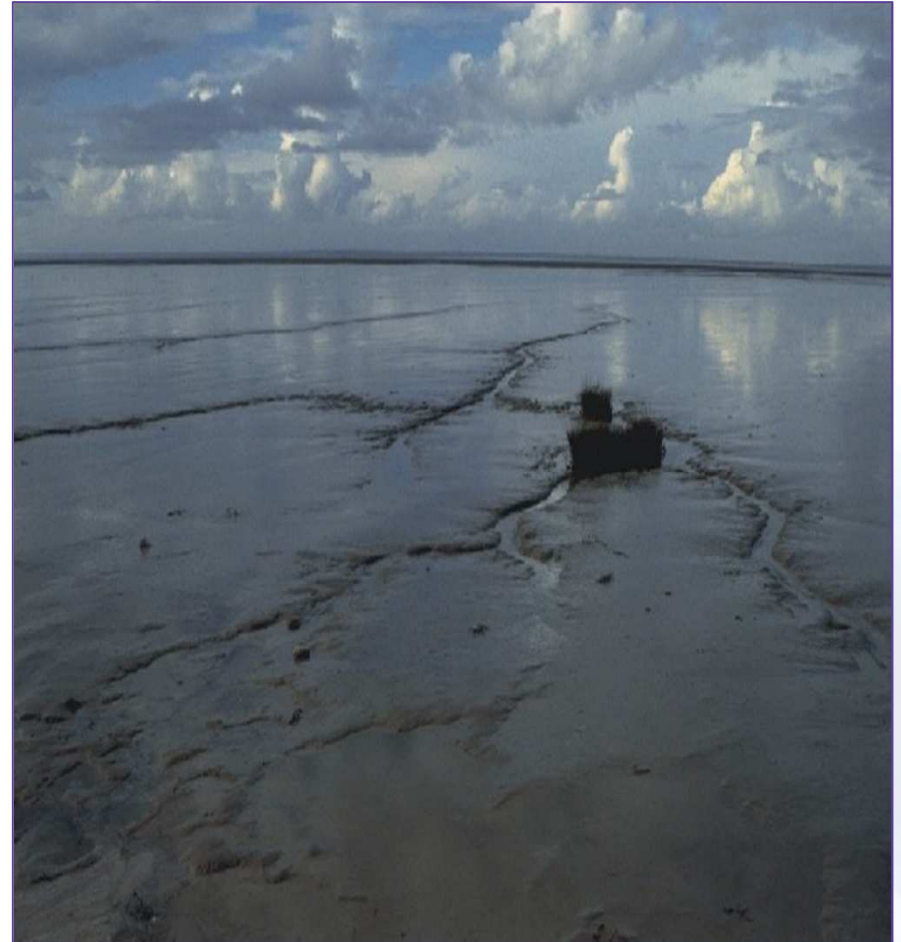
Mangroves



Tidal Flats

- **Nearly flat coastal area that is alternately covered and exposed by tides**
- **Consist of unconsolidated sediments and precipitated salts**

Tidal Flats



Marine Sabkhas

- **An area of coastal flats subject to periodic flooding and evaporation**
- **Develop in arid environments on flat featureless coastal plains whose muddy or sandy sediment is subjected to coverage by tides**
- **Represent transitional environments between land and sea**

Marine Sabkhas



Why are Coastal Zones Productive?

- **River export of nutrients**
- **Localized nutrient upwelling**
- **Water column mixing**
- **Re-suspension of nutrients during storms**
- **Ample light for photosynthesis**

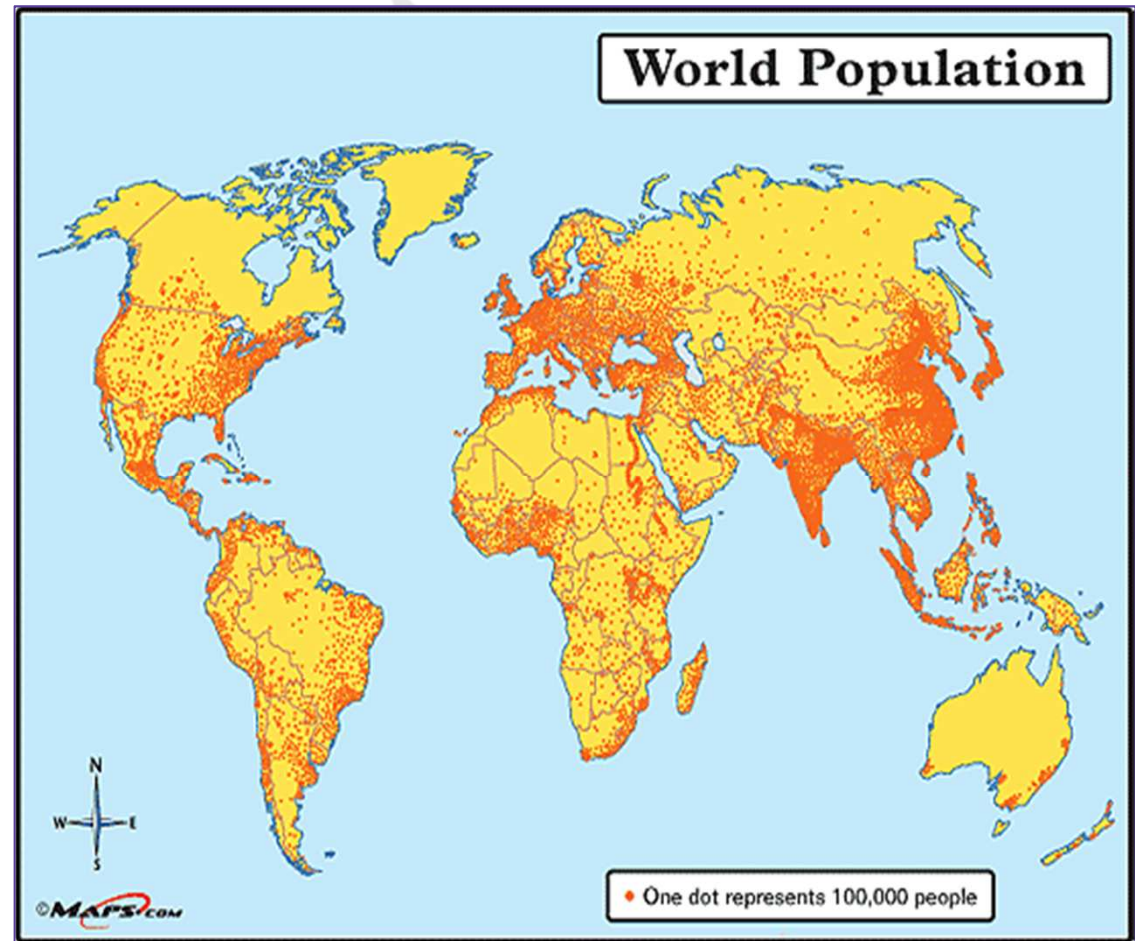
Importance of Coastal Environments

Why are Coastal Environments Important?

- **Most of seas' harvestable production comes from coastal areas (upwelling etc.)**
- **The open ocean is vast → contributes the bulk of the oceans' primary production...**
- **...but only a fraction of the harvestable fish and shellfish**

Why are Coastal Environments Important? *(contd.)*

- Of world population:
 - 10% live in coastal area <100 m elevation
 - 23% live within 100 km @ <100 m elevation
 - 50-60% live within 100 km of coastline



Threats to Coastal Environments

Population Growth

- **Increased solid waste production**
- **Polluted urban and agricultural runoff**
- **Loss of green space and wildlife habitat**
- **Increased coastal recreational activities**
- **Increased industrial activities**

Eutrophication

- The “over-production” of a water body due to presence of excessive amounts of nutrients (N and P) → “nutrient enrichment”
- **Main nutrient sources:**
 - Agricultural runoff (fertilizers)
 - Atmospheric NO_x
 - Sewage

Eutrophication - Effects

- Excessive nutrient loading → plant growth stimulation
- Plants multiply rapidly → “blooms”
- Biological production consumed by microorganisms → oxygen consumed
- Dissolved oxygen (DO) levels decrease:
 - Hypoxia (< 2 - 3 mg/l)
 - Anoxia (0 mg/l)
- Fish leave “dead zones;” benthic organisms killed
- Sunlight denied penetration to lower depths
- Odors

} *“Dead zones”*

Harmful Algal Blooms (HAB)

- Also known as “red tide”
- Microorganisms → “algal”
- Begin life as cysts beneath sea bed
- Certain “trigger factors” prompt their release
- Optimal ambient water conditions allow rapid multiplication → “bloom”
- Sometimes toxic byproducts produced → fish kills; PSP in humans etc. → “harmful”
- DO depletion due to increased productivity

Climate Change

- **Sea level rise**
 - Inundation of low-lying lands
 - Beach erosion
 - Intensified flooding
 - Increased salinity of rivers, bays, and groundwater tables
- **Land loss**
 - Erosion of coastal wetland systems
 - Ecological and economical consequences

Climate Change *(contd.)*

- **Storms and flooding**
 - Shore erosion increases vulnerability to storms
→ removal of beaches and dunes that would otherwise protect coastal property from storm waves
 - Increase in coastal flooding from rainstorms → low areas drain more slowly as sea level rises
 - Flooding from rainstorms may become worse if higher temperatures lead to increasing rainfall intensity during severe storms
 - More **energy** for tropical storm systems e.g. hurricanes

Climate Change *(contd.)*

- **Coastal water supplies: increase in salinity of both surface water and groundwater through salt water intrusion**
- **Coral reefs**
 - When water is too warm, corals will expel the algae (zooxanthellae) living in their tissues
 - → coral turns completely white → “**coral bleaching**”
 - When a coral bleaches, it is not dead...
 - ... but they are under more stress and are subject to mortality

Absence of ICZM

- **“Integrated Coastal Zone Management”**
- **Holistic approach to involve all stakeholders in management of the coast, including terrestrial and marine components of the coastal zone**
- **Many countries either lack or underrate the importance of ICZM**

Mitigating Threats to Coastal Environments

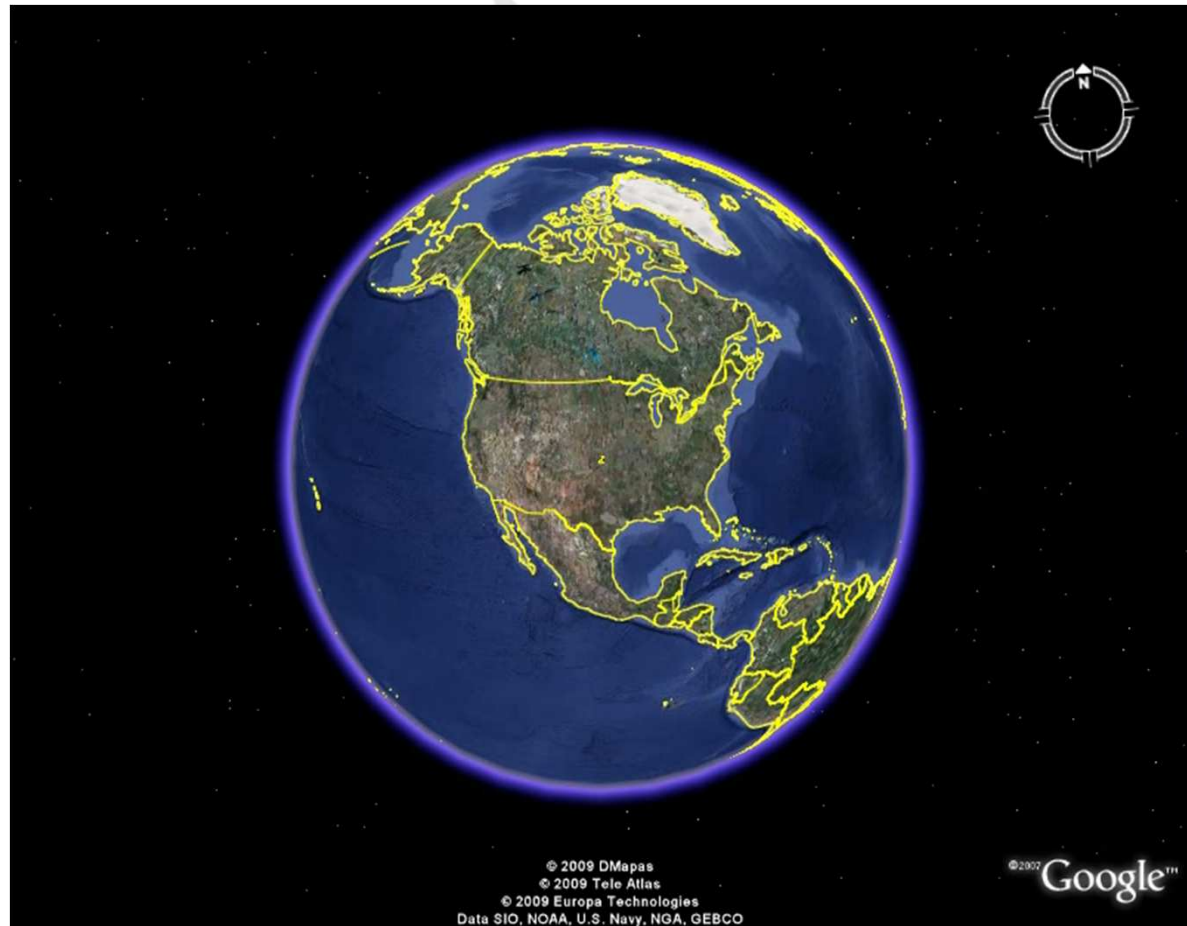
Mitigation Strategies

- **Education/Awareness**
- **A robust ICZM plan:**
 - Development of an understanding of the coastal zone as a system made up of interlinked components and processes;
 - Using this knowledge to create a plan for its best use; and
 - Implementation and enforcement of the plan
- **Combating climate change**

The Coastal Environment of Kuwait

Kuwait : Facts & Figures

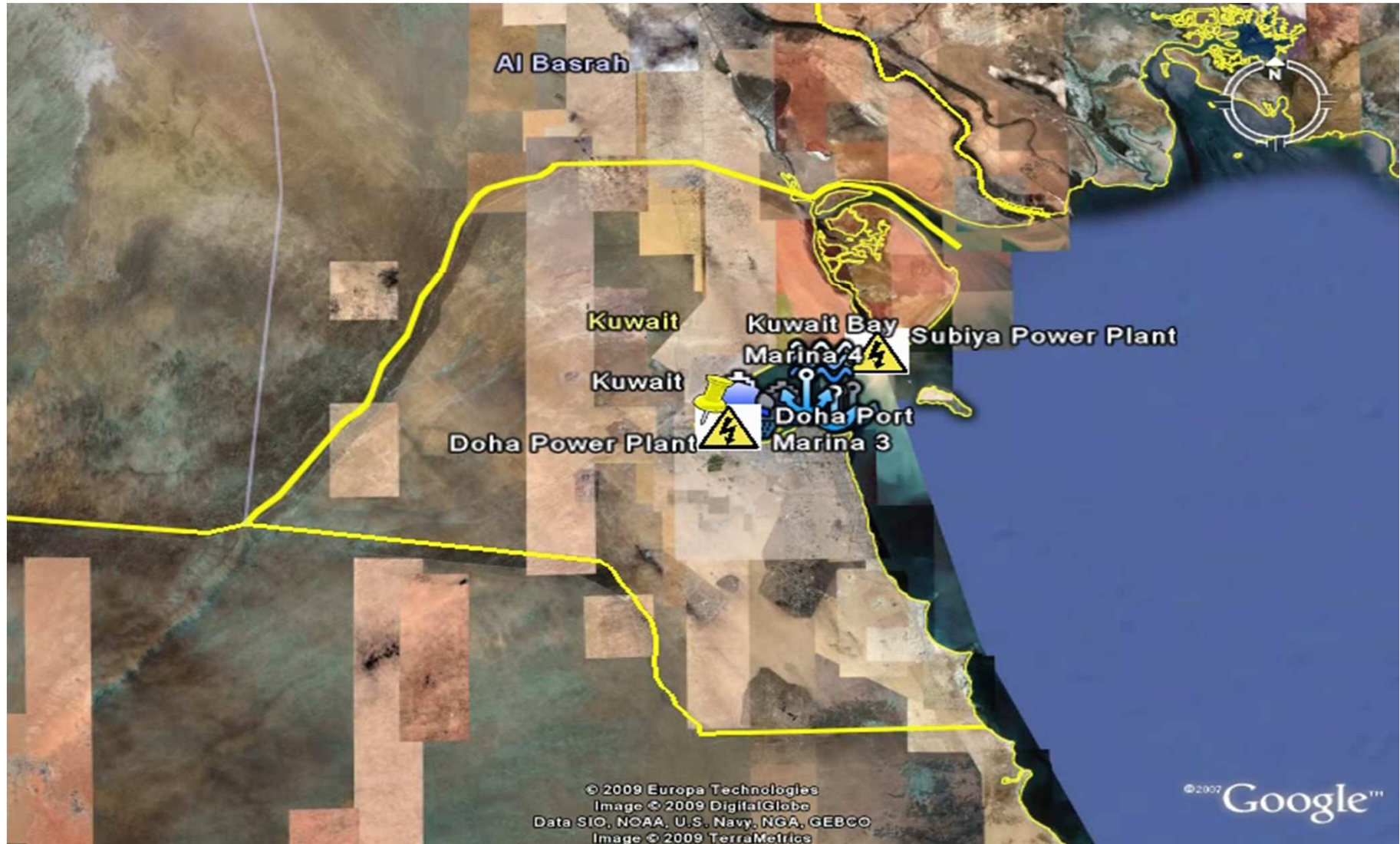
- **Population** ~ 4,000,000
- **Area** ~18,000 km²
- **Coastline** = 500 km (including 9 islands)
- **Kuwait Bay** = highly stressed water body



Southern Kuwait - Coastal Activities



Kuwait Bay - Coastal Activities



Kuwait - Islands



Northern Kuwait



Summary

Summary

- Coastal environments are extremely important from the following perspectives:
 - Ecology
 - Human sustainability/socio-economic activities
- The coastal zone defines where most coastal environmental activities are carried out
- Numerous threats exist to coastal environments
- These threats can be mitigated for

Questions?

