Mediterranean coastal hazards in a climate change context

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People and property are increasingly vulnerable to coastal hazards

Popularity - Islands

- Death
- Injury
- Illness
- Loss property
- Loss environment

Risk reduction: a significant part of sustainable development

Form and type reflect coastal vulnerability to particular hazards

Coastal form

A consequence of type and structure of the underlying rocks which influence intensity of a number of processes:

- sea level change;
- erosive action of wave action;
- weathering;
- deposition of sediments by currents;
- tectonic activity;

Coastal type

- sand beaches
- low-lying rocky shores
- cliffs
- clay covered coastal slopes
- estuaries
- mudflats
- barrier reefs
- anthropogenised coasts

(e.g. seawalls, breakwaters, groins etc)

Coastal vulnerability to storms

- the potential of a coastal stretch to be harmed by the impact of a storm.

Vulnerability assessment:

i. accounting for the modification of the coastal substrate

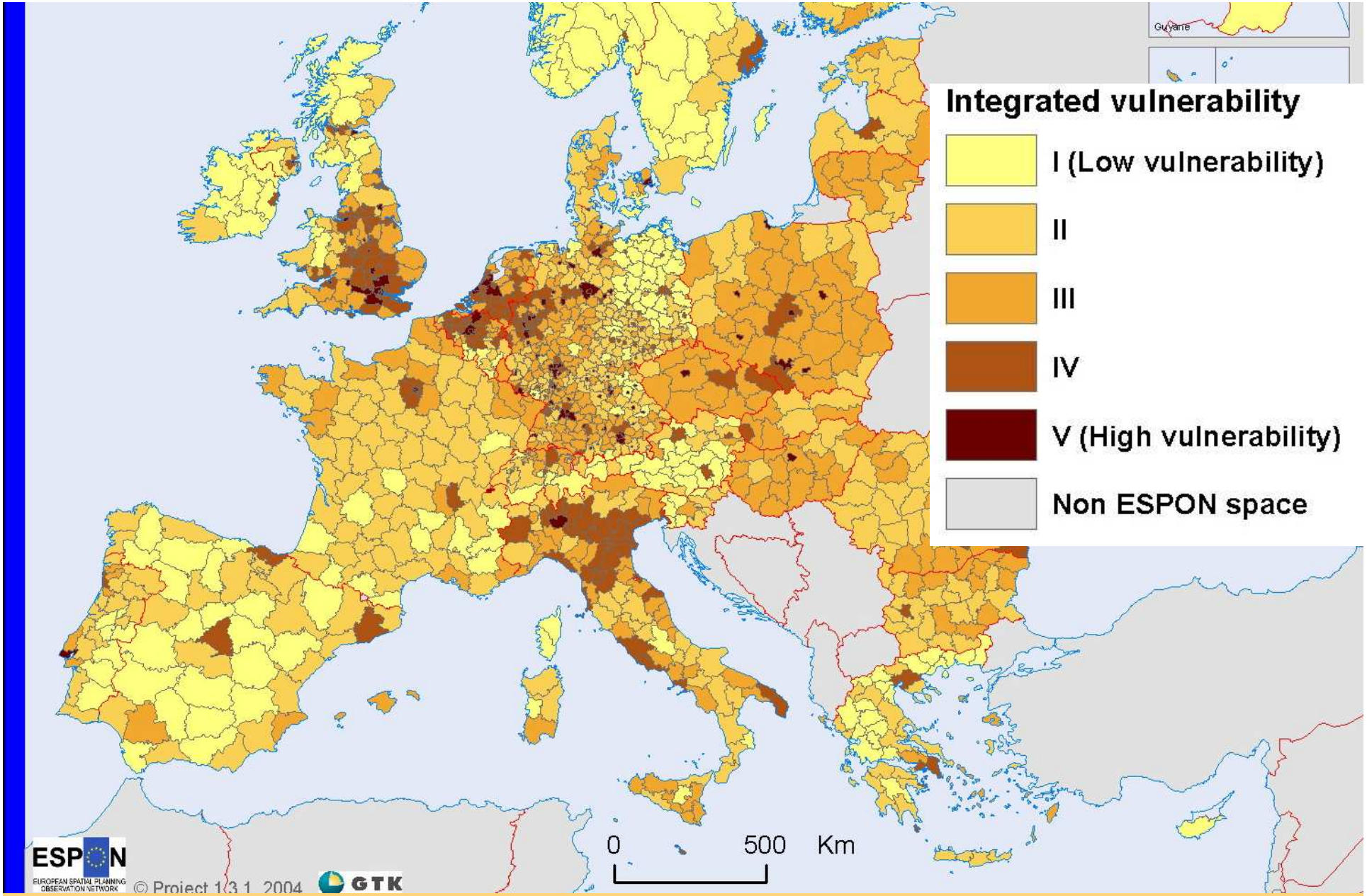
ii. impact on socio-economic and environmental values.

- identifies expected magnitude of damage along the coast due to storm hazards.

- allows (informed) decisions on mitigation/adaptation strategies.

Coastal regions in the European Union

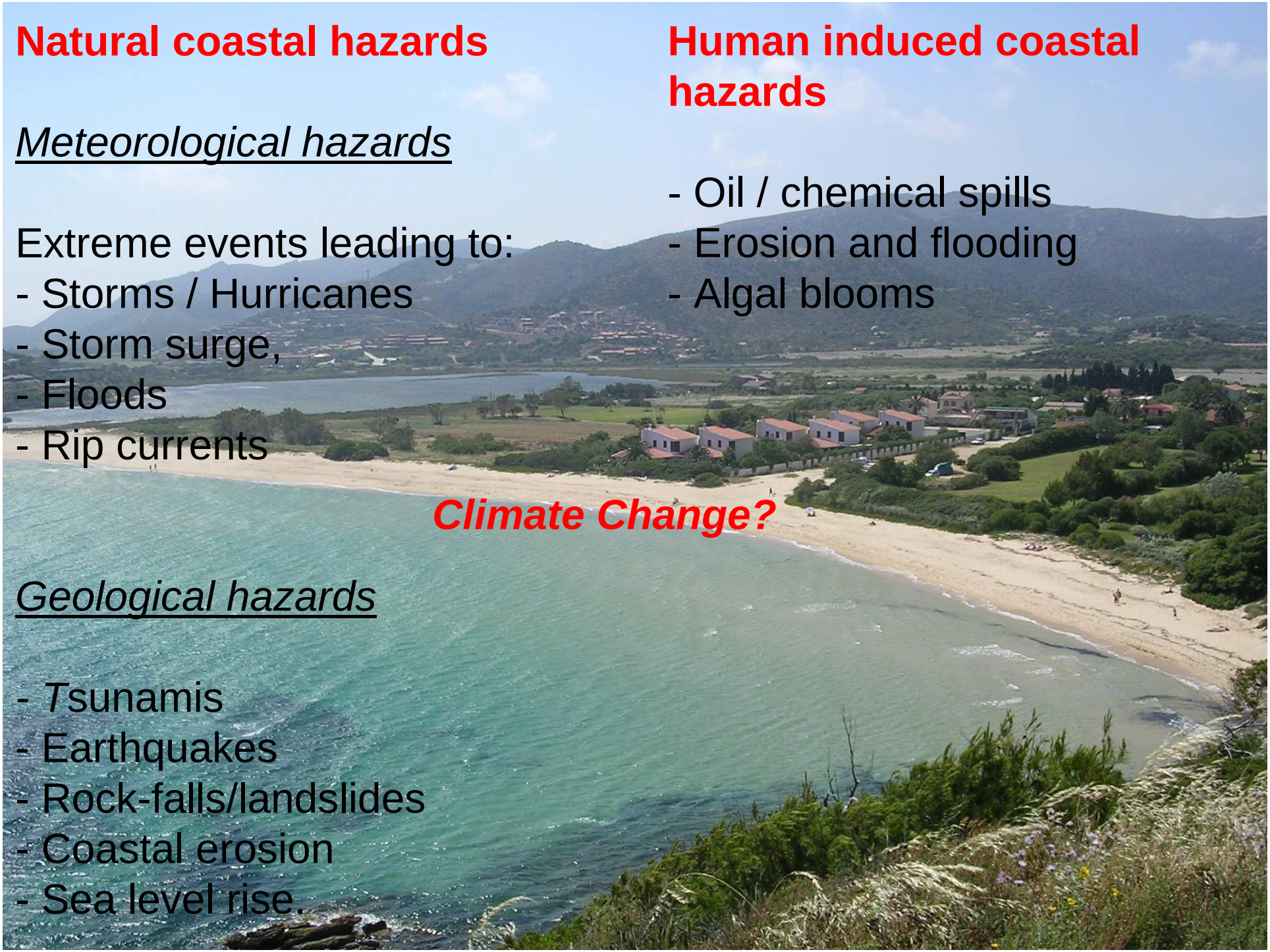
- > 89, 000 km.
- Support many large cities.
- Populations > 50,000.
- Major centers of tourism (Mediterranean scenario).
- Large trade centers.
- Important in food production



Degree of integrated vulnerability based on GDP per capita, population density, national GDP and proportion of fragmented natural areas to all natural areas equally weighted (30:30:30:10) – *Source:* Natural and Technological Hazards and Risks Affecting the Spatial Development of European Regions, (ed) Schmidt-Thomé, 2005).

Vulnerability map patterns:

- Vulnerability tends to decrease from east to west because of a lower coping capacity, as based on the lower national GDP/capita.
- Less fragmented natural areas have a lower vulnerability because the nature in larger undisturbed areas can recover faster than that in smaller areas.
- Densely populated areas with a high regional GDP per capita show the highest vulnerability, as the total amount of people and assets per km2 poses a higher vulnerability of total damage in case of a disaster.
- The varying vulnerability in western European countries in comparison to eastern European countries is based on the influence of low coping capacity levels in the latter ones.
- In consequence, the influence of the existing differences in population density and regional GDP per capita on the integrated vulnerability in western European countries is much greater in comparison with eastern Europe.
- Consideration of increased coastal area vulnerability is absent!



Natural coastal hazards

Meteorological hazards

Extreme events leading to:
- Storms / Hurricanes
- Storm surge,
- Floods
- Rip currents

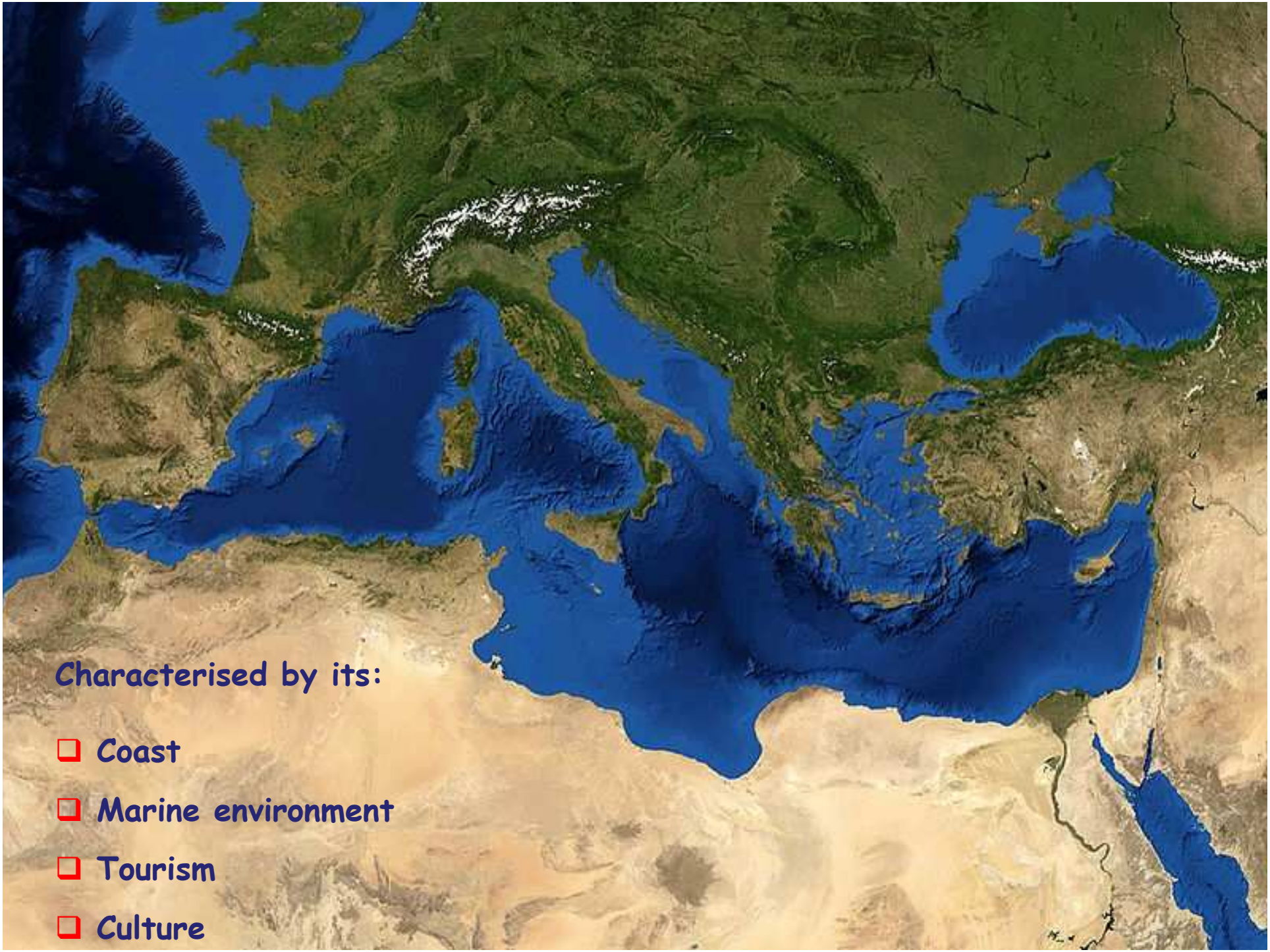
Climate Change?

Geological hazards

- *T*sunamis
- Earthquakes
- Rock-falls/landslides
- Coastal erosion
- Sea level rise.

Human induced coastal hazards

- Oil / chemical spills
- Erosion and flooding
- Algal blooms


Characterised by its:
Coast
Marine environment
Tourism
Culture

Value of Vulnerability assessment is clearly reflected in the 2008 ICZM Protocol for the Mediterranean.

A specific chapter on natural hazards, where signatories are advised to undertake coastal:

- vulnerability assessments
- hazard assessments

- prevention measures
- mitigation measures
- adaptation measures

to address the effects of natural disasters

Mediterranean Coast - *pressures*

- Housing and development, often as close as possible to the sea;
- Incompatible / conflicting land use practice;
- Legal conflicts (access rights and conservation);
- Absent perception of long-term conservation as a desirable goal;
- Poor understanding of the value of ecological services, including, for instance, fisheries or tourism.
- 46% population growth (1980–2000) and population density in coastal zones is ~ twice as high as on national average.
- Of 651 regions of the Mediterranean-rim countries, 221 touch the coastline (46,000kms).

Intensive human activities / fast population growth

(source: Report on the Seminar "Coastal Tourism in the Mediterranean: Adapting to Climate Change" Sardinia, Italy, June 2009)

Mediterranean marine environment

Shipping

- ~ 220,000 vessels > 100 tonnes cross / year – ~ 1/3rd world's total merchant shipping.
- Hazardous cargoes -potential threat to the marine environment.
- Discharge of chemical tank washings and oily wastes.
- At ~ 0.7 % of global water surface, Med receives 17% of global marine oil pollution.
- > 20% of world's total oil transportation through the Med / year.
- ~ 250 to 300 oil tankers crossing the Sea every day.
- ~ 10 accidental oil spills / yr.

Mediterranean Tourism

- World's most popular destination (31% of international tourist arrivals & accounting for 29% of receipts from international tourism).
- 2008: 300 million international tourists, 368 million by 2020.
- About half visit coastal zones.
- Including domestic tourism, coastal zones of Mediterranean countries were visited last year by an estimated 250 million visitors.
- 1990–2008 averaged annual growth of ~ 3.6%.

Climate change, including increased temperature and incidents of extreme weather events such as heat waves, torrential rains or floods will compound:

- Intensive human activities / fast population growth impact on coastal ecosystems.
- Shipping-related threats to marine pollution;
- Negative consequences for tourism through:

- heat waves;
- spread of diseases;
- drought;
- associated risk of fires;
- sea level rise potentially leading to coastal erosion;

Mediterranean Climate change trends

Source: IPCC (2007) report on Impacts, Adaptation & Vulnerability, chapter 9 (Africa) and 12 (Europe).

- 1901 to 2005: Warming trend throughout Europe well established at +0.90°C.
- 1979–2005: a trend considerably higher than the mean at +0.41°C per decade.
- Greater in winter in northern Europe but greater in summer in southern and central Europe.
- Summer cooling demands are expected to increase: around the Mediterranean - an additional 2 - 5 weeks will need cooling by 2050.
- Under high emission scenarios, N. Africa may experience temperature increases of up to 9°C in summer post 2070s.

Mediterranean Climate change trends

❑ Yearly precipitation trends are -ive in Southern Europe and E. Mediterranean, and water stress is projected to increase all around the Mediterranean:

- Crop productivity likely to decrease along Mediterranean shores.

- Forests projected to retreat in the South of Europe, and tree mortality is likely to accelerate.

- Water stress will increase around the Mediterranean basin.

  % area under high water stress in southern Europe likely to increase from 19% today to 35% by the 2070s (summer flows may be reduced by up to 80%).

The hydropower potential around the Mediterranean is expected to decline by 50% by the 2070s.

In 1995, about 193 million people out of a total EU population of 383 million faced water shortages !!

Mediterranean Climate change trends

- Winter floods - Likely to increase in maritime regions of Europe. Coastal flooding related to increasing storminess and sea-level rise is likely to threaten up to 1.6 million additional people annually as a consequence of beach erosion, overwash and inundation resulting in extensive infrastructural damage, limiting coastal use and degrading coastal ecosystem services.

- Warmer, drier conditions - especially in summer, will lead to more frequent droughts, as well as to a longer fire season and increased fire risk, particularly in the European part of the Med.

- Increased health risks due to more frequent heat waves, particularly in central and southern Europe, and greater exposure to vector- and food-borne diseases are anticipated to increase.

Climate variability and change already affect Europe's:

- Production systems (agriculture, forestry and fisheries).
- Key economic sectors (tourism and energy).
- Natural environment.

Most effects are estimated to be negative.

Europe's sensitivity to climate change has a distinct north–south gradient - indication that southern Europe will be more severely affected than northern Europe.

The already hot and semi-arid climate of southern Europe is expected to become warmer and drier.

Mediterranean S.D & Climate change

A wide range of climate change impacts that could be detrimental to SD of the region:

- Temperatures will continue to increase.
- Droughts will become more frequent.
- Water stress will grow.
- Food production will decline.
- Fire risks will increase.
- Heatwaves will become more frequent.
- Biodiversity will be affected (0.05-0.1°C shift in deep sea temps sufficient to induce significant changes in species richness and functional diversity).
- Jellyfish outbreaks or algae blooms will become more frequent.

(Source : UNWTO□UNEP□WMO, 2008; IPCC, 2007)

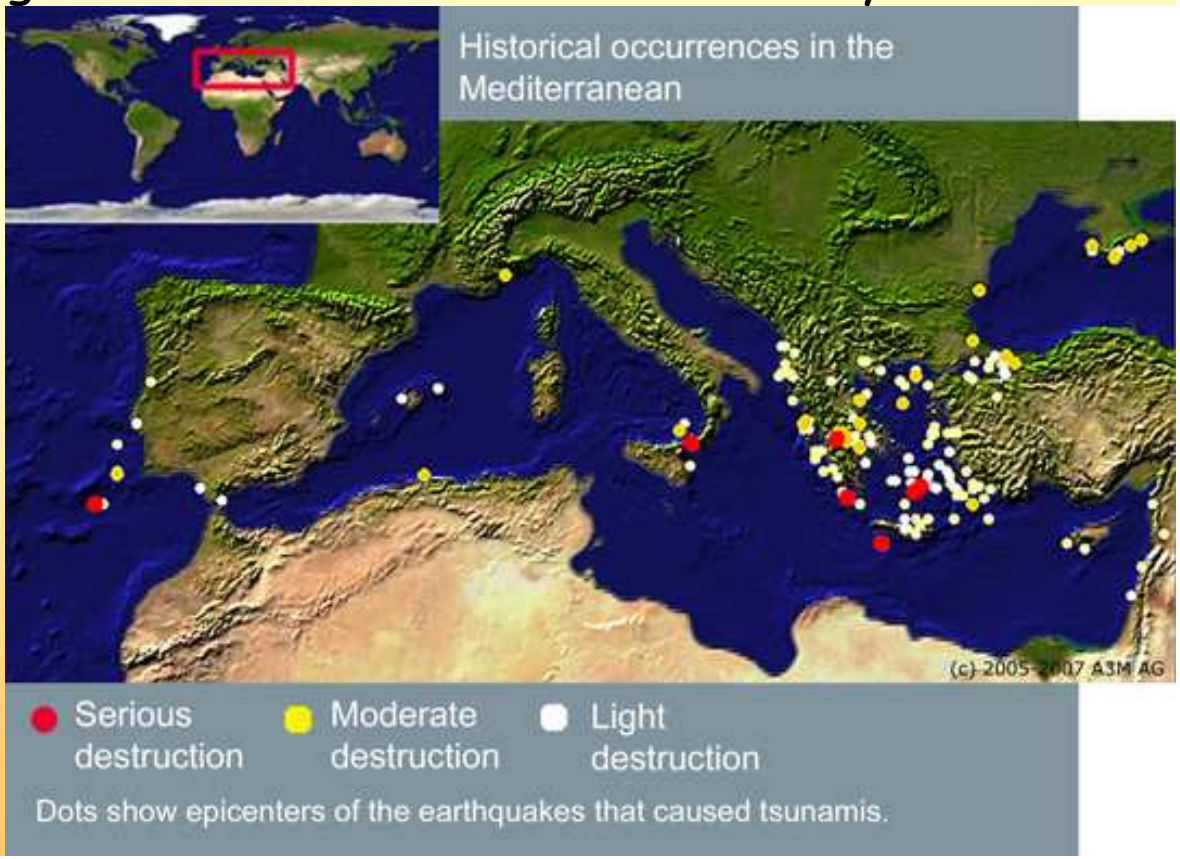
Mediterranean Tsunamis due to earthquakes caused by the African Plate drifting northwards underneath the Eurasian Plate.

10% of all tsunamis worldwide occur in the Mediterranean.

On average, one disastrous tsunami takes place in the Mediterranean region every century.

Thousands killed over the ages with Greece and southern Italy mostly affected.

Mediterranean, Black and Red Seas are the 2nd most common tsunami source region after the Pacific with 98 observed tsunamis.



Source: *www.tsunami-alarm-system.com*

Mediterranean tsunamis

- 2003: Algerian coast earthquake. Destroyed over 100 boats on Mallorca and flooded Palmas Paseo Maritimo.
- 1999: North-west Turkey earthquake. Tsunami within the enclosed Sea of Marmara. ~ 17,000 dead and thousands injured.
- 1963: Italy, near the town of Longarone, the entire northern slope of Mount Toc slid into the Vaiont dam. The water spilled over the dam and destroyed a number of villages with a wave of 140 metres. 4,000 people lost their lives.
- 1956: South-west coast of the island of Amorgos, Greece. killing 53 people, injuring 100 and destroying hundreds of houses.
- 1908: Messina (Italy) earthquake. City almost completely destroyed. More than 75,000 people dead.
- 1755: Lisbon earthquake. Two thirds of the city was destroyed from resulting fires. ~60,000 people dead.

Sea level rise

- Sea level rise by 2100 could be between 30 and 100 cm.
- Europe may be less threatened by sea level rise than many developing country regions.
- However, coastal ecosystems do appear to be threatened, especially enclosed seas such as the Baltic, the Mediterranean and the Black Sea.
- These seas have only small and primarily east-west orientated movement corridors, which may restrict northward displacement of organisms in these areas.

Impacts:

- - loss / inland migration of beaches
- - loss of up to 20% of coastal wetlands.
- - salinisation of agricultural land and water table
- - degradation / loss of aquatic ecosystems.

Hurricanes & Storm Surges in the Mediterranean ??

Mediterranean Hurricanes cited in meteorological literature

- September 1947
- September 1969
- September 1973
- August 1976
- January 1982
- September 1983
- December 1984
- December 1985
- October 1994
- January 1995
- October 1996
- September 1997
- December 2005
- September 2006

Mediterranean tropical cyclone - October 4-6, 1996

The storm caused extremely intense precipitation and severe floods in Sicily and over the southern part of Calabria (480 mm over 2 days, with 285 mm on 4 October alone). It produced gusts of up to 105 km/h, 29 m/s (55 knots, 65 mph), causing heavy damage in its short path

Mediterranean tropical cyclone - October 6-10, 1996

http://en.wikipedia.org/wiki/Mediterranean_tropical_cyclone

Floods in the Balearic Islands, Sardinia, and south Italy. Serious damage from winds up to 145 km/h reported over the Eolian Islands. Four deaths.

Mediterranean Hurricanes

- Recent US National Academy of Sciences study showed powerful link between rising ocean temperatures in the key hurricane breeding grounds of the Atlantic and Pacific and an increase in the intensity of such storms.

- 2004: Cyclone Catarina, South Atlantic
- 2005: Hurricane Vince, Madeira, Portugal; Katrina, New Orleans; Rita, US Gulf coast – the 4th most intense Atlantic hurricane ever recorded.
- 2008: Of 8 hurricanes, 5 major. Third most costly season on record (after2004, 2005, with over $41 billion in damage. Only year on record in which a major hurricane existed in every month from July through November in the North Atlantic.

- Suggestions that climate change induced warming in the Mediterranean enabling it to store enough heat to trigger the formation of its own hurricanes.

Mediterranean dust storms!