



Impacts of Climate Change on coastal wetlands in Morocco. Responses and Adaptation strategies

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Presentation Outline

1. Introduction

2. The coastal wetlands in Morocco

3. Vulnerability of coastal wetlands to global change

4. Impact of SLR on the Moulouya Wetlands

5. Responses and Adaptation Strategies

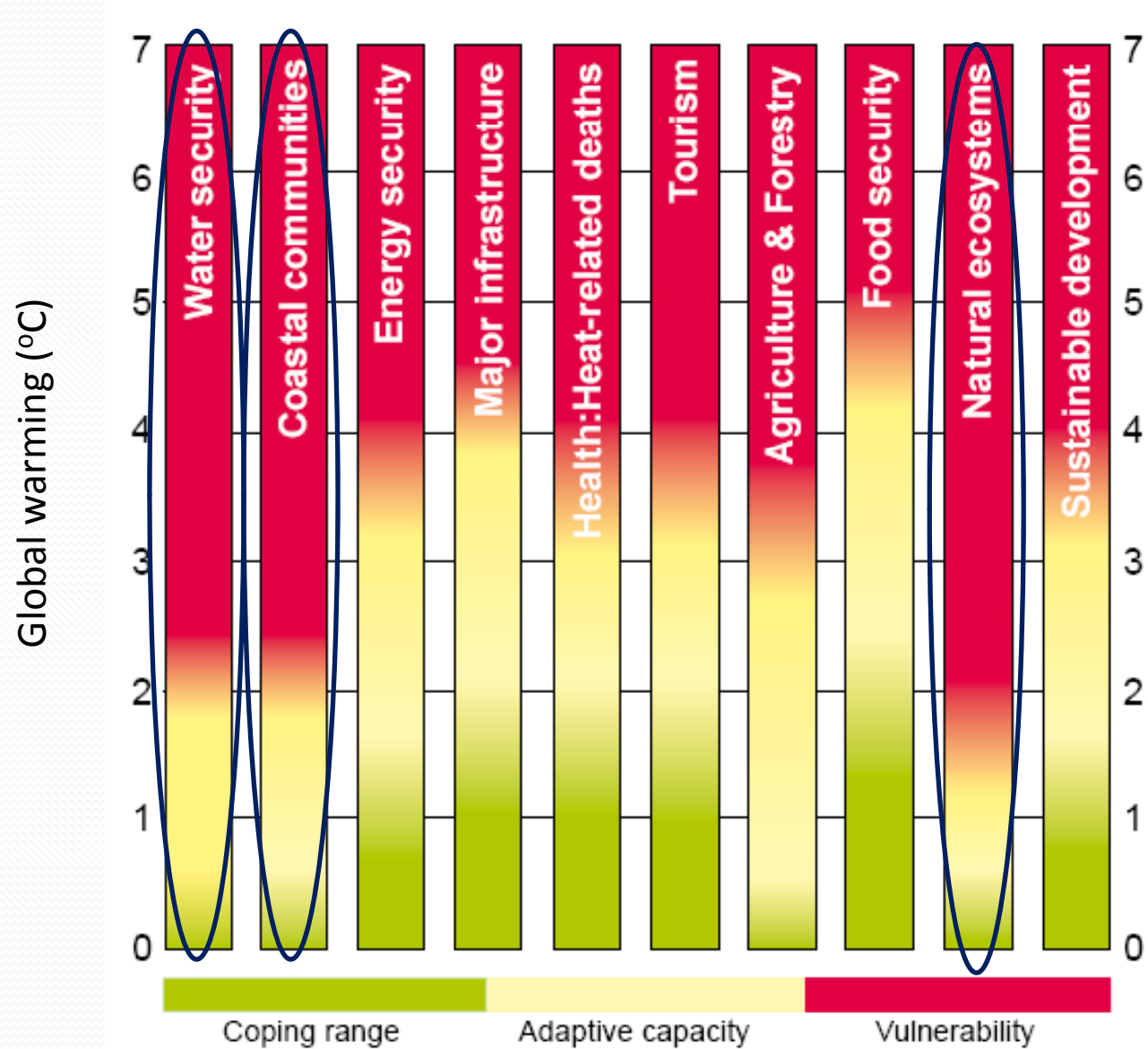
6. Conclusion



Introduction

- Coastal wetlands are among the most productive yet highly threatened ecosystems in the world;
- they produce more services related to human well being than most other systems
- The IPCC and WMO have identified coastal wetlands as ecosystems most vulnerable to large-scale impacts of climate change and sea level rise

Vulnerability for key sectors





Coastal Wetlands as Sentinels of Climate Change

Coastal wetlands are critical habitat for many species and perform important ecosystem services

These services include:

- improving water quality by filtering of sediments and nutrients,
- dissipating the energy and reducing the erosive effects of coastal storms (Flood protection)
- and recycling and exchanging nutrients within and among estuarine habitats.
- Nursery areas for fisheries
- Important for nature conservation



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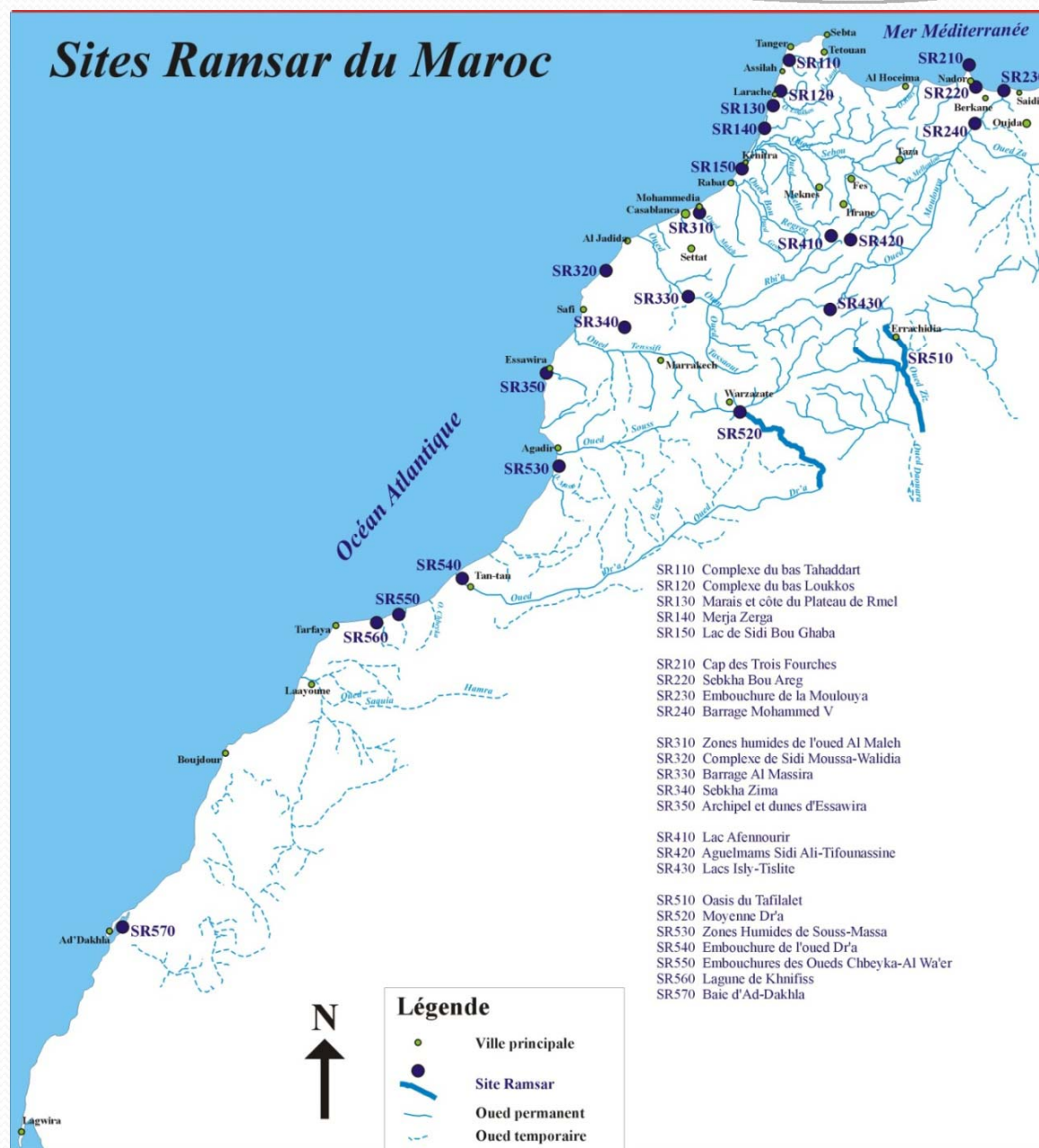
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The Moroccan wetlands



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- These wetlands represent important sources of food and habitats for many species, and provide services such as sustaining the local economy and protecting the life and property from climate extremes.
 - Moroccan wetlands have received relatively little attention, especially with regard to environmental conditions and risks
 - Yet, many of them continue to suffer stresses originating both from sea and land-based activities (urbanization, agriculture, fisheries, tourism, ports, industry, etc.) and are experiencing acute environmental problems, which have led to a decrease in their resilience and adaptability to climate change and sea-level rise.

Services



Pressions



Pressions





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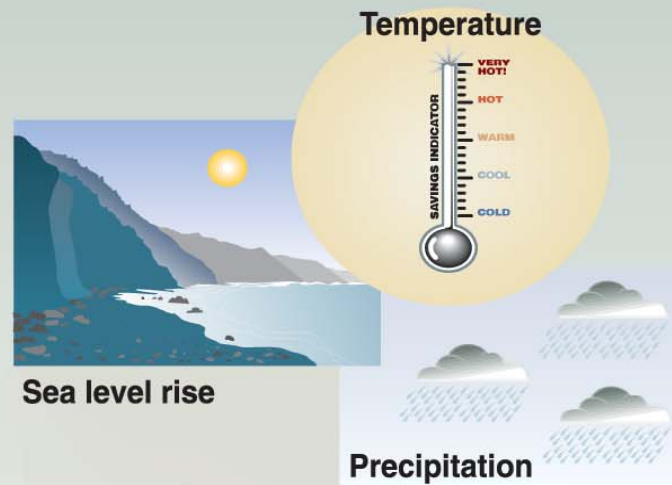
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Potential climate changes impact



Impacts on...

Health



Weather-related mortality
Infectious diseases
Air-quality respiratory illnesses

Agriculture



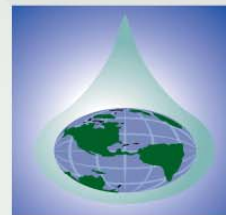
Crop yields
Irrigation demands

Forest



Forest composition
Geographic range of forest
Forest health and productivity

Water resources



Water supply
Water quality
Competition for water

coastal areas



Erosion of beaches
Inundation of coastal lands
additional costs to protect coastal communities

Species and natural areas



Loss of habitat and species
Cryosphere: diminishing glaciers



The Science: IPCC-AR4

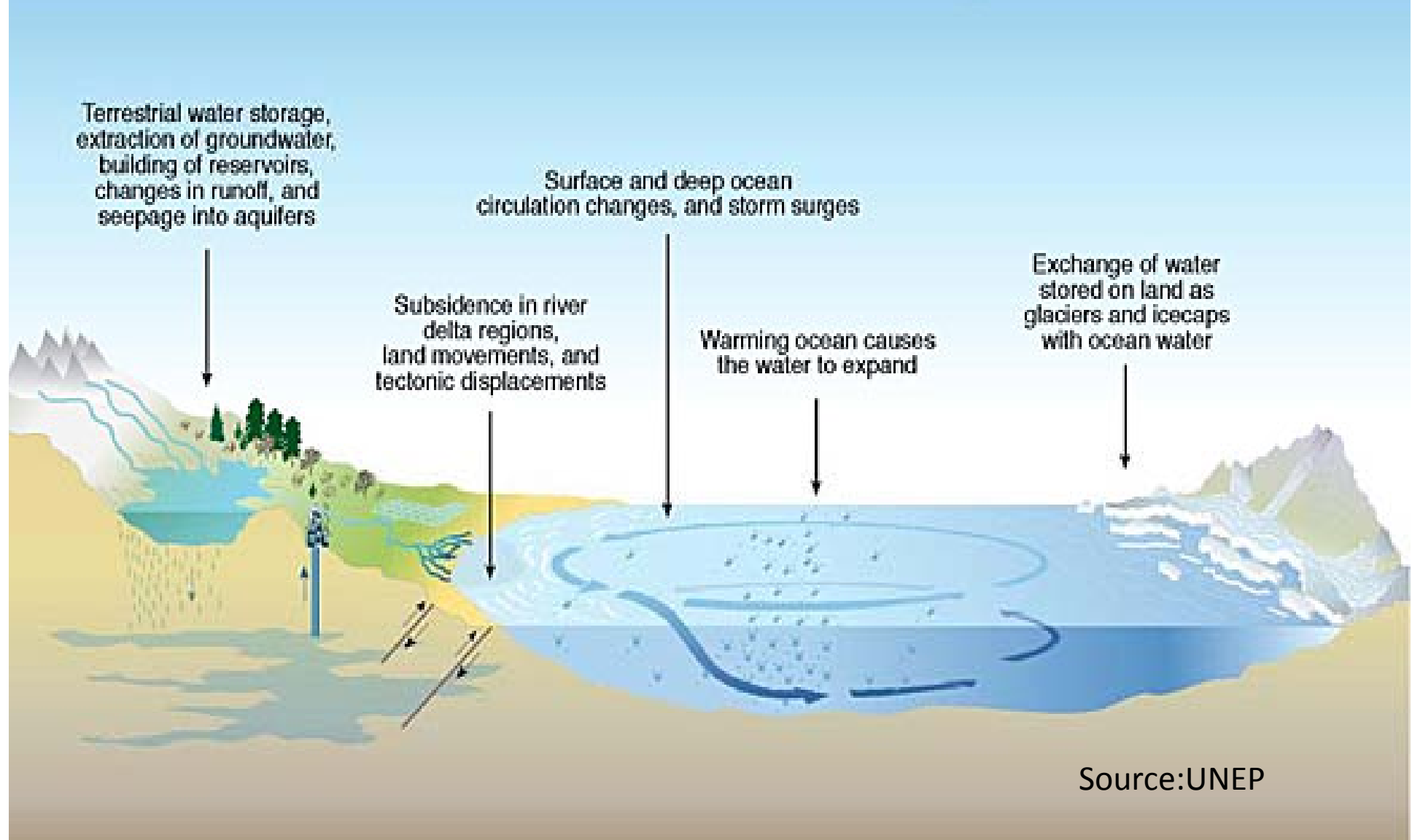
- Warming of the climate system is **unequivocal**, and is **very likely** due to increase in anthropogenic GHG concentrations;
- Even if GHGs were to be stabilised today, **temperature and sea level rise would continue for centuries**;
- **Adaptation** is essential, but there are substantial limits and barriers.



Accelerated Sea-level Rise

- Global mean sea level is expected to rise by 9 to 88 cm by 2100, with a central value of 48 cm. This is **2.2 to 4.4** times the rate of rise observed over the 20th century.
- On a local scale, land subsidence will add to climate change-induced sea-level rise.

What Causes the Sea-Level to Change?



Impacts biophysiques de l'EANM sur les ZC

(Manuel du PNUE, 1998)

- Submersion des terres basses
- Érosion des lignes de côtes
- Augmentation des probabilités de la fréquence des tempêtes
- Intrusion saline
- Élévation du niveau des nappes d'eaux souterraines
- Effets biologiques

Impacts socio-économiques

- Perte directe des valeurs économiques, écologiques, culturelles et de subsistance du fait de la perte des sols, d'infrastructures et d'habitats côtiers ;
- Accroissement du risque d'inondation pour les personnes, les sols et les infrastructures;
- Autres impacts liés aux changements dans la gestion de l'eau, la salinité et l'activité biologique.



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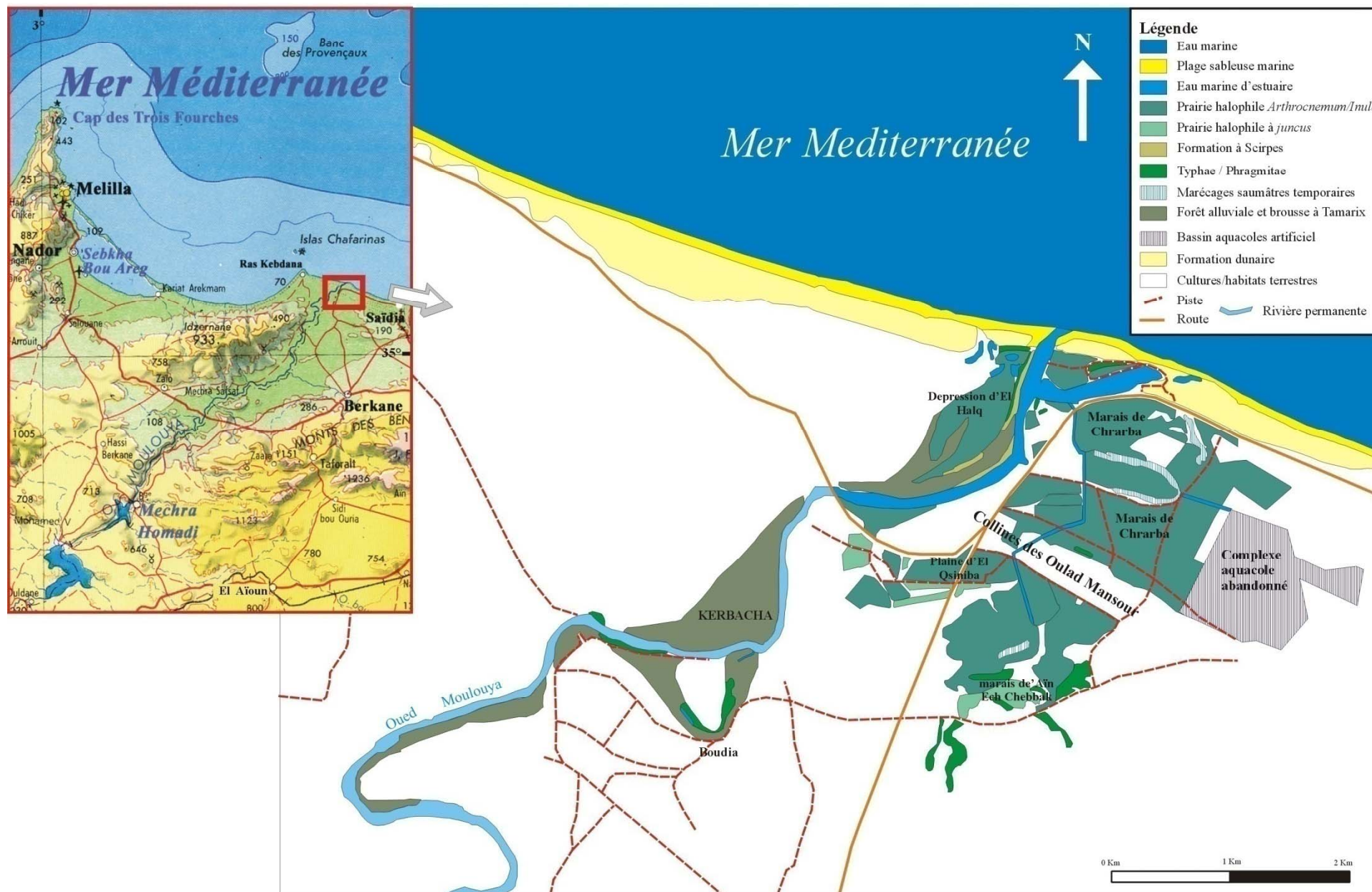
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Sites Ramsar du Maroc : Embouchure de la Moulouya

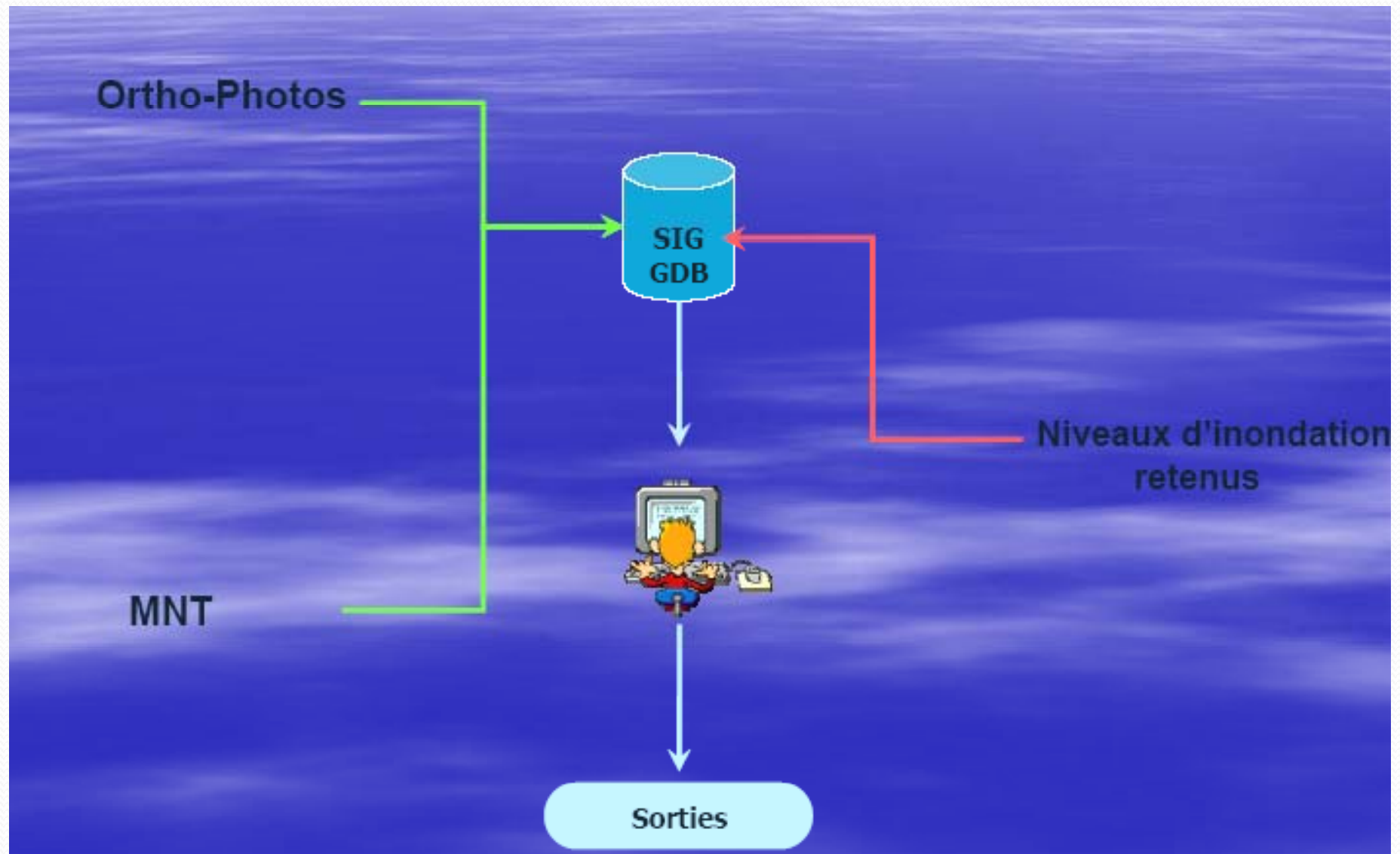


The Moulouya wetland

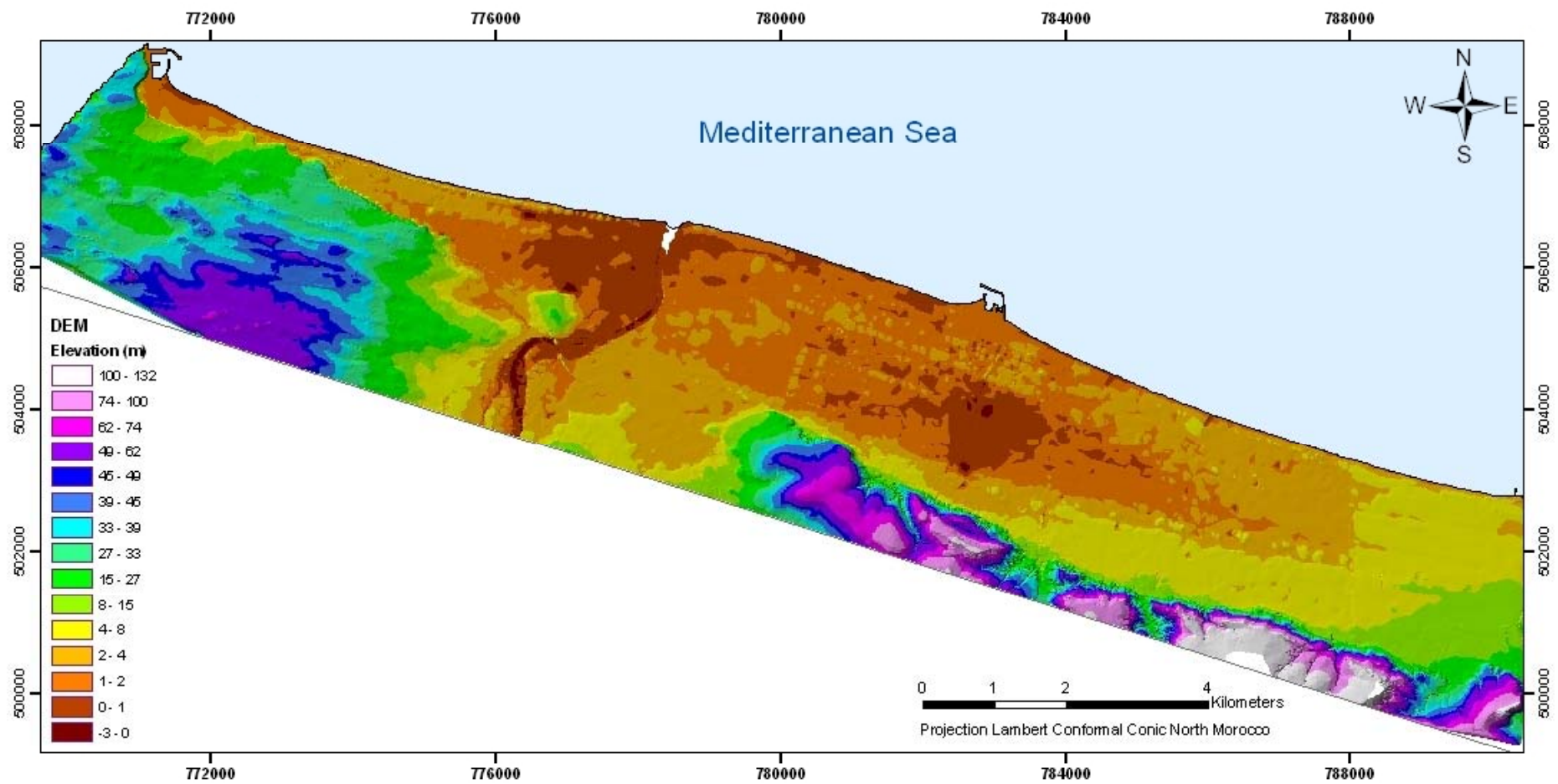




METHODOLOGIE



MNT

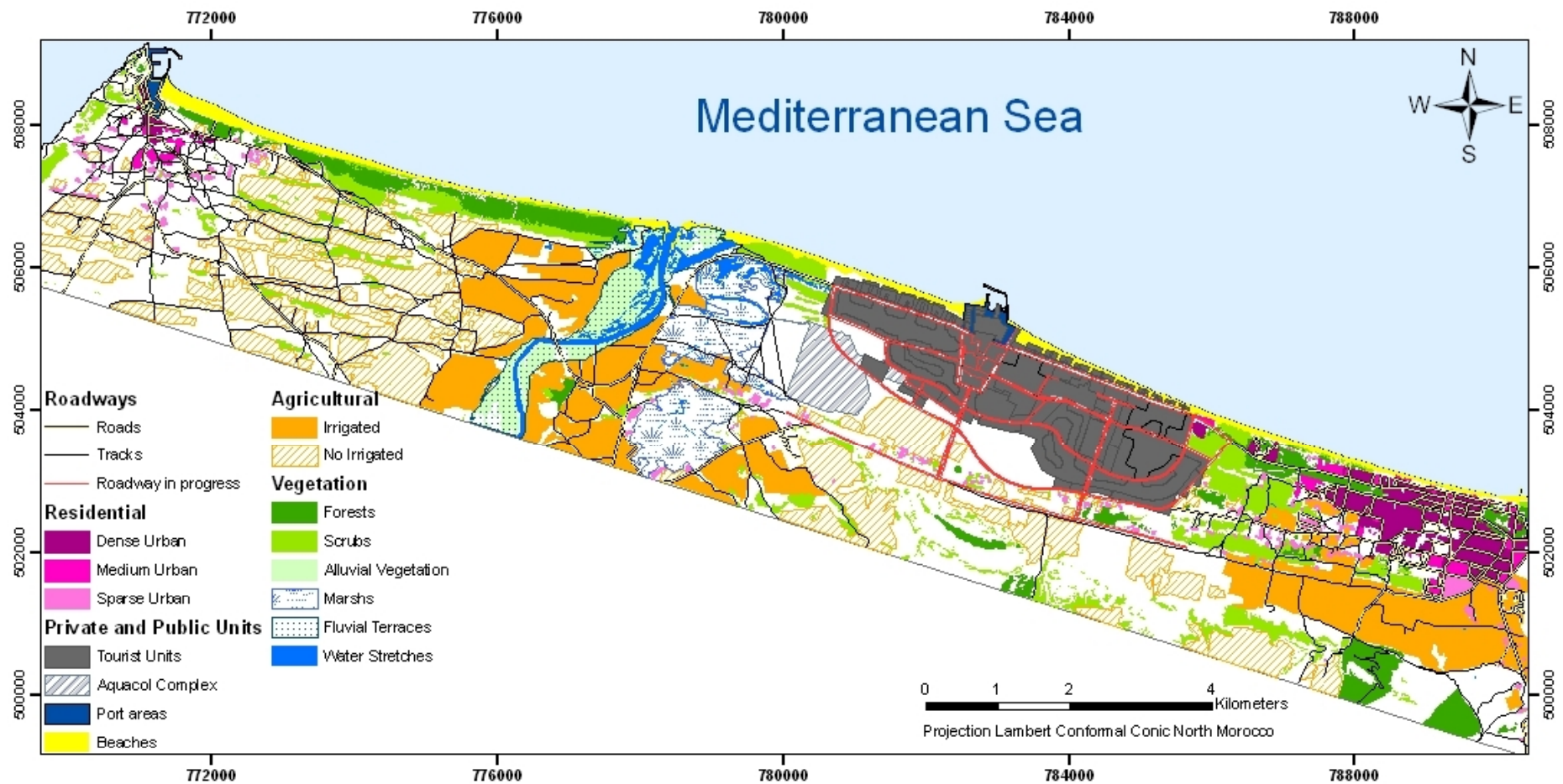




Scénario slr: 1m



Land use





Développement du tourisme balnéaire
Destruction des dunes littorales

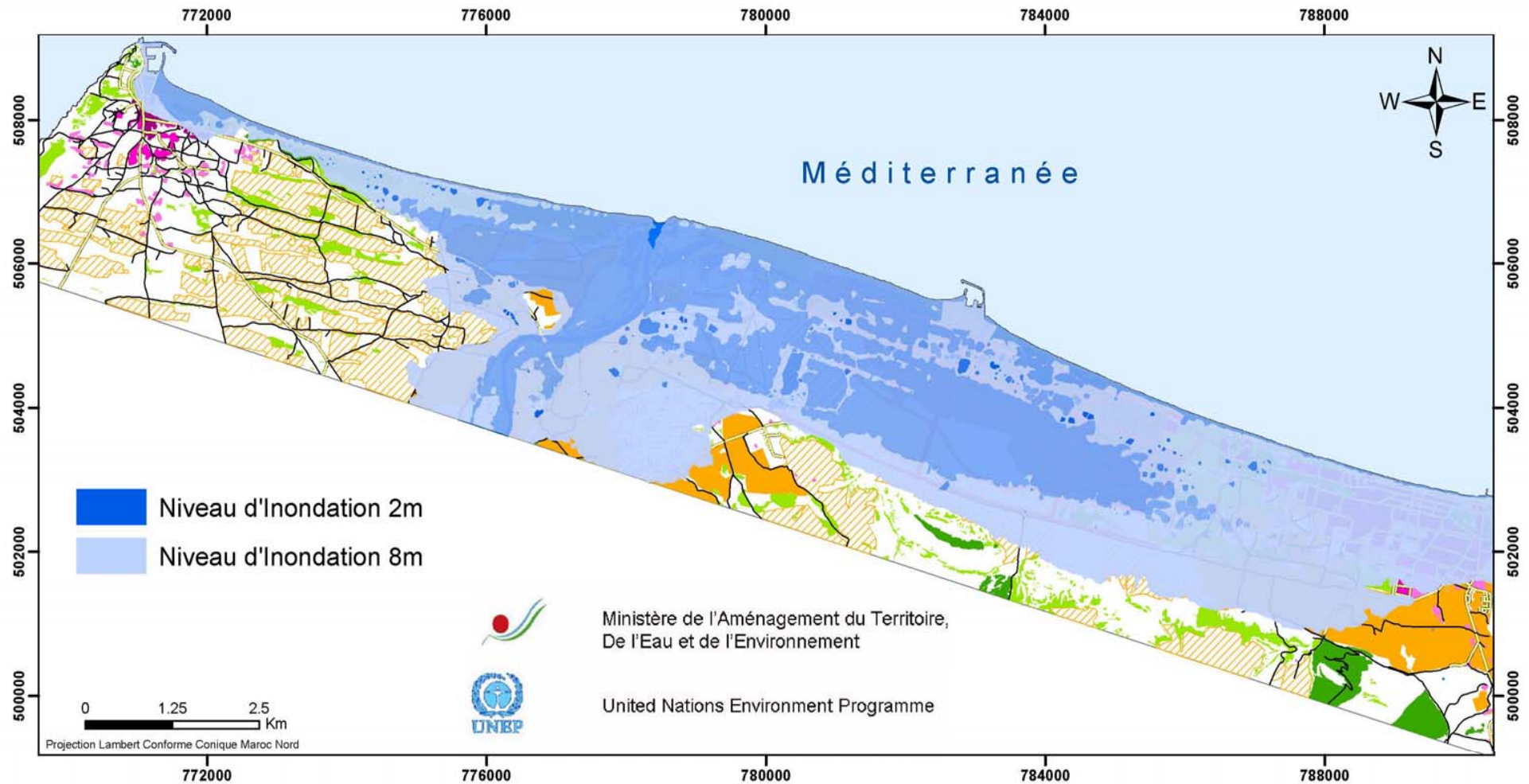
Destruction des dunes



Construction sur les dunes



Scénarios d'inondation



L'érosion côtière

Pertes potentielles des plages en % en 2050 et 2100

Horizon temporel	Avec accélération de l'élévation du niveau de la mer		
	Hypthèse basse	Hypothèse Moyenne	Hypothèse Haute
2050	9 - 10	25 - 27	49 - 54
2100	15 - 17	37 - 42	65 - 72

Avec l'Hypothèse moyenne: Perte potentielle d'environ 26% en 2050 et 40% en 2100

Pertes Potentielles en terres en 2050 et 2100

	2050	2100
Inondation	24%	59%
Érosion	51%	66%



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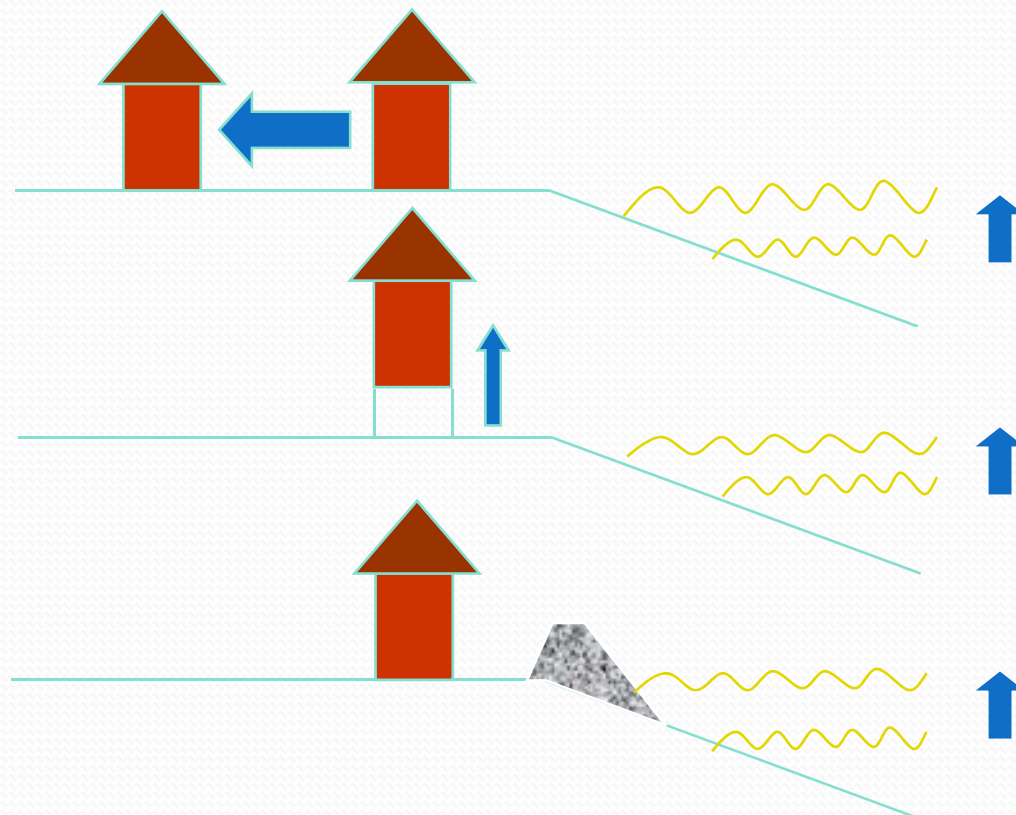
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Responding to Coastal Change

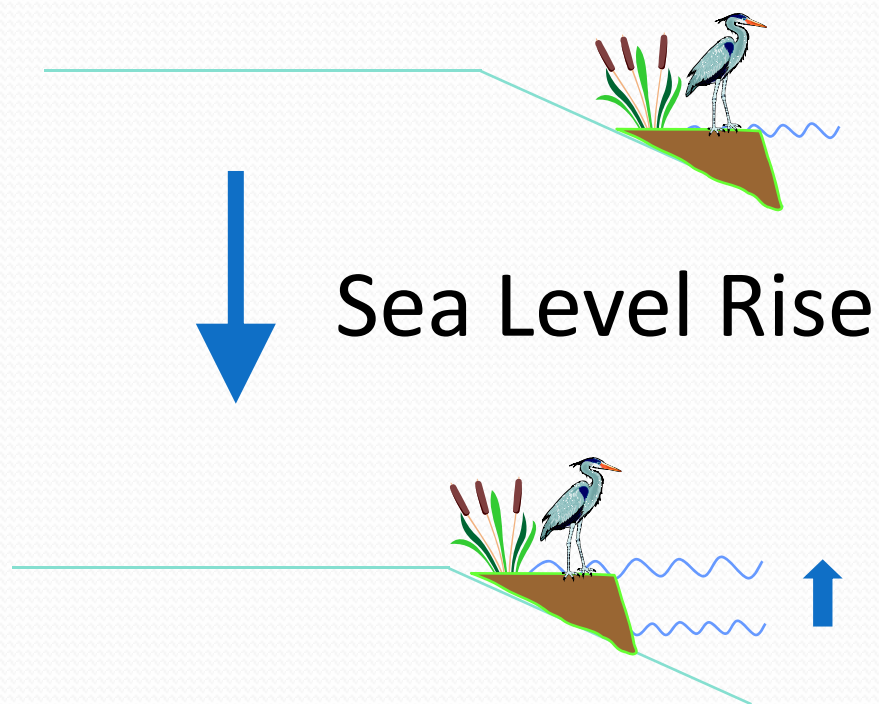
(including sea level rise)

- Retreat
- Accommodation
- Protect
 - Soft
 - Hard

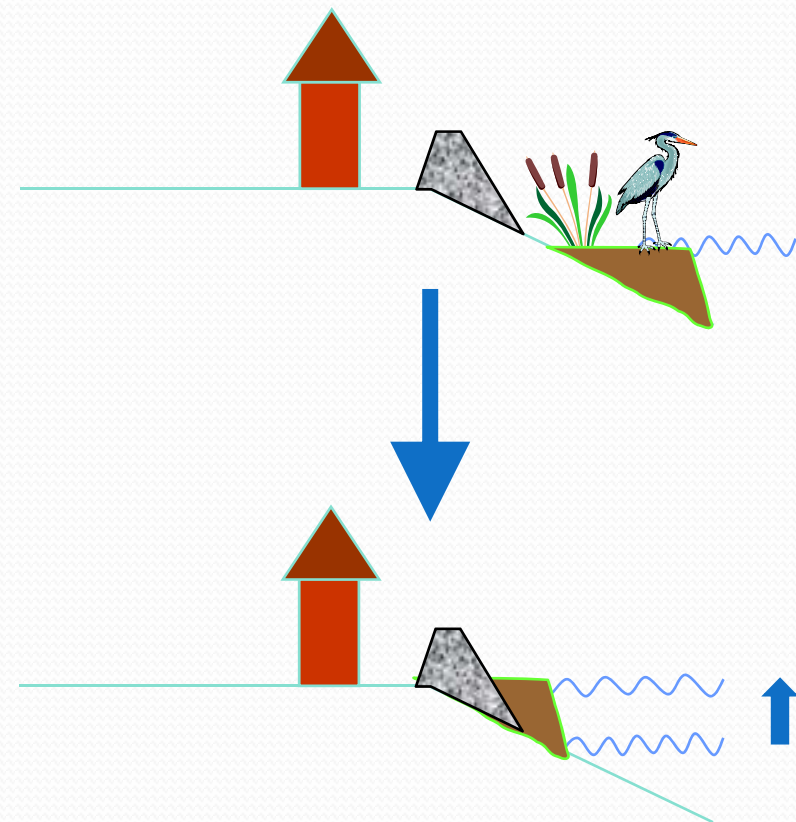


Coastal Squeeze

(of coastal wetlands)



(a) no hard defenses



(b) hard defenses

Stratégie d'adaptation SIBE de la Moulouya

Adaptation naturelle autonome de
l'embouchure et des marais salants
Mais conditionnée par:

- 1) La disponibilité d'espace naturel pour permettre la migration vers les terres
- 2) La disponibilité d'un stock de sable suffisant pour permettre le rééquilibrage des profils de plage

Stratégie d'adaptation des terres agricoles menacées



Reconversion des agriculteurs
en aquaculteurs ?

⇩ Option nécessitant une forte
composante de sensibilisation et
de formation

Mesures d'accompagnement pour le long terme

- La Gestion Intégrée des Zones Côtières
- La loi 'Littoral' et la réglementation
- Renforcement institutionnel

Fixation des dunes



Aménagement



Sensibilisation



Défi futur pour les ZC dans le contexte des CC au Maroc

- Barrages ou non?
- Tourisme balénaire?

Meilleure option: le dessalement d'eau de mer et GLZC



Conclusions

- Climate change will be a serious problem for coastal wetlands
- Impacts are strongly influenced by **human choice**
- Preparing to adapt essential, in the context of multiple stresses and managing existing problems



Conclusion

What is needed for adaptation?

- Scientific basis
- Political will
- Stakeholder process
- Participatory process
- Redefine and strengthen roles of institutions
- Integrated approach

Pillars of success

education

information

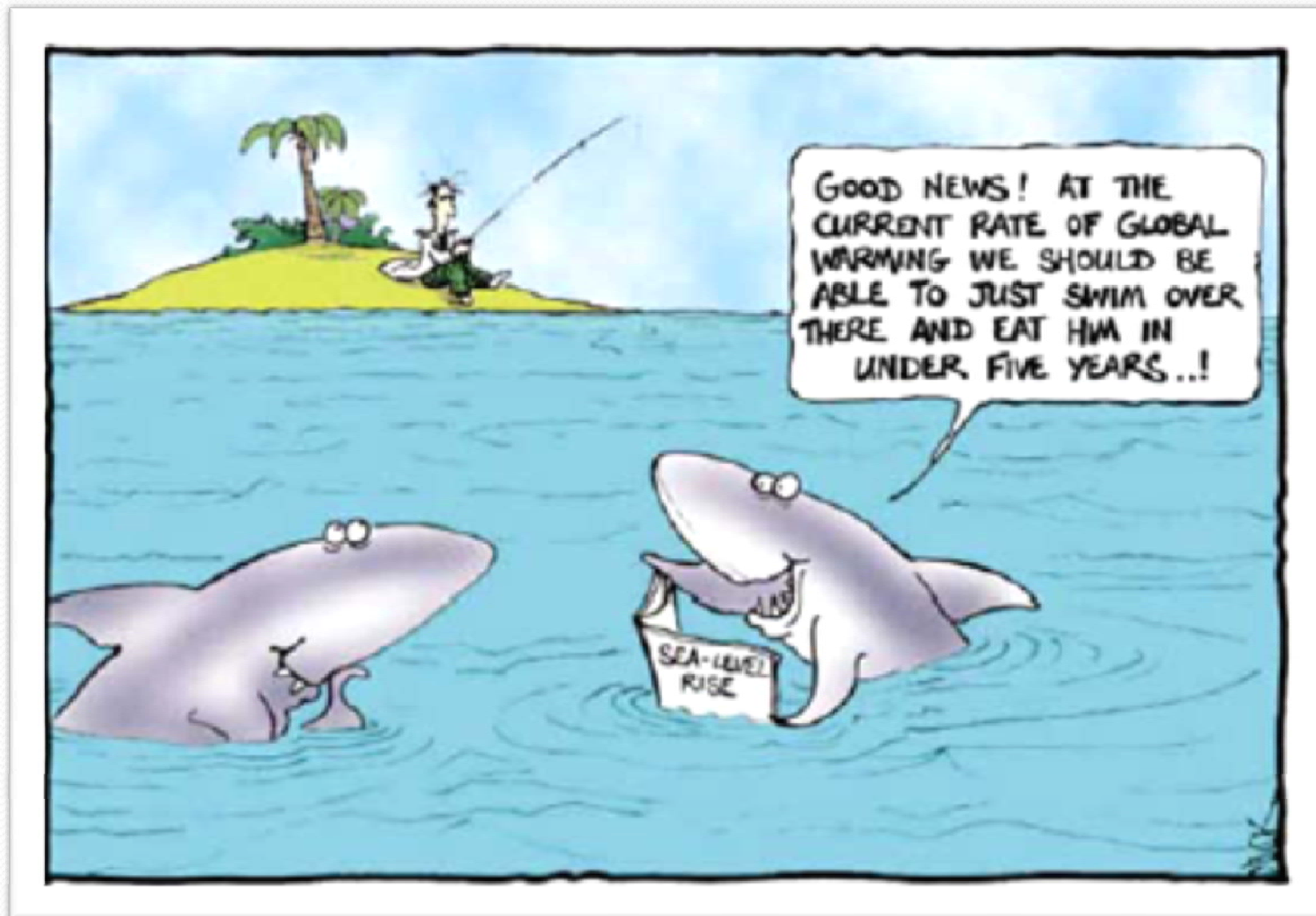
governance



Le défi des prochains siècles pour l'Afrique: les réfugiés climatiques!



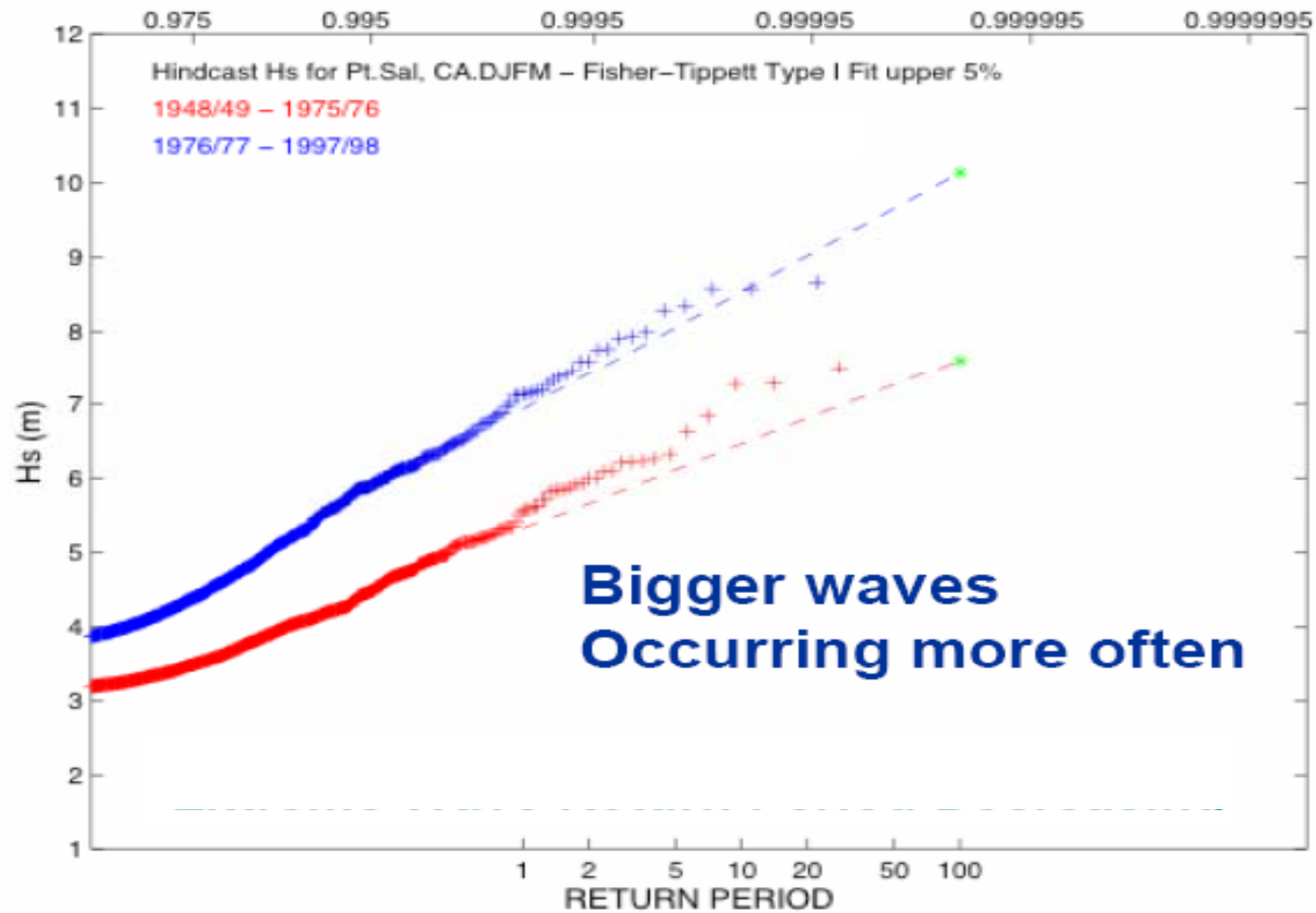
Merci!





Les mesures de protection pour le Court et moyen termes

- ❖ Le rechargement artificiel en sable pour réhabiliter les plages érodées;
- ❖ La réhabilitation et la fixation des dunes par la végétation;
- ❖ La construction de murs de protection et/ou d'enrochements pour protéger les zones urbanisées les plus exposées;
- ❖ L'installation d'un brise-lame au large de l'embouchure de la Moulouya;
- ❖ Le rehaussement des infrastructures portuaires.



(Source, Bromirski et al., 2004)



H_{1000} once/1000 years

H_{100} once/100 years

H_{10} once/10 years

H_1 once/year

Mean Sea Level (MSL)

COASTAL FLOODPLAIN

2/3 of the Moroccan coasts
are retreating



The challenge we all have

*How to put water in the
minds
of people?*



Adaptive options for water

Reduce demand

- Water conservation
- Pricing incentives
- Improve water use efficiency

Increase supply

- Recycling
- Groundwater
- Desalination
- Expansion of water markets/trading
- Pipes connecting catchments
- Irrigation channels in pipes
- Economic & institutional barriers