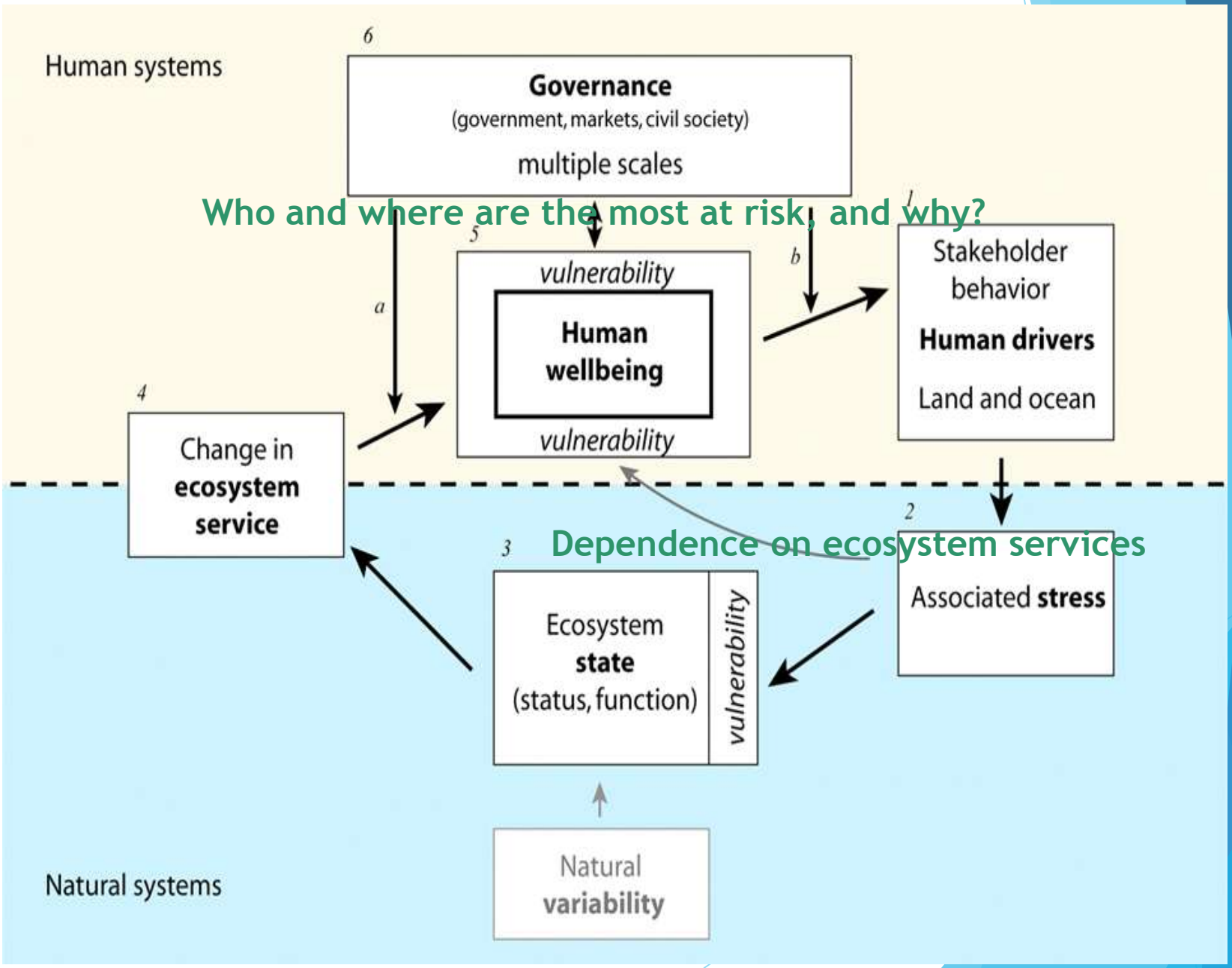
Socioeconomics & Patterns of Risk in LMEs

L. McManus

Conceptual framework



Indicator Subtheme	Indicator	Time Period	Metrics	Data sources
Demographics	Coastal population at 100 km zone	2010, 2100	Rural and Urban Fractions	http://sedac.ciesin.columbia.edu/
	Coastal population by elevation (m) and distance from shore (km)	2100	Pop at ≤10m, >10m elevation by ≤10km, ≤30km, ≤50 km from shore	DEM from http://tethys.eaprs.cse.dmu.ac.uk/ACE2
	Coastal Poor	2000s	National poverty lines	World Bank Development
Human wellbeing	Contemporary Human Development Index (HDI)	2009-2013	HDI metrics (Education, Life expectancy at birth, GNI per capita	http://hdr.undp.org/en
	Night Light Development Index	2006	Satellite data on nightlights and population	http://ngdc.noaa.gov/eog/dmsp/downloadNLDI.html
	HDI for 2100	2010-2100	HDI metrics modeled using socioeconomic pathways	IIASA, Wittgenstein Centre for Demography and Global Human Capital

Indicator Subtheme	Indicator	Time Period	Metrics	Data sources
Economic Activities	Fishing Revenues, Fish in protein	2001-2010	Cash and Landed Value, Per capita fish consumption	Pauly and Lam, TWAP LME Assessment Report; FAO
	Tourism Revenues, Tourism contribution to GDP	2004-2013	LME Tourism Revenues, LME Tourism Contribution to national GDPs	World Tourism and Travel Council 2014
Climate threats (this study)	Present day Climate, Sea level rise 2100	2010	Climate related deaths and property losses 1994-2013; Sea level rise 2100 RCP85, HDI for SSP1 and SSP3	EM-DAT; GermanWatch
Contemporary Threat (this study)	Socioeconomic vulnerability (HDI), Climate, Dependence	Present day	Coastal population 2010, Fish protein, Tourism contribution to GDP, HDI Gap, Climate threats, LME System States	LME System States from TWAP LME Assessment Report

Indicator assessment

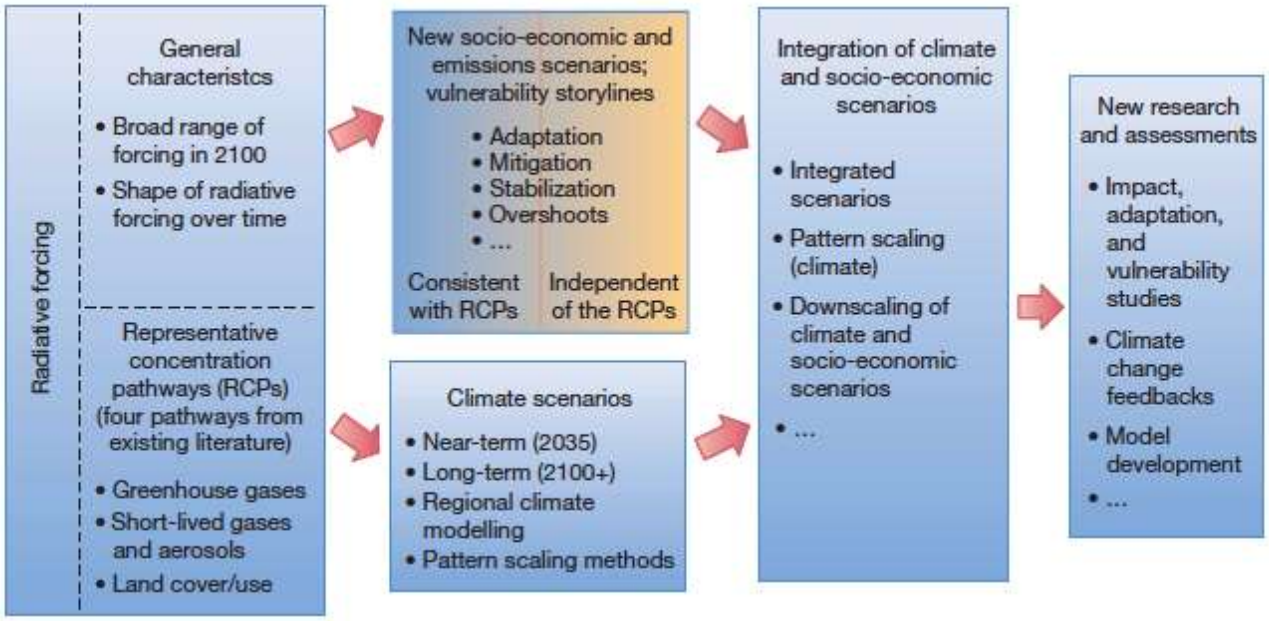
1. Spatial data layers (Population 2010 & 2100, NLDI)
    1. Clip 100 km and 50 km coast
    2. Obtain the values by coastal segments by country
    3. Aggregate the values associated with coastal segments to LME
    4. Use the % of coastal segment to LME total as weighting factor to scale non-spatial data
    5. Confidence level: **HIGH but the aggregation homogenizes segments at LME scale**
2. Non-spatial national data (HDI metrics, Coastal Poor, Tourism revenues)
    1. Obtain national values
    2. Use weighting factors (e.g. population, regional GDP, area) to get coastal segment values relevant to coast, i.e. 100km coast
    3. Aggregate the coastal segment values to the LME scale
    4. Confidence level: **MEDIUM**

Quantifying Risk and Vulnerability

- Vulnerability = characteristics of a person or group and their situation that influences their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard or environmental degradation (Wisner et al 2004)
  - Human Development Index --→ HDI Gap = 1-HDI
  - Dependence on LME services --→ Food protein, Tourism Revenues
- Risk/ Threat = chance of danger, damage, loss, injury or any other undesirable consequences for a household (or an individual or community (Heltberg et al. 2009)
  - Climate Risk Index
  - Climate + LME Environmental Degradation + Dependence = Contemporary Threat Index
  - Future Sea Level Rise 2100 = 2100 Sea Level Rise Threat Index

Future Reference Scenarios: Using Shared socioeconomic pathways (SSPs)

SSPs + Representative Concentration Pathways=Integrated Future Scenarios



2100 Sea level rise = RCP 8.5 (warmest GHG concentration pathway)
+ SSP1, SSP3 (fossil fuel-led development)

Index construction

1. Natural Disaster RISK = Exposure X Hazard X Vulnerability

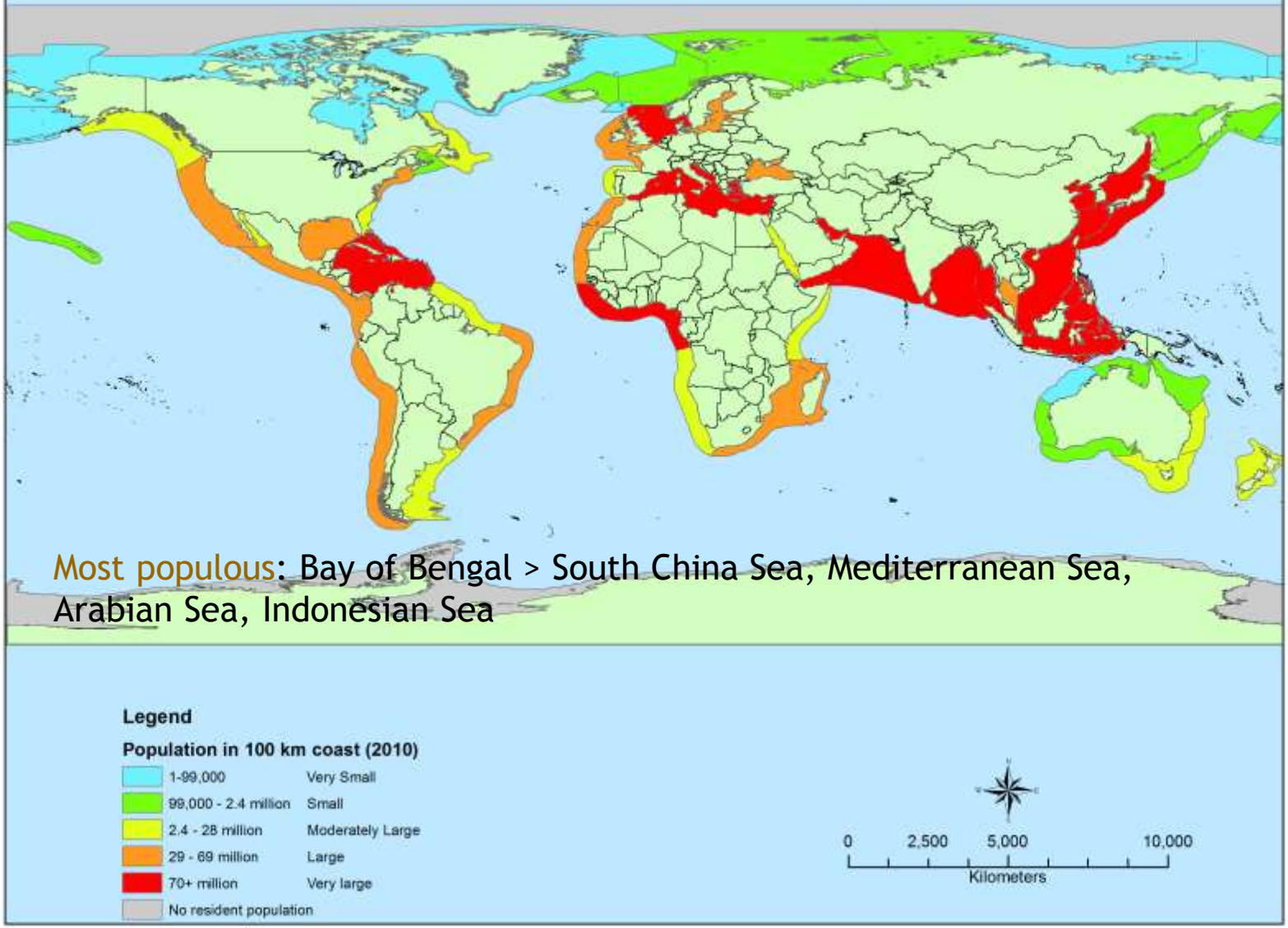
   Climate Threat Index = Coastal population 2010, Climate related deaths and property losses 1994-2013, HDI Gap

   Sea level rise Threat Index 2100 = Modeled population in 2100, Maximum sea level rise RCP85 2100, modeled HDI GAP

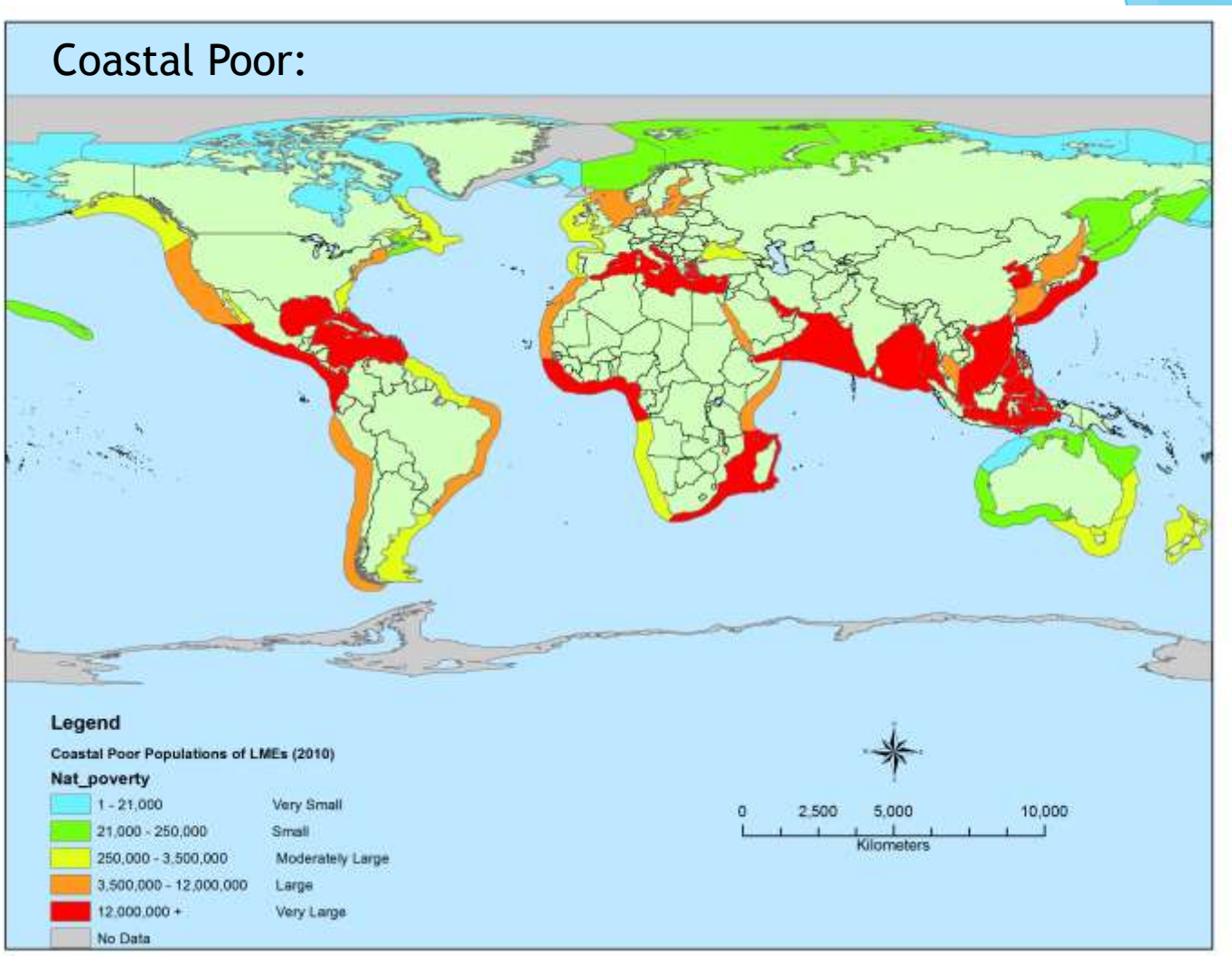
2. Generalized Risk Index = Exposure, Sources of Climate & Environmental Risks, Vulnerability (all sources)

   Contemporary Threat Index =Coastal population 2010, climate related deaths and property losses, LME environmental states, HDI Gap, Dependence on Fish and Tourism

Coastal Population

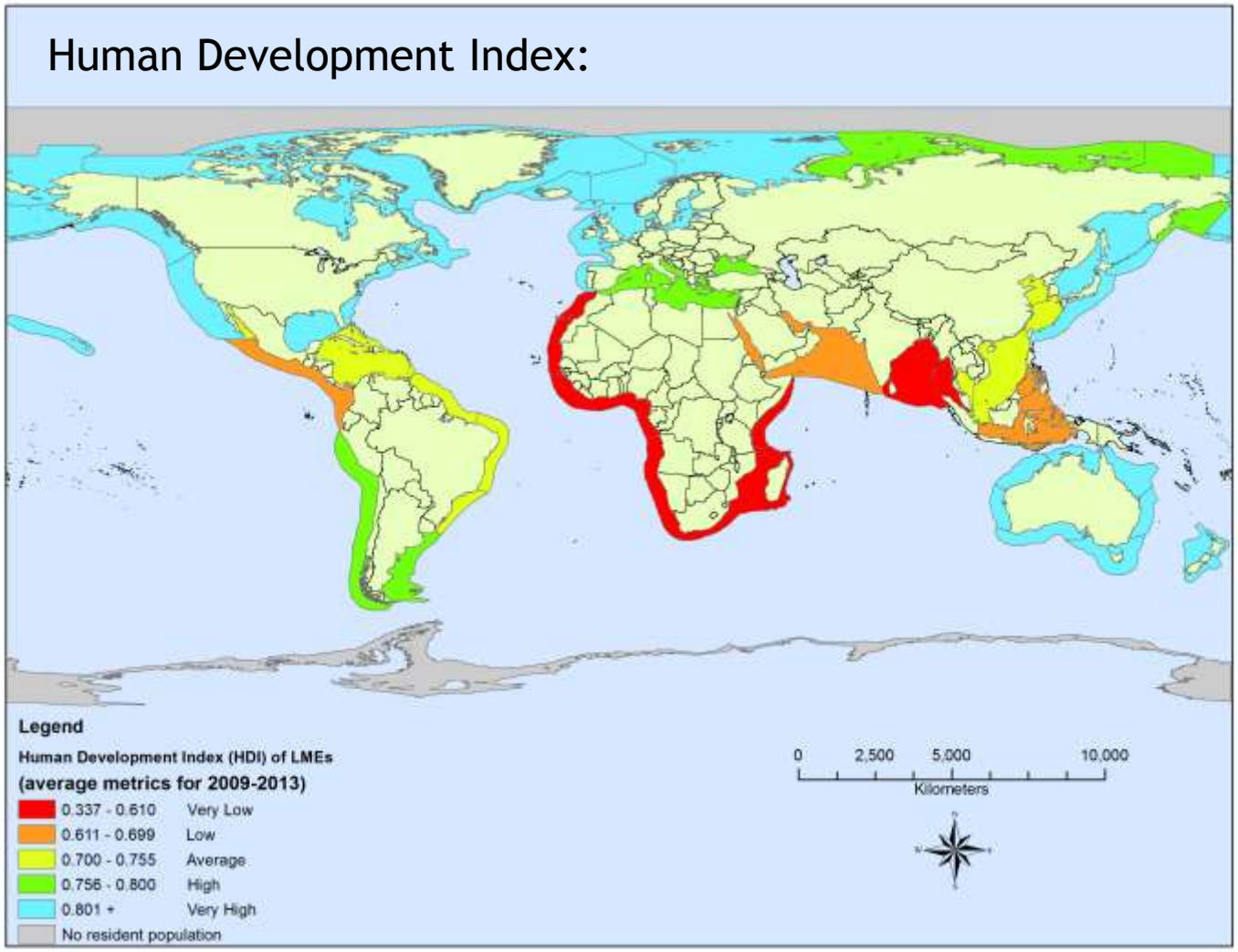


In 100 km coast, 2.5 billion in 2010 (40% of global population).
60% live in urban coastal areas.

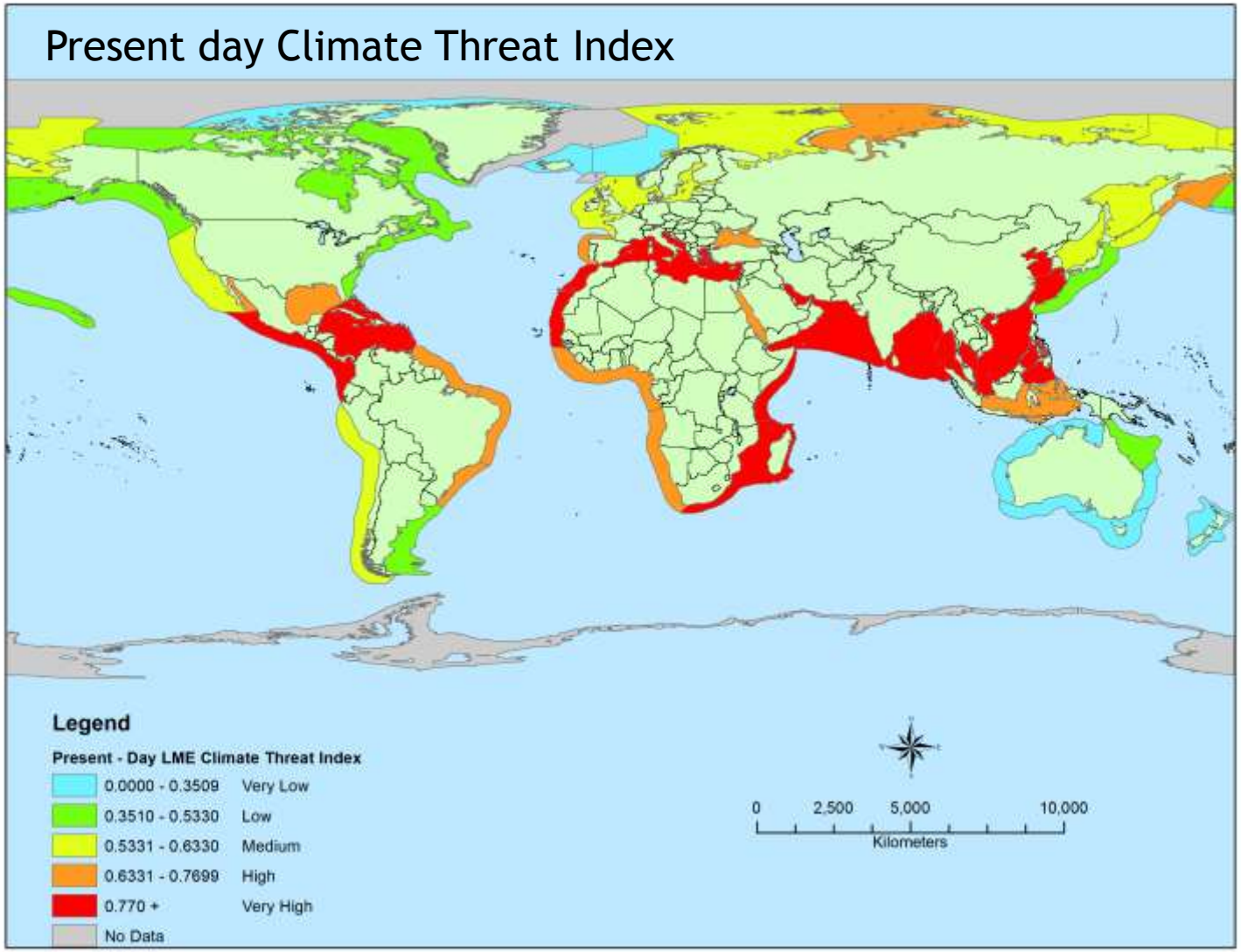


Coastal Poor: Bay of Bengal > Arabian Sea > South China Sea > Guinea Current> Mediterranean Sea > Caribbean Sea > Indonesian Sea > Pacific Central-American Coastal> Agulhas Current> Sulu-Celebes Sea

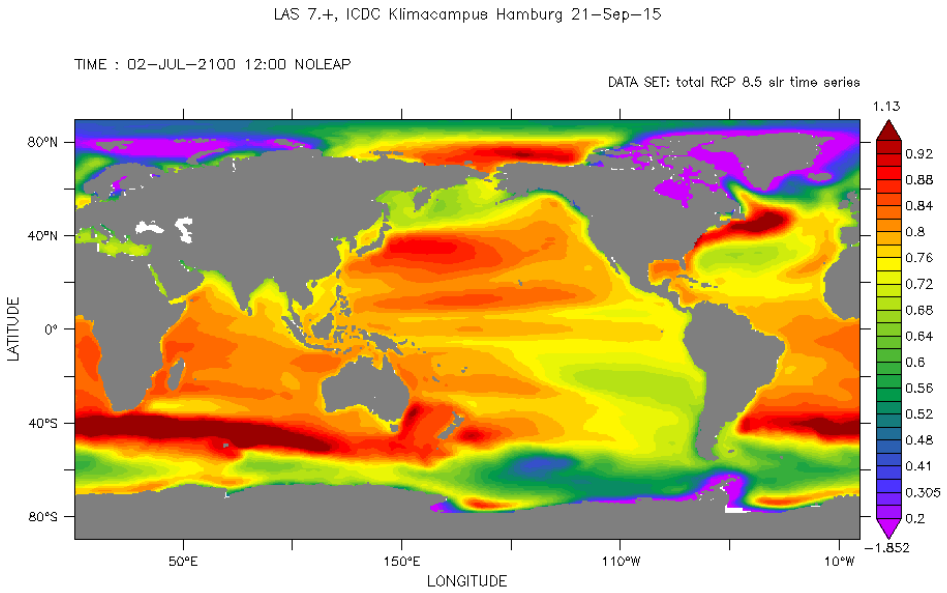
Human Development Index:



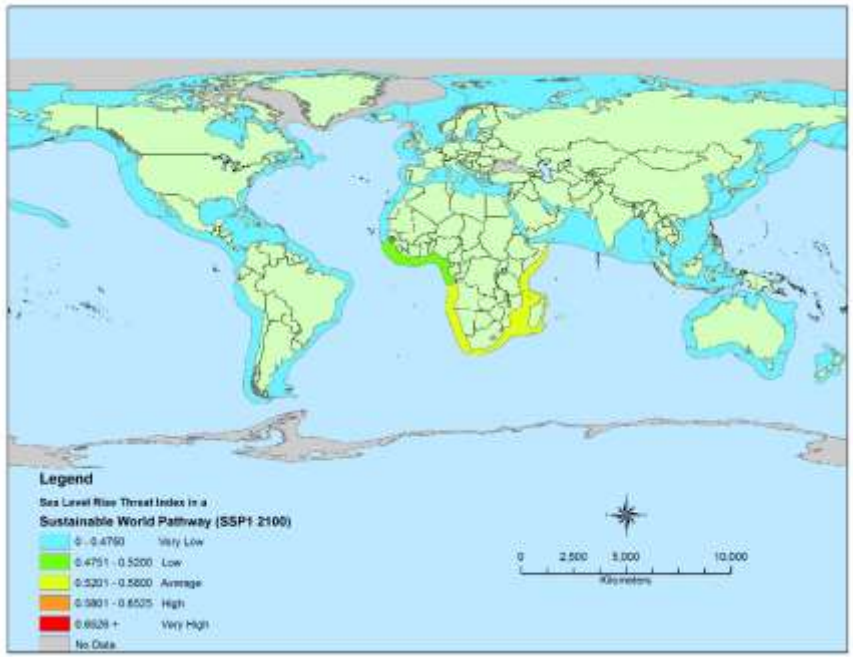
Lowest HDI (health, education and income): Somali Coastal < Guinea Current < Agulhas Current < Benguela Current < Canary Current < Bay of Bengal

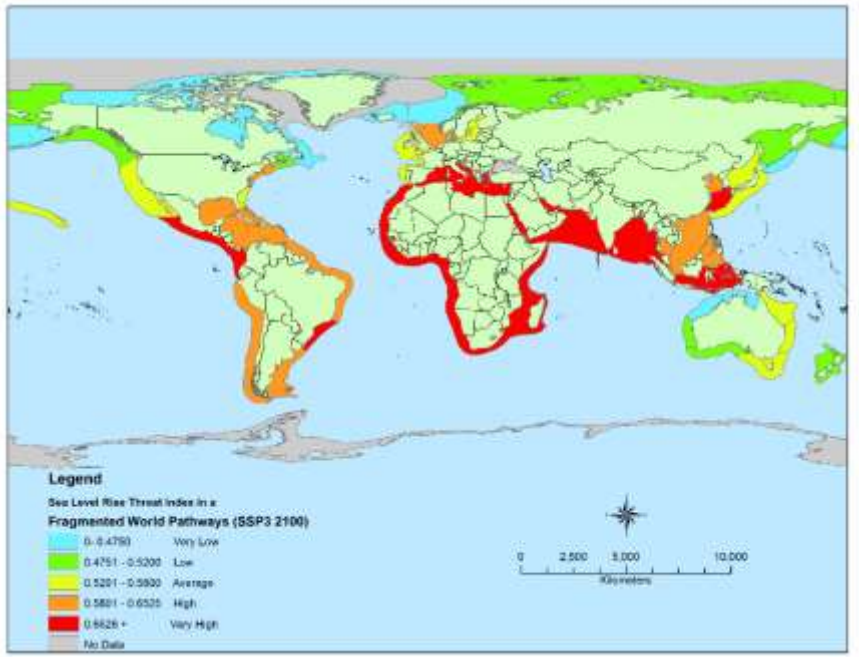


Most at risk: Bay of Bengal > Arabian Sea > South China Sea > East China Sea > Caribbean Sea > Yellow Sea > Sulu-Celebes Sea > Canary Current > Pacific Central American Coastal, Somali Coastal



total RCP8.5 ensemble mean ssh ts (m)





Multi-Indicator Patterns of Risk among LMEs

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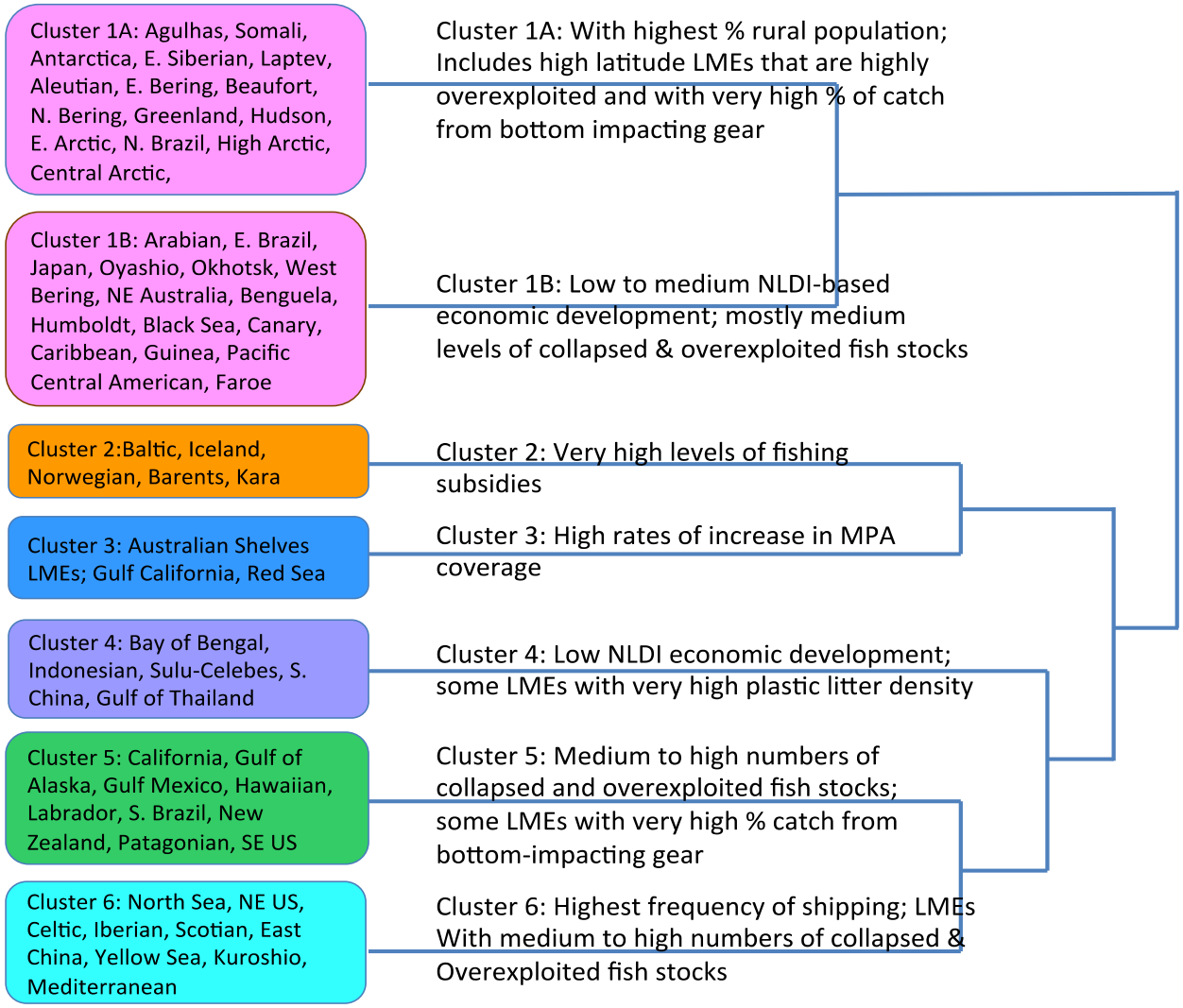
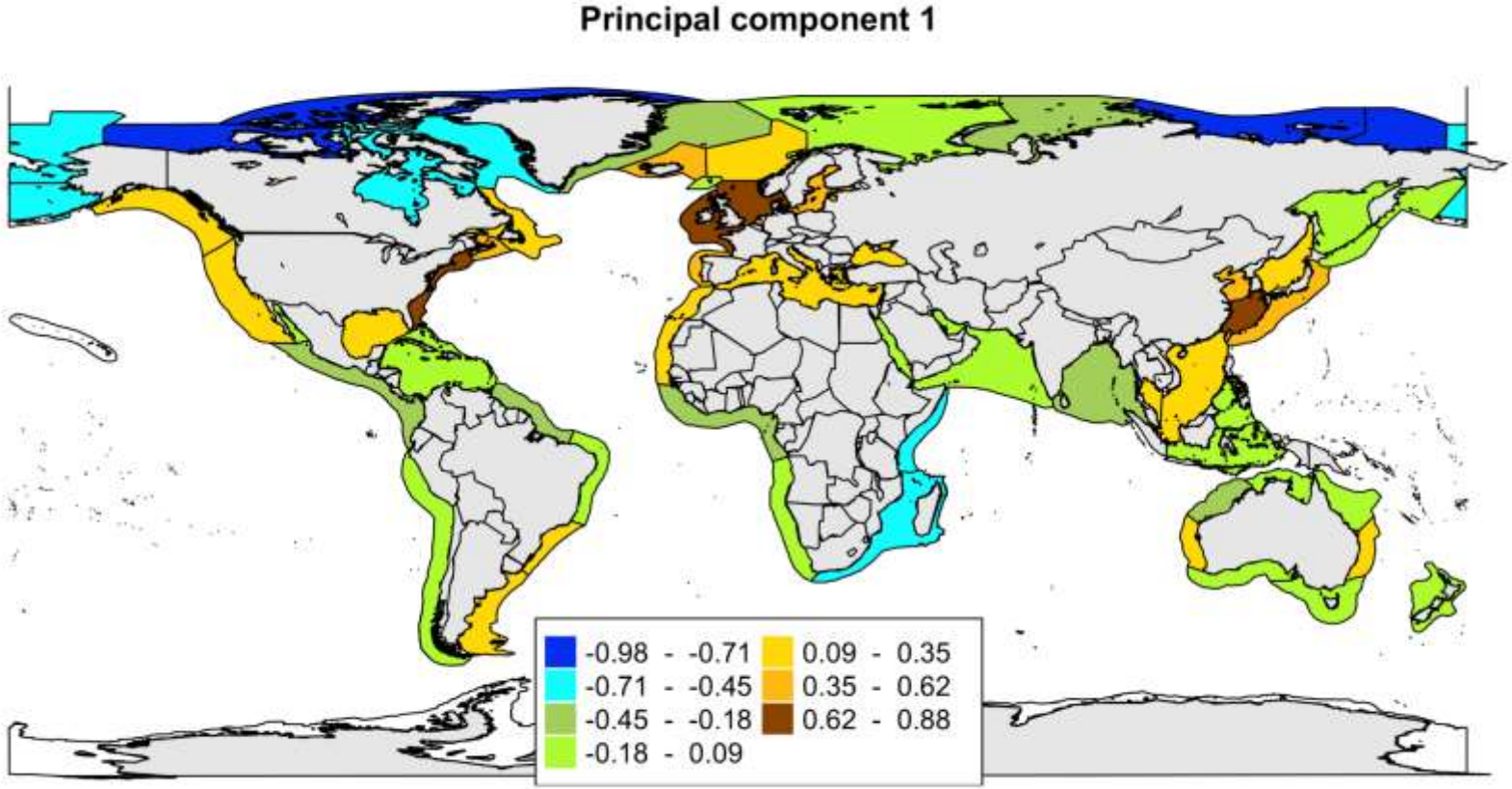
LME Assessment Authors

Multi-indicator analysis

1. Selecting indicators with **directionality** relative to RISK
2. Determining directional indicators with **least correlation** (below $R^2 \leq 50\%$; $r \leq 0.7$)
3. Analysis:
    1. Cluster Analysis = exploring how similar LMEs group together
    2. Principal Component Analysis = determining directional indicators with strongest influence in grouping LMEs
    3. HDI Weighted Scoring based on LME Environmental States = ONE of MANY WAYs to rank LMEs

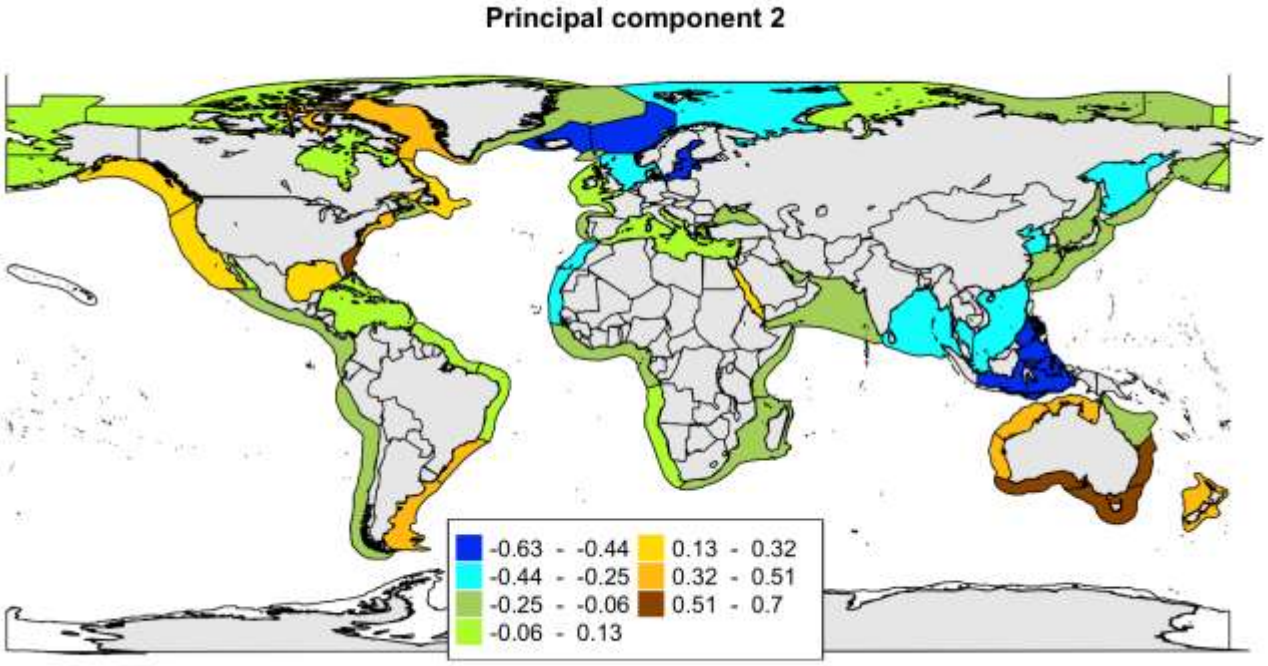
Cluster Analysis of 66 LMEs using 11 least correlated indicators





Shipping pressure (brown colors): Heavily developed regions such as the North Sea, east China Sea and Northeast US Continental Shelf LMEs have higher risks associated with shipping pressure.

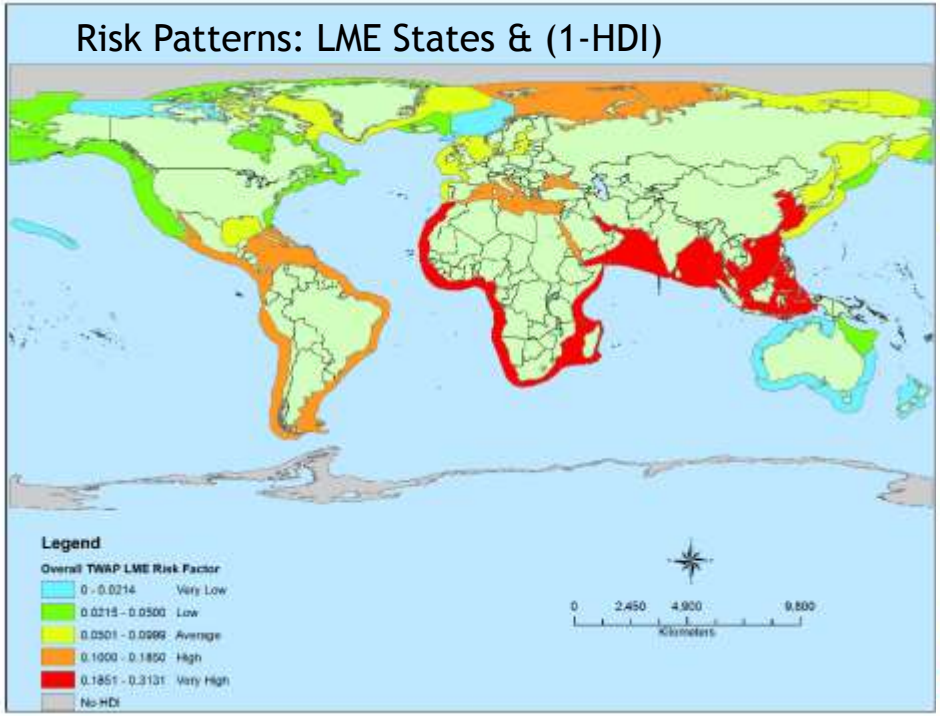
Coastal rural population density (blue colors): LMEs that have higher risk due to vulnerable rural population in coastal areas include the High Arctic LMEs



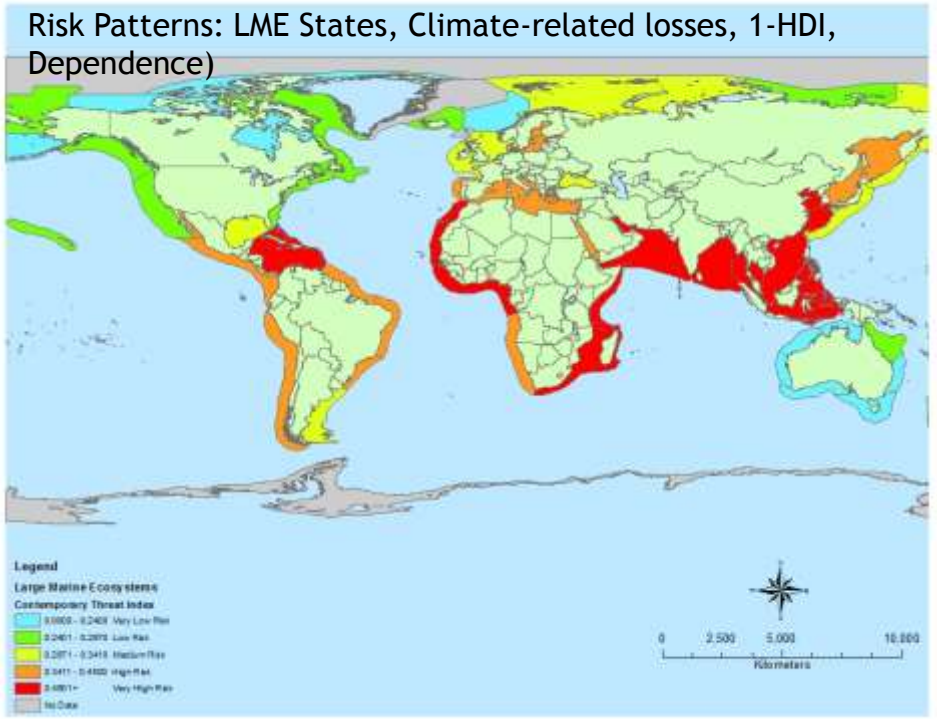
Catch from bottom impacting gear types (brown colors): Southeast US, and the Australian Shelf LMEs except the Northeast.

Pressures due to demersal non-destructive low bycatch fishing (blue Colors): Sulu-Celebes Sea, Indonesian Sea and the South China Sea LMEs; Norwegian Sea, Baltic Sea, Icelandic Shelf and Sea LME.

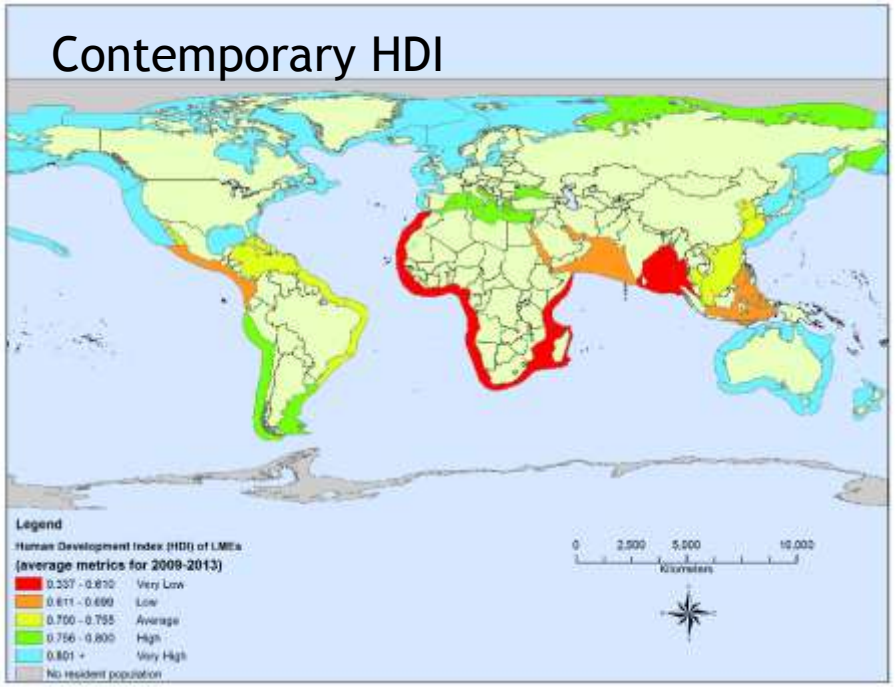
Risk Patterns: LME States & (1-HDI)



Risk Patterns: LME States, Climate-related losses, 1-HDI, Dependence)



Contemporary HDI



Key Messages

- **LME States**:
  - LMEs with developing economies: highest risks due to a combination of **coastal eutrophication** and **plastic litter density**, and moderate to high risks from **collapsed or overexploited fish stocks**
  - LMEs next to developed nations: high risks triggered by a combination of **high shipping frequencies**, high capacity-enhancing fisheries **subsidies**, and high **catches from bottom-impacting gear**
  - All LMEs, except for the Australian shelf LMEs, the Red Sea and Gulf of California, are at risk due to the low percentage of established **recovery zones** such as MPAs.
- Degrading LME conditions and climate related risks as **additional** burdens for socioeconomically compromised coastal populations of mostly tropical LMEs
- Improving education, health and livelihood, and reduce population growth, at national scale and in the coastal areas of LMEs, should decrease future risk levels.
- Sustainability **targets**: Enhanced human wellbeing within limits of healthy ecosystems.

Thank you!