Vulnerability of developing countries to climate change

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Sources

- UK DfID

- UK NERC QUEST
  - Global Scale Impacts of Climate change (GSI)

Vulnerability of national economies to the impacts of climate change on fisheries

Edward H. Allison[1,2], Allison L. Perry[1,3], Marie-Caroline Badjeck[1,4], W. Neil Adger[5], Katrina Brown[2,5], Declan Conway[2,5], Ashley S. Halls[6], Graham M. Pilling[7], John D. Reynolds[8], Neil L. Andrew[1] & Nicholas K. Dulvy[7,8]

Vulnerability assessment framework

Exposure (E)

Sensitivity/Dependency (S)

Potential Impacts (PI) (E+S)

-

Adaptive Capacity (AC)
Ability or capacity of a nation to modify or change to cope with changes in actual or expected stress
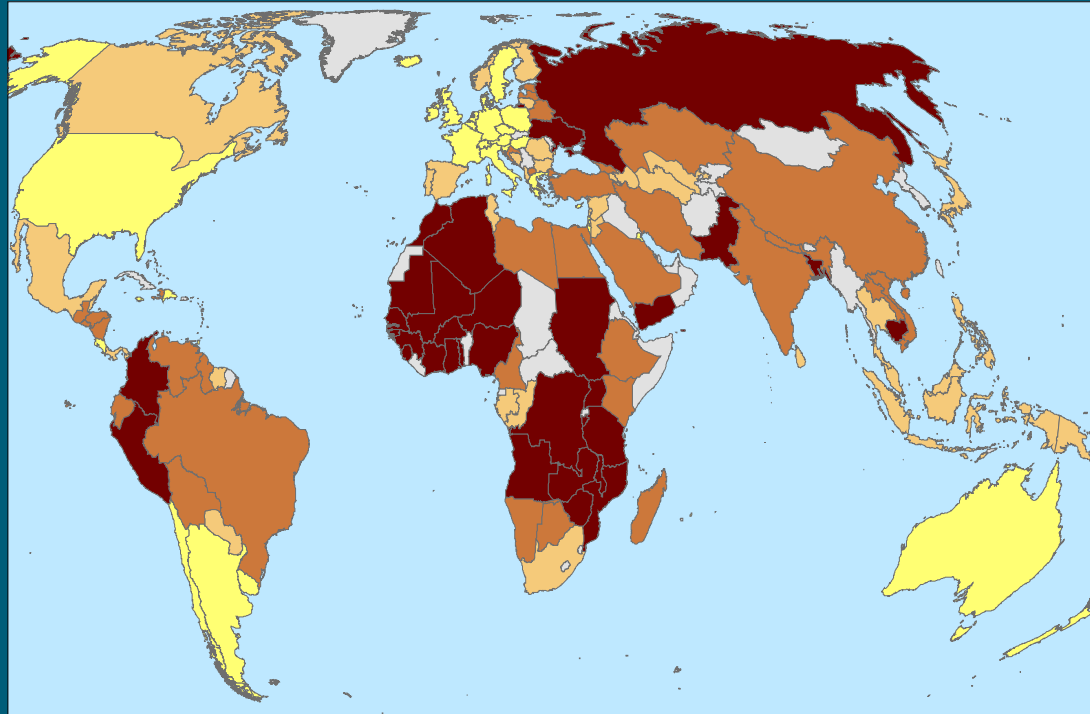
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VULNERABILITY
V = PI - AC

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Components

- Exposure: change in air temperature by 2050 (A1F1 & B2, one GCM)

- Sensitivity: fishery landings, employment, exports (FAO)

- Adaptive capacity: life expectancy, education, governance, GDP

- NOTE: national vulnerability

Very low
Low
Moderate
High
No data

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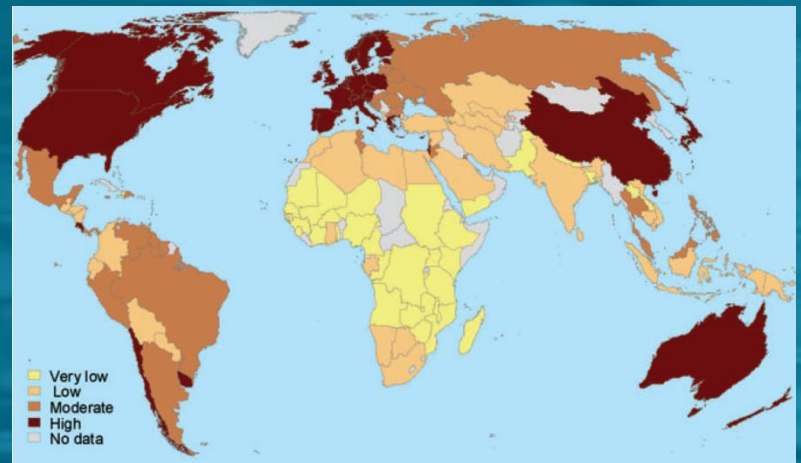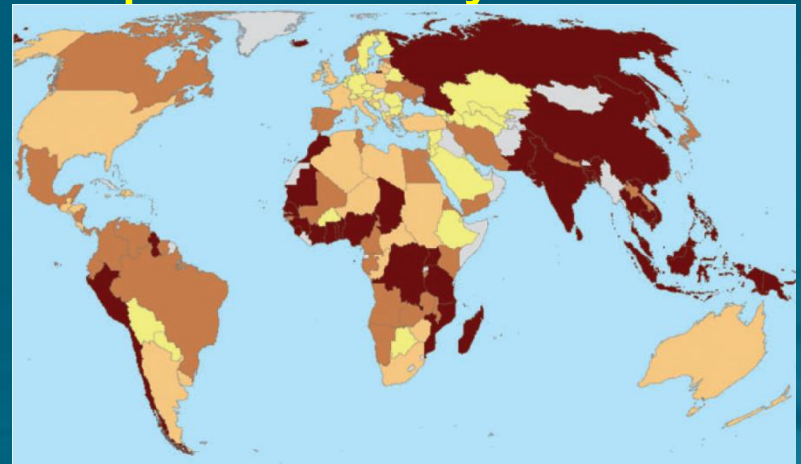
Vulnerability

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- Most vulnerable:
  - west and central Africa (AC)
  - Russia and Ukraine (high E and S)
  - 66% of vulnerable countries = Least Developed Countries
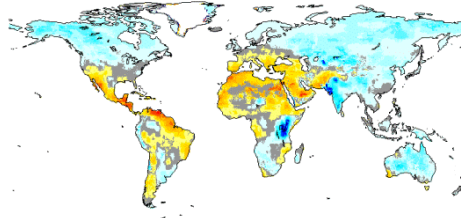
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QUEST GSI analyses

- Improve on limitations of Allison et al.
- Segregate potential impact by fishing sector
- Exposure is sea/land temperature
- Relate future potential impact to future adaptive capacity
- Examine uncertainty in Exposure and Sensitivity
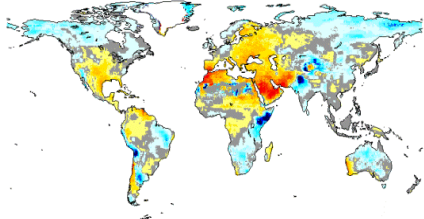- More countries, incl. SIDS

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Exposure: multiple GCMs
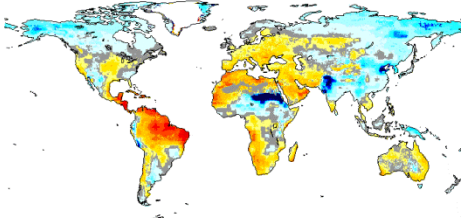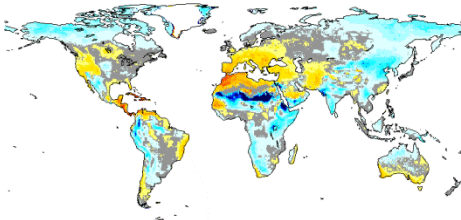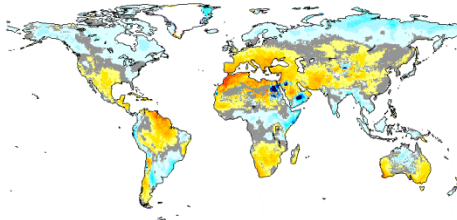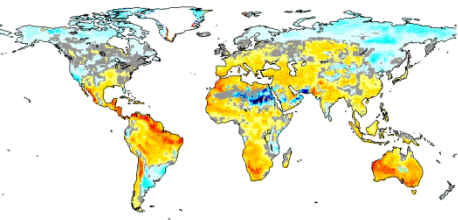
- 9 GCMs, 4 SRES emission scenarios
- Sea and land surface temperatures

Sensitivity

United Kingdom catches (tonnes) in these EEZs
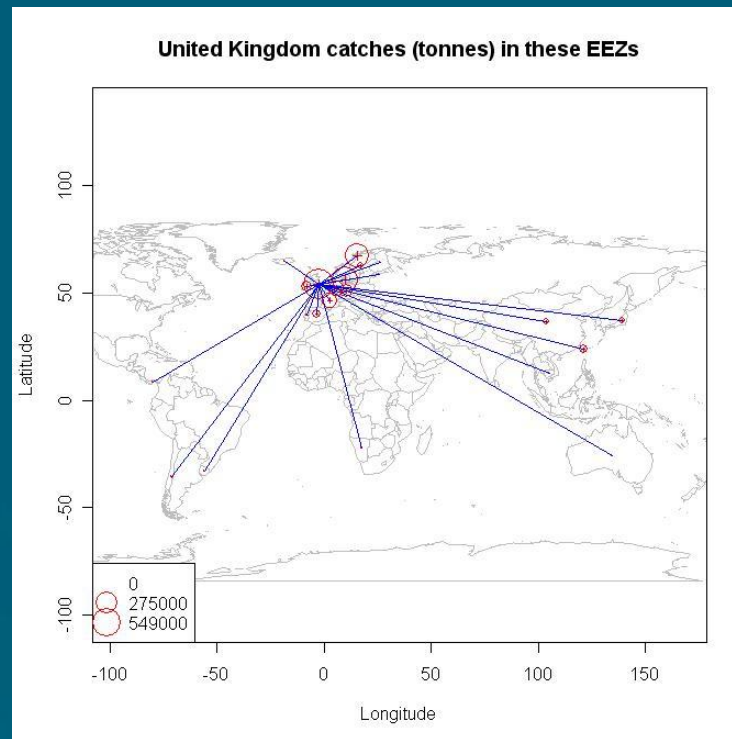
- Catches in freshwater, coastal marine (EEZ) and offshore marine (high seas areas)
- Potential Impact is location-specific
  - Take into account distant water fishing

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Adaptive Capacity

- National Gross Domestic Product (GDP)
- Is dependent on underlying emission scenarios (e.g. A1b, etc.)
- IMAGE2.3 population and GDP data projected into the future
- Therefore include future changes in AC (e.g. China) by 2050
- GDP correlated with other AC measures

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Vulnerability

- Vulnerability = PI – AC
- Examined at 2050
- Look at multiple GCM outputs
  - Examine uncertainty
- Ranked countries (>200) into vulnerability quartiles
- Uncertainty represented by variation in quartile ranking between GCMs

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Combined Marine and Freshwater Fisheries Vulnerability

Vulnerability Rank
1 2 3 4 no data
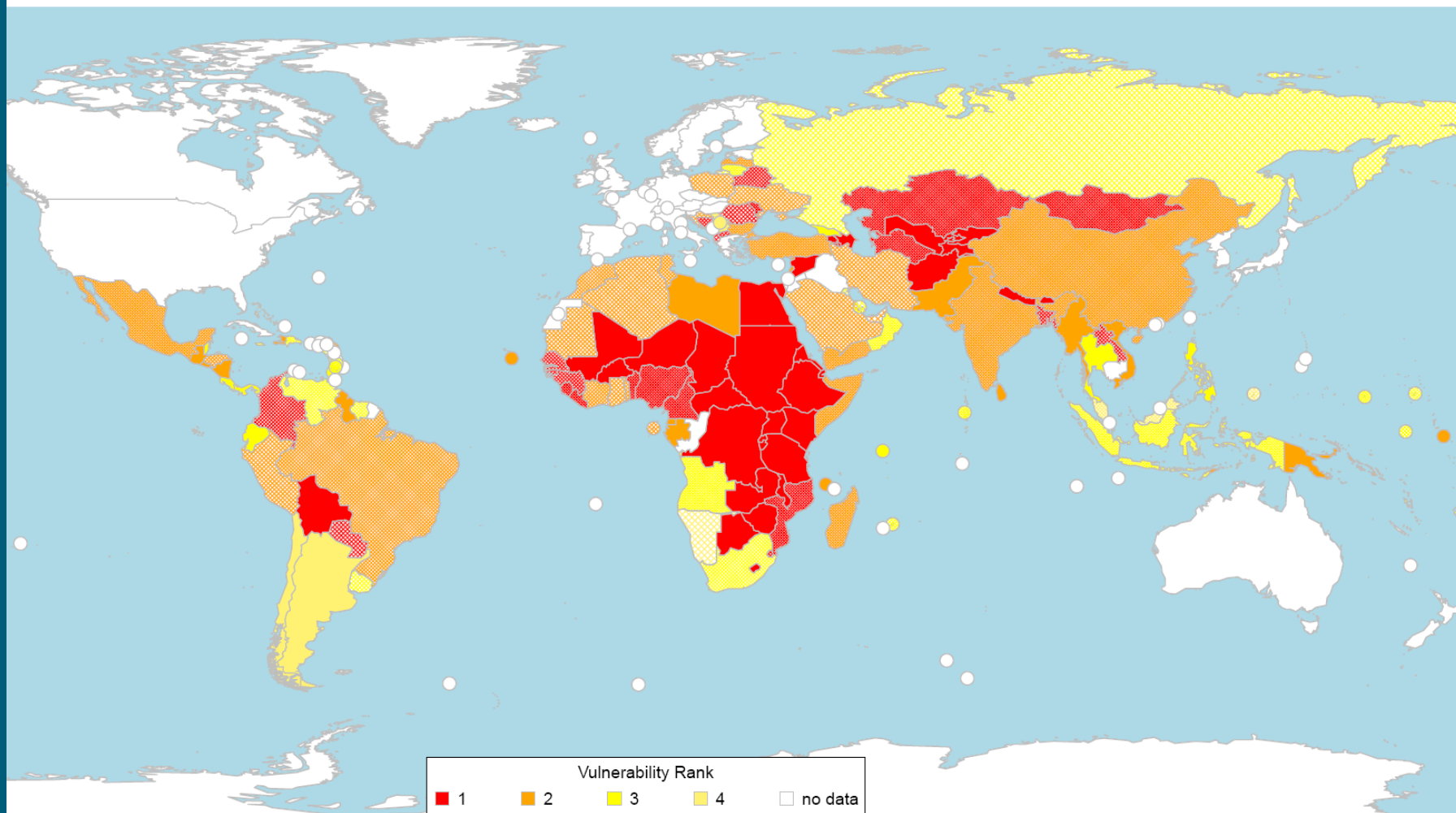
IMF developing countries, 2050 HadCM3 A1B

Example to show wider range of countries

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Top-10 ranked country details

	Country	Rank	Total PI	Marine PI	Freshwater PI	AC
1	Mali	1	1	NA	1	0.04
2	Afghanistan	1	1	NA	4	0.07
3	Niger	1	1	NA	2	0.03
4	Djibouti	1	1	1	NA	0.09
5	Chad	1	1	NA	1	0.03
6	Burkina Faso	1	1	NA	3	0.04
7	Central African Republic	1	1	NA	3	0.05
8	Ethiopia	1	2	NA	3	0.01
9	Congo (Kinshasa)	1	2	4	1	0.01
10	Malawi	1	1	NA	2	0.07

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Key messages

- Highly vulnerable countries have:
    - High impact (often freshwater fishery reliant)
    - Low adaptive capacity
- Regional pattern:
    - Africa highly vulnerable
    - Ex-Soviet states
    - Landlocked countries (fishery portfolio)

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Key messages

- Most are consistently highly vulnerable when alternative GCM outputs are used

- Uncertainty greatest:
  - NW African coast

  - Central Europe

  - South America

  - Bangladesh/Cambodia/Laos

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Sensitivity analyses

- Vulnerability ranking not significantly affected by:
  - Alternative SRES emission scenarios
  - Alternative biological hypotheses (e.g. Fish movement/production change)
  - Alternative Adaptive Capacity metrics
  - Inclusion of water stress within freshwater Sensitivity
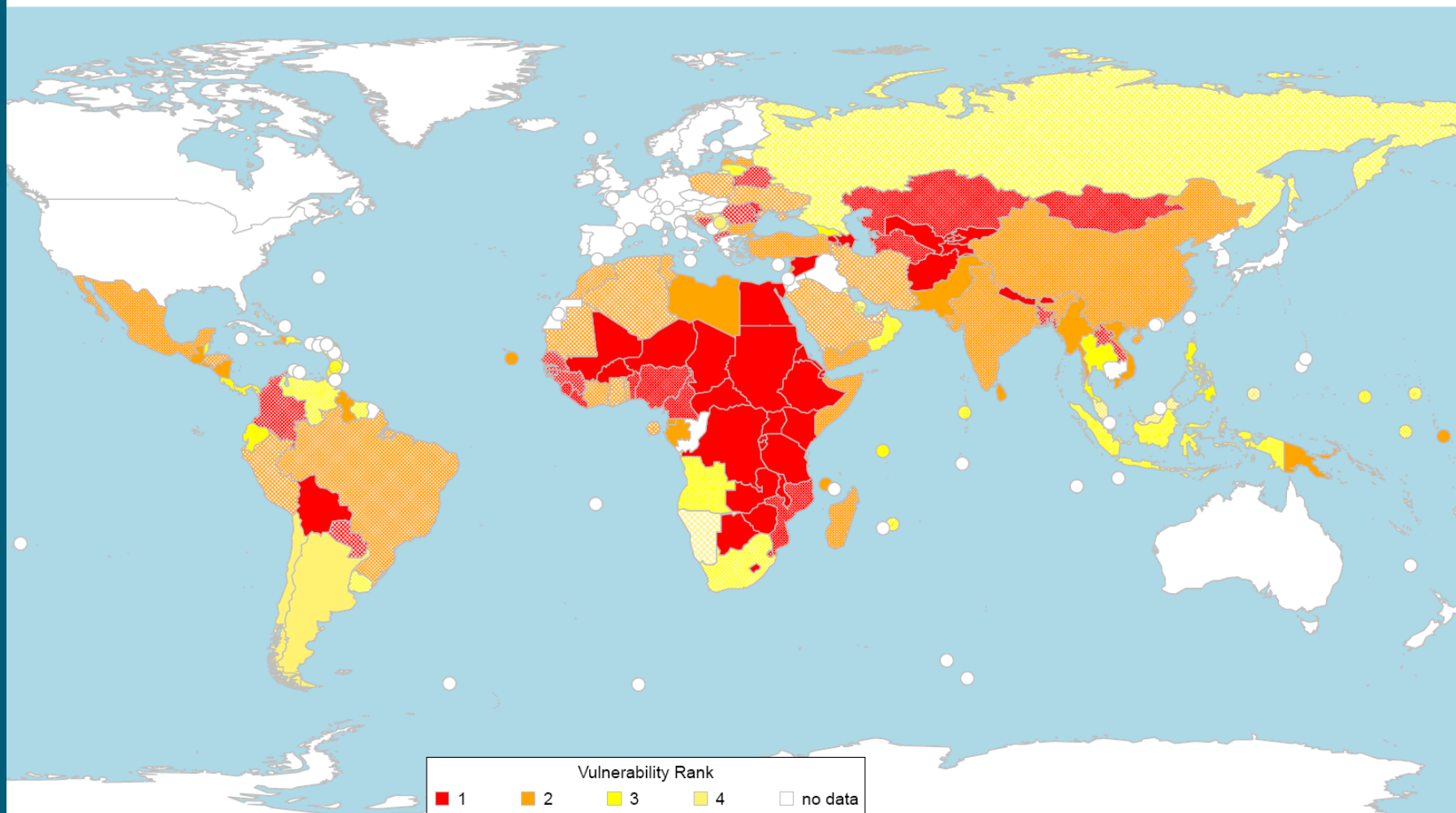- Results consistent with Allison et al.

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Adaptation

- Low adaptive capacity and higher climate impact often coincide

- Focus development in Africa, Asia, central Europe, and some SIDS

- Examine issues of:
  - Fishery portfolio
  - Trade (rich nations can buy their way out; e.g. China)

- Mountain to the sea (multi-sector) approach
  - E.g. Water stress

- Cooperation with trans-boundary resources

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Caveats

- National scale – not artisanal fisheries

- Vulnerability is relative – cannot compare different runs directly

- A characterisation of what the future might look like – *not a forecast*

  - Assume population and economies follow particular scenario pathways

  - Assume climate follows (e.g.) a HadCM3-like pathway

  - Not including extreme weather events

- Mechanistic models limited (Cheung et al.)

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Combined Marine and Freshwater Fisheries Vulnerability

Vulnerability Rank
■ 1 ■ 2 ■ 3 ■ 4 □ no data

IMF developing countries, 2050 HadCM3 A1B

Cefas