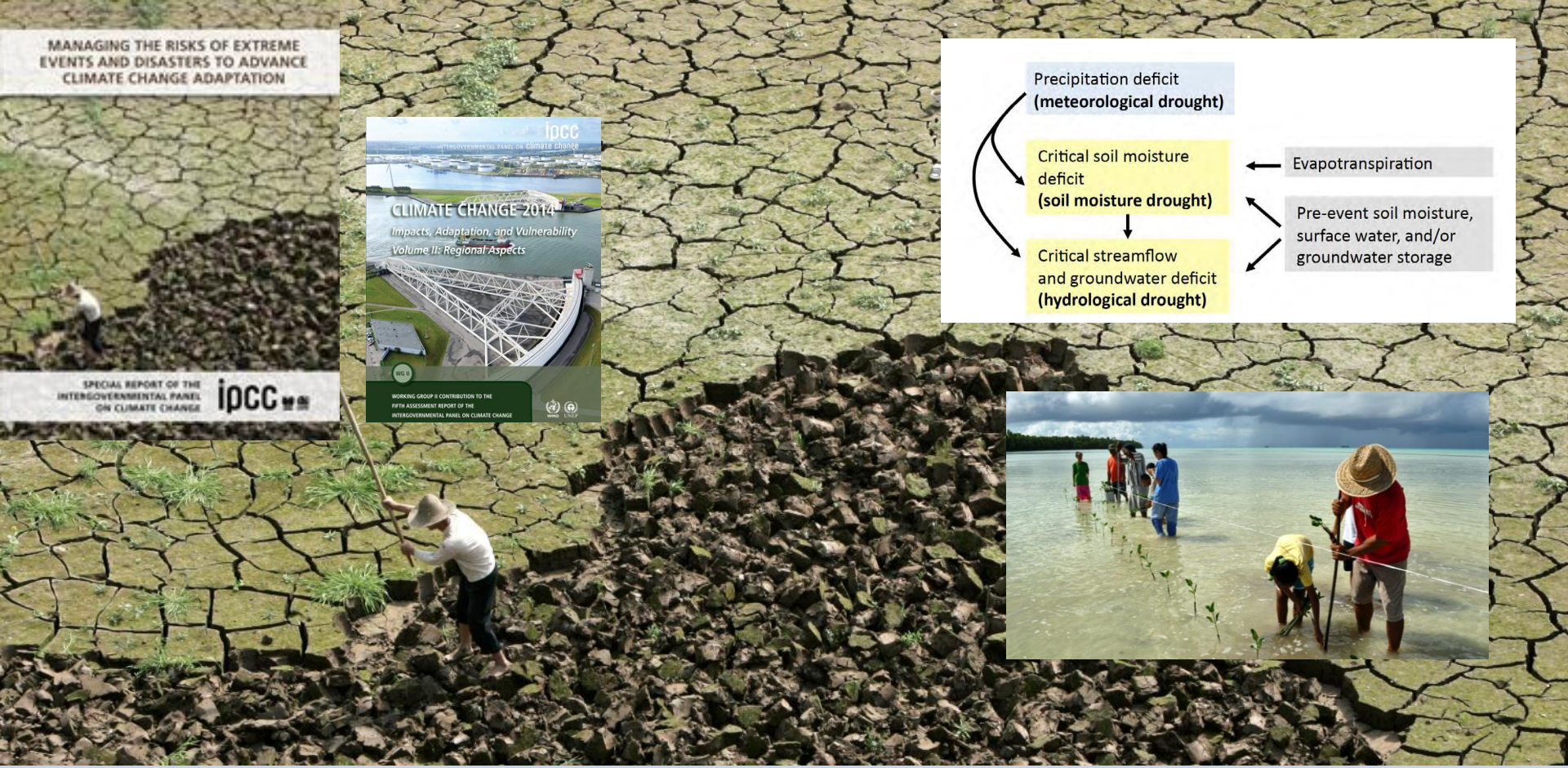


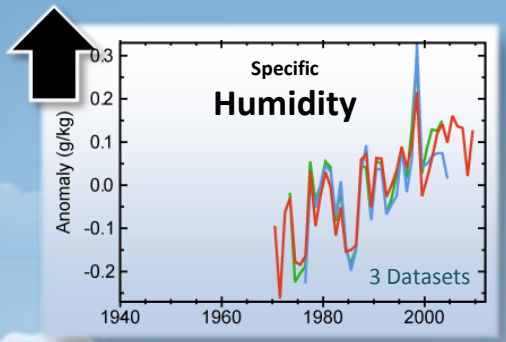
The IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

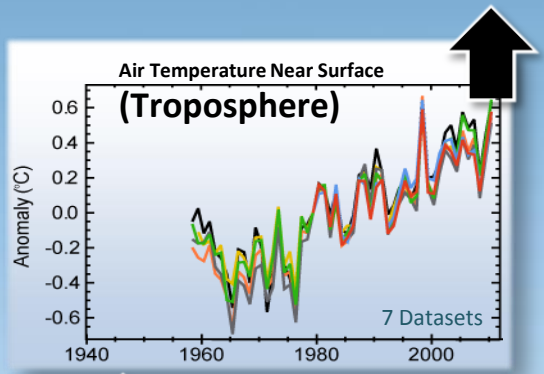
Roger Pulwarty (NOAA, GCOS, IPCC)

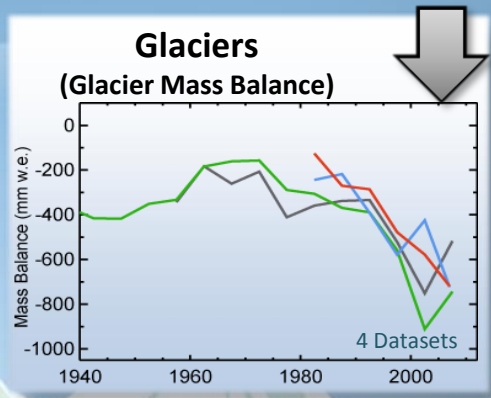
ipcc
INTERGOVERNMENTAL PANEL ON climate change

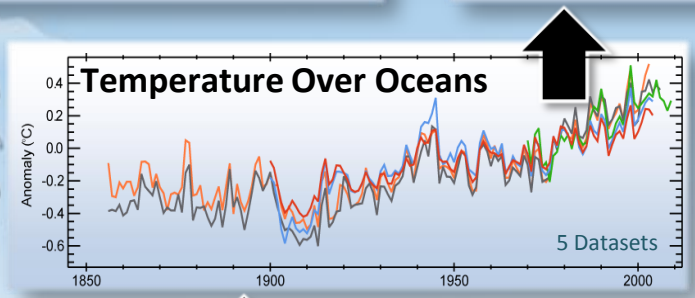
"This IPCC report addresses (for the first time) how integrating expertise in **climate science, hazards and disaster risk management, and adaptation** can inform, help to reduce and manage the **risks of extreme events and disasters** in a changing climate"

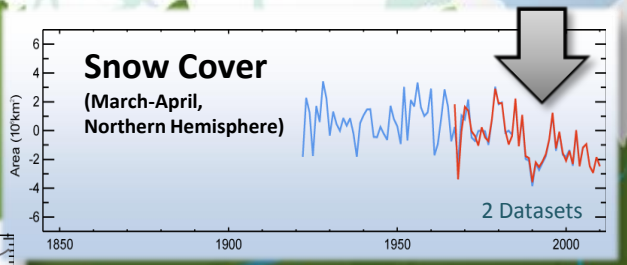
Observed Physical System Changes-What is in the data?

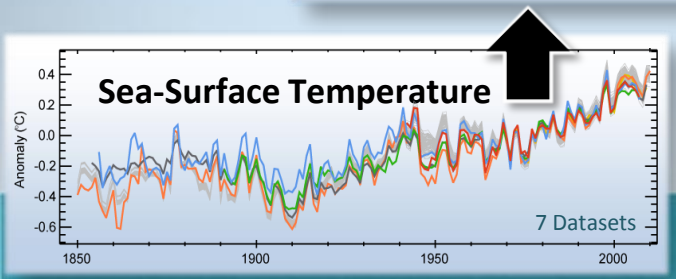


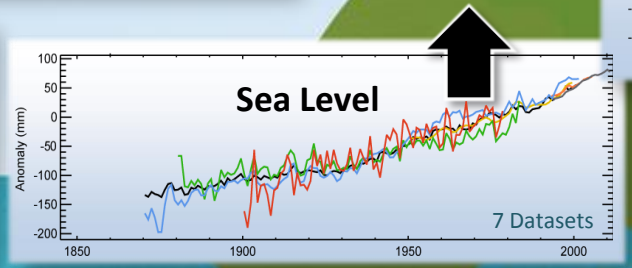


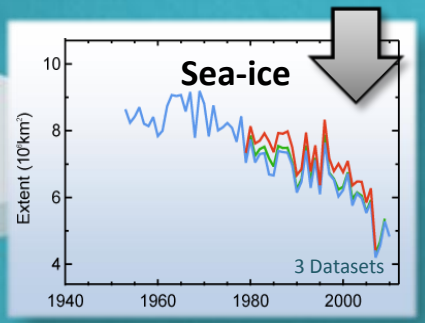


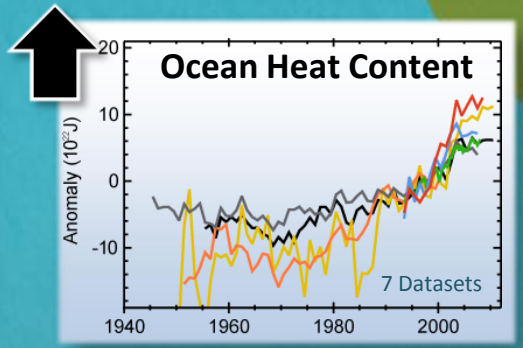


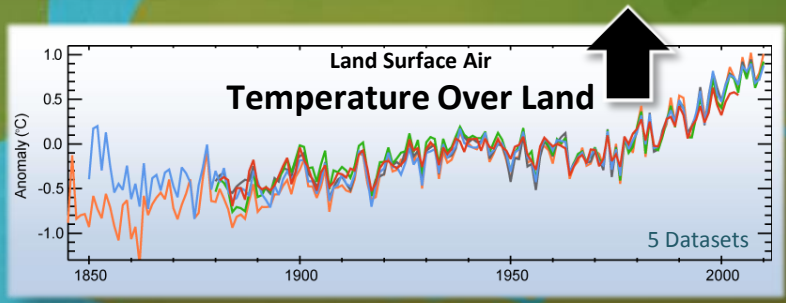




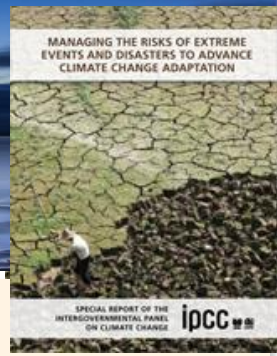


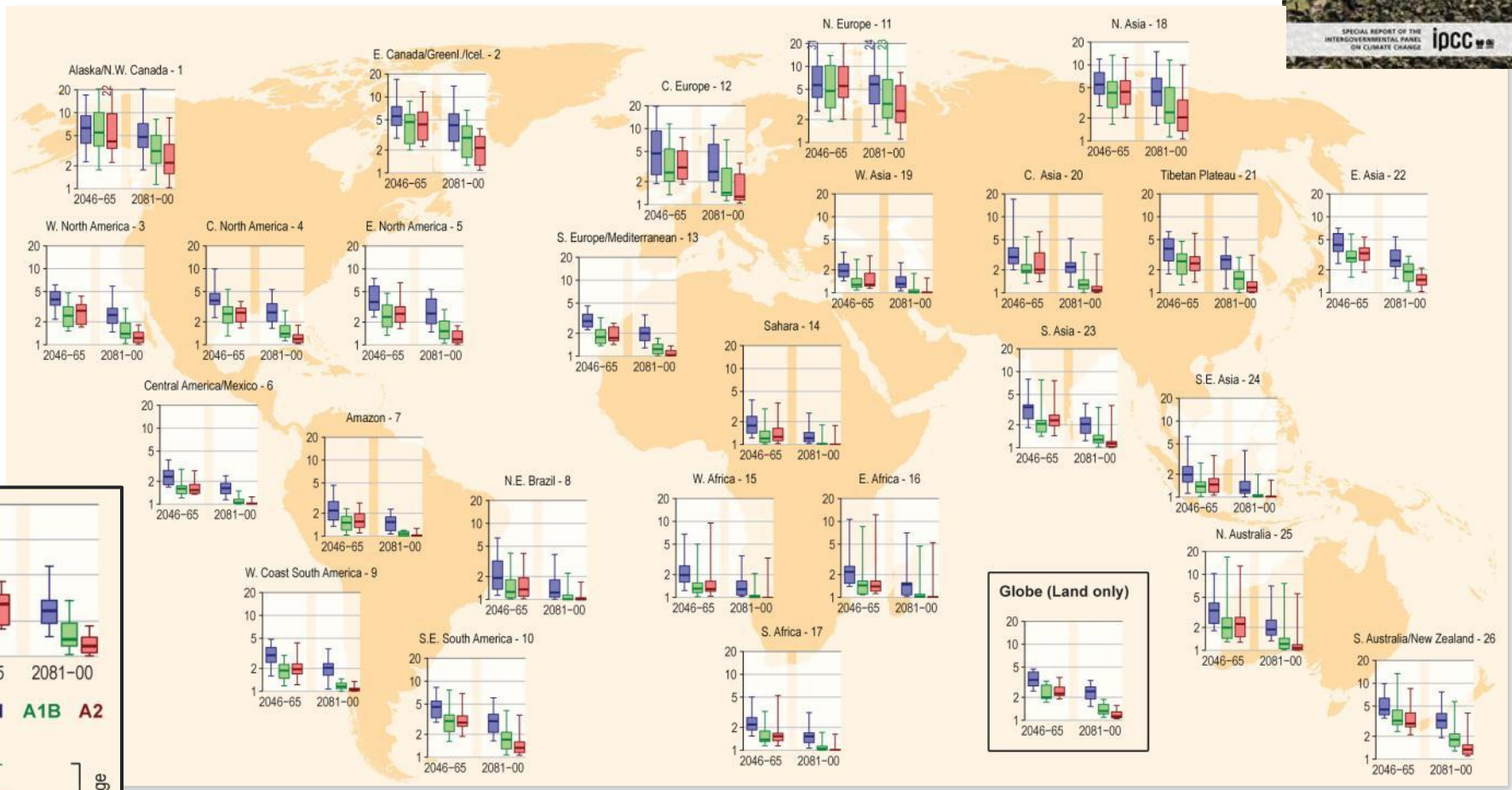






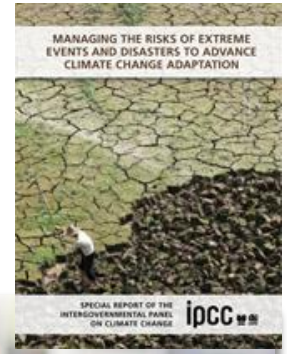
Climate models project more frequent hot days throughout the 21st century

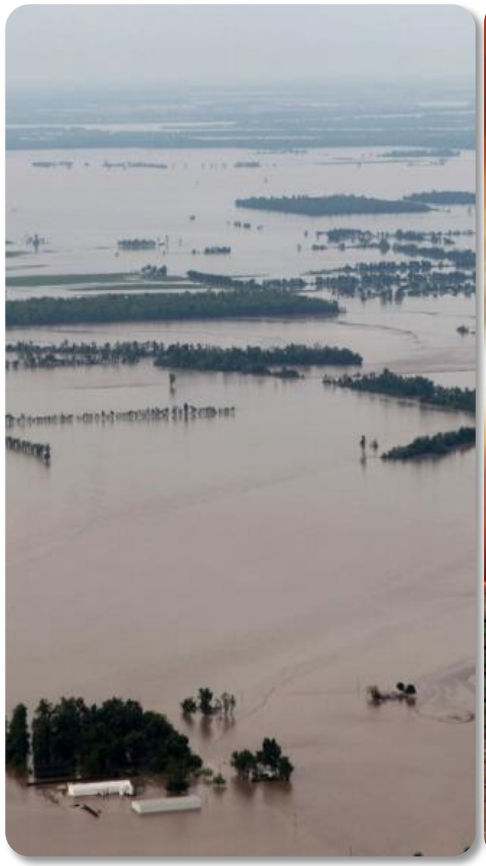


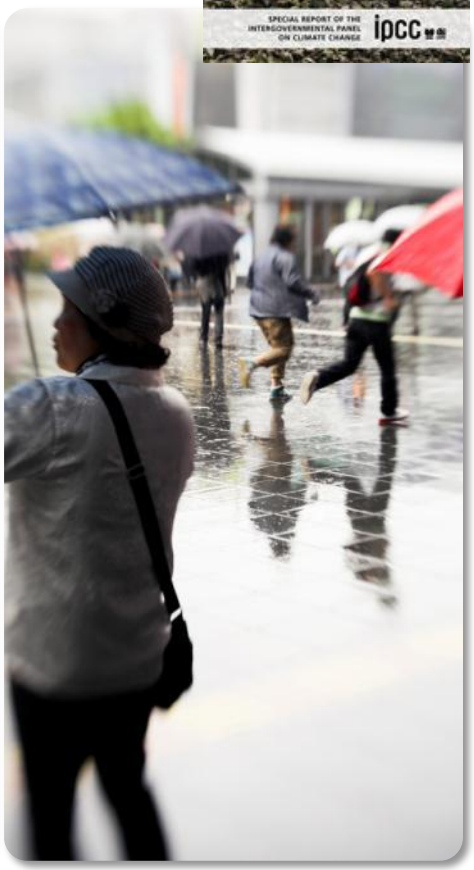


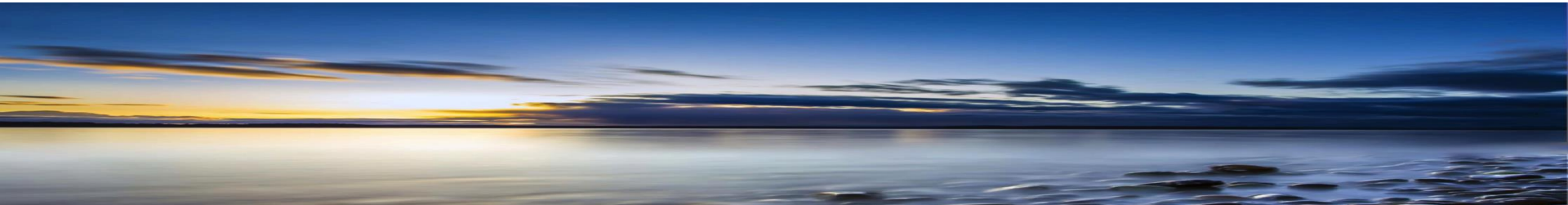
In many regions, the time between "20-year" (unusually) warm days will decrease

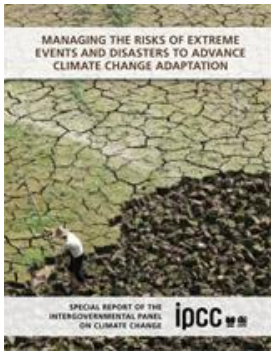
A changing climate leads to changes in **extreme weather** and climate events



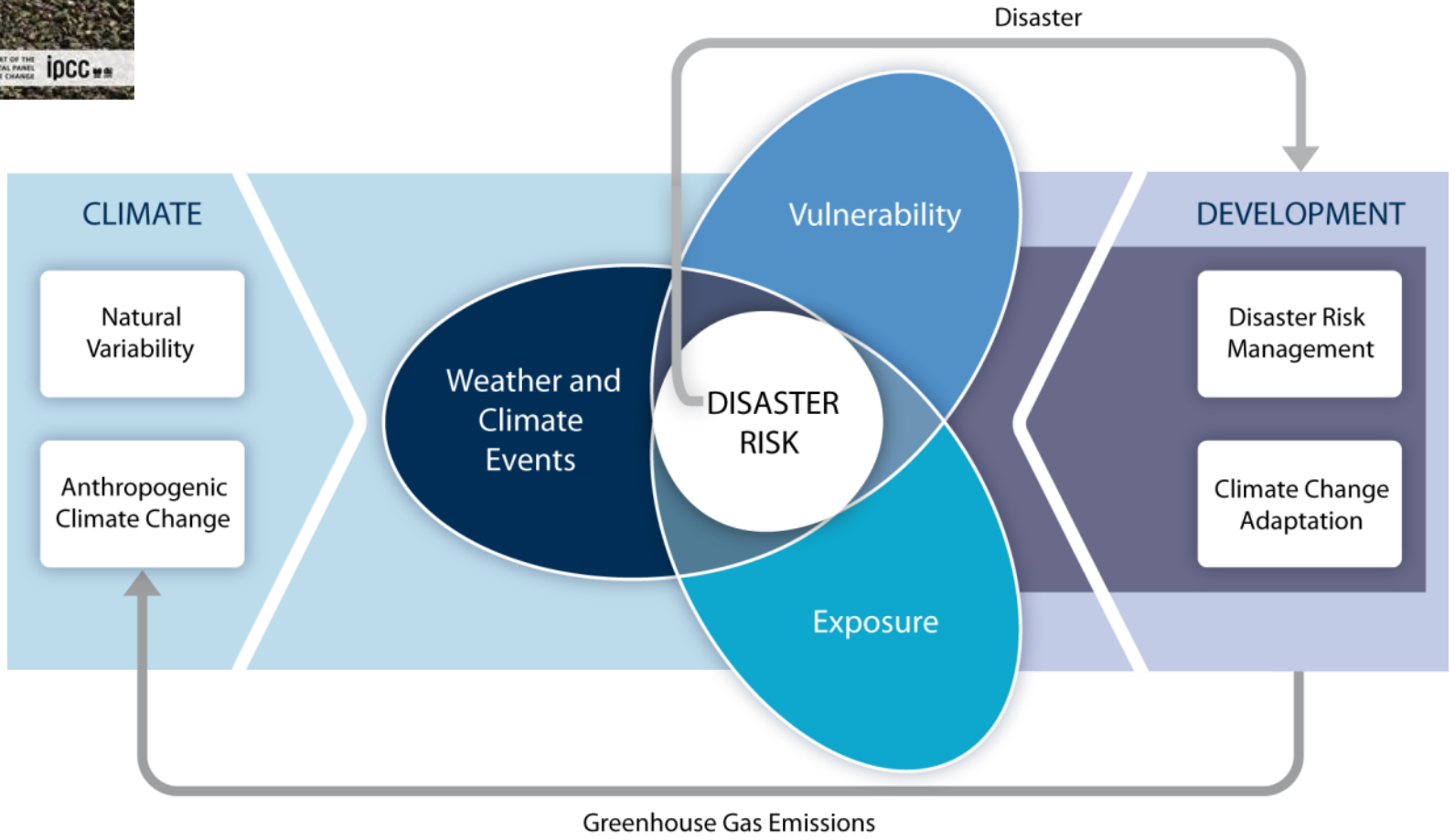






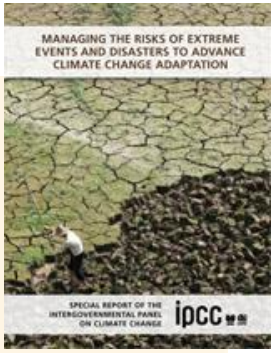


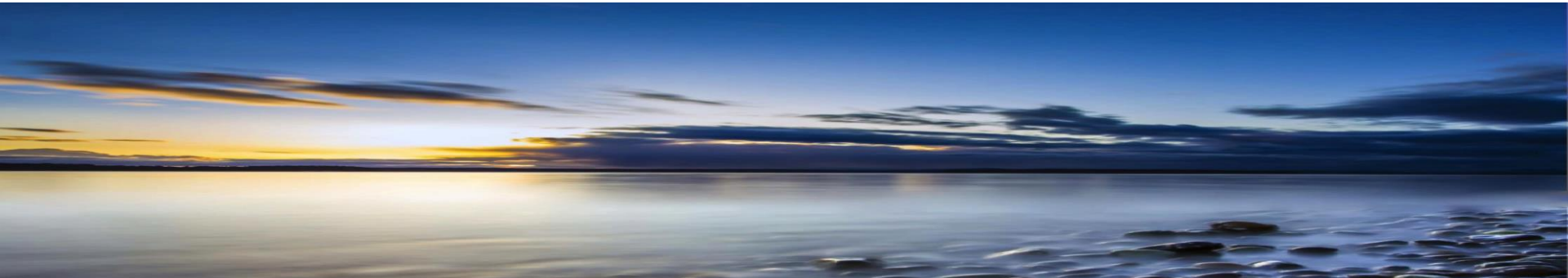
Increasing vulnerability, exposure, or severity and frequency of climate events increases disaster risk

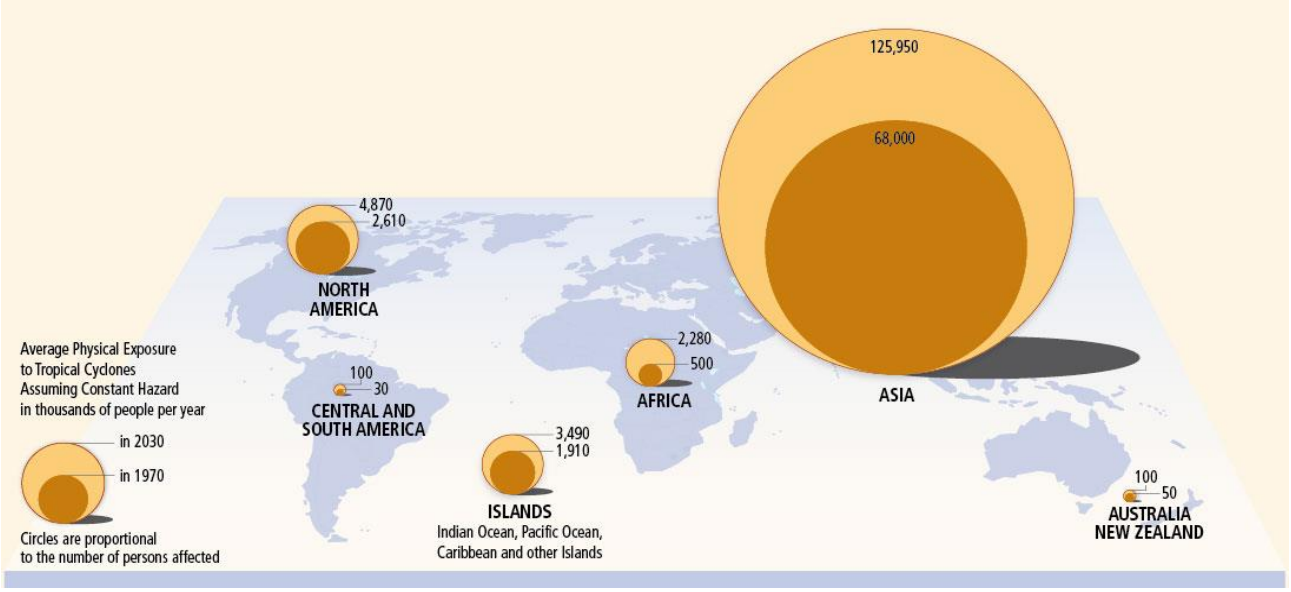


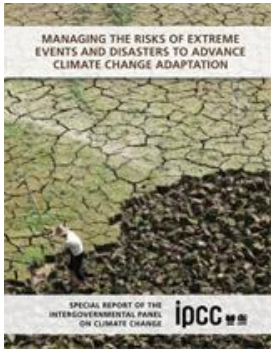
Disaster risk management and climate change adaptation can influence the degree to which ***extreme events translate into impacts*** *and* ***disasters***

Population exposed in 2050 (millions) relative to present

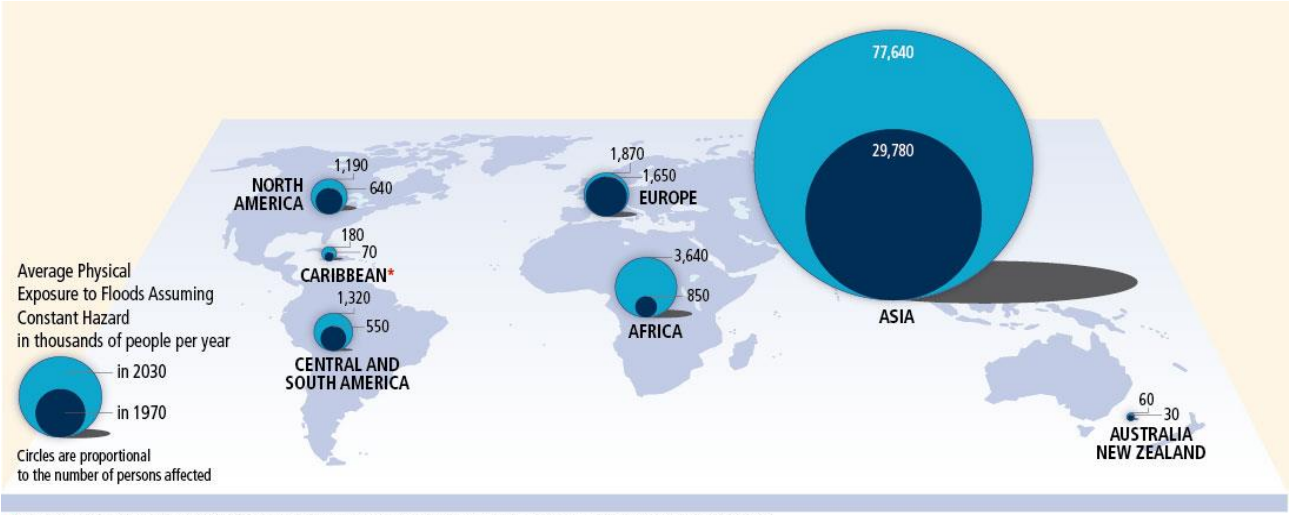








a. Tropical cyclones

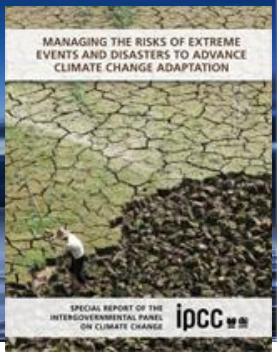


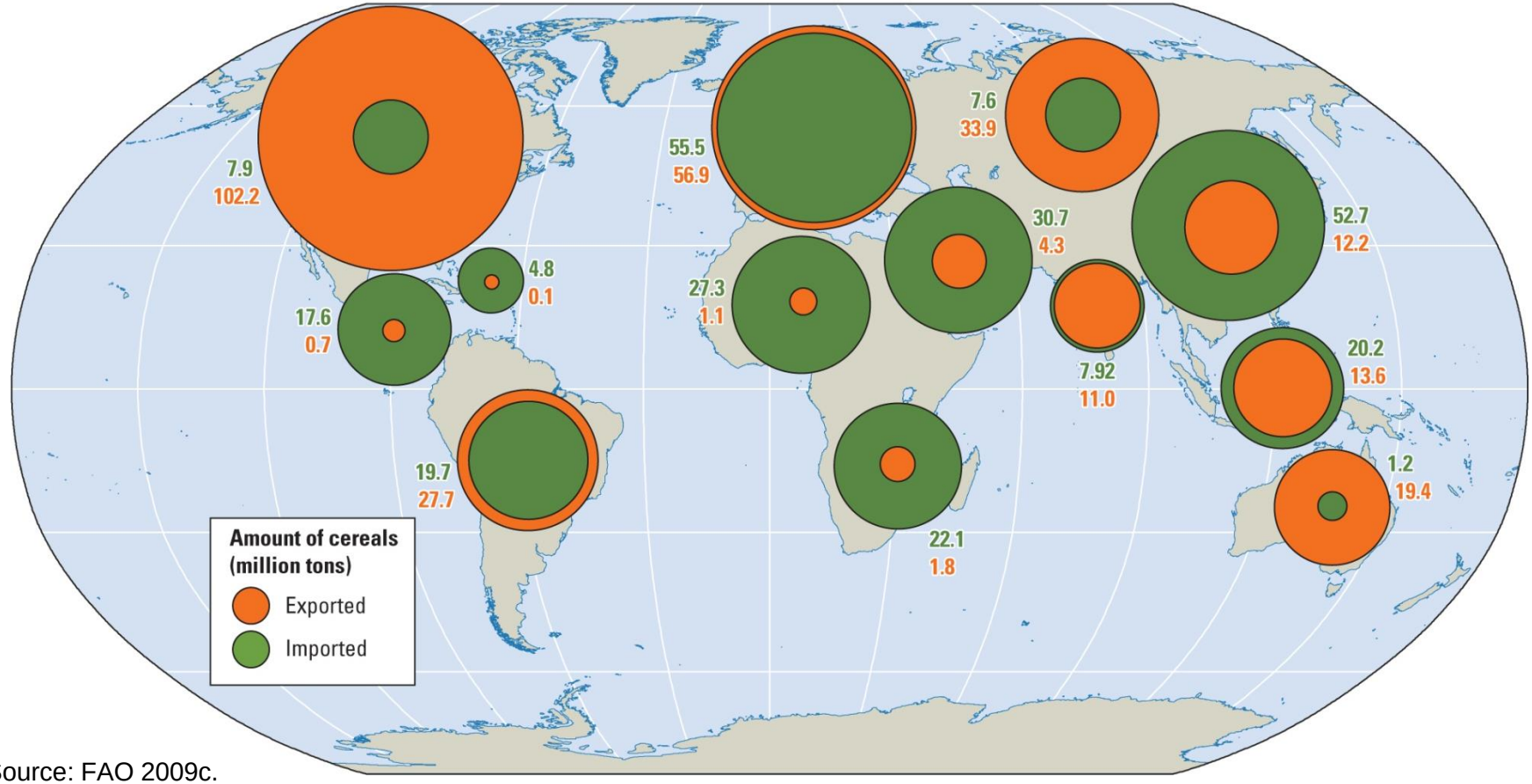
b. Flooding

*Only catchments bigger than 1,000 km² were included in this analysis. Therefore, only the largest islands in the Caribbean are covered.

Average physical exposure (1970, 2030) a. Tropical cyclones b. Flooding

Annual exports and imports (2002-2006 average)



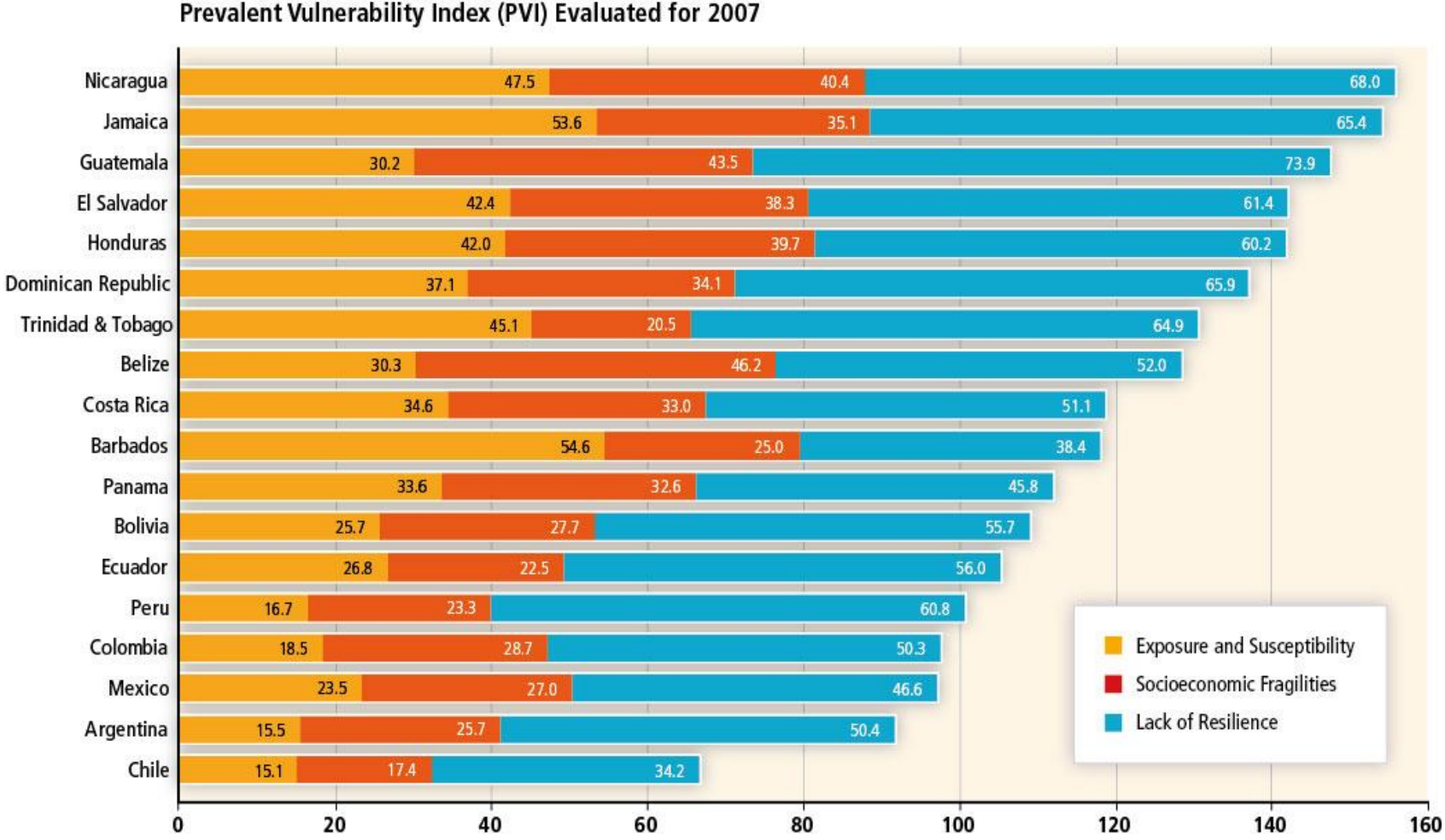


Source: FAO 2009c.

Note: Annual exports and imports are based on the average over four years (2002–2006)

Caribbean annual food import $3.5b.

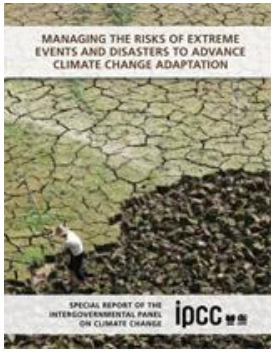
World Development Report 2010



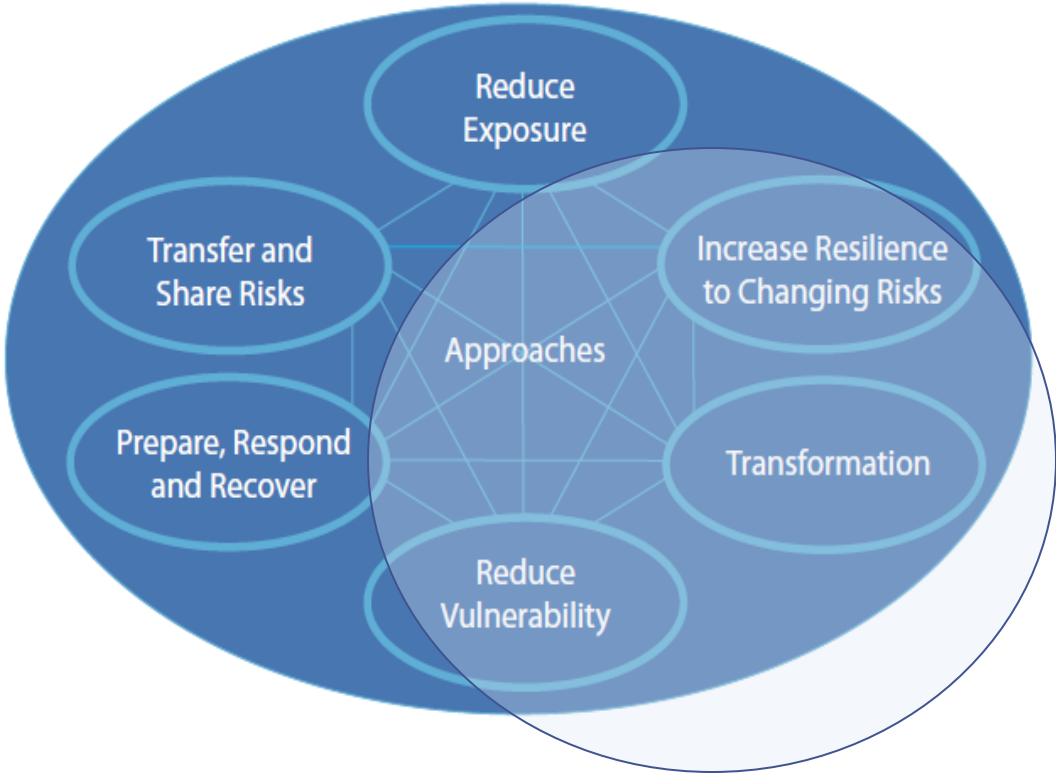
Prevalent Vulnerability Index: >>> property and wealth

- Exposure and Susceptibility
- Socio-economic Fragility
- Lack of Resilience

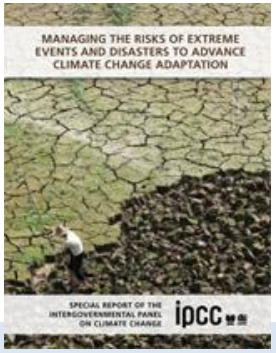
- **Information systems**
- **Infrastructure/technology**
- **Insurance**
- **Integrated systems**
- **Institutional capacity**



IPCC SREX-the Solution Space

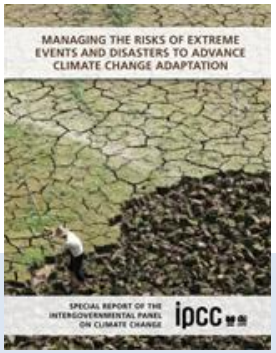


For exposed and vulnerable communities, even non-extreme weather and climate events can have extreme impacts



- Africa's largest recorded cholera outbreak
- over 90,000 affected
- over 4,000 killed
- began following onset of seasonal rains
- vulnerability and exposure increased risk

Managing the risks: heat waves in Europe



Risk Factors

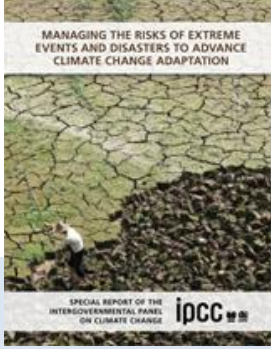
- lack of access to cooling
- age
- pre-existing health problems
- poverty and isolation
- infrastructure


France, August 2003 (over 14,000 dead)

Risk Management/ Adaptation

- cooling in public facilities
- Early warning systems
- social care networks
- urban green space
- changes in urban infrastructure

Projected: *likely* increase in heat wave frequency and *very likely* increase in warm days and nights across Europe



Risk Factors

- shore erosion
- saltcoastal intrusion
- coastal populations
- tourism economies

Risk Management/ Adaptation

- early warning systems
- maintenance of drainage
- regional risk pooling
- relocation

Projected globally: *very likely* contribution of sea level rise to extreme coastal high coastal levels (such as storm surges)

Local community livelihoods

Power Purchase Agreement (PPA)

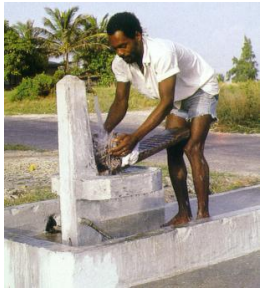
Changes in rainfall and precipitation during both the dry and wet seasons
Changes in precipitation

Increase in irrigation demand. Pressure to increase minimum flow

Changes in rainfall are most critical (during both the dry and wet seasons), though temperature extremes can also affect crops.

Ecosystem services

Total rainfall (projections for which are uncertain) is a key factor affecting the oil palm pollinator E. kamerunicus



Malaria

Generation during dry season

Annual rainfall which may increase or decrease by approx. 10-15% by the 2030s (relative to the 1970-1999 baseline).
Changes in precipitation

Groundwater supply

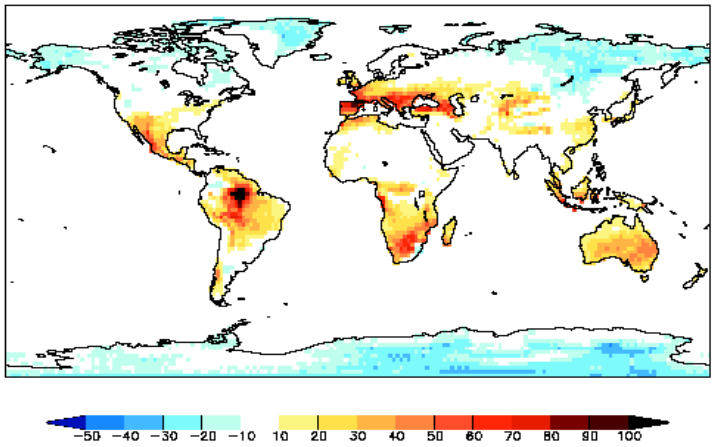
Changing patterns of precipitation, which can have disproportionately large impacts on groundwater recharge rates

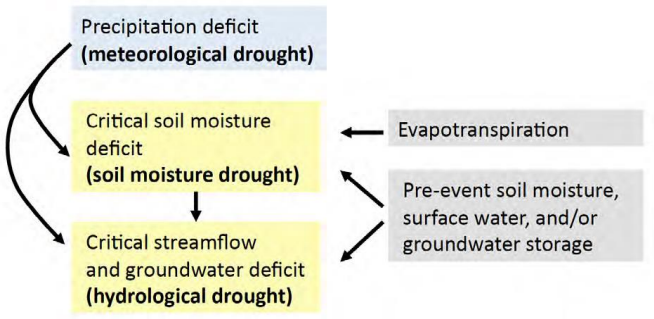
Community and social issues

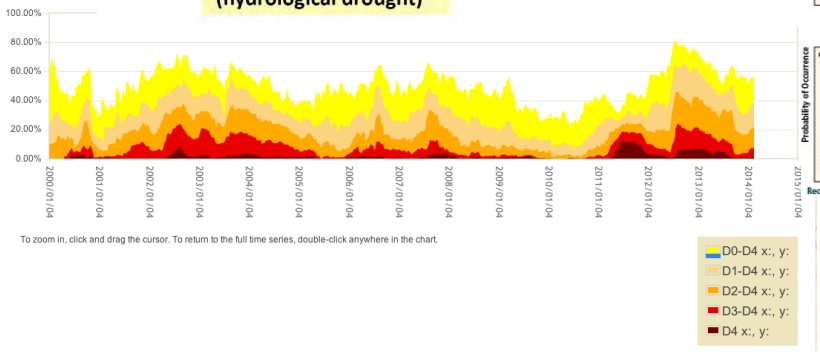
Changes in rainfall are most critical, though temperature extremes can also affect crops. Flood events can cause significant disruption in the local area.

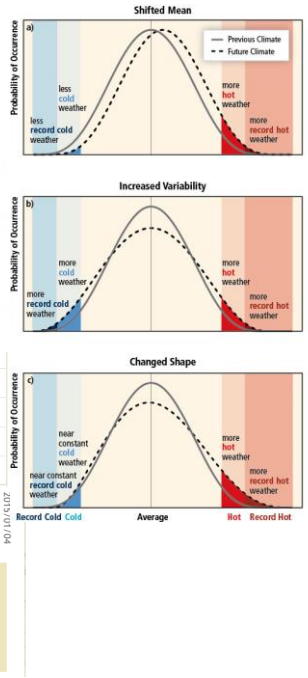
International Finance Corp , 2010

The Weather-climate continuum……..
……..and Adaptation deficits









6

Atmospheric chemistry

Ice sheets

Ocean surface upper full

Land

Atmosphere region global

1 DAY | 1 WEEK | 1 MONTH | 1 SEASON | 1 YEAR | 1 DECADE | 100 YEARS

Fronts, convective systems

Cyclones

Blocking

MJO

NAO

ENSO

QBO

PDO

AMO

'No or low regrets' practices with demonstrated evidence of having integrated observed trends in disaster risks to reduce the effects of disasters

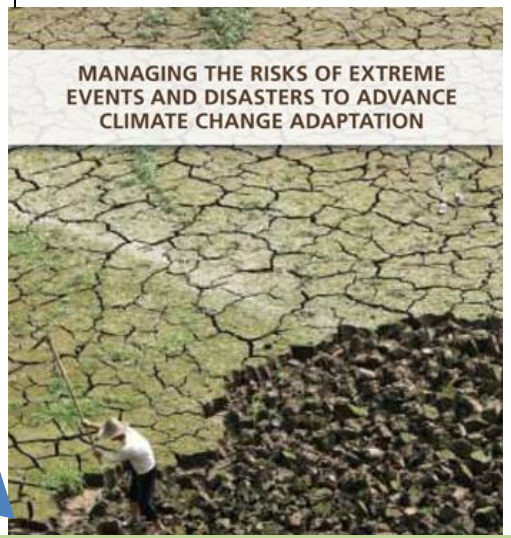
- Effective early warning systems and emergency preparedness (*very high confidence*)
- Integrated water resource management (*high confidence*)
- Rehabilitation of degraded coastal and terrestrial ecosystems (*high confidence*)
- Robust building codes and standards reflecting knowledge of current disaster risks (*high confidence*)
- Ecosystem-based/nature-based investments, including ecosystem conservation measures (*high confider*
- Micro-insurance, including weather- indexed insurance (*medium confide*
- Vulnerability-reducing measures suc pro-poor economic and human development, through for example improved social services and protec employment, wealth creation (*very confidence*)

Practices that enhance resilience to projected changes in disaster risk

- Integrated coastal zone management integrating projections of sea level risk and weather/climate extremes (*medium confidence*)
- National water policy frameworks and water supply infrastructures, incorporating future climate extremes and demand projections (*medium high*

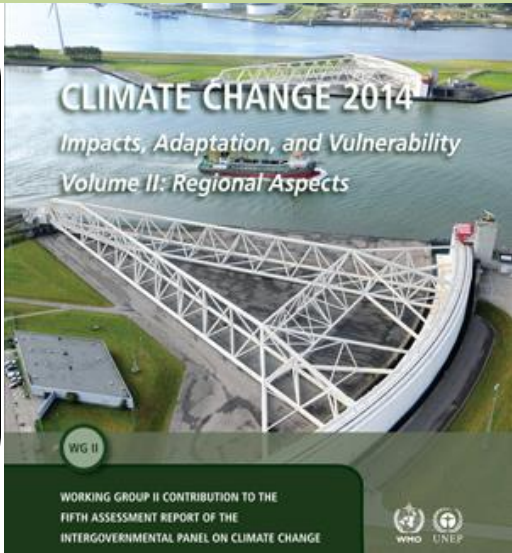
Effective early warning systems and emergency preparedness

Vulnerability reducing measures such as pro-poor economic and human development, through improved social services and protection



Risk Management

Resilience

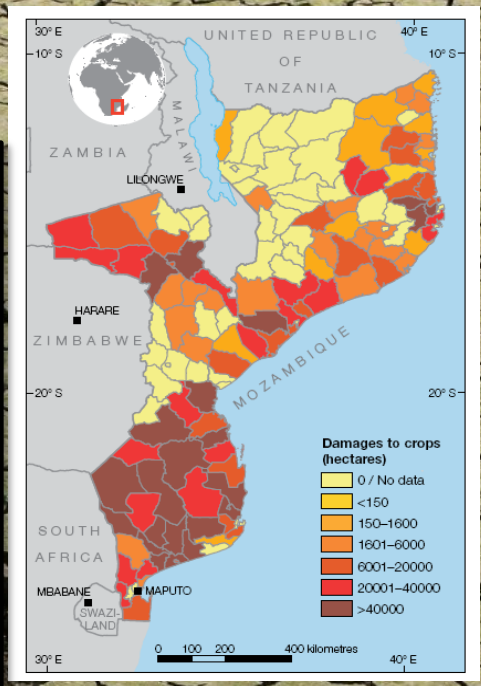


General Driving Force Category	Key Driving Forces Identified
Natural Systems (Hydroclimate)	• Changes in streamflow variability and trends • Changes in climate variability and trends (e.g. temperature, precipitation, etc.)
Demographics & Land Use	• Changes in population and distribution • Changes in agricultural land use (e.g. irrigated agricultural areas, crop mixes, etc.)
Technology & Economics	• Changes in agricultural water use efficiency • Changes in municipal and industrial water use efficiency • Changes in water needs for energy generation (e.g. solar, oil shale, thermal, nuclear, etc.)
Social & Governance	• Changes in institutional and regulatory conditions (e.g. laws, regulations, etc.) • Changes in flow-dependent ecosystem needs for ESA-listed species • Changes in other flow-dependent ecosystem needs • Changes in social values affecting water use • Changes in water availability due to tribal water use and settlement of tribal water rights claims

Sensitivity to ECVs-other variables?

Most estimates of disaster losses exclude indirect losses – livelihoods, informal economies, intangible losses including ecosystem services, quality of life and cultural impacts

In some areas drying due to climate change will be overlain on the periodic events/droughts those areas have always experienced



Short-term actions do not always provide long term risk reduction-can reduce or increase longer-term risks

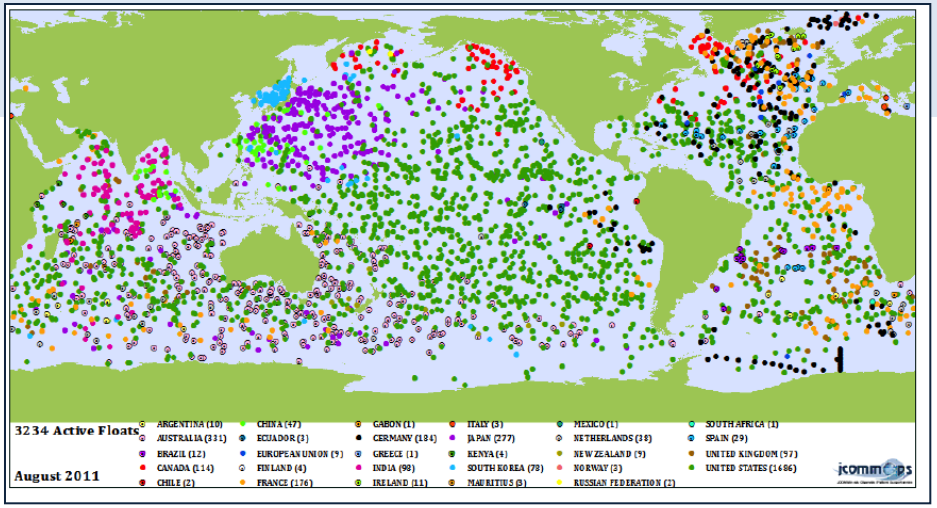
For exposed and vulnerable communities, even non-extreme weather and climate events can have extreme impacts

ISDR

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Observations and Monitoring: **the current availability and quality of climate observations and impacts data to support adaptation are inadequate for large parts of the globe**

- Ocean
  - Global coverage
- Satellites
  - Weather and Climate
- Atmospheric
  - Global and domestic
- Capacity Building
  - WMO/IOC JCOMM Capacity Building Workshops
  - SERVIR
  - Global Climate Observing S



Approach climate model output far more critically than at present, especially for impact assessment and scenario development at the local level-No substitute for monitoring and understanding local climates

Domain	GCOS Essential Climate Variables
Atmosphere (over land, sea and ice)	**Surface:**[1] Air temperature, Wind speed and direction, Water vapor, Pressure, Precipitation, Surface radiation budget. **Upper-air:**[2] Temperature, Wind speed and direction, Water vapor, Cloud properties, Earth radiation budget (including solar irradiance). **Composition:** Carbon dioxide, Methane, and other long-lived greenhouse gases[3], Ozone and Aerosol, supported by their precursors[4].
Ocean	**Surface:**[5] Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Surface current, Ocean color, Carbon dioxide partial pressure, Ocean acidity, Phytoplankton. **Sub-surface:** Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers.
Terrestrial	River discharge, Water use, Groundwater, Lakes, Snow cover, Glaciers and ice caps, Ice sheets, Permafrost, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Above-ground biomass, Soil carbon, Fire disturbance, Soil moisture.

[1] Including measurements at standardized, but globally varying heights in close proximity to the surface. [2] Up to the stratopause. [3] Including (N2O), (CFCs), (HCFCs), (HFCs), (SF6), and s (PFCs). [4] In particular (NO2), (SO2), (HCHO) and (CO). [5] Including measurements within the surface mixed layer, usually within the upper 15m.

Climate Information products

Historical Data

Climatologies
Special Publication

Indices
Analyses for CC
Metadata

Status reports
Reviews

Near real time data/ analysis

Web accessible statistics, visualization

Relative status of information

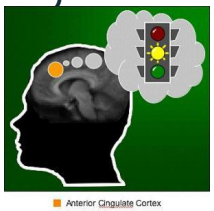
STATIC……DYNAMIC

Structural	Management	Operations	Public information	Planning
Design Safety factors Energy	Site planning Community health and well being Climate related standards	Siting designs Hazards and health Streamflow	National drought planning Resource allocation Agriculture Hazards and health	Monthly/ seasonal Planning Internationa Markets Demand

Zillman, Pulwarty others

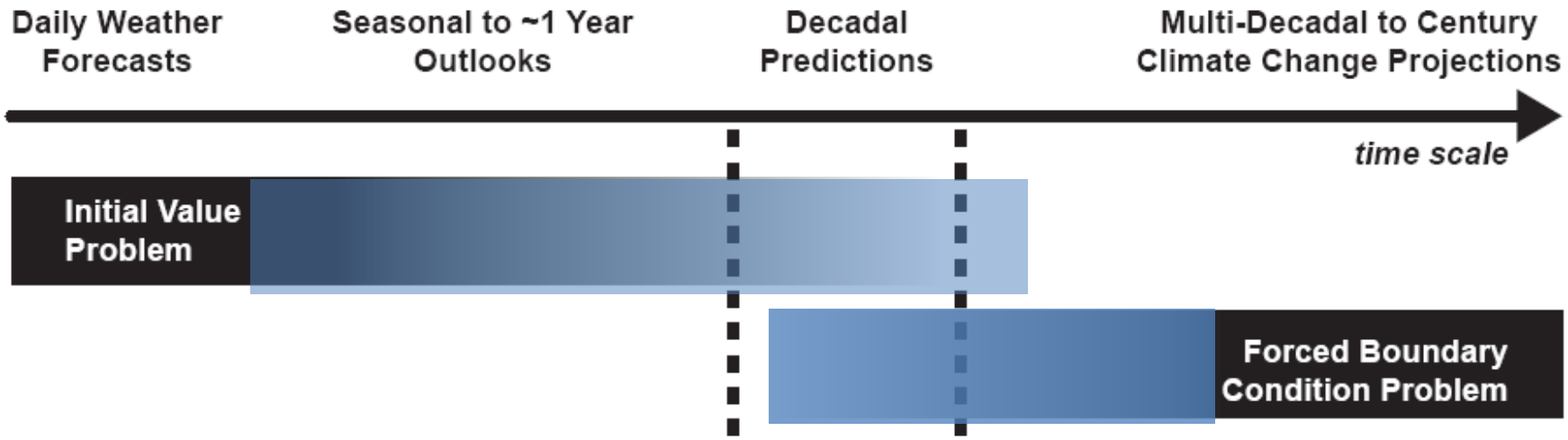
1. Acknowledge the cross-timescale nature of climate and of early warning information

Decadal prediction lies between initialized weather or seasonal forecasts, and future climate change projections-not just "extremes" OR "trends"-

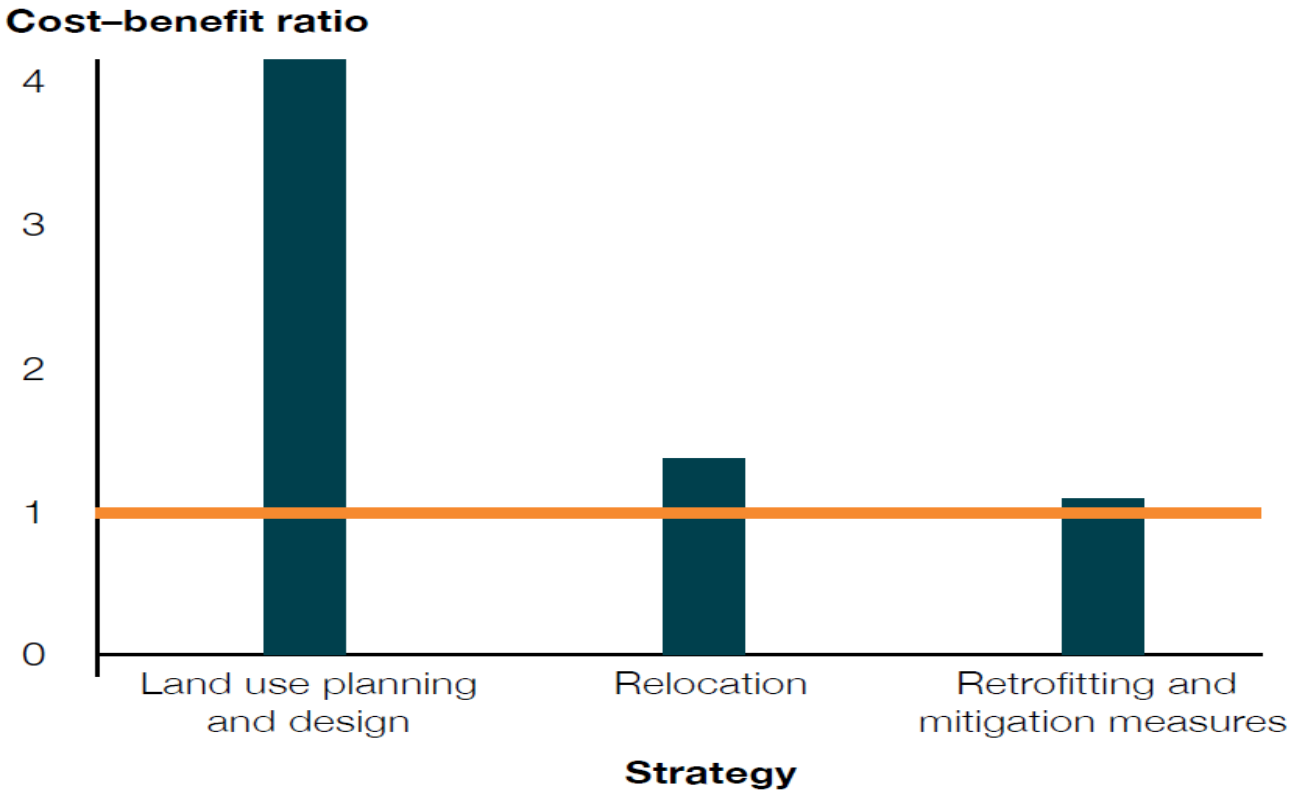


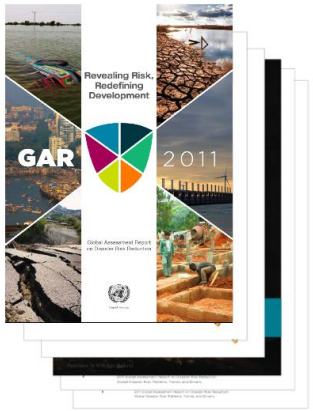
Globally

The total benefits of improved early warning systems could reach between 4 and 36 billion USD per year. Benefit-cost ratios between 4 and 35 with co-benefits (World Bank, 2011)



2. Understand and communicate the economic and social value of novel resource configurations, such as land-use, for resilience





3. Recognize “communication” as critical but not sufficient

- *Broad societal processes that create dynamic pressures and unsafe conditions are not easy to change, yet are fundamental to human vulnerability*

- More challenging is an understanding the socialization of lessons learned by particular individuals and organizations through their own, direct trial and error experiences

Creating integrated *information* systems: "The "last mile" is by far the longest…"

	Sub-Saharan Africa	South Asia	Caribbean
Underpinning Science and Data	Considerable gaps in data availability and monitoring	Gaps in science for drought & landslides, vulnerability & exposure	Gaps in science for floods & droughts, vulnerability & exposure
Risk Assessment Warnings Tools	Some systems in place but major gaps, particularly for flooding	Generally, systems in place for main hazards but some gaps	Generally, systems in place for main hazards but some gaps
Communication/ Dissemination	Major gaps in communication to the most vulnerable	Major gaps in communication to the most vulnerable	Generally, systems in place for main hazards but some gaps
Response	Information (risk assessments/warnings) does not always lead to action	Information (risk assessments&warnings) does not always lead to action	Information (risk assessments&warning) does not always lead to action

Ranger etc,(also Birkmann et al 2013, Pulwarty and Sivakumar 2014 etc etc.

Extremes in the context of variability and change:

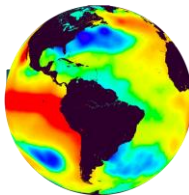
- Pressure for better information to support planning under changing extremes-rates and transitions

- Is a threshold an emergent property of some underlying set of attributes of a system? (models not calibrated for rapid transitions)

- **How does new information relate to what is already known?-how often should criteria for "robustness" be reconsidered?**

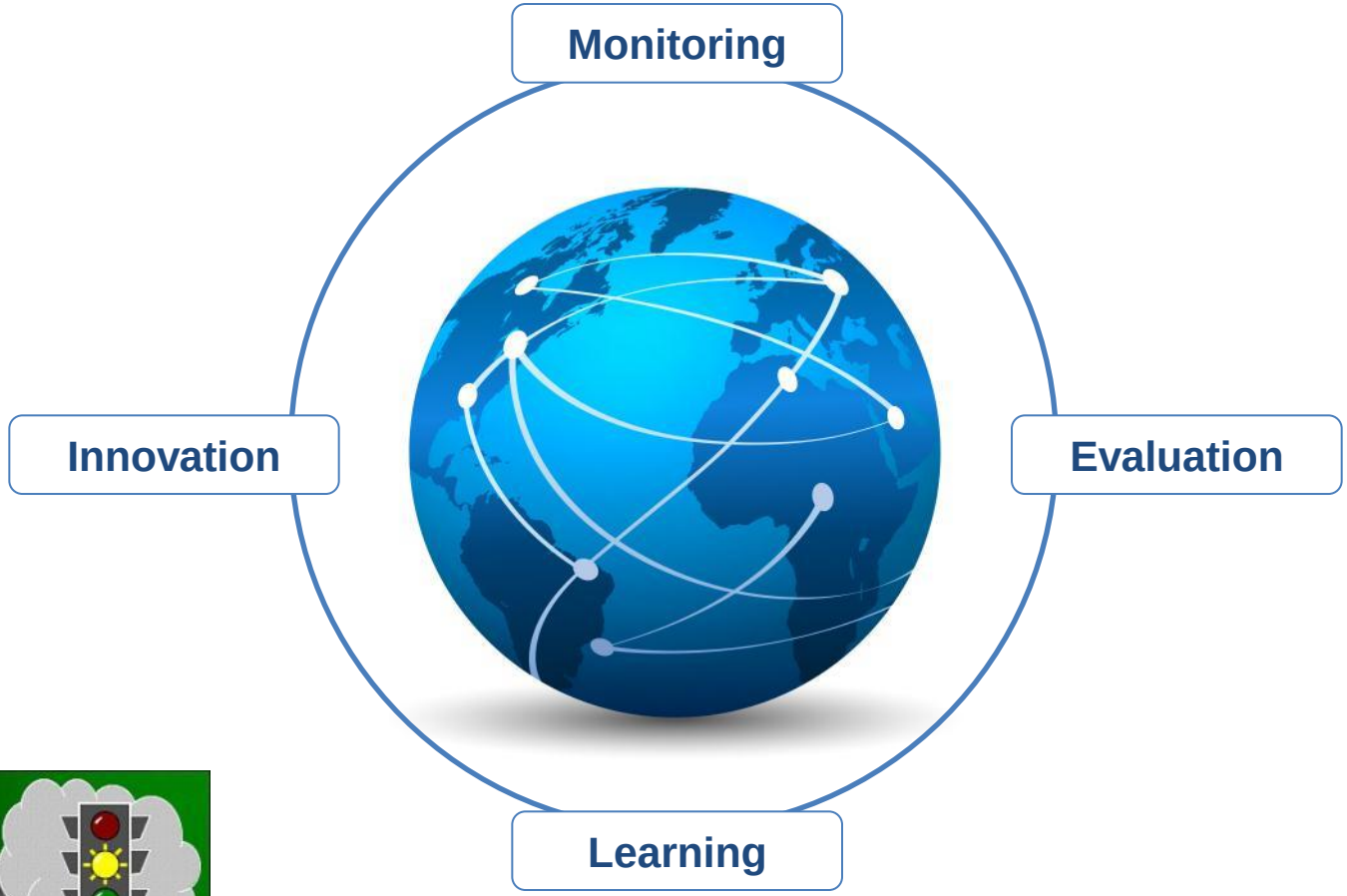
- Many public sector applications require a more systematic connection between early warning scenarios and recommended decisions than do private sector applications

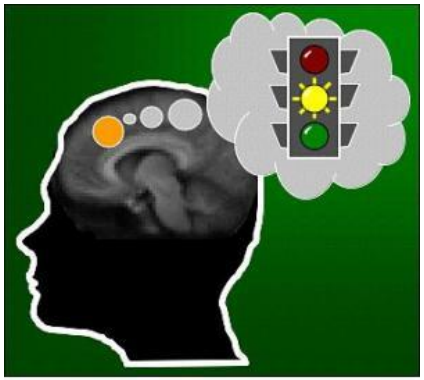
- More challenging is understanding the socialization of lessons learned by particular individuals and organizations through their direct trial and error experiences




RAIN
Apathy
DROUGHT
"Hydro-Illogical" Cycle
Panic
MORE DROUGHT
Concern

Focus on capacity and improving decisions- not just information use





How often should criteria for "robustness" be (re)considered?

Table 9-1 | Continued

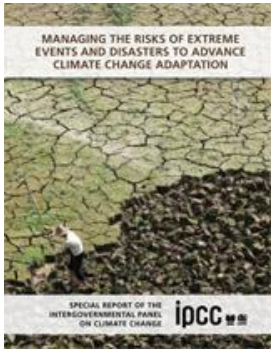
IPCC SREX, 2012 Chapter 9

	Key Message	9.2.1 Heat-waves	9.2.2 Hot weather and wildfires	9.2.3 Drought	9.2.4 Dzud	9.2.5 Cyclones	9.2.6 Floods	9.2.7 Epidemic Disease	9.2.8 Mega-cities	9.2.9 SIDS	9.2.10 Cold Climate	9.2.11 EWS
E. Managing Changing Risk of Climate Extremes and Disasters	Measures that provide benefits under current climate and a range of future climate change scenarios, called low-regrets measures, are available starting points for addressing projected trends in exposure, vulnerability, and climate extremes. They have the										●	●
	Multi-hazard risk manageme to reduce complex and comp		●									●
	Integration of local knowled technical knowledge can imp climate change adaptation.			●							●	
	Appropriate and timely risk communication is critical for effective adaptation and disaster risk management.		●									●
Hyogo Framework for Action – Priorities for Action	1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.					●	●				●	
	2: Identify, assess and monitor disaster risks and enhance early warning.	●	●					●				●
	3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels.						●					
	4: Reduce the underlying risk factors.	●		●							●	
	5: Strengthen disaster preparedness for effective response at all levels.				●	●			●	●		●

14-18 March 2015
Sendai, Japan

Hyogo Framework: Priorities for Action

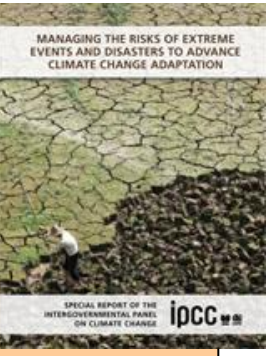
What the SREX did not do



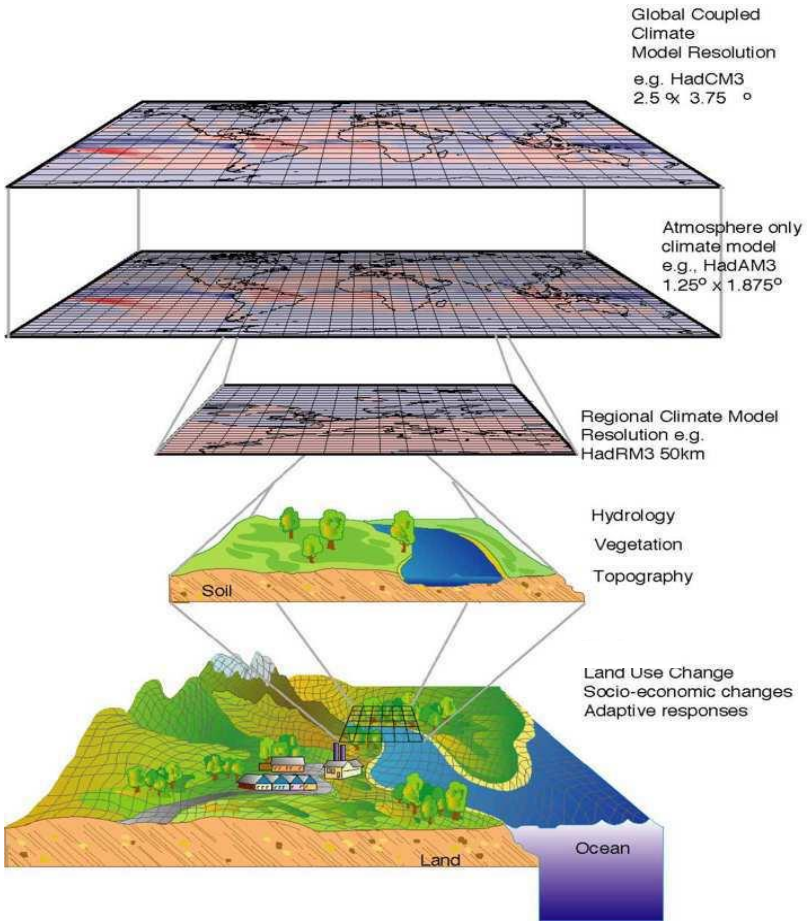
- Mitigation and avoided risk
- Detailed sector by sector impacts
- Interaction between disaster risk and shared socioeconomic pathways
- Developed applications of alternative risk management approaches

Question: The current availability and quality of climate observations and impacts data appear to be inadequate to support adaptation (from extremes, variability and change) for large parts of the globe. *What actions and work are needed to show and/or increase the value of existing observations for impacts assessments and warnings, and adaptation? Where are and how do we address the gaps?*

Challenge: *Sustain observations, research and management networks with at-risk, development and private sector communities that integrate probabilistic risk management based on past events and trends, with resilience strategies based on scenarios of rates of change, potential surprise and cumulative risks across climate timescales.*



All levels of observational needs to support services and adaptations

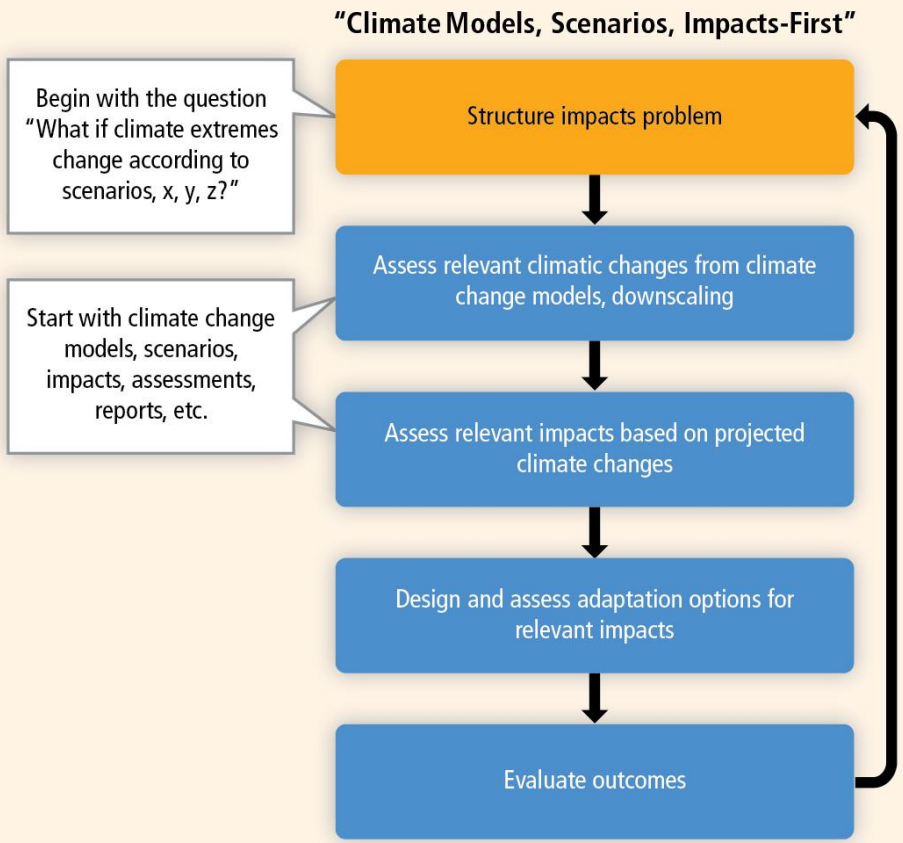


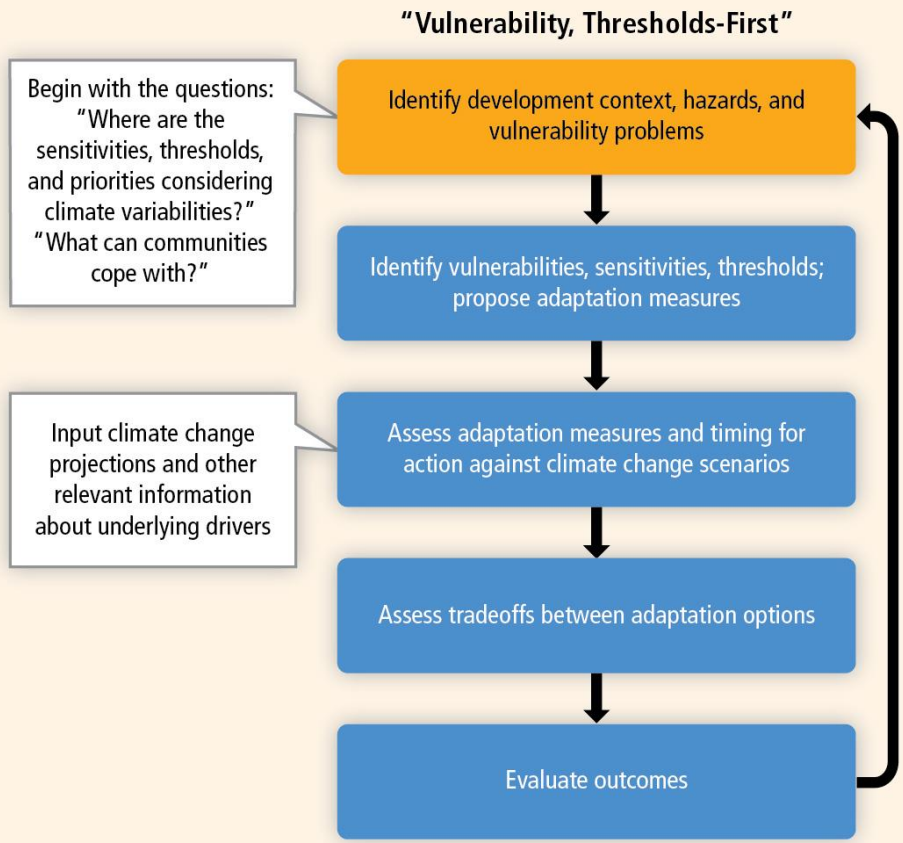
Thanks!

http://www.wmo.int/gfcs

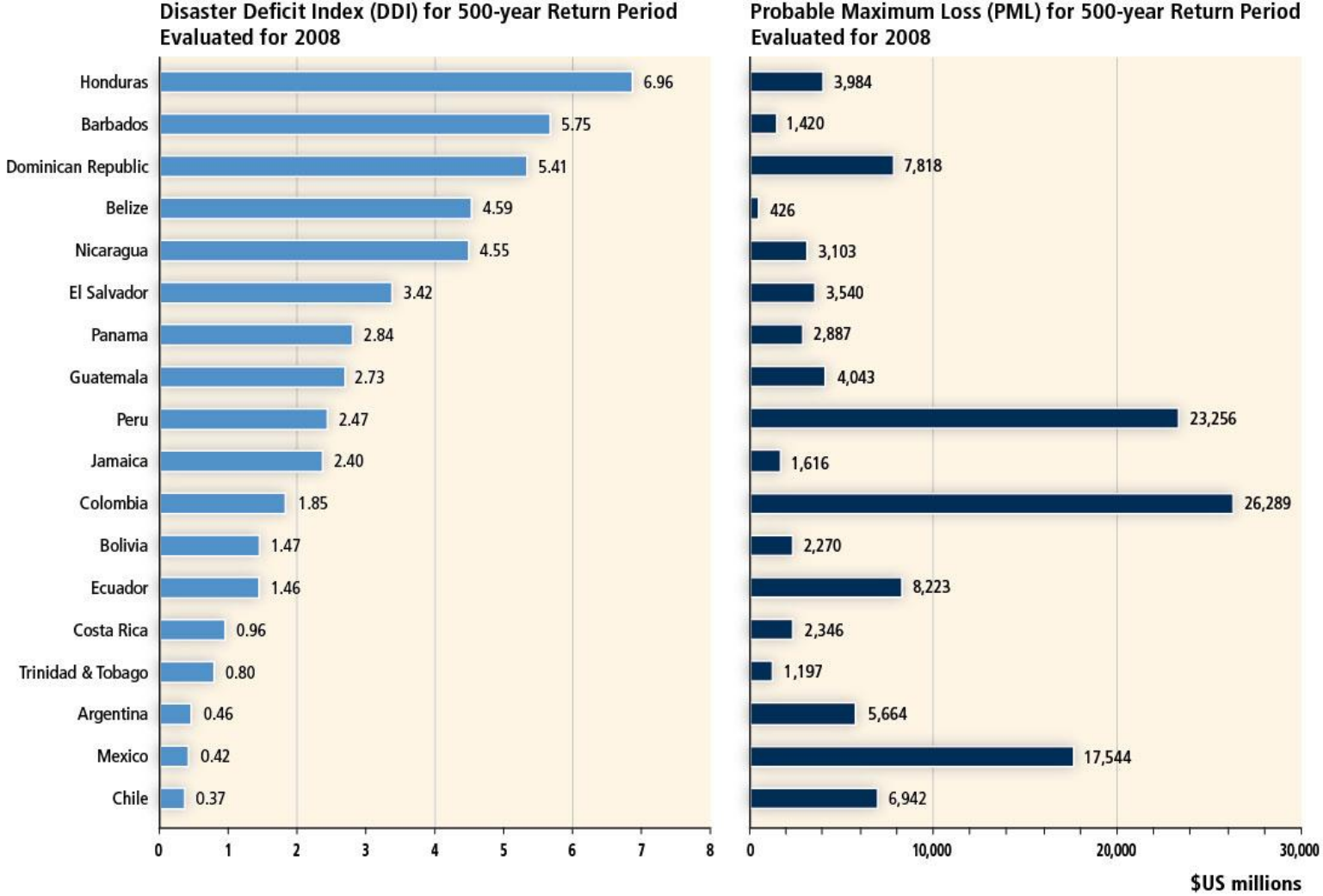
The relationship between public and private monitoring and research is not linear

- More than the simple costless transfer of basic knowledge from publicly-funded institutions to profit-oriented firms
- Ability to access and interact with federal sector research activity is an important determinant of the productivity of downstream state and private sector research
- Participating in this exchange can be an important determinant of private sector research productivity
- This works both ways



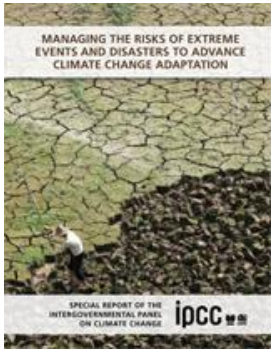


	Local *Households, Farmers, SMEs*	***National*** *Governments*	***International*** *Development organizations, donors, NGOs*
Solidarity	Help from neighbors and local organizations	Government post-disaster assistance; government guarantees/bailouts	Bilateral and multilateral assistance, regional solidarity funds
Informal risk transfer (sharing)	Kinship and other reciprocity obligations, semi-formal micro-finance, rotating savings and credit arrangements, remittances		
Savings, credit, and storage (inter-temporal risk spreading)	Savings; micro-savings; fungible assets; food storage; money lenders; micro-credit	Reserve funds; domestic bonds	Contingent credit; emergency liquidity funds
Insurance instruments	Property insurance; crop and livestock insurance; micro-insurance	National insurance programs; sovereign risk transfer	Re-insurance; regional catastrophe insurance pools
Alternative risk transfer	Weather derivatives	Catastrophe bonds	Catastrophe bonds; risk swaps, options, and loss warranties

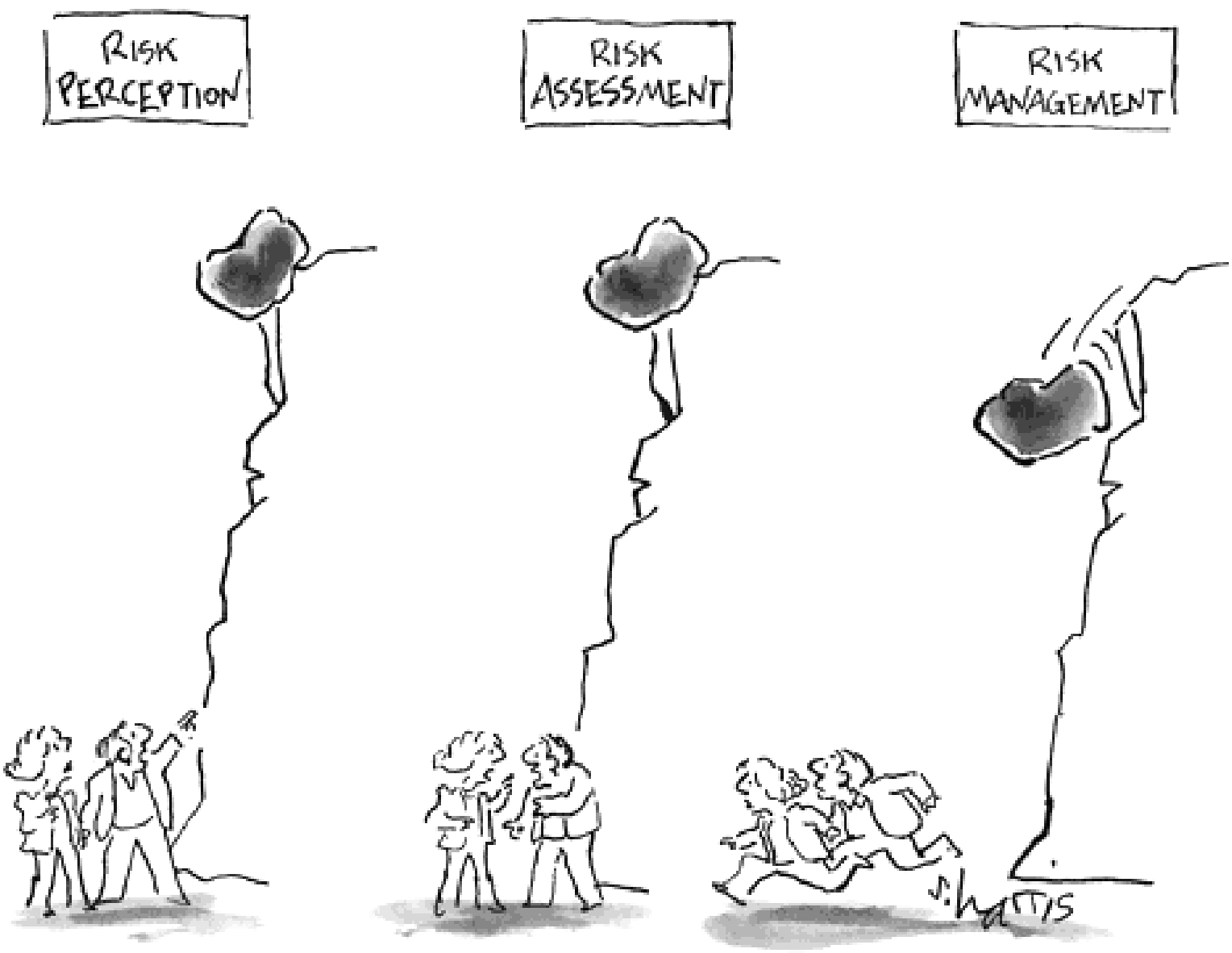


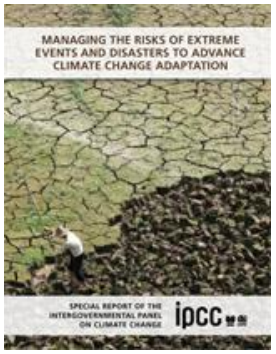
The DDI captures the relationship between the demand for contingent resources to cover the losses caused by the Maximum Considered Event (MCE) and the public sector's economic resilience (i.e. the availability of internal and external funds for restoring affected inventories).

DDI is greater than 1.0 = economic incapacity of the country to cope with extreme disasters even where indebtedness is carried to a maximum-greater the DDI, the greater the gap.



- First joint product of WGII and WGI
- First IPCC report with a focus on risk management
- First SPM to focus on multi-chapter key findings
- Novel figures and tables
- First IPCC report with a COI process
- First IPCC report with ambitious outreach goals





Sydney Harris, 2011

- Information systems for extremes and critical thresholds across temporal and spatial scales:

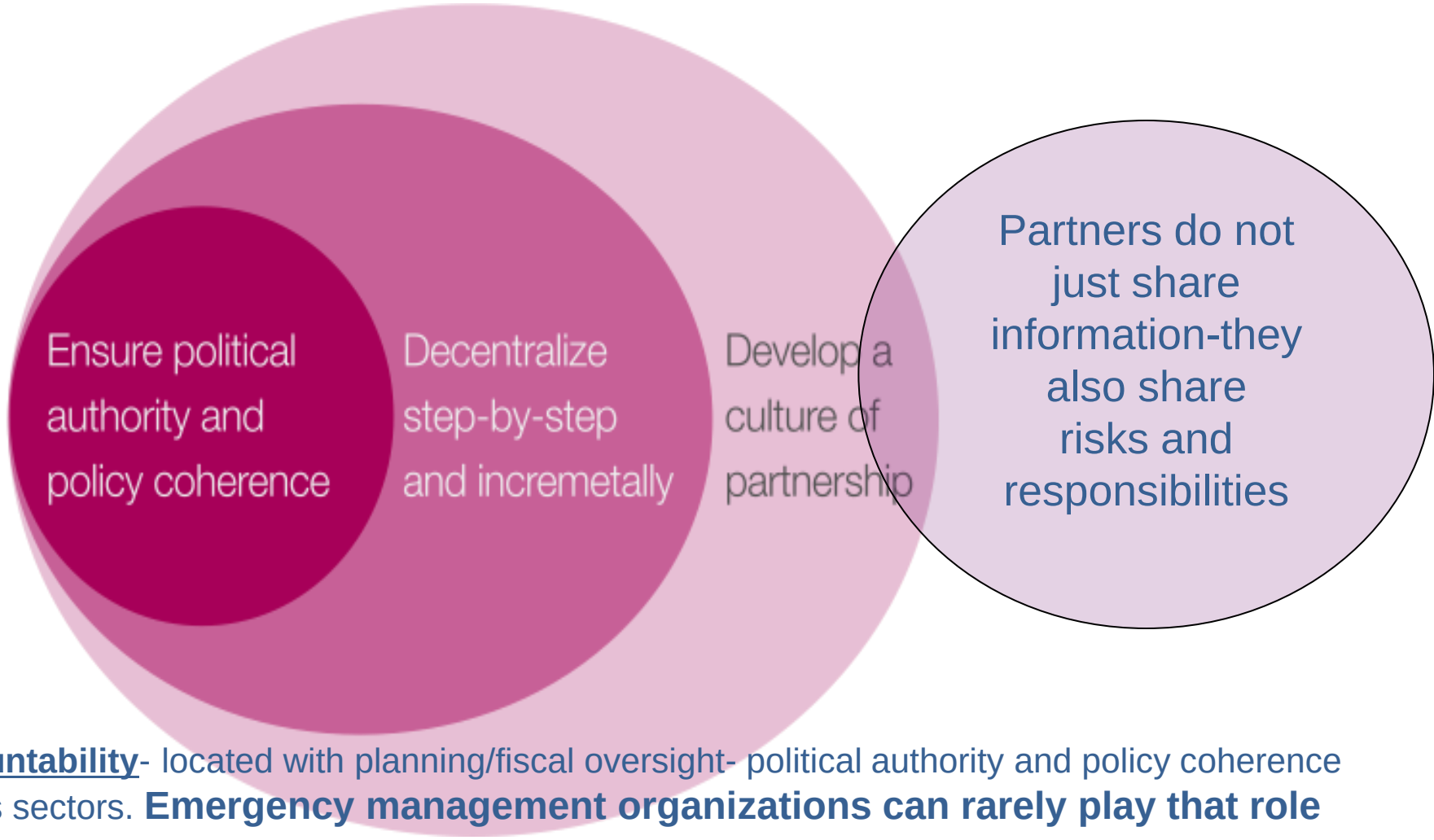
Systems may change faster than the models can be recalibrated-Projections may be most unreliable in precisely the situations where they are most desired

Approach climate model outputs far more critically than at present, especially for impact assessment and scenario development to support adaptation at the local level-confront models with data

Place multiple indicators within a statistically consistent triggering framework-esp. cross-correlation among units before a critical threshold is reached

Scenario planning (based on past, present and projected events)- better understand whether and how best to use probabilistic information with past data, potential surprise and cumulative risks across climate timescales

4. Sustaining “services” Climate risk management governance



Accountability- located with planning/fiscal oversight- political authority and policy coherence across sectors. **Emergency management organizations can rarely play that role**

Efficiency- achieved in partnership with at-risk sectors and local communities and organizations that represent them-

ISDR