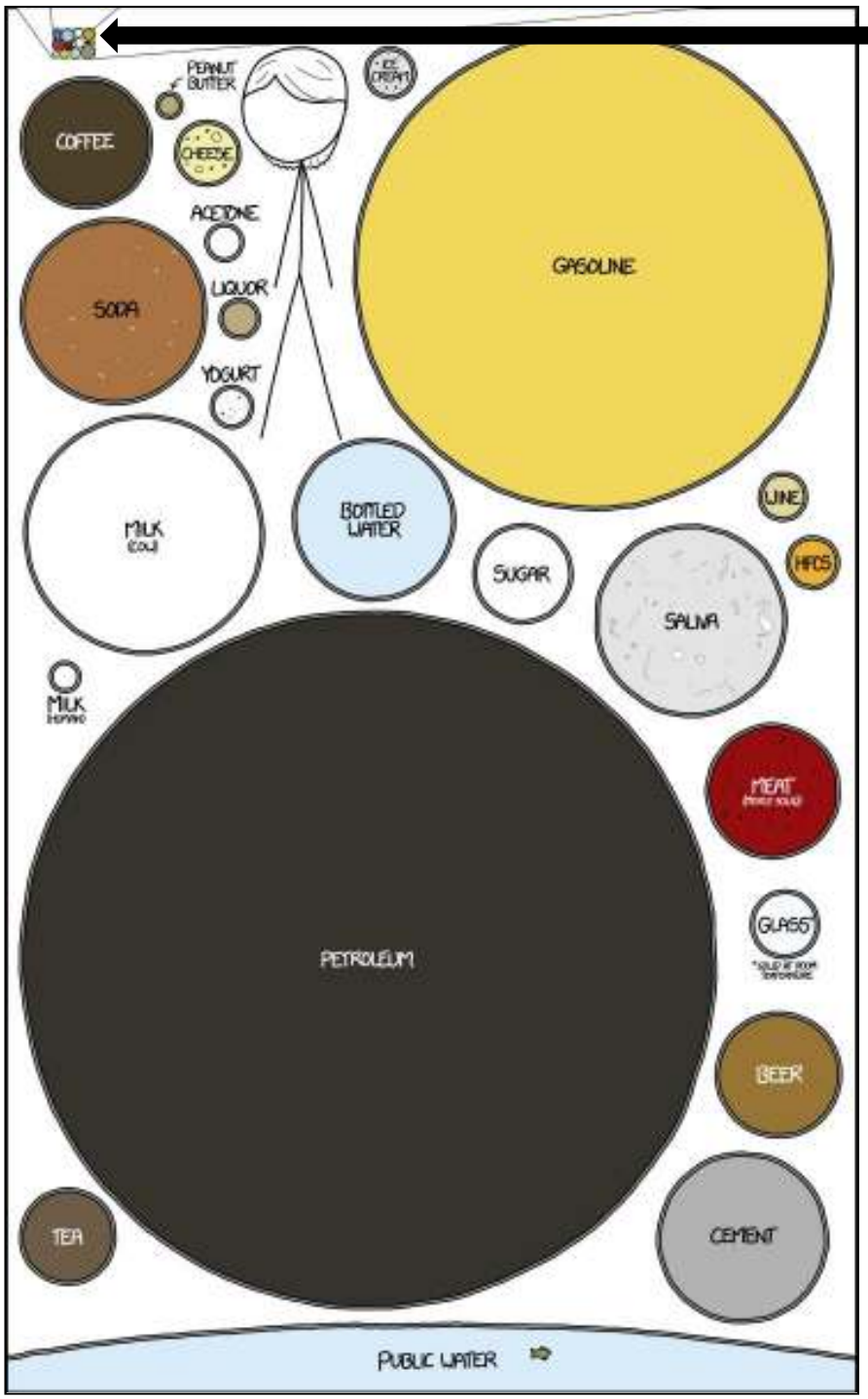
Climate Change and Cities

The gap between climate science and decisions

Drawing on material for two upcoming international meetings, and with input from Coleen Vogel, Wits University

Climate System Analysis Group
CSAG

Bruce Hewitson

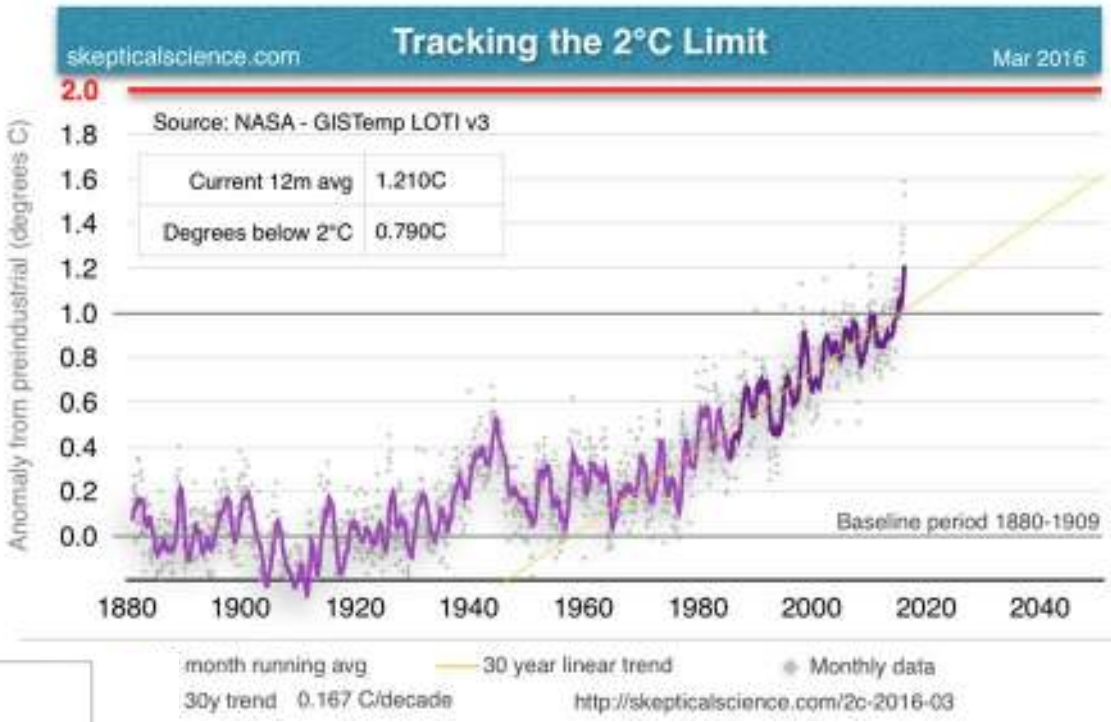


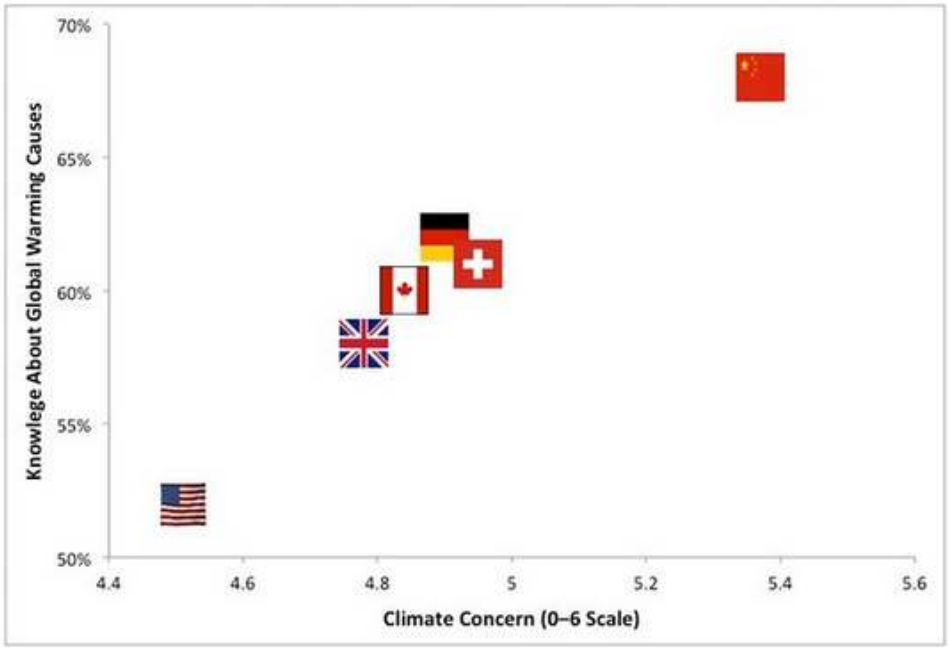
Consumption patterns driving global change

Cities major drivers of consumption patterns

Cities and their co-dependent regions are complex systems comprising infrastructure, linkages and flows, with evolving socio-ecological dynamics, much of which is climate sensitive

https://xkcd.com/1649/





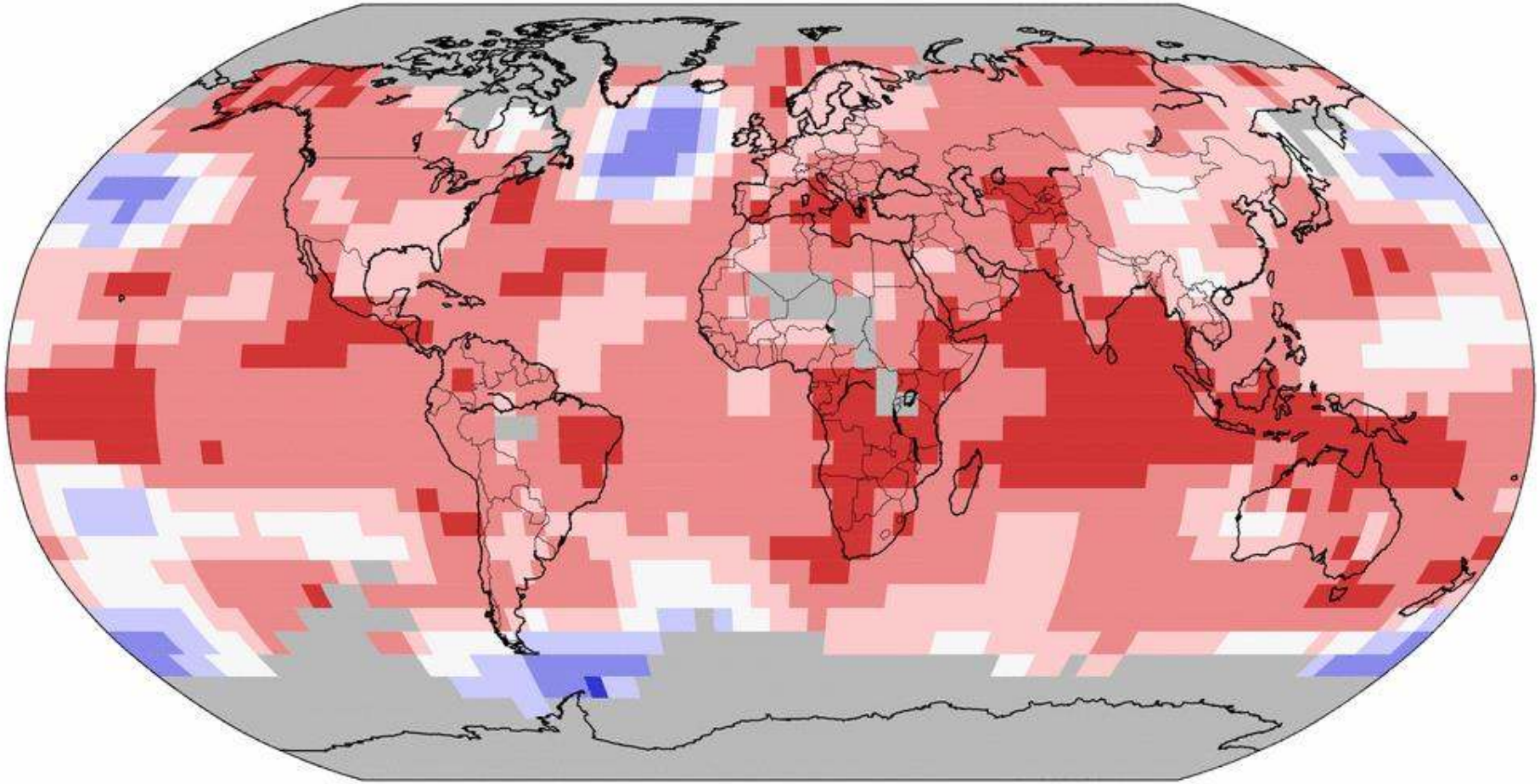
Concern about climate change (0-6 point scale) vs. average correct score on questions relevant to its causes in six countries. Illustration: Dana Nuccitelli, data from Shi et al. (2016).

Consensus
Concern
About Change

Land & Ocean Temperature Percentiles Jan–Mar 2016

NOAA's National Centers for Environmental Information

Data Source: GHCN–M version 3.3.0 & ERSST version 4.0.0



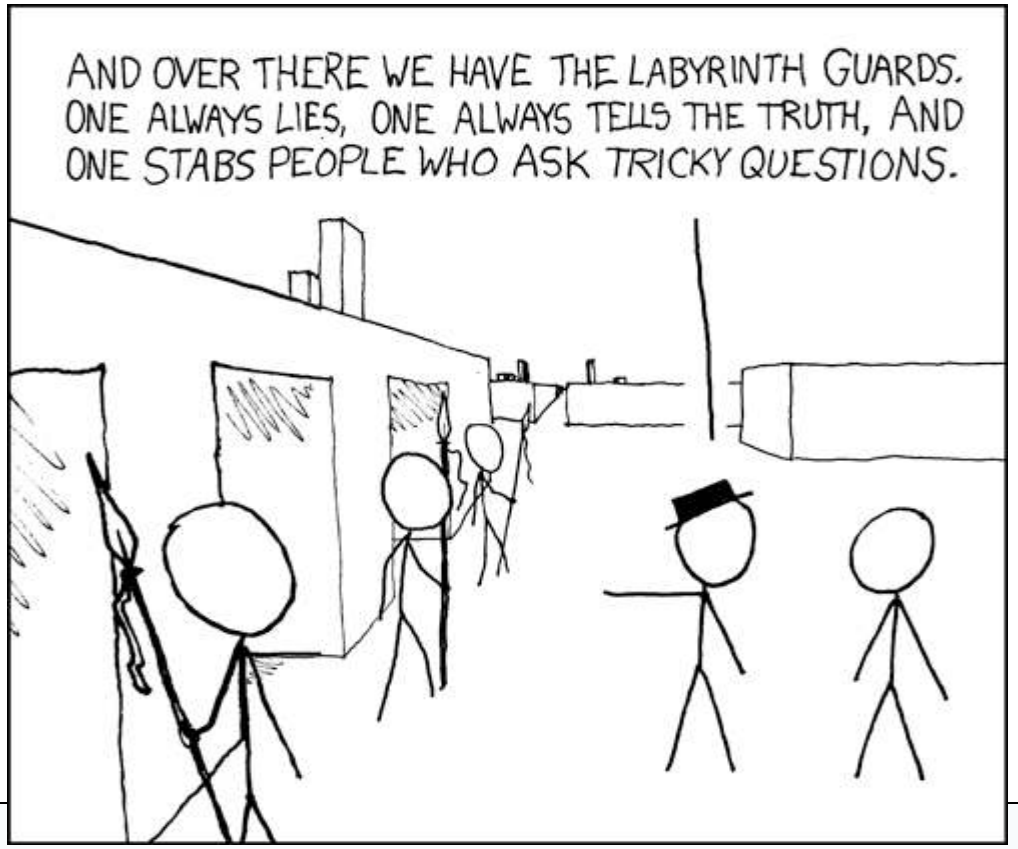
Record Coldest | Much Cooler than Average | Cooler than Average | Near Average | Warmer than Average | Much Warmer than Average | Record Warmest

Fri Apr 15 07:06:08 EDT 2016

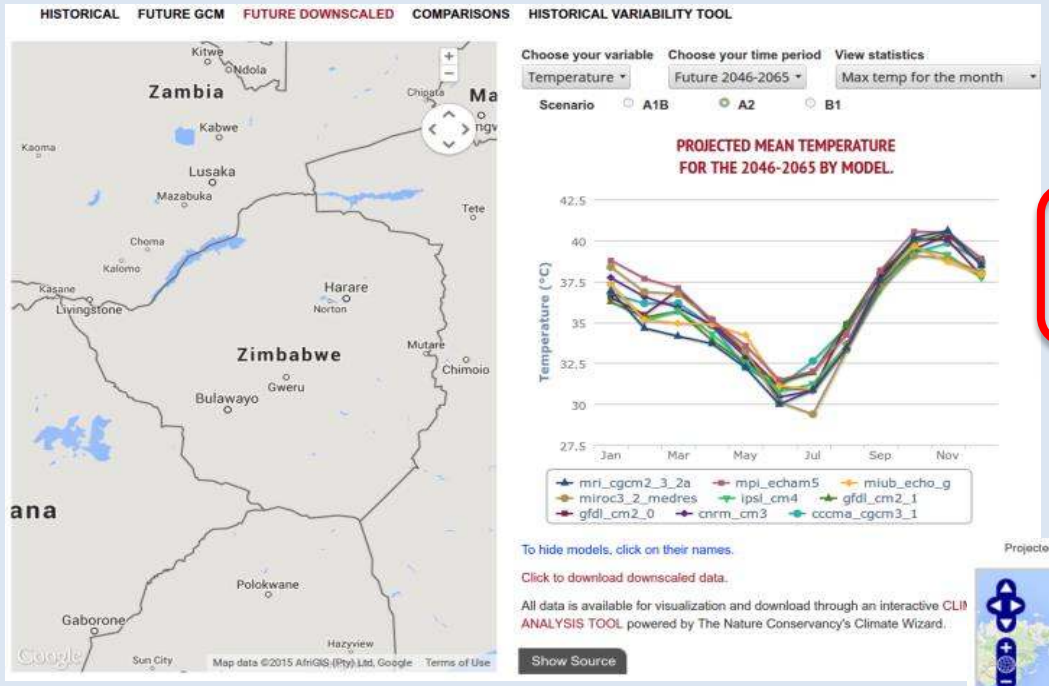
Future? What Future?
An ethical-epistemic problem

Climate change is a social problem, and hence a values problem:
"it comes down to making judgments about what is fair, equitable, and just"
[Richard Somerville]

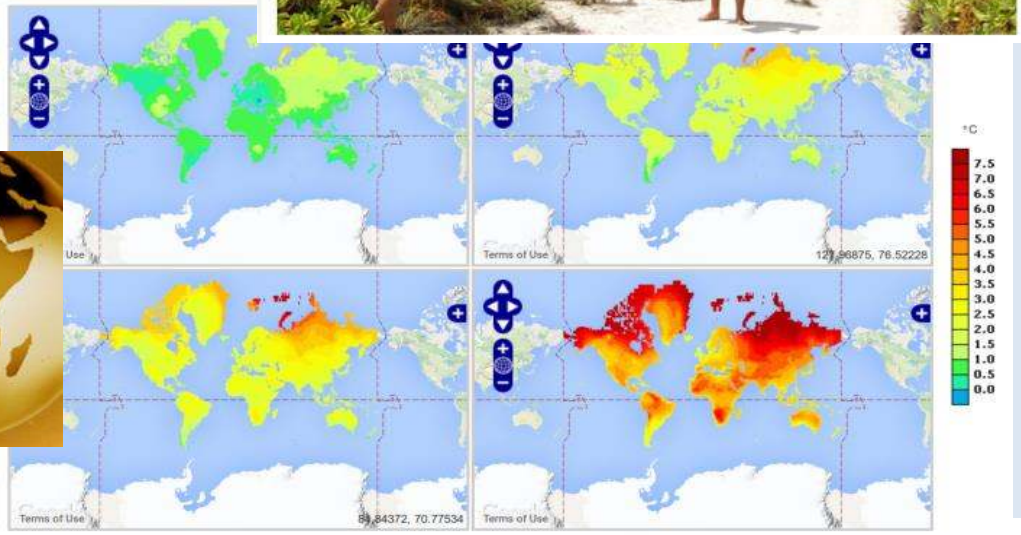
- Data is not information
- Information is not the same as knowledge
- Knowledge is not the same as understanding
- Understanding is not the same as Wisdom



"The past/future cannot affect us, but we can be affected by conceptions of the past/future."



We need credible facts and figures to meet the challenge that climate change is putting on farming world over. The portal provides users with vigorous, high-resolution climate data that can help assess the impacts of climate change on agriculture.



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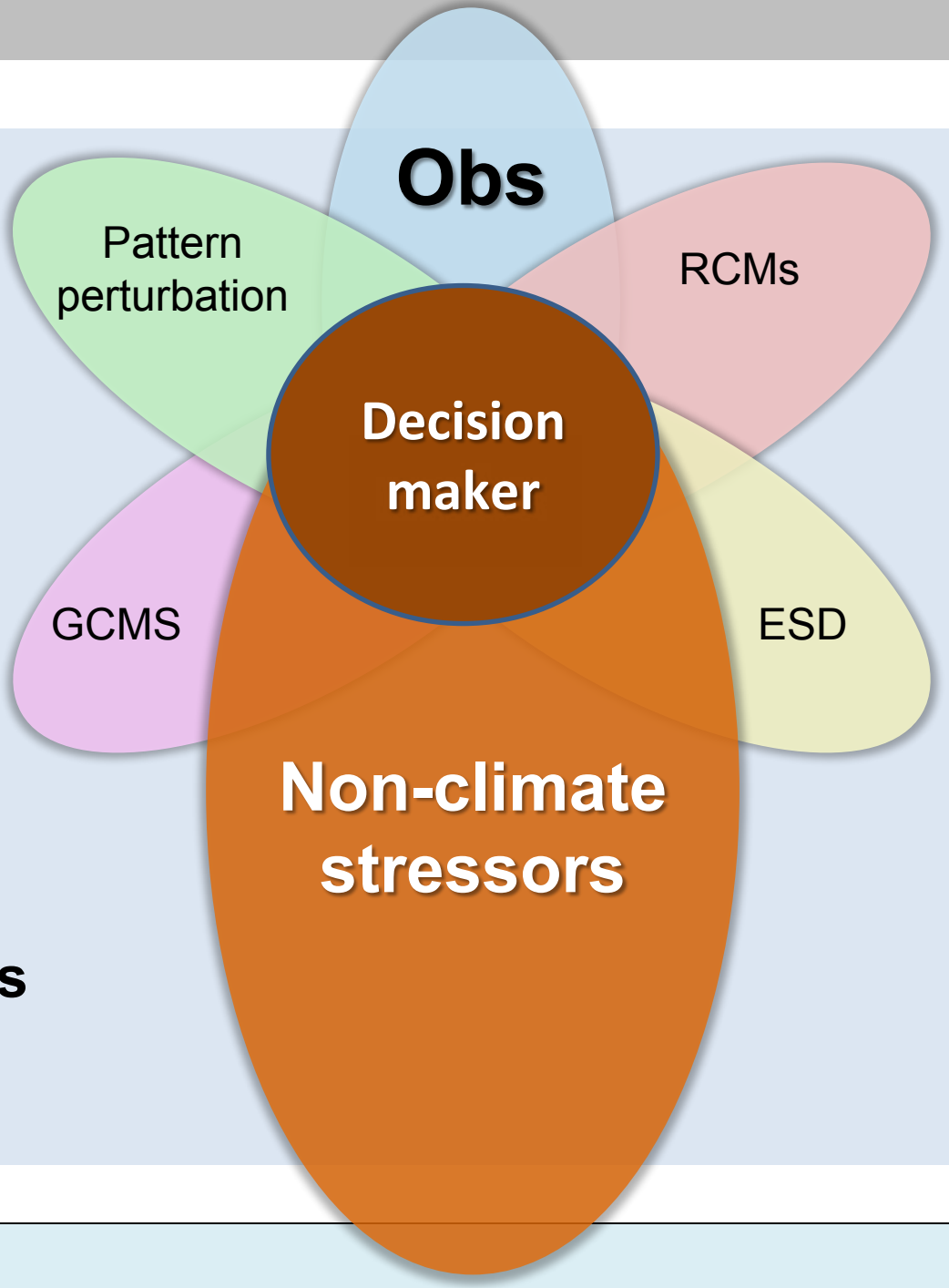
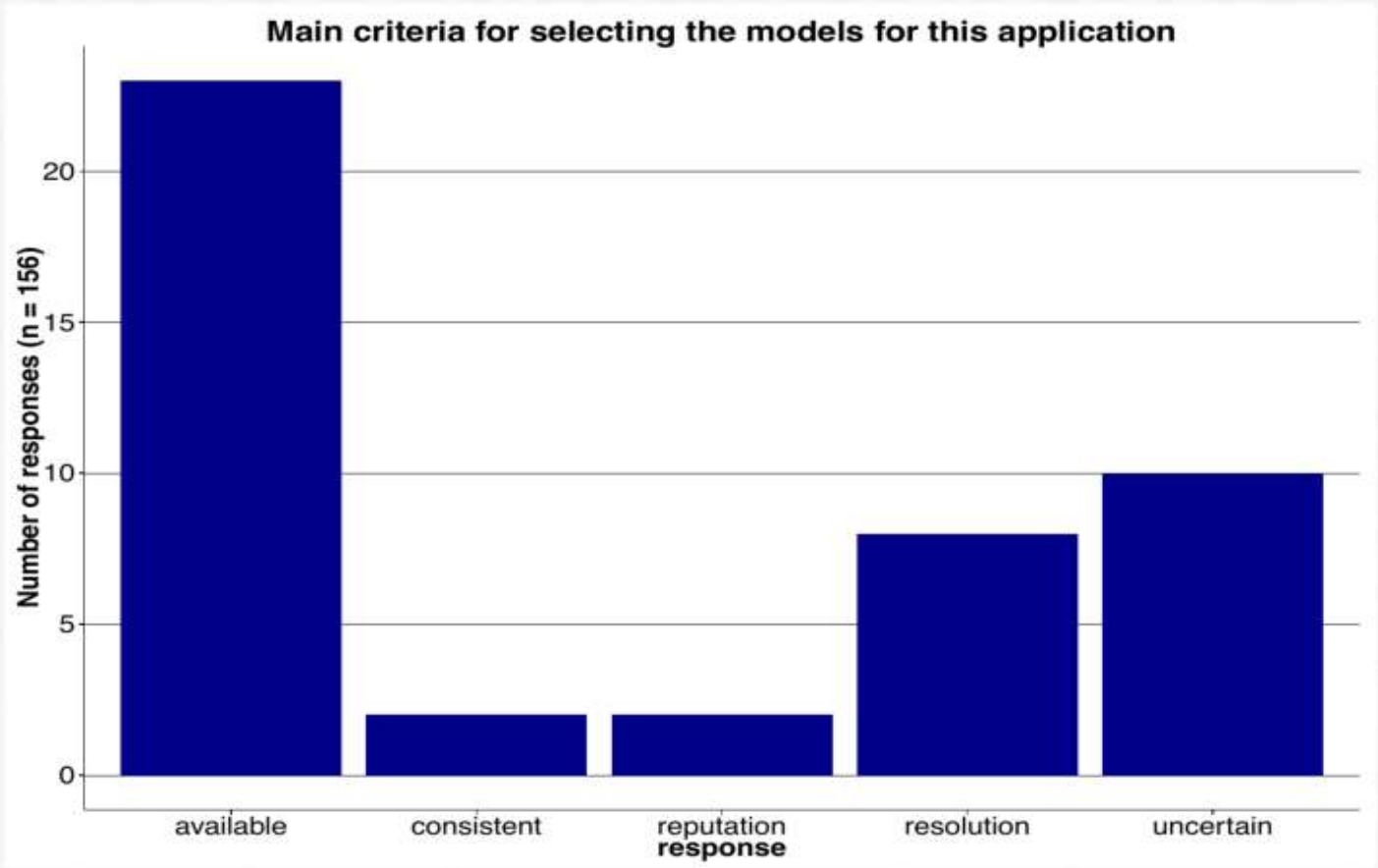
The decision maker's dilemma:

- Assess skill
- Understand confidence
- Consider uncertainty
- Accommodate dependency
- Reconcile contradictions
- Find trust amidst competing climate products and services



"The future cannot affect us, but we can be affected by conceptions of the future."



Availability!

Christiana Figueres: Executive Secretary of the United Nations Framework Convention on Climate Change (UNFCCC) - https://twitter.com/CFigueres

"As we begin to develop strategies for facing the threat of climate change, there are three basic questions we constantly ask ourselves:

- Who is responsible?
- Who is affected?
- Who should do something about it?

Were the answer to all three questions one and the same, the matter would be a relatively simple one. The fact that the answers are all different, puts us into the perplexing arena of an ethical predicament."

How we frame the information needs will be highly influential on the actions we undertake.

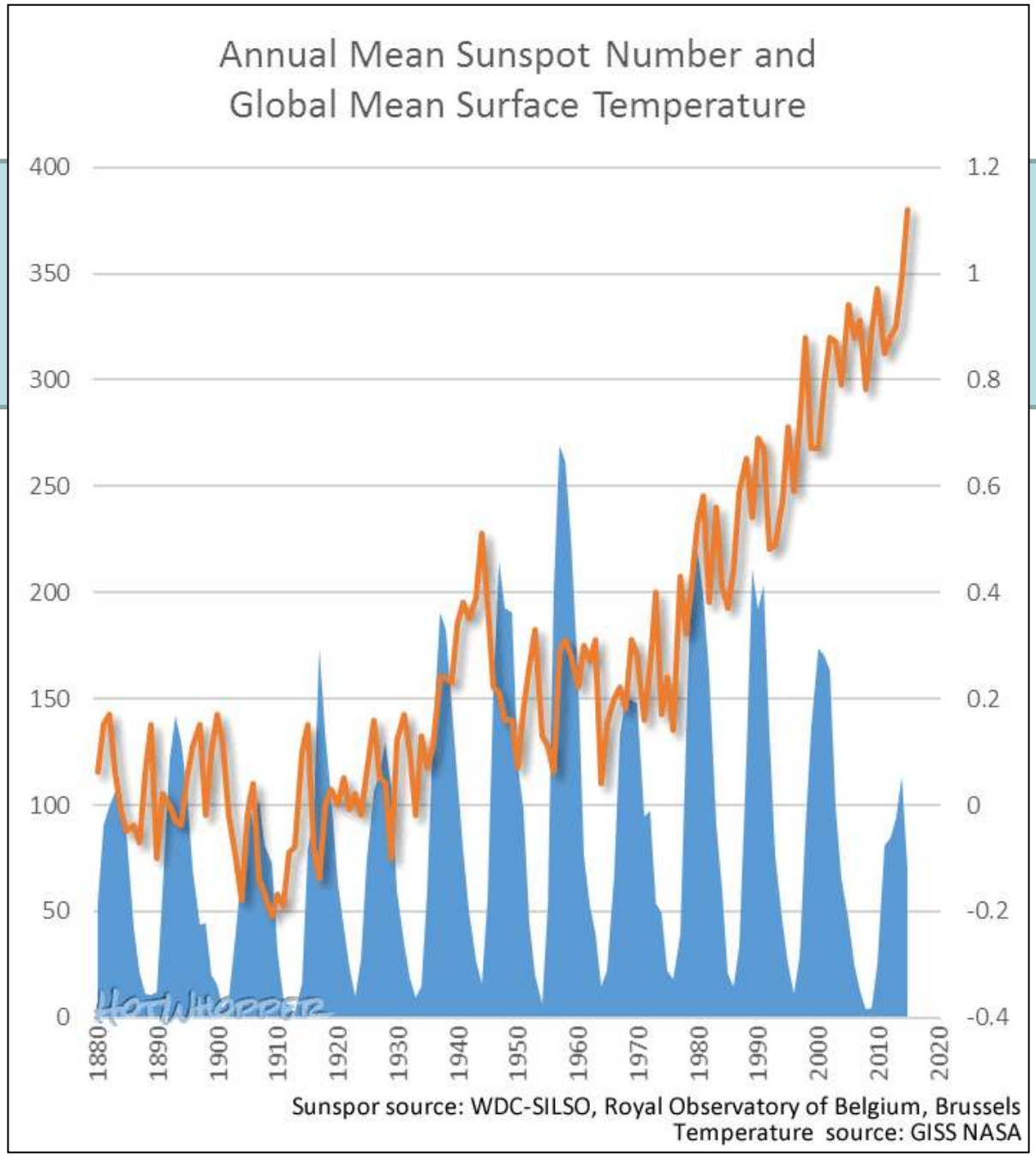
In part this is because of the multiple community's different priorities, language sets, interests, and conceptions of other communities.

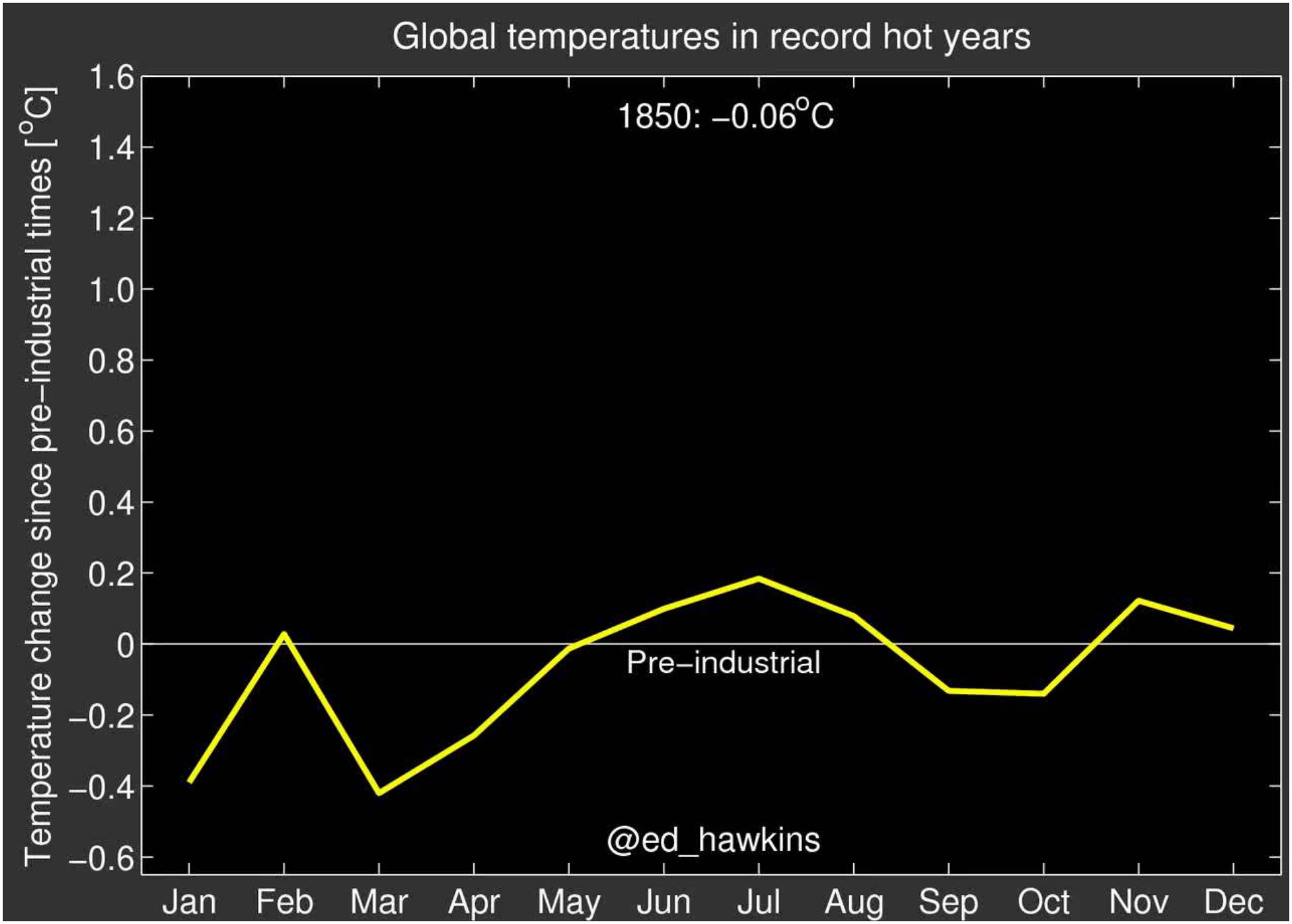
e.g. here today there is probably a limited consensus on defining "information".

Bridging the gap will, of necessity, require engagement in "3rd space thinking" – working in that interface where <u>getting the small stuff</u> right is really important.

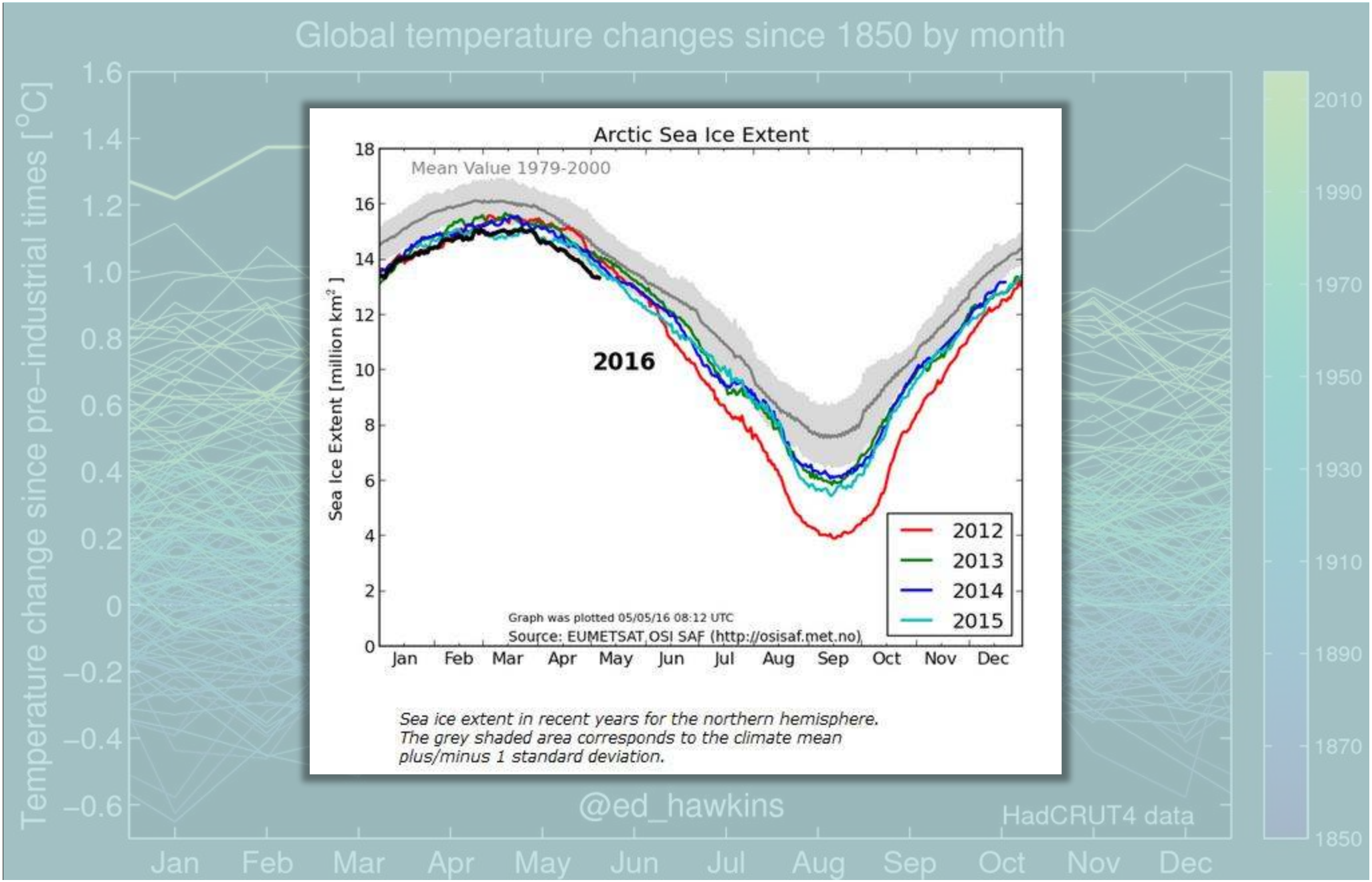
(Imagine building a bridge starting from each side, one side using meters, the other using yards)

There are many who would like to explain it all away.





From Ed Hawkins, University of Reading



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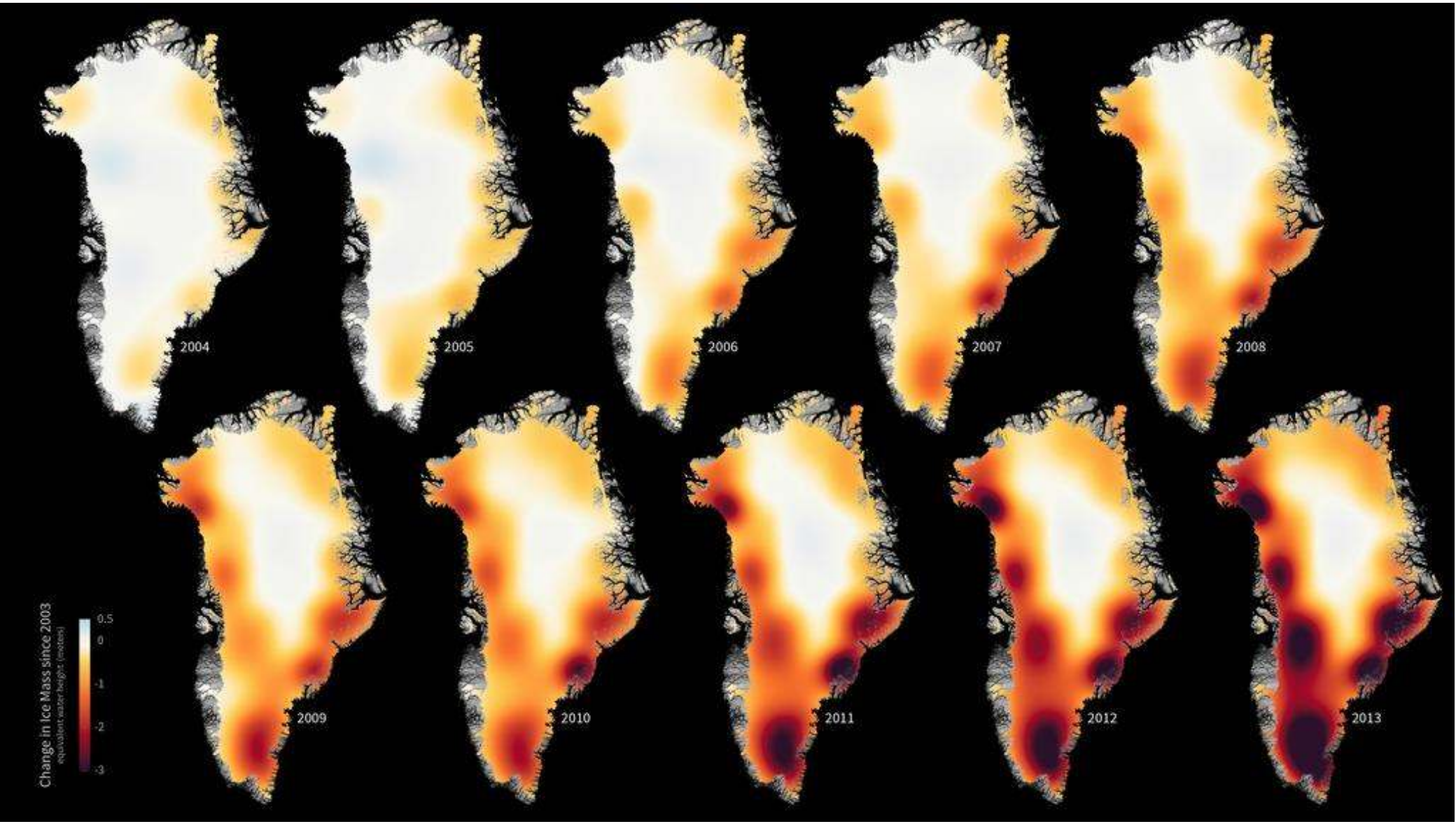
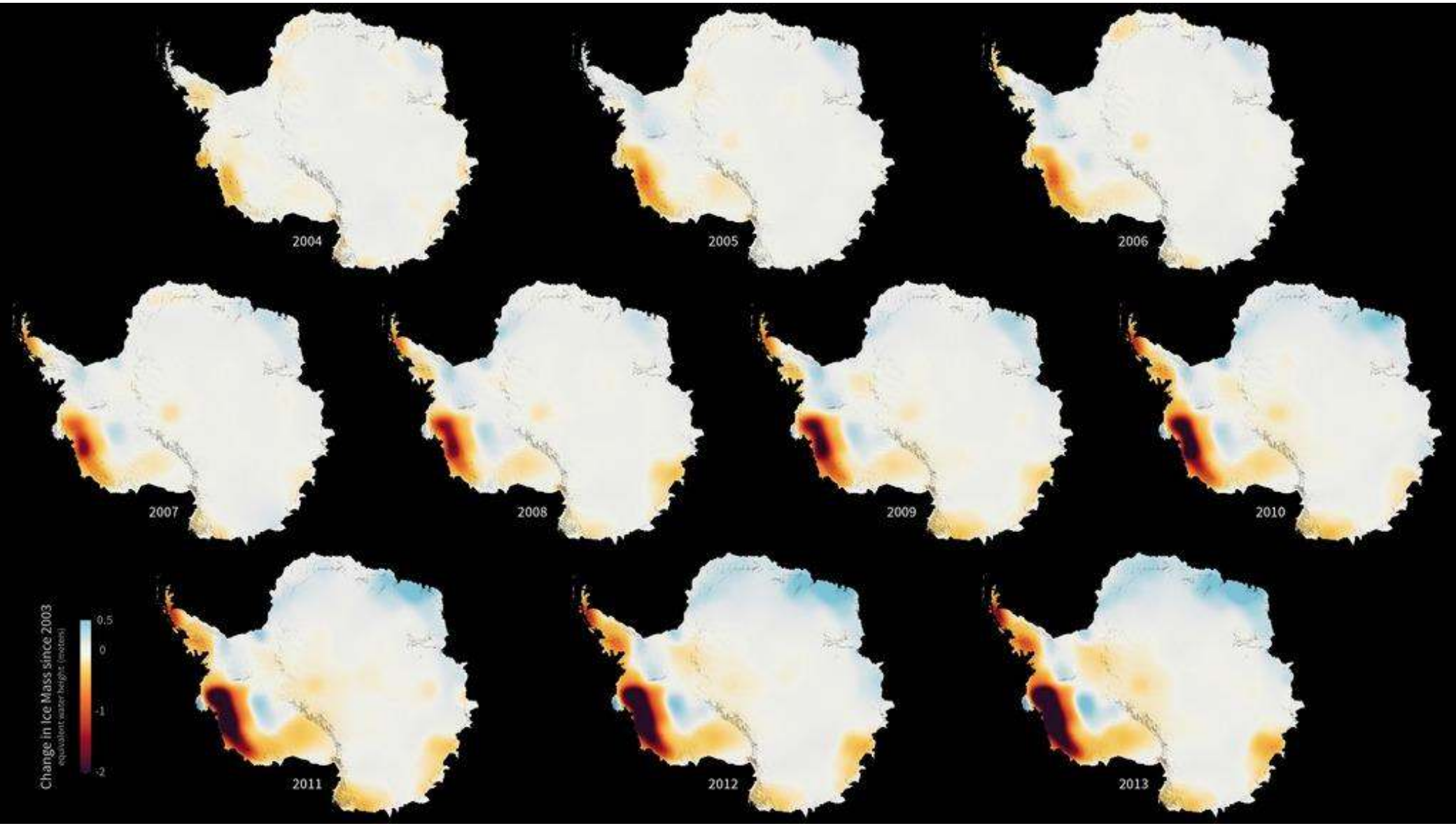
Ice loss relative to 2003



From GRACE satellite, NASA

Ice loss relative to 2003



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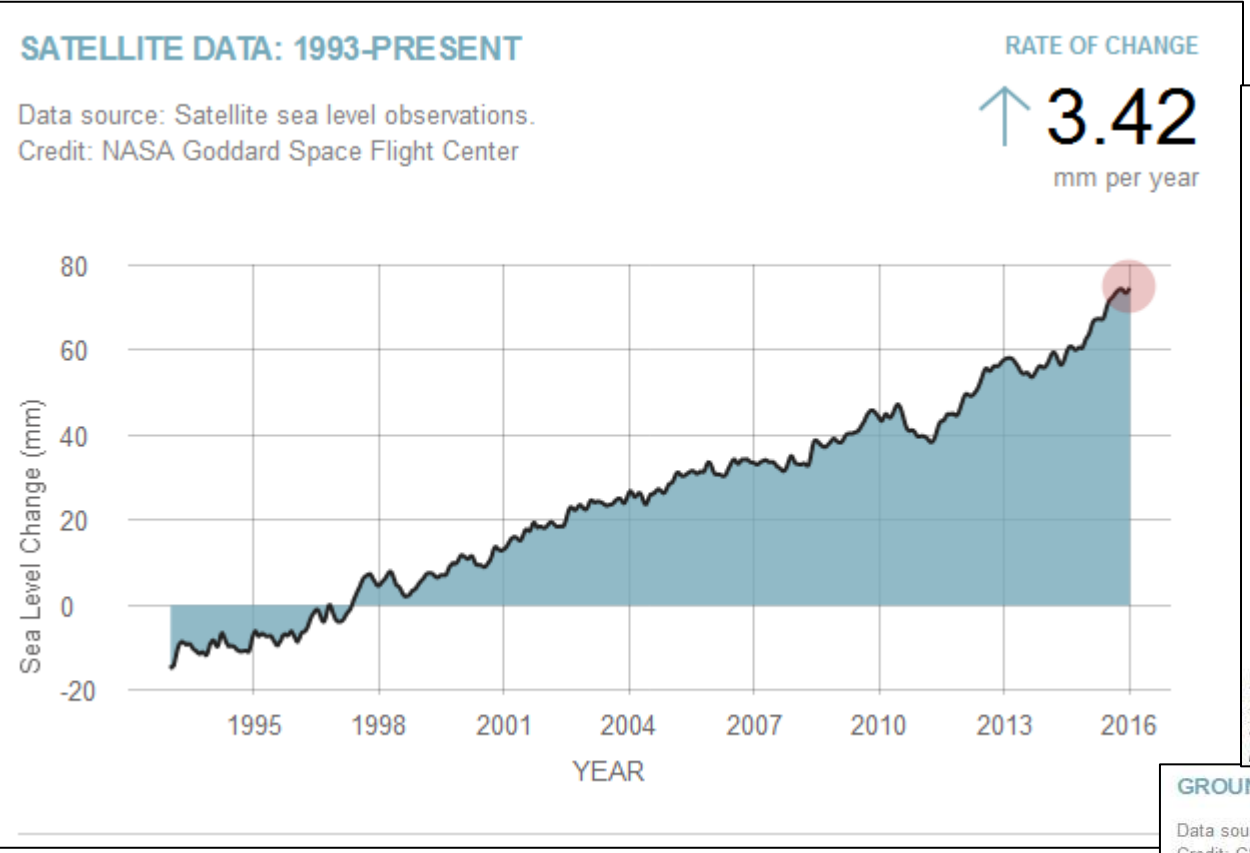


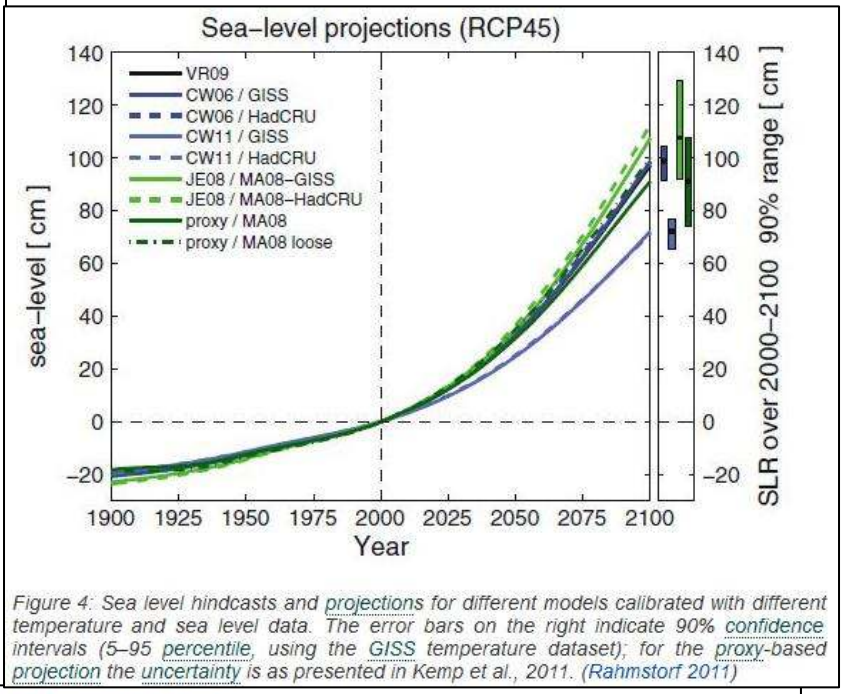
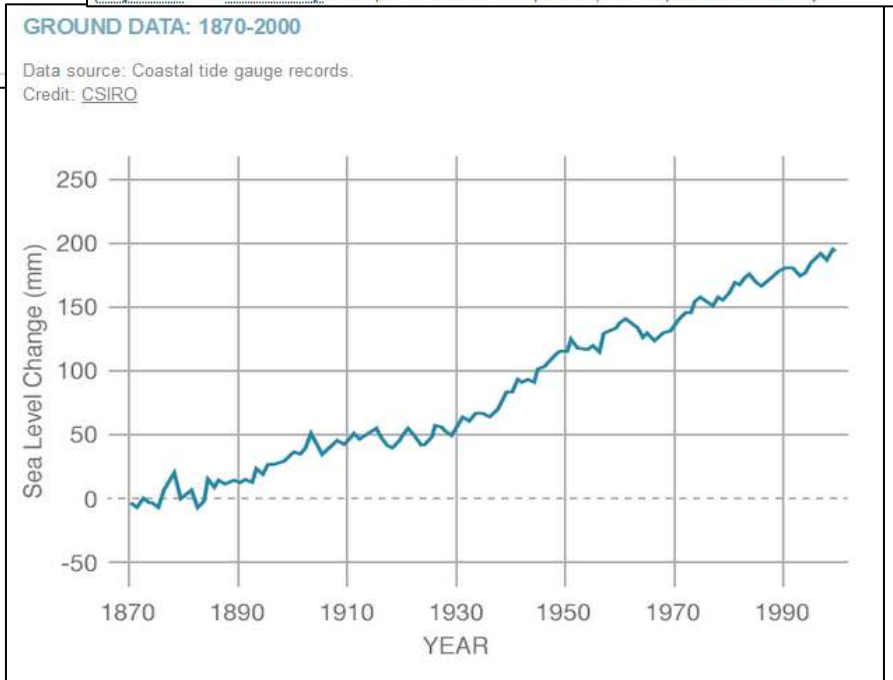


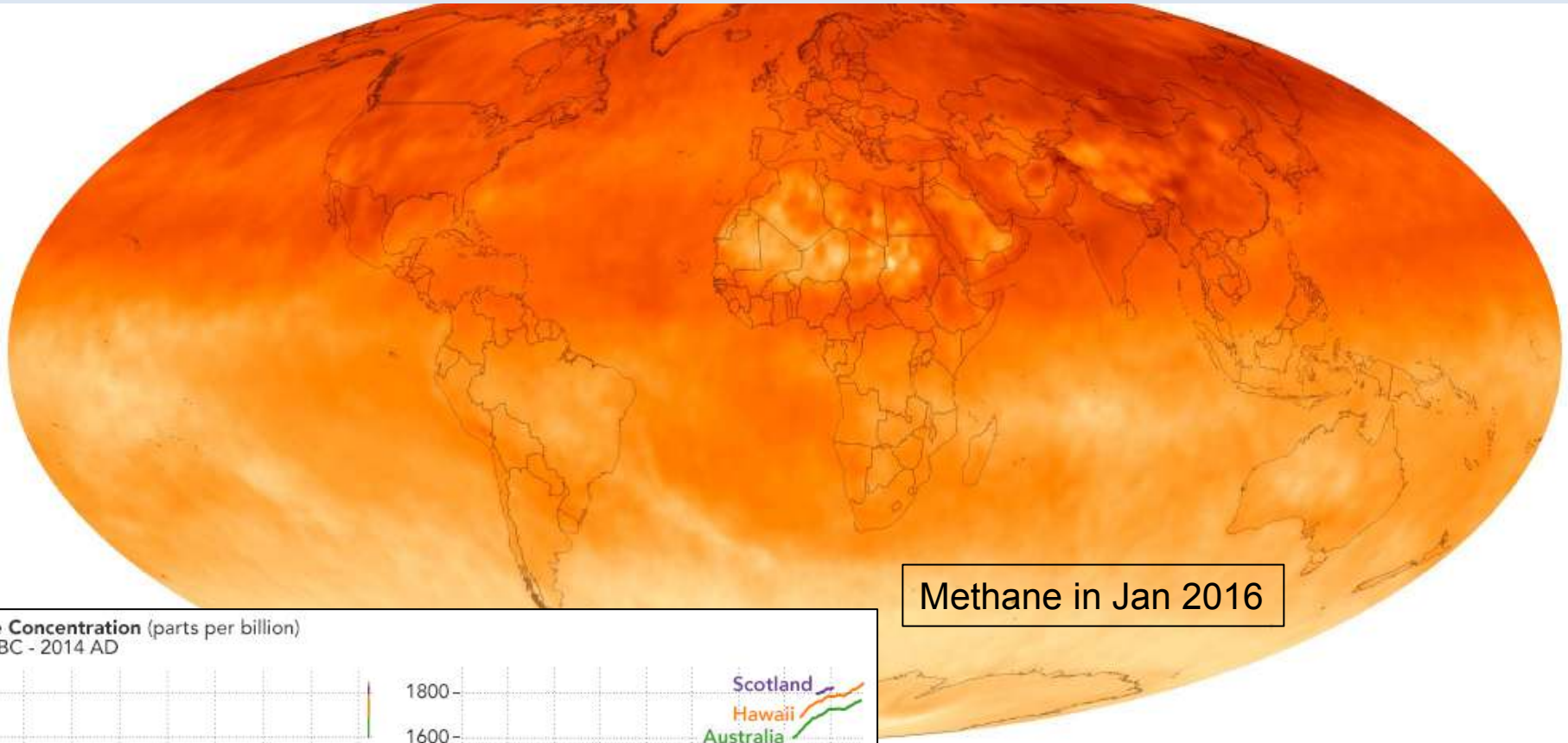
Figure 4: Sea level hindcasts and projections for different models calibrated with different temperature and sea level data. The error bars on the right indicate 90% confidence intervals (5–95 percentile, using the GISS temperature dataset); for the proxy-based projection the uncertainty is as presented in Kemp et al., 2011. (Rahmstorf 2011)

Recent evidence suggests we may have under-estimated the non-linear response: "*Ice sheets are contributing to sea level rise sooner, and more than anticipated*" Eric Rignot, NASA's Jet Propulsion Laboratory.

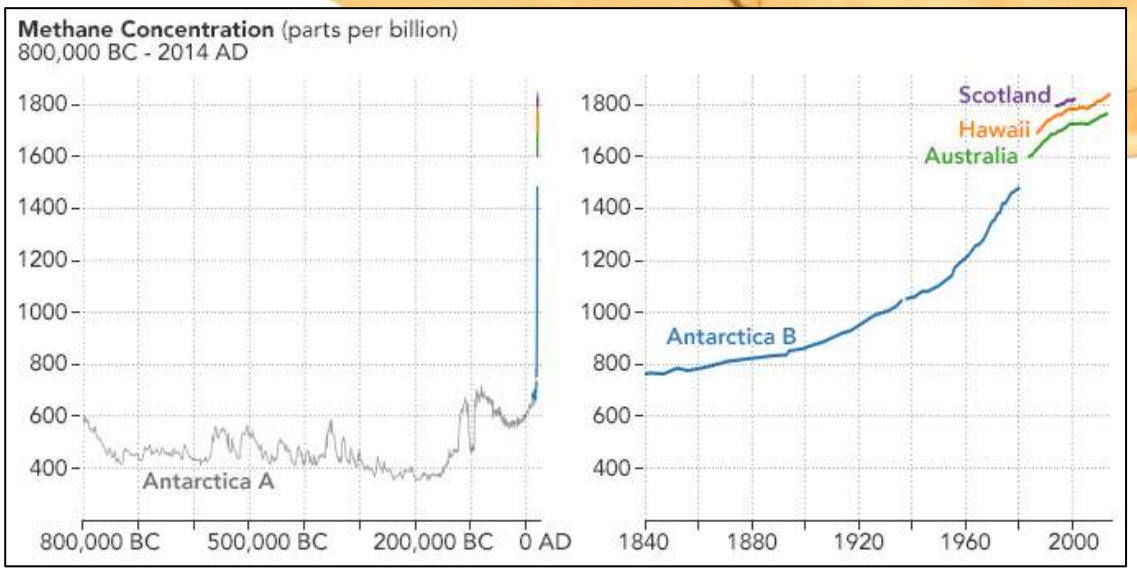
The majority of major cities are on coastlines!



Feedbacks and thresholds … the 4am nightmare.

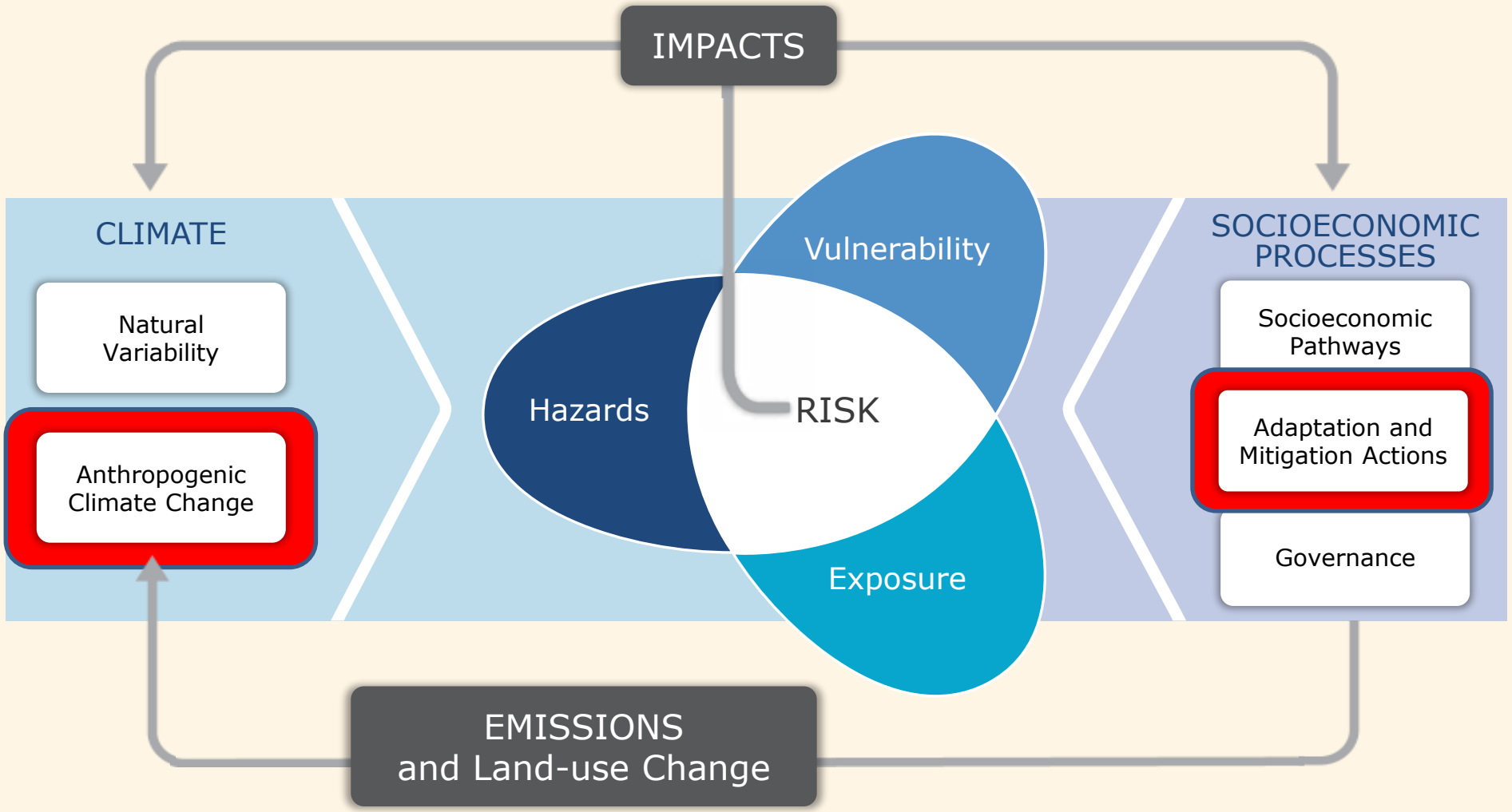


Methane in Jan 2016



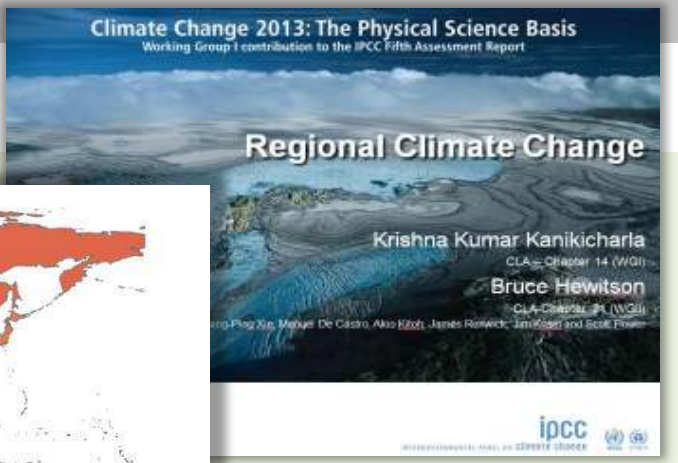
And thresholds: e.g. physiological survivability, health and disease, crops and cows, etc.

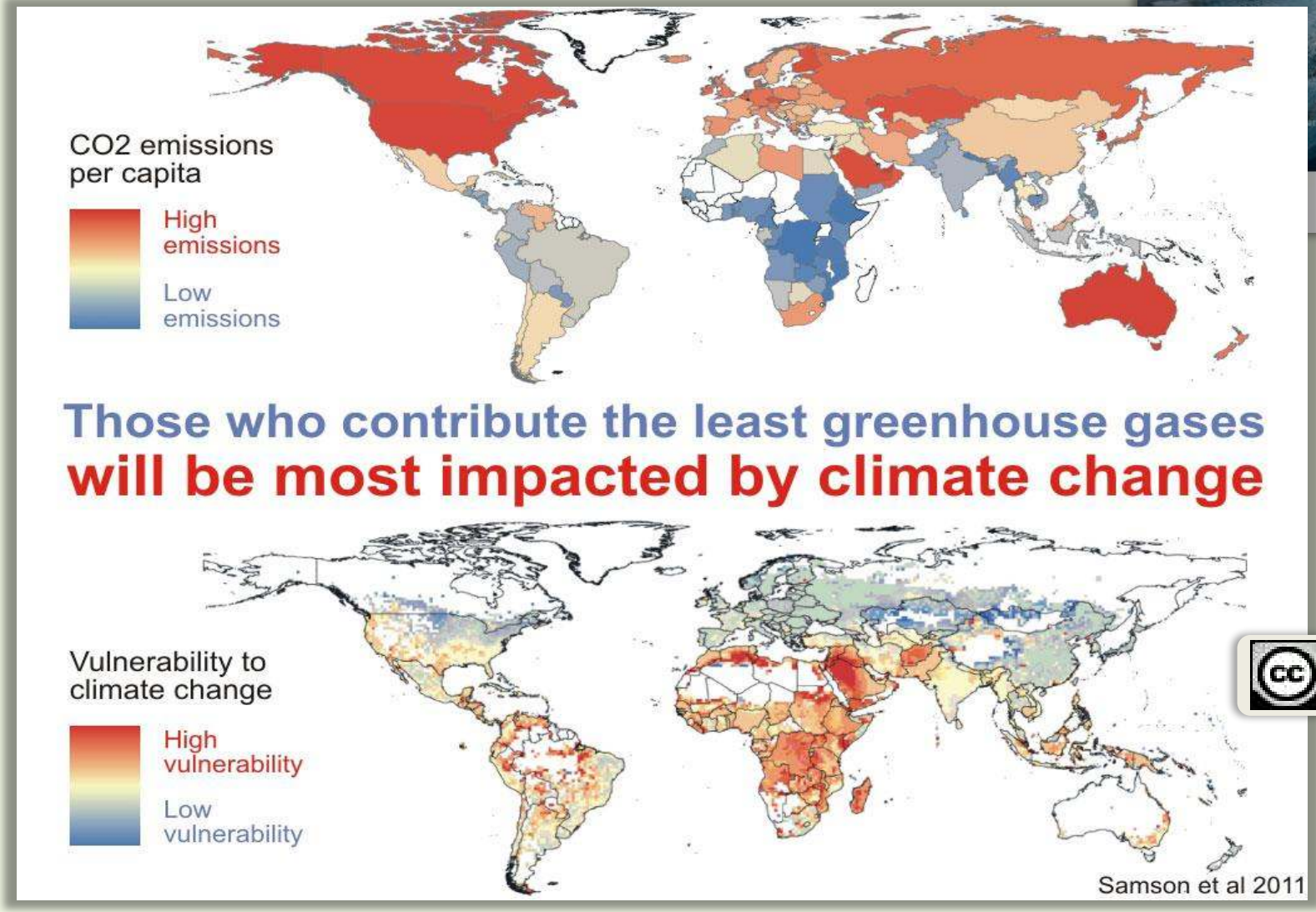
Added stress from Climate change → additional needs for adaptation and mitigation



Impacts and responses are PLACE and SECTOR specific

Consequences

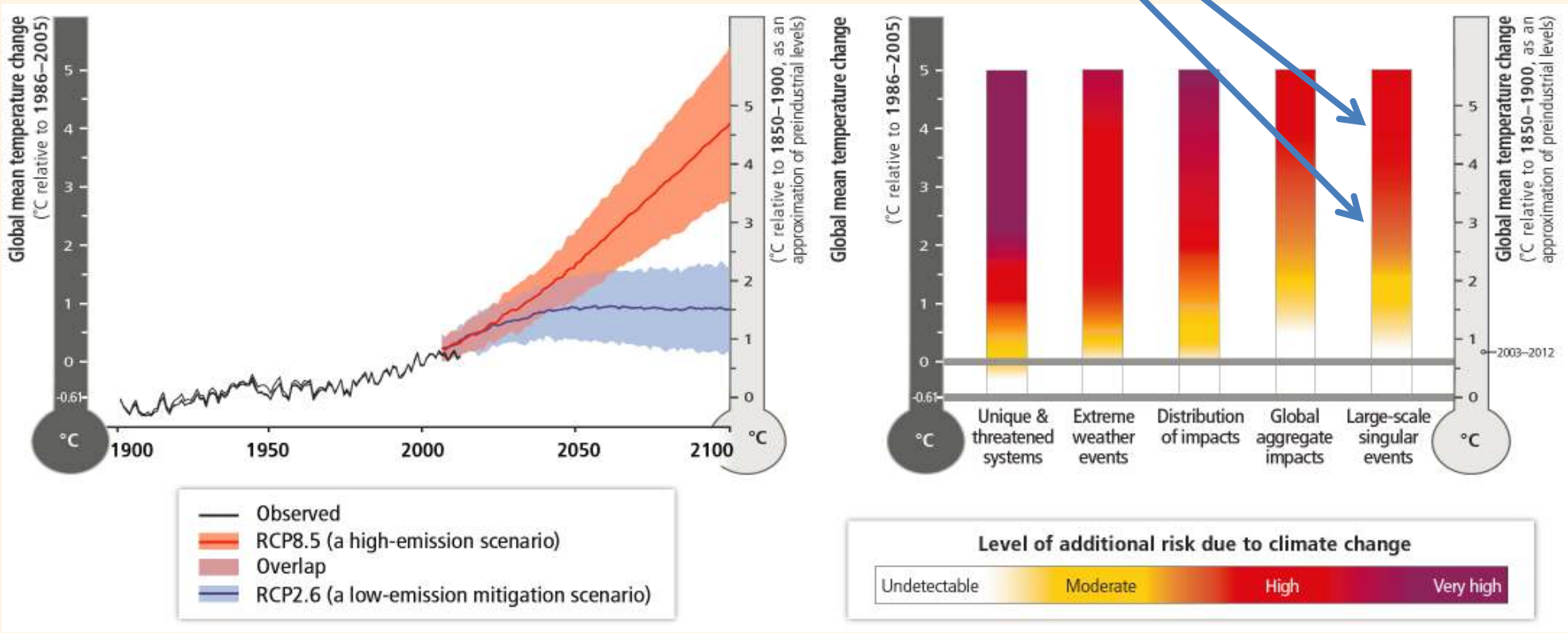




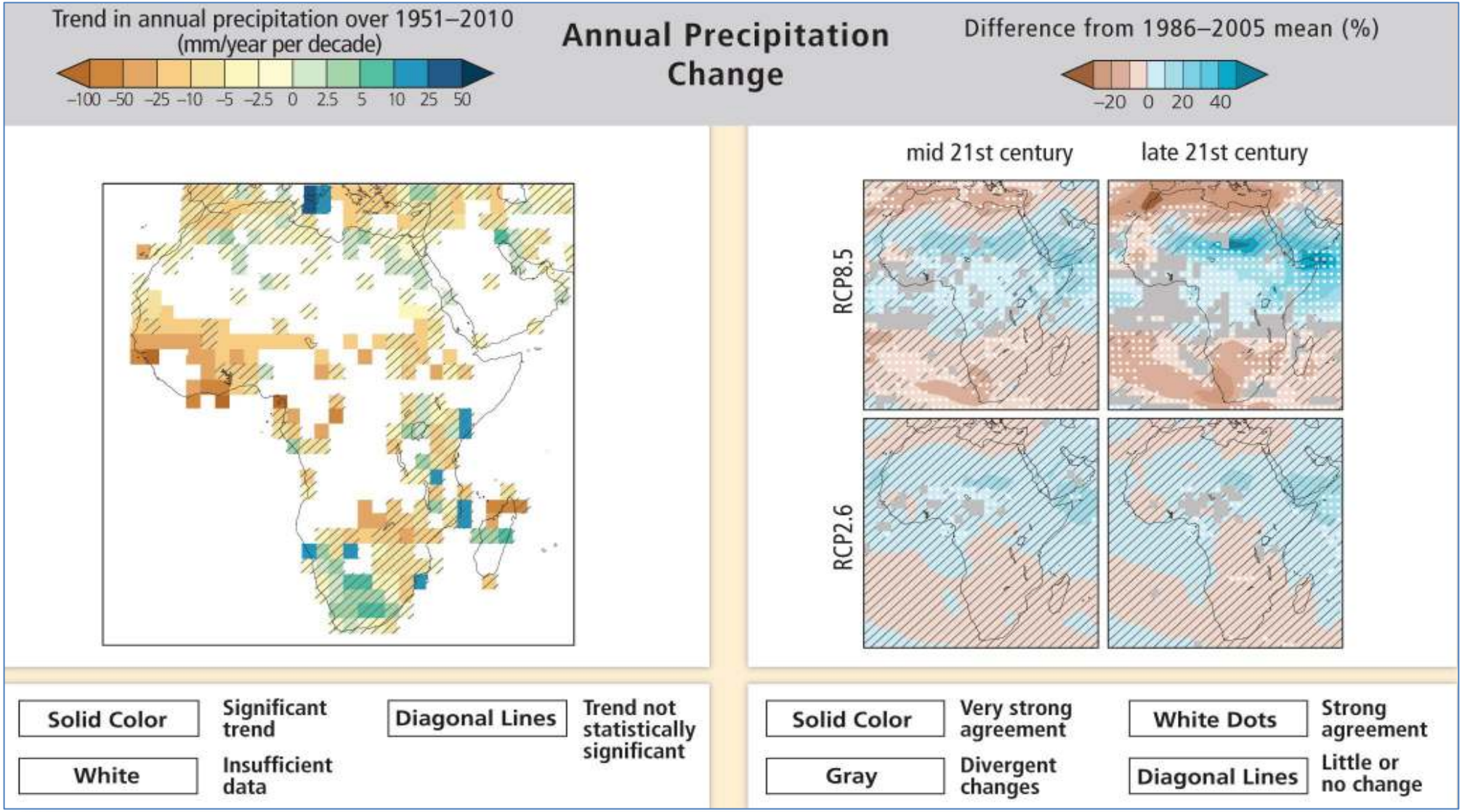
Where is society's acceptable level of risk?

WG2 Box SPM.1 Figure 1

Five integrative reasons for concern (RFCs) provide a framework for summarizing key risks across sectors and regions.



IPCC WG2 Fig 22.1



Issue: How to construct messages for the decision scale?

The role of information

“The future cannot affect us,
but we can be affected by conceptions of the future.”

“The past cannot affect us,
but we can be affected by conceptions of the past.”

We need Information for regions, rather than regional information.

This places a demand for data that are scale relevant,with tailored attributes and quantified uncertainty, and include co-behavior of variables across local, regional, hemispheric and global scales on the range of time scales of variability.

Cities and their co-dependent regions

The push for a 'Policy first' approach to adapting to climate change .... lower climate-related risks even if we don't know the exact profile of climate change in the decades ahead."

Complicated by the challenge of cross-community engagement without a common concept language

- regional "information"
- likelihood and uncertainty
- limits to skill
- scales in space and time
- signal and natural variability
- stability of climate relationships
- emissions scenarios
- etc.

The challenge:
[Moving] From "*it's real*" to "*here is the information you need to make good decisions for your stakeholders*" Chris Field, IPCC AR5 WGII co-chair

Maputo: 1.6 million people, 3.1% annual urbanization growth rate
(Africa generally urbanizing at 4%, the largest of any continent)

Cities and their co-dependent regions

- Contested values, authority, and accountability: according to whose values, by which authority, and with what accountability, will adaptation decisions be made?

- The ethical question of constructing and interpreting information for the decision scale for managing climate sensitive components of the co-dependent city-region system

- Consideration of thresholds of degradation and failure and the co-dependency of impacts;
  e.g.: Lusaka water in 2015/16 or Maputo's vegetable production in 2001

The challenge:
[Moving] From "*it's real*" to "*here is the information you need to make good decisions for your stakeholders*" Chris Field, IPCC AR5 WGII co-chair

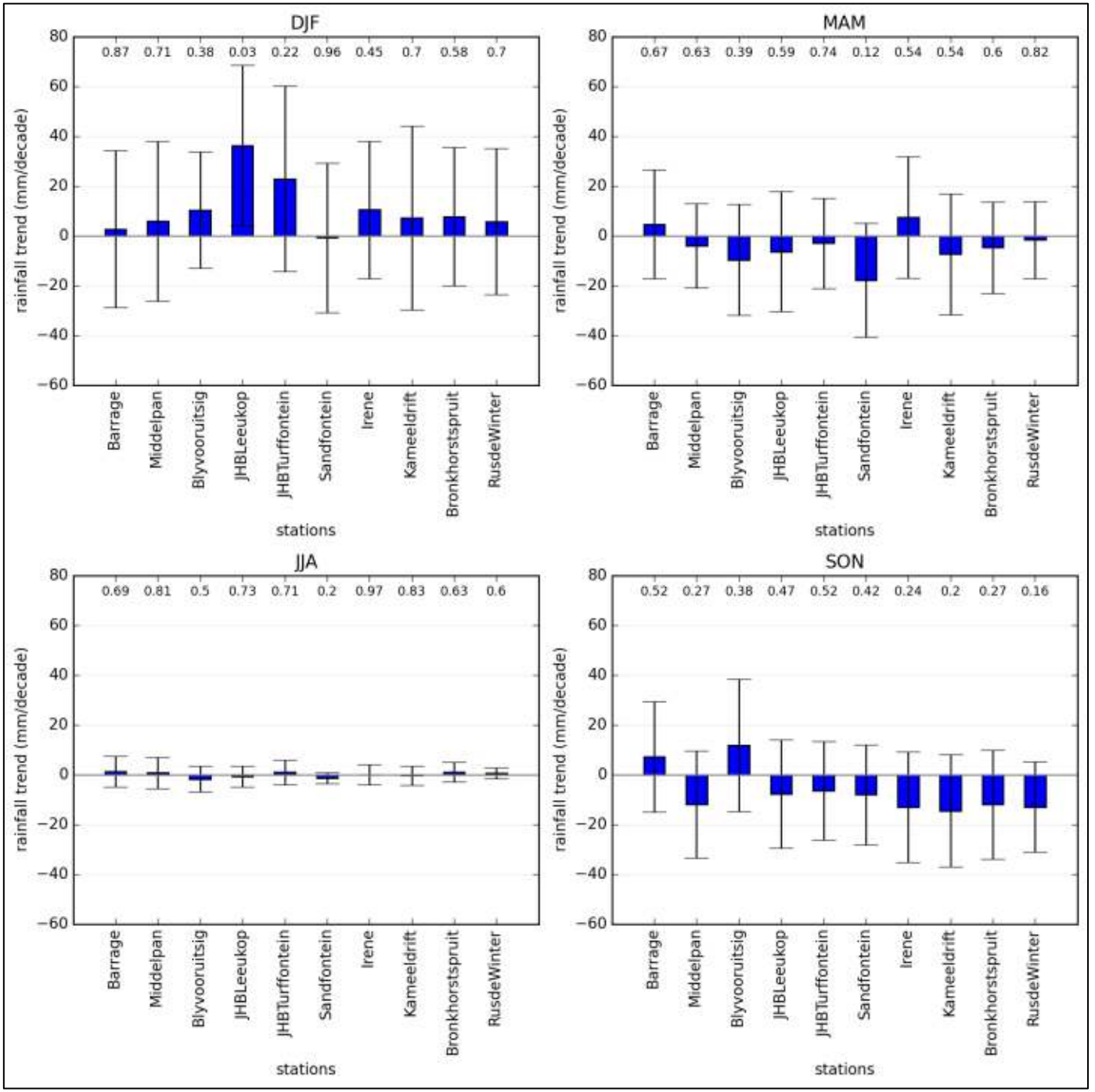
Maputo: 1.6 million people, 3.1% annual urbanization growth rate
(Africa generally urbanizing at 4%, the largest of any continent)

Pick a city: Johannesburg

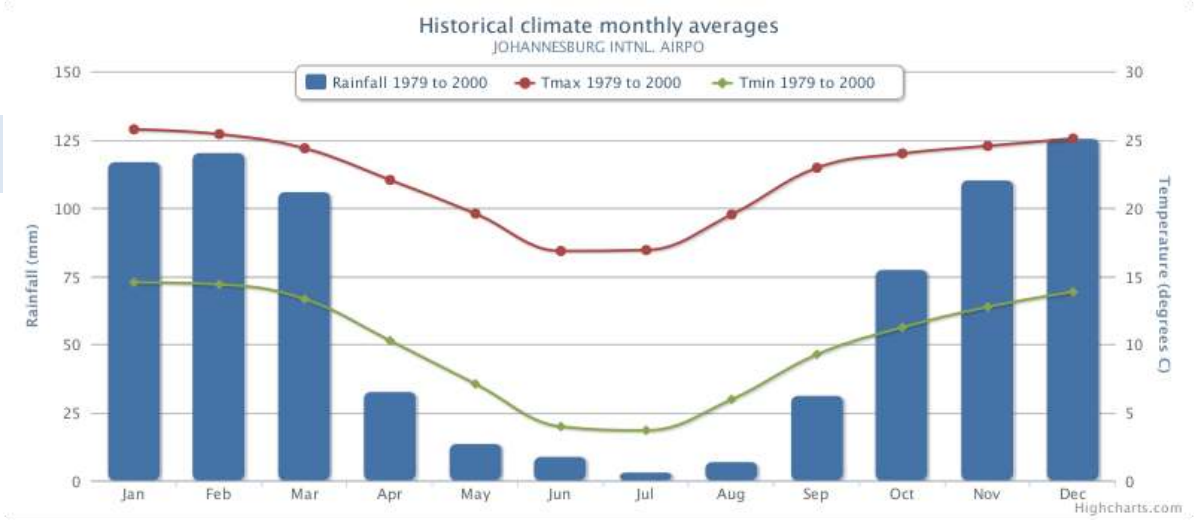
The urban system has key vulnerabilities, for example urban flooding under intense rain events.

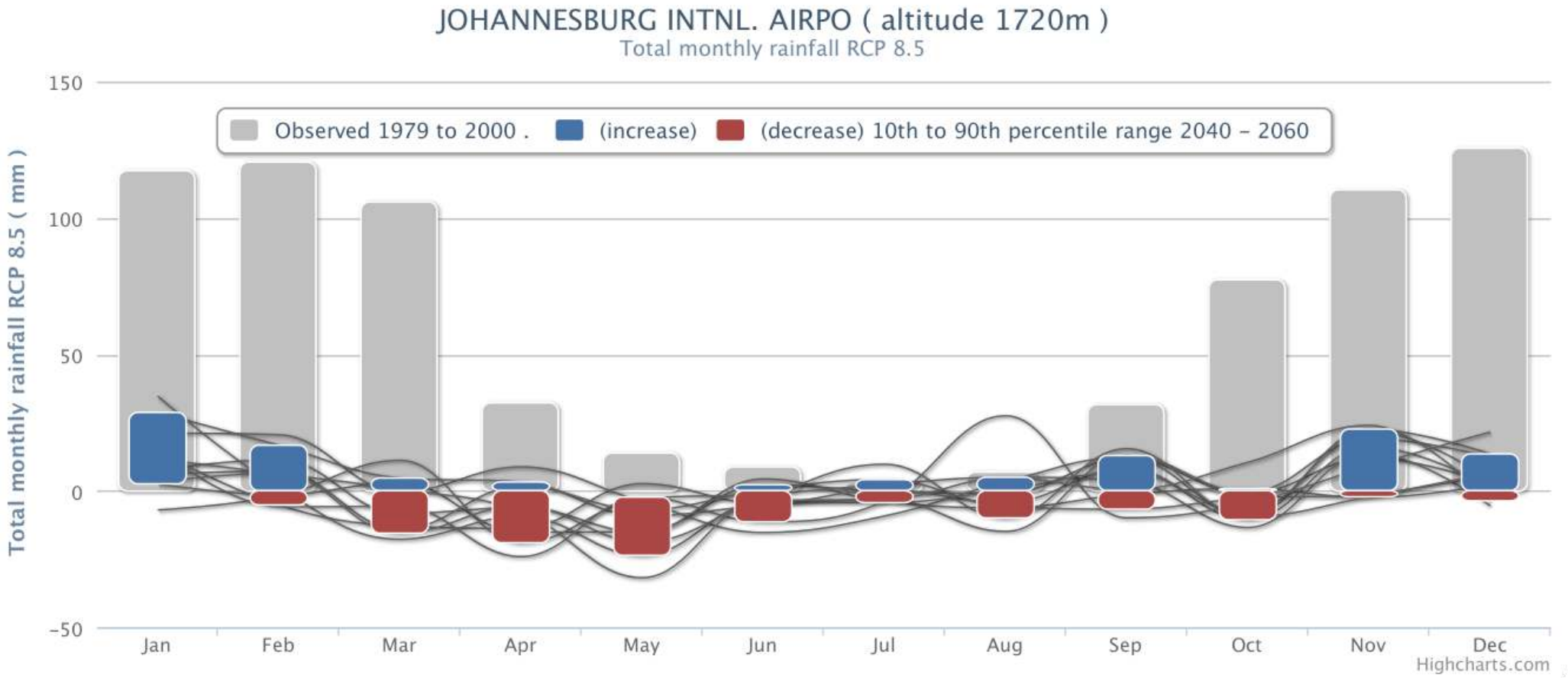
The city has regional co-dependencies, for example water from Lesotho and electricity from ESKOM.

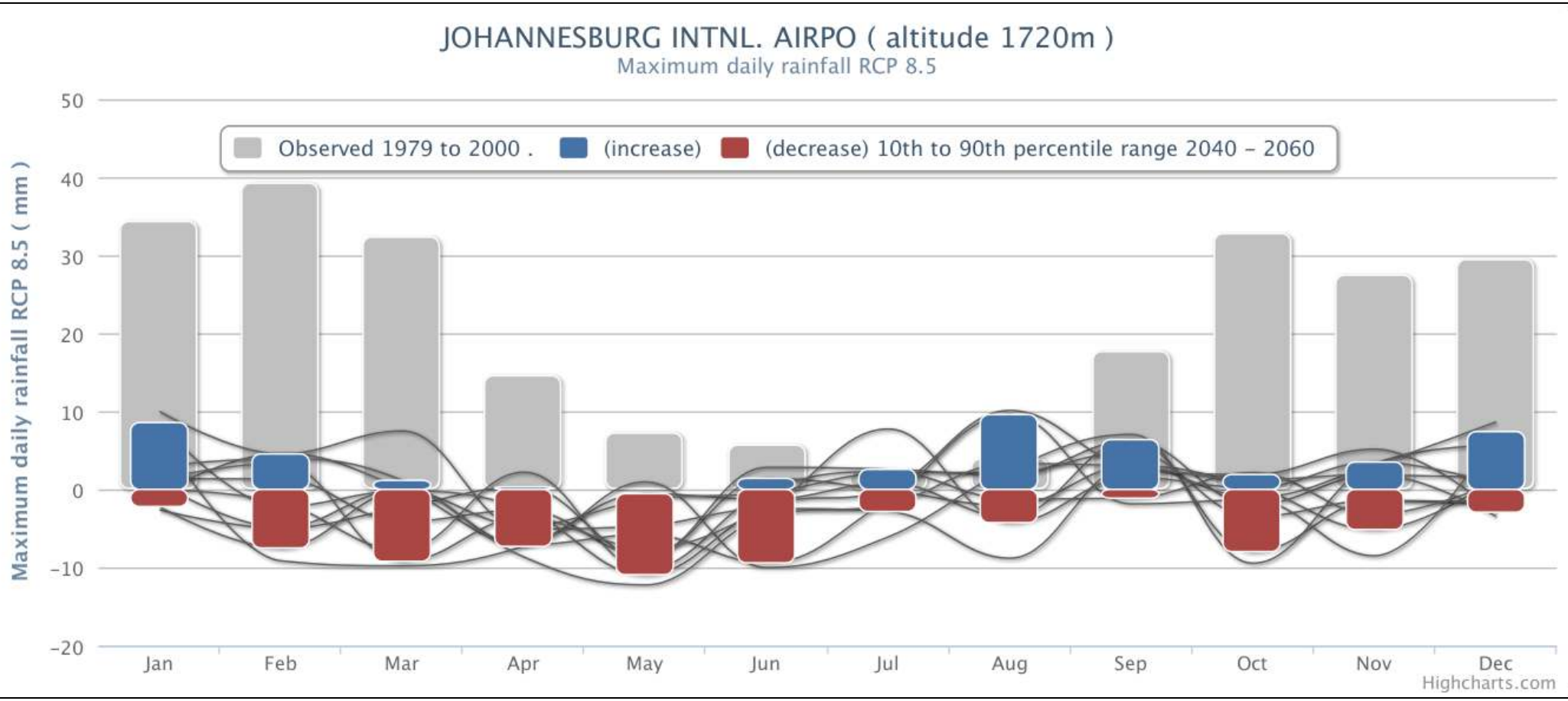
How then, would change in precipitation impact the linkages and fluxes in this system?



Baselines and projections






JOHANNESBURG INTNL. AIRPO (altitude 1720m)
Maximum daily rainfall RCP 8.5
Observed 1979 to 2000 .
(increase)
(decrease) 10th to 90th percentile range 2040 - 2060
Maximum daily rainfall RCP 8.5 (mm)
50
40
30
20
10
0
-10
-20
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Mar
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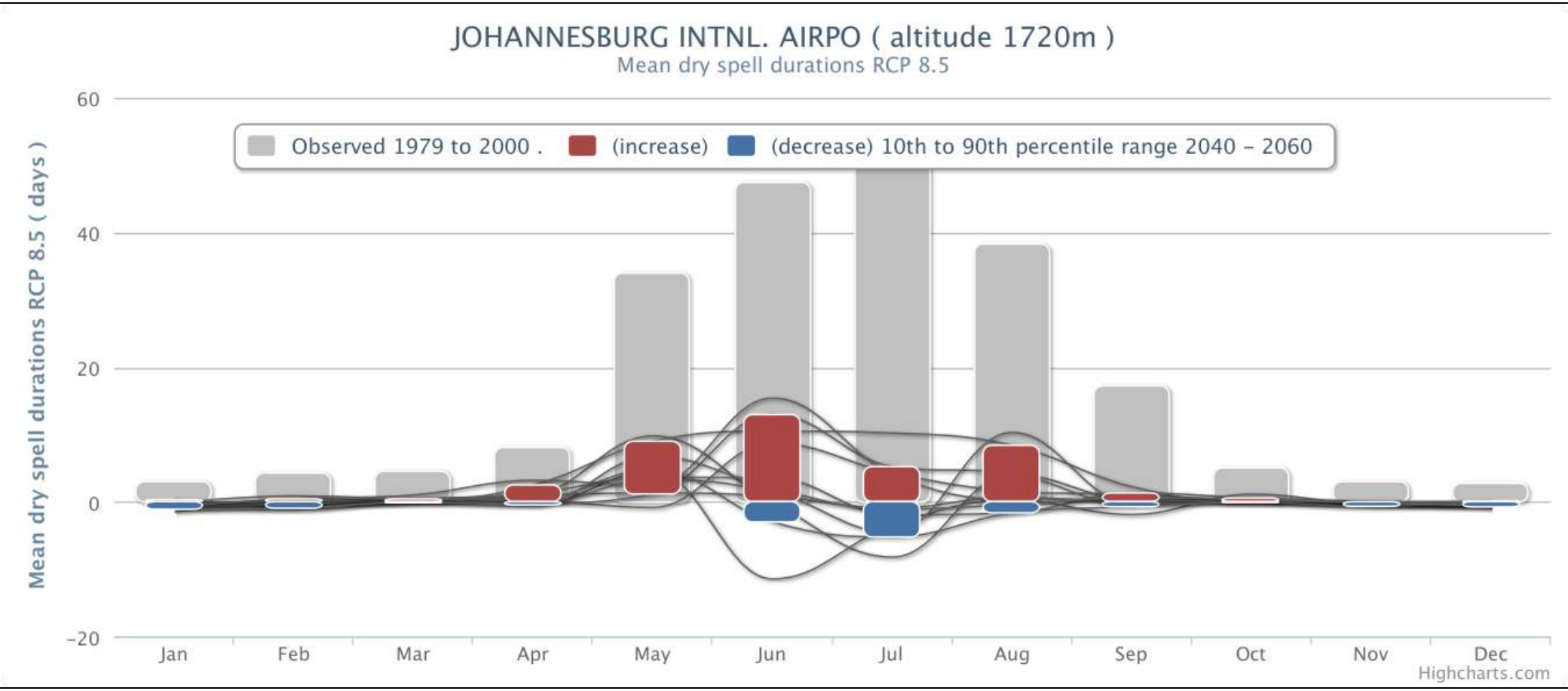
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Highcharts.com


JOHANNESBURG INTNL. AIRPO (altitude 1720m)
Mean dry spell durations RCP 8.5
Observed 1979 to 2000 .
(increase)
(decrease) 10th to 90th percentile range 2040 - 2060
Mean dry spell durations RCP 8.5 (days)
60
40
20
0
-20
Jan
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May
Jun
Jul
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Sep
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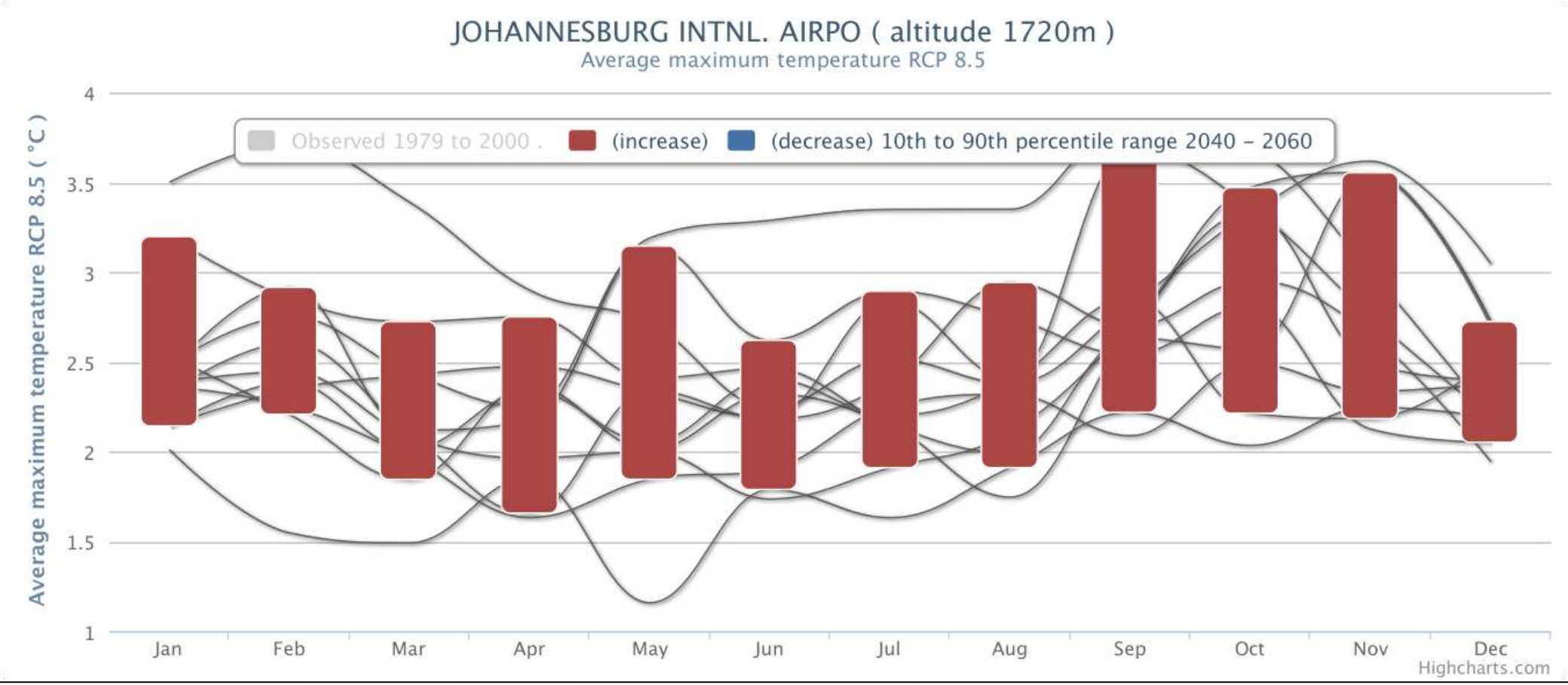
Nov
Dec
Highcharts.com


JOHANNESBURG INTNL. AIRPO (altitude 1720m)
Average maximum temperature RCP 8.5
Observed 1979 to 2000 .
(increase)
(decrease) 10th to 90th percentile range 2040 - 2060
Average maximum temperature RCP 8.5 (°C)
4
3.5
3
2.5
2
1.5
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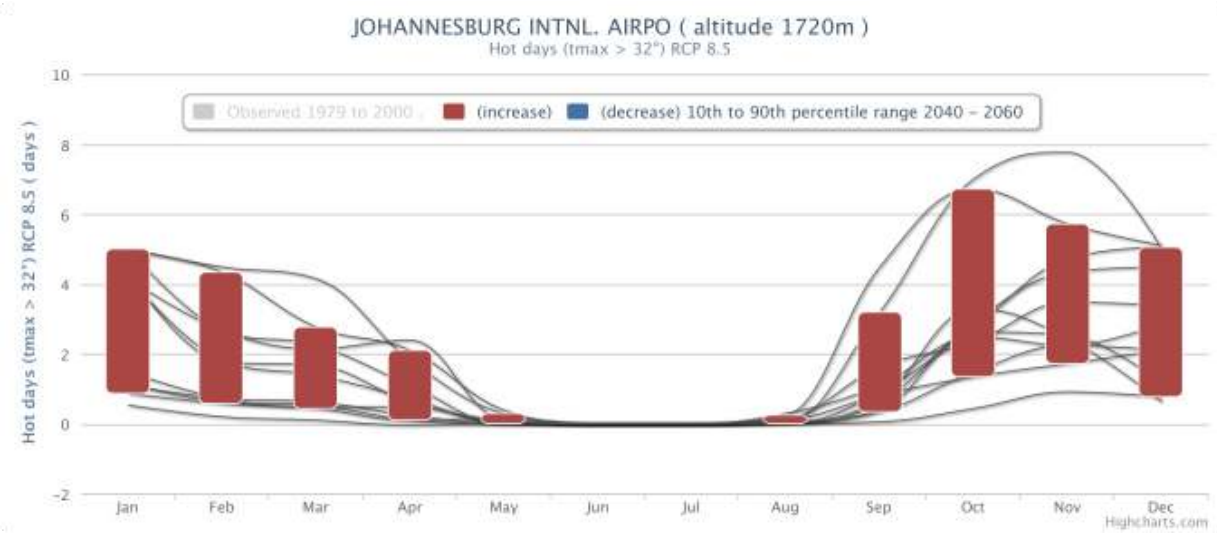
Highcharts.com


JOHANNESBURG INTNL. AIRPO (altitude 1720m)
Hot days (tmax > 32°) RCP 8.5
Observed 1979 to 2000 .
(increase)
(decrease) 10th to 90th percentile range 2040 - 2060
Hot days (tmax > 32°) RCP 8.5 (days)
10
8
6
4
2
0
-2
Jan
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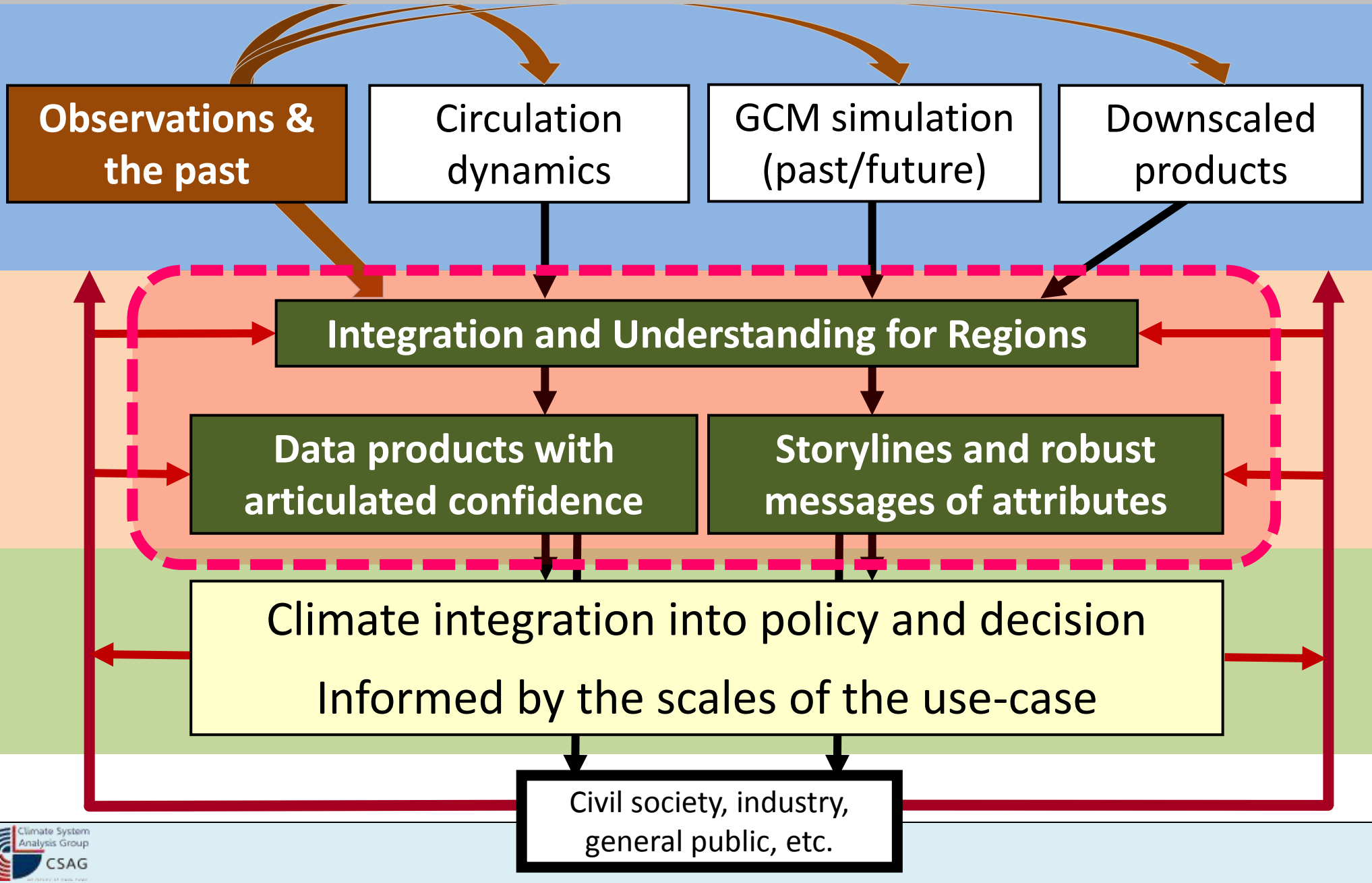
Nov
Dec
Highcharts.com

The Distillation Dilemma



City contexts

Issues in responding to a shared problem

- Strong planning focused environment
- Competing modes and methods including political contexts when making decisions.
- Technical versus ‘softer’/greener approaches
- Decision making is therefore linked to a way of operating.
- Linear approaches usually too simple.

Planning for change

- Developing City – competing, multi-stressor environment: issues of climate stress, water and energy demand.
- Engineering capacity and design for built, **'hard' infrastructure** to withstand extreme weather conditions and climate-related disasters such as flooding, heatwaves, drought needed.
- Maintenance protocols, planning, and monitoring systems required.
- **Ecological infrastructure** that can protect hard engineering structures and build greater resilience within a city.

(One approach) City adaptation planning

(example Ekurhuleni, F. Aucamp)

Change the **internal mind-set**

Incorporate environmental considerations into **all aspects of council business.**

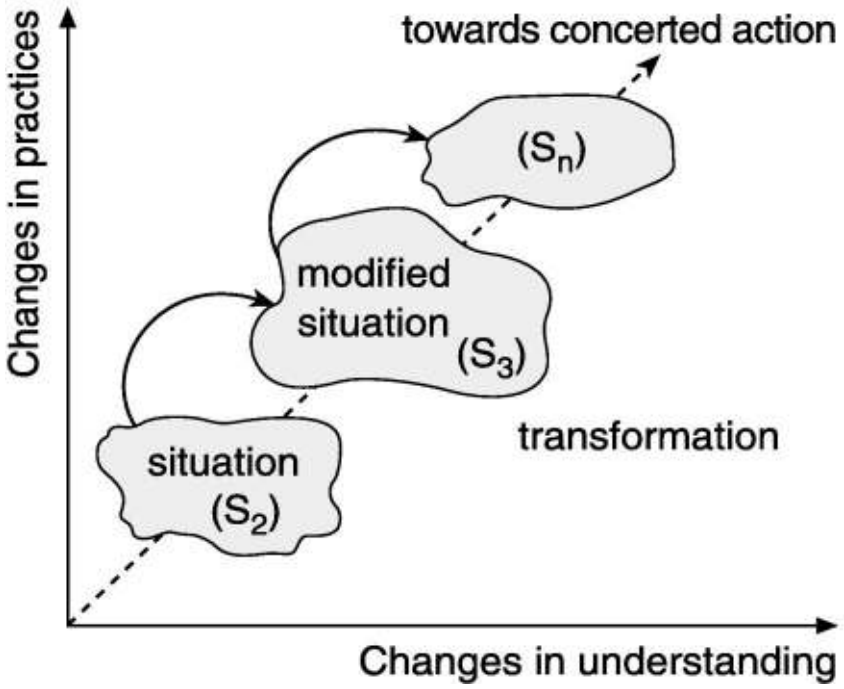
Plan **translates** the policy statements and ultimate outcomes into **tangible and practical actions for stakeholders**

Allocation to **responsible departments** in order to achieve the policy goals

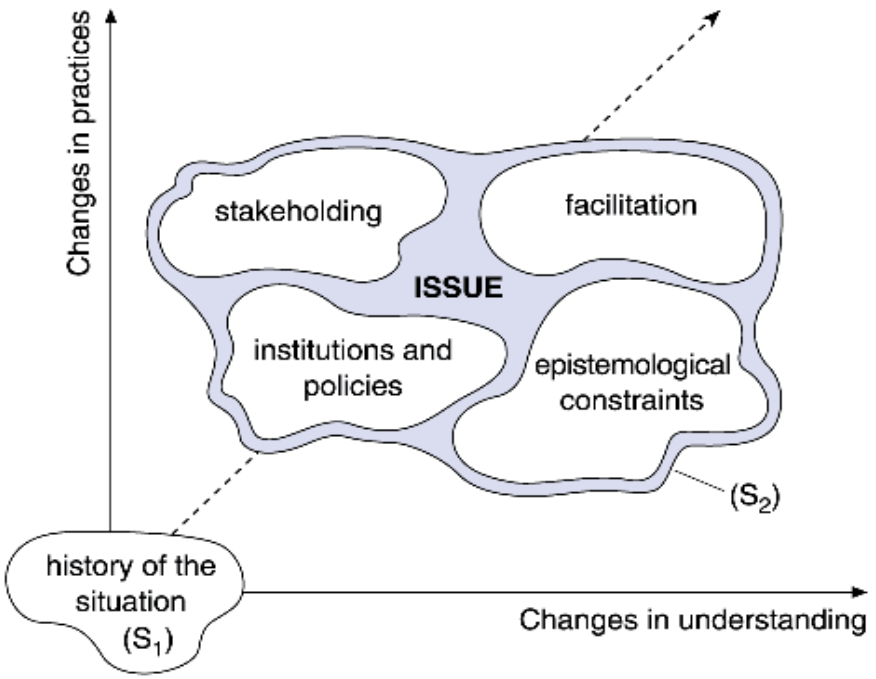
Policy goals **translate to high-level outcomes that should be reported on in the IDP/SDBIP**

Ensure **support** through KPIs that are monitored, assessed quarterly and funded

Transformative practice using systems approaches?



(after SLIM, 2004)



Social learning: a process of socially constructing an issue by actors in which their understandings and practices change, leading to transformation of the situation through collective / concerted action.

Future Resilience for African CiTies And Lands (FRACTAL)

Climate System Analysis Group
University of Cape Town

3 + 2 + 3 Cities with their co-dependent regions

- Maputo, Lusaka, Windhoek – core & funded
- Durban, Cape Town (Jhb) – partners, self-funded
- Cities have a signed commitment to engage
- Each city has partners from local academia and from city governance
- Tier 2 cities to evaluate knowledge transferability: (Blantyre, Gaborone and Harare)

Maputo: 1.6 million people, 3.1% annual urbanization growth rate
(Africa generally urbanizing at 4%, the largest of any continent)