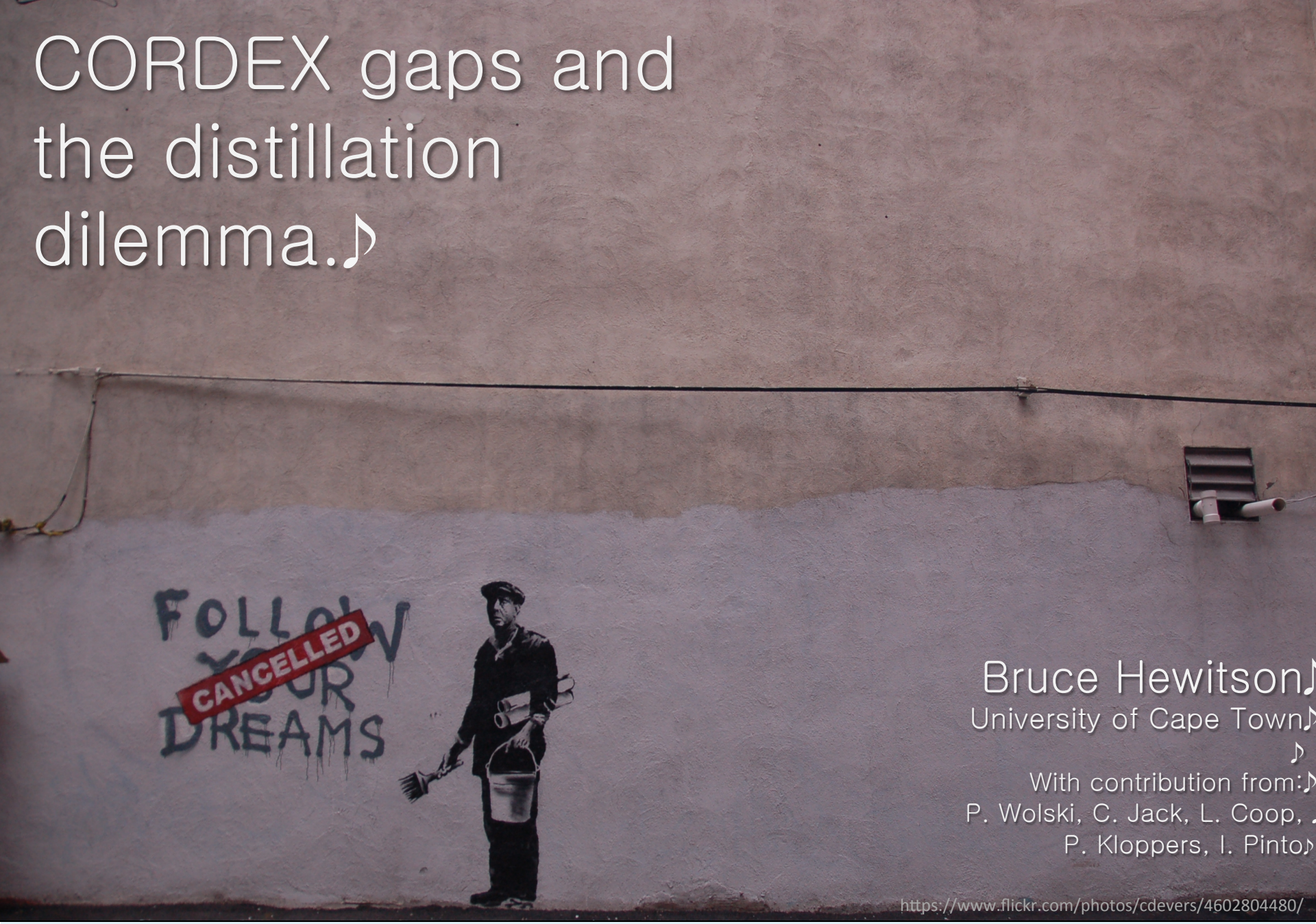
CORDEX gaps and the distillation dilemma.♪



Bruce Hewitson♪
University of Cape Town♪
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With contribution from:♪
P. Wolski, C. Jack, L. Coop, ♪
P. Kloppers, I. Pinto♪

https://www.flickr.com/photos/cdevers/4602804480/

“The insurance sector has already said that a world that goes above 2 deg is systemically uninsurable” and “… our moral responsibility of everyone alive today, is to align ourselves with 1.5 deg”

ADAPTATION FUTURES 2016 - Plenary Tuesday 10 May. Christiana Figueres, Executive Secretary of the United Nations Framework Convention on Climate Change. https://youtu.be/LOvDeIpVM8w

But what is the information for the decision-scale? An ethical-epistemic problem

At the conference was an initiative that said “*We take care of the [data] hassle... Transparently. Spatial and temporal grids of climate projections are harmonized. Biases on variables are corrected to make the data directly useable.*”

Future Resilience for African CiTies And Lands (FRACTAL)

Climate System Analysis Group

University of Cape Town

If ever we needed information distillation …

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
- 2 cities to evaluate knowledge transferability: Gaborone and Harare)

Google Earth

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

Capturing the essence

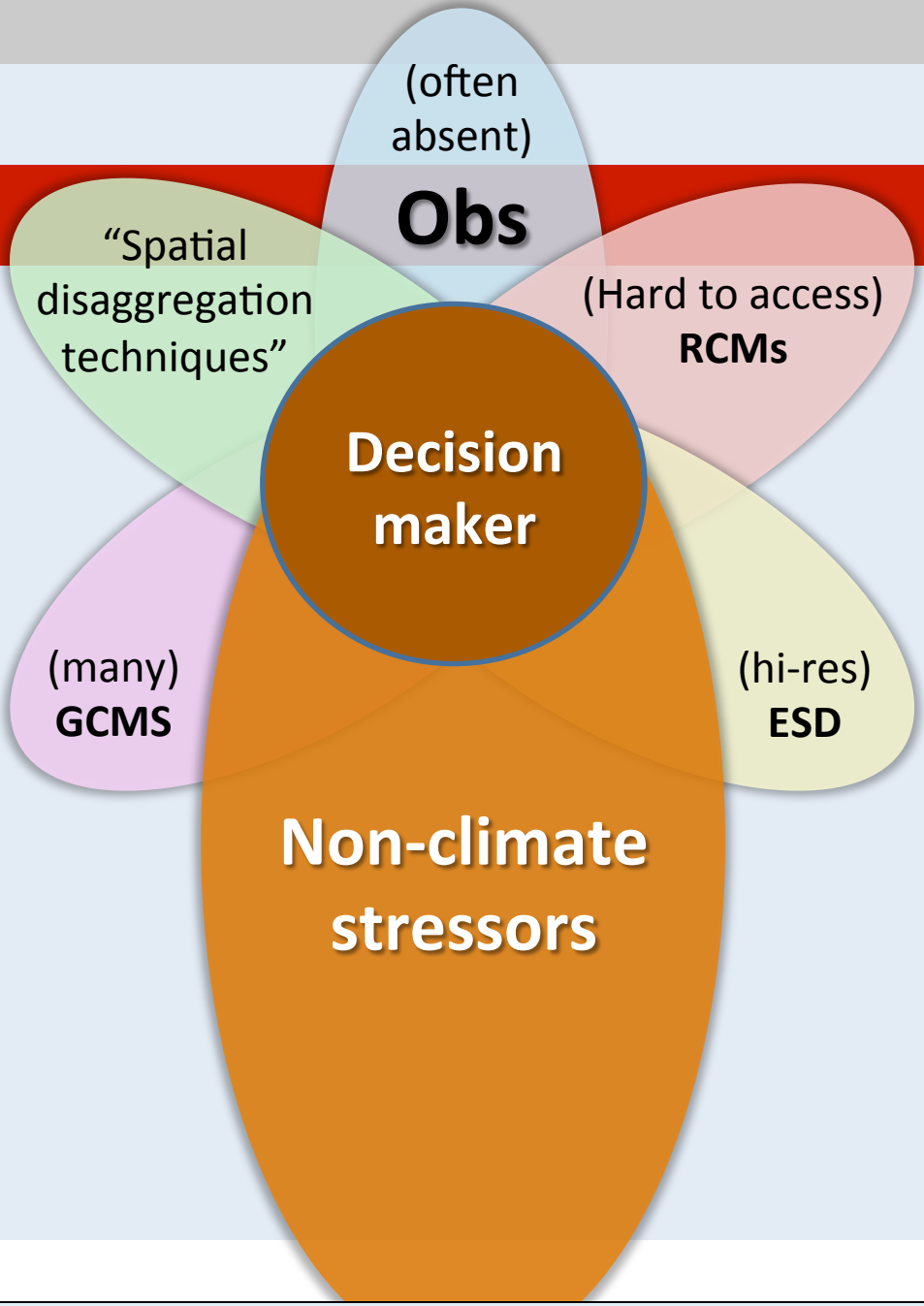
The Problem:

- A dominance of a linear supply chain mentality;
- which is chasing high resolution regional information;
- where "next-users" over-interpret the information;
- from badly communicated and contradictory data;
- provided by a plethora of portals;
- by self-authorized "boundary organizations";
- with little or no accountability;
- making multiple leaps of assumption;
- and using an ambiguous language set.

The decision maker's dilemma

Decisions are going to be made despite the confusion and complications of accessing "information"

CORDEX does not have sole responsible to meet this demand for information, but neither is CORDEX without responsibility to engage with the problem.



The gaps around CORDEX

1. The interface gap

- Everyone connects to a "next-user" and is a "next-user" – so everyone has some measure of responsibility
- The interface is complicated by positivist versus value paradigms: Physical scientists operate in a positivist paradigm; policy and decision makers have long rejected that and operate on values

2. The concept gap

- Terminology and language is ambiguous between communities:
  - Regional information versus information for regions
  - Decision scale versus target resolution
  - Information is data, data is not necessarily information
  - Uncertainty: a useful term to conflate error, noise, bias, and signal
  - Scenario: emission / climate / socio-economic / etc.

The gaps around CORDEX

3. The analysis gaps

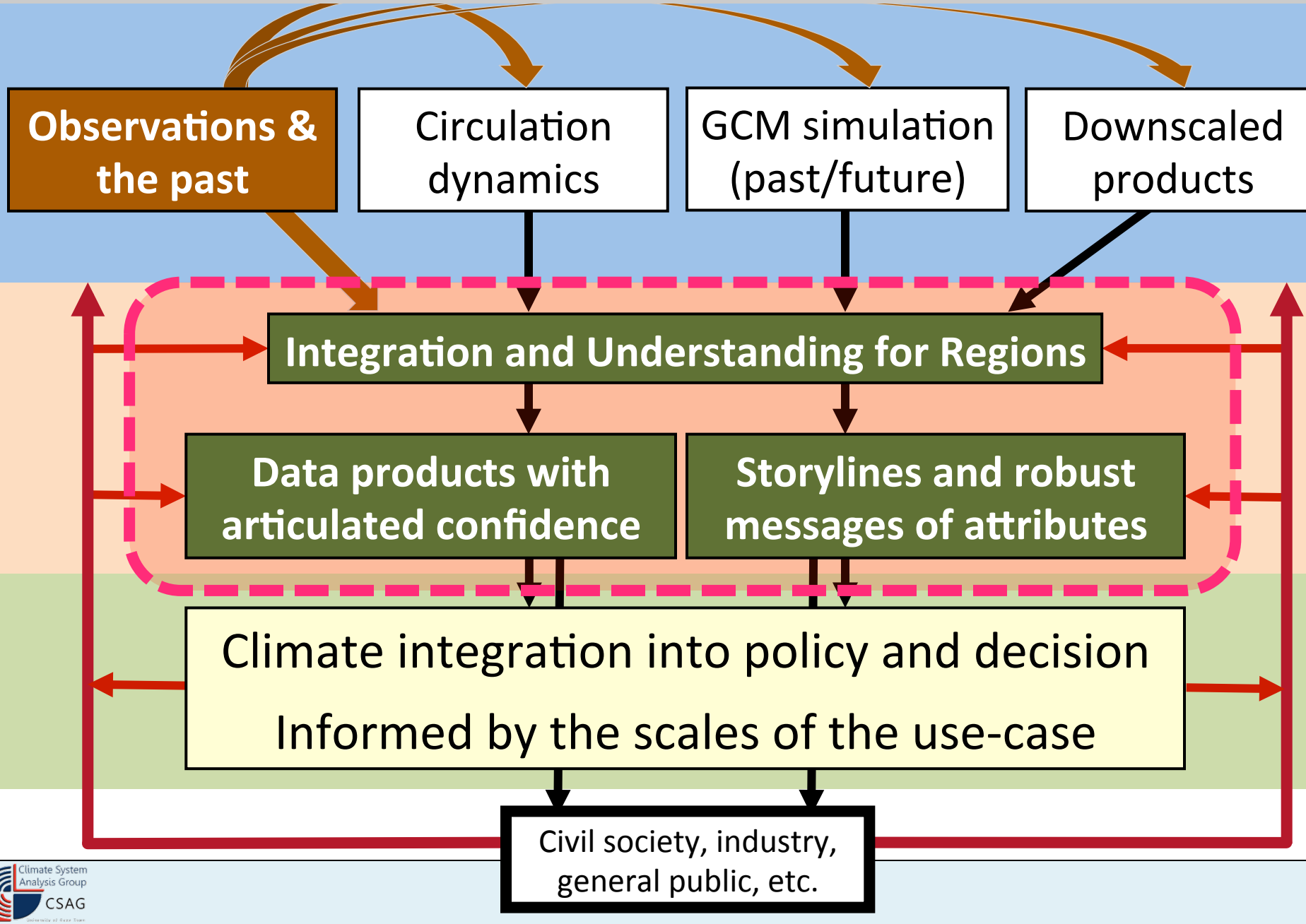
a) Analysis of the fundamental processes and dynamics of the climate system on multiple scales. CORDEX is good at this, as reflected in the peer-reviewed publications, yet opaque and mostly inaccessible to external communities.

b) Needs-driven analysis: usually somewhat simplistic post-processing of data sets (bias correction, mean and range, etc.) that attempts to address the (perceived) needs of an "end user".

c) Tailored information through the lens of system complexities at the decision-scales of thresholds and risk. Typically tries to consider the breadth of possibilities and likelihood of outcomes.

The last of these is the distillation dilemma

The Distillation Dilemma

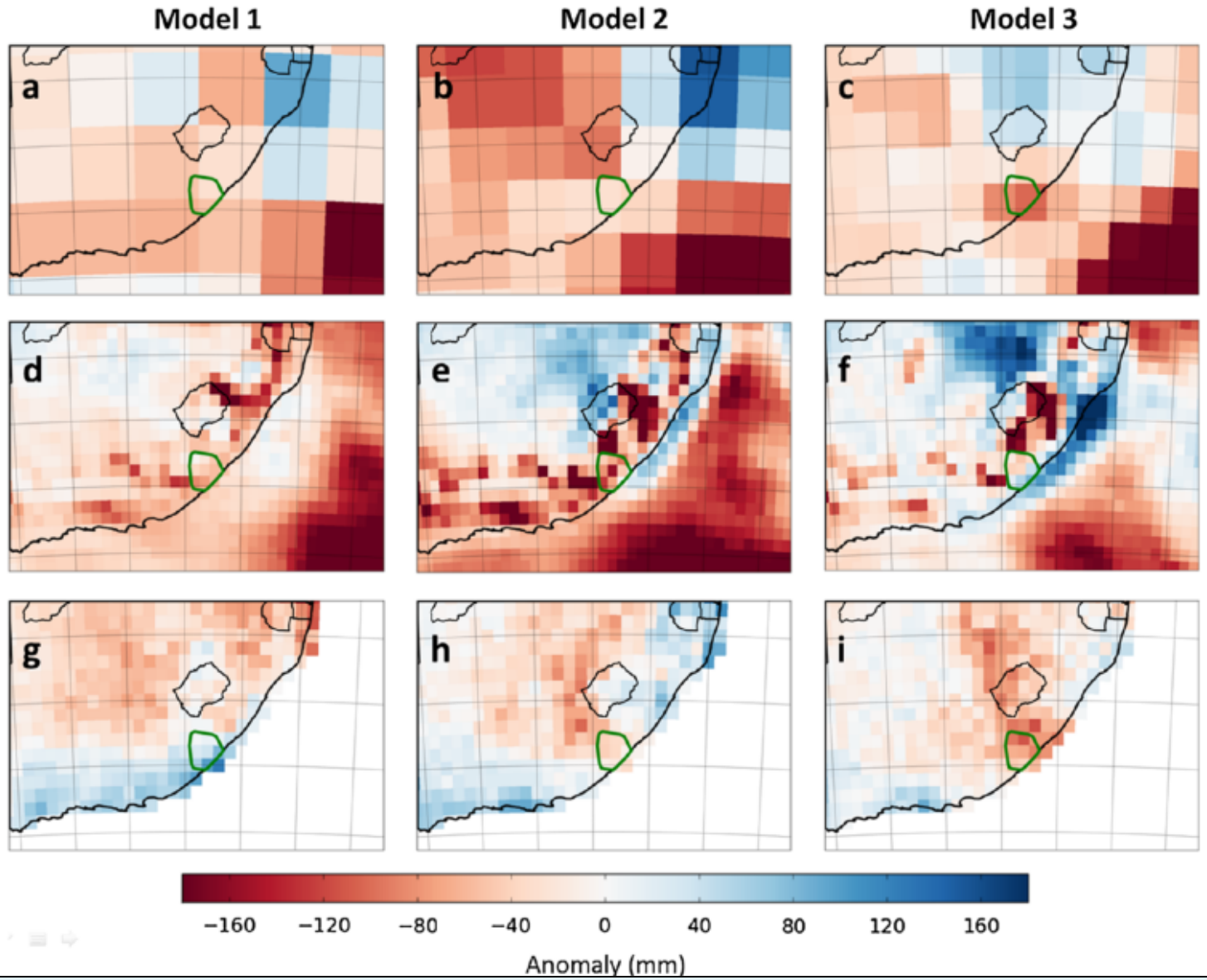


Daron et al., 2013: The role of regional climate projections in managing complex socio-ecological systems, Reg Environ Change 15:1–12, DOI 10.1007/s10113-014-0631-y

CMIP5 GCMs

RCM driven by GCM – taking information from RCM boundaries

Statistical downscaling taking GCM information local to the domain



A working definition of distillation

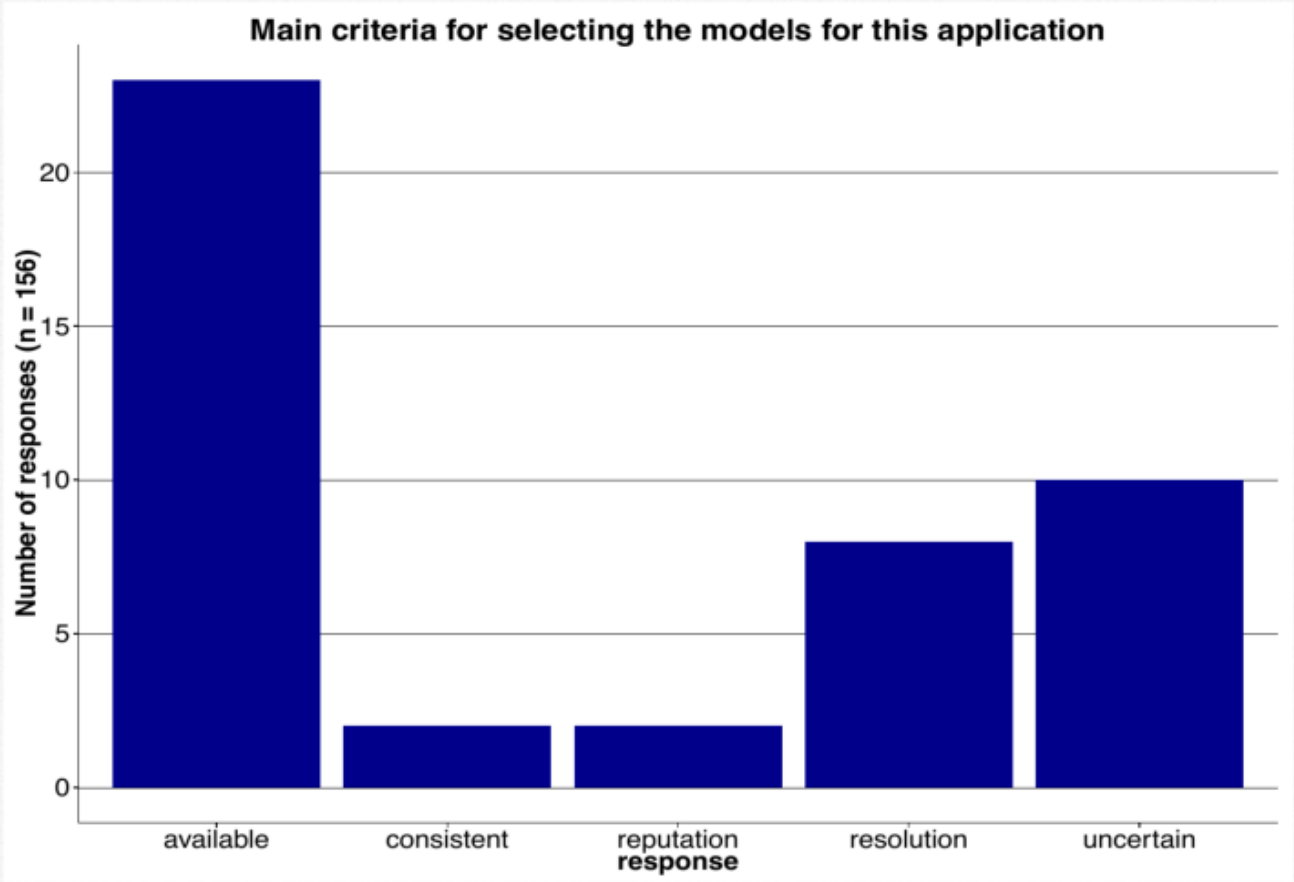
Distillation seeks to build the rigor and robustness:

a) Integrate multiple sources predicated on understanding the relative skill, strength and weakness at multiple scales in space and time;

b) Assess the influence of error, bias, and other sources of uncertainty on the resultant integrated message; and

c) Approach the task through the lens of a use-case application.

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

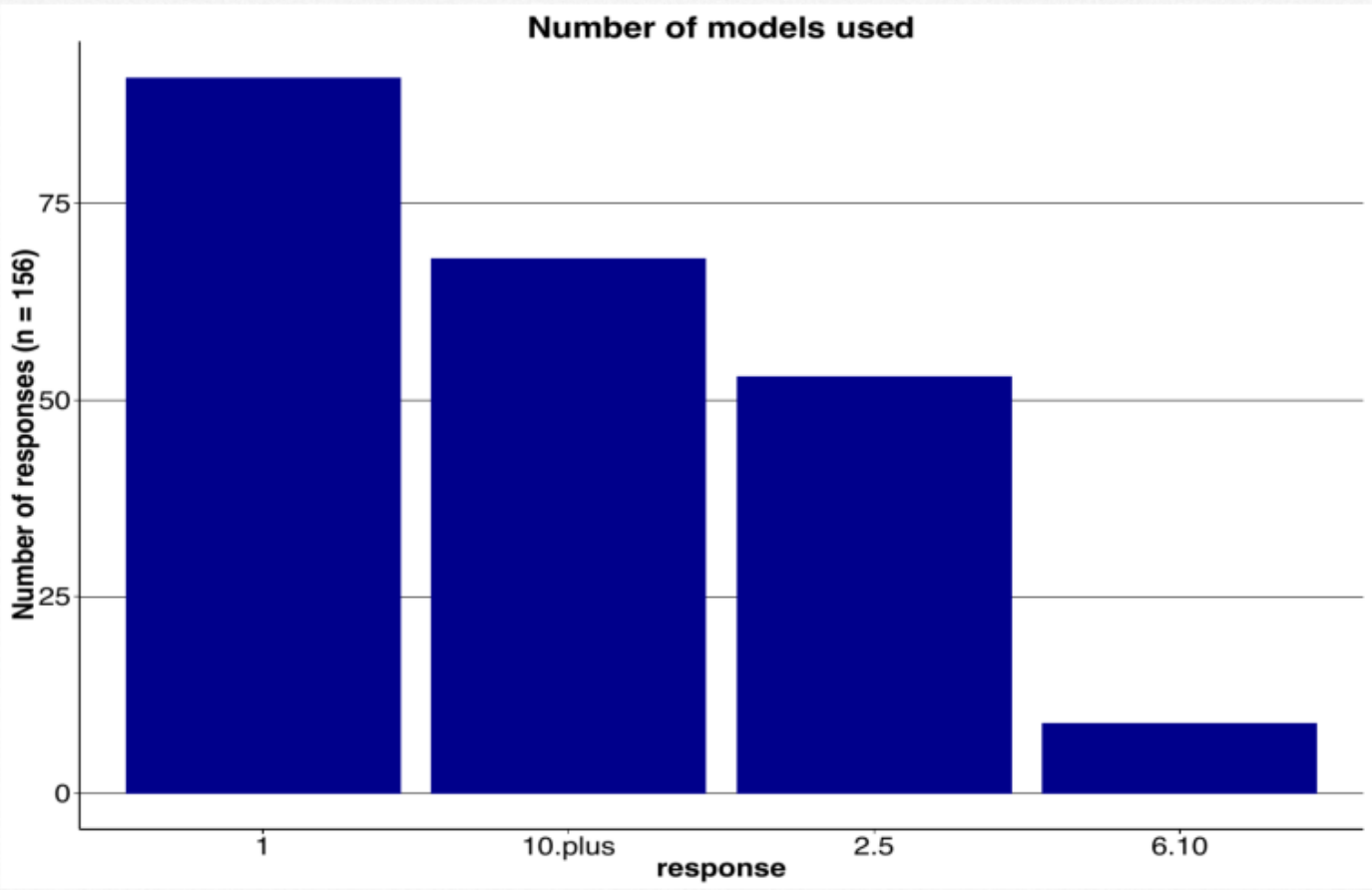


Majority are selecting by **Availability**

WGRC survey of VIA community

Common practice contrast

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



Majority are selecting by **Availability**, and then a large proportion only use **1 model**.

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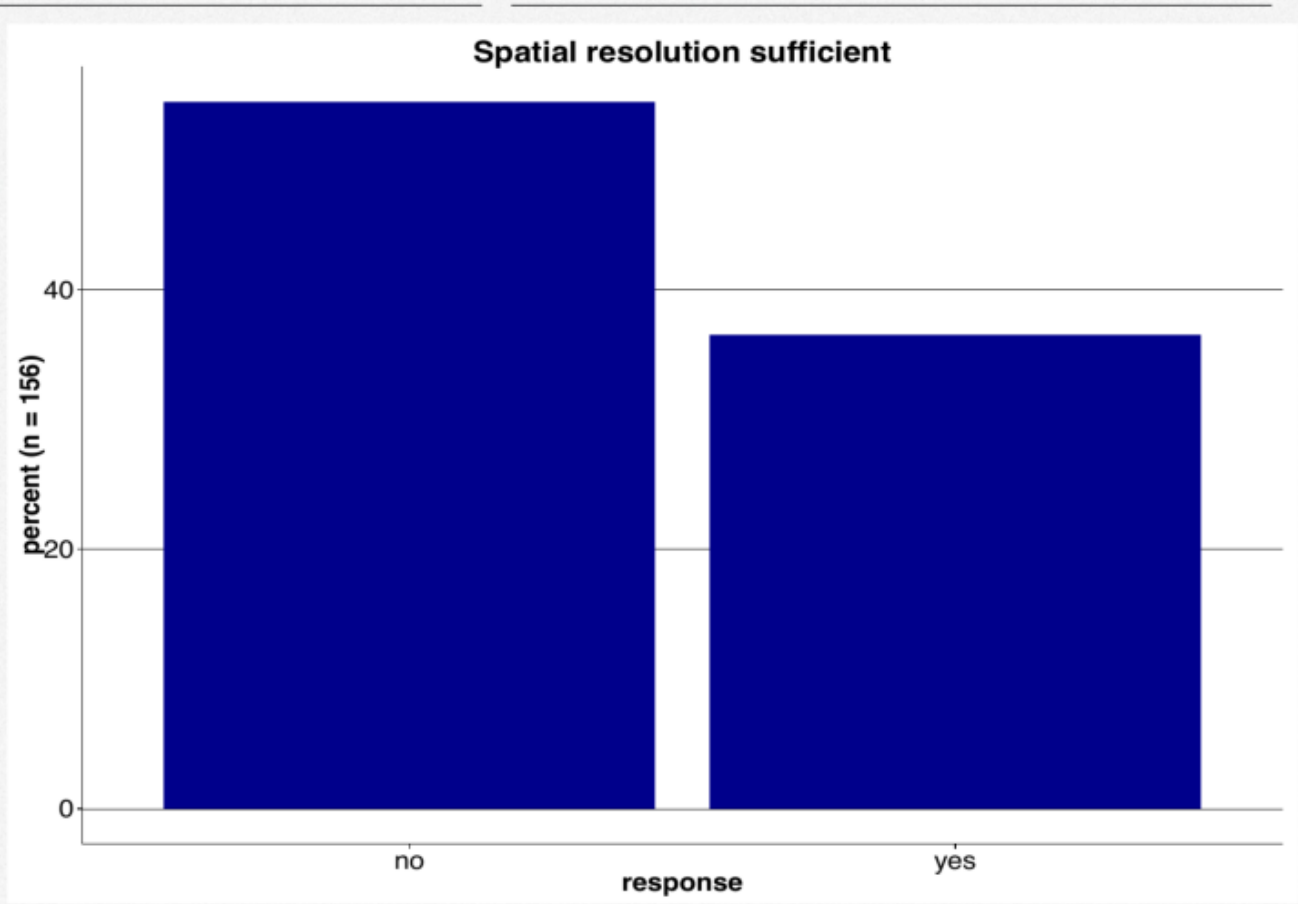

Majority are selecting by **Availability**, and then a large proportion only use **1 model**, and then most decide that the **resolution is not good enough**.

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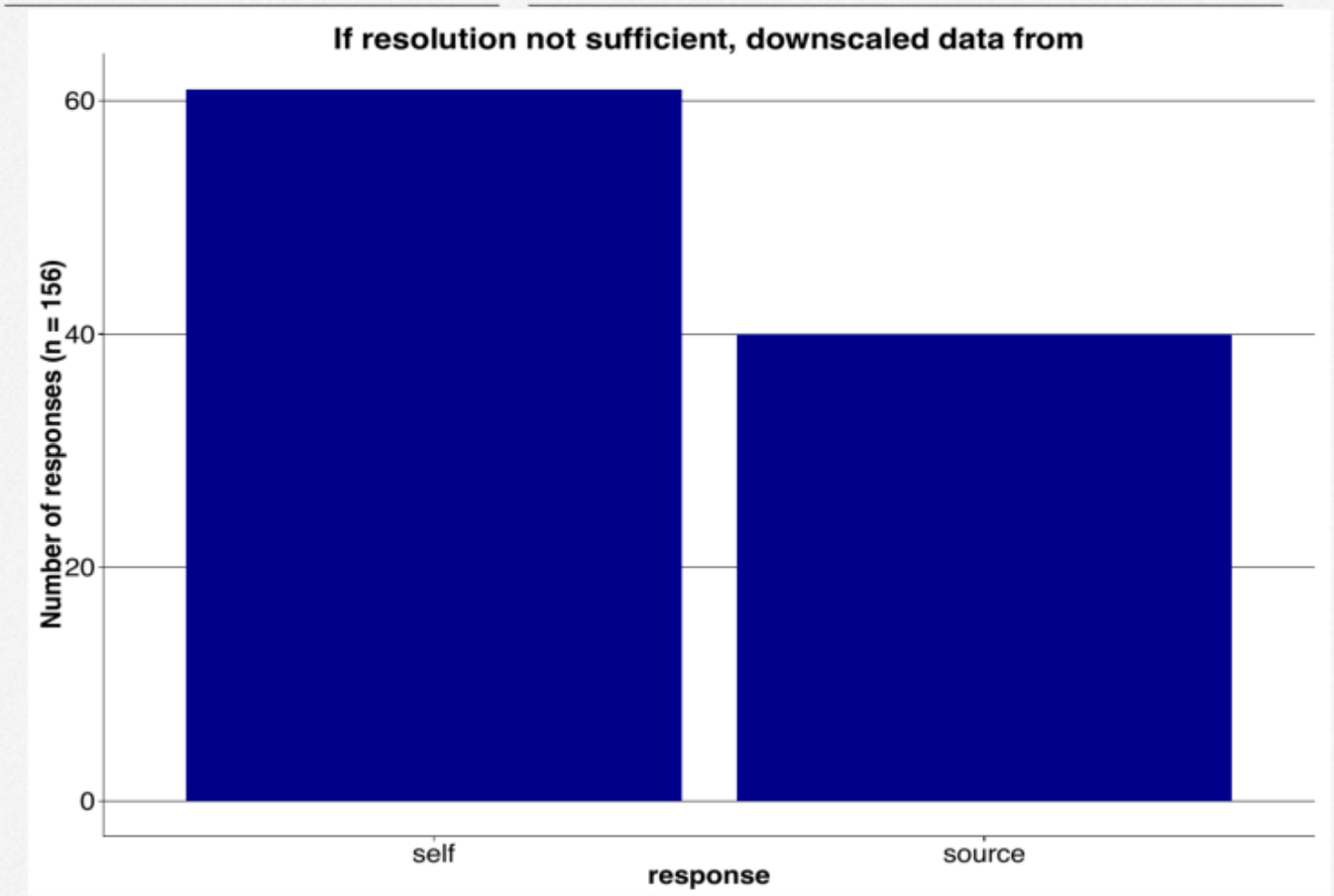
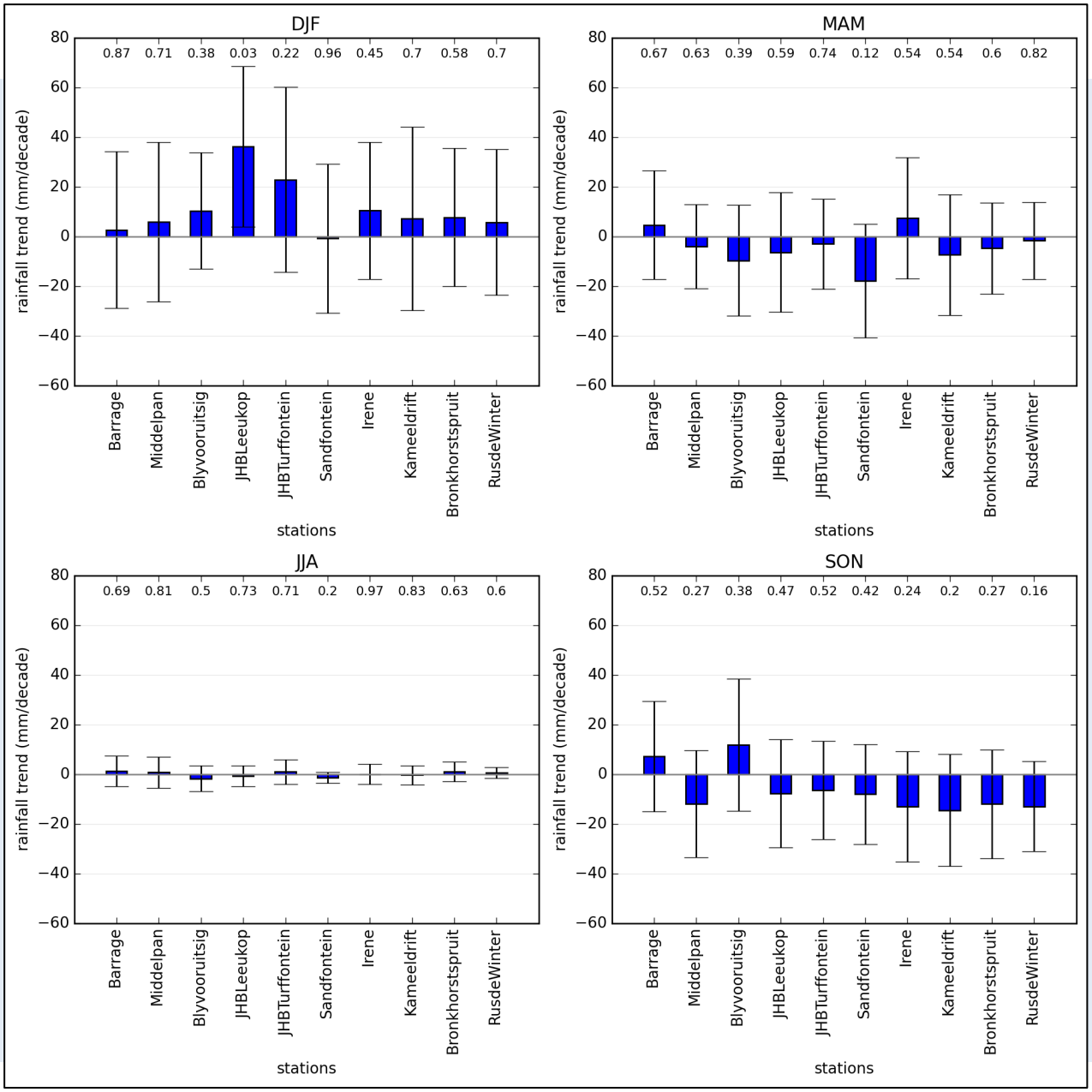


Majority are selecting by **Availability**, and then a large proportion only use **1 model**, and then most decide that the **resolution is not good enough**, and so they **do their own downscaling**.

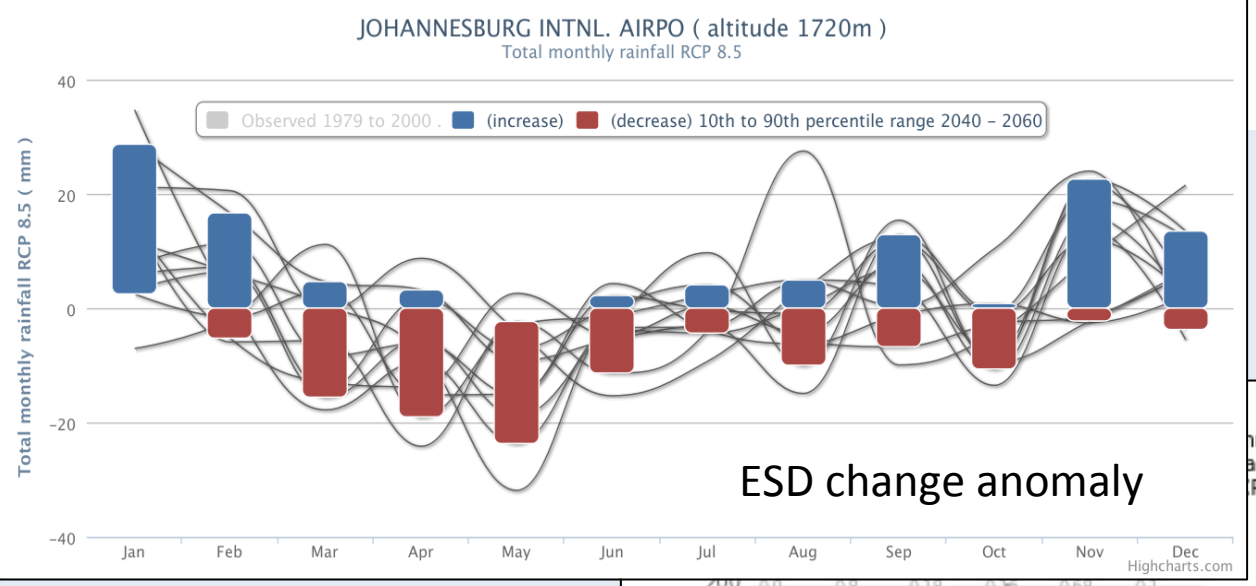
Common practice contrast



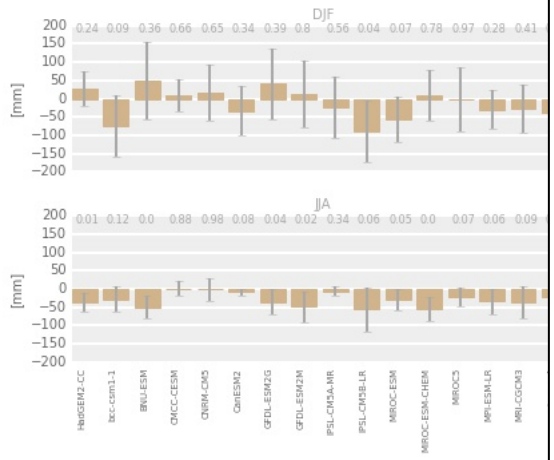
Starting a Distillation example: Johannesburg

No strong topographical forcing, convective regime, water stressed, and on a precipitation gradient.

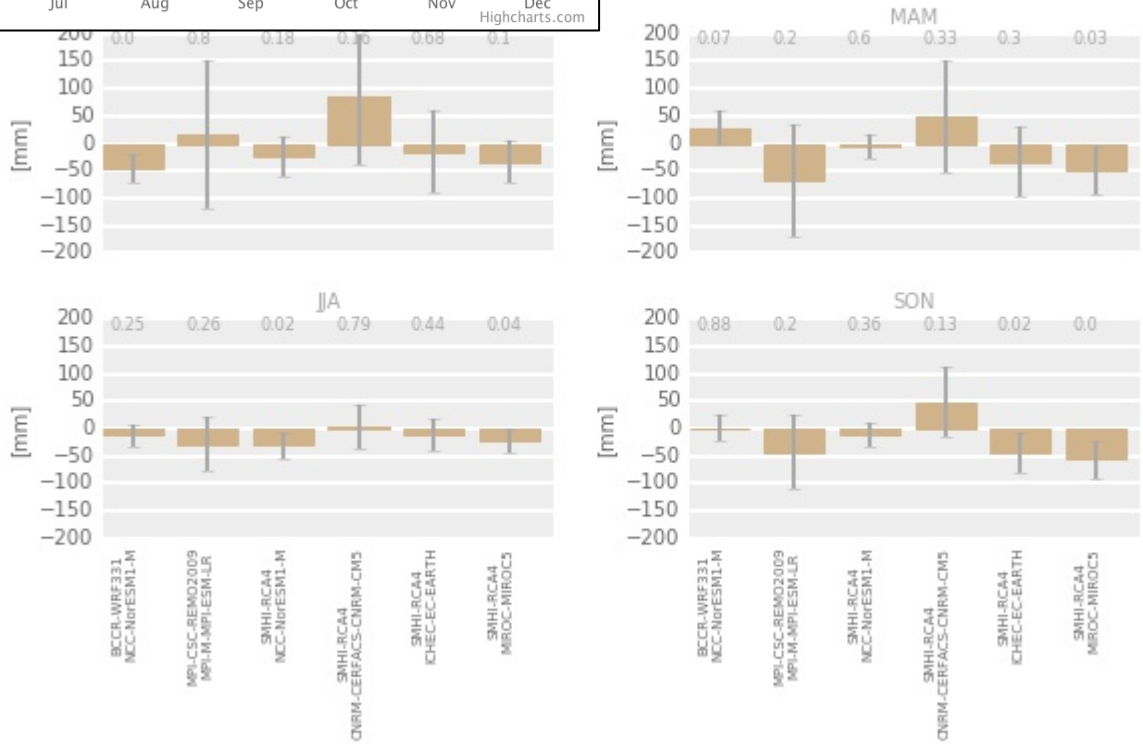
Historical trends from stations around the city: mean seasonal total precipitation.



ESD change anomaly



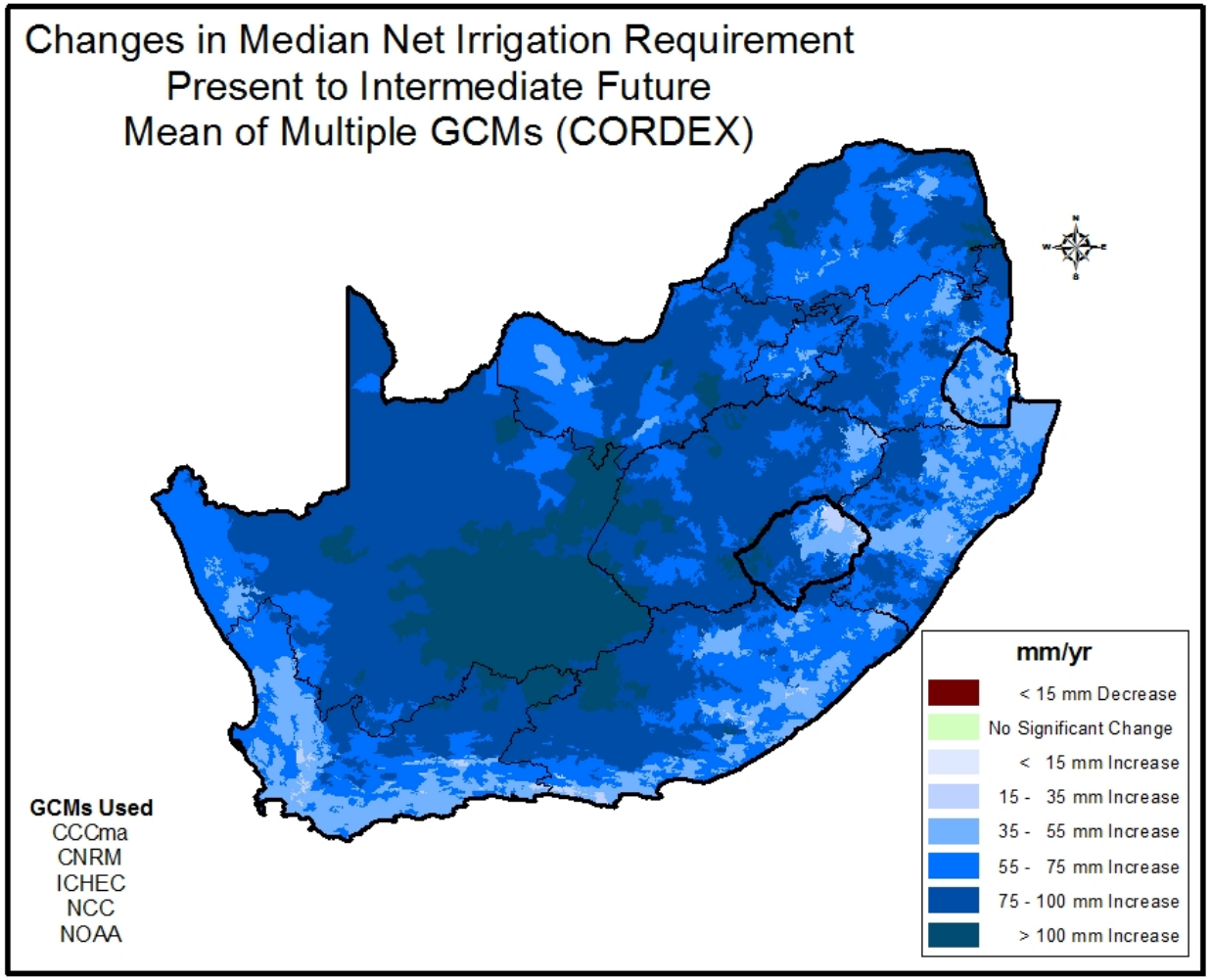
GCM change anomaly (CMIP5)



RCM (CORDEX) change anomaly

Data such as these are being regularly accessed an applied in the IAV community to produce policy relevant messages and inform planning decisions.

The Distillation Dilemma is not simply academic



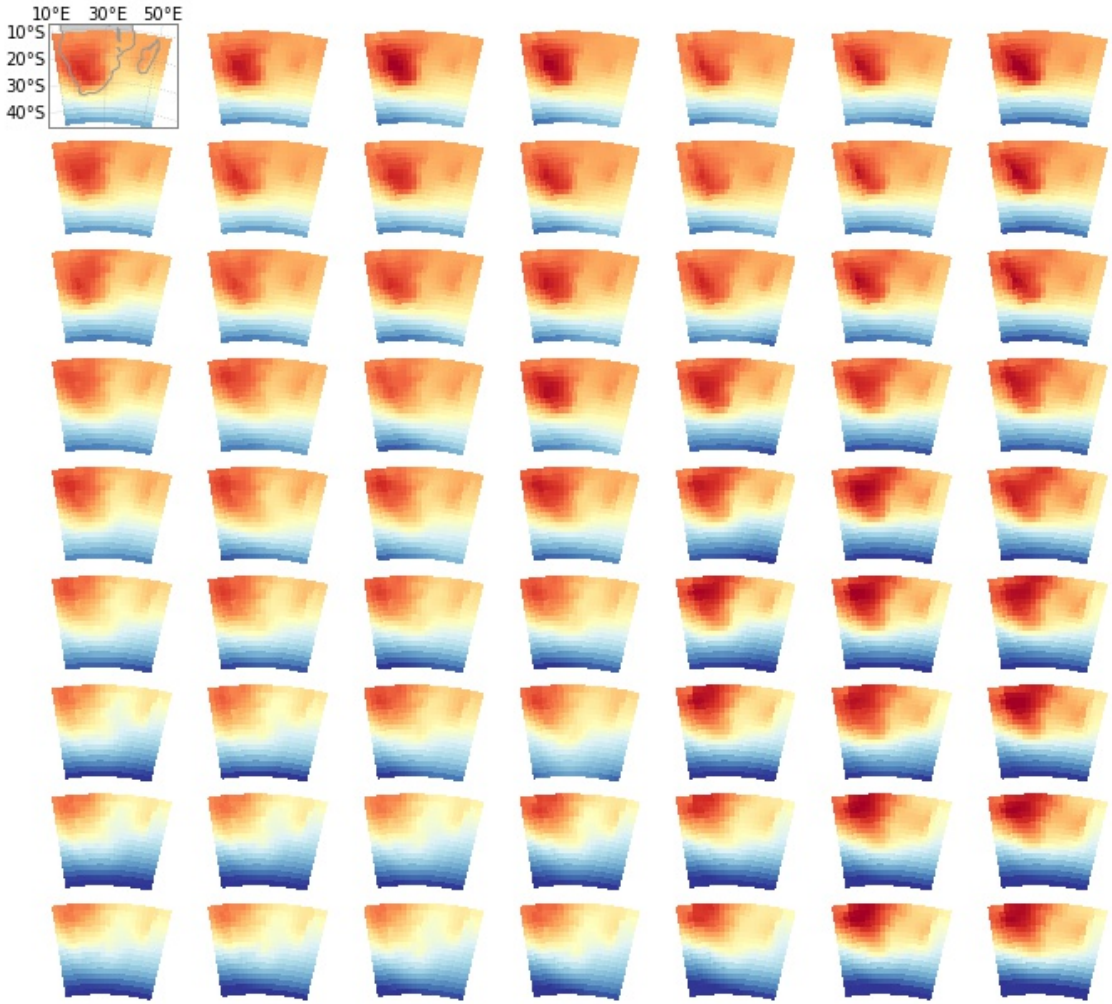
Schulze, R.E. 2016. Net irrigation requirements. Schulze, R.E. "Handbook Farmers, Officials and O Stakeholders on Adapta to Climate Change in the South African Agricultur Sector". Section H on Irrigation and Climate Change, Chapter H2.

The need for process-based assessment of the space-time composite performance of models

Much of the data use is predicated on skill of the surface diagnostic variables! Thus distillation requires a evidence basis to approach the "multi-multis":

- Multi-model ensembles
- Multi-method approaches (GCM, RCM, ESD, spatial disaggregation)
- Multi-scenario forcing
- Multi-observational baselines
- Multi-variate information needs
- Multi-sources signals with error
- Multi-scalar in time and space

A SOM-approach to processed based model assessment
Archetype maps, qtuv@850mb, WEU domain, based on 1979-2015 ERA-intirim.
SOM node maps for temperature:



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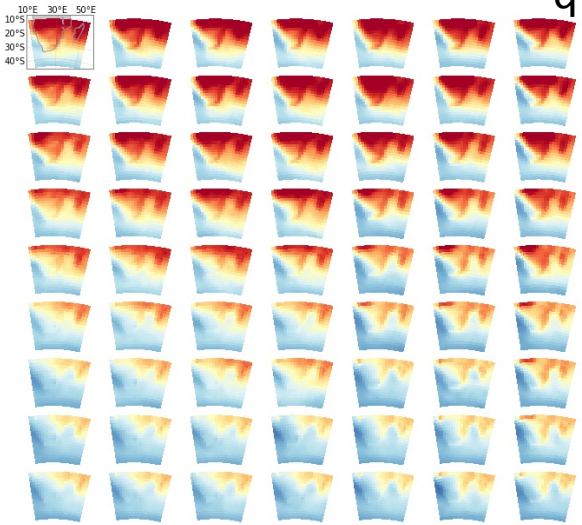
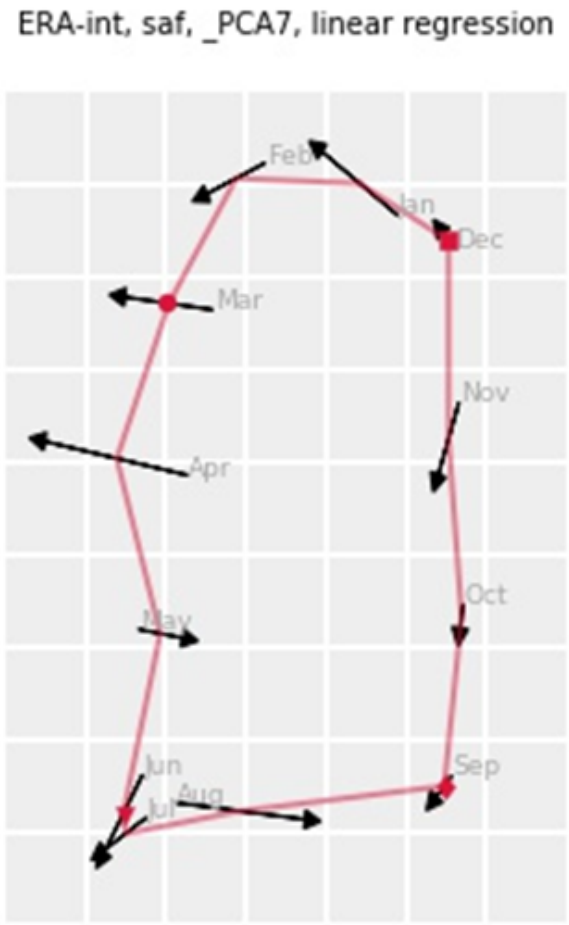
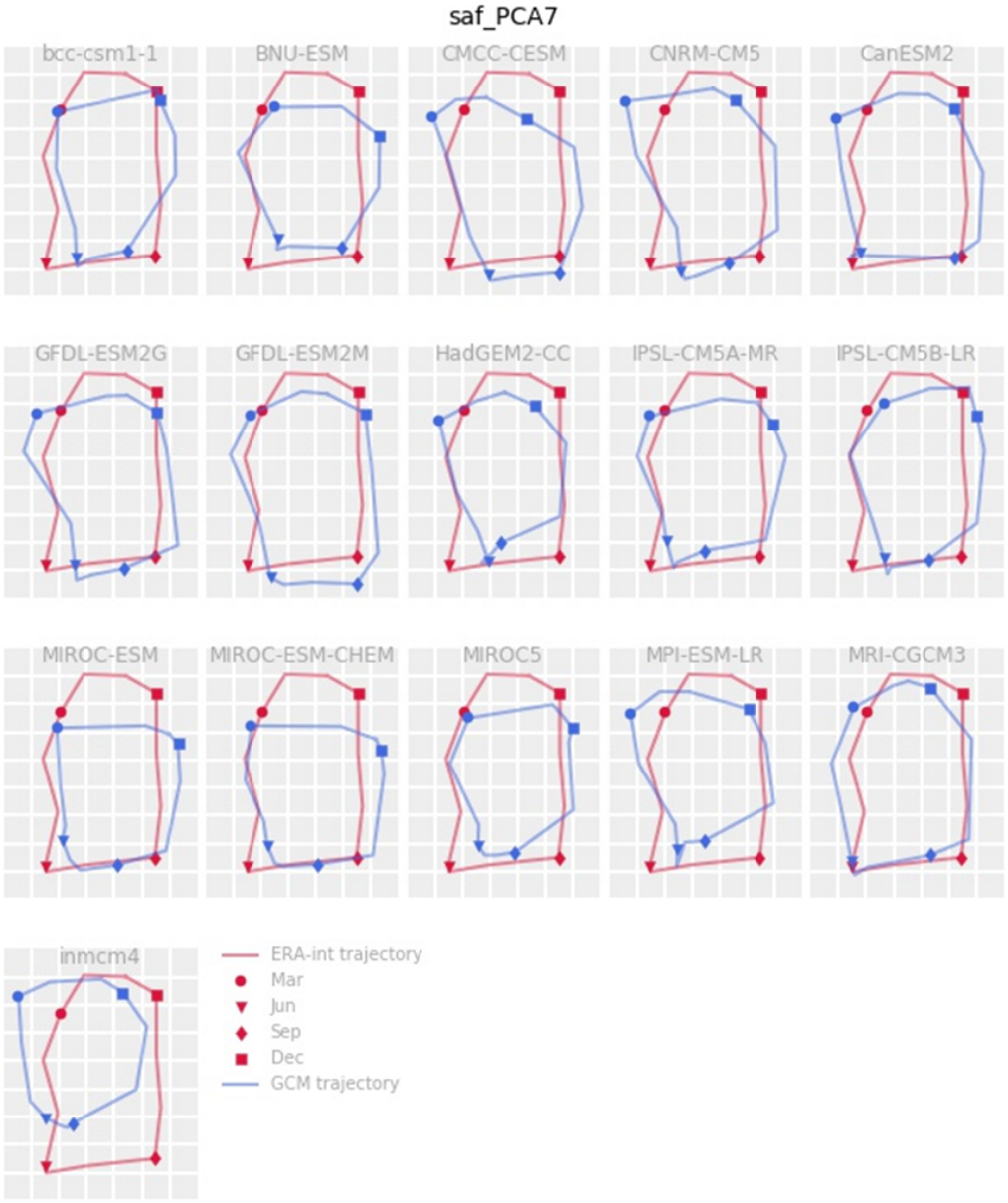


u,v

A SOM-approach to processed based model assessment

Mean seasonal cycle

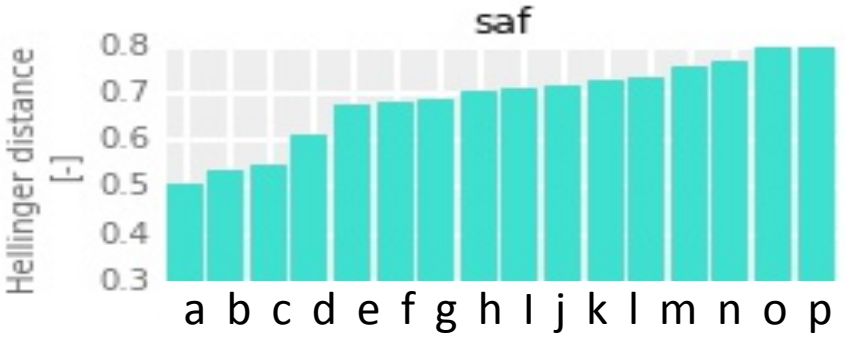


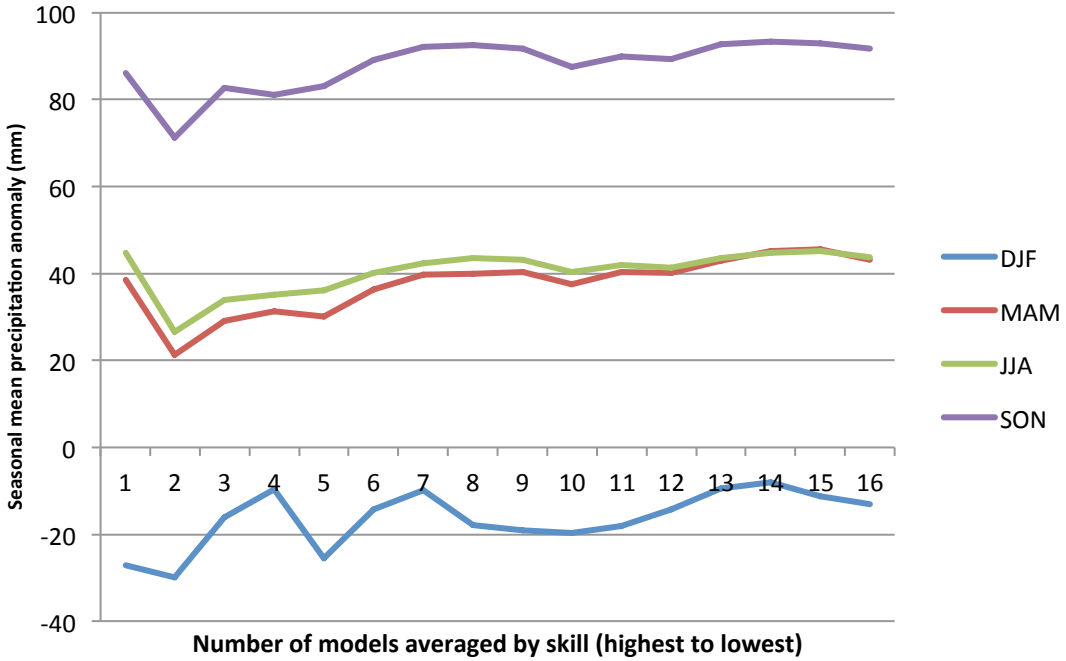


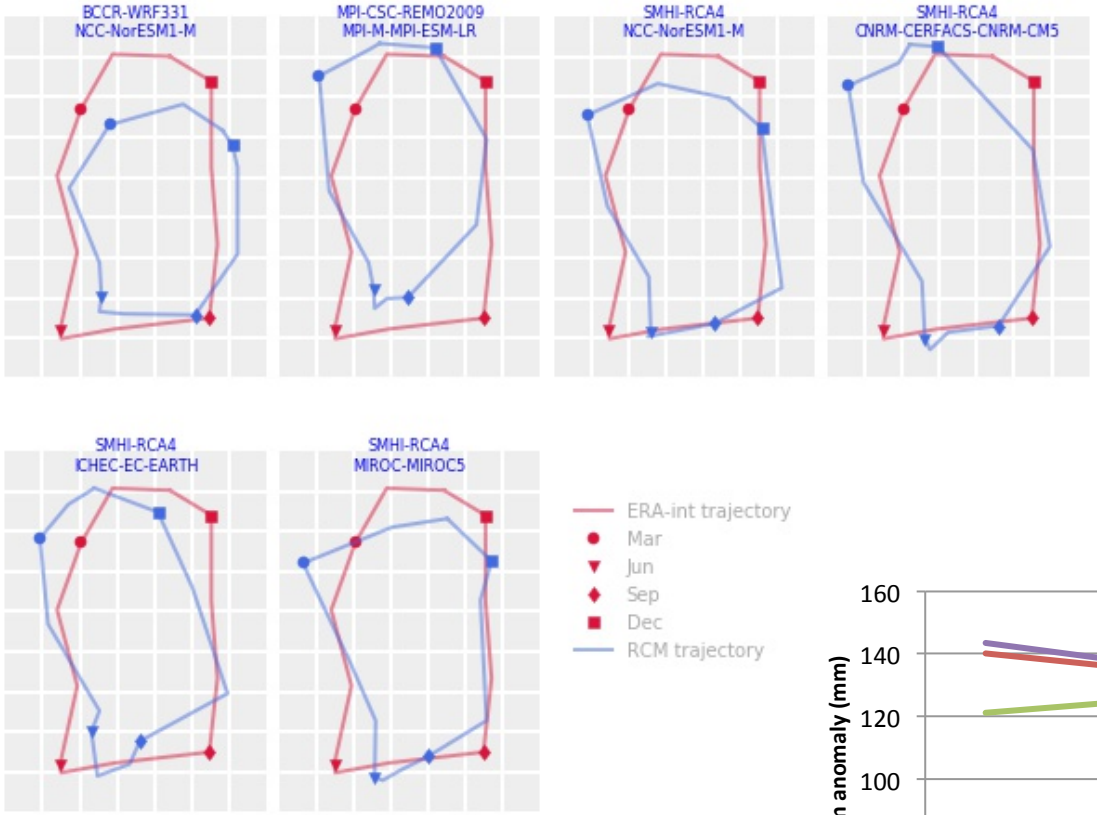
A SOM-approach to processed based model assessment

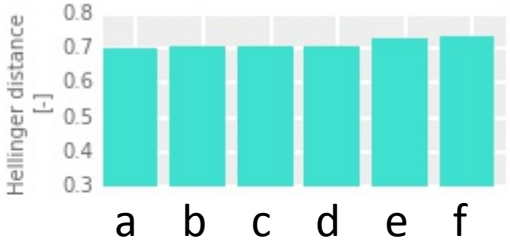
By assessing the time-space combined performance on the level of the driving atmospheric state, allows one to explore the model selection / mix in terms of the conditioning on local response.

(for a paper on distillation using Johannesburg and Copenhagen as exemplars – in preparation)



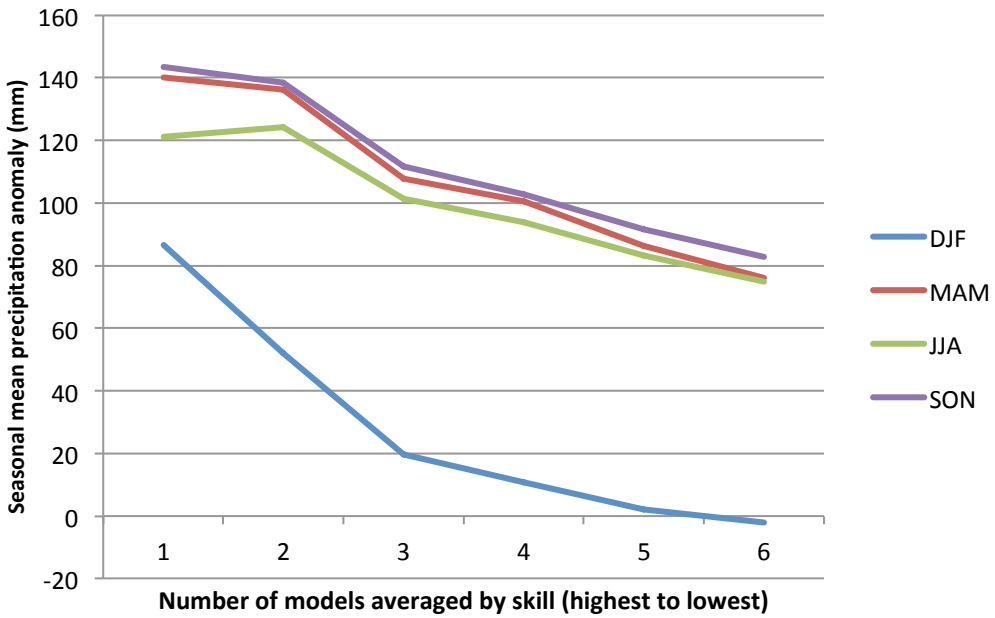






A SOM-approach to processed based model assessment

Applied to RCMs from CORDEX-Africa



Integrating messages

Message	Considerations
Stations indicate spatially cohesive historical trend to wetter	Strong message
Stronger mid summer synoptic state suggested by shift of circulation mean state (u,v,q,t)	Conditioning synoptic-scale conducive to wetter
GCM indicates drier summer (grid cell precipitation, assessed by skill of seasonal space-time variability).	GCM grid-cell scale poor accurate convective responses
RCMs indicates wetter summer (grid cell precipitation, assessed by skill of seasonal space-time variability)	RCM higher resolutions better for the convective processes
ESD suggests wetter summer (trained on station data)	Directly conditioned by GCM circulation

At this limited level of preliminary assessment, the suggestion would be that factors are conducive to mid-summer wetter conditions.

(paper with full details in preparation)

The research frontier

- Develop methods appropriate to source for building understanding about defensible information for regions
- Understand the contradictions and complications of differing messages from multiple data sources
- Manage the expectations around CORDEX – which is perceived as a central source by the applications communities (and IPCC).
- Consider your role in a next-user network, and how to contribute to the CORDEX gaps.