Meeting User Needs: climate service limits, ideals, & realities

- Drivers
- Evidence
- Attribution
- Modeling
- Projections
- Limitations
- Uncertainty
- Regions
- Interpretation
- The IPCC
- Ethics
- Etc …

1. Conceptual perspectives

2. An Example … (failed?)

3. Opportunities & approaches

Climate System Analysis Group
CSAG
University of Cape Town

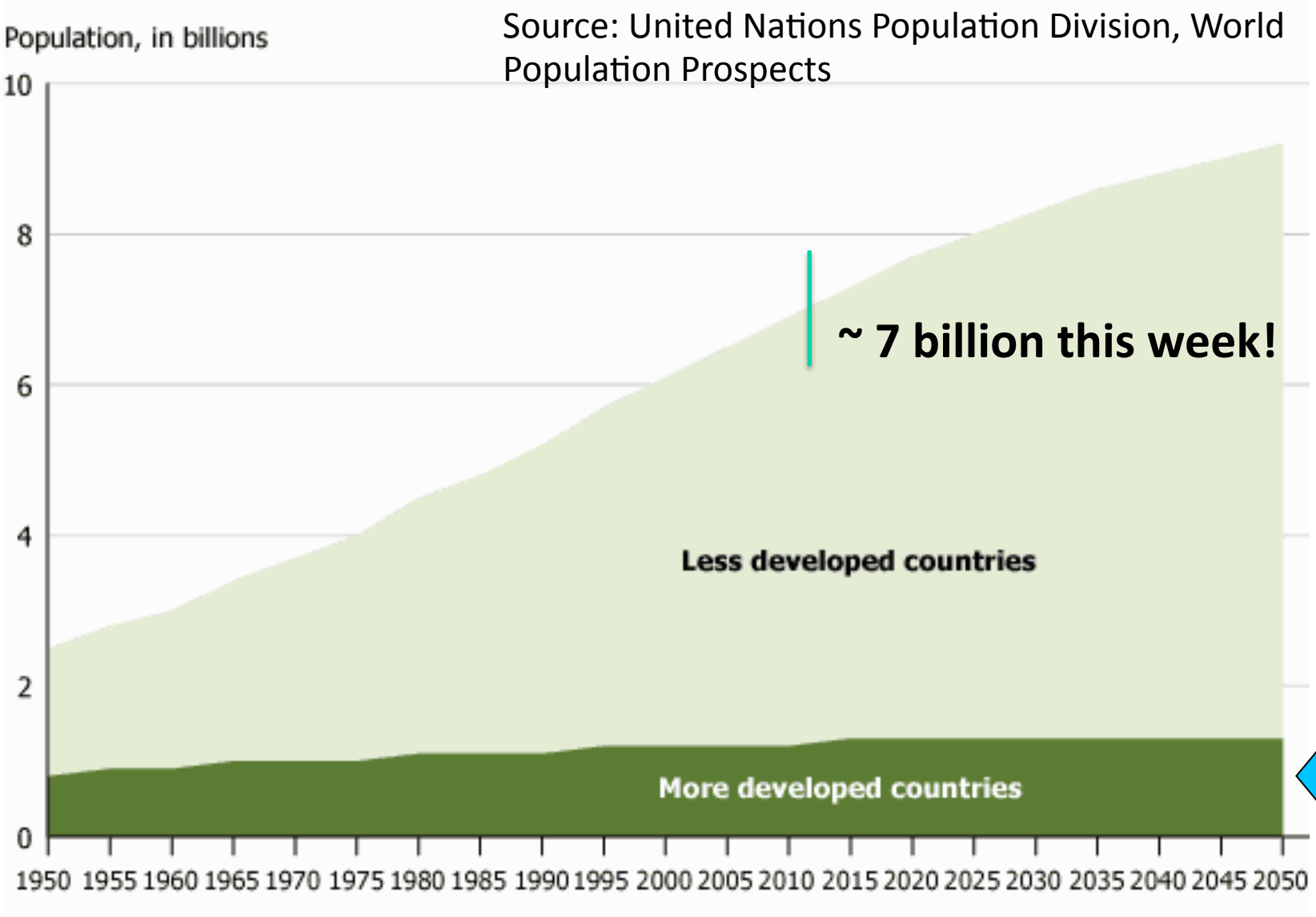
Bruce Hewitson
University of Cape Town

Expressions heard / seen during this week

- "end-to-end user-needs driven"
- "right-scaling"
- "actionable science"
- "co-production of services"
- "most critical need is not more science, but translation"
- "the need to provide reliable assessments of future climate changes has never been so high"
- "new confidence in regional temperature projections despite model deficiencies"

Take home message:

- Climate services do not simply build a **knowledge chain** (with weak links?) between producer and user communities
- Climate services contribute a component to a **messy knowledge network** that **shapes the decision space** of a **community's risk management**
- This changes the dynamics!



Primary source of climate services

Climate services to the world communities:

~85 % of 7 billion live in less developed countries!

Part 1: Concepts of services

Three ways of thinking about types of services:

Base services for providing a function to enable sustainability of an activity (e.g. electricity supply)

Delivery of a product to meet a (perceived?) consumer need and/or demand (e.g. grocery store)

Bringing expertise to a partnership for problem solving (e.g. an investment adviser to inform your financial planning)

Part 1: Concepts of climate services

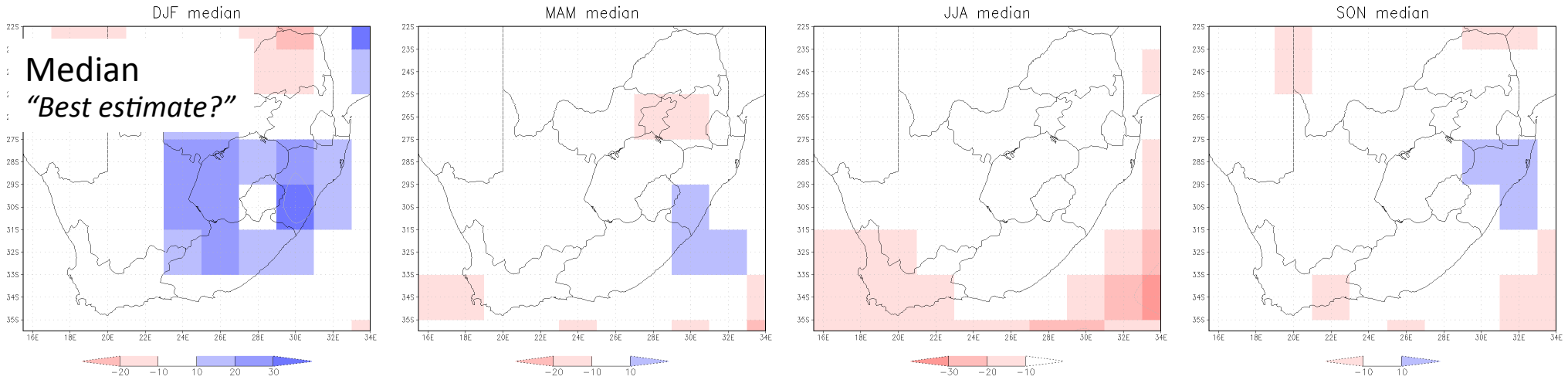
Q: What is assumed by "Service":

- Integration of knowledge into a context, in support of another communities agenda
- Presupposes an awareness of other relevant "knowledges", thresholds, vulnerabilities, and priorities
- Recognizes an evolving nature of knowledge, and hence the necessity for intimate coupling between communities
- Acknowledges ownership of response by the other party … services inform and do not dictate decision

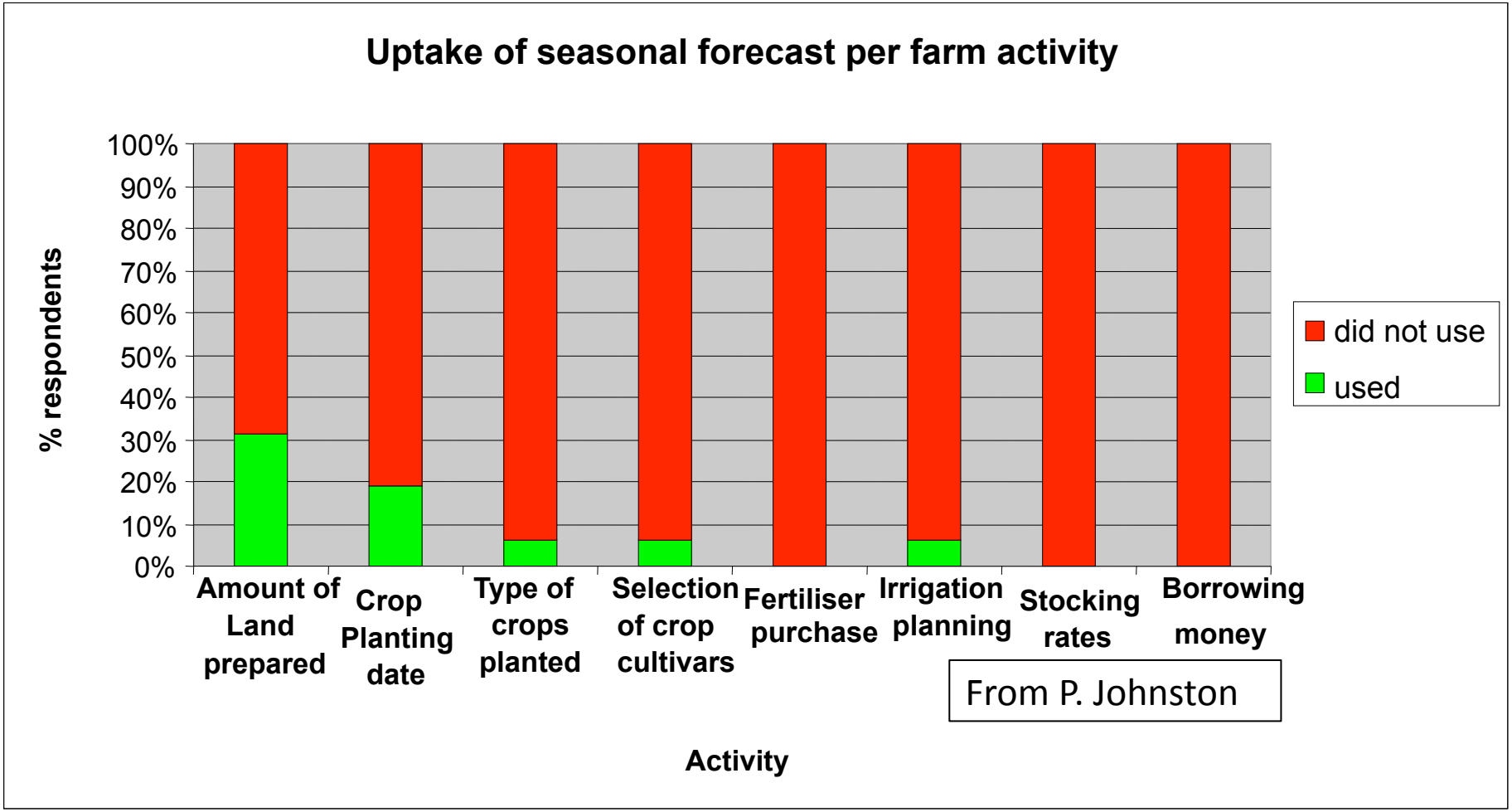
GCM projections of precipitation change

(2045-2064 : CMIP3, SRES A2 scenario)

- Is this a climate service?
- What is the information content?
- Who has responsibility for the message?



Sobering thought: even when provided, our information is often not used!



Part 1: Concepts of climate services

What comes with services

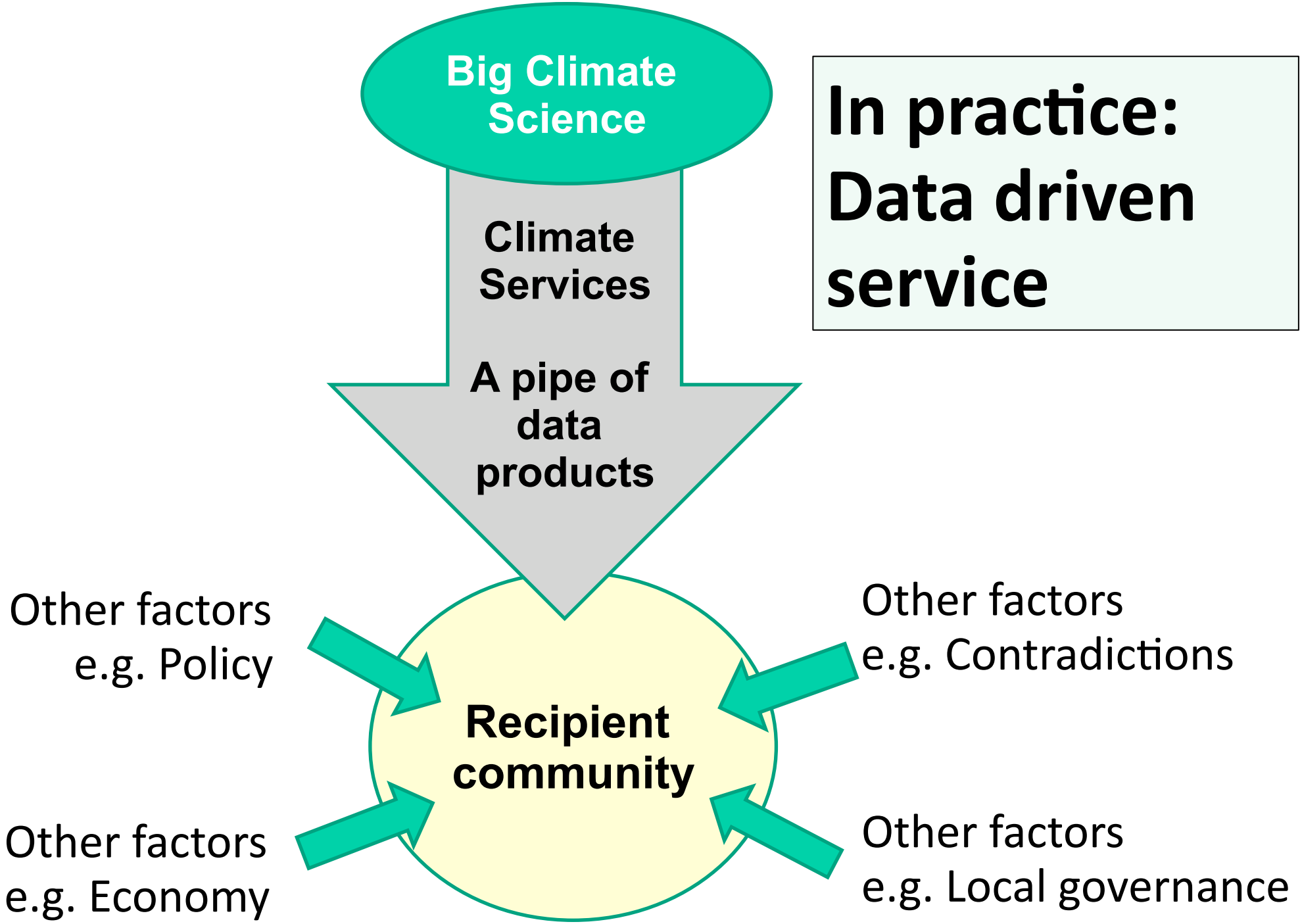
Services speak into another communities decision space

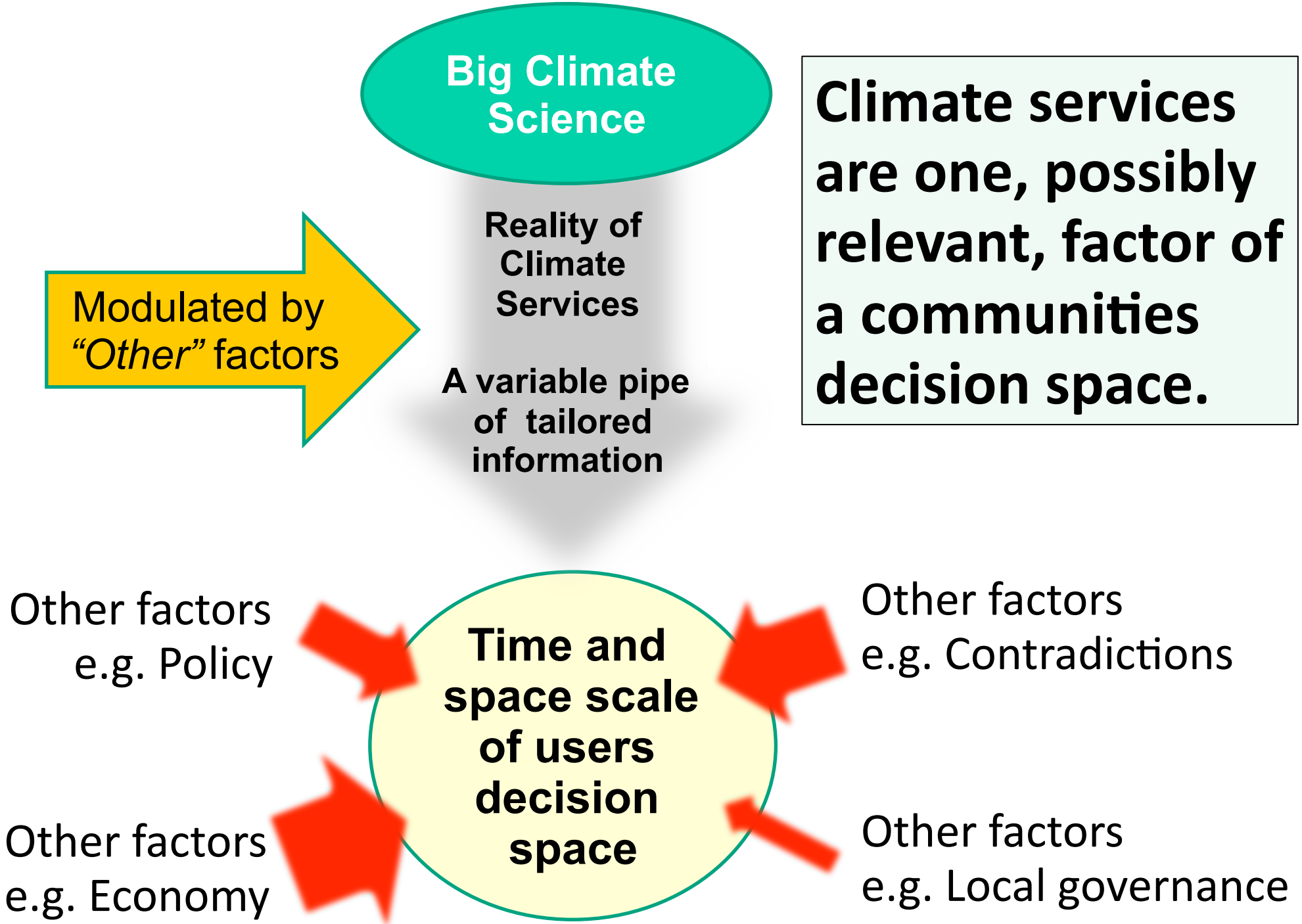
Knowledge = power (& opportunity for advantage: commercial service?)

Power carries responsibility based in a system of ethics

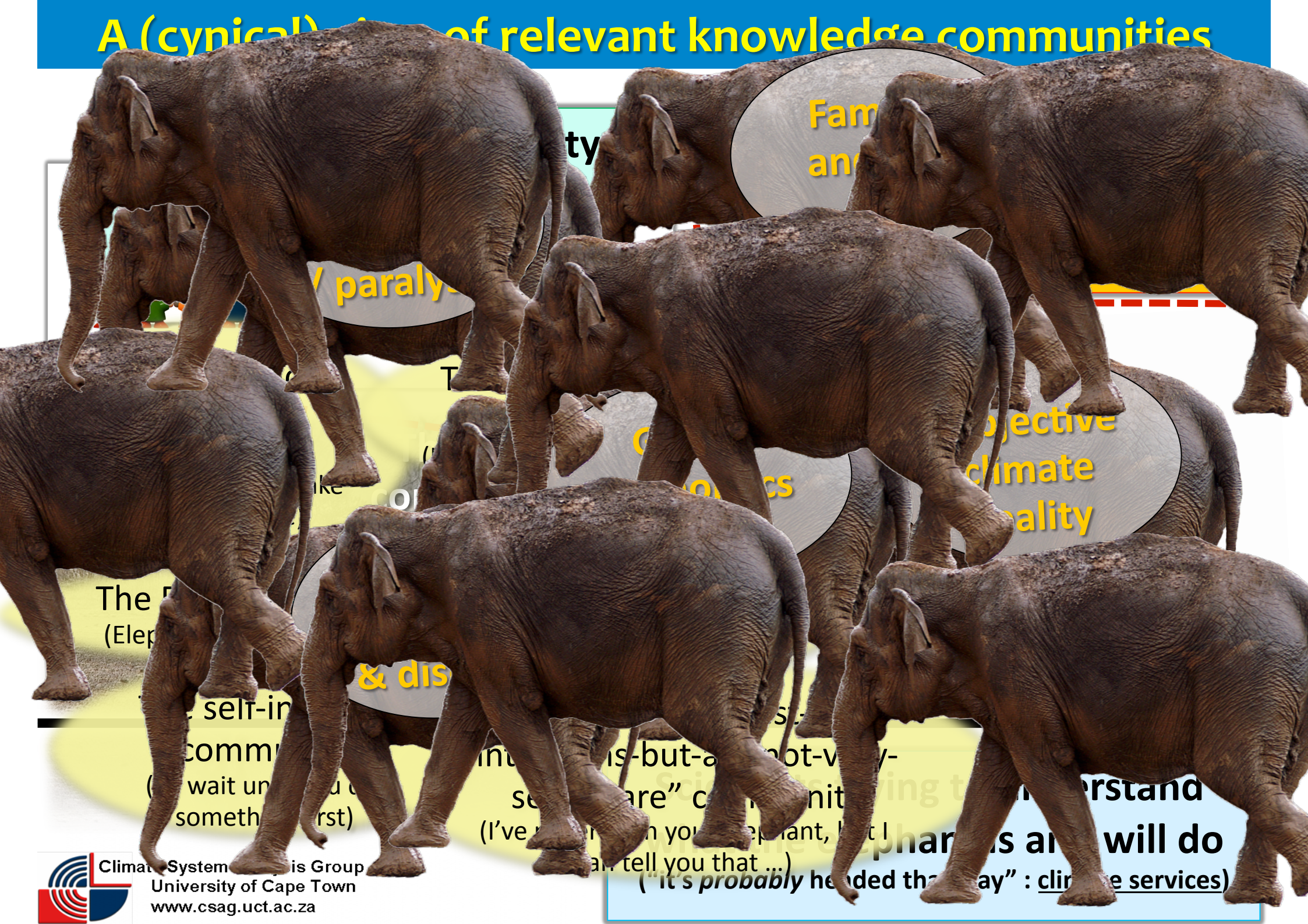
Whose ethics, whose values, whose accountability?

In practice: Data driven service




Big Climate Science
Reality of Climate Services
A variable pipe of tailored information
Modulated by "Other" factors
Climate services are one, possibly relevant, factor of a communities decision space.
Other factors e.g. Policy
Other factors e.g. Contradictions
Time and space scale of users decision space
Other factors e.g. Economy
Other factors e.g. Local governance

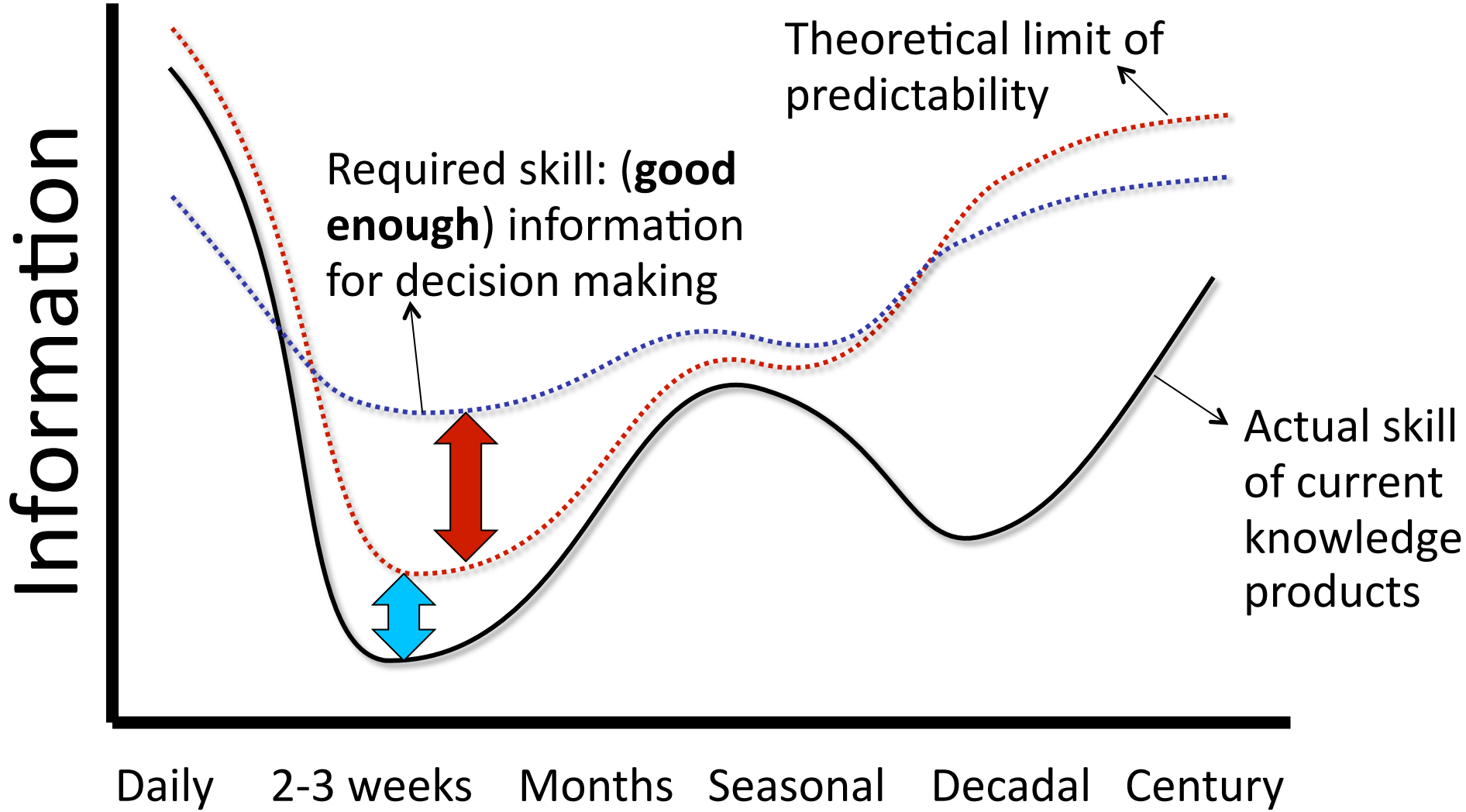
A (cynical) view of relevant knowledge communities



Climat System is Group
University of Cape Town
www.csag.uct.ac.za

So: What are we really trying to achieve?

For a given spatial scale, variable, metric, and application, provide relevant information to inform a decision space about proximity to sector thresholds in a risk management framework



Delivered by science

Needed by society

Data

Climate models, historical observations, trends, downscaling, projections, event frequency, …

↓

Information

Measures of vulnerability and risk, threshold exceedence, combinatory impacts, uncertainty and confidence, regional scale variations, …

↓

Knowledge

Assessing options, understanding consequences, evaluating responses, informing decision making, …

↓

A basis for action

Balance competing priorities, strategic investments in adaptation and mitigation, new research avenues, coordination of response frameworks, …

The knowledge chain approach to climate services

- A producer and consumer of data
- Built on the authority of "experts"
- Dominated by a one-directional information flow
- Producers define the knowledge product (possibly after consultation)

Climate System Analysis Group
University of Cape Town
www.csag.uct.ac.za

The resultant "Community confusion of Information"

A proliferation of portals and data sets, developed with mixed motivations, with poorly articulated uncertainties and weakly explained assumptions and dependencies, the data implied as information, displayed through confusing materials, hard to find or access, written in opaque language, and communicated by interface organizations only semi-aware of the nuances, to a user community poorly equipped to understand the information limitations

Contrasting the knowledge chain and a network of knowledge

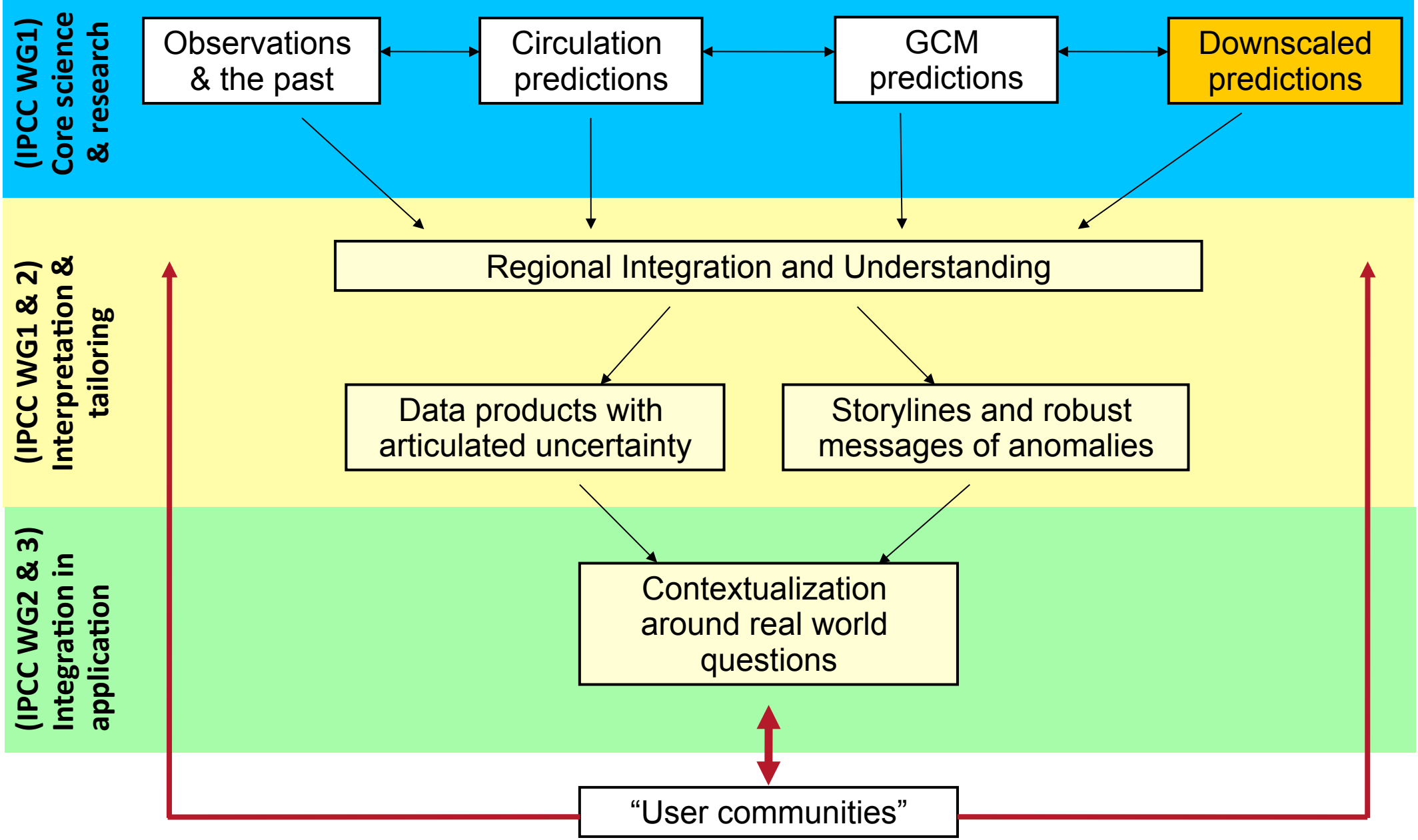
- What are the consequences of knowledge gaps?
- How best does one inform decision-making under conditions of incomplete information?
- What are the best investments in knowledge production for informing adaptation?
- How should one approach the integration of multiple streams of information across knowledge sets?

Part 2: Example of a climate service delivery

Consider the following combination:

GCM-a, ~2 deg resolution, 10 ensemble members
GCM-b, ~1 deg resolution, 5 ensemble members
GCM-c, ~2.5 deg resolution, 1 simulation
RCM-a 25 downscaling of 3 ensemble members from GCM-a
RCM-b 5km downscaling 1 ensemble member from GCM-b
Statstical downscaling to point scale of all ensemble members from GCM-a and GCM-b

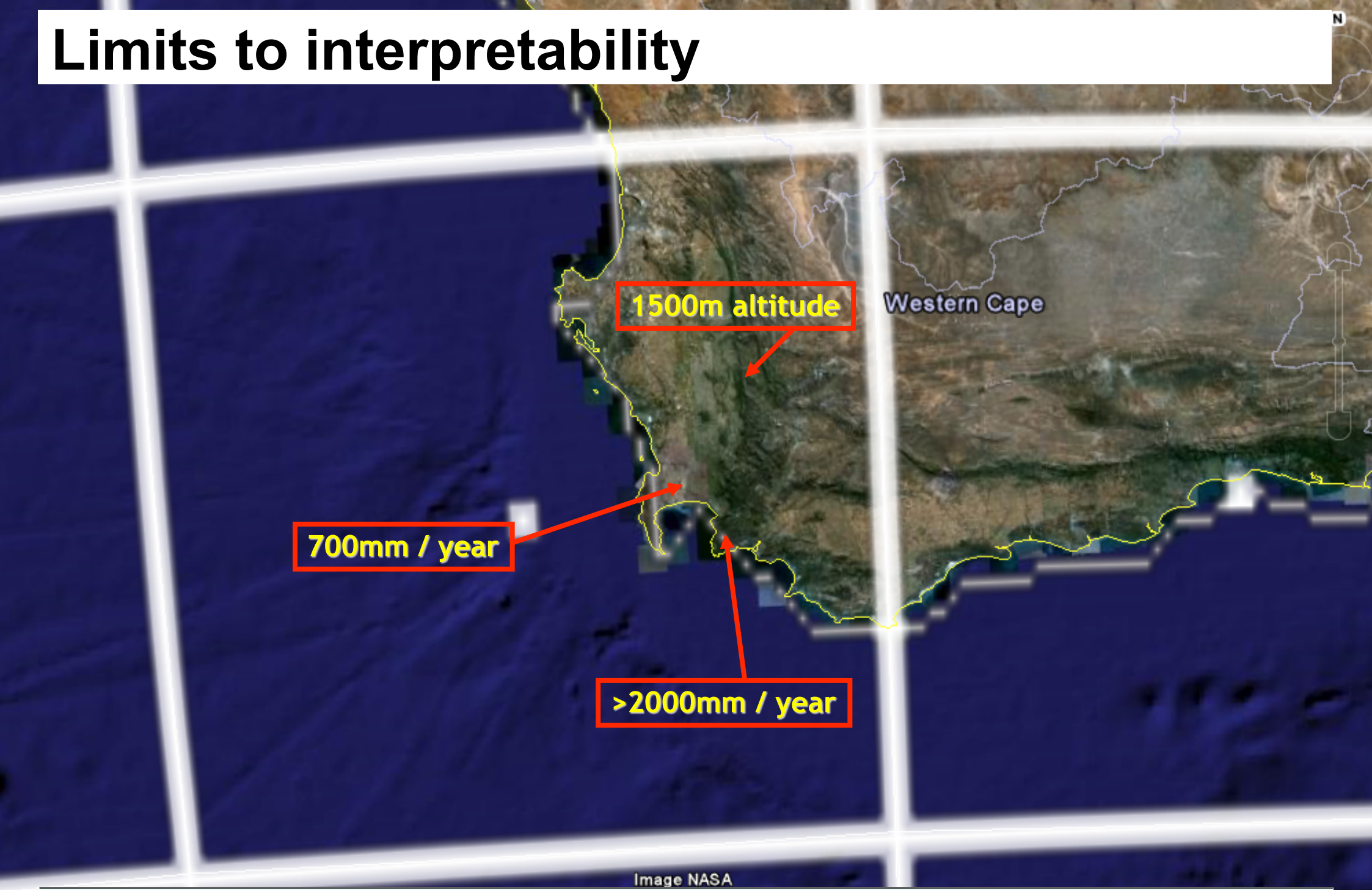
1. Which sources are relevant, according to what metric?
2. If you use only some sources, there <u>will</u> be contradictions with other sources, how to reconcile the contradiction?
3. If all sources are used, how do you combine multiple models, methods and resolutions?

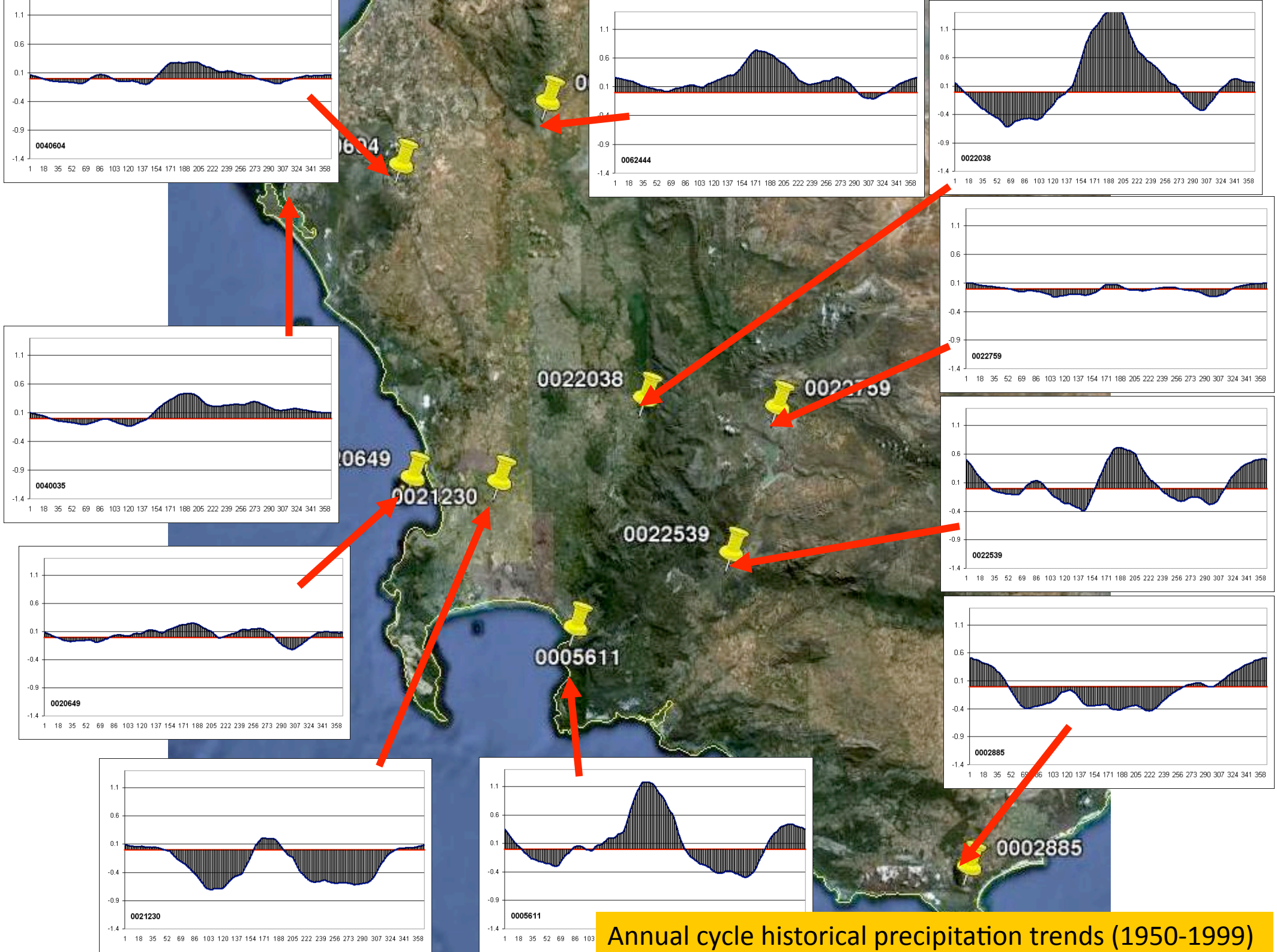


A framework of integration

Adapted from Hewitson et al., 2010

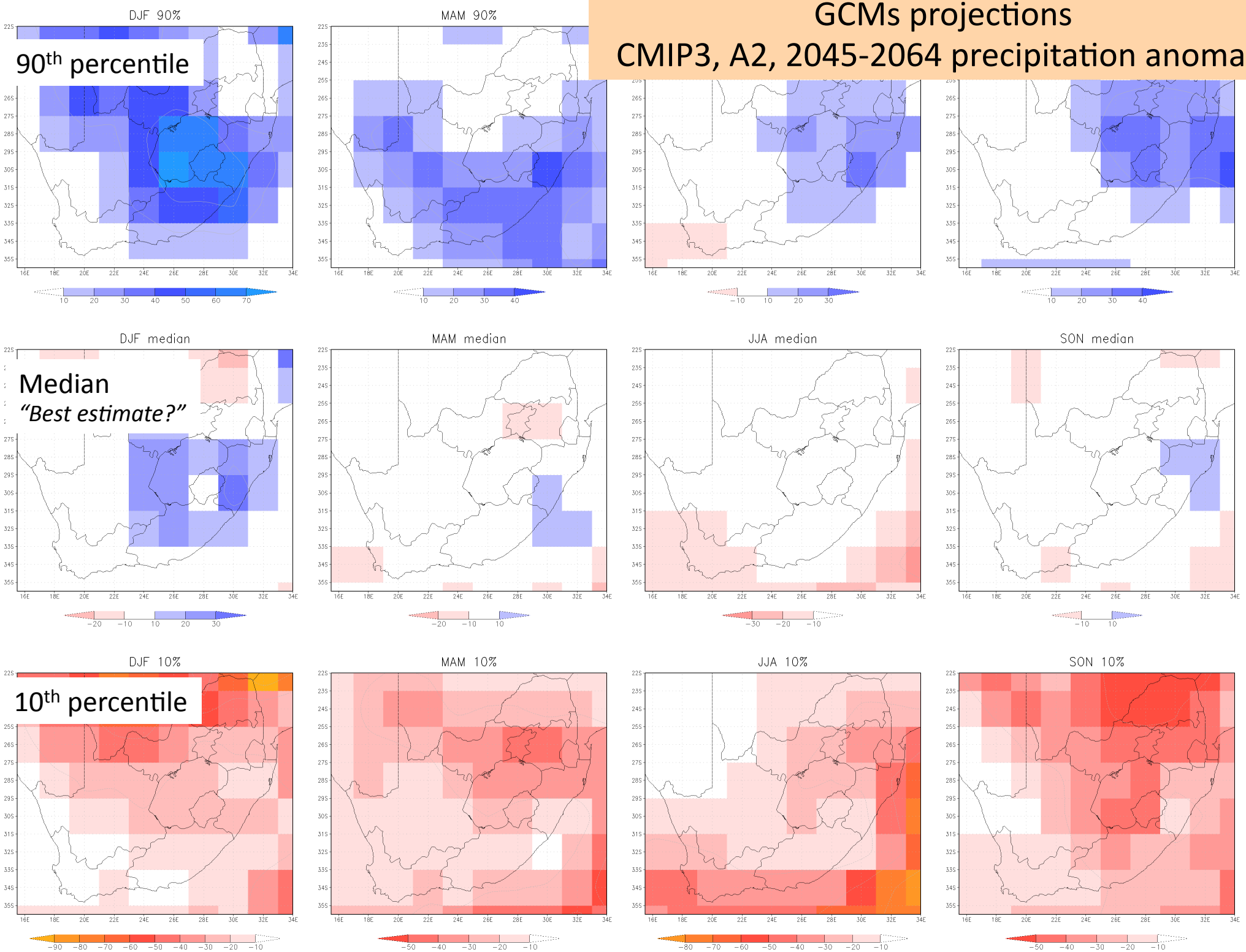
Limits to interpretability



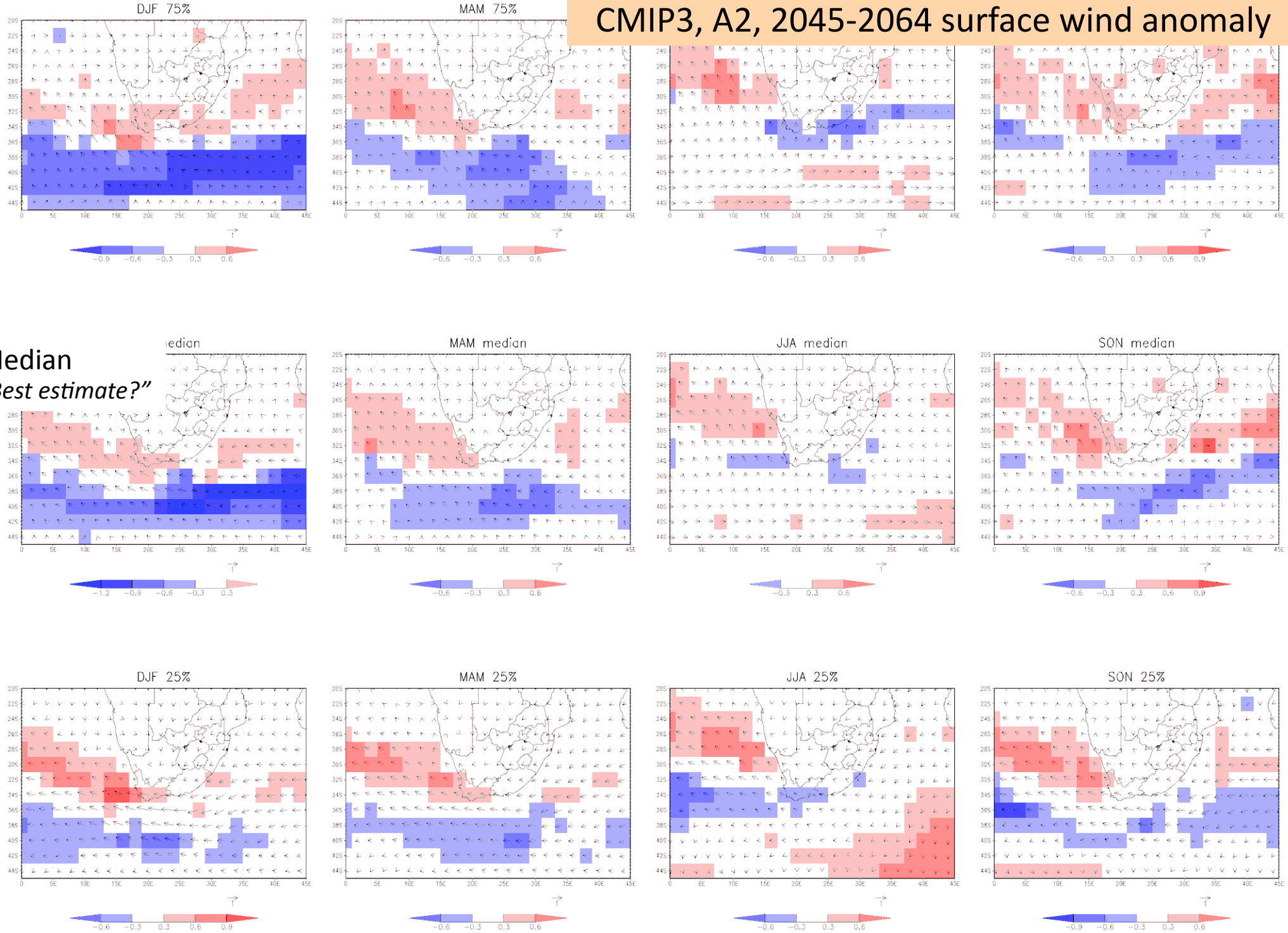


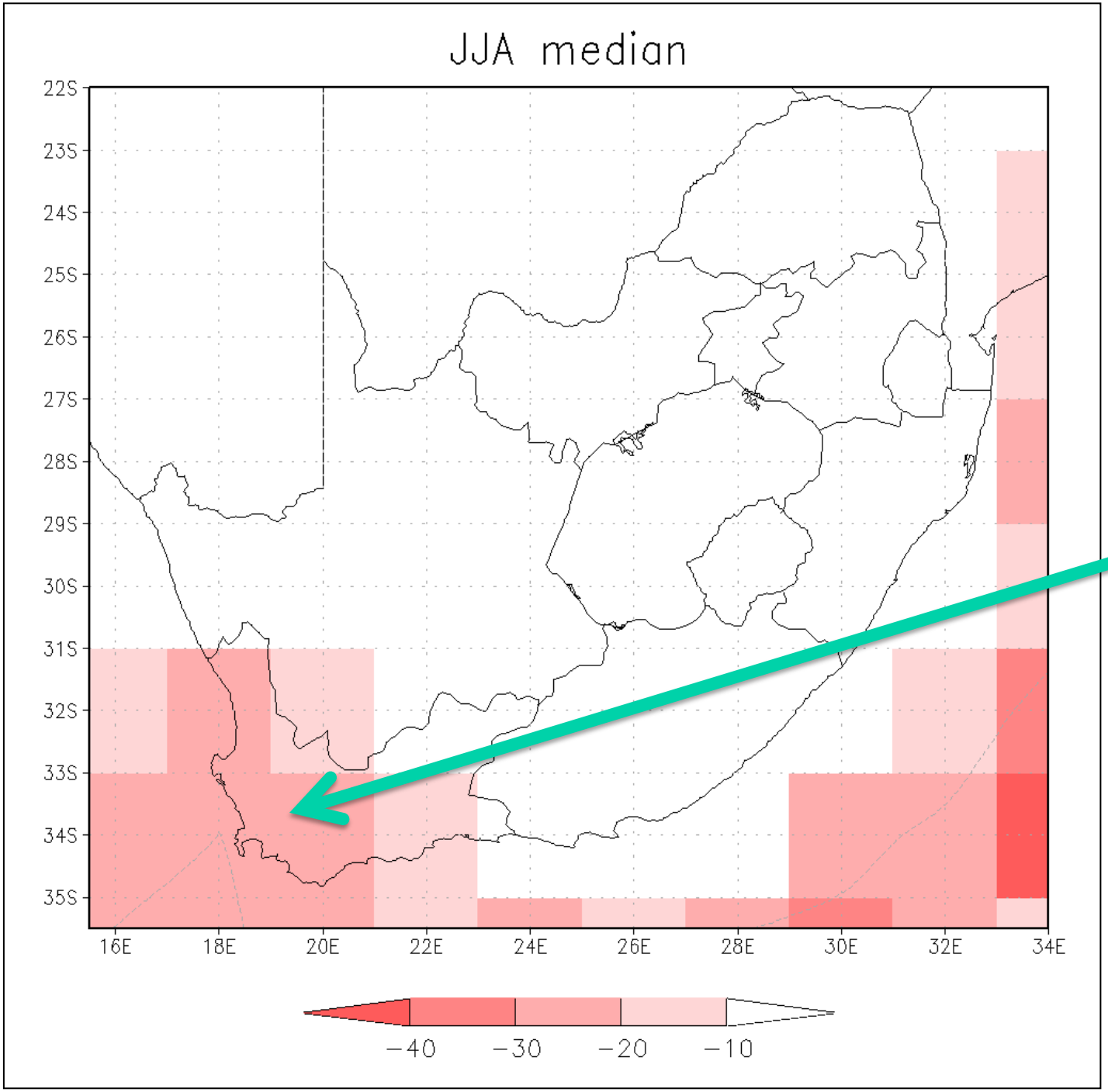
Annual cycle historical precipitation trends (1950-1999)

GCMs projections
CMIP3, A2, 2045-2064 precipitation anomaly



GCMs projections
CMIP3, A2, 2045-2064 surface wind anomaly



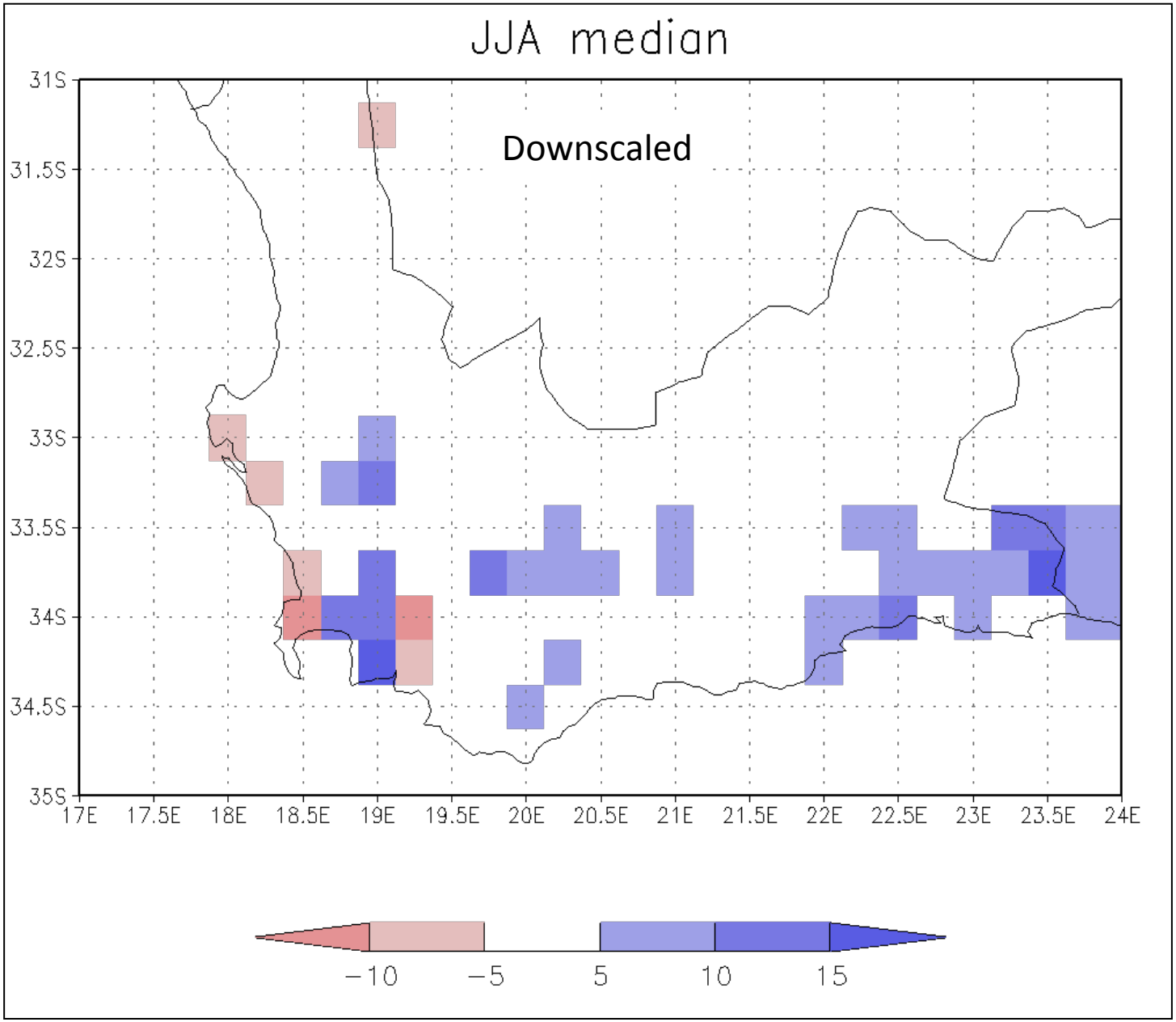


GCMs perspective on core rainfall season (winter)

AR4 multi-model median anomaly:

(2045-2064) - control

Consistent message of drying from nearly all GCMs



Downscaled PROJECTION

AR4 multi-model median anomaly statistically downscaled from CMIP3 GCMs, A2, 2045-2064

mm/month: max change = ~15%

Assess, distill, conclude, communicate a message:

But, users need information for:

- Urban storm water development
- Inter-annual variability for rolling multi-year water resource planning
- Soil moisture & heat stress for dryland agriculture
- Extreme event frequency for peri-urban flooding
- Chill units for viticulture and apple crops
- Etc.

In the decision space of many/most users, this climate service is not very useful.

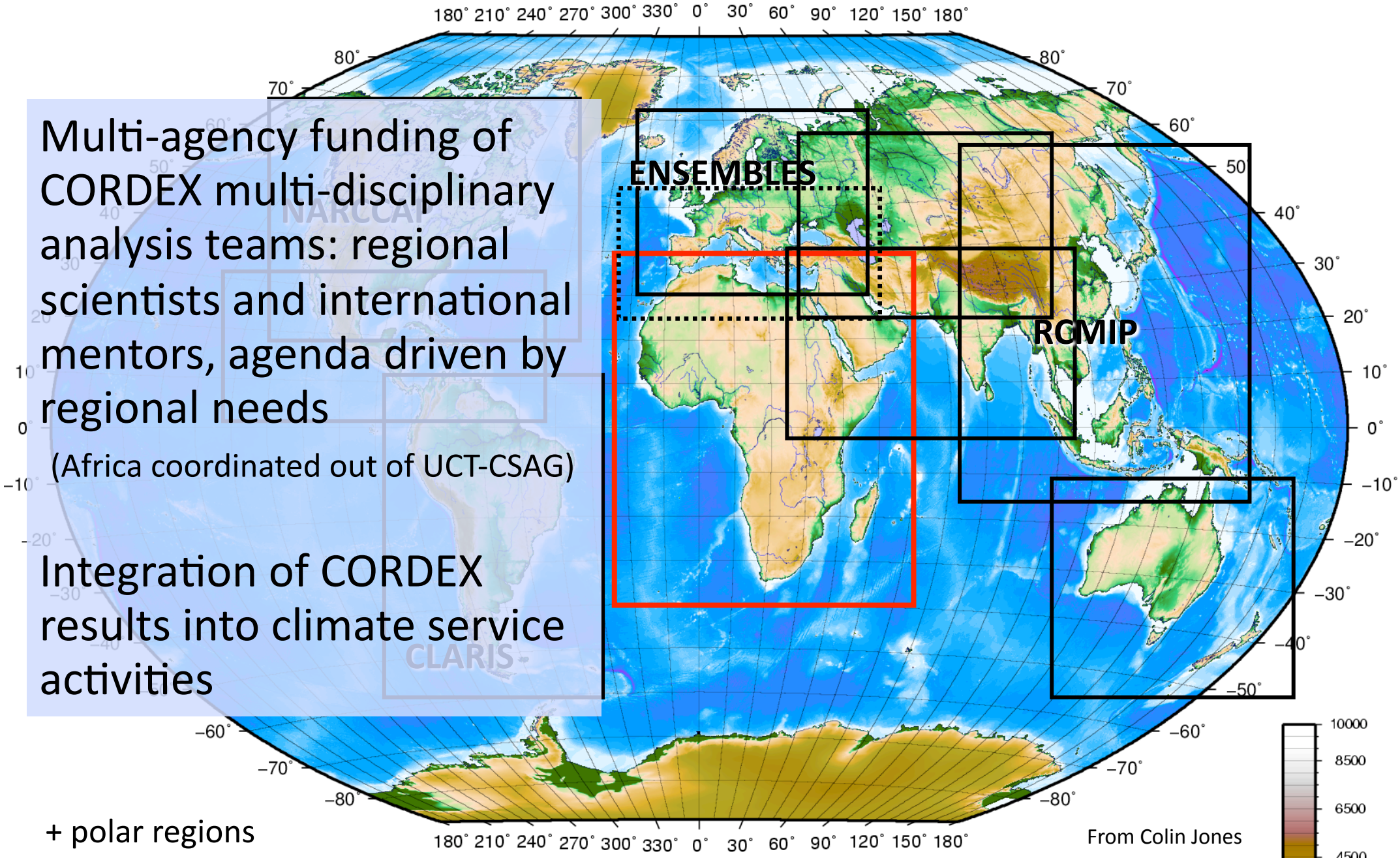
Part 3: Examples of opportunities / approaches

CORDEX : "The largest underfunded opportunity?"

Multi-agency funding of CORDEX multi-disciplinary analysis teams: regional scientists and international mentors, agenda driven by regional needs

(Africa coordinated out of UCT-CSAG)

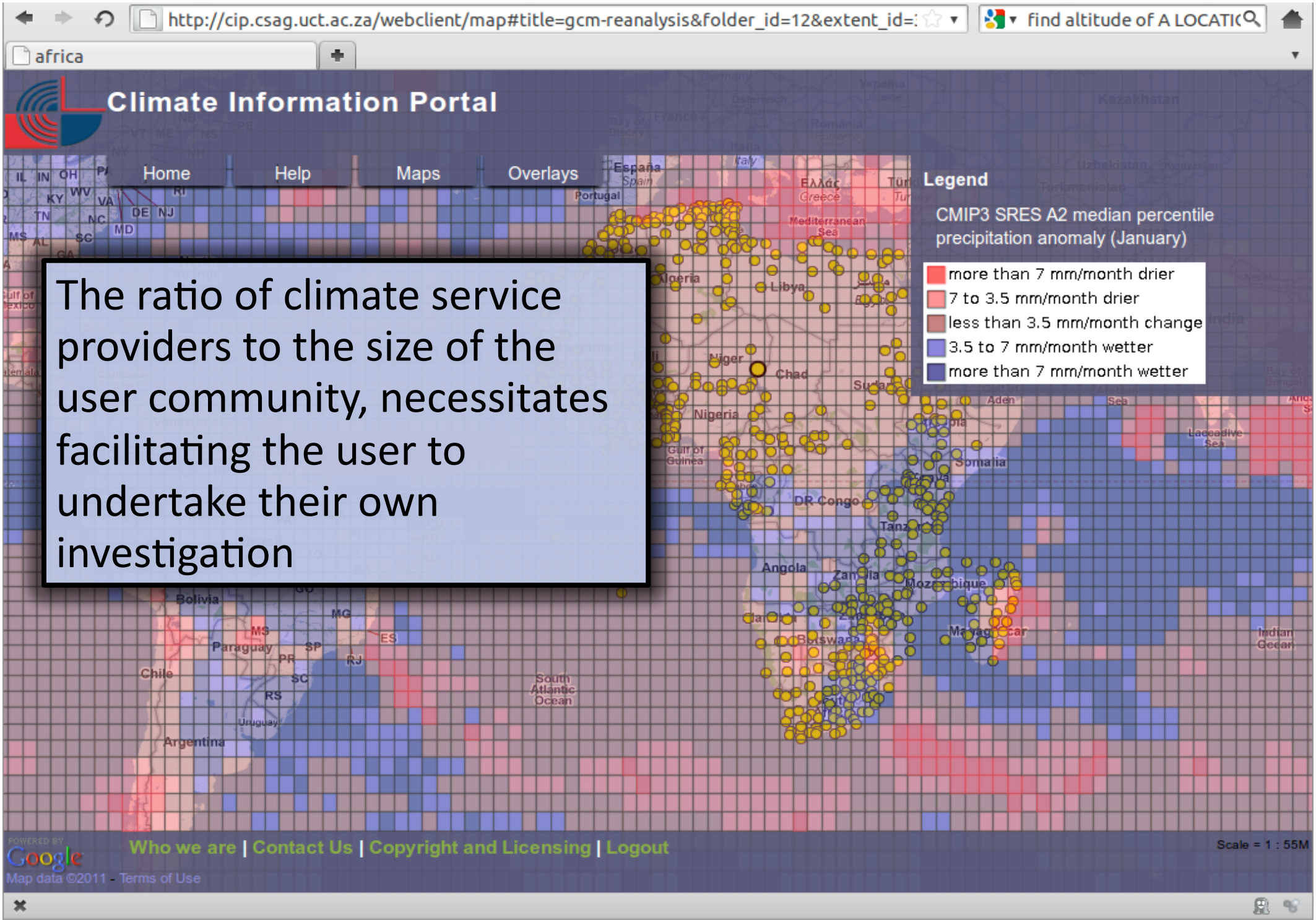
Integration of CORDEX results into climate service activities



+ polar regions

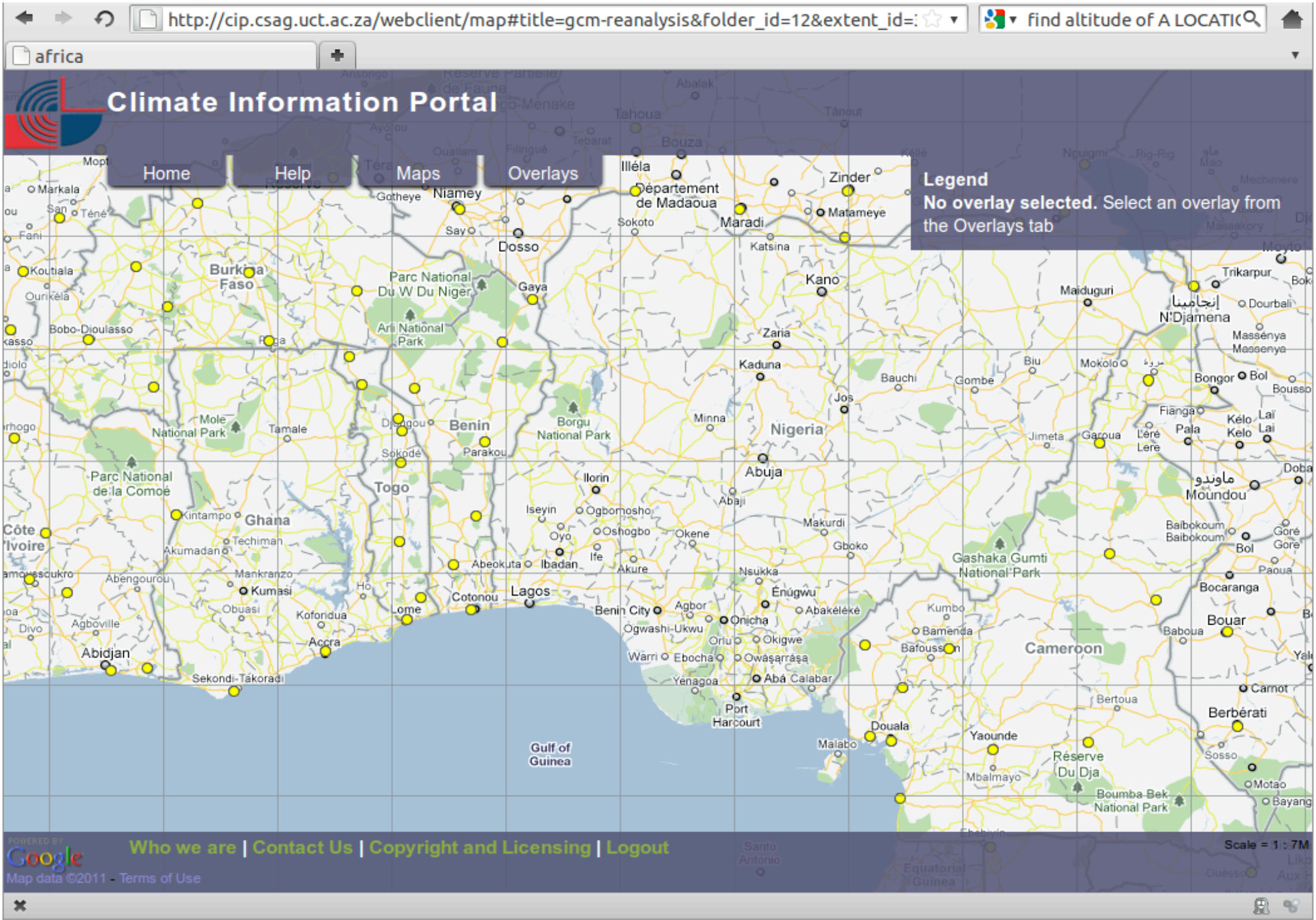
From Colin Jones

Changing a climate data portal into an information gateway



The ratio of climate service providers to the size of the user community, necessitates facilitating the user to undertake their own investigation

Changing a climate data portal into an information gateway



Changing a climate data portal into an information gateway

http://cip.csag.uct.ac.za/webclient/map#title=station-observed&folder_id=1&extent_id=

srtm download

africa

Climate Information Portal

Station Observed Records

Current location selected
NATITINGOU
Station ID: 65319
Coordinates: 10.32° N, 1.38° E
Altitude: 461 (meters)

Observed station records form an important basis for climate analysis in an area. Unfortunately, due to a number of complex reasons, there is a lack of observed data in many parts of the world. Compounding this is the problem of poor quality records from many stations. Data quality problems either require a great deal of work to resolve these problems or else result in the exclusion of the data for analysis purposes.

The data presented here has been extensively quality controlled. A large number of potential station data records have been excluded due to quality problems and only stations with more than **10 years of valid records** are included.

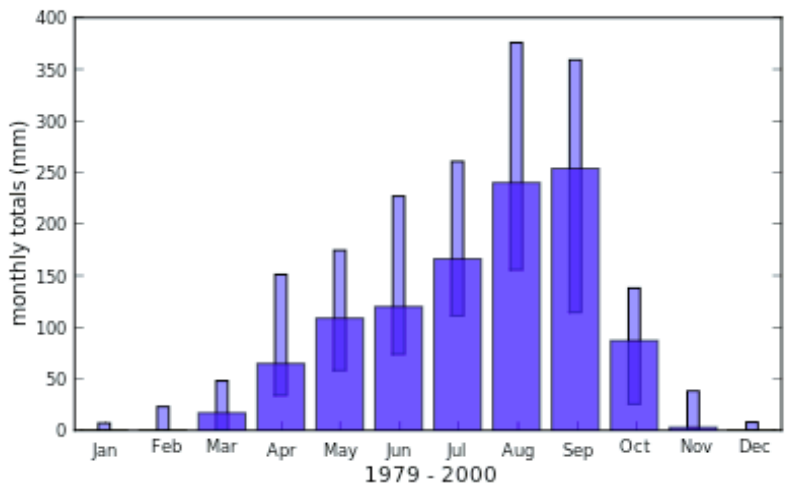
Observed monthly rainfall

Observed monthly rainfall climatologies are an important first look at the historical climate. Typically the inter-annual variability of monthly rainfall totals is high. If you have selected a location from the map you will see a plot of the monthly total rainfall climatology for your selected location to the right. Important things to look for include:

1. Seasonality: When are the wet and dry seasons?
2. Double seasons: Is there more than one wet season?
3. Inter-annual variability: Are there months with particularly high variability?

For many users the timing of the start and the end of the rainy season is very important. Some locations (typically tropical) will experience two separate rainfall seasons. This is generally related to the movement of the Inter-Tropical Convergence Zone (ITCZ) through the year. Finally, months with high inter-annual variability are important as this

Observed Monthly Rainfall Totals



Observed monthly rainfall totals climatology (wide bars) with 10th to 90th percentile inter-annual range (narrow bars)

Who we are | Contact Us | Copyright and Licensing | Logout

Map data ©2011 - Terms of Use

Changing a climate data portal into an information gateway

http://cip.csag.uct.ac.za/webclient/map#title=projection-monthly-tmax&folder_id=1&ex

srtm download

africa

Climate Information Portal

Future downscaled scenarios

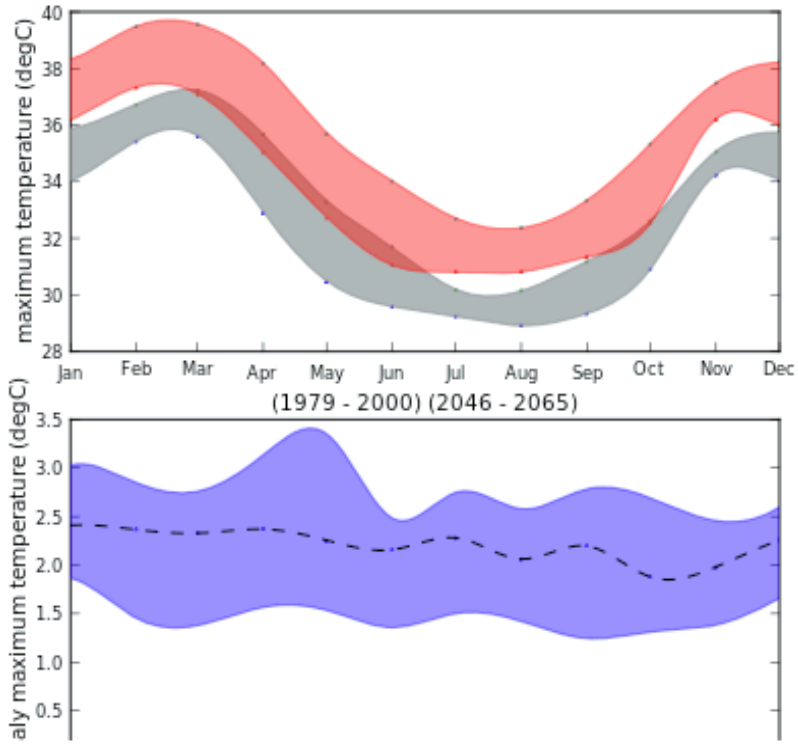
Envelopes of downscaled monthly mean maximum temperatures for both the 20th Century control simulations and a future period allows us to determine if the suite of CMIP3 model projections, after downscaling, show any strong change signal into the future. Envelopes of temperature projections for future periods are typically much narrower than the equivalent rainfall envelopes as temperature changes are less sensitive than rainfall to the local regional dynamics.

If you have selected a location from the map you will see a plot to the right showing control and future multi-model envelopes of monthly mean maximum temperatures as well as monthly anomaly envelopes. Temperature projection anomalies tend to be fairly uniform throughout the season as they are largely dominated by global scale warming signals. Temperature anomalies will almost always be positive except for some unique cases.

The use of multi-model envelopes is an attempt to capture the model uncertainty. While this is not a perfect representation of model uncertainty it is a pragmatic approach. If an median anomaly shows a strong positive or negative change and the multi-model envelope is small then we can be more confident in interpreting the anomaly. However, even if the median anomaly shows a strong change, if the multi-model envelope is large then we must

SRES A2 2046-2065 | SRES A2 2081-2100 | SRES B1 2046-2065 | SRES B1 2081-2100

Downscaled Monthly Daily Maximum Temperature Projections



Who we are | Contact Us | Copyright and Licensing | Logout

Map data ©2011 - Terms of Use

Concluding thoughts

1. Climate services bridge communities, language, and value systems
2. Scientific products are miss-aligned with most user's decision risk framework, in which climate is only one factor
3. Uncertainty language casts doubt; likelihood messages inform
4. Information on the exceedence in time, space, and frequency of user-defined thresholds is powerful
5. The issues of responsibility, accountability, credibility and values is largely missing from the climate services dialogue

In climate services, the three questions that producers and users need to collectively address:

1. Is the message <u>plausible</u>: Does it fall within the envelope of known possible variability?

2. Is the message <u>defensible</u>: On a regional scale, am I able to explain the understanding in terms of physical processes and dynamics?

3. Is the message <u>actionable</u>: at the time and space scales of user decision making – can I support the subjective risk-management decision of a user? (Would I spend my own money?)

Climate System Analysis Group
CSAG
University of Cape Town

Building Climate Information: each piece in the right place