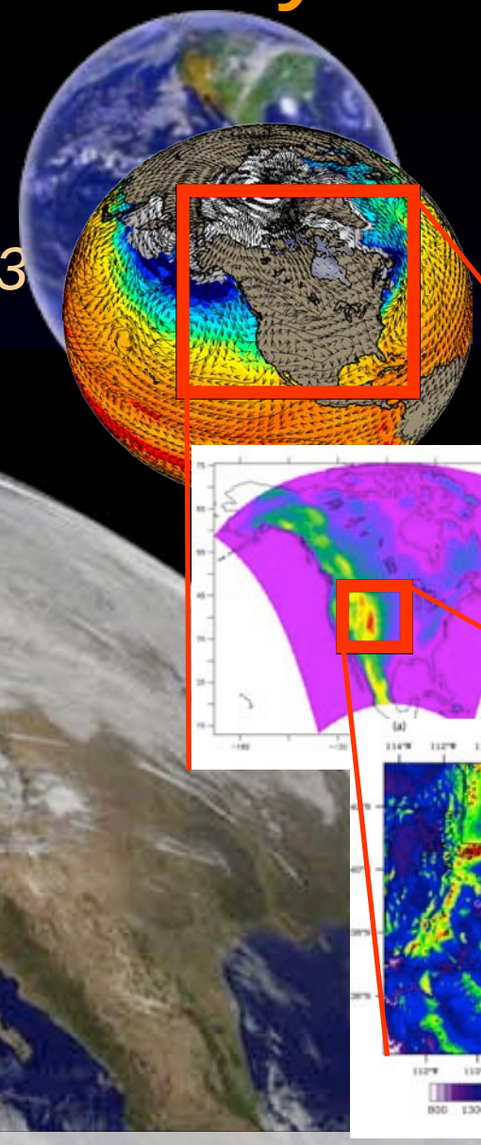
Usable Climate Science
Information and Knowledge for Society

Caspar Ammann, NCAR

CORDEX North America Meeting, Feb. 20, 2013

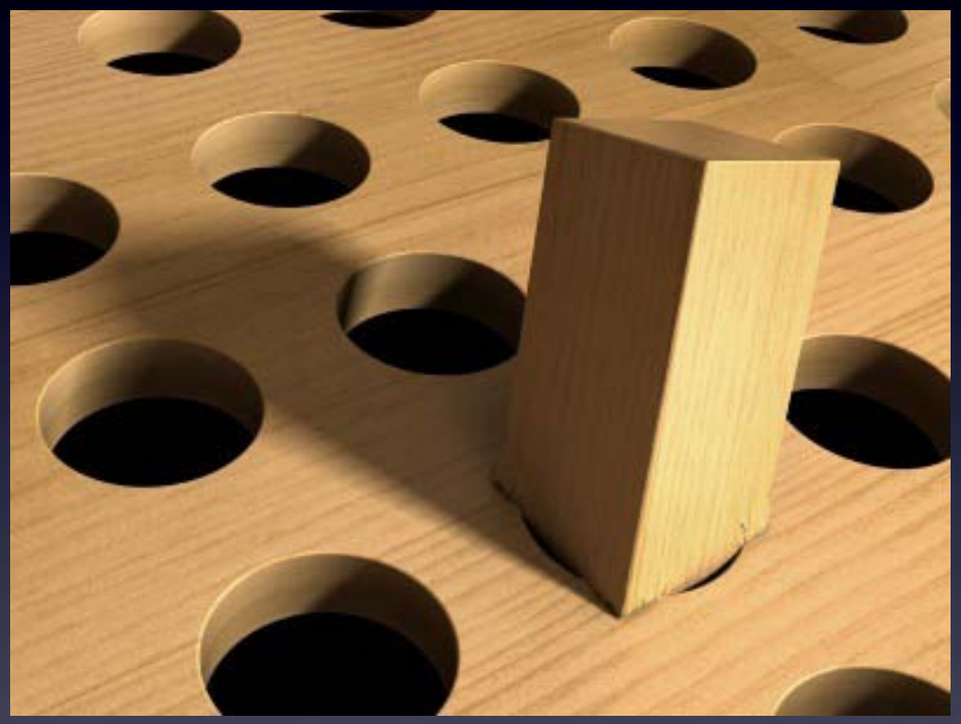


1: Usable data access and data transparency

2: Standardized evaluation: Application indices and metrics

3: Collaborative product and scenarios development

Challenges to make science more useful



- **Data** accessibility, in application-oriented, useful form (format, index, resolution)
- **Information about the data**: QC / evaluation across the production “chain” vs observations, ensemble
- **Translation of Scientific Knowledge** for exploration of impacts of change, guidance of use
- **Community of Practice** that collaboratively develops data requirements and scenarios

National Climate Prediction and Projection (NCPP) Platform

http://earthsystemcog.org/projects/ncpp/

NCPP

National Climate Predictions & Projections Platform

Connecting resources in the Earth Sciences

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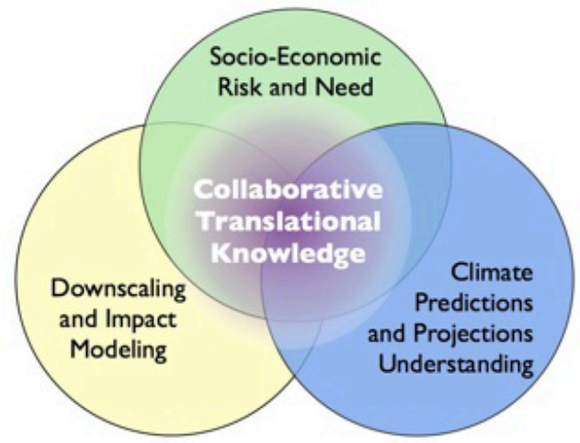
Understanding Climate Information

The National Climate Predictions and Projections Platform (NCPP) offers a collaborative environment to improve the generation, evaluation and translation of high-resolution climate information. Data is now available from many sources, but NCPP helps to make it more directly applicable for specific needs and to provide guidance regarding its use and uncertainties to practitioners. NCPP focuses on:

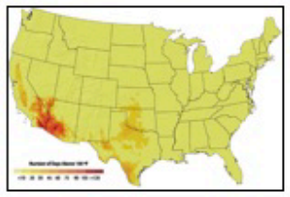
- Facilitate the **development of application-oriented communities** of scientists and practitioners in decision making or adaptation management to jointly generate decision-relevant products
- Develop a flexible and extensible **evaluation platform** that offers important performance metrics on methods, data and tools.
- Initiate and expand a **repository of practices and standards, translation and guidance** related to downscaling of climate data and the understanding of these data in climate change impacts and risk assessment studies

NCPP is dedicated to an Open-Source environment. CoG is supporting the multi-user and multi-entity development of products and relevant information around projects, but at the same time offers extensibility of tools and knowledge to other projects.

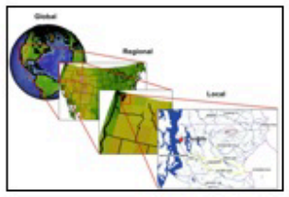
... more on NCPP Mission and Strategy



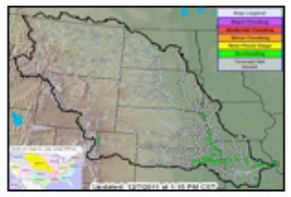
NCPP brings together climate and other scientists with practitioners to build application-oriented communities to collaboratively build tools and products that are combining the available knowledge and best practices in a useful and understandable way



Climate Data Service Capabilities



Data and Downscaling Evaluation and Translation

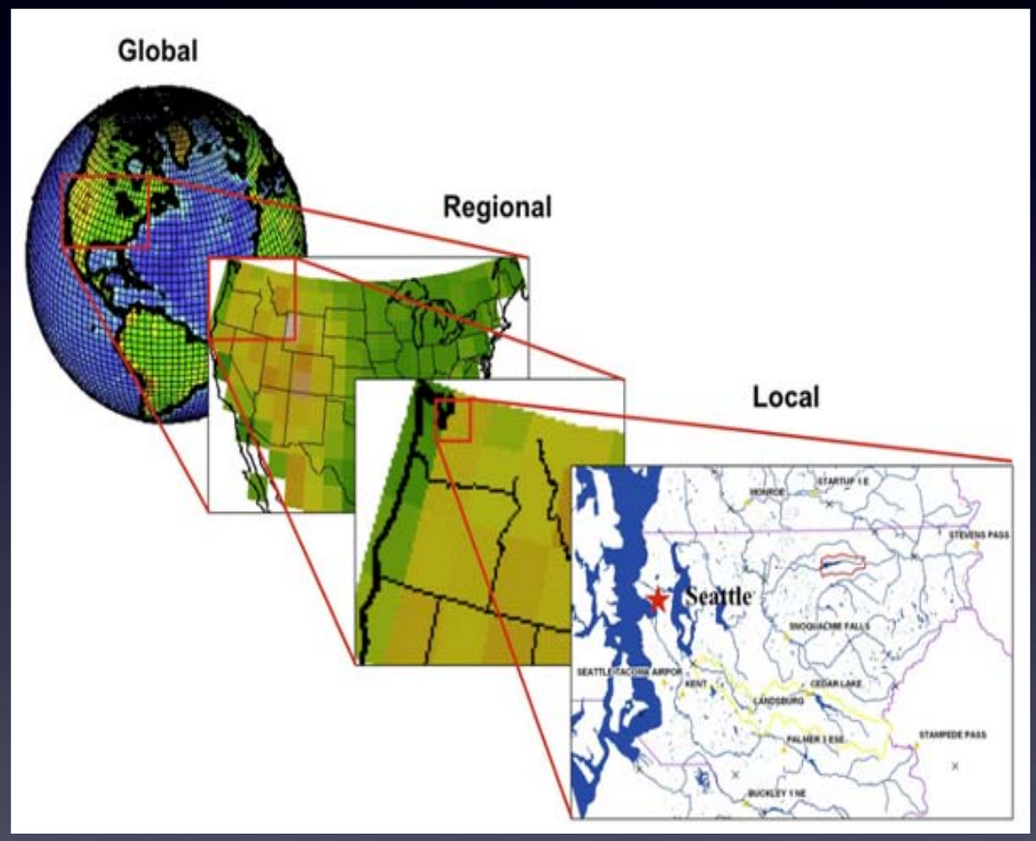


Regional and Sectoral Pilots and Applications

Quantitative Evaluation of Downscaling (QED)

Workshop: August 12-16 2013 Boulder

- Focus: Downscaling High-res climate data evaluation
- Development of Collaborative Infrastructure
- Initially: 4 sectors (extensible)
  - agriculture
  - ecology
  - hydrology
  - human health
- what we are looking for:
  - 2-3 applications per sector
  - partners to develop metrics

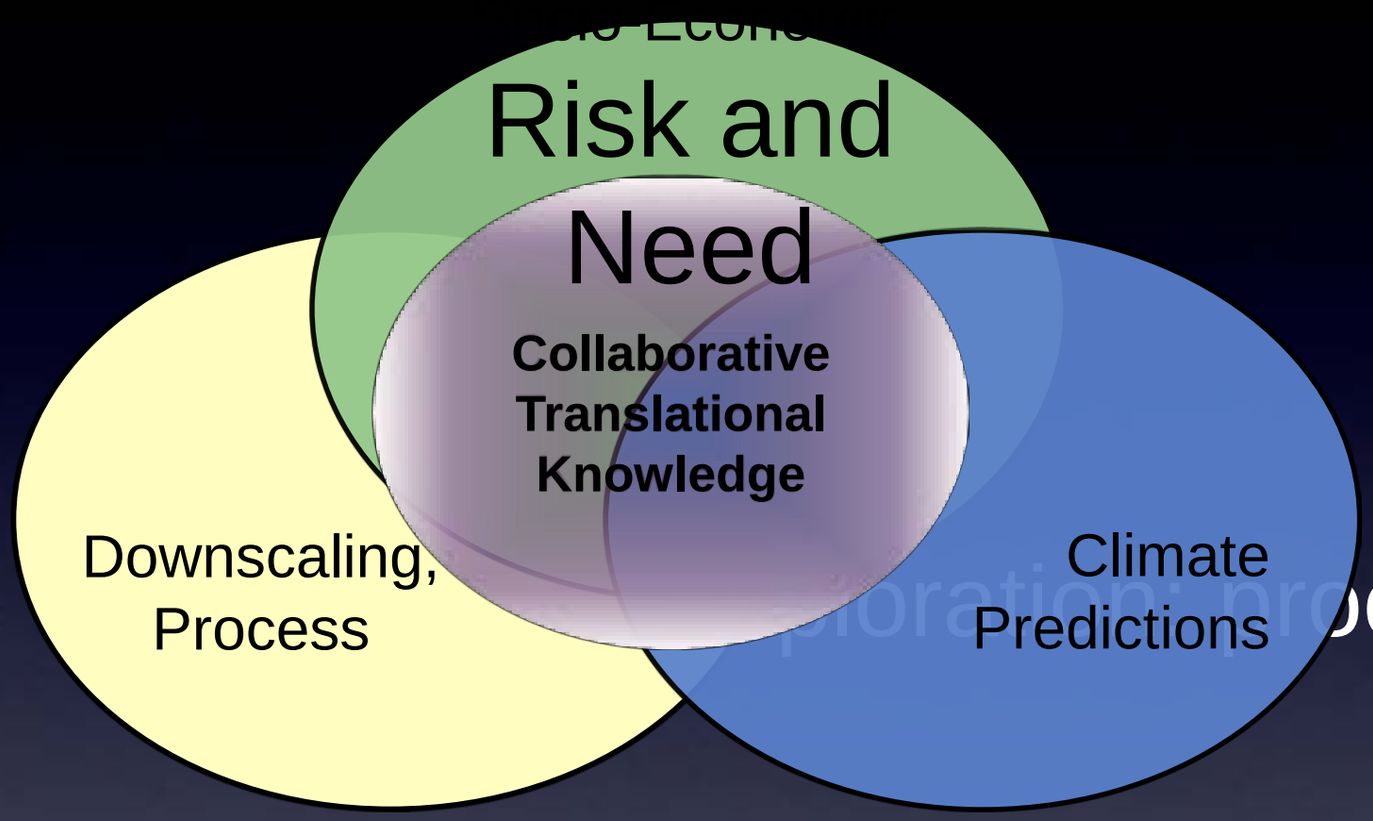


EaSM-2: Advanced Climate and Regional Model Validation for Societal Applications

PIs: *L. Buja (NCAR), W. Gutowski (ISU),* ***Co-****I's L. Kaatz (Denver Water), B. Brown (NCAR)*

1. Identify the variables and indices, based on water resource management needs, that threaten or otherwise influence decision-making, applying understanding of key processes and their spatial and temporal scales.
2. Adapt and convert established quantitative weather-forecast verification tools for climate-model metrics. Accessible and transparent metrics will be the cornerstone for establishing "best practice" uses.
3. Characterize changes seen in future climate projections, using the new tools to link the changes and their uncertainties to specific climate change impacts and needs.
4. Implement the new validation tools in the CESM diagnostics framework, where they can inform model development and enrich the model assessment through user-developed benchmarks.

some steps for making science useful



- ✓ Model development
- ✓ Data assimilation
- ✓ Downscaling
- ✓ process-scenarios, data
- ✓ Climate Data Archive

➡ climate data evaluation: application-oriented quality

➡ climate knowledge translation: cross-disciplinary

Transparent MetaData: CIM with CV

NCPP's Use of Standard Metadata To Promote Open and Transparent Climate Modeling

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1. CIRES, University of Colorado, Boulder, CO, United States. 2. NCAR, Boulder, CO, United States. 3. University of Michigan, Ann Arbor, MI, United States

What is NCPP?

The **National Climate Predictions and Projections Platform** develops comprehensive regional and local information about the evolving climate to inform decision making and adaptation planning. Within NCPP, users and scientists collaboratively generate, review, and analyze climate predictions and projections. NCPP's mission is to:

- Facilitate the development of **application-oriented communities** of contributors of scientific knowledge and expertise, and the practitioners who make it useful in decision making or management processes.
- Become an authoritative source for **practices, standards, recommendations, and guidance** related to the downscaling of climate data and the implementation and interpretation of that data in climate change impacts and risk assessment studies.
- Develop a flexible and extensible **evaluation platform** that offers important performance metrics on methods, data and tools.

NCPP is building the IT infrastructure to support this mission. A critical element of this is the development of **tools to create and view metadata and translational information** about the climate models, downscaling methods, and other processes to create derived data products.

What is the CIM?

The **Common Information Model** is a metadata standard used by the climate research community and others to describe the artifacts and processes they work with. This includes climate simulations, the specific model components used to run those simulations, the datasets generated by those components, the geographic grids upon which those components and data are mapped, the computing platforms used, and so on.

The CIM was originally developed by the Metafor project whose primary focus was CMIP5. Work is ongoing on creating version 2.0 of the CIM which will be better integrated into existing ISO metadata standards. The ES-DOC team is building a set of tools which allow users to create, archive, modify, query, and view CIM documents.

The CIM is defined as a large UML Model which gets converted to XML Schema to use with applications. Additionally, there exist Controlled Vocabularies (CVs) which define, among other things, the set of terms that a CIM Document can contain. For example, the CIM Schema may indicate that a model component can have a child component, but it is the associated CV that indicates that a component of type "atmosphere" can have a child component of type "radiation." CVs are stored as mindmaps. As with the UML models, they are converted to another (XML) format when used with applications.

The CIM is an evolving standard. NCPP is expanding the CIM Schema and its associated CVs to support descriptions of dynamic and statistical downscaling. To date NCPP has

- **added structural elements to the CIM Schema to support regional climate models used in downscaling**, such as explicit lateral boundary conditions, the ability to reference a Global Climate Model from which the downscaling occurs, etc.
- **created a Controlled Vocabulary for dynamical downscaling** which includes, for example, an expanded set of lateral boundary types, spectral nudging, more detailed land surface scheme descriptions, etc.

What Extra Information will NCPP Provide?

As users browse and discover climate data, they will have the opportunity to create and review extra information associated with that data. This information will help them interpret and understand the data and, importantly, decide whether or not it is appropriate for their particular needs (ie: their region, sector, index of interest, etc.). This information can be divided into multiple categories:

Formal Evaluations:
- Results of objective, quantitative evaluation of climate models and downscaling techniques according to evaluation protocols being developed by NCPP.
- Characterization and interpretation of uncertainty.

Process Documentation & Provenance:
- Descriptions of the processes followed to generate data for an application. For example, if three elements of the analysis are climate index, spatial aggregation and time period, this information would include a description of the method or algorithm used for the calculation of the index, native model grid scale resolution and how the data was spatially aggregated, and the time period of analysis.

Scientific Annotations:
- Descriptions of the scientific rationale related to potential user choices during data generation. For example, rationale behind choice of a specific dataset, time period, etc., and guidance on the impacts of these choices on the final interpretation of the results.
- Narratives, based on data analysis, that provide summary information of what has happened historically, e.g. trends or changes in seasonality, as well as a description of how climate is projected to change in the future. The underlying data analysis would be available from the narrative.
- Descriptions of the current state of understanding of the advantages and limitations of various downscaling techniques for specific user applications as well as guidance in narrative form on appropriate uses and interpretation of climate information. For example, expert judgments (based on analysis and evaluation) that the use of particular climate information is appropriate and scientifically justified for a particular application.

What can you do with CIM Documents?

ES-DOC is actively developing tools to use with the CIM. This includes:

Metadata Editor

Metadata Viewer

Metadata Browse & Search

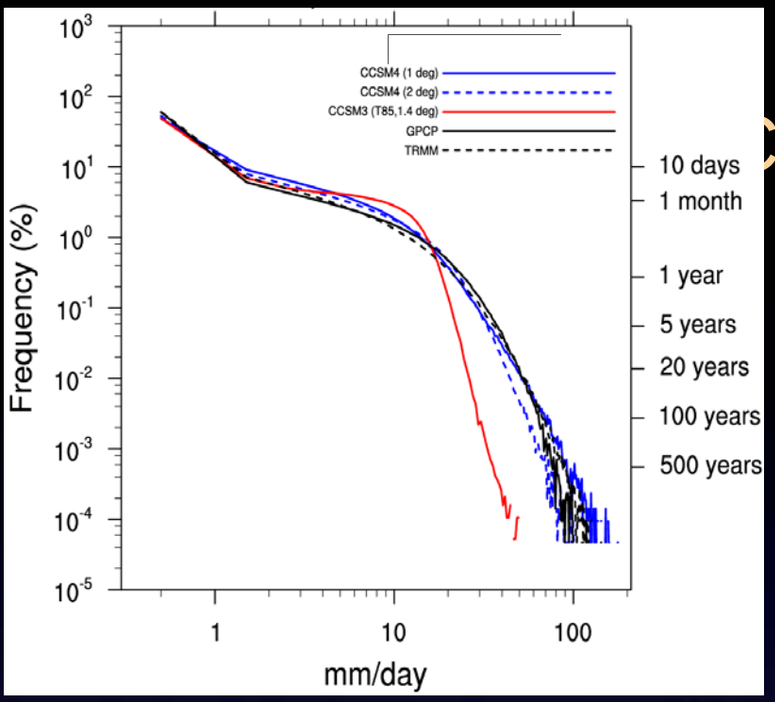
as well as a **Metadata Comparator**.

Using a common standard like the CIM will allow NCPP access to climate metadata from multiple communities. NCPP will also contribute useful content to the climate community's standard metadata. Furthermore, these tools can facilitate climate analysis by providing access to authoritative descriptions of downscaling models and datasets for the entire climate science community.

For more information go to: http://earthsystemcog.org/projects/ncpp

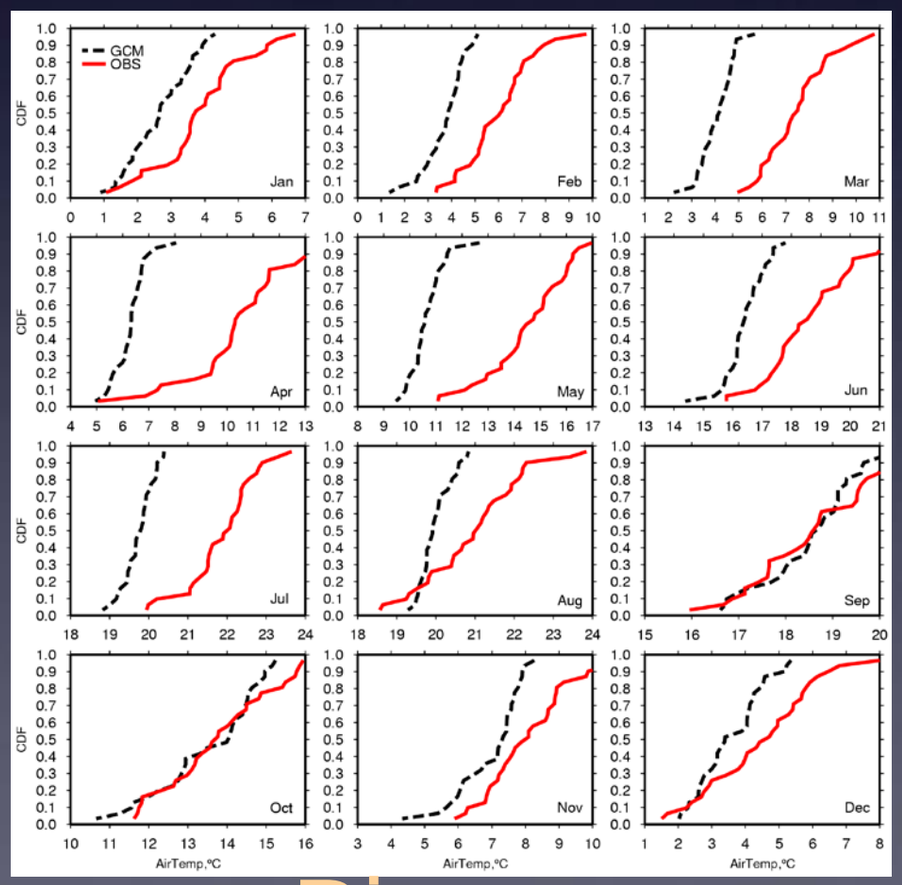
Evaluation in Application Context

Combine with MetaData as Translation and Guidanc

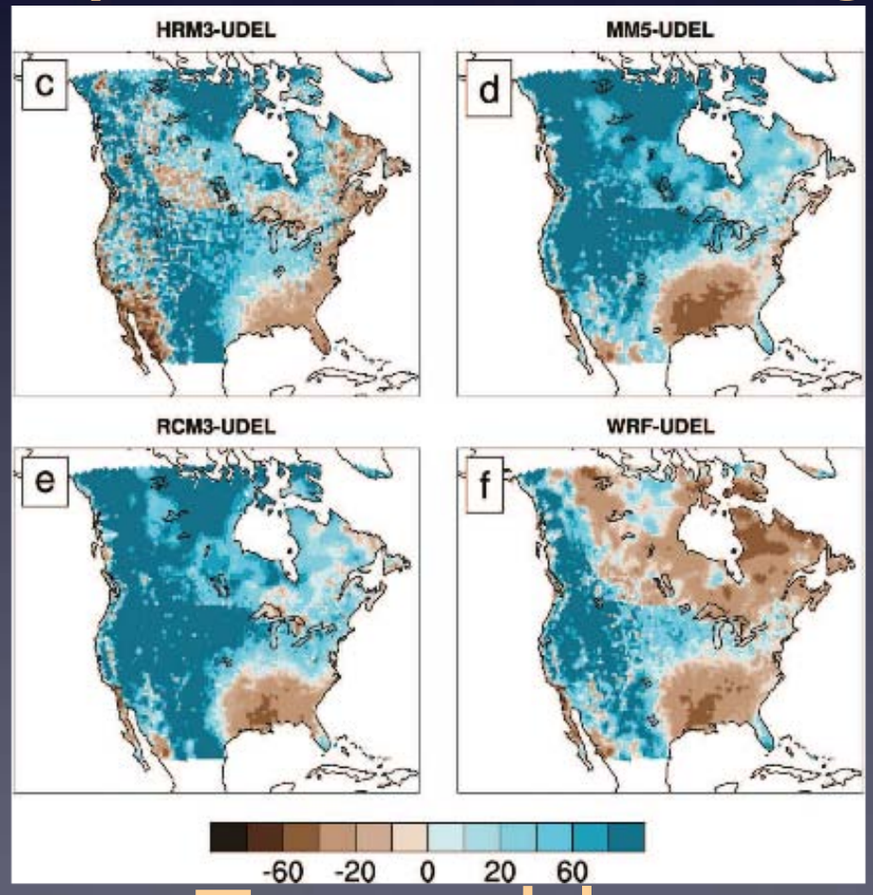


Extremes

Experimental Design



Biases



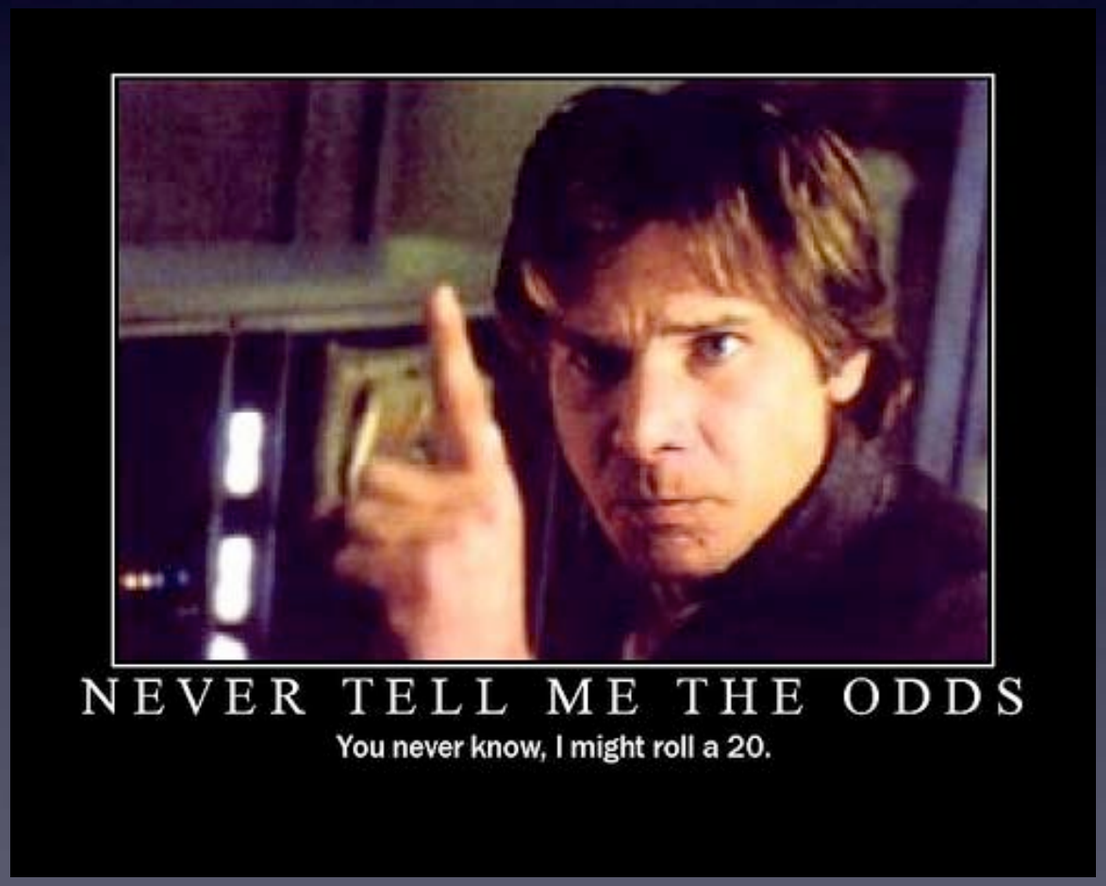
Ensembles

NCAR

Better Scenarios

what are the odds

what is possible



Collaborative Climate Product Development for local needs

"The timely production and delivery of useful climate data, information and knowledge to decision makers"

(NRC, 2001)

"Give me information in such a way that I can make decisions at a local level. What does this mean for me in the next N years"

Jargon-free, clear,

actionable,

expose the uncertainties

Science-brokers/translators are important

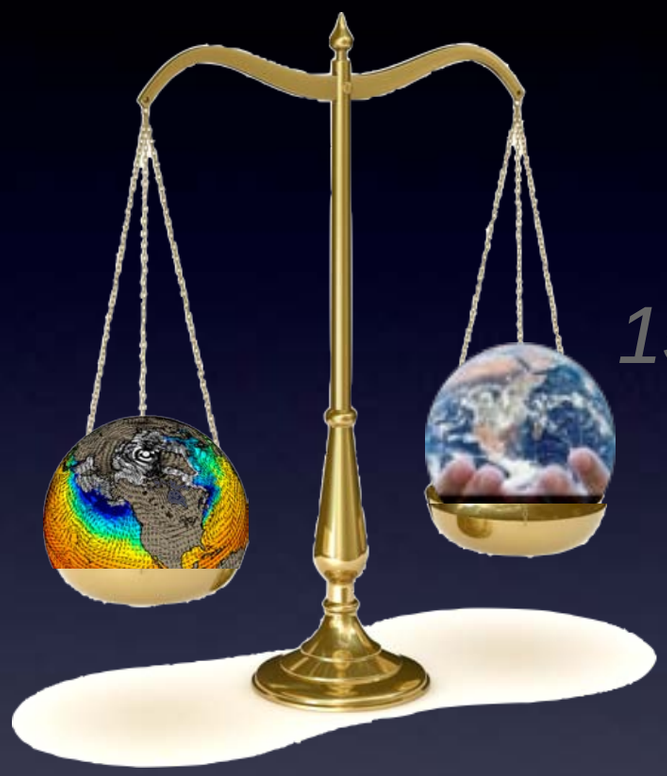
(Pew Report "Lost in Translation")

"Official" climate products & processes allow planners to make major, climate-informed, infrastructure decisions

….and stay out of court.

Summary and Outlook

To be useful and relevant, need to establish the right balance !



80% 10% Efficient data access, handling

15% 70% Flexible analysis, evaluation, exploratio

5% 20% Communication, visualization

Key needs:

- *New approach* to data and derivatives generation and access
- Standardized *evaluation and translation* of climate data / knowledge
- Environment for *quantitative exploration of impacts* in broader context