

Regional Climate Prediction: Prospects and Challenges

Todd Ringler
Theoretical Division
Los Alamos National Laboratory

LA-UR-07-5637

<http://public.lanl.gov/ringler/ringler.html>

My background

The majority of my work has been related to large-scale dynamics of the climate system.

I develop numerical methods for climate system models that (I hope) will improve the quality of the simulations (eventually).

If I am a global climate modeler,
how did I get interested in regional
climate prediction?

My interest in regional climate prediction stems from my view that a quantitative assessment of climate change impacts on the scale relevant to society is largely outside the scope of global climate models.

What is regional climate prediction?

What is regional climate prediction?

An understanding of anthropogenic climate forcing at the temporal and spatial scales relevant to socio-economics. (electric grids, water resources, ecosystem function).

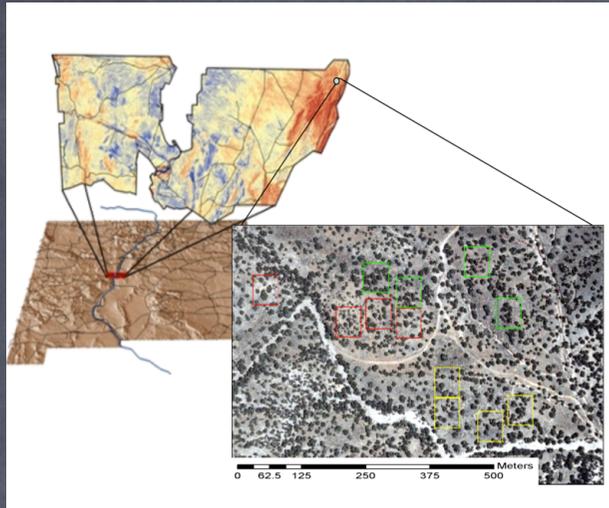
What is regional climate prediction?

An understanding of anthropogenic climate forcing at the temporal and spatial scales relevant to socio-economics. (electric grids, water resources, ecosystem function).

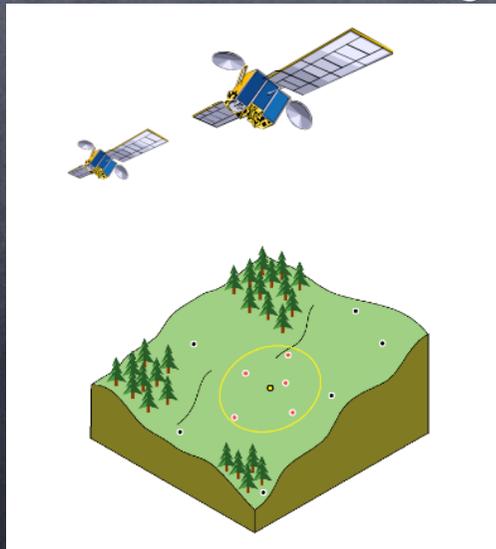
An effort that contains processes not currently resolved or accounted for by global climate models. (ecosystem dynamics, surface and ground water hydrology, climate-infrastructure dynamics).

Tools for regional climate prediction

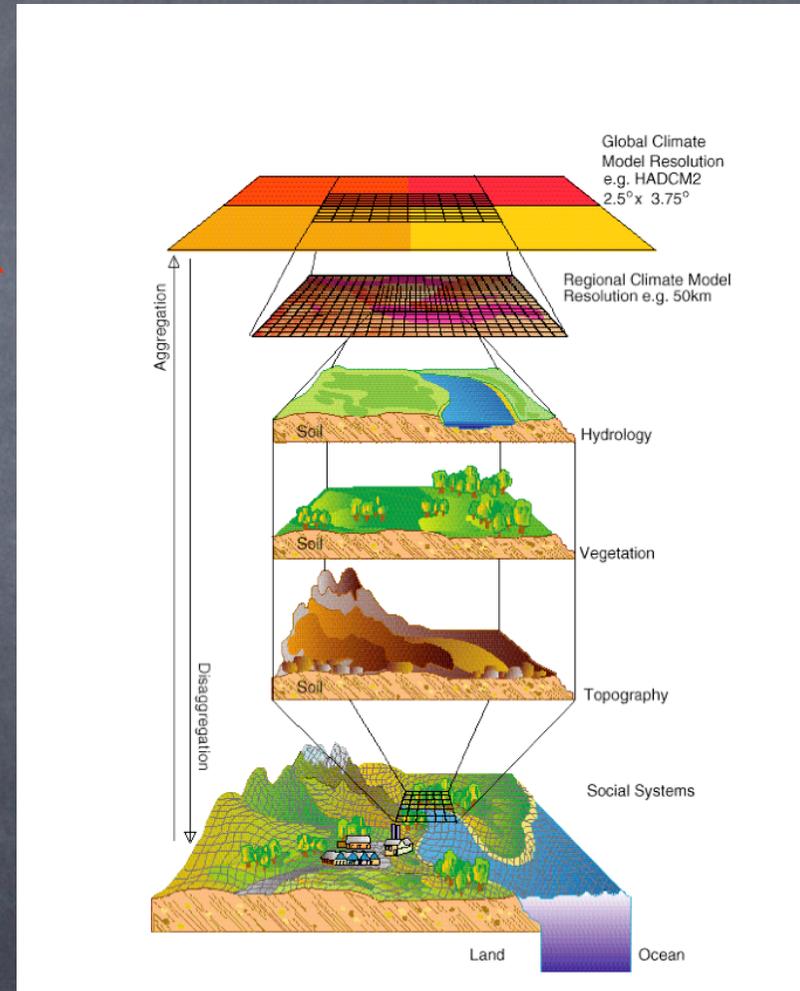
Field Observations



Remote Sensing



Integrated Modeling System

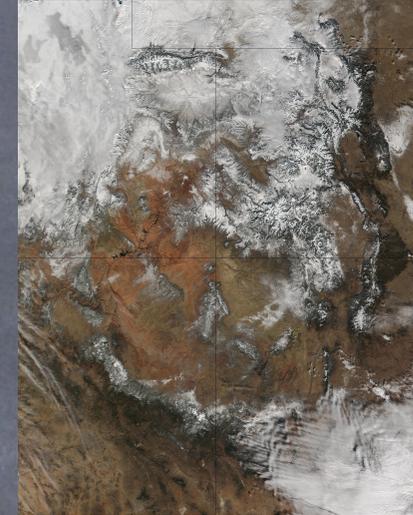


Tools for Prediction: A Focus on Downscaling

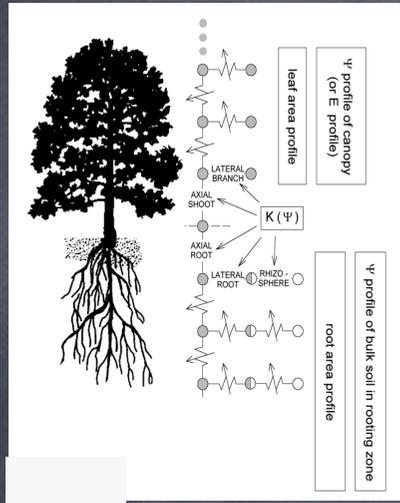
Global Climate Models: 200 km



Regional Models: 10 km



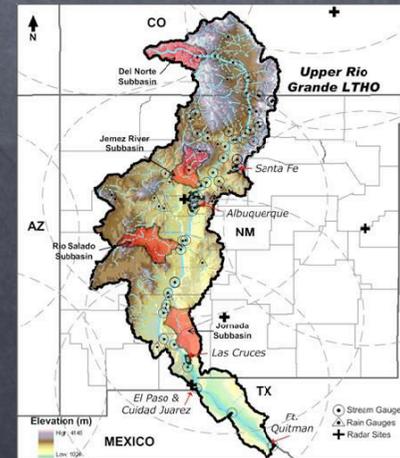
Plant Physiology Models: 1 m



Ecosystem Dynamics Models: 10 m



Surface Hydrology Models: 100 m



Prospects for Regional Climate Prediction: The next decade

Prospects for Regional Climate Prediction: The next decade

+ As in politics, all impacts are local -- i.e. people are going to want to know how climate change will impact their region.

Prospects for Regional Climate Prediction: The next decade

- + As in politics, all impacts are local -- i.e. people are going to want to know how climate change will impact their region.
- + Computing resources, knowledge of relevant processes, and acceptance of interdisciplinary work all support regional climate prediction science.

Prospects for Regional Climate Prediction: The next decade

- + As in politics, all impacts are local -- i.e. people are going to want to know how climate change will impact their region.
- + Computing resources, knowledge of relevant processes, and acceptance of interdisciplinary work all support regional climate prediction science.
- Resistance of funding agencies to regionally-organized efforts.

Leveraging questions that the broader society is starting to ask.

Leveraging questions that the broader society is starting to ask.

Reservoir Capacity

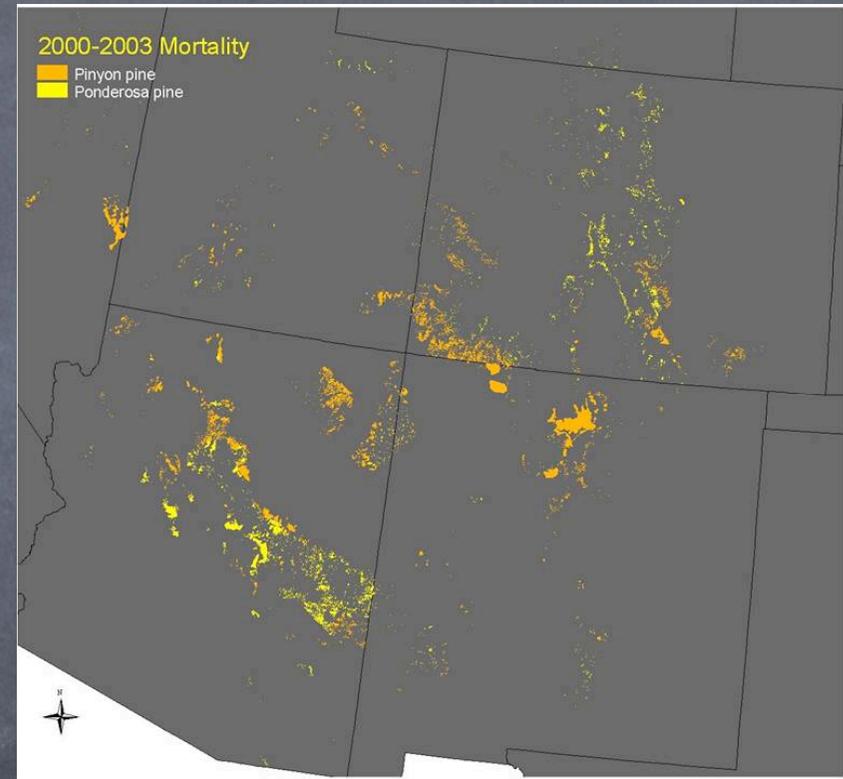


Leveraging questions that the broader society is starting to ask.

Reservoir Capacity



Pinon and Ponderosa Pine Mortality

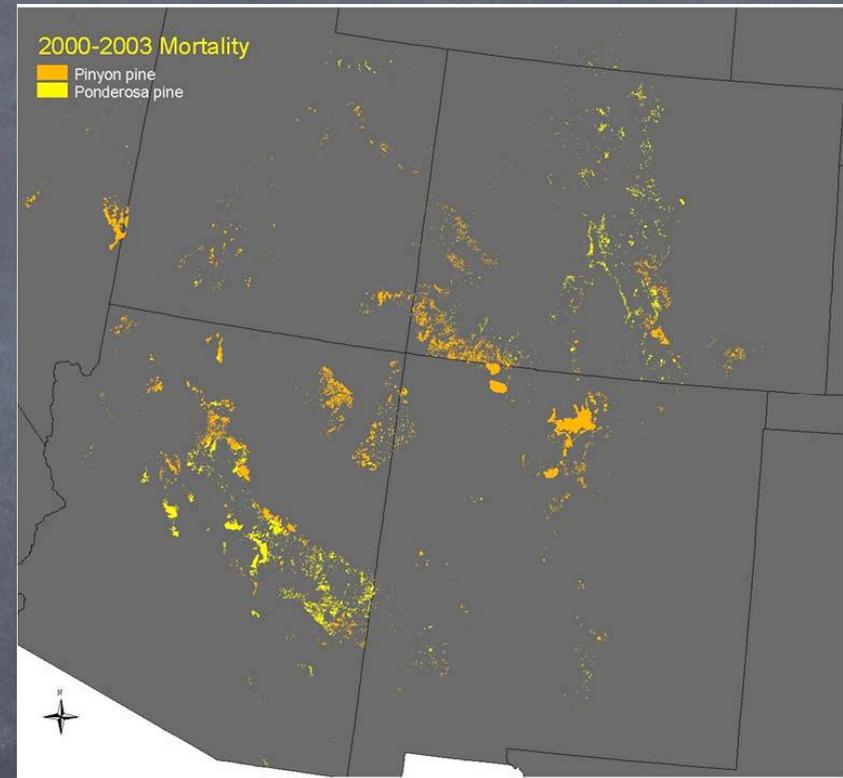


Leveraging questions that the broader society is starting to ask.

Reservoir Capacity



Pinon and Ponderosa Pine Mortality



both systems are driven by the same climate processes:
drought, temperature, evaporation, ...

Major hurdles in regional climate prediction

Downscaling, e.g. What does a 20% decrease in precipitation mean to a surface hydrology model?

Process models, e.g. Can we obtain equilibrium solutions of climate-ecosystem models in the face of episodic forcing such as drought?

Regional feedbacks, e.g. What do structural changes in terrestrial ecosystems mean to the regional water cycle?

Realistic expectations for the utility
of these models.

Realistic expectations for the utility
of these models.

More inklings on regional climate change will naturally
occur as our global models are used at higher resolution.

Realistic expectations for the utility of these models.

More inklings on regional climate change will naturally occur as our global models are used at higher resolution.

Scenario-based science using a subset of the predictions tools outlined above should reap great rewards in terms of answering “what if” questions.

Realistic expectations for the utility of these models.

More inklings on regional climate change will naturally occur as our global models are used at higher resolution.

Scenario-based science using a subset of the predictions tools outlined above should reap great rewards in terms of answering “what if” questions.

Climate (and society!) is not deterministic. As a result, impacts of climate change is not deterministic. Are our strategies for adaption robust enough to accommodate probability distribution functions?

Regional climate prediction as a motivator
for mitigation policy.

Effective mitigation policy is necessarily a
global activity.

Effective adaptation policy is necessarily a
regional activity.

Regional climate prediction as a motivator
for mitigation policy.

Effective mitigation policy is necessarily a
global activity.

Effective adaptation policy is necessarily a
regional activity.

A fleshing out of the latter may
provide additional urgency to the former.