Climate Data For Agricultural Analysis – Opportunities and Pitfalls

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Data needed to understand tradeoffs between agriculture and the environment

Resources:
- Climate
- Population
- Land (soil)
- Water
- Cultivars
- Livestock
- Energy
- Other Assets

Environmental and socio-economic variables:
- Poverty
- Greenhouse gas fluxes
- Biodiversity
- Water quality
- Soil degradation

Economic and institutional factors:
- Land tenure
- Market Access
- Credit Availability

Management:
- Planting/harvest dates/cropping intensity
- Irrigation
- Fertilization
- Plant protection
- Labor
- Other management practices

Agriculture and Forestry sectors

Marketed products:
- Food
- Fiber
- Fuel
- Timber
- Carbon credits
Summary

• Community has long history of archiving observational data and climate model output

• Understanding of the climate system has been substantially enhanced over the past 7 years following the large-scale release of data in phase 3 of the Coupled Model Intercomparison Project (CMIP3)

• New scientific questions and areas of inquiry have been catalyzed by availability of data to the global community

• New scientific questions and areas of inquiry have been catalyzed by interaction between different sub-communities around issues of data availability

• Data access and processing remain a technical challenge, and there exists tremendous potential “uplift” from coordination with other agricultural and environmental data streams
CMIP3 Overview

• World Climate Research Program activity sponsored by U.S. DOE at PCMDI (Lawrence Livermore National Laboratory)

• 24 global climate models from modeling centers around the world

• As of Jan 2009: 2570 users, 36 Terabytes archived (83,000 files), 536 Terabytes downloaded (1,781,000 files)

• 575 publications (data became available Dec 2004)
Lessons from the CMIP3 “Revolution”

- Investment in the technical infrastructure and human capital that enable access to a broad community of researchers can revolutionize a field of inquiry.

- A pressure now exists for climate modeling groups to participate and have their institutions represented, and for authors to use multi-model data for any related analysis.

- While the availability of data can enable scientific innovation, it can also limit the kind of science that is done – so engagement with the community at the outset is critical.

- Access catalyzes community contribution, including valuable insight about future improvements to the database, and to the data themselves – so again engagement with the community at the outset is critical.
Lessons from the CMIP3 “Revolution”

• The availability of an interesting, coordinated and well-managed database can spur demand from greater data volume. CMIP3 archived 36 Terabytes, but CMIP5 is expected to archive more than 1 Petabyte – the increase is almost entirely due to excitement in the community about the value of the CMIP3 database.

• Public archive creates opportunity for both physical and virtual infrastructure development – a variety of experts in fields outside of climate science (including computer science) are investigating ways to archive and analyze the CMIP data most efficiently.
1 Petabyte expected

Archiving split among 8 gateways around the globe

Uniform data access

Plans for some online data subsetting

Figure 3: Schematic summary of CMIP5 long-term experiments. Green font indicates simulations that will be performed only by models with carbon cycle representation.

Taylor et al., 2009
Figure 4. Quantitative comparison of VIC-ORG and VIC-BC-simulated soil saturation, evapotranspiration, runoff, and base flow with VIC-OBS. (a) VIC-OBS versus VIC-ORG and (b) VIC-OBS versus VIC-BC. The radial coordinates represent the ratio of variance (ROV) and root mean squared difference (RMSD): ROV as a radial distance from the reference arc (labeled with a red color) and RMSD as the radial distance from the point of reference (labeled VIC-OBS). The angular coordinate represents the pattern correlation. Four symbols represent four regions, four colors represent four seasons, and four numbers represent four variables. All values greater than 2.0 are set equal to 2.0.
Anticipated Benefits of a Climate Model Output Node in the GEOSSHARE Network

• Streamlined access to climate variables of interest

• Coordination of data format, grid, time-span, etc. with other data streams

• Co-location of multiple climate model outputs (CMIP5, CORDEX, ENSEMBLES, NARCCAP, gridded observations, etc)

• Potential for bias-correction

• Avenue for interaction with climate modeling community

• Potential for intellectual interfaces that have not yet been imagined
### Possible Pilot Climate Model Output Node

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<td>Bias-corrected temperature and precipitation fields</td>
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