AgMIP Climate Datasets and Scenarios

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The Challenge of Climate Change

- Climate change has potential for substantial impacts
- Uncertainties from data sources, global climate models, societal emissions, and scenario generation techniques
- Need consistent protocols to allow comparison among studies
• Constructing climate series for the current climate
  ➢ Observational datasets as proxies for gap-filling
• Generating probabilistic scenarios of future climates
  ➢ Incorporating mean and variability changes
  ➢ Near-term scenarios and emulated estimates
• Uncertainty and Agro-climatic analysis

Quality-controlled station observations are the gold standard for AgMIP.

Data from 1980-2010 allows us to examine 30 planting years (daily data required for crop modeling).

These data are used for calibration, provide helpful context for stakeholders, and help us understand current agro-climatic vulnerabilities.
**The .AgMIP Climate Format**

- Allows for easy use in IT tools developed for crop and economic models
- Works with translators that convert into many crop model formats
- Used extensively in AgMIP climate scenario generation tools

*Note: Excel template at [www.agmip.org](http://www.agmip.org) facilitates the use of this format*

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*WEATHER DATA : Ames, Iowa, USA

@ INSI   LAT   LONG   ELEV   TAV   AMP   REFHT   WNDHT
USAM 42.017 -93.750 329 11.2 14.6 2.0 2.0

@DATE   YYYY  MM  DD  SRAD  TMAX  TMIN  RAIN  WIND   DEWP  VPRS  RHUM
1980001 1980   1   1   1.2  1.3  -1.5  0.0   3.1  -0.3  6.0  89
1980002 1980   1   2   4.7  -0.3  -2.6  0.0   4.9  -7.6  3.5  58
1980003 1980   1   3   1.9  -0.3  -4.8  0.0   4.3  -9.0  3.1  52
1980004 1980   1   4   3.8   0.2  -2.6  0.0   4.1  -5.2  4.2  67
1980005 1980   1   5   1.0   0.2  -3.2  1.5   3.4  -2.5  5.1  82
1980006 1980   1   6   8.5   1.9  -7.0  2.1   9.1  -0.8  5.7  82
...
...
2010364 2010  12  30   2.6  4.0   1.7  0.0   5.1  2.0  7.1  87
2010365 2010  12  31   3.4  1.3  -1.5  0.9   5.3  -2.5  5.1  76
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Using AgMERRA and AgCFSR to fill in gaps

- Begins with NASA MERRA reanalysis and data assimilation
- MERRA relies on model physics for more complex variables (sunshine, rainfall)
- AgMERRA corrects to a gridded temperature and precipitation set and covers 1980-2010
- AgMERRA uses:
  - improved solar radiation
  - spatial patterns of rainfall from satellites
  - an adjustment to diurnal temperature range
- Tools developed to easily create .AgMIP-formatted time series
- Bias correction still necessary in most situations

AgCFSR = Similar dataset based upon NCEP Climate Forecast System Reanalysis
Evaluation of AgMERRA and AgCFSR (750+ sites)

- AgMERRA and AgCFSR compared against 750+ high-quality weather stations in agricultural regions
- Reanalysis maximum temperatures tend to be too cool; minimum temperatures tend to be too warm
- Reanalysis precipitation can have large biases
- AgMERRA and AgCFSR reduce these biases substantially
- WorldClim dataset can be used to provide further spatial information
The AgMIP Guide for Running Climate Scenario Generation with R

Available at: http://www.agmip.org/climate-team/

- Contains links to datasets, including processed versions of WorldClim (for some regions) and the CMIP5 GCMs
- Provides links to download R processing language (free) and climate scenario generation scripts
- Contains detailed descriptions of how the scripts can be set up and executed for AgMIP
- Designed for AgMIP studies in Sub-Saharan Africa and South Asia
- Updated regularly
Mean-change-only ("Delta") Scenarios

Most widely-used approach for climate impacts research

- Adjust historical climate observations according to climate changes projected by Global Climate Models
- Add temperature changes by month
- Multiply precipitation changes by month
- Does not change variability within a month (e.g., number of rainy days) or between years (e.g., El Niño)
Distribution of Climate Change Projections

Projected Climate Changes from 20 CMIP5 GCMs
(projections shown for Henry County)

Change in Temperature [-1°C to +8°C]
**Full Ensemble of Scenarios**

Azuero Peninsula, Panama (from Ruane et al., 2013)

- Black line and stars represent current temperature (top) + rainfall (bottom)
- Box-and-whiskers represent spread of GCM scenarios for each month
- Annual and seasonal metrics also shown

Fig. 2. Baseline (black line and stars) and A2 End-of-Century projected range (across 16 GCMs) of monthly, annual, and seasonal a) temperature and b) precipitation for Los Santos, Panama. S1: primera coa; May–August; S2: segunda coa; September–December.
Mean-and-Variability Change Scenarios

- R scripts are available to simultaneously adjust mean and variability (frequency of rainy days, standard deviation of minimum and maximum temperature, distribution of rainfall amounts)

- Variability shifts from GCMs are less trustworthy than mean shifts, so RCM projections of variability changes may be incorporated if there are enough RCM simulations to understand uncertainty
Probabilistic Near-term Climate Scenarios

- Developing probabilistic decadal scenarios with continuity across space and variables
- Allows examination of 95% wettest or driest decade according to vector-auto-regressive model based on historical observations and GCM projections

From Arthur Greene and James Chryssanthacopolous
Questions or Suggestions?

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For protocols, Climate Scenarios Guidebook, up-to-date events and news, and to join AgMIP listserve:
www.agmip.org