Part VIII: User and Policy Oriented Metrics and Applications

Session Chair: Jerry Meehl
Session Rapporteur: Forrest Hoffman
August 3, 2017

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User-Oriented Metrics and Evaluations - Alex Ruane 1/2

- AgMIP: Uncertainty for global prices: economic models > crop models > climate models
- ESM evaluation provides physical confidence in model outputs at the heart of applications
- VIACS Community - Vulnerability, Impacts, Adaptation, and Climate Services
- VIACS Advisory Board for CMIP6 (Alex is co-chair): build bridges between producers and users of climate model output
- VIA vs. CS: Understanding vs. operational user-oriented products and tools
- VIACS Advisory Board assessed 900+ CMIP5 variables for application use; often identified sets of variables, not just one; 60+ new variables requested
- 188 MIP experiments assessed for VIACS applications
- Working with stakeholders: Temporal scale of ag sector stakeholder interest (days to months to years)
- Stakeholders want credible climate data, highest resolution, single answer, basic understanding of process

User-Oriented Metrics and Evaluations - Alex Ruane 2/2

- Downscaling (dynamical or empirical), bias-correction, weather generators, ESM subsets, and climate emulators (e.g., MAGICC, HECTOR) help VIACS community use ESM outputs

- Bias-correction also often needed for reanalysis to improve simulations

- Many approaches for selecting climate scenarios; nearly all seek to impose climate changes on observed conditions (beware big %changes from dry GCM month imposed on wet obs)

- Selecting subset of models: “once you start eliminating models eventually you have none” - Dennis Lettenmeier; use historical performance (e.g., Giorgi and Mearns, 2002); often selected by availability, notion of performance, resolution, etc.

- Subset example for Ames, Iowa (Ruane and McDermid, 2017); GCM location amidst ensemble is fairly robust

- VIACS researcher priorities: regional patterns, seasonal progression and monsoons; modes of variability; enhanced evaluation of extreme events; regime shifts

- Key challenges for ESM-VIACS connections: need better VIACS models first (benchmarking crop models,

Extreme Events - Angie Pendergrass 1/2

- Outline: Defining, observing, absolute questions & relative answers, scales of relevance
- Challenges: Extreme events are rare in space and time; universally valid definitions; lack of observational data; scale mismatch between obs & model output
- Approaches in AR5: Indices for climate extremes defined by Expert Team on Climate Change Detection and Indices (ETCCDI); extreme value analysis → return values/periods
- Example: Extreme precipitation projection from HadCM (~1998); CMIP5 MMM extreme precip change and variation across models (Pendergrass and Hartmann, 2014)
- Possible role for convective organization across models (Pendergrass, Reed, and Medeiros, 2016)
- Definition of extremes matters… a lot! (Schär et al., 2016, *Climate Change*): Climate extremes indices, percentile changes, etc.
- Table of IPCC AR5 definitions for indices of climate extremes; Gleckler plot of extreme indices (based on Sillmann et al., JGR 2013)

Extreme Events - Angie Pendergrass 2/2

- Scales: Global, regional, local
- Global climate models vs. regional climate models at high resolution. Topography matters.
- Key points:
    - Defining extremes is important
    - Obs extremes is challenging
    - Climate models don’t capture extremes defined by absolute thresholds well
    - Providing answers on relevant scales is a challenge

Part VIII Discussion 1/2

- George: How robust are gridded local vs. global results? Need more ensembles. Communication to user community is difficult
- Peter Gleckler:
- Peter Cox: Do you really believe these extremes?
- Robert Pincus: It might be better to aggregate in different ways
- Bill Collins: GPCP is not measuring precip, but using radiances. TRMM was never designed to do short, instantaneous precip observations. We do have raingauge data, and we have means of extracting extremes from those data in a reliable way.
- Angie: Over the ocean, these satellite products is all we have.
- Robert: Ocean vs. land precip may change differently?
- Ben Sanderson: Differences between gridcell vs. point precipitation

Part VIII Discussion 2/2

- Angie: How do you adjust distribution of rain that makes sense?
- Alex R: Plot of corn sensitivity to climate variability changes
- Jerry: There is no drought index, and that seems bad.
- Angie: People cannot agree on one? Alex R: Drought is complicated because it comes in many forms. Impacts people are more interested in extent and return period.
- Joellen: Normal drought indices don't show what you see on the ground.

BG9 - New Approaches and Capabilities: Impact and Policy Relevant Metrics

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Key Scientific Advances Since the AR5

- Increased confidence in distributional effects
- Higher resolution models (some at ¼ degree)
  - Higher resolution atmosphere produces more realistic precipitation extremes
  - Higher resolution & richer forcing for land use, N fertilizer & irrigation (¼ degree)
  - Better resolution of hurricanes and circulation features
- New techniques for downscaling and bias correction
  - More organized and prominent work on empirical downscaling
  - More organized dynamical downscaling too
- Variable resolution models for focused study
- Focus on multivariate extremes

Shortcomings, Gaps, and Opportunities

- Establishment of a CORDEX-like activity needed (harmonized dynamical downscaling)
- Understanding the variability of tropical rainfall regimes
- Capturing/improving the diurnal cycle
- Co-temporaneous extremes
- Low frequency output of high frequency
    - Hourly: T<0°C, T<5°C, T>35°C, T>40°C, T>45°C; P=20-50 mm, 50-100 mm, >100 mm
    - Daily: P=1-5, 5-20, 20-50, 50-100, >100 mm/d; T <0°C, T<5°C, T>35°C, T>40°C, T>45°C
- Climate informatics (e.g., big data methods, cloud computing, GEE)
- Extractable subsets of model output
- Probabilistic climate change information for impacts

Long-Term Perspective

- Merge offline models with ESM projections to create better/more specific drought indices
- Better understanding of monsoons
- Better observations and resolve differences across products
- Hard to measure and poorly derived critical observations (e.g., evapotranspiration, humidity, soil moisture)
- Finer resolution of air quality and aerosol information, especially within urban areas
- Reanalysis of land models with better agriculture representation (better biogeochemistry land use in data assimilation systems)
- Hourly data for timeslices over certain time periods (conditional high frequency output)
- Full integration of economics, crop, and ESMs: from carbon to human outcomes