NARCCAP

NARCCAP: Overview and Regional Climate Change Results

Linda O. Mearns and the NARCCAP Team

National Center for Atmospheric Research, Boulder, CO

website: http://www.narccap.ucar.edu

NARCCAP Team: Melissa Bukovsky, Seth McGinnis, Larry McDaniel, Don Middleton, Doug Nychka, Steve Sain, Toni Rosati, Josh Thompson, NCAR; Phil Duffy, Climate Central; Isaac Held, GFDL; Richard Jones, Wilfran Moufouma-Okia, Simon Tucker, Hadley Centre; William Gutowski, Ray Arritt, Dave Flory, Gene Takle, Iowa State; Daniel Caya, Sébastien Biner, OURANOS; Ruby Leung, James Correia, Yun Qian, PNNL; Ana Nunes, John Roads, Scripps; Lisa Sloan, Mark Snyder, UC Santa Cruz; René Laprise, UQAM;

INTRODUCTION

The North American Regional Climate Change Assessment Program (NARCCAP) is an international program to produce high resolution climate change scenarios and investigate uncertainties in regional scale projections of future climate by nesting multiple regional climate models (RCMs) within multiple atmosphere-ocean general circulation models (AOGCMs) forced with the A2 SRES scenario and with historical data over a domain covering the conterminous United States and most of Canada and Northern Mexico.

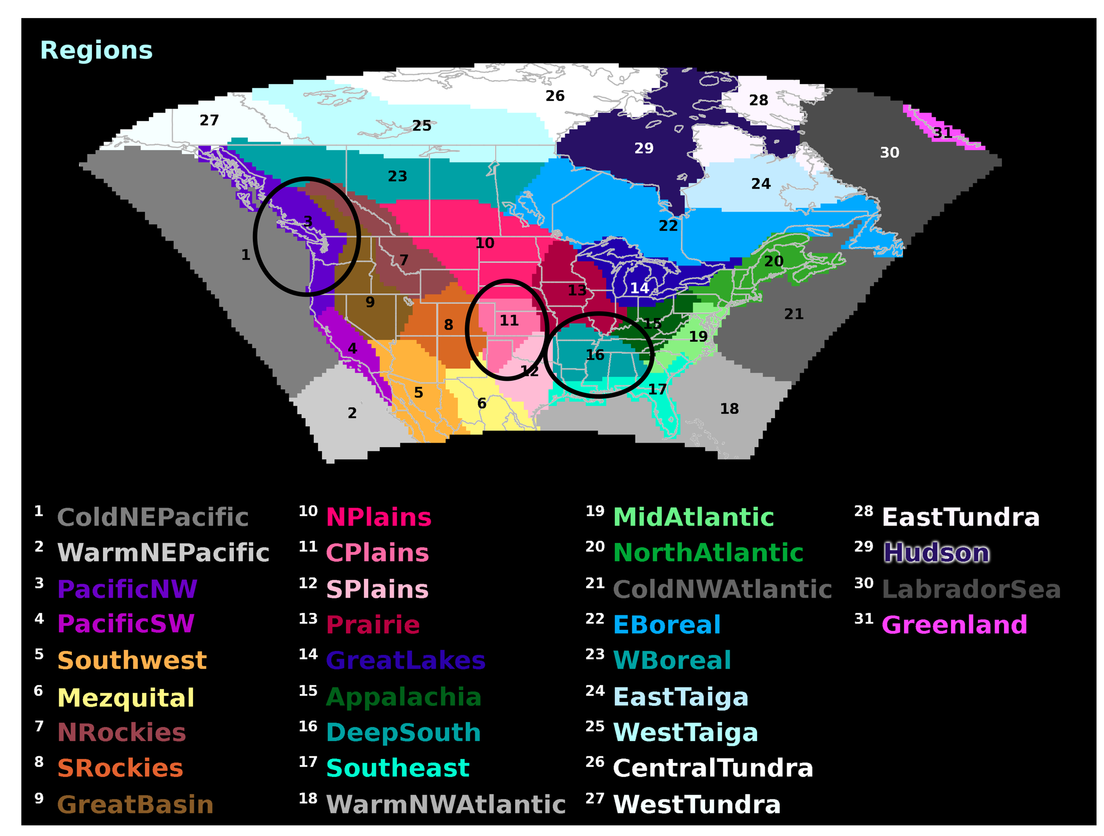
The resulting 60+ TB of data are being archived for distributed storage and made available to global change impacts researchers worldwide via the Earth System Grid (ESG). To ensure that the final product is usable by the impacts community, GIS practitioners, climate analysts, modelers, policy-makers, and other end users, data is stored in CF-compliant NetCDF format, making it fully compatible with many popular analysis programs, including ArcGIS, Matlab, IDL, and R. Tools are also available for converting data to plain text.

GOALS

- Exploration of multiple uncertainties in regional model and global climate model regional projections.
- Development of multiple high resolution regional climate scenarios for use in impacts assessments.
- Further evaluation of regional model performance over North America.
- Exploration of some remaining uncertainties in regional climate modeling (e.g., importance of compatibility of physics in nesting and nested models).
- Creation of greater collaboration between US and Canadian climate modeling groups, as well as with the European modeling community.
- Quantification of uncertainty across all models.

REGIONALIZATION

Developed by M. Bukovsky, NCAR



This subregionalization was created to aid in the analysis of NARCCAP simulations in subregions of the North American domain. It is, in essence, a simplification of the terrestrial ecoregions provided in Ricketts et al. (1999), and over the U.S. it closely follows the regions used by NEON (National Ecological Observatory Network, Kampe et al. (2010)). Several standard climate classifications also informed the final regionalization. Each subregion tries to capture a homogeneous climate and important features of the climate system (e.g., the Deep South captures the eastern US winter time maximum).

NARCCAP AT A GLANCE

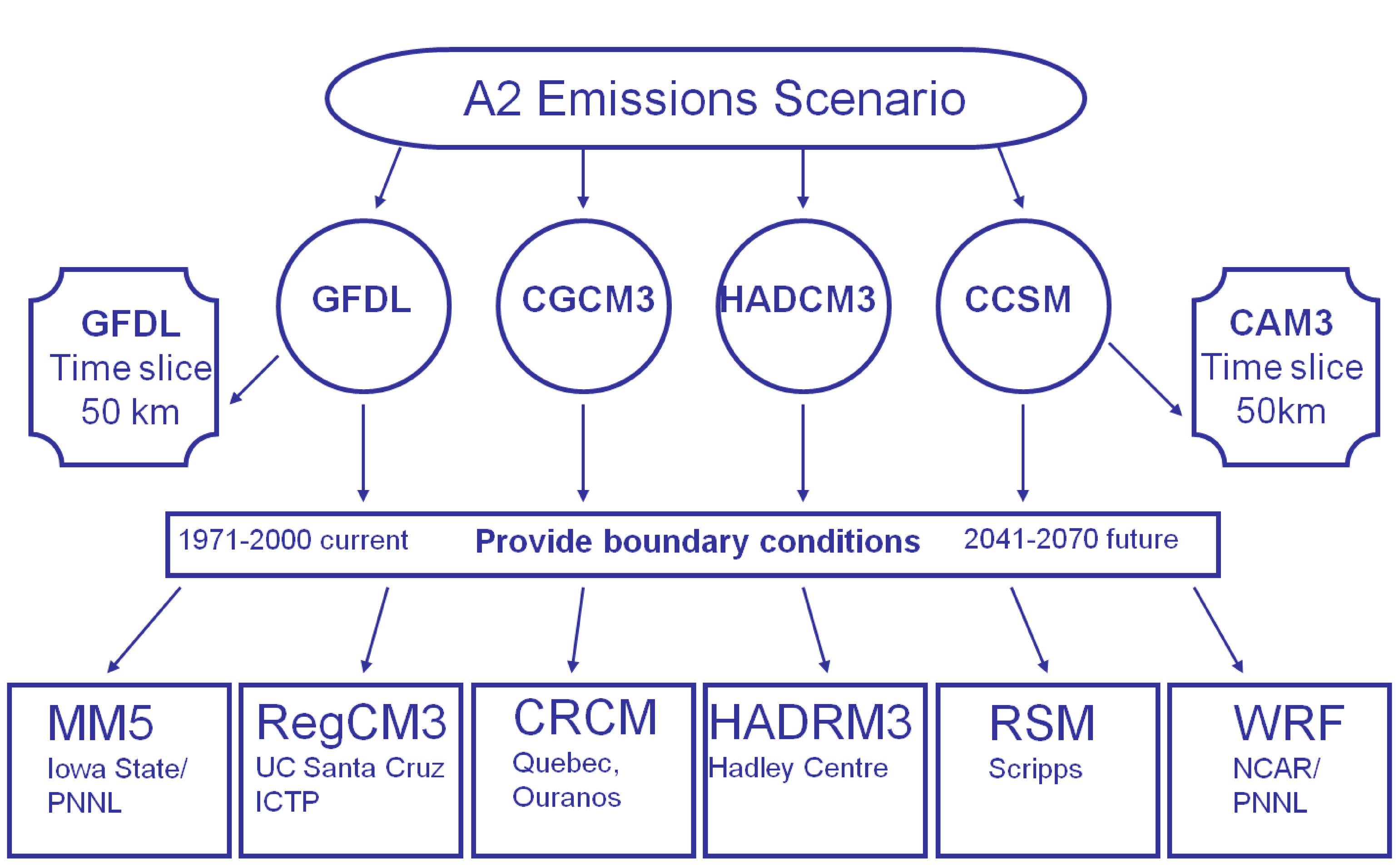
- 4 different AOGCMs driving 6 different RCMs
- 50 km spatial resolution
- 3 hourly temporal resolution
- 52 output variables
- 2 high-resolution AGCM timeslice experiments
- Future scenario: SRES A2

Phase I: RCMs are driven by historical (1979-2004) observed (NCEP2 Reanalysis) data

Phase II: Each RCM is driven by 2 GCMs for current (1971-2000) and future (2041-2070) scenarios. GCM/RCM pairings are chosen for maximum value in statistical analysis.

Timeslices: Atmospheric components of the GFDL & CCSM global models are run at 50 km resolution using observed SST data (offset in the future scenario) instead of a coupled ocean.

NARCCAP PLAN – Phase II



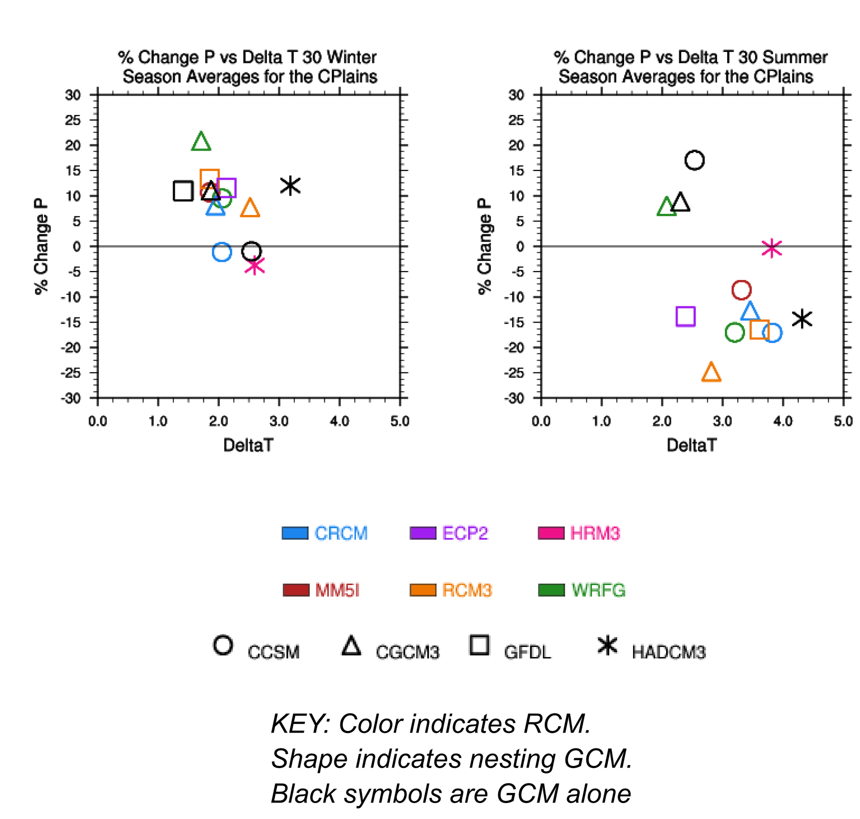
EXPERIMENTAL DESIGN

NARCCAP uses a fractional factorial design to manage funding limitations. Each RCM is paired with two GCMs. Timeslice experiments are also performed for two of the GCMs (CCSM & GFDL). Each RCM is paired with one of the two timeslice GCMs.

GCM / RCM	Phase I	Phase II			
	NCEP	GFDL	CGCM3	HADCM3	CCSM
CRCM	X		X		X
ECPC	X	X		X	
HRM3	X	X		X	
MM5I	X			X	X
RCM3	X	X	X		
WRFP	X		X		X

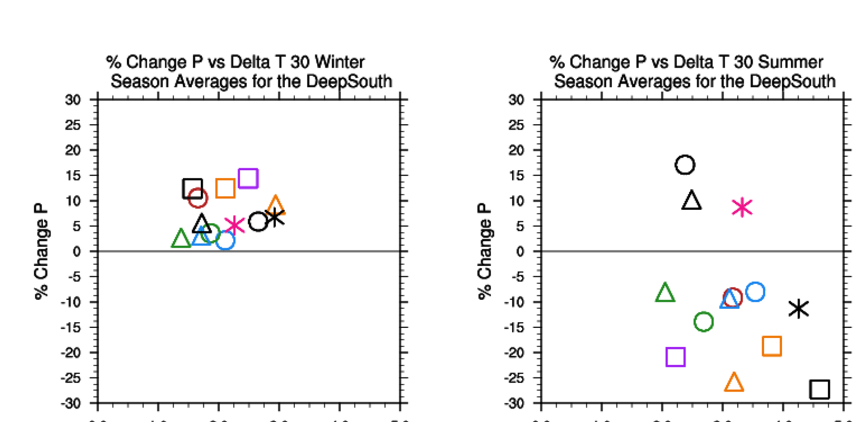
SAMPLE SUBREGIONAL ANALYSIS

We analyze three different subregions to represent the variability of climate change responses in different parts of the domain and across different model combinations. The plots present seasonal (winter/summer) changes in precipitation and temperature from the four different GCMs and from nine of the GCM-RCM combinations. We examine the overall spread of the results and the relationships between the changes in the RCMs and those in the parent GCMs.



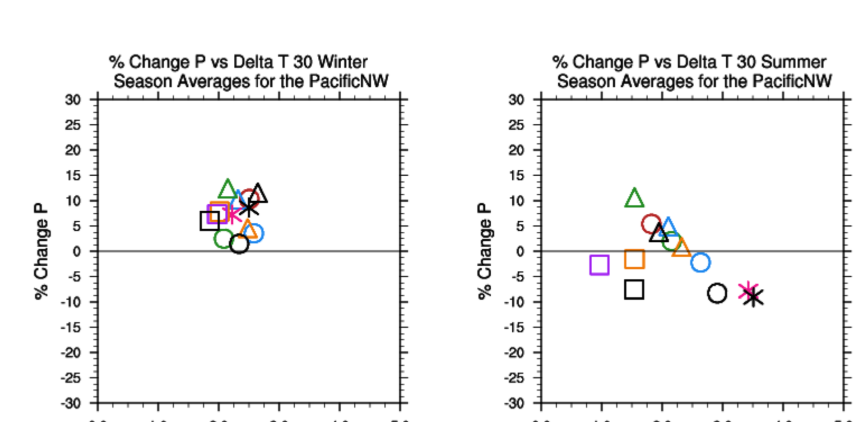
Central Plains

This sub-region displays considerable scatter in seasonal change in temperature and precipitation in all seasons. In winter two of the GCMs represent the outside range for temperature change. Considerable distance is found between the responses of the GCMs and the RCMs driven by them, such as the HadCM3 vs. HRM3, which show different directions of precipitation change in winter. The RCMs show a greater range of precipitation change than do the GCMs. In summer there is much wider scatter of change in precipitation than in winter. Some RCMs follow the parent GCM pattern of change closely (e.g. CGCM3 and WRFG) while others depart (e.g., CGCM3 and RCM3).



Deep South

This sub-region displays low variability of climate change in winter across the different models with change in precipitation ranging from 2 to 15%, and change in temperature from 1.3 to 3°C, whereas in summer, there is a wide spread both in temperature and precipitation. The GCMs exhibit a larger range in precipitation change than do the RCMs in summer.



Pacific Northwest

In winter, there is extremely low variability in climate change across the different model combinations, with temperature change ranging from 2 to 3°C and precipitation change from 0 to 12% increase. Summer exhibits a much wider range of change across the RCMs and GCMs (1 to 4°C in temperature and -10% to +10% change in precipitation).