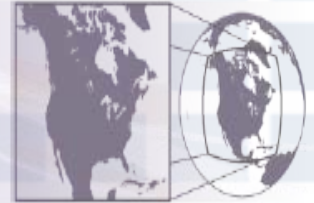




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# NA-CORDEX



## The Development of North America CORDEX

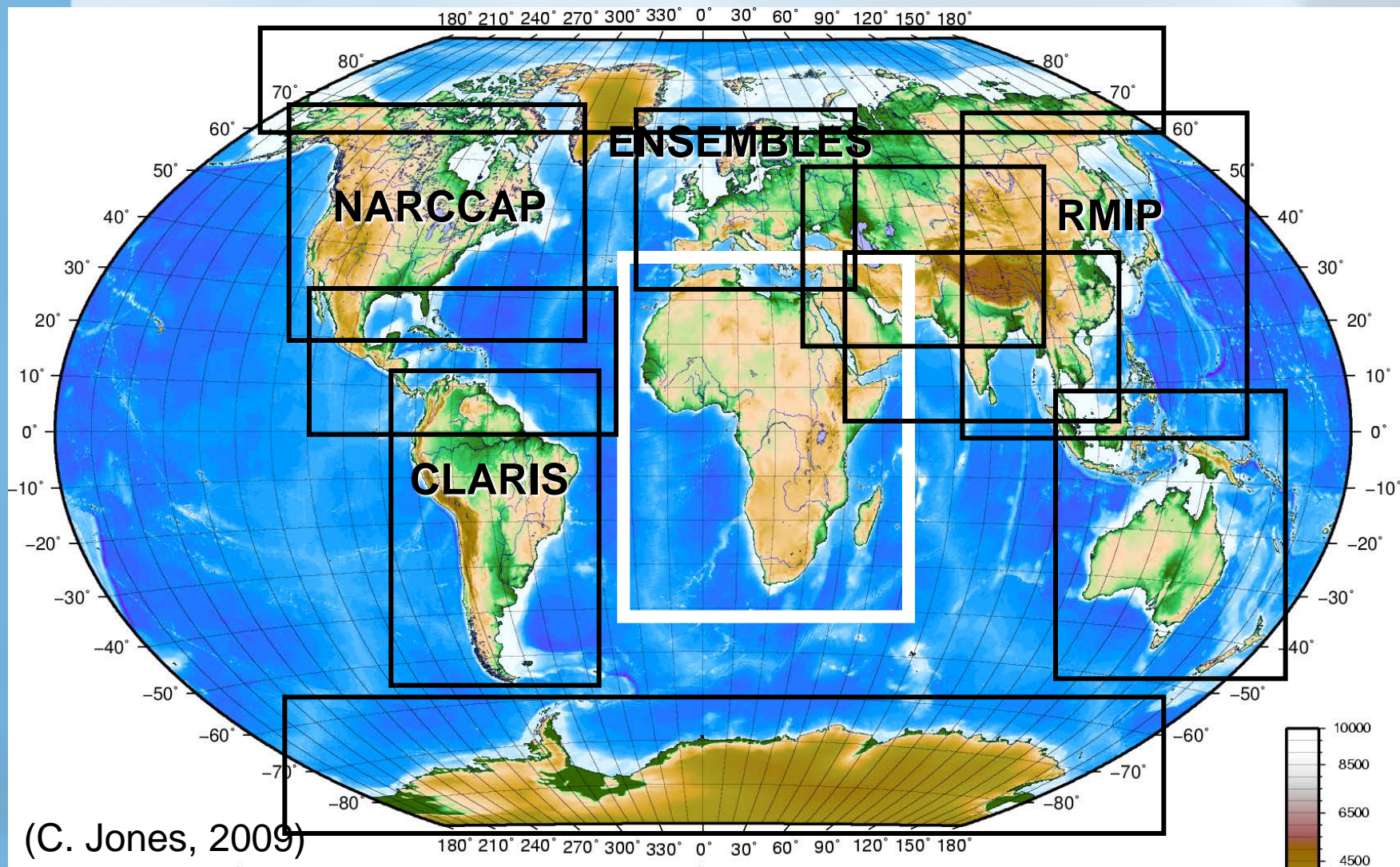
Linda O. Mearns, NCAR; William Gutowski, Iowa State;  
Joseph Barsugli, NOAA; Lawrence Buja, NCAR;  
Gregg Garfin, U. Arizona; Dennis Lettenmaier, U. Washington;  
Lai-Yung Leung, PNNL

AGU Fall Meeting  
San Francisco, CA  
December 12, 2013

National Center for Atmospheric Research

# Coordinated Regional Downscaling Experiment (CORDEX)

## ~ Regions ~



# General Aims and Plans for CORDEX



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Provide a set of regional climate scenarios covering the period 1950-2100, for the majority of the populated land-regions of the globe.

Make these data sets readily available and useable to the impact and adaptation communities.

Provide a generalized framework for testing and applying regional climate models and downscaling techniques for both the recent past and future scenarios.

Foster coordination between regional downscaling efforts around the world and encourage participation in the downscaling process of local scientists/organizations

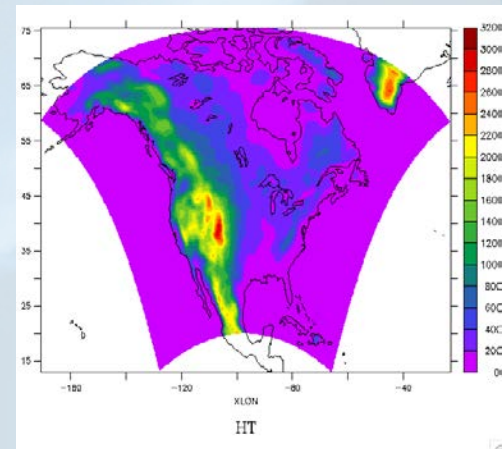
# The North American Regional Climate Change Assessment Program (NARCCAP)



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[www.narccap.ucar.edu](http://www.narccap.ucar.edu)

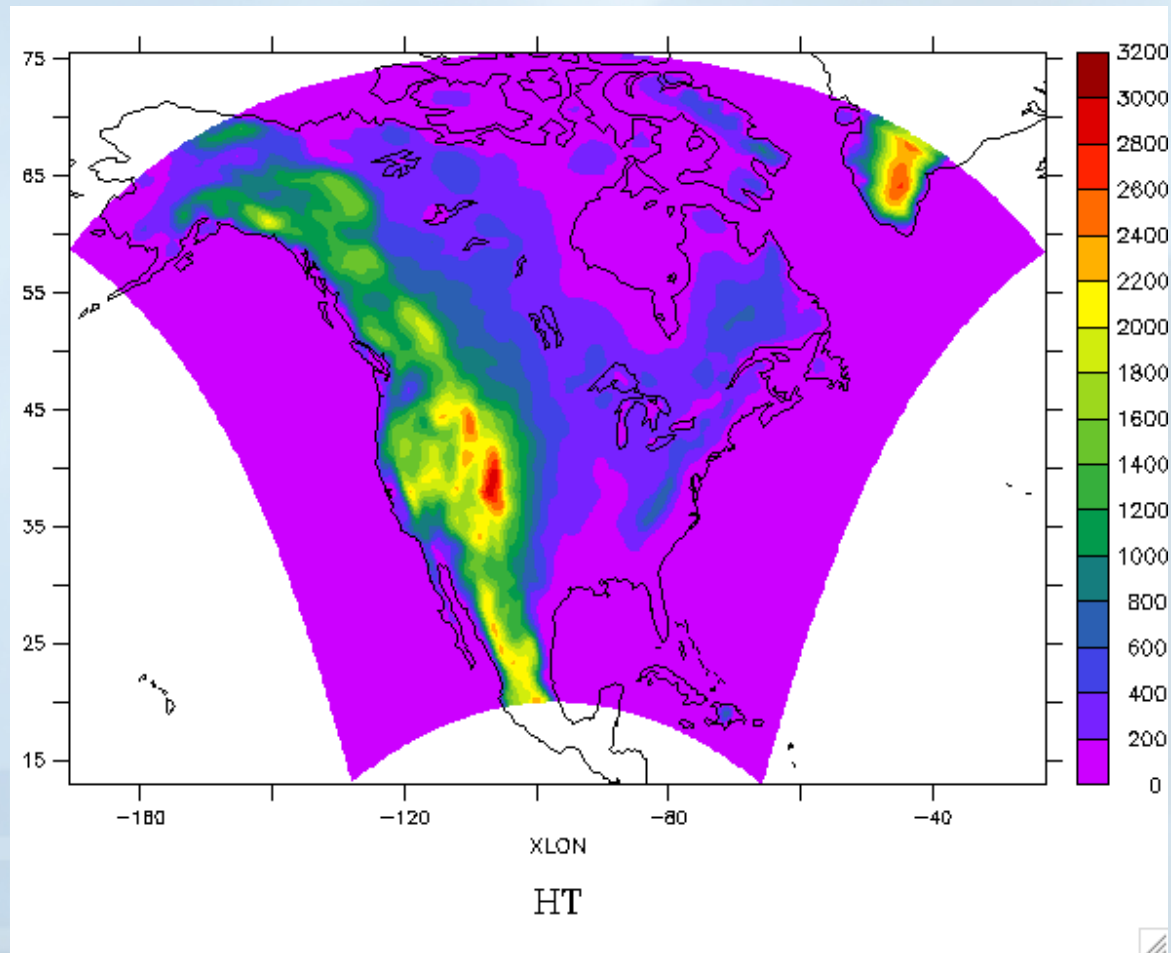
- Explores multiple uncertainties in regional and global climate model projections  
4 global climate models x 6 regional climate models
- Develops multiple high resolution (50 km) regional climate scenarios for use in impacts and adaptation assessments
- Evaluates regional model performance to establish credibility of individual simulations for the future
- Participants: Iowa State, PNNL, LLNL, UC Santa Cruz, Scripps, Ouranos (Canada), UK Hadley Centre, NCAR
- Initiated in 2006, funded by NOAA-OGP, NSF, DOE, USEPA-ORD – 5-year program



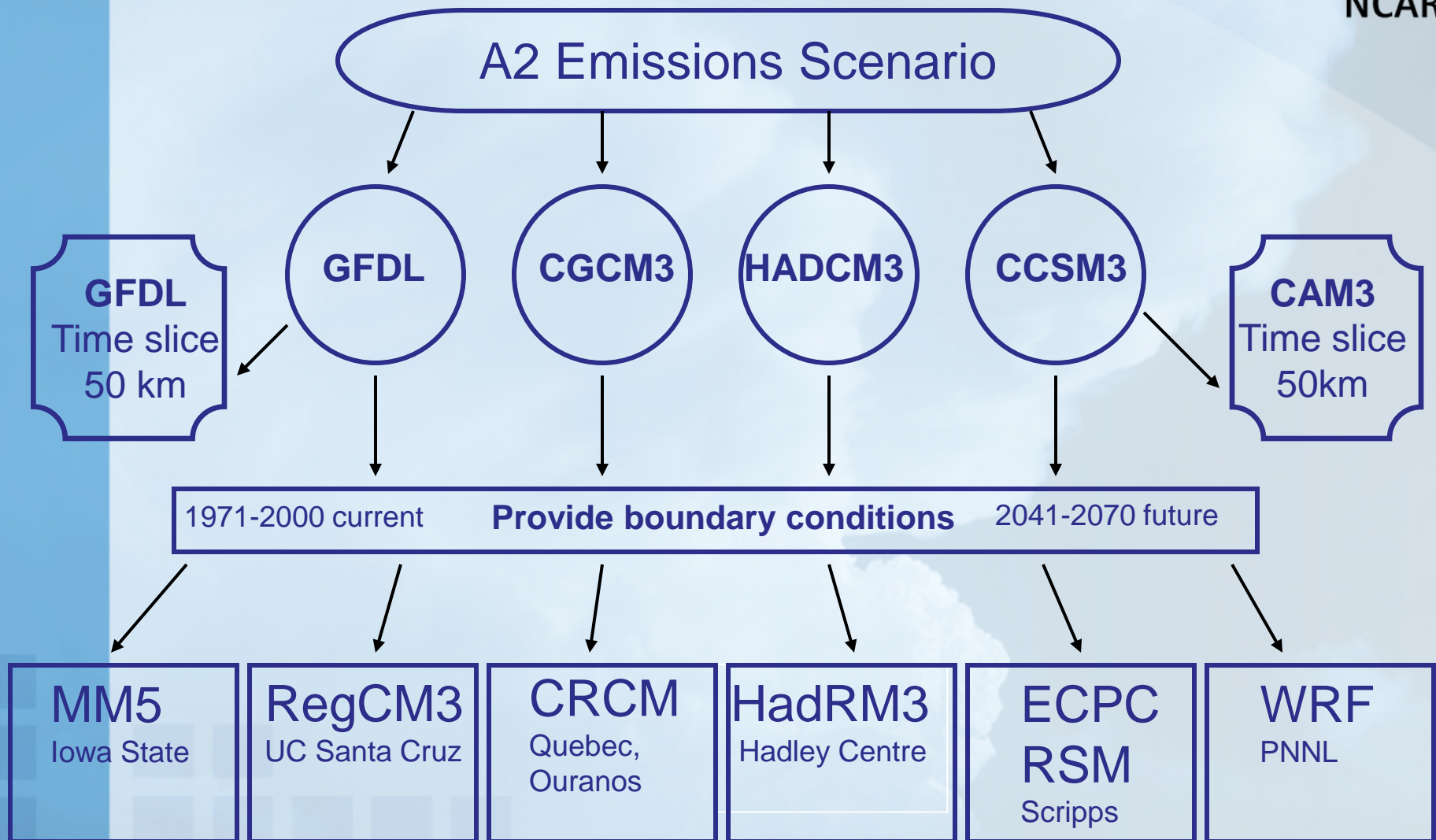
# NARCCAP Domain



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# NARCCAP PLAN – Phase II



# NARCCAP Experimental Design

## A2 Emissions Scenario

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		AOGCMs			
		GFDL	CGCM3	HADCM3	CCSM3
RCMs	MM5			X**	X1**
	RegCM	X1**	X**		
	CRCM		X1**		X**
	HadRM	X**		X1**	
	RSM	X1**		X	
	WRF		X**		X1**

1 = chosen first GCM

Red = run completed

\*\* = data loaded

# Advantages of Experimental Design



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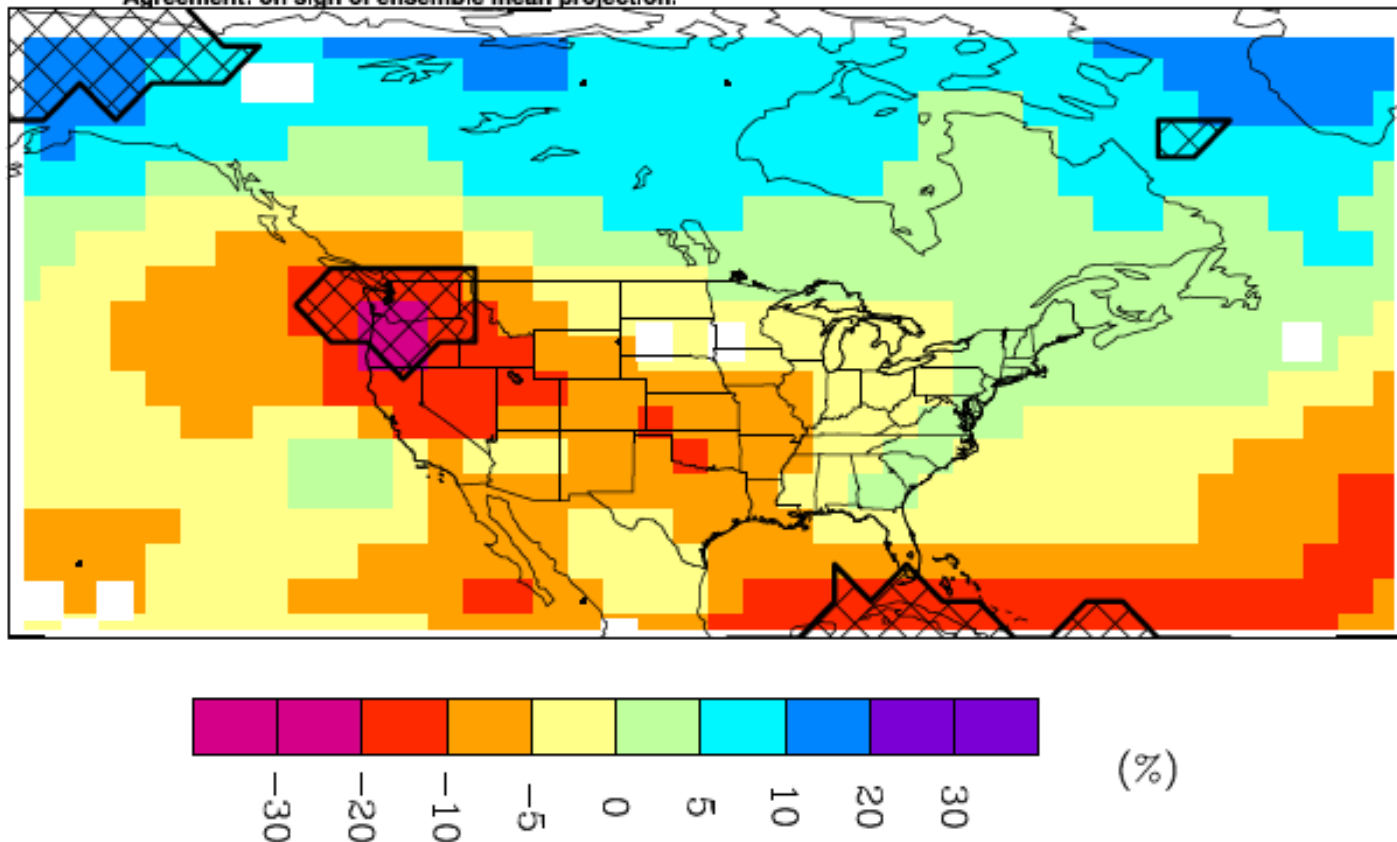
- More robust estimates of error due to missing cells
- Particularly important for determining the relative contribution of the different factors in ANOVA – provides more robust results

# Change in Summer Precipitation

## WITH ENSEMBLE AGREEMENT AND SIGNIFICANCE

Precipitation 1971-1999 vs. 2041-2069 Months: 06,07,08

Agreement: on sign of ensemble mean projection.

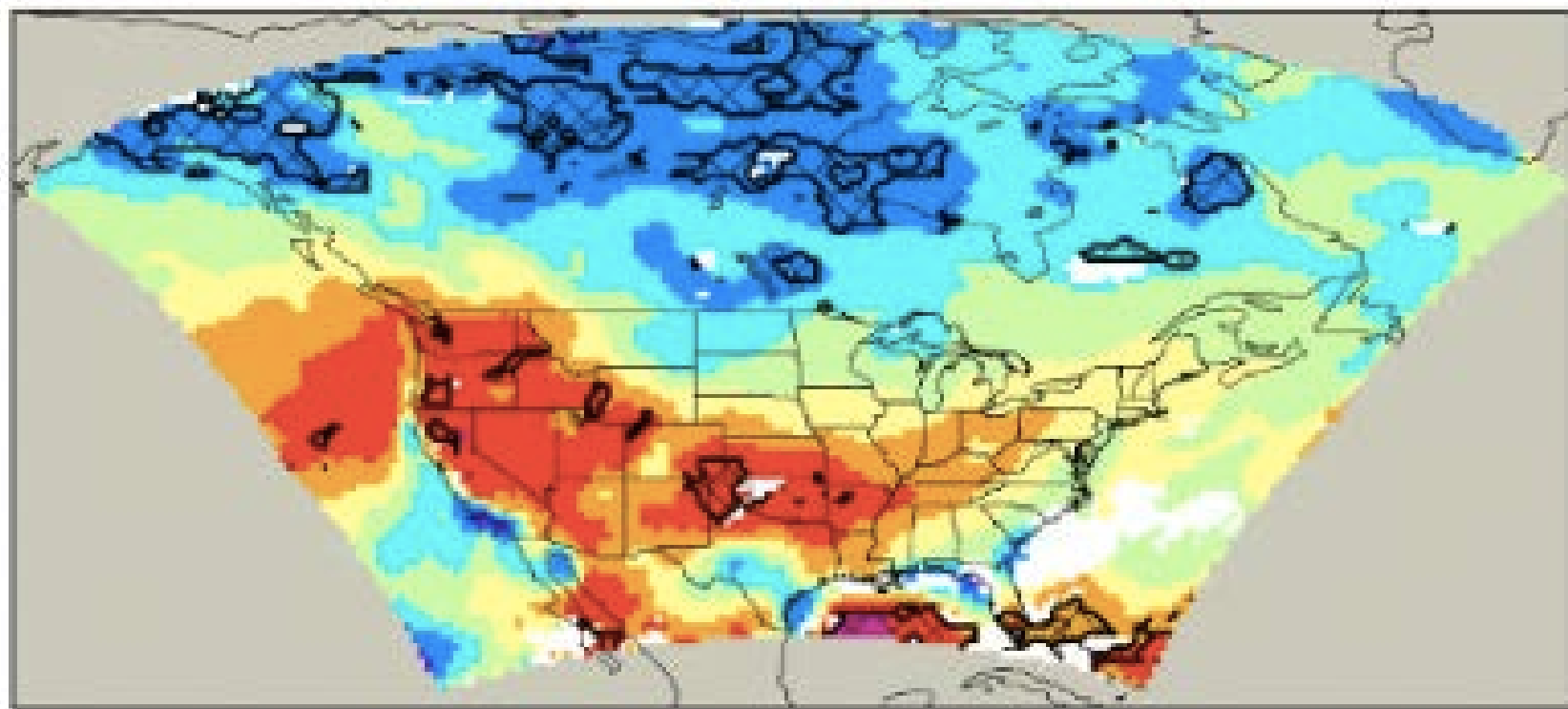




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# 11 RCMs

## Change in Summer Precipitation



-20 -10 -5 0 5 10 20

# Climate Change Conclusions



- The RCMs tend to intensify patterns of change in precipitation (i.e., greater decreases in summer; greater increases in winter) compared to GCMs
- RCMs dominate overall variance in summer (for temperature and precipitation) and GCMs are dominant in winter
- But more process level studies will be necessary to determine if RCM changes are more credible than those of GCMs

## **A Coordinated Regional Downscaling Experiment ~ North America Program ~**

### **Executive Committee**

W. J. Gutowski, Jr. – Iowa State Univ. (Co-Chair)

Linda Mearns – NCAR (Co-Chair)

Lawrence Buja – NCAR

Gregg Garfin – Univ. Arizona

Dennis Lettenmaier – Univ. Washington

Ruby Leung – PNNL



# Five Themes

- Approaches to modeling regional climate change
- Evaluation, metrics, diagnostics, observational needs
  - What metrics and process-oriented approaches can be used to assess the added value of dynamical, statistical, and hybrid downscaling?
- Characterization of uncertainty in regional climate projections



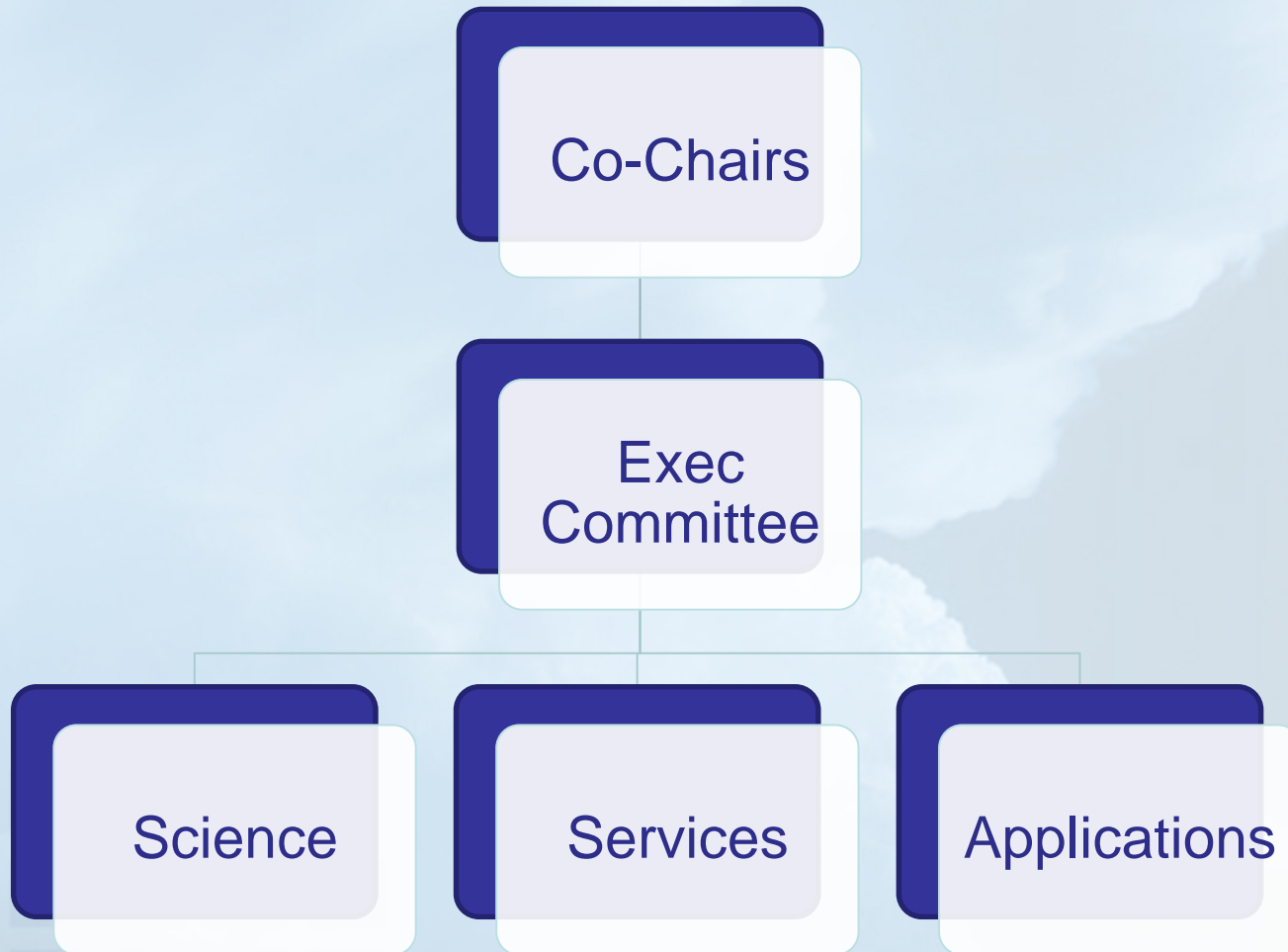
# Themes (cont'd)

- Improving the use of regional climate change information: stakeholder engagement and use inspired research
  - What are the key indicators and metrics for assessing the value of North America CORDEX climate simulations and climate change information to inform risk management decisions?
- Computational Requirements, Data Services, and Product Delivery

# NA-CORDEX Org Chart



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# Modeling Elements of NA-CORDEX



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- Regional climate model simulations
- Statistical downscaling
- Stretched grid global model simulations

# NA-CORDEX Simulations Already Produced



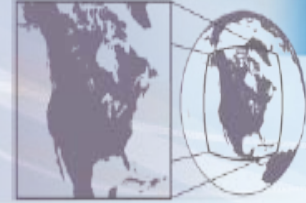
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- Canadian – UQAM (R. Laprise) and U. Victoria
- French – P. Lucas-Picher
- UK Met Office - Mexico – R. Cerezo-Mota
- Iowa State – R. Arritt



# Priorities of Uncertainties

- Sampling range of GCMs
- Sampling range of RCMs
  - And investigating multiple resolutions
- **Internal variability** (i.e., sampling multiple realizations of single GCM)
  - This element has been under-explored in GCMs and RCMs
- RCPs - lower priority – not important until after 2050 – much might be gleaned from pattern scaling from one RCP to another



## Some basics of RCM portion

- 5 different RCMs
- 6 different GCMs
- 150 years 1950-2100 each simulation
- High representative concentration pathway (RCP 8.5) (future scenario)
- Two spatial resolutions 25 km and 12 km
- ERA-Interim runs (20 years) at 50, 25, 12 km
- In planning phase – proposal being written

# Value of Scenarios of Experimental Designs



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- Provides series of options based on different funding possibilities
- Clearly presents what can be explored (e.g., GCM, RCM, and interaction effects; or GCM, RCM, remainder term) and degree of error in calculations based on matrix density

# Scenarios of Experiments NCAR

- Common to all: ERA-Interim driven runs – at 3 resolutions: 50, 25, 12 km for all RCMs (total of 300 years).
- Assume a fairly even sampling of GCMs and RCMs (based on Mearns et al. 2013 results)
- Then three possible experimental designs based primarily on different sampling schemes for 25 and 12 km simulations
- All will include similar sampling of internal variability

# Scenario I



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5 RCMS, 6 GCMs, full matrix at 25 km = 30 simulations, 150 years each; half matrix (15 simulations at 12 km). IV – from two GCMs, 3 additional realizations, each RCM at 25 km

50 km	RCM1	RCM2	RCM3	RCM4	RCM5
ERA-I	1	1	1	1	1

25 km	RCM1	RCM2	RCM3	RCM4	RCM5
ERA-I	1	1	1	1	1
GCM1*	4	4	4	4	4
GCM2*	4	4	4	4	4
GCM3	1	1	1	1	1
GCM4	1	1	1	1	1
GCM5	1	1	1	1	1
GCM6	1	1	1	1	1



## Scenario 1 (cont'd)

12 km	RCM1	RCM2	RCM3	RCM4	RCM5
ERA-I	1	1	1	1	1
GCM1*	1	1			1
GCM2*	1	1			
GCM3	1		1		1
GCM4		1		1	
GCM5			1	1	1
GCM6			1	1	

Total years: 9,000 at 25 km; 2,250 at 12. Half of years at 25 km are the IV runs.

# Scenario II



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Half  
fraction

25 km	RCM1	RCM2	RCM3	RCM4	RCM5
ERA-I	1	1	1	1	1
GCM1*	4		4		4
GCM2*		4		4	
GCM3	1	1			
GCM4	1	1			1
GCM5			1	1	1
GCM6			1	1	

Half  
fraction

12 km	RCM1	RCM2	RCM3	RCM4	RCM5
ERA-I	1	1	1	1	1
GCM1*	1		1		1
GCM2*		1		1	
GCM3	1	1			
GCM4	1	1			1
GCM5			1	1	1
GCM6			1	1	

Total years:  
4,500 at 25  
2,250 at 12

# Activities



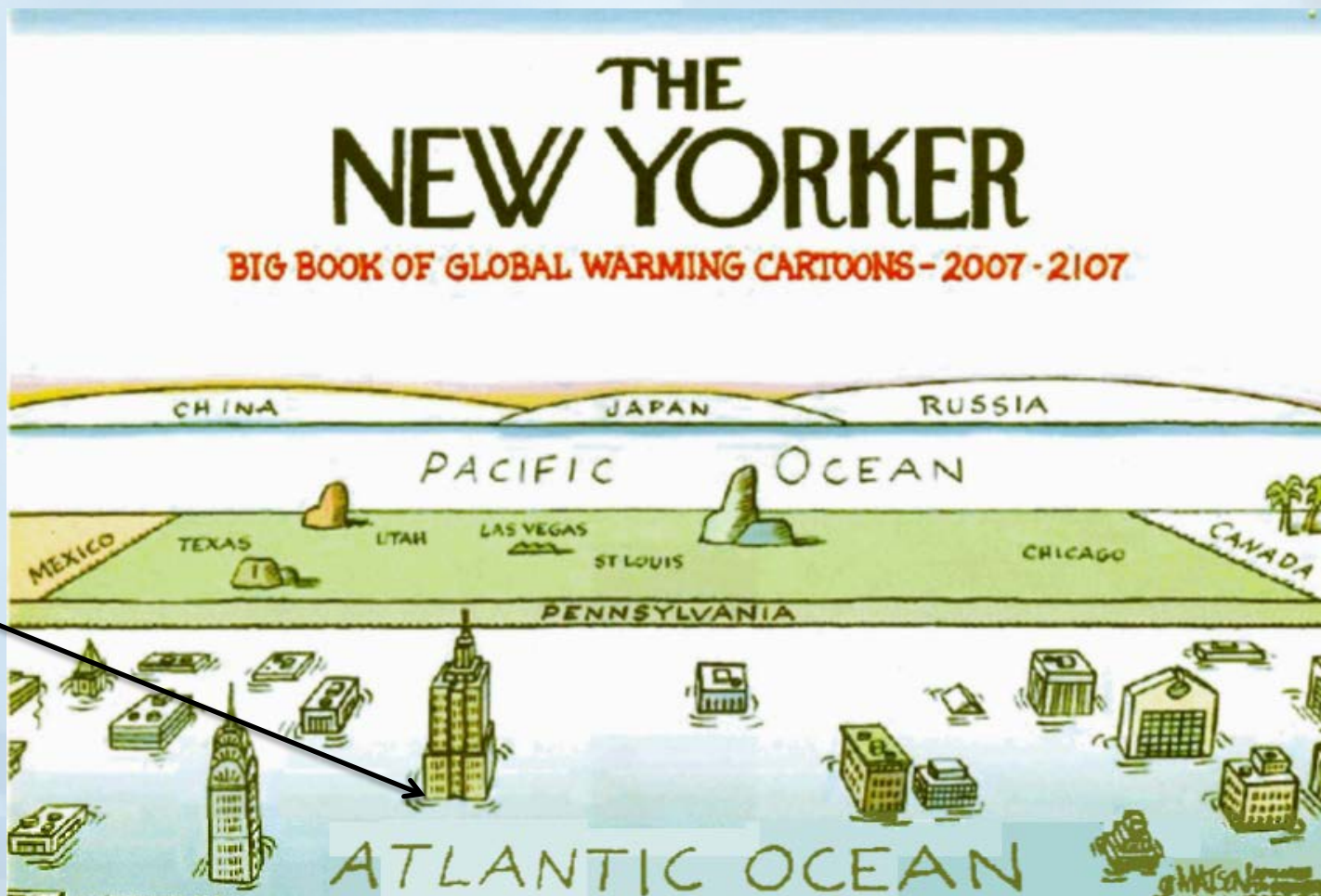
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- NA-CORDEX Meetings: Dec. 2012 in San Francisco, February 2013 and June 2013 at NCAR, side meeting at CORDEX meeting in Brussels – to further develop integrated plans/proposal
- Survey of potential users – to determine more detailed user needs
- Coordination with groups already producing simulations (e.g., French, Canadians, British)
- Discussion with agency program managers on level of interest
- DOE-funded workshop being planned for 2014 involving other agencies as well

# THE END



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320 m SLR