



**Presentation to:  
2009 NARCCAP Users' Meeting**

**11 September 2009**

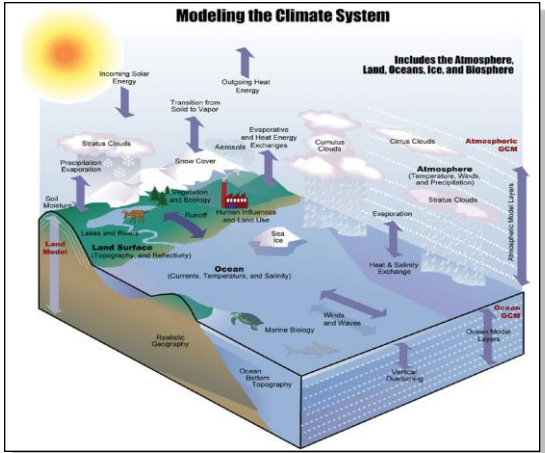
**Glenn Higgins**

**Atmospheric Sciences & Engineering Department  
Northrop Grumman**

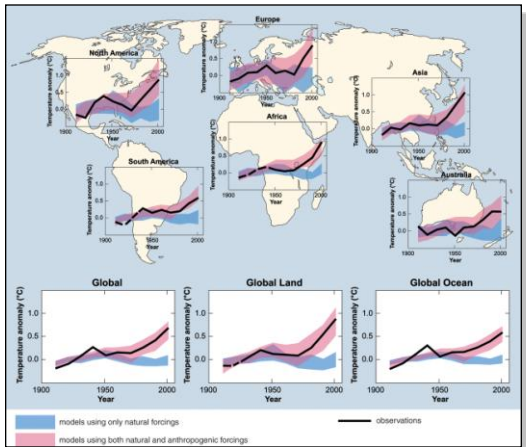
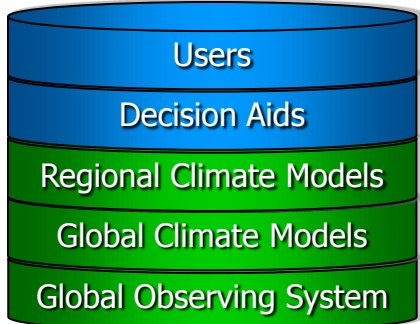
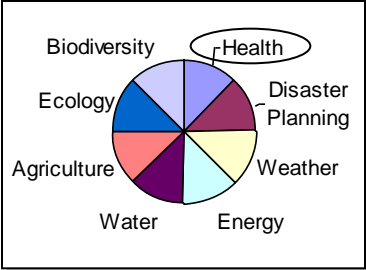
# Introduction

- IPCC reports have focused considerable attention on climate change and global and regional climate modeling
- However, there is a gap between the science products that climate models produce and the “engineering” products that planners need to:
  - Support mitigation and adaptation efforts at local and regional levels
- Today I will discuss NG’s strategy and efforts to bridge the gap:
  - Through Regional Climate (downscaling) and Decision Aid modeling
- Decision Aids translate scientific products from climate models to engineering products for local and regional planners
- We have used NARCCAP data to develop example decision aid products in or to engage with potential users- some examples to follow

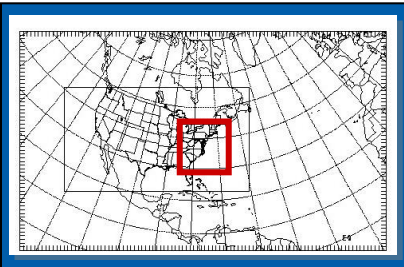
# Climate Modeling and Decision Aids



Observations, Best Science, and Physical Models



Raw Global-scale model results



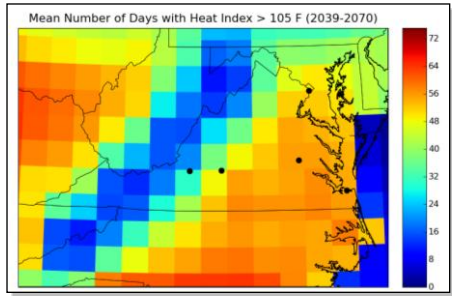
Regional Downscaling  
Captures local effects and better physics

## Actionable decision aid

City	Metro Pop	Mean "Oppressive" Days Per Year (Models have monthly biases with respect to GHCN removed)			Change in Deaths due to Change in Oppressive Days	
		Current	Future	Change	Deaths per Million	Additional Deaths for Metro
Richmond	1.2 M	17.47	47.22	29.8	26.78	32
Lynchburg	246 K	11.91	36.56	24.7	22.19	5
Roanoke	296 K	10.69	34.16	23.5	39.90	12
Wash. DC	5.3 M	16.31	35.56	19.3	17.33	92
Norfolk	1.8 M	13.28	38.31	25.0	22.53	40

'Change' is Future value - Current value

Empirical and explicit decision domain modeling



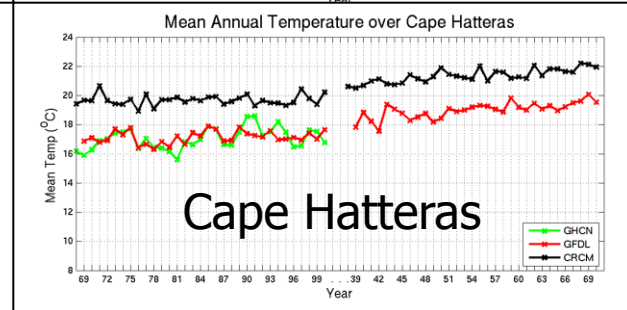
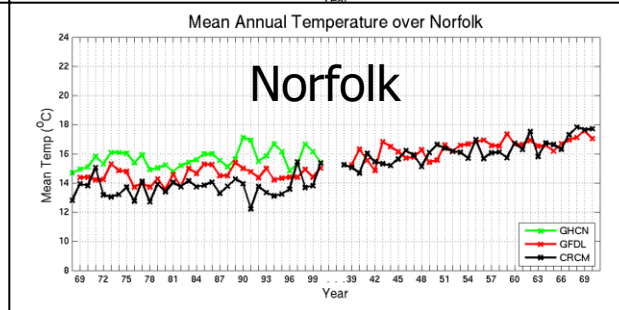
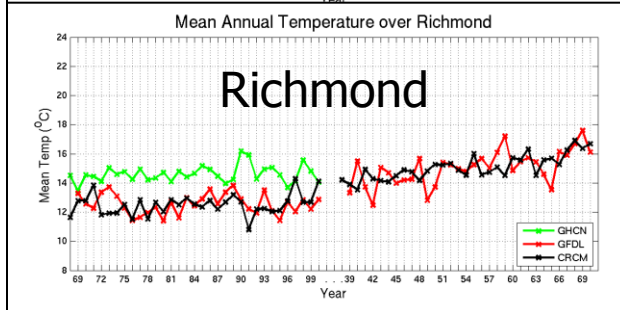
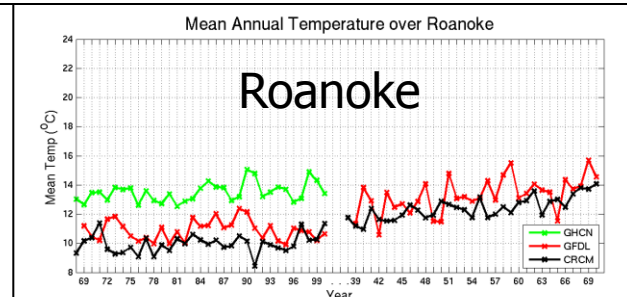
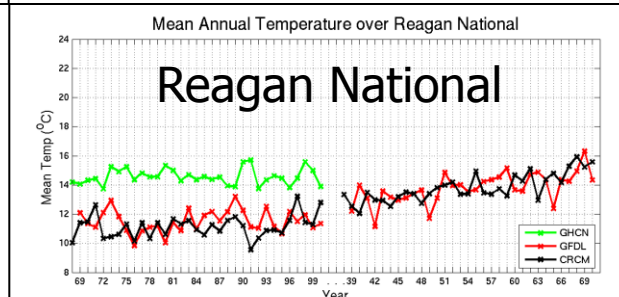
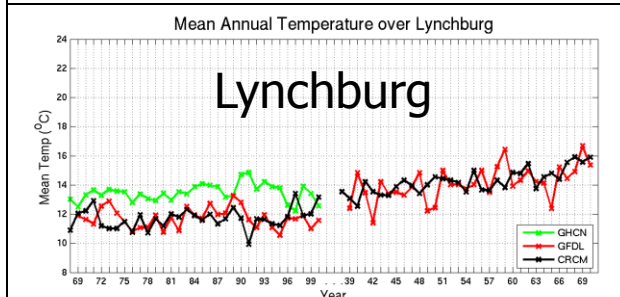
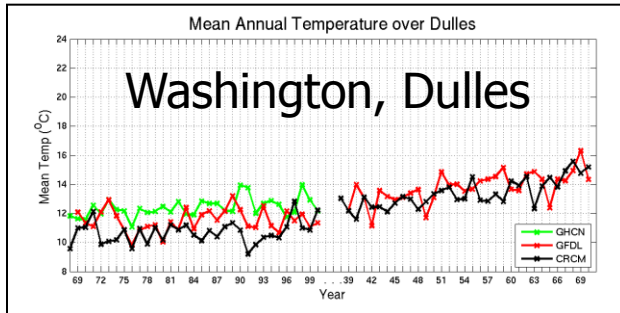
High resolution regional model results

## Some Examples of Climate Products and Decision Aids

# Some Examples Climate Products and Decision Aids Annual Temperatures for Several Cities

Plots below show the mean annual temperature over each site

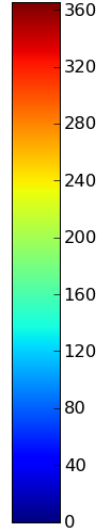
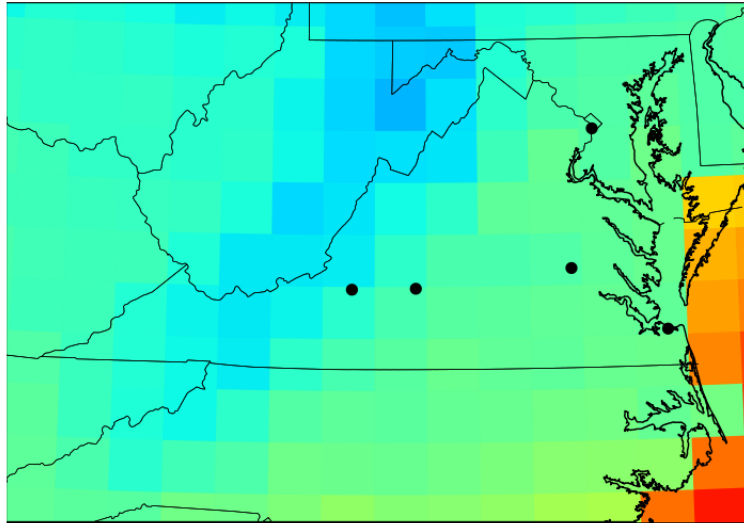
- At most sites, temp increases throughout the current and future periods, although the rate of increase is much higher in the future period
- Biases are evident at some sites and vary by season



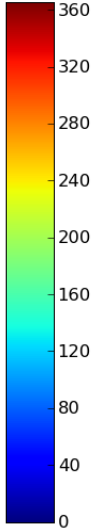
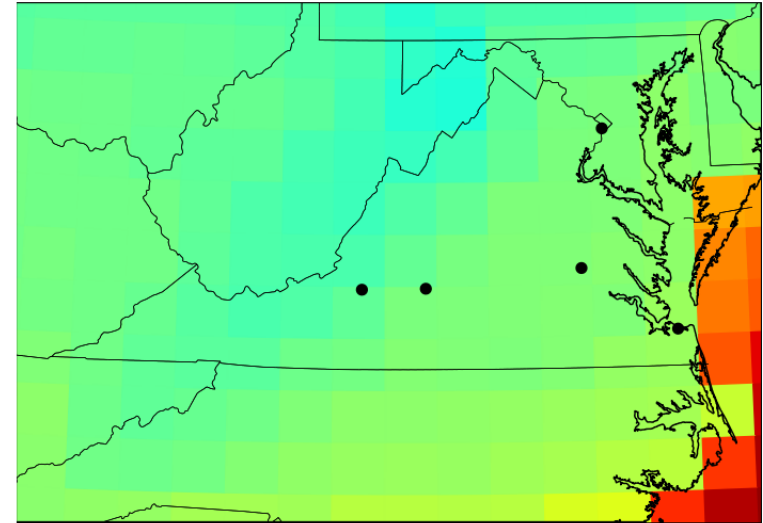
**NARCCAP data from GFDL and CRCM**

# Some Examples Climate Products and Decision Aids Agriculture: VA Growing Season

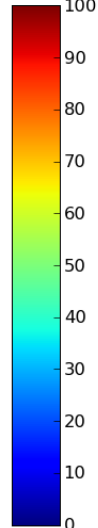
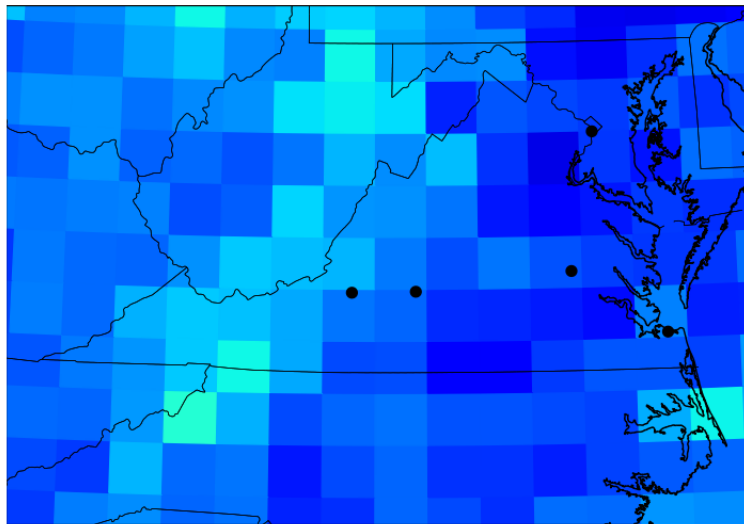
GFDL Mean Length of Growing Season 1969-2000



GFDL Mean Length of Growing Season 2039-2070



GFDL Mean Length of Growing Season (Future-Current)



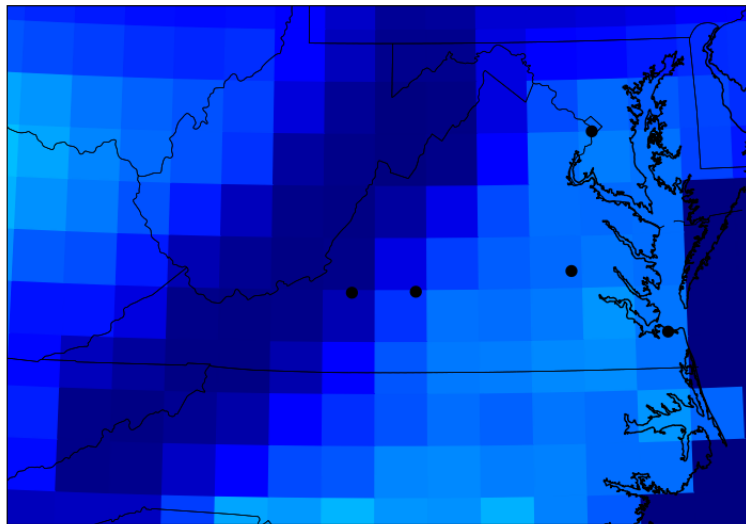
Bias corrected by month	Days in Growing Season	
	Current	Future
Richmond	179	196
Lynchburg	171	185
Roanoke	166	187
Washington DC	157	176
Norfolk	196	228

Use: Agricultural planning, crop selection and rotation, trends in food sources

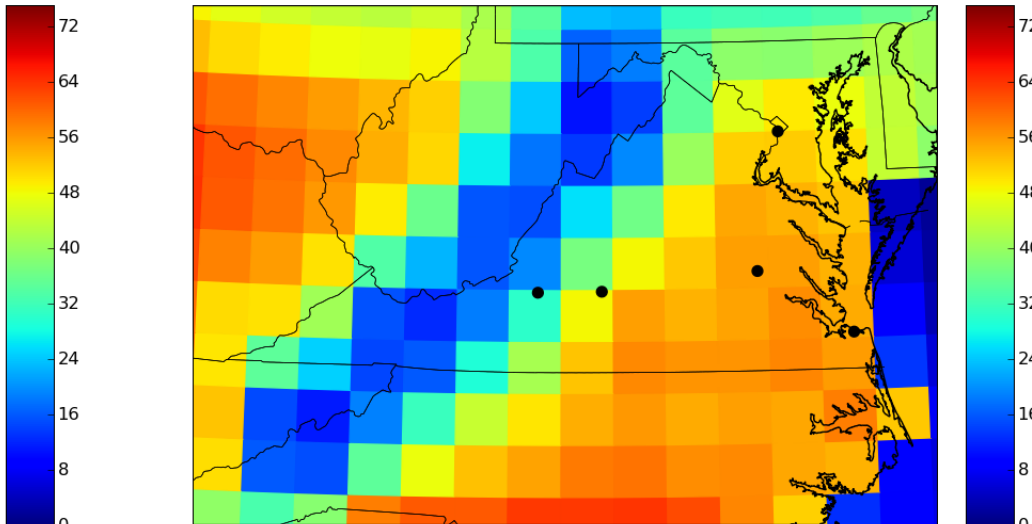


# Some Examples Climate Products and Decision Aids Health: VA Heat Index

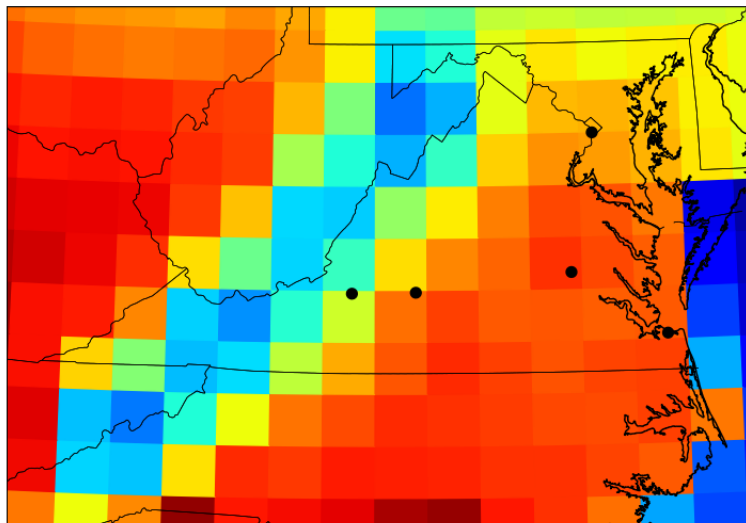
Mean Number of Days with Heat Index > 105 F (1969-2000)



Mean Number of Days with Heat Index > 105 F (2039-2070)



Mean Number of Days with Heat Index > 105 F (Future-Current)



Bias corrected by month

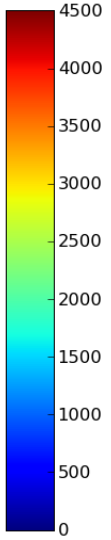
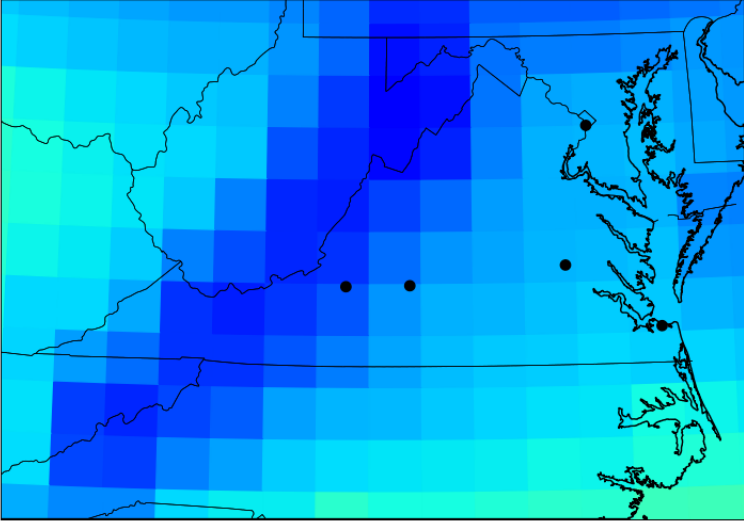
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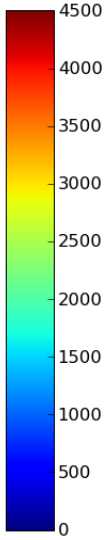
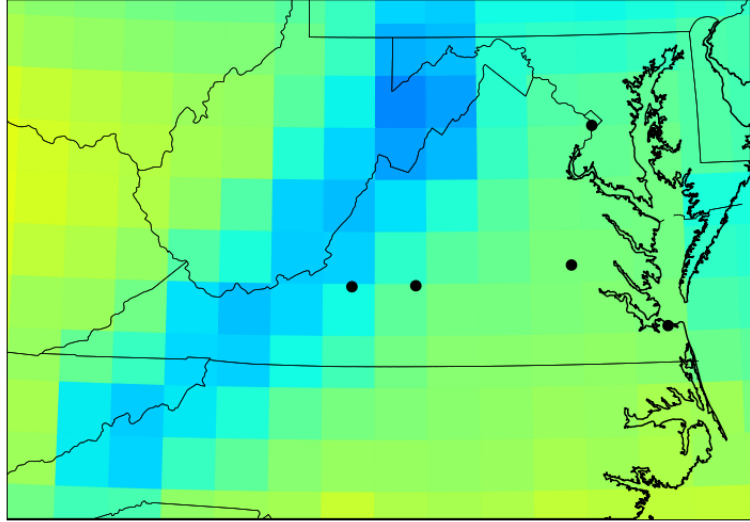
Use: City planning, emergency planning, public facility planning, HVAC planning

# Some Examples Climate Products and Decision Aids Energy: VA Cooling Degree Days and Energy Demand

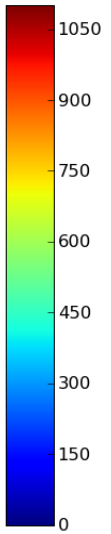
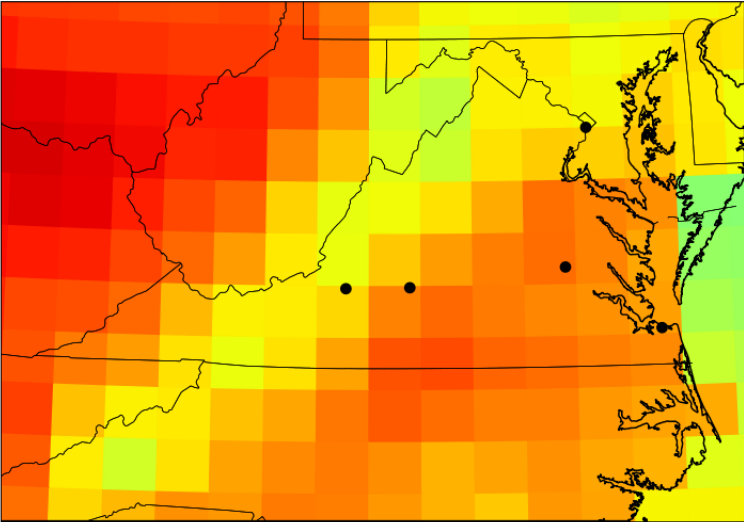
Annual Number of Cooling Degree Days (1969-2000)



Annual Number of Cooling Degree Days (2039-2070)



Annual Number of Cooling Degree Days (Future-Current)



## Bias corrected by month

City	Metro Pop	Mean CDD Per Year			Change in Residential Electricity Demand	
		Current	Future	Change	KWhr/ Capita	Metro MW-Hr
		Richmond	1.2 M	1538	2480	942
Lynchburg	246 K	1206	2088	882	423	104
Roanoke	296 K	1202	2040	838	377	112
Wash. DC	5.3 M	1134	1850	716	286	1518
Norfolk	1.8 M	1708	2604	896	430	772

'Change' is Future value - Current value

Use: Strategic energy planning, future energy demand, power plant needs, alternative power sources



# Summary

- Northrop Grumman is reaching out to regional and local planners in order to understand user needs for climate information
- The combination of global and regional climate models and user-oriented decision aids can provide critical information to planners
- Using past climatic data as a surrogate for future planning is not consistent with IPCC projections
- Although climate models have weaknesses, they are improving and offer the best guidance for planning today
- Running multiple simulations with multiple climate models creates a range of solutions and permits probabilistic estimates
- Interaction with users is critical to optimally tailoring decision aid development and making best use of climate data
- **NARCCAP data have helped us develop example decision aid products and understand issues with the data, such as biases and differences among models**

***NORTHROP GRUMMAN***

