NCAR

Regional Climate Modeling in North America and Europe: Why such Different Paths?

L. O. Mearns,
M. Bukovsky, E. Coppola, J. Christensen, D. Paquin, D. Matte, and F. Giorgi

ICRC CORDEX Meeting
Trieste, Italy

National Center for Atmospheric Research

Perspectives

NCAR

Currently taking informal expert judgement approach to investigation

POSSIBLE EXPLANATIONS

- Nation State
- Filippo moved!
- Balance of RCMs and GCMs within nation state
- Funding vehicles – different structures

Very much a work in progress – not easy to analyze

Basic contrasts

NCAR

- NA Domain much larger than Europe's
- Europe applies many more RCMs
  - Europe supports many more RCMs
- North America applies fewer
  - NA supports fewer (2 or 3)
- Basic questions: why is the number of models supported so different; and what difference does it make in terms of determining future regional climate change
  - What difference in terms of adaptation planning, etc.

In the beginning …

- RegCM1 was US model
- Canadian model – U. Québec (R. LaPrise) developed and supported CRCM along with Ouranos
- But, there were other US models:
  - RAMS (Pielke Sr.)
  - RSM (J. Roads)
  - What happened to them?
- Then WRF becomes dominant (in US)

NA Programs

- PIRCS – funded by EPRI
- NARCCAP – multi-agency – NOAA, NSF, EPA, DOE
- NA-CORDEX - not formally funded – used ‘donated’ funding for producing simulations (but funding for data set development and distribution – ESTCP)

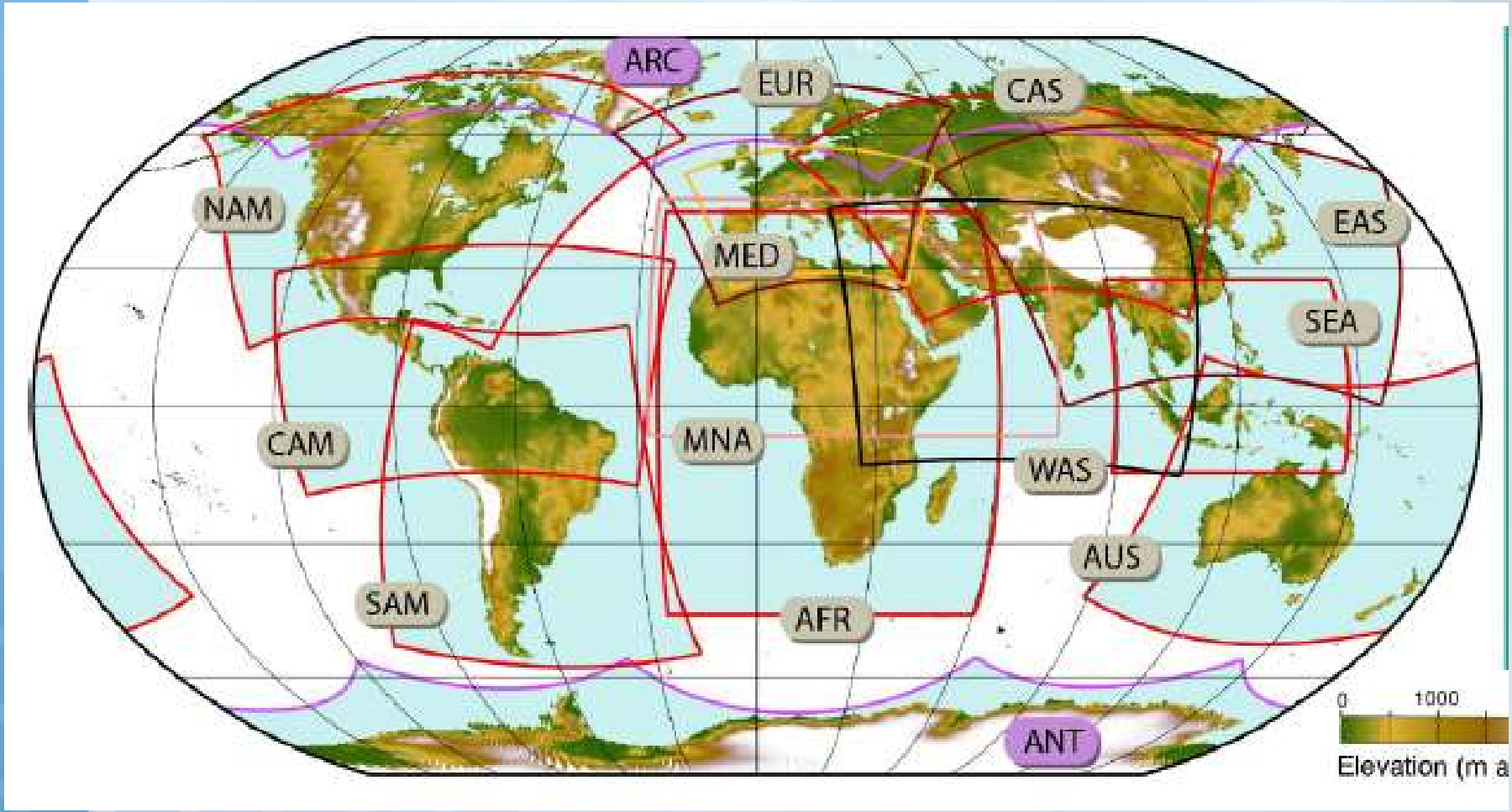
European Programs

- PRUDENCE
- ENSEMBLES
- Euro-CORDEX
- EUCP

All involve both major EU funding and national funding

CORDEX Domains

NCAR



ENSEMBLES

NCAR

Table 1 The RCM × GCM matrix; label X indicates that the corresponding RCM × GCM pair was available in ENSEMBLES at the time of the study

	BCM	CNRM	HC-lo	HC-med	HC-hi	MPI
C4I					X	
CNRM		X				
DMI	X	X				X
ETHZ				X		
HC-lo			X			
HC-med				X		
HC-hi					X	
ICTP						X
KNMI						X
METN	X			X		
MPI						X
SMHI	X		X			X
UCLM				X		

Déqué et al. 2012

NA-CORDEX

NCAR

	GFDL-ESM2M (2.5)	MPI-ESM-LR (3.6)	HadGEM2-ES (4.6)	CanESM2 (3.7)	EC-EARTH (3.3)	MPI-ESM-MR (3.4)
RegCM4 (Iowa State & NCAR)	25km 50km	25km 50km	25km 50km			
WRF (U. of Arizona & NCAR)	25km 50km	25km 50km	25km 50km			
HIRHAM5 (DMI)					50km	
CanRCM4 (CCCma)				25km 50km		
CRCM5* (UQAM & OURANOS)	25km	25km 50km		50km 25km		50km 25km
RCA4 (SMHI)				50km	50km	

*With and without nudging depending on institute.

Orange = RCP 4.5 and RCP 8.5
Black = RCP 8.5 Only
Purple = RCP 2.6, RCP 4.5, and RCP 8.5

Comparison of Programs

NCAR

- **PRUDENCE** (2001-2004) - 30 yr time slices, 50 km grid, SRES A2 and B2, 2 GCMs, 6 RCMs
- **ENSEMBLES** (2004-2009):Transient 1960-2100 (some only 2050), 25 km grid, SRES A1B, 8 GCMs, 16 RCMs (but sparse filled matrix)
- **EURO-CORDEX** (2009-ongoing):Transient, 12km – 50km, 3 RCPs, multiple GCMs and RCMs
- **EUCP** (2017-May 2022): CPM time slices, analysing large CORDEX RCM-GCM matrices
- **PIRCS:** 3-month periods, 1988 and 1993, 50 km, NCEP BCs, 6 RCMs
- **NARCCAP**: 30-year time slices, 50 km grid, SRES A2, 4 GCMs, 6 RCMs, balanced factorial design
- **NA-CORDEX**: transient, 25 km grid, (mainly) RCP 8.5, 6 GCMs, 6 RCMs, 24 runs

Opinions So Far

- Based on nation state analysis, makes sense since NA comprised of 2 states, Europe, many states, thus many regional models
- NA missing out on some important numerics and physics explorations by not using more RCMs
- Added value of co-ordinated effort in Europe - e.g., Euro-CORDEX General Assembly, less so in US

Opinions so Far (cont'd)

NCAR

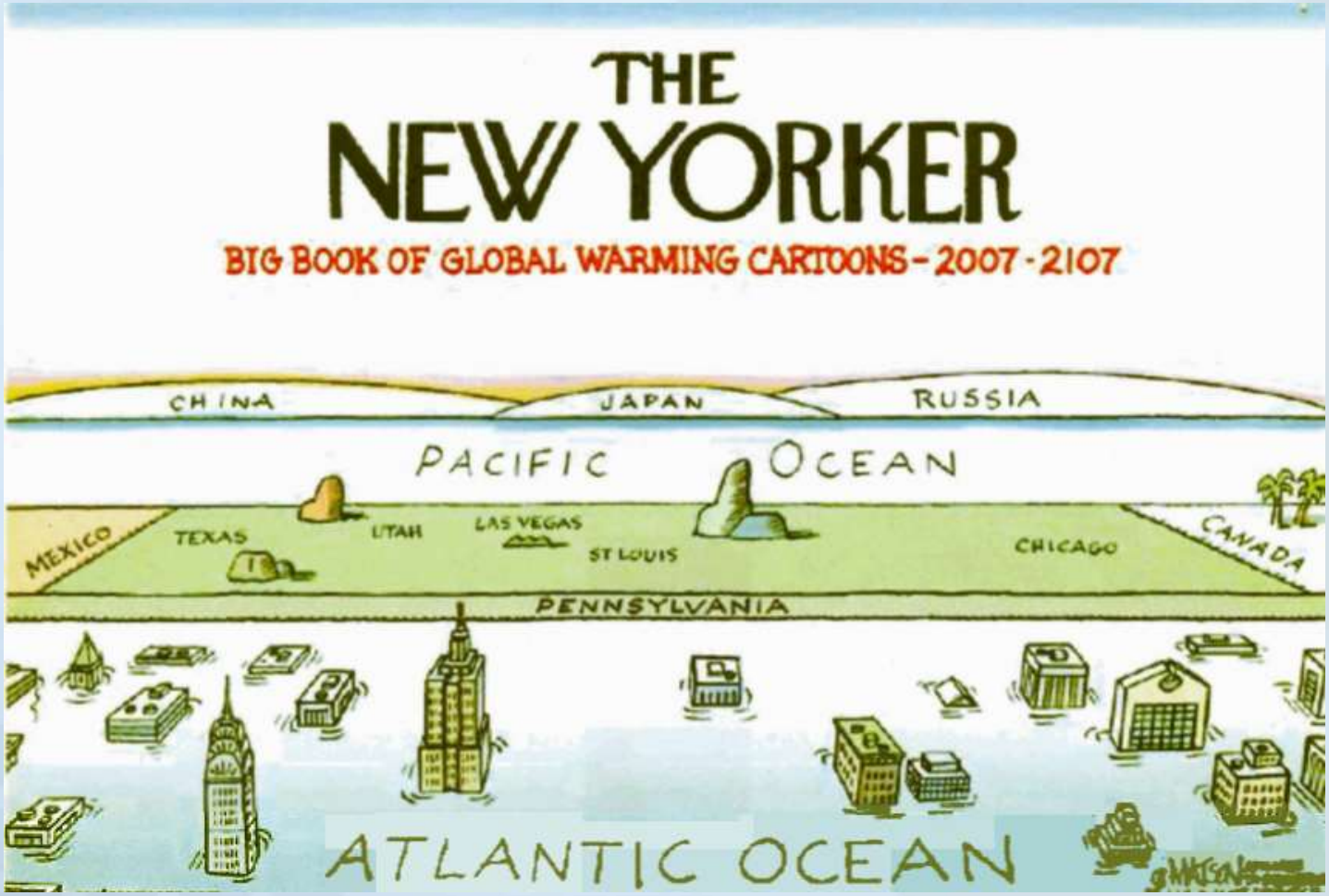
- At NCAR, using 'other' models is not encouraged (but not prevented). Note NARCCAP received an NCAR wide award.
- NA puts most climate resources into further development of global models (five total in US and Canada).
- In US, lack of high quality organization across agencies (e.g., NSF, NOAA, EPA, DOE – getting funding for NARCCAP was a rare success in this regard).

Future Directions

- Interview US/Canadian program managers – get more in depth perspective on attitudes towards RCMs vs. GCMs/stretched grids
- Determine approach for comparing the difference in information (and uncertainty) through using more/fewer RCMs.
- Additionally, use of more ensemble members for driving the RCMs
- Develop relationship ‘tree’ for RCMs

The End

NCAR


THE
NEW YORKER
BIG BOOK OF GLOBAL WARMING CARTOONS - 2007 - 2107
CHINA
JAPAN
RUSSIA
PACIFIC OCEAN
MEXICO
TEXAS
UTAH
LAS VEGAS
ST LOUIS
CHICAGO
CANADA
PENNSYLVANIA
ATLANTIC OCEAN