



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

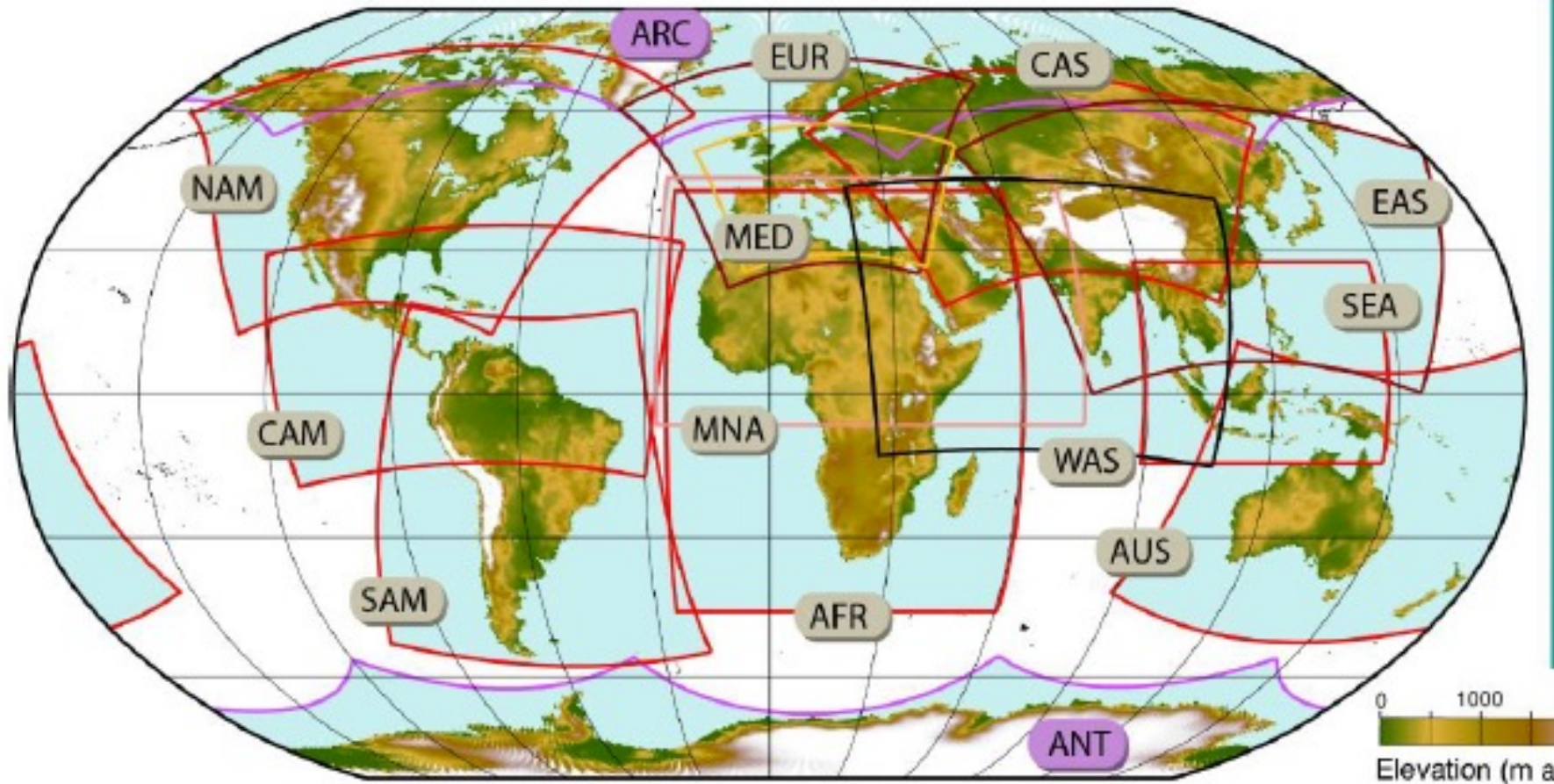
- PRUDENCE
- ENSEMBLES
- Euro-CORDEX
- EUCP

All involve both major EU funding and national funding

# CORDEX Domains



NCAR



# ENSEMBLES

**Table 1** The RCM  $\times$  GCM matrix; label X indicates that the corresponding RCM  $\times$  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		



# 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



NCAR

- 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

