A Validation Against Observations of 24 Global Climate Models over Canada: Which GCMs Model Best, Where?

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Outline

1. Global Climate Models - IPCC AR4
2. Climate Observations - NCEP Reanalysis
3. Methodology - Model Validation Against Observations
4. Results – CGCM3T63, Ensemble, Uncertainty, Best models where
5. Next steps
1. Global Climate Models

- What is a GCM?
  - mathematical models
  - been around 35 years
## 24 GCMs used in IPCC AR4

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<th>MODEL</th>
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Difference in models

- Spatial variations (grid sizes, shapes)
- Temporal variations (no leap years, some 360 days)
- Each model has varying degrees of complexity with its atmospheric and oceanic physics and their connection
- Sub-grid scale processes (parameterization) between models vary even more (eg. Snow? Sea ice? Soil layers?)
Single Grid Model Validation

Validation of Global Climate Model Output
Charlottetown, Prince Edward Island
1971 to 2000

Too cold Too warm
Too wet Too dry
2. Climate Observations

NCEP Reanalysis

- When no climate data (observations) are available for your area of interest, or if you want a larger generalized picture of the regional climate (not climate station view), one can try reanalyzed data.

- This data set is a global analysis beginning in 1948 using a single analysis system for the entire dataset.

- Analyses are available every six hours.

- Data are archived on a 2.5 x 2.5 degree lat/lon grid and a gaussian grid (~1.9 degrees lat, 2.5 degrees lon).

Problems with NCEP Reanalysis

• Number of reported problems associated with the NCEP/NCAR Reanalysis

• Several institutions have web pages devoted to providing information including NCEP, NOAA-CIRES CDC, NCAR's DSS

• Usually site specific
3. Methodology

- The objective was to compare annual mean temperature and precipitation values for the period 1971-2000 from NCEP reanalysis (observations) to back projections from 24 GCMs used in IPCC AR4 (2007) using a common grid resolution at 2.5 x 2.5 degrees across Canada.
- For temperature, red is too hot, blue is too cold, white is just right.
- For precipitation, blue is too wet, red is too dry, white is just right.
4. Results - Temperature
Results - Temperature

Ensemble

Difference from Observation (°C)

- -5
-5 to -4.5
-4.5 to -4
-4 to -3.5
-3.5 to -3
-3 to -2.5
-2.5 to -2
-2 to -1.5
0 to 0.5
0.5 to 1
1 to 1.5
1.5 to 2
2 to ≥2.5
Results - Temperature

Range

Difference from Observation (°C)
- 0 to 2
- 2 to 4
- 4 to 6
- 6 to 8
- 8 to 10
- 10 to 12
- 12 to 14

14 to 16
16 to 18
18 to 20
20 to 22
22 to 24
24 to 26
Results - Precipitation

CGCM3T63
Results - Precipitation

Ensemble
Results - Precipitation

Difference from Observation (mm/day)
- 0 to 0.5
- 0.5 to 1
- 1 to 1.5
- 1.5 to 2
- 2 to 2.5
- 2.5 to 3
- ≥3.5

Range
Preliminary Results - Best Models Where
What’s Next

• GIS maps of best models, where

• GCM annual variability (standard deviation)

• New IPCC AR5 models
IPCC AR5 Ensemble Projections (12 GCMs)
Temperature 2050s

Common Grid – Model Ensemble (AVG)
Annual Mean change from (1961–1990) to (2041–2070)

Air Temperature – Mean (2m) degC