

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

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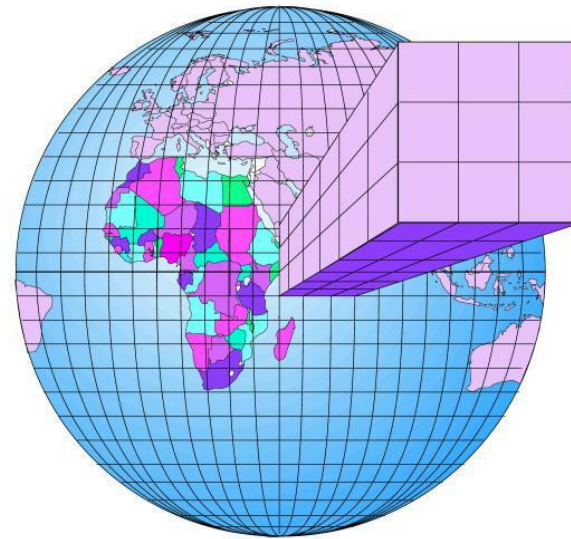
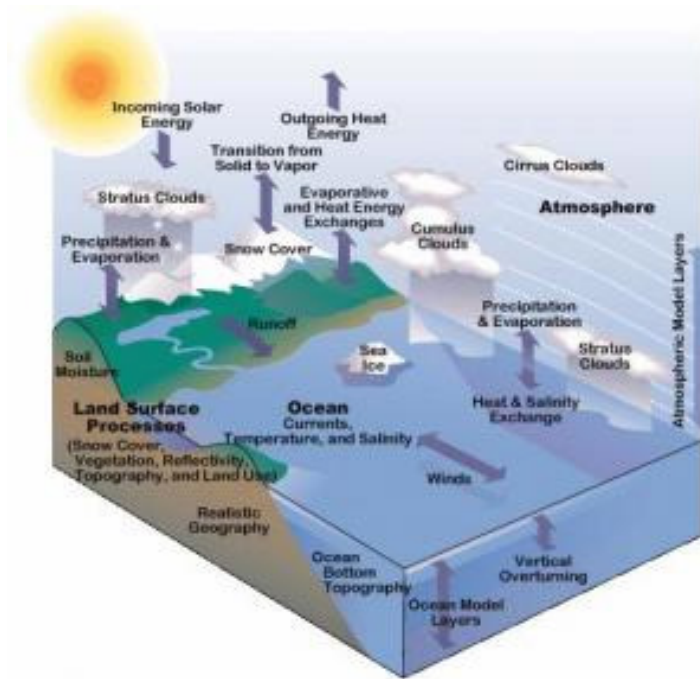
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Outline

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

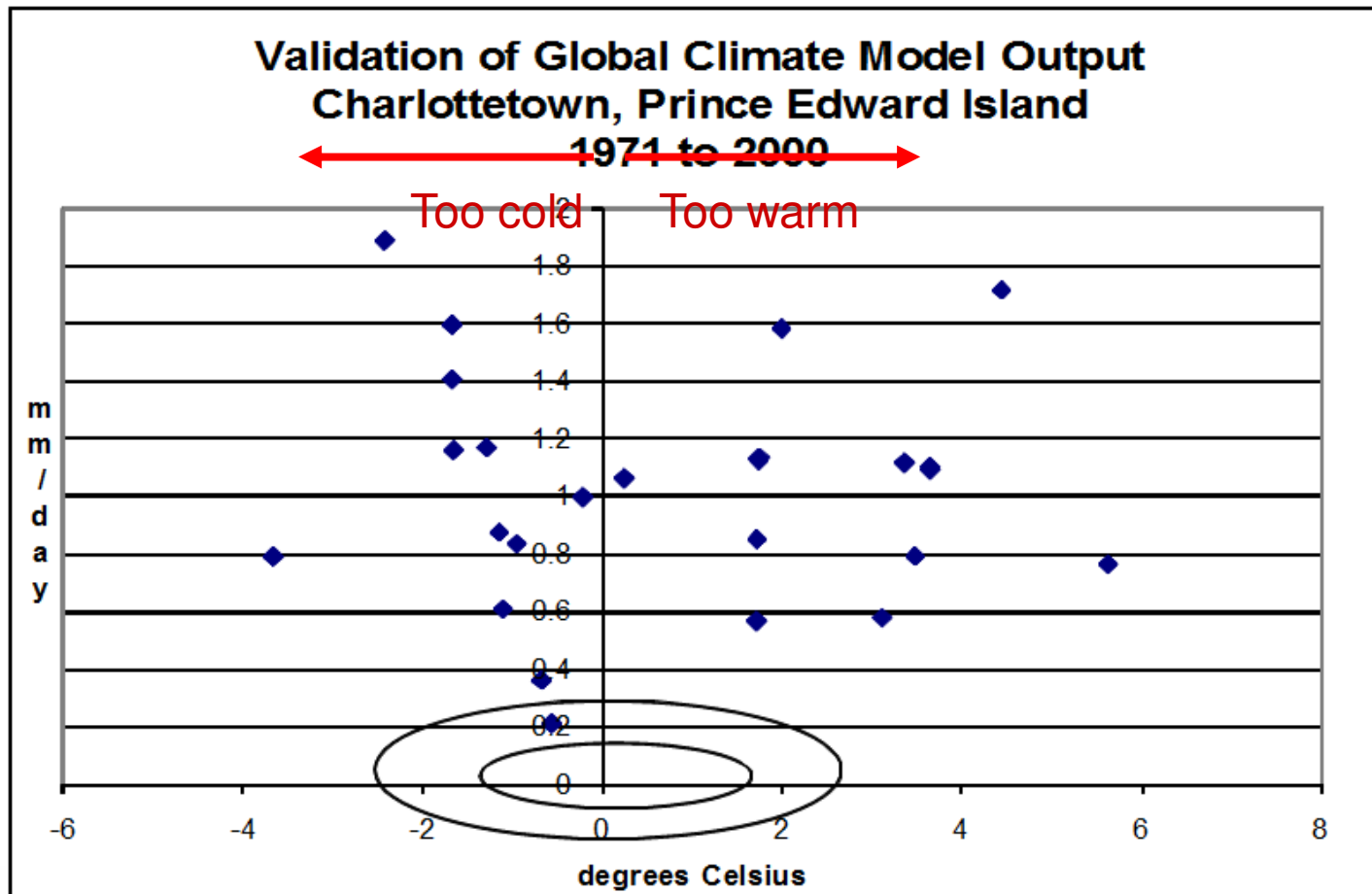
24 GCMs used in IPCC AR4

CENTRE	MODEL
Bjerknes Centre for Climate, Norway	BCM2.0
Canadian Centre for Climate Modelling and Analysis (CCCma), Canada	CGCM3T47
Canadian Centre for Climate Modelling and Analysis (CCCma), Canada	CGCM3T63
Centre National de Recherches Meteorologiques, France	CNRMCM3
Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	CSIROMk3.0
Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	CSIROMk3.5
Max Planck Institute für Meteorologie, Germany	ECHAM5OM
Meteorological Institute, University of Bonn Meteorological Research Institute, Germany	ECHO-G
Institute of Atmospheric Physics, Chinese Academy of Sciences, China	FGOALS-g1.0
Geophysical Fluid Dynamics Laboratory (GFDL), USA	GFDLCM2.0
Geophysical Fluid Dynamics Laboratory (GFDL), USA	GFDLCM2.1
Goddard Institute for Space Studies (GISS), USA	GISSAOM
Goddard Institute for Space Studies (GISS), USA	GISSE-H
Goddard Institute for Space Studies (GISS), USA	GISSE-R
UK Meteorological Office, United Kingdom	HADCM3
UK Meteorological Office, United Kingdom	HADGEM1
National Institute of Geophysics and Volcanology, Italy	INGV-SXG
Institute for Numerical Mathematics, Russia	INMCM3.0
Institute Pierre Simon Laplace, France	IPSLCM4
National Institute for Environmental Studies, Japan	MIROC3.2 hires
National Institute for Environmental Studies, Japan	MIROC3.2 medres
Meteorological Research Institute, Japan Meteorological Agency, Japan	MRI-CGCM2.3.2
National Center for Atmospheric Research (NCAR), USA	NCARPCM
National Center for Atmospheric Research (NCAR), USA	NCARCCSM3

Difference in models

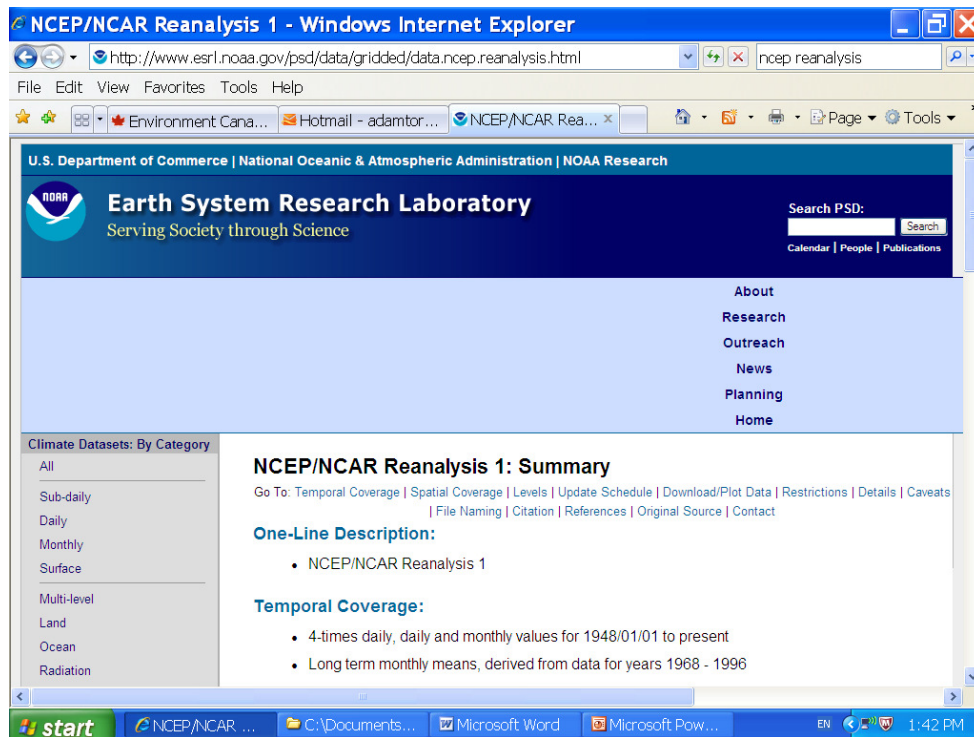
- Spatial variations (grid sizes, shapes)
- Temporal variations (no leap years, some 360 days)
- Each model has varying degrees of complexity with its atmospheric and oceanic physics and their connection
- Sub-grid scale processes (parameterization) between models vary even more
(eg. Snow? Sea ice? Soil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

Single Grid Model Validation



2. Climate Observations

NCEP Reanalysis

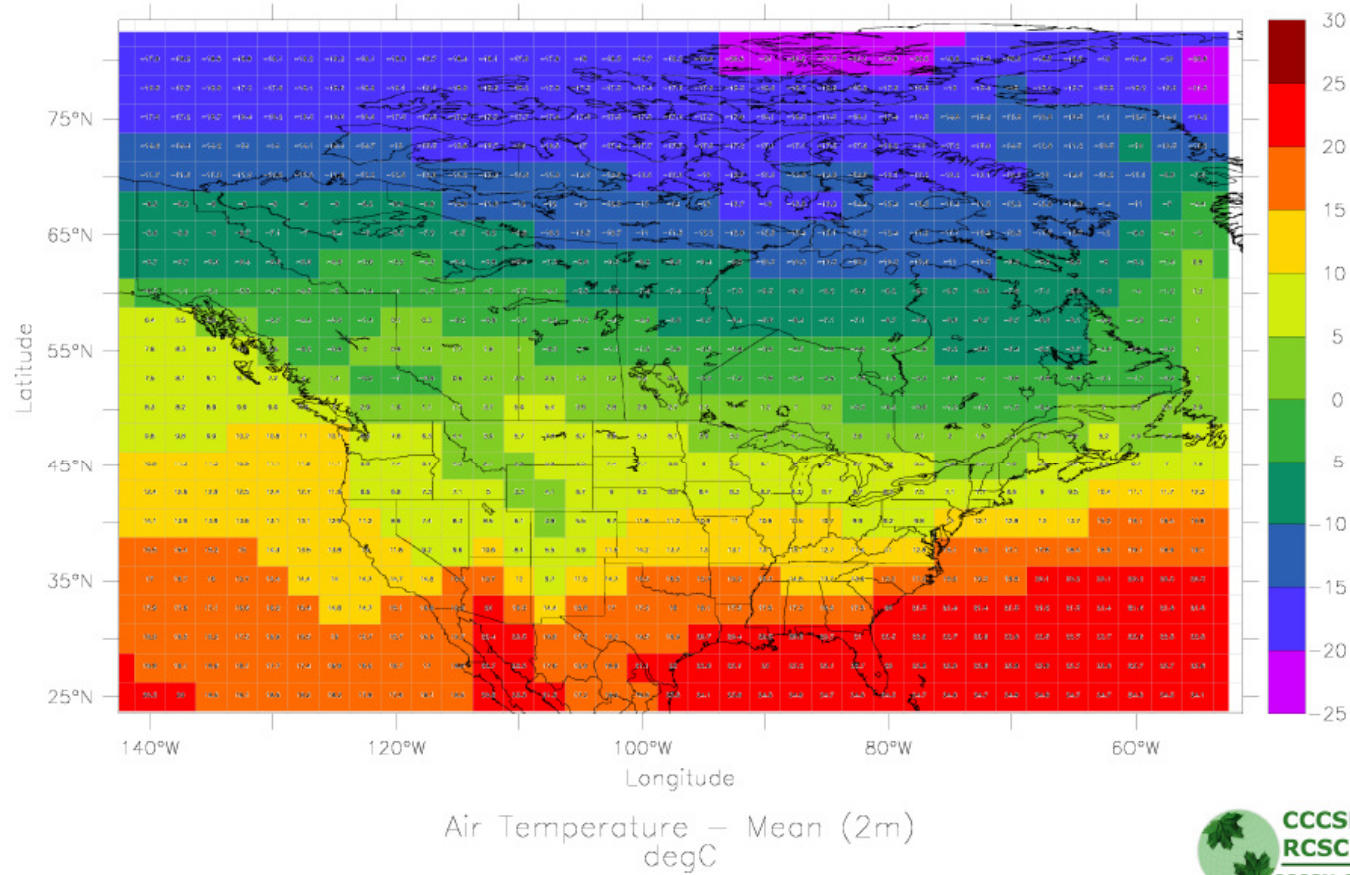


- When no climate data (observations) are available for your area of interest, or if you want a larger generalized picture of the regional climate (not climate station view), one can try reanalyzed data
- This data set is a global analysis beginning in 1948 using a single analysis system for the entire 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)
- E. Kalnay *et al.*, 1996. The NCEP/NCAR 40-Year Reanalysis Project. *Bulletin of the American Meteorological Society*

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

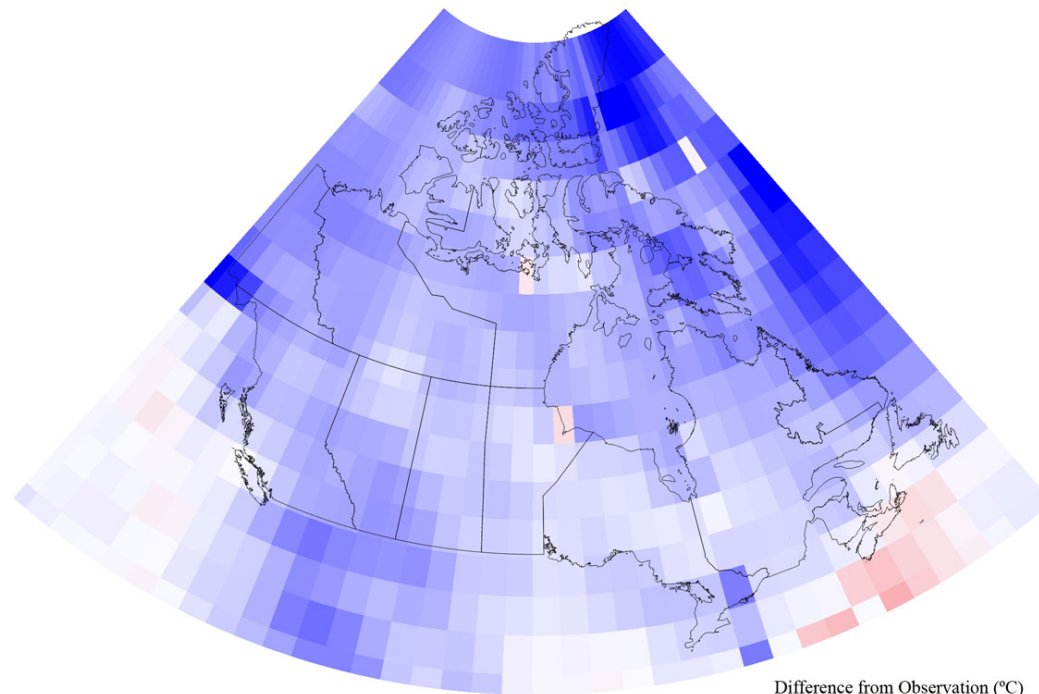
Observed - NCEP (Run 1) - BASELINE Annual Mean of (1961-1990)



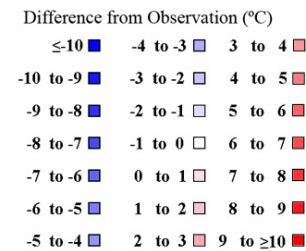
3. Methodology

- 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

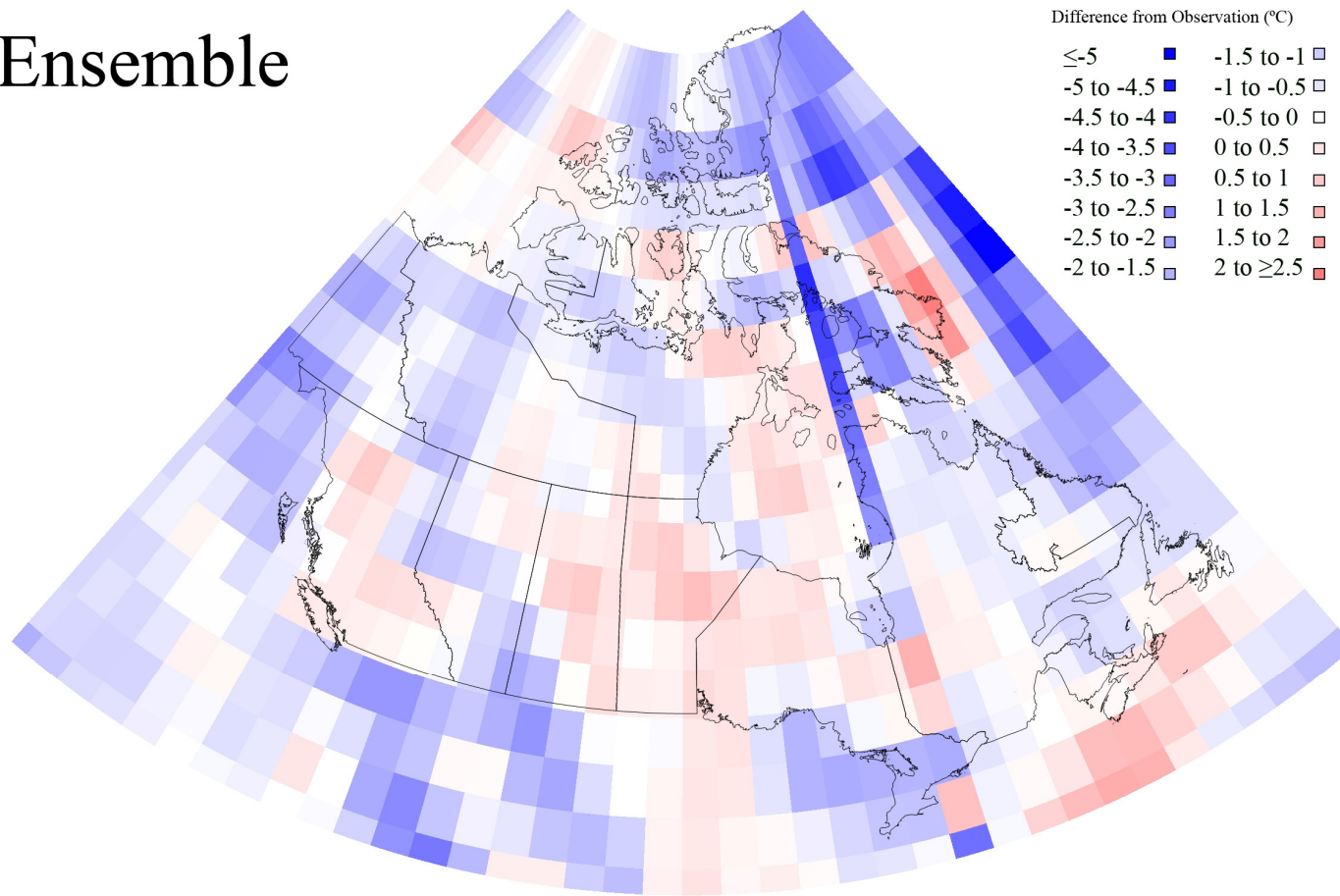


CGCM3T63



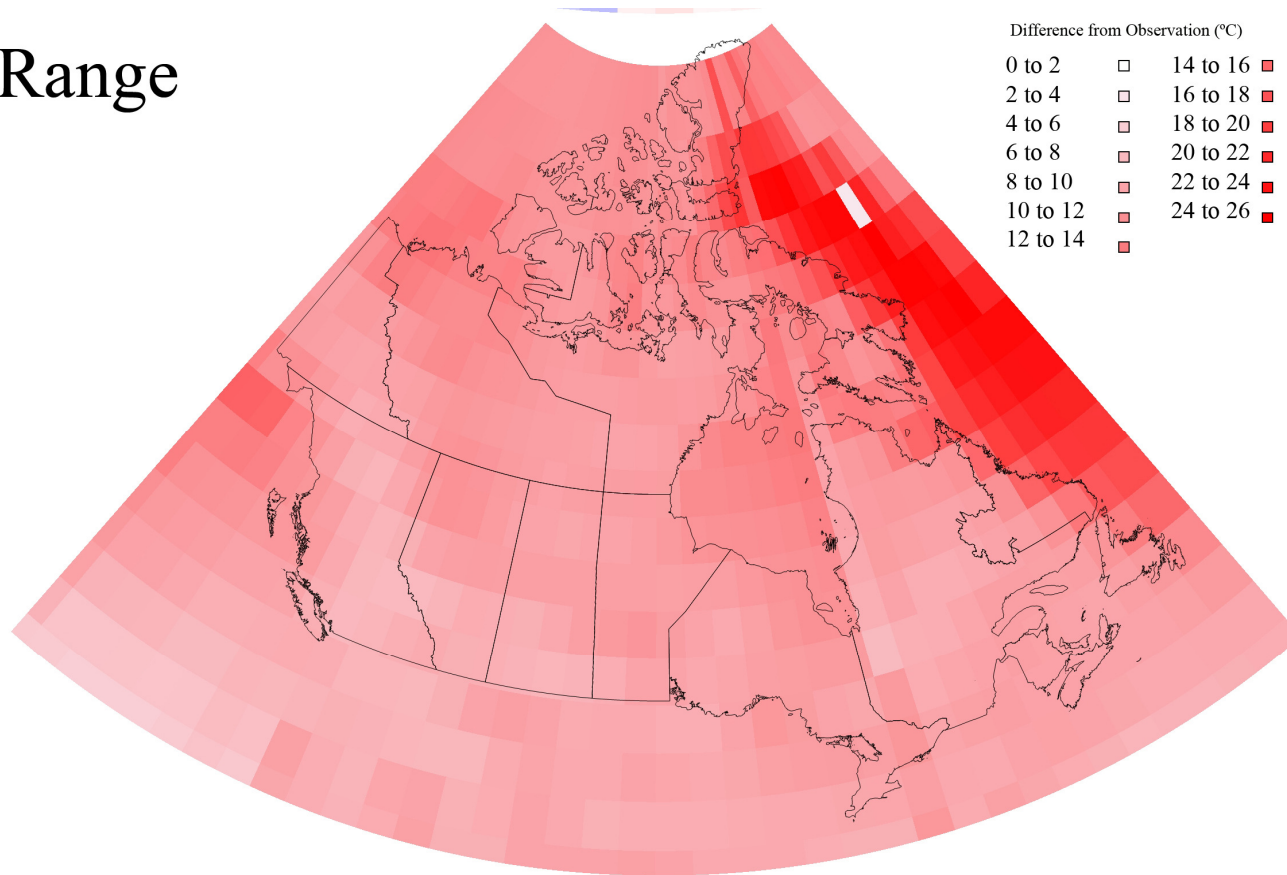
Results - Temperature

Ensemble

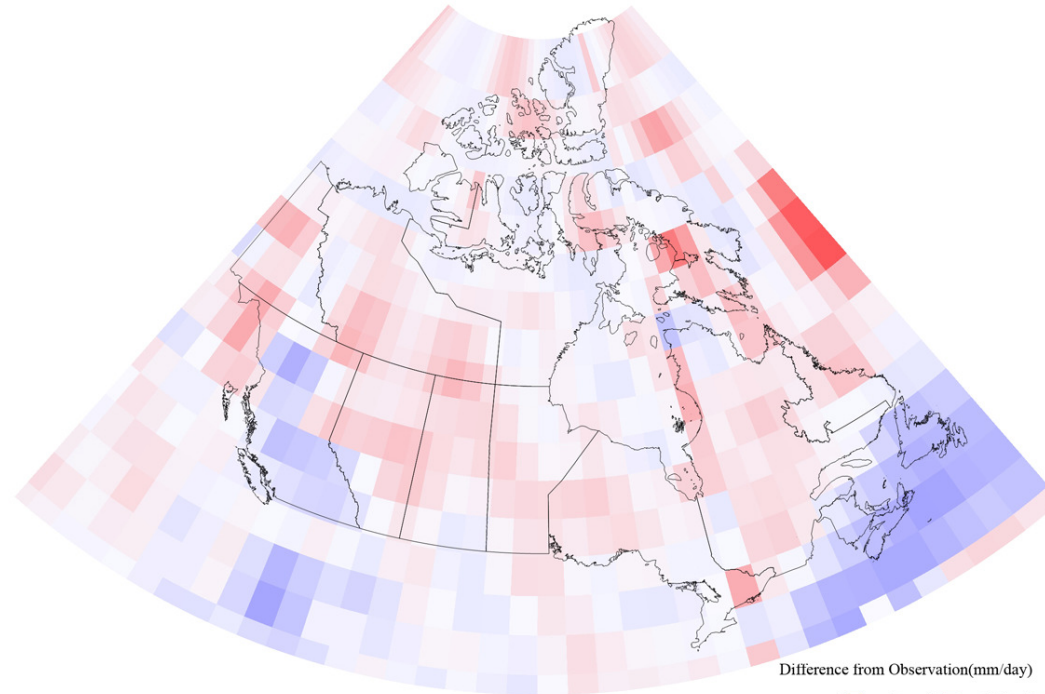


Results - Temperature

Range



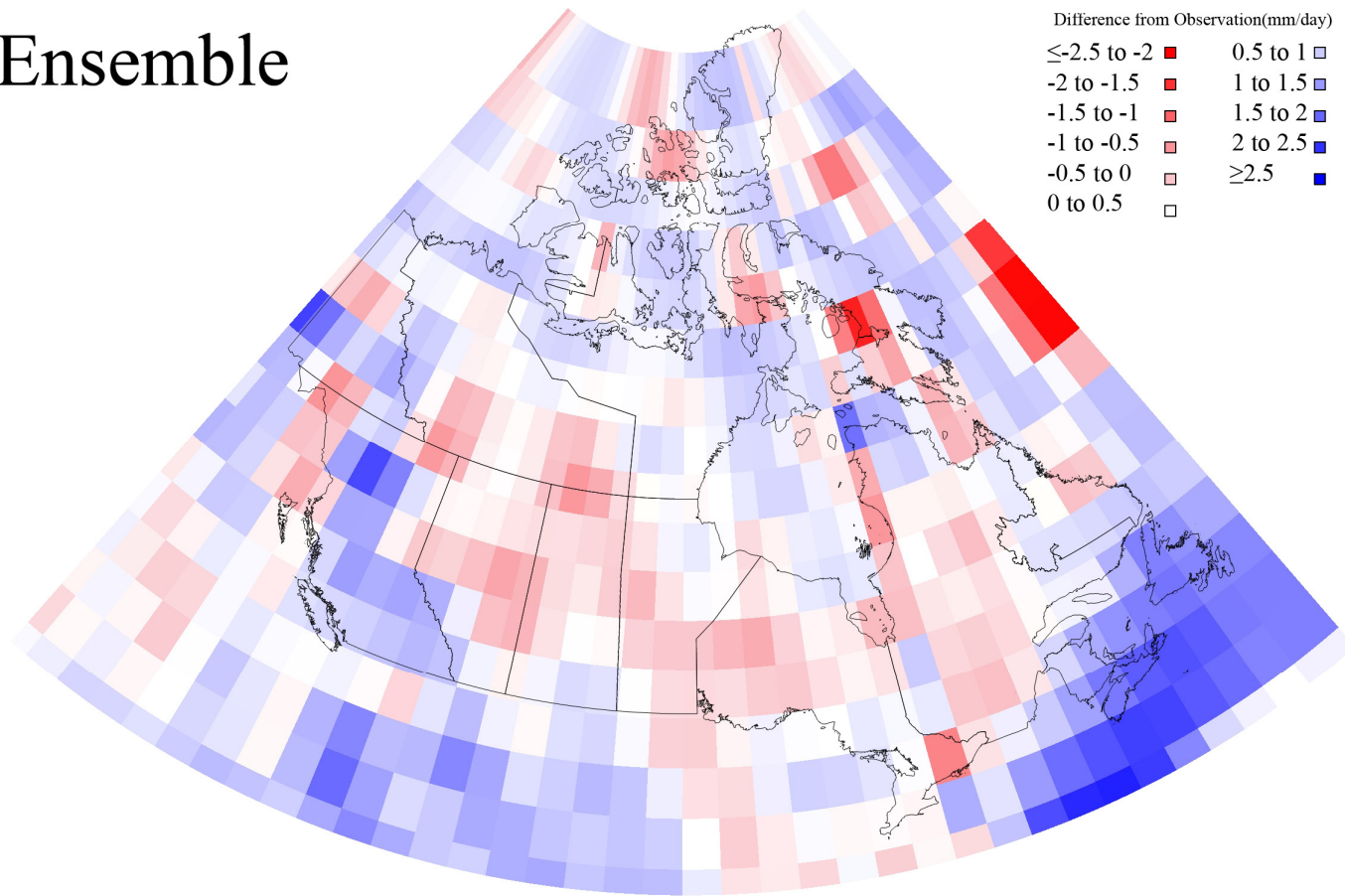
Results -Precipitation



CGCM3T63

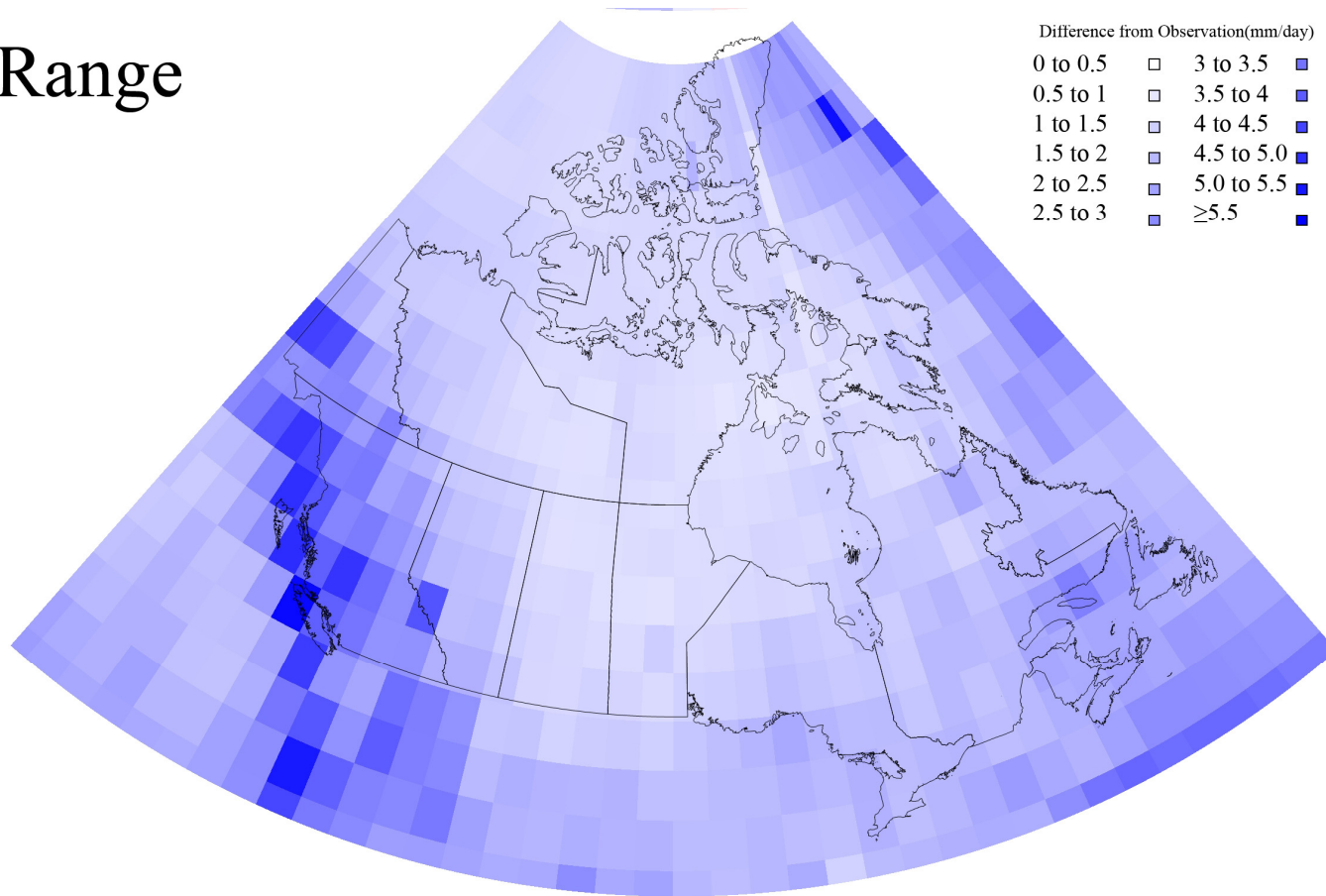
Results -Precipitation

Ensemble

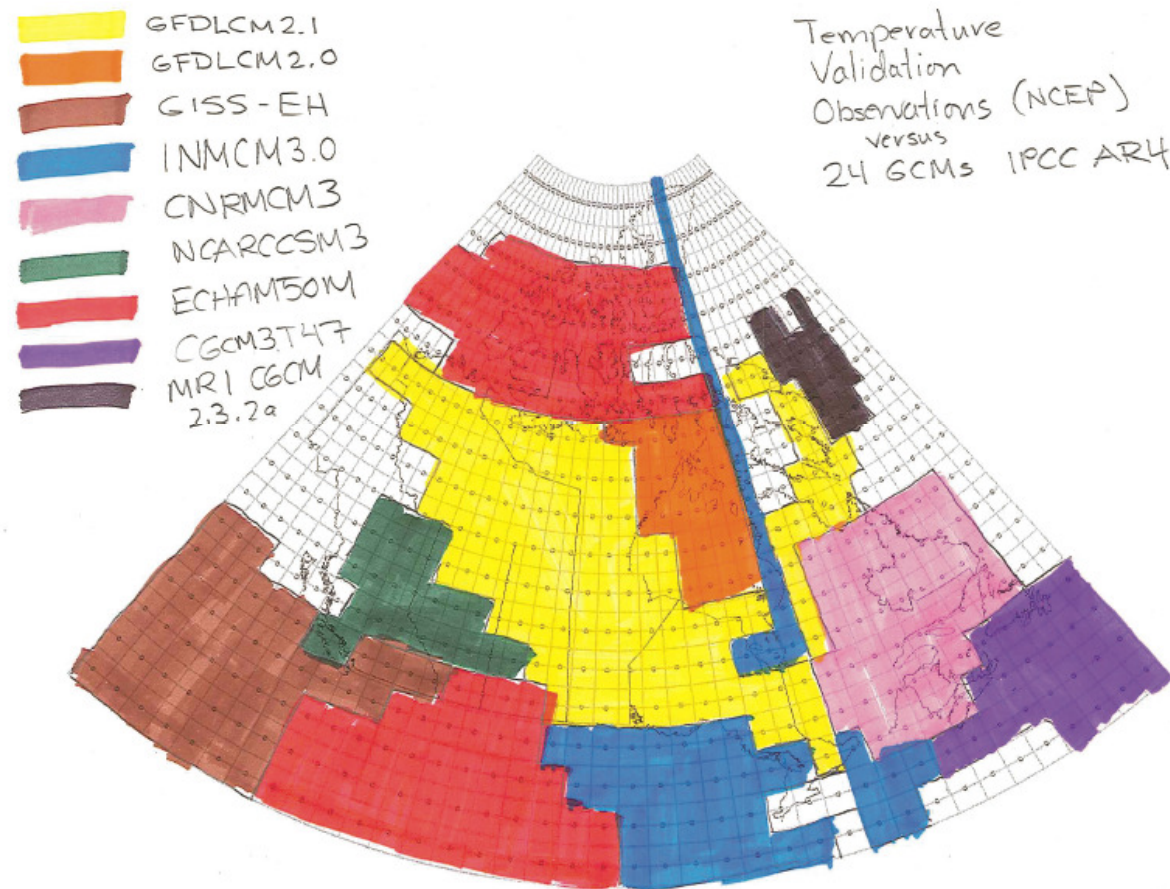


Results -Precipitation

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)

