

The Canadian IPY effort

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Outline of talk

1. Work based on Environment Canada's weather forecast model, GEM
2. Work based on a middle atmosphere climate model, CMAM

1. Work based on Environment
Canada's weather forecasting
model, GEM

GEM-BACH

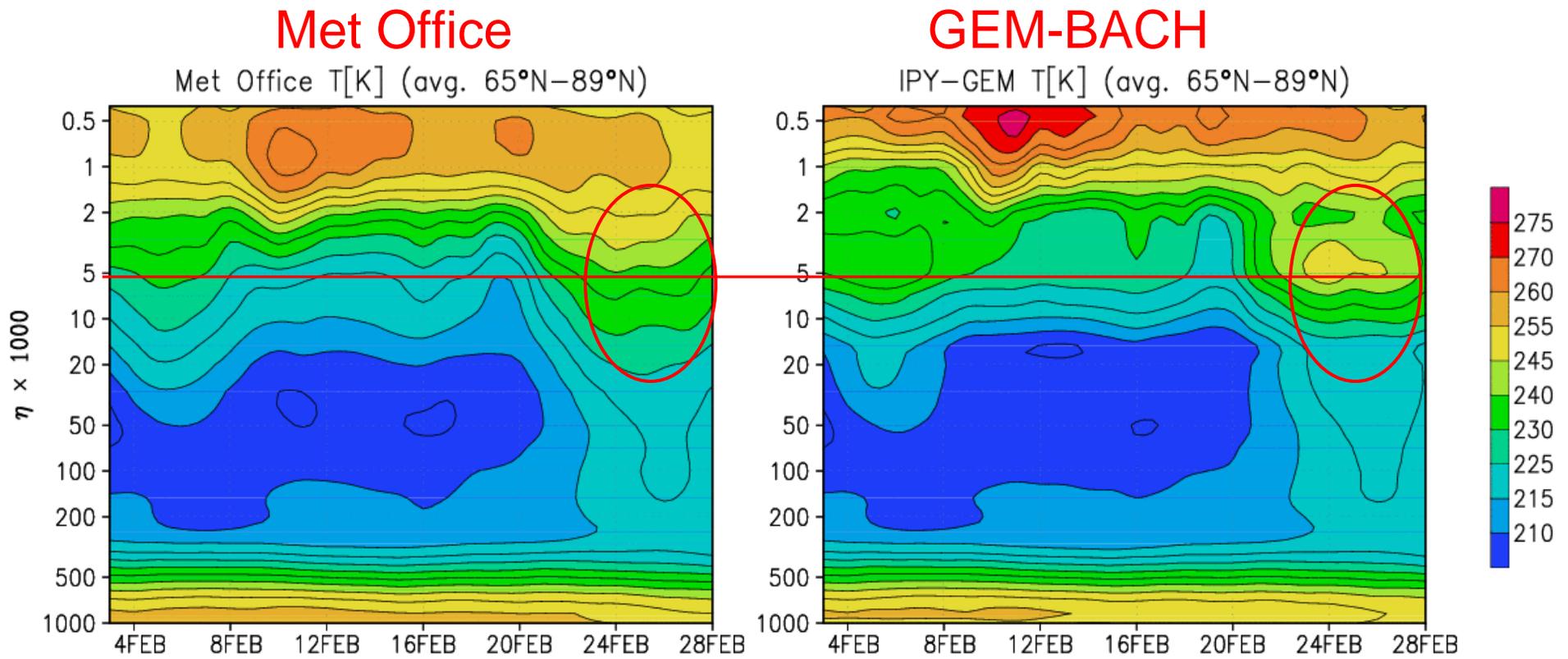
- **Matt Reszka**, Jean DeGrandpré, Cécilien Charette, Saroja Polavarapu
- Global Environmental Multiscale (GEM) model
1.5° × 1.5° × 80 levels, sfc to 0.1 hPa (65 km)
- A version of global model used for operational weather forecasts by CMC
- 57 species advected, 143 gas-phase chemical reactions, heterogeneous chemistry
- Hines nonorographic GWD scheme

GEM-BACH's assimilation scheme

- **4D-variational (4D-Var) assimilation scheme from the Canadian Meteorological Centre (CMC).**
- **Standard meteorological observations from CMC**
- **Only dynamic variables (horizontal wind, temperature, moisture variable, and surface pressure) are assimilated every 6 hours.**
- **Online chemistry provides species estimates during 6-hour forecasts**
- **Digital filter applied to analysis**

Polar mean temperature in Feb. 2007

- Overall vertical structure similar to Met Office analyses
- Most differences occur above 10 hPa
- Differences during SSW (red oval)



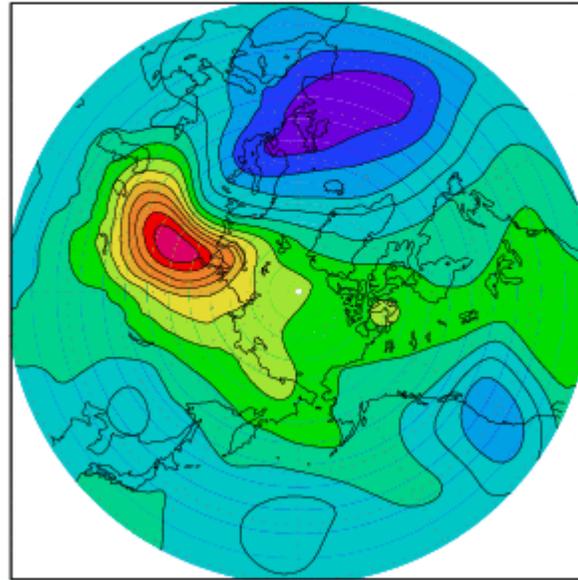
Matt Reszka

5 hPa:
GEM-BACH
is warmer
everywhere

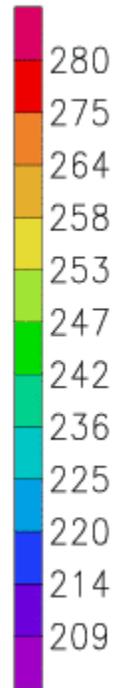
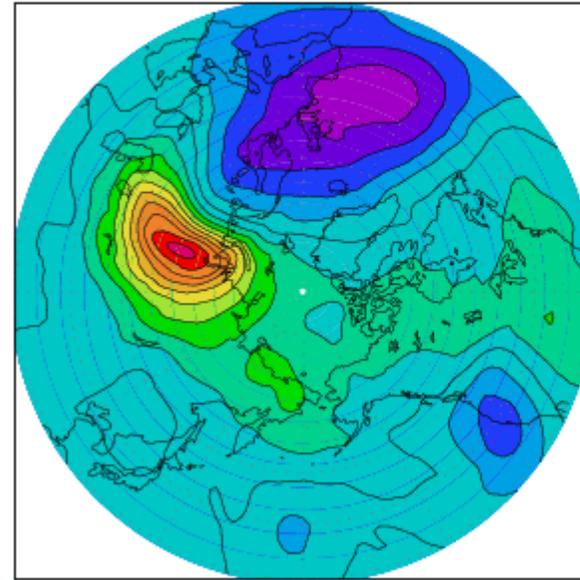
Differences
due to TOVS
bias
correction?

10 hPa: Both
quite similar

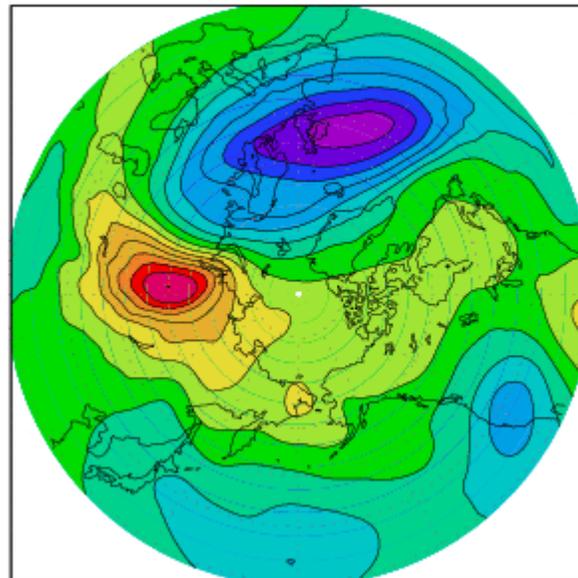
IPY-GEM 12Z25FEB2007



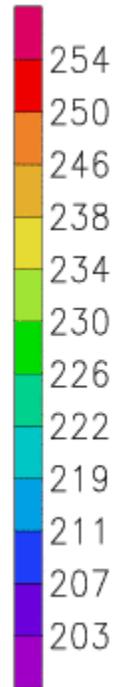
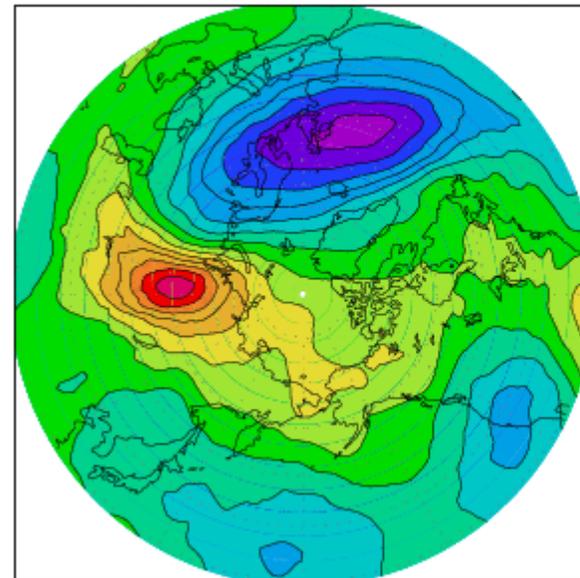
Met Office 12Z25FEB2007



IPY-GEM 12Z25FEB2007

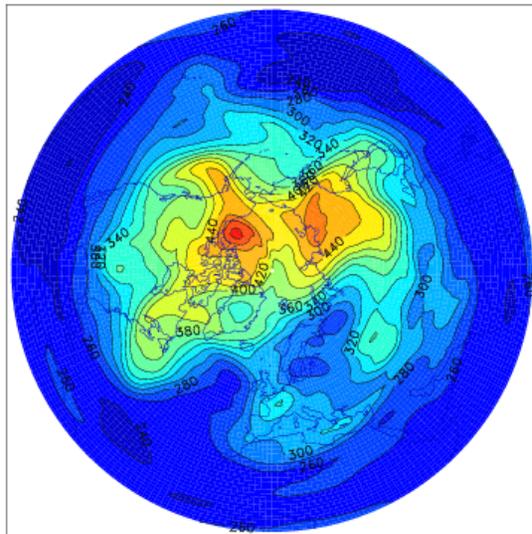


Met Office 12Z25FEB2007

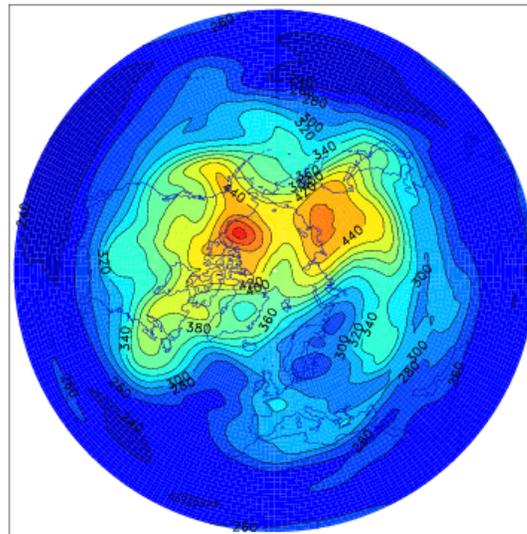


Compare NH total column ozone to WOUDC

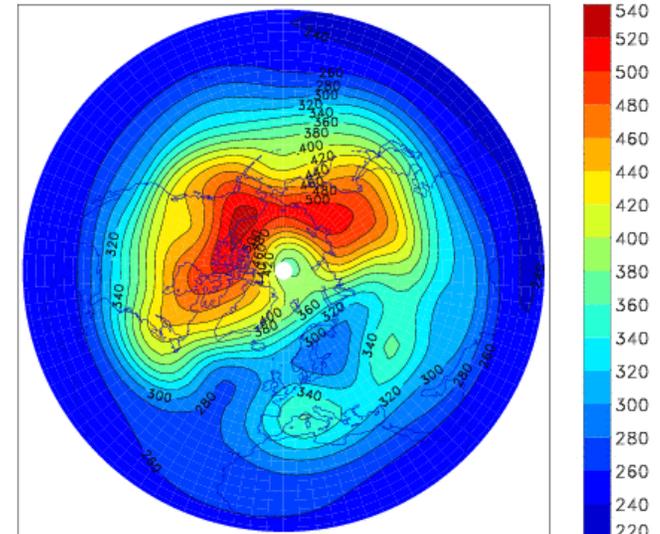
GEM-BACH
Feb. 25 12Z
snapshot



GEM-BACH
Feb. 25 daily avg



WOUDC
Feb. 25 local
solar noon



- Similar large scale structure
- Time averaging still retains details
- Fine structure due to good horizontal resolution

Matt Reszka

**2. Work based on a middle
atmosphere climate model,
CMAM**

CMAM Data assimilation system

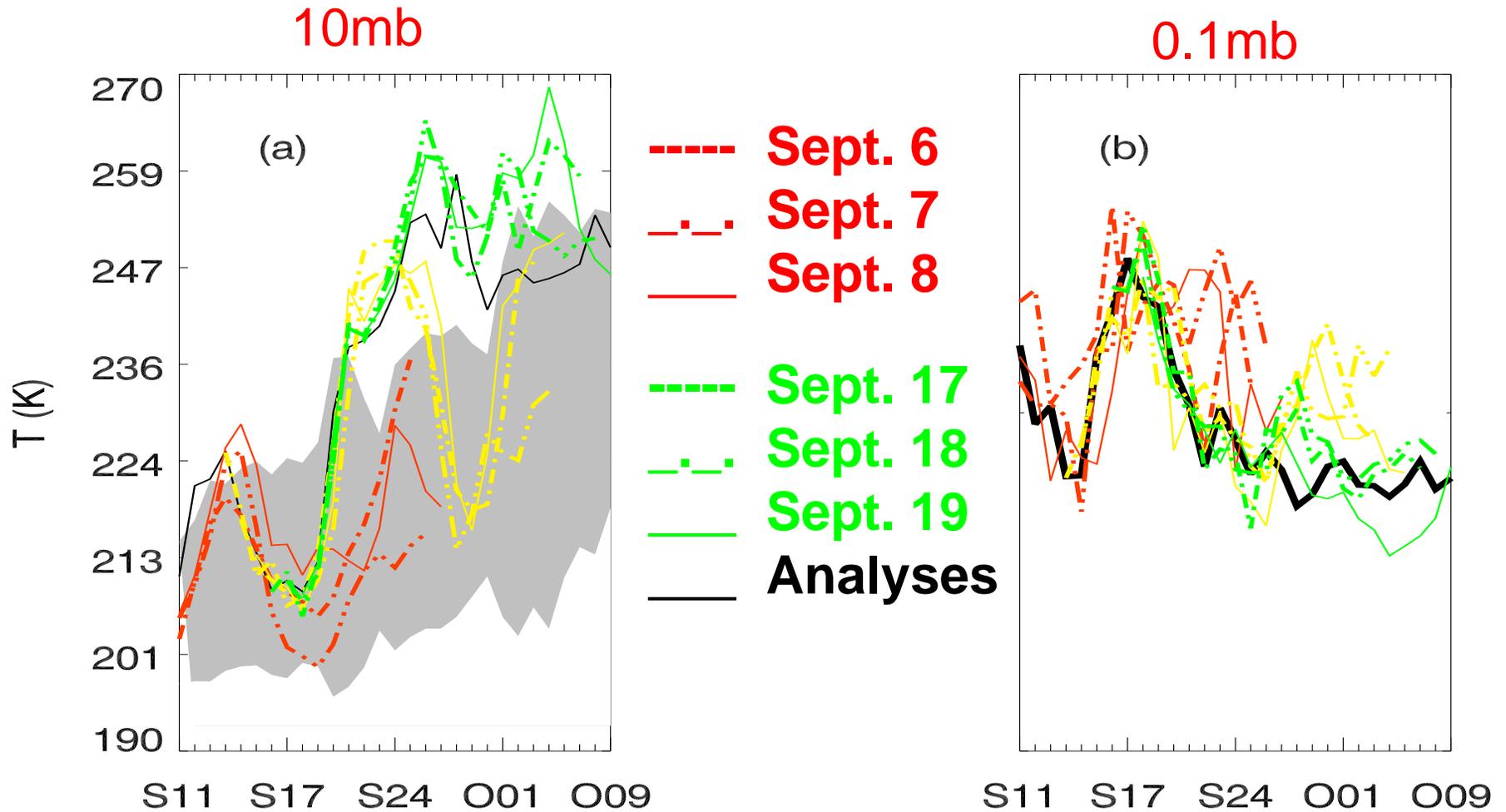
- **Shuzhan Ren, Stephen Beagley**, Yulia Nezhlin, Yves Rochon, Saroja Polavarapu
- Canadian Middle Atmosphere Model (CMAM)
3.75° × 3.75° × 71 levels, surface to 95 km
- CMAM documented in WMO ozone assessments
- 44 species advected, 127 gas-phase chemical reactions, heterogeneous chemistry
- Scinocca non-orographic GWD scheme

CMAM's assimilation scheme

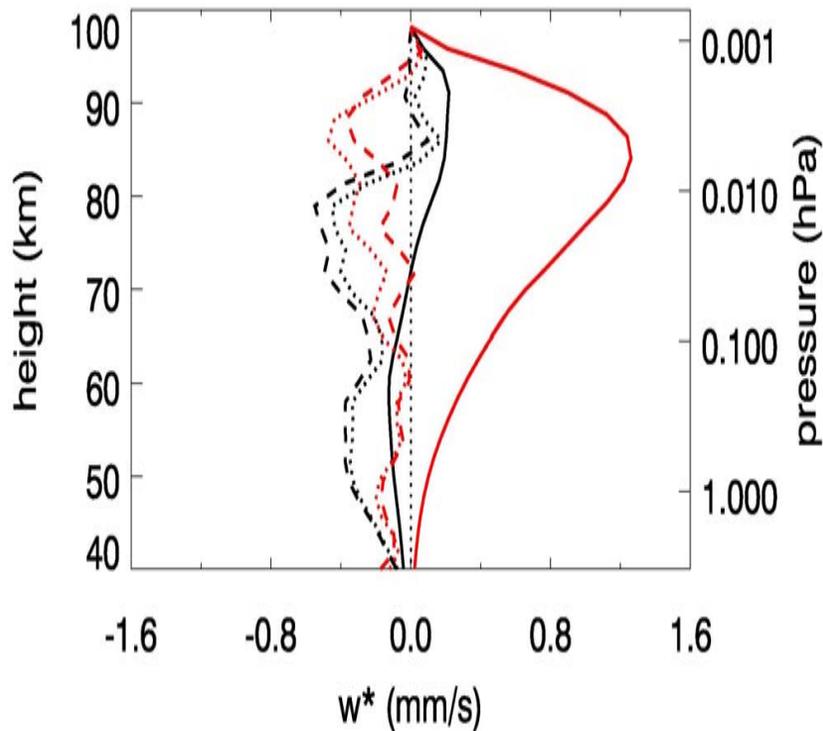
- **3D-variational (3D-Var) assimilation scheme from the Canadian Meteorological Centre (CMC). FGAT.**
- **Standard meteorological observations from CMC**
- **Only dynamic variables (horizontal wind, temperature, moisture variable, and surface pressure) are assimilated every 6 hours.**
- **Online chemistry provides species estimates during 6-hour forecasts**
- **IAU (Analysis increments only) filtered**
- **TOVS bias correction coefficients updated every 6 hours**

- In 3dvar, the correlation between the stratosphere and mesosphere is removed so that observations below 1 hPa have NO influence on the mesosphere *during the data assimilation*.
- Information of observations below 1 hPa can be spread into the mesosphere through vertically propagating (resolved and unresolved) waves *during the model integration*.
- Can investigate the coupling of the stratosphere and mesosphere during stratospheric sudden warming (SSW) events

Time series of temperature at 88S from various forecasts



Contribution from resolved waves, planetary waves and subgrid scale waves to mesospheric cooling during Sept. 25 - Oct. 1, 2002 over the south pole



Red: the ensemble of forecasts that capture the SSW (**hits**).

Black: the ensemble of forecasts that miss the SSW.

———— subgrid waves

- - - - resolved waves

..... planetary waves ($k < 5$)

$W^* > 0$: **cooling**,

$W^* < 0$: **warming**

Summary

- Canada has two research efforts which plan to produce analyses for the SPARC-IPY archive of analyses during 2007-9. They will be available from the SPARC data centre.
 - GEM-BACH will provide chemistry from 6h forecasts, as well as dynamic variables, at relatively high resolution
 - CMAM-DAS will provide chemistry from 6h forecasts, as well as dynamic variables, with a very high vertical domain
- This archive also includes analyses from operational centers such as ECMWF, Met Office, NCEP, GMAO, KNMI...