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# GEM-MACH for HTAP

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**Environment Canada**

**Modeling Air Quality from the Global to Local Scale  
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# GEM-MACH

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- On-line coupled meteorology and chemistry model
- Based on the NWP model GEM (Environment Canada's operational model)
- Operational configuration:
  - One-way coupling (meteorology affects chemistry)
  - Limited-area system with a domain covering North America
  - Full process representation of oxidant and aerosol chemistry:
    - gas-, aqueous- & heterogeneous chemistry mechanisms
    - aerosol dynamics
    - dry and wet deposition (including in- and below-cloud scavenging)
  - 2-bin sectional representation of PM size distribution (i.e., 0-2.5 and 2.5-10  $\mu\text{m}$ ) with 8 chemical components



# GEM-MACH (cont'd)

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- Other configurations:
  - Limited-area, continental coverage, two-way coupling (AQMEII-2 , P Makar)
  - Limited-area, high-resolution (2.5km instead of 10km) for upcoming PanAm games in Toronto (C. Stroud)
  - Limited area, 12-bin sectional representation of PM size distribution for Oil Sands monitoring project (P. Makar)
  - Global model with Linoz stratospheric ozone chemistry for ozone data assimilation and UV index forecasting (J. de Grandpré)



# HTAP version of GEM-MACH

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- 400 x 200 lat-lon grid (0.9 deg resolution);
- Lid at 0.1 hPa
- Use of HTAP anthropogenic and volcanic emissions
- Use of BEIS3 for biogenic emissions
- Use of gas-phase chemistry module only
- Coupling in the UTLS with Linoz stratospheric ozone chemistry package



# Work so far

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- Preparation of the emissions (twice!)
- Several 6-months integrations that have help identify issues with:
  - Surface ozone overprediction
  - Dry deposition for certain vegetation types
  - Plume rise algorithm used for volcanic emissions
  - SO<sub>2</sub> : looking into a simplified parameterization for SO<sub>2</sub>-oxidation

