

# Updates from ECCC:

Validation Efforts, New Airmass Factors and surface concentrations

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Environment and Climate Change Canada

TEMPO DART Team meeting: Monday, June 15, 2026



# ECCE's Regional Air Quality Deterministic Prediction System

## GEM-MACH (GEM weather forecast model + MACH on-line chemistry and particle physics)

- **Anthropogenic and Biogenic Emissions** (CO, NO<sub>x</sub>, VOCs, PM etc.)
  - Can-US-Mex gridded hourly emissions of pollutants over North America
  - Biogenic emissions from vegetation data and temperature and light-dependent emissions functions.
- **Wildfire emissions**
  - Canadian Forest Fire Emissions Prediction System (**CFFEPS v4.1**)

### Technical specifications:

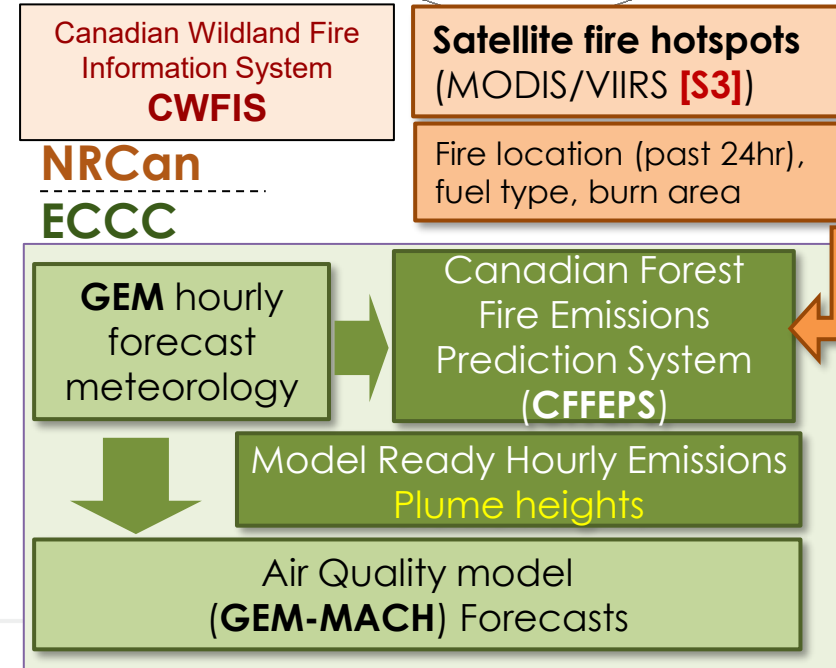
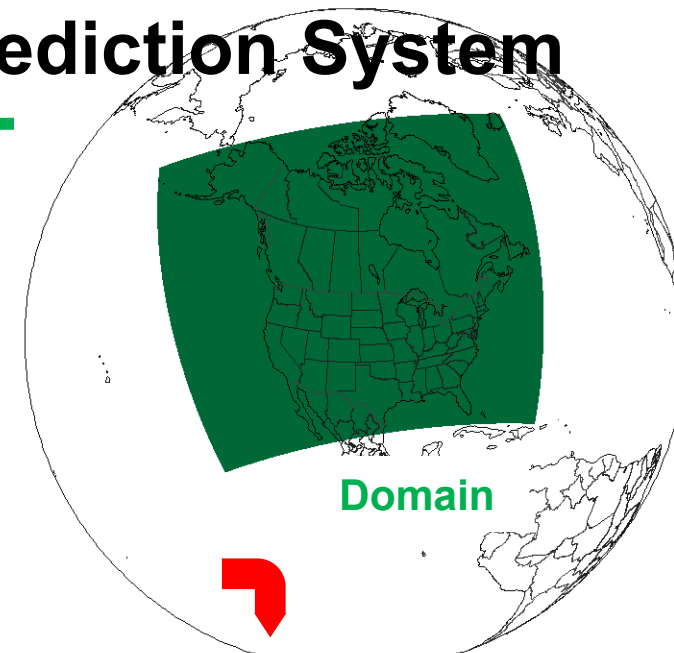
- 10-km grid resolution covering North America
- Provides 72-hour AQ forecast for e.g. **O<sub>3</sub>**, **NO<sub>2</sub>**, **PM<sub>2.5</sub>**, **HCHO** twice a day (00, 12 UTC)

→ The GEM-MACH profiles are used (at the time of the TEMPO overpass) for new Air Mass Factor calculations (NO<sub>2</sub>, HCHO)

→ Utilize the profiles to get surface concentrations from satellite observations

$$C_{\text{sat}} = \frac{VCD_{\text{sat}} \cdot C_{\text{mode}_l}}{VCD_{\text{model}}}$$

**Weather-office public page:** <https://weather.gc.ca/firework/>



# TEMPO NO<sub>2</sub> vs Pandora

## - snow V3

### Snow-Covered Insights From Above and Below: High-Frequency Measurement of Nitrogen Dioxide From Space and Ground

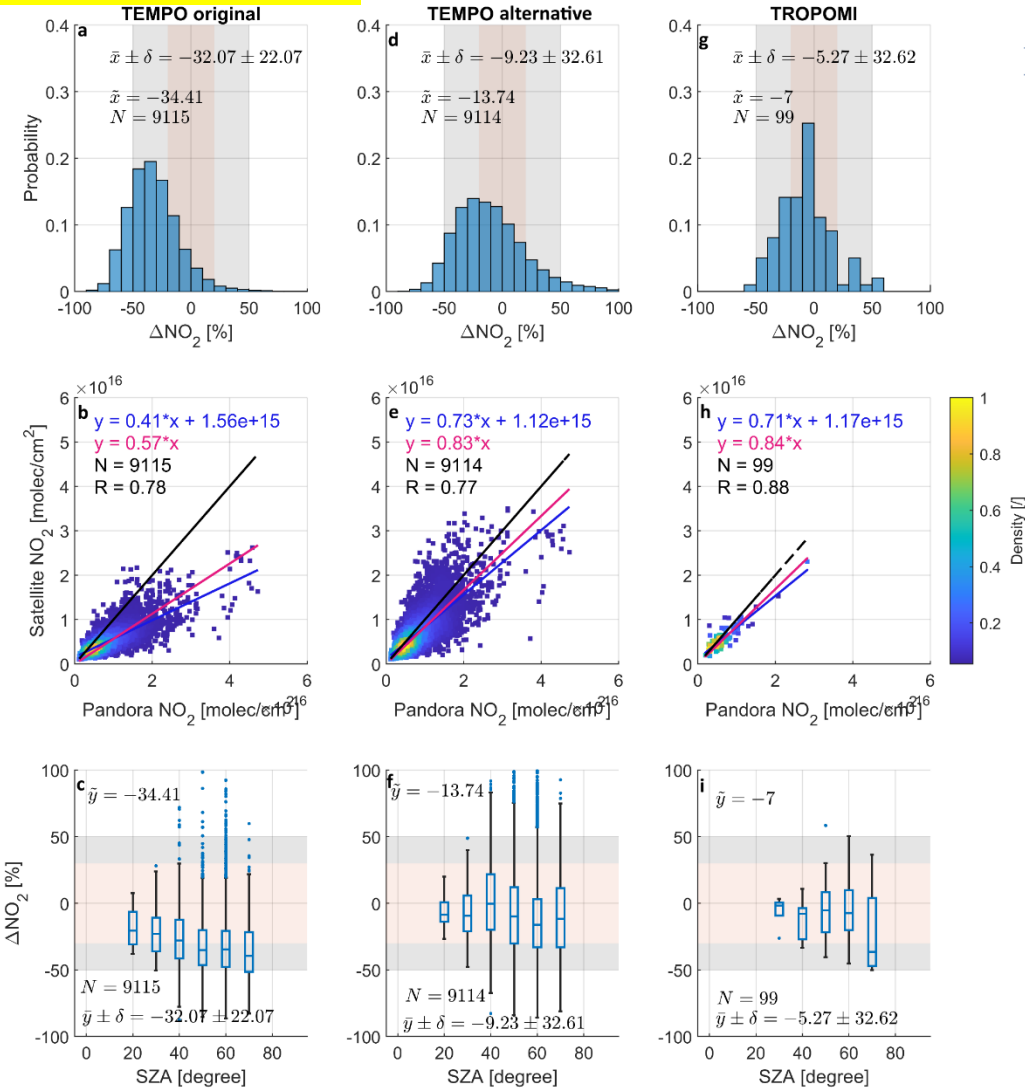
[D. Griffin](#) ✉ [X. Zhao](#), [C. McLinden](#), [N. Yazdani](#), [C. R. Nowlan](#), [G. González Abad](#), [V. Fioletov](#), [Elisabeth Galarneau](#), [Cris Mihele](#), [Sumi Wren](#), [Yushan Su](#), [Lukas Fehr](#), [Adam Bourassa](#)

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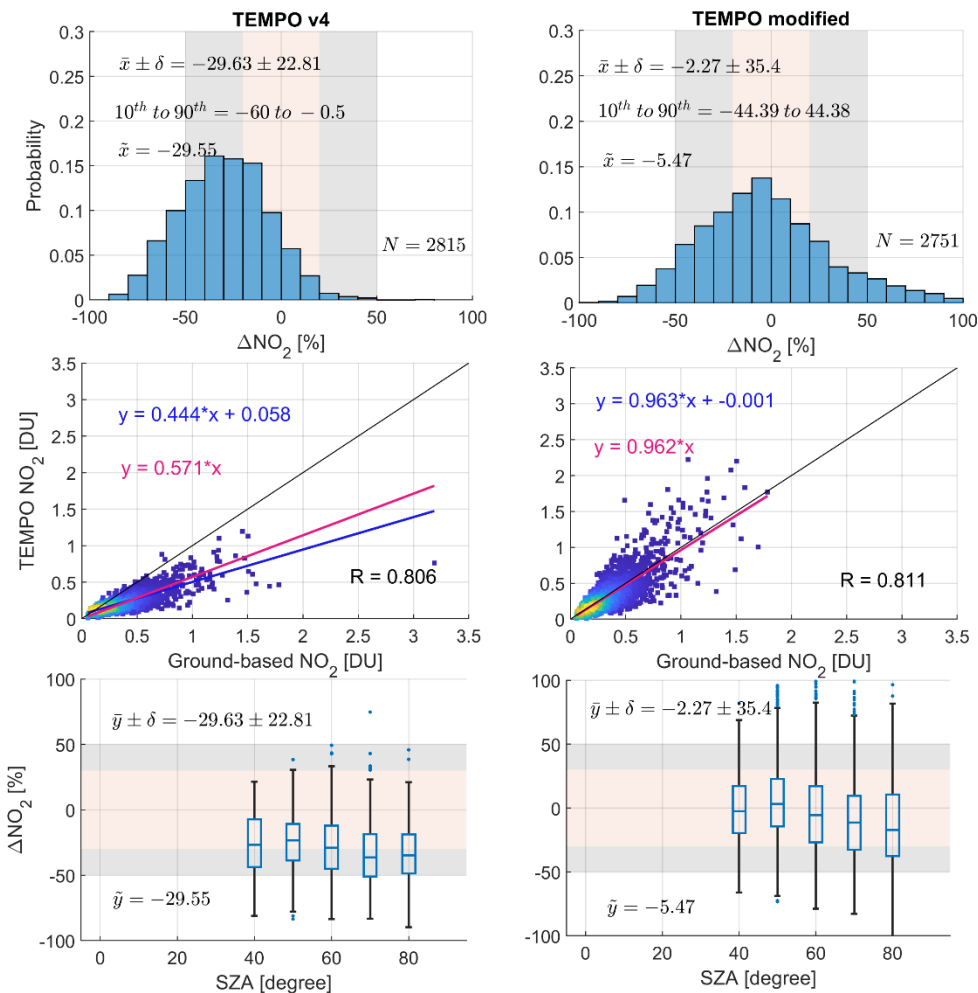
## Comparison to Pandora stations for August 2023 - March 2025



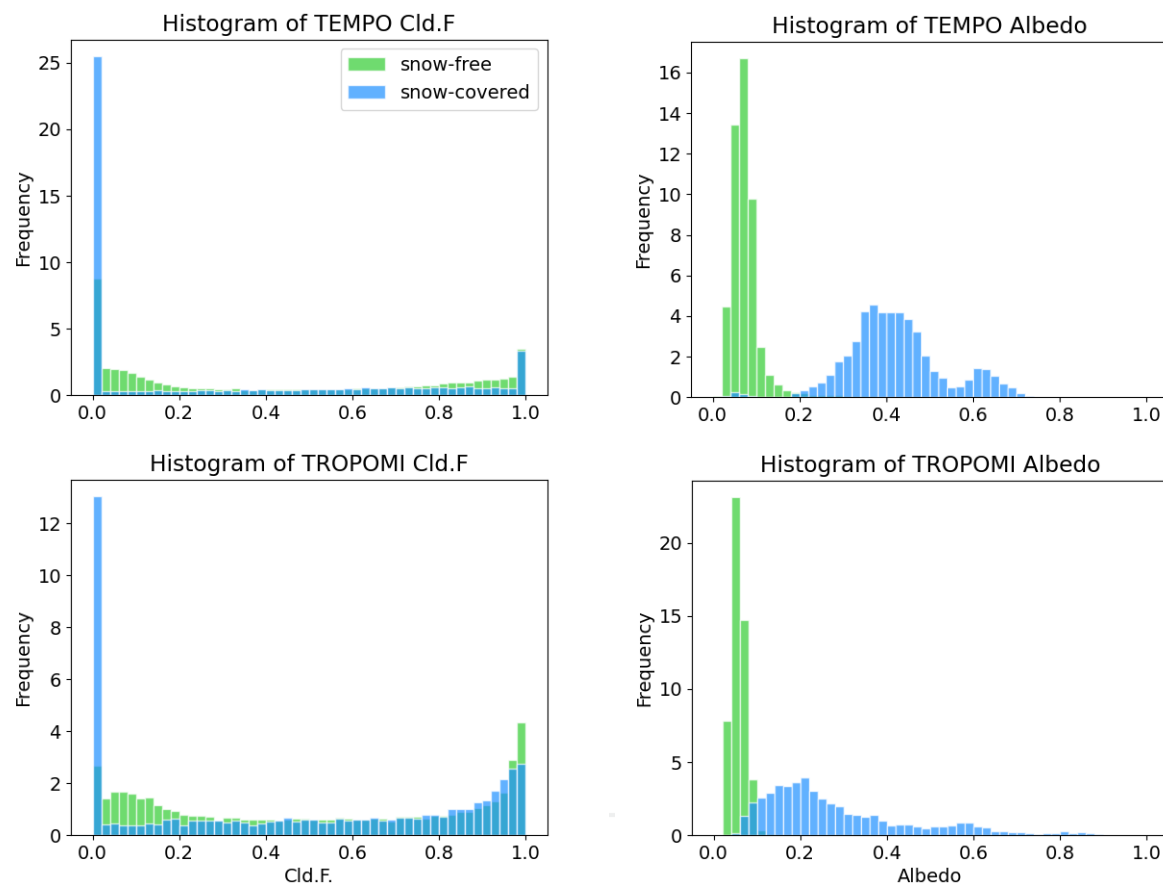
- Original TEMPO NO<sub>2</sub> has a low bias of 32% compared to Pandora (ground-based remote sensing)
- Bias improves to -9% using alternative AMF that correct for albedo and cloud fraction (as well as high-resolution NO<sub>2</sub> profiles)
- TROPOMI NO<sub>2</sub> does not have the same issue as TEMPO (better albedo and cloud fraction over snow)

# TEMPO V4 Updates - snow

November 2025- March 2026



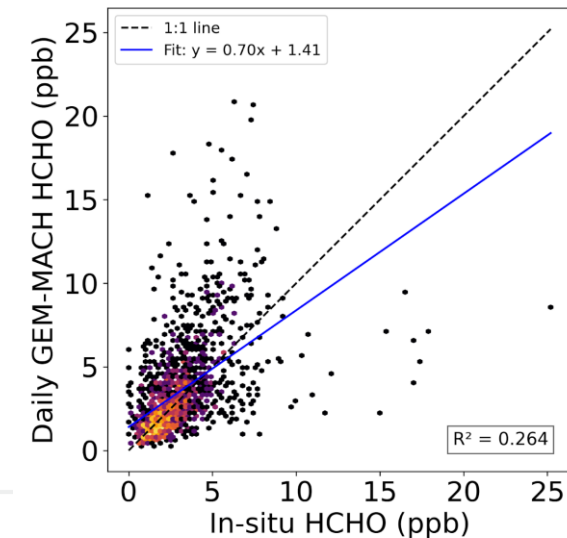
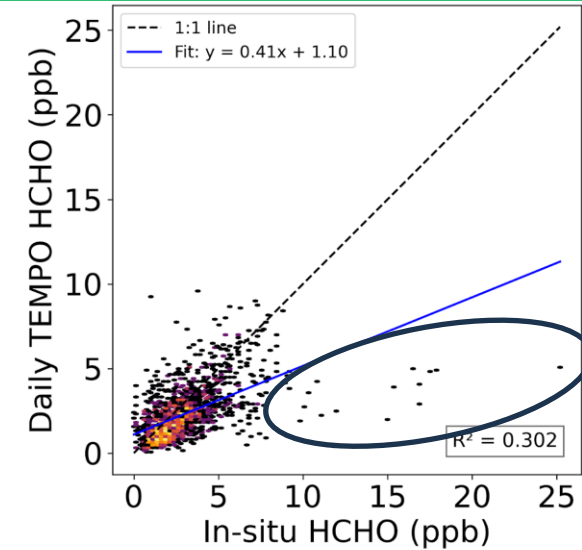
- The cloud fraction is much improved in v4 (high-bias resolved for snow-free conditions)
- TEMPO NO<sub>2</sub> over snow is still low biased in v4: due to albedo as well as cloud fraction
- Corrections in ECCC version: Albedo and cloud-fraction utilizing GOES-R



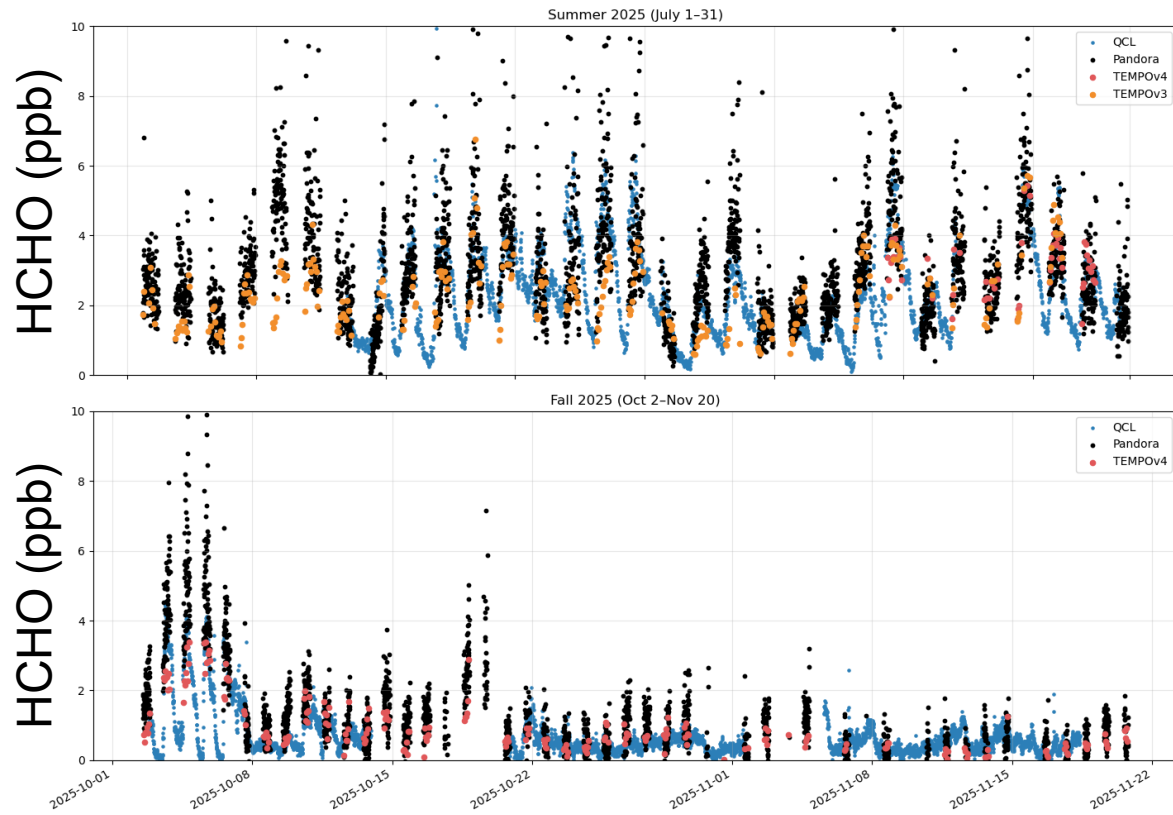
# TEMPO “surface” HCHO

V4, 2023-2025

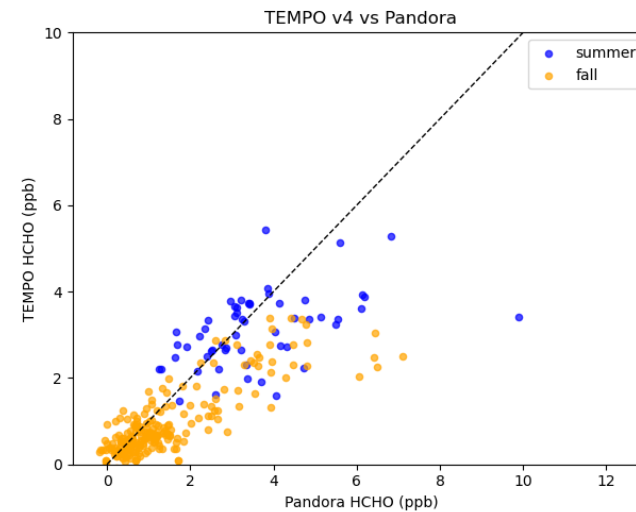
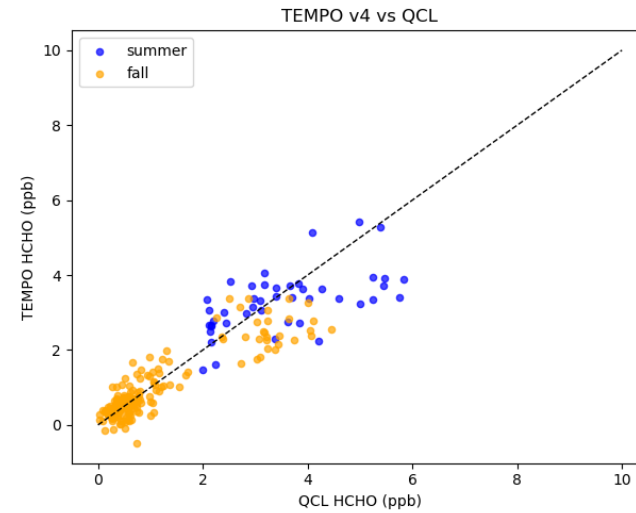
- Utilizing the GEM-MACH model profiles the TEMPO HCHO columns are scaled to surface concentrations
- Comparison to AQS HCHO measurements, shown are daily averages within 20km of AQS site
- Initial results look very promising (2023-2025, v4)
- Some very high values at a few AQS sites (investigating quality filters)
- “TEMPO surface” HCHO concentrations are in better agreement than the model surface concentrations (often too high)



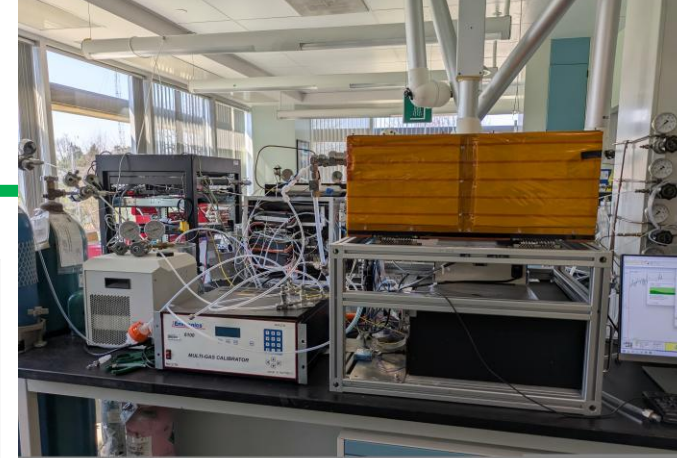
# TEMPO “surface” HCHO



- High frequency measurements of surface HCHO with QCL instrument
- Pandora MAX-DOAS measurements retrieved surface concentrations
- TEMPO are coincident measurements (20km averages), model scaling to surface



**PRILIMINARY**



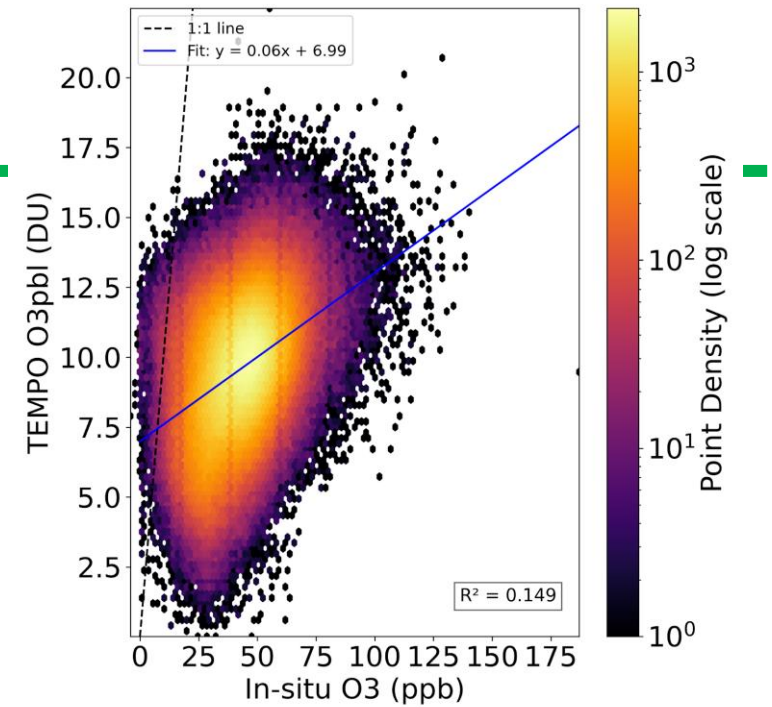
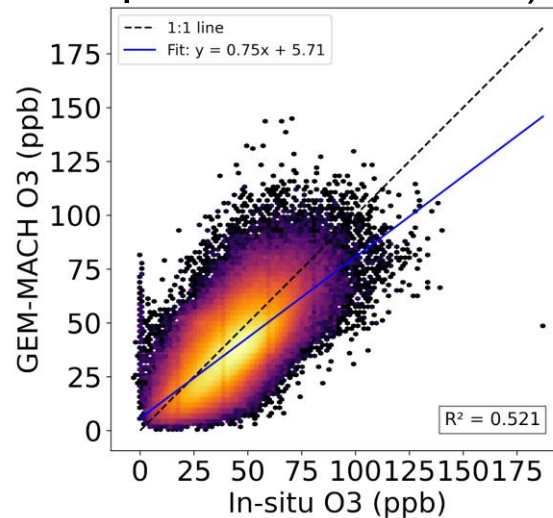
HCHO measurements at  
Downsview (Toronto)

# TEMPO O<sub>3</sub> to surface O<sub>3</sub>

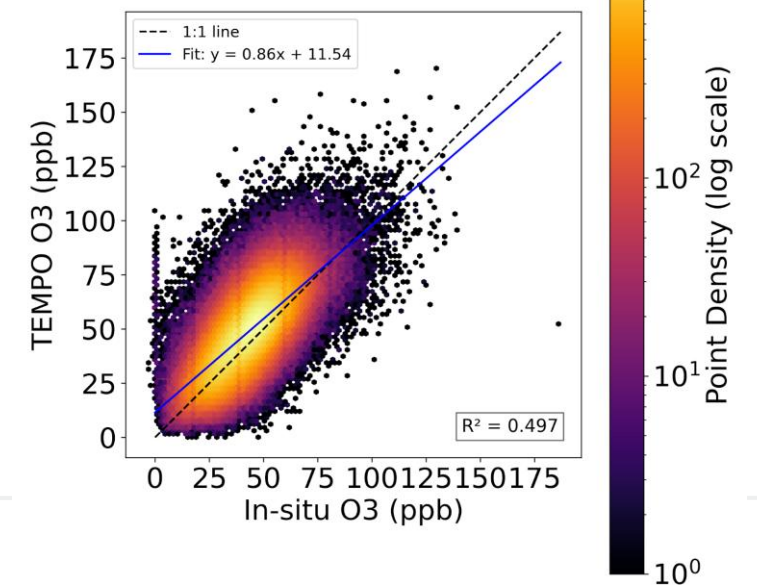
V4, 2023-2025

- Initial results looking at the O<sub>3</sub> profile (0-2km)
- Can a similar model scaling be applied to get O<sub>3</sub> surface concentrations from the O<sub>3</sub> (0-2km) column “O3pbl”)?
- Model scaling to get TEMPO surface O<sub>3</sub> seems very promising
- Small improvement from the model surface concentrations (closer to 1-to-1, improvement of bias)

**PRILIMINARY**



From AQS and NAPS (Canada)

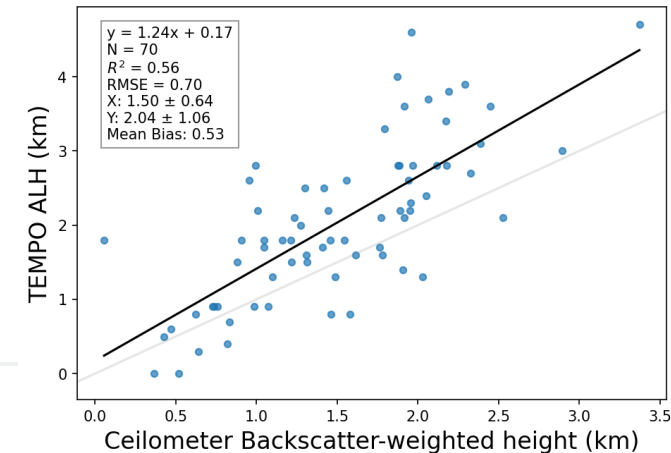
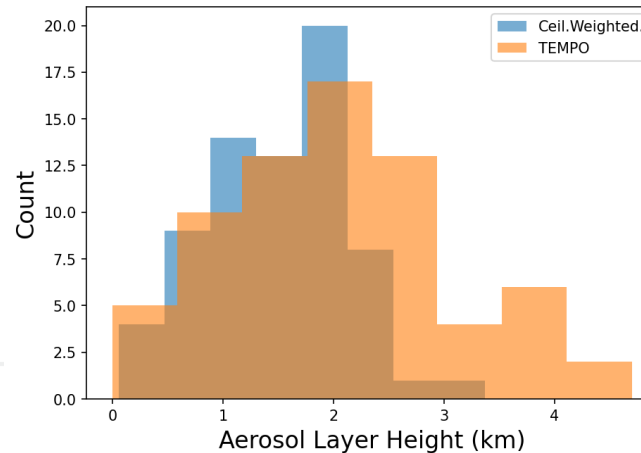
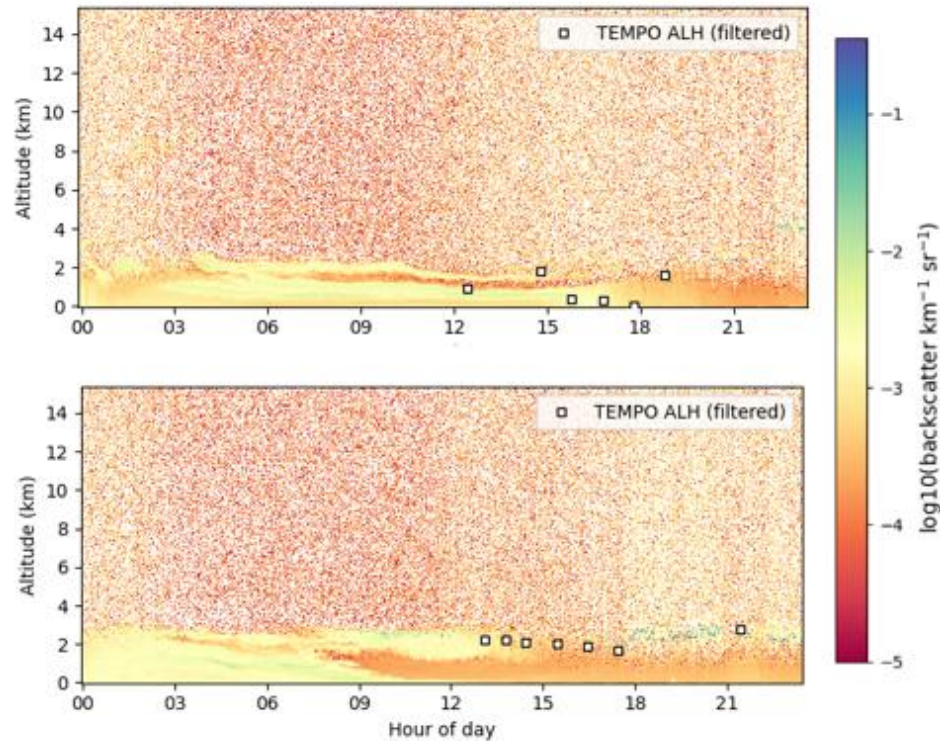
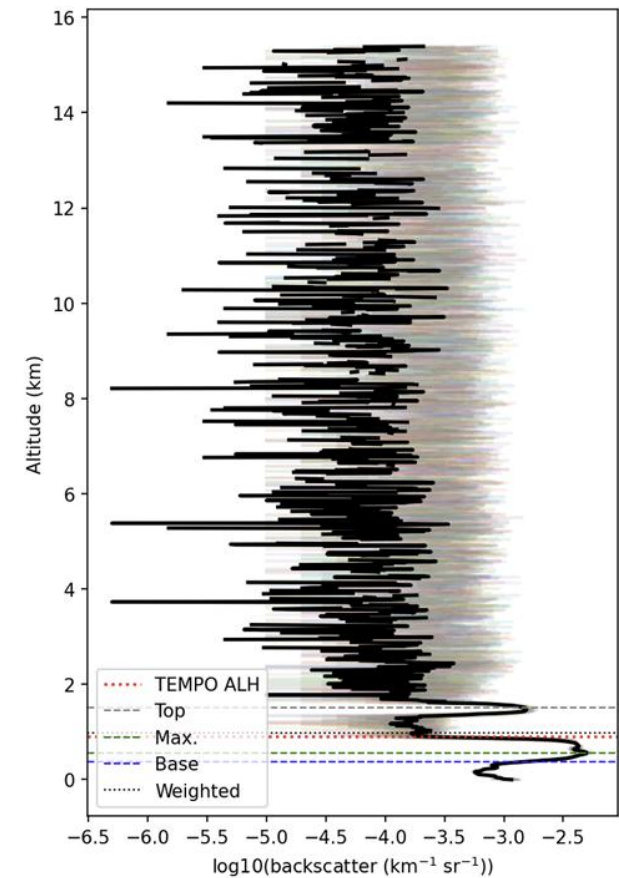


# TEMPO aerosol layer heights

- Comparisons to ceilometers at: East Trout Lake, SK; Squamish, BC; Stony Plain, AB
  - Useful for comparisons of ALH < 6 km
  - Averaged 10 min of measured backscatter profiles

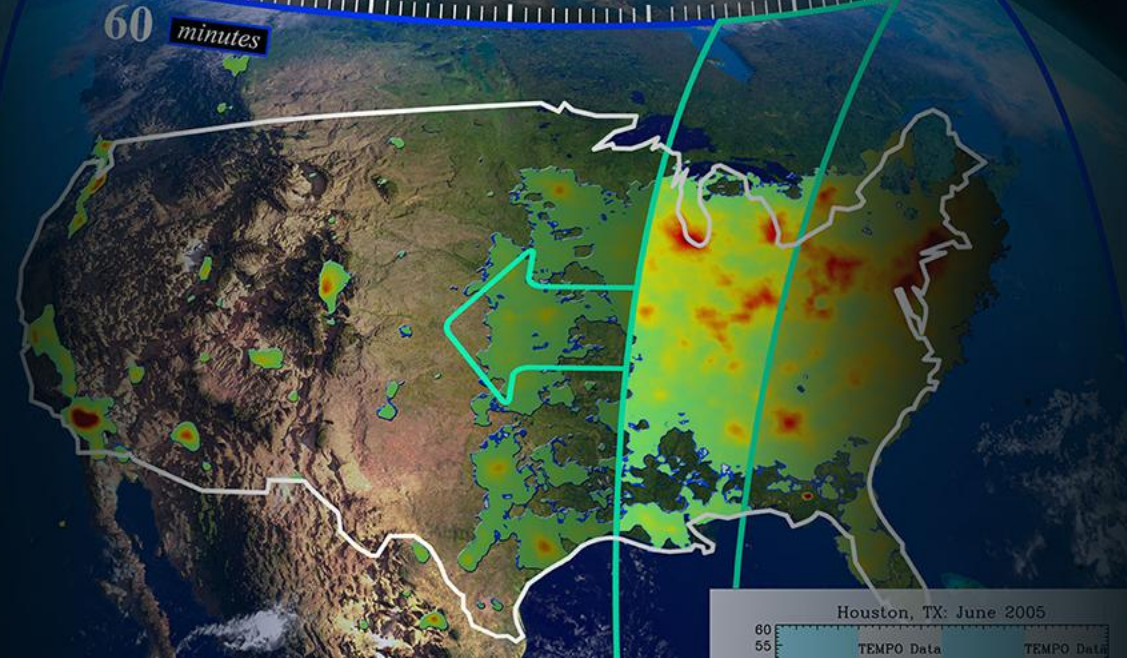
Provided by Javeria Rizwan

Best definition of aerosol layer from ceilometer:  $\frac{\sum \beta_i z_i}{\sum \beta_i}$   
 $R^2 = 0.56$ ; Mean Bias = 0.53 km  
 Further comparisons to MPLNET Lidars



# Summary and Future work

60 minutes



*Hourly Measure of Pollution*

- V4 shows improvement in terms of cloud fraction (snow-free scenes), however, low bias over snow remains for  $\text{NO}_2$  (due to albedo and cloud fraction)
- Promising first results showing good agreement with surface measurements for HCHO and ozone
- TEMPO AER\_LH appears to be in good agreement to ground-based observations (ceilometers)
- If interested in any of the datasets (TEMPO “surface” or new AMFs) please contact:  
**[Debora.griffin@ec.gc.ca](mailto:Debora.griffin@ec.gc.ca)**