

GOSAT observations of tropospheric CO₂ and CH₄
concentrations over permafrost regions
and
comparison with in situ measurements of the
ASCENDS/ABOVE 2017 airborne science campaign

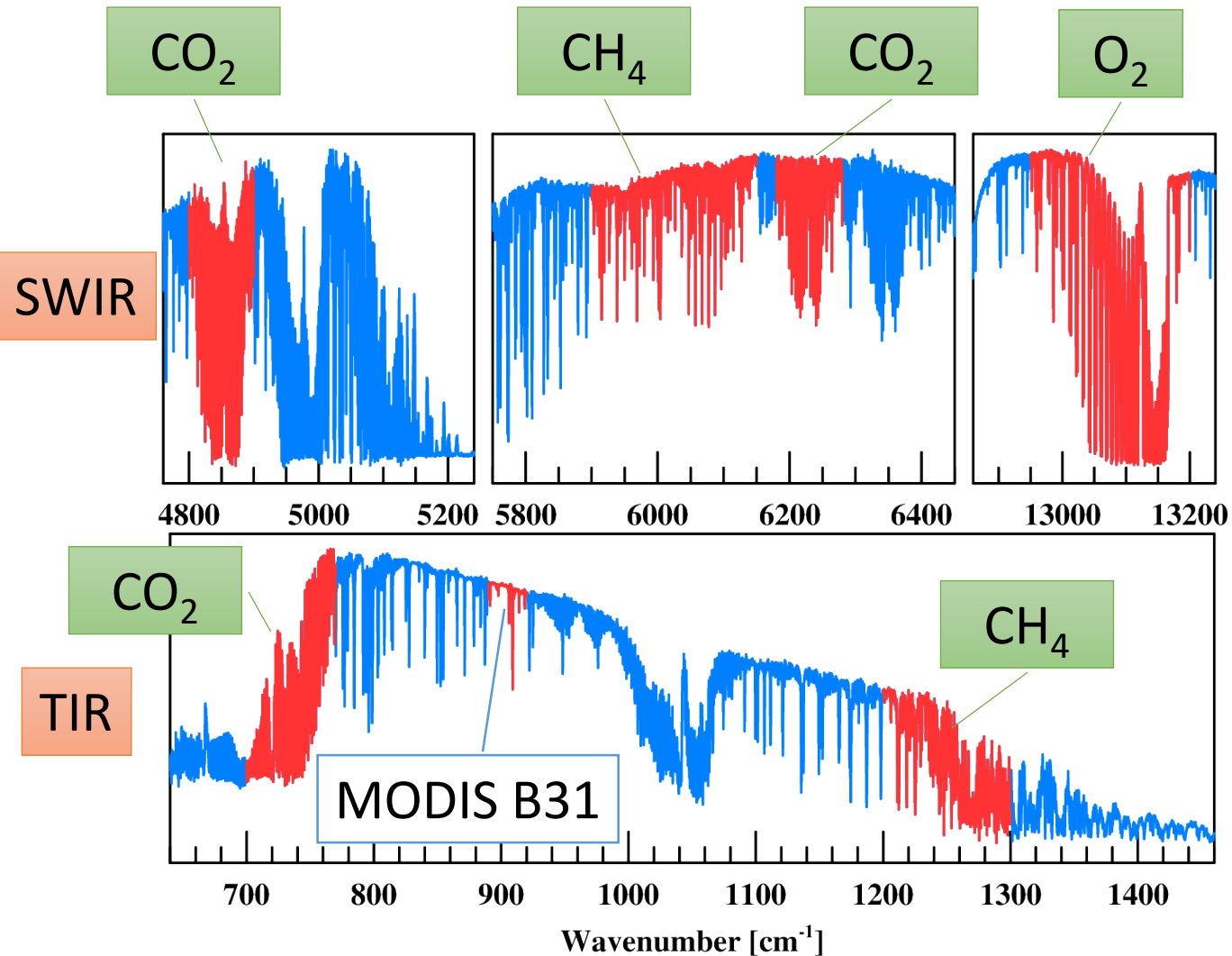
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1. JAXA, 2. RESTEC, 3. NASA/LaRC, 4. NASA/GSFC

TANSO-FTS onboard GOSAT

- Simultaneous measurements in SWIR and TIR at the exactly same footprint
→ vertical profile of GHG up to 2 layers in the troposphere
- 2 linear polarization measurements in SWIR
→ better correction for aerosols
- Pointing system
→ local emission sources
- 10 years observation with uniform quality (June 2009 ~)
- GHG emission from megacities
- GHG emission from permafrost regions

JAXA/EORC experimental algorithm



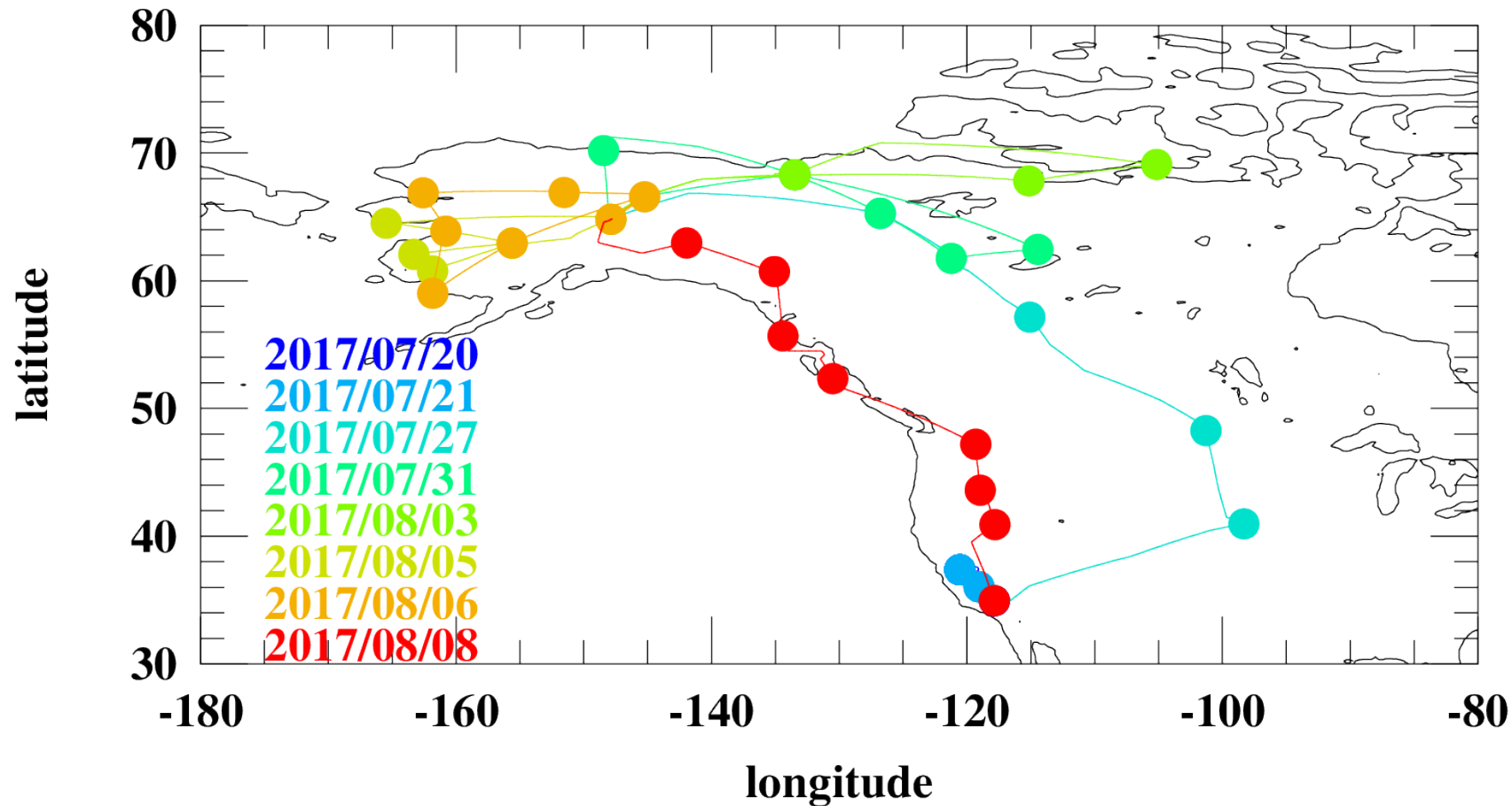
A full physics algorithm which uses:

- SWIR and TIR simultaneously
- Polarized spectra in SWIR

CO₂ and CH₄ retrieval:

- 5 layers in total, with 2 layers in the troposphere

ACENDS/ABoVE 2017 campaign

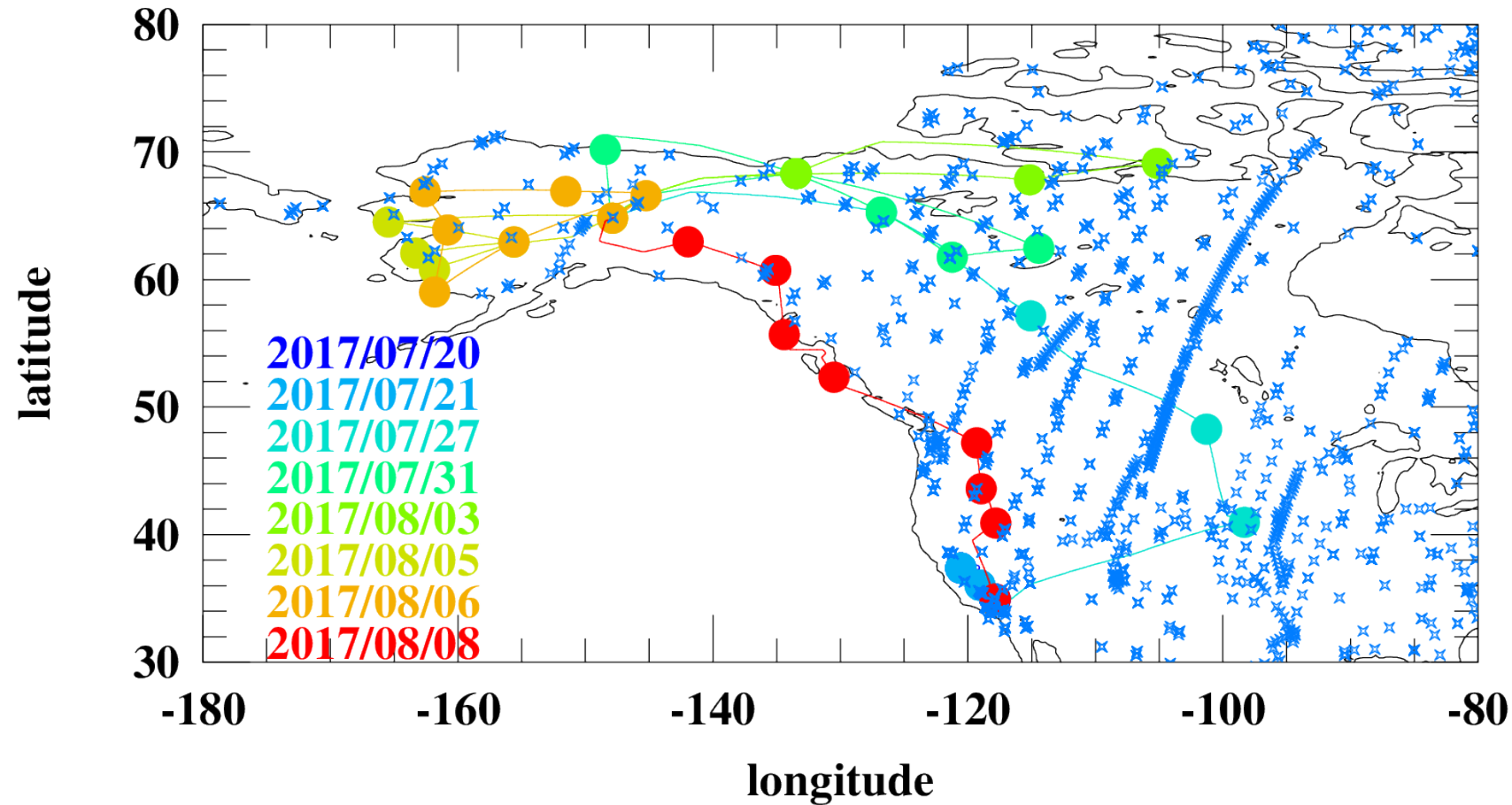


8 flights by NASA DC-8

- Lidar measurements for the ASCENDS mission
- In situ measurements of CO₂ and CH₄ using Picarro

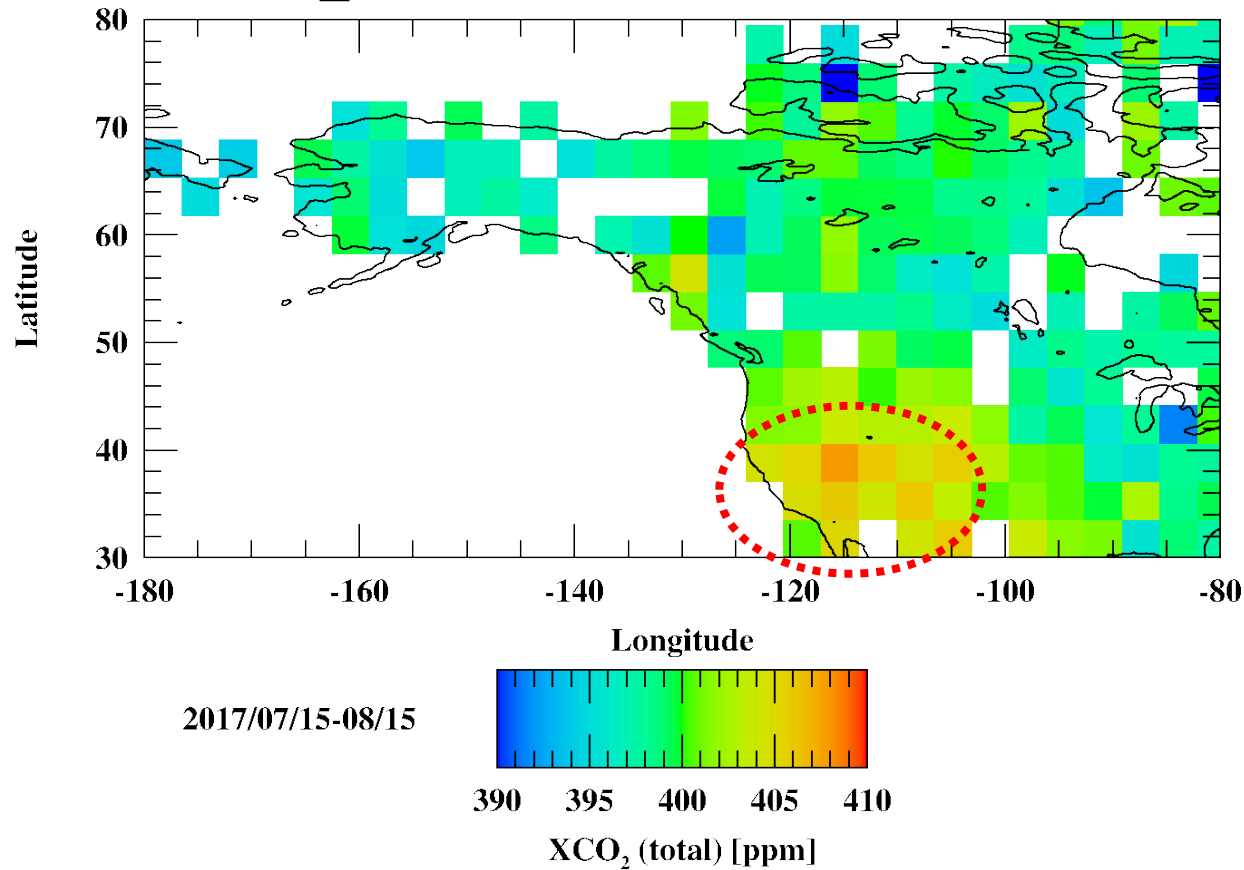
Total 47 vertical profiles

ASCENDS/ABoVE 2017 + GOSAT Jul 15-Aug 15

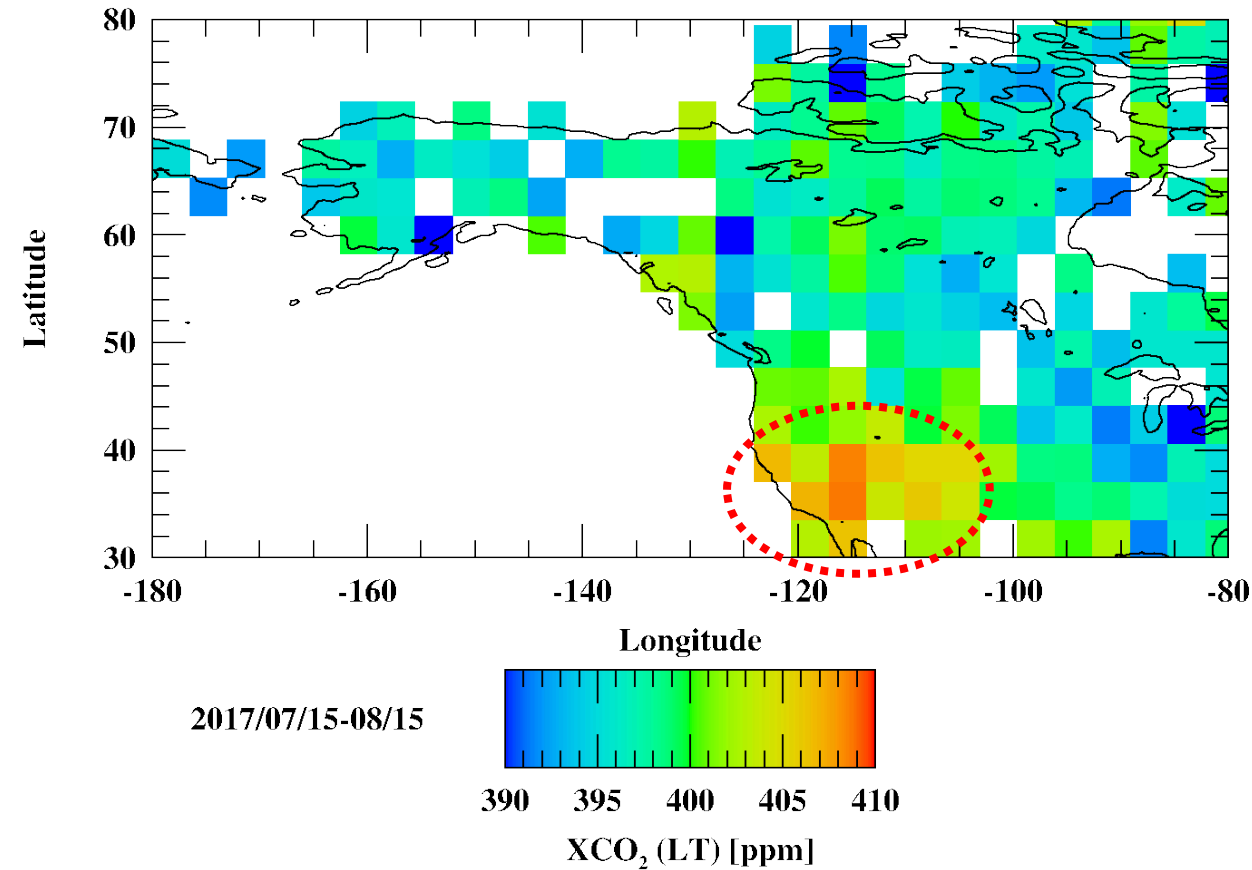


✕ GOSAT retrievals
which pass pre and
post screening

CO₂ 1 month mean concentrations

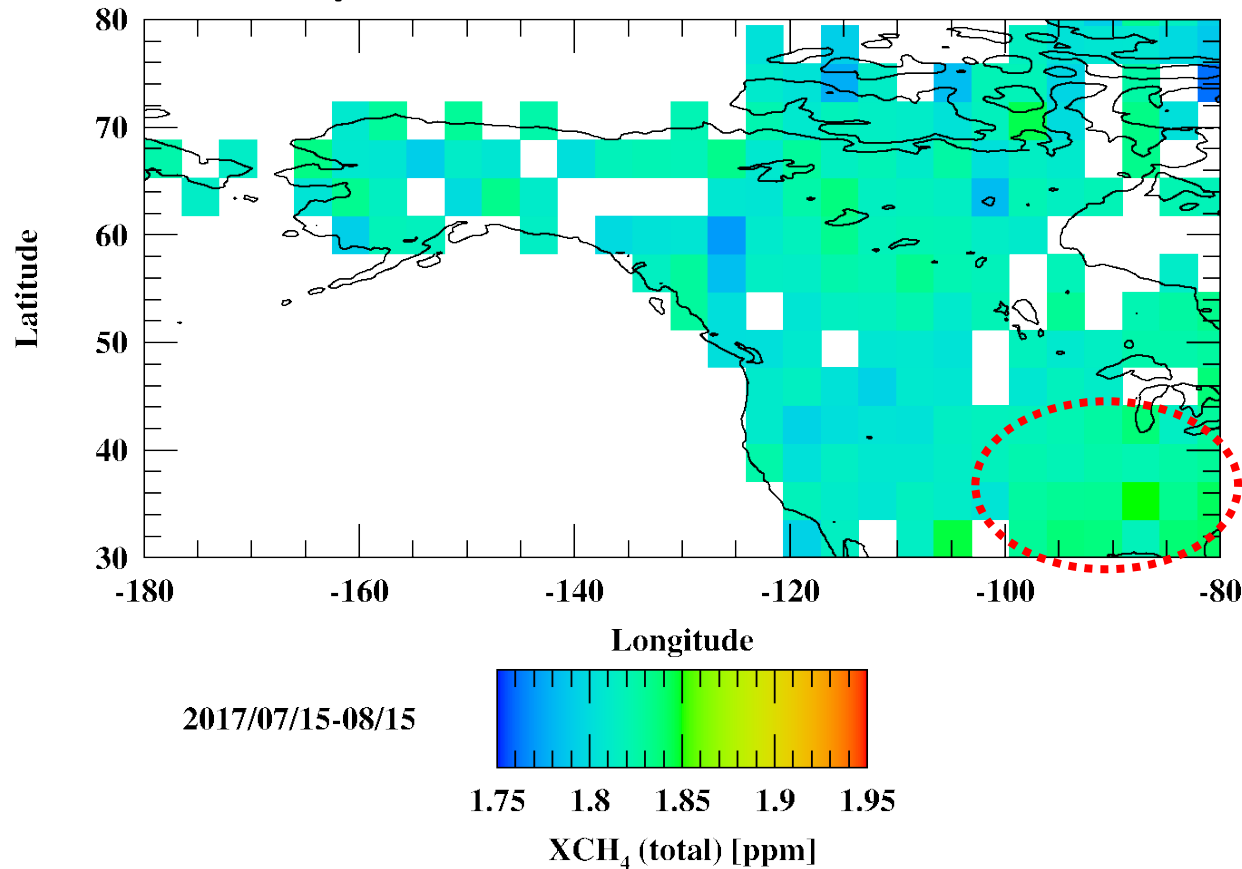


Column average

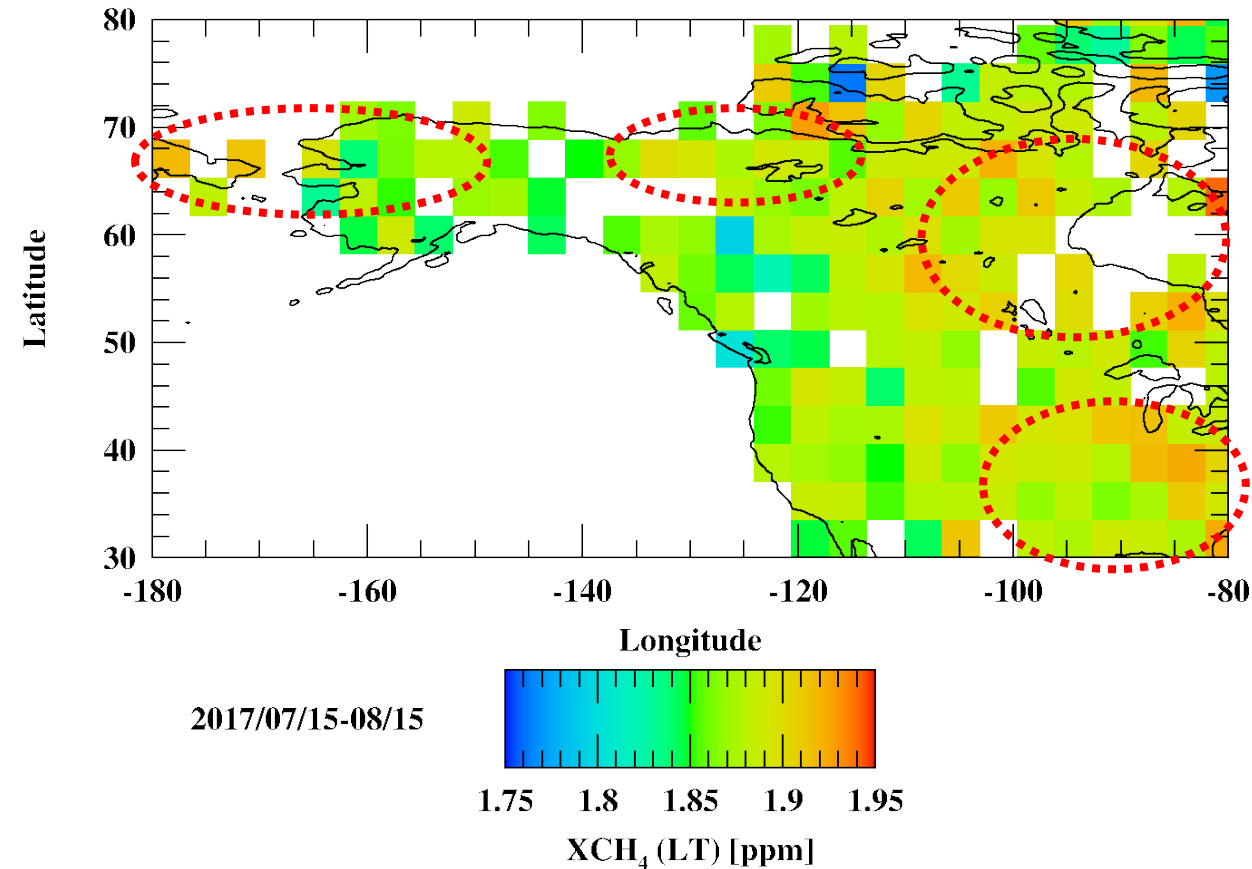


Lower troposphere

CH₄ 1 month mean concentrations



Column average



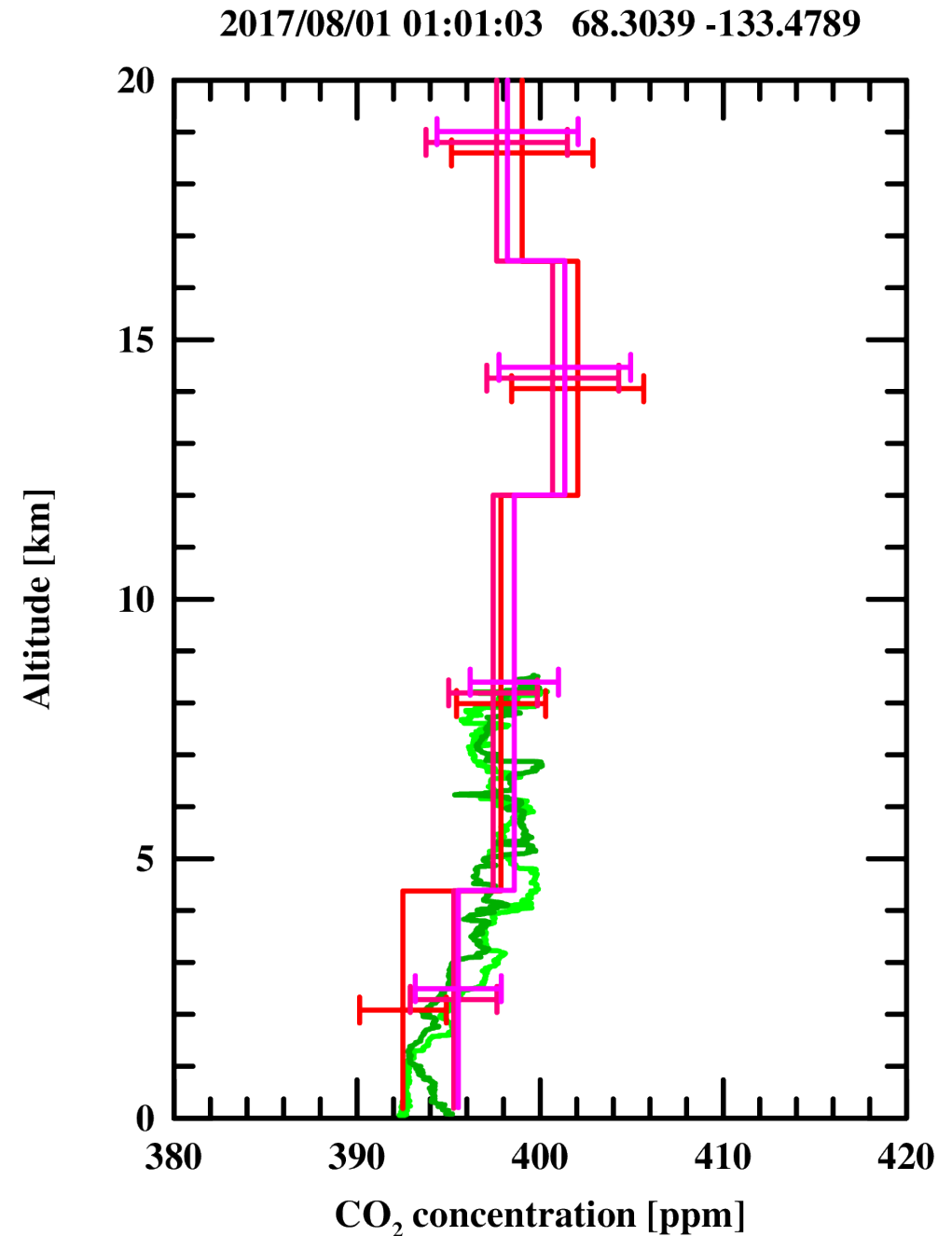
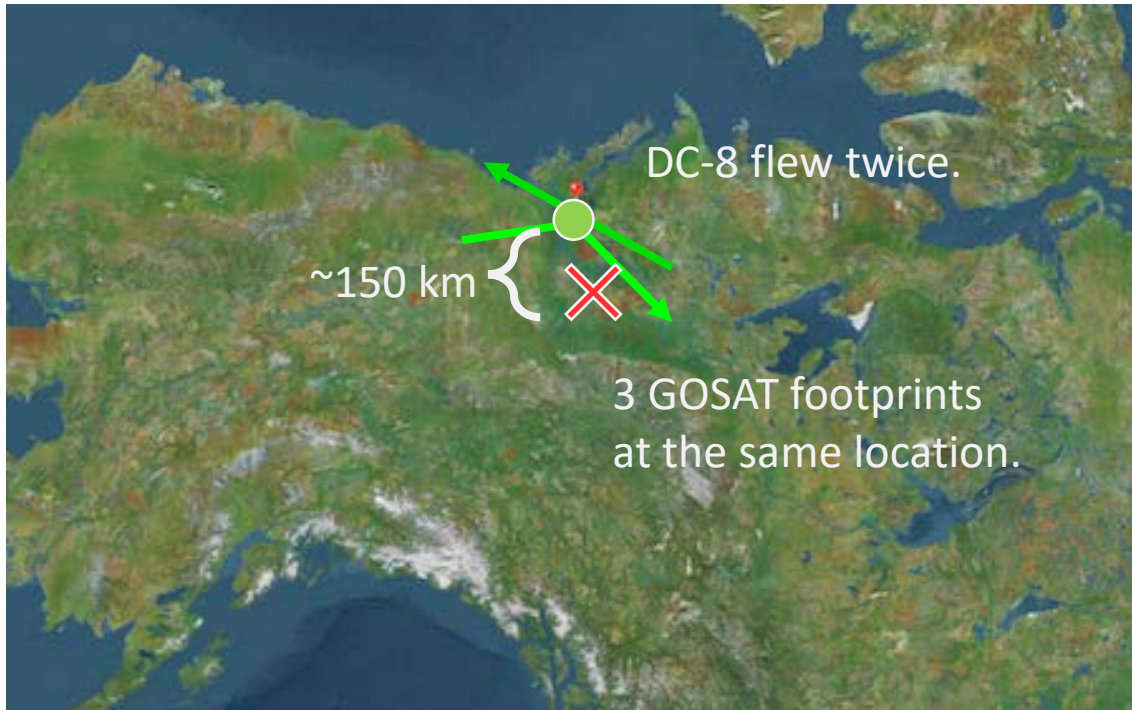
Lower troposphere

Comparison with the in situ data : Match up criteria

- $\Delta T < 6$ hours
- $\Delta \text{lat} < 2^\circ$ and $\Delta \text{lon} < 2^\circ$
- Nearest 3 GOSAT retrievals
- We have 7 sets of match up, with 2 in the permafrost region.

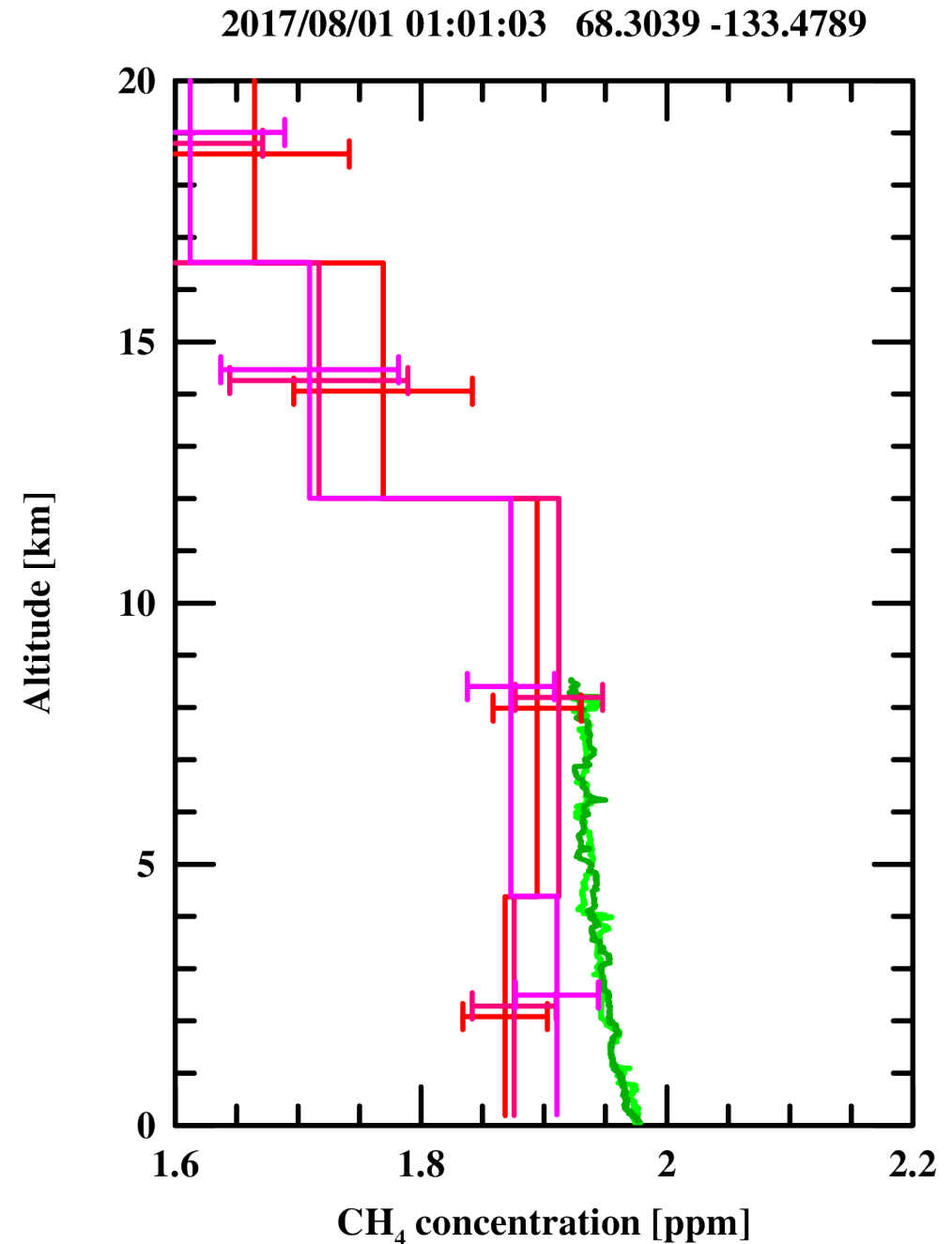
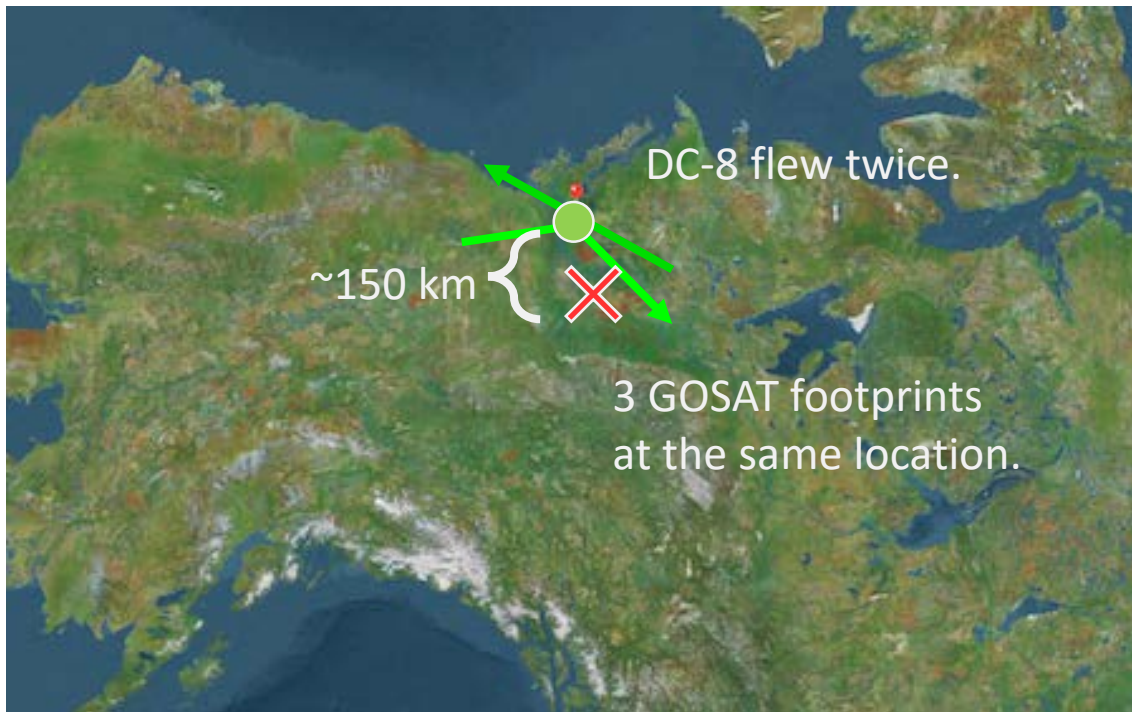
Case 1 (CO₂) : Inuvik

- 2 in situ profile measurements
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = -1.5 \text{ hr}$



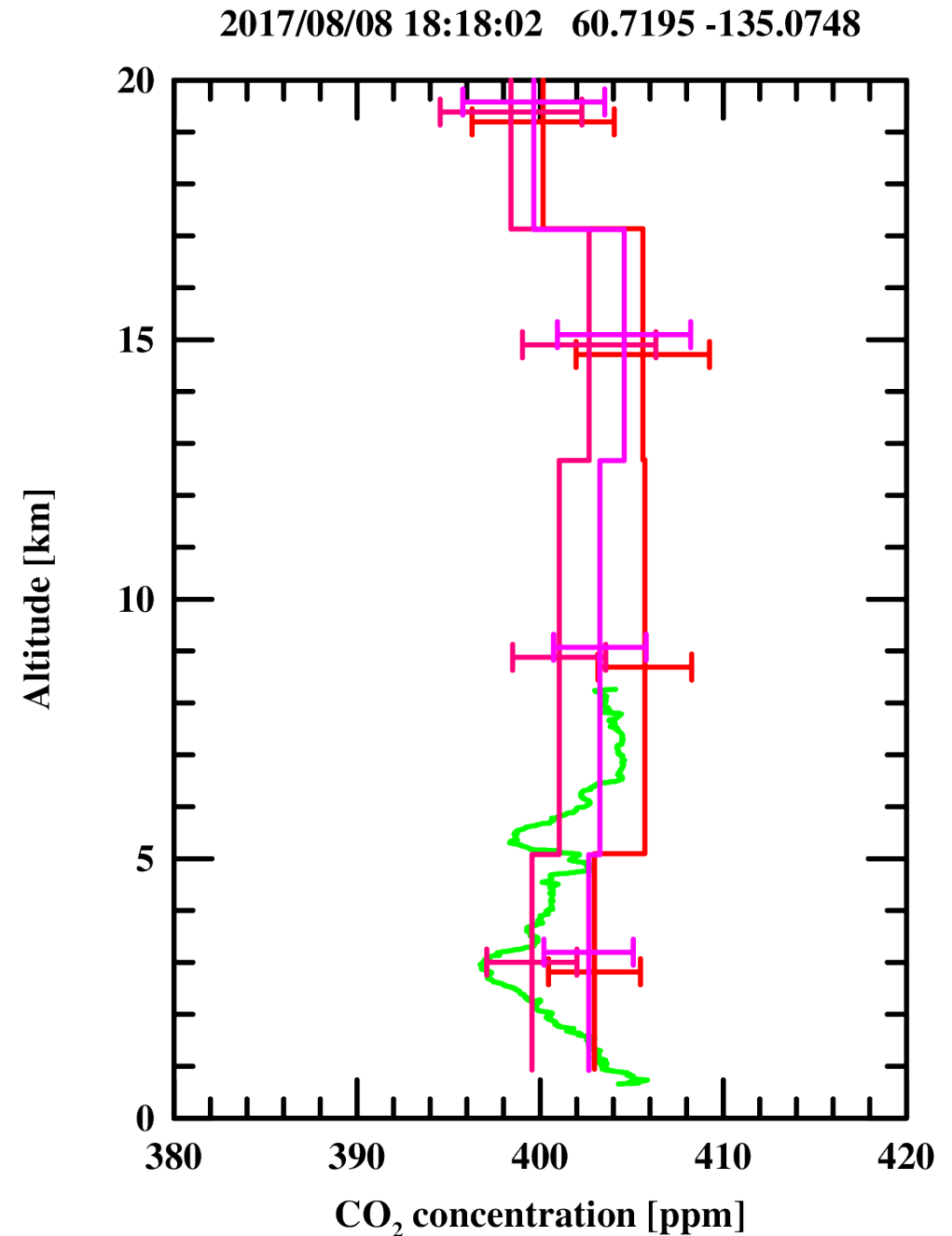
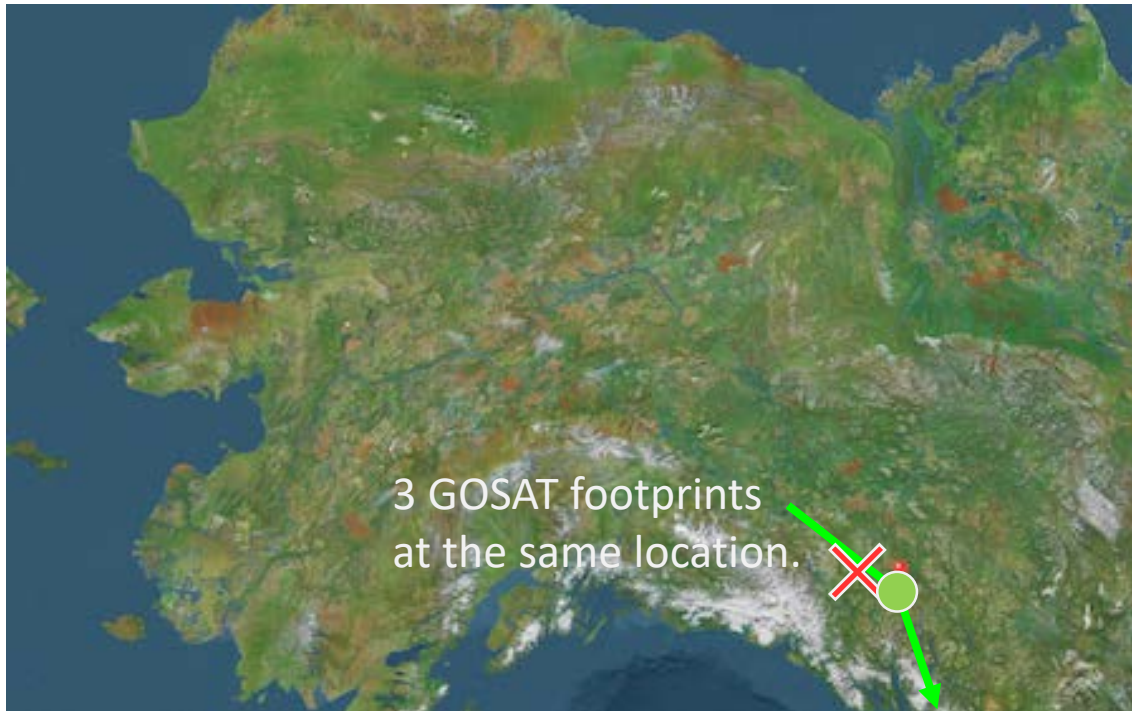
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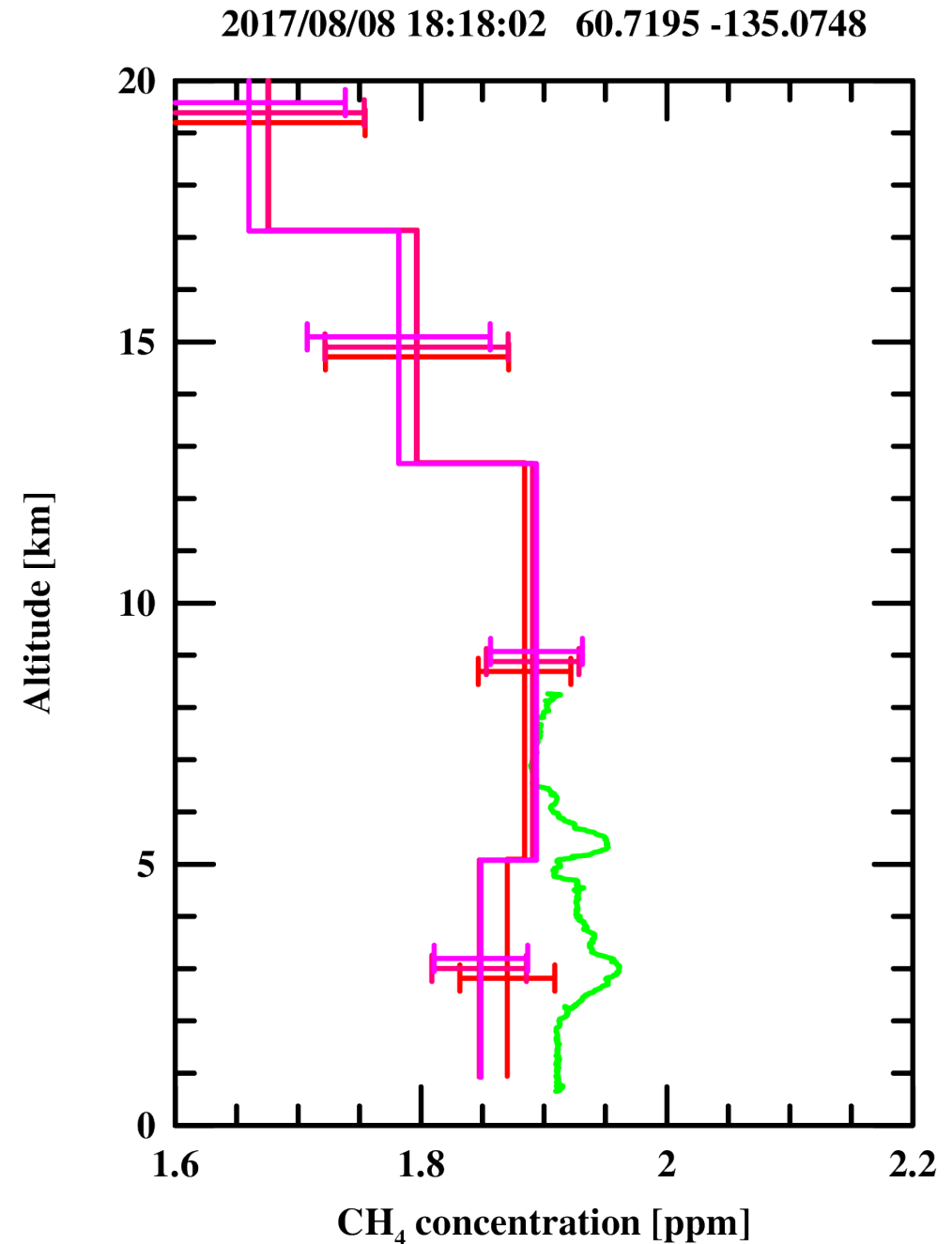
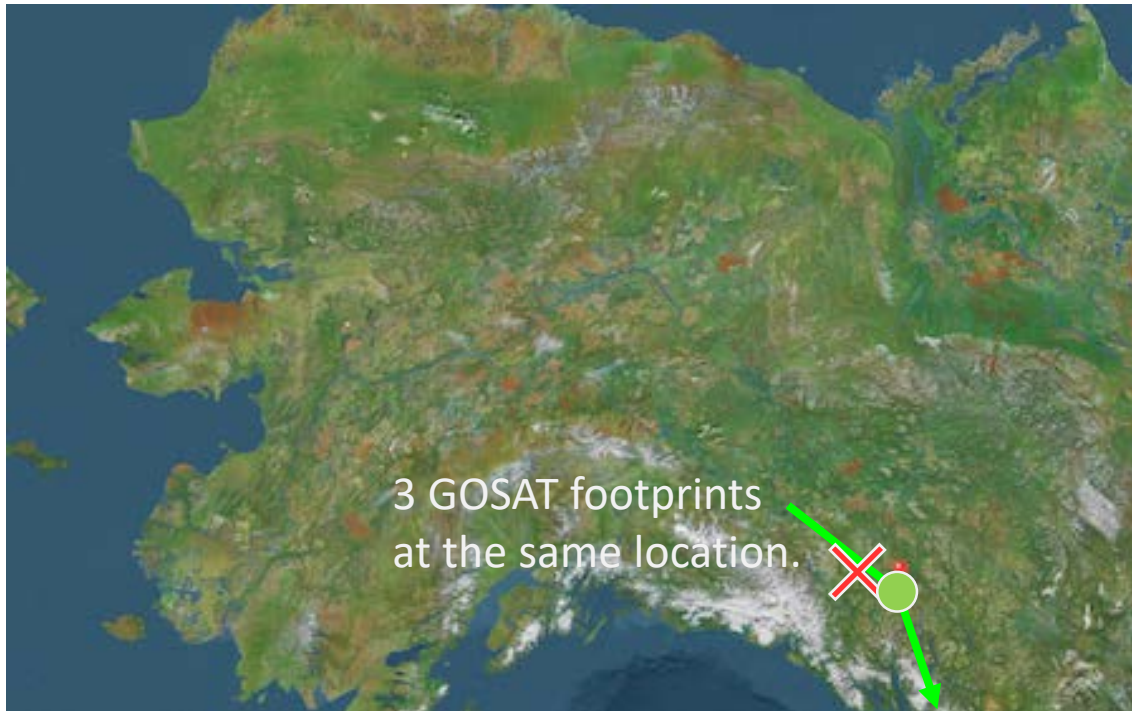
Case 2 (CO₂) : Whitehorse

- 1 in situ profile measurement
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = 4.7 \text{ hr}$



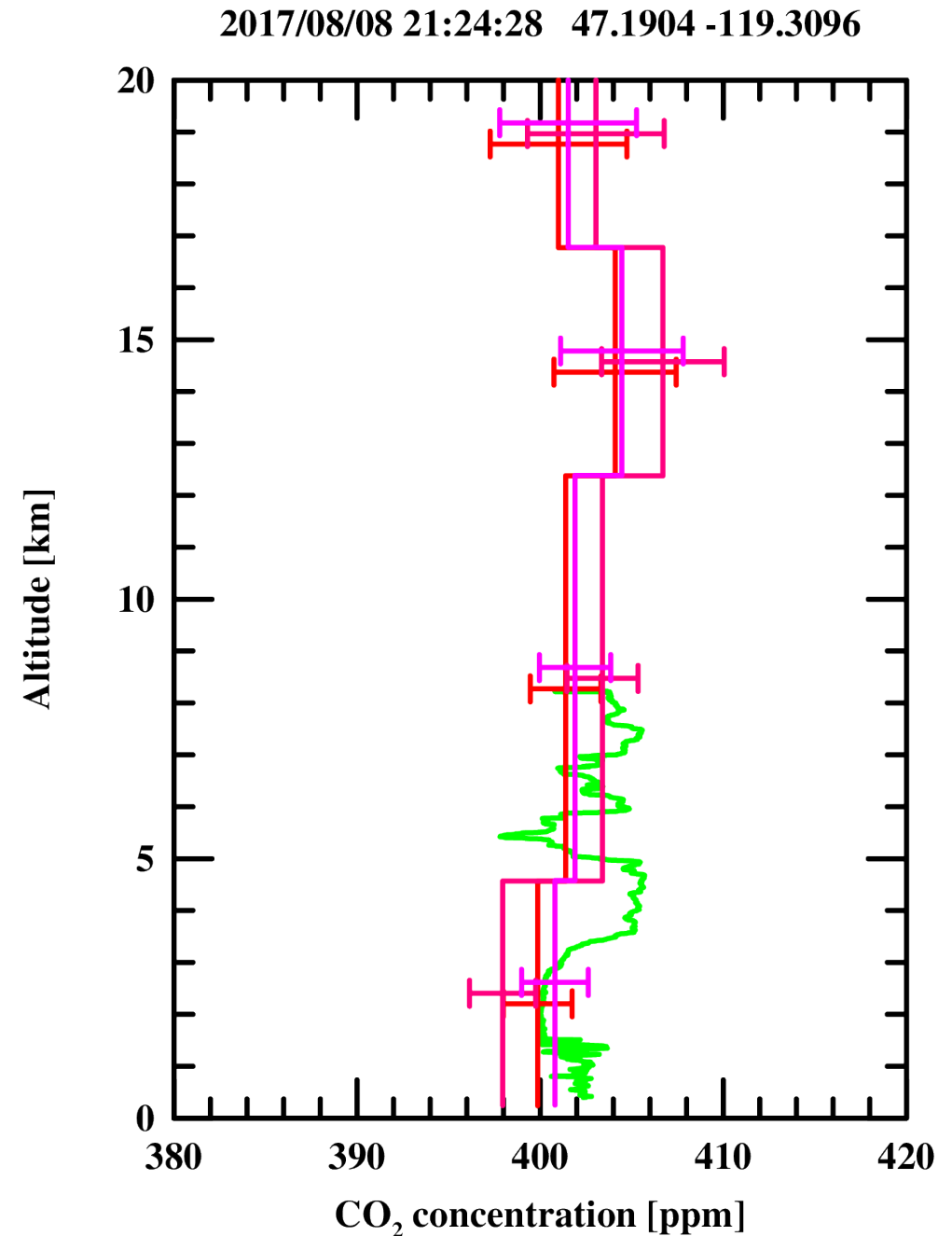
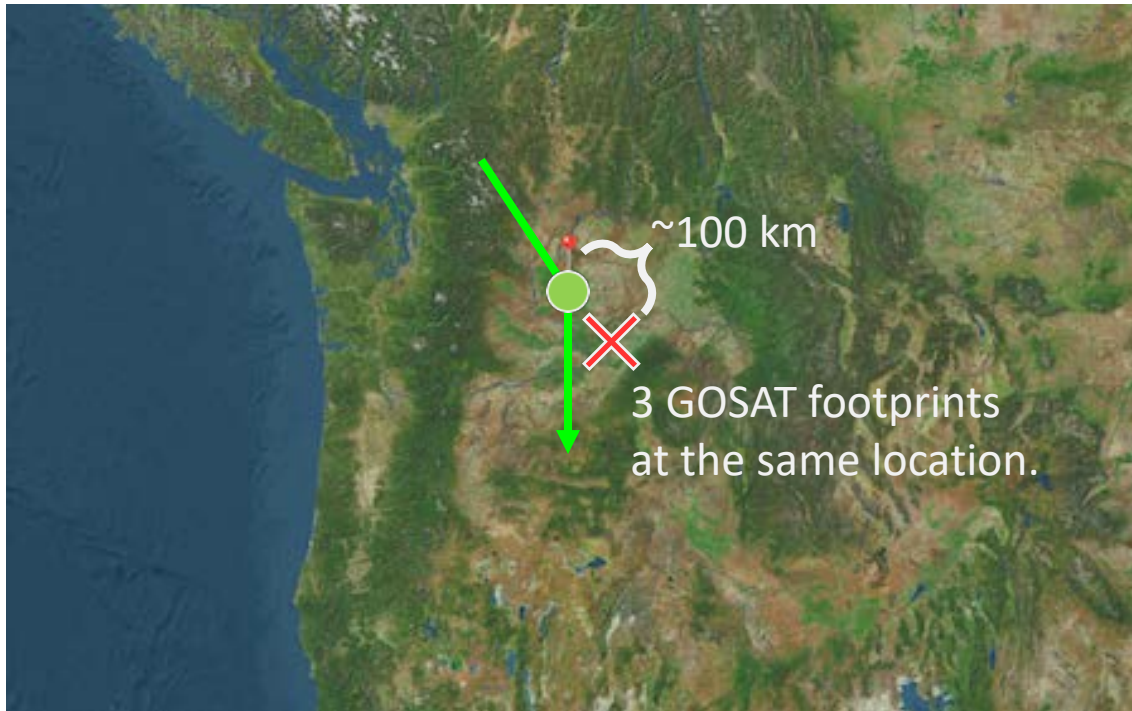
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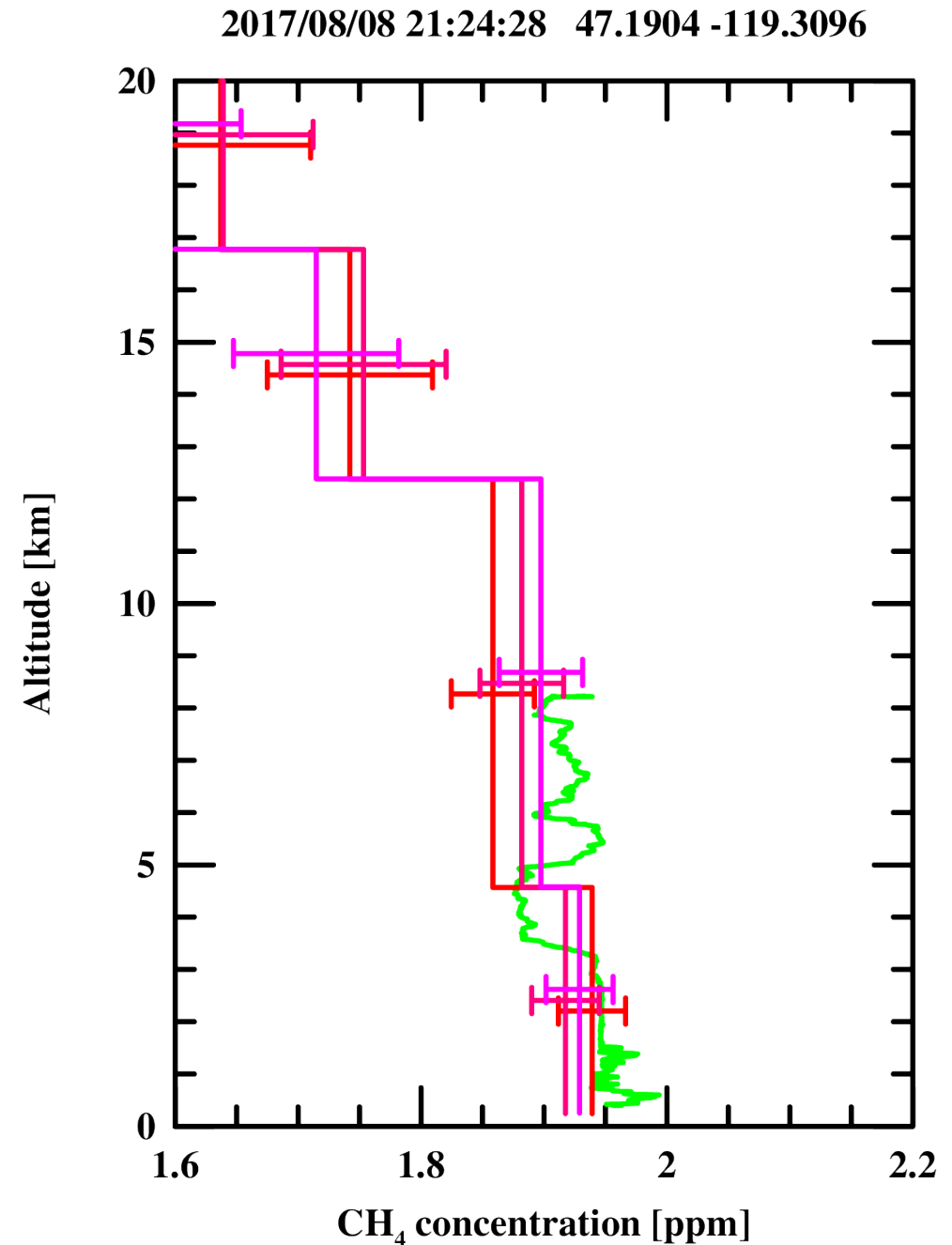
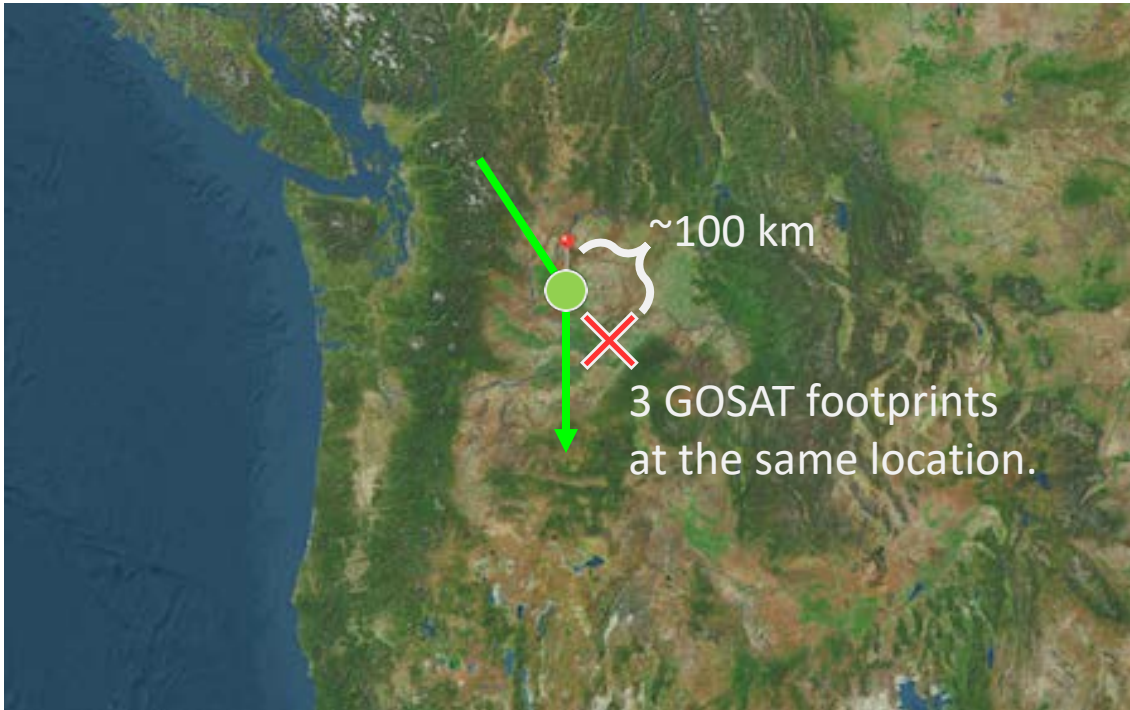
Case 3 (CO₂) : Moses Lake

- 1 in situ profile measurement
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = 0.0$ hr



Case 3 (CH₄) : Moses Lake

- 1 in situ profile measurement
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = 0.0$ hr



Summary

- From GOSAT SWIR and TIR observations, we retrieved tropospheric concentrations of CO₂ and CH₄, which can be used for monitoring GHG emissions in the permafrost regions.
- Comparison with the ASCENDS/ABOVE 2017 campaign data shows that for CO₂, GOSAT retrievals agree well with the in situ airborne measurements.
- For CH₄, however, GOSAT retrievals are underestimated. Further investigations are needed.

Thank you for your attention.

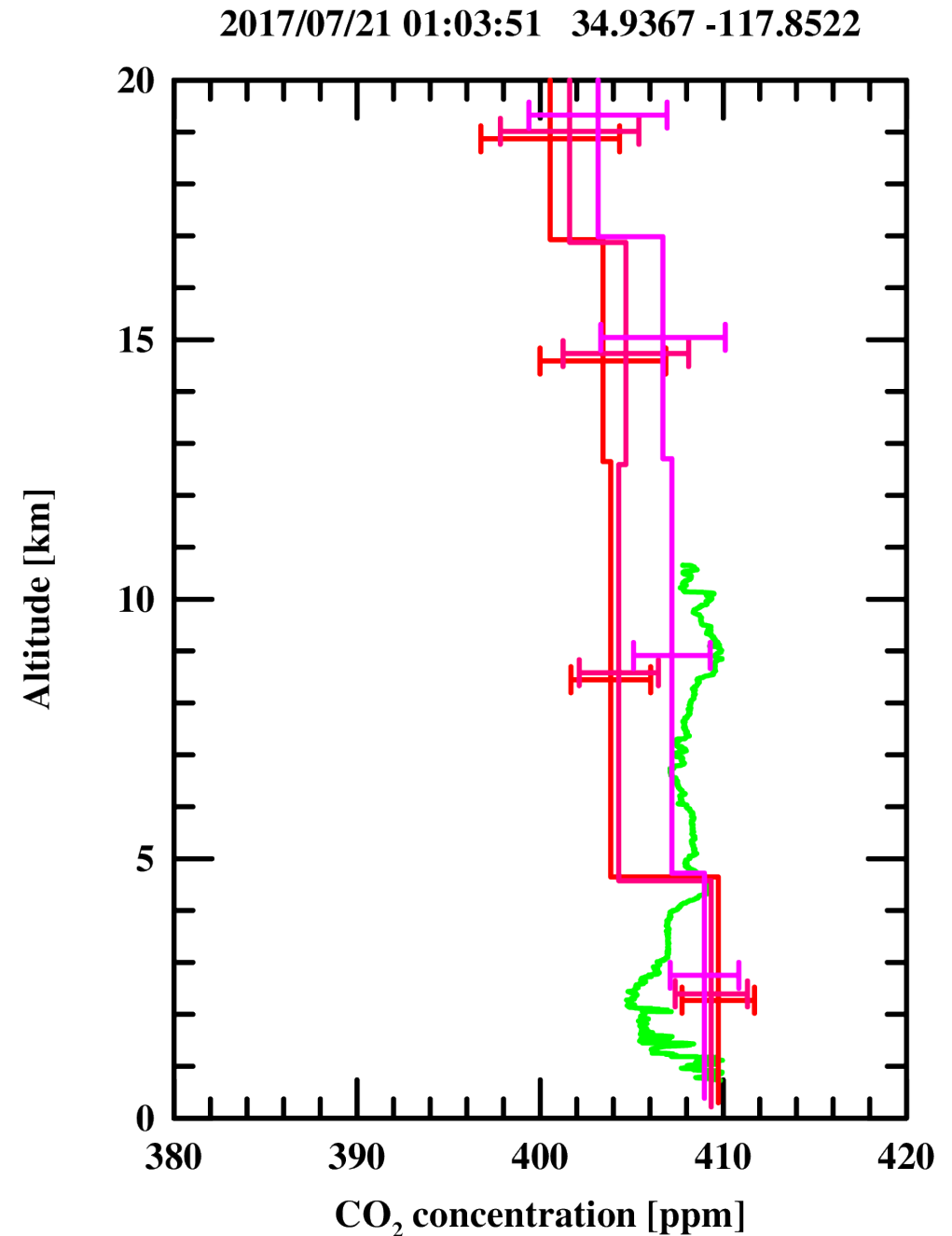
Acknowledgements

- Meteorological data
NCEP_Reanalysis 2 data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their web site at <https://www.esrl.noaa.gov/psd/> .
- A priori for CO₂
CarbonTracker results provided by NOAA ESRL, Boulder, Colorado, USA from the website at <http://carbontracker.noaa.gov> .
- A priori for CH₄
CarbonTracker-CH4 results provided by NOAA ESRL, Boulder, Colorado, USA from the website at <http://www.esrl.noaa.gov/gmd/ccgg/carbontracker-ch4/>.

Backup slides

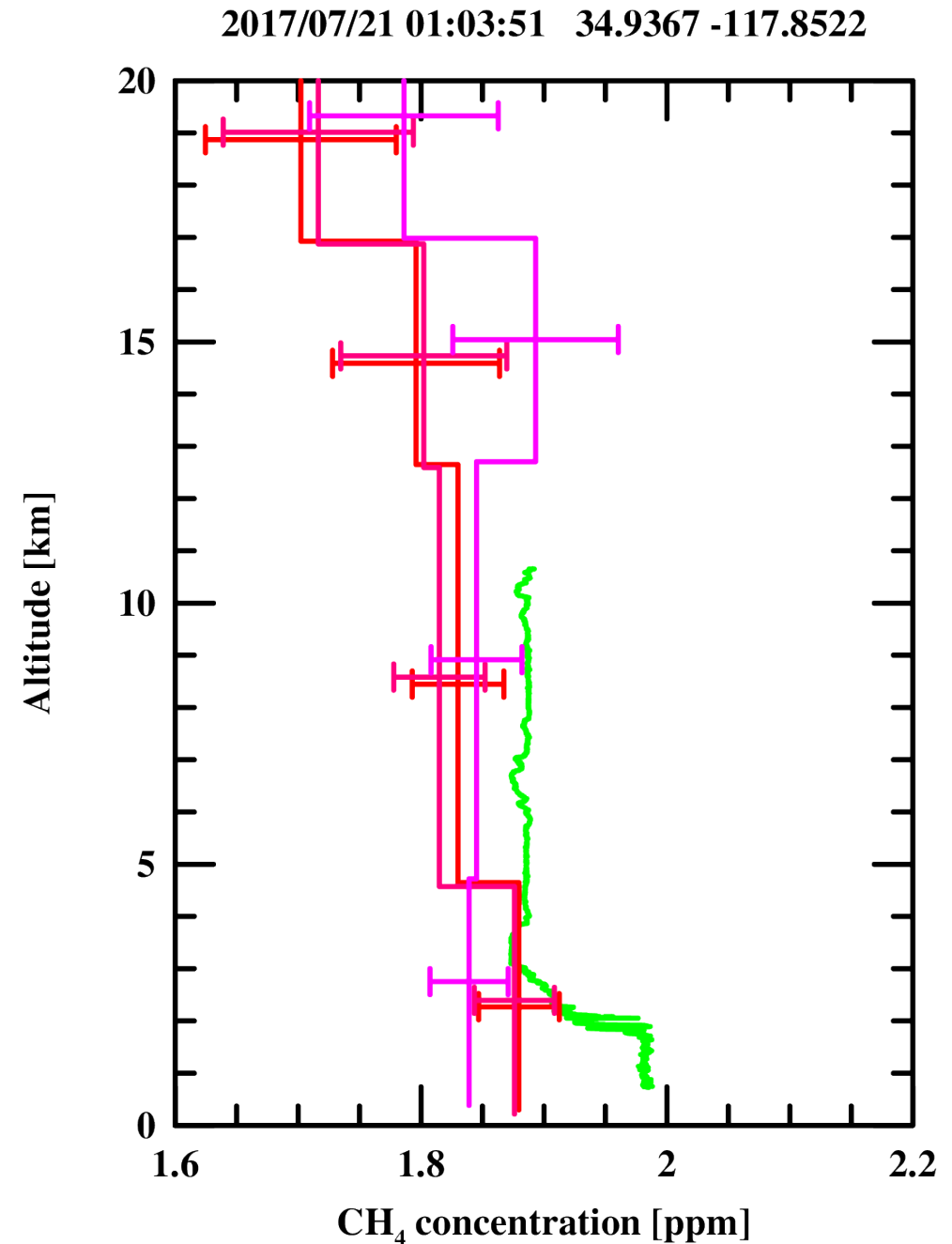
Case 4 (CO₂) : Edwards AFB

- 1 in situ profile measurement
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = -4.1 \text{ hr}$



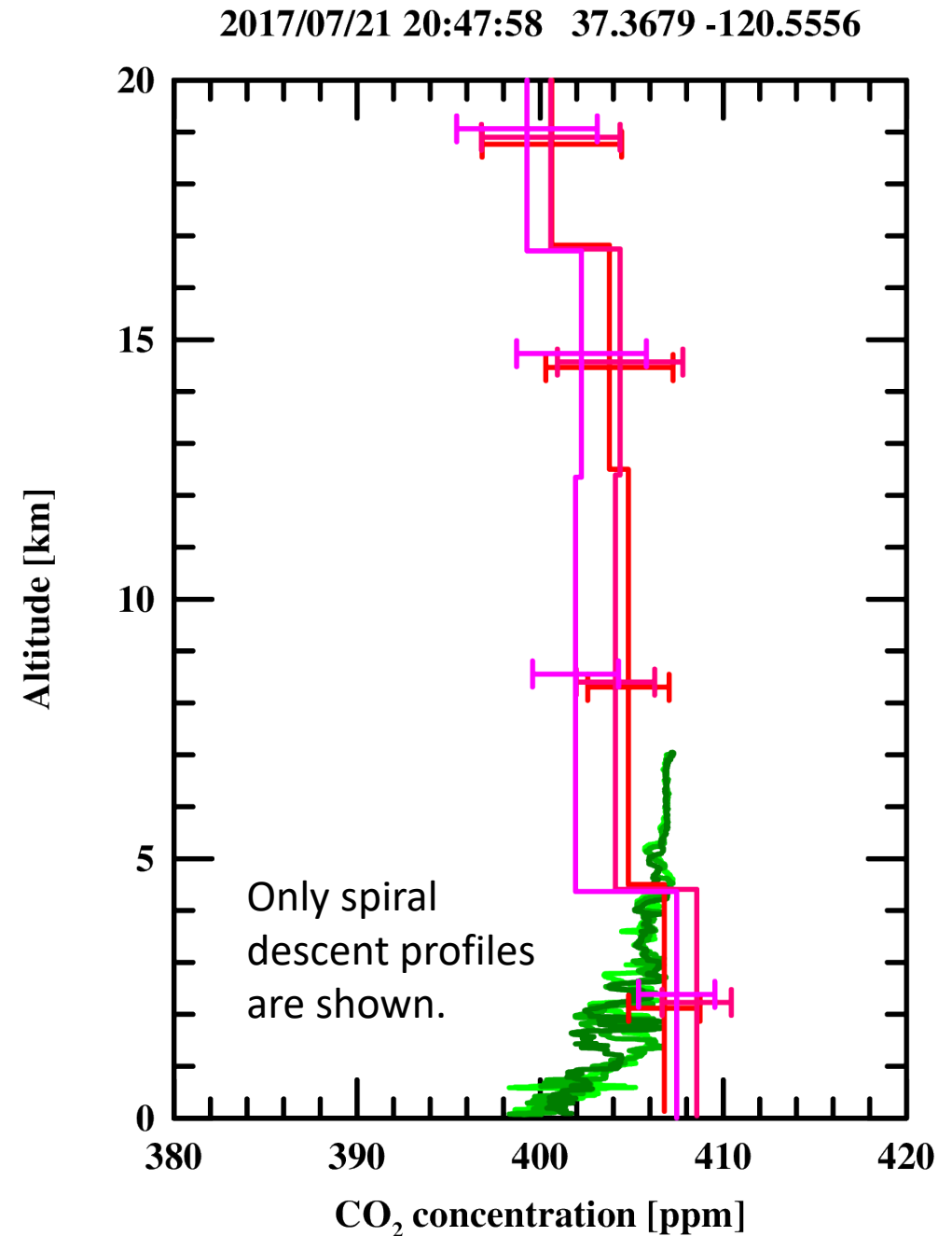
Case 4 (CH₄) : Edwards AFB

- 1 in situ profile measurement
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = -4.1 \text{ hr}$



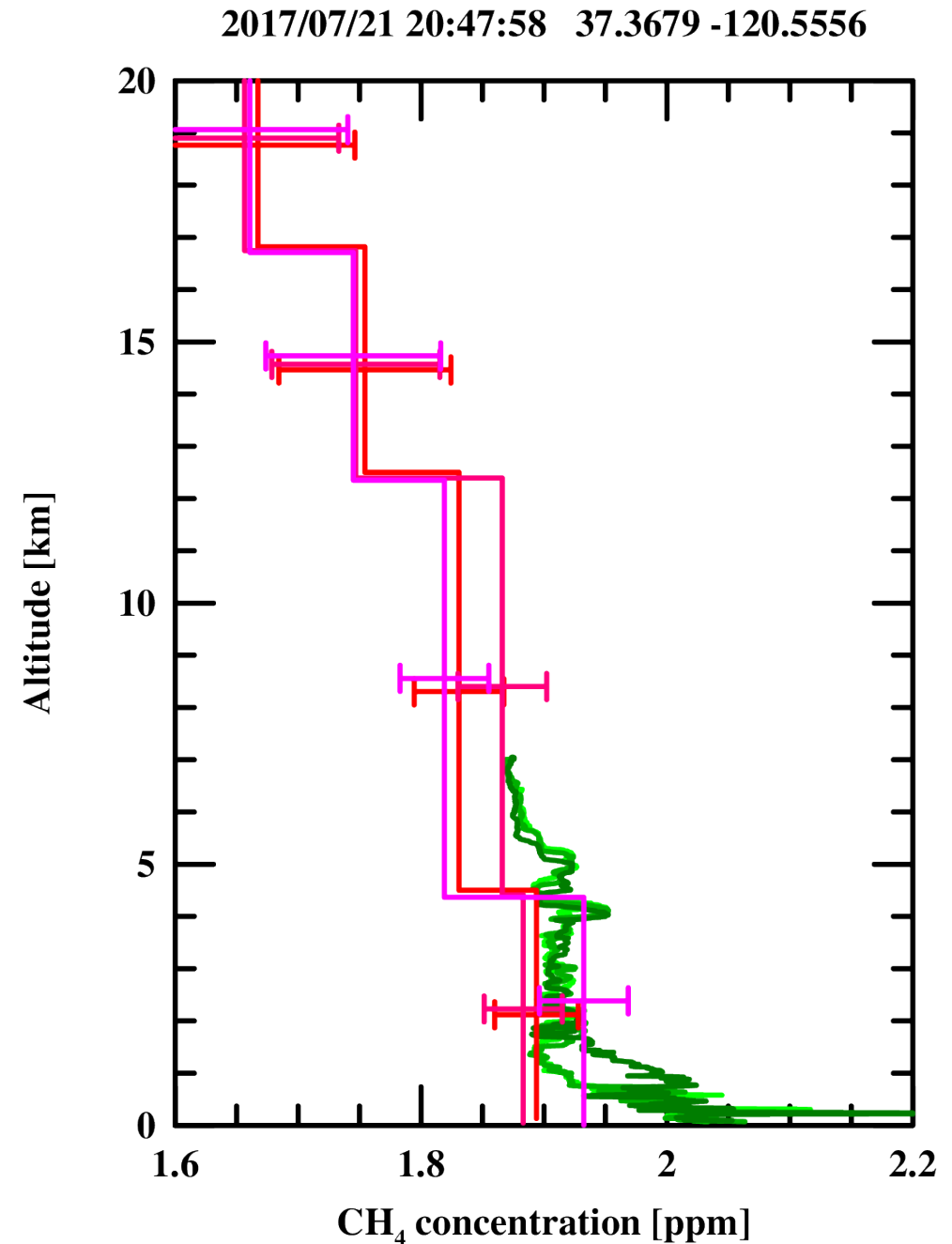
Case 5 (CO₂) : Castle Airport

- 3 (6) in situ profile measurements
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = 0.7 \text{ hr}$



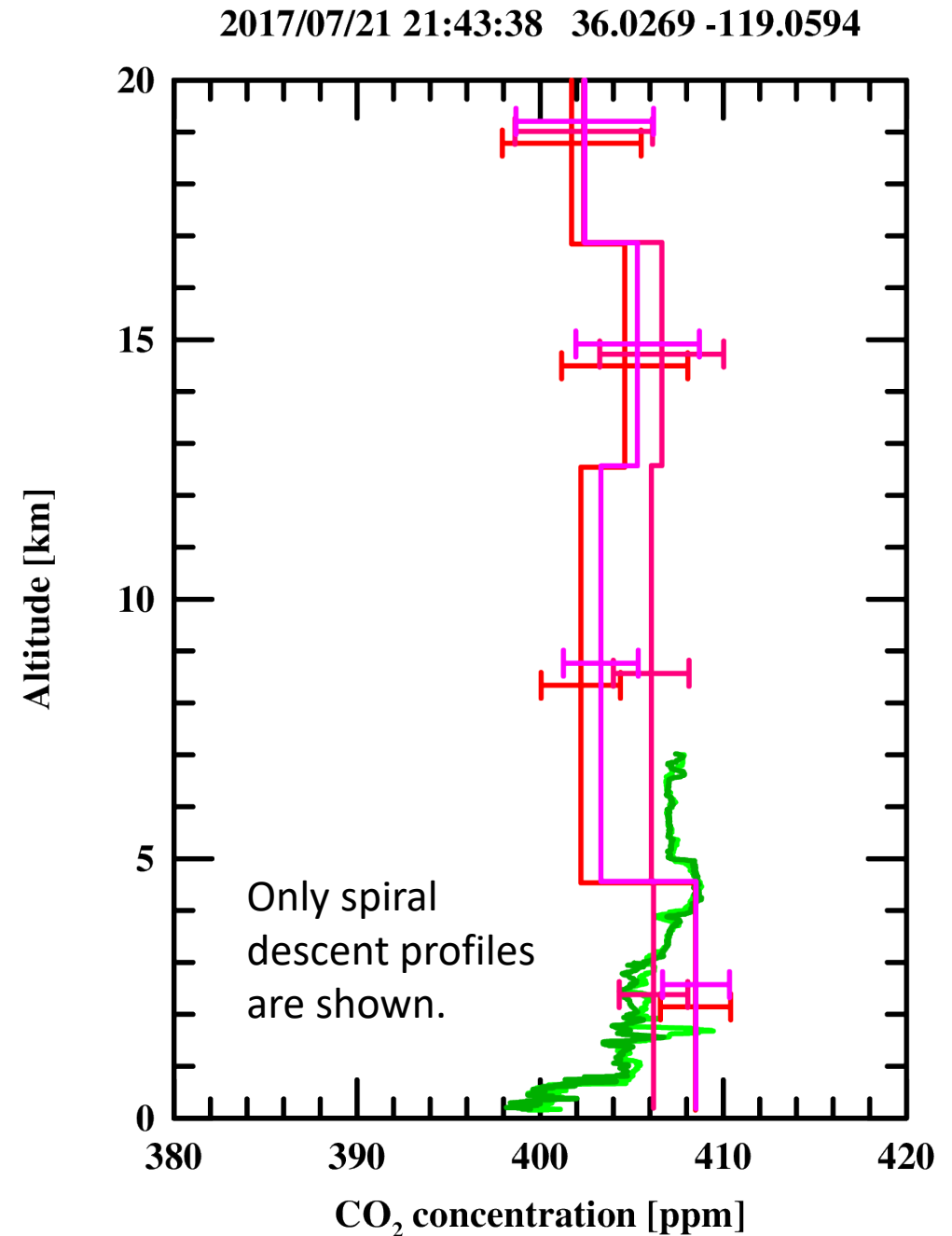
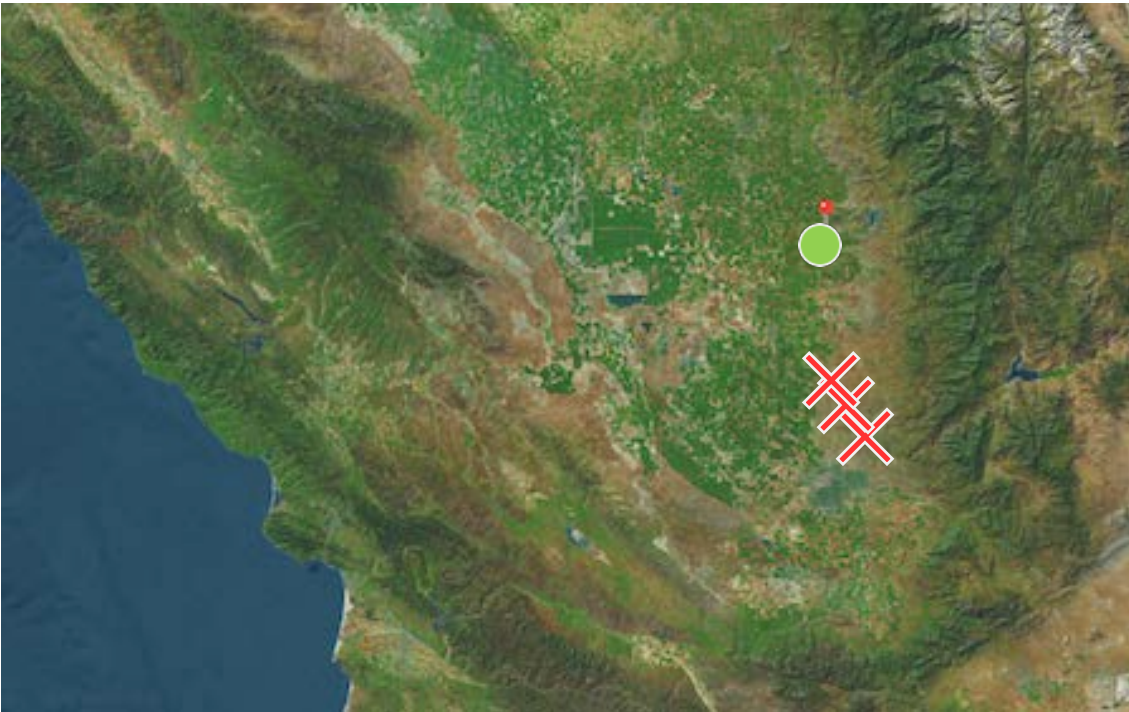
Case 5 (CH₄) : Castle Airport

- 3 (6) in situ profile measurements
- 3 GOSAT observations
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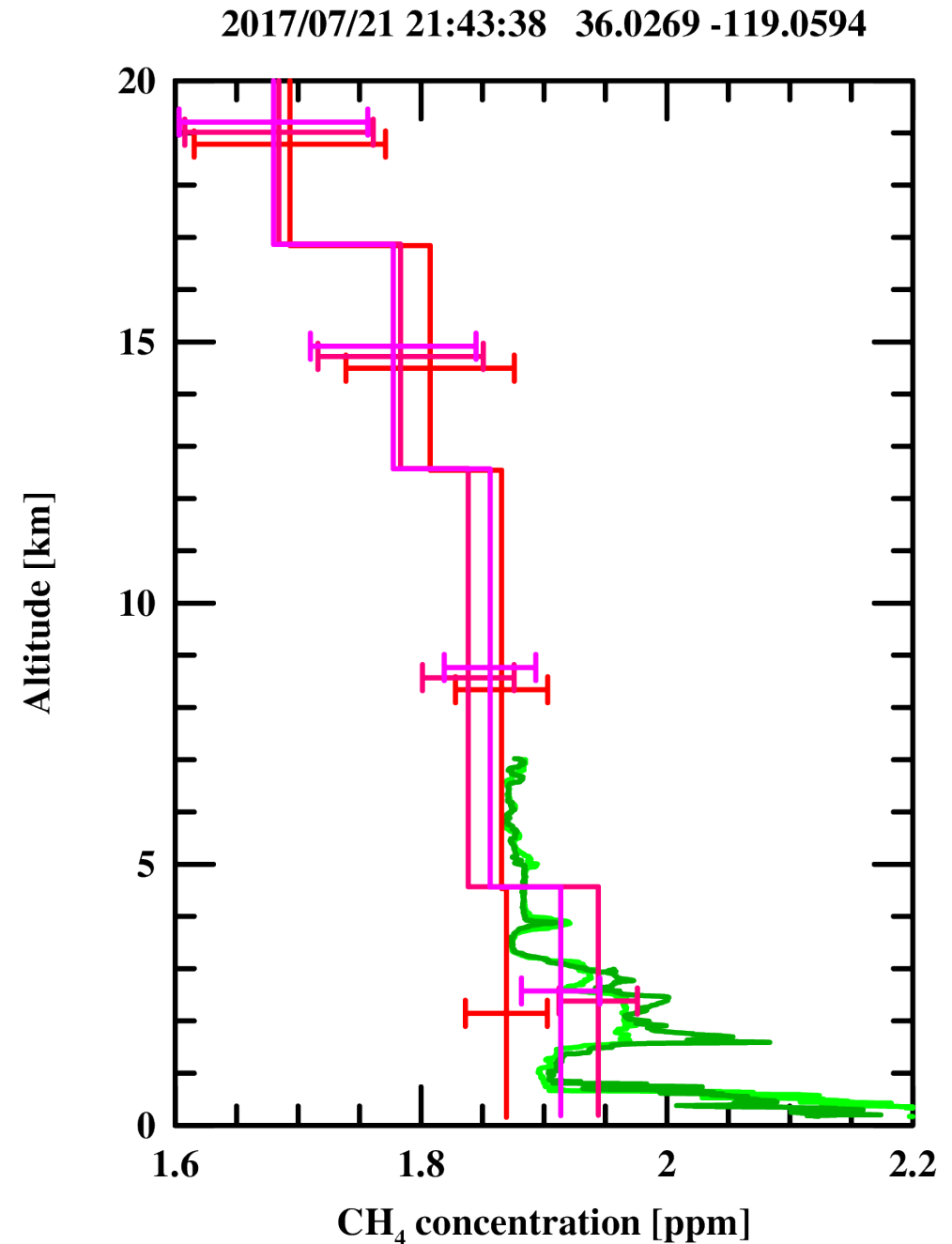
Case 6 (CO₂) : Porterville

- 2 (4) in situ profile measurements
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = -0.3 \text{ hr}$



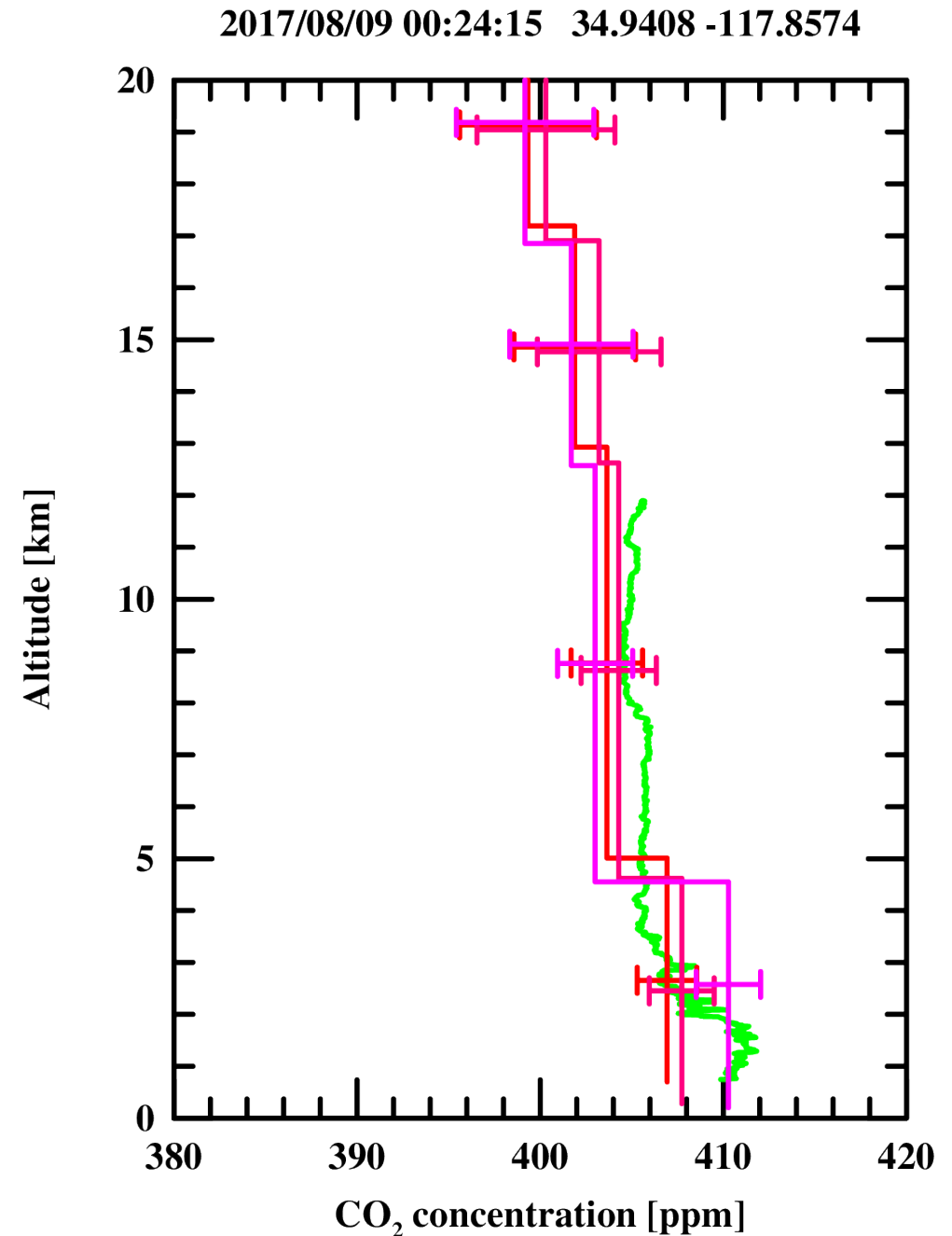
Case 6 (CH₄) : Porterville

- 2 (4) in situ profile measurements
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = -0.3 \text{ hr}$



Case 7 (CO₂) : Edwards AFB

- 1 in situ profile measurement
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = -2.9 \text{ hr}$



Case 7 (CH₄) : Edwards AFB

- 1 in situ profile measurement
- 3 GOSAT observations
- $\Delta T = T_{\text{GOSAT}} - T_{\text{DC-8}} = -2.9 \text{ hr}$

