

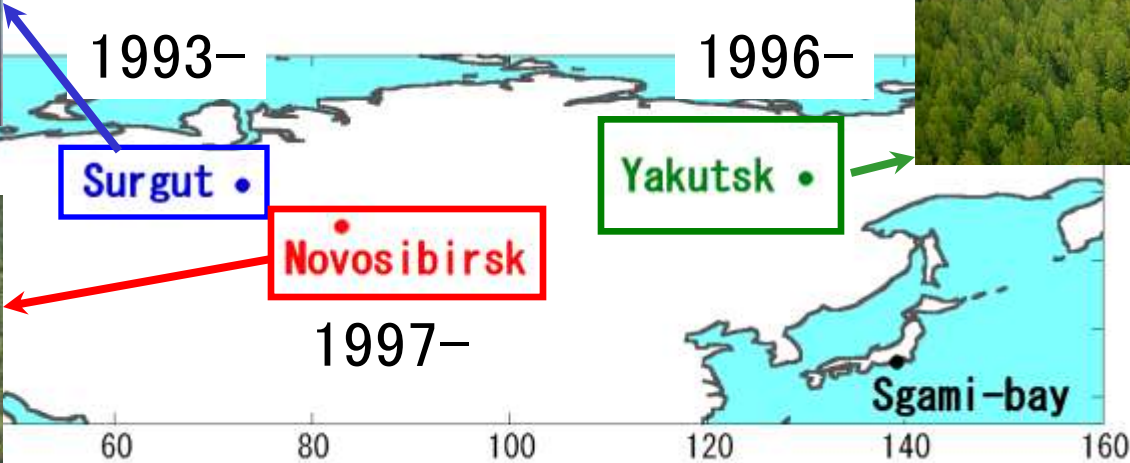
# Temporal and spatial variations of atmospheric carbon dioxide and methane over Siberia



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N. Fedoseev<sup>3</sup>, S. Mitin<sup>4</sup>, M. Sasakawa<sup>1</sup> and S. Maksyutov<sup>1</sup>

1:NIES, Japan, 2: IAO, Russia, 3: PI, Russia, 4: IMB, Russia

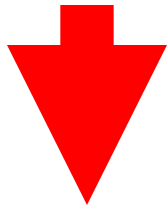
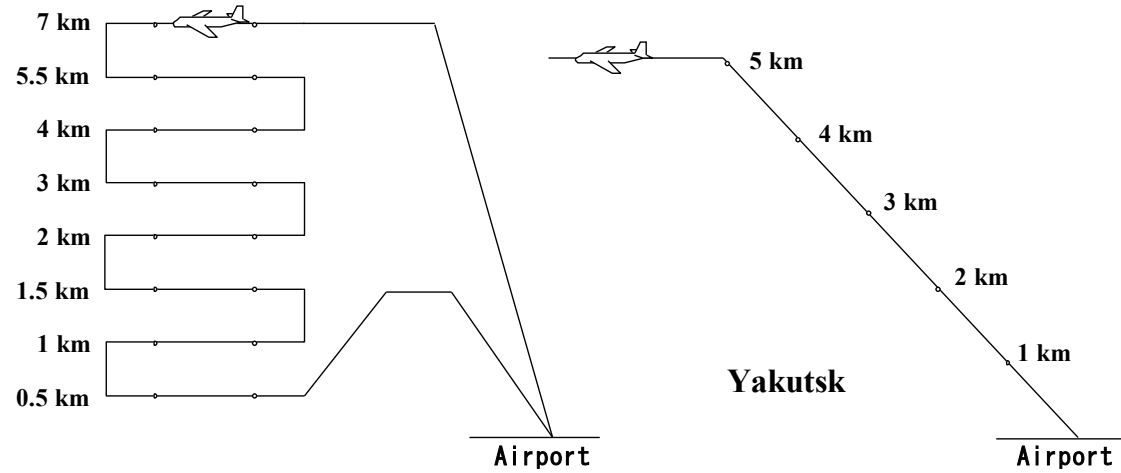
# Sites of aircraft observation



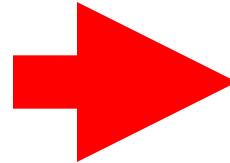
# Sampling and Analyses



**Surgut,  
Novosibirsk,**

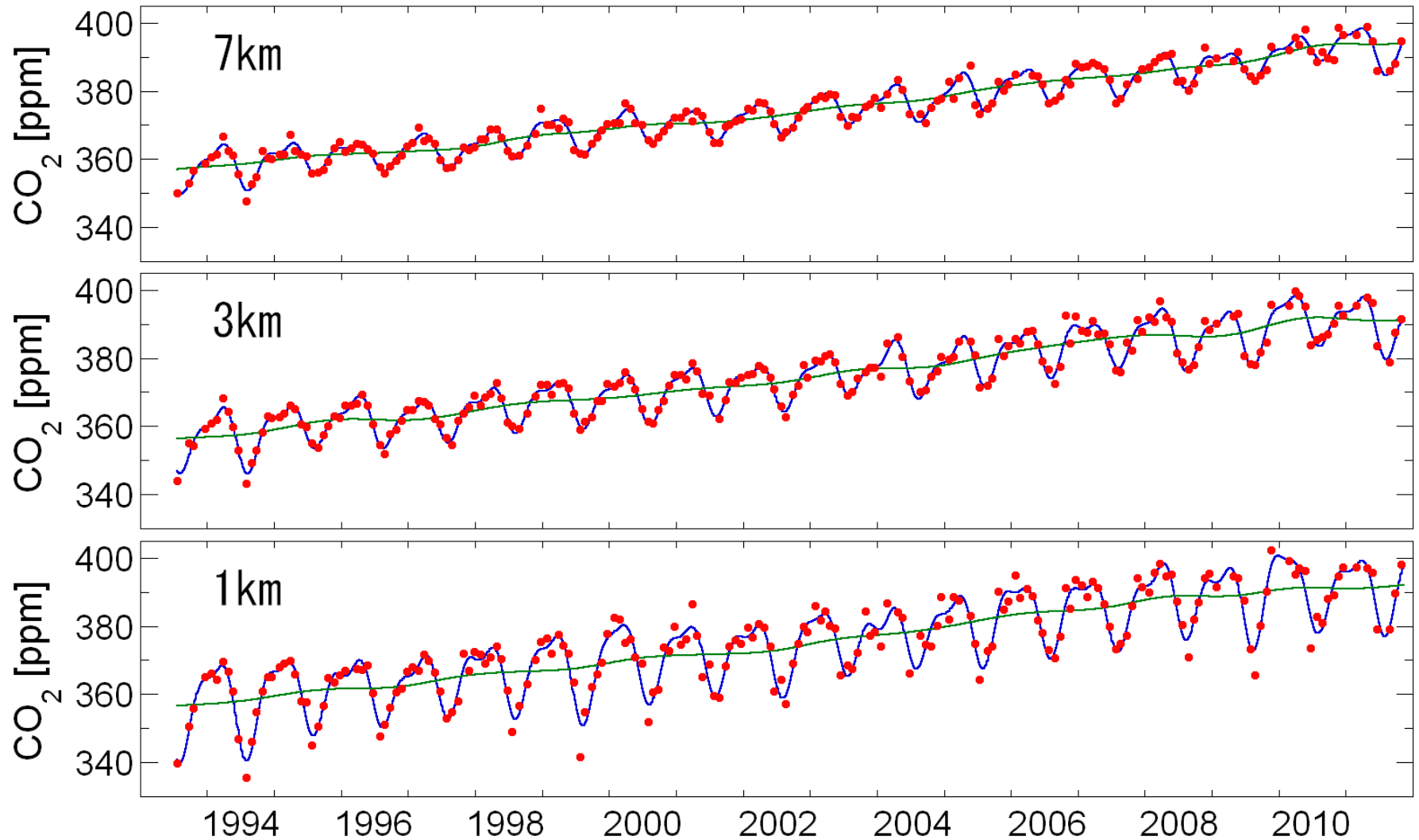


**NIES**

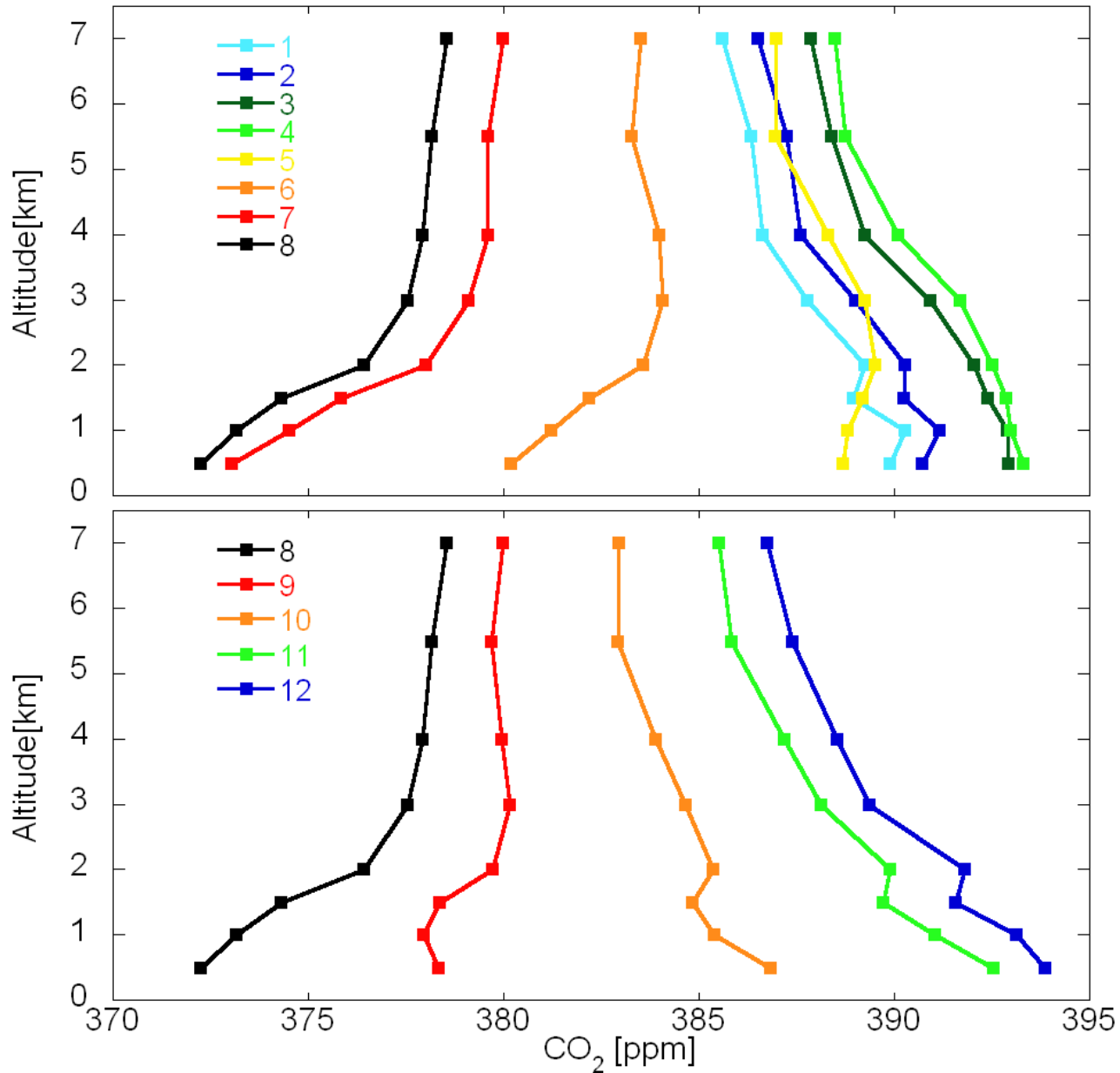


- $\text{CO}_2$
- $\text{CH}_4$
- $\text{CO}$
- $\text{H}_2$
- $\text{N}_2\text{O}$
- $\text{SF}_6$
- $\text{CO}_2$  isotope

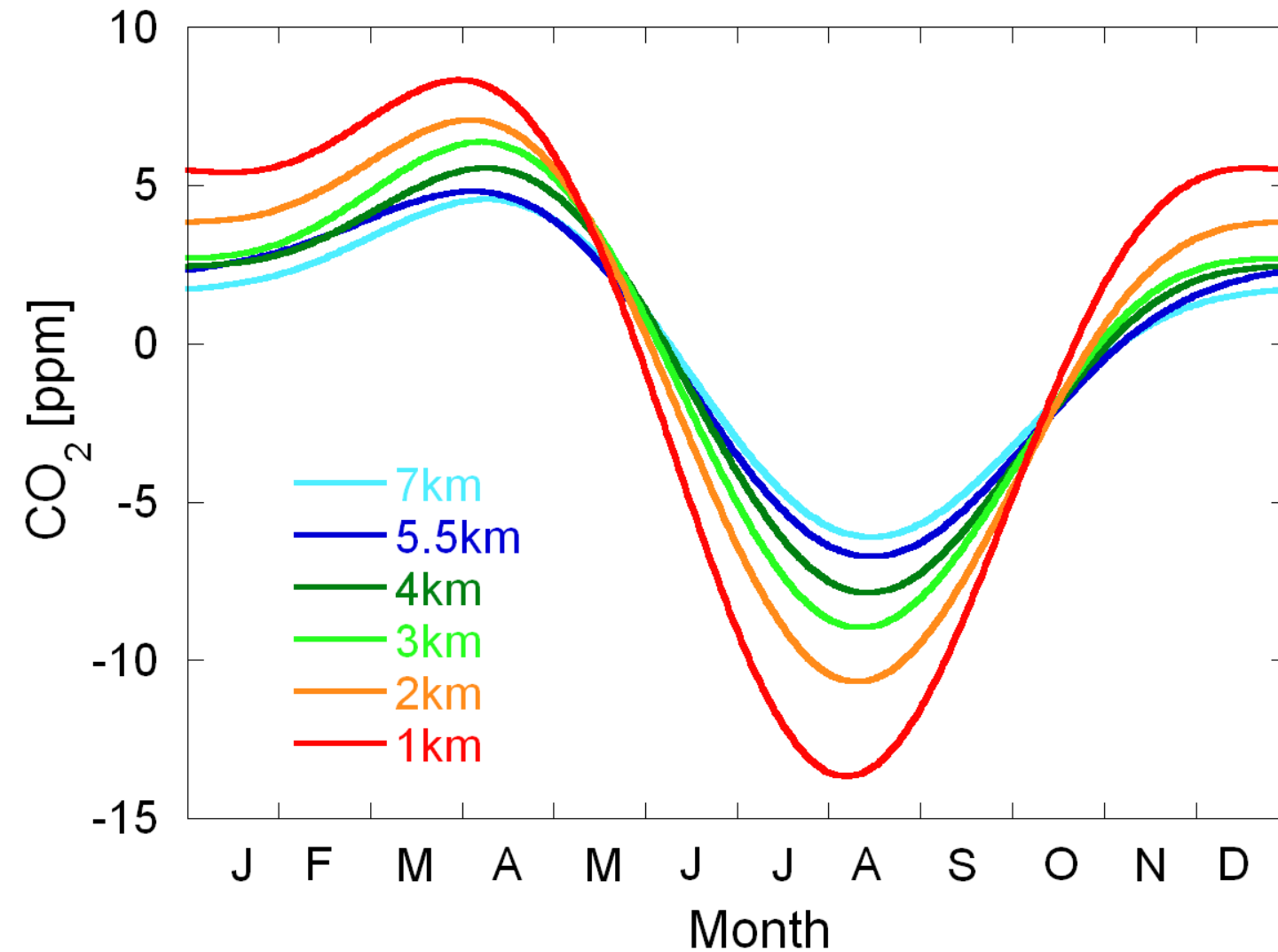
# Time series of CO<sub>2</sub> over Surgut



# Monthly averaged vertical profiles of CO<sub>2</sub> over Surgut

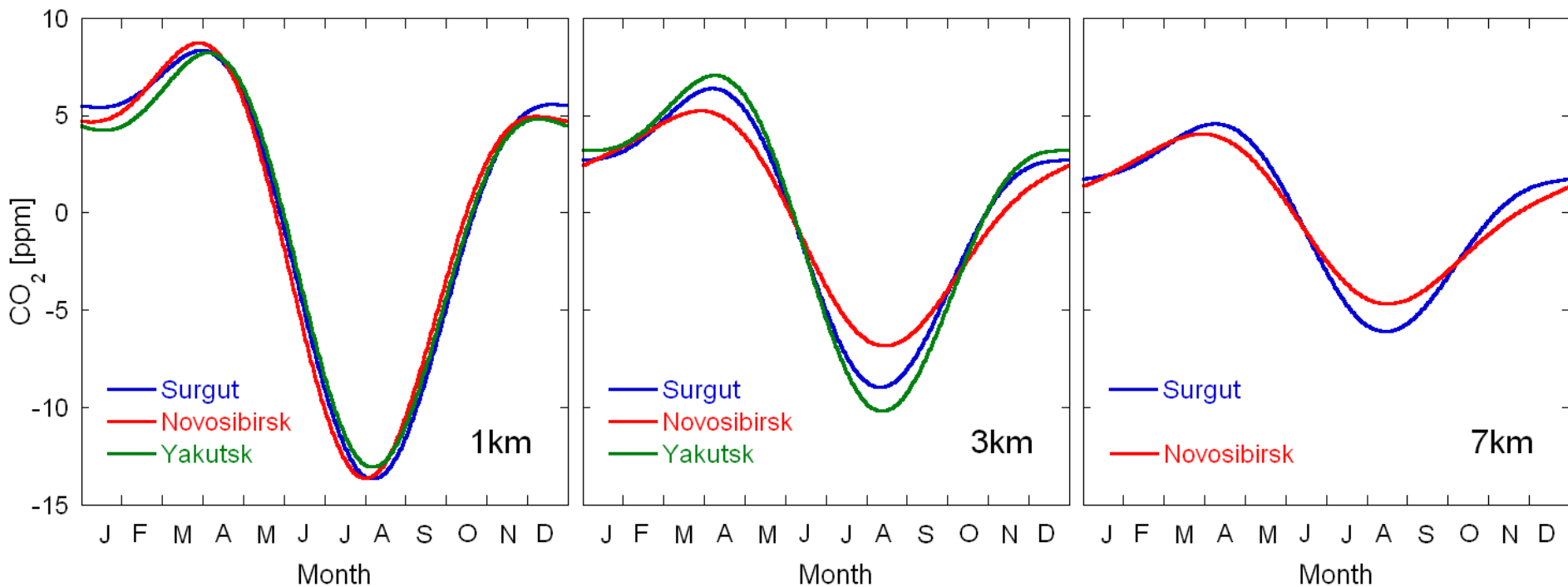
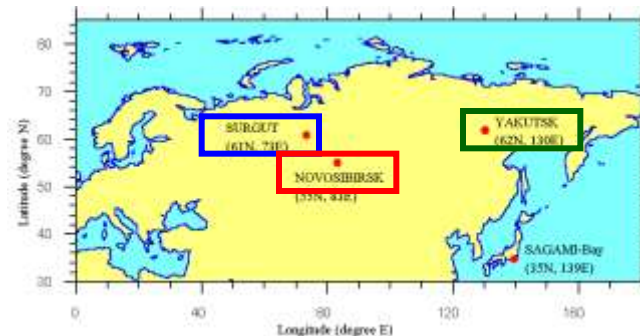


# Averaged seasonal variation of CO<sub>2</sub> over Surgut

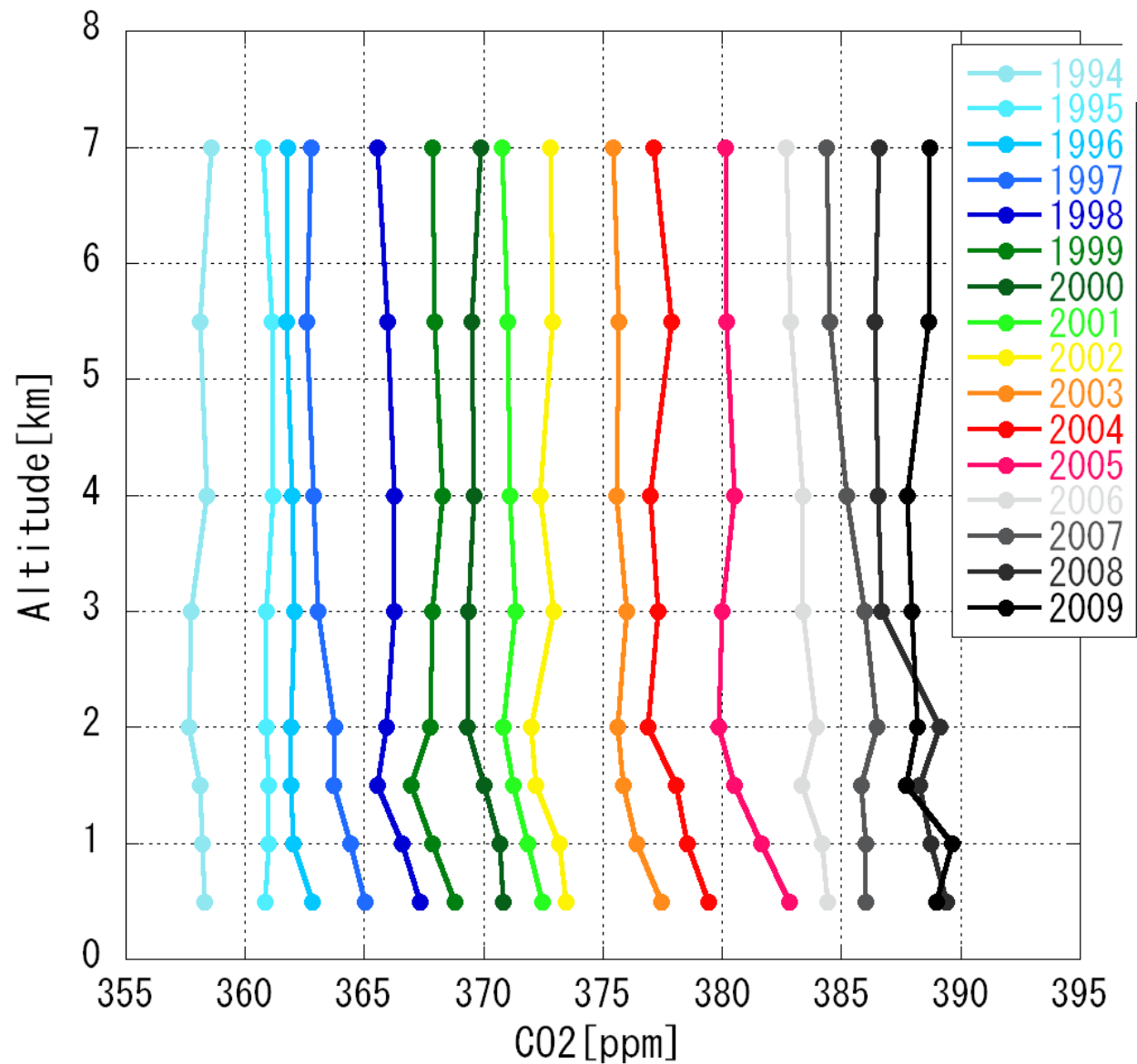




# Comparison of seasonal variation over 3 sites

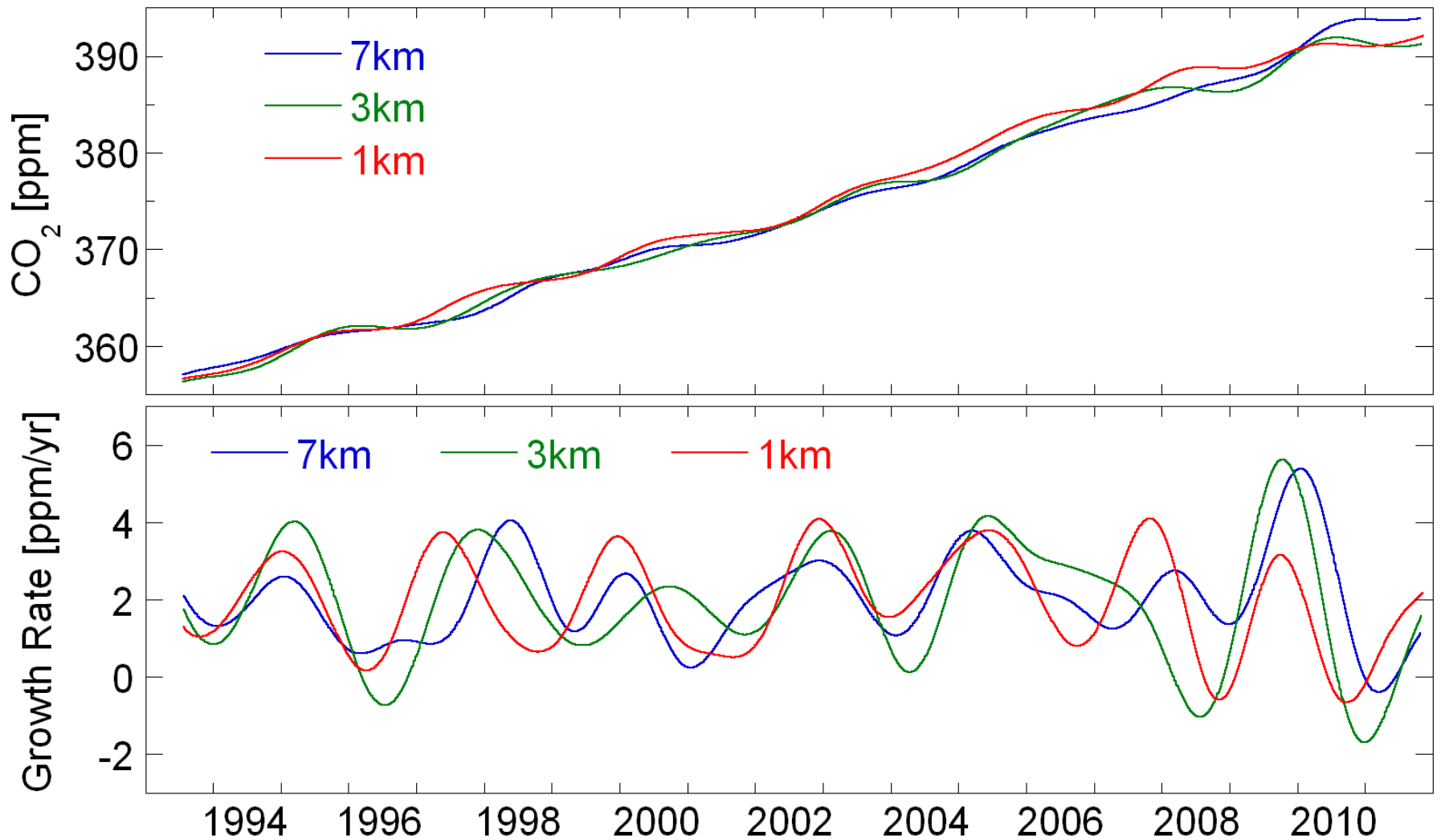


# Annual Mean CO<sub>2</sub> over Surgut

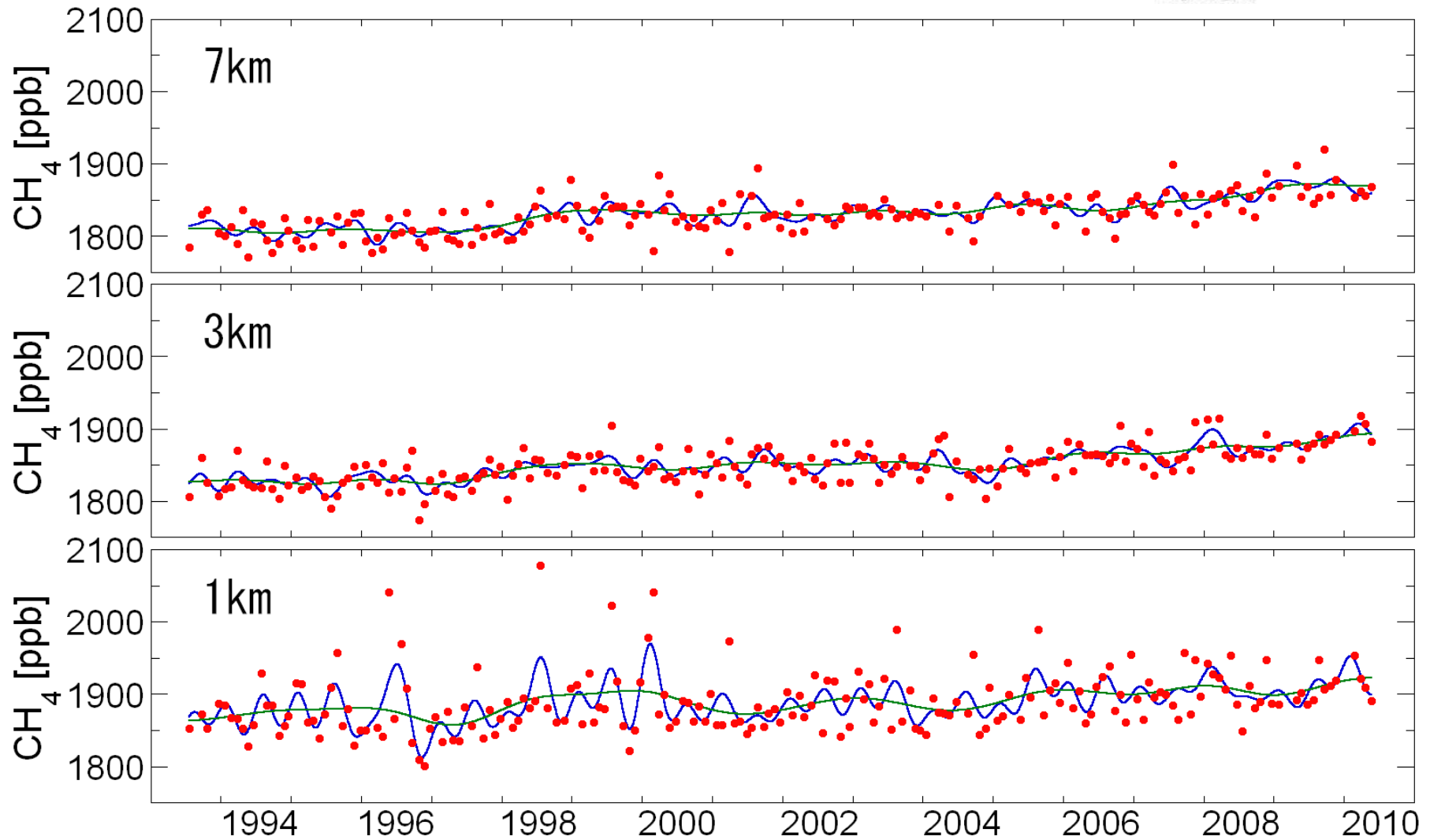




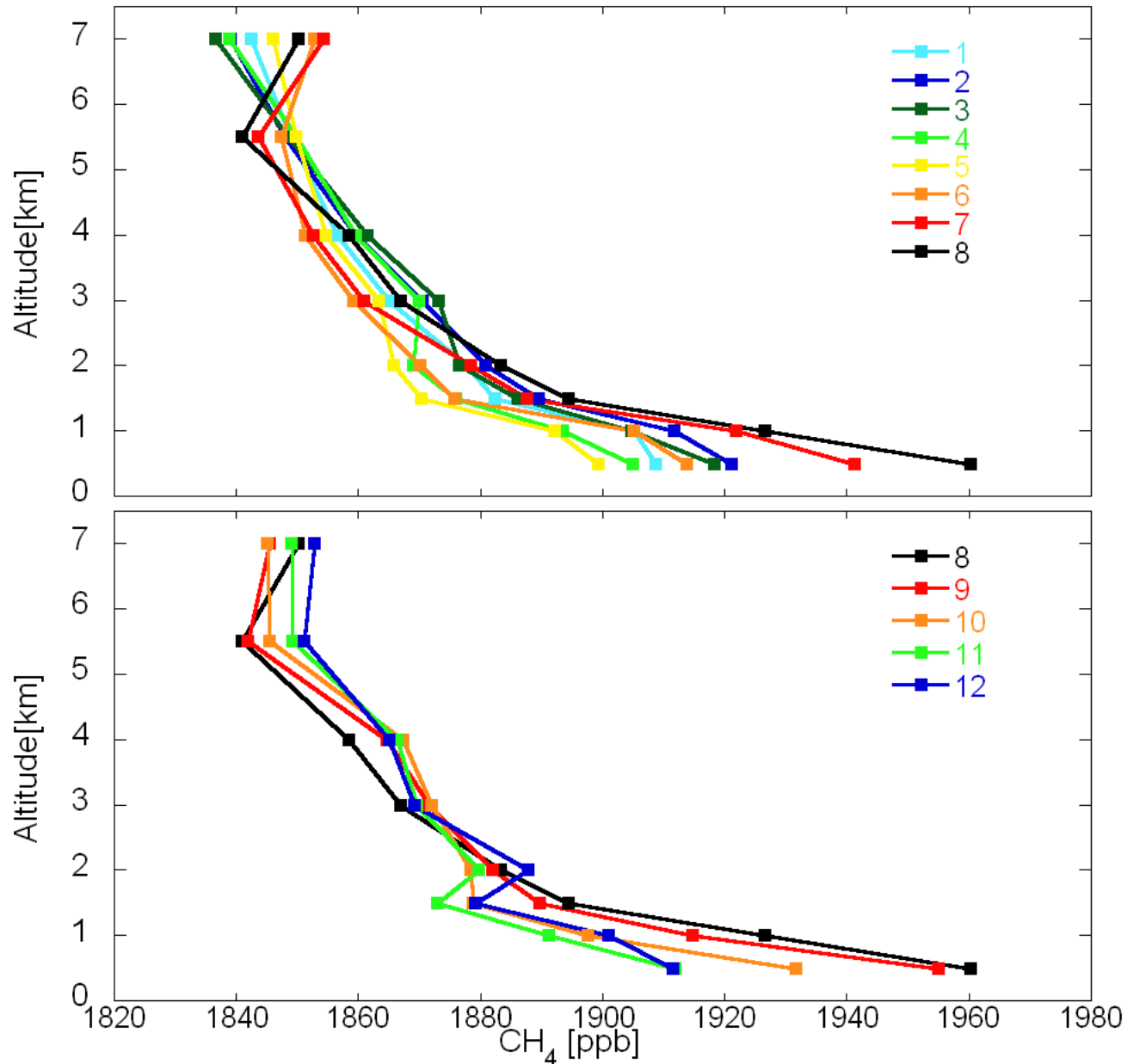
# Trend and Growth Rate



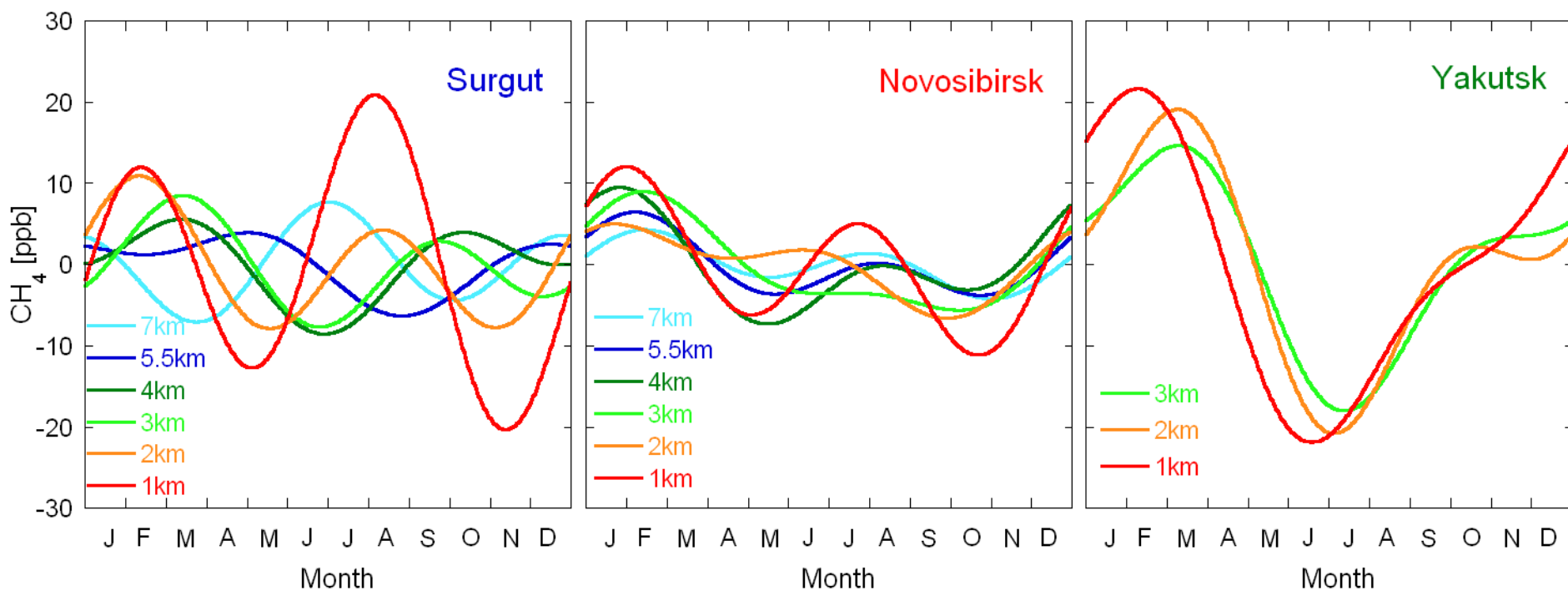
# Time series of CH<sub>4</sub> over Surgut



# Monthly averaged vertical profiles of CH<sub>4</sub> over Surgut



# Averaged seasonal variation of CH<sub>4</sub> over 3 sites





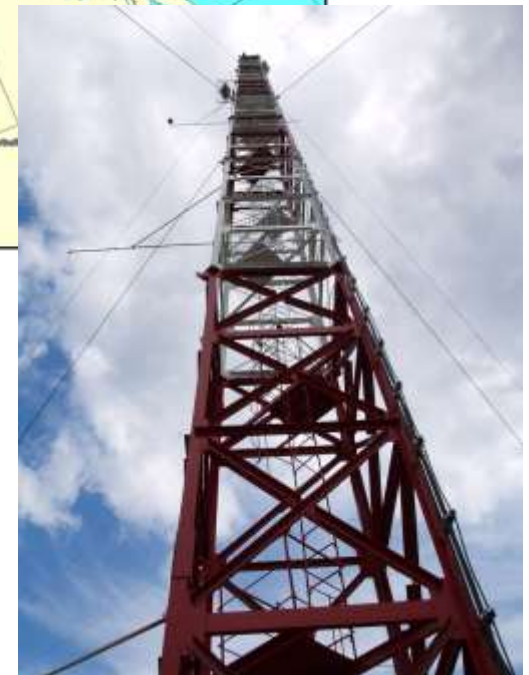
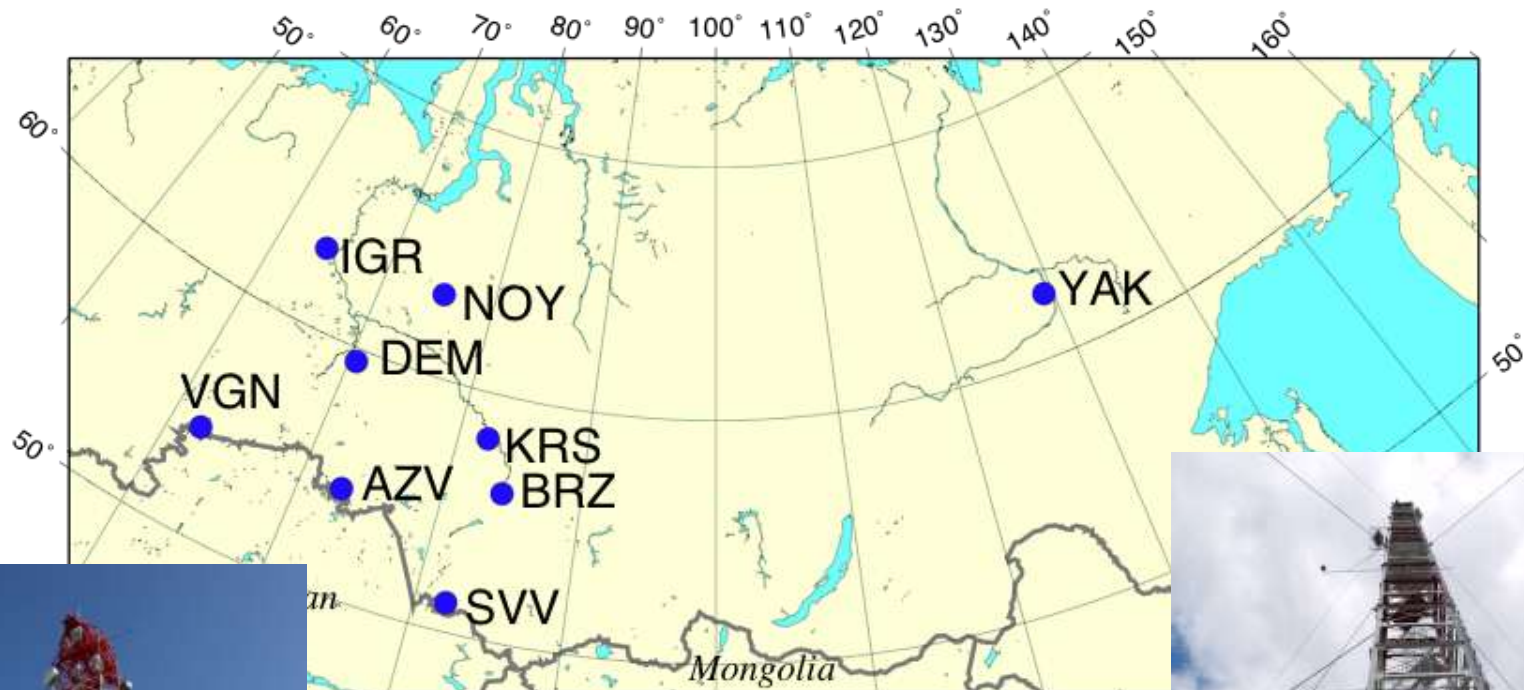
# Inverse calculation using NIES TM

- Off-line global 3-D transport model
  - transport: JCDAS
  - resolution:  $2.5^{\circ} \times 2.5^{\circ}$ , 19 sigma level
  - Semi-Lagrangean advection scheme



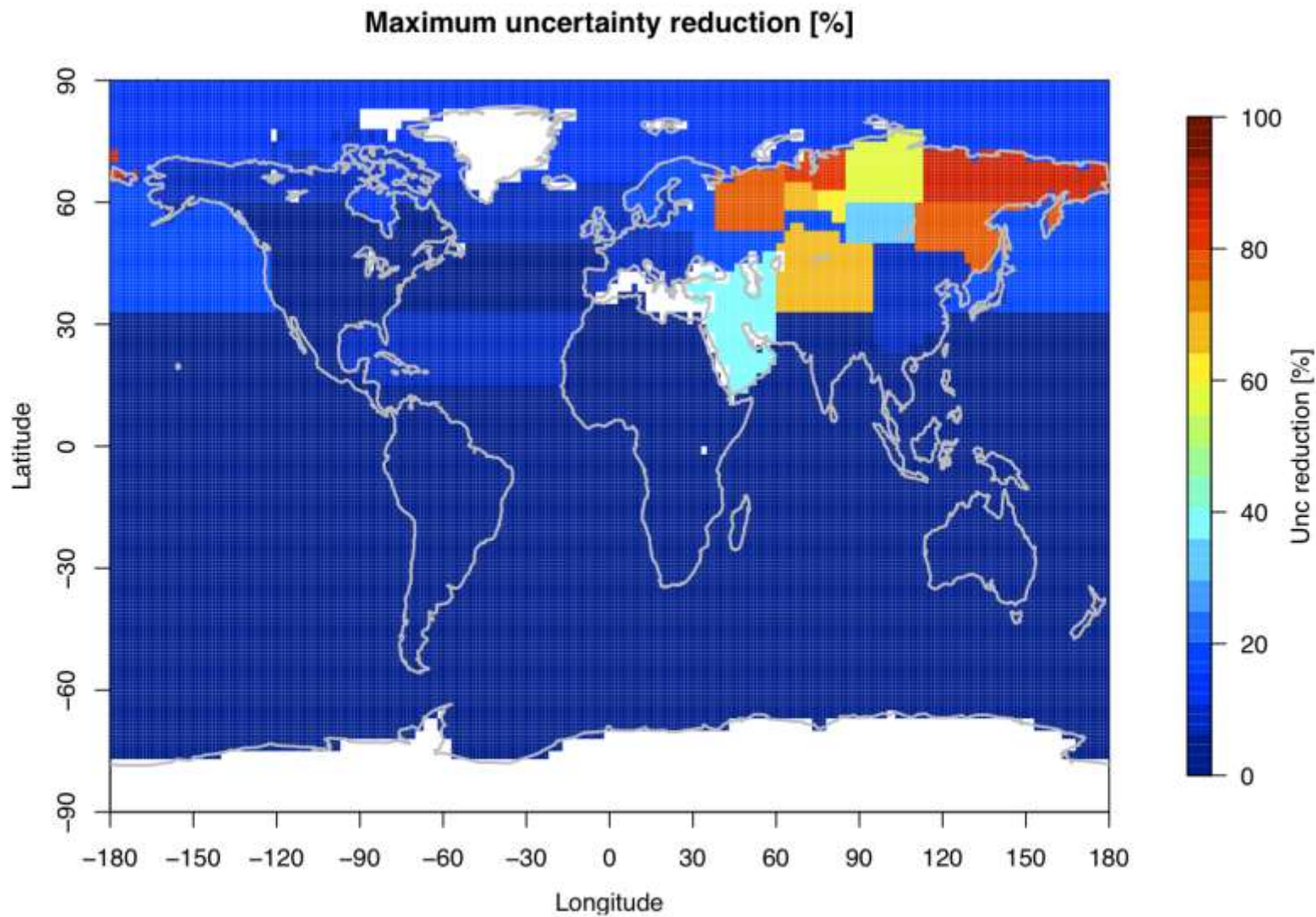
# Tower measurement network

Japan–Russia Siberian TALL Tower Inland Observation Network: JR–STATION



Sasakawa et al., Tellus B (2010), (2012)

# Uncertainty Reduction for CO<sub>2</sub> fluxes



# Summary

Aircraft monitoring over Siberia since 1993.

Large seasonal CO<sub>2</sub> amplitude of 22 ppm at 3 sites.

Annual mean CO<sub>2</sub> is constant along the altitude.

Growth rate is larger in 2009-2010 but smaller in 2011.

CH<sub>4</sub> is higher near the surface through the year.

CH<sub>4</sub> in YAK min. in summer, but in SUR max. in summer.

CH<sub>4</sub> in FT started to increase again in 2006.

Siberian observations changes the flux estimation more emission in winter and more absorption in summer.

Siberian observations reduce the flux uncertainty more than 70%.