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# Atmospheric concentrations of methane and carbon dioxide

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# **Outline:**

**Measurement system**

**Calibrations**

**Seasonal cycle of concentrations**

**Possible marine emissions**

**Future plans**



**To be useful atmospheric observations must be accurate  
WMO – Global Atmosphere Watch expert group  
recommendations**

**CO<sub>2</sub> measurement compatibility better than  $\pm 0.1$  ppm**

**CH<sub>4</sub> measurement compatibility better than  $\pm 2$  ppb**

**Calibration gases directly traceable to  
WMO – Central Calibration Laboratory (CCL) primary standards  
at NOAA, Boulder**



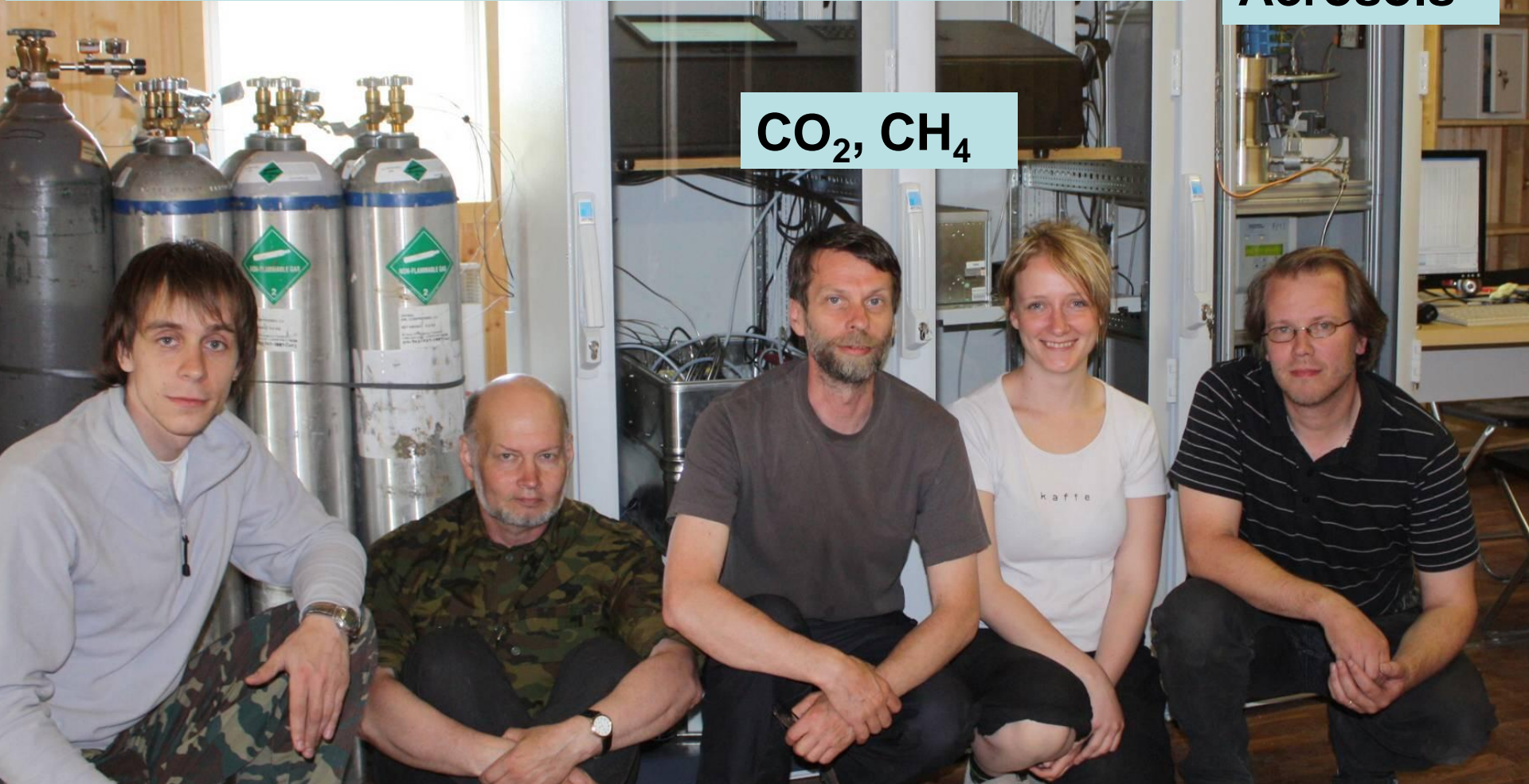


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## Measurements in Tiksi started in July 2010

Aerosols

CO<sub>2</sub>, CH<sub>4</sub>

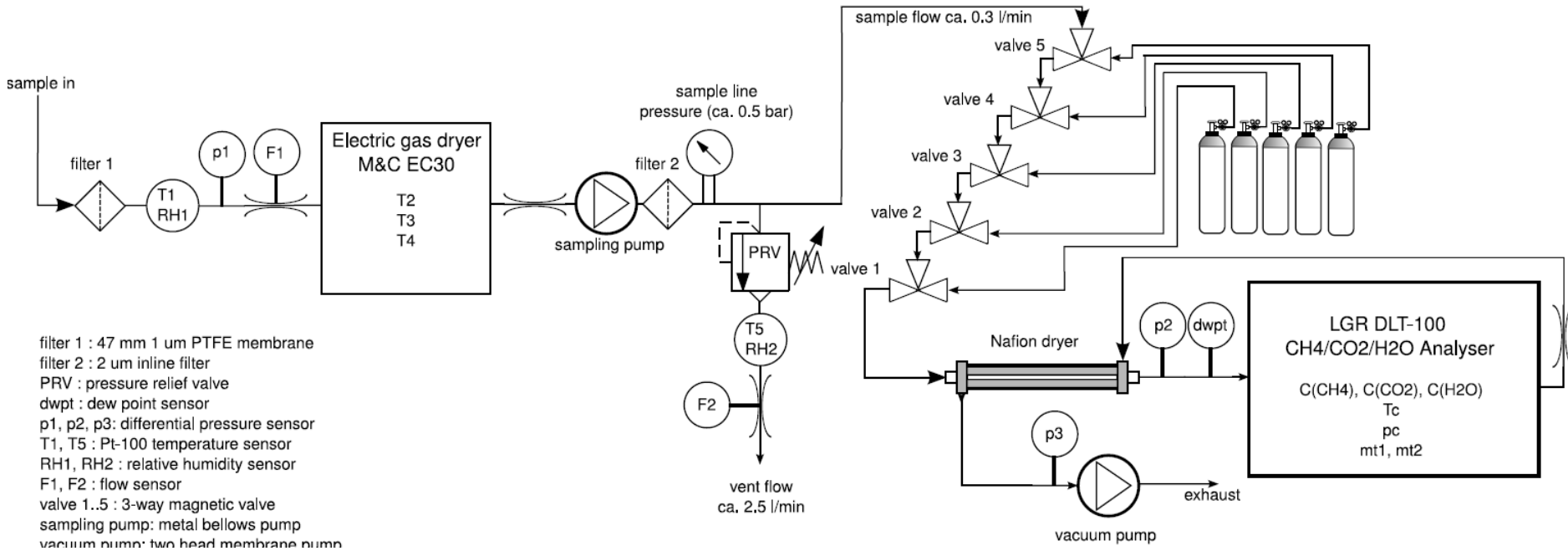


Researchers from Voeikov Main Geophysical Observatory and  
Finnish Meteorological Institute



# Measurement system

TCCCMS (Tiksi CH<sub>4</sub>/CO<sub>2</sub> Concentration Measurement System) Flow Diagram



filter 1 : 47 mm 1 um PTFE membrane  
filter 2 : 2 um inline filter  
PRV : pressure relief valve  
dwpt : dew point sensor  
p1, p2, p3: differential pressure sensor  
T1, T5 : Pt-100 temperature sensor  
RH1, RH2 : relative humidity sensor  
F1, F2 : flow sensor  
valve 1..5 : 3-way magnetic valve  
sampling pump: metal bellows pump  
vacuum pump: two head membrane pump

1. Sampling line
2. Cryo cooling drier
3. Sampling pump
4. Sample Air Control Unit
5. Working standards
6. Primary calibration standards
7. Concentration analyzer DLT-100
8. Vacuum pump
9. Control and data collection computer

Concentrations are measured in the Clean Air Facility using new laser technology by Los Gatos Research, Inc (DLT-100).  
Air is sampled from the 10 m tower.



**In Tiksi, we have 6 cylinders prepared in CCL for calibration and 2 cylinders for target gases prepared in MGO**

**Calibration gases are used for calibration.**

**Target gases are 'unknowns' for checking that system produces stable results.**

**We measured every third day 3 CCL prepared cylinders and MGO target for 7 minutes**

**Additionally MGO target was measured every 16 hour for 5 minutes**

**I used 2 CCL cylinder measurements for calibration and 1 CCL and 1 MGO cylinder as targets for checking performance**

**Calibration was done on monthly basis**



## **Methane calibration performance**

**In Tiksi, we have 6 cylinders prepared in CCL for calibration and CCL target cylinder, deviated 0.15ppb from the assigned value if we compare the average of all 16 about monthly periods.**

**SD of these about monthly values was 0.7ppb**

**The maximum and minimum deviations (of individual monthly periods) were 1.5 and -1.2ppb.**

**MGO cylinder which was measured every 16 hour, the average deviation (over 16 periods) was -0.12ppb, the max and min deviations of the individual months were 1.7 and -1.9 ppb.**



## **Methane calibration performance**

**Individual calibration measurements have higher variability.**

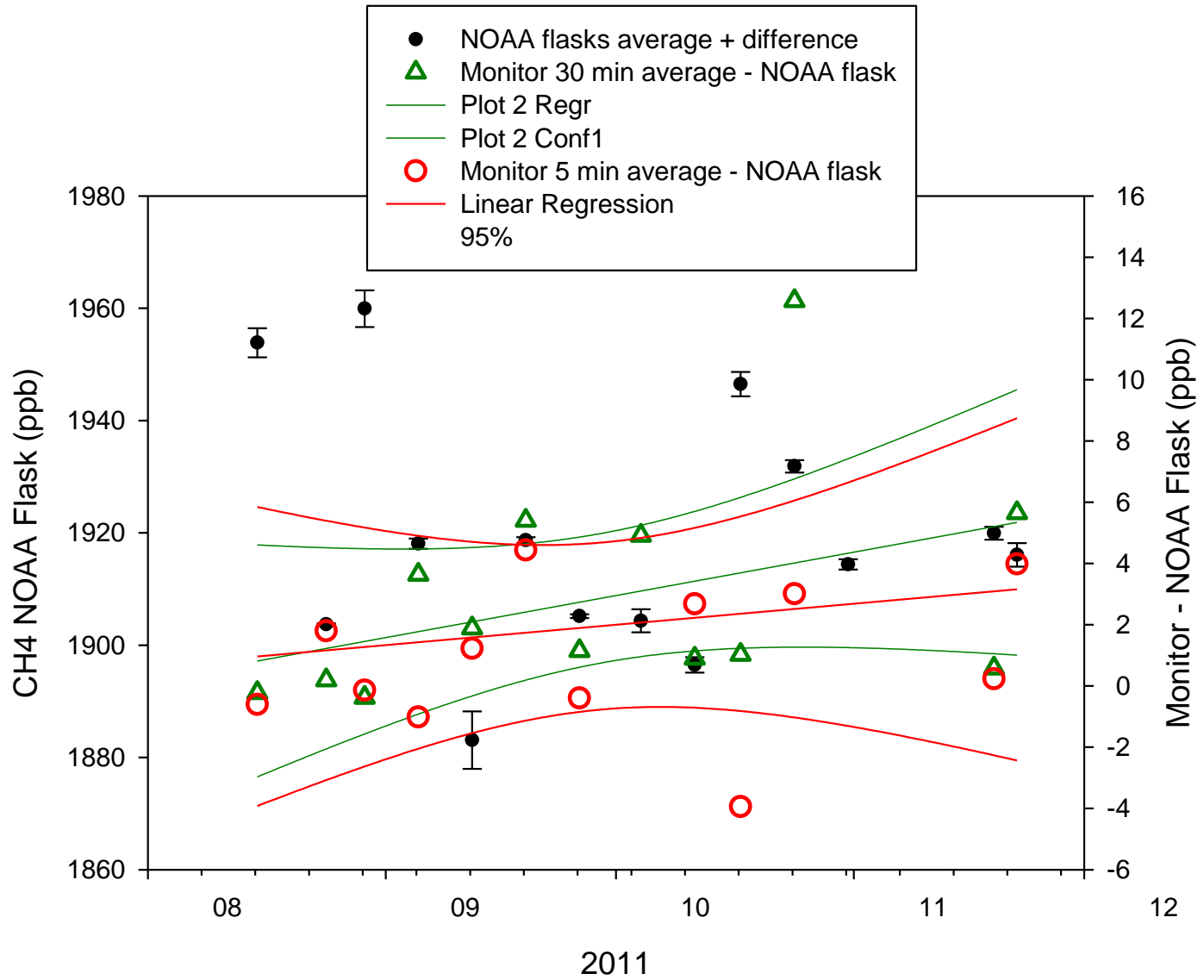
**Within a month standard deviation of calibration and target gas concentrations were close to 2 ppb.**

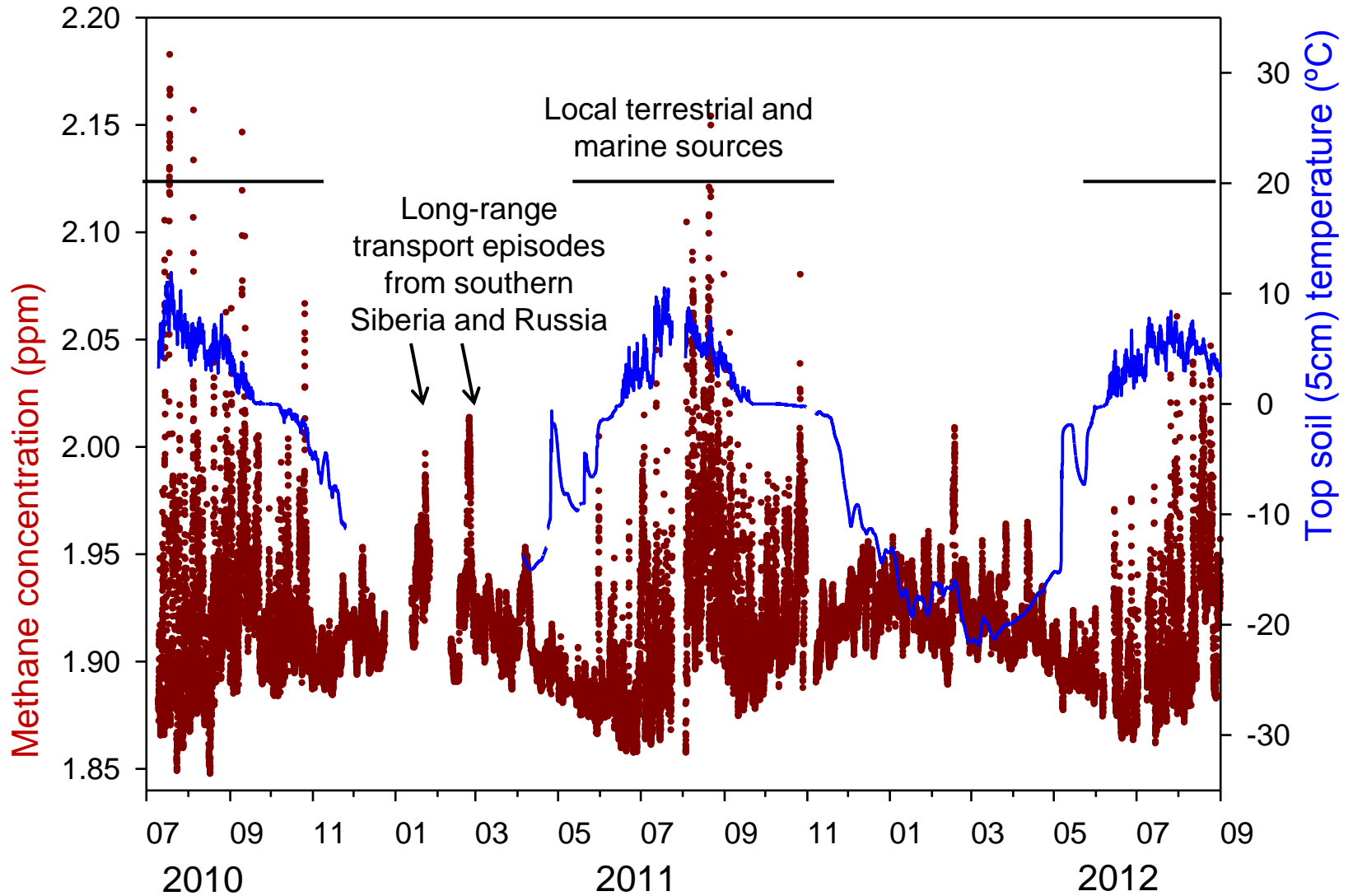
**MGO 16 hour target has on the average standard deviation of 2.0 ppb as an average over 16 about monthly periods. The highest monthly SD was 3.7 and lowest 1.2ppb.**

**The highest variability is usually in winter and lowest (luckily) in the late summer and early autumn.**

**August 2011 is very interesting. Then, MGO target deviated - 0.05 ppb and SD of the target measurements was 1.2ppb. For the NOAA cylinder, which was used as a target in the calibration cycle, the average deviation was -0.3ppb, SD 2.0ppb.**

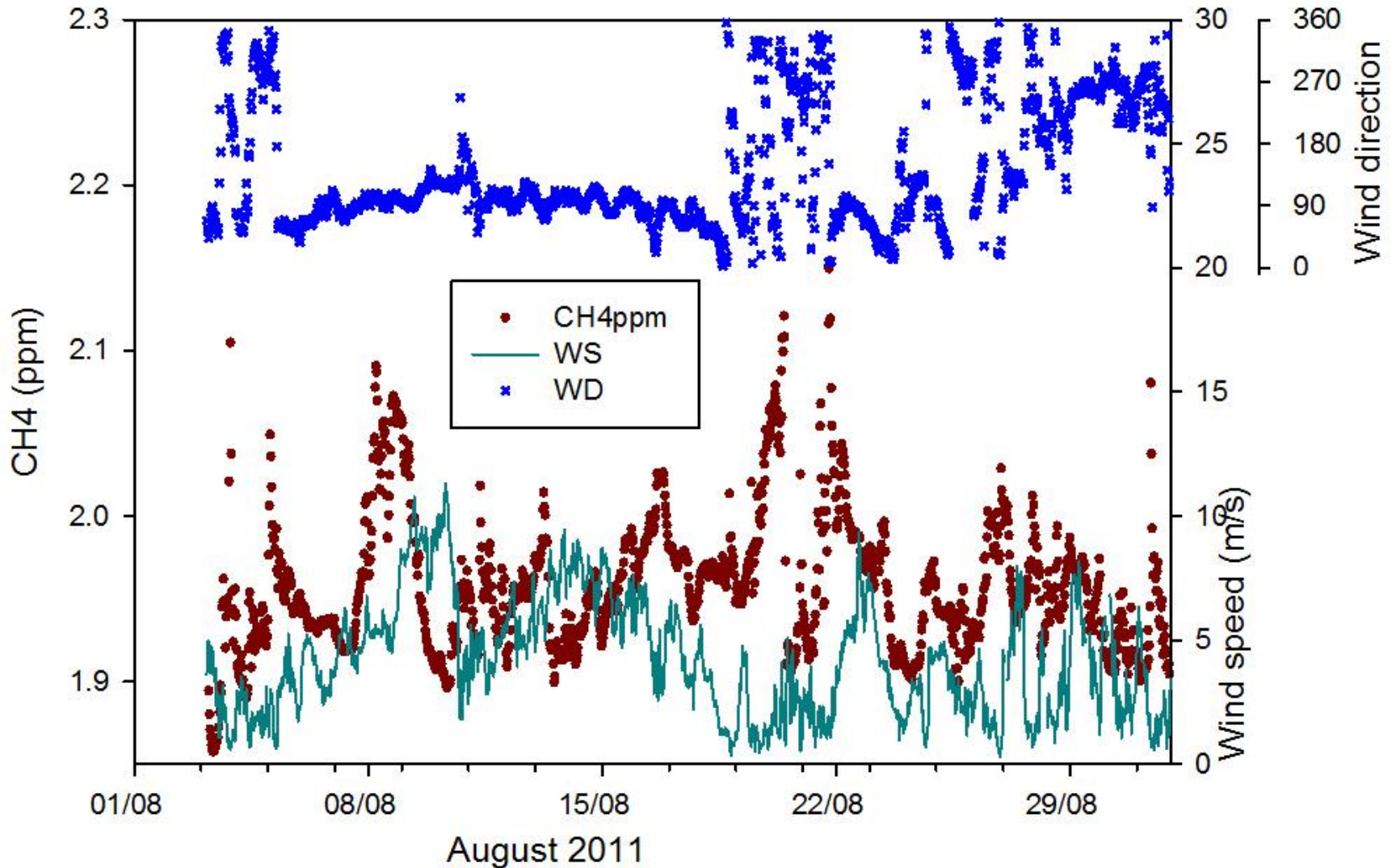






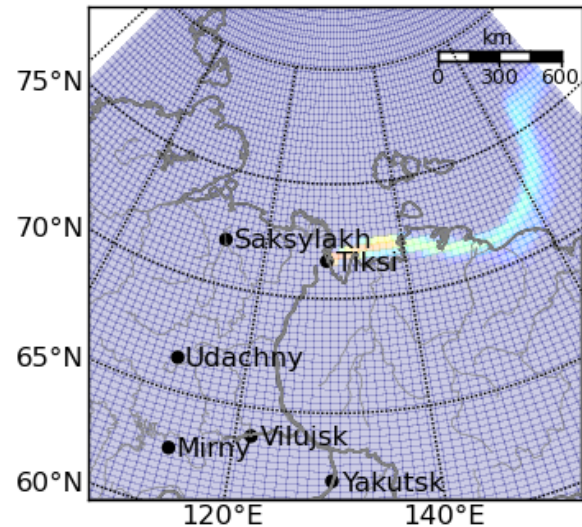
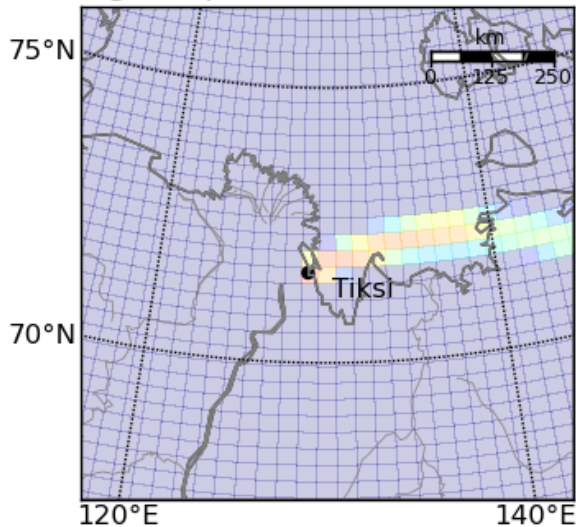
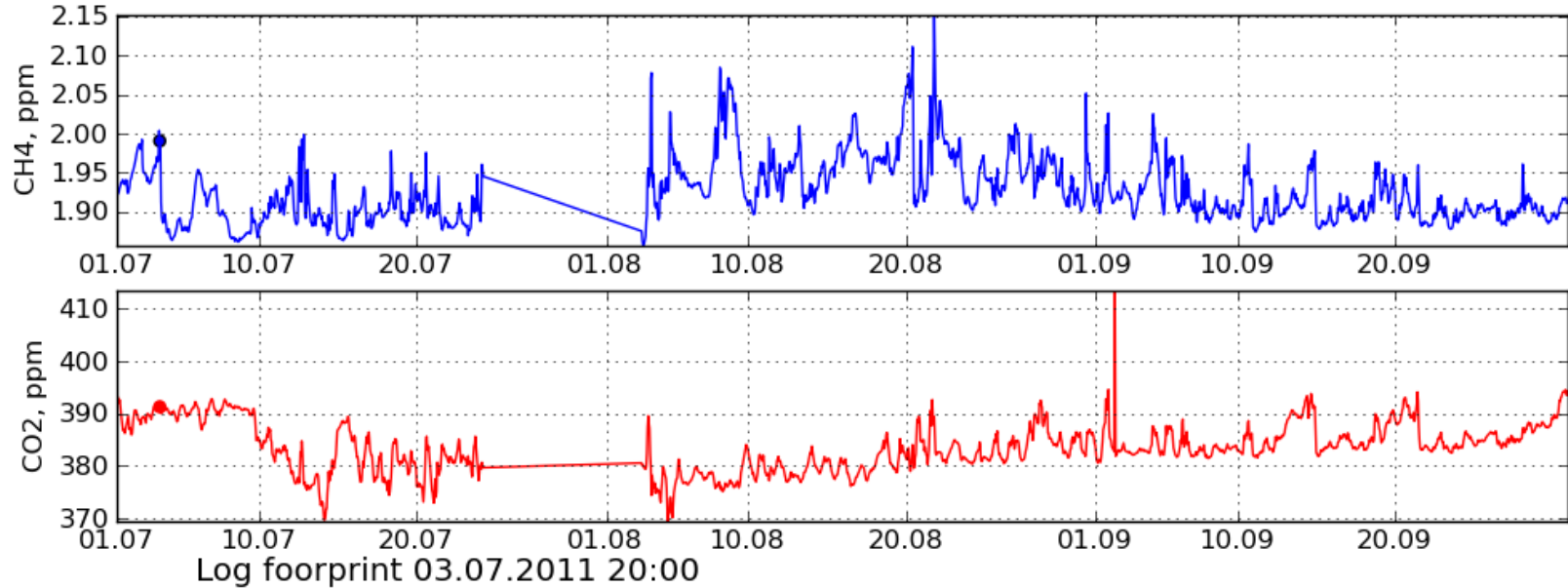


# CH<sub>4</sub> and wind in August 2011

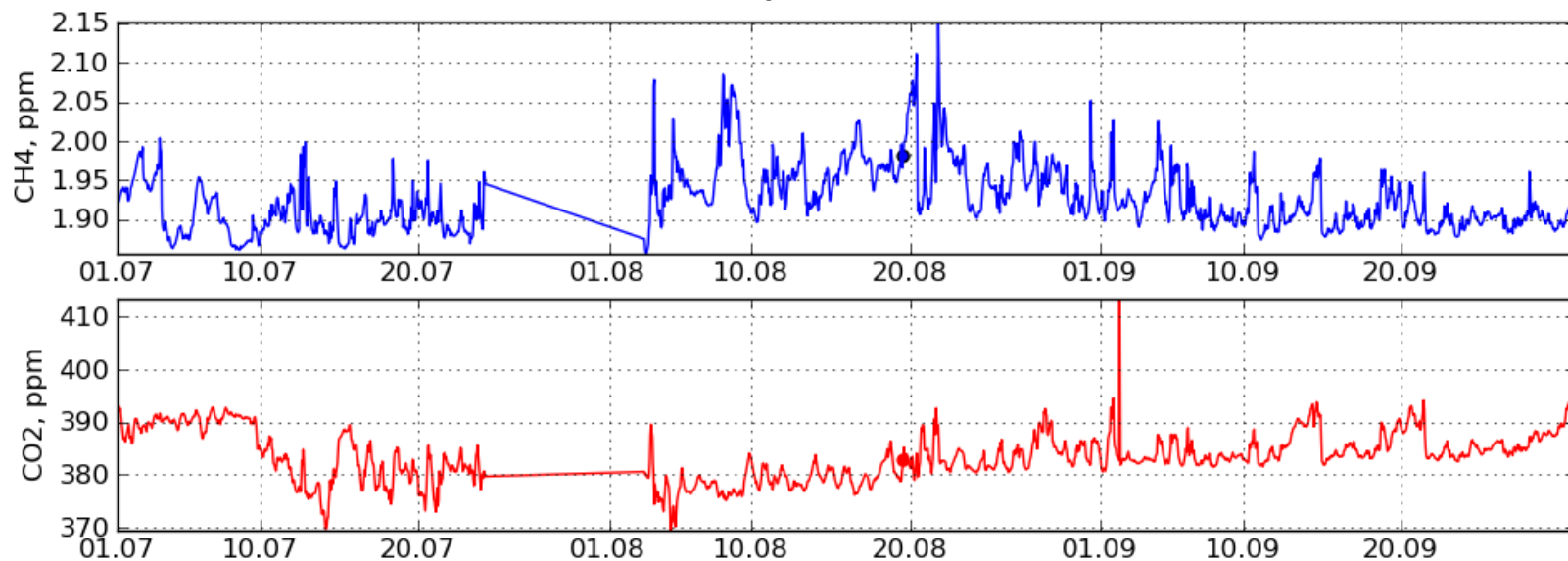




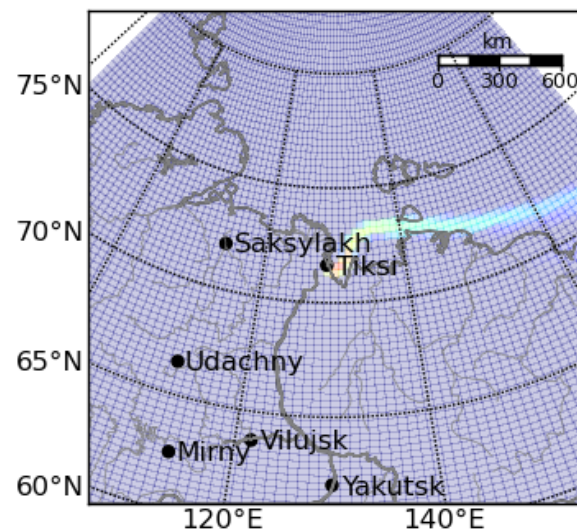
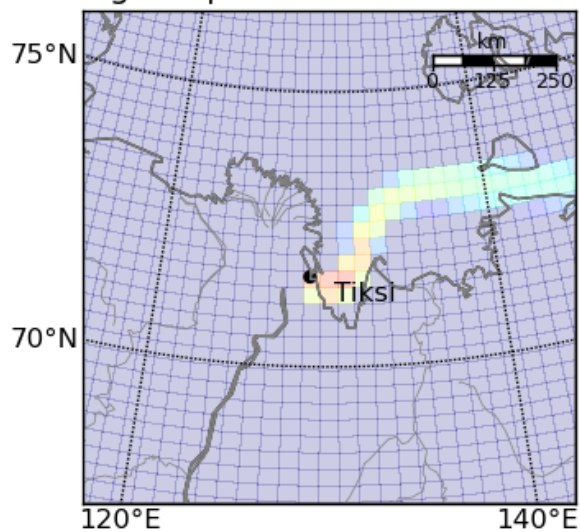
# Source areas by Kouznetsov, Sofiev



# Source areas by Kouznetsov, Sofiev



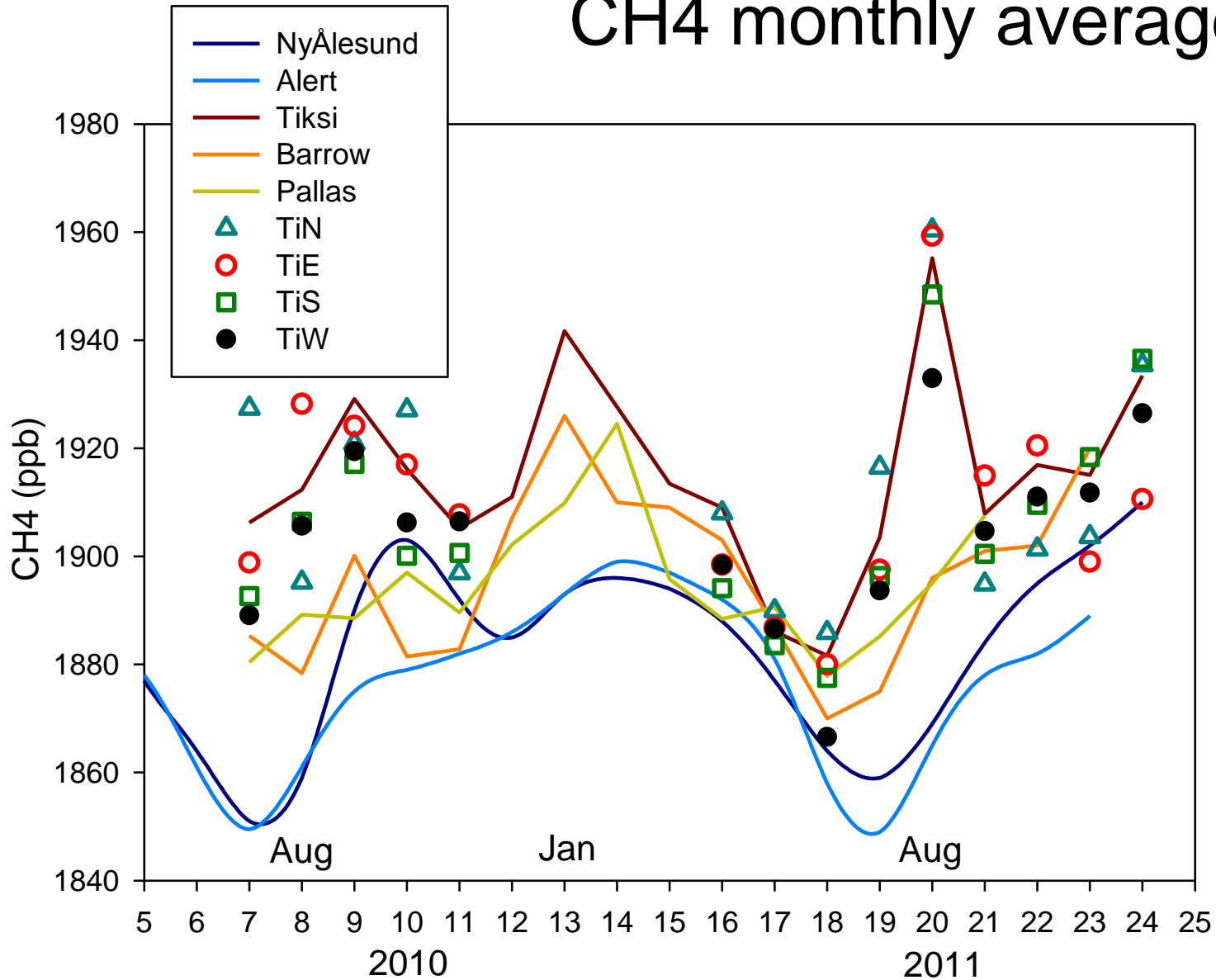
Log footprint 19.08.2011 17:00







# CH<sub>4</sub> monthly averages



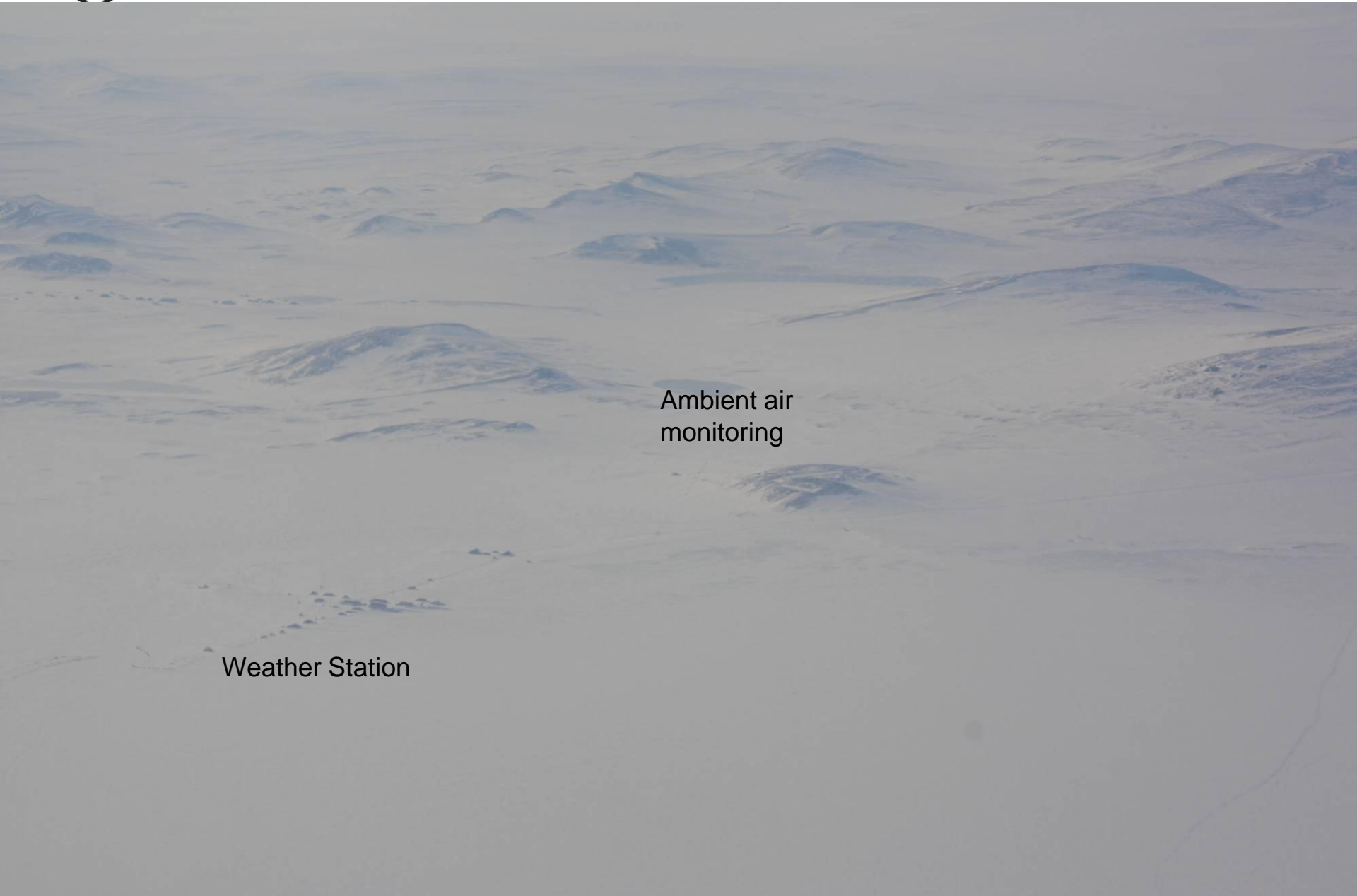


## **Conclusions:**

- **Methane concentration measurements by Los Gatos DLT100 roughly meets the GAW compatibility target**
- **Carbon dioxide measurements does not meet the target**
- **We observed interesting marine and terrestrial emissions**

## **Future:**

- **Picarro G2301**
  - **improvement of CH<sub>4</sub> precission,**
  - **CO<sub>2</sub> will meet the GAW target**
  - **We are running out of the MGO target gas**
  - **New target gas cylinder from FMI**



Ambient air  
monitoring

Weather Station