GREENHOUSE GASES MEASUREMENTS DURING THE INTERNATIONAL POLAR YEAR

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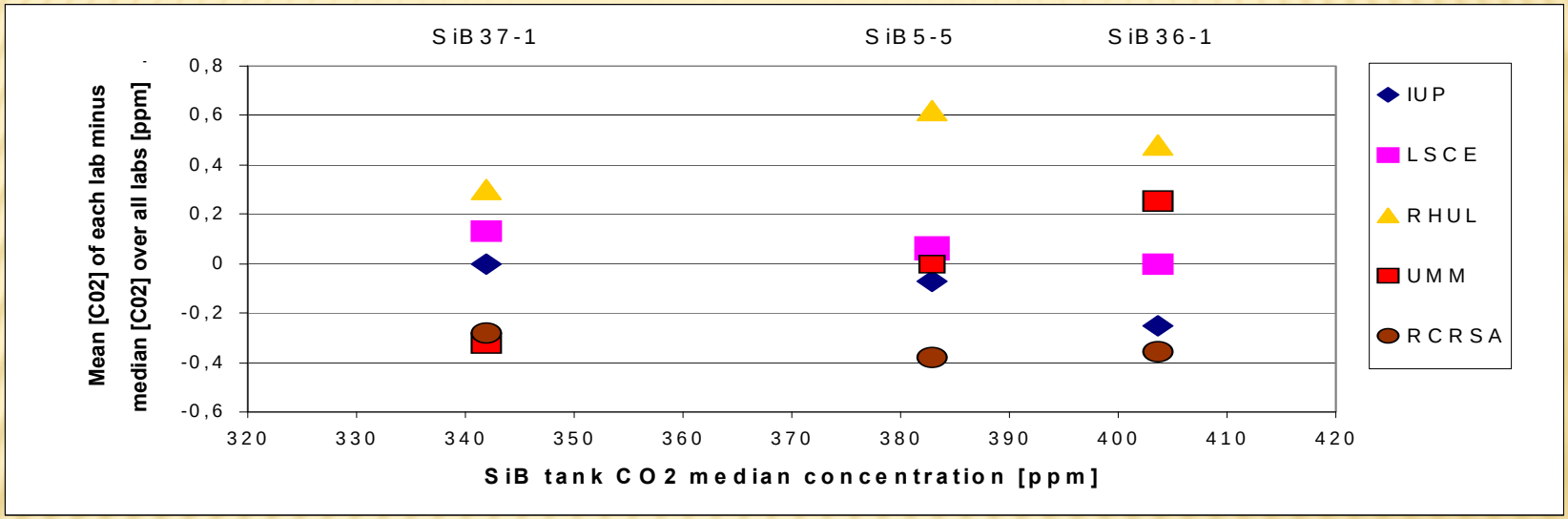
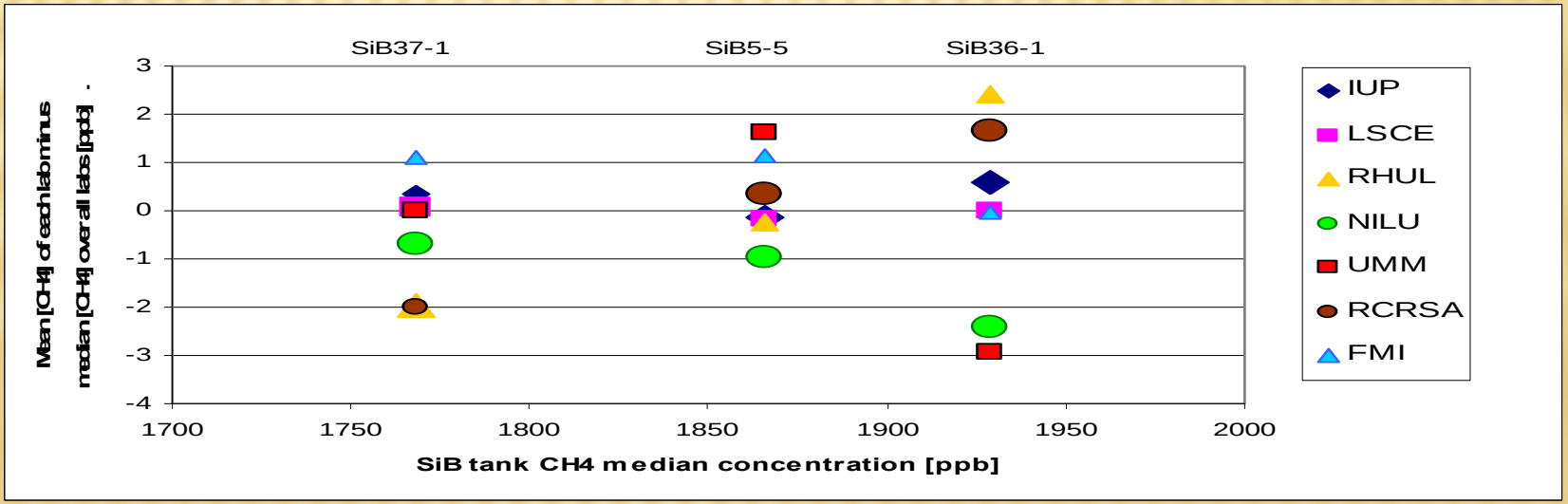
This report has two main parts. First part provides data of GHG measurements in the Arctic ocean during the POLARCAT by r/v “Akademik Fedorov”. The second part presents briefly results of regular GHG measurements on Russian Arctic stations during 2003-2007.

PARAMETERS OF INSTRUMENTS AND METHOD

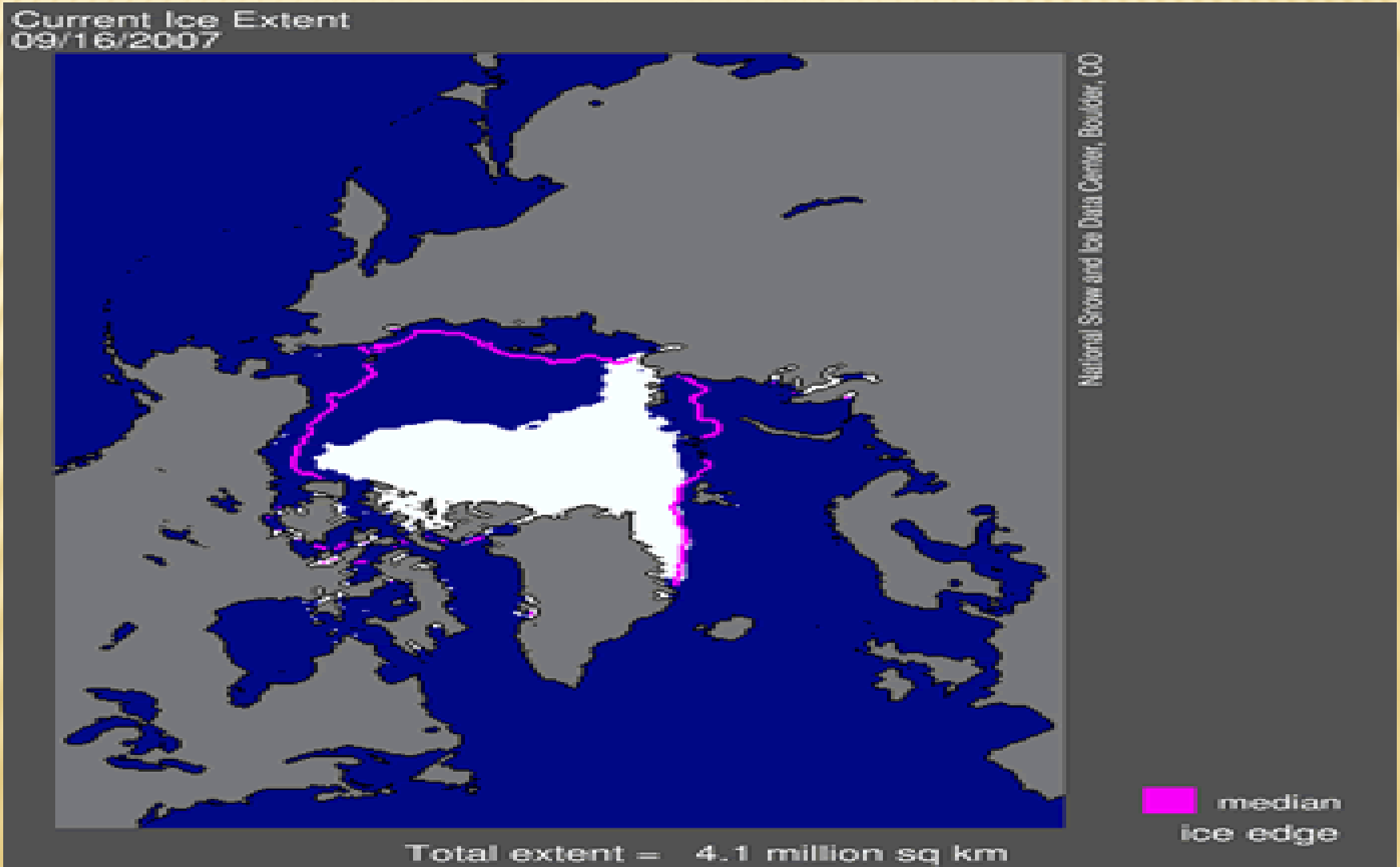
Near in our report we present the data of GHG measurements received during some routes of r/v “Akademik Fedorov” in Arctic Ocean in summer of 2007-2008 and ice drifting unit NP-35 in April 2008. For data receiving we used the pair flasks sampling method. Air probes analysis had been carried out in the laboratory. The CO_2 concentration measured by the URAS-2T gas analyzer, concentration of CH_4 by the gas chromatograph Tsvet-500M. For the calibration of GHG scales we used 5 gas standards of NOAA and 3 working standards of the Stockholm University (CO_2) and 1 gas standards from Heidelberg University (CH_4). We carried out comparisons of CO_2 and CH_4 measurements scales with some of European laboratories in 2004. The results of comparisons showed on the next slide. As indicated on it a maximum difference from the control value was – 0.38 ppm (0.1%) for CO_2 and 2 ppb (0.11%) for CH_4 .

Difference of data CO_2 and CH_4 measurements of gas control tank in some European laboratory and (RCRSA) MGO (brown circles) to its true value. Institut für Umweltphysik, University of Heidelberg, Germany (IUP) Laboratory des Sciences de Climate et de l'Environement , France (LSCE), Royal Holloway, University of London, UK (RHUL) NILU – Norvay (NILU) and etc.





NEXT FIGURE PRESENTS THE SITUATION ON ARCTIC OCEAN IN SEPTEMBER 16, 2007, WHEN ABSOLUTE MINIMUM OF THE ICE AREA (NEAR 4.13 MILLION SQUARE KM) WAS ACHIEVED. THE VIOLET LINE SHOWS BORDERS OF SOLID ICE FOR SEPTEMBER 1979.



PART 1
OBSERVATIONS OF GHG IN ARCTIC OCEAN IN 2007-2008

DATA OF AIR SAMPLING FOR 2007-2008

Direct track of R/V Akad. Fedorov

Sample #	Date
1	26.07.2007
2	27.07.2007
3	27.07.2007
4	28.07.2007
5	29.07.2007
6	30.07.2007
7	31.07.2007
8	31.07.2007
9	02.08.2007

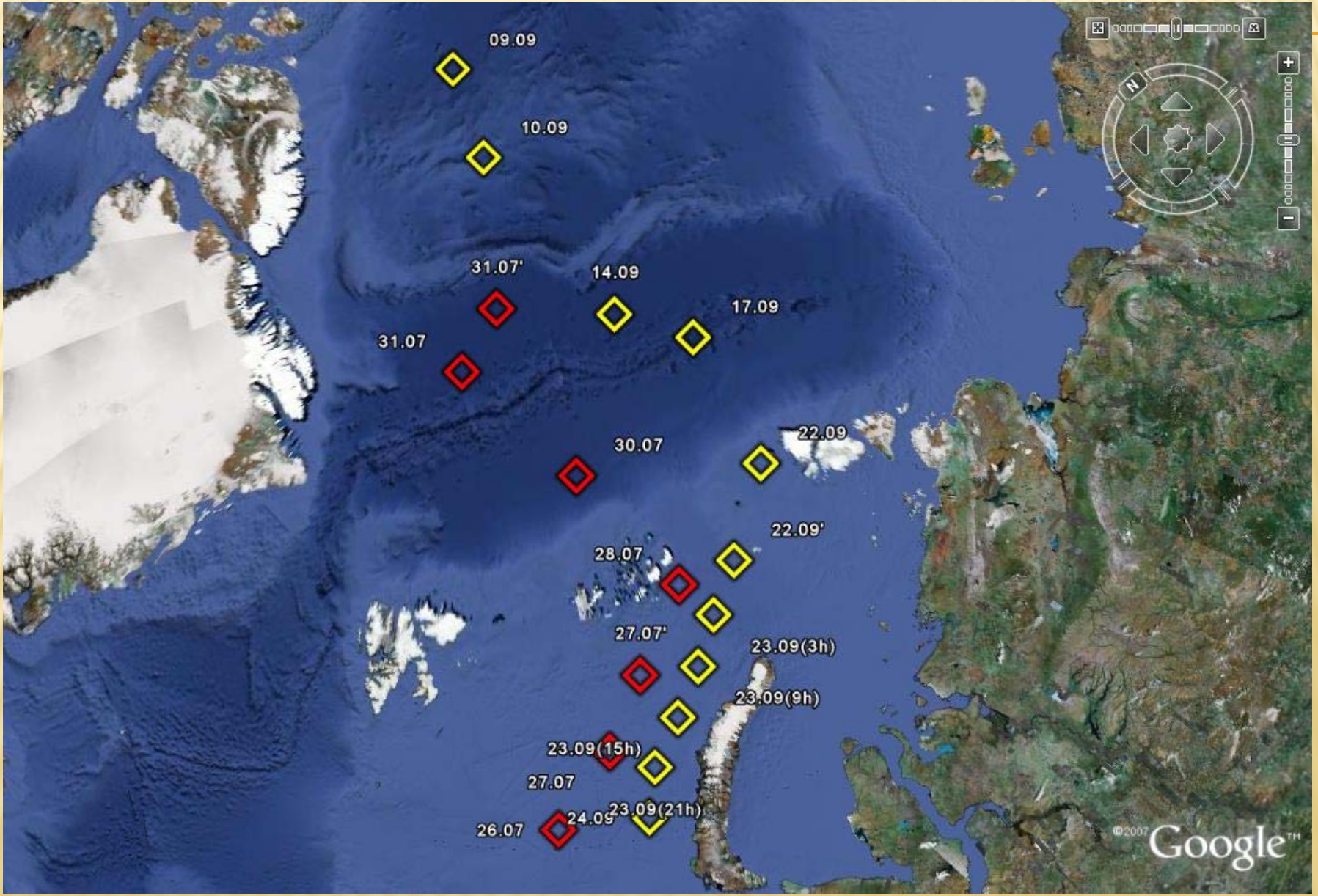
Reverse track of R/V Akad. Fedorov

Sample #	Date
1	09.09.2007
2	10.09.2007
3	12.09.2007
4	14.09.2007
5	17.09.2007
6	17.09.2007
7	22.09.2007
8	22.09.2007
9	22.09.2007
10	23.09.2007
11	23.09.2007
12	23.09.2007
13	23.09.2007
14	24.09.2007

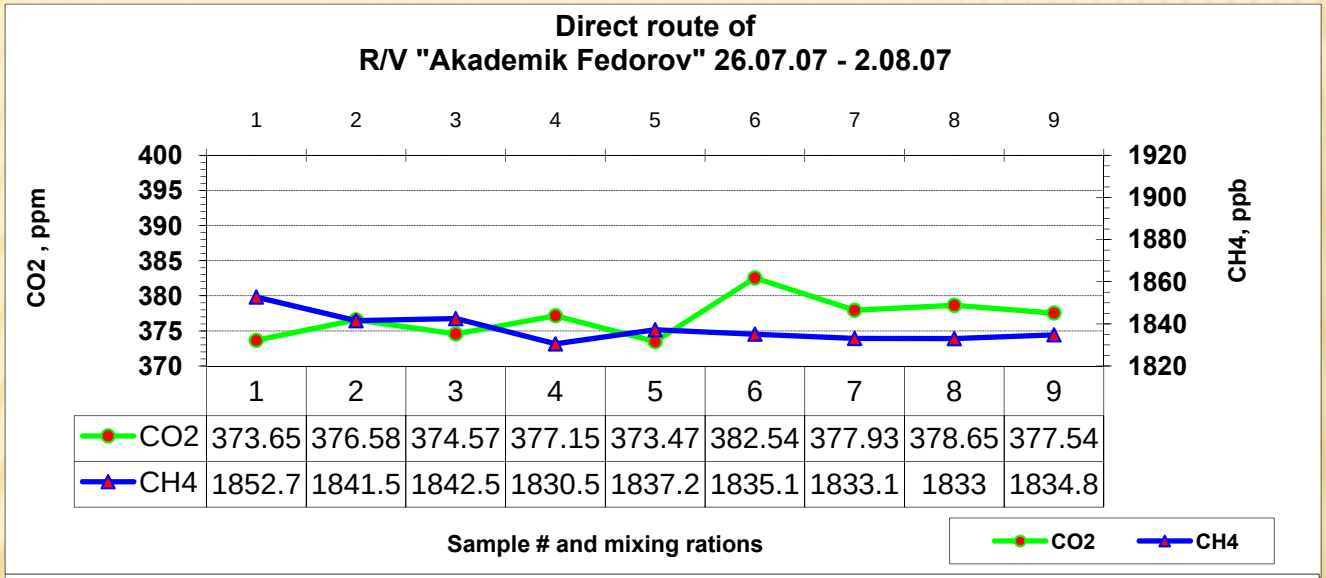
Drifting ice-station

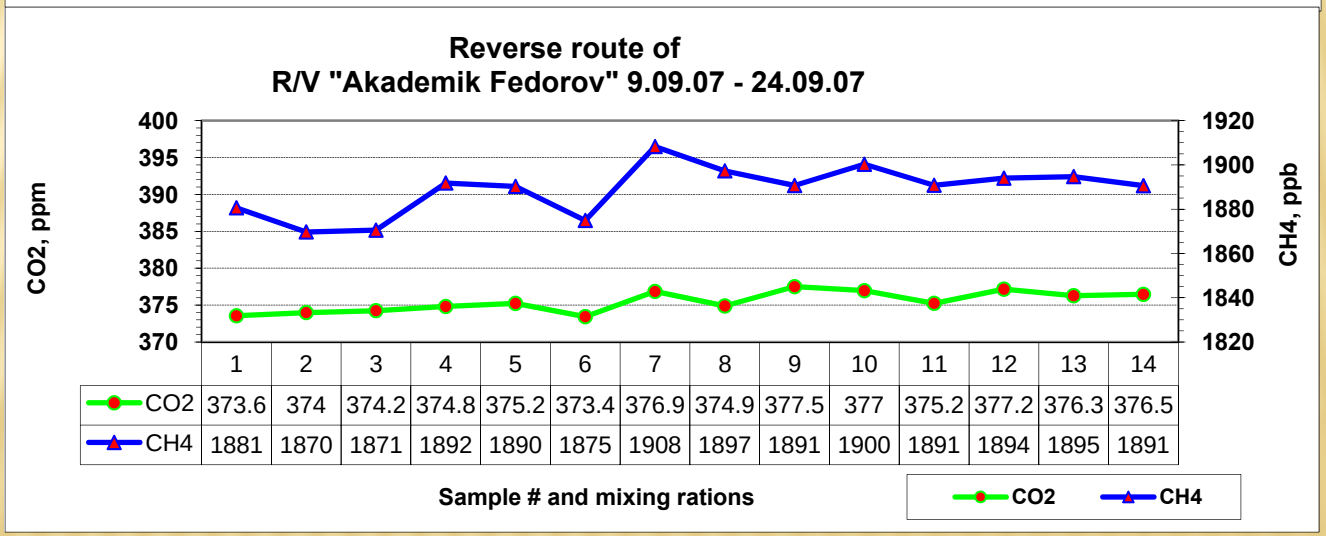
Sample #	Date
1	11.04.2008
2	13.04.2008
3	16.04.2008
4	18.04.2008
5	20.04.2008
6	22.04.2008
7	23.04.2008
8	24.04.2008

The route of r/v “Aralemik Fedorov” in August – September 2007

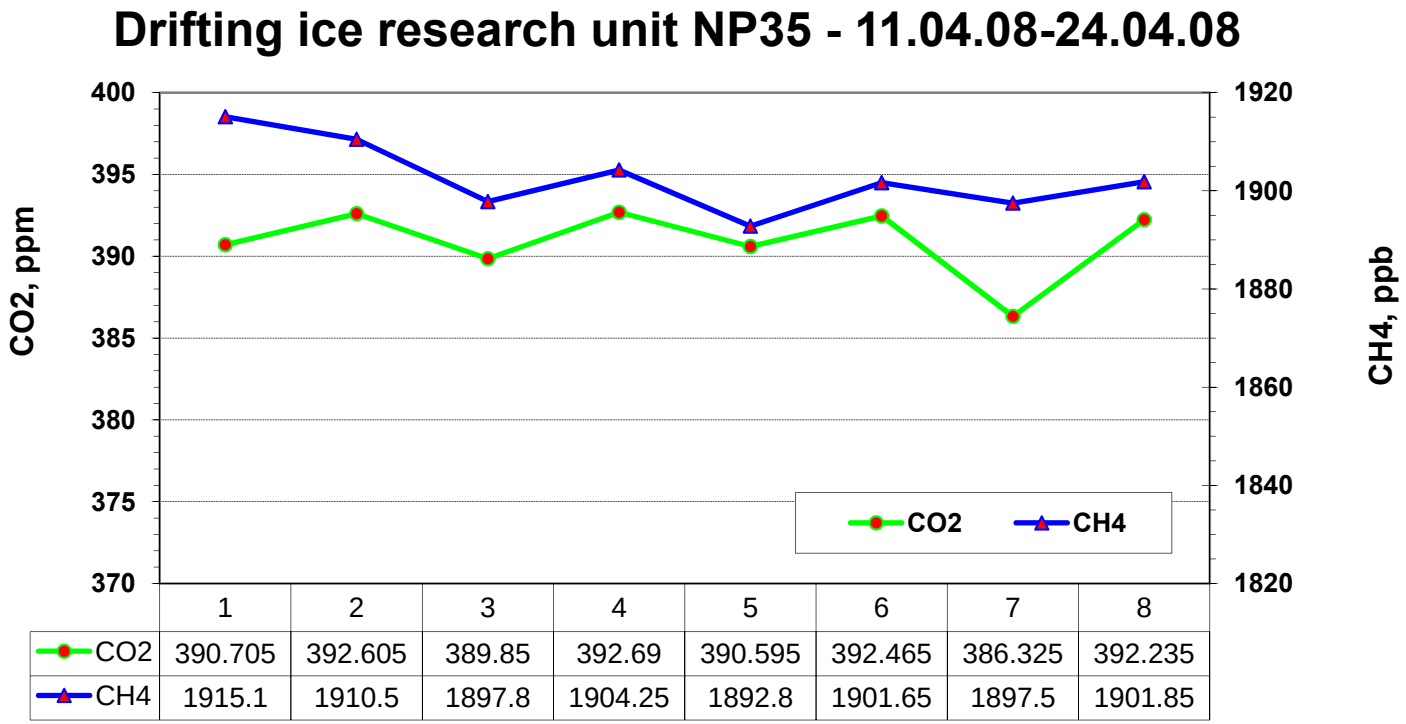


DATA OF CO2 AND CH4 FLASKS SAMPLING MIXING RATIOS MEASURED ON R/V "AKADEMIK PHEDOROV" IN 2007 (ROUTES OF R/V SHOWED ABOVE).



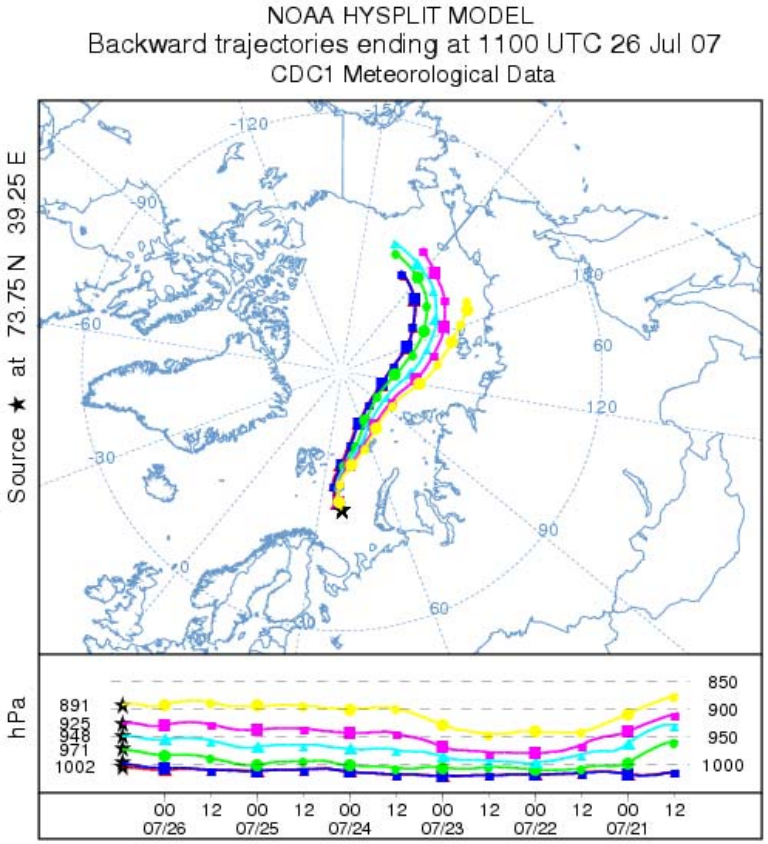


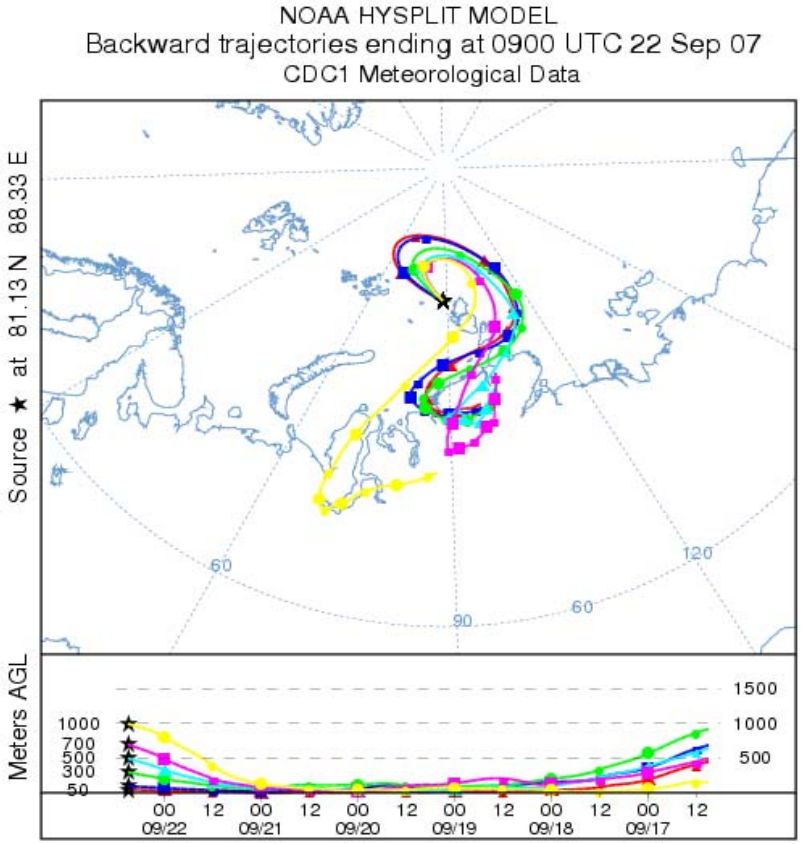
Data of CO_2 and CH_4 mixing ratio measurements on NP-35



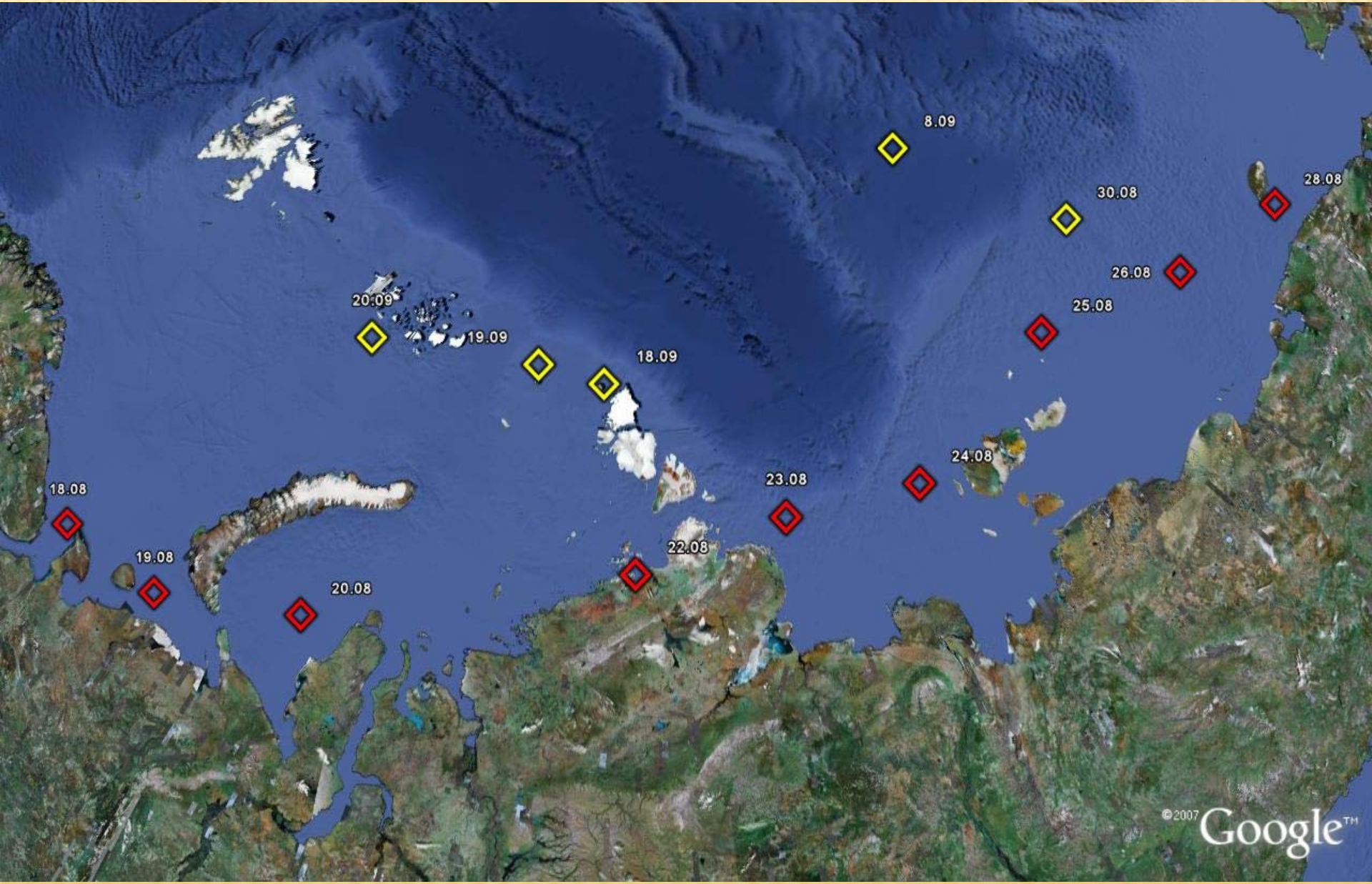
	1	2	3	4	5	6	7	8
CO2	390.705	392.605	389.85	392.69	390.595	392.465	386.325	392.235
CH4	1915.1	1910.5	1897.8	1904.25	1892.8	1901.65	1897.5	1901.85

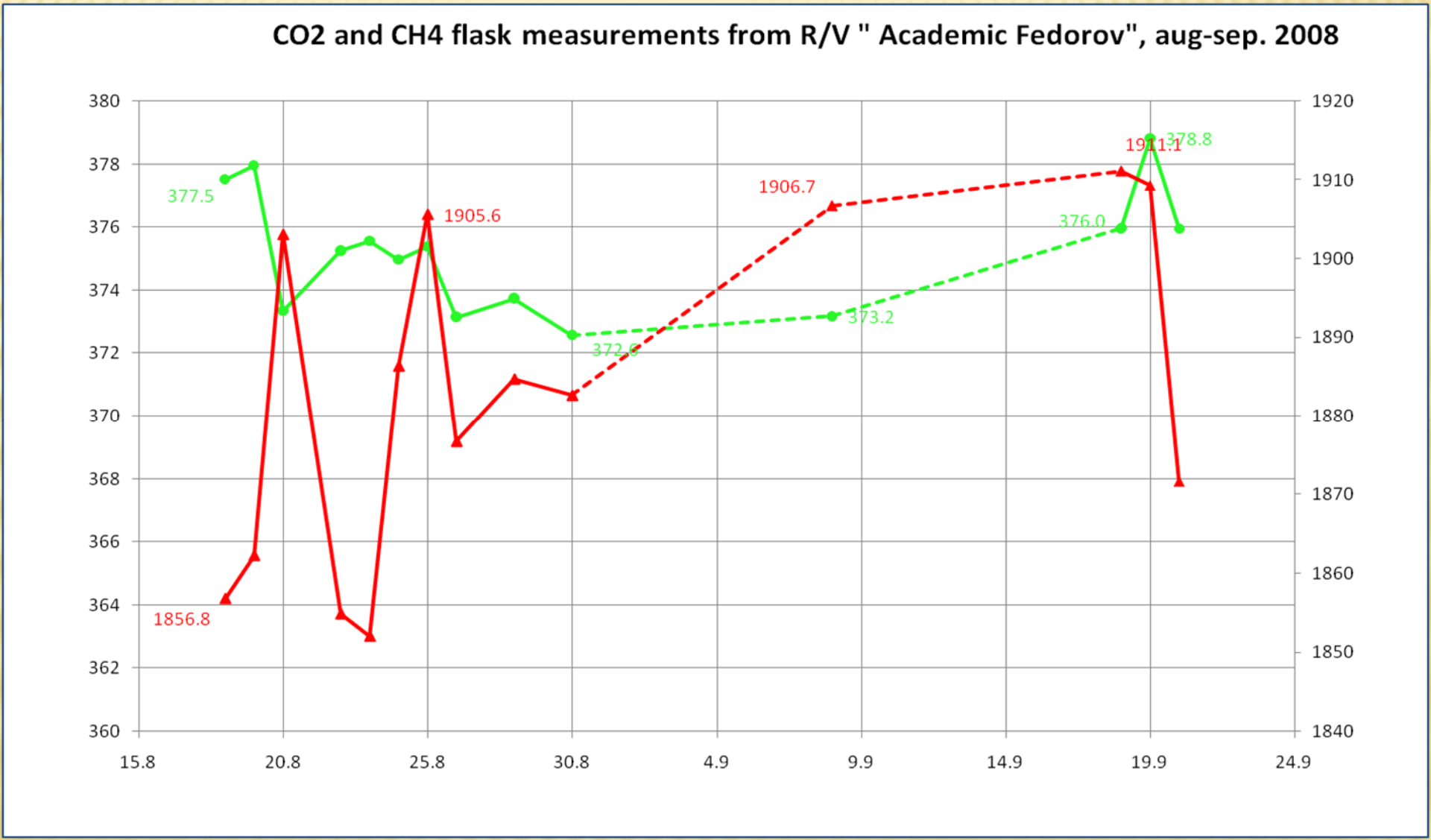
Number of the point of air sampling and mixing rations

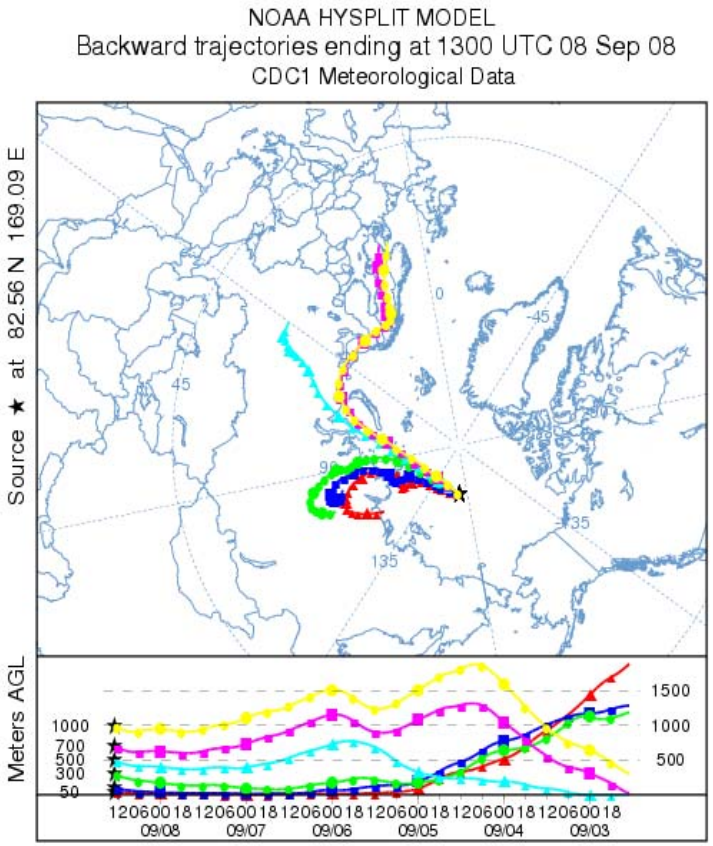

NOAA HYSPLIT MODEL
Backward trajectories ending at 1100 UTC 26 Jul 07
CDC1 Meteorological Data
Source ★ at 73.75 N 39.25 E
hPa
891
925
948
971
1002
850
900
950
1000
00 12 00 12 00 12 00 12 00 12 00 12 00 12
07/26 07/25 07/24 07/23 07/22 07/21

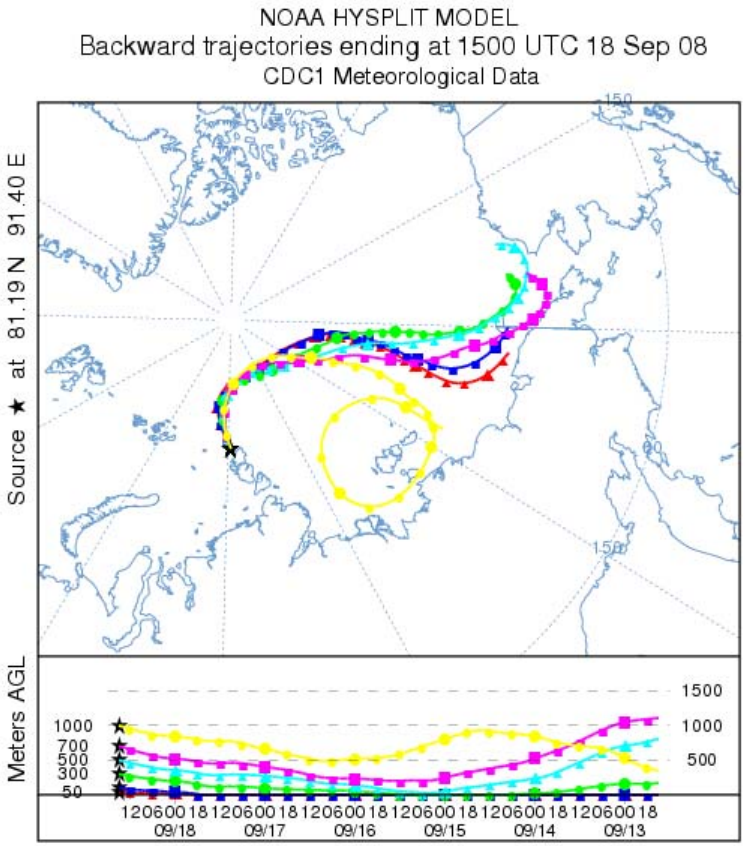

NOAA HYSPLIT MODEL
Backward trajectories ending at 0900 UTC 22 Sep 07
CDC1 Meteorological Data
Source ★ at 81.13 N 88.33 E
Meters AGL
1000
700
500
300
50
1500
1000
500
00 12 00 12 00 12 00 12 00 12 00 12 00 12
09/22 09/21 09/20 09/19 09/18 09/17

The route of r/v “Aralemik Fedorov” in August – September 2008




CO2 and CH4 flask measurements from R/V " Academic Fedorov", aug-sep. 2008
380
378
376
374
372
370
368
366
364
362
360
1920
1910
1900
1890
1880
1870
1860
1850
1840
15.8
20.8
25.8
30.8
4.9
9.9
14.9
19.9
24.9
377.5
1905.6
1856.8
1906.7
1911.1
378.8
376.0
373.2
372.6


NOAA HYSPLIT MODEL
Backward trajectories ending at 1300 UTC 08 Sep 08
CDC1 Meteorological Data
Source ★ at 82.56 N 169.09 E
Meters AGL
1000
700
500
300
50
1500
1000
500
120600 18 120600 18 120600 18 120600 18 120600 18 120600 18 120600 18
09/08 09/07 09/06 09/05 09/04 09/03


NOAA HYSPLIT MODEL
Backward trajectories ending at 1500 UTC 18 Sep 08
CDC1 Meteorological Data
Source ★ at 81.19 N 91.40 E
Meters AGL
1000
700
500
300
50
1500
1000
500
120600 18 120600 18 120600 18 120600 18 120600 18 120600 18 120600 18
09/18 09/17 09/16 09/15 09/14 09/13

ANALYSIS OF DATA 2007-2008

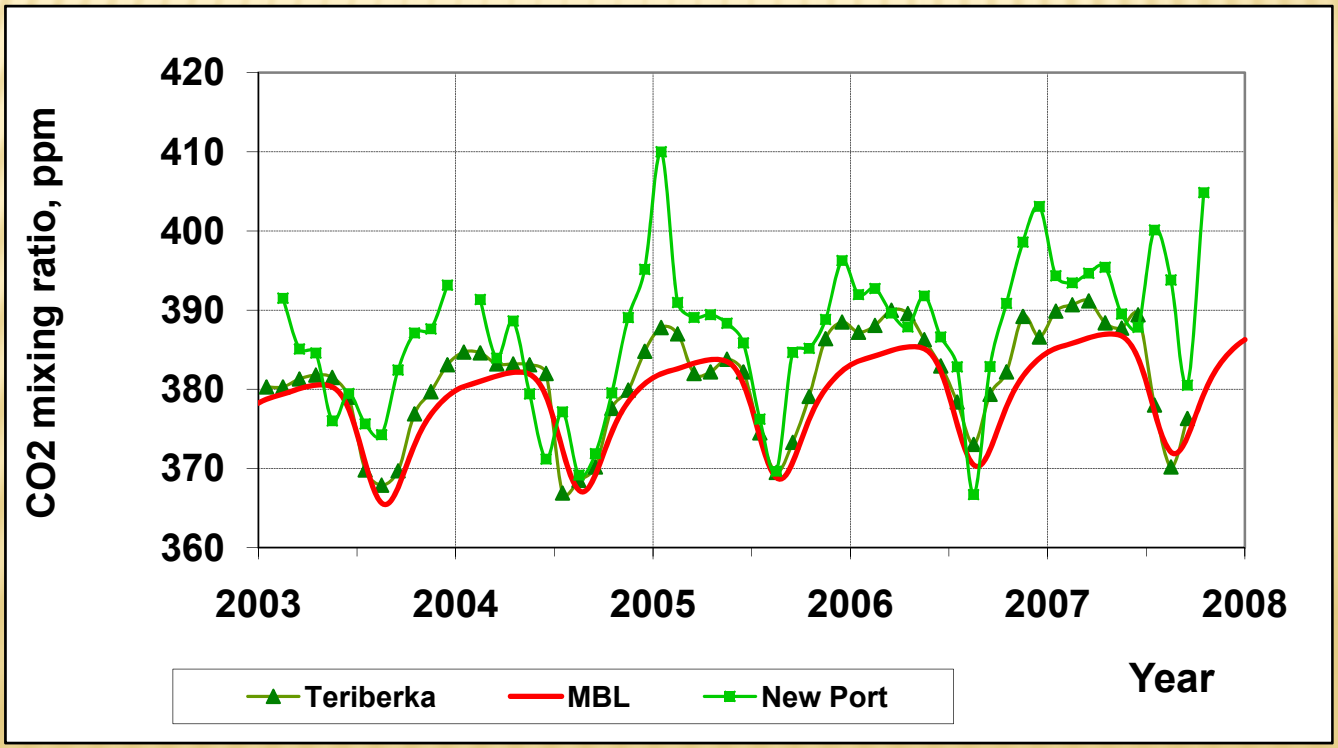
As it had seen from previous figures, there were observed at least two anomalies of CO_2 and CH_4 concentrations: 1) a growth of carbon dioxide to the North of 82^0 n.l. in the last week of July (about 4-5 ppm), 2) very high CH_4 concentrations (1890 -1900 ppb) on the part of route from the Severnaia zemla island to Novaia zemla island.

CO_2 anomaly in all possibility had caused by crossing of r/v "Akademik Phedorov" the region of solid ice, when all back air mass trajectories (NOAA Hysplit model) showed transfer from the North. CH_4 anomaly may be caused by two reasons: a transport of the polluted air mass through the region of natural gas deposits (the southern transfer) and a transport of cold air mass from the North, where activity of OH-radicals was decreased. The same situation was observed on drift ice research unit NP-35, but it was located of 10^0 to the North of the r/v route.

During September 2008 greater part of r/v route run near the route 2008 but in the back direction. How in 2007 there were observed some points with high CH_4 concentrations, but few points have lesser concentrations. For some from them trajectory analysis was carried out.

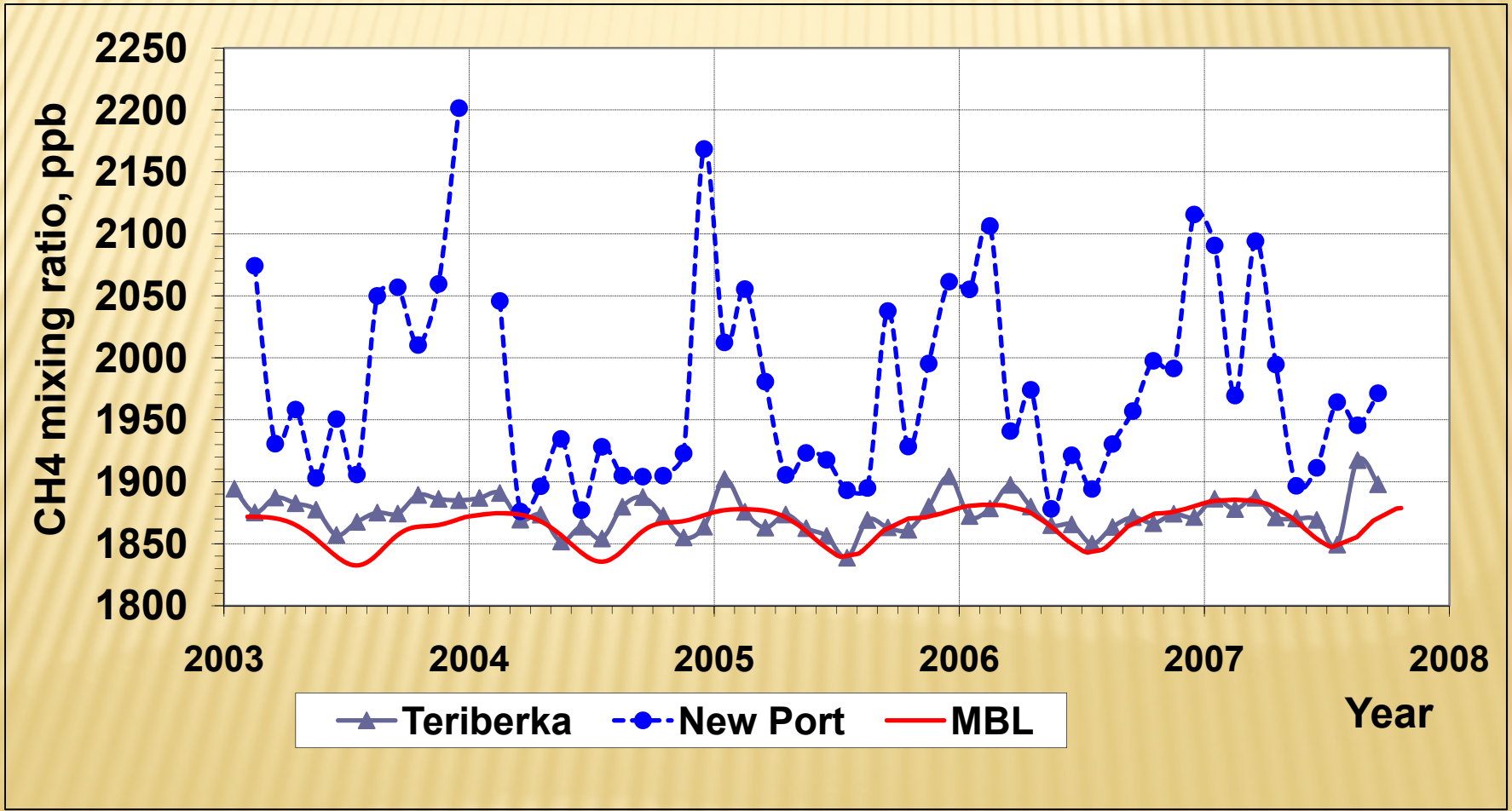
Russian network of GHG monitoring stations in the arctic region. New Port and Teriberka are operating stations. Measurements on the Tiksi observatory are planning to begin in September 2009

Data of CO2 mixing rations observed at New Port and Teriberka stations in comparisons with mbl. As indicated by figure there was observed exceeding of the amplitude of seasonal variations of CO2 concentrations over MBL (what is used as the reference level) on 20 – 80% (New Port) and on 9 – 15% (Teriberka). The last difference may be explain by the weather conditions, but a variation more than 20% is not easy to explain. Most likely a reason of high amplitudes is the oil gas burning in the oil deposits located about 800-1000 km to the South. An average annual trend of the MBl estimated, as 1.5 ppm per year, but for New Port it is estimated as 2.8 - 3.0 ppm per year.



Comparison between CH4 average monthly mixing rations observed at New Port, Teriberka stations and MBL.

As indicated by figure there was observed exceeding of the amplitude of seasonal variations of CH4 concentrations over MBL in 5-6 time. In all probability it caused by leakages and technological discharges in the region of natural gas deposits on Pur-Tazovski peninsula located about 80-250 km from station. The regional background exceed MBL and Teriberka background on 100-110 ppb.



CONCLUTION

As it follows from results of GHG observations on r/v Academik fedorov:

- there is a large range of variation of CO_2 (373 – 383 ppm) and CH_4 (1830-1910 ppb) concentrations in Arctic Ocean in short summer season (August – September) in the latitudes range from 72 to 90^0,
- these variations exceed the same variations of arctic background stations,
- there is strong impact of anthropogenic sources of Siberia on a forming regional background in Arctic (exceeding of the seasonal variation of MBL for New Port station up to 80% foe CO_2 and 500-600% for CH_4),
- all those results show a necessity of more extensive investigations of GHG in Russian Arctic, where the climate warming occur more extensive.

THANKS