



# St. Petersburg city campaign (EMME)



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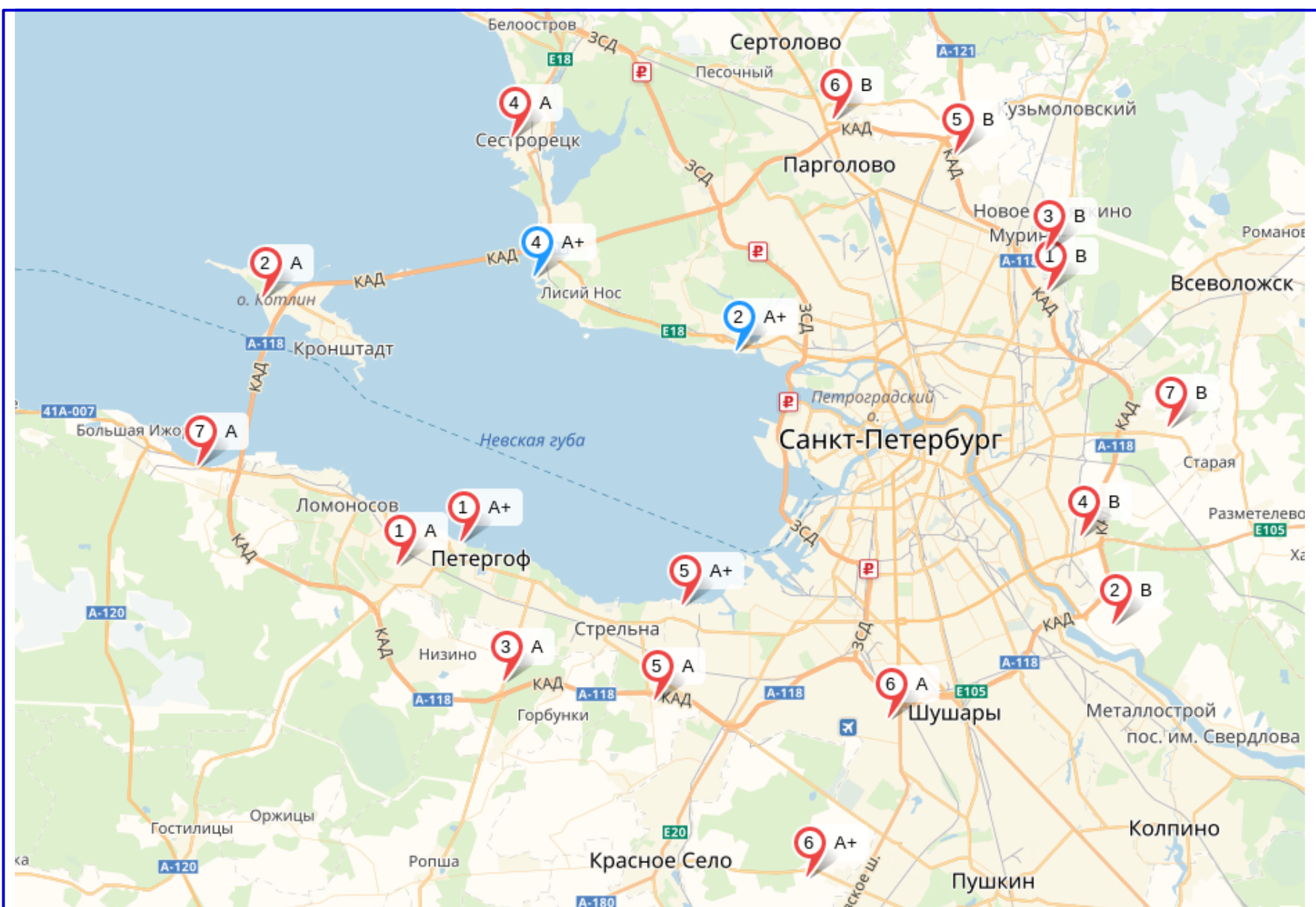
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The concept and first preliminary results of the **EMME** observational campaign - the **Emission Monitoring Mobile Experiment**, carried out by SPbU, KIT and Bremen University in March-April 2019, are presented.

The campaign was based on the mobile remote sensing measurements of direct and scattered solar radiation in various spectral ranges (Frey 2019, Ionov 2015).

The goal of EMME is to estimate the emission of CO<sub>2</sub>, CH<sub>4</sub>, CO and NO<sub>2</sub> for St. Petersburg - a megacity with a population of ~ 5 million (Hase 2015).

The solution to this problem was based on a combined approach. An important step was the planning of the experiment - a few hours before the start of mobile measurements, the position of St. Petersburg NO<sub>2</sub> plume was forecasted using the HYSPLIT dispersion model (Stein 2015). The forecast made it possible to identify preliminary up- and downwind locations of measurement points for two mobile crews carrying Bruker EM27/SUN FTIR spectrometers. Having started measurements, the crews received real-time information on the current localization of the megacity plume: the NO<sub>2</sub> vertical column is monitored by using mobile DOAS measurements around the city ring. On the basis of this information, the EM27/SUNs were moved, if necessary, to the most appropriate locations.

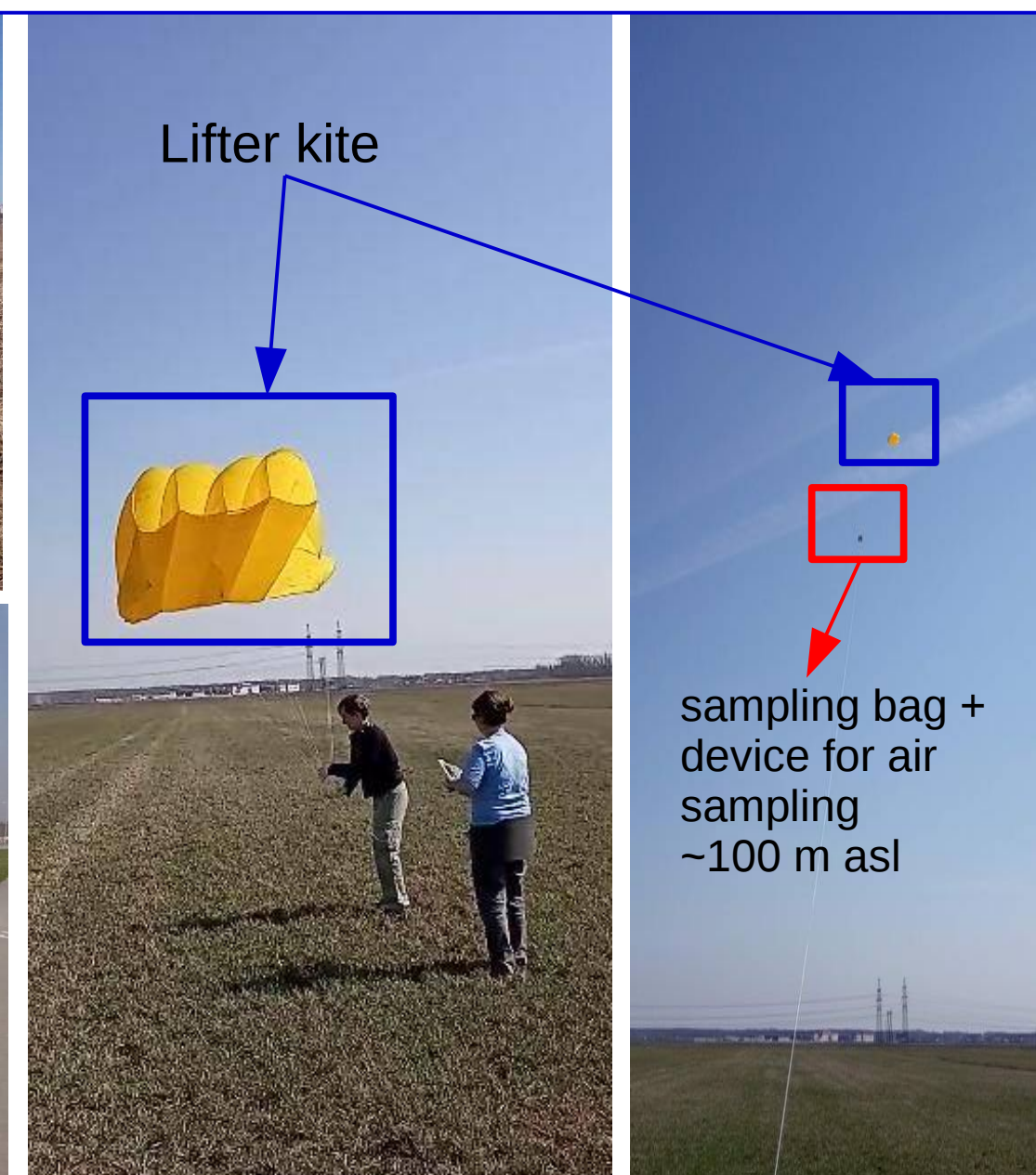


The set of the points for the possible up- and downwind positioning of two EM27/SUNs has been checked during the preparatory stage of the EMME (December 2018 – February 2019). Observational points are mostly located near the St.Petersburg ring roadway. Point 1A – is the location of the Faculty of Physics, SPbU.

List of the location of EM27/SUNs (#80 and #84) during the EMME campaign.

Red – in the city plume  
 blue – clean sector:

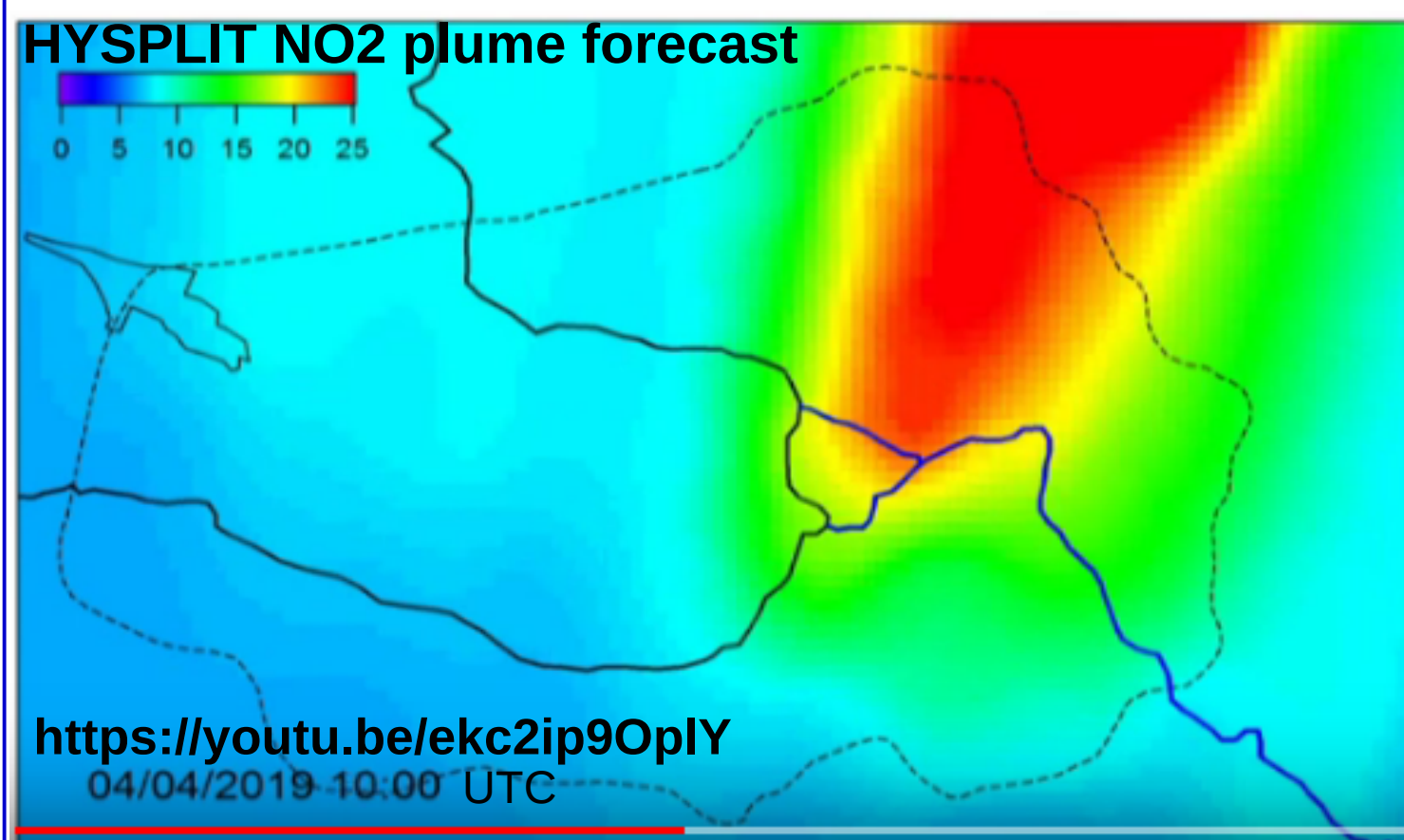
Date	#80	#84
20190321	1A	7B
20190327	2B	2A
20190401	2B	2A
20190403	3B	1A
20190404	3B	5A
20190406	2A	7B
20190412	1A	1A
(side-by-side obs.)		
20190416	5A+	2A
20190418	3B	5A,6A+
20190424	2B	2A
20190425	3B	5A
20190430	2B	2A



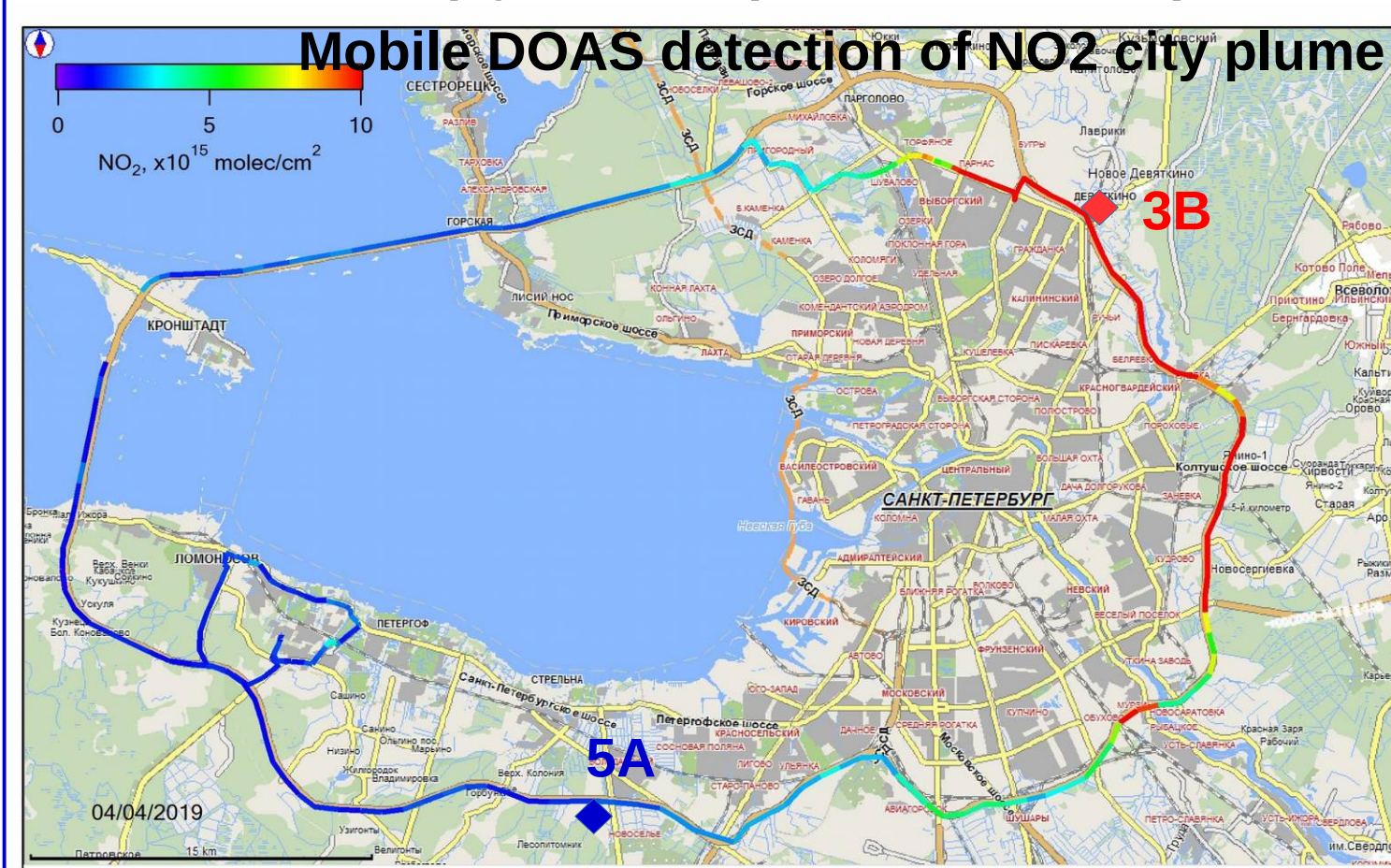
Totally, field observations (including 12.04.2019 - a day of side-by-side measurements) were carried out during the **12 days of March-April of 2019**. In addition to FTIR EM27/SUN, meteorological info and in-situ data on CO<sub>2</sub>, CH<sub>4</sub>, CO, N<sub>2</sub>O, H<sub>2</sub>O, NO<sub>2</sub>, NO and O<sub>3</sub> concentrations (sampled by air bags) are available for the observational points.

## 04 April 2019 – detection of St.Petersburg emissions (preliminary results)

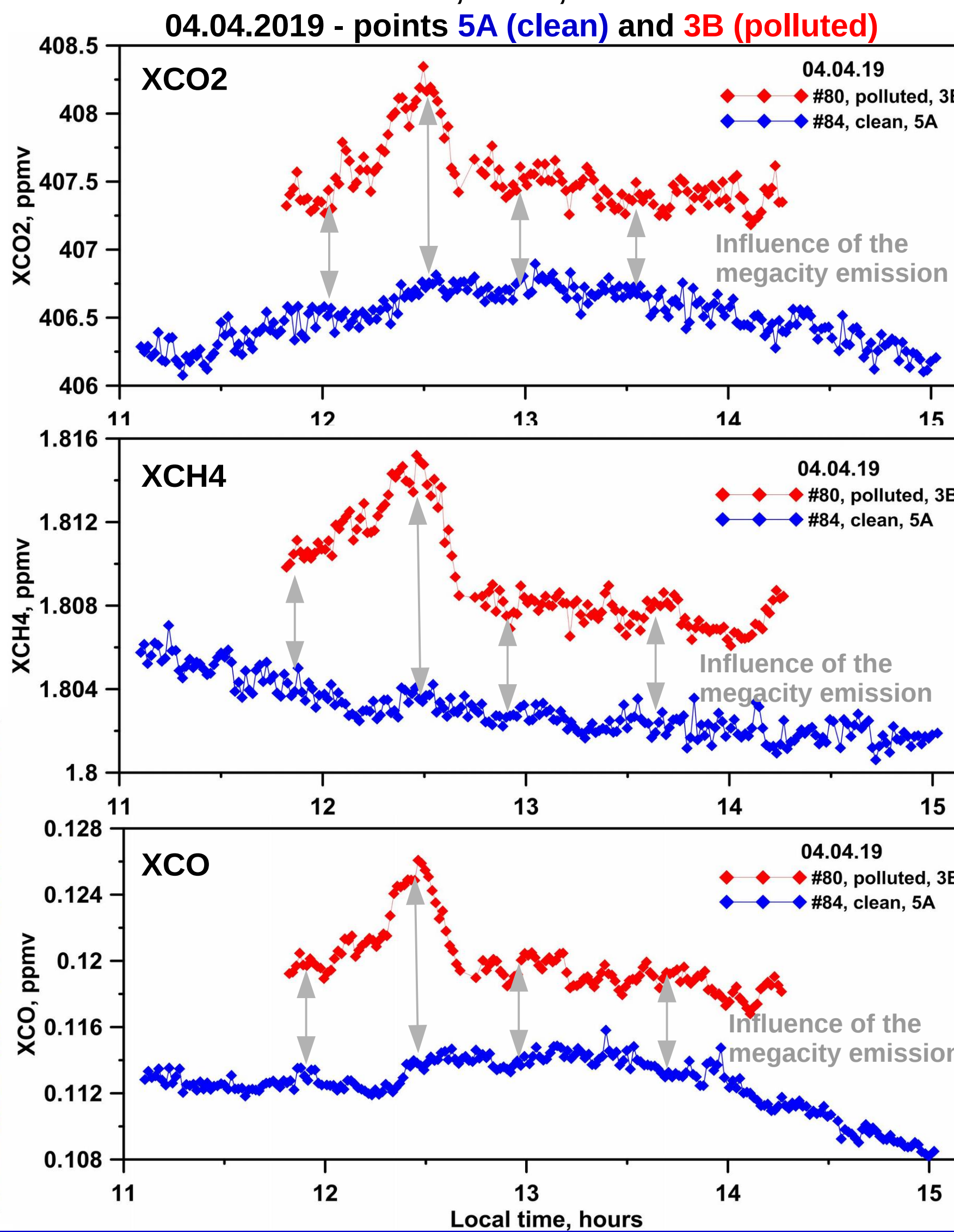
HYSPLIT NO<sub>2</sub> plume forecast: preliminary points for EM27/SUNs positioning on 04.04.2019 were chosen as 5A (up-) and 3B (downwind).



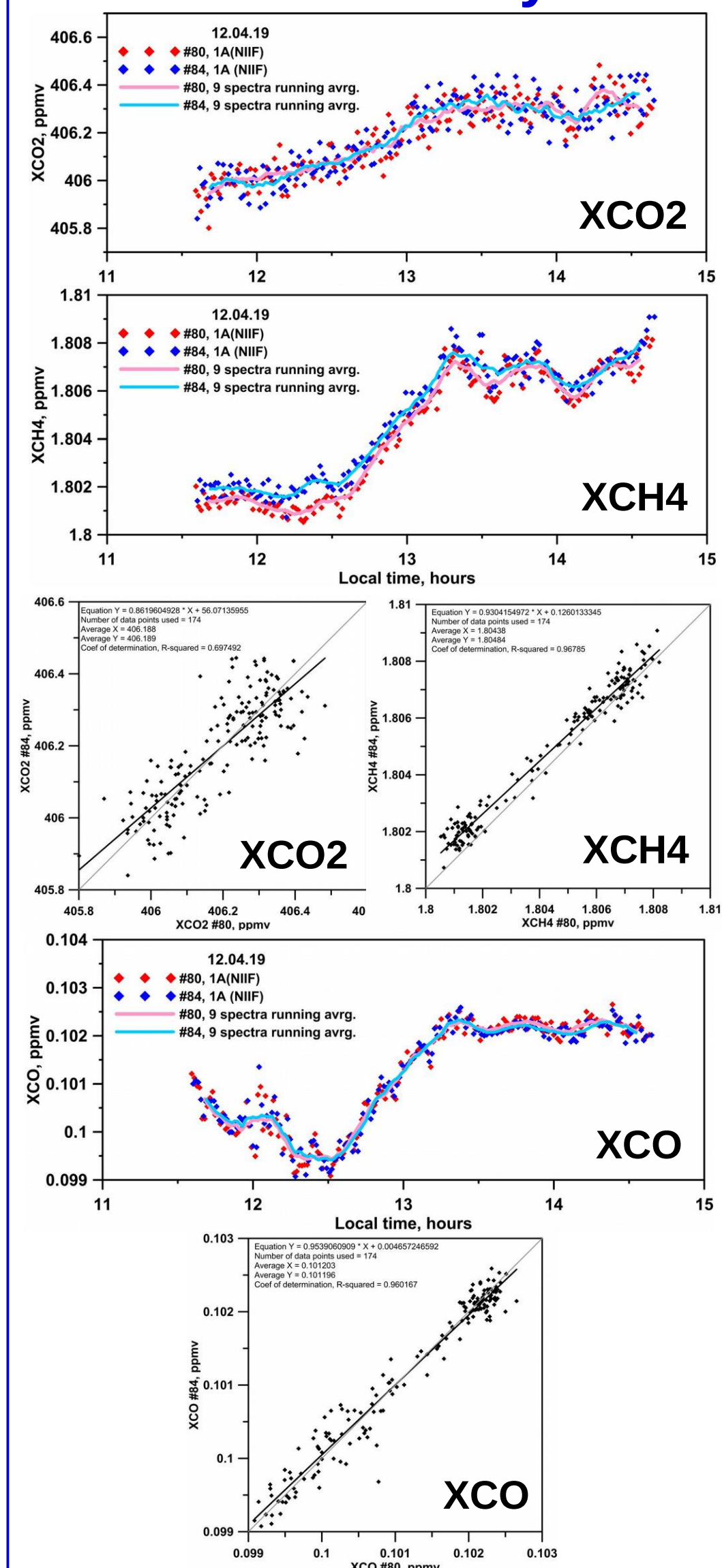
Info on the actual location of NO<sub>2</sub> city plume was provided in real time by the 3<sup>rd</sup> crew as a result of mobile DOAS observations of NO<sub>2</sub> tropospheric vertical column (by OceanOptics HR4000Vis).



Up- and downwind measurements by #80 & #84 EM27/SUN: XCO<sub>2</sub>, XCH<sub>4</sub>, XCO



## 12 April 2019 – #80 & #84 side-by-side



### References:

Frey et al.: Building the COllaborative Carbon Column Observing Network (COCCON): long-term stability and ensemble performance of the EM27/SUN Fourier transform spectrometer, Atmos. Meas. Tech., 12, 1513-1530, <https://doi.org/10.5194/amt-12-1513-2019>, 2019.  
 Hase et al.: Application of portable FTIR spectrometers for detecting greenhouse gas emissions of the major city Berlin, Atmos. Meas. Tech., 8, 3059-3068, doi:10.5194/amt-8-3059-2015, 2015.  
 Ionov et al.: 2015: Quantification of NO<sub>x</sub> emission from St.Petersburg (Russia) using mobile DOAS measurements around entire city. Int. J. Remote Sensing, 36, 9, 2486–2502, 2015.  
 Stein et al.: NOAA's HYSPLIT atmospheric transport and dispersion modeling system, Bull. Amer. Meteor. Soc., 96, 2059-2077, <http://dx.doi.org/10.1175/BAMS-D-14-00110.1>, 2015.

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### Further steps:

- accurate processing/analysis of FTIR EM27/SUN spectra and ancillary data acquired during EMME campaign and side-by-side measurements;
- evaluation of St.Petersburg emissions by coupling of a box model and the EMME observational campaign results.