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Accurate continuous observations of carbon dioxide and methane dry mole fractions in the arctic atmosphere near the Dikson settlement, Siberia

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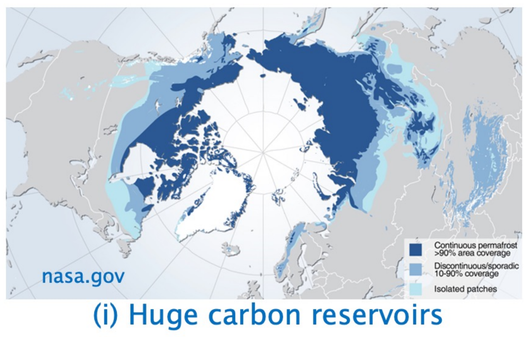
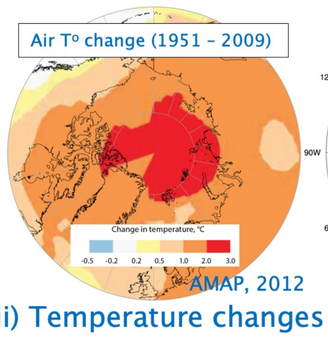
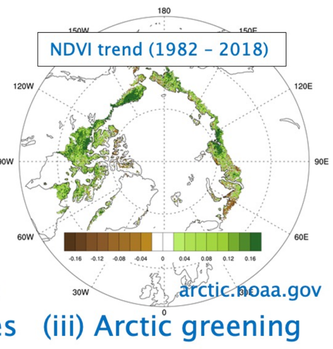
Why monitor CO_2 and CH_4 in the Arctic?



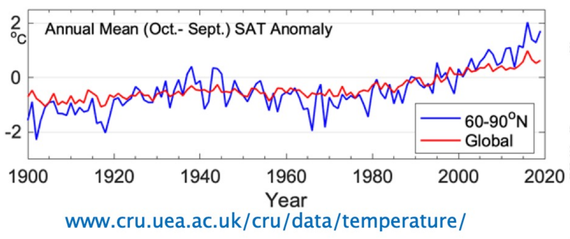
(i) Huge carbon reservoirs



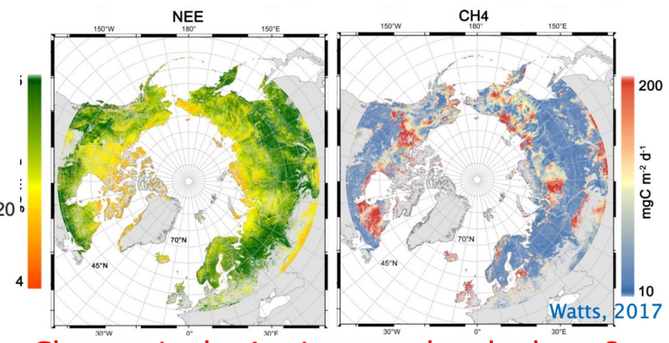
(ii) Temperature changes



(iii) Arctic greening

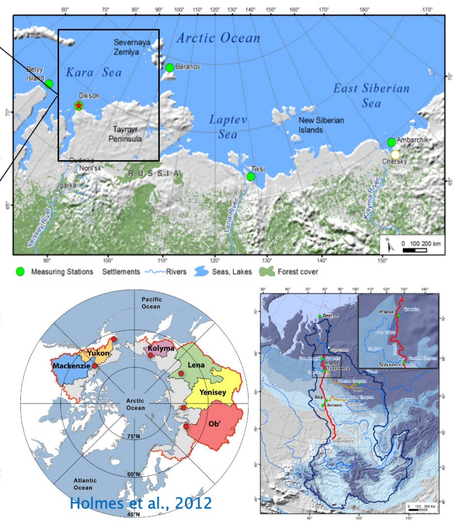


Arctic mean annual SAT anomalies (1900–2019 vs 1981–2010)



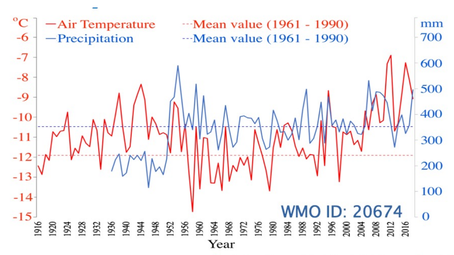
Changes in the Arctic net carbon budgets ?

Study area: Yenisei River gulf

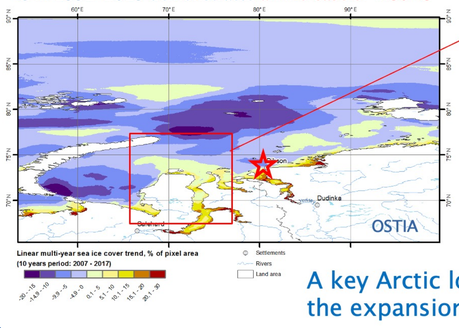


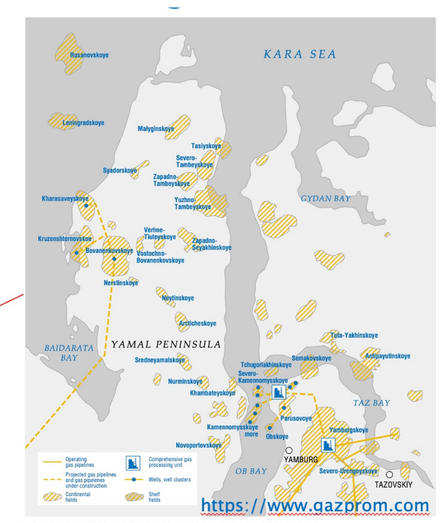
Yenisei: the major Arctic river catchment

Natural vs man-caused changes



A mean air temperature of -12 °C in 1961–1990 and -10.14 °C in 1991–2019 demonstrates an increase of 1.86 °C

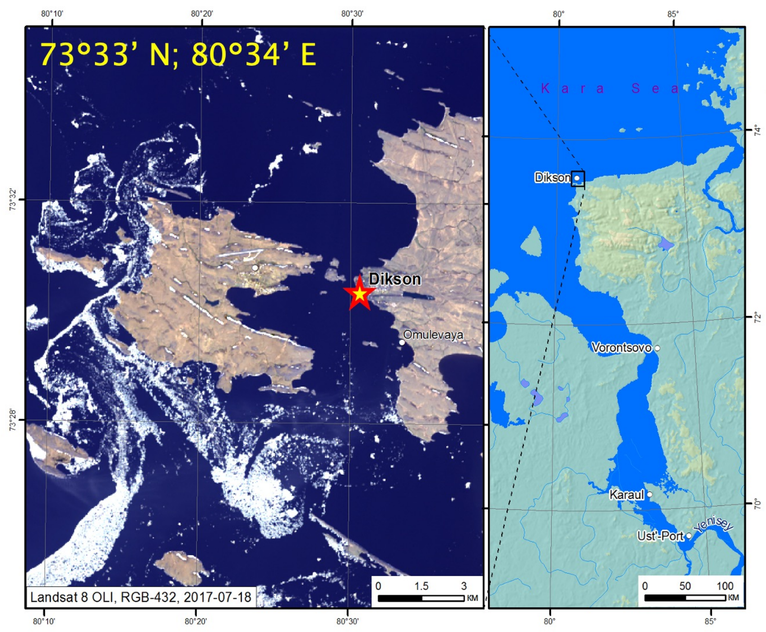


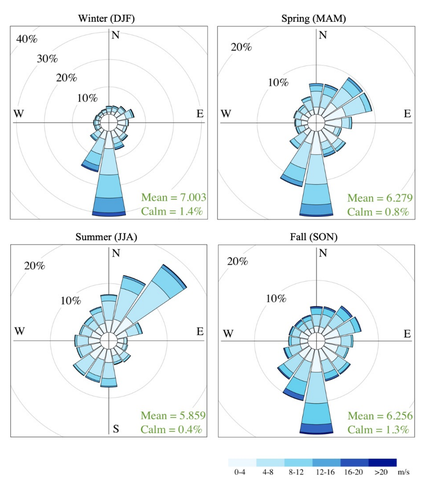


Field Pre-Development Scheme for the Ob & Taz Bays and the Yamal Peninsula

A key Arctic location given the recent Arctic warming and the expansion of gas/oil production in the Yamal area

DIAMIS: new carbon observation station





Detecting both natural and man-caused atmospheric carbon signatures

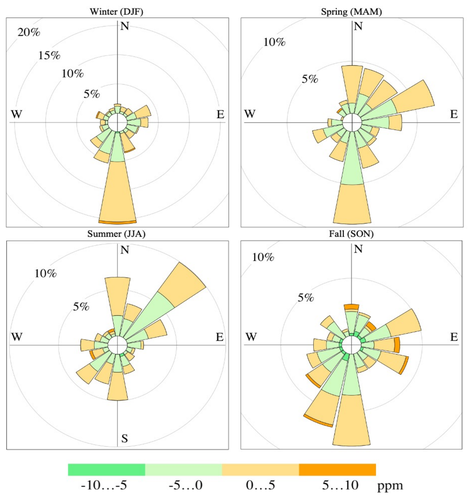
Predominance of northeast (summer) and southwest (winter) wind directions throughout the year: the two predominant domains to which the measurement station is sensitive – marine shelf areas by northward and land surface by southward

Instrumental setup

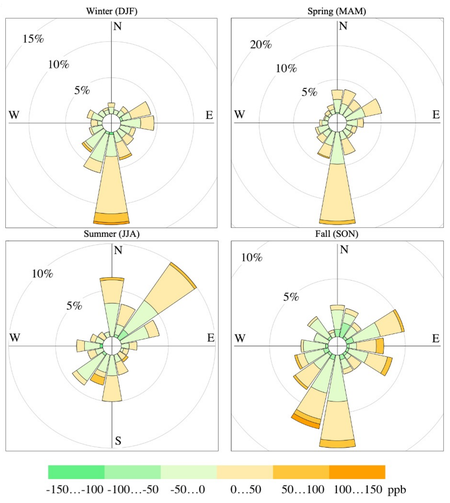
CRDS analyzer Picarro G2301-f continuously measures atmospheric mole fractions of CO_2, CH_4 and H_2O;
Regular calibrations of the CRDS analyzer against WMO-traceable reference gases filled at MPI-BGC;
Wind speed and direction – sonic anemometer Gill R3-50 (Gill Instruments ltd.), supplied by a built-in heating against freezing;
Air temperature and humidity – T/RH sensor Vaisala HMP155;
Precipitation – rain gage tipping bucket TRM-525M (Texas Electronics Inc.), equipped by a built-in heating;
Data series are logged by Sutron 9210B Xlite.

CO_2 and CH_4 atmospheric anomalies

Carbon dioxide

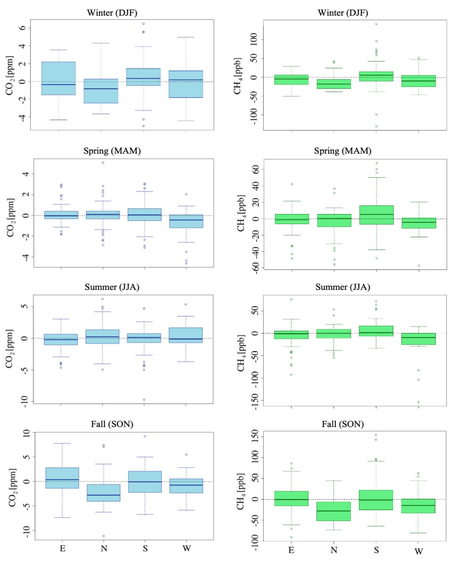


Methane



The deviations from the smooth seasonal cycle, i.e. the synoptic variations reflect local carbon sources and sinks in study area:

- Mostly during fall and winter the northern domain (oceanic) demonstrates average negative anomalies both for carbon dioxide and methane, reflecting possible C sinks over the Arctic
- Air masses coming from the western (oceanic/continental) domain show on average weak negative methane anomalies throughout the year, that is only partly right for carbon dioxide
- Throughout the year the southern (continental/polluted) and the eastern (continental/pristine) domains can serve both weak sources and sinks of carbon dioxide and methane



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