Anomalies of dissolved methane in the Arctic waters according to the observed data and results of numerical modeling

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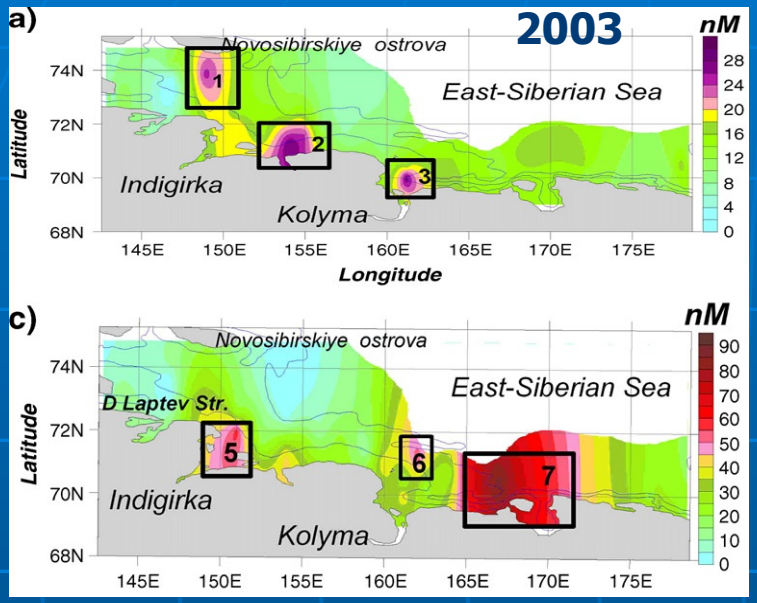
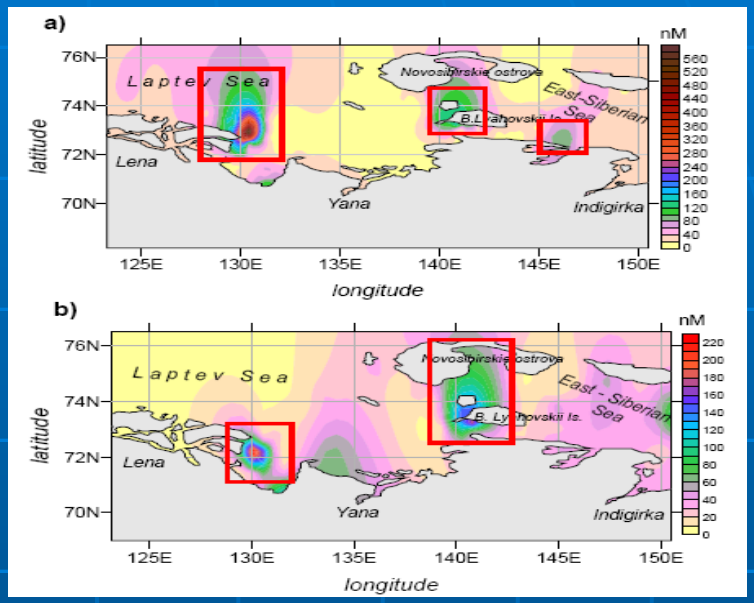
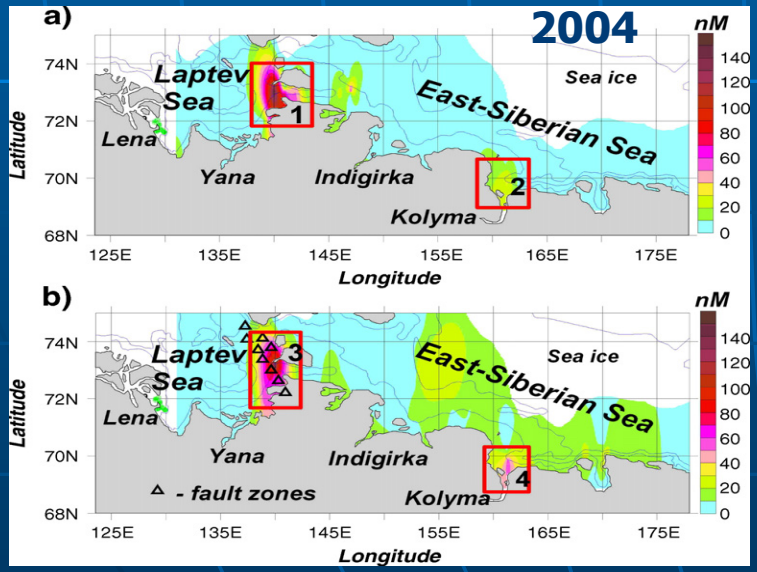
Dissolved methane in the East-Siberian Sea (IARC-FEBRAS cruises)



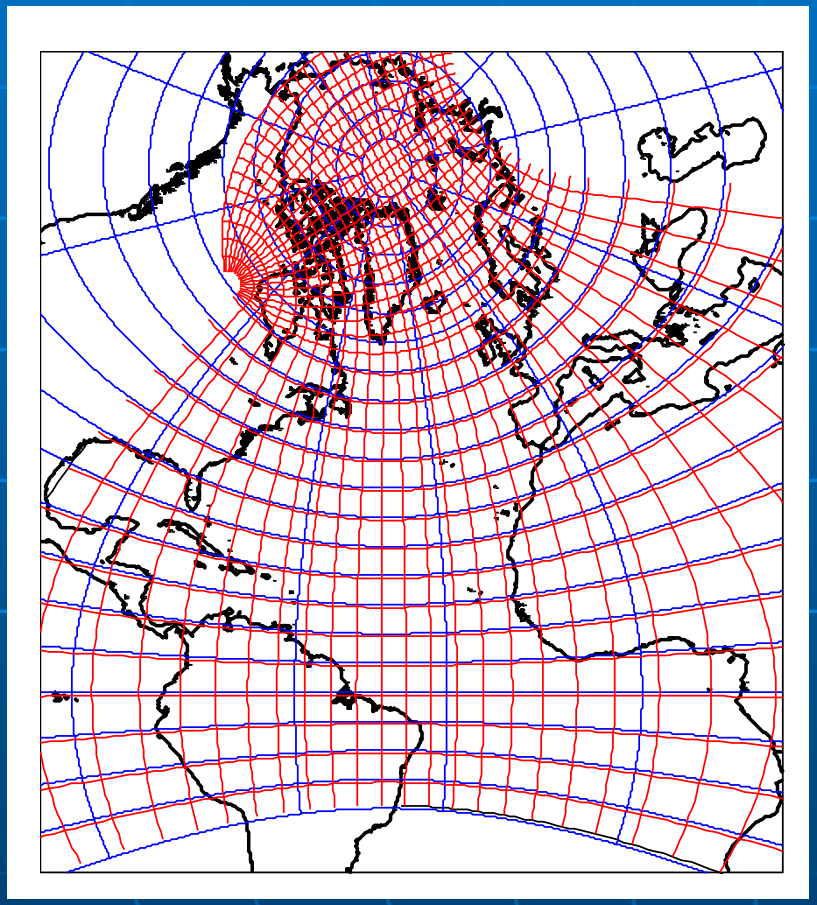


2005



- Distribution of dissolved methane in the surface layer (a), and bottom layer (b) (Shakhova and Semiletov, 2006)
- Surface layer maximum: 2003 - 30 nM, 2004 - 115 nM, 2005 – 500 nM
- Bottom layer : 2003 - 87 nM, 2004- 154 nM, 2005 – 220 nM

Coupled Ice-Ocean Model
3D World Ocean Circulation Model of ICMMG based on z-level vertical coordinate approach



The model grid has1x1 degree resolution in the North Atlantic. At 65N, the North Atlantic spherical coordinate grid is merged with the polar grid, which is a result of the spherical coordinate rotation and reprojection of its hemisphere onto the area above 65N (see *Murray, [1996]* for details).

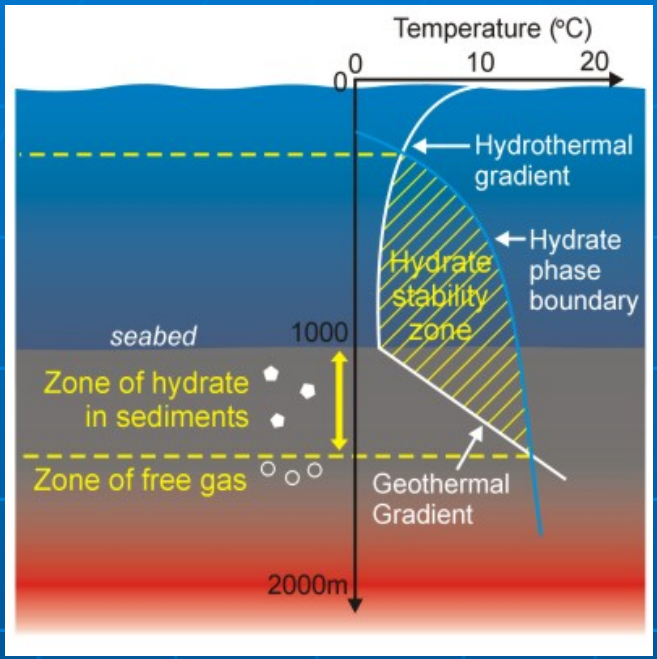
The horizontal spacing in the polar grid varies from 50 to 34 km. Maximum model resolution is in the vicinity of the North Pole.

Vertically, the grid has 33 constant layers, with a higher resolution near the surface.

The minimum shelf depth is 50 m.

(Kuzin1982, Golubeva at al.,1992, Golubeva,[2001], Golubeva and Platov,[2007])

Methane hydrates in the Arctic ocean

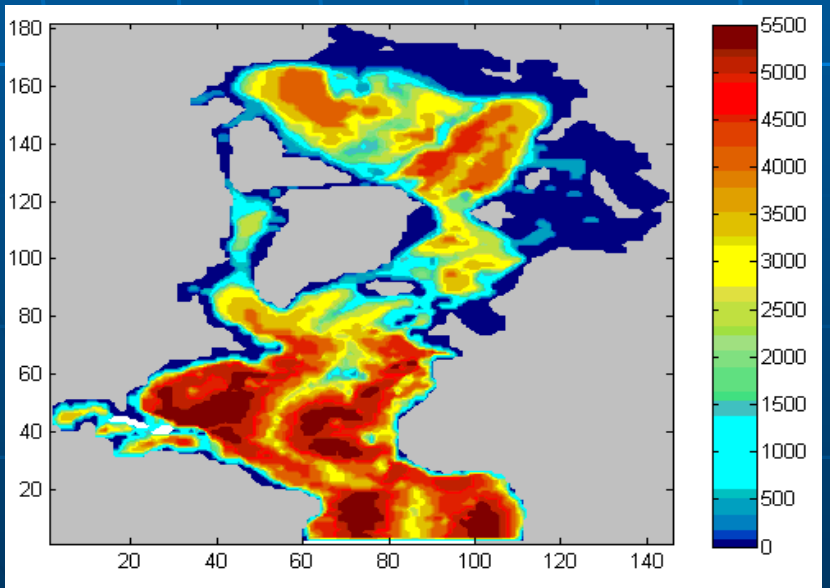


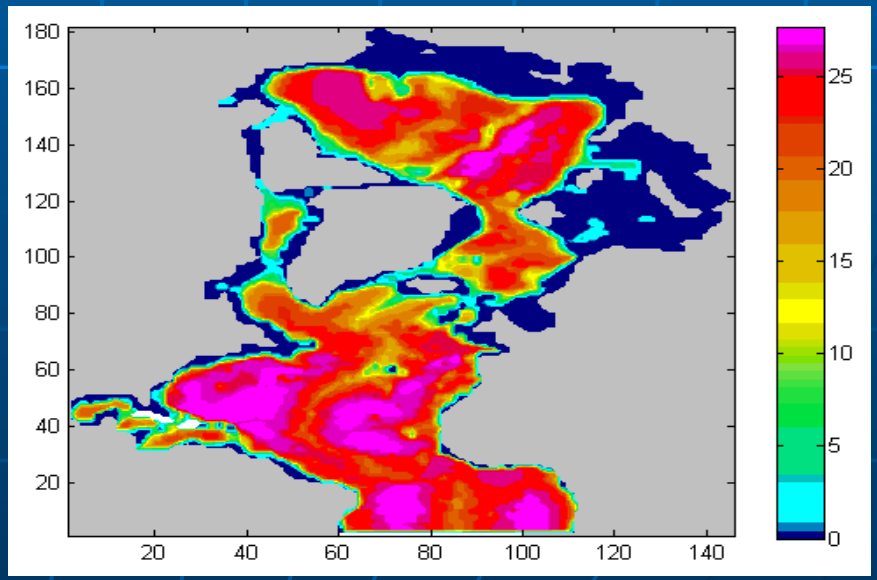
Thermobaric conditons of the methane hydrate existence

$$\frac{1}{Tstab} = 3.79\times10^{-3} - 2.83\times10^{-4}\log Pstab$$

Gas hydrates are an ice-like material comprised of gas molecules entrained by frozen water. They are trapped by sediments in permafrost and on the ocean bottom.

The total amount of methane in the Arctic Ocean sediments is estimated to 540 Gton C (Kvenvolden, K.A., 1988**), which to a large degree could be released when warmer waters penetrates the shelves.**



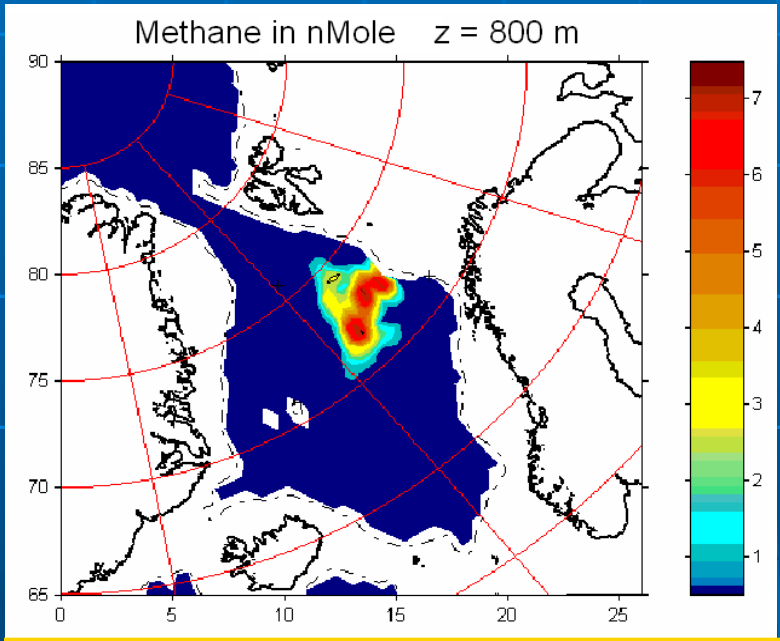


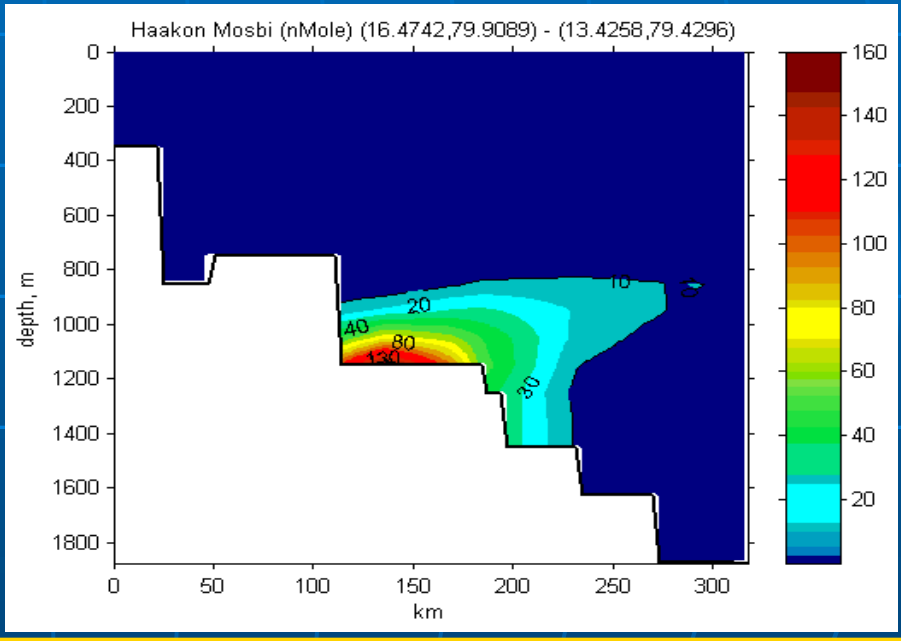
Submarine fluid venting

One mechanism to release methane from the sediment to the ocean is through submarine mud volcanism, hydrocarbon seeps and vents (Mazurenko L. L., Soloviev V. A. 2003)

The results of investigations show that gas hydrates are located close to these places immediately at the sea bottom (Milkov A.V. 2000)

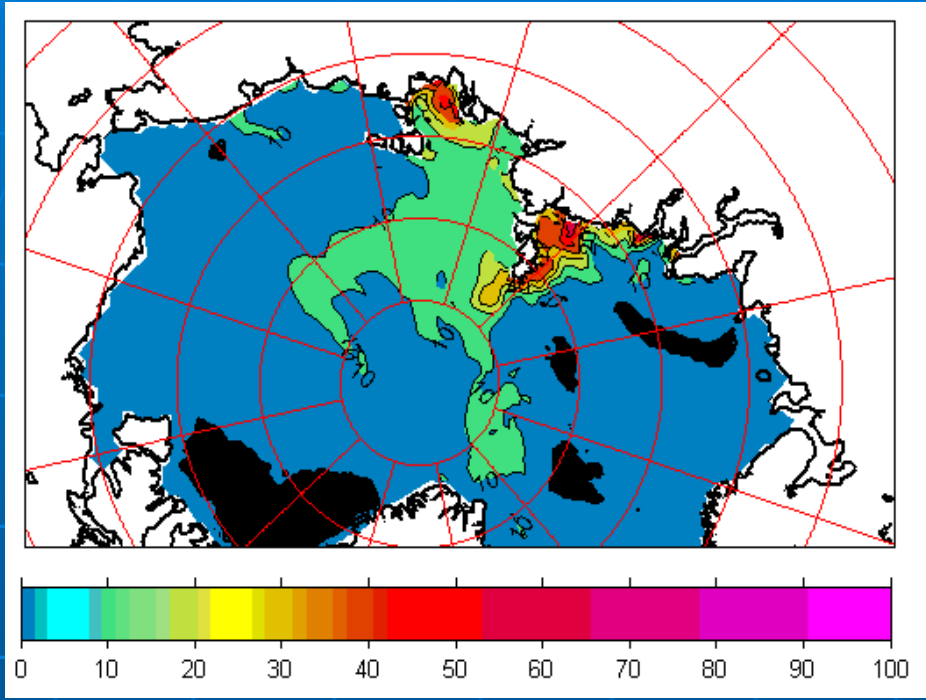
Modeling of the methane concentration in water over a Haakon Mosby submarine mud volcano



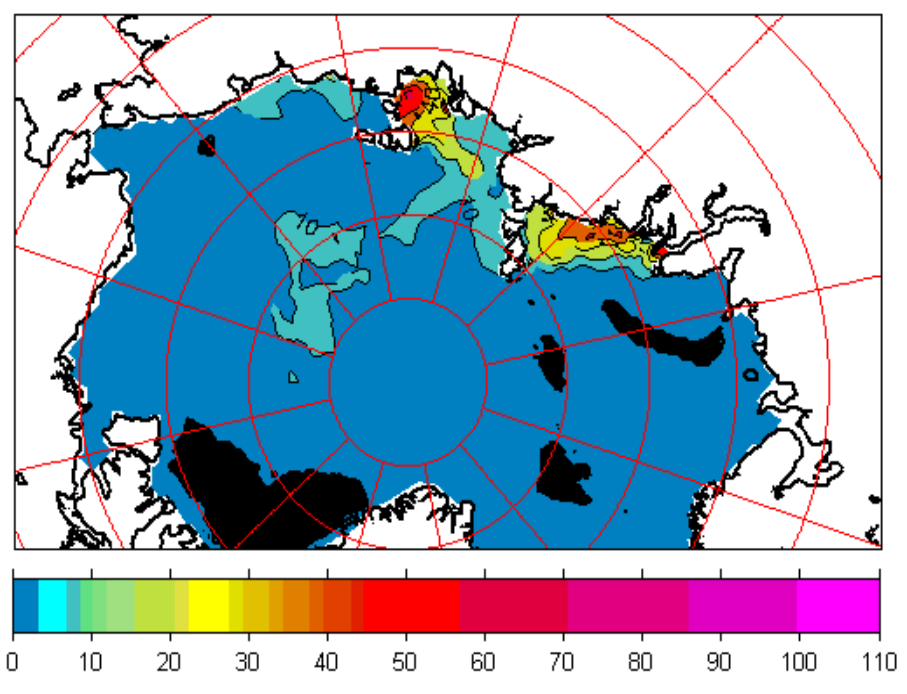


The transport of the dissolved methane by ocean currents from an submarine volcano is investigated. On the depth of 1000 m the methane concentration in water reaches 50 nM. On the depth of 800 m plum starts to spread in a horizontal plane, forming a layer with the raised methane concentration.

The Siberian rivers as methane sources



1994



1997

The dissolved methane is transported in the Arctic ocean according to the system of currents and depends on the considered period.

- The tracer propagate to the central part of the Arctic and then is transported by the Transpolar Drift to the Greenland.
- The tracer is blocked in the shelf zone and only small part penetrates to the central Arctic.