Investigations of fast ice in the Sogo Bay

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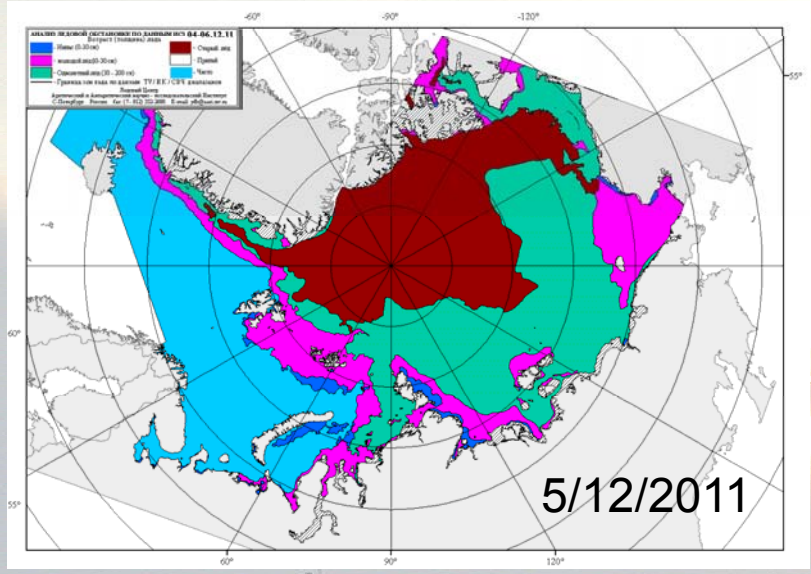
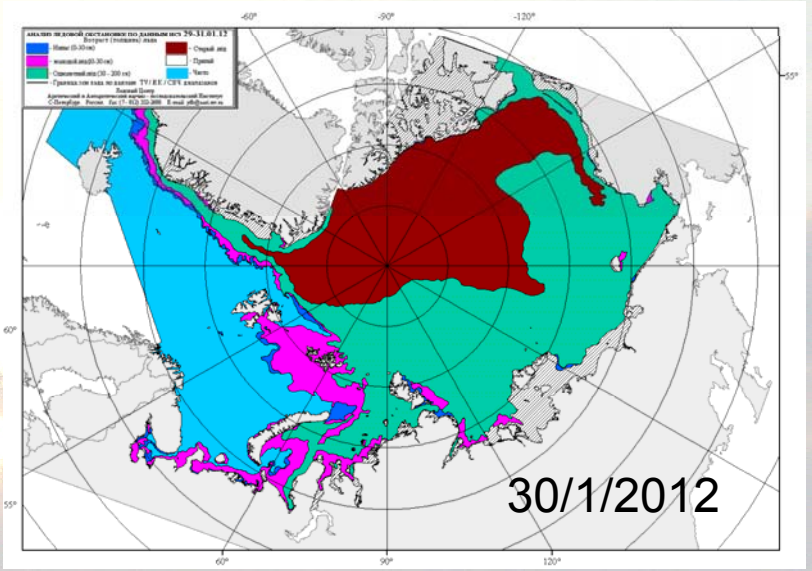
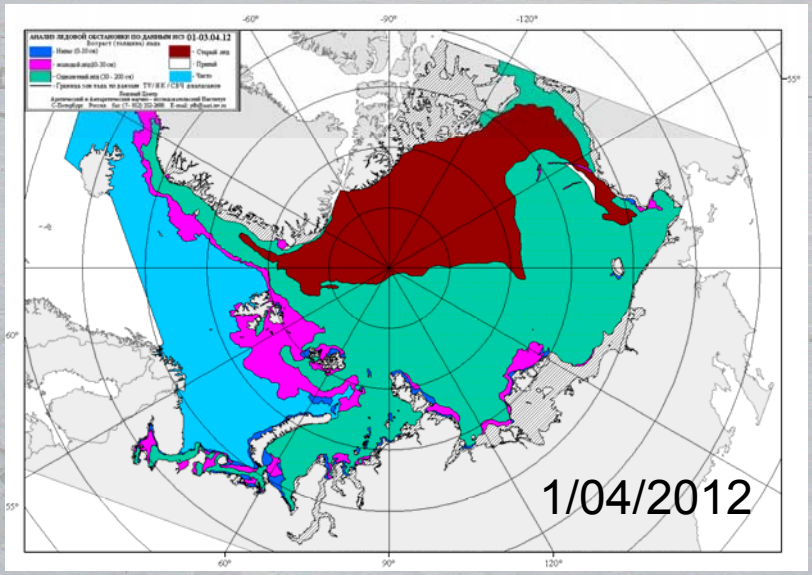
Rationality

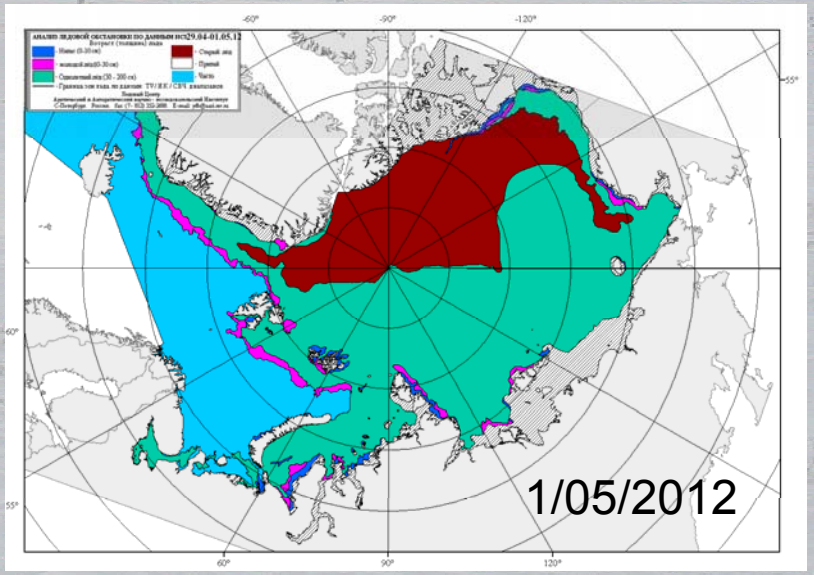
1. Fast ice – the important part of the Arctic climate system
2. Fast ice – possible source of sediments in the Arctic Ocean

Development of fast ice area in 2011 – 2012 years

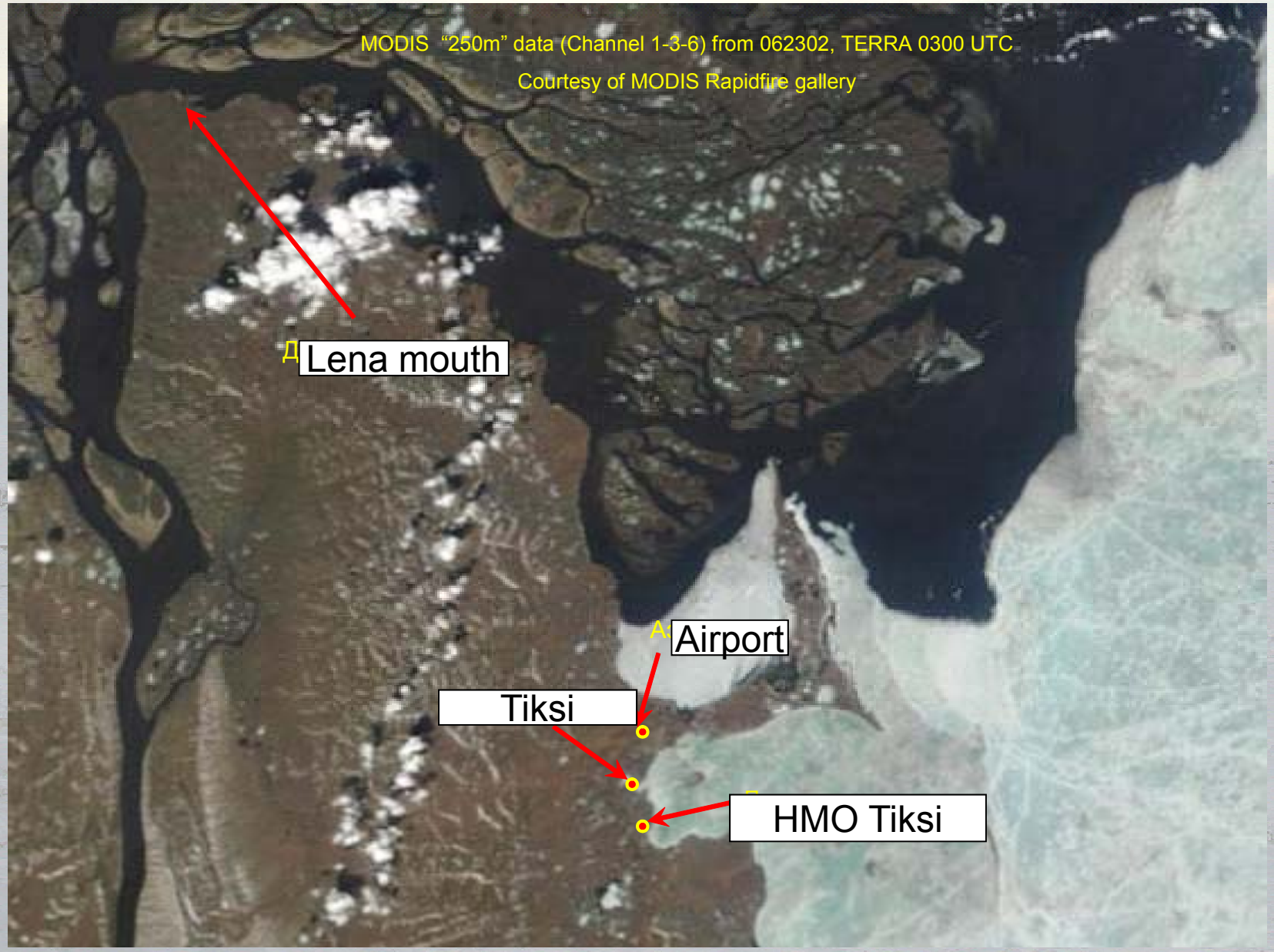




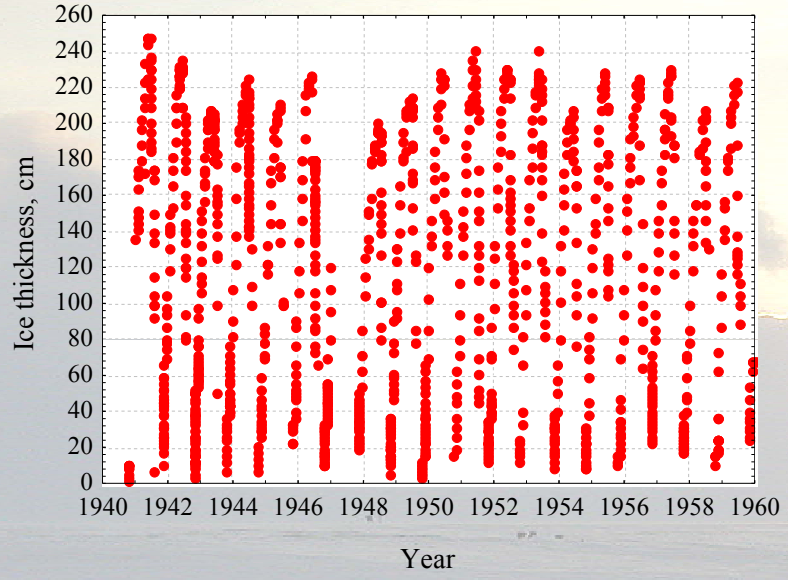


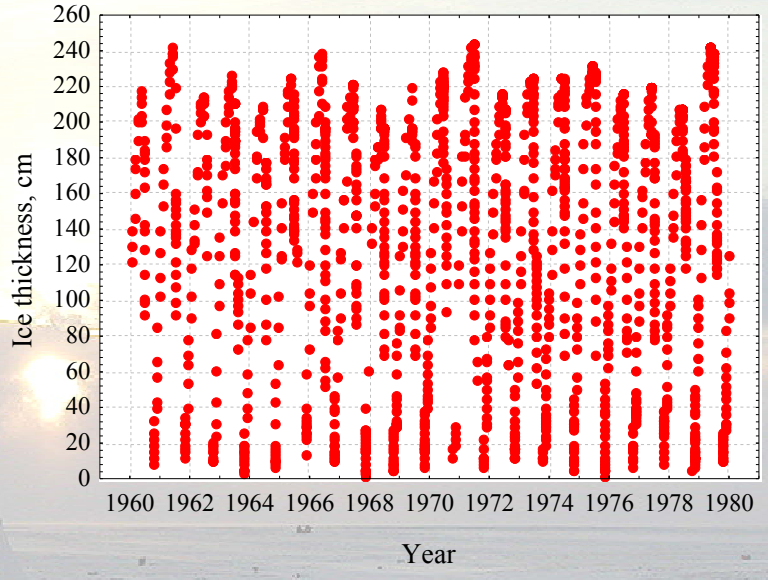


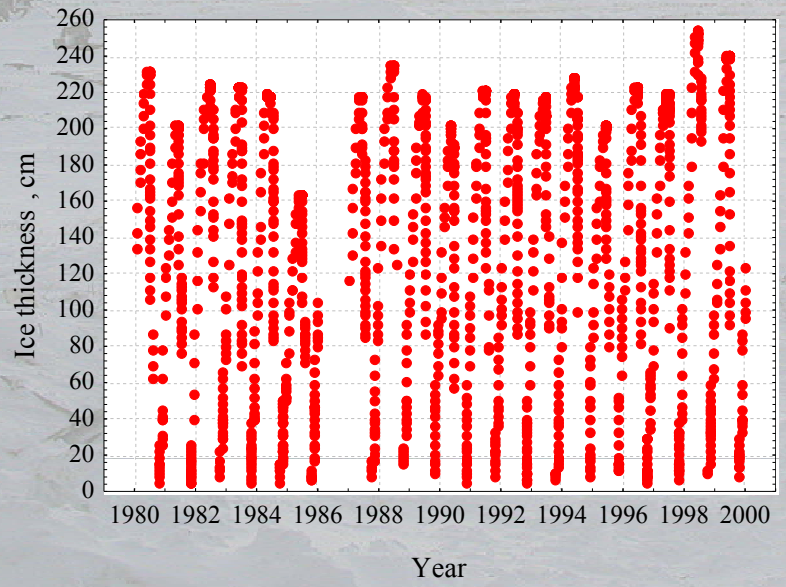
View of Tiksi region from space

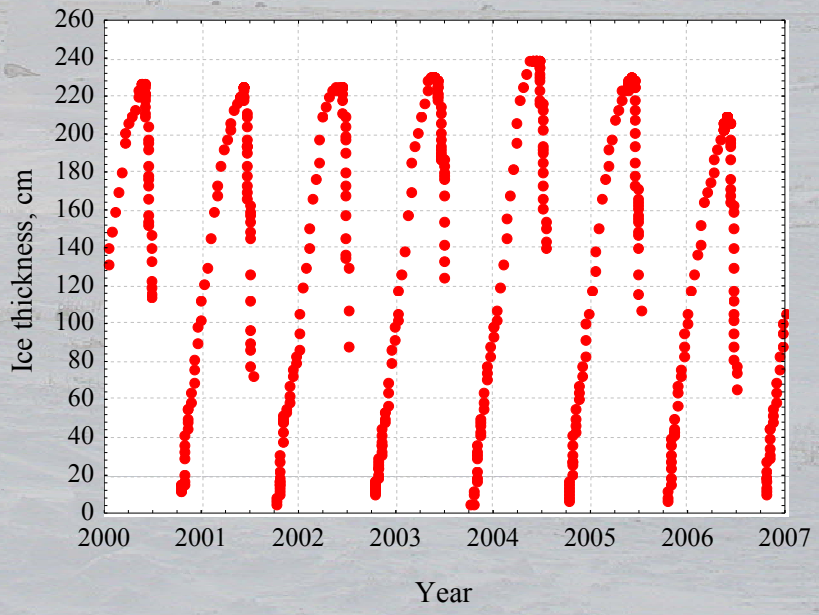


Long-term variability of fast ice thickness in the Sogo bay (historical records)

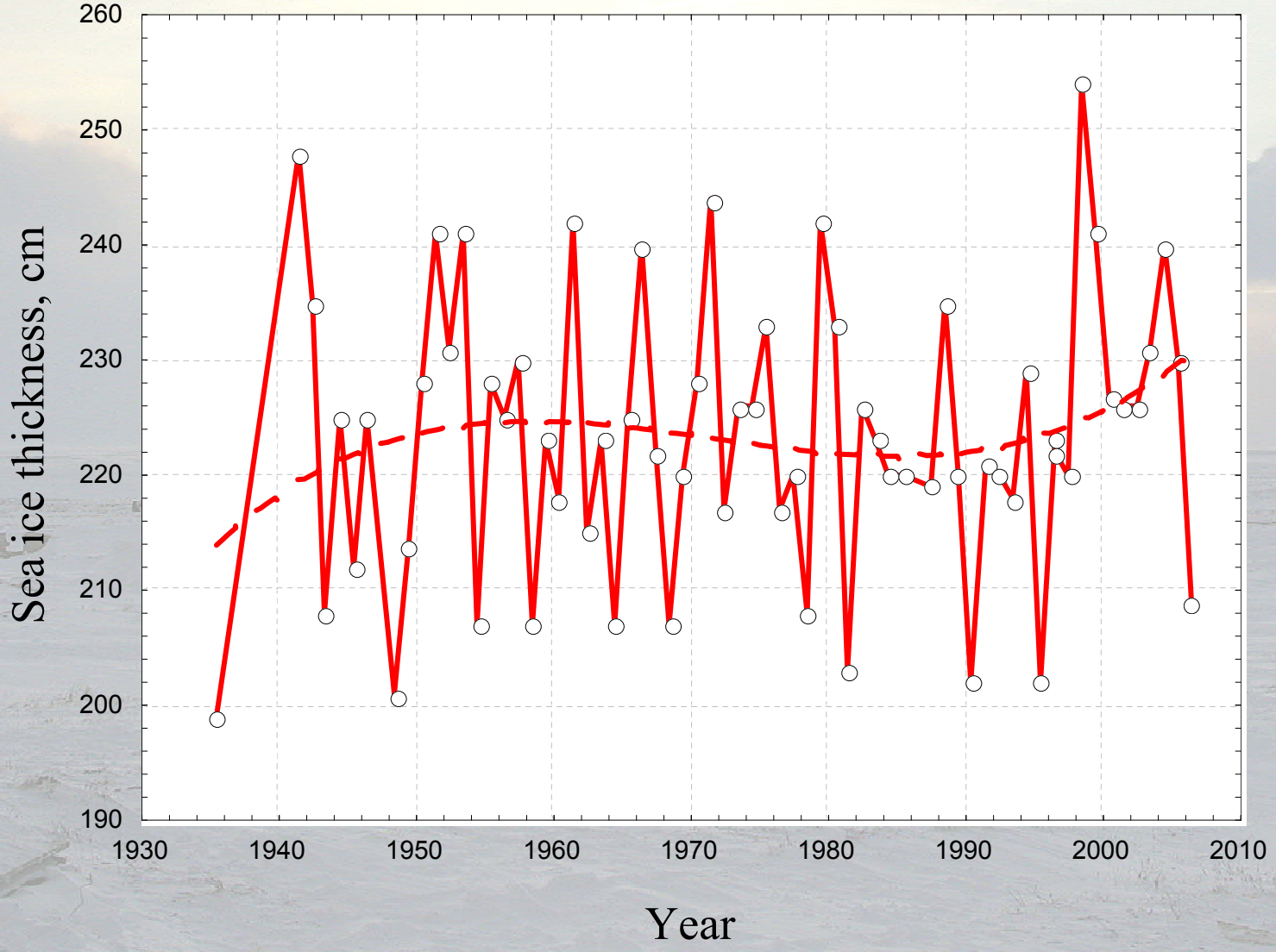




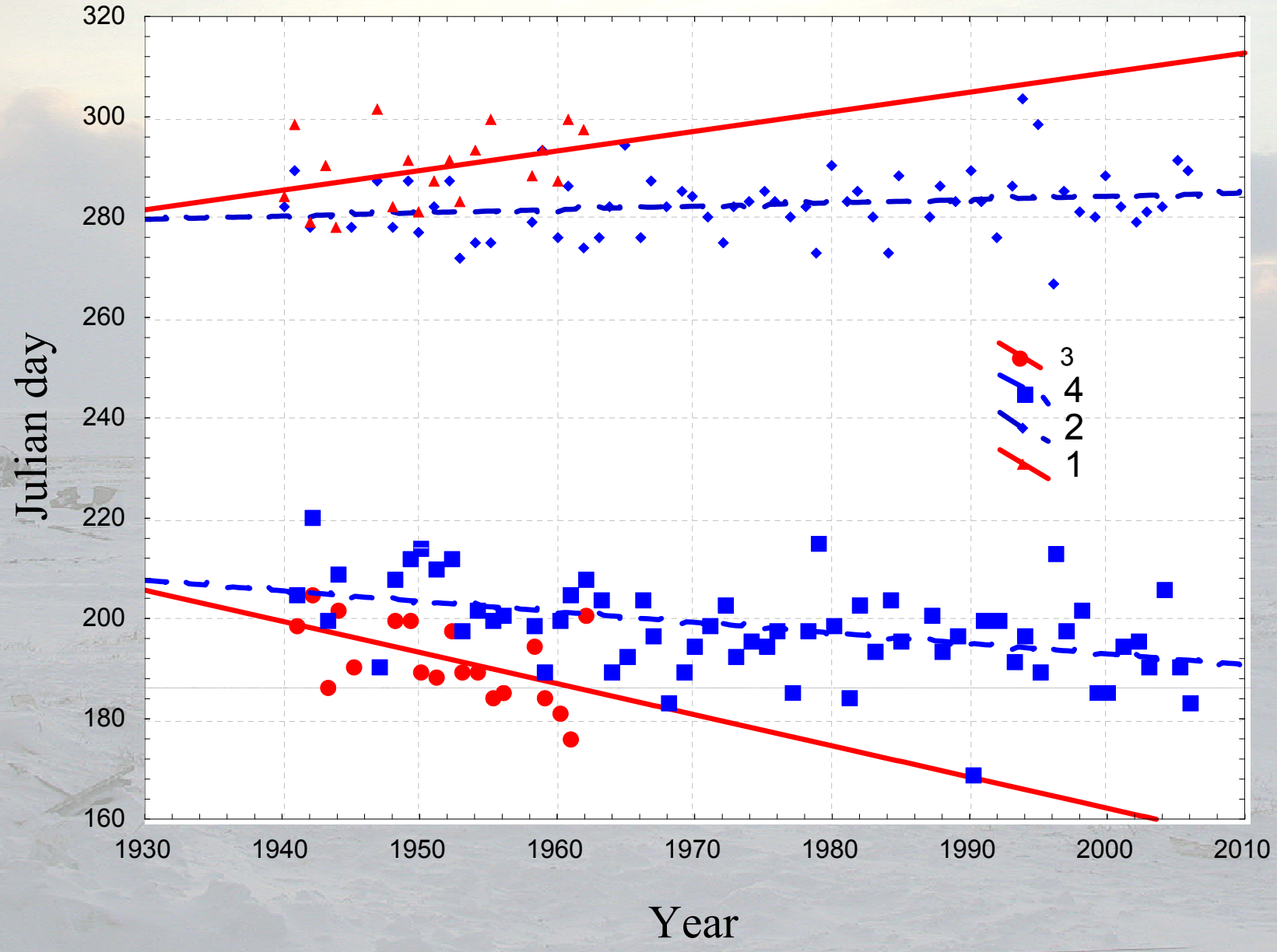




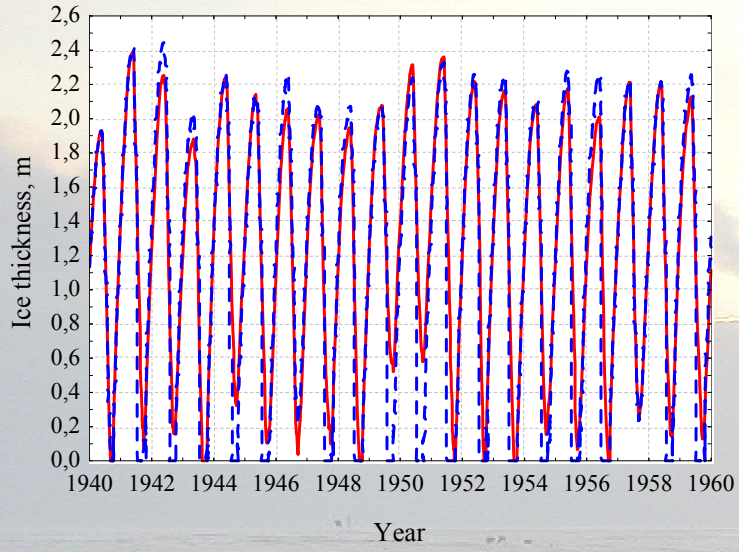
Interannual variability of maximal fast ice thickness in the Sogo Bay

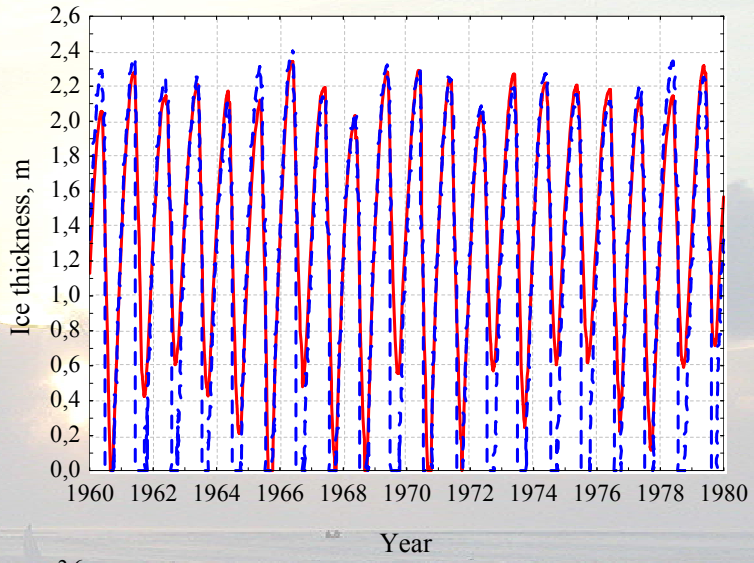


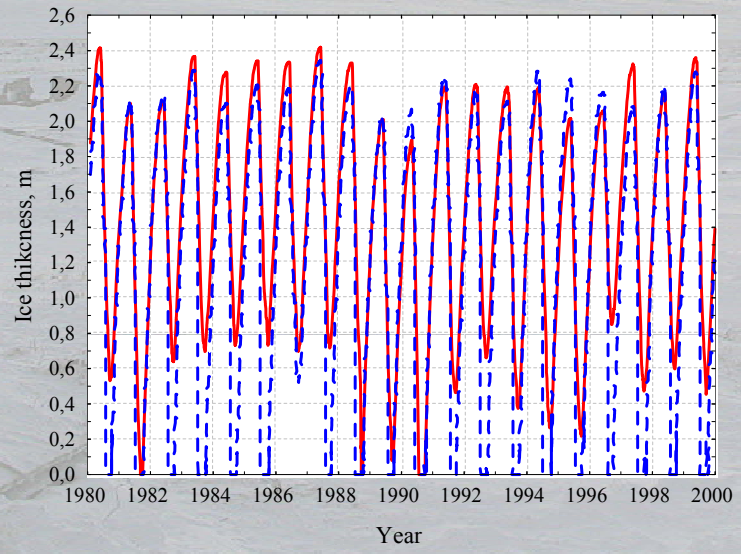
Dates of fast ice formation (1) and destruction (3), appearance (2) and disappearance (4) of drifting ice in the Sogo Bay

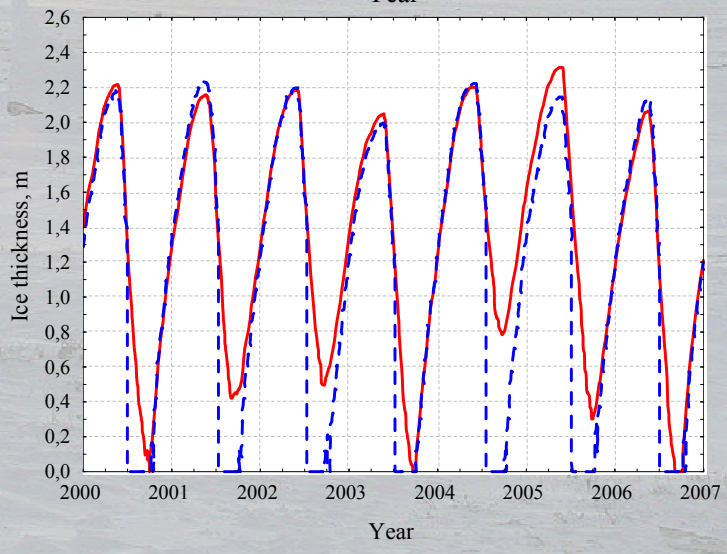


Interannual variability of fast ice thickness, calculated with thermodynamic model AARI



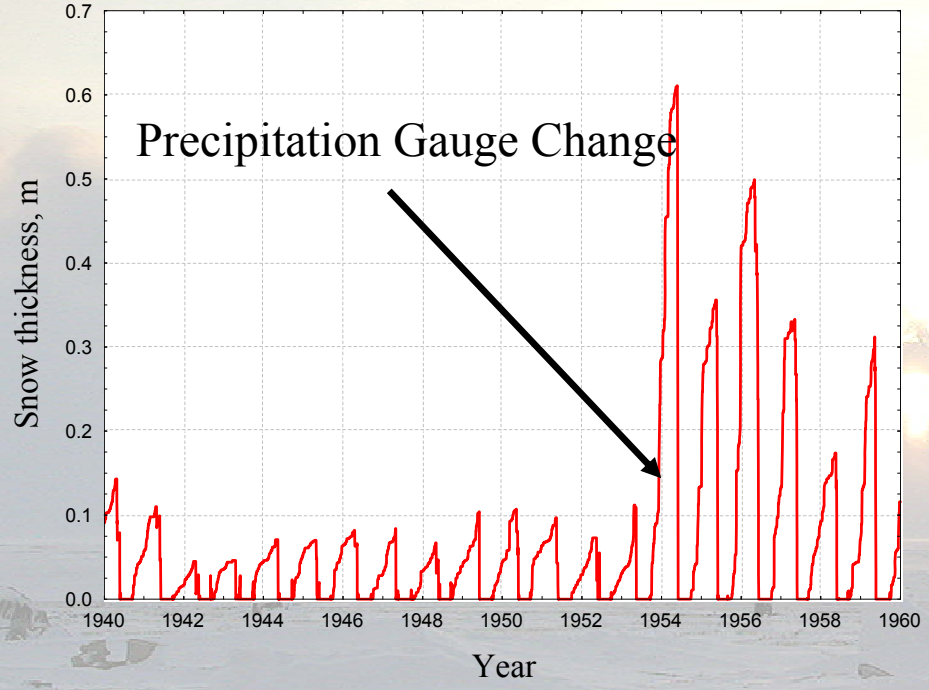


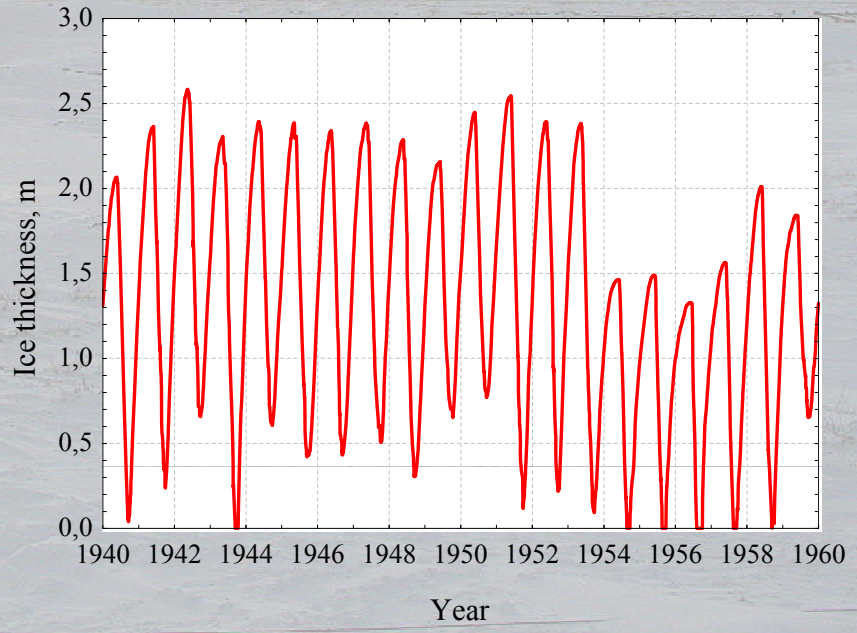




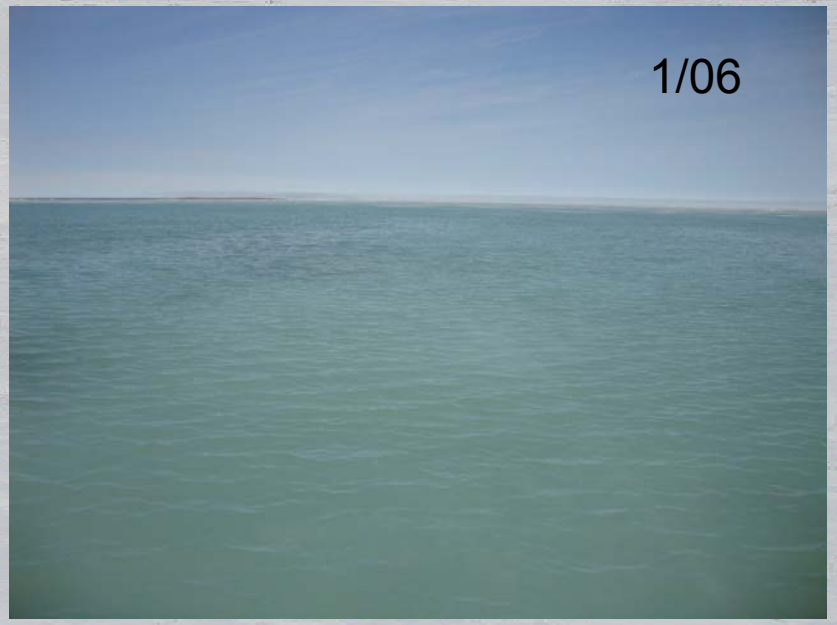
Solid lines – with data of standard meteorological data, dash lines – the same, but taken into account dates of fast ice appearance and destruction.

Snow thickness calculated with data about snow precipitation and response of model

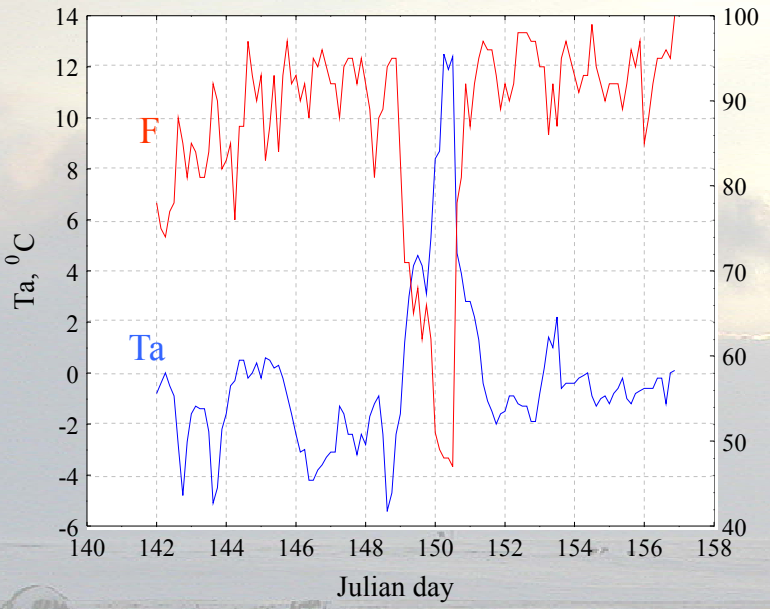


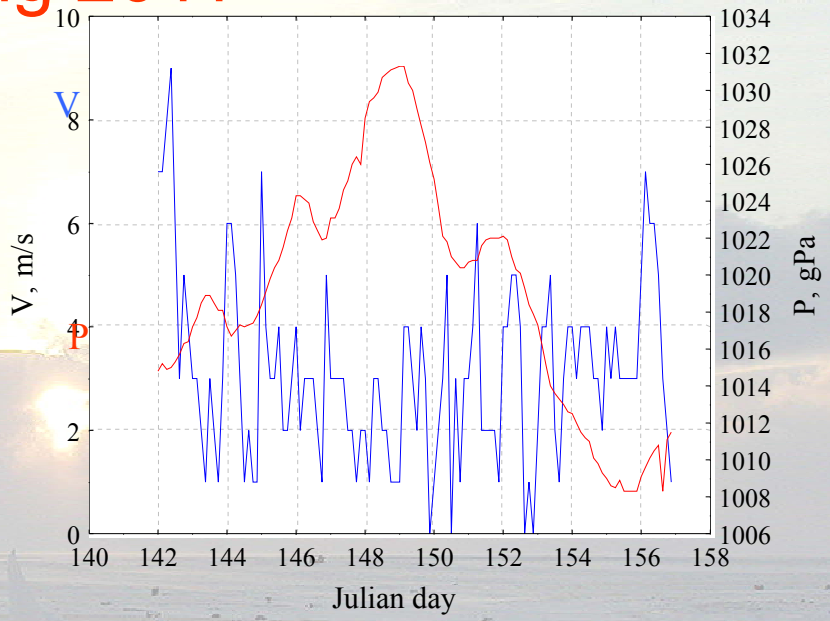


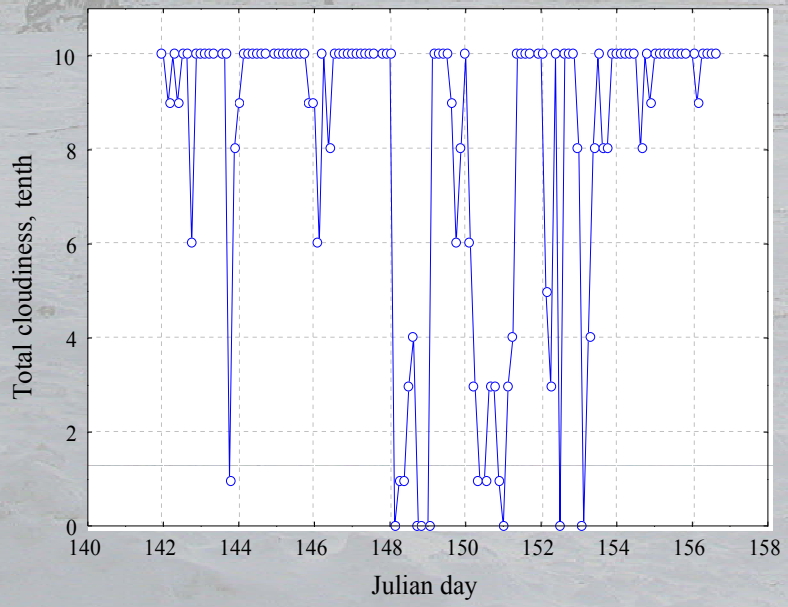
Fast ice near HMO Tiksi in spring 2011

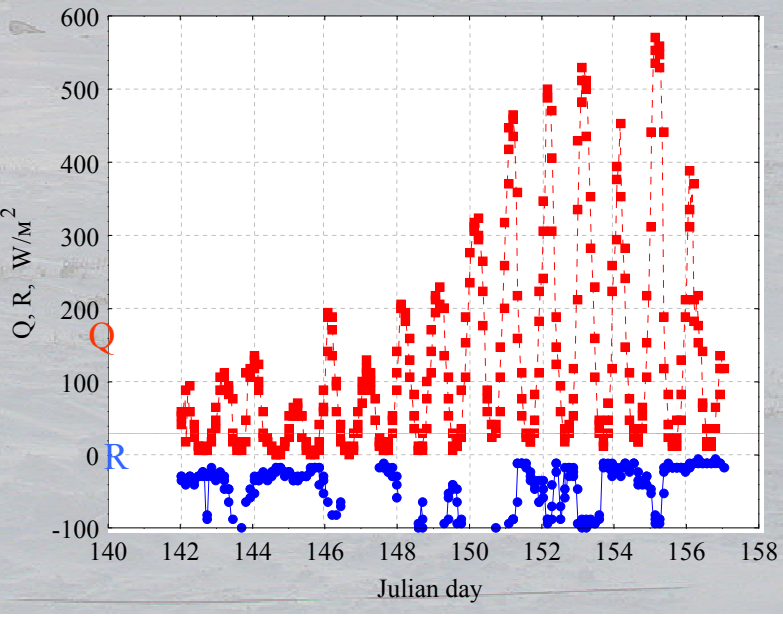


Meteorological conditions during fast ice studies in spring 2011

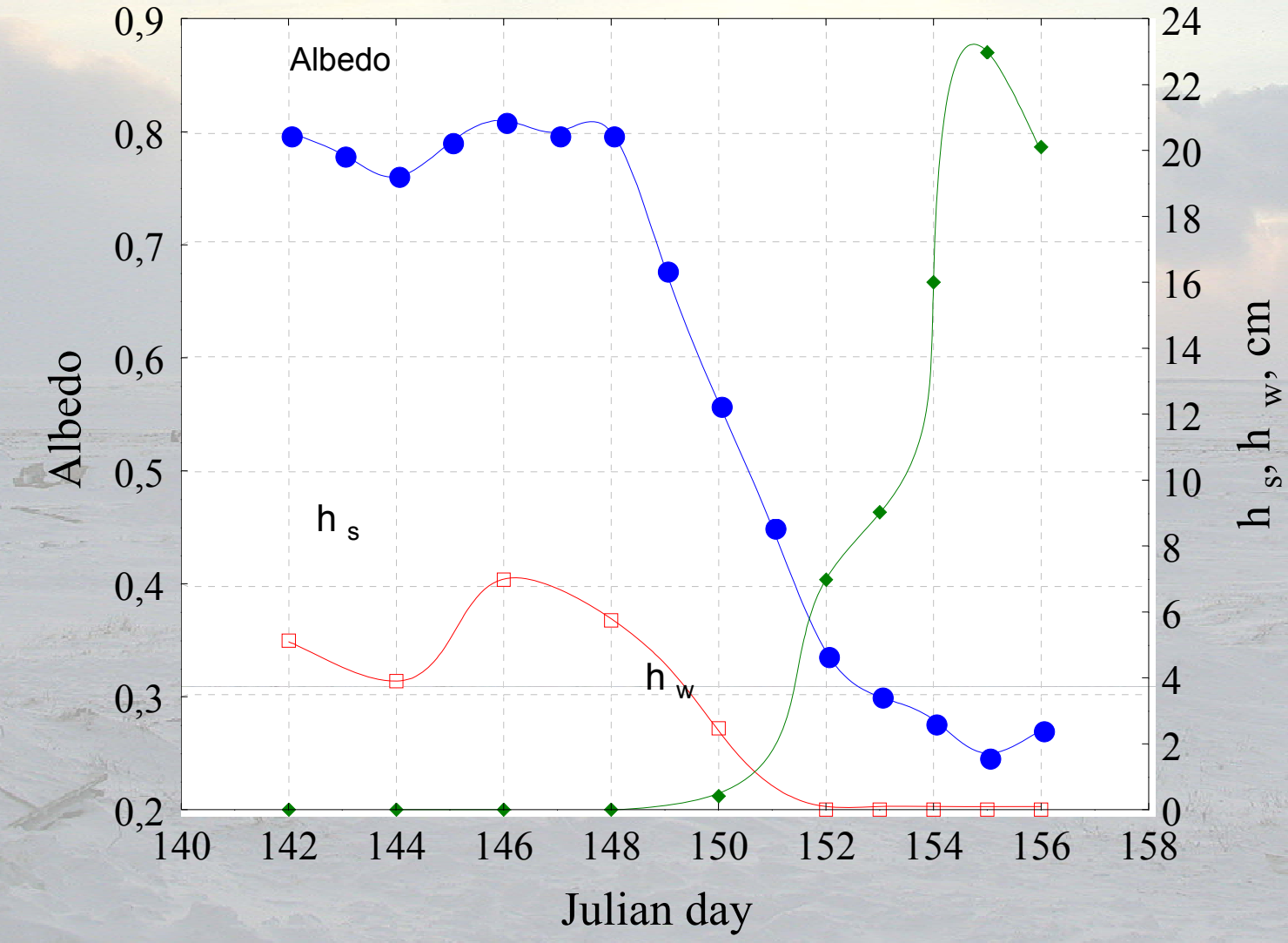




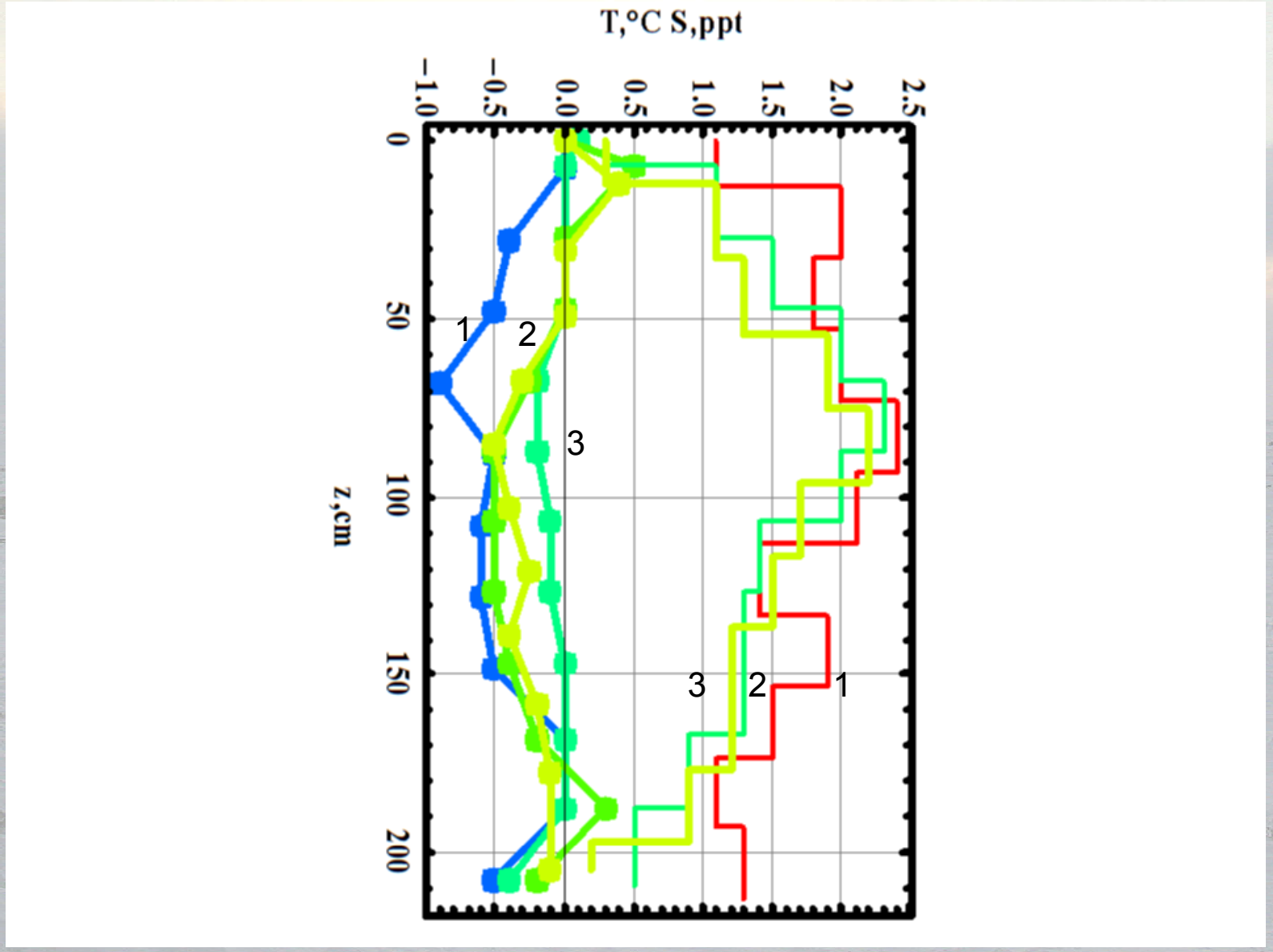




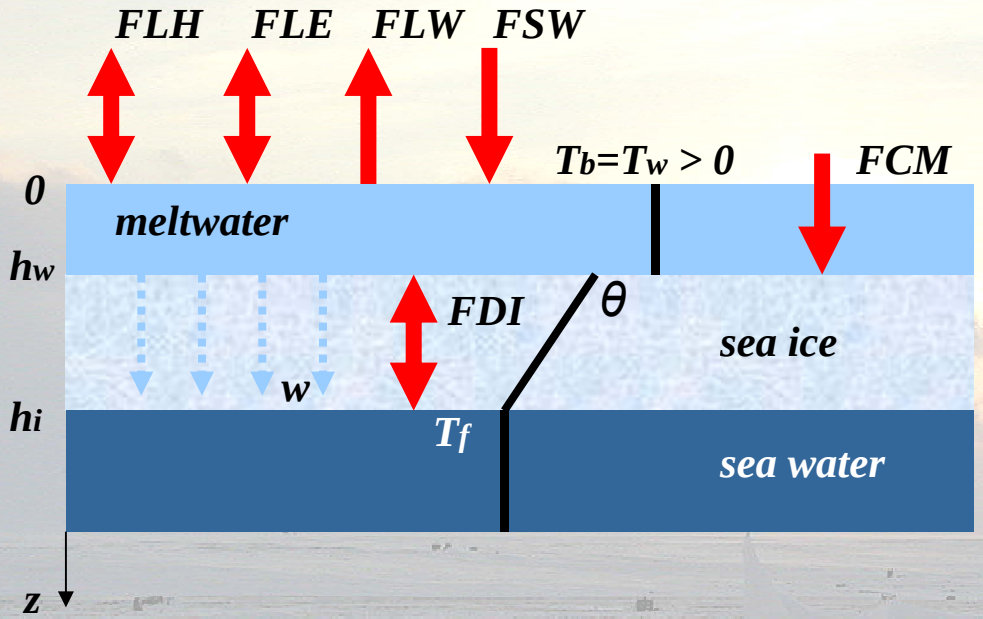
Averaged on the 100 meter route surface albedo, show thickness and water depth on fast ice during experiment in May 2011



Distributions of temperature (left) and salinity (right) May 25 (1), May 29 (2), and June 1 (3) 2011 year



Thermodynamic model of the ice cover melting

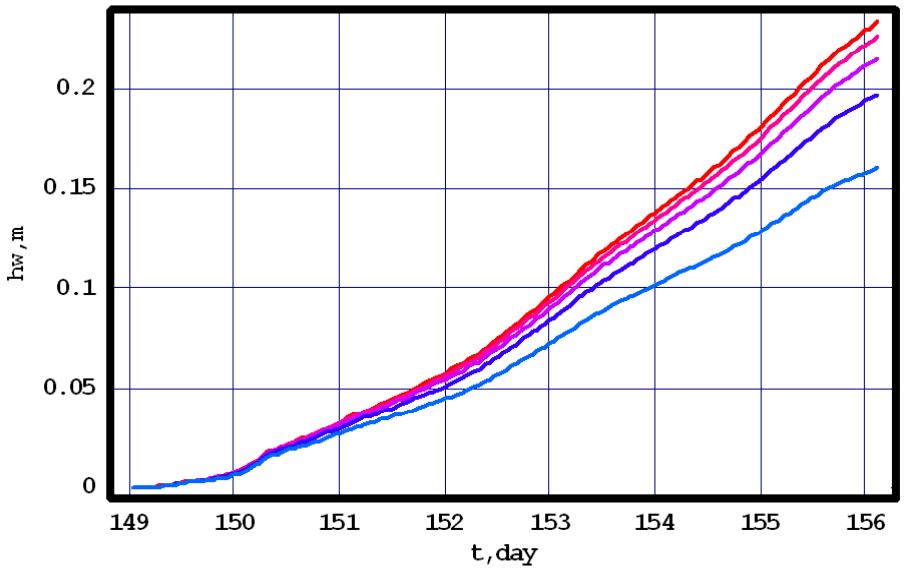


$$\rho_i L\left(\frac{dh_w}{dt}+w\right)=k_i\frac{\partial T^+}{\partial z}+FCM,\qquad (\rho C)_w\left(h_w\frac{dT_w}{dt}+(T_w-\theta)\left(\frac{dh_w}{dt}+w\right)\right)=FDI-FCM$$

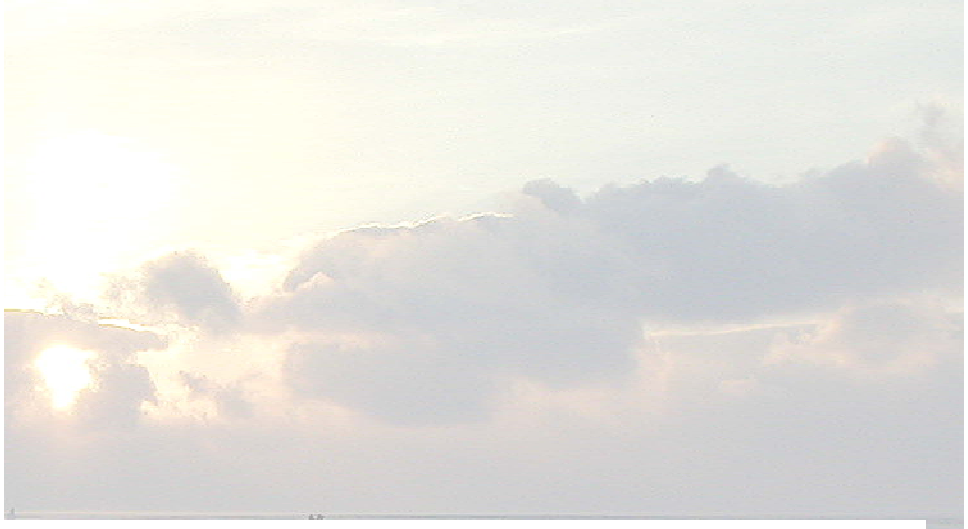
$$FDI=FSW+FLW+FSH+FLH$$

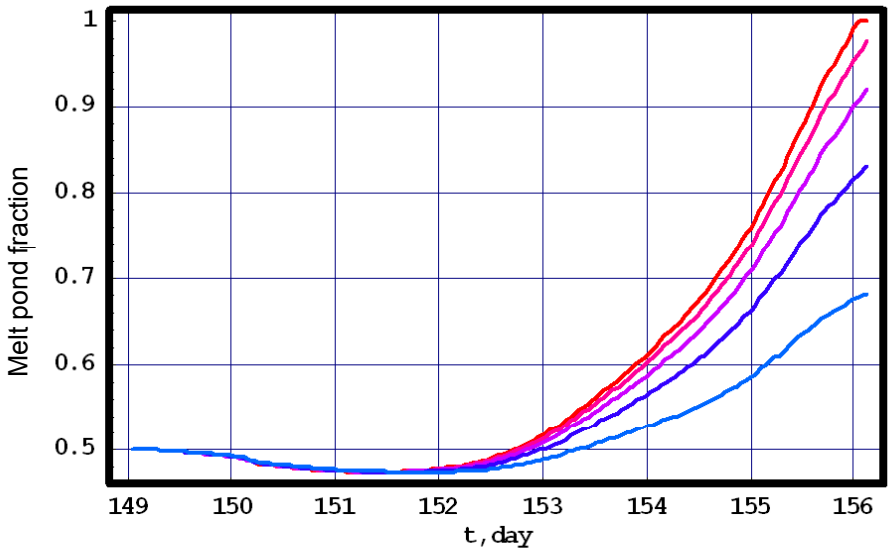
$$FCM=sign(T_w-\theta)(\rho C)_w J\,|T_w-\theta|^{4/3},\qquad J=\gamma\left(g\beta\kappa_w^2/\nu_w\right)^{1/3}$$

Model estimations of melting water depth (a) and area (b) for different velocities of filtration (0, 0.1, 0.2, 1, and 2 cm/day)



a





b

Fast ice near HMO Tiksi in spring 2012

New direction of investigations – processes of sedimentation in sea ice

Sediments in ice core (March 2012)

Conclusions

Historical records show that the maximal thickness of fast ice in the Sogo Bay during period of observations ranged from 2 to 2.5 meters and does not demonstrate any significant trends, especially taken into account probable errors of measurement due to different positions the points of measurements as well as local effect of changes in snow depth. Even during the first decade of 21 century the maximal thickness of fast ice had been higher than in more colder years in the middle of 20 century.

Field studies, executed in springs 2011 and 2012, showed the strong influence of dynamic processes during first stage of fast ice formation in peculiarities of its melting and sedimentation. It was revealed and modeled that short – term, but strong increase of air temperature above not deformed fast ice (2011), could be the trigger for intensive melting of its upper surface and formation of rather deep water layer, continued after drop of air temperature below freezing point. Same time few events of fast ice destruction during autumn 2011 leaded to increase of sediments in its upper layer, formation of holes in ice cover in spring 2012 and respectively to drying of fast ice upper surface.

Thank you for attention