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The sea-ice drift dynamics in the period of catastrophic ice-pack fragmentation in the Arctic Ocean

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The statistics of ice-field accelerations and time series of local energy release events was observed at the ice-research station "North Pole 32" that had been established in 2003 and drifted on the pack ice in the region north from Franz Josef Land. In February 2004, a basin-wide ice-pack shearing and fragmentation occurred in this region.

The energy of impact interactions between middle-size ice-fields (10^8 J) is comparable with the energy release in seismic shocks. The changes in the parameters of the autocorrelation function of drift accelerations, such as the first zero-crossing lag and the periodicity of positive and negative correlations were revealed a few days prior to the large-scale perturbation (10 February 2004). The posterior analysis of the distribution of waiting times for accelerations whose amplitudes (A) exceed the cut-off value $A_{cut-off}$, that is $N_{A>Acut-off}(> \tau)$, was performed for three periods of observations: (a) from 1 January to 31 January (a "remote" period); (b) 1 February to 10 February (a "predecesser" period); (c) 11 February to 28 February (a "posterior" period). In the remote and posterior periods of observation the $N_{A>Acut-off}$ versus τ dependences exhibit a power law relation $N_{A>Acut-off}(> \tau) \propto \tau^{\gamma}$, whilst in the immediate interval before the catastrophic perturbation, the time sequence of ice-field accelerations does not follow the power law. This decorrelation of the drift dynamics was in agreement with the behavior of daily-measured autocorrelation functions that demonstrated a disordered motion of ice fields in the predecesser period. At the same time, the energy release, E, in events of accelerations was distributed according to a scaling law $N(>E) \propto E^{-b}$(here N is the number of events with energy greater than E) both in quite period, and in the period covering the large-scale perturbation. The b-value was equal to 1.5 ± 0.2.