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Sea-ice melt onset associated with ice deformation events during early summer near the North Pole in the Arctic Ocean

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In the central Arctic Ocean, autonomous observations of ocean mixed layer and ice documented the transition from cold spring to early summer. Our ice motion measurements using GPS drifters captured three events of lead opening and ice ridge formation in May and June. We clarify how these ice deformation events are linked with the onset of sea ice melt. In early June, the buoy array detected a shear deformation coincident with a temperature peak at 6 m below the ice bottom. At this time, an autonomous profiler shows there was a slow decrease of temperature with depth and nearly homogeneous salinity profiles, with persistently stable mixed layer. We use a one-dimensional numerical simulation incorporating the Local Turbulence Closure (LTC) scheme to investigate the mechanisms controlling basal melt onset. According to the simulation, a combination of the extremely slow ice motion and incoming solar energy input at the open lead, followed by a transient low pressure system, produced a thin, low density surface layer by advection of warm lead water under the ice. This enhanced stratification near the surface facilitates storage of solar radiation within the thin layer, instead of exchange with deeper layers, leading to early onset of basal ice melt preceding the upper surface melt.