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Transformation of Temperature Signal in Atlantic Water in the Arctic Ocean due to Joint Effect of Advection-Diffusion

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Recent decades were marked by significant changes in the state of the Arctic climate system components, including decrease of the ice cover, increase of surface air temperature, and warning of Atlantic Water layer (AW) in the Arctic Ocean. According to several observation-based studies the process of AW warming had occurred in a series of pulses, separated by intervals of colder water inflow. These warm pulses are anticipated to originate in the Nordic Seas or in the North Atlantic Ocean, since after entering the Arctic Ocean interior AW looses direct contact with the atmosphere. Due to sparse measurements, propagation of warm anomalies across the Arctic Ocean is hard to trace. Several published results are controversial and give large uncertainty in estimation of speed of anomalies propagation. In this theoretical study we show that under certain conditions, a "train" of anomalies moving in a decelerating flow may collapse, resulting in a solitary anomaly far downstream. We applied a hierarchy of analytical and numerical models, based on simplified transport-diffusion equation with prescribed horizontal speed and diffusion coefficient. We estimated typical "collapse" length scales for various frequencies of initial anomalies supply depending on the flow properties. Our results suggest that this mechanism may be applicable for explaining the observed temporal variability of temperature in the AW layer in

the Arctic Ocean during the recent decades. Another possible application of our results is explanation of disappearance of the seasonal cycle in the AW. Existence of strong seasonal cycle in AW at the entrance of the Arctic Ocean in Fram Strait and the absence of this variability mode in the Laptev Sea (about 2 thousand kilometers downstream) may be explained by suggested "anomalies collapse" mechanism.