

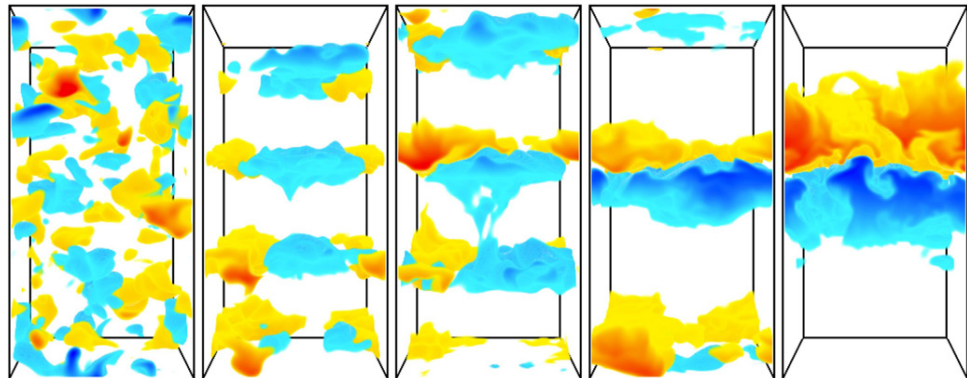
# A census of Arctic staircases over the years

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**Project description:** Under the Arctic sea ice, warm, salty water originating from the Atlantic Ocean subducts below the cool, fresh surface waters that are in contact with the sea ice. There is a sufficient amount of heat contained within the Atlantic water to melt all Arctic sea ice within five years, if it rose to the surface. Between the surface and the warm Atlantic layer, the water's density changes suddenly every few metres, forming a density "staircase." These staircases have significant implications for vertical transport. In order to predict how the Arctic climate will continue to change in the future, it will be important to know when and where these staircases existed in the past and how they have been changing over time.

Many Arctic staircases have been detected through measurements of temperature, salinity, and depth collected by Ice Tethered Profilers, autonomous instruments attached to sea ice, that were first deployed in 2004 and continue to collect measurements across the Arctic today. However, there are data from many other field campaigns and cruises in the Arctic, which have seldom or never been analyzed in this manner. These include the AIDJEX campaign, where scientists lived out on the ice for a year from 1975-1976. The selected student will collect various historical data sets and use established algorithms to detect staircases and calculate the properties of hundreds of thousands of Arctic Ocean profiles.

*Figure:  
Snapshots from  
a simulation of  
staircase  
formation  
(Rosenblum et  
al., 2011).*



**Requirements:** We accept students at any level. Basic programming experience in Python, or motivation to learn fast, is strongly preferred.

## **Bibliography:**

Toole, J., R. Kirshfield, M. Timmermans et al. (2011), "The Ice-Tethered profiler: Argo of the Arctic", *Oceanography*, 24(3):126-135, <https://doi.org/10.5670/oceanog.2011.64>

Untersteiner, N., A. Thorndike, D. Rothrock et al. (2007), "AIDJEX revisited: A look back at the U.S.-Canadian Arctic Ice Dynamics Joint Experiment 1970-78", *Arctic*, 60(3):327-336, <https://doi.org/10.14430/arctic233>