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**The formation of thermohaline staircases for large salt concentration differences in double diffusive convection**[1] YANTAO YANG, Physics of Fluids Group, University of Twente, ROBERTO VERZICCO, Dipartimento di Ingegneria Industriale, University of Rome "Tor Vergata", DETLEF LOHSE, Physics of Fluids Group, University of Twente — In the upper layers of the tropical and subtropical ocean, step-like mean profiles for both temperature and salinity are often observed, a phenomenon referred to as thermohaline staircase. It consists of alternatively stacked mixing layers, and finger layers with sharp gradients in both mean temperature and salinity. It is believed that thermohaline staircases are caused by double diffusive convection (DDC), i.e. the convection flow with fluid density affected by two different scalars. Here we conducted direct numerical simulations of DDC bounded by two parallel plates and aimed to realise the multi-layer state similar to the oceanic thermohaline staircase. We applied an unstable salinity difference and a stable temperature difference across the two plates. We gradually increased the salinity Rayleigh number $Ra_S$, i.e. the strength of salinity difference, and fixed the relative strength of temperature difference. When $Ra_S$ is high enough the flow undergoes a transition from a single finger layer to a triple layer state, where one mixing layer emerges between two finger layers. Such triple layer state is stable up to the turbulent diffusive time scale. The finger-layer height is larger for higher $Ra_S$. The dependences of the scalar fluxes on $Ra_S$ were also investigated.

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