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Lagrangian pathways under the Filchner-Ronne ice shelf and in the Weddell Sea

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The objective of the study is to construct Lagrangian pathways under the Filchner-Ronne ice shelf (FRIS) and in the Weddell Sea using the data of numerical simulation of currents and Lagrangian numerical methods. The yearly cycled results of modeling for the circulation, temperature, and salinity in the Weddell Sea and the FRIS cavity from the Whole Antarctica Ocean Model (WAOM) were used to run the particle-tracking model (Parcels) for computing Lagrangian particle trajectories. The original version of the Parcels model does not have an option for particle reflection from the solid boundaries including the ice shelf. Therefore, the corresponding kernel was developed in the current study. The Parcels model gives an error in interpolation when it cannot find enough grid nodes around the particle. To avoid these errors, the function of particle recovery was developed. To analyze the variations of movement of the water masses under the FRIS, a set of particles was released in the Ronne Depression near the ice shelf front. Particles were released at two depths: 350 m and 500 m under the sea surface. Particles were released each 4 hr within 365 days. Simulation continued for 20 years of particle movement. The results of Lagrangian analysis generally agreed with schemes based on water mass analysis. The released particles first move southward along the Ronne Trough. The flow then turns to the east reaching the passage between Berkner Island and Henry Rise after 3 years. After 10 years, the flow of transformed water reaches the Filchner Trough through which water flows out to the shelf of the southern part of the Weddell Sea. Over time, the particles penetrate into all parts of the cavity. Some of the particles cross the Ronne Shelf front, and then they are carried away by currents on the Weddell Sea shelf. In 20 years, almost the same number of particles left the cavity through the Ronne ice front (43%) and the Filchner ice front (37%) whereas the rest of the particles (20%) remained under FRIS.