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# Horizontal convection in water heated by infra-red radiation and cooled by evaporation.

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The circulation in a fictitious ocean, driven solely by latitudinal variations of incoming solar radiation, has been examined in a laboratory experiment.

Fresh water was heated from above by an infra-red lamp placed at one end of a tank, and then cooled as the water moved away from the heat source. The heat radiated from the lamp was absorbed in a thin (less than 1 mm) layer next to the surface, and then advected and diffused away from the lamp region. In similarity with the ocean, the surface cooling was greatly dominated by evaporation, which here accounted for over 80 % of the total energy loss.

The velocity- and temperature fields were recorded with PIV technology, thermometers and an IR camera. The measurements showed a closed, steady circulation with a thin, fast, gradually cooling surface current away from the lamp. Below the surface current the water was stably stratified with a comparatively thick and slow return current. The thickness and speed of the surface- and the return current increased with distance from the lamp.

New scaling laws pertaining to this radiation-evaporation system have been derived and shown to agree qualitatively with the experimental results. Surprisingly, when based on oceanic values for radiation and evaporation, the scales give a circulation strength that is comparable in magnitude to the meridional overturning circulation - even though these are based on molecular rather than turbulent values for diffusion of heat and viscosity. The reason is the weak dependence on these coefficients. The results indicate that if the ocean was forced purely by solar radiation and latent heat loss to the atmosphere, it would be comparatively insensitive to turbulent diapycnal mixing.