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Influence of the short-term variability of surface forcing on deep convection

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Deep convection occurs in regions of the ocean where strong buoyancy loss from a preconditioned ocean to the atmosphere leads to a very deep mixed layer. In a one-dimensional approach, the deepening of the mixed layer depends on the integrated value of the buoyancy loss, but this surface loss is highly variable in time. In the Gulf of Lion, for example, the mean winter surface heat loss is about 200 W/m^2, but can reach values higher than 500 W/m^2 for very short times (typically 2 days).

The effect of this short-term variability is investigated using an idealised model. The MIT model is integrated over a square box of size 64km x 64 km x 2km initialised with homogeneous salinity and a linear vertical temperature gradient. A time-periodic cooling is then applied over a disc of radius 20km at the centre of the surface of the box. All the time-periodic forcing have the same integrated value, but different shapes with periods of either 4, 10 or 20 days.

The depth of the mixed layer does not seem to depend on this time-variability, but only on the integrated value of the heat flux. Plotting the lateral buoyancy fluxes out of the patch, as well as their vertical structure, shows that most of the buoyancy gains take place close to the surface. Possible explanations for this are investigated.