Geophysical Research Abstracts,
Vol. 11, EGU2009-11620, 2009
EGU General Assembly 2009

Wintertime thermal winds over Iceland

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The present study describes simulations of thermal flows in Iceland during a day of strong radiative surface cooling. The thermal flows are organized by the topography as well as the differential cooling of the land and the sea. Idealized simulations reveal that there is strong land breeze at the coast. This land breeze has previously been referred to as “katabatic wind” which is in many cases considerably weaker than the land breeze and is created in the sloping topography. The topography:

• gives rise to the katabatic winds which sometimes merge with the land breeze and
• reduces or eliminates the land breeze in many coastal regions
• contributes to channeling of the winds and a stronger ageostrophic component of the coastal winds.
• gives rise to strong cyclonic flow aloft through a deformation of the temperature field (adiabatic warming) over the mountains. This flow is as much as ten times deeper than the katabatic winds and the land breeze at the surface.

The katabatic winds weaken and cease to exist if the land breeze, or possibly other background flows, do not constantly remove the stagnant cold air at lower levels. When the cold pool deepens the driving force behind the katabatic flows weakens, i.e. the horizontal temperature gradient above the mountain slopes.

A “peninsula”-effect contributes to a sheltering on the left hand hand side of peninsulas and an acceleration of the flow on the right hand side when looking from the sea towards land. This reflects the analogous results of a similar study of thermal winds in Iceland during a day of strong surface heating