14. Wind Climatology

14.1 Local Winds

Establishment of local wind systems by thermally induced pressure gradients.
Driving force: differential heating

The main steps in the development are shown in Fig. 14.1. Note, that for length scales below 100 km the effect of the Coriolis force is small and the air flow follows mainly the pressure gradient.

Examples of local and regional wind systems which are based on this concept:
- sea-breeze winds
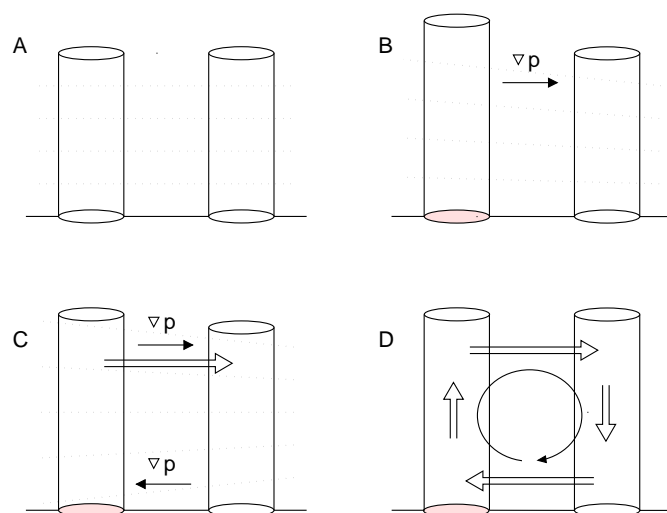- mountain/valley winds
- monsoon winds.

Fig. 14.1. Schematic development of a wind system. **A**. Two columns of air are in hydrostatic equilibrium each. The air is in rest. **B**. Differential heating causes the temperature of the left column to rise and a horizontal pressure gradient between the two columns in larger heights establishes. **C**. This results in a horizontal wind flow directed towards lower pressure and thus produces a horizontal pressure gradient (and a wind flow) at the surface in the opposite direction. **D**. Due to the conservation of mass vertical motion of air is necessary to close the circulation.

14.2 General Circulation of the Atmosphere

(mostly dynamical in nature)
   fig.: global circulation
   fig.: Hadley circulation
   ITCZ: convective clouds
air motion directed towards the equator, by Coriolis force deflection to right
trade winds: east to west (both hemispheres)
   Circulation north and south of 30 deg is characterized by strong westerly wind
regimes (Rossby circulation).
   Seperation of tropical air from cold (ant)arctic air masses
$\longrightarrow$ region of strong horizontal contrasts in temperature, pressure, humidity, . . .
   With this circulation westerly waves are coupled which transport energy from
equatorial regions to polar regions.
   Year-to-year-variability $\longrightarrow$ wind index

14.3 Wind Resources

Generally, strong wind resources can be expected in regions with permanent (steady)
strong wind regimes. That is
   – local wind systems (monsoon type)
   – orographically induced wind systems
   – strong winds resulting from the global circulation (westerlies)
   figs.: wind maps