Heating of the atmosphere by the sea

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Abstract. An important component of atmospheric heating is the the surface heat flux from the sea. We give expressions for the main components of this flux.

The heat flux components are latent, sensible and radiative heating. These can be parameterised in terms of the surface temperature T_s as follows.

1. Latent Heat

$$Q_L = L\rho K_L |V| (q_s - q_a)$$

where L is the latent heat of vaporisation of water, ρ is the air density, K_L is an empirical constant of order unity, V is the wind velocity, q_a is atmospheric specific humidity, q_s is the specific humidity corresponding to sea-surface temperature T and is given by

$$q_s = \frac{0.622e}{p - 0.378e},$$

where e is the vapour pressure in millibars given by

$$\log_{10} e = 9.4 - \frac{2.35\times10^3}{T_s}.$$

2. Sensible heat

$$Q_s = C_p \rho K_s |V| (T_s - T_a)$$

where C_p is the specific heat of air at constant pressure, ρ is the density of air, K_s is an empirical constant of order unity, and T_a is air temperature.

3. Net longwave radiation

$$Q_p = Q_0(1 - 0.62C + 0.0019\alpha)(1 - A) - \varepsilon\sigma T_a^{\,4}(0.39 - 0.05e^{0.5})(1 - a_0C^2) + 4\varepsilon\sigma T_a^{\,3}(T_s - T_a)$$

where Q_a is the clear sky radiation received at the surface, C is the cloud cover fraction in tenths, α is the solar noon altitude, A is the oceanic albedo, ε is the emissivity of water, σ is the Stefan-Boltzmann constant and a_0 is a constant.