EMS Annual Meeting Abstracts,
Vol. 6, EMS2009-427, 2009
9th EMS / 9th ECAM

9th EMS Annual Meeting
9th European Conference on Applications of Meteorology
High resolution meteorology
- applications and services

Velocity spectra in the marine atmospheric boundary layer

A.-S. Smedman

Uppsala University, Department of Earth Sciences, Uppsala, Sweden (ann-sofi.smedman@met.uu.se, +46 18 551124)

Velocity spectra in the marine atmospheric boundary layerAnn-Sofi Smedman and Ulf Högström Department of Earth Sciences, Meteorology, Uppsala University
Spectra of longitudinal and vertical velocity have been studied at a marine site, Östergarnsholm, in the Baltic Sea during a period of six days with near neutral or slightly unstable conditions when the wave state gradually changed from pure wind sea to strong swell having approximately the same direction as the wind. During the period with pure wind sea, u- and w-spectra are shown to be in complete agreement with a new theory for the neutral atmospheric surface layer, which was earlier shown to agree very well with measurements over flat land surfaces. These spectra are used as references for the analysis of the corresponding spectra during the subsequent time period. The sensible heat flux was upward but small during the entire sequence of events. The analysis shows that the shape of both the longitudinal wind spectrum and the vertical wind spectrum start to deviate from their 'ideal' forms as soon as the wave age parameter co/U exceeds about 0.8. The spectral modification appears to start at a frequency around 0.2 Hz, resulting in two processes that evolve gradually as co/U increases: 1) A down-scale cascade effect, which causes the lower frequency limit of the f—2/3-range to gradually move to higher values of normalized frequency, f = nz/U. This effect proceeds at a greater pace in the vertical velocity component and more slowly in the longitudinal. 2) A low-frequency modification, which lifts the entire spectral level in the normalized w-spectra below 0.2 and creates a maximum in the corresponding normalized u-spectra which gradually moves towards lower frequencies. It is argued that this low-frequency spectral behaviour is a secondary effect caused by strong reduction of the friction velocity u*, which in turn, is a result of an upward directed uw co-spectral component accomplished by swell.