GTP Workshop, 'Turbulence and Scalar Transport in Roughness Sublayers', Abstract for suggested brief oral presentation by GTP Workshop, 'Turbulence and Scalar Transport in Roughness Sublayers', Abstract for suggested brief oral presentation by *Ulf Högström* and *Ann-Sofi Smedman*:

The surface roughness length for sensible heat and matter over the sea during high wind conditions

The flux of sensible heat and of matter is approximately height constant from a point within the atmospheric surface layer to some depth below the water surface. For the study of this flux an analogy to Ohm's law is sometimes useful: the flux is then considered to be subjected to a series of resistances on its way from the water to the atmosphere or vice versa. In this chain of resistances, the resistance at the surface itself is often considered as a bottleneck. Whereas the atmospheric and oceanic resistances are mostly considered as due to turbulent processes, which are generally speaking quite effective, the processes governing the transport across the air/water interface is traditionally modelled as a molecular conduction process through an atmospheric and an oceanic microlayer. In the Liu et al. (1979) model a 'surface renewal' approach is introduced, which treats the exchange process across the interface as a series of randomly occurring events which trigger corresponding episodic conduction events. Liu et al. (1979) pointed out explicitly that they predicted that their model would be effective only in light and moderate winds. Donelan (1990) speculated that increase of wave slope at high wind leads to an increase of surface area and possible disruption of the surface microlayer, which would act to increase the total heat flux. Based on data from numerous field experiments, Fairall et al. (2003) nevertheless argue that a modified surface-renewal relation adequately describes their data for $U_{10} < 18$ ms^{-1}:

$$R_q = R_r \exp(3.4 - 3.5 R_r^{1/4}) \qquad (1)$$

where

$$R_q = u_* z_{0q} / \nu = R_t = u_* z_{0T} / \nu \qquad (2)$$

and z_{0q} is the roughness length for matter (water vapour), z_{0T} the corresponding roughness length for sensible heat, u_* friction velocity and ν kinematic viscosity.

Relation (1) has been tested with the aid of data from the air/sea interaction site Östergarnsholm in the Baltic Sea. We find that this relation is in agreement with our measurements for $U_{10} < 10$ ms^{-1}, but that R_q and R_t are much larger than predicted by Eq. (1) for winds in the range $10 < U_{10} < 14$ ms^{-1}. These results are related to our finding that the exchange coefficients for sensible heat, C_{HN} and for water vapour, C_{EN} are not constant but increase significantly for $U_{10} > 10$ ms^{-1}. In the case of the flux of sensible heat, our results were obtained with the MIUU turbulence instrument, which has separate sensors for the vertical wind (hot film probes) and for temperature (thin platinum wire). Most previous results have been obtained from sonic instrument, which give both vertical wind and temperature and which were shown to give erroneously low fluxes for a combination of wind speed in excess of 10 ms^{-1} and water/air temperature difference below c. 4K.

The observed dramatic increase of R_q and R_t for high winds in our data appears to be the result of a combination of factors. Wind above 10 ms^{-1} appears to be an adequate requirement, but the effect increases significantly if the water/air temperature difference is small enough (c. 1K). This finding was shown to be related to the occurrence of a particular turbulence regime, termed the UVCN regime, the Unstable Very Close to Neutral regime, which is accompanied by pronounced downbursts of relatively cold air.