Geophysical Research Abstracts
Vol. 14, EGU2012-2119, 2012
EGU General Assembly 2012

Influence of a clear cut on properties and vertical coupling of coherent structures

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Little is known about the influence of coherent structures on the exchange process, mainly for in the case of forest edges. Thus, within the frame of the third intensive observation period (IOP3) of the EGER project (ExchanGE processes in mountainous Regions, DFG PAK 446), measurements were taken along a forest-to-clearing transition. From these high frequency turbulence data, the dominant large-scale motions were extracted using an already existing wavelet methodology which was developed for homogeneous forest canopies. The aim of this study was to identify whether there is better vertical coupling at the forest edge.
At first, it was found that, at the forest edge, coherent structures contribute less to total turbulent flux than within the forest. Accordingly, these coherent motions do not ensure that there is better vertical coupling between the forest stand and the overlying atmosphere at the forest edge. But unlike within the forest, structures reveal similar time scales at all measuring heights at the edge. Thus, although coherent fluxes are lower at the forest edge, the associated coherent structures can propagate better in the vertical direction there. Consequently, it is to doubt whether the routine has detected the relevant transport scales at the forest edge, because it was developed for homogeneous, dense forest canopies. The relative contributions of sweeps and ejections to coherent flux reveal that there might be even larger circulations that cause better ventilation at the forest edge. Ejections dominate during the daytime, whereas sweeps contribute more during nighttime. Thus, there is systematic outflow during the daytime and inflow of fresh air directly at the forest edge during the nighttime. Because this effect is not caused by differences in wind direction, the following hypothesis is formulated. It is assumed that thermal differences between clear cutting and forest trigger large circulations located above the clear cutting and which exhibit a diurnal cycle. These larger circulations above the clear cutting induce additional vertical motions, but only directly above the forest edge. These fluxes cannot be routinely captured via standard eddy covariance technique as its time scales are too long.