Geophysical Research Abstracts
Vol. 19, EGU2017-6271, 2017
EGU General Assembly 2017

Project "Convective Wind Gusts" (ConWinG)

Susanna Mohr (1,3), Alexandra Richter (2), Michael Kunz (1,3), Bodo Ruck (2,3)

(1) Institute of Meteorology and Climate Research (IMK-TRO), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany, (2) Institute for Hydromechanics (IfH), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany, (3) Center for Disaster Management and Risk Reduction Technology (CEDIM), Karlsruhe, Germany

Convectively-driven strong winds usually associated with thunderstorms frequently cause substantial damage to buildings and other structures in many parts of the world. Decisive for the high damage potential are the short-term wind speed maxima with duration of a few seconds, termed as gusts. Several studies have shown that convectively-driven gusts can reach even higher wind speeds compared to turbulent gusts associated with synoptic-scale weather systems.

Due to the small-scale and non-stationary nature of convective wind gusts, there is a considerable lack of knowledge regarding their characteristics and statistics. Furthermore, their interaction with urban structures and their influence on buildings is not yet fully understood. For these two reasons, convective wind events are not included in the present wind load standards of buildings and structures, which so far have been based solely on the characteristics of synoptically-driven wind gusts in the near-surface boundary layer (e. g., DIN EN 1991-1-4:2010-12; ASCE7). However, convective and turbulent gusts differ considerably, e.g. concerning vertical wind-speed profiles, gust factors (i.e. maximum to mean wind speed), or exceedance probability curves.

In an effort to remedy this situation, the overarching objective of the DFG-project “Convective Wind Gusts” (ConWinG) is to investigate the characteristics and statistics of convective gusts as well as their interaction with urban structures. Based on a set of 110 climate stations of the German Weather Service (DWD) between 1992 and 2014, we analyzed the temporal and spatial distribution, intensity, and occurrence probability of convective gusts. Similar to thunderstorm activity, the frequency of convective gusts decreases gradually from South to North Germany. A relation between gust intensity/probability to orography or climate conditions cannot be identified. Rather, high wind speeds, e.g., above 30 m/s, can be expected everywhere in Germany with almost similar occurrence probabilities.

A laboratory experiment with an impinging jet simulating the downdraft was performed to investigate the propagation of a gust within built environment. The aim is to investigate the interaction of the resulting convective gusts along the near-surface layers with different urban structures – from single street canyons up to more complex block array structures. It was shown that high velocities are conserved within street canyons over longer distances compared to open terrain conditions. In addition, the experiments revealed the ratio of building height to downdraft size as a crucial factor with regard to vertical velocities at roof level and the pressure distribution on the facades.