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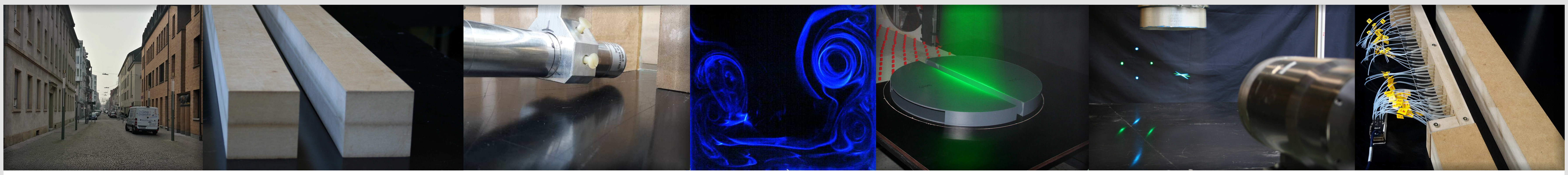

Simulation of density driven down-gusts and their interaction with street canyons

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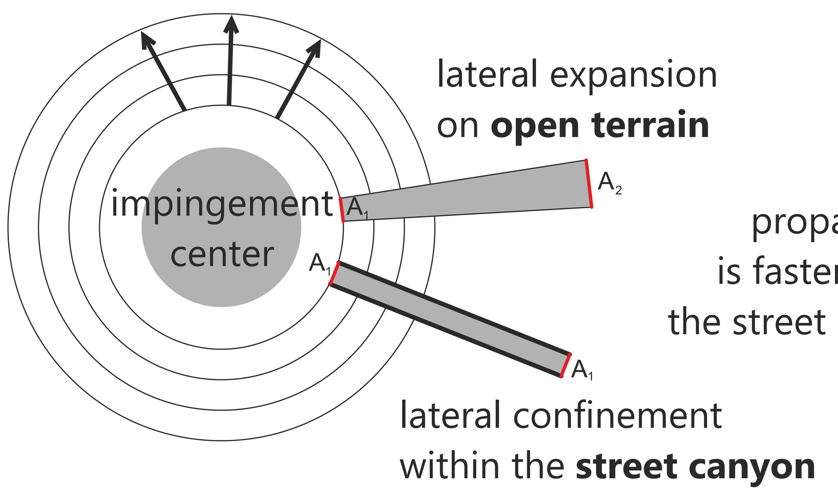
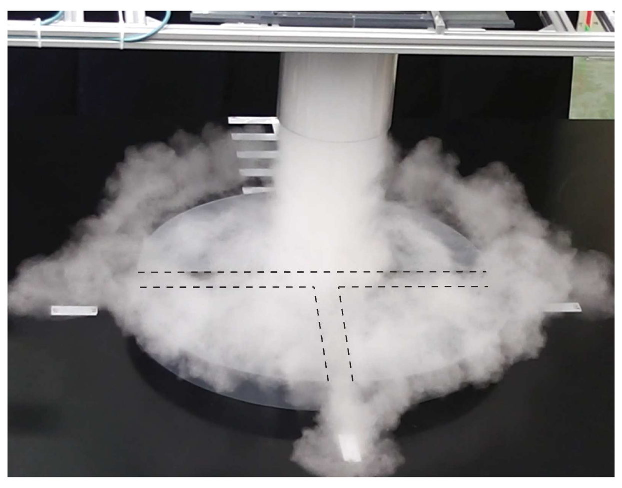
Motivation

- downdrafts generate high velocities close to the ground
- what happens within a city where the flow is guided by street canyons?
  → laboratory experiments with a single street canyon





Similarity and Setup

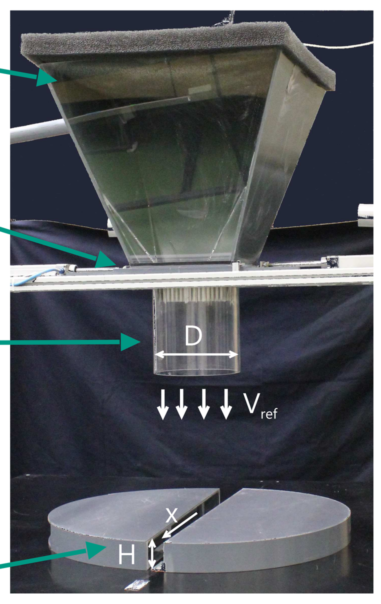
- following the similarity criterion of Lundgren
- simulated down-gusts consists of CO_2-air-mixture ($\rho > \rho_{air}$)
- diameter of simulated gust D = 240 mm

Model similarity

$$Re^2 = \frac{\Delta\rho}{\rho}\frac{g(0.5D)^3}{\nu^2} = Gr$$

propagation of gust front independent on Reynolds number for Re >3,000

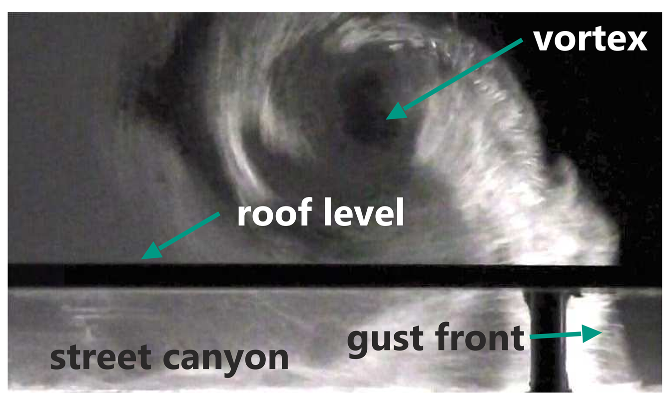
see Lundgren 1992: Microburst modelling and scaling



Visualization

- generation of a ring vortex
- ring vortex propagates above roof level
- vortex generates a gust front within the street canyon

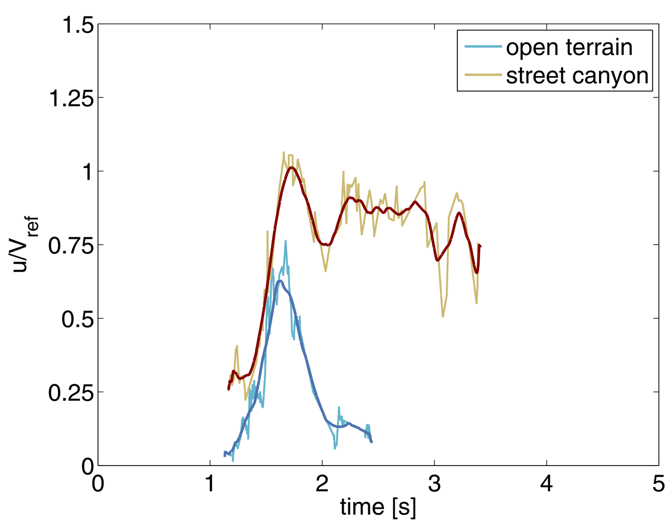
propagation on open terrain



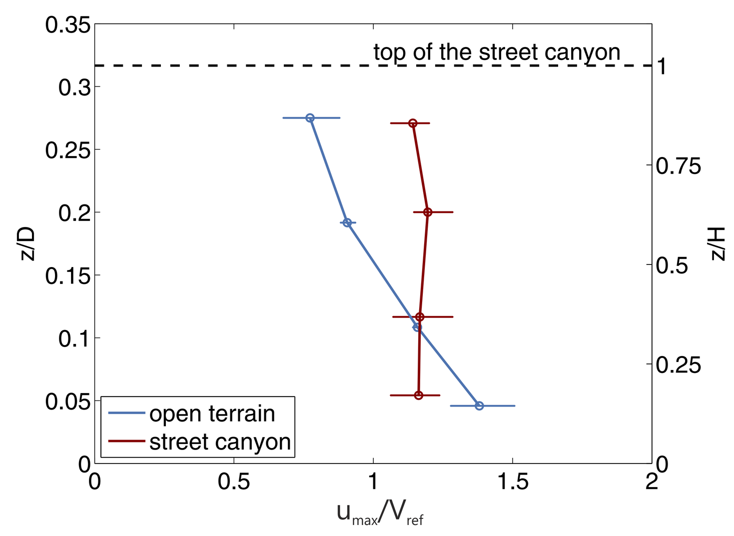
propagation within a street canyon

Velocity Measurements

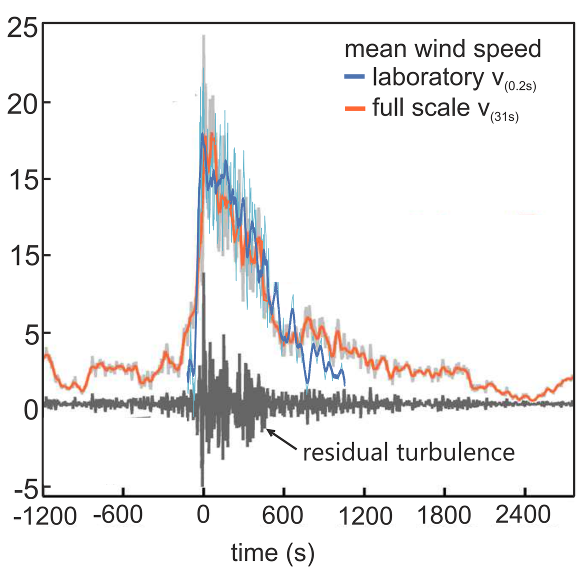
LDV-measurements
- sudden increase in velocity in both cases
- lab experiments + full scale data show good agreement
- within the street canyon:
  temporal and spatial conservation of high velocities



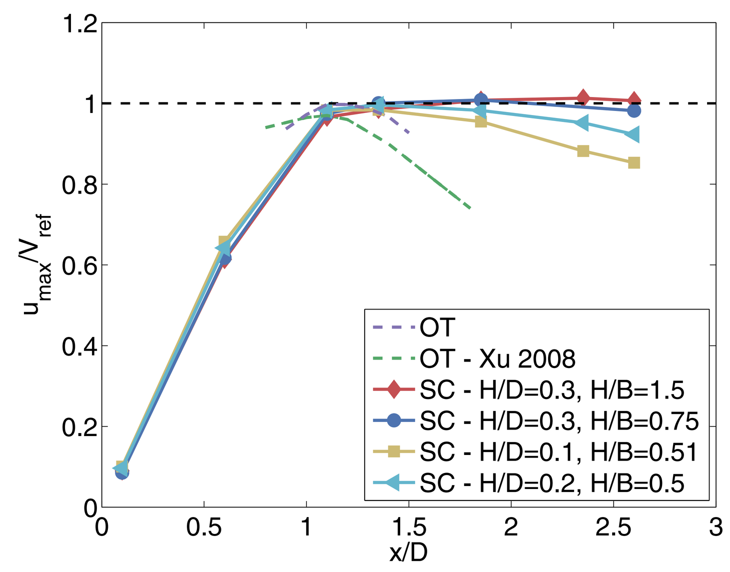
velocity time series with running mean (t_{avg} = 0.2s) at z/H = 0.87



maximum horizontal velocities at x/D = 0.9



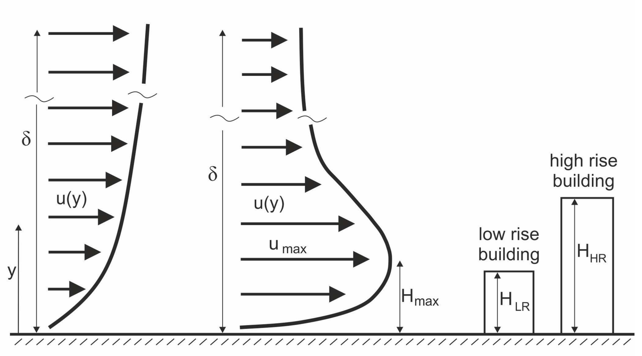
times series of a full scale event in Hatzenbühl, Germany and scaled time series of laboratory experiment



max. velocities on open terrain (OT) and within the street canyon (SC) (performed with another exp. setup)

Scales and Outlook

- downdrafts are large compared to urban structures
  e.g. downdraft diameter D~1.5 km, building height H~15m
  → factor 100
  → problems with downscaling for lab experiments
  → investigation of trends (systematical reduction of H/D)
- further experiments with block arrays representing an idealized city



ratio of downburst size and building height

block array (idealized city)