

URBAN CLIMATOLOGY

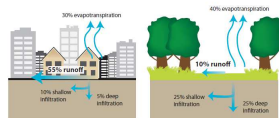
VII. Spatio-temporal variability of other meteorological elements in urban areas

7.1 Urban climate effects

Table U2 Urban climate effects for a mid-latitude city with about 1 million inhabitants (values for summer unless otherwise noted)

Variable	Change	Magnitude/comments
Turbulence intensity	Greater	10–50%
Wind speed	Decreased	5–30% at 10 m in strong flow
Wind direction	Increased Altered	In weak flow with heat island 1–10 degrees
UV radiation	Much less	25–90%
Solar radiation	Less	1–25%
Infrared input	Greater	5–40%
Visibility	Reduced	
Evaporation	Less	About 50%
Convective heat flux	Greater	About 50%
Heat storage	Greater	About 200%
Air temperature	Warmer	1–3°C per 100 years; 1–3°C annual mean up to 12°C hourly mean
Humidity	Drier More moist	Summer daytime Summer night, all day winter
Cloud	More haze More cloud	In and downwind of city Especially in lee of city
Fog	More or less	Depends on aerosol and surroundings
Precipitation		
Snow	Less	Some turns to rain
Total	More?	To the lee of rather than in city
Thunderstorms	More	

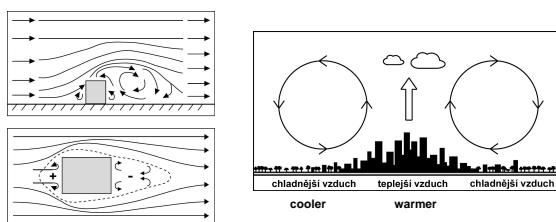
7.2 Humidity in urban areas



- Spatial and temporal variability of air humidity in urban areas is the result of evapo-transpiration, condensation and advection processes.
- There are several positive and negative feedbacks.
- Higher temperature -> higher intensity of evapotranspiration (that is however low due to lack of vegetation)
- No consumption of latent heat -> rising temperature
- Fast runoff -> less intensity of evaporation
- **Urban dry island**

7.3 Wind field in urban environment

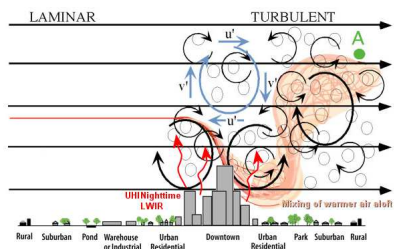
Wind field in urban environment is modified due to **mechanical** (left figure) and **thermal** (right figure) effects



Wind field modification in urban environment in vertical (above) and horizontal direction (below)

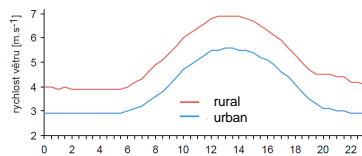
Local circulation resulting from temperature differences between rural and urban areas (modified after Munn 1968)

Intensity of turbulence

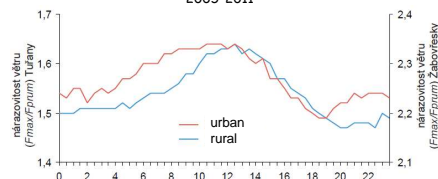


The ratio between maximum daily wind speed and mean daily wind speed may be used as a simple measure of **intensity of turbulence**. The ratio is clearly higher at the urban station.

Intensity of turbulence

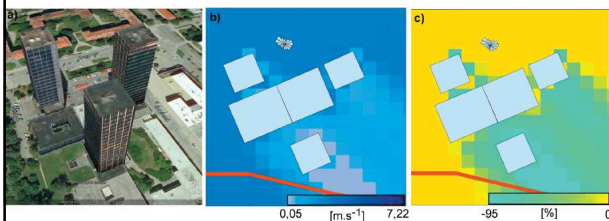


Daily variation of mean maximum wind speed at Tuřany and Žabovřesky stations in the period 2005–2011



Daily variation of the intensity of turbulence defined as a ratio of maximum wind speed (F_{max}) and mean wind speed (F_{prum}) at urban and rural stations, period 2005–2011

Wind field modification



Modification of wind speed near obstacles calculated using WAsP model - an example for for high-rise buildings (60 m) at Šumavská str. a) study area (black - buildings, green - roughness, red - altitude); b) mean wind speed near buildings for NW wind direction; c) relative reduction of mean wind speed near buildings for NW wind direction

7.X Final remarks and questions

1. How does the vegetation in urban areas influence humidity?
2. What can be the most important negative effects of wind field modification in urban areas?