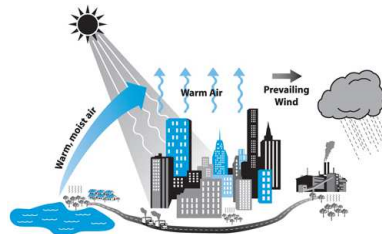


URBAN CLIMATOLOGY

VI. Precipitation in urban areas

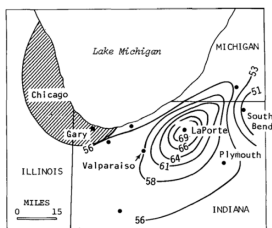
6.1 Urban precipitation

- precipitation is not continuous in time and space
- empirical studies sometimes show contradictory results
- it is hard to separate urban influence from others (position, relief, ...)



Modification of precipitation regime in urban environment; a general model adopted from <http://www.ucar.edu/communications/staffnotes/0603/cities.shtml>

Urban precipitation



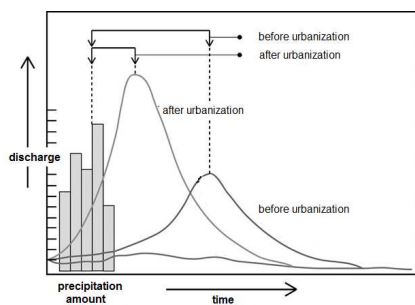
- Precipitation anomaly in La Porte, USA (Changnon 1968) and project METROMEX
- It is not clear whether urban environments initialize new precipitation events or whether they just intensify existing precipitation
- Most studies proved that precipitation totals in cities and in their leeward side are 5-15% higher compared to rural areas
- The summer is the time of maximum urban effect on precipitation

Urban precipitation

Precipitation in urban areas is modified due to **three different effects**:

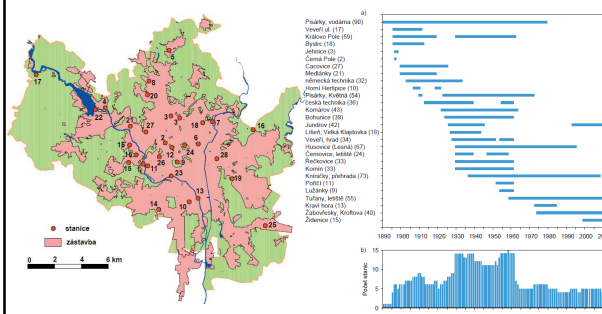
- **thermal effect** (UHI and stronger convection in summer → more showers and thunderstorms)
- **mechanical effect** (higher roughness → lower velocity of atmospheric fronts → more precipitation)
- **pollution effect** (more condensation nuclei)
- Due to UHI there is lower proportion of precipitation in the form of snow
- Ice particles of anthropogenic origin → condensation nuclei for stratus clouds → more frequent light snowfall in city

6.2 Water runoff in urban environment

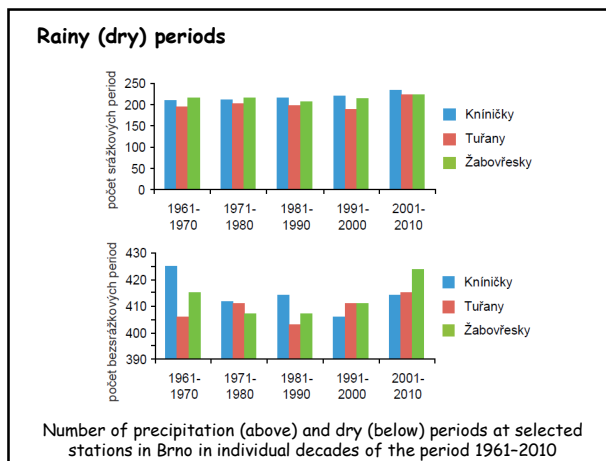
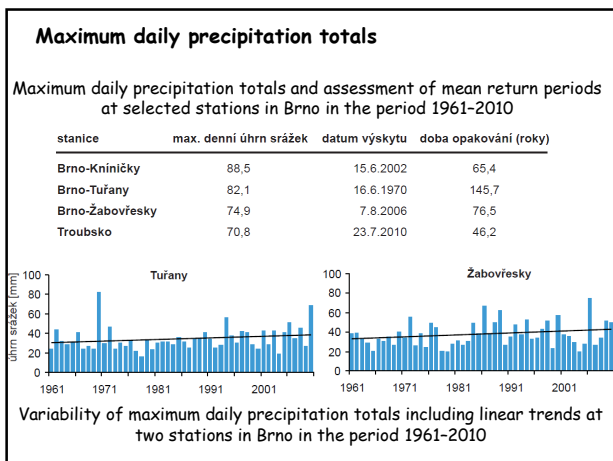
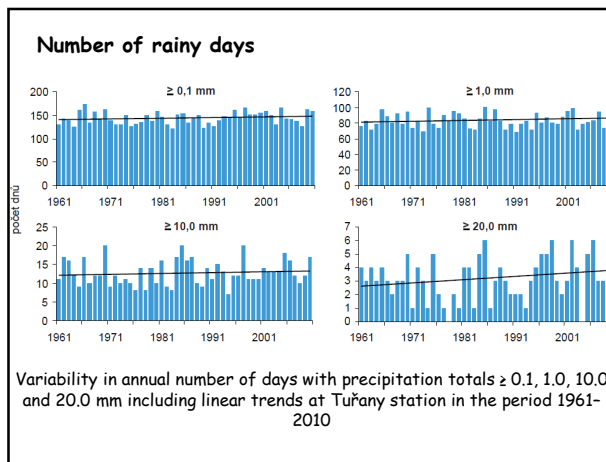
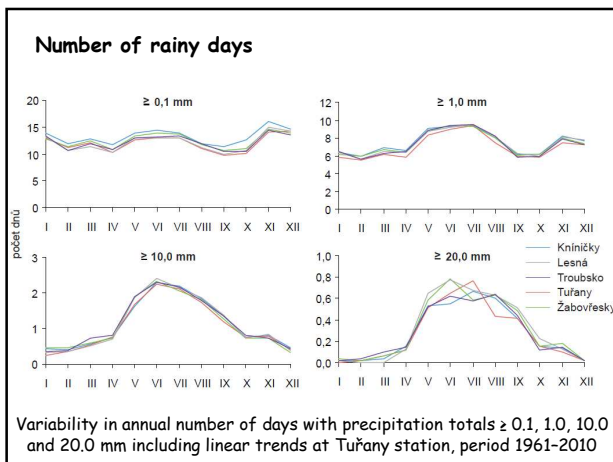
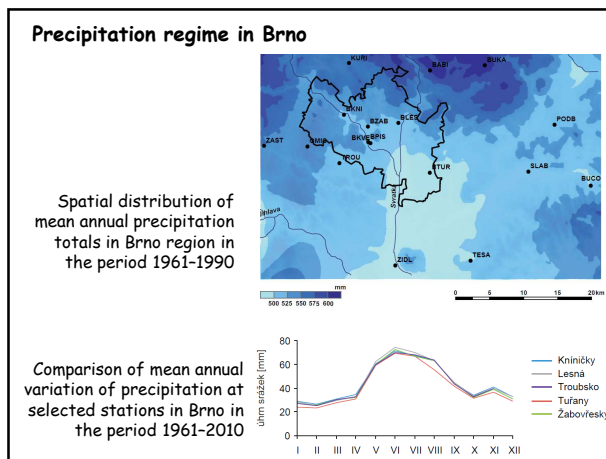
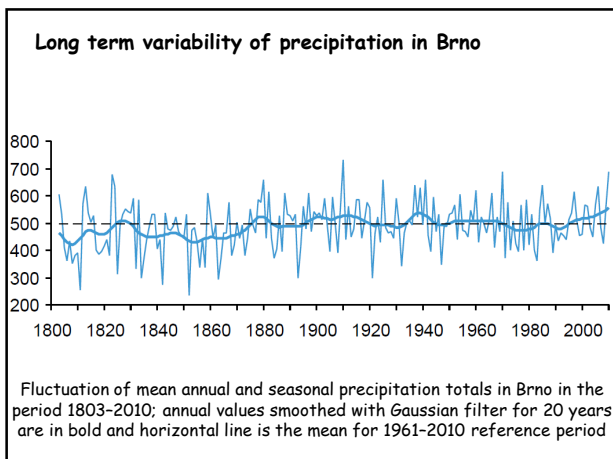


Before and after urbanisation hydrograph (adopted from Christopherson 1997)

6.3 Precipitation regime in Brno



Network of stations in Brno area and its temporal development in the period 1890-2012: a) period of measurements; b) number of stations



6.4 Final remarks and questions



Urban precipitation and Global warming projections

- Higher probability of occurrence of short-term extreme precipitation totals and flash floods
- Longer periods without any precipitation, higher probability of drought occurrence
- Non-uniform precipitation distribution during the year

1. What are the main impacts of changed precipitation regime on people living in cities?
2. How we can define extremity of precipitation regime?
3. What is the role of other factors such as relief, position, land use etc.?
4. How can be negative effects mitigated in urban-planning design?