



GLOBAL **HEAT** HEALTH  
INFORMATION NETWORK

## Part 5.1

# Urban climate Fundamentals

Essential elements of urban  
climatology for understanding  
the urban heat island

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17.02.2021 / web lecture

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Hamburg - view from University in direction of trade fair and Altona

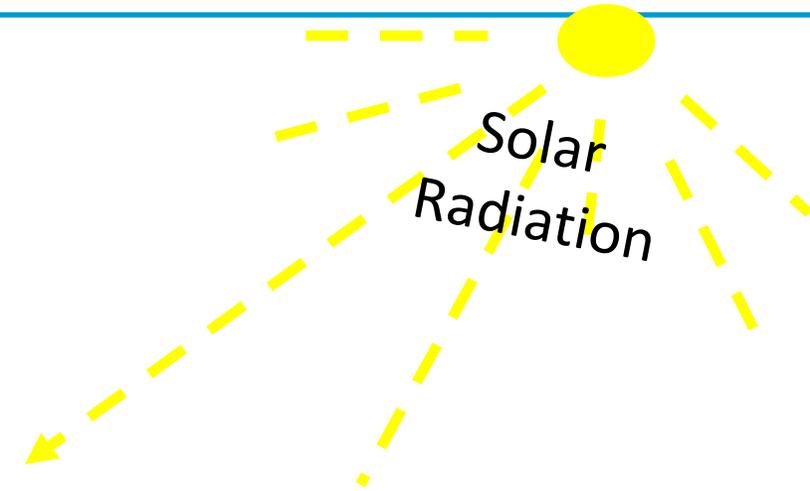
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## Essential elements

- Radiation,
- Temperature,
- Pressure,

Pressure

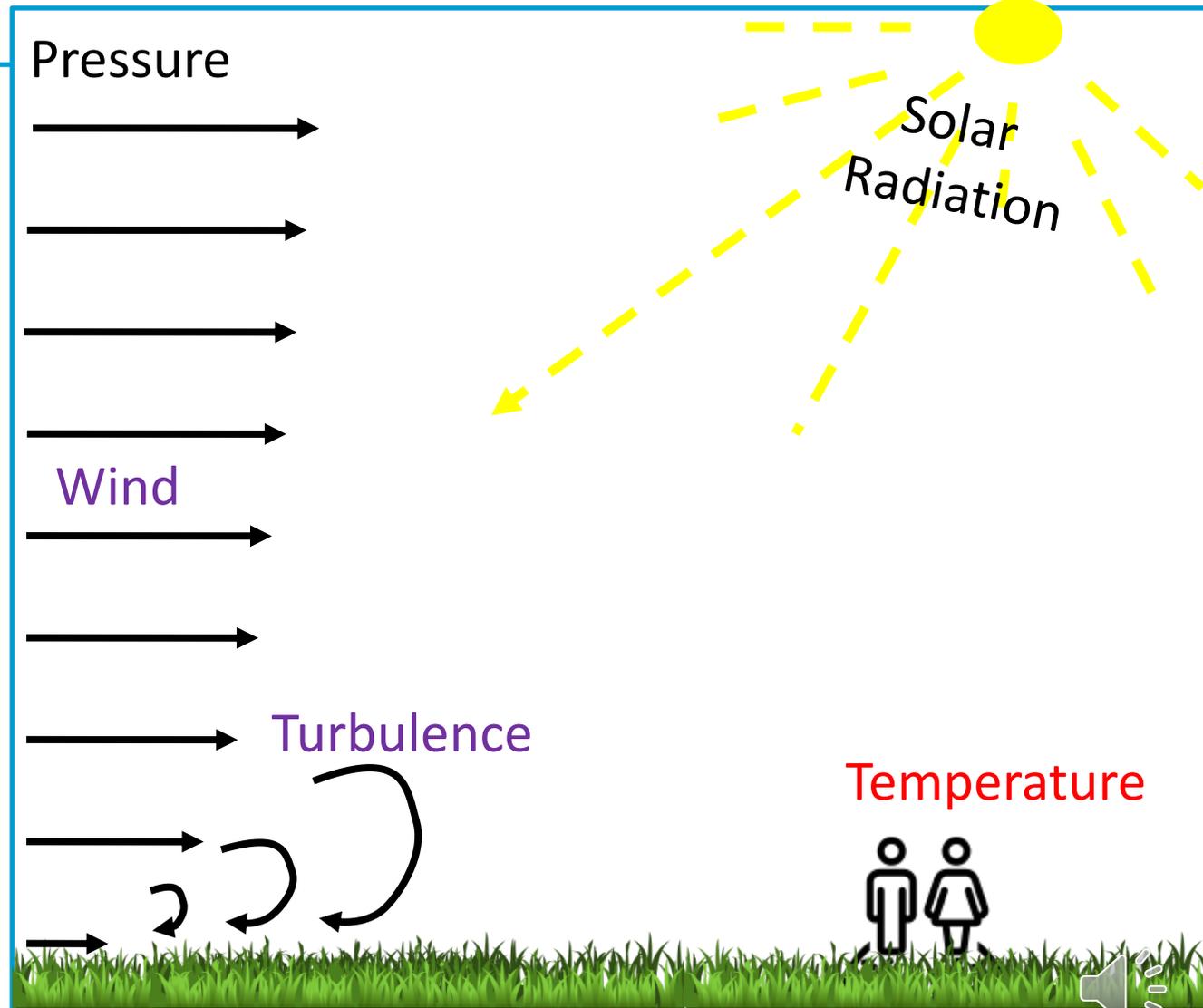


Temperature



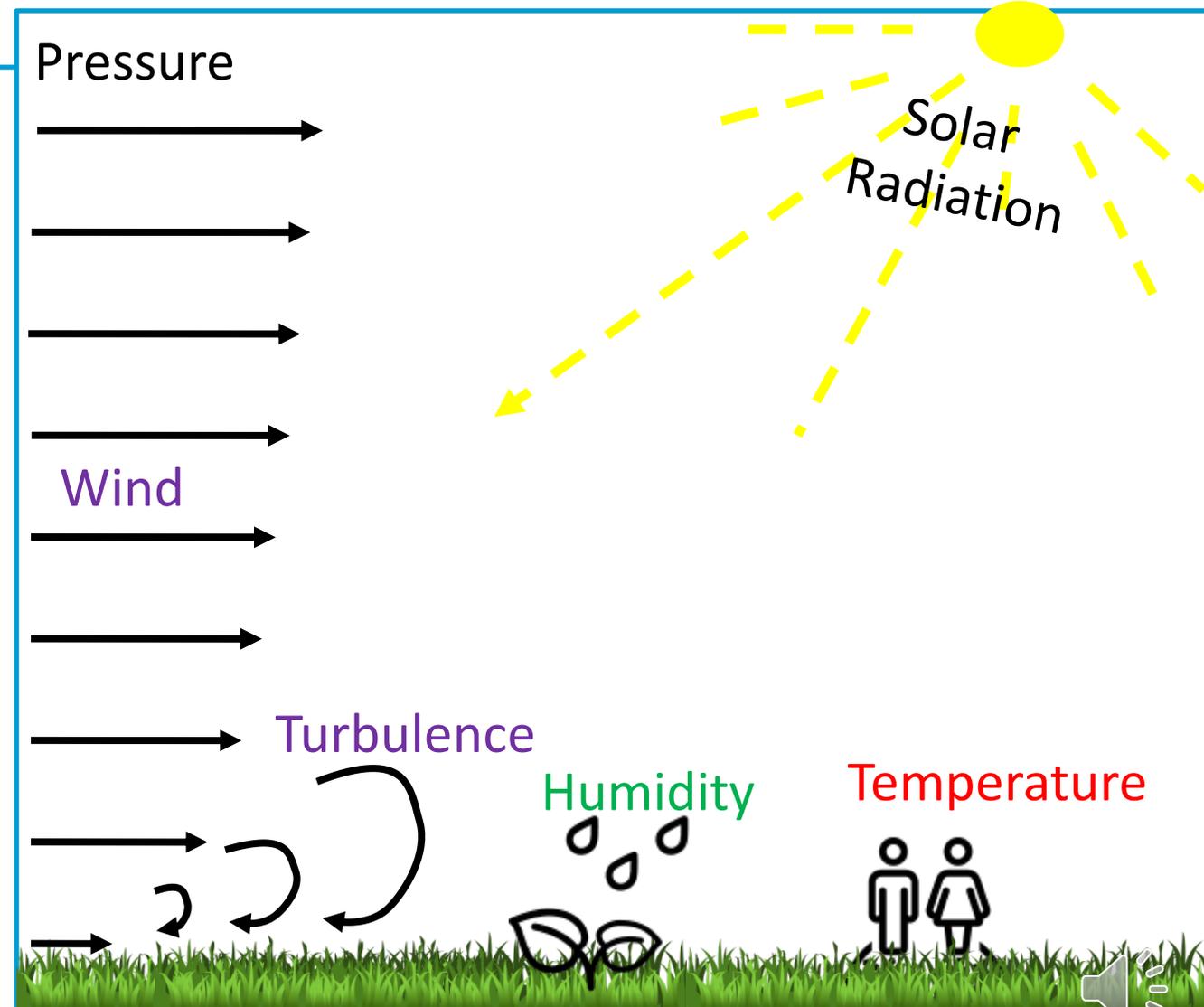
## Essential elements

- Radiation,
- Temperature,
- Pressure,
- Wind,
- Turbulence,



## Essential elements

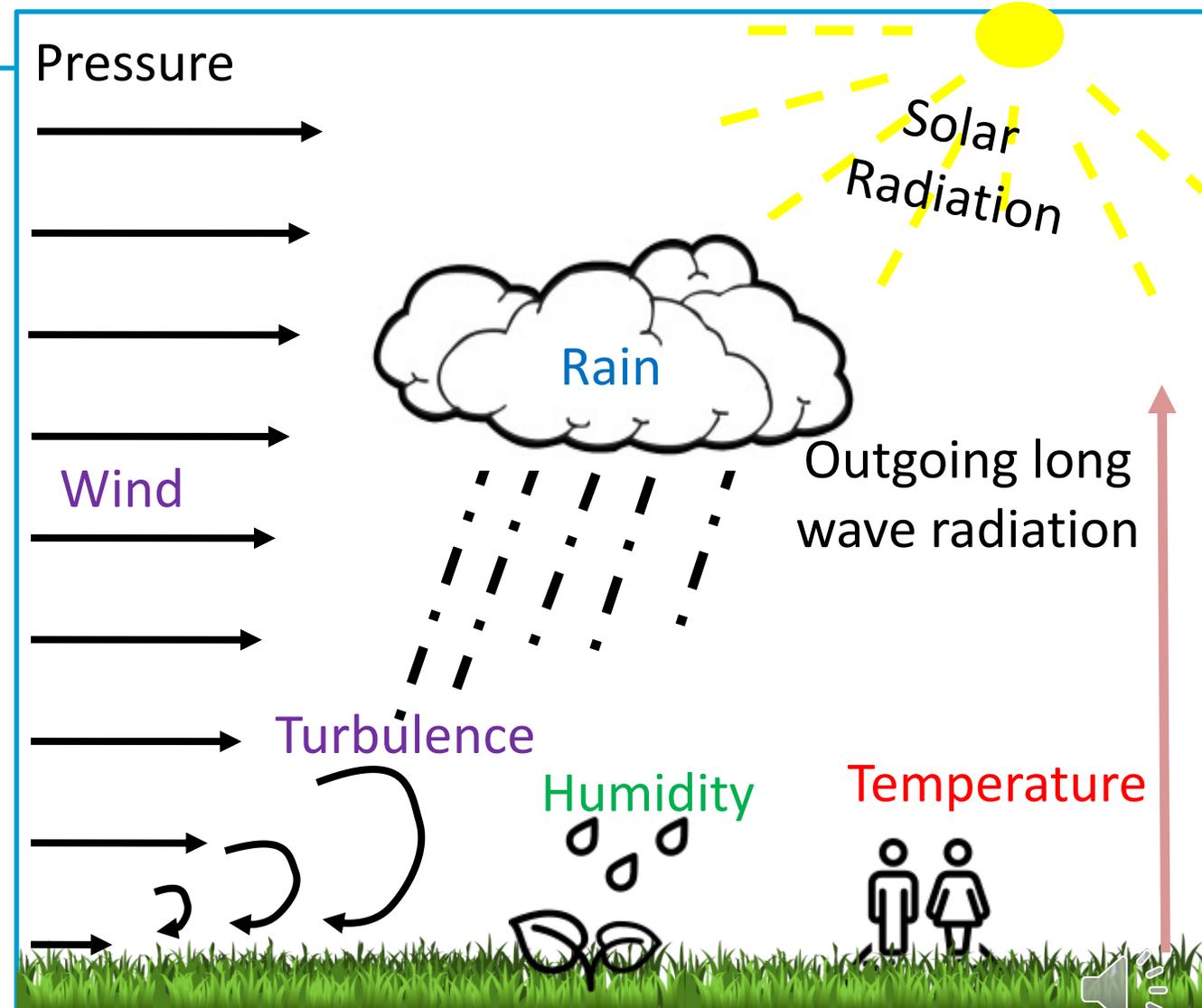
- Radiation,
- Temperature,
- Pressure,
- Wind,
- Turbulence,
- Humidity,



## Essential elements

- Radiation,
- Temperature,
- Pressure,
- Wind,
- Turbulence,
- Humidity,
- Clouds, precipitation.
- Water bodies, mountains, vegetation, surface specifics (e.g. Albedo).

All elements influence local climate.

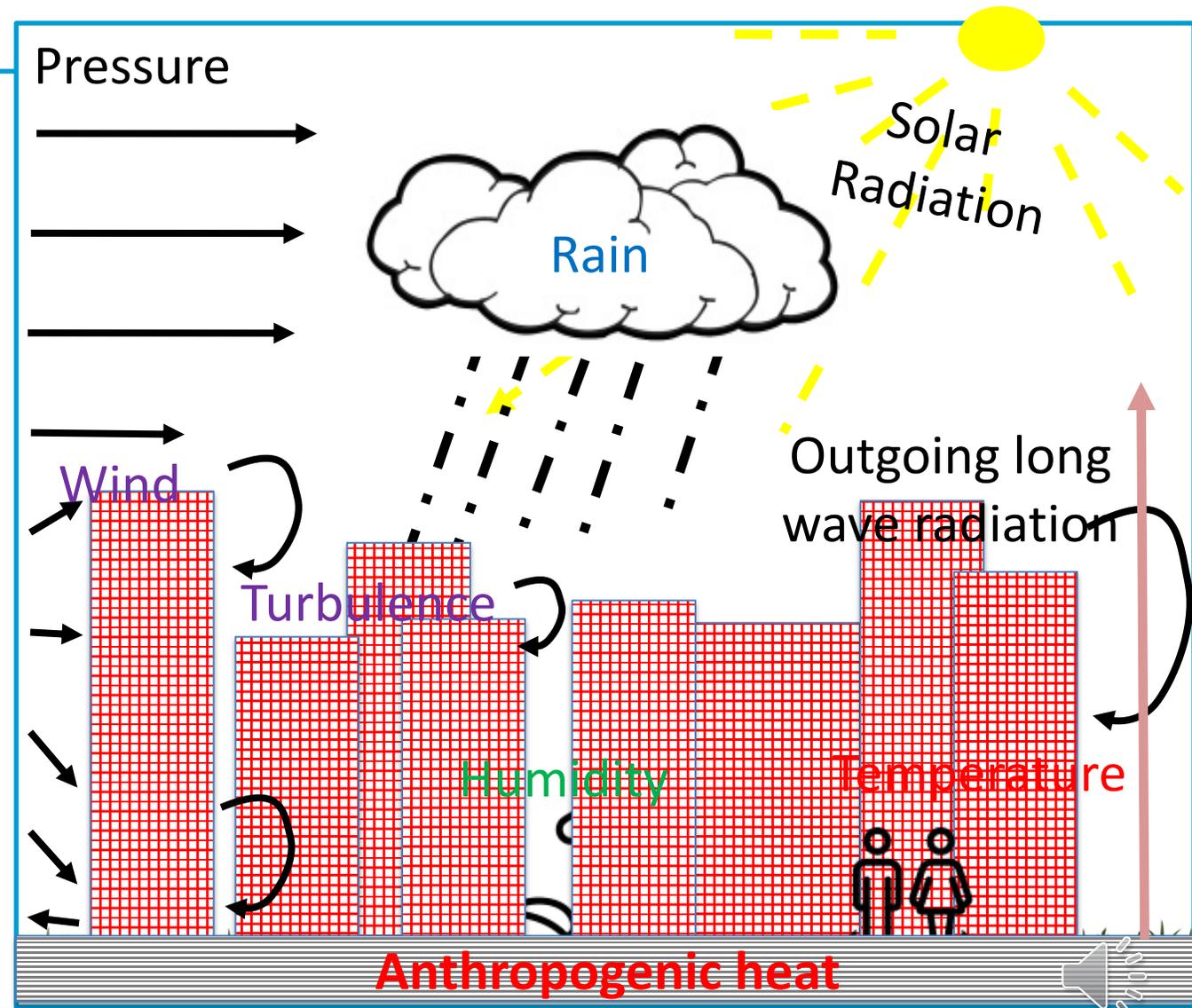


## Essential elements in cities

- Same elements as outside cities.
- Plus:
  - Urban fabric (heat storage ability, albedo),
  - Anthropogenic heat emissions,
  - Other anthropogenic emissions (pollutants),
  - Heat/humidity uptake and emission above ground (elevated surfaces).

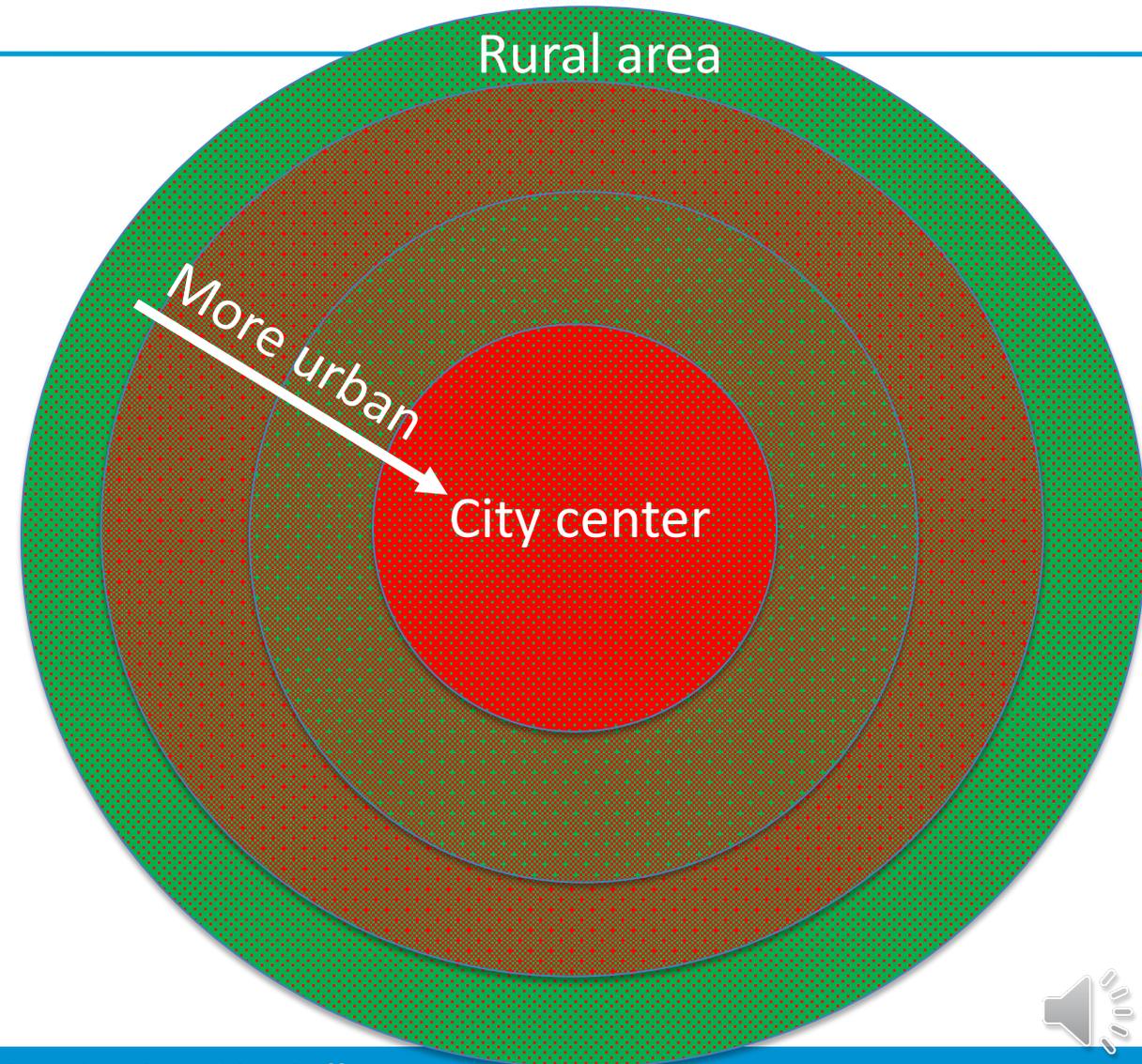
Changes in “natural” surface energy and humidity budget.

➔ Values of wind, temperature, humidity in urban areas differ from surrounding values.



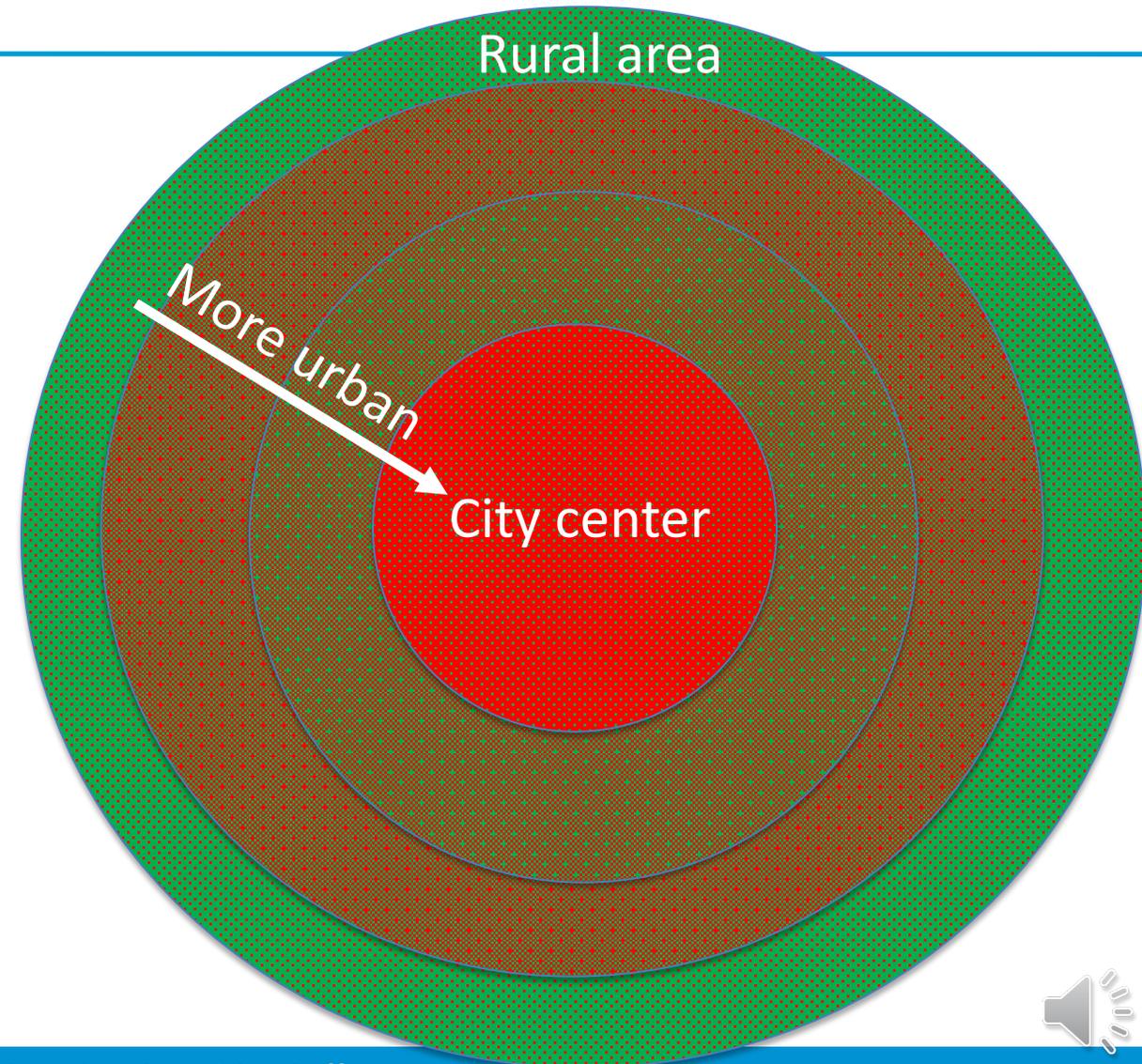
# Why urban heat island (UHI)?

- Urban fabric is heterogeneous.
- Cities more densely build in their center:
  - Lower wind speed due to buildings (reduced heat exchange with atmosphere),
  - More heat storage,
  - Larger anthropogenic heat values.



## Why urban heat island (UHI)?

- Urban fabric is heterogeneous
- Cities more densely build in their center:
  - Lower wind speed due to buildings (reduced heat exchange with atmosphere),
  - More heat storage,
  - Larger anthropogenic heat values.
- Warmer city center compared to more natural surrounding
  - **looks like an island in the ocean.**



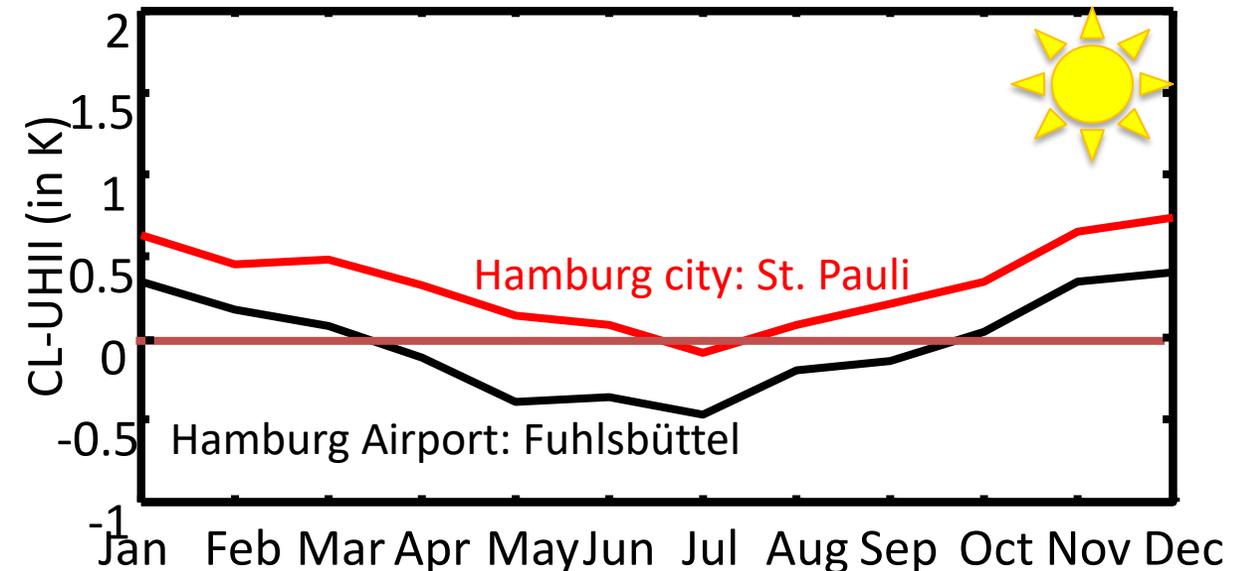
# How is the UHI Intensity (UHII) calculated?

- Temperature difference between values at an urban and a close-by more natural site.
- Important for UHII calculation:
  - Same regional climate in and outside city,
  - Sites at same altitudes above sea level,
  - Same assessment method (sensor, model, ...).



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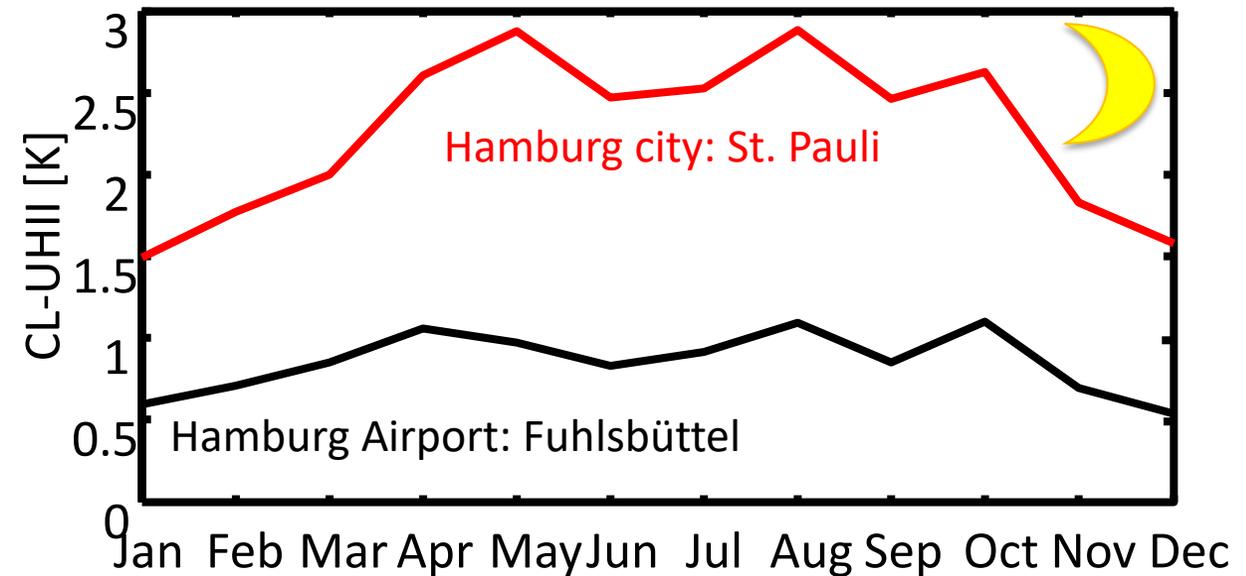


CL-UHII in climate average based on differences of **maximum temperatures** 2 m above ground (Figure based on Schlünzen et al., 2010; doi: 10.1002/joc.1968)



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  - Same regional climate in and outside city,
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- Be aware:
  - UHII depends on space, time and height.
  - UHII is not total temperature.
  - UHII is an add-on to regional temperature.



CL-UHII in climate average based on differences of **minimum temperatures** 2 m above ground (Figure based on Schlünzen et al., 2010; doi: 10.1002/joc.1968)

