



Asta Gregorič

5. 2. 2019

Določanje stabilnosti ozračja z Rn-222 in pomen pri študiju emisij črnega ogljika

Detecting atmospheric stability by Rn-222 and its implication for BC emission studies

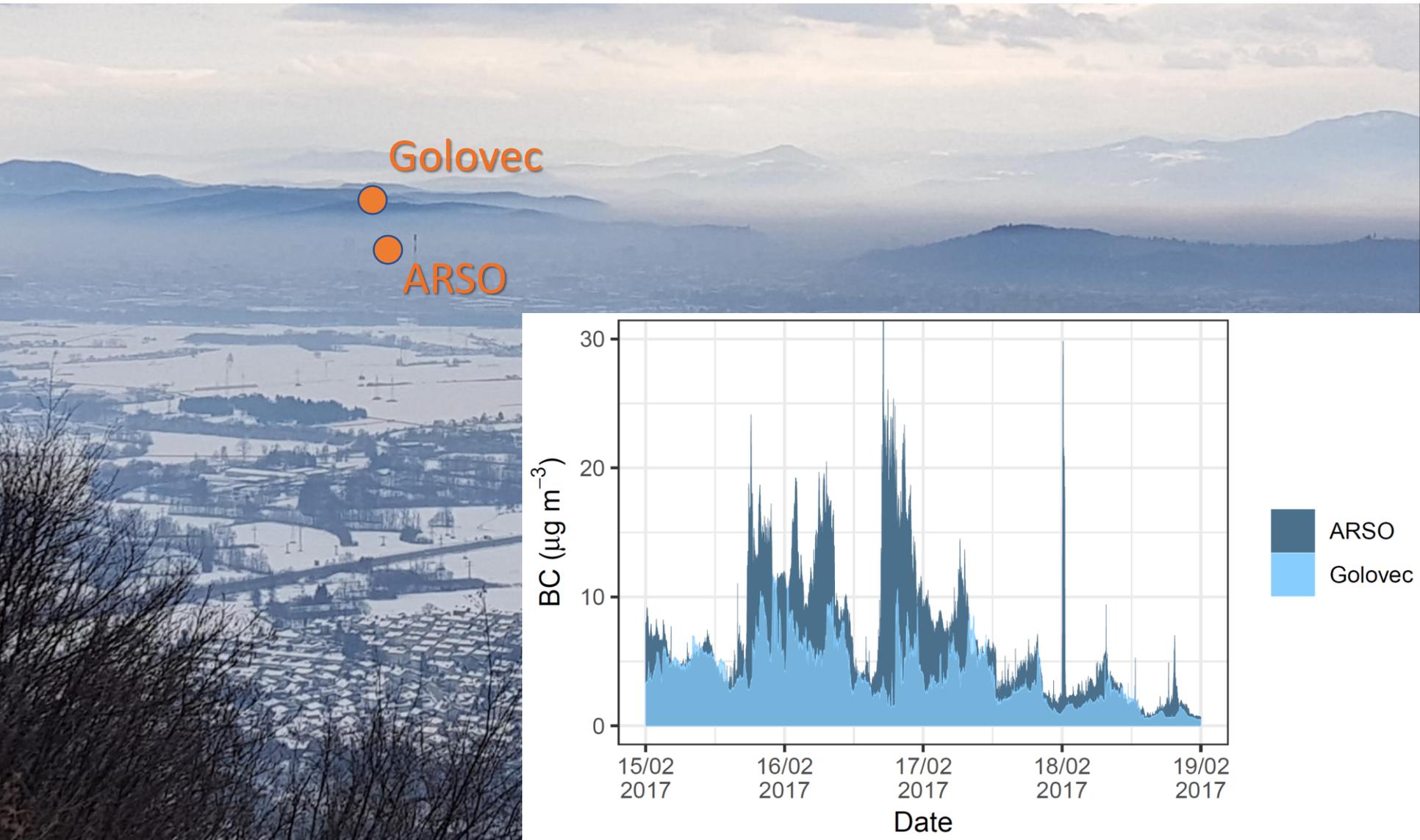
Lokalni, regionalni in globalni viri onesnaženja zraka

Znanstveno strokovni posvet, UL, Filozofska fakulteta

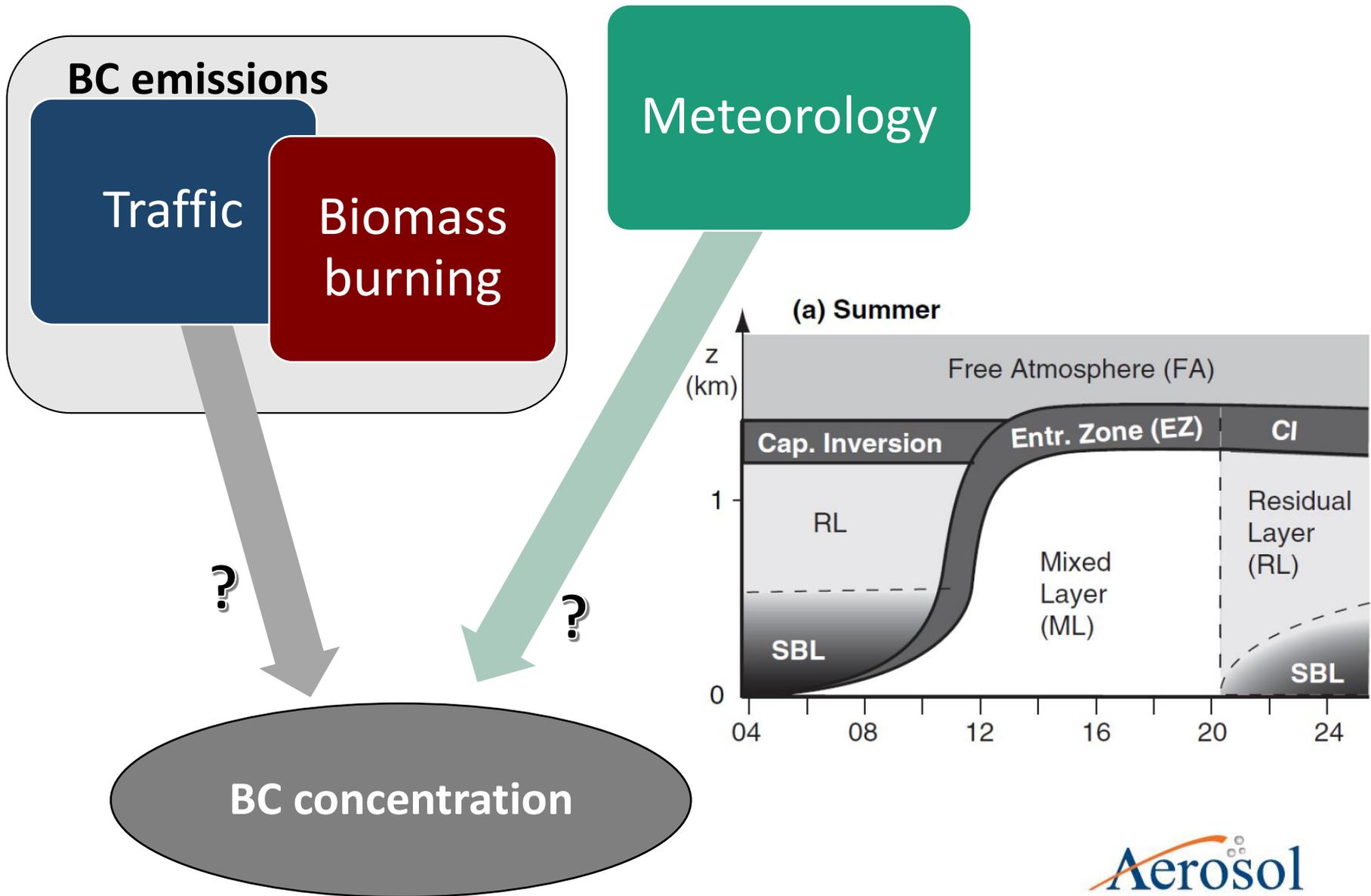
Air quality – emissions & meteorology



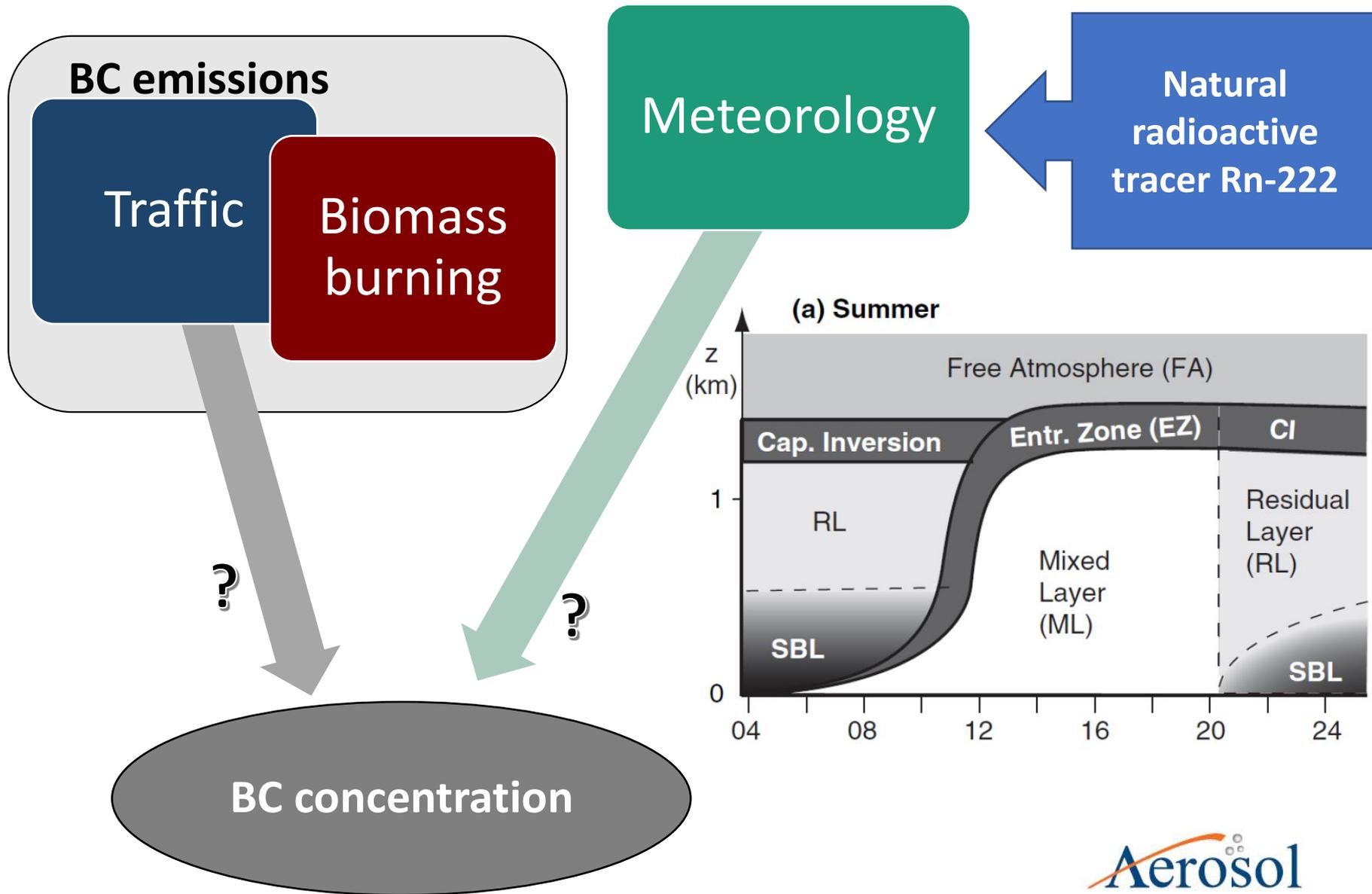
Air quality – emissions & meteorology



Air quality – emissions & meteorology

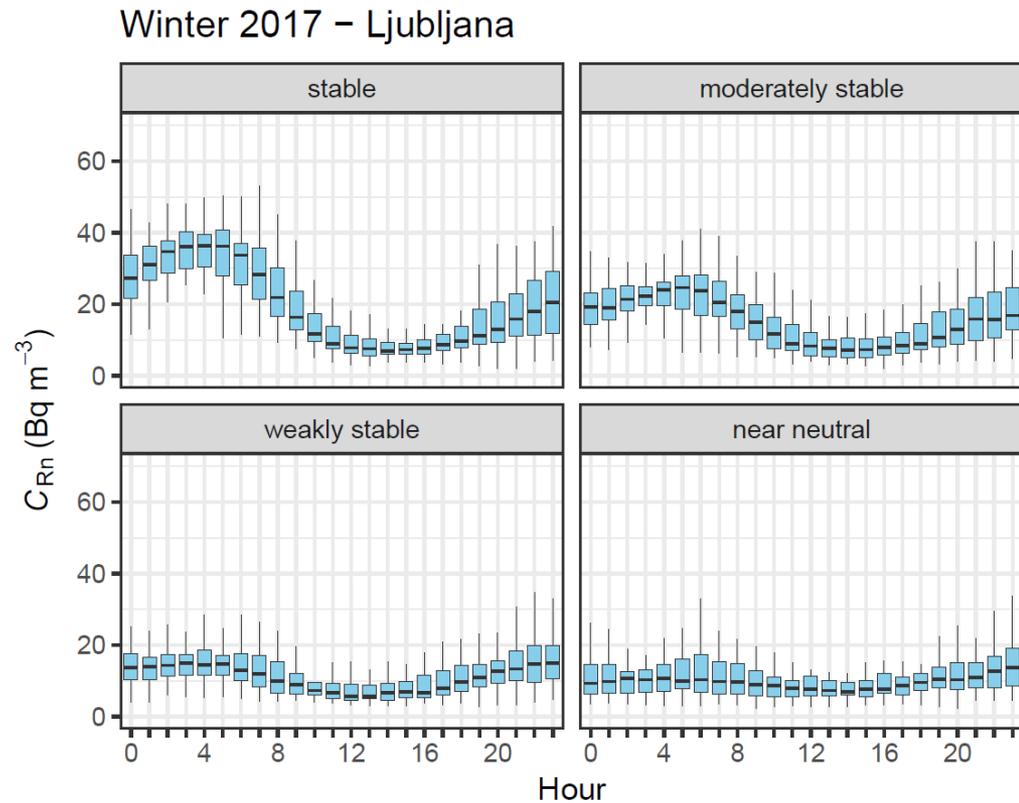


Air quality – emissions & meteorology



Radon (^{222}Rn) tracer

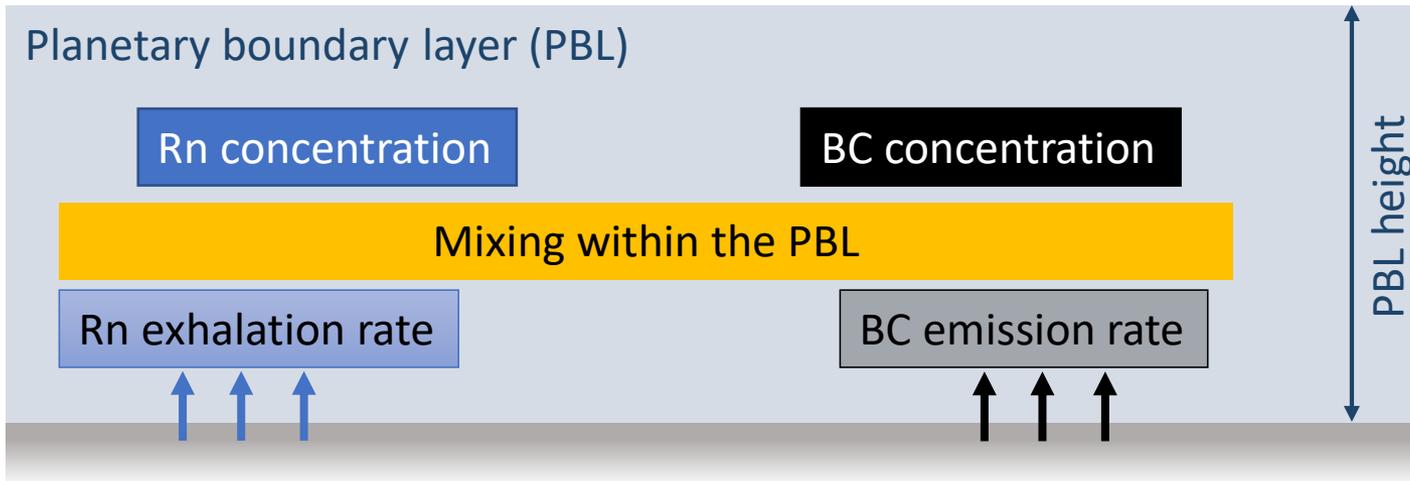
- Naturally occurring (exhalation from the Earth's surface)
- Noble gas
- Radioactive \rightarrow easy to measure very low concentration
- The only sink is radioactive decay ($t_{1/2} = 3.82$ days)
- **Assumption: constant source**



Atmospheric stability classification based on Chambers et al, ACP, 2015

Method: Eulerian box model

Williams et al., *Tellus B*, 2016

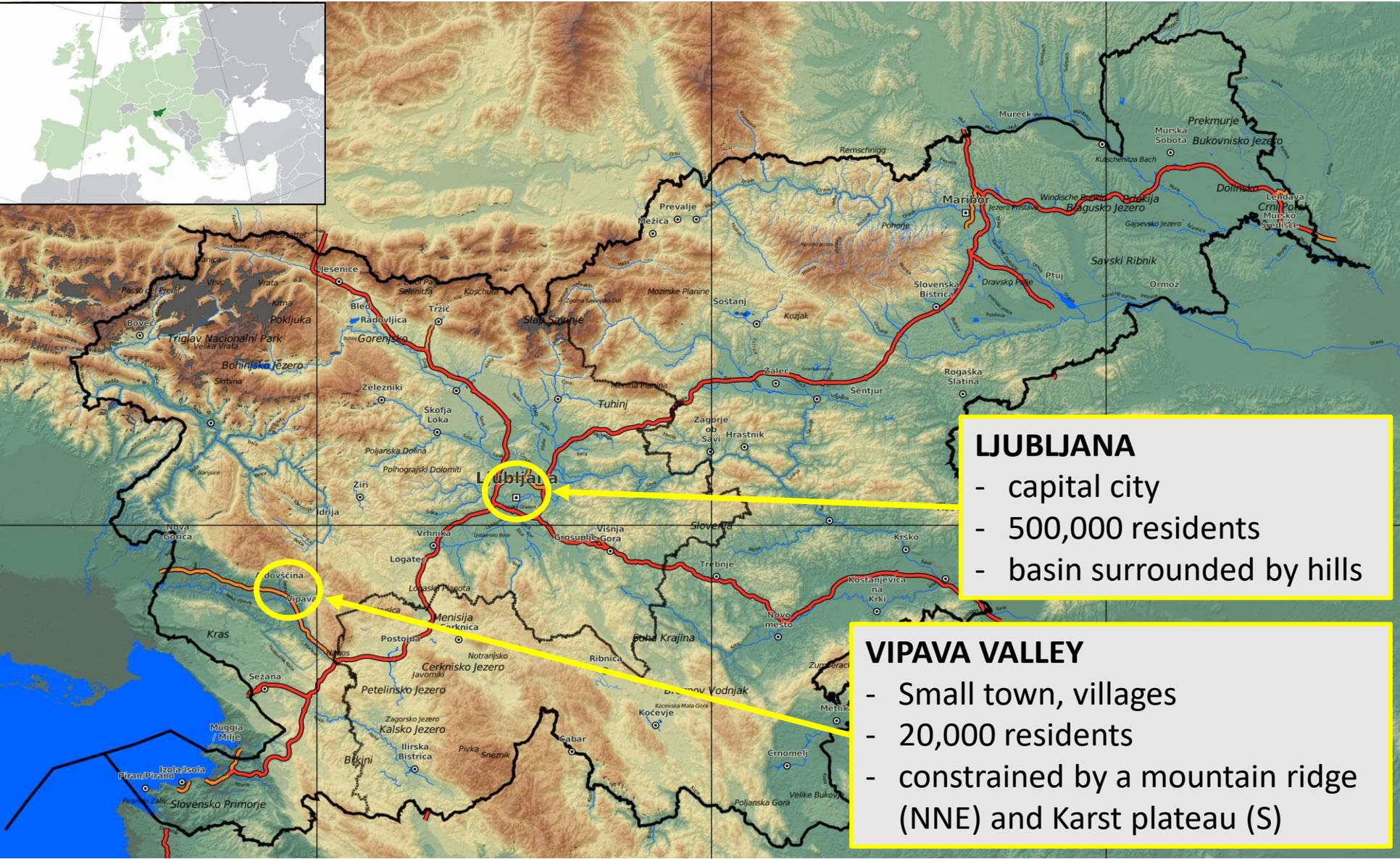


$$Ch = E\Delta T + C_0 h_0 e^{-\lambda'(t-t_0)} + \left\{ \begin{array}{l} C_0(h - h_0)e^{-\lambda'(t-t_0)} \\ C_{residual}(h - h_0)e^{-\lambda'(t-t_0)} \end{array} \right. \left. \begin{array}{l} \text{for } \frac{dh}{dt} \leq 0 \\ \text{for } \frac{dh}{dt} > 0 \end{array} \right\}$$

$$\Delta T = \frac{1 - e^{-\lambda'(t-t_0)}}{\lambda'}$$

C ... concentration
 E ... emission rate
 h ... mixing height
 λ' ... decay constant

Case study: Ljubljana, Vipava valley



LJUBLJANA

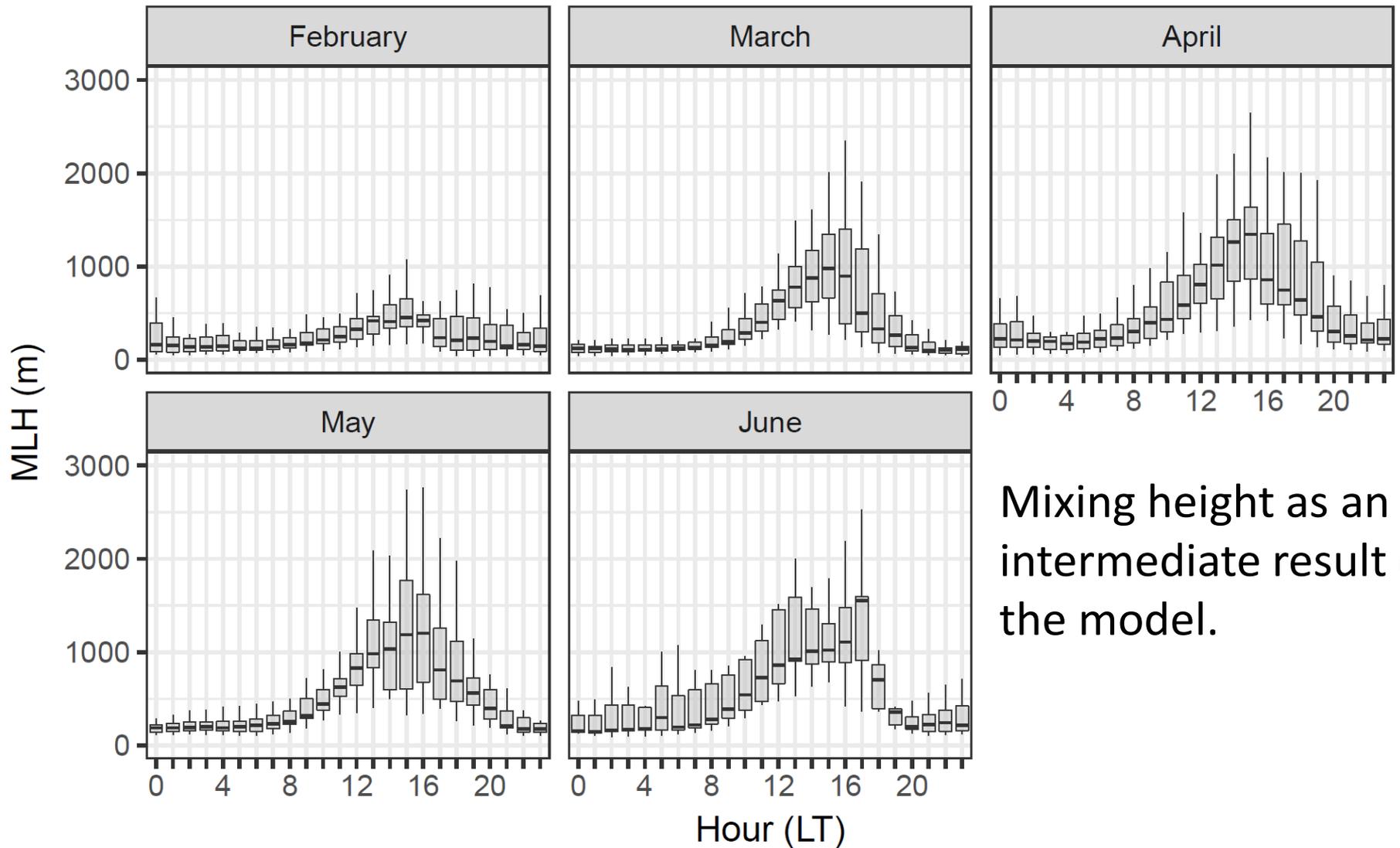
- capital city
- 500,000 residents
- basin surrounded by hills

VIPAVAL VALLEY

- Small town, villages
- 20,000 residents
- constrained by a mountain ridge (NNE) and Karst plateau (S)

Effective mixing height (Ljubljana)

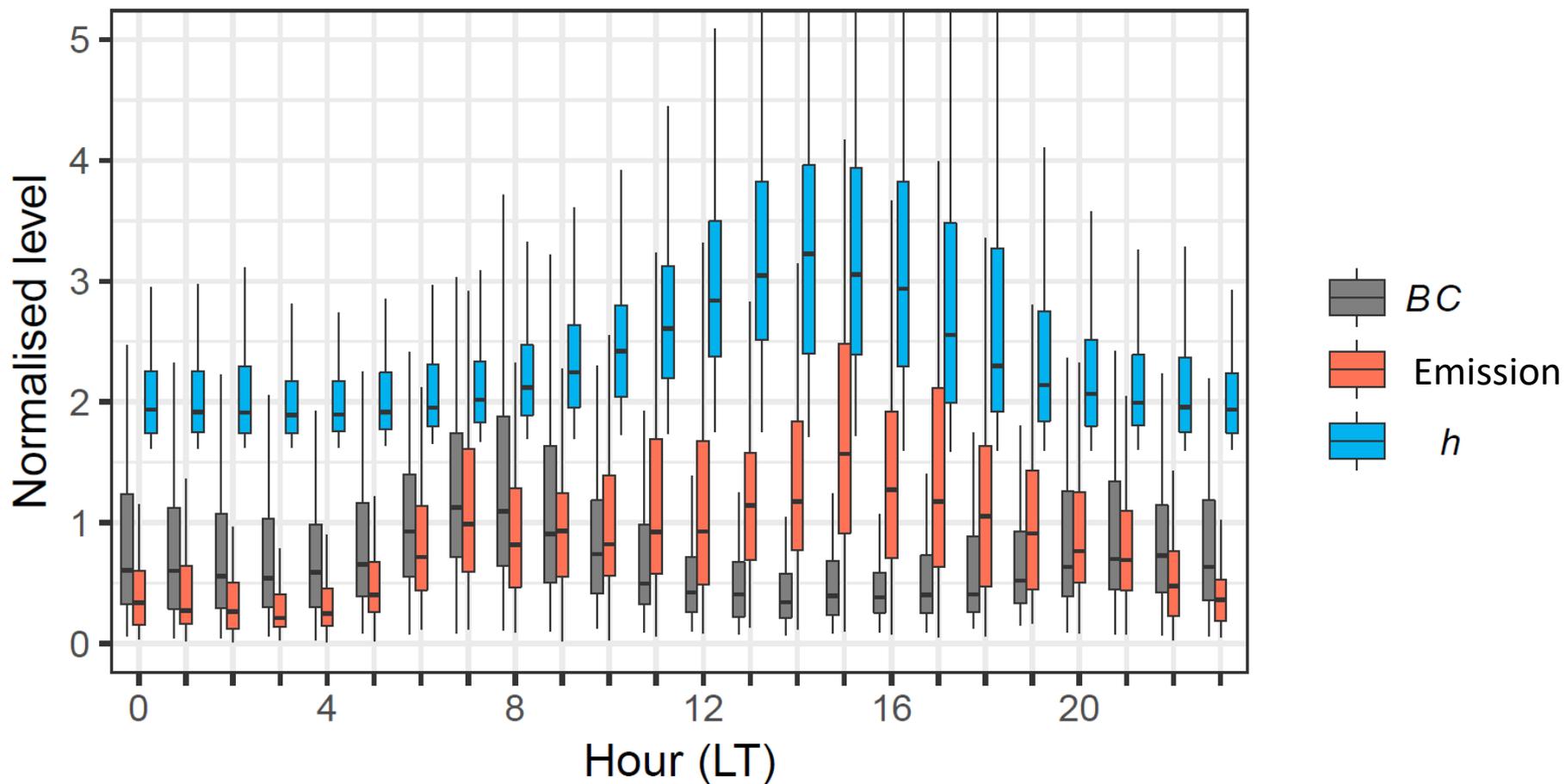
Ljubljana



Mixing height as an intermediate result of the model.

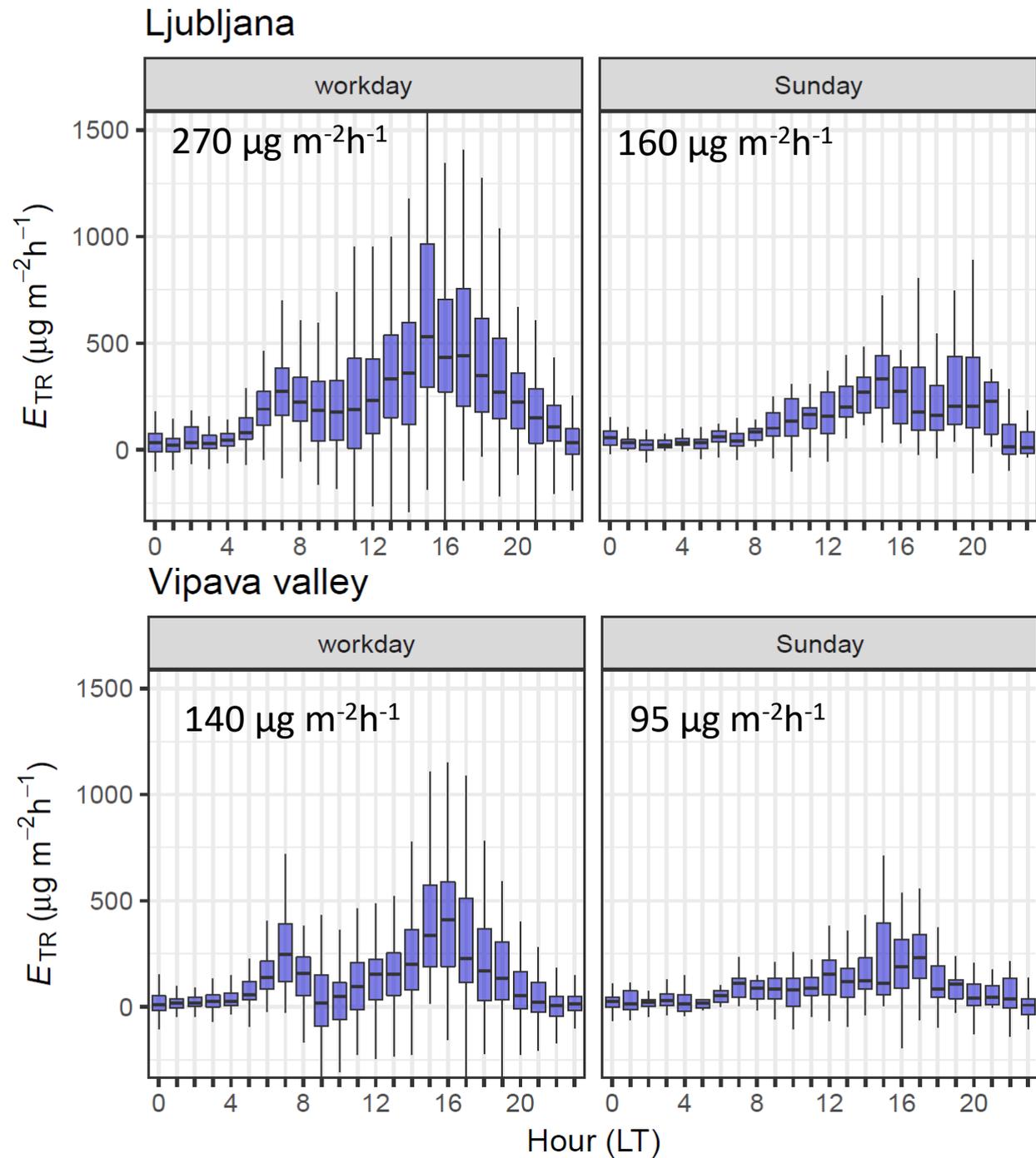
BC emission rate – diurnal profile

Ljubljana, May 2017



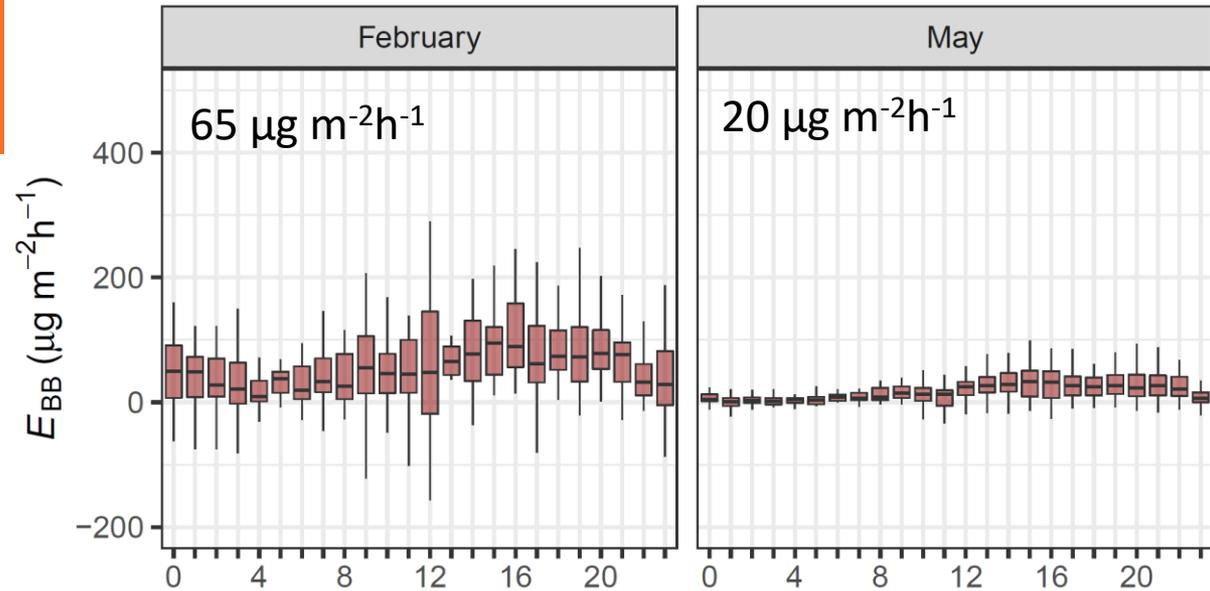
BC emission – traffic

- Higher emissions in Ljubljana
- different diurnal pattern
- Emissions calculated for **different area**

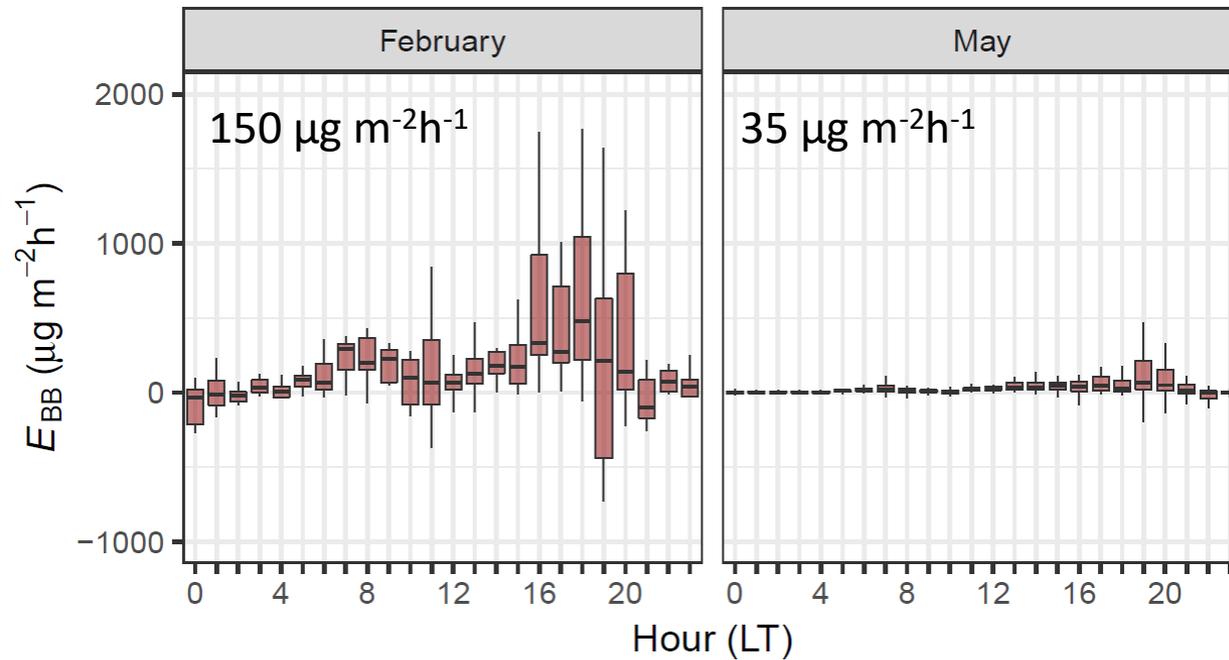


BC emission – biomass burning

Ljubljana



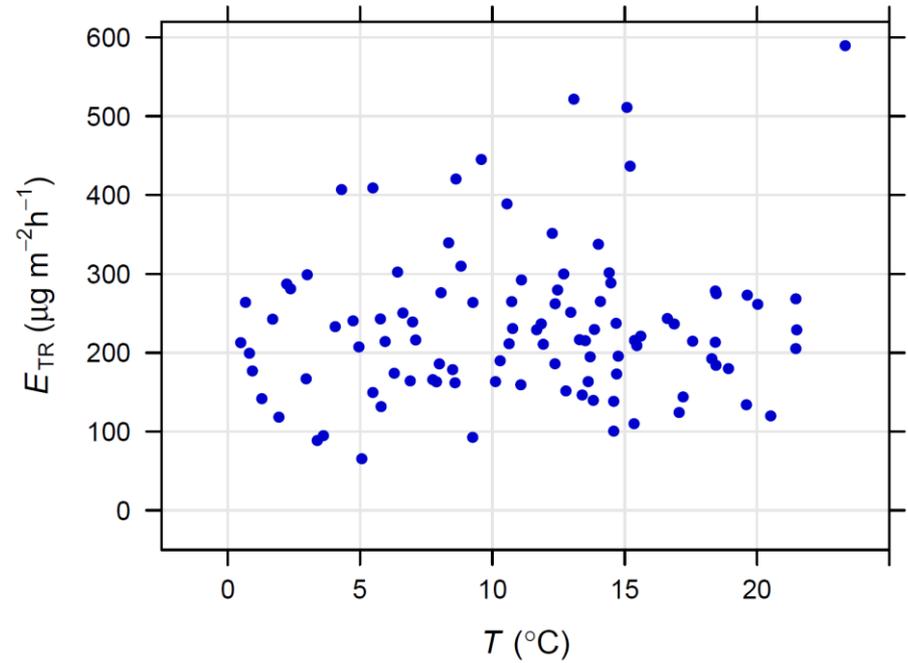
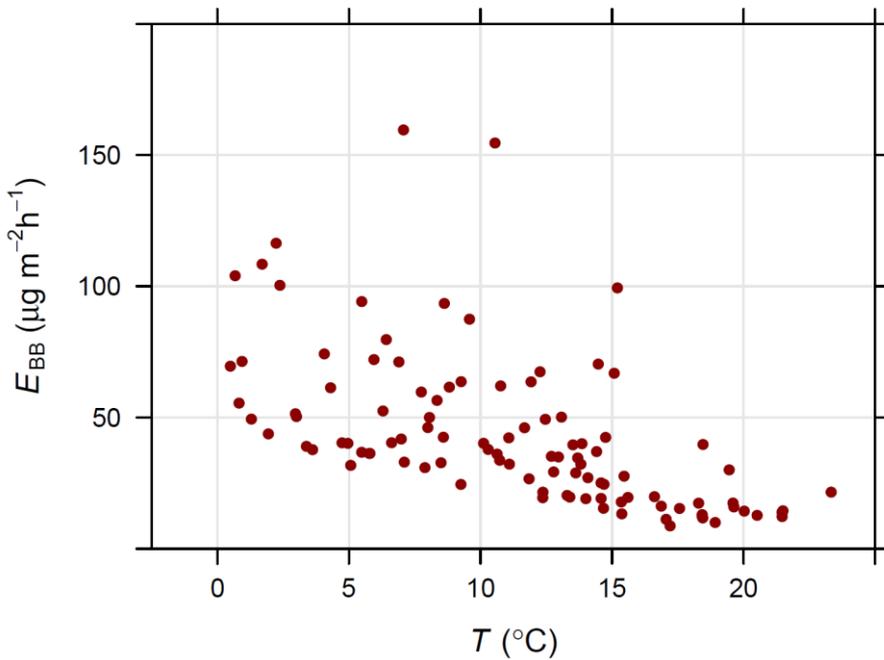
Vipava valley



Note change in scale!

Temperature dependence

- BC emission by biomass burning depends on air temperature (heating demand).



Summary

- Radon can be used as a reliable natural tracer for atmospheric stability and estimation of mixing height
- Detailed information of **mixing height** gives us important information for determination of **BC emissions** – with **high time resolution**
- More emissions from biomass burning in stable atmospheric conditions (winter, night) → stronger influence on air quality.
- Significant contribution of **biomass burning** in rural areas.

Thanks to co-authors

- **G. Močnik, L. Drinovec** (Jožef Stefan Institute)
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- **S. Stanič, M. Mole, L. Wang** (Uni. of Nova Gorica)



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Hvala za pozornost!
Thank you for your attention!