Quantification of the practical predictability of thunderstorm occurrence using machine learning

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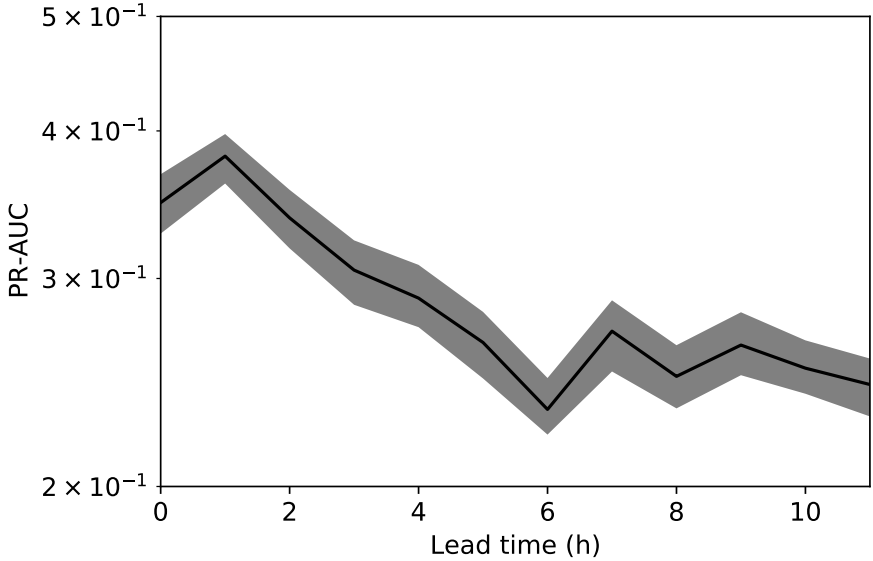
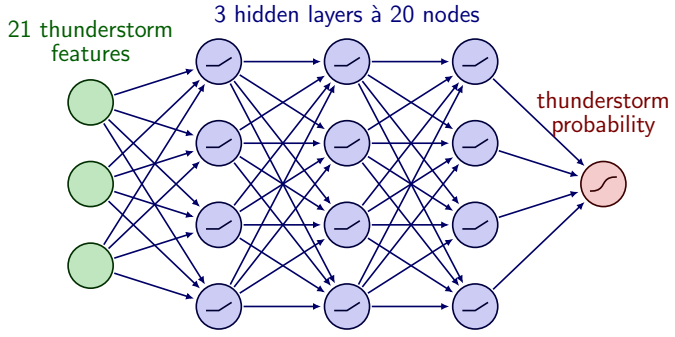
Post-processing of thunderstorm occurrence as a function of lead time



SALAMA model (Vahid Yousefnia et al. 2023, under review)



In essence:

- Model solves *binary classification task*
- Labels follow *spatiotemporal criteria* (here: lightning)

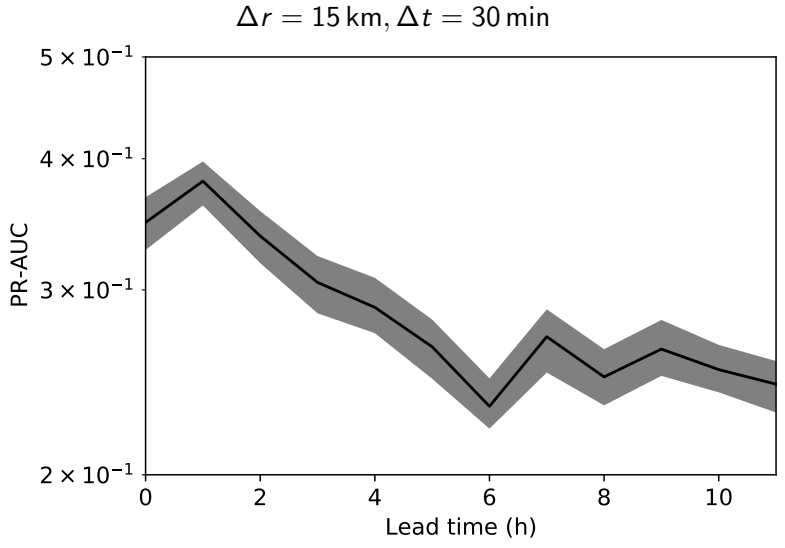
Spatiotemporal label configuration

Definition of thunderstorm target

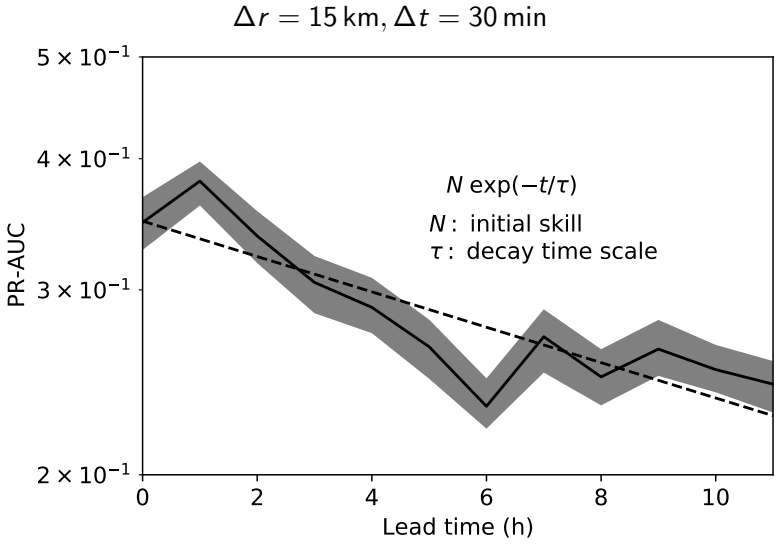
Thunderstorm occurs at (x, t) if a lightning flash is detected at any (x_l, t_l) with

$$\|x - x_l\| < \Delta r \qquad |t - t_l| < \Delta t$$

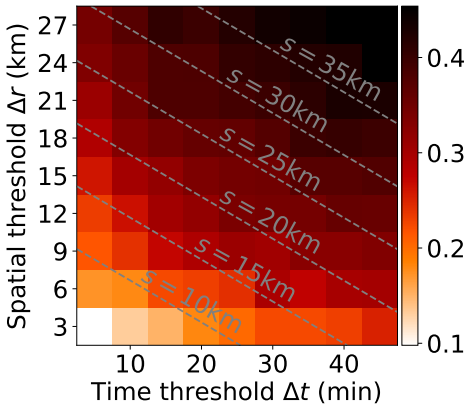
Next: Variation of spatiotemporal thresholds



Next: Variation of spatiotemporal thresholds



Variation of initial skill

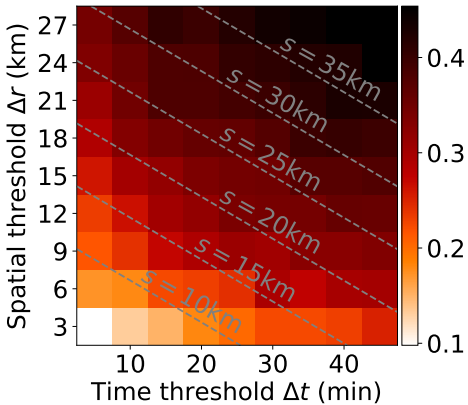


spatial resolution scale:

$$s = \Delta r + c\Delta t$$

Fit: $c = 5.6(3)\,\mathrm{m/s}$

Variation of initial skill



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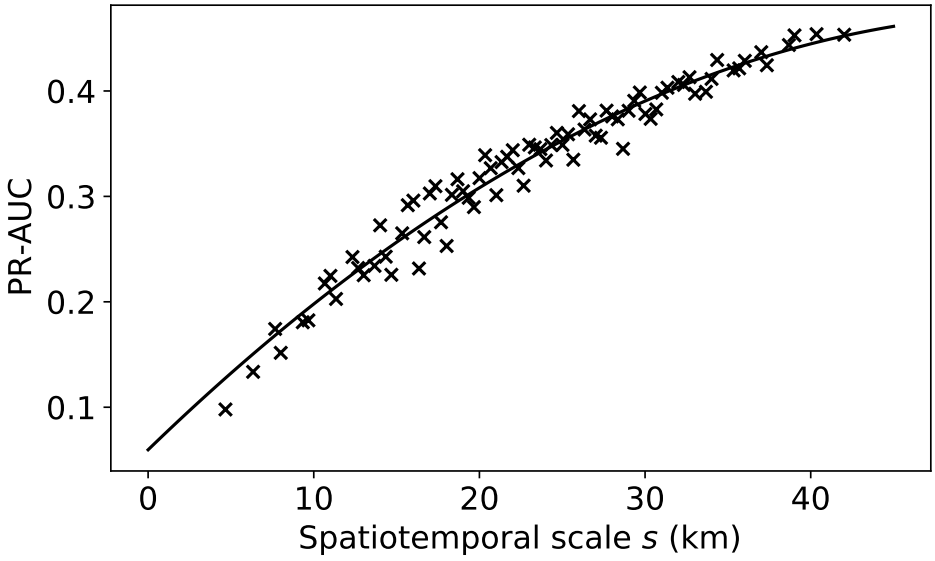
$$s = \Delta r + c\Delta t$$

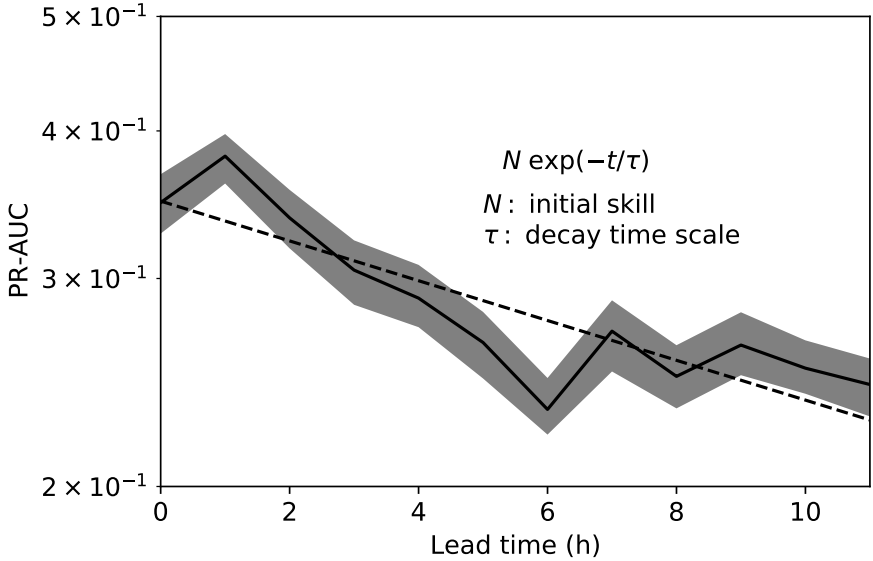
Fit: $c = 5.6(3)\,\mathrm{m/s}$

$\Rightarrow$ We can assign to each configuration $(\Delta r, \Delta t)$ a meaningful spatiotemporal scale s

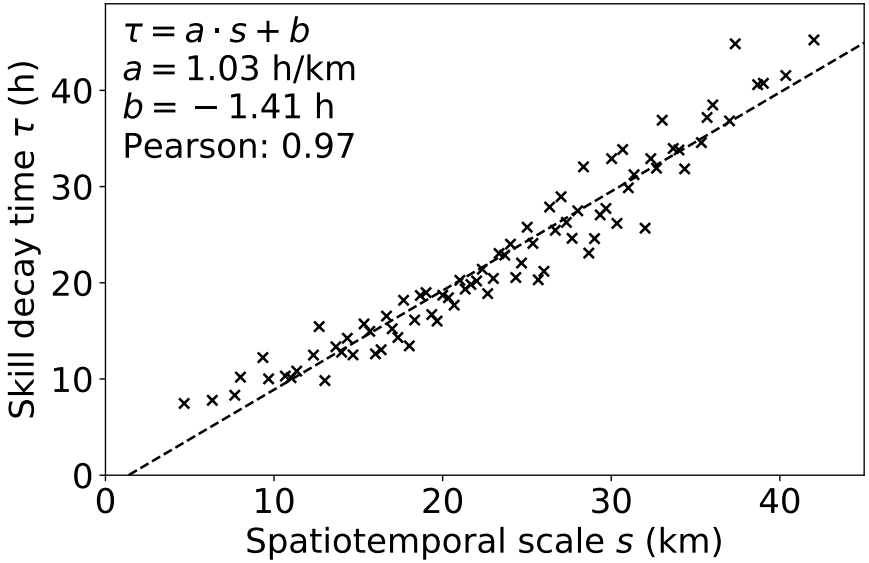
Variation of initial skill



Skill decay time



Skill decay time vs. spatiotemporal scale



Thank you for your attention.

More details: arXiv:2303.08736 (submitted to Q. J. R. Meteorol. Soc.)

Feel free to contact me: kianusch.vahidyousefnia@dlr.de

Sources I

Vahid Yousefnia, Kianusch et al. (2023). *A machine-learning approach to thunderstorm forecasting through post-processing of simulation data*. arXiv: 2303.08736 [physics.ao-ph].