

SALAMA: A Machine Learning approach for lightning forecasting through post-processing of simulation data

arXiv:2303.08736, submitted to Q. J. R. Meteorol. Soc.

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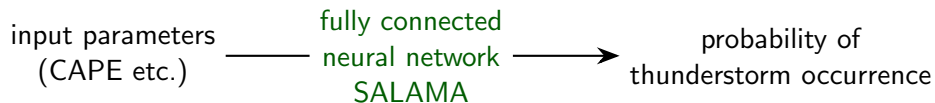
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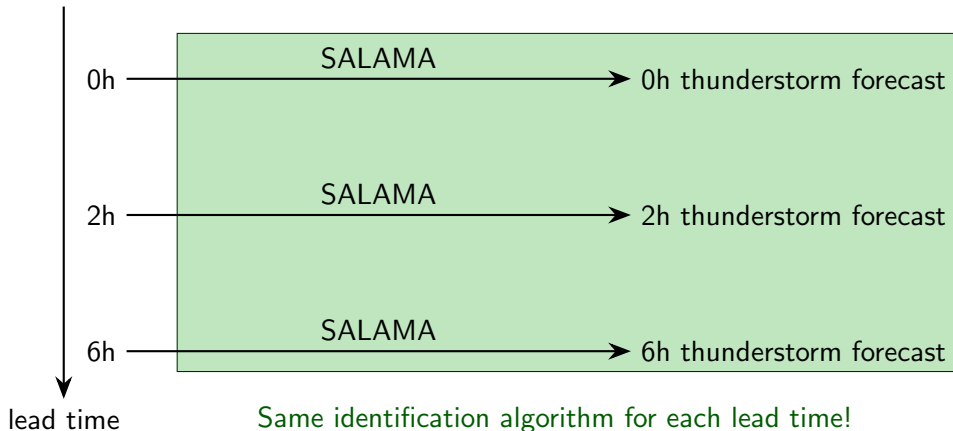
Introduction

Main assumption: Thunderstorms are visible in NWP forecasts.



The art of post-processing

NWP forecasts
of input parameters

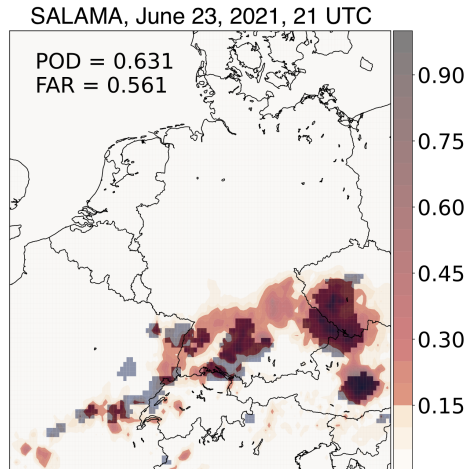


Model training

input parameters
ICON-D2-EPS
Jun-Aug 2021
0-2 h lead times

labels
LINET

training



Skill dependence on lead time

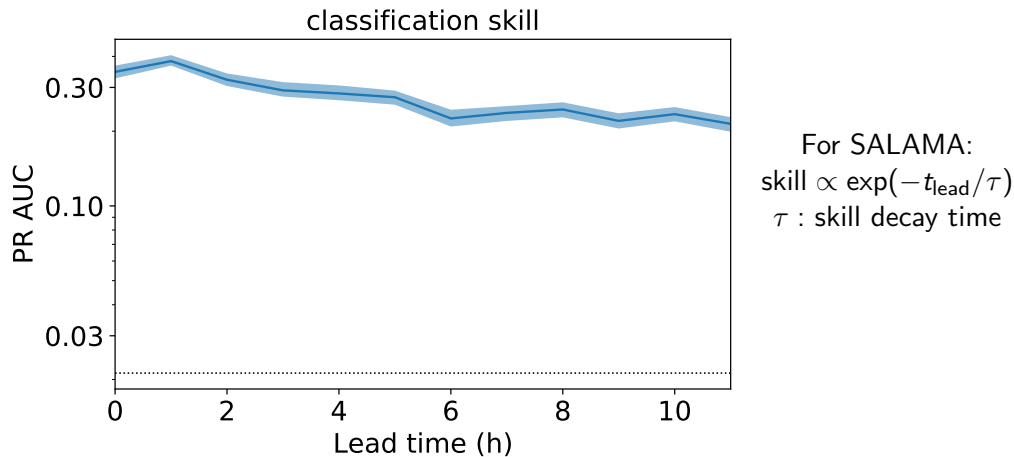


Figure: (a) Classification skill (quantified by the area under the PR curve) as a function of lead time.

Skill dependence on spatial resolution scale

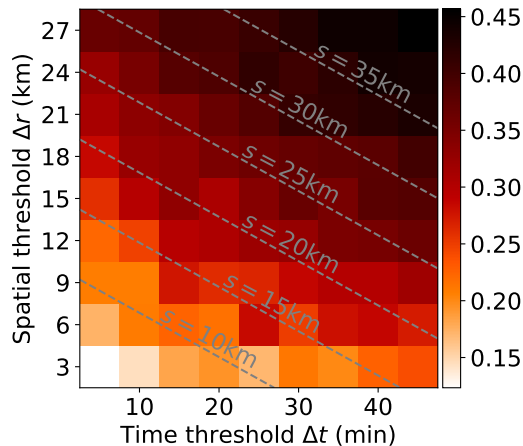
Definition of thunderstorm target

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

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

So far: $\Delta r = 15 \text{ km}$, $\Delta t = 30 \text{ min}$

Skill dependence on spatial resolution scale



spatial resolution scale:

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

Fit: $c = 5.2(3) \text{ m/s}$

Figure: Classification skill of SALAMA as a function of the label configuration. The slope of the dashed lines is chosen such that classification skill is approximately constant along the lines.

Decay time of skill vs. lead time

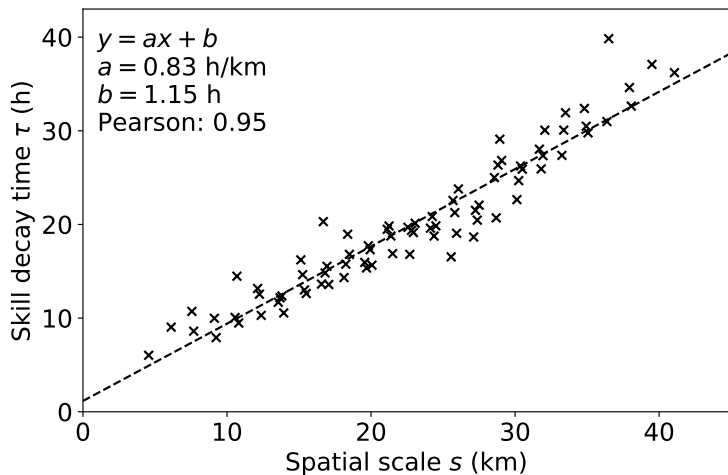


Figure: Decay time of classification skill as a function of the spatial scale.

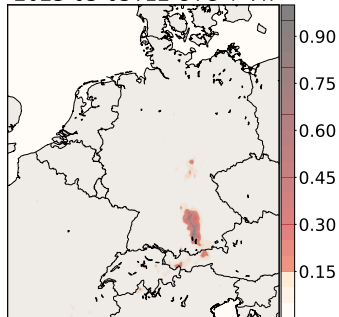
Summary

SALAMA: Inferring the probability of thunderstorm occurrence

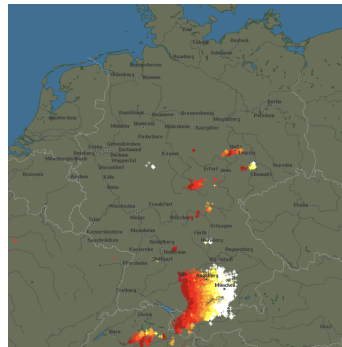
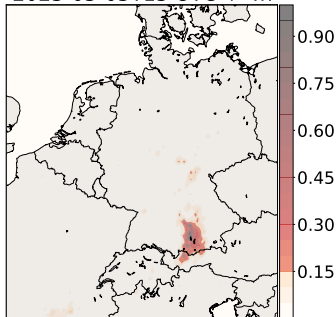
- ▶ Training of a neural network, using high-resolution NWP data and lightning data
- ▶ No explicit use of location, time, or forecast range $\Rightarrow$ universal signature?

"Operational" use: May 5, 2023, 19 UTC

2023-05-05T12 UTC + 7h



2023-05-05T15 UTC + 4h



19 UTC (lightningmaps.org)

Thank you for your attention.

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

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