Lightning Potential Index in the Czech Republic during convective events of summer 2018 using COSMO NWP model

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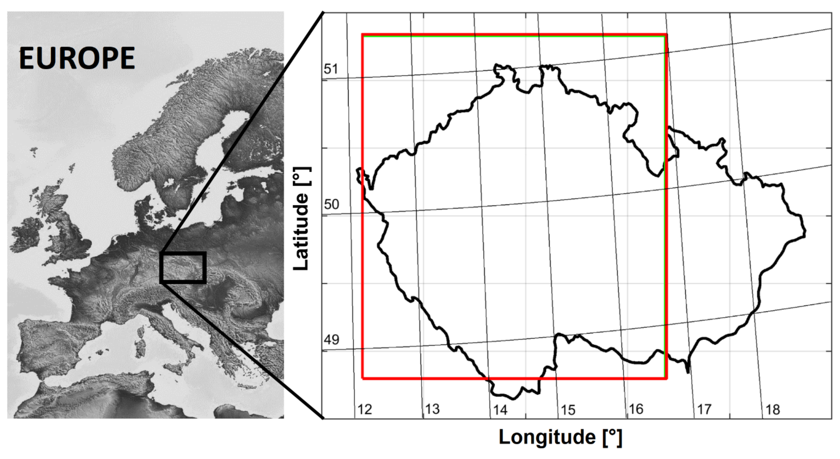

Fig. 1 Geographical location of provided lightning observations. The inner two rectangles indicate model domains with a horizontal resolution of 1.2 km (red) and 2.2 km (green).

Date	Beginning of the forecast	Number of recorded discharges	Label of the run
June 1	06 UTC	47580	18060106
June 10	06 UTC	28378	18061006
July 15	12 UTC	2681	18071512
August 2	12 UTC	10132	18080212
August 3	06 UTC	1070	18080306
August 4	12 UTC	12309	18080412
August 8	12 UTC	15114	18080812
August 13	12 UTC	1213	18081312
August 24	12 UTC	5278	18082412
September 21	12 UTC	5457	18092112

Tab. 1 List of processed days of 2018. From left to the right: date in 2018, beginning of the forecast, number of recorded discharges in an interval of 12 h starting from the beginning of the forecast, & label of the model run.

Name	Type of cloud microphysics	Horizontal resolution	Number of grid p.	Integration time step
CO12 M1	1-moment (M1)	1.2 km (CO12)	271x231	10 s
CO12 M2	2-moment (M2)	CO12	271x231	10 s
CO22 M1	M1	2.2 km (CO22)	161x141	15 s
CO22 M2	M2	CO22	161x141	15 s

Tab. 2 Four configurations of the model.

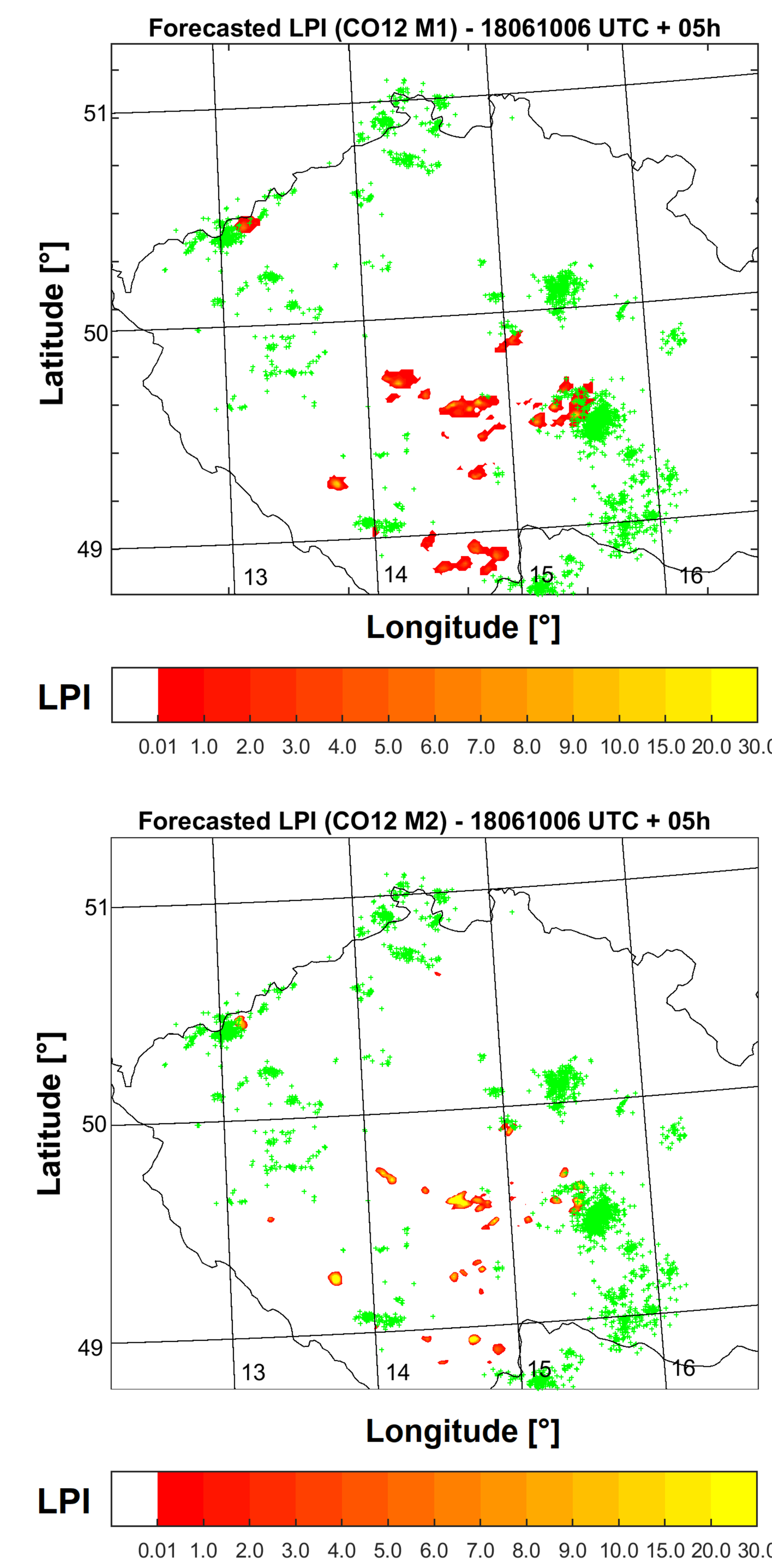

Fig. 2 LPI forecasts by CO12 M1 (top) & CO12 M2 (bottom). Green crosses represent observed lightning.

Motivation

Lightning is still considered as severe meteorological hazard. Currently, many Numerical Weather Prediction (NWP) models operationally use the **Lightning Potential Index (LPI)**, which enables to determine areas prone to lightning.
Here, we investigate the potential of LPI for forecasting lightning by comparing hourly forecasts for **10 thunderstorm events** (Tab. 1) in the Czech Republic (Fig. 1). Specifically, we compare **four configurations of COSMO NWP model** (Tab. 2) that differ in horizontal res. (1.2 and 2.2 km) & cloud microphysics (1- and 2-moment cloud microphysics).

Methods

We evaluated binary lightning forecasts (Fig. 2) for varying lead time (1–10 h) against nb. of observed lightning by EUCLID network within eight areas (4.8x4.8 km to 240x240 km) surrounding model grid points (Fig. 3).
To generally assess the possible success of lightning prediction, we evaluated LPI forecasts by Area under the Receiver Operating Characteristic (**AROC**).
Results showed that forecasts almost always outperform the random forecast (AROC = 0.5; Fig. 4) for the four configurations of the model.

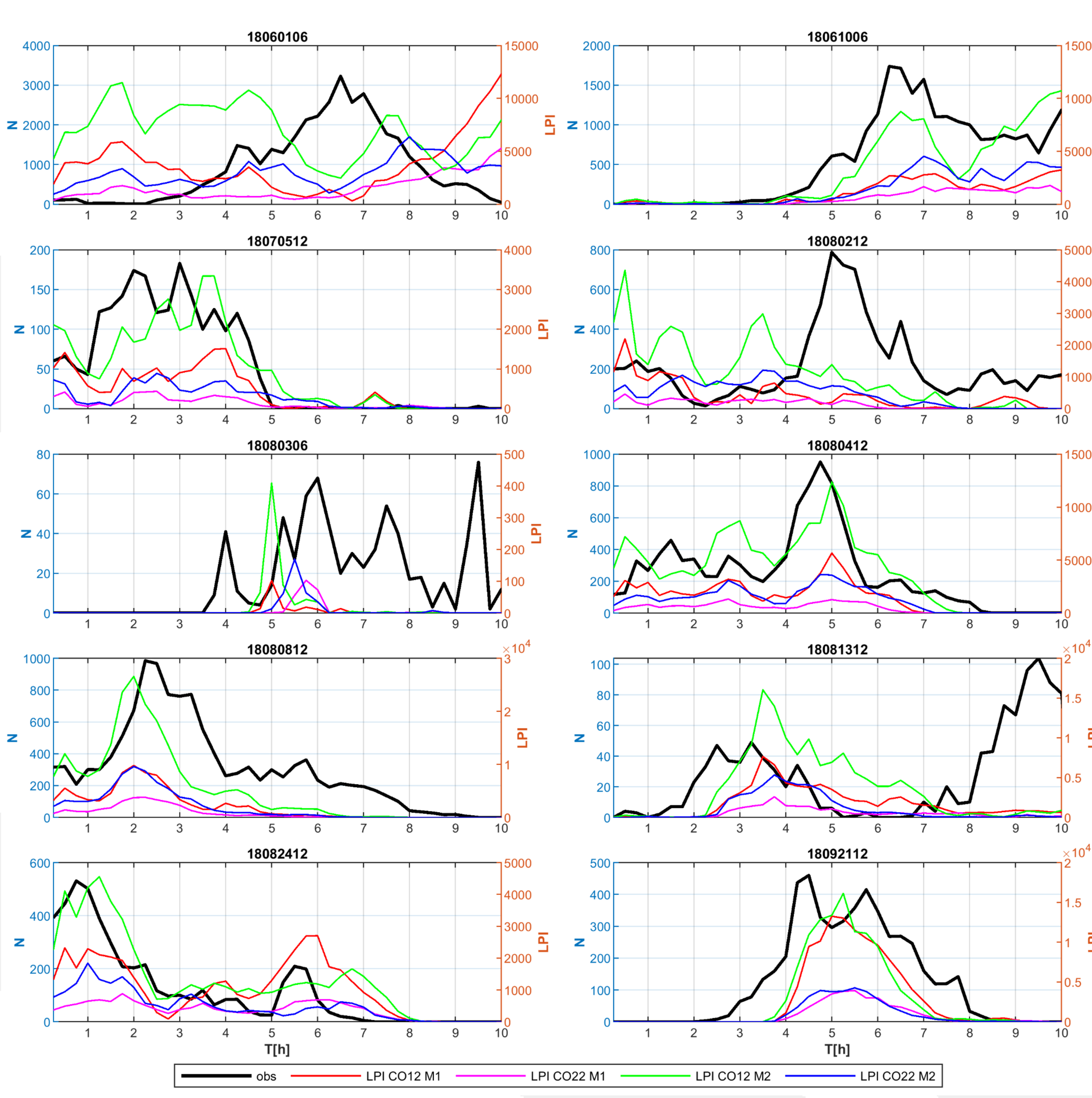

Fig. 3 Number of observed flashes (left axis) and LPI (right axis) accumulated over the evaluation domain within 15 min time intervals.

Conclusions

- Lightning Potential Index (LPI) is a suitable tool for implicit forecasting of lightning
- As expected, more successful forecast is reached for the model with 2-moment clouds microphysics
- As expected, more successful forecast is reached for model runs with higher horizontal resolution

We acknowledge the Siemens lightning detection network BLIDS for providing us with observed lightning flashes during the study events over the Czech Republic.

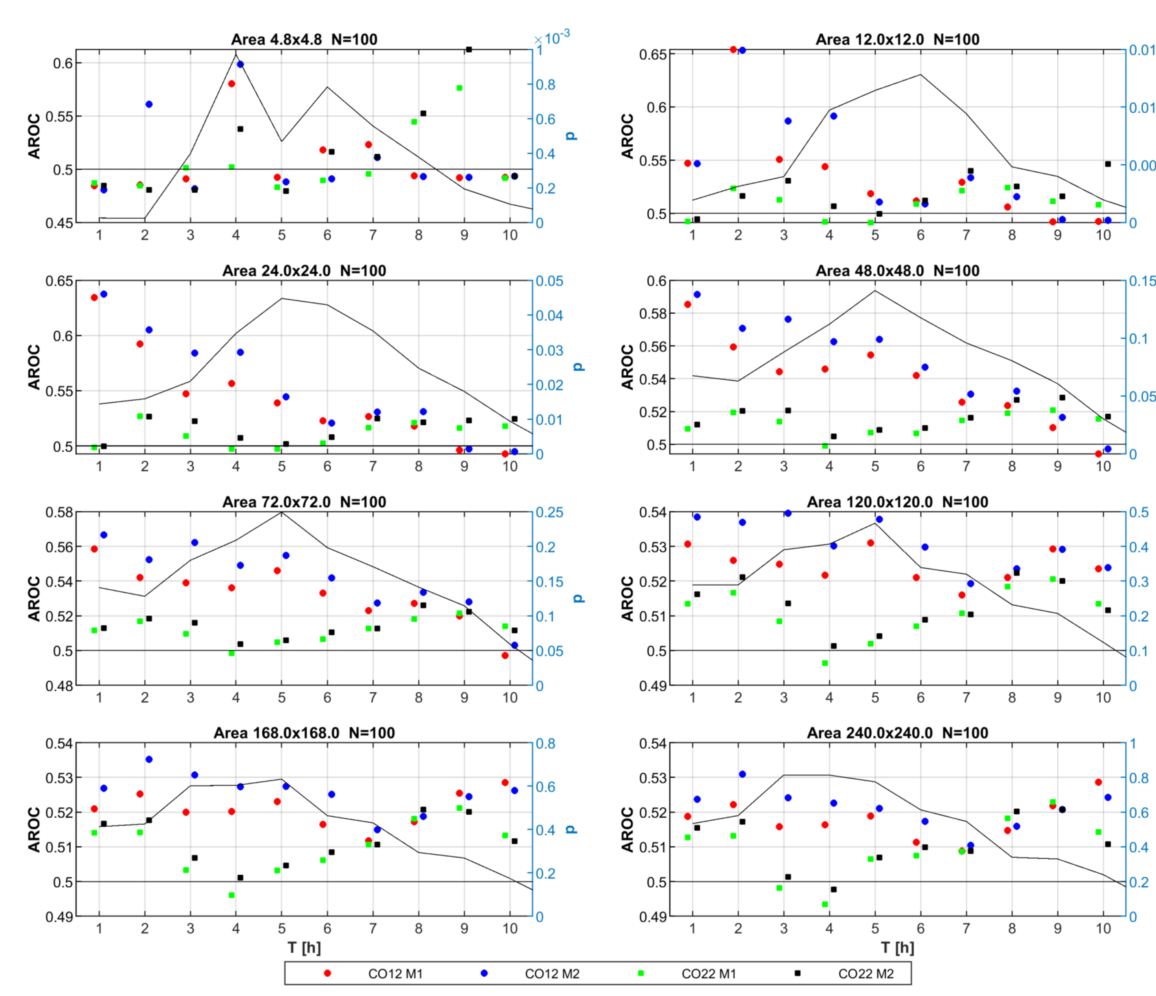

Fig. 4 Dependence of AROC (left axis) on lead time (horizontal axis) and areal sizes in km (title) for the 4 configurations of the model (Tab. 2). Forecasted quantity is that at least 100lightning strokes were recorded in corresponding hour in the given area. Line of the random forecast AROC = 0.5 is emphasized in bold. The black curve shows the probability of the event (right axis).

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