

Capabilities of Eulerian based lightning jump algorithm

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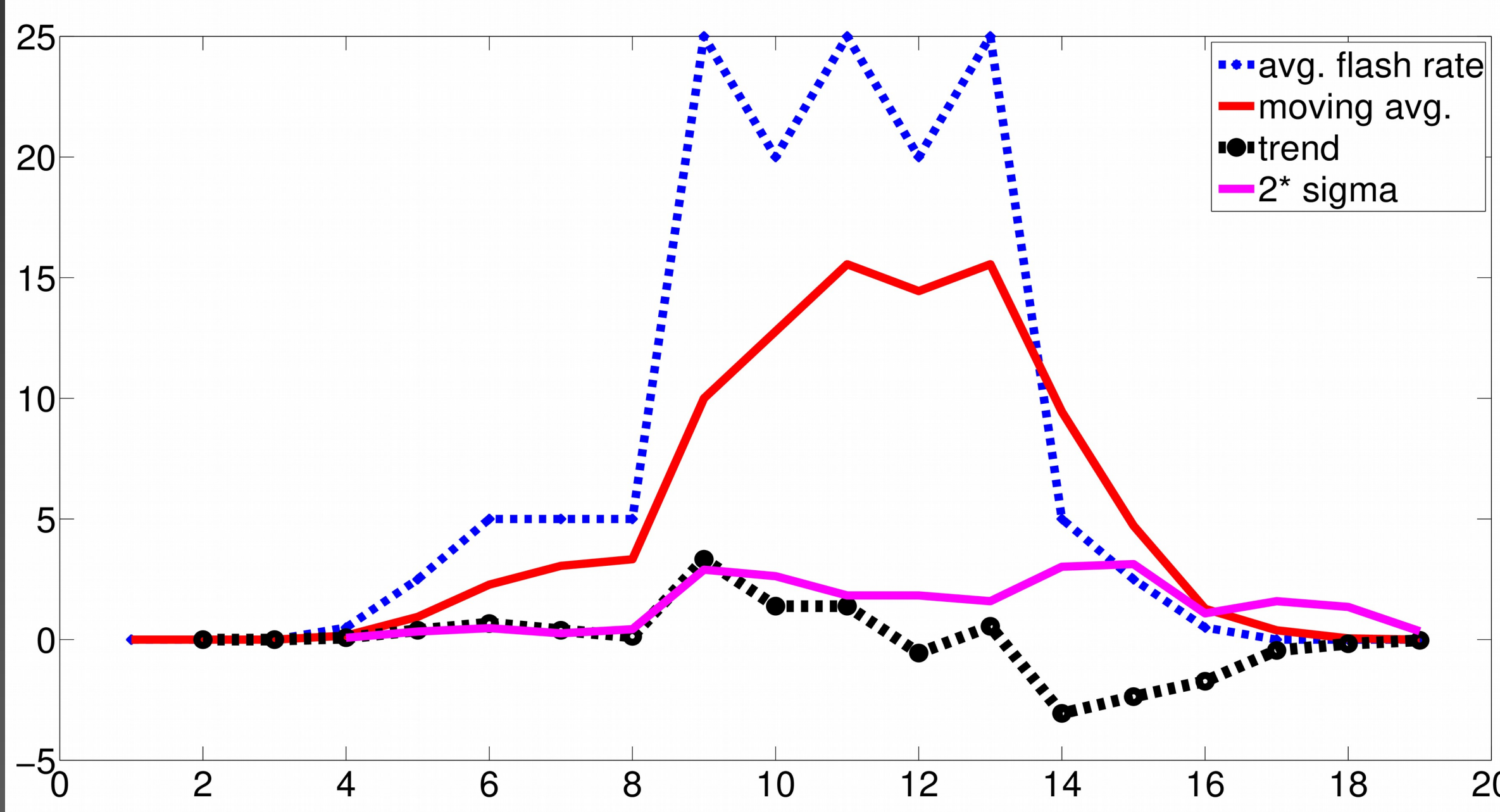
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Aim & Motivation

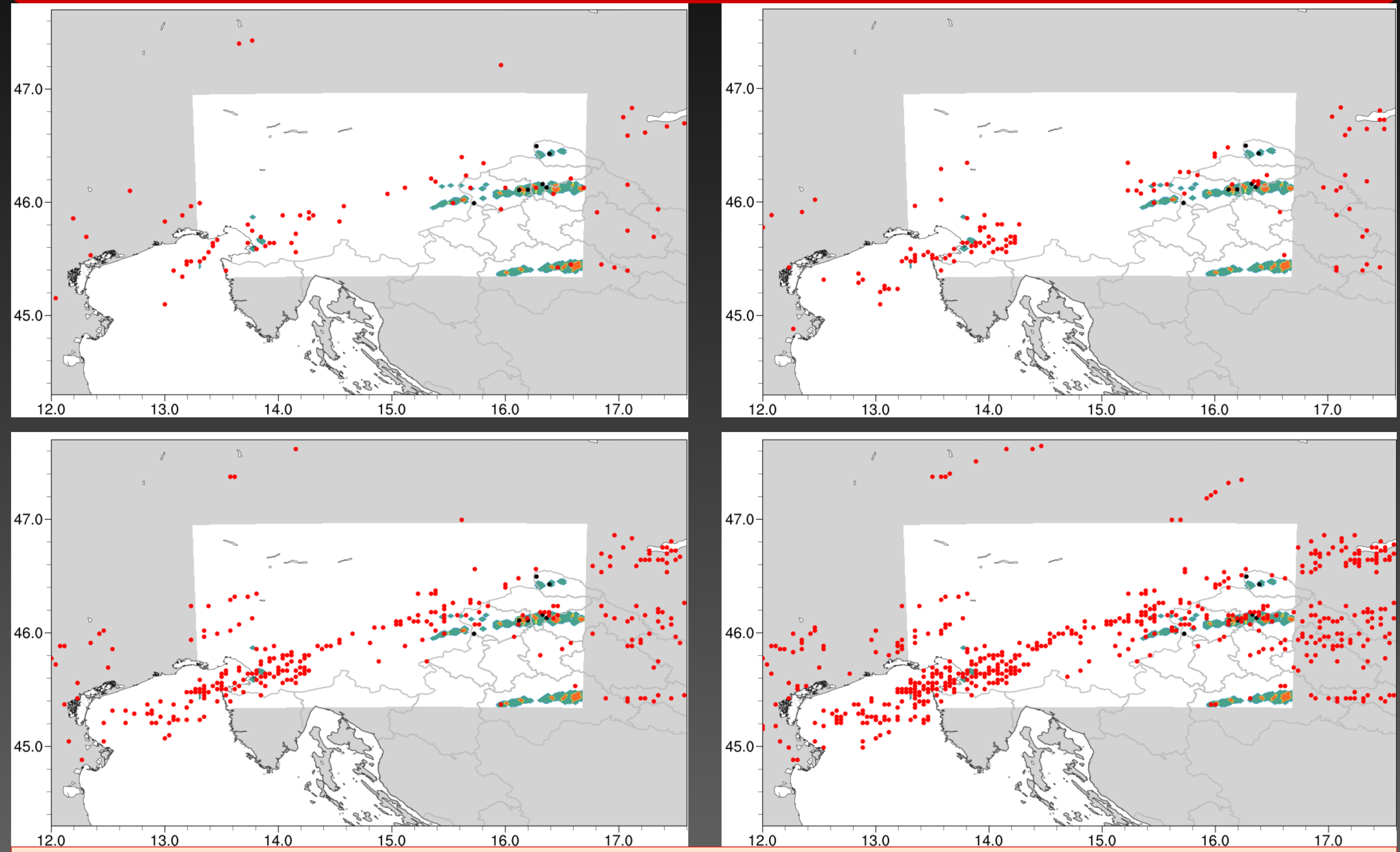
Hail measurements are often rare and sporadic, leaving large areas with no observations. Good substitute for such lack of measurements are radar estimates of hail but limited to radar reach. Other valid methods were developed to compensate, such as media reports, mobile app's or satellite assessments. Also, recently, lightning jump was introduced as now-casting predictor for severe weather effects (hail, wind gusts and tornadoes). In this poster we discuss further expansion of lightning jump toward development of new method for hail assessment in areas not covered with radar. We present new Eulerian based lightning jump which uses only lightning data on relatively high resolution (3x3 km) without aid of storm track algorithms.

Lightning jump algorithm



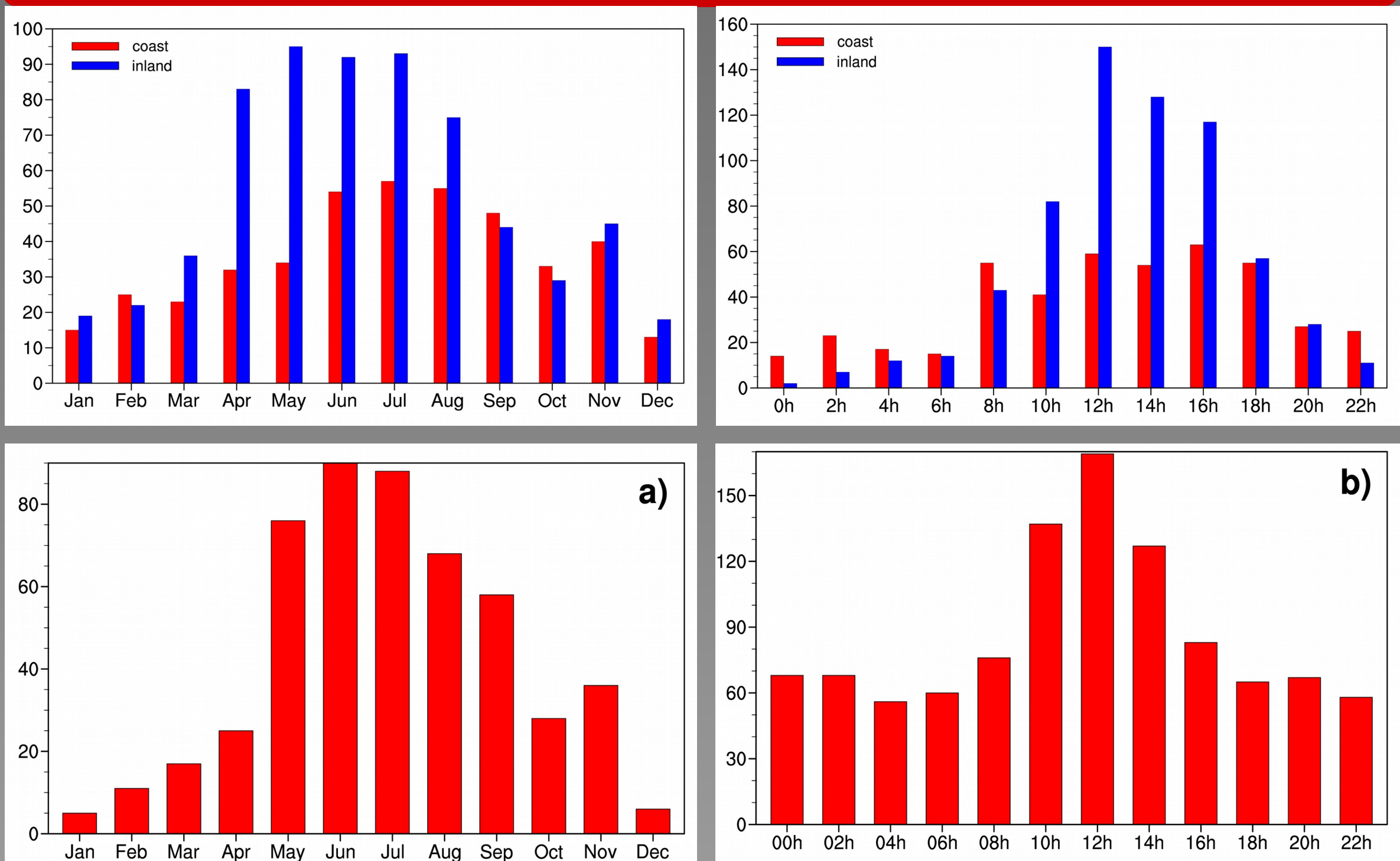
Mathematical principle for lightning jump computation is similar to other presented, but it is computed on each point separately. We are still exploring best parameters to close mathematical models since approach is different and recommended parameters (minimum flash rate of 10 strikes/time step and breach of 2 standard deviation) are not ideal. Upper figure illustrates simulated process of computation of lightning jump.

Various Jump parameters vs radar estimates



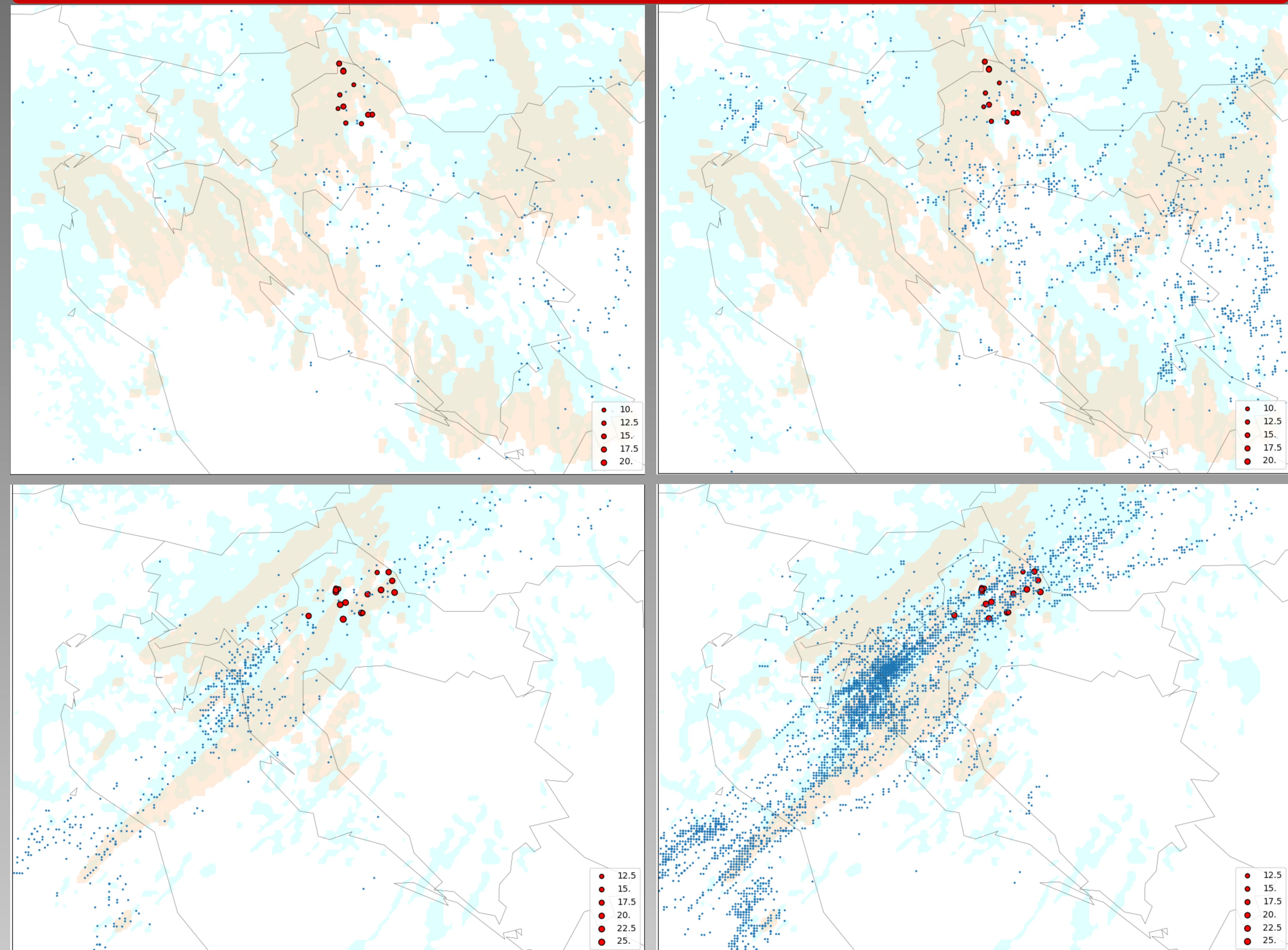
Comparison of radar estimates of hail and occurrence of lightning jump are presented for hail episode occurred on 17.6.2008. Red dots present lightning jump, black dot's are ground measurements and colored shades are for radar. For radar we used Waldvogel algorithm with 2-km neighborhood, reflectivity threshold 51 dBZ, and ΔH_{thrs} 3.2 km. For Lightning jump we used sigma parameter of 2 (upper left figure) and sigma parameter of 1.5 for other three figures which include different trend parameter.

Hail vs Lightning jump



Here we compare annual (left sub-figures) and diurnal cycle (right sub-figures) of hail (upper sub-figures) and lightning jump (lower sub-figures) for Istrian county of Croatia. It can be seen that on annual scale there is high resemblance of hail and lightning jump. On diurnal scale such resemblance is not so clear due to relatively high activity of lightning jump during the night time.

Various Jump parameter vs WRF Hailcast outputs



Figures show two hail events recorded on hail pad network in northern Croatia. Upper figures are from 16.7.2014. and lower from 16.9.2017. Left figures correspond with sigma parameter set to 2 and right figure have sigma parameter to 1.5. Blue shades correspond with WRF 3.8.1. Hailcast radar reflectivity of 40dBz or higher, orange overlay is Hailcast output of hail. Blue dots are lightning jumps and red dots are hail measurements. To learn more about Hailcast case study visit poster area P3 on Thu, 07 Nov, 14:30-16:00 and look for title "Analysis of the WRF-HAILCAST model applied to the Croatian area" b Barbara Malečić

Lightning jump in 2D

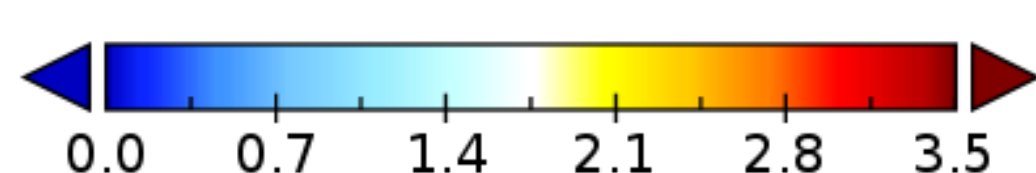
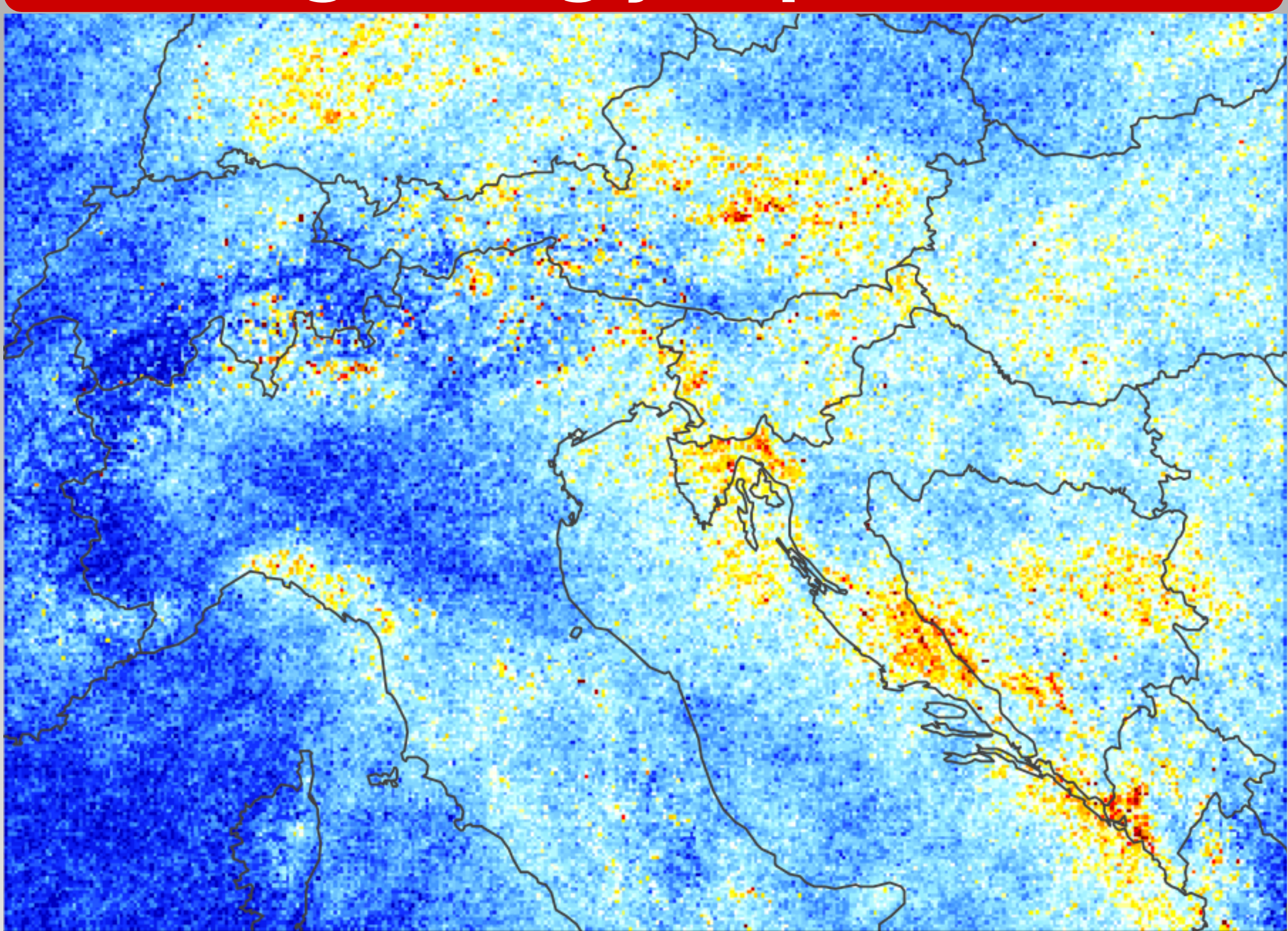


Figure represents annual mean lightning jump frequencies over 10 years of lightning measurements provided by LINET network. Parameter used for determining a lightning jumps are 1.5 sigma and additional parameter imposed on trend. Values suggest presence of hail and/or wind gusts on each grid point with frequencies varying between 0.5 to 3.5 days per year.

Summary & Conclusions

Eulerian based lightning jump is new approach to lightning data offering insights of severe storms from "ground" perspective. Results show potential in assessments of hail events and possibly wind gusts as well. There are significant differences between radars estimates of hail and occurrences of lightning jump but those are the first attempts. However, lightning jump dose occur in relative vicinity of hail event and it is evident that lightning and hail are closely connected as we can see from all figures presented.

We would appreciate any discussion on the topic.

Acknowledgements

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