Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2020-205-RC1, 2020

Natural Hazards and Earth System Sciences
Open Access
Discussions

Interactive comment on "Predicting power outages caused by extratropical storms" *by* Roope Tervo et al.

Anonymous Referee #1

Received and published: 7 September 2020

General remarks

The article investigates windstorm impacts on the power grid in Finland. The authors present a methodology to identify storm objects as polygons and combine them with meteorological and non-meteorological data to predict power outages. They use ERA5 reanalysis data, a national forest inventory and a dataset with information about time and location of power outages in Finland. Storm objects are identified using a fixed wind speed threshold of 15 m/s are tracked in time and space. A large set of meteorological and non-meteorological parameters is gathered for each storm object. From these parameters the most relevant are selected and five different methods are used to classify the storm objects with respect to the damage they caused to the power grid using three damage classes. It is tested how well the different methods are able to

Printer-friendly version

Discussion paper

predict the class of a storm object using cross-validation. Finally, the best performing classification method is applied to three test cases of severe storms.

In general, the article addresses the very interesting and relevant topic of predicting the impacts of extreme weather events. The authors use state-of-the-art data and methodology. However, there are some issues in the manuscript and there are some parts that need more detailed explanation and discussion. These issues should be addressed before the manuscript is accepted.

The authors use sophisticated methods for classification of storm objects with a large set of parameters. What is missing in the study is an analysis of the relevance of the individual parameters for the classification task. It remains unclear which of the parameters play an important role. It might be, for example, that it is mainly the size of the storm object or the number of transformers under the object that is relevant for the damage, while the standard deviation of wind direction plays a minor role. It would be beneficial to include an analysis of the importance of the parameters, at least for the best performing method, to add more scientific insight to the rather technical aspects of classification task.

The authors should discuss what is the benefit of using storm objects, rather than directly relating wind speeds and other parameters to power outages in a certain area, for example in a grid-based approach. Following the approach in the manuscript, one is able to assign a damage class to the whole area of the storm object. However, this does not provide any information about the specific location of the outage. I would suggest to discuss in more detail what could be the use of such a large-scale damage information for an energy provider (see also my specific comment further below).

In many figures the labels are hardly readable.

The manuscript needs to be checked for English language.

Specific remarks:

Page 3, line 81: What is the spatial resolution of the forest inventory?

Page 3, line 84-88: It could be useful to introduce Figure 1 already here in the data section. This would be helpful for the reader to understand the extraction of storm object feature in section 3.2. You should also go into more detail about the spatial accuracy of the local and national data set.

Page 4, line 97: Can the storm polygons have "holes", if within the area of a polygon areas with winds below 15 m/s exist?

page 4, line 103: Here you mention pressure objects for the first time. Are they defined by the 1000 hPa threshold? Please describe in more detail. Also, when you use the word "object" on its own, it is not clear if you refer to a "storm object" or "pressure object". Therefore you should only use "storm object" and "pressure object". Later you also use the term "wind object".

page 5, algorithm 1: What is the "previous pressure object"? Is it previous in time? Or is there another for-loop that cycles through the pressure objects, which is not mentioned in the algorithm? What is "other object"? You mention "object", without specifying if it is a storm or pressure object. Please revise the algorithm, so that it is easy to understand for the reader.

page 5, line 123-128: From your description it is not clear how you selected the relevant parameters. You write about a fitted Gaussian distribution. How do you fit it, to which data and with which purpose? What is class one and two? What is the criterion for selecting the 35 relevant parameters?

page 7, line 130-131: At this point it is not clear how you define the three classes. To make it easier for the reader, I would suggest to spend some words on how the classes are defined here, or to move this part to page 8, line 155, where the classes are actually introduced.

page 7, line 136-138: You write "the local dataset contains 24,542 storm objects".

Would it be more precise to say that "24,542 storm objects are related to outages in the local outage dataset"? It would be very informative to know how many outages are in the dataset in total and how many of them are NOT related to a storm object. Maybe you can add that information here.

page 7, figure 1a: Can you explain why the network topologies look so different in the northern and southern area? In the north it looks like branches that end somewhere, in the south it rather looks like district boundaries. Figure 1c and d: What is shown here in red color? Number of outages per area? Please add a legend. I would recommend to plot the grid topology with a darker color on top of the shading to increase its visibility.

page 8, line 153-154: Please explain in more detail what is shown in figure 4. Does one dot represent the outages and affected customers related to a specific stom object? Is the line a linear regression?

page 10, table 2: The caption say "Classes for local dataset", but shown are also classes for the national dataset.

page 10, line 153-154: Is "model" the correct term here? Isn't it rather "classification algorithm"?

page 11, equations 1, 2, 3: If you use equations, you need to define the individual variables. Also, the equations are not easily understood without further explanation.

page 14, section 4.1: As far as I can see it is not mentioned in the text which classification algorithm was used for the case examples.

page 15, figure 5: The figures should be as self-explanatory as possible. Please explain in the caption what the numbers represent.

page 16, line 305: The term "cell" is usually used for convective thunderstorms, but not for large-scale winter storms. I would suggest to simply use the word "storm".

page 17, line 307: The authors state that "the model is able to provide a more specific and geospatially accurate prediction of caused damage to the power grid than for example weather warning." I do not think that this statement is true. If I understand the model correctly, it assigns a damage class to the whole area of a storm object. This area can be quite large, as figure 6a and 6b show. Furthermore, the model provides no geospatial information about where inside this area the damages are expected. I suppose that weather warnings are available for Finland at a much higher spatial resolution. Additionally, weather warnings are released in advance of an event. In this manuscript the authors do not take into account forecast uncertainty. Therefore, a comparison to weather warnings difficult.

Figures A1 and A2: The figure labels are hardly readable and the figure caption is not self-explanatory. There are abbreviations used in the figure titles which are not defined. Please spend some more words on what is shown on the figures. Can you explain the peak at -1000 in the figure titled "speed_self" and "angle_self"? It appears to be completely detached from the rest of the distribution. Why is there no blue line in the figures titled "AVG Wind gust"?

Technical comments

page 2, line 50 "showed that" instead of "showed at"

page 3, lines 63-66: Please check the description of the paper organization. There are missing words and incomplete sentences.

page 7, line 136: Do not use blank spaces to separate numbers in order to prevent line breaks.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2020-205, 2020.