Interactive comment on "Detection and characterization of extreme wind speed ramps" *by* Ásta Hannesdóttir and Mark Kelly

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Responses to reviewer Matti Koivisto

We would like to thank you for the constructive comments and suggestions. We will address your comments in order, where the reviewer comments are with blue italic font.

In the paper "Detection and characterization of extreme wind speed ramps" the authors present a method for characterizing wind speed ramps. The method uses 3 steps: comparison of filtered and unfiltered 10 min standard deviations (SDs) to find interesting 30 min event windows, wavelet transform to find the interesting events in

these windows and a ramp function fit to estimate and characterize the actual ramping events. The method is applied to multiple years of data from three locations. The method is interesting and generally well presented; however, please consider the following comments.

Introduction:
1) It would be good to specify even clearer if the aim of the presented methodology is to: a) Forecast ramp events (the time when they are expected to start and how long they are expected to last), or b) Summarize/specify ramp behavior of measured (historical) data

Good suggestion. We will specify further in the introduction that this method is used to characterize wind speed ramps in wind speed measurements. The focus in the present study is not related to ramp forecasting or wind power ramps in connection with the electric grid, but rather extreme wind speed fluctuations that may be considered for load purposes.

Figure 2: 2) It would be clearer to move this figure after Section 3.1; I would prefer that all figures are mentioned in the text before they appear in the paper.

Yes, good point. We will change the placement of the figures as far as the Copernicus latex template allows.

Intro/Section 3:
3) A general question: Why is a (relatively) complex 3-step ramp event characterization method needed? Could one just calculate differences from the data, i.e., study variables such as y_delta = y_t - y_t-lag? Considering different lags (e.g., 1 s, 1 min, 10 min, 1 hour), one could study the probability distributions of such y_delta variables (PDFs, SDs, percentiles, etc.) to characterize wind speed variability (ramping). What

does the proposed methodology offer compared to such very simple calculations?

This is an interesting question and a valid consideration. We have tried similar methods earlier. The main disadvantage of such an approach is that you would have to choose different pre-defined time lags and the method would not provide you with a single characteristic rise time (or time lag) of the ramp. The method would always provide an amplitude (y_delta) estimate for all the pre-defined time lags and how would you know what is the appropriate time lag? One might think the appropriate time lag is the one giving the largest amplitude, but small scale fluctuations will often have a significant impact on such amplitude estimates. The main advantage of the current method is that it gives a characteristic estimate of both the time-scale and the amplitude of the studied ramps. The method finds unique events relevant for loads and is not influenced by, or used to characterize small-scale turbulence.

Intro/Section 3.1:
4) Are there any other comparable "ramp event identification" methods in the litera-ture? How does the proposed method, and especially the comparison of filtered and unfiltered 10 min SDs compare to them?

Yes, some have been referenced and one will be added. The un/filtered standard deviations are different than the 'fast' ramp characteristics, though these statistics are affected by the ramps and turbulence.

Section 3.1:
5) Are the 10 min SDs calculated using a sliding 10 min window, or using pre-defined 10 min windows (e.g., 00:00-00:10, 00:10-00:20, and so on)?

Thank you, good question. The 10-minute standard deviations are calculated from pre-defined windows. This information will be added to the paper.

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6) Some of the selections, e.g., taking 10 min means, using L = 2000m and taking 0.1% of the highest values seem a bit arbitrary. Has some validation been carried out that the selection of high variance events really chooses the important ramp events? Maybe comparison to possible other "ramp event identification" methods?

Yes some choices seem to be arbitrary and even though we generally try to avoid such choices some are unavoidable. Taking 10-minute averaging times is often argued as a good choice within wind energy, as that time scale is in the 'spectral gap'; it is standard practice in our field. Slower (>10 minute) ramps may affect production, but do not appreciably affect loads. The scale L=2000m is at the lower end of the mesoscale range, and in the current study we want to exclude the largest mesoscale fronts from the characterization. Taking 0.1% is an arbitrary threshold, but it only influences the number of detected events.