Interactive comment on "A methodology to conduct wind damage field surveys for high impact weather events from convective origin" by Oriol Rodríguez et al.

Reply to Anonymous Referee #1

We thank Anonymous Referee #1 for reviewing our manuscript "A methodology to conduct wind damage field surveys for high impact weather events from convective origin". We believe that the comments provided identified points which were not clear enough and also helped us to reconsider the structure of the text. We provide an item-by-item reply below:

(1) the manuscript does not fit within the scope of the journal;

Reply: NHESS "Aims and scope" section (https://www.natural-hazards-and-earth-system-sciences.net/about/aims_and_scope.html), lists five paragraphs describing the journal scope, being the 4th "the design, development, experimentation, and validation of new techniques, methods, and tools for the detection, mapping, monitoring, and modelling of natural hazards and their human, environmental, and societal consequences". The manuscript, as indicated by its title, describes a methodology to perform wind damage field surveys so we believe it fits well under the journal scope explained in the paragraph quoted as it is a contribution to improve the detection, mapping and characterization of wind damage. This is important as allows to better characterize specific meteorological phenomena, with the particularities associated with damage from convective storms. The comment of the reviewer indicates that a clearer link between the topic and the scope of the journal should be explicitly explained, an aspect which will be incorporated in the corrected version.

(2) the aim of the manuscript is not clearly stated: why is this methodology necessary? what are the new ideas that the authors are bringing on conducting wind damage surveys? how is this methodology relevant for other regions of Europe besides Spain?

Reply: The aim of the manuscript is introduced in lines 45-46 "The objective of this paper is to propose a methodology to conduct wind-field damage assessments of convective-driven events in a systematic way, to contribute to the creation and maintenance of homogeneous databases." The methodology includes three deliverables which are a damage survey summary, a geolocated information table and a data location map, all of them described in Section 2.3. The presented methodology may contribute to homogenize the way of collecting information for studying strong-convective winds phenomena. Building up meteorological databases of severe weather events that discriminate between tornadic, downbursts and other convective winds, is a task which requires in-situ damage assessment data and this research tries to contribute to this objective. In the specific case of Spain, the interest to know which type of severe weather convective wind phenomenon damaged an area is not only from the meteorological point of view, but also from the public reinsurance perspective, as it is reported in De Groeve *et al.* (2014). In the new submitted version, we will explain this aspect more clearly.

(3) some of the recommendations for wind damage survey are common sense (but I do understand that is necessary to have a document collecting all of them), but most of them are just vague and not clearly explained; how are the forest damage assessments used to differentiate between damages produces by tornadoes and other types of convective winds? There is no clear mentioning in the entire manuscript on how to use the proposed methodology to differentiate between damages associated with different types of convective winds events;

Reply: Thanks for indicating this issue; we thought that giving proper references was enough to cover this point but we understand the need to expand it briefly. As reported in other studies cited in the text (Hall and Brewer, 1959; Holland *et al.*, 2006; Bech *et al.*, 2009; Beck *et al.*, 2010; Rhee and Lombardo, 2018), it can be assumed that fallen direction of trees indicate the direction of maximum wind speed in a strong-convective winds event. Knowing how is the damage swath pattern of both theoretical tornado and downburst and comparing it to the damage pattern found during a damage survey assessment in a forest area, one may estimate which phenomenon took place.

As explained in Bech *et al.* (2009), a simple approximation to describe a tornado vortex near the surface is given by the Rankine vortex model, which is defined in polar coordinates, by:

$$\begin{cases} v(r) = \dfrac{v_{max} r}{R} \text{ when } r \leq R \\ v(r) = \dfrac{v_{max} R}{r} \text{ when } r > R \end{cases}$$

where v(r) is the velocity in function of the distance to the centre of the vortex r, v_{max} is the maximum velocity, and R is the radius where v(r) = v_{max}.

To model tornadoes, a Rankine vortex with tangential and radial wind components is combined with a translational movement. As it is explained in Bech *et al.* (2009), two parameters are used, based in Peterson (1992a), to characterize this model: parameter G, which is the ratio between v_{tang} and v_{trans}, and parameter α which is the angle between v_{rad} and v_{tang}, corresponding 0° to pure inflow, 90° to a pure tangential case and 180° to a pure outflow.

In the figure attached below it is shown the two-dimensional wind field associated to three different vortex configurations and their theoretical damage swath pattern (as a rectangular panel below each two-dimensional wind field), which are described by the maximum wind vectors perpendicular to the translational movement. In the first column, translational velocity is 1/4 maximum tangential velocity (G = 4) and, in the second, translational velocity is equal to maximum tangential velocity (G = 1).

In case (a), where tangential and inflow maximum velocities are equal (α = 45°), a convergence damage pattern is identified, whereas in case (c), where the radial component is zero (α = 90°, i.e. pure tangential flow), damage swath presents a rotational pattern. In case (e), which presents pure outflow with no tangential velocity (α = 180°, i.e. downburst), there is a clear divergence in the damage swath pattern. Thus, based on this model, if fallen trees pattern presents convergence or rotation, it can be assumed that a vortex caused the damage, whereas if it is divergent, it might be a downburst.

Nevertheless, it is also noticeable that in cases where tangential and translational velocities are similar ($G \approx 1$, see for example the second column of the Figure), damage swaths may present only little differences. This can occur in weak (EF0 or EF1) tornado or downburst events. Then, even with a detailed damage survey, if there is no direct witness or image of the meteorological phenomenon, it may not be possible to know which type of phenomena caused the damage.

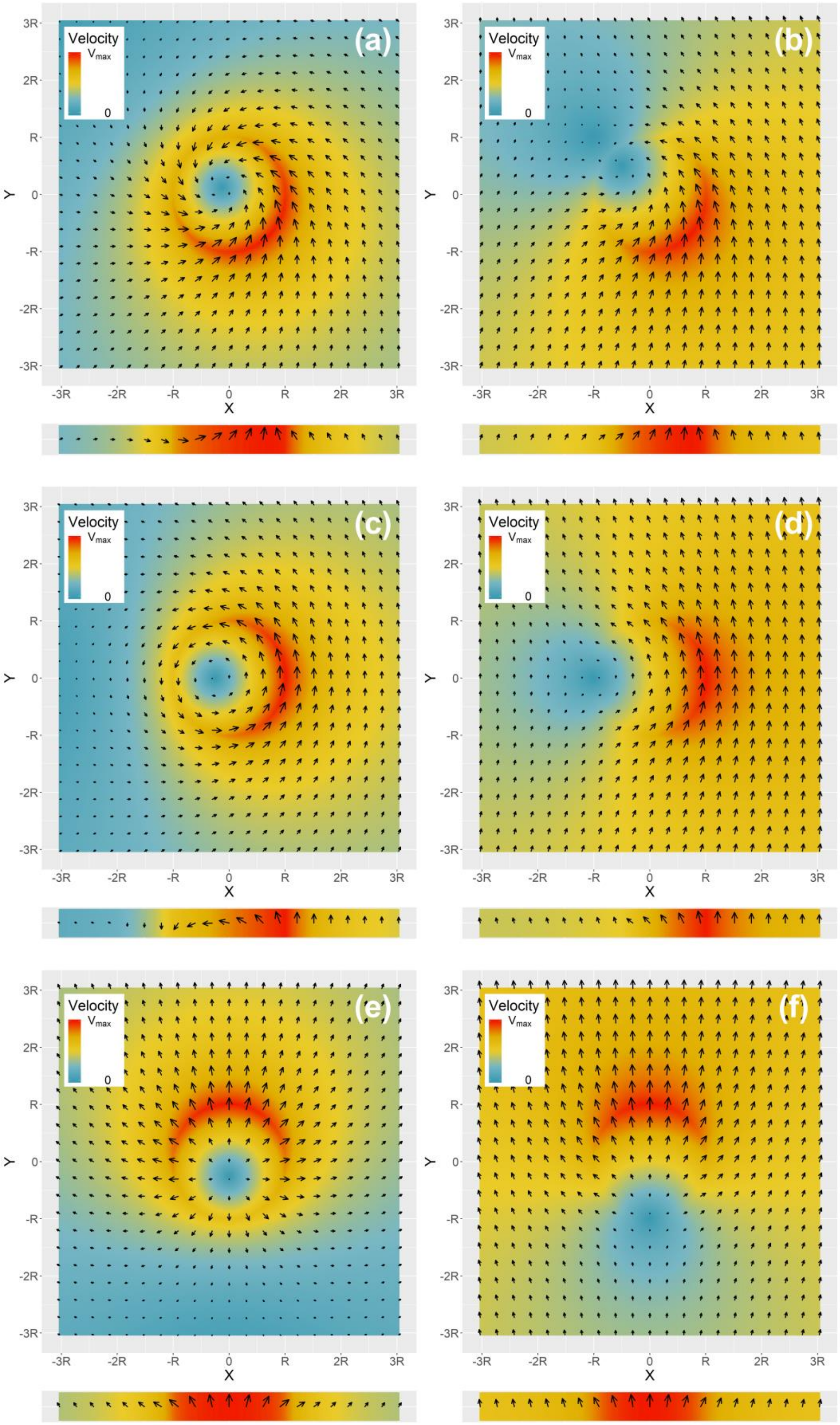

Figure 1. Wind fields and damage swaths for the cases (a) G = 4 and α = 45°, (b) G = 1 and α = 45°, a pure tangential velocity (c) G = 4 and α = 90°, (d) G = 1 and α = 90°, and a pure outflow (e) G = 4 and α = 180°, (f) G = 1 and α = 180°. Adapted from Figures 3 and 4 of Bech *et al.* (2009).

We will include this explanation and the Figure in Section 3 (Discussion).

(4) the manuscript is not very well structured and the English is not of publication quality and requires major improvements.

Reply: From the previous comments we agree that the original structure, based on the chronological order of steps carried out during damage surveys, can be improved. Maintaining previous elements of the structure we propose to change some subsection parts to explain better their meaning. In particular, we formulate a three-part methodology centred on the in situ damage survey tasks (ISDS): pre-ISDS, ISDS and post-ISDS.

In the original structure, it is commented firstly how to prepare the visit to the affected area. After that, survey tasks are explained (previous considerations, how to conduct the man-made structures damaged analysis, the collection of vegetation damage data and how to perform witness enquiries). Then, the deliverables are presented (the damage survey summary, the geolocated information table and the data location map) and, finally, there is a brief discussion where three challenges of applying this methodology are explained. Nevertheless, according to this comment and to Referee #3 we propose to modify the manuscript structure by merging “Survey planning” and “previous considerations” sections into a new one entitled “Pre in-situ survey tasks” and by removing the two case studies from the manuscript. Moreover, the deliverables of a case study will be attached as supplementary material to clearly illustrate this concept with a real example. Therefore, the manuscript structure will be as follows:

1. Introduction
2. Methodology
    - 2.1. Pre in-situ survey tasks
    - 2.2. In-situ survey tasks
        - 2.2.1. Man-made structures damage assessment
        - 2.2.2. Forest damage assessment
        - 2.2.3. Witness enquiries
    - 2.3. Post in-situ survey tasks and deliverables
        - 2.3.1. Damage survey summary
        - 2.3.2. Geolocated information table
        - 2.3.3. Data location map
3. Discussion
4. Summary

In addition, as Referee #3 suggested, we will add a flow diagram (see below) in Section 2 to clarify the structure and application of the proposed methodology.

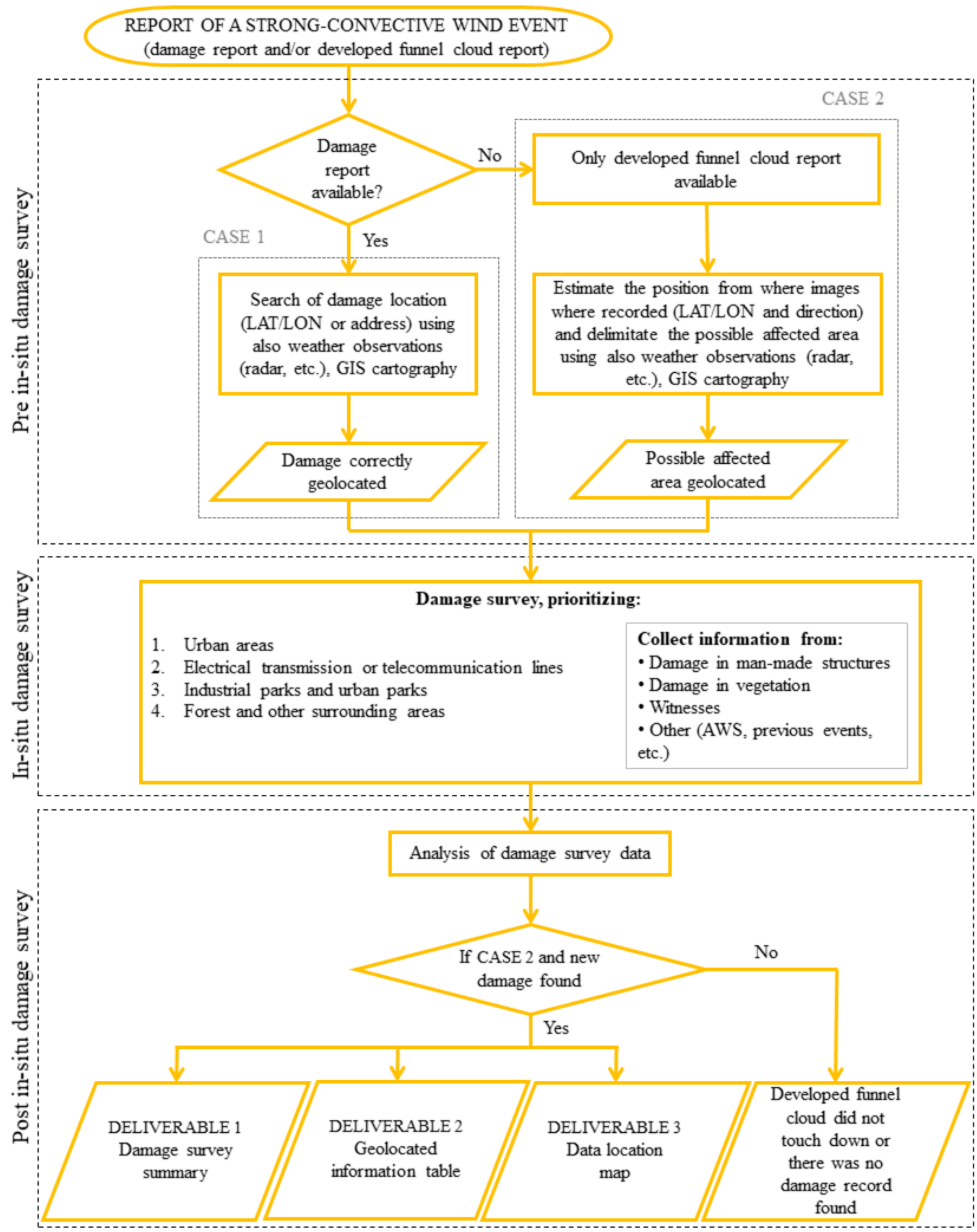

Figure 2. Flow diagram of the structure and application of the proposed methodology to carry out strong-convective wind damage assessment.

In the new manuscript version English will be revised and corrected.

(5) I do encourage the authors to further develop, refine, and describe their methodology in more details and to make it available as a report to the scientific community.

Reply: Thank you very much for your comments and encouragement. With your -and the rest of reviewers- suggestions, we are working on an improved version of the manuscript for a further submission.