ESSL
European Severe Storms Laboratory

ESSL Guide:

Logistics for Wind Damage Surveys

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Preface

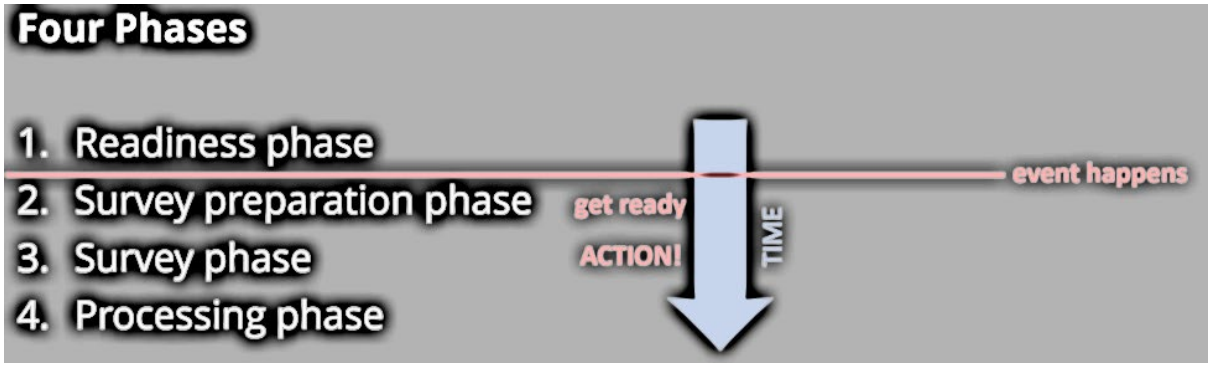
ESSL encourages competent weather services and other related organizations to perform wind damage site surveys after as many events as possible.

ESSL will actively offer help with a survey that may concern violent tornado damage (cases suspect of IF4 or IF5 intensity). In case of lack of local capacities, ESSL will actively lead and perform such a survey.

This guide was written from the ESSL perspective but can easily be adapted to the needs of other organizations.

Guide structure

1. *Readiness phase*: everything that needs to be pre-prepared before the event.
2. *Survey preparation phase*: actions needed to be taken after the event occurred and before the survey is conducted.
3. *Survey phase*: actions needed to be taken during the survey.
4. *Processing phase*: actions needed to be taken after the survey.



1. Readiness phase

Definition of team roles, training and knowledge

Selected persons within national meteorological institutes or voluntary observer networks / persons need to acquaint themselves with the state-of-the-art damage assessment scales. Learning about the damage assessment procedures and the damage indicators during the site survey will cost significant amount of time that can otherwise be spent rating the damaged structures.

ESSL recommends using the IF-scale and the IF-scale guide, which can be found on the ESSL webpage in the section Publications – Severe Weather Surveys:

https://www.essl.org/cms/publications/detailed-survey-reports/

It is important to know about the potentially available personnel that is knowledgeable concerning the surveys and the roles that single people can take. More widespread events will require more personnel, and their roles will need to be delegated by a team manager that will stay in the office. For a larger event, following roles may be needed:

- **Team manager**: communicates with officials and the on-site team leaders. Determines the locations where the site-survey teams are dispatched. Is responsible for the collection of data from the surveyors and the external sources (media, people calling in). The team manager makes sure that surveyors are not disturbed by third parties, such as media.
- **On-site team leader**: the most experienced person in the team. Decides the priorities in the survey and serves as a point of contact with the team manager.
- **On-site surveyors**: work with the team leader.

Regarding the size of survey teams, 2-3 people per team is ideal.

An e-mail template should be prepared to rapidly inform third parties about the event and steps to be taken. An example text for such an e-mail template from the ESSL perspective is provided in Attachment A of this document.

Technical readiness

In case a **damage assessment app** is used, it is important to try out and practice with the damage assessment app before an actual event. Make sure that login credentials are known if needed.

Being able to take aerial imagery (drone/plane/helicopter) or having contact with people that can perform that is important, especially for larger scale events. If the surveying person has **drone available**, flying with the drone should be practiced. Extra batteries should be prepared if the survey time is long. Drone pilot license, drone registration and drone insurance need to be taken care of.

The following drone checklist is used at the ESSL:

At home

- Are all batteries loaded?
- Are car charger and cables packed?
- Is the car-independent backup battery with 12 V socket packed?
- Check for restricted flying zones.
- Are drone and remote control updated and ready to fly?
- Permits required?
  Over private land: flying over is permitted but starting/landing requires permission of the owner.

On site

- Wind direction? (relevant for remaining flight time at most distant point)
- Check terrain on topographic map: Height differences? Power lines? Power plants or towers?
- Based on this determine …

1) … optimal starting point, ideally on a hilltop free of trees or on an elevated platform – for long line of visual sight (legal requirement!) and for ideal radio signal transmitting
2) Minimum area free of obstacles for starting and landing: 10 x 10 m. With very good GPS signal and visual sensors a square of about 1.5 x 1.5 m of even landing surface is sufficient.
3) … flight height (also based on size of suspect area): 50m? 100m? higher?

   (legal limit for basic license is 120 m above local ground)

Drone scanning strategy

If time is pressing or area very large: Record **video on flying out**, take **photos** (stand still for best sharpness!) **on flying back**.

If time allows, take video and photo from both directions (viewing angle of houses/objects should cover two sides of objects, ideally even four sides) and take overview pics from higher and detailed shots from lower altitude.

Back at home

Determine height difference between recorded absolute altitude (recorded together with lat/lon with every photo and video) and real altitude at starting point. There can be a data bias.

Further technical aspects

An **independent, battery-powered, satellite-based, mobile internet connection** is vital for communication in remote areas or after large-scale events when the regular mobile internet infrastructure can either be destroyed or overloaded by high demand. Equipment needs to be tested on a regular basis.

Each survey team will need a **car or pickup truck** in most cases. 4WD is preferrable to be able to drive on dirt roads. The vehicle should be clearly marked as a professional survey car to facilitate recognition by local authorities and affected communities and individuals.

A ready-to-go storm survey case shall be prepared. See content list below.

Storm survey case to be ready:

- **Labeled vest**
- **Helmet**
- **Ruler (for measurements of brick sizes and refrigerated large hail)**
- **Name badge**
- **Business cards**
- **Sun and rain protection, insect repellent**
- **Clip board for printed maps and paper notebook**
- **Printed IF Scale document**
- **Safety boots/shoes**

Labeled vests and helmets should be prepared. Helmets are important when surveying the damage in the settlements as loose objects can fall or be thrown during the clean-up work. If helmet is not needed, labeled sun cap can also be worn. Labeled vests offer recognition of surveyors that clearly separates them from public onlookers. This can help when communicating with both officials and locals. Name badges can have similar effects. If it is desirable to establish further contact with locals, one may use business cards to share the contact information. Safety boots (especially against nails) will prevent foot injury when walking on the rubble.

To increase the chance of successful communication with locals, a **quick fact sheet** concerning the tornadoes and the usefulness of tornado surveys can be created. We suggest an A5 format on hard paper. An example text for such a quick fact sheet is provided in Attachment B.

2. Survey preparation phase

Preparation phase begins with being informed about the event and ends with the arrival at the survey site.

The information regarding the event must reach the team manager. Team manager reaches out to the potential surveyors for a meeting (**survey preparation meeting**) to discuss the scale of the event, the necessary workforce, and the needs for transportation to the event site or accommodation. Surveys often take more time than expected. Detailed survey of significantly damaged single building structure may take around one hour. A day is typically needed for cases of several houses affected. A larger scale event can take days to weeks, depending on the number of survey teams available. The more damage to the structure and the bigger the structure is, the more time is required for a detailed survey. Navigation around the event site, driving into the affected area or finding a suitable parking place can also take large amount of time.

A preliminary report about the event should be submitted to the ESWD. Team manager makes sure that person responsible for ESWD reporting is informed about the event and is invited to the survey preparation meeting.

The survey should be organized as quickly as possible. Some of the damage may be cleaned up within 24 h after the event.

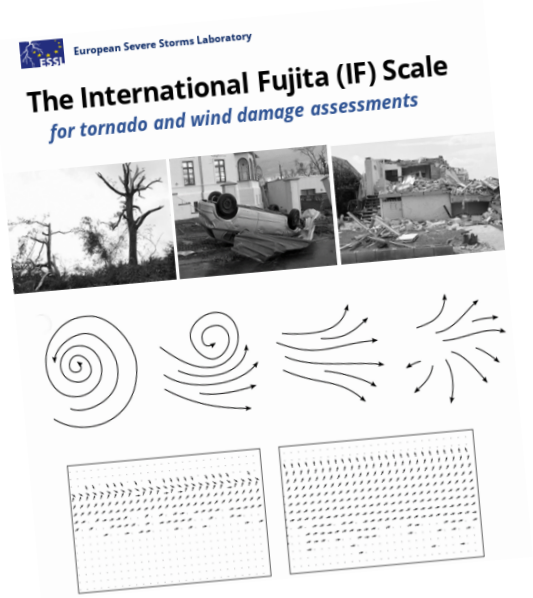
The result of the survey preparation meeting should be:

1. **How many surveyors are needed and available?**
2. **How much time (very rough estimate) will be needed to travel to site survey and complete it?**
3. **Will surveyors need accommodation if survey should last for multiple days?**
4. **Which partners can be asked for cooperation: weather service or local VOPs (ESSLs Voluntary Observer Persons), for example?**
5. **Planning for a quick overview of the path of the event using aerial imagery. This is important, because it is necessary to identify the most impacted areas and provide overview of the damage before the significant clean-up starts.**

Survey teams are formed and sent to different areas during the meeting or pending the aerial imagery overview if it will be available soon and does not need to be performed by one of the team members.

Before departure, it is vital to go through the checklist for the most important preparations and equipment. See example checklist below.

Notes:



CHECKLIST before departure

Survey teams should prepare:

- Computer tablets with high-quality topographic maps (pre-downloaded for offline functionality – check!) and the necessary power supply
- Damage-assessment app, check functionality and login credentials, to be used with a high-quality mobile device (geographic location system needs to be working well)
- Independent, battery-powered, satellite-based, mobile internet connection (for example Starlink ®) for remote areas or large-scale events with potential destruction of infrastructure or overload of systems.
- If available: printed maps (provide best overview in the field during team discussions)
- If available in addition to a high-quality smartphone: High-quality camera equipment
- Drone equipment (see drone checklist above)
- Cool box with drinks and food. Groceries and water may not be available in the affected area!
- Equipment from the storm survey case
- Car (ideally pick-up, fully fueled, extra fuel for large-scale events with destruction of infrastructure)
- Document that allows survey teams to enter the affected areas. Survey admittance document is secured by the team manager. See Attachment C.

Additional notes:

3. Survey phase

Survey phase includes travel of the teams to the survey site. This can take up to one working day. In the meantime, team manager gathers more information and plans the details of the on-site activities.

Before entering the site, teams may need to pass police controls. The survey admittance document shall be shown together with an ID.

Survey teams should first concentrate on the areas with the most significant damage.

When conducting the survey in extensive damage areas, we advise conducting multiple cross-sections. This will help to establish the progression of the damage along the path and the area affected by the individual tornado intensities.

Rating the damaged structures

A

Using a **damage assessment app**:

For each of the damaged object, at least one photo is taken, damage indicators and degree of damage are determined and saved along with the location (geographical coordinates) of the object via the app.

Ideally the app contains an option to display already submitted data points on the map. This makes the coordination between teams easier and planning of further surveys of the area.

B

In case a **damage assessment app is not available**:

Damage indicators and degree of damage are noted either in the printed map or in the notebook together with the geographical coordinates of the damaged object.

If there is enough time, objects outside of the primary cross-sections should be rated too.

Cross-sections are chosen in best case scenario by team manager using aerial imagery. In practice, on-site teams may need to deviate from the plan and cross-sections do not need to be in a straight line. Cross sections should cross the areas of the suspected most significant damage first.

Debriefing

At the end of the working day, a **daily survey debriefing** should be conducted with the rest of the team and team manager to discuss the preliminary findings, future progress, changes to the plan and to express support. The person responsible for the ESWD reporting joins debriefing as well to update the preliminary report.

Interacting with local inhabitants

Locals can behave differently when approached by survey teams. Every approach to locals should be wary but confident. Empathizing with the inhabitants is supported by putting oneself in the locals' position. Still, the members of the survey team need to keep their mission in mind.

Some locals will not want to be disturbed and should not be asked about their experience with the event. Some locals may seek contact with the survey teams, as they are interested in the event or the work being done. Information and business cards can be helpful to establish further contact. Before entering private property, the owner, if present, should always be asked to grant access. Some locals may be angry at the survey teams and in such cases, backing off is advisable, not insisting on investigating or looking at the property.

Physical challenges

Site surveys are physically demanding, requiring a lot of walking in sometimes hazardous conditions, such as with sharp pieces of debris or among the cleanup effort. Heat stroke and sunburn are a threat in the summer months, and it may be impossible to hide from sun in the significantly damaged area. Enough water, sun protection and breaks are needed. In case working conditions are difficult, it is advisable to shorten the site survey time.

Mental challenges

Site surveys can be mentally challenging, especially if fatality occurred with the event. It is important to reassure yourself that the task you are doing is important and your role requires you to be present at the site and active there.

Debriefings shall be used to communicate emotional distress from the survey. Strategies for dealing with mental stress at the survey site and after the event should be consulted with psychologists. The site surveyors should be given access to an emergency psychologist if deemed necessary.

Cleanup in Mira (VE, Italy) after an IF4 tornado passed over a historic villa.

4. Processing phase

If a damage assessment app was not available during the survey, data should be entered into a computer spreadsheet to conform with a standardized format. The format follows the standard of the damage assessment app. The data should easily be displayed onto a map along with the photo reference, DI and DoD.

After the survey is finished, meetings among the whole team should follow to discuss the gathered data, establish the rating and other required information.

The outcome of the survey should be a **survey summary document** that contains the following basic information:

- Maximum intensity
- Area affected (path length, mean and maximum width)
- Area affected by different intensities.
- Map showing the tornado track with different intensities plotted.

The survey summary document can also contain information on:

- Extraordinary damage occurrence
- Circumstances under which people were killed or injured.

Example for the first page of a survey summary document

Attachment A

Example text for e-mail template (from ESSL perspective)

Dear colleagues,

According to preliminary information, a potentially violent tornado has occurred in the area … on … around … o clock.

First indications of magnitude led us to assume that we cannot exclude IF4 intensity on the International Fujita Scale in the present case. As a standard in such cases, ESSL is performing independent scientific site surveys to assess the nature and intensity of the event, which is important for climatological and other scientific questions.

We are kindly offering our services also to your institute in case you are interested in cooperating in this matter. We can offer the added value of our many years of international experience in such activity. We can provide the necessary organizational structure for field works in an area of catastrophe, based on state-of-the-art technical equipment and human knowledge for the assessment of extreme tornado cases. In addition, our offer supports international recognition of the findings, comparability according to the standards of the IF-Scale and knowledge transfer to your own employees via joint co-work if desired.

In case you are interested in our full survey data and in sound information as soon as feasible, it is possible to commission ESSL to perform such a site survey. We can offer such work for lumpsums that on average cover our costs. Note that ESSL, as a non-profit research organization, shall not generate profit.

In any case, we kindly ask for information whether you are planning to dispatch own survey teams within the first two days after the event. In this case, we would like to offer to coordinate the field survey effort with you, exchange data on a fair basis, and discuss the findings with you.

Kind regards,

Attachment B

Example text for quick fact sheet about tornadoes and tornado surveys (ideally to be printed on A5 sized hard paper, from ESSL perspective)

Tornado info sheet

Your area has been hit by a tornado or other severe wind event.

Tornadoes are rare but extremely dangerous weather phenomena. Tornadoes are violently rotating columns of air that extend from the surface into a parent cloud. Several hundred tornadoes are observed in Europe every year – most of them are short-lived and occur over the water.

Some tornadoes can become violent with wind speeds in excess of 400 km/h. Such tornadoes can toss vehicles for hundreds of meters or destroy even sturdy buildings and are typically connected to strongly rotating thunderstorms - called supercells. Even the weaker tornadoes can reach peak winds of 200 km/h and cause significant damage to trees and roofs.

Many tornadoes have been documented in Europe in the past, but it is only in recent years that stronger emphasis is placed on their detection in Europe. Because tornado paths are typically short and narrow, they almost never hit a meteorological station that observes the weather. To establish the nature of the wind damage (tornado or some other phenomenon) and to understand how the tornado can impact on the buildings, we need to perform the damage survey as soon as possible after the event.

Such research forms a basis for future warnings and for safer buildings that are better able to withstand tornadoes. For this reason, the European Severe Storms Laboratory (ESSL) conducts site surveys and damage assessments after strong tornadoes or other extreme wind events. You can find an overview of our research on the website www.essl.org

If you would like to update us with important facts about the event in your neighborhood, please email us at inflow@essl.og

Attachment C

Sample document that allows survey teams to enter the affected areas: survey admittance document (from ESSL perspective)

Survey admittance 2026

HIGH PRIORITY / URGENT
To officials / To whom it may concern

This is to certify that Mr/Ms …, born …, is officially entitled by ESSL to perform scientific site surveys in the severely affected areas after a tornado or other severe weather event. Such site surveys are extremely important to be conducted in the very first hours and days after the event to improve future warnings of similar events and mitigate future loss of life and property.

From the ESSL perspective, and as ESSL official, this document entitles the holder to

- immediate and urgent access to the affected areas
- pass police controls or other checkpoints and enter areas with restricted access
- perform damage assessment in the restricted areas including damage analysis
- take photos and videos of damaged objects
- take photos and videos by flying a drone
- enter the areas affected by car or 4WD Pickup truck
- drive on otherwise closed roads and dirt roads

All activities shall conform with the national law and local regulations. The holder of this document shall present its ID to officials in case of controls or checkpoints.

We kindly ask for your allowance.

Kind regards,

S i g n a t u r e

on behalf of the ESSL Director