



The International Fujita Scale: A Globally Applicable Scale for Tornado and Wind Damage Classification

Pieter Groenemeijer (1,2), Alois M. Holzer (2,1), Martin Hubrig (3), Thilo Kühne (1), Rainer Kaltenberger (4), Juan de Dios Soriano (6), Lothar Bock (5), Délia Guitiérrez Rubio (6), Bas van de Ploeg (7), Gabriel Strommer (2), and Thomas Schreiner (2)

(1) European Severe Storms Laboratory (ESSL) e.V., Wessling, Germany, (2) European Severe Storms Laboratory - Science & Training, Wiener Neustadt, Austria, (3) Independent forestry consultant, Germany, (4) Zentralanstalt für Meteorologie und Geodynamik (ZAMG), Austria, (5) Deutscher Wetterdienst (DWD), Germany, (6) Agencia Estatal de Meteorología (AEMET), Spain, (7) Netherlands

Classifying tornado and damaging wind intensity is usually done by assessing the inflicted damage, since reliable in-situ measurements are typically lacking. Damage scales are used to express the intensity. It is important that such scales are temporally and globally consistent to allow for comparisons between events. The most widely used scales are the Fujita (F-) and Enhanced Fujita (EF-) scales. The latter is currently being redefined in a formal process of the American Society of Civil Engineers. The EF-scale that was adopted by NOAA in 2007 introduced the concept of Damage Indicators, i.e. objects that are damaged to a certain Degree of Damage (DoD), each DoD being associated with a particular range of wind speeds.

The EF-scale has been augmented nationally by some countries, such as in Canada and Japan. This was done to adapt it for use in those countries after having been designed for use in the United States. It lists DI's typical for the United States, built according to US construction practices. The 6-level EF-scale (EF0 – EF5) introduced an increase of wind speeds for the lower steps of the scale, but decreased it considerably for the higher steps. This adjustment has complicated comparisons with older events that have been rated using the F-scale.

Here we introduce an International Fujita (IF) scale that has been developed based on a number of workshops to which experts from several countries provided their input. This new scale features a large number of generic DoD's rather than DoD's based on building practices unique to one particular country. Wind speed estimates are based on a number of publications in the scientific literature and on some of the national extensions to the EF-scale. The scale takes into account the uncertainty of the "measurement" of the damage by using a finer scale than the original Fujita scale at lower wind speeds, where estimates are more accurate because they could be compared with anemometer measurements, i.e. in large-scale windstorm events. The IF-scale wind speeds are compatible with the original Fujita scale, but instead of specifying wind speed ranges uses a central value and an error estimate.

Important features of the scale are the treatment of buildings as a range of DoD's with increasing sturdiness, as was originally proposed by Ted Fujita. In addition, roofs of buildings are considered a separate DoD. Furthermore, forestry experts have been consulted to include an estimates if vegetation damage.