"50 years return period wet-snow load estimation based on weather station data for overhead line design purpose"

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General comments

The authors adapt a new parameterization of the classical cylindrical wet snow accretion model for the use with meteorological data, recorded at 87 weather stations in France. The new parameterization of the model has been evaluated before, using WRF simulations and observed wet snow accretion in the southern part of Iceland (Nygaard et al., 2013). The goal of the present study is to show the applicability of the modified parameterization in countries where wet snow events occur under less severe and windy conditions than in Iceland. The authors propose limiting conditions for the model application ("wet snow window") and adjust model parameters in order to implement it for the estimation of wet snow loads at the 87 weather stations. They compare the model results with observations, recorded in a dedicated wet snow data base. Finally they determine characteristic values of wet snow loads (i.e. 50 years return period loads) for those stations in France by a peak over threshold method.

The paper is completely in accordance with the scope of the journal. The authors adapt and validate a model in order to estimate the wet snow accretion on structures in France. The study is a pre-condition for modelling, mapping and monitoring of potential hazardous wet snow accretions and their impact on overhead lines in countries with similar climatic conditions. It establishes links between new modelling concepts, recent versions of international standards and employs (new) long term data sets (meteorological as well as wet snow observation data).

The paper is well structured, mostly clear and easy to understand. The methods are outlined clearly, the results are plausible and the conclusions are concise.

Recommendation: Accept after minor revision.

Specific comments

Structure of comments: Page, Line: "Citation (if necessary)", Comment

1) 5139, Title: To my opinion the title would reflect the contents of the paper more clearly if it would refer to the data sets used. On one hand the goal of the paper is to show the applicability of the modified parameterization in countries where wet snow events occur under less severe and windy conditions than in Iceland. This would be an argument for the title as it is (a more general one). On the other hand, authors adjust, implement and test the model (parameters) in order to estimate the wet snow loads at the 87 weather stations in France and they compare it with observations in France.
2) 5140, 16: The abstract should include information of main results of chapters 4.3 to 4.5.
3) 5141, 19: equation (1), *M* is defined as "linear mass density". Shouldn't be *A* defined as cross-sectional area per unit length instead of "cross-sectional area of the ISO reference collector" due to dimensional reason? $[kgm^{-1}s^{-1}] \neq [kgm^{-3}m^{-2}ms^{-1}]$ if M $[kgm^{-1}]$, η_1, η_2, η_3 [-], w $[kgm^{-3}]$, A [m2], V $[ms^{-1}]$
The reference to "ISO reference collector" doesn't define the length of the reference collector, ISO 12494 Annex B.3.1 says: " … The overall design of the standard measurement device should be in principle as follows: a) A cylinder with a diameter of 30 mm is placed with the axis vertical and slowly rotating

around the axis. The cylinder length should be a minimum 0,5 m, but if heavy ice accretion is expected, length should be 1 m. …"

4) 5143, 1: equation (6), sqrt of outer bracket is wrong, cp. equation (2)
5) 5143, 5: " … compares very well with the ISO reference collector as: – the height a.g.l. of a snow covered conductor is close to 10m …" Maybe I am wrong, but to my understanding this might be true for distribution networks (i.e. "medium" voltage networks) but it does not for transmission networks (i.e. "high" voltage networks), what EN 50341-1 (2012) is valid for, too. For those networks conductors are located in higher levels above ground, aren't they?
6) 5143, 7: " … the torsion resistance of a conductor is such that it can slowly rotate around its axis everywhere but near its fixations …" To my understanding, that's true for single conductors (most often used in distribution networks), but not for conductor bundles (often used in distribution networks), cp. comment 3).
7) 5144, 24: equation (10), Any reason for using this equation (simplicity in comparison to the original equation of Makkonen (1989))? Figure 1 (below) shows, that the criterion of eq. (10) is more conservative than the one used by Makkonen (1989) for pure phase, applied for T_{wb}=-0,2°C (green dashed line in figure 1). Furthermore, it is slightly more conservative than the calculation of relative humidity (RH) for moist air conditions, based on the calculation of RH by psychrometer formula (green dotted line in figure 1).

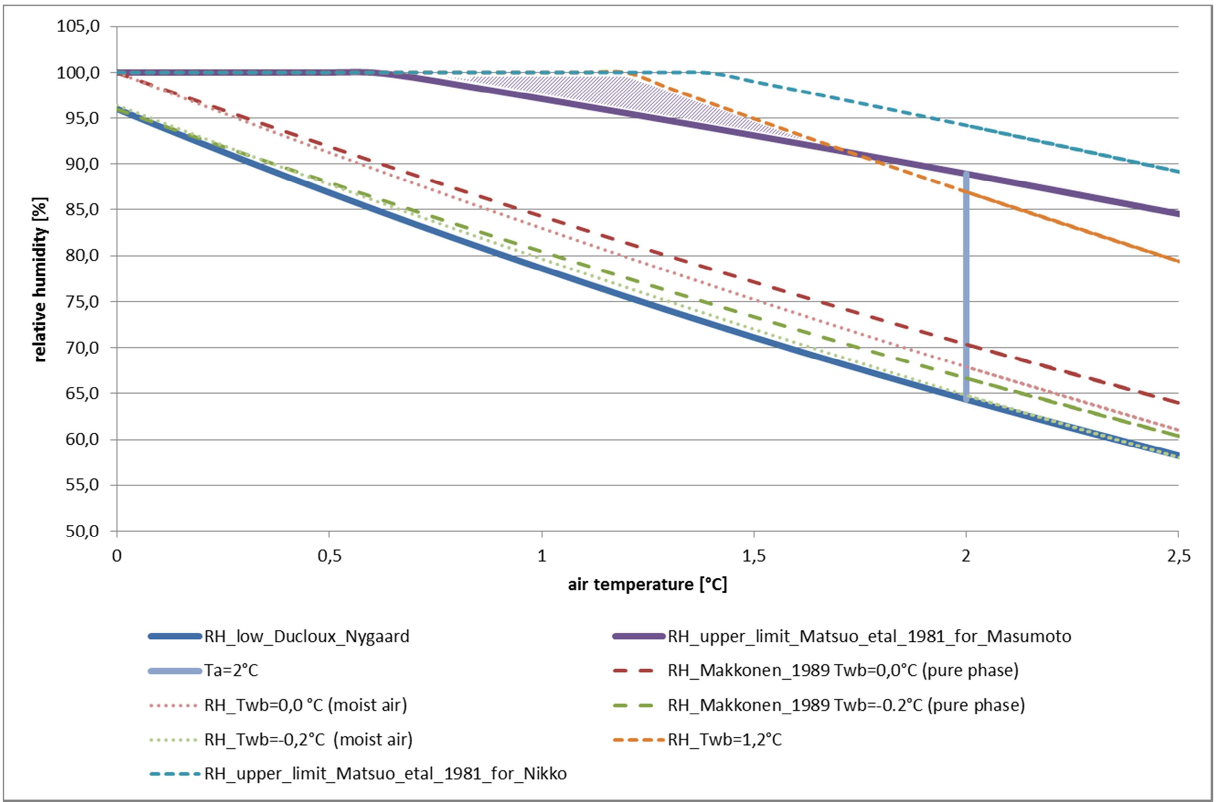

Figure 1: Compare to Figure 2 of Ducloux and Nygaard (2014)

8) 5145, 7: equation (11), Any reason for using this equation instead of T_{wb}=1,2°C? Figure 2 of the paper shows, that the criterion of eq. (11) is in the air temperature range from 0,7°C to 1,7°C less conservative than the criterion T_{wb}=1,2°C (see shaded area in Fig. 1). Equation (11) was proposed by Matsuo et al. (1981) on the basis of meteorological data of one station in Japan (Masumoto). " … Matsumoto is [located] about 90 km inland from the sea shore, Nikko being about 120 km inland. The heights of the Stations [above sea level] are […] 610 m at Matsumoto, and 1,292 m at Nikko …" (Matsuo et al., 1981). Are these locations comparable to (mainland) sites in France?

9) 5145, 22: " … For instance, 1000m can mean equivalent water precipitation intensity of 0.5mmh^{-1} as well as 5mmh^{-1} according to …" The sentence is misleading as it is, to my opinion due to two reason: First, to my understanding, the intention is to illustrate the statement in line 18 " … Moreover, the same visibility may lead to very different snowfall rates, …". Second, its position after eq. 13 may lead to misinterpretation. Rasmussen et al. (1999) state " … Under rapidly changing conditions, visibility is an unreliable indicator of snowfall intensity unless crystal types and degree of riming and aggregation are known …" Knowing the reason of different visibilities (crystal types and degree of riming and aggregation) the relation to eq. 13 would be obvious. So, maybe just rearranging and/or short explanation would make it clearer.

10) 5146, 17: Equation 14 is valid for Hellmann rain gauge. I did not find information about rain gauges used in France. Are they comparable to Hellmann?

11) 5147, 6: " … wet-snow loads in France, the reasonable constant value of 400 kgm^{-3} proposed in ISO annex for wet-snow density ρ_s is adopted. …" Admirat (2008) used the equation ρ_s=200+20U for 1<U<10 ms^{-1}, i.e. ρ_s=400 for U=10 ms^{-1}. Maybe a reference to Admirat (2008) supports the statement before.

12) 5147, 23: " … and CR (which leads to k) …" Please explain, how CR leads to k. As far as I understand the equations before, CR is used to correct P. P itself is a recorded value (as mentioned by the authors before) leads to w. As far as I understand the discussion in chapter 2.2 authors set k=1 ?!

13) 5148, 4, 10: n=0,5 or n=-0,5 as well as n-range from -0,6 to -0,4, cp. to eq. 7 and 9?

14) 5148, 4, 11: How Ta was handled in CR for uncertainty estimation? Ta is not mentioned to be a recorded value or a parameter. Tests show, that uncertainty estimation as described by the authors is quite sensitive to variations in Ta.

15) 5148, 4, 16: " … The two classical parameters of that gamma law can easily be determined from its mean, which is 1.1 greater than its median value, and its coefficient of variation, which is 35 %. Those two estimations come from simulations of 20 000 cases, which are built with different couples (P ,U) and different durations. …" To my opinion this is not clearly to understand.

    As far as I understand the paragraph before (lines 12-15), numerical simulations with fixed couple(s) of (P, U, duration) with randomly varying (Vt, ρ_s , n, what about CR, see comment 12) result in " … a gamma law whose median value is the value calculated according to the mean values of the four parameters …" That's clear and reproducible.

    On the other hand, the formulation " … Those two estimations come from simulations of 20 000 cases, which are built with different couples (P ,U) and different durations …" doesn't say if in those simulations the parameters (Vt, ρ_s , n, CR) are fixed and (P, U, duration) are varied (randomly)? (I guess that's what you did.)

    Or do all values (P, U, duration) as well as (Vt, ρ_s , n, CR) vary randomly? If so, what distributions did you assume for (P, U, duration)? Or did u use measured values for (P, U, duration)?

    Furthermore, does " … which is 1.1 greater than its median …" denote: median=1.1*mean? If so, the formulation " … and its coefficient of variation, which is 35 %. …" says exactly the same: The coefficient of variation (cv) of the gamma law depends on the shape parameter of the gamma law only. If that cv is (about?) 35%, the shape parameter of the gamma law is approx. 8,16 and the relation median=1.1*mean follows from cv "by definition", i.e. it does not depend on the scale parameter. The factor 1,1 and/or the cv seem to be approximate values: If cv=35% then the factor should be 1,04, i.e. median=1.04* mean?

16) 5148, 21: The specified confidence interval [60% of median-180% of median] seems to be a result of approximation, too. Exact values are [58% of median-188% of median] for cv=35%?

17) 5149, 9: Any reason for using POT instead of other methods (for instance "classical" Gumbel-approach)? See comment 22), too.

18) 5149, 18: Simulations for 4 weather stations. Why 4 stations? Results similar? Stations in different regions?

19) 5149, 21: Cv is " … about 15% … " means, that 15% is an approximation. Why do you use this approx. here. The exact value seems to be 17% in order to be in agreement with the simple rule specified thereafter: " … [79% of the "calculated value"–141% of the "calculated value"] …". As far as I can see it, you do not use cv=15% anymore. Or *is* cv=15% and the limits of the "simple rule" are adjusted in order to "fulfill" the "conditions" regarding ISO ice classes (see line 25 and thereafter)?

20) 5154, 26: 2,6 kgm^{-1}*1,1=2,86 kgm^{-1}≈2,8 kgm^{-1} ?
21) 5155, 1: 2,6 kgm^{-1}*[0,79 to 1,41]=[2,05 to 3,67 kgm^{-1}] ≈[2,0 to 3,6 kgm^{-1}]?
22) 5155, 8: What's the advantage of using POT instead of other methods (for instance "classical" Gumbel-approach)? You get the same "amount" of data as for Gumbel, i.e. no additional values (that's the most common explanation/advantage of using POT instead of other methods). Maybe it is just the simple fact, that in some years there are no wet snow events, i.e. the application of Gumbel for instance would bear a conceptual problem? Does POT "solve" this problem?
23) 5155, 13: " … such a value, which has been associated with a real noticeable event (one 225 kV collapsed tower and a dozen of 400 kV damaged 15 towers) is more than extremely rare. …" How do you decide, that " … such a value … is extremely rare … " out from a (limited) data set of observations and measurements? To ask the other way around: What is the basis for the assumption, that the data (observations, measurements, damages) just reflect e real rare event?
    The concept has been used in the backround document by Sanpaolesi (1998). It is still under discussion by the community, see Sadovský et al. (2012) and Kasperski (2014), for instance. Kasperski (2014), for instance, notes: " … Without considering a consistent strategy in regard to uncertainties in confined sets of observations, the background document to the Eurocode recommends the general approach to neglect exceptional observations for the specification of the characteristic value. […] Strictly speaking, the exceedance probability of such a limiting value depends on the type of probability distribution and the variation coefficient …" Sanpaolesi (1998) used the Gumbel distribution for their analysis.
    To make it more clear: The concept may be used because it is mentioned and has been used in/for the Eurocode. Maybe it is a good idea to point out more clearly, that it is under discussion and may imply additional uncertainties.
24) 5156, 3: " … It is suggested to use the above criterion only when the exceptional aspect of the value can be checked, i.e. according to a real event database, as in the case of the exceptional Lille event of March 2012. …" cp. Comment 23)
25) 5156, 6: Any chance to compare the results to Admirat (2008)? Are the consistent to each other? (At least the maps of wet-snow events are similar. The values are valid for different return periods. Any chance to compare them?)

Technical corrections

Structure of comments: Page, Line: "Citation (if necessary)", proposed correction

1) 5146, 6: " … velocity is *bigger* than 1ms^{-1} … ", greater than ?
2) 5146, 3: " … of snowflakes (Böhm, 19*99*; …", of snowflakes (Böhm, 1989;
3) 5146, 7: " … Based on the work of Yuter et al. (2006) *and* Nygaard et al. (2013a) set Vt to 1.7ms^{-1} …", … Based on the work of Yuter et al. (2006), Nygaard et al. (2013a) set Vt to 1.7ms^{-1} …
4) 5146, 13 (and thereafter): " … given in WMO report no.67 (1998) …", either add WMO (1998) to references or cite as Goodison et al. (1998)
5) 5148, 14: " … a gamma *law* whose median value …". a gamma distribution whose median value
6) 5148, 12: "which is 1.1 greater than its median value …", … which is 1.1 times greater than its median value …
7) 5149, 19: " … represented by a normal law whose … ", … represented by a normal distribution whose …
8) 5151, 18: " … wet-snow events in plains since …", … wet-snow events in specific plains since …
9) 5152, 18: " … in areas *slightly* above 500 m. …", … in areas above 500 m. …" (this depends on the point of view …)
10) 5153, 19: " … to check if the *criterion* proposed in … ",to check if the criteria 20 proposed in
11) 5161, Table1: maybe it is a good idea to add a "totals" line, chapter 4.3 would be easier to read
12) 5168, Figure 3: Please enlarge numbers and text.
13) 5170, Figure 5: Please improve figure quality.

References

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