Figure S1. Example of time series of daily insurance loss per person (in NOK, 2015 values) for an arbitrary municipality.
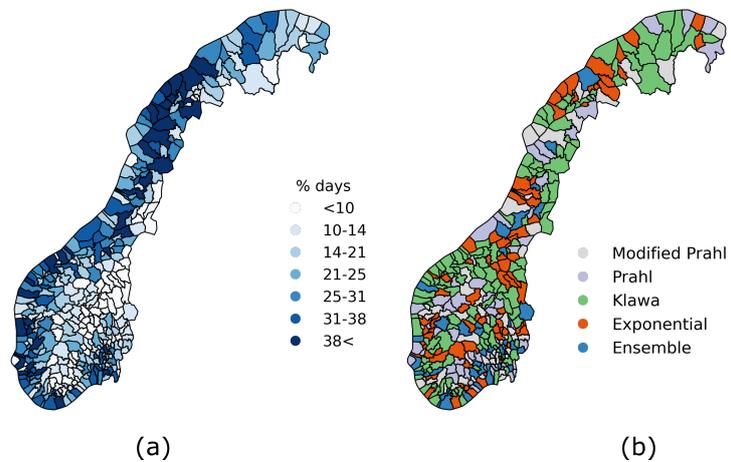

Figure S2. (a) Map showing the proportion of non-zero loss days above the 98th percentile wind speed in all Norwegian municipalities, (b) map indicating which models show the smallest MAE.
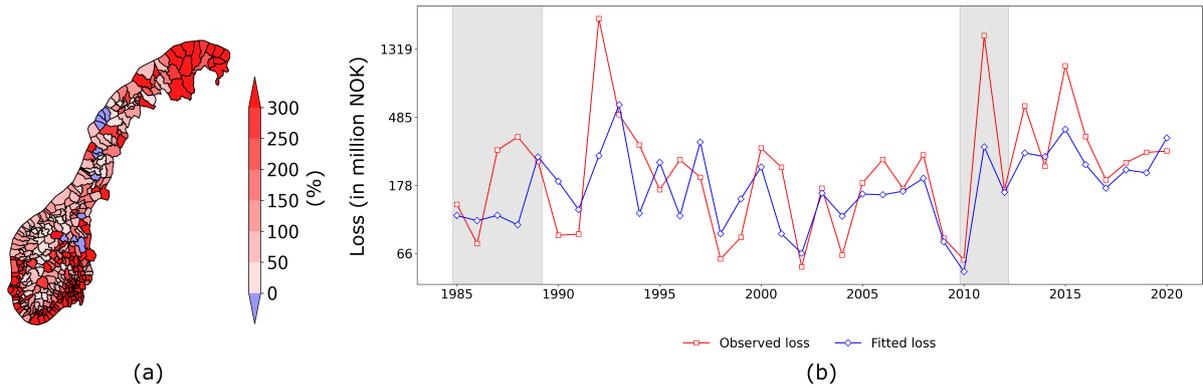
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Figure S3. (a) Relative difference in the smallest MAE of storm damage functions fitted at municipality and national level, (b) annually-aggregated national losses using all the loss days from the insurance data (red line) along with the annual national loss estimates (blue line), which are the sum of each municipality's best-performing-model estimate. Note that the y-axis is logarithmic, and the shaded region represents the testing period.
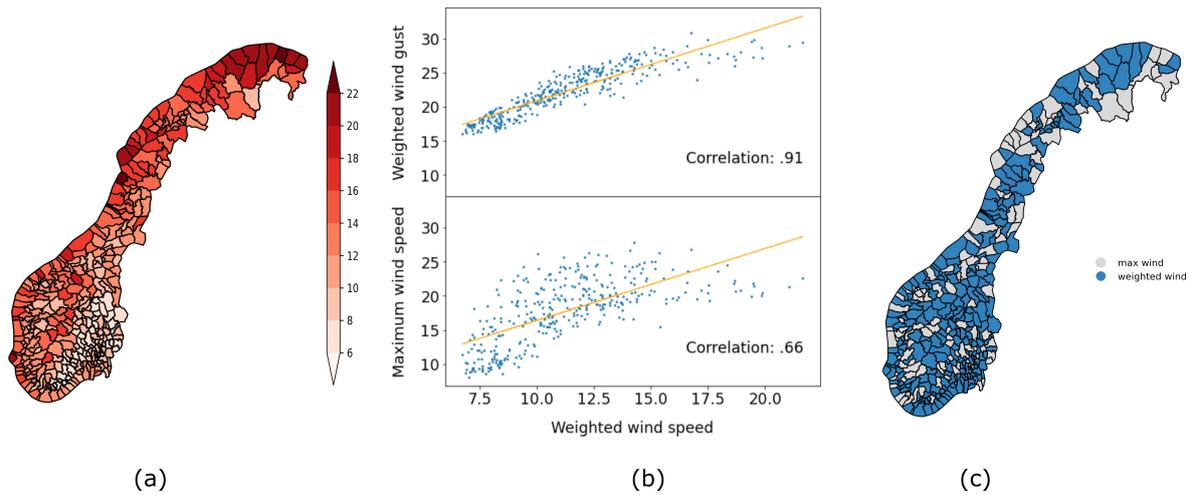

Figure S4. (a) Map showing the 98th percentile of the population-weighted daily maximum wind speed for each municipality for the period 1985-2020. (b) Spatial correlations between the 98th percentile of the population-weighted daily maximum wind speed and the 98th percentile of the population-weighted daily wind gust (top) and the 98th percentile of the daily maximum wind speed (bottom) and (c) municipalities with smallest CV among the five models with weighted and maximum wind speeds on test data. Municipalities in grey (blue) are where maximum (weighted) wind speed shows the lowest CV.
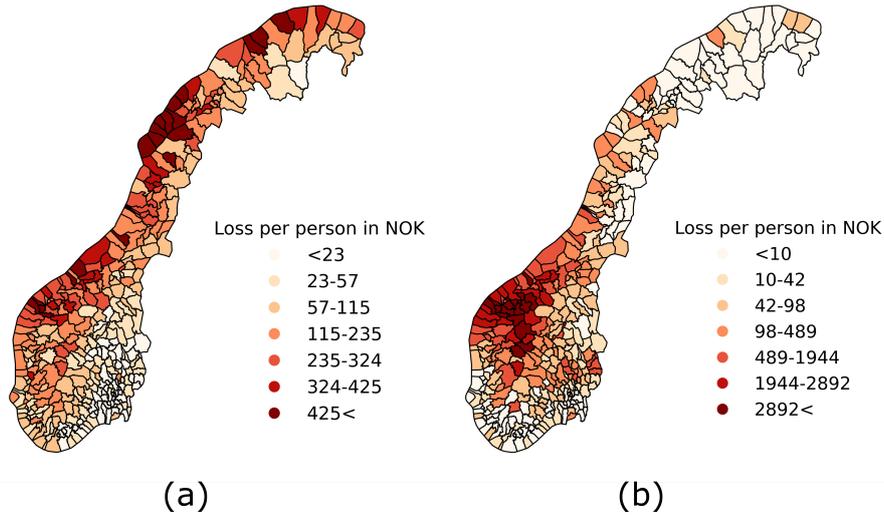
Figure S5. Maps of Norway showing (a) the annual average loss per person in each municipality during the study period 1985-2020 and (b) the average loss per person in each municipality caused by the storm Dagmar (25.12.2011-27.12.2011). To account for the skewness involved in the loss data and for meaningful visualization, the loss is split non-linearly with class boundaries at the 20th, 40th, 60th, 80th, 90th and 95th percentiles.
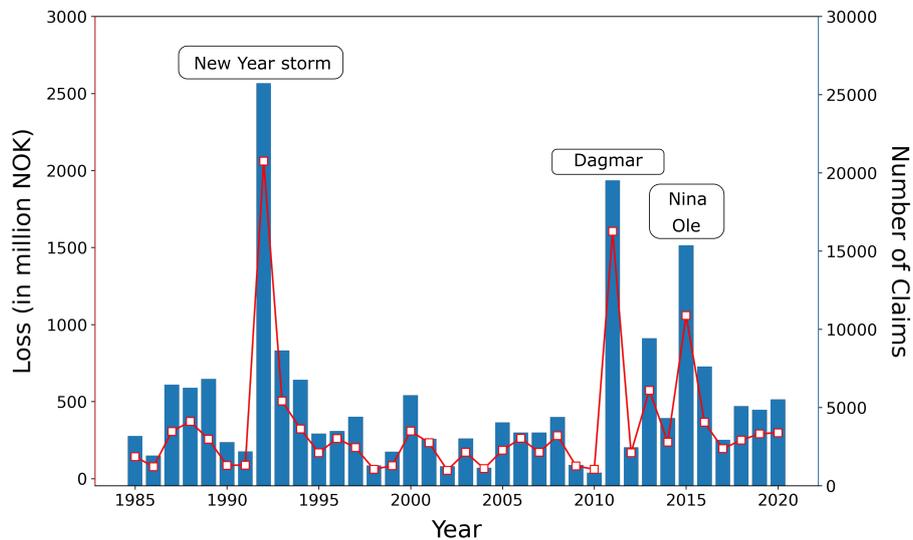

Figure S6. Annual number of insurance claims (blue bars) and monetary losses (red line, 2015 inflation-adjusted) associated with strong wind events in Norway from 1985 to 2020.
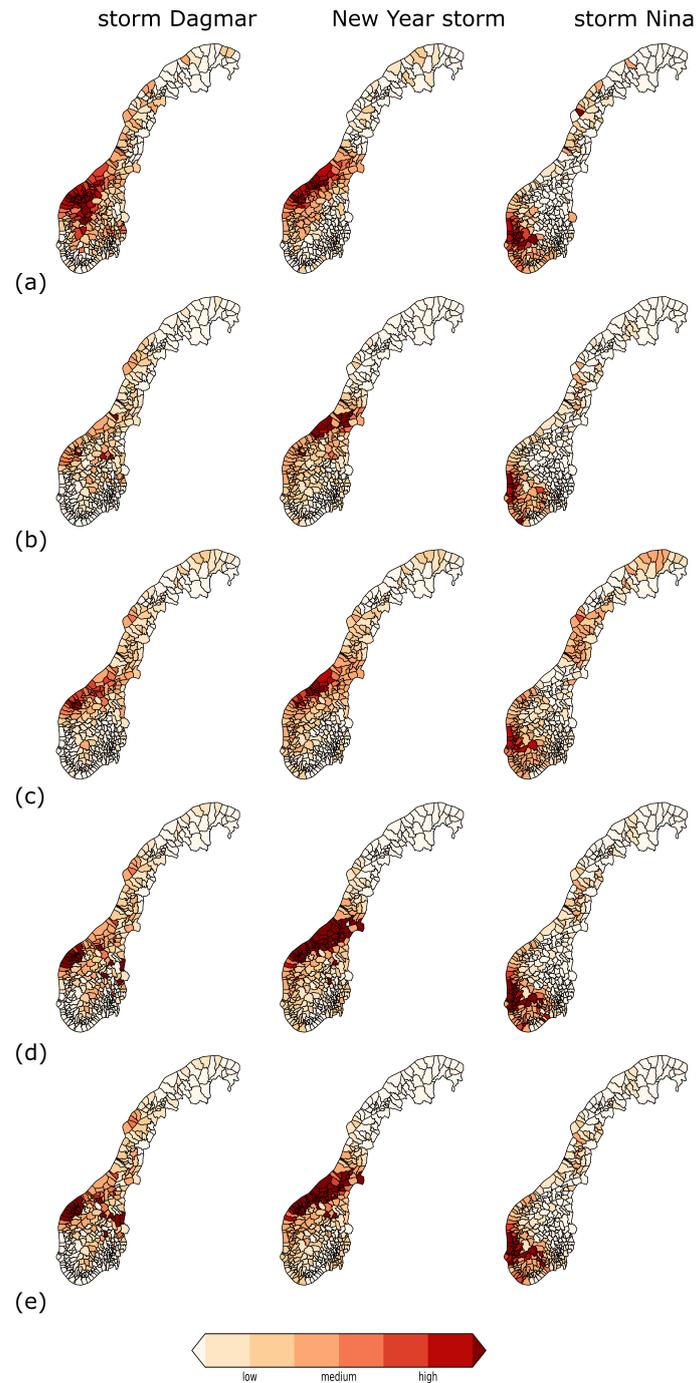
Figure S7. Spatial patterns of observed and estimated losses for the three most damaging events, where (a) display the observed losses and (b), (c), (d) and (e) are their estimates from the exponential, Klawa, modified Prahl and Prahl models respectively. The class boundaries of the colour bar are the 20th, 40th, 60th, 80th, 85th, 90th and 95th percentiles of the observed losses of their respective events. Table S2 shows the spatial correlations between observed and estimated losses.
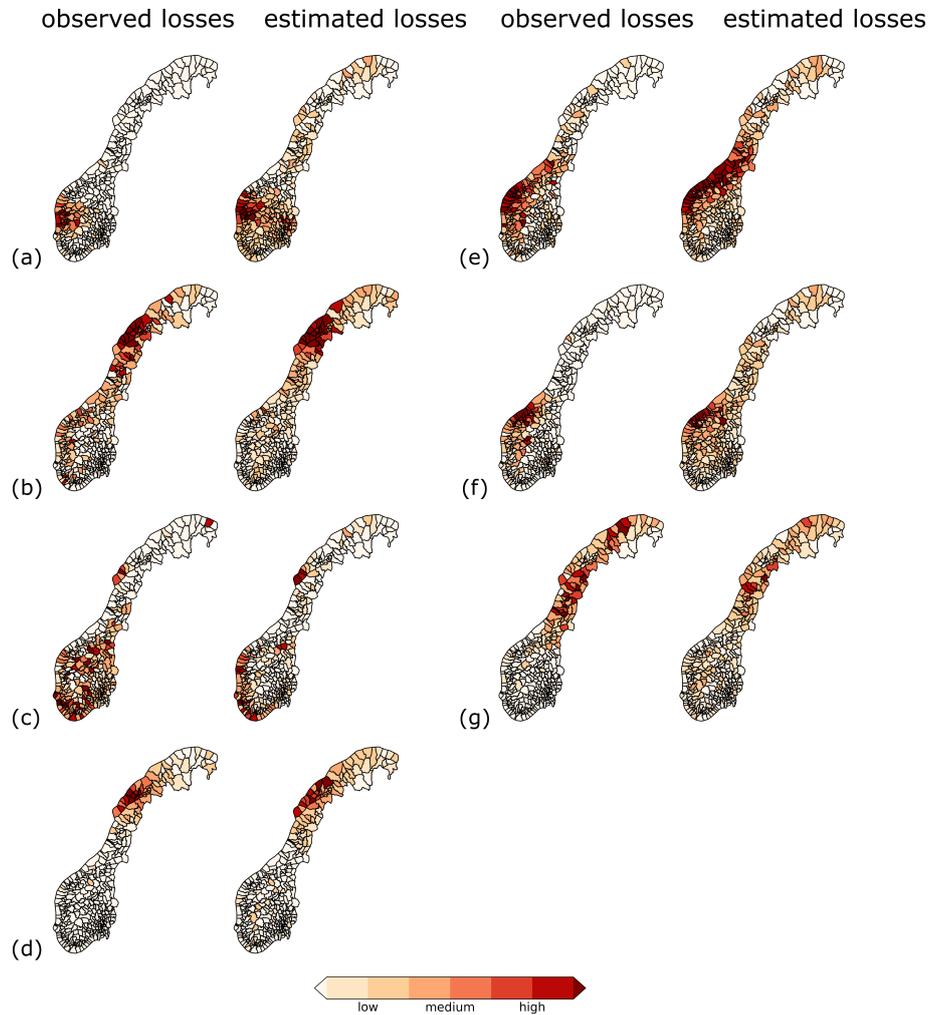
Figure S8. Spatial patterns of observed and estimated losses from the closest model to the observed loss for seven damaging events, where the panels represent (a) storm of 1994, (b) storm Ole, (c) storm of 1987, (d) storm Frode, (e) storm Tor, (f) storm of 1988 and (g) storm Narve. The Spearman rank correlation between observed and estimated losses of events are 0.46, 0.45, 0.44, 0.56, 0.51, 0.43 and 0.50 respectively. The class boundaries of the colour bar are the 20th, 40th, 60th, 80th, 85th, 90th and 95th percentiles of the observed losses of their respective events.
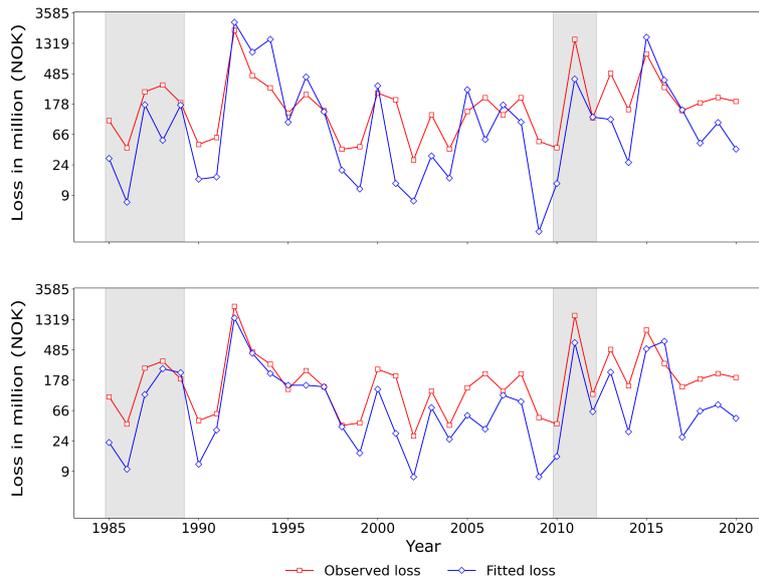
Figure S9. Annual time series of observed and estimated national losses for the extreme loss class from the deterministic exponential model (top) and deterministic model by Klawa (bottom). Note that the y-axis is logarithmic and the shaded region represents the testing period.
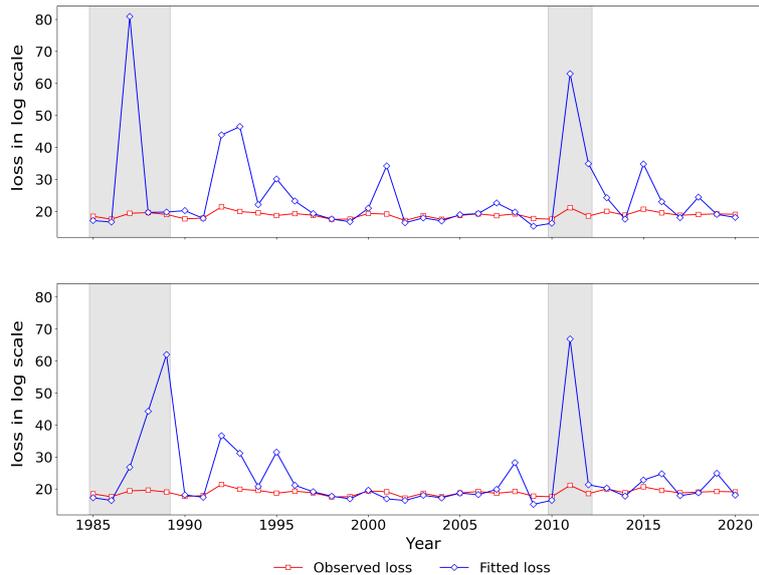

Figure S10. Same as Fig. S9 but using the probabilistic models: modified Prahl model (top) and model by Prahl (bottom). Note that the y-axis is logarithmic and the shaded region represents the testing period. Loss estimates from roughly 20% of the municipalities are responsible for the large margin between the observed and estimated losses.
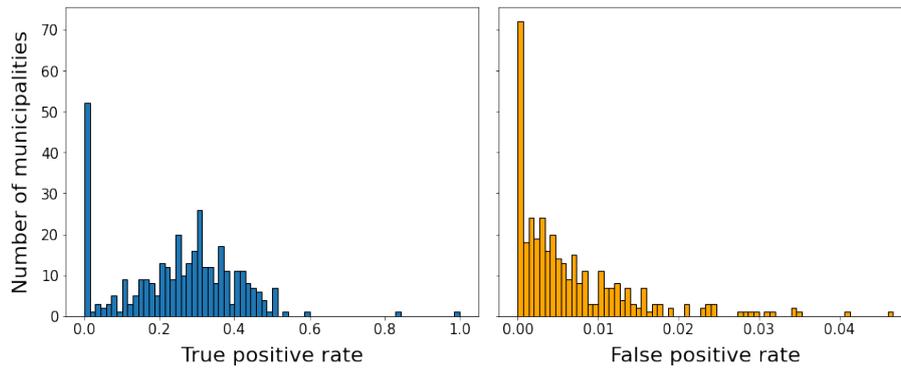
Figure S11. Distributions of the (left) true and (right) false positive rates of the damage classifier using the testing data.

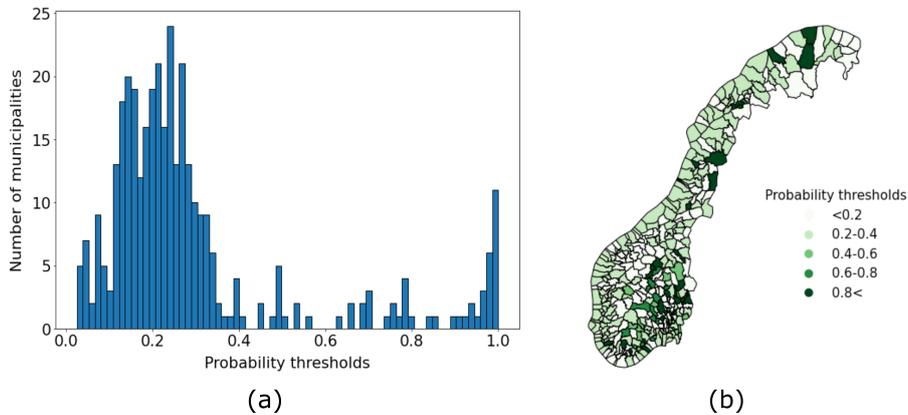(a)   (b)

Figure S12. (a) Distribution of the probability thresholds for all municipalities and (b) map of the best probability thresholds for each municipality based on precision-recall curves and F-scores.

Event	Number of claims	Loss in million NOK (2015)	Period	Region of impact
New Year storm	22823	1933	01.01.1992	Western Norway
Dagmar	14247	1274	25.12.2011 - 27.12.2011	Western Norway
Nina	9525	593	09.01.2015 - 12.01.2015	South-west Norway
Storm of 1994	5306	261	23.01.1994	South-west Norway
Ole	2418	237	07.02.2015 - 10.02.2015	West and northern Norway
Storm of 1987	5014	235	16.10.1987 - 17.10.1987	Southern Norway
Frode	2876	234	12.10.1996 - 13.10.1996	Northern Norway
Tor	3940	214	29.01.2016 - 31.01.2016	Western Norway
Storm of 1988	2853	184	22.12.1988 - 23.12.1988	Central western Norway
Narve	2080	182	17.01.2006 - 24.01.2006	Northern Norway

Table S1. Features of then most damaging storm events that occurred in Norway during the study period (1985-2020). The event periods are as defined by Norwegian Natural Perils Pool.

Damage function	New year storm	storm Dagmar	storm Nina
Exponential	0.57	0.64	0.66
Klawa	0.53	0.68	0.57
Modified Prahl	0.58	0.66	0.68
Prahl	0.58	0.67	0.67

Table S2. Spearman's rank correlation between observed and estimated losses of individual models for the three most damaging events.

Event	Accuracy (%)	Recall (%)
New Year storm	75.5	77
Dagmar	66.6	63.4
Nina	76.7	71.5
Storm of 1994	69.7	86.7
Ole	69.7	60

Table S3. Classification accuracies and recall scores for the top five damaging wind events in Norway ordered with decreasing monetary loss (see Table S1). The accuracy column shows the proportion of municipalities in which the damage classifier accurately predicts both the events and non-events. Recall scores indicate the proportion of municipalities where the damage classifier was able to predict an event that actually occurred.