

User needs for extreme wind information in the forest, insurance and offshore energy sectors

To be able to tailor extreme wind information in order to address the needs of various end-users, a synthesised understanding summarizing these needs is required. In this article we summarize the user needs for extreme wind information in the forestry, insurance and offshore energy sectors. For the offshore energy, wave risk information needs are also included.

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Extreme winds pose major risks to life, property and forestry, while extreme ocean waves can impact on offshore infrastructures and coastal communities. In the ERA4CS project “WIND and wave Scenarios, Uncertainty and climate Risk assessments for Forestry, Energy and Reinsurance” (WINDSURFER), the consortium partners have co-developed new methods, tools and assessments of extreme wind and wave risk with a focus on the selected three key sectors: insurance, forestry and offshore energy. This article summarizes the user needs identified in the project for extreme wind information in these three key sectors. For the offshore energy, wave risk information needs are also included.

Forestry. Wind is the dominant abiotic cause of forest damages in Europe (Seidl et al. 2014; Reyer et al. 2017; Gregow et al. 2017). The mapping of user needs for the forestry sector was done as an outcome of a stakeholder workshop that was held as a part of the project “Sustainable, climate-neutral and resource-efficient forest-based bioeconomy” (FORBIO) (<https://www.uef.fi/web/forbio>). The identified forestry sector’s needs for meteorological and climate data consists of: a) forecasts and warnings which include information on sustained and gust wind speed and wind direction with spatial resolution of EU NUTS 3 (<https://ec.europa.eu/eurostat/web/nuts/background>) or higher. Forecasts should: a) contain information

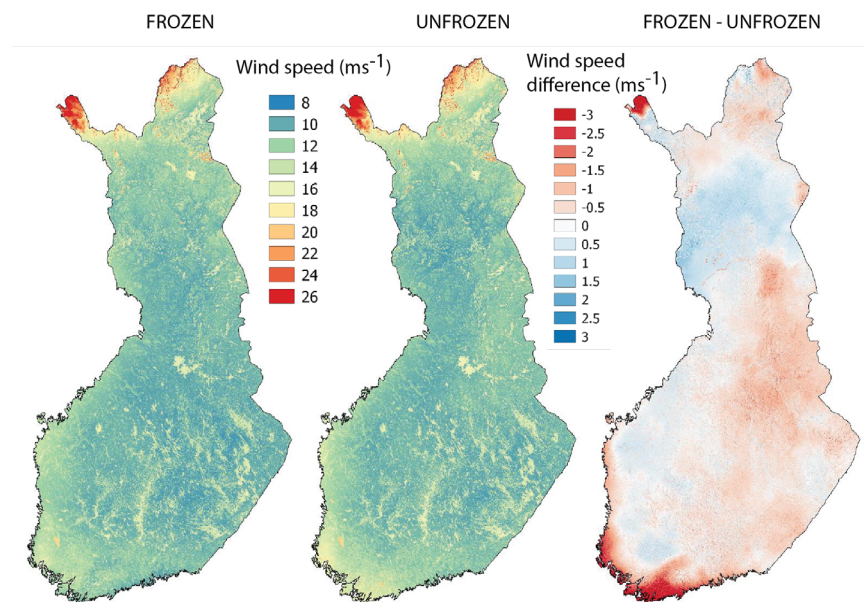


FIG 1: 10-year return levels of maximum wind speed (m s^{-1}) during period of frozen (left) and unfrozen (middle) soil in pine forests growing on peatlands. The difference between the two maps (FROZEN-UNFROZEN) is shown on the right. Adapted from Laapas et al., (2019).

about the reliability (skill) of the forecast, b) an estimate about the possible magnitude of damage caused by the (forecasted) storm, c) climate scenarios that cover both near future and extend until the end of this century, and include information on the possible change in extreme wind speeds and possible change of prevailing wind direction, d) climate scenarios should include information also on other factors

such as soil frost and soil wetness which influence wind throw risk, e) information on the occurrence, frequency and strength of past storms during the recent decades and openly available high spatial resolution GIS datasets, for example, depicting 10-year return level of maximum wind speed under frozen and unfrozen soil conditions (Fig. 1). The skill of forecast varies from a weather condition to another. In item a) mentioned

needs to have an estimate about the forecast skill that can be understood and that the forecaster includes it into the forecasts an estimate about the possibility to make accurate forecasts under the prevailing weather conditions.

Insurance sector. The damage to infrastructure, property and life from damaging windstorms still account for the largest sources of insurance loss in Europe. For example, the three windstorms (Anatol, Lothar, Martin) that struck in Dec 1999 inflicted €18 billion of insured losses to property and infrastructure across Europe. To better assess the risks from European Windstorms, the insurance sector requires improved information to assess windstorm risk. The results for the insurance sector are based on the understanding gained in the Copernicus Climate Change Services (C3S) SECTEUR project on user needs for Climate Services. For insurance, the primary need for information is for European Windstorm risk, especially spatial maps of maximum wind gusts for major historical storms. This is for assessing wind damage and/or for evaluating industry pricing models (known as ‘catastrophe models’). There is a growing need for information on climate change and insurance risk, which is largely driven by financial regulators (such as the Bank of England for the London market).

Energy sector and offshore infrastructures. Extreme waves driven by strong winds can have substantial impacts on the energy sector and offshore infrastructures. For example, a windstorm on 12 December 1990 generated a significant wave height of about 12 m in the central North Sea (close to the 100-year return level), causing extensive damage on the Ekofisk platforms. Estimating the probabilities of extreme wind and wave events requires observations to be supplemented or combined with atmospheric and wave models, such as the recently completed NORA10EI wind and wave hindcast (see Fig. 2, from Haakenstad

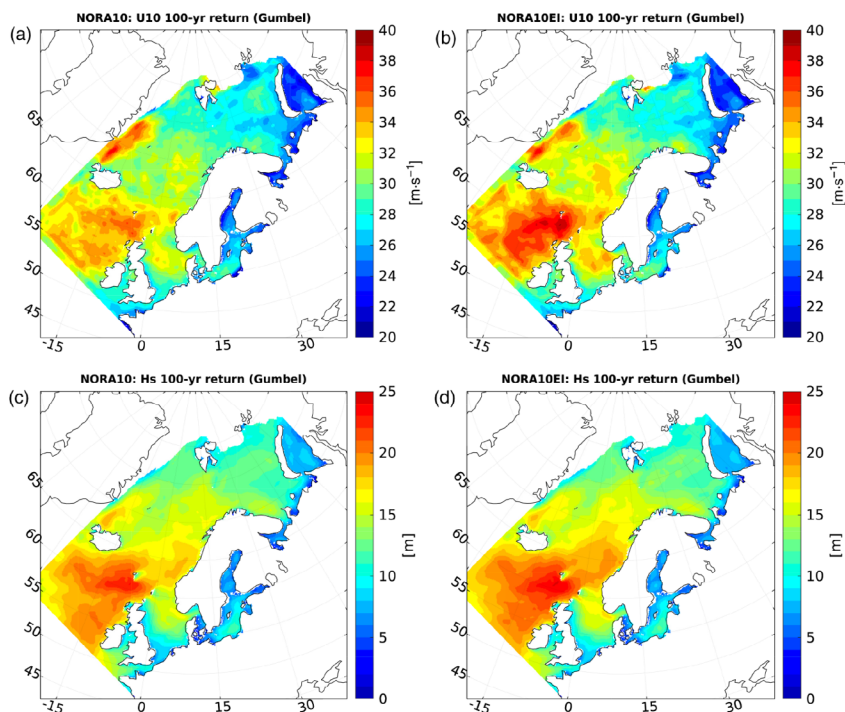


FIG 2: Map of 100-year return values of 10-m wind speed (upper panels) and significant wave height (lower panels) for the period 1979–2017. Estimated based on NORA10 are shown on the left, panels (a) and (c). The corresponding estimates for NORA10EI are found on the right, panels (b) and (d). The NORA10EI based estimates are higher than the NORA10 (Reistad et al., 2011) estimates, particularly in wind speed (up to 5 m s^{-1} difference), less so in significant wave height. Adapted from Haakenstad et al., (2020).

et al., 2020). Here we compare the 100-year return values of NORA10EI (Haakenstad et al., 2020) with the older NORA10 hindcast (Reistad et al., 2011), the former funded by WINDSURFER. NORA10EI uses ERA-Interim on the boundaries for consistent forcing (Dee et al., 2011). The differences are generally quite modest, except for the region south of the Faroe Islands (where the 100-year return estimate of the wind speed is 5 m s^{-1} higher), but it is clear that the choice of boundary and initial conditions can significantly influence the return values from high-resolution hindcasts. In the case of offshore energy, return levels of extreme events with very low probabilities (long return periods) are essential in-

formation. Regulators and owners require consideration of 1,00-year to 10,000-year events. Hindcasts and reanalyses are useful for these calculations as the relatively short observational time series available hinder calculation of robust estimates for such extreme events. One can also consider using simulated cases, e.g. a large ensemble of climate model simulations to expand the available amount of data (Breivik et al., 2014, Meucci et al., 2018).

Acknowledgements: We thank Strategic Research Council of the Academy of Finland project Forbio (project number 314224), and the ERA4CS Windsurfer project. ØB is grateful to Equinor for additional funding of the offshore hindcast archives.

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