INDEPENDENT INSULATION GROUP

Report R19-1018-02 Rev 01

Feasibility of using Satellite Data to predict Insulator Pollution Levels

Report 2: Modelling and comparisson of results

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Revision history

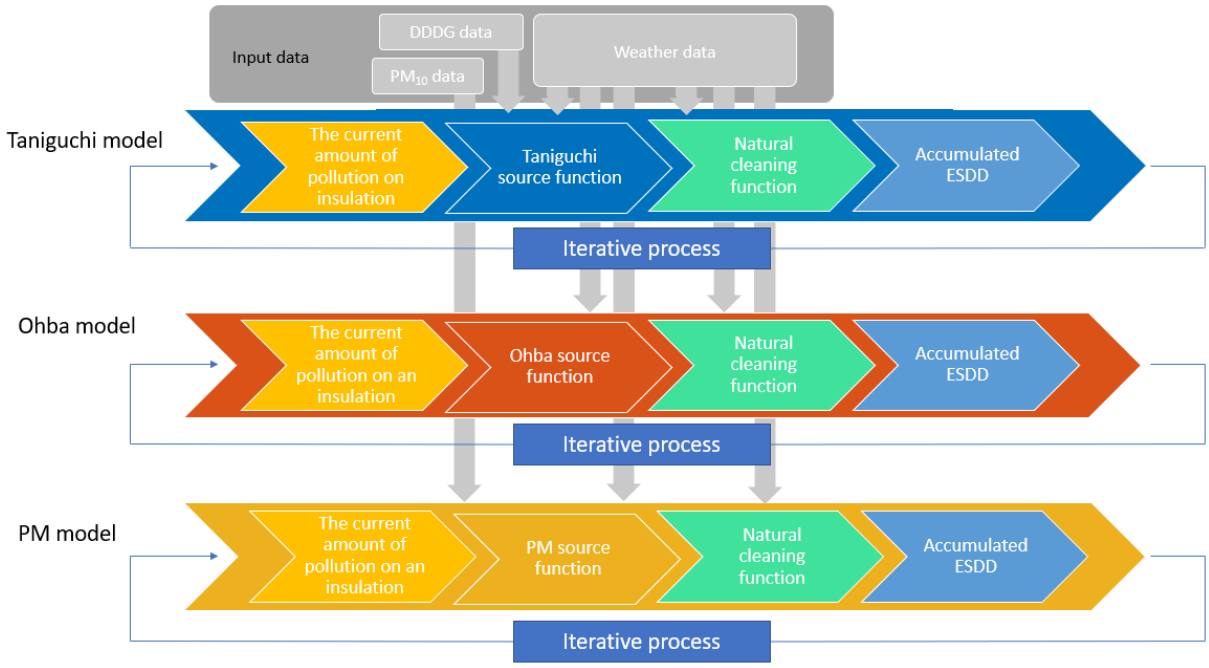
Date	Revision	Description
2019-05-22	1	Minor changes in of text in Summary and Conclusion.

Summary

Statnett actively builds new overhead lines and upgrades older ones. The dominating source of pollution at Statnett are salts originating from the sea. Thus, in case the overhead lines are closer to the coastal area (taking into account that strong wind can transport salts to quite a distance inland), statistical insulation selection is an optimal option. The statistical selection requires two main input parameters, i.e. pollution stress in the form of design pollution level and pollution flashover performance curves for the insulator in question.

The main goal of this project was to provide best possible estimation of design pollution levels using advanced weather modelling, ground-based and satellite-based data and to compare the results with the conclusions from earlier investigations. These were based on Directional Dust Deposit Gauges (DDDG), which were then converted into Design ESDD (Equivalent Salt Deposit Density). The design ESDD levels obtained earlier for eleven sites were used for comparison with the same levels obtained using three different approaches/models developed in this project.

Three models intended to calculate design pollution levels all using mesoscale based weather data has been developed. Each model uses the unique pollution source function and common natural cleaning function as illustrated below.

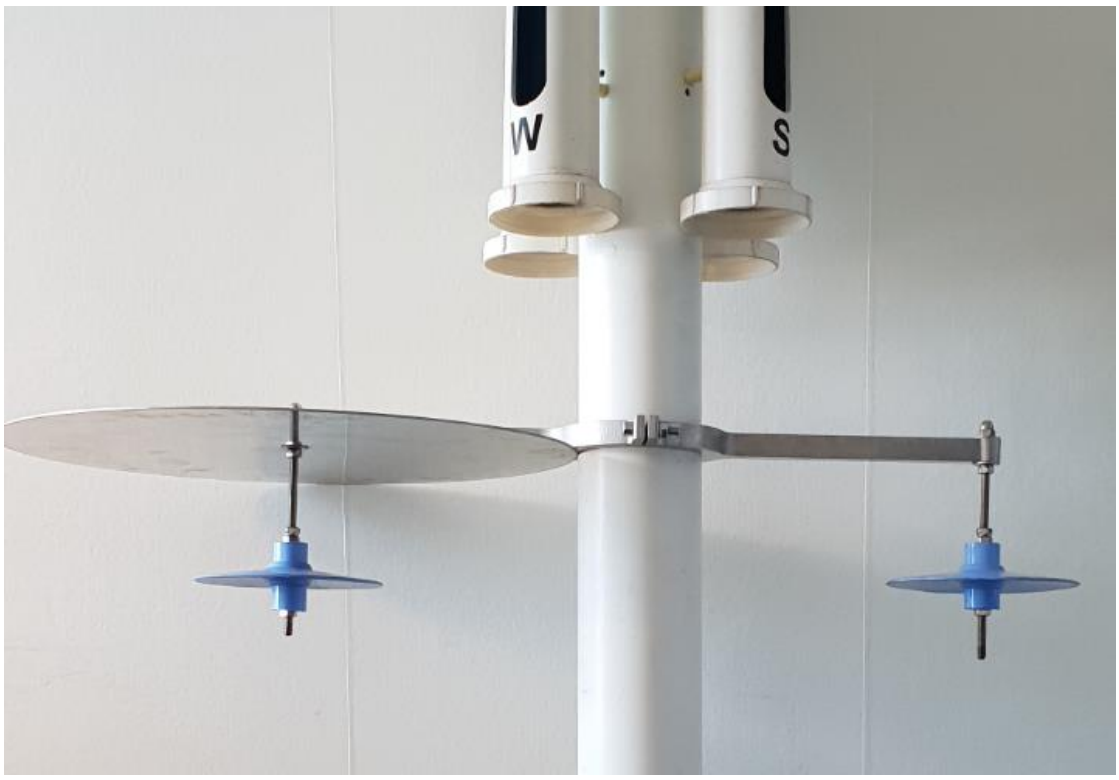


The results showed that the Ohba and PM models provided the most accurate results compared to the earlier obtained Design ESDD. The standard deviation was 0,03 mg/cm^2 for the PM model; 0,05 mg/cm^2 for the Ohba model and 0,06 mg/cm^2 for the Taniguchi model. The Ohba and PM models also provided the most accurate results if comparing with the monthly maximum DDDG measurements. This made these two models promising for further evaluation because they provide the results without any actual site measurements such as the DDDG. Thus, they are also promising for the creation of complete pollution maps of larger areas. The missing comparison for so far is the verification using actual ESDD measurements, only DDDG measurements were available from earlier investigations.

The use of satellite AOD measurement is not suitable for estimation of salt pollution on insulators due to the following:

- The amount of sea salt, which is the main pollutant in Norway, cannot directly be resolved from AOD measurement.
- The AOD sampling rate is low and limited to the conditions of clear sky, no snow cover and daylight.

It is recommended to perform a solid verification of the Ohba and PM models by actual ESDD measurements on real insulators in the area, where some suspected pollution outages took place. This can be done using a set of modified DDDG as per below, which combine DDDG measurements with direct ESDD measurements with/without simulation of natural cleaning.



It is also recommended to investigate the feasibility of using an advanced chemical transport model for direct calculation of the salt concentration in air. This would remove errors associated with the converting PM_{10} into salt concentration in air. The EMEP model developed by Meteorological institute (MET) of Norway was found as an open source and thus can be considered as the first option but requires discussions with experts from MET.