

**Wind, Ice and Snow Load Impacts on Infrastructure and the Natural Environment.
(Researcher project - KLIMAFORSK)**

Application Number: ES543685 Project Number: -1

Applicant

Project Owner

Institution / company (Norwegian name)	METEOROLOGISK INSTITUTT
Faculty	
Institute	
Department	
Address	Postboks 43 BLINDERN
Postal code	0313
City	OSLO
Country	Norge
E-mail	post@met.no
Website	met.no/
Enterprise number	971274042
eAdministration	

Project administrator

First name	Øystein
Last name	Hov
Position/title	Forskningsdirektør
Phone	22963360
E-mail	oystein.hov@met.no
Confirmation	4 The application has been approved by the Project Owner

Project manager

First name	Harold
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Last name	Mc Innes
Institution / company (Norwegian name)	Meteorologisk institutt
Faculty	
Institute	
Department	
Address	P.O.Box 43, Blindern
Postal code	0313
City	Oslo
Country	Norway
Position/title	Research Scientist
Academic degree	PhD
Preferred language	English
Phone	22963187
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Project info

Project title

Project title	Wind, Ice and Snow Load Impacts on Infrastructure and the Natural Environment.
Project title (alternative language)	Vind, is og snølaste sin påvirkning på infrastruktur og miljø

Primary and secondary objectives of the project

Primary and secondary objectives	<p>Main objective: To quantify climate change impact on technical infrastructure and the natural environment caused by strong winds, icing and wet snow.</p> <p>Sub-objectives: -To improve the description of cloud microphysical processes of importance for simulating atmospheric icing. -To quantitatively assess future wind and ice design loads on electric transmission lines in different geographical regions in Norway. -To establish risk assessment models for weather hazard induced damages on forests.</p>
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Project summary

Project summary

Strong winds, atmospheric icing and heavy snowfall are weather phenomena that can cause severe damage to technical infrastructure such as the electric power grid as well as natural environments such as forests. The objective of WISLINE is to improve predictions and design values of atmospheric icing, heavy snowfall and damaging winds in the current climate, and to provide quantitative estimates of changes in these parameters in the future, for evaluating the changing risks of forest wind throw and disruption of technical infrastructures, in particular the electric power grid. In order to meet this objective, the project will: 1) Improve the description of physical processes in the atmospheric models, enabling a better quantification of icing and heavy snowfall events; 2) Establish improved post-processing and bias-correction methods for better assessment of icing and damaging winds. That will serve as input to impact models for analysis of icing on electricity transmission lines and wind-throw and breakage in forest stands in a future climate. 3) Apply the improved physical parameterizations, post-processing tools and bias correction methods, carry out high-resolution simulations of icing conditions and damaging winds in future climates; 4) Develop post-processing tools that can enable users to make better decisions with respect to future weather challenges. All datasets and results of WISLINE will be open to end-users (scientists, forestry management, infrastructure owners, planners, and the public). Open access to data will be made available through data distribution systems operated by MET in order to support public and private sectors to adapt to climate change. MET Norway will through its core mandate, extend the results demonstrated in the project into its base datasets for current and future climate in Norway.

Popular science presentation (written in English)

In January 1998 atmospheric icing made extensive damage to the power network in eastern Canada and left approximately two million people without electricity. On 26 December 2011 the storm Dagmar hit Norway, damaging vast areas of forest in southern Norway and causing insurance payouts of approximately 60 millions NOK. While accurate weather forecasts are essential for protecting life and property against dangerous weather events, design of technical infrastructure and long term planning with respect to wind, ice and snow loads require knowledge about both present and future climate.

The WISLINE project will focus on wind, icing and wet snow since the most extensive damage often is caused by a combination of these loads. WISLINE aims to improve methods for estimating wind, ice and snow by developing models and verifying them against real life data. The project will especially focus on atmospheric icing on overhead power lines and wind and snow damage to forests as these phenomena occur relatively frequently in Norway. Data from the network of weather stations, observations of icing on a 420 kV power line in Hardanger in western Norway and data from a Norwegian forest damage database provide data that will be used for

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	<p>verification. The next step will then be to describe these loads in future climate by applying the methods on data from climate models.</p> <p>The main objective of WISLINE is to bring insight into how climate loads will change in a future climate, and produce tools and datasets available for scientists, planners and other stakeholders. This is of great importance to the society as large investments in technical infrastructure are currently being planned, e.g. the Norwegian main grid of power transmission lines will during the next ten years be upgraded for 50 to 70 billions of kroner. The knowledge, methods and data from WISLINE will support design of infrastructure and protection of environment in a changing climate.</p>
<p>Popular science presentation (written in Norwegian)</p>	<p>I januar 1998 mistet mer enn 2 millioner innbyggere strømmen i den østlige delen av Canada da tunge islaster gjorde enorm skade på kraftledningsnett. Sterk vind og snø kan også gjøre skade på skog. Den 26. desember 2011 ble Norge truffet av uværssystemet Dagmar som blant annet ødela store mengder skog. Dette medførte forsikringsutbetalinger i størrelsesorden 60 millioner kroner.</p> <p>Skader som påføres av været kan imidlertid forebygges. Mens presise værvarsler er essensielt for å beskytte liv og verdier mot farlig vær, er dimensjonering av teknisk infrastruktur og planlegging på lang sikt avhengig av omfattende kunnskap om både eksisterende og fremtidig klima. Prosjektet WISLINE vil ha fokus på vind, is og våt snø siden de mest omfattende skadene ofte er knyttet til en kombinasjon av disse klimalastene. WISLINE sitt mål er å forbedre metoden for å vurdere is, vind og snølast. </p> <p>Prosjektet vil ha fokus på ising på høyspentledninger samt vind og snøskade på skog siden dette forekommer relativt ofte i Norge. Observasjoner fra værstasjoner, målinger av is på kraftledning på Ålvikfjellet i Hardanger og skogskade data vil bli brukt til å sikre at modeller gir realistiske estimater av vind, is og snølast i dagens klima. Neste steg blir å beskrive klimalastene i et fremtidig klima ved å bruke denne metodikken på data fra klimamodeller.</p> <p>WISLINE vil gi innsikt i hvordan klimalaster som vind, is og snø vil endre seg mot et fremtidig klima, samt metodikk og data som blir tilgjengelig for forskere, planleggere og andre interessenter. Dette er av stor betydning for samfunnet siden store investeringer i infrastruktur er under planlegging. For eksempel planlegges det en oppgradering av det sentrale kraftnettet til en sum av 50 til 70 milliarder kroner. Kunnskapen som oppnås gjennom WISLINE vil sammen med metodikk og datasett støtte opp under dimensjonering av teknisk infrastruktur samt bidra til å sikre naturmiljø som skog.</p>
<p>Publication</p>	<p>4 I understand and accept that the text provided in the fields for "Popular science presentation" will be made publicly</p>

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available.

Funding scheme

Supplementary info from applicant

Programme / activity	KLIMAFORSK
Application type	Researcher project
Topics	
Other relevant programmes/ activities/projects	
Discipline(s)	Meteorology, Climatology, Forestry
If applying for additional funding, specify project number	
Have any related applications been submitted to the Research Council and/or any other public funding scheme	No
If yes, please provide further information	

Progress plan

Project period

From date	20150101
To date	20181231

Main activities and milestones in the project period (year and quarter)

Milestones throughout the project	From		To	
WP2.1	2015	2	2015	3
WP3.2.1	2015	2	2016	4
WP3.2.2	2015	2	2018	2
WP4.1	2015	2	2016	4

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WP1.1	2015	3	2016	2
WP1.2	2015	3	2016	4
WP1.3	2015	3	2017	2
WP1.4	2015	3	2016	3
WP5.1	2015	3	2018	4
WP2.3	2015	4	2016	1
WP2.4	2015	4	2016	1
WP2.5	2015	4	2016	1
WP2.6	2015	4	2016	3
WP3.1.1	2016	1	2017	4
WP3.1.2	2016	3	2018	4
WP2.2	2016	4	2017	1
WP4.2	2016	4	2017	4
WP3.1.3	2017	1	2018	4
WP3.2.3	2017	1	2018	4
WP3.2.4	2017	1	2018	4
WP3.1.4	2017	3	2018	4
WP4.3	2017	4	2018	2
WP4.4	2017	4	2018	3
WP4.5	2018	1	2018	4

Dissemination of project results

Dissemination plan

All datasets and results of WISLINE will be open to end-users as described in the project plan (WP5).

WISLINE intends to have close contact with users within the targeted impact studies described in WP3 and WP4. For this purpose a user contact group will be set up to communicate results and to get user feedback.

The project plans to submit at least 5 papers, of which the first three are a part of the PhD. Tentative topics(titles) are:

Paper 1: A comparison of the performance of (i) the current AROME microphysics scheme; (ii) the revised AROME microphysics scheme; (iii) the

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Thompson scheme; all running in AROME - against validating observations of icing events (subm. month 30)
 Paper 2: A present-day icing climatology for Norway, based on simulations with the improved AROME (subm. month 36)
 Paper 3: A future icing climatology for Norway for the years 2060-2070 using the improved AROME combined with downscaled output from CMIP5 21st century runs with NorESM (submit month 42)
 Paper 4: Modelling snow and wind damage risks on forests. (submit month 46)
 Paper 5: The application of downscaling techniques of extreme winds in complex terrain in Norway (Submit month 45)

Budget

Cost plan (in NOK 1000)

	2015	2016	2017	2018	2019	2020	2021	2022	Sum
Payroll and indirect expenses	1620	2725	2740	1918					9003
Procurement of R&D services									0
Equipment									0
Other operating expenses									0
<i>Totals</i>	1620	2725	2740	1918					9003

Specification

Cost code (in NOK 1000)

	2015	2016	2017	2018	2019	2020	2021	2022	Sum
Trade and industry	180	270	280	198					928
Independent research institute	1150	2045	2050	1430					6675
Universities and University Colleges	130	180	180	130					620

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	2015	2016	2017	2018	2019	2020	2021	2022	Sum
Other sectors									0
Abroad	160	230	230	160					780
<i>Totals</i>	1620	2725	2740	1918					9003

Funding plan (in NOK 1000)

	2015	2016	2017	2018	2019	2020	2021	2022	Sum
Own financing	335	851	844	473					2503
International funding									0
Other public funding									0
Other private funding									0
From Research Council	1285	1874	1896	1445					6500
<i>Totals</i>	1620	2725	2740	1918					9003

	2015	2016	2017	2018	2019	2020	2021	2022	Sum
Decided by Research Council of Norway	0	0	0	0					6790
Originally applied from Research Council of Norway	1500	1900	1900	1700					7000

Specification

Person for whom a fellowship/position is being sought

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	2015	2016	2017	2018	2019	2020	2021	2022	Sum
Grants for overseas researchers									0
Researcher positions									0
Hourly-based salary including indirect costs	800	870	857	910					3437
Procurement of R&D services									0
Equipment									0
Other operating expenses									0
<i>From Research Council</i>	1285	1874	1896	1445					6500

Partners

Partners under obligation to provide professional or financial resources for the implementation of the project

1

Institution/ company	KJELLER VINDTEKNIKK AS
Department/ section	
Address	Postboks 122
Postal code	2027
City	KJELLER
Country	
Enterprise number	980037185
Contact person	Bjørn Egil Kringlebotn Nygaard
Contact tel.	
Contact e-mail	bjorn.nygaard@vindteknikk.no
Partner's role	Research activity

2

Institution/ company	NORSK INSTITUTT FOR SKOG OG LANDSKAP
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Department/ section	
Address	Postboks 115
Postal code	1431
City	ÅS
Country	
Enterprise number	970167641
Contact person	Svein Solberg
Contact tel.	
Contact e-mail	sos@skogoglandskap.no
Partner's role	Financing and Research activity

3

Institution/ company	UNIVERSITETET I OSLO
Department/ section	
Address	Postboks 1072 Blindern
Postal code	0316
City	OSLO
Country	
Enterprise number	971035854
Contact person	Jón Egill Kristjánsson
Contact tel.	
Contact e-mail	j.e.kristjansson@geo.uio.no
Partner's role	Financing and Research activity

4

Institution/ company	National Center for Atmospheric Research
Department/ section	
Address	P. O. Box 3000 Boulder CO 80307-3000
Postal code	CO 80301
City	Boulder
Country	

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Enterprise number	
Contact person	Roy Rasmussen
Contact tel.	
Contact e-mail	rasmus@ucar.edu
Partner's role	Research activity

Attachments

Project description

Filename	WISLINE_proposalNY.pdf
Reference	ES543685_001_1_Projektbeskrivelse_20150216

Curriculum vitae (CV) with list of publications

Filename	McInnes.pdf
Reference	ES535503_002_1_CV_20140902

Filename	Kristjansson.pdf
Reference	ES535503_002_2_CV_20140902

Filename	Thompson.pdf
Reference	ES535503_002_3_CV_20140902

Filename	Haugen.pdf
Reference	ES535503_002_4_CV_20140902

Filename	Solberg.pdf
Reference	ES535503_002_6_CV_20140902

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Filename	Nygaard.pdf
Reference	ES535503_002_7_CV_20140902

Filename	CV_PhD-candidate_Engdahl.pdf
Reference	ES535503_002_8_CV_20140903

Grade transcripts (Doctoral and student fellowships)

Filename
Reference

Referees

Filename
Reference

Recommendation and invitation

Filename
Reference

Confirmation from partner(s)

Filename	LoI_UiO.pdf
Reference	ES535503_008_1_AktiveSamarbeidspartnere_20140902

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Filename	LoI_NFLI.pdf
Reference	ES535503_008_2_AktiveSamarbeidspartnere_20140902

Filename	LOI_KVT.pdf
Reference	ES535503_008_3_AktiveSamarbeidspartnere_20140902

Filename	LoI_SLU.pdf
Reference	ES535503_008_4_AktiveSamarbeidspartnere_20140902

Filename	LoI_NCAR.pdf
Reference	ES535503_008_5_AktiveSamarbeidspartnere_20140902

Other items

Filename	Supportletter-Skogbrand.pdf
Reference	ES535503_010_2_Annet_20140903

Filename	Supportletter-dNk.pdf
Reference	ES535503_010_3_Annet_20140903

Filename	Support letter - Statnett.pdf
Reference	ES535503_010_5_Annet_20140903

Filename	WISLINEprogressplanNY.pdf
Reference	ES543685_010_6_Annet_20150216

