31st Nordic Meteorological Meeting – NMM31
Reykjavík, 18-20 June 2018

O1.1
Plans for surface processes and surface data assimilation in HARMONIE-AROME

Patrick Samuelsson
Swedish Meteorological and Hydrological Institute

Currently we are in total some 24 countries in Europe and Northern Africa who develop and use the ALADIN-HIRLAM NWP system. The system is applied in different configurations, i.e. different combinations of model components, but from now on most of them refer to SURFEX (Surface Externalisée, in French) for all the surface processes (land, sea, lake, town) and for surface data assimilation. The configuration used by HIRLAM is named HARMONIE-AROME.

Historically we have long experience within the HIRLAM project with surface modelling and surface data assimilation. For obvious reasons we have devoted much of our attention to forest and snow conditions over land, on lakes and on sea-ice conditions. The last release of the HIRLAM model included for example explicit canopy, i.e. the trees were given a separate energy balance, a simple 1-layer snowpack separated from the soil, a multi-layer diffusion soil scheme, sub-grid separation of forest and open land, the lake model FLake, and a simple sea-ice scheme. The data assimilation was based on Optimal Interpolation (OI).

Unfortunately, until recently, SURFEX has offered less advanced land-surface processes for operational use than HIRLAM did. Therefore, the latest official meteorological release of HARMONIE-AROME still uses Force-restore for the soil (i.e. composite vegetation-soil-snow surface with two prognostic soil temperatures), an averaged (1 patch) vegetation for the grid box, no lake model, but a bit more advanced multi-layer sea-ice scheme (SICE). However, recent development now allow us to run separated forest and open land (2 patches) and lake model FLake for the MetCoOp operational setup. On the other hand, from the beginning SURFEX has offered a Town Energy Balance model (TEB) which has been used operationally for many years now. As in the HIRLAM model, surface data assimilation is currently based on OI.

We have identified problematic behaviour of HARMONIE-AROME related to too simplified surface process description. But the future looks promising! The latest SURFEX release offers e.g. explicit canopy (inspired from HIRLAM), multi-layer snow scheme (12 layers) and multi-layer soil scheme (14 layers). Activities are now ongoing to test these options in climate mode, i.e. running HARMONIE-AROME without data assimilation, with the ambition to reduce systematic biases before data assimilation is activated.

Also, activities are ongoing where OI will be first replaced by Extended Kalman Filter (EKF). We need to replace OI for two main reasons; (i) the number of prognostic surface variables is increasing beyond what is feasible to assimilate with OI and (ii) we wish to utilize satellite products/radiances related to e.g. soil moisture, snow conditions, Leaf-Area Index (LAI) and surface temperature. The longer term solution includes going for Ensemble Kalman Filter (EnKF) which can be logically combined with the NWP system already running in Ensemble mode.

Land-surface modelling is heavily dependent on physiography data, e.g. vegetation type, LAI, albedo, roughness length. We continuously examine and test different physiography data bases. Examples on impact from improvements in physiography will be shown.

O1.2
Polar lows in ECMWF versus Arome Arctic

Matilda Hallerstig [1] (matildah@met.no), Linus Magnusson [2] (linus.magnusson@ecmwf.int)
[1] MET Norway and ECMWF
[2] ECMWF

Polar lows are small, intense cyclones on the cold side of the polar front. They produce short-lived, but intense storms with heavy snow showers and strong, gusty winds that can cause large damages in affected areas. Historically they have been poorly represented by global NWP models such as ECMWF, but should be in the scope since the resolution upgrade to 9 km resolution in 2016. By running sensitivity experiments on selected case studies we compare the performance of the ECMWF system with the 2.5 km Arome Arctic limited area model that is in operational use for forecasting polar lows at MET Norway. The main focus is on wind speed and wind gust, since they are most relevant parameters for the impact of polar lows. The studies so far have shown that ECMWF HRES is able to simulate the polar lows, but that wind speed is generally too low. Arome Arctic captures wind speed better but does not represent the highest peaks as well. Running ECMWF HRES with higher resolution (5 km) showed little improvement in wind speed, while altering the way convection is handled produced significantly stronger winds. A goal in this project is therefore to investigate whether the difference between Arome and ECMWF is due to the different resolutions or due to differences in the convection schemes.

O1.3
Comparison of AROME-Arctic and Satellite-Derived Sea Ice Albedo

Viivi Kallio1 (viivi.kallio@fmi.fi), Yurii Batrak2, Teresa Valkonen2, Kati Anttila1, Emmihenna Jääskeläinen1, Ekaterina Kurzeneva1, Laura Rontu1, Terhikki Manninen1

1 Finnish Meteorological Institute

2 Development Centre for Weather Forecasting, Norwegian Meteorological Institute

The surface albedo of sea ice in the Arctic has a large impact on the radiation and energy balance of the region. During the melting season the sea ice covered areas experience vast changes, e.g., the albedo of sea ice drops significantly.

The AROME-Arctic forecasting system uses an estimate based on the ice surface temperature to represent the sea ice albedo. In order to study the accuracy of this estimate and to determine the potential for assimilating satellite based sea ice albedo products, we have made a comparison of the CM SAF surface albedo SAL product and the surface albedo from the operational AROME-Arctic. Consecutive 6-hour forecasts from the operational AROME-Arctic starting at 00, 06, 12 and 18 UTC were used. The comparison is made for the period from April to August in 2016 with weekly averaged data for both sources.

The sea ice albedo derived from the SAL product varies significantly on a monthly scale, whereas the model albedo has lower variance. The results show differences in sea ice albedo over the whole comparison area, especially for the summer months. The differences are the largest over the marginal ice zone. These findings can be used for improving the albedo parameterisation in the model system.

This work has been conducted in the Copernicus Arctic Regional Reanalysis project.

O1.4
The effect of SST and roughness on the meridional moisture transport and precipitation of extratropical cyclones

Nina Karusto1 (nina.karusto@fmi.fi)
1 University of Helsinki

The effect of increasing sea surface temperature (SST) and roughness on the meridional moisture flux (MMF) and precipitation of extratropical cyclones are studied with idealized baroclinic wave simulations. The main objective is to quantify MMF, precipitation and several other factors of extratropical cyclones as the SST and roughness length are increased. Additionally MMF and precipitation are considered in various latitudes. The simulations are done in idealized conditions with Weather Research and Forecasting (WRF) model where the surface is only water. The sensitivity studies are conducted by changing the SST homogeneously throughout the domain and changing the surface roughness length which depends on the wind speed. Increasing SST caused MMF and precipitation to increase, as well as, e. g. latent heat flux (LHF) increased and minimum surface pressure decreased. On the other hand, increasing roughness length caused MMF and precipitation to decrease, additionally, LHF decreased and minimum surface pressure increased. The largest effect of SST and roughness had on the LHF and convective precipitation and the smallest on the minimum surface pressure.

O1.5
WOD – Operational and On Demand Weather Forecasts

Ólafur Rögnvaldsson1 (or@belgingur.is), Joao Hackerott1, Karolina Stanislawska1, and Logi Ragnarsson1
1 Belgingur Ltd.

Belgingur's operational and on-demand weather forecasting system (hereafter called WOD – Weather On Demand) can be used to create medium to high resolution weather and seasonal (up to nine months) forecasts for any location worldwide. These forecasts can both be deterministic in nature as well as non-deterministic (also called ensemble forecasts). As the back-bone of WOD is the WRF-Chem atmospheric model the system can be used to simulate the dispersion of volcanic ash and gasses during eruptions as well as dust from sand storms. The system can also be used for general air quality simulations, but these are not applicable for sudden onset events as they typically require detailed pre-processing of location dependent input data.

Output from the WOD system can be accessed via APIs through JSON queries, forecasts can also be visualized through standardized weather charts and meteograms that can be embedded within existing websites in a simple manner, or as standalone URLs. Through the WOD API interface users can both initiate a single forecast as well as choosing to let that forecast run at regular intervals. The system can handle multiple requests simultaneously but the user must keep in mind that domain sizes, forecast resolution, and duration may need to be restricted, depending on available hardware per WOD installation.

The WOD system can be installed locally and/or accessed as a Software As A Service (SAAS) on Belgingur's High Performance Computers (HPCs).

O2.1
Probability forecasts: quantifying uncertainty in forecasts

Marko Laine[1] (marko.laine@fmi.fi)
[1] Finnish Meteorological Institute

It is now well understood that the concept of probability offers the best way to quantify uncertainty in forecasts. However, deterministic point forecasts are still the main way to disseminate forecasts, as they are usually easier to interpret. There are several reasons why probability forecasts will be more and more topical in meteorology. Ensemble prediction systems for NWP are directly designed to estimate the forecast predictability and uncertainty. Increased resolution of the models has the effect that, for example, precipitation events are accurate only with respect to their occurrence probabilities, not on their exact spatial and temporal locations. Using probabilities to disseminate forecasts brings challenges as the concepts involved are not necessarily clear to meteorologists, not to mention the public. There is a wide scale on how different people understand probability statements. If used correctly, probability forecasts provide the best and cost-efficient decisions. This presentation will discuss different aspects of the concepts of probability, both on mathematical and on practical perspective, as well as verification, calibration and different uses of probability forecasts.

O2.2

Improved prediction of ship-icing for application in operational weather forecasting

Eirik Mikal Samuelsen[1] (eiriks@met.no)
[1] Norwegian Meteorological Institute

A ship travelling in sub-freezing conditions may encounter sea spray, rain, fog, or snow freezing onto various parts of it. Such ship icing, particularly sea-spray icing, is a well-known threat for ships operating in a cold marine climate. Throughout the last 60 years there have been several efforts trying to model this elusive phenomenon. However, the lack of accurate field observations poses questions to the accuracy of previous modelling approaches including the parameterization of the physical processes of the models. As a consequence, the current study presents and utilises previously unused historical icing data obtained from ship observations in Arctic-Norwegian waters from 1980 to 2006 supplemented with reanalysis data. On the basis of a unique data set derived from observations recorded on a particular ship type of the Norwegian Coast Guard, a completely new icing model has been developed. Verification of this Marine Icing model for the Norwegian COast Guard (MINCOG) and comparison with currently-applied methods in operational weather forecasting, reveals higher accuracy of MINCOG compared to the other methods. A major finding of the study is that nature dictates an upper limit to the degree of icing that may arise from wave-ship interactions, since high waves and very low air temperatures rarely coexist. In fetch-limited areas near the ice edge in which the lowest temperatures occur there will namely be low waves and little sea spray available for freezing even in strong-wind conditions. For this reason methods assuming a direct relationship between the local wind speed and the local wave height, as is common in many state-of-the-art icing models, will overestimate the spray amounts and icing rates in such conditions. Furthermore, it is also highlighted in the study that the inclusion of snow may be important for ship icing to arise, and that icing occurs most frequently during cold-air outbreaks from the ice. In addition, when a more general approach is applied to the icing problem, a different prediction method utilising the temperature at 850 hPa provides a potential for forecasting icing several days or weeks ahead in time.

O2.3
Cold-season thunderstorms and aviation

Robert Mäkitie (robert.makitie@fmi.fi)

Master's Thesis – University of Helsinki
Finnish Meteorological Institute (Aviation)

The theory of deep moist convection is well known and it helps us to predict where and when thunderstorms will occur during the warm-seasons. With the help of CAPE (Convective Available Potential Energy) it is easy to predict the occurrence of thunderstorms, but during cold-season the CAPE value is not as helpful. When thunderstorms strikes during the cold-season the CAPE value have been measured to be almost zero. This then indicates that no convection should occur which then means no lightning strikes should either occur. Cold-seasons thunderstorms happen rarely in Finland and the observations that are available are not always the best, which makes the cold-season thunderstorms a hard and unpredictable phenomenon. This means cold-season thunderstorm should be studied more and approached from a different viewpoint.

In my research, I have analysed three cold-season thunderstorm cases close to Helsinki-Vantaa airport (EFHK), where more than one lightning strike have occurred that has associated with a hit on an arriving or departing airplane. These three cases are: 1st of May 2014, 23rd of May 2016 and 3rd of January 2017. In my research I have additionally studied other countries researches on cold-season thunderstorms that I then have compared to my cases and my results.

From my cases I can confirm that the CAPE value is to no good use during cold-season thunderstorms, because from the nearest sounding observation that takes place in Jokioinen, the CAPE value was almost zero close to the lightning strikes. It also occurred that EL (Equilibrium Level) is not in every case over the temperature -20°C that it is during the warm-season. In one of my cases the EL was lower than -20°C, which then leads to a thought; does an airplane has a bigger role as an outside lightning igniter, when the cumulonimbus clouds are really low and weak. Also by using the hydroclass radar it came up that not all cumulonimbus clouds develop snowhail inside the cloud in the cold-season, which then creates the charge for the lightning. Comparing my three cases to other countries researches a lot of similarities could be seen, but the biggest difference was the climatology between Finland and the other countries. Comparing the alghortimes that the other countries created to my three cases, I was able to see that Finland is colder making their algorithms not useful in Finland. The algorithms that they created didn't base on the CAPE value, instead it based on the temperature above the ground approximately 1000 at feets height, the height on the freezing level and on the intensity of the precipitation.

Predicting cold-season thunderstorms is possible, it only requires studying more cold-season thunderstorm cases so it is possible to create an own algorithm for Finland. The algorithm would calculate different atmospheric conditions than CAPE to predict a risk of cold-season thunderstorms. By adding the synoptical scale to the prediction it gives a better understanding of what can create cold-season thunderstorms. It seems to be that cold-advection is one of the bigger reason for cold-season thunderstorms in Finland that sometimes occurs with the lake-effect.

O2.4
Upgraded physiography databases over Iceland for NWP model HARMONIE-AROME

Bolli Palmason[1] (bolli@vedur.is)
[1] Icelandic Meteorological Office

The Icelandic Meteorological Office (IMO) in 2011 started running the hi-res mesoscale model HARMONIE-AROME at 2.5 km resolution over Iceland and the surrounding seabanks. In the beginning the focus of the NWP team at IMO was to improve the windspeed forecast in the model to simulate better the frequent storms in wintertime. In 2014 the focus shifted towards the apparent errors in the physiography databases used by the model to setup the model domain. The three main databases used were the GTOPO30 for topography, the HWSD soil database and the main database ECOCLIMAP-II for land cover/use all available for the whole globe at 1 km resolution. The ECOCLIMAP-II database does not only provide the surface cover types but also other key parameters like albedo, LAI, soil depths and many key parameters for vegitation and etc. ECOCLIMAP-II is an upgrade to the previous ECOCLIMAP-I over Europe, but unfortunately Iceland was not included in the upgrade so the two versions of the database is identical over the Iceland domain. The errors over Iceland were for example in the glacier extents, vegitation fractions and type, soil depths and compositions and etc. The first version of upgraded databases was ready in late 2014 and included updates for all three databases. For the GTOPO we used the best available elevation model from the National Land Survey of Iceland to completly overwrite the data for Iceland. For the HWSD sand/clay fractions we got help from Ólafur Arnalds - a soil scientist and a professor at the Agricultural University of Iceland (AUI). The ECOCLIMAP-II update was done by combining three databases into one new land use database for Iceland: the Corine database, the AUI Nytjaland (vegitation map of Iceland) and a soil map of Iceland from professor Ólafur. The updated databases have been used operationally in the HARMONIE-AROME model since autumn 2015 and were used for the ICRA-2016 reanalysis for Iceland.

The presentation will cover the updates and verification experiments.

O2.5
Surface fluxes at Gufuskálar in Iceland

Geoffrey Dumont (Icelandic Meteorological Office & University of Iceland)

O3.1

Extreme weather in Northern Europe

Andrea Vajda (andrea.vajda@fmi.fi)

Finnish Meteorological Institute, Finland

Northern Europe experiences a substantial amount of extreme weather phenomena during every year and their frequency is more likely to increase during the coming decades due to climate change. These extremes weather events can cause significant damage in various sectors leading to economic losses and societal impacts. Storms associated with strong winds and precipitation, snow related events such as snowfall, blizzard, sea effect snowfall, heavy snow load, and freezing rain impact transportation, energy sector, infrastructure and forests during the cold season resulting in disruptions, considerable damage and failure to critical infrastructure systems. Summer season hazardous conditions related to severe thunderstorms, intense forest fires triggered by sustained drought and warm periods are also having an increased impact on various sectors of society. End-users need better knowledge about the frequency and severity of weather related hazards in the present and future climate in order to increase preparedness, develop adequate prevention measures and adaptation strategies. This presentation provides an overview of the occurrence and probability of the extreme weather and climate events mentioned above in Northern Europe in the present climate and their projected changes during the 21st century. We will also present examples of how the weather and climate related risk management and the adaptation work could be improved.

O3.2

Three extreme dust storms in Iceland

Pavla Dagsson-Waldhauserova [1, 2] (pavla@lbhi.is), Haraldur Olafsson[3, 4], and Olafur Arnalds[1]
[1] Agricultural University of Iceland, Faculty of Environment, Hvanneyri, Iceland
[2] Czech University of Life Sciences Prague, Prague, Czech Republic
[3] University of Iceland, Department of Physical Sciences, Reykjavik, Iceland
[4] Icelandic Meteorological Office, Reykjavik, Iceland

Icelandic desert areas cover over 44,000 km2 suggesting Iceland is the largest Arctic as well as European desert. Satelite MODIS pictures have revealed dust plumes traveling over 1000 km at times. The mean frequency of days with dust suspension was to 135 dust days annually in 1949-2011. The annual dust deposition was calculated as 31 - 40.1 million tons affecting the area of > 500,000 km2, which places Iceland among the most active dust sources on Earth.

Three unusual dust events were observed and measured: The first, an extreme wind erosion event of the fresh Eyjafjallajokull 2010 volcanic ash, the second, a Snow-Dust Storm in 2013, and the third, a suspended dust during moist and low wind conditions. Frequent volcanic eruptions in Iceland (new eruption each 3-4 years on average) represent important inputs to dust variability. Freshly deposited ash prolongs impacts of volcanic eruptions as we observed after the 2010 Eyjafjallajokull eruption. In

September 2010, an extreme storm was recorded with the maximum wind speed of 38.7 ms-1. The maximum saltation was 6825 pulses per minute while the aeolian transport over one m wide transect and 150 cm height reached 11,800 kg m-1. This storm is among the most extreme wind erosion events recorded on Earth.

Dust events in South Iceland often take place in winter or at sub-zero temperatures. The Snow-Dust Storm occurred in March 6-7th 2013 when snow was nearly black with several mm thick dark layer of dust deposited on snow. Dust was transported over 250 km causing impurities on snow in the capital of Iceland, Reykjavik. This has been the first observation of clumping mechanism of particles on snow in natural conditions. Maximum one-minute PM10 concentration was measured as 6500 µg m-3 while the mean (median) PM10 concentration during 24-hour storm was 1,281 (1,170) µg m-3.

Dust can be also suspended during wet and windless conditions as a result of dark desert surface heating. We measured particle number concentration (PM~0.3-10 µm) up to 149,954 particles cm-3 min-1 during rainy period in August 2013. The particles were mainly of the close-to-ultrafine size. Wet dust particles were mobilized within < 4 hours.

Icelandic dust is fine and of volcanic origin. It interacts with cryosphere and have similar effects on snow and ice albedo, melting and density as Black Carbon. The climate impacts of Icelandic dust should more investigated.

O3.3
TBA

Elín Björk Jónasdóttir (Icelandic Meteorological Office)

O3.4 Observations of a breaking mountain wave

Guðrún Nína Petersen (Icelandic Meteorological Office), Stephen Mobbs (National Centre for Atmospheric Science), Haraldur Ólafsson (University of Iceland & Icelandic Meteorological Office) & Ioana Colfescu (National Centre for Atmospheric Science)

O3.5
Current research in aviation meteorology – “stratospheric” overview

Björn Sævar Einarsson (Icelandic Meteorological Office)

O4.1
Climate effect from anthropogenic aerosol emissions on Arctic region.

Kalle Nordling1 (kalle.nordling@fmi.fi),Joonas Merikanto1, Petri Räisänen1, Petteri Uotila2, Declan O'Donnel1, Hannele Korhonen1
1Finnish meteorological Institute
2University of Helsinki

Arctic is the most sensitive region to global climate change. According to the observations the warming rate in the Arctic is at least twice as large as for the whole globe. [1] This feature is known as the Arctic Amplification. Both global warming and Arctic warming are driven by increased greenhouse gas concentrations, but short lived climate forcers such as aerosols have also contributed to the historical temperature changes in Arctic[2]. However the relative contributions of different modern day climate forcers are not well known. Unlike well-mixed greenhouse gases, the concentration of aerosols varies greatly both spatially and temporally due to their highly inhomogeneous sources and short lifetimes. Here rises the question of how global anthropogenic aerosol emissions affect the climate in the Arctic region.
Arctic amplification is known to be linked to local processes such as decline in sea ice fraction and remote processes modulating the zonal energy transport to the Arctic region [3]. We study these processes by running two global climate models (Echam6, NorESM) with identical anthropogenic aerosol schemes. We find that most of the aerosol driven Arctic temperature effects of modern day aerosols originate from remote aerosol forcing in mid latitudes. This remote effect modulates the sea ice fraction and leads to similar but opposite seasonal cycle as caused by greenhouse gases. These are important finding as it indicates that air pollution reduction and legislation might cause warming in Arctic and leading more extreme weather events to mid-latitudes. [4][5]

References

[1] Susan Solomon. Climate change 2007-the physical science basis: Working group I contribution to the fourth assessment report of the IPCC, volume 4. Cambridge university press, 2007.
[2]Moritz, Richard E., Cecilia M. Bitz, and Eric J. Steig. "Dynamics of recent climate change in the Arctic." Science 297.5586 (2002): 1497-1502.
[3] James A Screen and Ian Simmonds. The central role of diminishing sea ice in recent arctic temperature amplification.
Nature, 464(7293):1334, 2010.
[4] Judah Cohen, James A Screen, Jason C Furtado, Mathew Barlow, David Whittleston, Dim Coumou, Jennifer Francis, Klaus Dethloff, Dara Entekhabi, James Overland, et al. Recent arctic amplification and extreme mid-latitude weather. Nature geoscience, 7(9):627, 2014.

[5] James E Overland, Klaus Dethloff, Jennifer A Francis, Richard J Hall, Edward Hanna, Seong-Joong Kim, James A Screen, Theodore G Shepherd, and Timo Vihma. Nonlinear response of mid-latitude weather to the changing arctic. Nature Climate Change, 6(11):992, 2016.

O4.2
The structure of extra-tropical cyclones in a warmer climate

Victoria Sinclair[1] (Victoria.Sinclair@helsinki.fi) Päivi Haapanala[1], Jouni Räisänen[1], Mika Rantanen[1] and Heikki Järvinen[1]
[1] Institute for Atmospheric and Earth System Research / Physics, Faculty of Science, University of Helsinki, Helsinki, Finland

Extra-tropical cyclones constitute a large part of the circulation in the mid-latitudes and can lead to high impact weather such as strong winds, heavy rainfall and snow. Therefore, it is vital to understand how the properties of extra-tropical cyclones will change in the future. However, the current generation of climate models do not provide a clear prediction of how the number of extra-tropical cyclones will change in the future nor a clear answer to how the properties of extra-tropical cyclones, for example, their precipitation patterns and associated low-level winds, will change. The overall aim of this study is to determine how the structure of extra-tropical cyclones will change in the future when the climate warms. We address this aim by performing highly idealised “climate change” experiments using a state-of-the-art atmosphere only model in an aqua-planet configuration. Multiple 10-year long simulations are conducted with OpenIFS, a version of ECMWFs Integrated Forecast System (IFS) which is freely available under license to academic institutions. A control experiment and an experiment where the sea surface temperatures are uniformly warmed by 4K are performed. In both experiments, extra-tropical cyclones are tracked using TRACK, an objective tracking algorithm, and then composites of the 200 strongest, and the 200 most typical (“mean”) cyclones are created. The mean composite cyclone does not change in structure, however the most intense composite cyclone shows notable changes to the structure of the cyclone: the area of strong winds increases, the location of the heaviest precipitation moves further ahead of the warm front and expands. These results indicate that high impact weather associated with extreme extra-tropical cyclone in the future may affect larger areas than in the current climate.

O4.3
Examples of how to provide climate services to the public

Hanne Heiberg[1] (hanne.heiberg@met.no), Inger Hanssen-Bauer[1]
[1] Norwegian Meteorological Institute (MET Norway) and Norwegian Centre for Climate Services.

This is the abstract text:

The presentation will focus on how climate services are provided to the public by the Norwegian Centre for Climate Services (NCCS) and the Norwegian Meteorological Institute. Climate projections have been calculated for Norway until 2100 for several climate indices, like temperature, precipitation, runoff, flooding, days of snow coverage etc., for high and moderate emission scenarios. The climate projections and observations are presented graphically as grid and time series for different types of regions in Norway. The datasets with diurnal 1 x 1 km resolution are available for download. In order to provide the most critical information for local climate adaptation and long term planning, a climate fact sheet has been produced for each county, in close collaboration with county and municipal administration.

Observation data at MET have been publicly available on the web since 2004. However, new web technology provides new opportunities in the construction of our new data portal. Based on the success of our weather forecast site, yr.no, the user can easily search for the closest observations to his location in the new data portal.

O4.4
How about your temperature-trend preferences?

Trausti Jónsson (Icelandic Meteorological Office)

O5.1
Forecasting applications from ground-based active remote sensing

Ewan O'Connor[1,2] (ewan.oconnor@fmi.fi)
[1] Finnish Meteorological Institute
[2] University of Reading, UK

Ground-based active remote sensing instruments are capable of providing vertical profiles of many atmospheric parameters at high temporal and vertical resolution. Such instruments provide measurements of parameters such as aerosol, wind, turbulence and cloud, from which other products can be derived. One major advantage of ground-based remote sensing is the ability to capture rapidly evolving features in the boundary-layer, a particular challenge for numerical models to forecast. Reliable products from such instruments would therefore provide an additional source of information for forecasters to exploit. Suitable products can include qualitative products as well as quantitative products, with identification of cloud phase, cloud type, precipitation type, boundary layer evolution (aerosol layering), all aiding forecaster decisions.

Recent technological advances have permitted the development of commercial active remote sensing instruments that are robust, require minimal maintenance, and can operate unattended continuously for long periods. This makes them suitable for network applications. Harmonised retrievals across the network then provides additional added value.

This talk will provide an overview of the current activities in ground-based active remote sensing and demonstrate practical examples that can be used by forecasters and for model evaluation (NWP and air quality). The talk will also present some new instruments and applications being developed that will become available in the near future.

O5.2
Coastal wind from Synthetic Aperture Radar

Birgitte Rugaard Furevik[1,2] (birgitte.furevik@met.no), Knut Frode Dagestad[1], Ivar A. Sejerstad[1]

[1] Meteorologisk Institutt (MET Norway)

[2] Dansk Meteorologisk Institut (DMI)

High resolution Synthetic Aperture Radar (SAR) images have been available for three decades and are used operationally for oceanic applications, in particular for sea ice mapping and oil spill surveillance. Over the ocean, scatterometers are providing wind fields with good temporal coverage. Near the coasts and in fjords however, SAR can complement these observations for use in forecasting and verification for high resolution modelling.

The operational atmospheric forecasting model at MET at present is AROME, run at 2.5km spatial resolution as an ensemble with 11 members (MEPS). From verification, coastal winds from AROME show a bias in certain situations. It is investigated if SAR is able to provide reliable measurements compared to ground observations, and be used for postprocessing of the 10m winds in AROME.

SAR images from Sentinel-1 and Envisat are converted into wind speed using wind directions from ECMWF forecasts. The wind fields are available to the forecasters in near-real time in the forecasting tool DIANA (diana.met.no). Sentinel-1 images since March 2017 are converted into wind fields and the wind speed from SAR is used in the verification of AROME and against coastal stations and buoys. The verification is done with data from March-October 2017.

Overall, SAR winds verify better against masts and buoys than AROME, showing a higher correlation (0.8) and less variability (RMSE) than the model. AROME has a negative bias and SAR a positive bias compared to in situ observations. The wind speed distribution of AROME is better than SAR when comparing to local observations. SAR has a high number of 0 m/s winds but otherwise no winds in the interval up to around 2 m/s, due to the threshold detection level of the sensors. Most importantly, SAR has too many cases with winds of 3-9 m/s, leading to the overall positive bias in wind speed. The reason for this difference is not known. Between AROME and SAR, the correlation is high offshore and decreases with distance inland from the coast and into the fjords.

O5.3
Remote sensing systems and new data sourses.

Igor Gansvind
Senior research fellow remote sensing system design laboratory,
Scientific Geoinformation Centre Russian Academy of Science
Moscow.

Ignik-1g@yandex.ru

Progressively increasing data set of global observations from different satellites opens the way for Earth climate and weather studies in combining data on the ocean,atmosphere,and ice dynamics for gaining new insights into critical aspects of climate change.The dynamics of ice and snow structures of Arctic cryosphere is a key indicator to the climate state.As evident from the satellite and ground based data the area of glaciers in Yakutia (the EAST Siberia) decreased over the last 60 year almost 60%.

Remote sensing satellites in a low Earth near polar orbits provide the required high resolution measurements to estimate sea-ice thickness,ice-sheet changes,snow cover.New satellite mission NASA ICE Sat-2 (Ice, Cloud, and land Elevation Satellite 2) will be launched in September 2018-03-26 into a such orbit with an altitude of approximately 500 km is designed to provide measurements of the sheet elevation and see ice freeboard. The sole instrument on the board will be Advanced Topographic Laser Altimeter System (ATLAS),a space based LIDAR. For the first time such a device – CALIOP (Cloud-Aerosol Lidar with Ortogonal Polarisation) has been installed on the satellite CALIPSO entered the Train-A,

Small satellite constellations are financially have enable rapid revisit and provide flexibility for replenishing space assets for data continuity. Constellations provides natural disaster monitoring and response operations planning. The Firebird constellation consists of two spacecrafts, TET-1 and BIROS(Bi-special Infrared Optical System) launched into sun-synchronous orbit with altitude 500 km 2016-06-22, has a mass 130 kg The objective are detection, monitoring and quantitative analysis of High Temperature Events like forest fires and volcanoes or other hot spots. The satellite data made available worldwide for scientific purposes by DED (German Remote Sensing Data Center).

O5.4
TorMic-Prosject: Radar-Based Detection and Forecasting Tornadoes and Microbursts

Sevim M.-Gulbrandsen[1] and the Referencegroup on Radar[1]
[1] Norwegian Meteorological Institute, Norway

Forecasting extreme wind and precipitation events are a high priority task at the Norwegian Meteorological Institute. Tornadoes and microbursts are severe weather events and have a high impact on safety and decision making. The occurrence of tornadoes and microbursts in Norway are infrequent and are mainly concentrated in the southern regions. Climate changes imply that the amount of these events will increase with time. The project “TorMic - (radar-based) forecasting of tornadoes and microbursts over Norway” is investigating how to set up warnings of these phenomena.

Tornadoes and microbursts are convective phenomena. The convection on a synoptic scale can be forecasted in advance by state-of-the-art numerical weather prediction (NWP) models on the basis of the available data a day or two before. However, convection on a local scale of few kilometers is characterized by a limited predictability in time. Thus frequent data assimilation cycles, every one hour or so, would be needed to properly represent thunderstorms within NWP. A radar-based method and nowcasts are widely used to monitor the evolution of heavy precipitation events over the next few (1-2) hours and can be used to detect the occurrence of hail and mesocyclonic rotation. In this context, the TorMic-project aims at implementing a mesocyclone and tornado detection algorithm based on radar observations. For this we will try to adapt existing mesocyclone and tornado detection algorithms to fit the Norwegian environmental conditions. To facilitate this we plan to set up a database with convective events. The method will be evaluated over selected case studies extracted from the archived radar observations, moreover a dedicated scan on a mobile X-band radar placed at the Oslo airport will be operated during the summer of 2018 to test the best radar setup targeted to our purposes. TorMic is a part of a local project at MET-Norway, that aims to give new methods in forecasting of extreme weather events. Though this project is focused on Norwegian meteorological and environmental conditions, nonetheless we believe that the outcomes will also be relevant also for other countries with a similar climate.

O5.5

Describing the wind in a Norwegian fjord using synchronized doppler lidars

Hálfdán Ágústsson, Martin S. Grønsleth, Ola Kaas Eriksen, Ove Undheim,
Kjeller Vindteknikk, Norway.
halfdan.agustsson@vindteknikk.no

In 2014, the Norwegian Public Roads Administration started an evaluation of the atmospheric conditions pertaining to the design and construction of a 'ferry-free' road connection between Kristiansand and Trondheim on the western coast of Norway. This implies crossing 8 fjords with widths between 2 and 7.5 km, depths up to 1300 m and typically surrounded by steep mountains up to 800 m. Therefore, a detailed description of the wind, wave and ocean current climate at the proposed crossings is required for the study of the designs of possible fjord crossing solutions.

The latest addition to the already extensive observational campaign consists of 4 synchronized doppler LIDARs. In a global context, this places the observational campaign at the forefront with the most sophisticated atmospheric campaigns executed do date using lidar technology. The LIDARs will be operated at several of the proposed bridge crossings, and were deployed in Halsafjorden (Møre and Romsdal, West-Norway) in August 2017 and will be moved to another location during the summer of 2018. The LIDAR data complements 3-dimensional 10 Hz observations of wind (started in 2014) from sonic anemometers in tall meteorological masts, located at both ends of each proposed crossing. The observed dataset is further corroborated by large datasets of simulated weather at high spatial resolution, as well as simulations of the sea state and ocean currents.

The four LIDARs operate in two synchronized pairs making it possible to retrieve the horizontal wind vector (i.e. wind speed as well as wind direction) at any location, in particular along the proposed bridge deck location at the crossings. The accuracy of the LIDARs derived winds is quantified by comparison with observations from the sonic mast anemometers, facilitating the extrapolation of wind conditions observed at mast locations to e.g. mid-span in the fjord. The two pairs of synchronized LIDARs allow for observations of spatial coherence at any relevant separation distance and of turbulence characteristics of the flow at scales relevant for such long bridges. Currently this includes measurements of turbulence at the mast location, the proposed bridge centre and at locations 67 and 200 m from the centre. However, the resolution of the turbulence data is limited by the observational technique so that the highest frequency and smallest vortices can not be resolved. Horizontal and vertical scans were performed and winds derived from these LIDAR scans are to be used to infer how well simulated winds reproduce the spatial structure of the observed flow, aiding in identifying atmospheric phenomena which may be relevant for the bridge design, structure and operations. We will present relevant results from the observational campaign in Halsafjorden, showing e.g. the comparison and calibration of lidar derived winds versus observations from sonic anemometers, observations and analysis of the four-dimensional wind field, as well an example of the analysis of single- and two-point statistics of the flow turbulence.

O6.1
Remote Sensing of Sea Ice

Ingibjörg Jónsdóttir (ij@hi.is)

University of Iceland

Satellite imagery, available from the SENTINEL constellation (ESA, Copernicus programme), offers numerous possibilities for sea-ice monitoring and research. Other valuable sources include MODIS, VIIRS, LANDSAT (NASA) and NOAA AVHRR optical and thermal images, as well as passive microwave images (SSM/I, AMSR). Ice conditions in the East-Greenland Current vary considerably on a daily to decadal time scale, and merging radar-, microwave-, multi-spectral- and thermal imagery has given valuable insight into sea-ice properties and motion, as will be presented here.

For a number of reasons, remote sensing of sea ice is a challenging subject: The sea-ice cover is ever changing, the electromagnetic properties of the ice are dependent on the ice type, age and thickness, deformation, snow cover, water content and salinity. The cloud cover over the ice complicates matters even further, along with winter darkness in high latitudes. The sea-ice information is needed in real time for navigators but the data is also an essential input in climatology and a basis to understand air-ice-sea processes. Different variables of sea ice can be detected by different observation systems. For more or less the same reasons as mentioned above, remote sensing is an ideal tool for ice monitoring and research. The last decades have seen sea-ice studies going from simple detection (knowing how to avoid the ice) to having elaborate systems to study various ice properties and movement, under conditions that are changing fast.

O6.2
Creating a cloud-free MODIS snow cover product using spatial and temporal interpolation and temperature thresholds

Justinas Kilpys[1] (justinas.kilpys@gf.vu.lt), Egidijus Rimkus[1], Silvija Pipiraitė[1]

[1] Institute of Geosciences, Vilnius University, Vilnius, Lithuania

In the Baltic states (Lithuania, Latvia and Estonia), snow cover is important for water resource management, agriculture and ecosystems. Snow cover characteristics are determined using ground-based and remote sensing observations. Ground-based measurement network are scarce to provide detail regional information about the snow cover, while visible remote sensing imagery is limited to the cloud free days.

To minimize the influence of clouds, multi-step post-processing was used to fill the gaps in MODIS snow data time series. In the first step, MODIS snow cover products from Terra and Aqua satellites (MOD10C1 and MYD10C1, version 6) were merged to create the combined product. In the second step, the cloudy pixels were filled with cloud-free values from 8 neighbouring pixels. In the third step, the backward and forward temporal filtering was applied to reduce cloud-gaps. In the fourth step, temperature thresholds were applied to reject false snow cover pixels. The temperature threshold was different for snow accumulation and mid-winter (November-February) and snow ablation period (March-April). In the last processing step, average of the backward and forward gap-filling approaches is calculated.

Using generated cloud-free MODIS product annual and monthly snow cover days were calculated for Lithuania in the period 2012-2017. Time series of MODIS snow cover days were validated with daily measurements from meteorological stations in Lithuania. The overall accuracy of created MODIS cloud free snow-cover product was 0.88 and the critical success index was 0.46. The lower scores were determined for the coastal stations where snow cover is ephemeral and also during the accumulation and ablation periods of snow cover.

Daily cloud-free MODIS snow cover product can be used for hydrological and climatological application as it provides good spatial overview of snow cover conditions in the region. It is of interest on the country border regions and trans-boundary river basins were in situ measurement networks are scarce, or data is not available.

O6.3
On the measurement of wind gusts: from traditional anemometry to new methodologies applying Doppler lidar and research aircraft measurements

Irene Suomi1, Sven-Erik Gryning2, Christof Lüpkes3, Jörg Hartmann3, Ewan O'Connor1,4, Timo Vihma1, Carl Fortelius1

1) Finnish Meteorological Institute, irene.suomi@fmi.fi

2) DTU Wind Energy, Technical University of Denmark, Denmark

3) Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

4) University of Reading, Reading, UK

Information on wind gusts is needed for assessment of wind induced damage and risks to safety. The wind gust speed is defined as the maximum of short-duration (typically 3 seconds) moving averages of wind speed. Therefore, gusts represent the extremes of the fluctuating wind speed and they have been found as the key parameter to explain wind induced damage. Wind gust observations are useful in risk assessments (e.g. by insurance companies), in estimation of design loads and in preparedness planning and operational monitoring to support operational severe weather forecasting.

The measurement of wind gust speed requires a high temporal resolution of the anemometer system because of the short duration of the gust. Traditional measurement techniques at weather stations based on cup and sonic anemometers fulfill this requirement. However, these measurements are limited to heights and regions where the supporting structures can reach. The standard measurement height for wind is 10 m. For practical reasons, existing measurements are mainly concentrated over densely populated land areas, whereas from remote locations, such as the marine Arctic, wind gust information is available only from sparse coastal locations. Recent developments of wind gust measurement techniques based on measurements from Doppler lidar and research aircraft can potentially provide new information from heights and locations unreachable by traditional measurement techniques. Research aircraft can provide gust measurements from remote locations whereas Doppler lidars can be used to measure gust profiles even through the full extent of the atmospheric boundary layer, and thereby increase our understanding of the physical processes responsible for gusts. In this presentation we will provide a short overview of current wind gust measurement techniques and present the new techniques based on Doppler lidar and research aircraft measurements. Finally, potential future directions of wind gust measurement techniques will be discussed.

O6.4
The value of Doppler LiDAR systems to monitor turbulence intensity during storm events in Iceland

Yang Shu[1], Guðrún Nína Petersen[2], Sibylle von Löwis[2], David C. Finger[1]

1) Reykjavik University, School of Science and Engineering, Reykjavik, Iceland

2) Icelandic Met Office, Reykjavik, Iceland

Doppler Light Detection and Ranging (LiDAR) system have been used widely to measure wind velocity and atmospheric turbulence profiles. The temporal and spatial scale of atmospheric turbulence is very dynamic, requiring an adequate method to detect and monitor turbulence with high resolution. The Doppler lidar system can provide continuous information about the wind field using the Doppler effect form emitted laser signals. In this study, we use a Leosphere Windcube 200s lidar systems stationed near Reykjavik city Airport and at Keflavik International Airport, Iceland, to evaluate turbulence intensity by estimating eddy dissipation rate (EDR). For this purpose, we retrieved radial wind velocity observations from Velocity Azimuth Display (VAD) scans (360°scans at 15° and 75° elevation angle) to compute EDR. The preliminary result reveals that the lidar observations can detect and quantify atmospheric turbulence with high spatial and temporal resolution. This finding is an important step towards enhanced aviation safety in a subpolar climate characterized by severe wind turbulence.

O6.5
Icelandic weather and climate and the influence on the meteorological and human history

Haraldur Ólafsson (University of Iceland & Icelandic Meteorological Office)

O7.1
Development of the weather observations network at the Icelandic Meteorological Office (IMO)

Sibylle von Löwis[1] (sibylle@vedur.is), Vilhjálmur Þorvaldsson[1]
[1] Icelandic Meteorological Office, Bústaðavegur 7-9, IS-108 Reykjavík

In the last ten/fifteen years the weather observations network has undergone an immense change. During the last 15 years the number of manned synoptic and manned precipitation observation stations has decreased by 51% while at the same time the number of automatic weather stations (AWS) has increased by 54%. The first AWS were installed in the early 90’s.

The Icelandic Meteorological Office operates 141 AWS and 57 manned synoptic and manned precipitation stations. An AWS usual consists of a temperature, a humidity, and a wind sensor. 32% of the stations are equipped with atmospheric pressure sensor and 39% with precipitation gauge (tipping bucket or weighing). Solar radiation, soil temperature, cloud height or visibility are measured at only few stations. Several mountain stations only measure temperature and snow depth.

Since the beginning of the automated measurements at IMO, dataloggers from Campbell Scientific, Inc. have been used for data logging and measuring signals from various sensor which, often has been analogue. Nowadays, more and more meteorological sensors are coming with digital interfaces, which simplifies their connection to microcontrollers. This, and the cost of electronic components makes it possible to build a low cost datalogger unit.

A new datalogging unit for AWS has been under development. This unit consists among other things of an ultra-low power ARM microcontroller, flash memory for storage of measurements, communication module for example GPRS or Ethernet, and solar panel charger. Different kind of sensors are already supported, and support for new sensors can be added. Among the advantages of the unit is it lightweight and low cost as well as ease of configuration and installation.

It is planned to install at least three weather stations with this new unit for testing in the capital region this summer.

O7.2
Winter and high-altitude dust size distributions with the balloon-borne Light Optical Aerosol Counter (LOAC)

Pavla Dagsson-Waldhauserova [1, 2] (pavla@lbhi.is), Haraldur Olafsson[3, 4], Jean-Baptiste Renard[5], Damien Vignelles[5], and Nicolas Verdier[5]

[1] Agricultural University of Iceland, Faculty of Environment, Hvanneyri, Iceland
[2] Czech University of Life Sciences Prague, Prague, Czech Republic
[3] University of Iceland, Department of Physical Sciences, Reykjavik, Iceland
[4] Icelandic Meteorological Office, Reykjavik, Iceland
[5] LPC2E-CNRS / Université d'Orléans, Orléans, France

Iceland has the largest area of volcaniclastic sandy desert on Earth where dust is originating from volcanic, but also glaciogenic sediments. Total Icelandic desert areas cover 44,000 km2 which makes Iceland the largest Arctic as well as European desert. The mean frequency of days with dust suspension was to 135 dust days annually in 1949-2011. The annual dust deposition was calculated as 31 - 40.1 million tons yr-1 affecting the area of > 500,000 km2. About 50% of the suspended PM10 are submicron particles. Icelandic dust is of volcanic origin; it is very dark in color and contains sharp-tipped shards with bubbles. Such properties allow even large particles to be easily transported long distances as revealed on the satellite MODIS images with dust plumes traveling over 1000 km at times. There is a need to understand better the vertical distribution of such aerosols as well as their residence time in the atmosphere, especially during occasions such as polar vortex.

Four LOAC flights were performed under meteorological balloons during the Iceland Polar Vortex 2016 campaign in January 9-13 2016 when stratospheric polar vortex occurred above Iceland. LOAC is an optical aerosol counter that uses a new optical design to retrieve the size concentrations in 19 size classes between 0.2 and 100 µm, and to provide an estimate of the main nature of aerosols. Vertical profile of aerosol size distribution showed the presence of volcanic dust particles up to altitudes of 8 km for two of the flights (9-10 January). The MODIS satellite images confirmed a dust plume present above the southern coast from the deposits of September 2015 glacial outburst flood (jökulhlaup) while the rest of the country was covered by snow. These deposits had been actively suspended in November and December 2015. The ground PM10 mass concentration measurements in Reykjavik showed elevated PM measurements over 100 µg m-3, confirming the particle presence 250 km far from the source.

The number concentration exceeded 200 particles cm-3 at altitude of 1 km and 60 particles cm-3 at altitude of 5 km, which is at least 5 times higher than during background conditions. The particles were < 3 µm in size at >1 km altitude while largest particles, up to 20 µm, were detected close to the ground. Such high number concentrations in several km height were captured by LOAC only during Saharan dust plume with larger particles (around 5 µm). Our results show that fine volcanic glacially reworked dust can reach high altitudes relatively close to the dust source and reside in terms of days under the stratospheric polar vortex conditions. The remaining question is the further transport of these high altitude particles outside Iceland.

O7.3
Frequency and Characteristics of Volcanic Ash and Dust Suspension Events in Iceland

Mary K. Butwin[1,2] (mkb5@hi.is), Sibylle von Löwis[2], Melissa A. Pfeffer[2], Throstur Thorsteinsson[1]
[1] University of Iceland, Institute of Earth Sciences, Environment and Natural Resources, Reykjavik, Iceland
[2] Icelandic Meteorological Office, Reykjavik, Iceland

Much of the research regarding particulate matter (PM) in dust storms has focused on large global source areas such as in the subtropics. However, the high latitudes have been found to be a major source area for PM. Iceland's PM is unique in that it is mostly produced by volcanic eruptions and basaltic in nature. New particles produced by an eruption get deposited on the surface and are later resuspended. These new particles along with the pre-existing surface material undergo multiple erosion processes; i.e. glacial, fluvial and aeolian.

The frequency of volcanic ash and dust resuspension events, hereafter PM events, occurring in Iceland is dependent on weather conditions, proximity to a source area, and the time since the last ash rich eruption. Due to the frequently windy conditions and the fineness of volcanic ash, loose ash is frequently suspended into the atmosphere and affects the annual frequency of PM events. Within one year of the Grímsvötn eruption (2011) and two years since the Eyjafjallajökull eruption (2010) the frequency of PM events decreased below the 40-year average of 135 events per year by 45%. Volcanic ash is also worked into the surface, buried in snow packs on glaciers, or deposited outside of Iceland after resuspension; which results in lower than average PM events in the years following 2011.

Due to the basaltic nature of PM in Iceland, the physical characteristics are quite different from other major source areas. One of the major differences is the greater surface area compared to other natural dusts and minerals, as would be found in major source areas such as: The Sahara, Asia, and North America. The surface area is a key component in studying PM, as it can affect nucleation of water vapor, and can have greater health impacts. In addition, volcanic ash physical characteristics can pose a greater risk to human health compared to other natural dusts because it can be needle like in shape. Knowing the physical characteristics of PM is beneficial to understanding the hazards that Icelandic PM events pose.

O7.4
Changes in total ozone over Reykjavik during the late winter polar vortex seasons 1952 – 2018

Árni Sigurðsson (arnisig@vedur.is)
Veðurstofa Íslands, Icelandic Meteorological Office

Total ozone has been measured in Reykjavik since 1952 and with the same Dobson 50 instrument since 1957. By subtracting the less variable summer averages from the February to April averages, possible errors in the calibration can be bypassed from the highly variable polar vortex seasons data. It is interesting to see how temperature and sunspot numbers influence the total ozone amounts. Decades of warm or cold conditions can be clearly seen in few years running averages, also periods of high or low sun activity.

Temperature variations influence the thickness of the troposphere and create high or low shapes on the tropopause surface. The ozone density is highest within the lowest part of the stratosphere. Anomalies of ozone depend to a large degree on the localized thicknesses of the troposphere as can be seen on air mass rbg satellite images. This seems to explain the relationship between total ozone amounts and temperature and why during cold winter conditions the ozone is higher and during mild conditions the ozone amounts are less. Since temperatures are expected to rise in coming decades problems with low ozone minimums and high UV radiation may probably continue

O7.5
Weather and impact observations using a mobile weather app in Finland

Pauli Jokinen[1] (pauli.jokinen@fmi.fi), Ismo Karjalainen[1] (ismo.karjalainen@fmi.fi)
[1] Finnish Meteorological Institute

Since the summer of 2017 the Finnish Meteorological Institute (FMI) has implemented the possibility for the general public to send their own weather related observations through the FMI mobile weather app for smartphones. The list of possible observations have included very local weather phenomena that are otherwise hard or impossible to detect such as large hail or tornadoes. In addition the users are encouraged to send information on weather impacts such as wind damage or traffic disruptions. The users have the option to view their own and other users' observations on a map and filter phenomena that they are interested in.

Statistics have been gathered through this pilot project on the quality and quantity of citizen weather observations. This data helps to assess how viable these observations are as a supplementary source of information alongside the more traditional weather observations carried out by national meteorological and hydrological services.

The methods used to attract users to send their own observations are discussed. Furthermore we illustrate how meteorologists on duty can utilize the citizen observations during their shifts.

We share our thoughts on the successes of the project as well as discuss the shortcomings. These include viewpoints from the meteorologists and researchers as well as the citizens who send the observations. Finally future plans for the project are highlighted.

O7.6
Changes in soil temperature

Guðrún Nína Petersen (Icelandic Meteorological Office)

O8.1
Scapegoat, shillyshally or cicerone, the choice is yours.

Pererik Åberg, (pererik.aberg@svt.se)
Meteorologist at Swedish Television

How is it possible to show the public different weather scenarios and gaining trust instead of being called a dither? While the earth is warming and extreme weather events are more likely it´s crucial to have the public confidence even after one or two missed forecasts.

During my 20 years in presenting the weather on Swedish Television I have had some troubled situations to show several developments for the coming three to five days during my limited airtime. When taking a stand I´ve gotten criticism from meteorologist that it was to deterministic and when showing numerous options comments from the public have been that I don´t know squat about what´s going to happen.

With that said we have been able to give society a heads up to incoming extreme events. This information has been gratefully received and used by governmental agencies. But how to get the multiple-solution-message through to the individual person while keeping their confidence is and will be very important. Especially in cases where they need to take action.

At Swedish Television (SVT) we are in the progress of developing a way to turn this weakness into a strength by presenting alternative solutions in a smart and active way. By explaining the difficulties you're gaining the audience trust. Sounds easy, but it´s not. My presentation will discuss how individuals will perceive uncertain forecasts and I will show examples of how it might be represented in a way that been proven, both of experience and in the research of Dr Susan Joslyn at the University of Washington, to be successful.

I encourage comments and questions from the participants during my presentation.

O8.2 & O8.3
Impact based warnings, training the public and getting the message across

Elín Björk Jónasdóttir, group leader of weather services

Helga Ívarsdóttir, forecaster

Icelandic Meteorological Office

After more than a year of planning the Icelandic Meteorological Office launched a new weather warning system on 1. November 2017.

The warning system is a two-tier impact based colour coded warning system where the colour of warnings is decided by the likelihood of a certain weather materializing and the possible societal impact the weather is estimated create. This new system is far removed from the older warning system where single climatological thresholds were used for the whole country and societal impact was not considered.

At the start of the project it became obvious that the hardest part of issuing warnings from the forecaster's perspective would be to assess the possible impact. To decrease the pressure on the forecasters a close cooperation between forecasters and the Icelandic Civil Protection Authorities has become much better.

The experience from this first winter will be discussed, as well as concerns and lessons learnt along the way. We will also introduce statistics of warnings issued this winter and plans for upgrade before next winter, along with unexpected consequences, the yellow warning fatigue and challenges of introducing likelihood of weather to the public.

O8.4
New practise for weather warnings in Norway

Solfrid Agersten[1] (solfrid.agersten@met.no)
[1] Norwegian Meteorological Institute

Norwegian Meteorological Institute (MET Norway) and The Norwegian Water Resources and Energy Directorate (NVE) have started to use the Common Alerting Protocol (CAP) for distributing alerts and forecasts for extreme and severe weather and the danger of floods, landslides and avalanches. The use of CAP is the first of its kind in Norway, and serves as the start of a Norwegian standard (CAP-NO) which may be used for other types of alerts. The presentation will be about the weather warning collaboration and implementation of the CAP standard using the colour scale; green, yellow, orange and red. The talk will also be about some of the warning procedures, new tools and criteria for different weather types. The goal has been to improve communication and effectiveness of the warning services, so the presentation will give examples of warning products and services.

At last I will give some updates from the EMMA conference in Lisbon in May. The EMMA Project intends to display the alerts and warning of EUMETNET member countries in an easy understandable way by professionals and the public on the website meteoalarm.eu. Meteoalarm intention is to use CAP and the collaboration between the European countries is of interest also for the Nordic countries.

O8.5
Numerical Modelling Education at the University of Helsinki

Victoria Sinclair[1] (Victoria.Sinclair@helsinki.fi) and Heikki Järvinen[1]
[1] Institute for Atmospheric and Earth System Research / Physics, Faculty of Science, University of Helsinki, Helsinki, Finland

Today numerical weather prediction models play a key role in both research and operational meteorology. It is therefore vital that the next generation of meteorologists are educated both in the theory of meteorology but are also trained in the hands-on use of these complex numerical models. At the University of Helsinki, the “Laboratory Course in Numerical Meteorology”, known more often simply as NumLab, has been taught since the 1970s. Previously a different numerical was selected each time the course was taught which resulted in huge amount of preparation for the lecturer. Since 2015, the numerical model that students have learnt to use has been OpenIFS, and this will remain so for the foreseeable future. OpenIFS is a portable version of the Integrated Forecast System (IFS) developed and used operationally at ECMWF. OpenIFS has the same dynamical core and physical parameterizations as the IFS, but no data assimilation scheme, and is available to universities and research institutions under license for no cost. NumLab is aimed at MSc and PhD level students and is divided into two parts: during the first part of the course students learn to compile and run OpenIFS on a high performance computing (HPC) system and how to post-process, plot, and analysis the model output. During the second part of the course students conduct small research projects in groups during which time they learn to modify the source code and perform sensitivity studies. At the end of the course there is a final seminar. To date, about 60 students have taken the course, and have thus learnt very work-relevant skills. In this contribution, I will discuss the course in more detail and reflect on our experiences of teaching numerical modellng skills.

O9.1
On recent developments and challenges associated with the operation and utilization of renewable energy

Øyvind Byrkjedal, Kjeller Vindteknikk

The technology development within renewable energies has over the recent years put increasing demands on having a precise knowledge of atmospheric processes and changing weather conditions. Renewable energy sources as wind and solar have become highly competitive to other sources and are in many regions outcompeting traditional energy sources. The reduced cost of energy from renewable is governed by the technology developments and improved utilization of the wind- and solar resources.

Within wind energy, the turbines are now designed with adaptive systems tailored to the specific site, and with more intelligent systems to maximize the energy harvest while minimizing the fatigue loads that are caused by e.g. turbulent flow and ice buildup on the turbine blades. In order to control such systems in an optimal way, accurate weather forecasts are required in addition to good sensor technology.

The increase of the share of these volatile renewable energy sources is challenging for operating a stable electrical grid. Ramps in the energy production from wind energy can be caused by the passage of high wind systems while in solar energy partly cloudy days can be challenging. For both applications, improved predictability of such events is important and requires further research and development within the field of meteorology.

O9.2
Wind, Ice and Snow Load Impacts on Infrastructure and the Natural Environment

Harold Mc Innes[1] (haroldmi@met.no), Andreas Dobler[1], Bjørg Jenny Engdahl[1], Kristian Ingvaldsen[2], Bjørn Egil Nygaard[2], Svein Solberg[3]
[1] The Norwegian Meteorological Institute
[2] Kjeller Vindteknikk
[3] The Norwegian Institute of Bioeconomy Research

Loads from wind, atmospheric icing and wet snow occasionally cause damage to forests and technical infrastructure such as power lines, leading to large expenses and sometimes danger to human life. There has been a need for more and improved data on these climatic loads, and consequently The Norwegian Research council has financed the research project Wind, Ice and Snow Load Impacts on Infrastructure and the Natural Environment (WISLINE), which main objective is "To quantify climate change impact on technical infrastructure and the natural environment caused by strong winds, icing and wet snow". The fulfilment of this objective requires skilful modelling of processes in clouds, production of datasets for present and future climate together with risk modelling of forest damage.

WISLINE addresses microphysical processes in the NWP model AROME through a PhD project, and datasets describing wind and icing climatology in Norway for both present and future climate are prepared. These data are furthermore coupled with forest damage data in order to fit a statistical model and produce a risk map for weather-induced forest damage. The project involves The Norwegian Meteorological Institute, The University of Oslo, Kjeller Vindteknikk, The Norwegian Institute for Bioeconomy and National Center for Atmospheric Research in Colorado.

Several experiments have now been carried out with different modifications of the AROME microphysics scheme in order to investigate distribution of ice and liquid water as well as precipitation processes. During this work a bug in the microphysics was revealed, leading to a bug fix which will be implemented in the code that is run operationally. The model's ability to predict supercooled liquid water and consequently atmospheric icing is currently being improved.

A dataset for present climate (2000-2015) at 2.5 km resolution has been produced by downscaling wind, temperature and precipitation from the NORA 10 dataset against one year of data from the AROME model. Furthermore a 12 year hindcast dataset from AROME has been prepared, and is currently being validated. This dataset covers the entire of Norway and has variables such as soil moisture and soil temperature in addition to the atmospheric data. These data are now being correlated with forest damage data in order to fit a model for predicting weather-induced forest damage.

Datasets for future climate are now being prepared, and will allow us to study how climate change impacts climatic loads on technical infrastructure and forests. A master study carried out under the

WISLINE project has also provided interesting results on impacts of climate change on icing conditions in Norway using a so-called pseudo-global-warming method.

O9.3
Forecasting energy wood moisture change with meteorological grid data

Johanna Ruotsalainen[1] (johanna.ruotsalainen@fmi.fi), Johanna Routa[2], Marja Kolström[3], Jari Lindblad[2], Lauri Sikanen[2]

[1] Finnish Meteorological Institute, Aviation and Military Weather Services, Kuopio, Yliopistonranta 1F, FI-70210 Kuopio

[2] Natural Resources Institute Finland, Luke, Yliopistokatu 6, FI-80100 Joensuu, Finland

[3] University of Eastern Finland, School of Forest Sciences, P.O. Box 111, FI-80101 Joensuu, Finland

Energy wood is an important source for biomass energy production in Finland. In 2016, heating and power plants consumed 7.3 million cubic meters of forest chips, chipped energy wood, in Finland. A cost-effective system for procuring energy wood calls for good quality material but also low transportation costs. Moisture content influences on energy wood calorific value and obviously on transportation costs and furthermore CO_2 emissions.

Natural drying is widely used to decrease the moisture content of energy wood piles. Drying is depended on weather and microclimatology of the storage area. Meteorological data based models can be used to forecast moisture content change. We found out that evaporation and precipitation are major meteorological factors influencing the drying process. We have developed models for both in stand and for roadside storage piles. Models are simple one-dimensional linear regression models and are therefore easily adopted to forest companies own systems.

Forecast area covers whole country because Finnish Meteorological Institute has a database for interpolated meteorological observations in a 10 km x 10 km grid. This grid data is interpolated with Kriging method and it contains observations of e.g. temperature, wind, relative humidity and precipitation. Potential evaporation is estimated with Penman-Monteith method.

Our models work well with stem wood, but there are challenges with harvesting residues such as tree tops and branches. For example determining the initial moisture content, the moisture content of fresh wood, is done at the moment with average values because measuring moisture content on field operations would be expensive and time consuming. Also, in contrast to stem wood, harvesting residues have higher surface area to volume ratio effecting on evaporation rate. Storage pile properties such as height, form and structure have impact on modelling moisture changes.

Description of microclimatological conditions of the storage areas e.g. shadowing of surrounding forests and snow (above and sometimes also under the pile) could be improved in the future. Also dry matter loss has to be taken into account. Furthermore, we have so far only used history data to forecast current moisture levels, but in the future, it could be possible to use numerical weather prediction models to produce the needed input data for moisture change forecasts.

O9.4
Useful meteorological concepts from recent research

Haraldur Ólafsson (University of Iceland & Icelandic Meteorological Office)

O9.5
The ICRA-2016 reanalysis for Iceland and products developed for the national power company Landsvirkjun

Bolli Pálmason (Icelandic Meteorological Office)

Posters

ICELANDIC AEROSOL AND DUST ASSOCIATION (ICEDUST)

Pavla Dagsson-Waldhauserova [1, 2] (pavla@lbhi.is), Haraldur Olafsson[3, 4], Olafur Arnalds[1], Ragnhildur Gudrun Finnbjornsdottir[5], Þorsteinn Johannsson[5], Mary K. Butwin[3,4], Throstur Thorsteinsson[3], Sibylle von Lowis of Menar[4], Melissa Anne Pfeffer[4], and Outi Meinander[6]

[1] Agricultural University of Iceland, Faculty of Environment, Hvanneyri, Iceland
[2] Czech University of Life Sciences Prague, Prague, Czech Republic
[3] University of Iceland, Department of Physical Sciences, Reykjavik, Iceland
[4] Icelandic Meteorological Office, Reykjavik, Iceland
[5] Environment Agency of Iceland
[6] Finnish Meteorological Institute, Finland

Iceland is the largest Arctic and European desert with high dust event frequency as well as many active volcanoes producing large amounts of tephra. The Icelandic Aerosol and Dust Association (IceDUST) was established in the year 2016 to promote collaboration and communication in the field of aerosol research in Iceland with the emphasis on local volcanic dust. Over 40 publications have been published on Icelandic dust and volcanic ash by the IceDUST members. The IceDUST Association serves as a platform for communication between the Icelandic aerosol researchers, in addition to providing information to other academic bodies located in Iceland and abroad.

International researchers with interest in Icelandic volcanic desert environments have recently joined the Association. The members are from the research institutions in Finland, Austria, Czech Republic, United Kingdom, France, Germany, Italy, Norway, Canada, Ireland, Japan, Serbia, USA, and other. Icelandic working groups at different research institutions monitor or research aerosols, volcanic dust and fresh volcanic ash. The groups focus is on:
i. Field monitoring of dust sources at the surface
ii. Atmospheric conditions and aerosol concentrations near surface and as in the upper atmosphere
iii. Radar and Lidar monitoring
iv. Health impacts of dust and volcanic ash
v. Dust modeling and forecasting
vi. Remote sensing
vii. Atmosphere-cryosphere interactions of dust deposited on snow and ice

The IceDUST Association launched a website about its activities and publications. It can be found at https://icedustblog.wordpress.com/. The publications are arranged in order of specific research themes such as:
i. Review papers and books on Icelandic and High Latitude dust
ii. Long-term studies and quantification of dust events
iii. Field and *in situ* measurements in Iceland
iv. Long range transport of Icelandic dust
v. Atmosphere-cryosphere interactions of Icelandic dust, volcanic ash and Black Carbon including their climate implications
vi. Health effects of Icelandic volcanic dust and ash
vii. Extreme events in Iceland

If you are interested in IceDUST activities or you have just witnessed a dust storm in Iceland or high latitude areas which you would like to report, please contact us at pavla@lbhi.is.