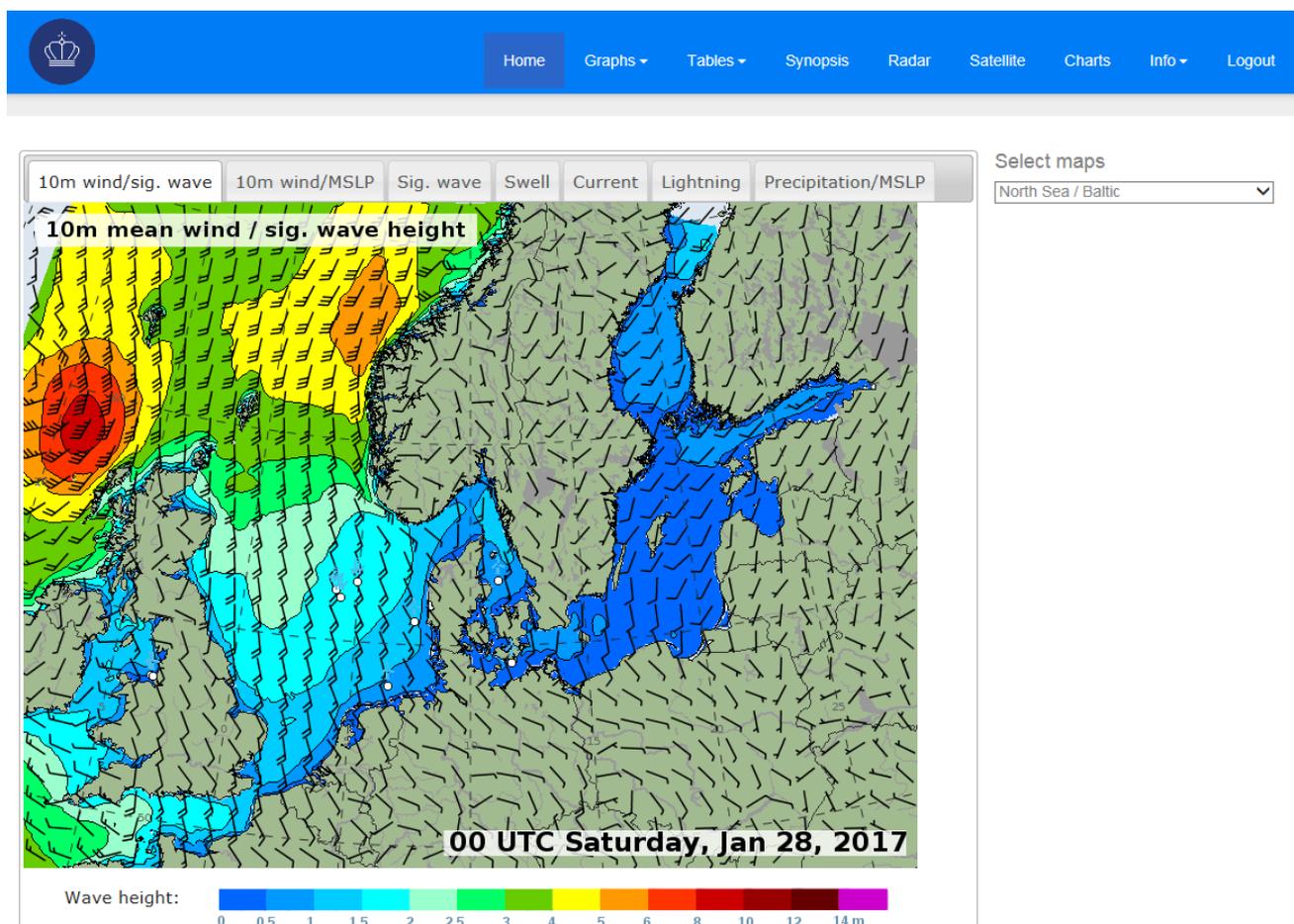
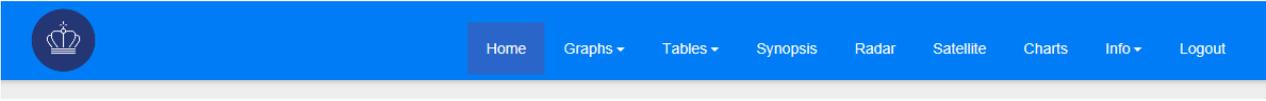




# Marine Forecast Service User Guide



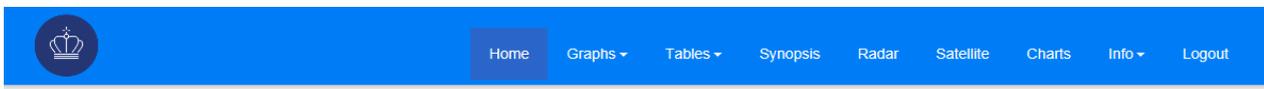
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## Introduction

The Marine Forecast Service web site displays an overview of various MetOcean data (meteorological and oceanographic data). These are available as specified, detailed model outputs from the DMI-HARMONIE (DMI-[High Resolution Limited Area Model](#)) which is run each 6th hour and presents data with one hour intervals, currently up to 54 hours from the latest model run. Thereafter most data from the ECMWF (The [European Centre for Medium-Range Weather Forecasts](#)) model, in a slightly coarser resolution, are presented on a time range of up to 10 days. An exception is the Lightning Index, solely extracted from the DMI HARMONIE model and thus only available up to 48 hours from latest model run. Other exceptions are Current, Sea level and Sea temperature which is available up to 120 hours from latest model run.

Data from the DMI HARMONIE and ECMWF models are accessible via the [Menu Tool Bar](#) under the panes [Home](#), [Graphs](#) and [Tables](#):



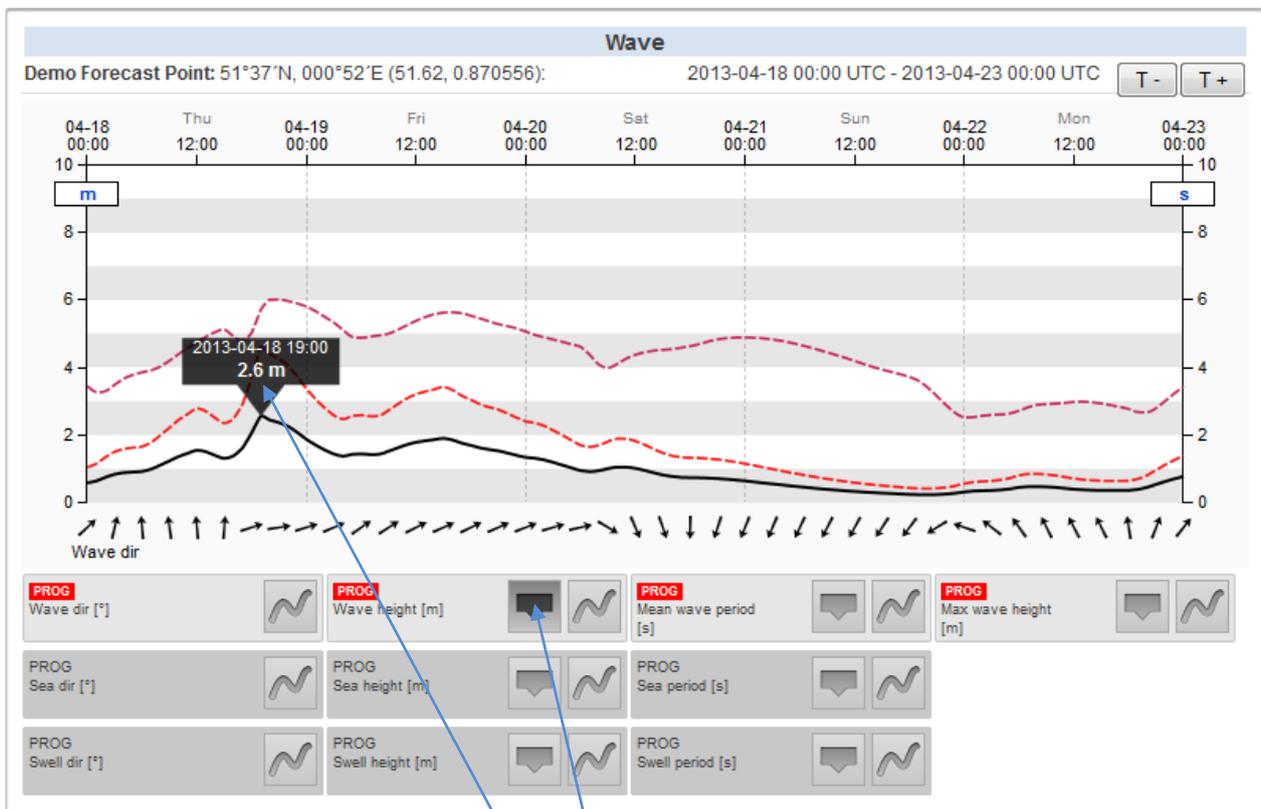
## Graphs

Graphs are divided into **Forecast**, **Observation** and **Probability**.

The interactive graphs make it possible to add and remove parameters in the presentation by clicking the graph button .

The light grey button colour indicates that the parameter is shown in the window and the darker grey colour indicates that the parameter is currently not shown.

The forecast graphs are flexible in time. It is possible to vary the period of interest from 3 to 10 days ahead by clicking the “T-” and “T+” buttons in the right part of the header in the graph window.



This is also highlighted with the red “**PROG**”-square, which means that the data is forecast data shown currently in the graph window.

A green “**OBS**”-square means that the data is observation data and the blue “**ENS**”-square means that the data is ensemble data.

It is possible to highlight a single forecast parameter in order to get the exact forecast value by using the mouse-over function and it is also possible to highlight the

entire graph in yellow by moving the mouse cursor across the button for the parameter.

Direction arrows for sea, swell, sig. wave, wind and current are shown below the graph window.

The above graph window is the **Wave**-window. The graph buttons for direction, height and period are ordered in columns, so that direction is the 1<sup>st</sup> column, height is the 2<sup>nd</sup> column and period is the 3<sup>rd</sup>.

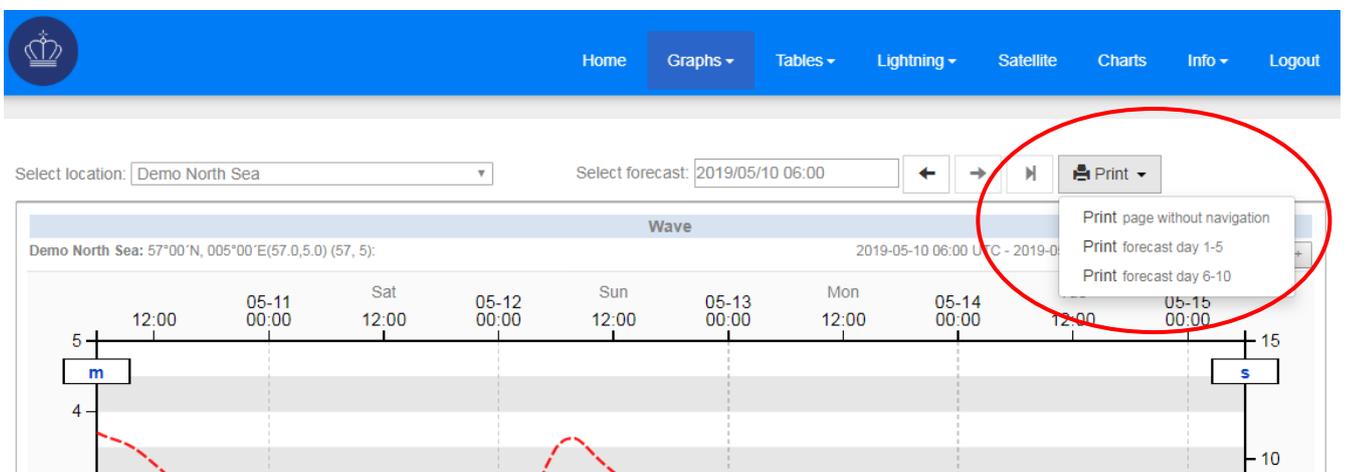
The parameters wave (Hs), sea (wind waves) and swell are ordered in rows, so that wave is the 1<sup>st</sup> row, sea is the 2<sup>nd</sup> row and swell is the 3<sup>rd</sup> row.

Wind data is shown in the **Wind**-window. The data for “Precipitation”, “2m temperature”, “Sea temperature”, “Lightning”, “MSLP”, “Visibility” and “Relative humidity” are shown in the **Weather**-window and “Current” and “Sea level” data is shown in the **Current**-window.

Print graph report

It is also possible to print the forecast. Here you can choose:

- Print the graphs, as you see them on MFS
- Graphs showing the forecast 1-5 days ahead
- Graphs showing the forecast 6-10 days ahead



## Observation

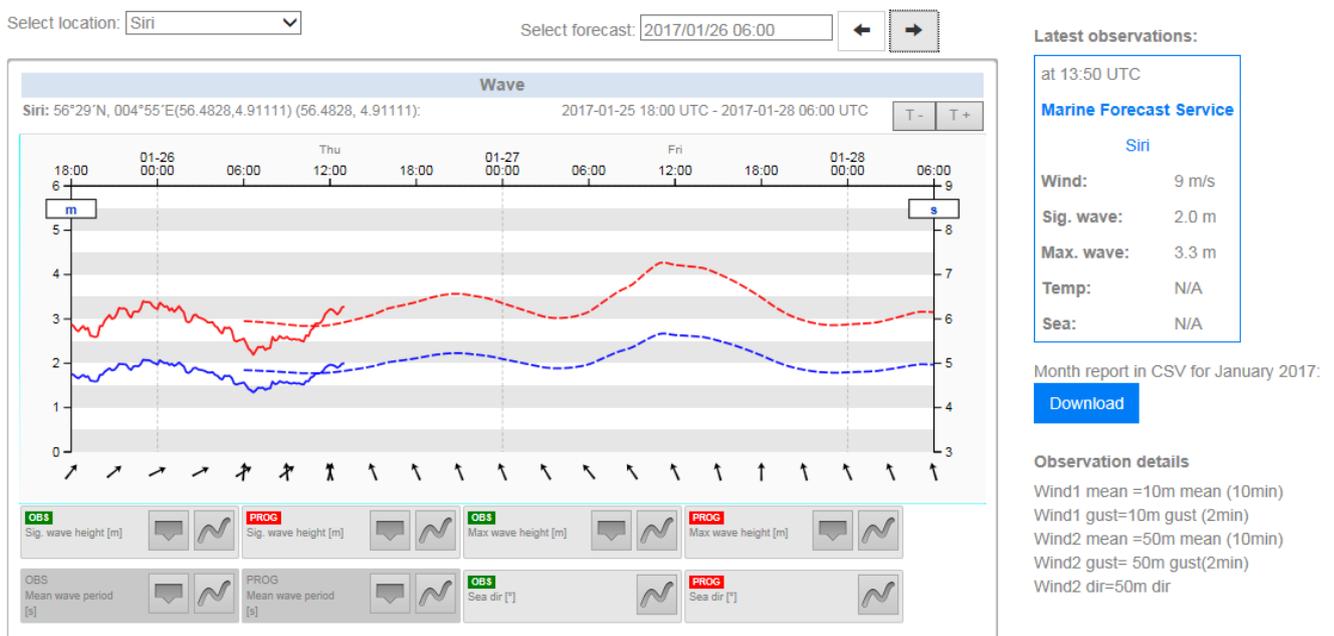
If observation data is provided from the client to DMI, the data will be shown in **Observation** both in **Graphs** and **Tables**. This offers an overview of the observed values and the forecast values of the displayed parameters. Observation data is displayed by a solid line with the same colour as the forecast data. In below figure

the significant wave height (blue line), the maximum wave height (red line) and the direction of the sea are displayed.

If wind observations are available, the height from mean sea level is shown to the right of the window in “Observation details” and also to the right of the table with observations in [Tables](#). Please keep that in mind when comparing forecast data from one level with observation data from another level.

Above “Observation details” you will find a link to download all observation data for each month displayed as graphs. You can change month under “Select forecast”.

Just above this link, you will find a display with the “Latest observations”. Please note that the observation data is not necessarily from the timestamp shown in the top of the display but is the latest data at that time.



Please note that there will be minor discrepancies between the model output and the observations, in time as well as in quantitative terms. In a “perfect forecast” the graphs would be similar and generally the differences will be least in the beginning of the forecast and also in uncomplicated weather situations, where no frontal passages occur. In the opposite end of the scale, delayed frontal passages, hard predictable increasing surface winds ahead of these and other small-scale meteorological phenomenon may lead to larger discrepancies between the observations and the model output data. In such case you shall be welcome to contact the Operation Centre for a clarification about the situation.

## Probability

The Marine Forecast Service web site includes probability forecast parameters which provide valuable information about the reliability of the forecasted weather development. This feature is only available for Northwest Europe.

The **Probability** data is from ECMWF and is compared to the high-resolution data for both 10m mean wind and for significant wave height. The available data is the median, minimum, maximum and the 10<sup>th</sup>, 25<sup>th</sup>, 75<sup>th</sup>, 90<sup>th</sup> percentile.

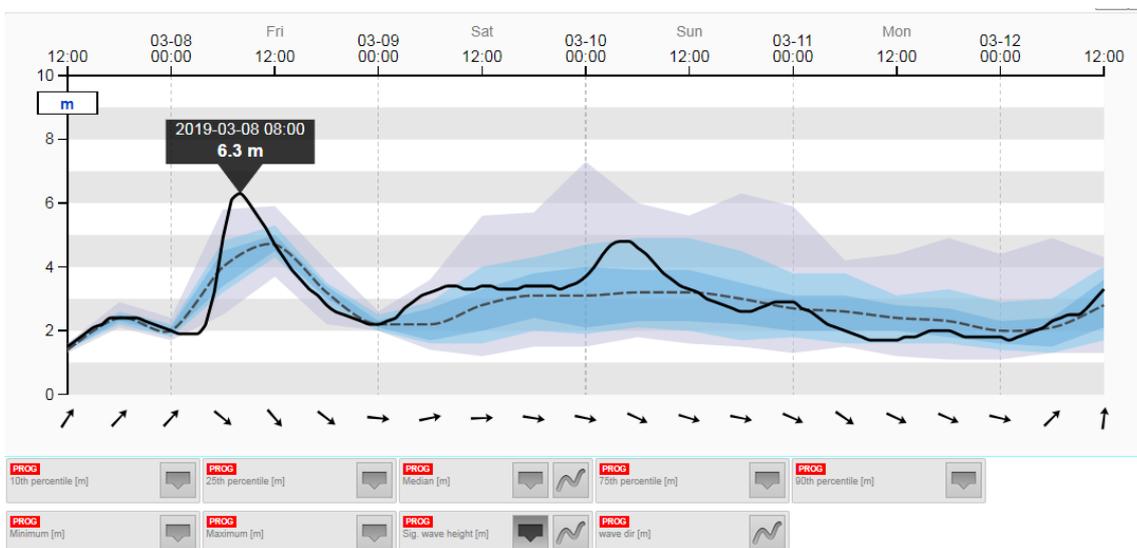
The **Probability** data is a probabilistic interpretation of the forecasts from the Ensemble Prediction System (EPS) for a given location. It displays the time evolution of the distribution of several atmospheric and wave parameters in the ensemble forecasts (currently made of 50 members, each starting from slightly perturbed initial conditions) for up to 10 days. The 10-day EPS-data provide information every 6 hours. The ensemble median is shown as a dashed white line and the high-resolution deterministic forecast is shown with a blue line for significant wave height and a black line for 10m mean wind.

Since all ensemble members are on average equally likely, the probability of a weather event is simply defined as the proportion of EPS members forecasting this event. Note that if none of the 50 members has the event, the computed risk should not be considered to be strictly 0%, as it should not be strictly be considered 100% just because all of the 50 members have the event.

When creating the **Probability** data for a specific location, the four surrounding grid points are considered, and the nearest sea point is selected.

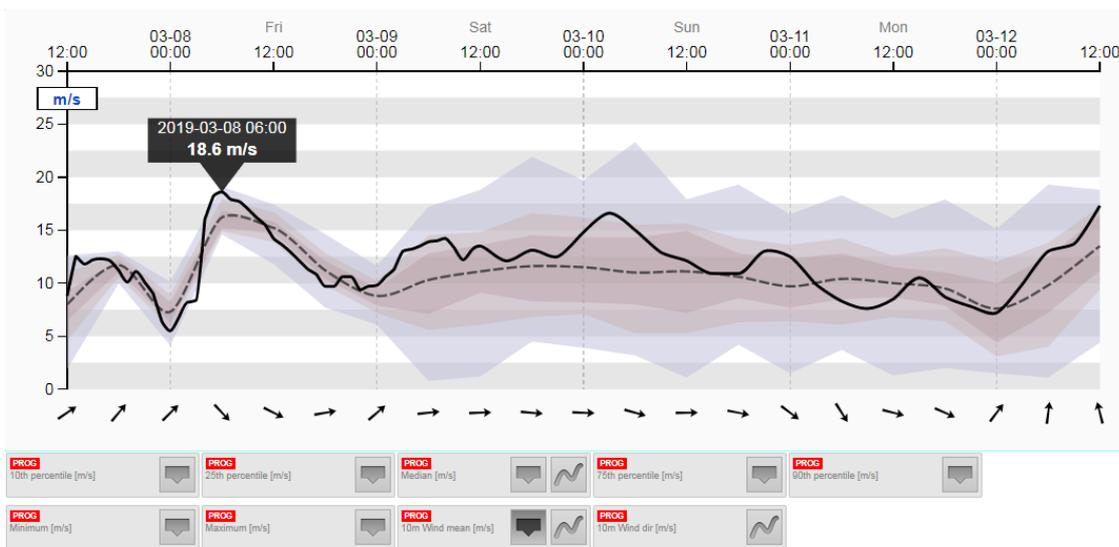
### *The use of the **Probability** data*

If the median (50<sup>th</sup> percentile) has the value of 1.5m significant wave height at a given time, then it means that 25 of the ensemble members forecast a wave height below 1.5m and the other 25 members forecast above 1.5m at that specific time. In a few occasions you will see that the high-resolution forecast has values lower or higher than the minimum and the maximum. Below is an example showing a peak in the significant wave height of 6.6m where the 90<sup>th</sup> percentile has a value of 6.1m.



The probability data should be used as a tool for estimating how reliable the forecast is for the coming 10-day period regarding wave height and wind. The confidence level for the forecast is high the first days and becomes lower from Saturday the 9<sup>th</sup> in above example. The mentioned peak of 6.3m Hs should thus be treated with caution and will most likely be forecast too high. A rule of thumb says that the ensemble median scores higher than the high-resolution forecast after day 5.

Below is the associated probability data for wind, where the mentioned peak is shown for wind as well.



## Table with Weather Window Finder

The forecast table makes it possible to insert user-defined weather limits for different operational scenarios. The limits can be saved for later use as a “scenario”. You will find this possibility just above the table. When weather limits are inserted, the possible weather windows are shown as green in the table and the Weather Window Finder. Yellow is near the limit and red is exceeding the limit. The Weather Window Finder is a visual summary of the different potential weather windows for each parameter where a limit is inserted and is displayed for the next 48 hours.



Select location: Demo North Sea

Select forecast: 2016/08/24 00:00

1200 1800 0000 0600 1200 1800 0000 0600 1200

Jan 17 Jan 17 Jan 18 Jan 18 Jan 18 Jan 18 Jan 19 Jan 19 Jan 19

Column visibility Print Show 10 rows Clear limits

Scenario: Select scenario

Date	10m Dir (°)	10m Mean (m/s)	10m Gust (m/s)	50m Mean (m/s)	Sig. wave height (m)	Max wave height (m)	Wave period (s)	Wave Dir (°)	Swell height (m)	Swell period (s)
Maximum limit:	<input type="text"/>	<input type="text" value="10"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text" value="1.5"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Minimum limit:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
20160824 0000	166	5.0	5.7	5.8	0.6	1.0	4.4	224	0.5	5.0
20160824 0100	162	5.7	6.5	6.5	0.6	1.1	4.1	217	0.5	5.0
20160824 0200	165	5.9	6.8	6.8	0.6	1.1	3.8	210	0.5	4.9
20160824 0300	159	6.1	7.0	7.0	0.6	1.1	3.7	203	0.5	4.8
20160824 0400	153	6.3	7.2	7.3	0.7	1.2	3.6	196	0.5	4.6
20160824 0500	149	6.8	7.8	7.9	0.7	1.2	3.6	187	0.4	4.6
20160824 0600	145	7.4	8.5	8.6	0.7	1.3	3.5	176	0.4	4.6
20160824 0700	152	8.0	9.2	9.3	0.8	1.4	3.5	168	0.3	4.8
20160824 0800	151	8.4	9.6	9.8	0.8	1.5	3.6	164	0.3	4.9
20160824 0900	151	9.1	10.4	10.7	0.9	1.6	3.7	160	0.3	5.0

Showing 1 to 10 of 161 entries

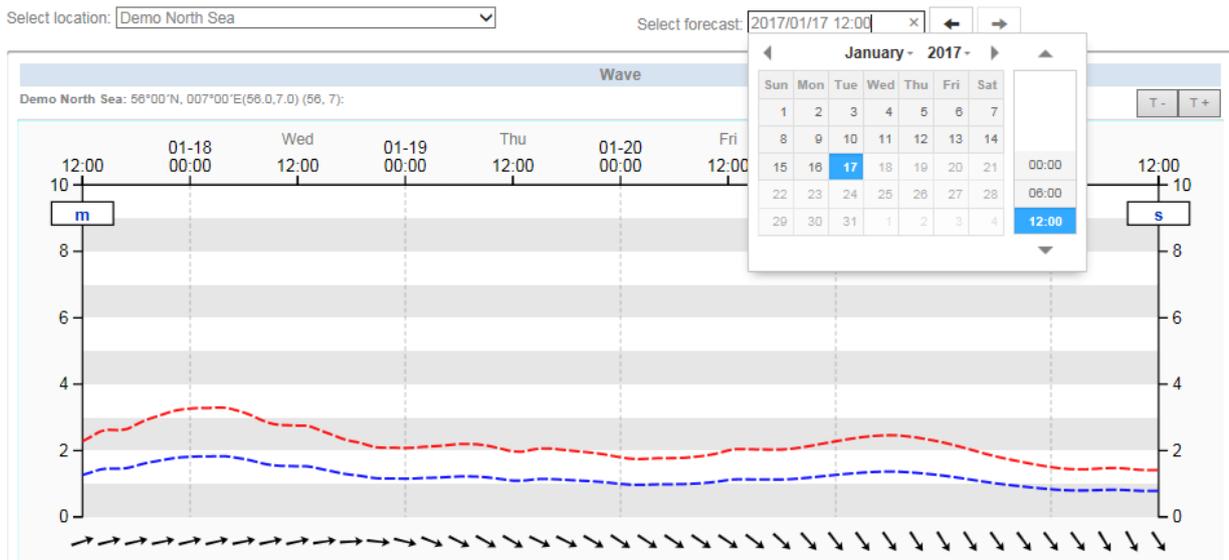
Previous 1 2 3 4 5 ... 17 Next

It is possible to see all available forecast parameters by clicking [Column visibility](#) and then add the other parameters.

Probability data is also available as table data as well as observation data, but observation data is of course only available if the client provides data from an installed buoy, LIDAR or metmast at a preferred location.

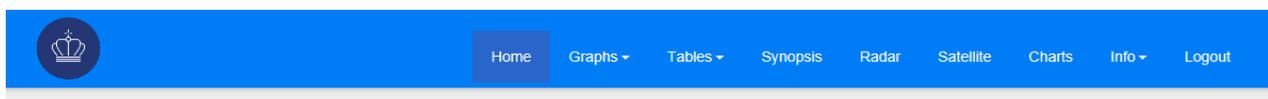
## Retrieving historical observation- and forecast data

Just below the menu toolbar you will find an option for retrieving old data under the **Graphs** pane as well as under the **Table** pane, in graph- as well as in table form. These archived data will be available back to the first active day for the chosen forecast position, aiding you to evaluate the historic, weather related aspects of an eventual pausing of the operation for a given location.

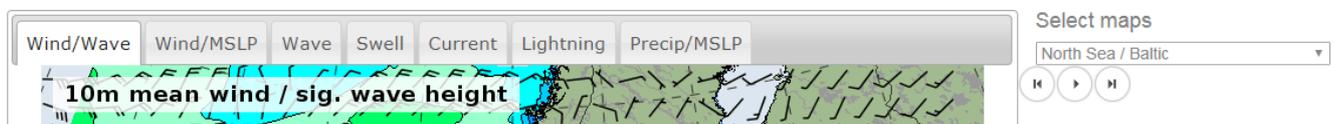


## Home

Data from the DMI HARMONIE and ECMWF model are accessible via the **Menu Tool Bar** under the panes **Home**, **Graphs** and **Tables**:

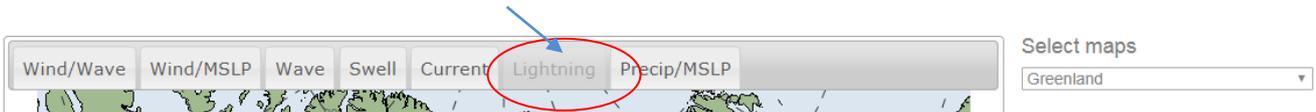


The most relevant data are shown as composite data fields under the pane **Home** for the following parameters:



This feature is available for Northwest Europe, Greenland, US Eastcoast, Caribbean Sea and East Asia. Other regions can be setup as well by request.

When a parameter not is available, for instance lightning risk for the Greenlandic area, the tab becomes light grey:

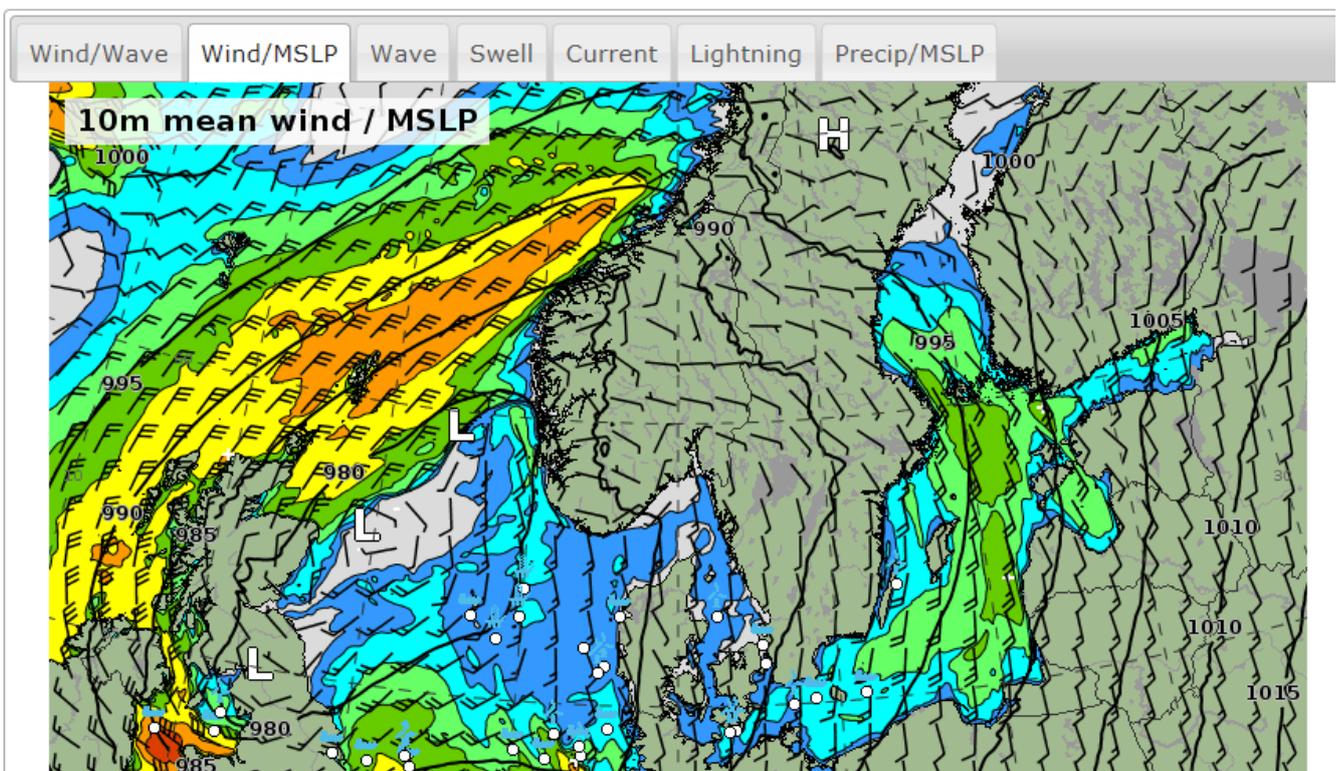


Below are listed definitions of the used parameters and terms:

### *10m mean wind*

The 10m wind, also called the 10m mean wind, is the computed average wind vector in 10m above the ground for every grid point in the model. You can find the field displayed along with the significant wave height ([10m wind/sig. wave](#)) and along with the mean sea level pressure ([10m wind/MSLP](#)). The 10m mean wind is of course also shown in [Graphs](#) and [Table](#).

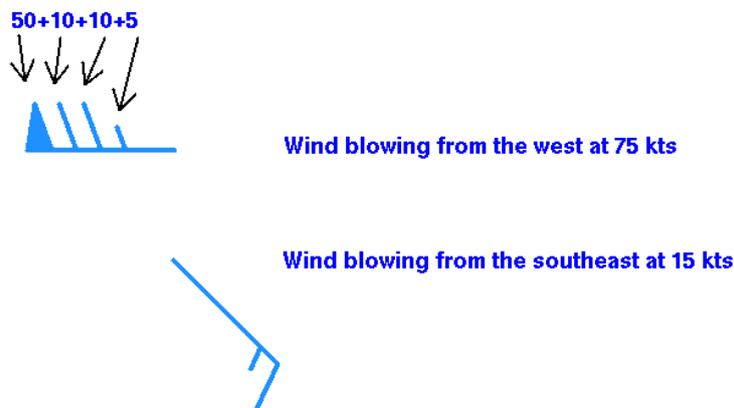
The international standard for wind symbols, here shown on a map west of Norway is given below.



The legend for the strength of the wind is divided into colours with an increment of 2 m/s, as shown below, from 6 m/s. An exception is the 24.5 m/s limit which is the limit for 10 Beaufort – storm force.



The arrow is pointing in the direction the wind will blow. The feathers show the force of the wind. A big feather equals 10kts and a small one 5kts. A flag represents 50kts, storm force. See below example:



### *10m wind gusts and 50m/100m winds*

The 10m wind gusts are peak winds, to be expected beyond the mean wind. The data are found in the [Graphs](#) pane under [Forecast](#) and are shown with the wind force in knots or meters per second (m/s) up the Y-axis and direction of the wind as vectors along the X-axis, also displaying the time and direction from where the wind comes. The 10m gusts are represented by the red graph and are also shown under the [Table](#) pane. The gusts are normally highest in a cold and unstable air mass, as well as in connection with frontal zones. In the graph window for wind, you will also find mean, direction and gust data for the wind in 50m and 100m elevation, displayed in the same manner, but with different graph colours.

### *MSLP*

The **M**ean **S**ea **L**evel **P**ressure is the forecast value of the pressure reduced to mean sea level. The parameter is displayed together with the 10m wind ([10m wind/MSLP](#)) and with the accumulated precipitation ([Precipitation/MSLP](#)) under [Home](#) and is also found in [Graphs](#) under [Weather](#) and in [Table](#).

## *Sig. wave height and max wave height*

The significant wave height is defined as the average height of the one-third highest waves of a given wave group. This parameter is displayed along with the 10m wind under [Home](#) as [10m wind/sig. wave](#) and alone with the sea direction (nearly equal to direction of the wind) as [Sig. wave](#). The significant wave height is shown as a blue graph in [Graphs](#).

The period for significant wave height can be displayed as the "mean period". This is also equivalent to the period called "zero crossing period" or "Tz".

The period can also be displayed as the "peak period" abbreviated as "Tp".

The max wave height is shown as a red graph in [Graphs](#) and is normally 1.6 to 1.8 times higher than the associated significant wave height.

## *Sea*

Wind generated waves (also known as wind waves) as a function of wind force, duration- and distance over which the wind creates these (also known as fetch). The sea is not displayed as a single forecast parameter as a field under [Home](#) but is instead used to deduce significant wave. See below. The height of the sea, the direction and the period are shown in [Graphs](#) and [Table](#).

## *Swell*

The swell refers to waves with a longer wave period and length, than the wind driven seas in the area. The swell is not generated by the local wind but originates from seas formed some distance from the area, most often coming from another direction than the seas. The swell is described as a swell height, a direction and a swell period.

In [Graphs](#) under [Forecast](#), the pink graphs show the swell height in meters and the swell period in seconds along the Y-axis to the left side of the coordinate system. Along the X-axis the swell direction (coming from) is shown as a function of time.

## *Current*

The surface current is also displayed as a field in [Home](#). The strength is shown in knots in the colour-legend and the direction is shown as arrows. Please note that the current direction we use in MFS is "coming from", i.e. 90 degrees in the [Table](#) means coming from east (towards west or 270 degrees).

Current is also shown in [Graphs](#) with speed along the Y-axis as a function of time along with the direction depicted as arrows.

## Sea Level

The sea level parameter include input from tidal sea surface elevation, 10 wind speed and direction, MSLP, 2m air temperature, 2m air humidity and other inputs.

## Lightning

The lightning index is a composite model output based on various atmospheric instability indicators, implying an increasing risk of lightning and thunderstorms from 0 to 100. The parameter is displayed graphically in [Lightning](#) under the pane [Home](#) in the interval 20-100 (see below legend) and also found in [Graphs](#) and [Table](#) in the interval 0-100.



The legend provides a practical risk assessment, starting with index 20 and steps of 20 up to 80; then with intervals of 5 from 85 up to 100. We normally refer to following terms of use, anticipating that all values below 20 means practically no risk of lightning:

Low risk : 20 - 59  
 Medium : 60 - 84  
 High risk : 85 - 100

If you subscribe to our active lightning now casting service, *DMI Maritime Service* will monitor the actual real time weather situation and contact you by phone when we judge the situation to be obvious for lightning to occur in the area of interest. This may happen when the lightning index is medium or even low, bearing in mind that the lightning index is merely a risk indicator and not a real observed or measurable parameter.

Lightning detection for the Danish area is available in connection with the weather radar data.

## Precipitation

This parameter is displayed in the [Graphs](#) pane under [Weather](#) as well as under [Home](#) together with MSLP ([Precipitation/MSLP](#)) and is defined as the accumulated amount of precipitation per time step (one hour for HARMONIE data and three hours for ECMWF data). Thus if an estimate of the accumulated precipitation over a given area is required for a given period, you must add the amount from each one-hour step, to obtain this.

## Visibility

Visibility is a very tough meteorological parameter to forecast. Please be careful only to use the visibility forecast as a rough indication for the possible visibility and for indicating the risk for foggy conditions.

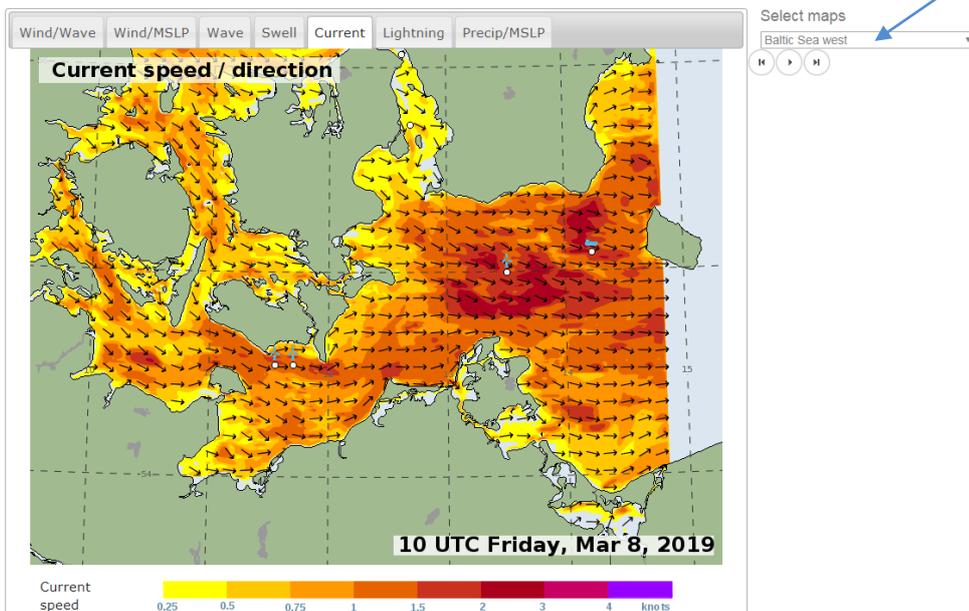
The visibility forecast is for 2m above mean sea level and is displayed in the [Graphs](#) pane under [Weather](#) and of course also in [Tables](#).

## Relative Humidity

The forecast for relative humidity is for 2m above mean sea level and is displayed in the [Graphs](#) pane under [Weather](#) and of course also in [Tables](#).

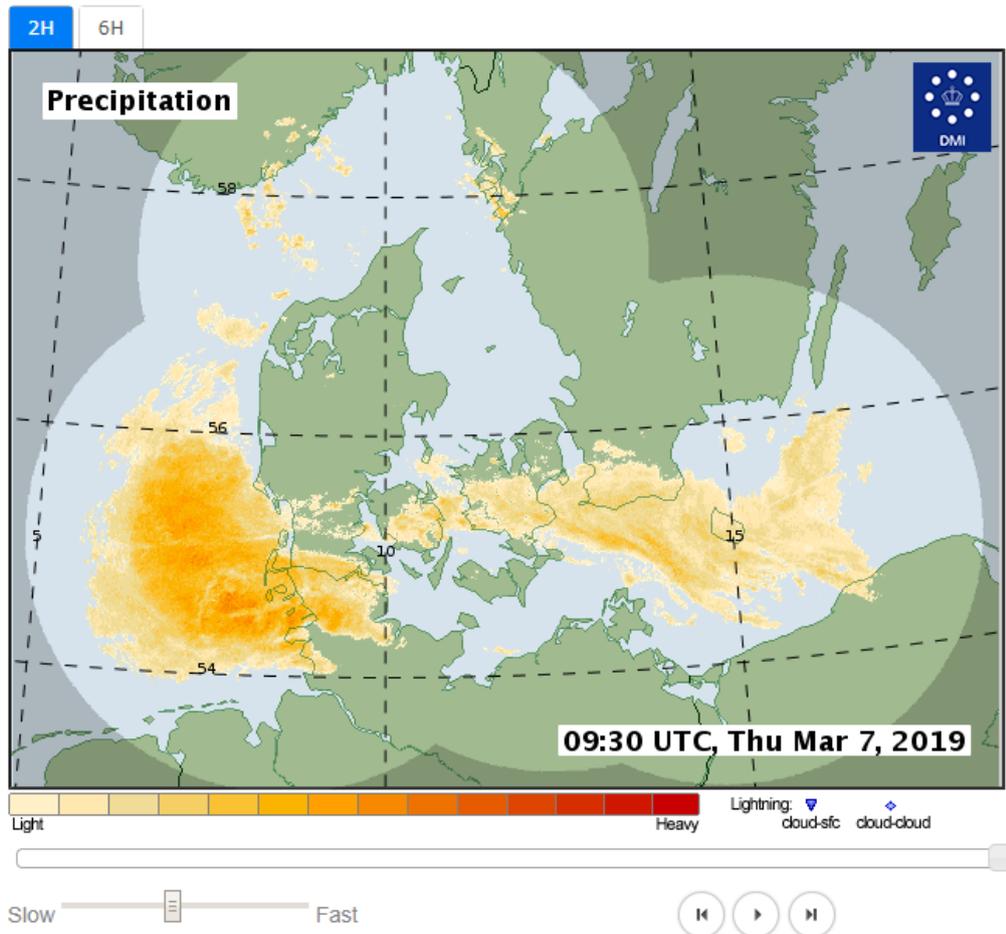
## Detailed site-specific forecast maps

The Marine Forecast Service web site includes more detailed forecast maps and also site-specific forecast maps. This allows the user to evaluate the weather development at his specific location up to 48 hours by using the slider (left mouseclick).



## Radar and lightning detection (in Danish area)

The 2- or 6 hours weather radar animation displays precipitation intensities on a colour scale ranging from light to heavy and detected lightning is shown as blue triangles and squares.



Under certain circumstances, a false echo may be displayed. The main reason for this is “ground clutter”, when low elevation beam angles are used and when a low-level inversion exists (warm air aloft and cold underneath).

Another phenomenon, leading to false echoes is called “high super-refraction” also known as ducting. If the radar beam bends down towards the earth’s surface enough to intersect with this, some of the energy from the earth will then backscatter to the radar and lead to false echo.

A false echo most often differs from a real one in terms of an unusual shape with sudden, sharp changes in intensity. Furthermore, the motion tends to be erratic, so the best comparison is surface observations as well as satellite data.

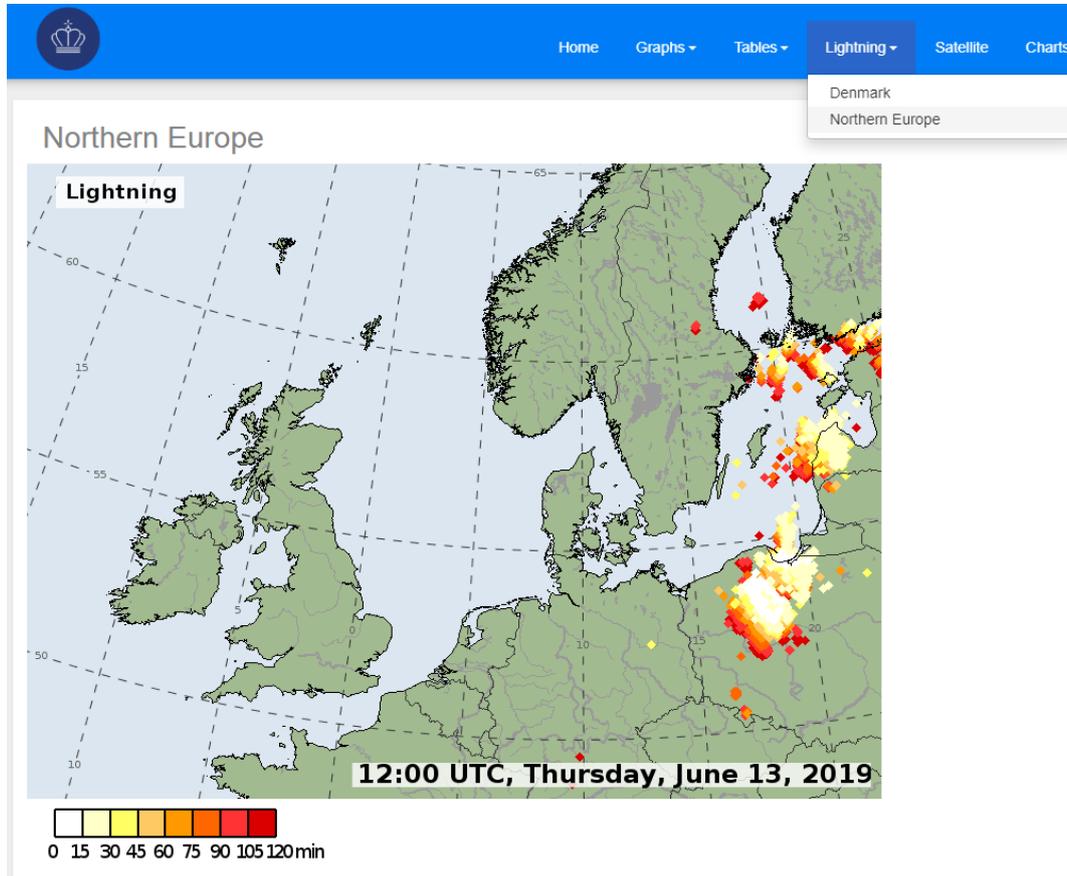
In some cases, precipitation may fall even though the radar does not show any echo. This is sometimes the case when the radar beam fails to reach the precipitation producing cloud droplets. For example, dissipating showers may still produce precipitation, although they may not be visible on the radar.

In situation with advection of warm air over a colder surface, low clouds may produce drizzle, which is often not detected even during moderate intensities.

## Lightning detection (in main part of Europe)

Lightning for the main part of northern and central Europe is depicted in colours as shown in below picture.

Click on refresh to get the latest data. Data are updated every 5<sup>th</sup> minute.



## Satellite

The satellite animation offers 3- or 9 hours animations in both the visual and infrared channel. The infrared channel is virtually a temperature channel, displaying temperature of the cloud tops. Lower and warmer clouds will appear grey, while higher clouds will appear whiter. This is a very usable feature when it is too dark to see heavy showers or thick frontal clouds, when precipitation is expected.

### *Precipitation*

Please note that this product has a more limited use at night (when dark) as the data input from visible light is missing.

The objective of this satellite-based precipitating clouds product is to support detailed precipitation analysis for now casting purposes. The product primarily provides probability results for precipitation occurrence and secondary it indicates

the precipitation intensity. It is not intended to provide information on the type of precipitation.

The data is determined from a comprehensive dataset of collocated satellite data, precipitation rates from surface radar and surface temperatures from NWP. Special attention has been given to spectral features in the visible range, which implicitly contain information on cloud microphysical properties at the cloud top, such as optical thickness, effective radius and cloud phase.

The most common errors in the precipitating clouds product are mentioned below. When the sun is low in the sky, high clouds cast a long shadow over low-lying clouds. This is an effect that the product cannot correct. The shadow will be misinterpreted to be an area with little or no cloud water.

An opposite effect of the shadow is seen when the edge of a higher-lying cloud that are oriented toward the sun becomes brighter than the rest of the cloud. This is because this part of the cloud receives more sunlight than the rest of the cloud. The bright edge will thus be interpreted as more cloud water than there actually is. Such serious shadow errors only occur when the sun is low in the sky and there are clouds in several levels, so higher-lying clouds may cast a shadow over low-lying clouds.

Another type of error that may occur in this product is errors in surface albedo (how much light the surface reflects). If this is not set correctly, it will from rural areas with much vegetation look like there is a constant thin layer of clouds and snow will look like thick clouds. Albedo data is updated every day, but only in those areas without clouds. It can take several days before snow-covered surfaces are correctly adjusted in the product. Fake clouds due to snow cover can be recognized as they do not move.

## Charts

Under the [Charts](#) menu you will find latest analysis surface and forecast charts from UK Met Office, displaying analysed and forecasted highs, lows and fronts.

The forecast charts are available on following time steps from the analysis: 24hr, 36hr, 48hr, 60hr, 72hr, 84hr, 96hr and finally 120hr forecasts.

It is also possible to download the charts directly at the upper right corner.

