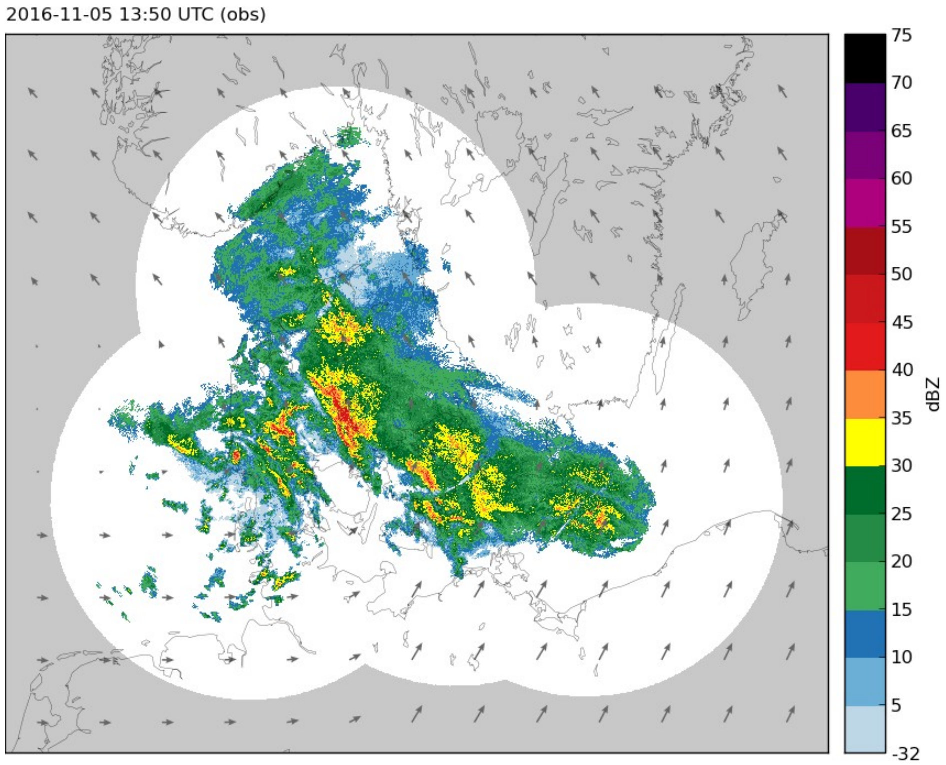
On the DMI radar nowcast forecasts

Content

The area covered corresponds to the rectangle shown in the figure below. The light part is the region for which radar observations or forecasts are available, grey is ”out of range”. In the observation period the light and grey regions are fixed, in the forecast period they will move and transform, depending on the velocity field.



One file is uploaded per radar forecast. Each file is a compressed zip archive. They are named **nowcast.dk.com.OBSTIME.zip**, with OBSTIME being the time of the last observed radar image used in the forecast and in the format YYYYMMDDHHNN, corresponding to year, month, day, hour and minutes. All times in all DMI products are UTC.

Each zip archive contains a suite of files, all of which are in HDF5 format and follow the EUMETNET OPERA ODIM specfication:
http://www.eumetnet.eu/sites/default/files/OPERA2014 O4 ODIM H5 v2.2.pdf

The file **flow.dk.com.OBSTIME.h5** contains the flowfield used for nowcasts, as well as for the in-between frame interpolation of the observations, in the form of 2D horisontal velocity components for each pixel of the field, in units of m/s. Temporal resolution is 10 min, spatial resolution is 500 m. The velocity field is determined entirely from the radar observations.

The 11 files named **interpolated.dk.com.TIME.h5**, where TIME runs from OBSTIME minus 10 minutes to OBSTIME, contain interpolated observations, in the form of 2D composite cappi data, providing altogether observed radar precipitation with one minute resolution.

The rest of the files are named **nowcast.dk.com.OBSTIME.NOWCASTTIME.LEADTIME.h5**, where NOWCASTTIME = OBSTIME + LEADTIME is the valid time of the forecast and has the same format as OBSTIME, whereas LEADTIME is the forecast length in minutes. For the first hour the time resolution is 1 minute, for the last 2 hours is is 10 min. The forecast sequence is based on the flow field and the 2D composite cappi field derived from the radar volume scans obtained at OBSTIME

The spatial resolution (pixel size) in the ”internal” and ”nowcast” files is 500 m. Notice that the actual resolution provided by the radars depends on the distance to the radar. Close to the radar is it higher than 500 m, far from the radar it is less than 500 m.

The files contain reflectivety in the form of an 8 bit binary value, dBZ_{binary} , running 0 - 255. The reflectivity measured in *dB*, *dbZ*, can be obtained as

$$dBZ = O + G\ dBZ_{binary} \tag{1}$$

where O is an offset value and G a gain value found in the file.
Important: The binary value of 0 indicates ”no radar echo” (and not -32 dBZ) and should be set to ”not-a-number” as regards dBA and 0 mm/h for precipitation rates. Binary value 255 indicates ”out of range” = no information for this point at this time.

Deducing precipitation rate

Subsequently Z can be obtained from dBZ,

$$Z = 10^{dBZ/10} \tag{2}$$

and converted to rain rate, R, using a standard Marshall-Palmer $Z - R$ relation, $Z = aR^b$, yeilding

$$R = (\frac{Z}{a})^{1/b} = (\frac{10^{(dBZ/10)}}{a})^{1/b} \tag{3}$$

At DMI we use currently use a = 200, b = 1.6, Z has units of $mm^6\ m^{-3}$ and R is in units of $mm\ h^{-1}$. More advanced approaches, such as derivation of re-adjustments factors based on comparison with rain gauges, or use of weather dependent Marshall-Palmer relations can be made.

In practice it is almost impossible to keep weather radars calibrated in an absolute sense. In part due to wear and tear they will drift. Hence, the reflectivity obtained with different radars from the same precip will vary, even if they are co-located and of similar type.

To compensate for differences in radar signal reciever efficiency the DMI radar receivers are calibrated relative to one another by observing the sun and taking Virring as *truth*. This is done using a 5 day running mean.

Variations in deduced reflectivity from precip in regions where the radars overlap are monitored. However, no adjustments are done based on this, as things like different distance to precip (= different resolution), weather induced, unknown variations in the path of the radar signals, VPR corrections, etc. makes correction fairly complicated and assumption dependent.

In a recent study Maite Monica Lovring in her master thesis, Comparision of Rainfall Forecasts and Evaluation of Flood Predictions, Tech. Univ. DK, 2016, found the DMI radar precipitation estimates were low by a factor of about 1.9 relative to rain gauge measurements. The study was done for the Copenhagen area, in a 3 month period in which precip was mainly light to moderate. The factor is likely different for heavy, convective precipitation.

The factor 1.9 was confirmed by the rain gauge based adjustment factors used at DMI in the derivation of radar based rain gauge adjusted area precipitation. This derivation is currently done with some delay, in order to quality control the rain gauge data. DMI expects to start also real-time derivation of rain gauge based adjustment factors during the course of WSC.

Conditions of usage
Remember, the provided data are for usage in WSC only. All other types of usage requires an extra written agreement with DMI. Do not distribute the above ftp address to people outside of WSC.

Thomas Bøvith and Henrik Vedel, DMI, 20161214