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Improvements of Fog Now-Casting by Cloud Radar Measurements at the Munich Airport

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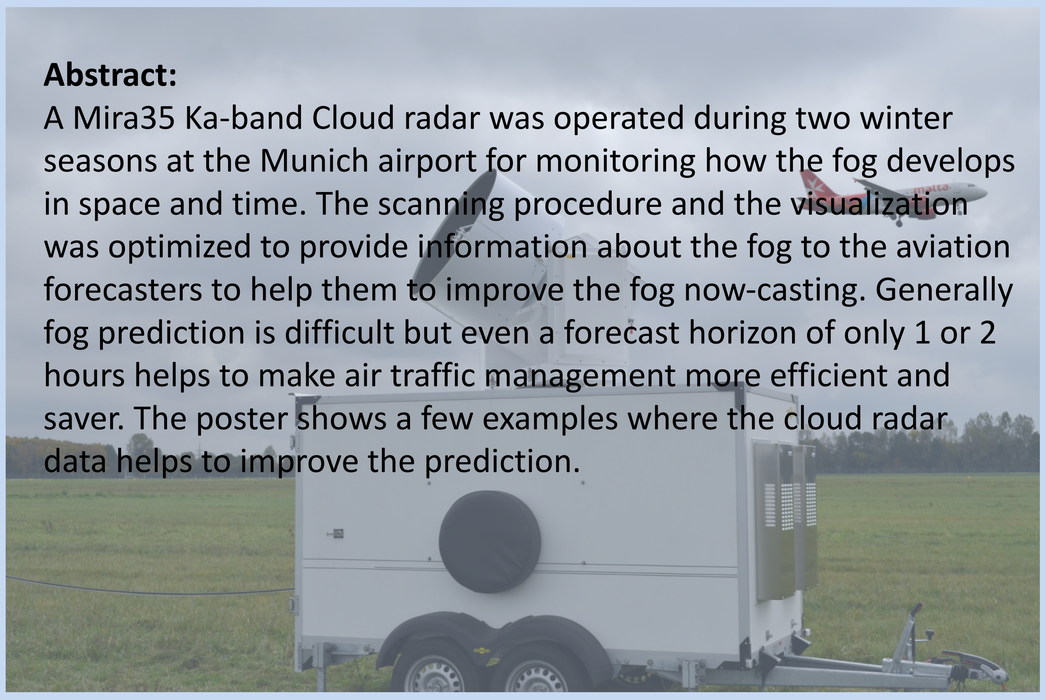
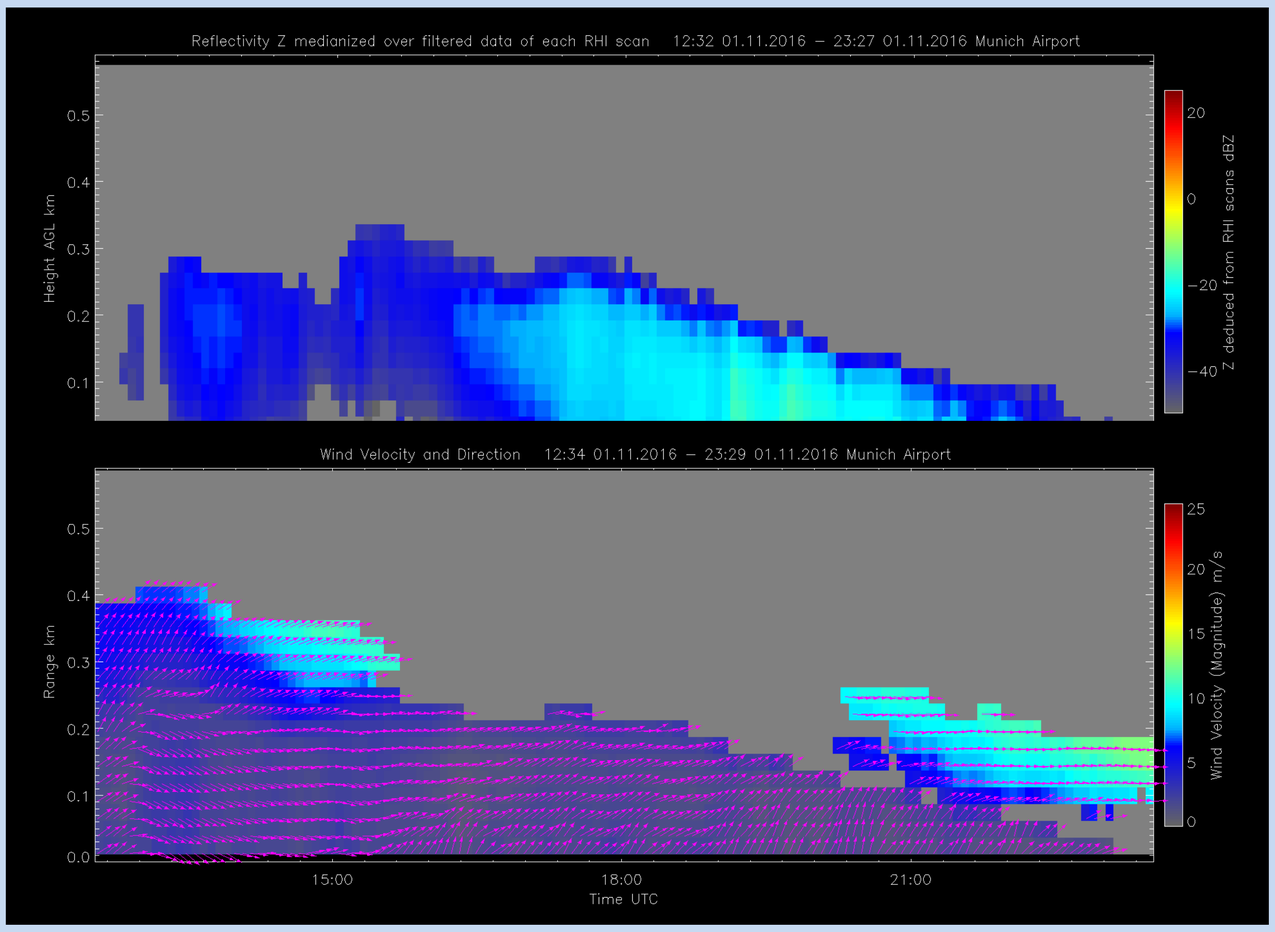
Abstract:
A Mira35 Ka-band Cloud radar was operated during two winter seasons at the Munich airport for monitoring how the fog develops in space and time. The scanning procedure and the visualization was optimized to provide information about the fog to the aviation forecasters to help them to improve the fog now-casting. Generally fog prediction is difficult but even a forecast horizon of only 1 or 2 hours helps to make air traffic management more efficient and saver. The poster shows a few examples where the cloud radar data helps to improve the prediction.



For measuring fog down to 25 m though the blind spot of the pulsed MIRA-35 radar is 200 m RHI scans where made. PPI scans with low elevation were made for monitoring the propagation of fog fields in a 15 km radius around the airport. A 5 minute scanning scheme with on RHI and one PPI per cycle was chosen.

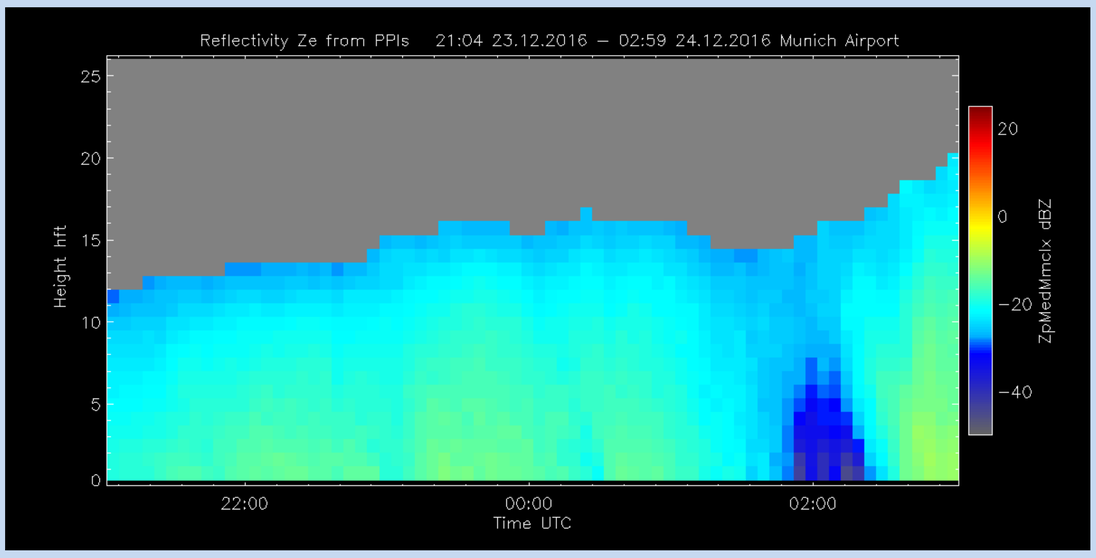
A Javascript based web interface was developed for providing access to the RHI and PPI animations, time-height cross sections giving a 6 hours overview, and also other information like web cam images. See http://guest.metek.de/tefis for more details and links to many nice fog cases.

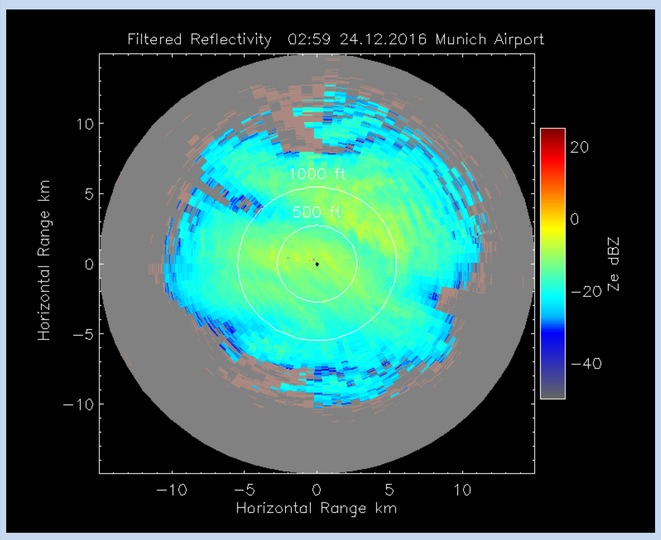


The images above show a fog case where the fog top was descending continuously between 6 and 11 pm allowing extrapolate the time when the fog vanishes.

The wind vectors in the lower plot are deduced from the PPI scans by a VAD algorithm. Each height profile of the reflectivity (upper plot) is deduced from one complete RHI scan by a "VRD algorithm" (**V**elocity **R**HI **D**isplay) which works similar to VAD algorithms. Some of the wind vectors are deduced from insect signals (plankton). Therefore we wind information is available in many cases where no hydrometeors are present.

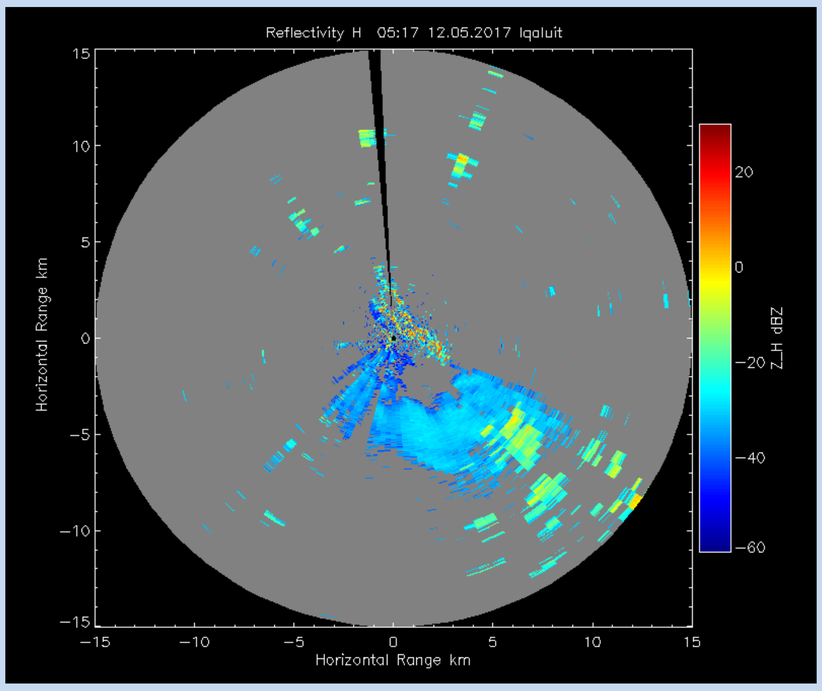
In this case the wind deduced from the plankton above the fog shows the reason why the fog descends, the wind velocity above is increasing.

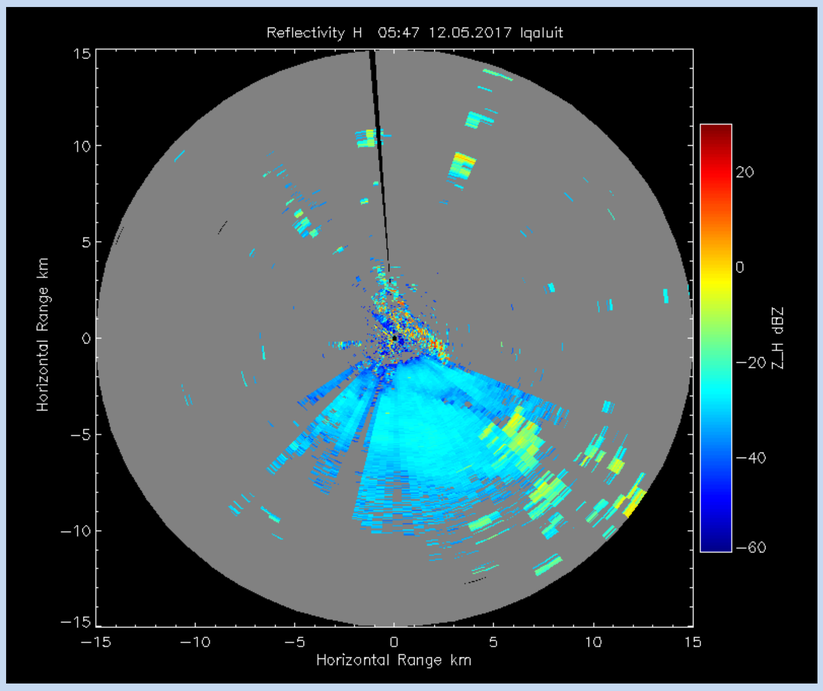


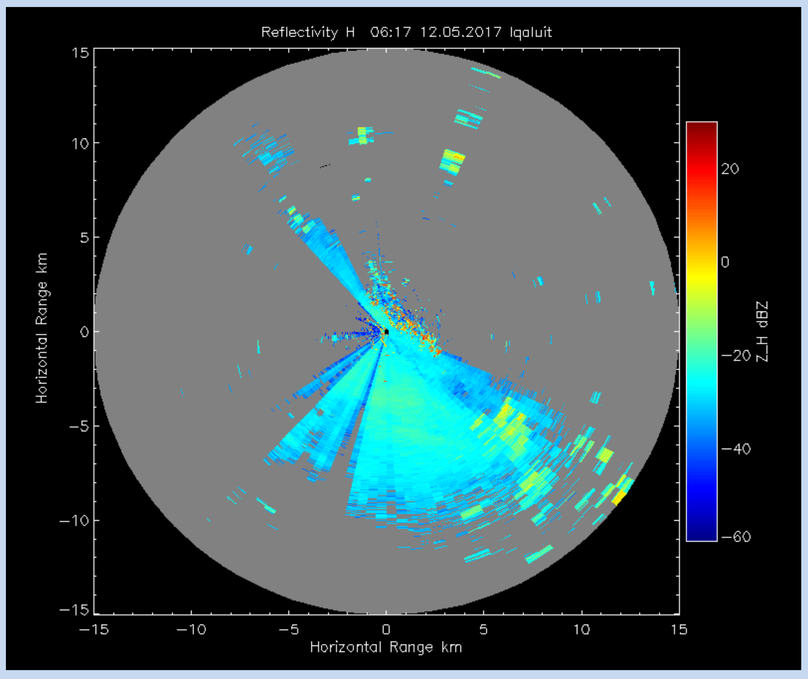


In the example above time-height cross section of the reflectivity looks like there should be strong fog but the webcam image on the right shows that the visibility is good. Drizzle looks on the radar data very similar to fog. We tried to distinguish between drizzle and fog by deducing the droplet falling velocity from the RHI scans by a VRD algorithm, but the accuracy was not sufficient for a reliable fog – drizzle classification. Sometimes drizzle can be recognized by in-homogeneous regions with reflectivities above -20 dBZ as seen in the PPI above.

Solution: If the reflectivities look like fog but the visibility is good then it is a thick drizzling layer. The condensation conditions are too good for fog. The drizzle often is strong enough to wash out the smaller fog droplets at lower altitudes. For the forecaster it is important to understand this situation because in this situation the fog will return as soon as the air gets less humid and condensation decays.







The main goal of the fog campaign at the Munich airport was to track fog fields as they are approaching from a nearby lake. This did not work because we had chosen the elevation angle of the PPI scan too high (3.2°). Due to this the fog fields approached below the radar. One of our customers has configured a scanning procedure which includes a PPI at an elevation of 1 deg. Of course there is a lot of beam blockage at this low elevation but some free sectors allow tracking fog fields as can be seen on the three PPIs above.

Acknowledgements: Thanks to Paul Joe for setting up the low elevation PPI at the site in Iqaluit and thanks to Environment Canada for providing this data.
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