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From cloud observations to a fully automatic METAR by combining ground-based and space-borne remote sensing data

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The automation of DWD's observing network makes it necessary to develop a fully automated system for providing cloud information in the Meteorological Aerodrome Report (METAR) at German international airports after the year 2020. Very low clouds with cloud base heights (CBHs) below 1500 ft (about 460 m) above ground level as well as the occurrence of towering cumulus or cumulonimbus inside a 8 km radius around a certain airport are particularly important for air traffic control. Within the DWD project "AutoMETAR" it is planned to use ground-based and space-borne remote sensing data as input for novel algorithms, which will finally allow the automatic determination of CBH, cloud coverage, and convective cloud types relevant for aviation. In particular, ceilometers are used for determining CBH from the vertical profile of the attenuated backscatter coefficient, from which cloud coverage can be indirectly inferred through temporal integration. The convective cloud types can be derived from a combination of radar data, lightning radiolocation and satellite-based cloud masks. A particular challenge which has to be addressed is due to the fact, that various types of ceilometers derive different CBH values for the same cloud situation. This is caused by the different optical design, application of manufacturer-specific algorithms and lack of a generally accepted definition of CBH. In order to address the latter, a Sony Alpha 7 camera was set up 178 m away from a 300 m high broadcasting mast in Hamburg to take photos when the mast was partly obscured by low clouds. A newly developed image analysis, which explicitly determines the vertical profile of the extinction coefficient, revealed that a slant optical range (SOR) value of 1000 m is an adequate quantitative criterion to obtain a visibility-based CBH. Preliminary results show a promising performance of this approach, which will be the foundation for a fully automated reporting of the cloud information in the METAR.