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How ceilometer detects some specific meteorological conditions?

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The importance of clouds in the climate system and the difficulty in determining their behavior and their contribution to climate change is well known among the scientific community. Therefore, there is a need for improvement of methods for automatic and continuous description of cloud characteristics. Ceilometers constitute a priori a reliable instrumental method for sounding the atmosphere and describing cloudiness, specifically the evolution of the cloud base height (CBH). Besides the temporal and spatial distribution of cloudiness, the CBH (which is linked to cloud type) is an important characteristic in order to describe the impact of clouds in a changing climate.

In this work, several typical cloudiness situations are described as seen by a ceilometer in Girona (Spain). We show cases for winter and summer as examples of expected conditions in these seasons. Usually in winter there is not enough solar radiation to develop local convective clouds (the differential temperature between surface and the upper air is not large enough) and most winter cloudiness is related with synoptic situations, and more specifically, with fronts that cross the area. However there are some local clouds associated to subsidence inversions. The evolution of the CBH as detected by a ceilometer is analyzed for an episode with fronts passing continuously overhead. On the other hand, in summer there is cloudiness associated to synoptic situations (fronts crossing over the region) like in winter, but there is also another source of cloudiness: the surface heating and the subsequent convection that produces low clouds (cumulus humilis) almost daily. Episodes corresponding to these conditions are also described in basis of ceilometer measurements. The analyzed cases partially explain the monthly CBH distributions, which show a yearly cycle with more uniform distributions (which are sometimes bimodal) in winter and peaked distributions in summer (spring and autumn corresponding to somewhat transition seasons). Finally, the whole sky camera (installed in the same situation as the ceilometers) images confirm the meteorological situations explained. The results obtained allow us to assume that the ceilometer can provide sufficiently robust data for displaying some cloudiness characteristics, including the vertical cloud structure.