

Ceilometer measurements in the Southern Ocean

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Current climate models display a consistent deficit of reflected shortwave radiation over the Southern Ocean which is mainly due to the poor representation of clouds. Recent work has also shown that reanalysis also perform poorly relative to satellite observations in terms of cloud fraction. In particular, satellite observations have shown that low-level clouds (with tops below 3 km) are ubiquitous over the Southern Ocean. But, most satellite instruments, even the current generation of active satellite instruments, have difficulties in sampling low level clouds. As part of the New Zealand Deep South challenge project focussed on improving the representation of clouds in the Southern Ocean, we have begun to deploy autonomous instruments on 'ships of opportunity'.

This study discusses measurements from a Väisälä CL51 laser ceilometer and ancillary instruments on the first two research voyages in the Southern Ocean and initial results. The route of the first voyage covers a return trip from Wellington (New Zealand) to Terra Nova Bay (Antarctica) onboard the R/V Tangaroa and occurred in January to mid-February 2015. The second deployment is onboard the Aurora Australis Australian Antarctic Division supply ship and began in October 2015 and is planned to finish at Macquarie Island in March 2016. The sampling provided by the ships route allows the ceilometer measurements of the height of the cloud base in a region where limited data apart from, potentially biased, satellite measurements of low-level cloud exist. Analysis of the boundary layer height derived from the ceilometer is also presented. The climatological structure derived from the ceilometer measurements is first detailed. We then compare these measurements with satellite and ground-based observations. We then examine variations in these measurements relative to their meteorological context. Details of plans for future voyages are also detailed. We will also present a preliminary analysis of a case study of clouds and local meteorological conditions made while the ship was moored continuously at Davis, Antarctica (69S, 78E) for several days in October 2015. During this interval, data collected by the ship-based ceilometer, radiometers and an all-sky camera were supplemented with shore-based wind-profiling radar and radiosonde observations