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Vertical profiles through an Antarctic surface ozone depletion event

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Profiles of ozone, temperature, wind speed and acoustic backscatter were measured during a surface ozone depletion event at Halley, Antarctica. Halley is a coastal station located on the Brunt Ice Shelf, and during the austral springtime, experiences occasional ozone depletion events. These events are initial observed as a decrease in surface ozone, sampled at 4m. The vertical extent of the depleted air is then investigated using a tethered blimp platform carrying a coupled ozone sonde - tether sonde. The blimp is capable of lifting to an altitude of ˜500m, which allows profiling of the full depth of the relatively shallow boundary layer. The structure of the boundary layer at Halley is dominated by stratification; stable boundary layers are frequently complex in the temperature field domain if buoyancy becomes sufficient to suppress turbulent mixing. For weaker stratification, a simple boundary layer develops.

Three profiles are presented from case studies in Spring, 2006.

ů Simple stratification with clear correspondence between the O3 and temperature structure. ů A similar case for temperature structure, but where there is no ozone depletion, confirming that the correspondence is not spurious. ů A complex case, showing that large scale overturning due to internal wave activity can produce confusing the profile signatures, with no clear boundary layer depth.

Due to the clarity of the profile signature, analysis of the first case study can be taken further . Similarity theory states that the turbulent thermal diffusivity should be similar to tracer diffusivity, e.g ozone. The thermal diffusivity can be extracted from the temperature profile and direct measurements of surface heat flux. Surface ozone flux can be estimated from the ozone profile and similarity.