

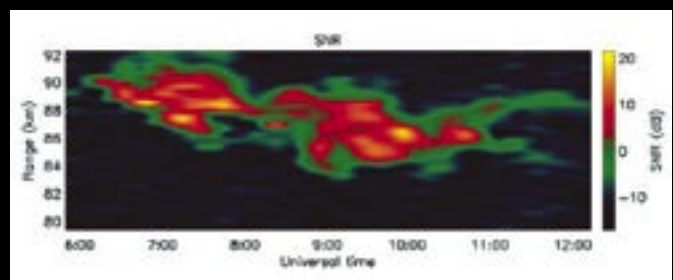
Polar Mesosphere Summer Echoes above Antarctica

In the summer of 2003–04, the first observations of Polar Mesosphere Summer Echoes (PMSE) above Antarctica were recorded using the Very High Frequency (VHF) radar at Davis.

PMSE are strong radar echoes associated with extremely cold temperatures – as low as -140°C – that occur in the ‘mesosphere’, some 50–92 km above the Earth, during summer. PMSE are also associated with the presence of increased water vapour content in the cold summer mesopause region. This water vapour originates from natural processes, such as the oxidation of methane, meteor ablations and volcanic eruptions, and anthropogenic emissions, such as rocket and space-shuttle exhaust gases. In fact, ‘noctilucent’ or night shining clouds, which are also associated with increased water vapour and lower temperatures in the mesosphere, were first observed in 1885, some two years after the spectacular eruption of Krakatoa and corresponding to the time needed to transport water vapour to the mesopause.

The seasonal occurrence of PMSE is dependent in part on a critical mesosphere temperature threshold (less than 150 K or -123°C). In 2004–05, observations of PMSE and noctilucent clouds will be undertaken at Davis using the VHF radar and lidar, to investigate the threshold temperature dependencies of each.

PMSE were first observed in 1979 using a VHF radar at Poker Flat, Alaska. The first observations of PMSE in the southern hemisphere were conducted at Machu Picchu base on King George Island during the summer of 1992–93. It has been suggested that southern hemisphere PMSE differ from their northern hemisphere counterparts, however, the first summer of PMSE observations at Davis revealed their intensity to be similar to those reported at equivalent northern hemisphere latitudes.



Polar Mesosphere Summer Echoes (PMSE) observed at Davis on the VHF radar on 3 February 2004. PMSE manifest themselves as strong radar echo returns. The radar echo strength is often measured using signal-to-noise ratio. Over 27 days of observation, the Davis PMSE events occurred at an average peak height of 86 km and ranged from 81–92 km. The peak PMSE height was slightly below the summer mesopause temperature minimum at 88 km, and above the noctilucent cloud layer at 83–84 km. A complete season of observations and rigorous instrument calibration are now needed to substantiate these results.

Background image: A noctilucent (night shining) cloud above Davis station on 18 February 1998. These clouds are the visual indicator of cooling processes in the summer mesosphere.

International interest is now focussed on whether there is any measurable difference in summer mesopause temperatures between the northern and southern hemispheres. A proposed interhemispheric comparison of the properties of PMSE will contribute to this effort.

PMSE events provide a monitor of the background wind and a proxy for the temperature and water vapour content in the little-studied mesosphere. Research using the Davis VHF radar will make an important contribution to the long-term investigation of these phenomena and will add to the limited knowledge of polar mesosphere climatology; and thus to our capacity to detect climate change in the mesosphere.

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