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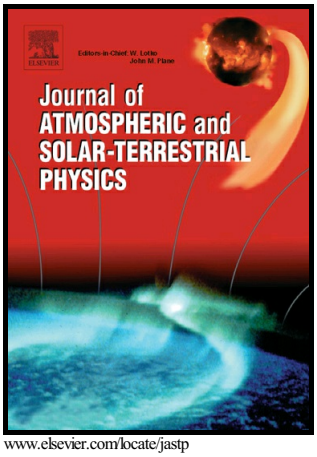


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# Using polar mesosphere summer echoes and stratospheric/mesospheric winds to explain summer mesopause jumps in Antarctica

Franz-Josef Lübken[a], Ralph Latteck[a], Erich Becker[a], Josef Höffner[a], Damian Murphy[b]

[a] *Leibniz-Institute of Atmospheric Physics, Schloss-Str. 6, 18225 Kühlungsborn, Germany*
[b] *Australian Antarctic Division, Kingston, Tasmania, Australia*

**Abstract**

Recent high resolution temperature measurements by resonance lidar occasionally showed a sudden mesopause altitude increase by ∼5 km and an associated mesopause temperature decrease by ∼10 K at Davis (69°S). In this paper we present further observations which are closely related to this 'mesopause jump', namely the increase of mean height of polar mesospheric summer echoes (PMSE) observed by a VHF radar, very strong westward winds in the upper mesosphere measured by an MF radar, and relatively large eastward winds in the stratosphere taken from reanalysis. We present a detailed explanation of mesopause jumps. They occur only when stratospheric winds are moderately eastward and mesospheric winds are strongly westward. Under these conditions, gravity waves with comparatively large eastward phase speeds can pass the stratosphere and propagate to the lower thermosphere because their vertical wavelengths in the mesosphere are rather large which implies enhanced dynamical stability. When finally breaking in the lower thermosphere, these waves drive an enhanced residual circulation that causes a cold and high-altitude mesopause. The conditions for a mesopause jump occur only in the Southern Hemisphere (SH) and are associated with the late breakdown of the polar vortex. Mesopause jumps are primarily, but not only, observed prior and close to solstice. Our study also shows that during the onset of PMSE in the SH, stratospheric zonal winds are still eastward (up to 30 m/s), and that the onset is not closely related to the transition of the stratospheric circulation. Unlike previously published re-

*Email address:* luebken@iap-kborn.de (Franz-Josef Lübken)