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Characterisation of oscillatory motions in the stable atmosphere of a deep valley

Y. LARGERON[1], C. STAQUET[1], C. CHEMEL[2]

[1] LEGI, UJF/CNRS/G-INP, BP 53, 38041 Grenoble cedex 9, France
[2] National Centre for Atmospheric Science (NCAS), Centre for Atmospheric & Instrumentation Research (CAIR), University of Hertfordshire, College Lane, Hatfield, AL10 9AB, UK

In a valley sheltered from strong synoptic effects, the dynamics of the valley atmosphere at night is dominated by katabatic winds. In a stably stratified atmosphere, these winds undergo temporal oscillations. For an infinitely long slope with a slope angle α of constant value and a constant buoyancy frequency N, their frequency is given by $N\sin\alpha$ (McNider 1982). Such an unsteady flow in a stably stratified atmosphere generates internal gravity waves (IGWs). The numerical study by Chemel *et al*. (2009) showed that, in the stable atmosphere of a deep valley, the oscillatory motions associated with the IGWs generated by katabatic winds are distinct from those of the katabatic winds. The IGW frequency was found to be independent of α and about $0.8N$. This study did not consider the effects of the background stratification and valley geometry on these results. The present work extends this study by investigating those effects for a wide range of stratifications and slope angles, through numerical simulations for a deep valley. The two oscillatory systems are reproduced in the simulations. The frequency of the oscillations of the katabatic winds is found to be equal to N times the sine of the maximum slope angle. The IGW frequency is found to vary as $C_w N$, with C_w in the range 0.7-0.95. These values for C_w are similar to those reported for IGWs radiated by any turbulent field with no dominant frequency component. Results suggest that the IGW wavelength is controlled by the valley depth.

References

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