UPPER ATMOSPHERE MOTIONS MEASURED BY LASER RADAR

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ABSTRACT

In recent years a number of workers have obtained vertical profiles of the mesospheric sodium layer using a laser radar tuned to the sodium D line resonance. These measurements have shown the existence of considerable vertical structure in the layer. By using a steerable lidar system, and measuring the profile at various slant angles and azimuths, it is possible to observe not only the vertical structure but also horizontal variations in the sodium concentration, i.e., a three-dimensional picture of the sodium layer can be obtained. To scan in two horizontal coordinates over a large number of points is unfortunately beyond the capabilities of most present lidars, mainly because of the limitations on sensitivity and pulse repetition rates available. It is possible, however, to obtain statistical information on the horizontal structure by measuring at three spaced points only. We have made measurements of this type at São José dos Campos (23^{o}S, 46^{o}W) and have obtained results consistent with the existence of uniform horizontal motion of the layer. The method of analysis used is to cross-correlate the profiles at the three measuring points for various time displacements, and thus determine the time lag between similar profiles being obtained at the horizontally displaced points. The technique is rather similar to that used for analysing the results of the spaced antenna method used for measuring ionospheric drifts. The measured horizontal velocities are of the order of 50 m/s, comparable with those derived from meteor observations. The method has potential for measuring horizontal and vertical motions over the entire sodium layer, extending from about 80 to 100km.