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Temperature Disturbances Induced in the Mesosphere by the Horizontally Propagating Turbulent Patch

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Role of the mesospheric turbulence in defining the large- and small-scale structure of the mesosphere is unique. However, the fact that atmospheric turbulence occurs as turbulent patches which move through the atmosphere is ignored by the modelers until recent years. In the present work an effort to understand the birth, evolution, and dissipation of temperature disturbances induced by the turbulent patch moving horizontally through the atmosphere have been made.
Assuming existence of the background downward heat flux we have set up a boundary value problem for nonhomogeneous heat equation that treats the turbulence dissipative heating and turbulent mixing. This two-point boundary value problem is solved analytically by Fourier method. An obtained solution allows us to conclude that moving turbulent patches can form the temperature structures which are similar to the well-known mesospheric inversion layer. It is shown that such temperature structures are formed by a diffusion process which keeps the value of the background downward heat flux propagating through the turbulent patch.
A question of relaxation of the temperature changes induced by the moving turbulent patch is also considered. It is shown that air parcels oscillate with decaying amplitude since the turbulent patch left the considered atmospheric domain. This process is described by a simplest mathematical model of the temperature field within the “oscillating tail” which follows the moving turbulent patch. It is shown that the length of this “tail” is strictly dependent on the propagation velocity of the turbulent patch. It is also noted that temperature disturbances within the upper and low parts of the “oscillating tail” are opposite in sign.