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Reactive-diffusion waves in the Earth's mesosphere

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It is well known, that the distributed chemical systems possessing nontrivial non-linear properties can demonstrate broad spectrum of reactive-diffusional waves such as traveling fronts, pulses, periodic waves, etc. These waves were found in the systems of difference nature: chemical, biological, geological and some others, but up to now they have not been found in the atmospheric photochemistry. In this work we consider the influence of horizontal (in a zonal direction) eddy diffusion on the mesospheric photochemical system, which includes all the most important photochemical reactions in the mesopause region (80-87 km). It was shown in resent works, that this system can demonstrate photochemical oscillations of the minor gas constituents (H, OH, HO2, O and O3), playing key role in the mesosphere, with the time periods of 2, 3 and 4 days. These oscillations are subharmonical response of the mesospheric chemistry on the external periodic forcing (daily variations of luminosity); their appearing is controlled by vertical eddy diffusion coefficient. In the work we demonstrate numerically that zonal eddy diffusion causes "wave of the phase": phase of the any oscillations enumerated above becomes to move in zonal direction with constant velocity whose magnitude is determined by (zonal) eddy diffusion coefficient and length of the corresponding meridian, and depends on period of photochemical oscillations. Besides, the period of oscillations determines type of the waves and their travel direction. So, in the case 3-day oscillations we have found fronts and pulses, which can travel both eastward, and westward. In the case 2 or 4-days oscillations we have found fronts and pulses, which travel only in western direction.