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On Turbulent Convective Diffusion in the Free Atmosphere

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Extended Abstract

Turbulent diffusion is an important research direction in the turbulent phenomenon. Phenomenological description of turbulent diffusion is a complex and still unsolved problem [1]-[2]. This article devoted to mathematical model for the turbulent convective Diffusion in the Free Atmosphere. The main goal of this research is to build a mathematical apparatus for studying atmospheric turbulence, determining its main characteristics, influence of divergence and rotor operators on the particle velocity vector, processing pressure distribution, diffusion temperature and ideal gas particle concentration. Here real gases differ from their ideal model if their molecules have finite dimensions and between them are forced attraction at considerable distances and repulsion when the molecules approach each other. An ideal gas does not interact between particles and consists of point particles phenomena moving randomly or following Brownian motion. There are could be air, gas methane, helium, nitrogen, argon, propane, oxygen. Any real gas is closer to ideal when lower its pressure then higher its temperature. The introduced mathematical model has been described by using *momentum conservation equation* from which the Navier-Stokes initial value problem was solved by using vector analyse and mathematical physic methods. The three-dimensional particle velocity and the energy conservation law was determined and from which the scalar pressure distribution was found [3]-[4]. Wherein the determined expression

$$E_B + E_K + E_P + E_T = 0$$

presented the three-dimensional energy conservation law for the unit mass, where E_B is a binding energy, E_K is a kinetic energy, E_P is a potential energy, E_T is a random Brownian energy

in which
$$E_T = \begin{cases} laminar \quad flow \ , if \ E_T = const, \\ turbulent \quad flow \ , if \ E_T \neq const \end{cases} .$$

By using thermodynamic equilibrium law was found diffusion temperature for convective turbulent flow. From mass conservation law was determined the substance concentration matrix in the free the atmosphere.

Thus, presented mathematical model of turbulent diffusion has been demonstrated main properties describing behavior of the particle velocity and the processing pressure, the particle concentration and the energy conservation law. When the random Brownian energy equal constant in the one-dimensional case we have well-known Bernoulli equation. Introduced mathematical apparatus allow studying an ideal gases and exploring the convective turbulent flow without using Reynolds, Raleigh, Prantle, Schmidt numbers that can avoid numerous experiments and relevant calculation for defining stability or instability characteristics [5].There we can see natural link between thermodynamic characteristics and hidden dependencies of the velocity vector from the processing pressure distribution that make variety turbulent effects in agreement with the energy conservation law and clear mathematical evidence that conservative force field effectively makes discontinuous fluctuations and has space-time dependent impact of divergence on the velocity vector and the processing pressure [4], [6] . Processing pressure function provides an interpretation of instability effect and nonlinear interaction, which has been associated with the breakdown of the wave spectrum and saturation of the nonlinear interaction in the nature of the turbulent effects. The three-dimensional energy conservation law regulates the processing pressure which affects the particle velocity vector which is in turn regulates the diffusion temperature in the free atmosphere.

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