Wed2.3 Toqué, Lignières & Vincent

Turbulent diffusion of a passive scalar in a bidimensional flow: Astrophysical application.

Nathalie Toqué[1], François Lignières[2] & Alain Vincent[1]

1. Dynamiques des Fluides Astrophysiques,
LATT, FR
nathalie.toque@ast.obs-mip.fr
http://webast.ast.obs-mip.fr/latt/dfa/

2. Dynamiques des Fluides Astrophysiques,
LATT, FR
francois.lignieres@ast.obs-mip.fr
http://webast.ast.obs-mip.fr/latt/dfa/

3. Université de Montréal, QC
vincent@astro.umontreal.ca

We study the evolution of a passive scalar in a two-dimensional flow, highly sheared and stratified in temperature. The simulations are realised with a two-dimensional spectral code without subgrid model. In the physical space, the grid is supplied with 6×256^2 squared meshes. The flow is turbulent ($Re_{turb} \approx 120$) and anisotropic ($\sqrt{\frac{<u_x{}^2>}{<u_z{}^2>}} > 1$). The Richardson number of each simulated flow is less than ¼. The Peclet number of the passive scalar is $Pe_{turb} \approx 100$.

The purpose of this study is to find a relation between the diffusion coefficient of the scalar and the velocity components of the flow. This relation is designed as follows : $\frac{D_L}{lv} \propto A^{-\alpha}$.

★ D_L is the diffusion coefficient. It is calculated with Lagrangian particles which are advected by the flow.

★ lv is the product between the length scale and the velocity scale of the flow. The mean value slightly grows with the Richardson number.

★ A is defined as follows : $A = \sqrt{\frac{<u_x{}^2>}{<u_z{}^2>}}$ and belongs to the interval : $1 < A < 40$.

★ For the set of simulated flows, the exponent α is found in the interval: $0.912 < \alpha < 1.069$.

The contribution of this study is to improve the results of Vincent *et al.* It is double :

● The flow is calculated with the Navier-Stokes equations and is stratified. In Vincent & al, the velocity field is generated with the Ornstein-Uhlenbeck process.

● The law : $\frac{D_L}{lv} \propto A^{-1}$ is not valid for any anisotropy value. This limitation is not detected in the simulations of Vincent *et al.*

With such a relation, the Standart Evolution Model of Solar-type stars could take into account the influence of the differential rotation on abundances.

References

Vincent, A., Michaud, G and Meneguzzi, M. 1996 On the turbulent transport of a passive scalar by anisotropic turbulence; *Phys. Fluids* **8**, 1312-1320.

Michaud, G and Vincent, A. 1997 Abundance Anomalies and Anisotropic Turbulent Tranport in Stars; *Procc. ClarkeWest97*.