CLUSTERING OF FLOATING PARTICLES IN STOCHASTIC VELOCITY WITH SMALL COMPRESSIBLE COMPONENT

K. Koshel\textsuperscript{a}, V. Klyatskin\textsuperscript{b}, O. Aleksandrova\textsuperscript{a} and E. Ryzhov\textsuperscript{c}

\textsuperscript{a}. V.I. Il’ichev Pacific Oceanological Institute of RAS – Russie, kvkoshel@poi.dvo.ru
\textsuperscript{b}. A.M.Obukhov Atmospheric Physics Institute of RAS – Russie, kvkoshel@poi.dvo.ru
\textsuperscript{c}. Department of Mathematics, Imperial College London - Royaume-Uni, ryzhovea@gmail.com

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It is well-known that floating impurities can cluster into narrow, elongated stripes. Existing theories predict the occurrence of clustering in the compressible velocity fields. When we consider a velocity field with potential and solenoidal components, complete clustering is possible only if the potential component magnitude exceeds the solenoidal one \cite{1,2}. However, this result is valid only asymptotically \cite{1,2}. In the ocean, the ageostrophic component of the velocity field is, in most cases, small \cite{3,4}. Thus, for floating particles the potential component of the velocity is also small in comparison with the quasi-ageostrophic incompressible component \cite{1}. In the present work, we investigate numerically clustering of floating impurities in a stochastic velocity field with a small potential component. We consider the random velocity in the form

$$\mathbf{U}(\mathbf{R}; t) = \gamma \mathbf{U}_p(\mathbf{R}; t) + (1-\gamma) \mathbf{U}_s(\mathbf{R}; t), \quad (0 \leq \gamma \leq 1),$$

where $\mathbf{U}_p(\mathbf{R}; t)$ is potential component and $\mathbf{U}_s(\mathbf{R}; t)$ is solenoidal one.

Fig. 1. Particle density distributions for one diffusion time associated with potential component of the velocity. $t = 0.16$, $\sigma_{U} = 1.3333$. (left - $\gamma = 1$, right - $\gamma = 0.2$) The light grey square area is the initial particle distribution.
We show that, in such flows, clustering of the impurities can occur. However, unlike the case with a large potential component, the clustering is much slower process in the case with small potential component. Furthermore, we investigate the dynamics of clustering by means of statistical topography characteristics.

![Graph showing the cluster area and mass for the threshold density value $\bar{\rho} = 1$ and for parameters from fig. 1(right).](image)

From the statistical topography point of view in the case of a positive definite density field $\rho(R,t)$, clustering happens in almost every realization (or with probability 1) if the asymptotic relations are simultaneously valid [2]

$$\left\langle s_{\text{hom}}(t, \bar{\rho}) \right\rangle \rightarrow 0 \quad \left\langle m_{\text{hom}}(t, \bar{\rho}) \right\rangle \rightarrow 0,$$

when $t \rightarrow \infty$

where $s_{\text{hom}}(t, \bar{\rho}), m_{\text{hom}}(t, \bar{\rho})$ are the specific area and the specific mass of the particles encompassed within the regions of the random field $\rho(R,t)$ exceeding the prescribed level $\bar{\rho}$ [1,5,6]. Fig. 2. shows that the relations are valid for the case $\gamma = 0.2$ but are accomplished much slower than in the case without solenoidal component (black line).

**Références**


1995, pp. 3–6