



Contribution ID: 24

Type: Oral 20 Minutes

Methods for extracting Lagrangian coherent structures from unsteady velocity data

Thursday, 17 May 2018 09:44 (15 minutes)

The fact that examining Eulerian entities in unsteady velocity fields gives misleading information on Lagrangian coherence is now well-established. In this talk, I will review a range of techniques which have been proposed to extract coherent structures from given velocity data. These include the commonly used finite-time Lyapunov exponents, as well as methods such as curves/surfaces to which there is maximal attraction, transfer (Perron-Frobenius) operator methods for identifying sets which are coherent to transport, clustering methods which group similarly behaving particles, Lagrangian-averaged vorticity for identifying vortices in a frame-independent fashion, and sets which are most susceptible to random perturbations. Each seeks different characteristics, and thus the appropriate method for a given problem needs to be chosen carefully. These methods—not currently well-known in the porous media community—may offer new approaches for extracting coherence in porous flows.

References

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Session Classification: Parallel 9-G

Track Classification: MS 4.15: Lagrangian methods for scalar transport in porous media