Network description of fluid transport: Lagrangian Flow Networks

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Fluid transport between different locations of a fluid domain could be conveniently represented by the concept of Lagrangian flow networks, in which a discrete representation of the transfer operator for the advection dynamics defines links between fluid regions. Fluid dispersion and mixing become naturally measured by network-theory quantities such as degree, or newly introduced network entropies. The recently developed powerful methods of community detection in graphs become useful to identify coherent regions in the fluid flow. Clustering coefficients identify the location of periodic orbits [1, 2]

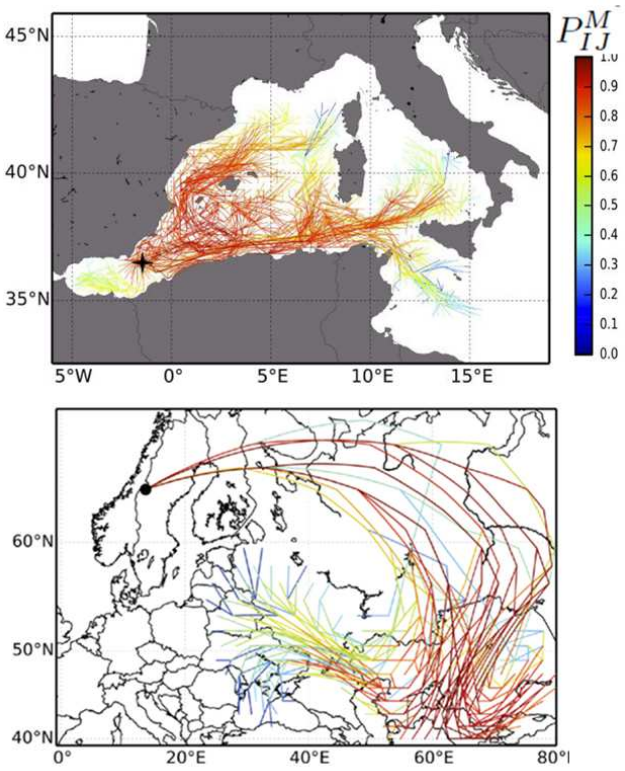

Figure 1: Examples of optimal transport paths obtained with network methods in a flow in the western Mediterranean (top) and in the atmosphere over western Europe (bottom).

In this contribution we will describe the basics of this type of network construction, with applications to realistic geophysical flows, namely the surface circulation in the Mediterranean, with ecological implications, and an atmospheric blocking event [1, 3, 4].

[1] E. Ser-Giacomi, V. Rossi, C. López, E. Hernández-García, *Flow networks: A characterization of geophysical fluid transport*, Chaos **25**, 036404 (2015).

[2] V. Rodríguez-Méndez, E. Ser-Giacomi, E. Hernández-García, *Clustering coefficient and periodic orbits in flow networks*, Chaos, to appear (2017).

[3] P. Monroy, V. Rossi, E. Ser-Giacomi, C. López, E. Hernández-García, *Sensitivity and robustness of larval connectivity diagnostics obtained from Lagrangian Flow Networks*, ICES Journal of Marine Science, to appear (2017).

[4] E. Ser-Giacomi, R. Vasile, I. Recuerda, E. Hernández-García, C. López, *Dominant transport pathways in an atmospheric blocking event*, Chaos **25**, 087413 (2015)