Exploring the mesoscopic structure of the world air transportation network

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Air transportation networks have been extensively studied in the network science literature. Researchers focus on airlines networks, national, regional, continental and worldwide networks using monoplex or multiplex approaches. Inspired by recent results on community-aware centrality measures [1], in this work, an extensive analysis of the macroscopic, mesoscopic and microscopic topological properties of the world air transportation network is performed. Based on the community structure uncovered by the Louvain algorithm, the original network is split into local components and global components. The local components are made of the communities by removing the intercommunity links. The global components are formed by removing all the intracommunity links and subsequent isolated nodes. Results reported in figure 1 shows that the main local components are geographically distributed over seven areas (North America, Europe, East & Southeast Asia, Africa-West and South Asia Oceania, South America, Russia). The main global component is distributed among all these areas (figure 2). A comparative analysis of the macroscopic, mesoscopic and microscopic properties of these various main networks reveal some consistencies. Indeed, density of all the components is low. However local components are all denser than the overall network. Transitivity is low and more particularly for the global component. All the networks are disassortative. Except for the Russia component, the hub dominance is relatively small. The study also reveals some dissimilarities. For example, the diameter of the local components ranges from 4 to 9 as compared to a value of 13 for the original network. The highest k-core subnetworks (k=31 and k=29) of the original network are mainly localized in the European component, and in the North America components. The maximum k-truss subnetwork (k=24) of the original network is in the North America component. It is followed by the European component (k=22). The remaining components exhibit low values of max k-truss. Comparative evaluation of degree and betweenness centrality measures allows to clearly identify the reasons behind the anomalies reported in several studies [2,3]. One of the main advantages of this approach is to get a better understanding of the similarity and differences of the various regional air transportation systems. Results indicate that it is more informative than considering the world air transportation network as a single entity. Indeed, if one considers the centrality measures, it allows to clearly distinguish airports having a regional influence from those with an international influence.

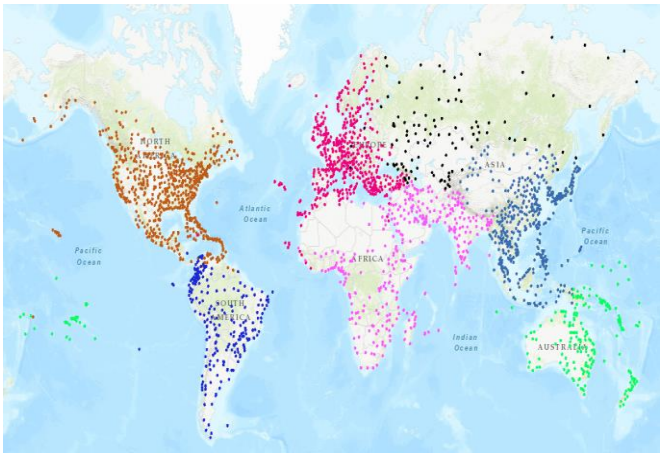


Figure 1 The 7 main local components. Each color represents a component



Figure 2 The main global component

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