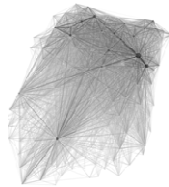


Problem of flow data visualization

The visualization of flow matrices is notably difficult because of:

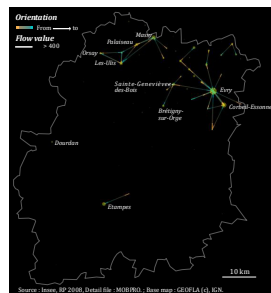
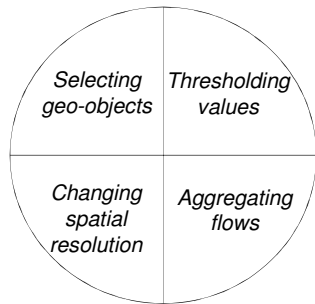
- the variability of origin-destination (OD) lengths;
- the spatial localization of nodes;
- the relative orientation of links;
- the number of nodes (N places) and of links (N^2);
- the direction and value of links;
- the geographical scale;
- etc.



Spaghetti-effect

Case study: an OD matrix representing Essonne's commuters at the city scale in 2008. Source: disaggregated data from the French Census (INSEE)

Classical solutions



General issues in flow mapping

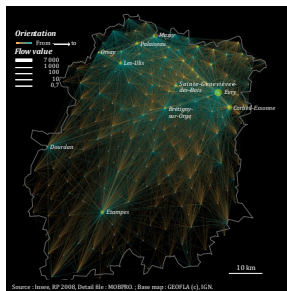
Several solutions can be applied in order to reduce the *spaghetti-effect*. All of them aims to reduce the complexity of the flow map by selecting graphical features, or by thresholding or aggregating flow values.

Thresholded flow map

MAPOD objective

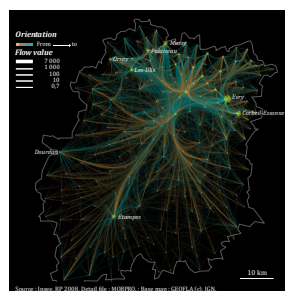
To geovisualize all the information available in an OD matrix without *a priori* selection of information. To enable the analysis of short distance commuting patterns as well as long distance relationships. To obtain readable and aesthetical maps!

→ Extension of an open-source flow visualization software (JFlowmap)



Use of an appropriate colormap

Dark background and double coloration of the features' light



Modification of links geometry

Edge bundled features (visual graphic aggregation)

The (+) : A free tool – easy to use – portable & interactive (more a visualization software than a mapping software)

The (-) : Memory intensive.

MAPOD approach

MAPOD (*Mapping Origin-Destination matrices*) is an innovative interactive application for the geovisualization of local transport demand summarized in the form of an OD matrix.

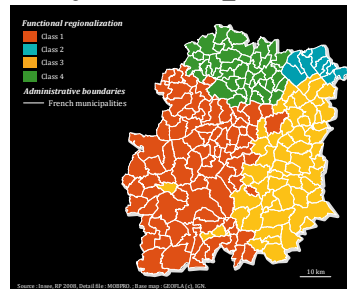
MAPOD deals with the key-problem of visualizing complex spatial networks. It is integrated in JFlowMap (Boyandin, 2010) that enables *edge bundling* and interactive flow geovisualisation.

We have extended JFlowMap in order to include 1) the **transformation of geographical spaces into “geographical chord diagrams”** preserving the proximities and cardinal orientations of nodes 2) the **partitioning of space into functional regions with respect to flow values**.

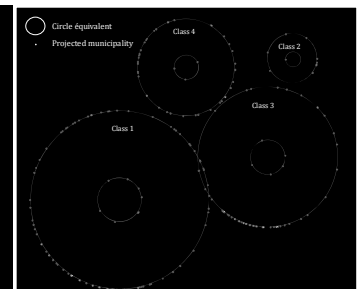


MAPOD won the first prize of the french Saint-Dié-des-Vosges International Festival of Geography (FIG'2013) competition on *geovisualization and dynamic cartography*.

Key-concepts



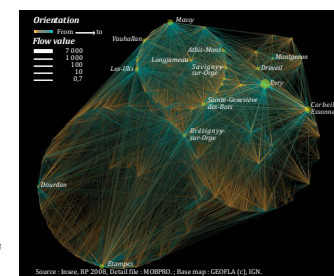
Functional regionalization



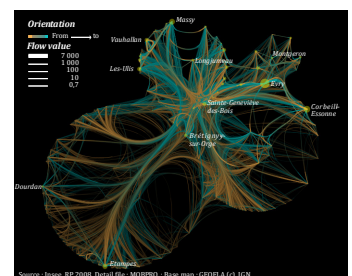
“Geographical” chord diagrams

Inside each region, municipalities are projected onto one of the two concentric circles computed as the basis for “geographical” chord diagrams. The inner circle contains the central cities, whereas the outer circle the ones from the periphery. Vicinities and cardinal directions are preserved as far as possible

Results



“geographical” chord representation



Final visualization

The final visualization of “geographical” chord diagram is to be read in conjunction with the edge bundled map on the left column.

Main references

1. Boyandin I., Bertini, E., Lalanne, D., 2010, Using Flow Maps to Explore Migrations Over Time, *Proceedings of Geospatial Visual Analytics Workshop in conjunction with the 13th AGILE International Conference on Geographic Information Science (GeoVa)*, Guimaraes, Portugal, 4 p. <http://code.google.com/p/jflowmap/>
2. Bonin, O., Bahoken, F., Mermet, S., 2013, CARTOD, CARTographie d'une matrice de flux Origine-Destination. Application de visualisation de la demande de transport locale, *M@ppemonde* (in press) <http://mappemonde.mgm.fr/>