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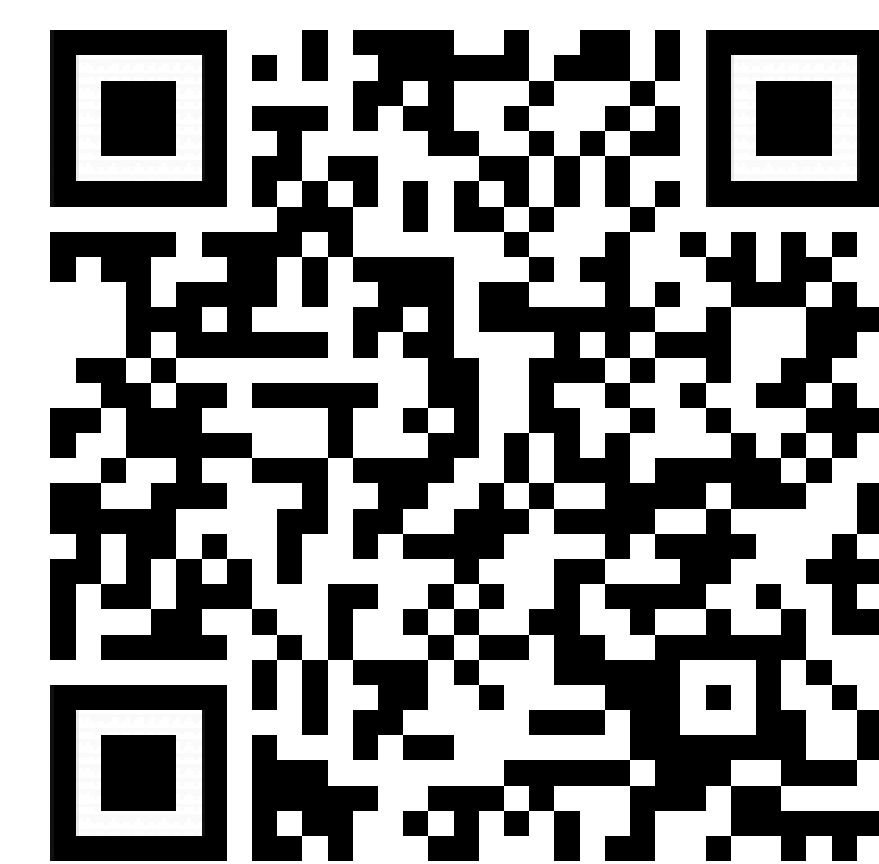


Exploring Temporally Evolving Communities through the Lenses of Location Semantics

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INTRODUCTION

On mobile phone data set covering Milan city we **detected communities** from connectivity patterns and explored their **time evolving characteristics** through the lenses of location semantics. In this way we anticipated and explored dynamic change in communities on a city scale.

TELECOM AND LOCATION SEMANTIC DATA

1. CDRs provided by the Semantics and Knowledge Innovation Lab (SKIL) of Telecom Italia, time period: November and December 2013, covering spatial area of Milan city with surrounding area
2. Copernicus Land Monitoring Service – Urban Atlas – land use and land cover data
3. Open Street Map – points of interest

COMMUNITY DETECTION AND FREQUENT COMMUNITIES

We performed community detection using Louvain algorithm over graphs generated from telecom data. The results represent daily based snapshots of community structure over telecom network. Although community structure differs for each day, some similar patterns are repeating. To detect structures that are consistent over time we applied FP-Growth algorithm, Fig. 1

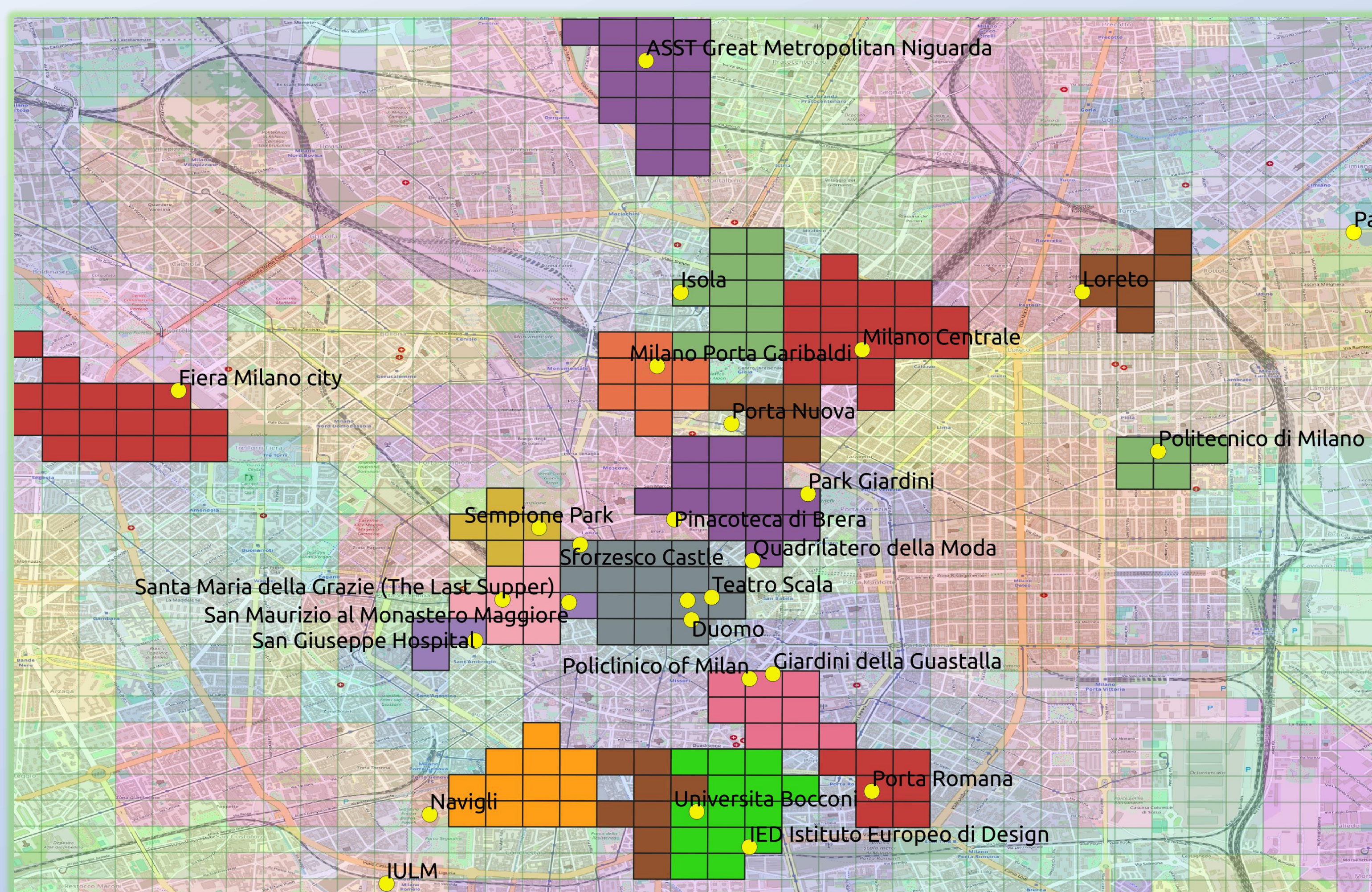


Figure 1. Frequent items generated clusters over selected locations in Milan city

Figure 4. Spatial direction of communities related to Duomo

Spatial distribution of communities is also changing through time. From Fig. 4 we can observe how centroids of communities are spatially distributed in specific direction. Such behavior is observed for communities formed around Duomo Cathedral, while for other locations spatial direction of communities is different.

TEMPORAL EVOLUTION OF COMMUNITIES

Community structure differs significantly from day to day. Community associated to specific location varies in shape, size and spatial distribution.

Additional measures to evaluate temporal evolution of the communities:

- area of the communities
- pairwise distance between location point and centroid of each community related to that location.

In Fig. 2 we present the dynamic of change in community area for two locations with different semantics, Bocconi University and Duomo Cathedral in the city centre.

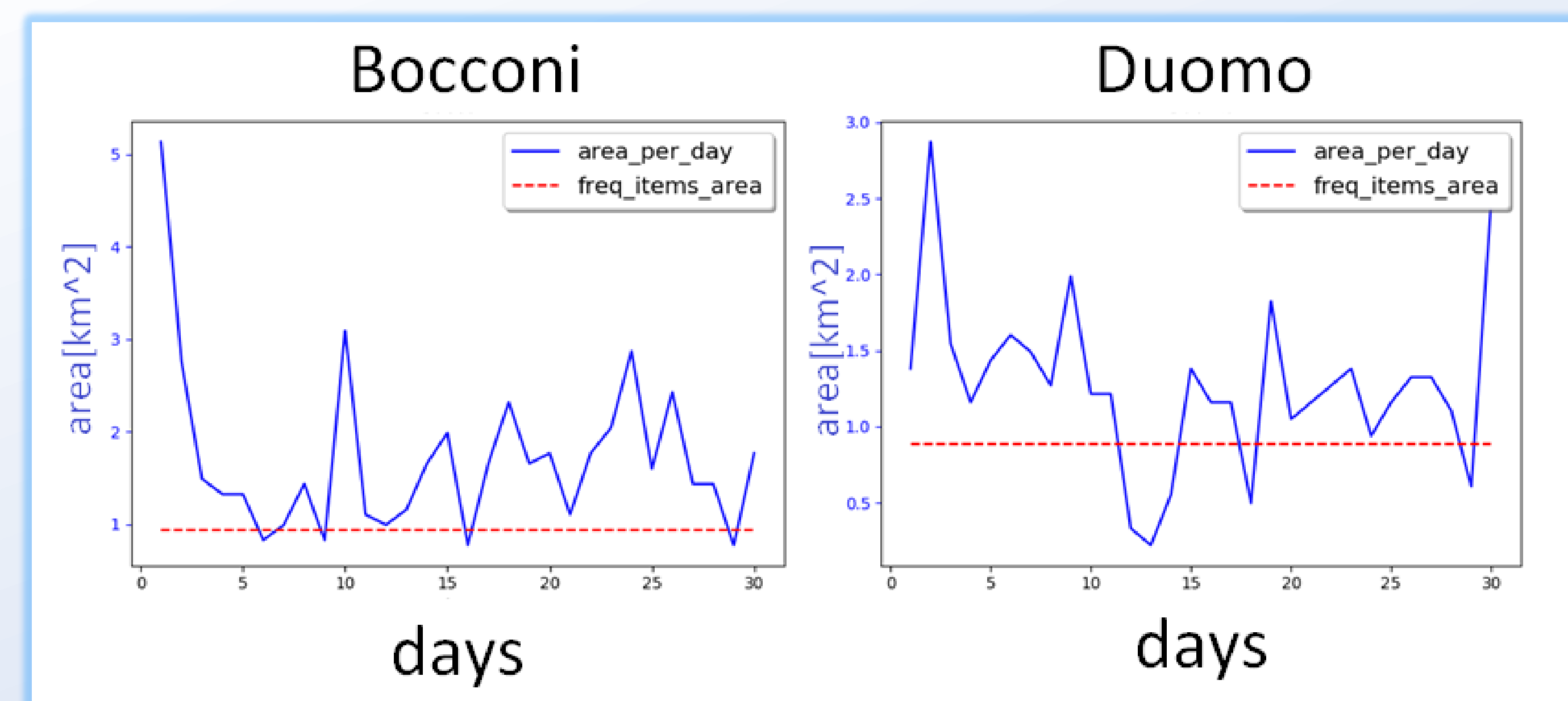


Figure 2. Area of communities compared to area of frequent community

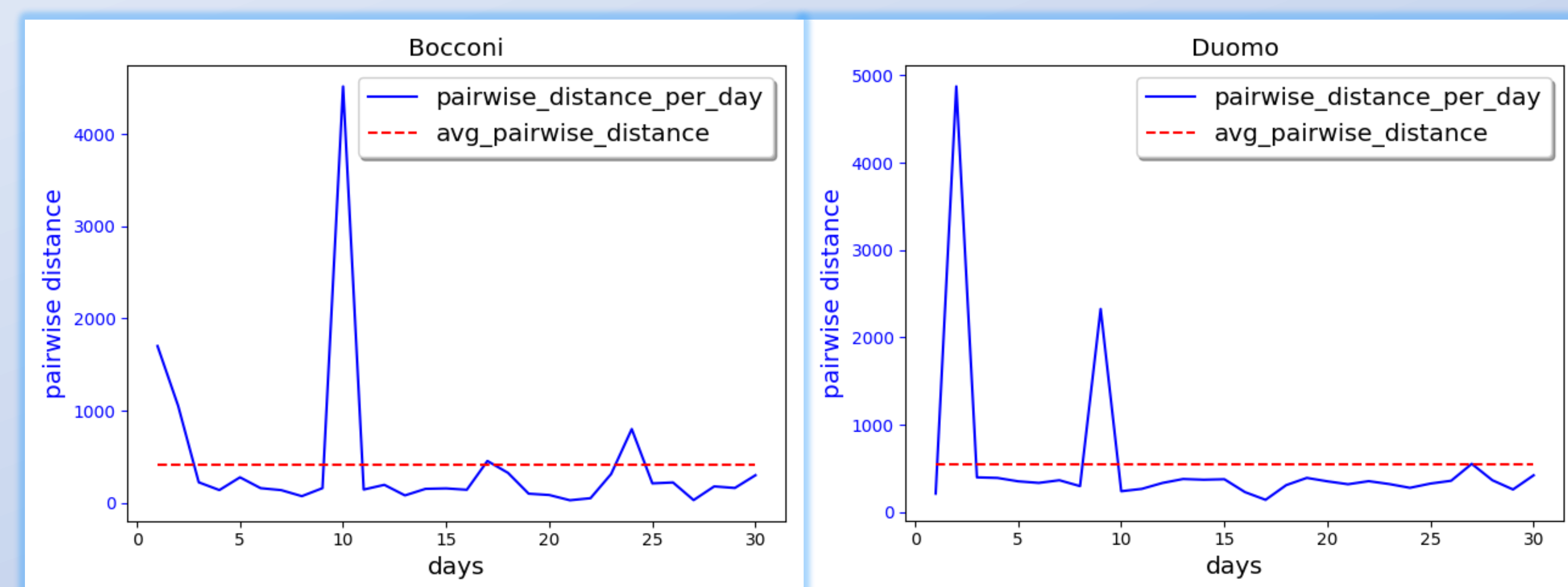


Figure 3. Pairwise distances between location point and centroids of communities. Pairwise distance high picks indicate spatial distributed community with disjoint parts, Fig. 3.

