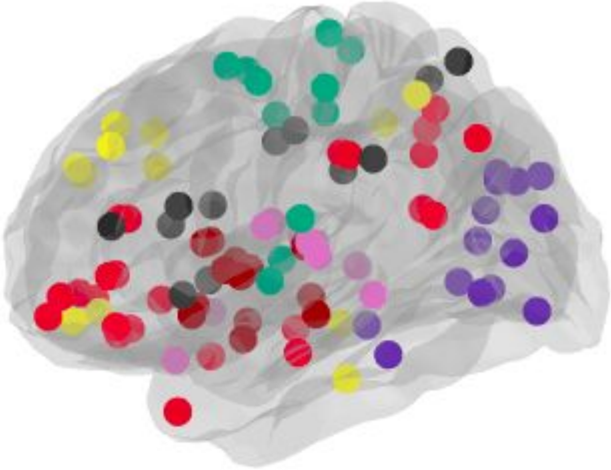
Dynamic Brain Analysis Update

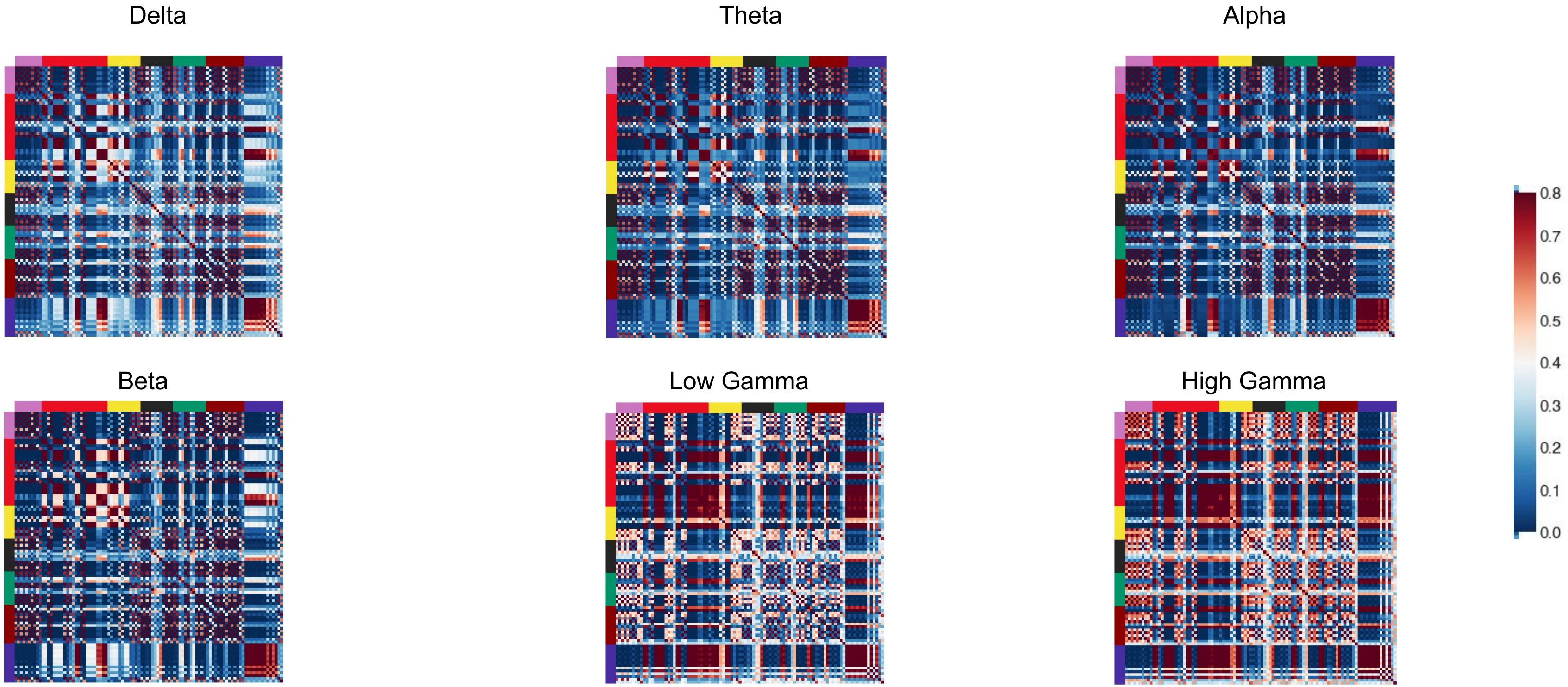
ROI of the brain



Auditory = pink
Default mode = red
Frontoparietal = yellow
Sensorimotor = green
Visual = purple
Salience = black
Subcortical = brown

MODULE ALLEGIANCE

Modular allegiance matrix (calculated from adjacency matrices)

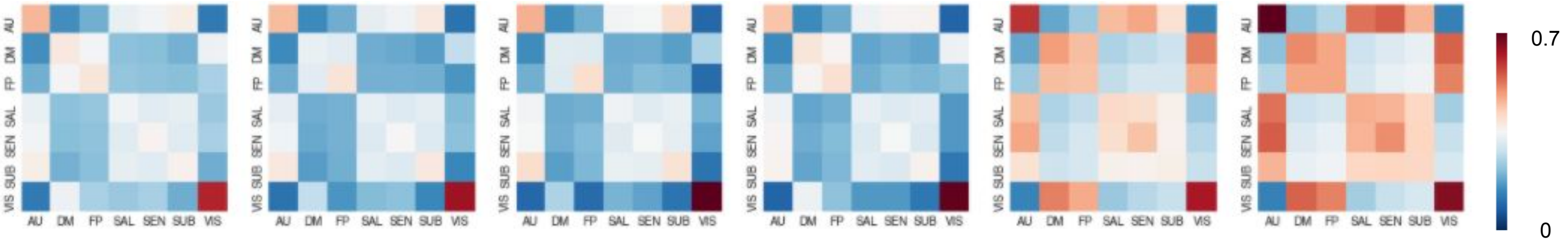


The visual (purple) system stands out as having a high module allegiance for all frequency bands (this suggests the visual system will have high recruitment)

Modular allegiance matrix at system level, including copies which have been normalized for the size (no. of nodes) of each system

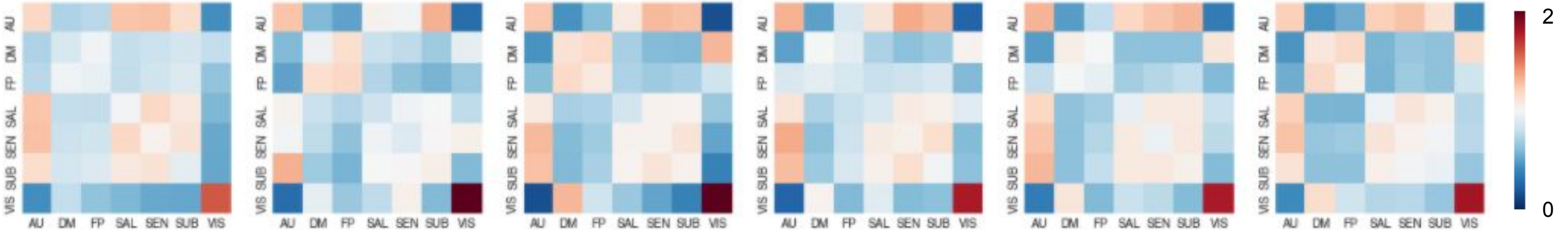
Delta | Theta | Alpha | Beta | Low Gamma | High Gamma

Modular allegiance matrices



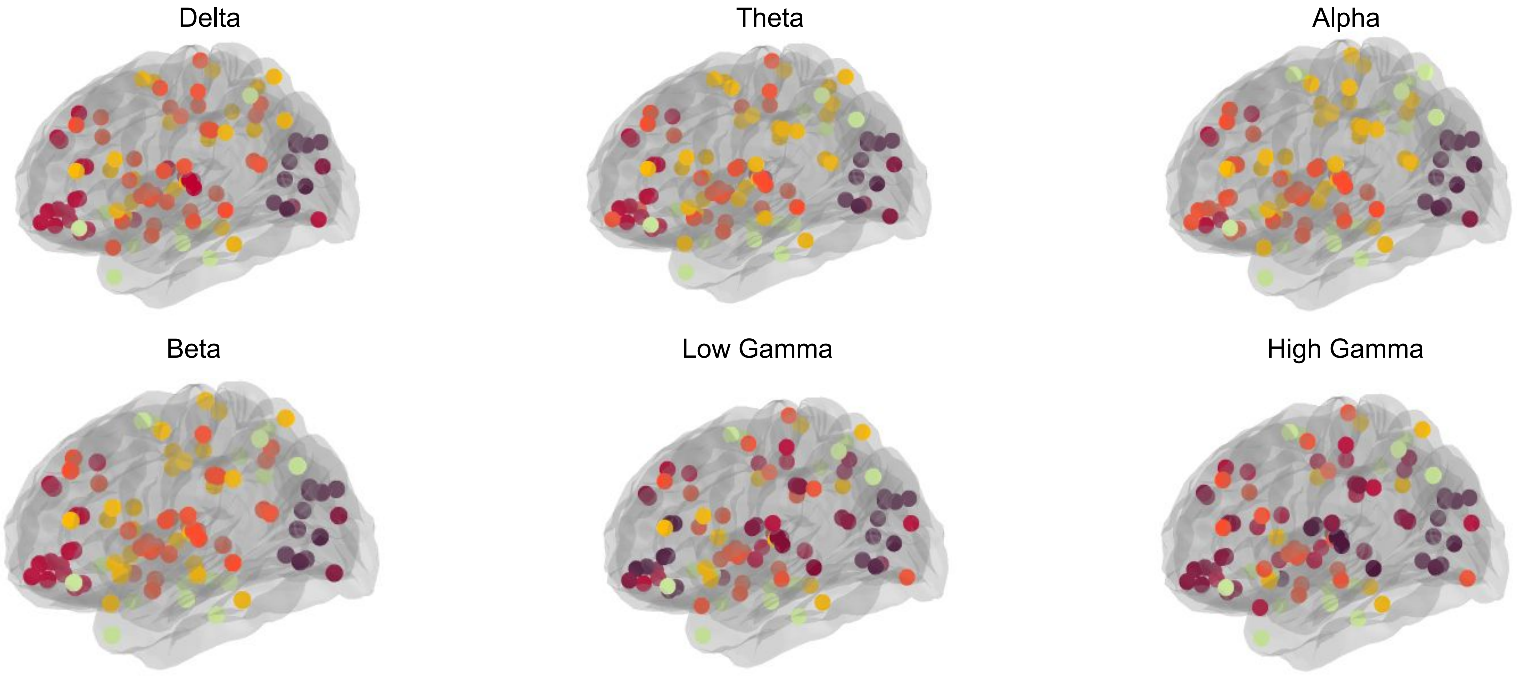
- ‘DM’ and ‘FP’ appear to have low integration with other systems, highlighted by the low modular allegiance
- As suggested by the high modular allegiance on the previous slide, the ‘visual’ system appears to have high recruitment

Normalized modular allegiance matrices



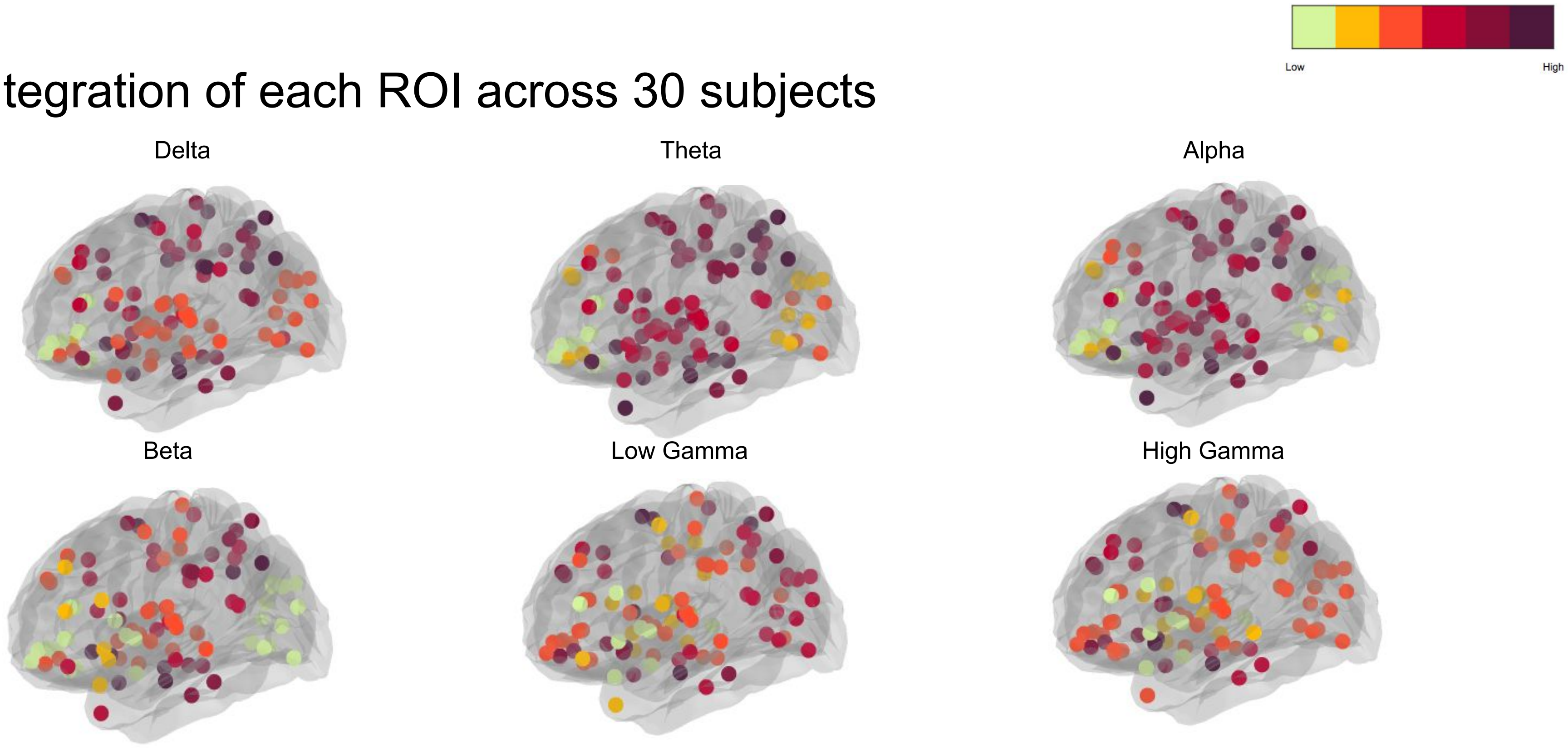
Recruitment (system level): The recruitment of a system is high when regions within the system tend to be assigned to the same module throughout layers
Integration (system level): Systems are highly integration when regions belonging to two different systems are frequently assigned to the same community

Recruitment of each ROI across 30 subjects



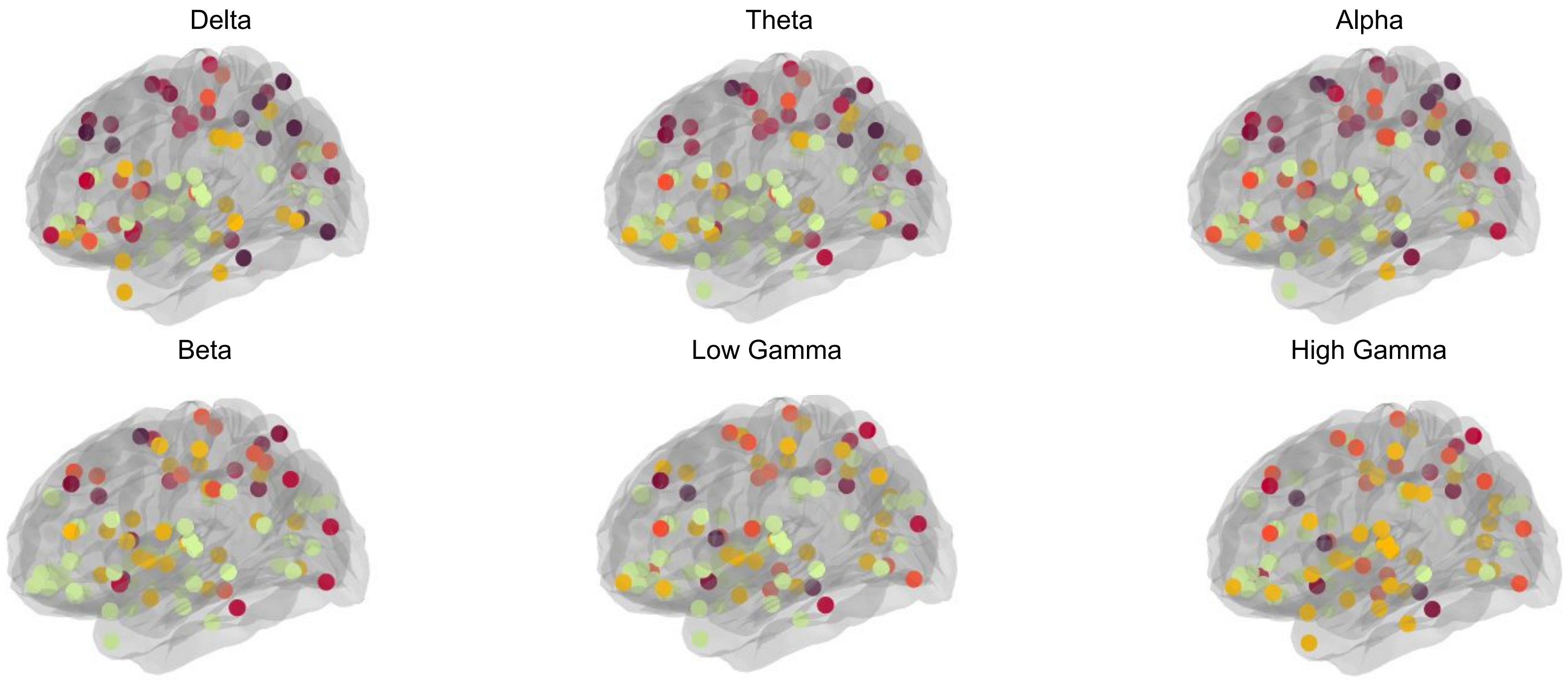
Recruitment coefficient: This function calculates the recruitment coefficient for each node of the network. The recruitment coefficient of a region corresponds to the average probability that this region is in the same network community as other regions from its own system.

Integration of each ROI across 30 subjects



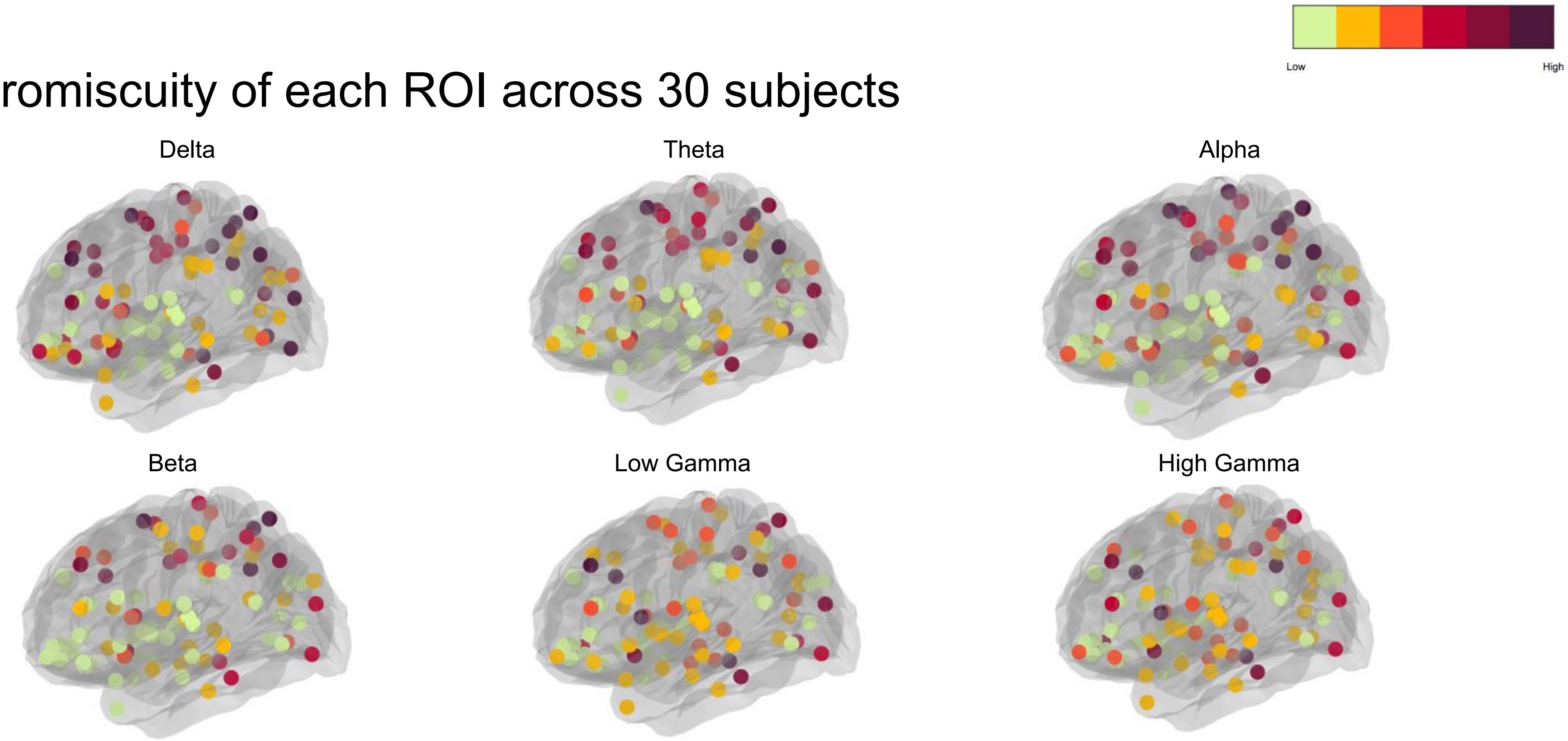
Integration coefficient: This function calculates the integration coefficient for each node of the network. The integration coefficient of a region corresponds to the average probability that this region is in the same network community as regions from other systems.

Flexibility of each ROI across 30 subjects



Flexibility coefficient: This function calculates the flexibility coefficient. The flexibility of each node corresponds to the number of times that it changes module allegiance, normalized by the total possible number of changes.

Promiscuity of each ROI across 30 subjects

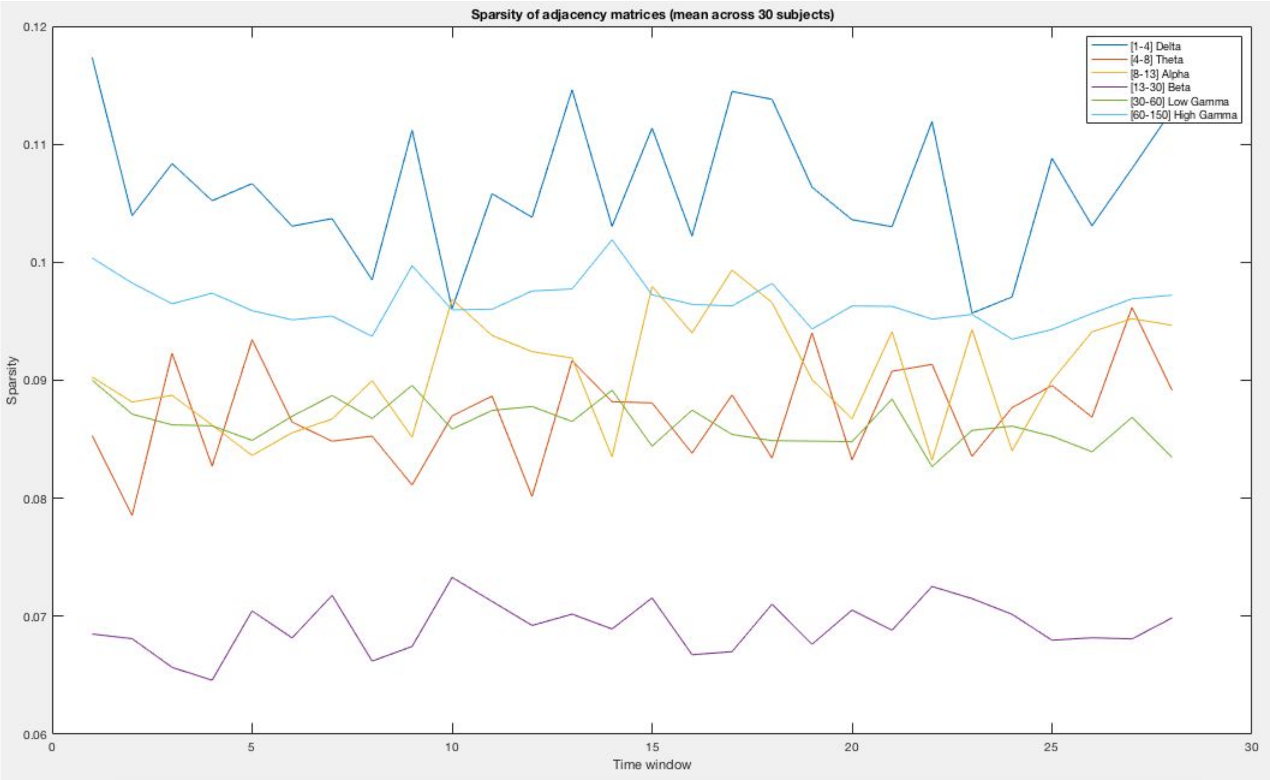


Promiscuity coefficient: This function calculates the promiscuity coefficient. The promiscuity of a temporal or multislice network corresponds to the fraction of all the communities in the network in which a node participates at least once.

Distance Metrics

Comparing Time Windows

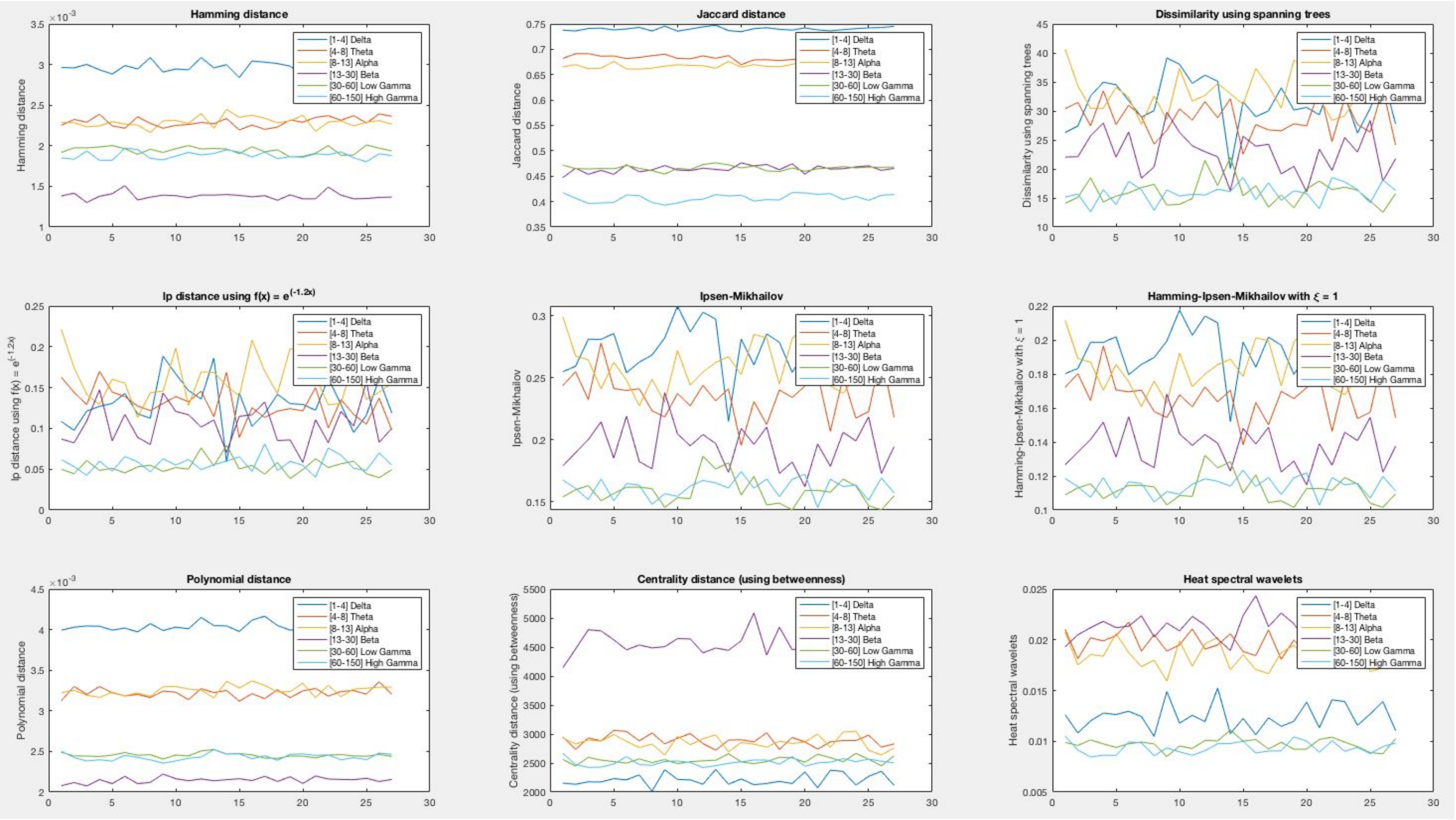
Adjacency matrices sparsity



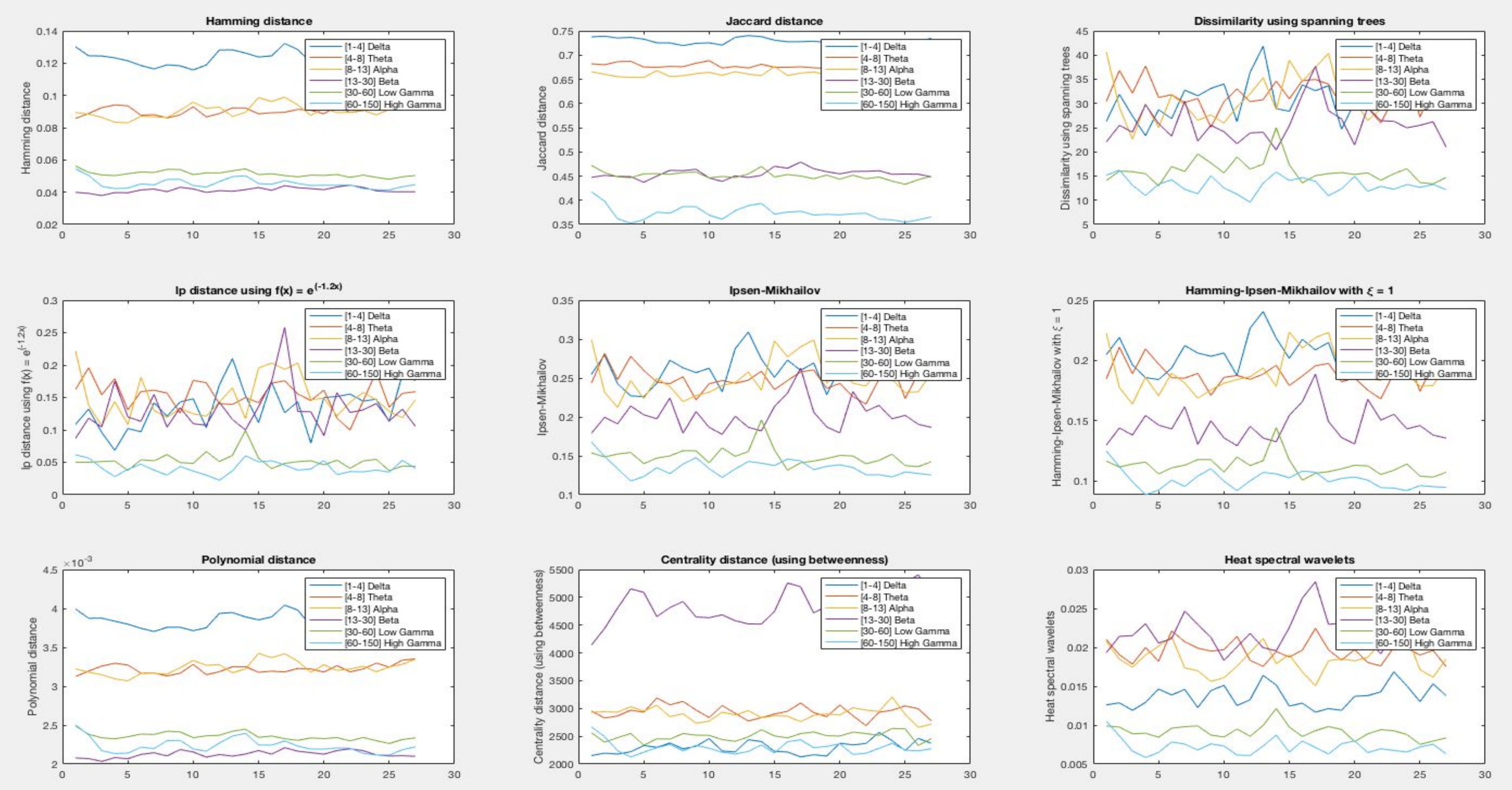
Threshold function used can be found here: https://www.pnas.org/content/106/26/E66

30 subjects

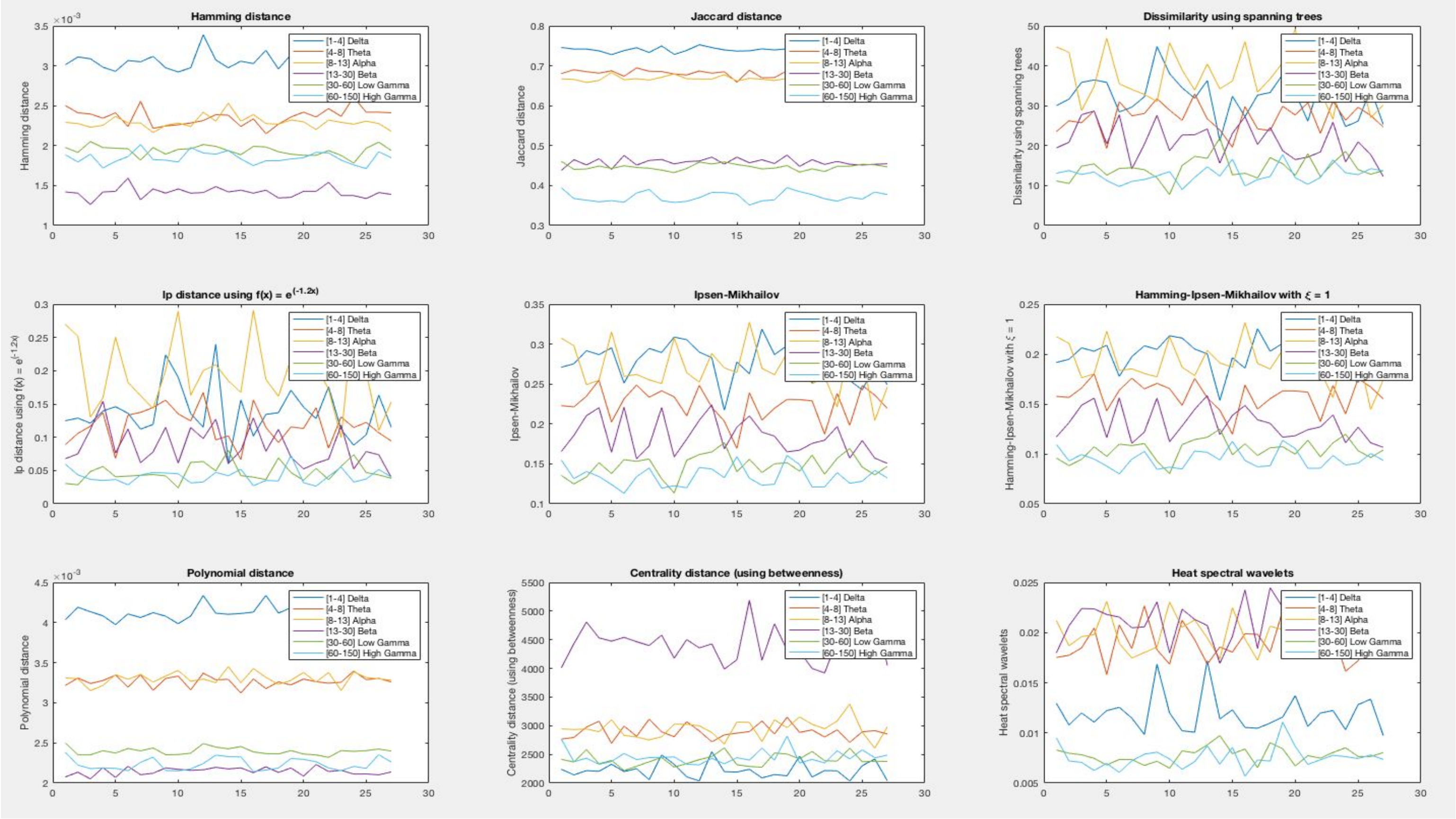
‘Distances’ calculated between time window 1 and n = 2,...,28



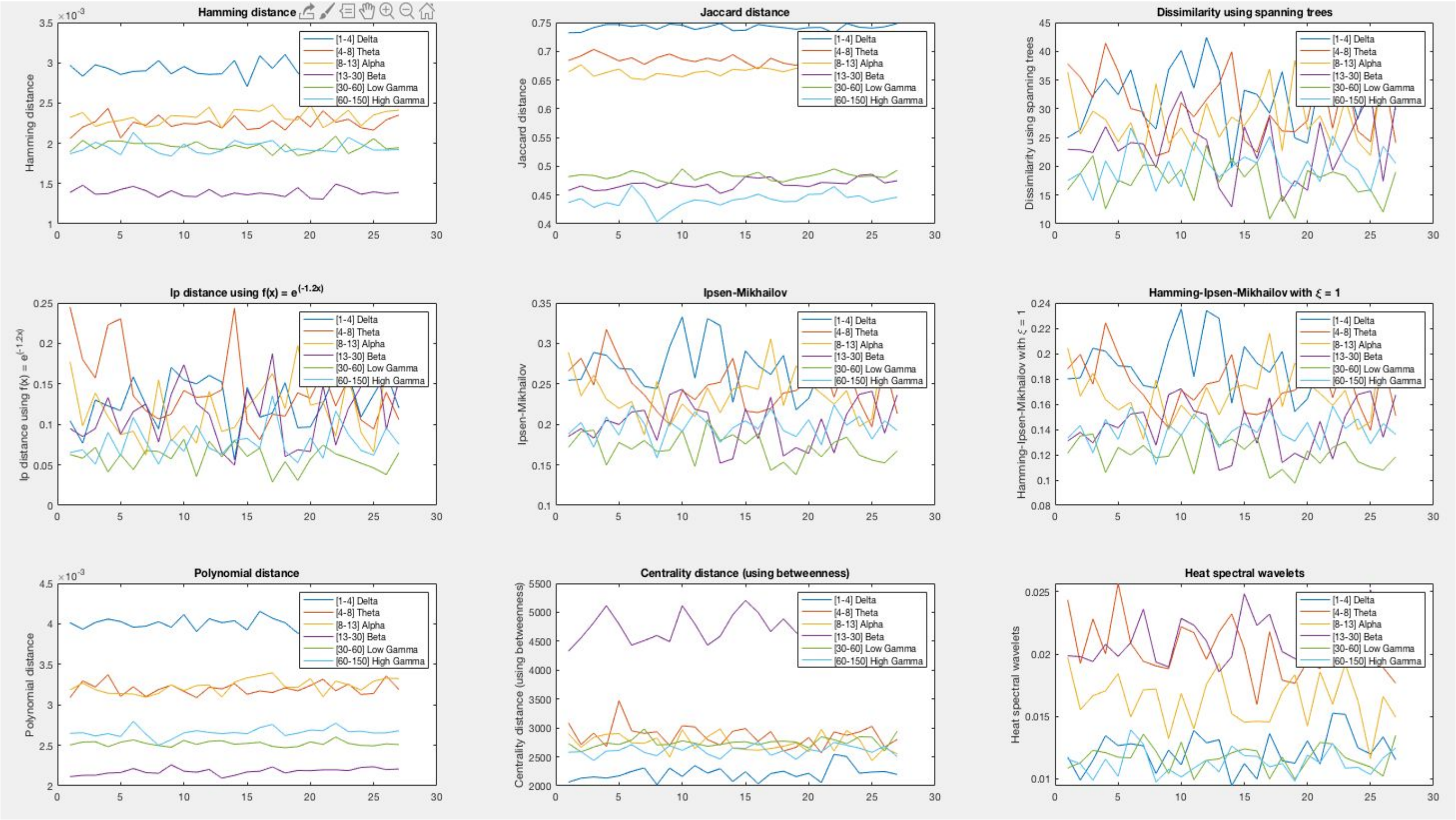
‘Distances’ calculated between consecutive time windows



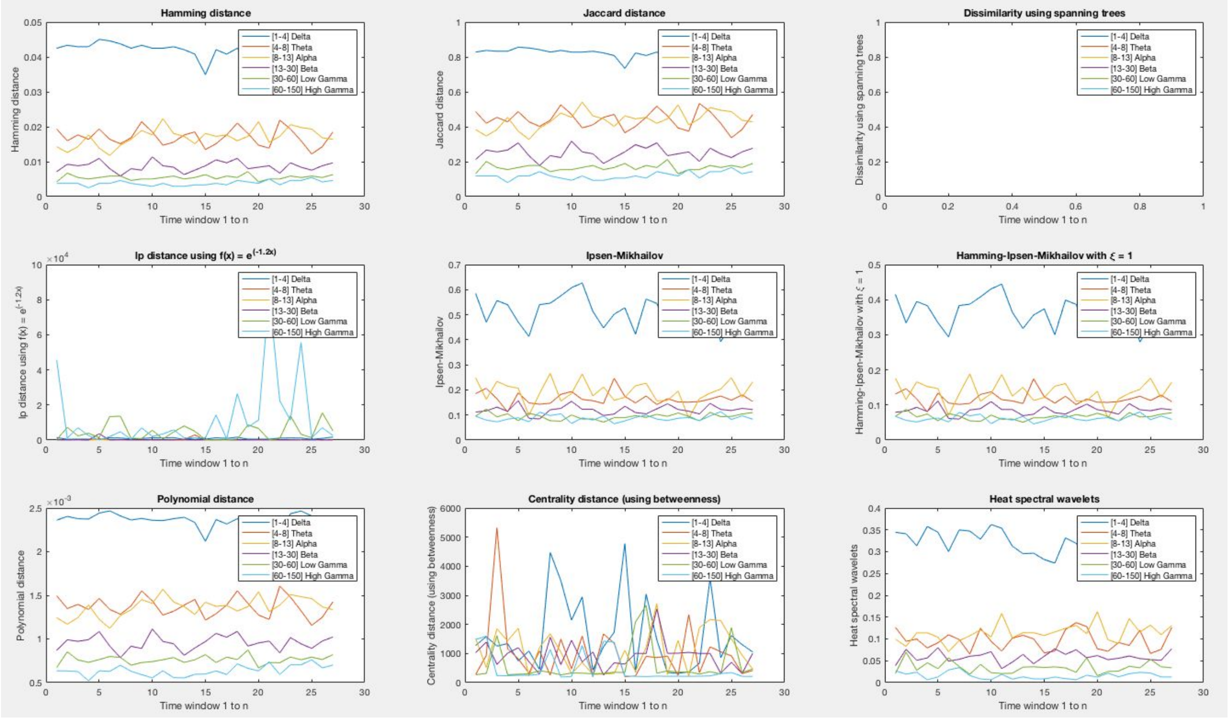
‘Distances’ calculated between time window 1 and n = 2,...,28



‘Distances’ calculated between time window 1 and n = 2,...,28



‘Distances’ calculated between time window 1 and n = 2,...,28



New threshold function

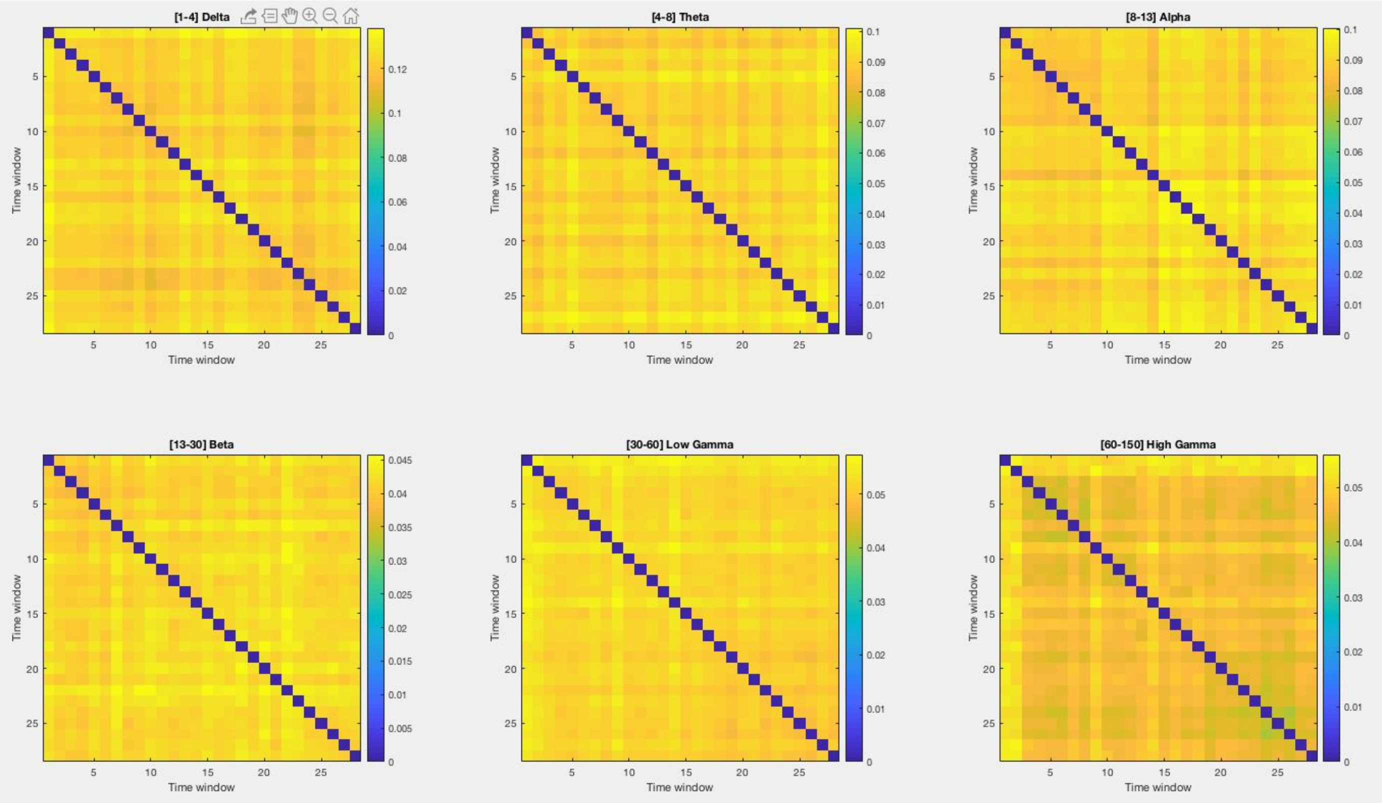
Here I have used a new threshold function to create the adjacency matrices, where I have kept the top 3% of the strongest edges, resulting in matrices that all have the exact same sparsity. Interestingly, the frequency bands still split out for some of the distances.

Note that with only 3% of the edges kept, the graphs are not fully connected, hence why there is no ‘dissimilarity using spanning trees’ (although they are connected in the sense of having a giant component, I believe).

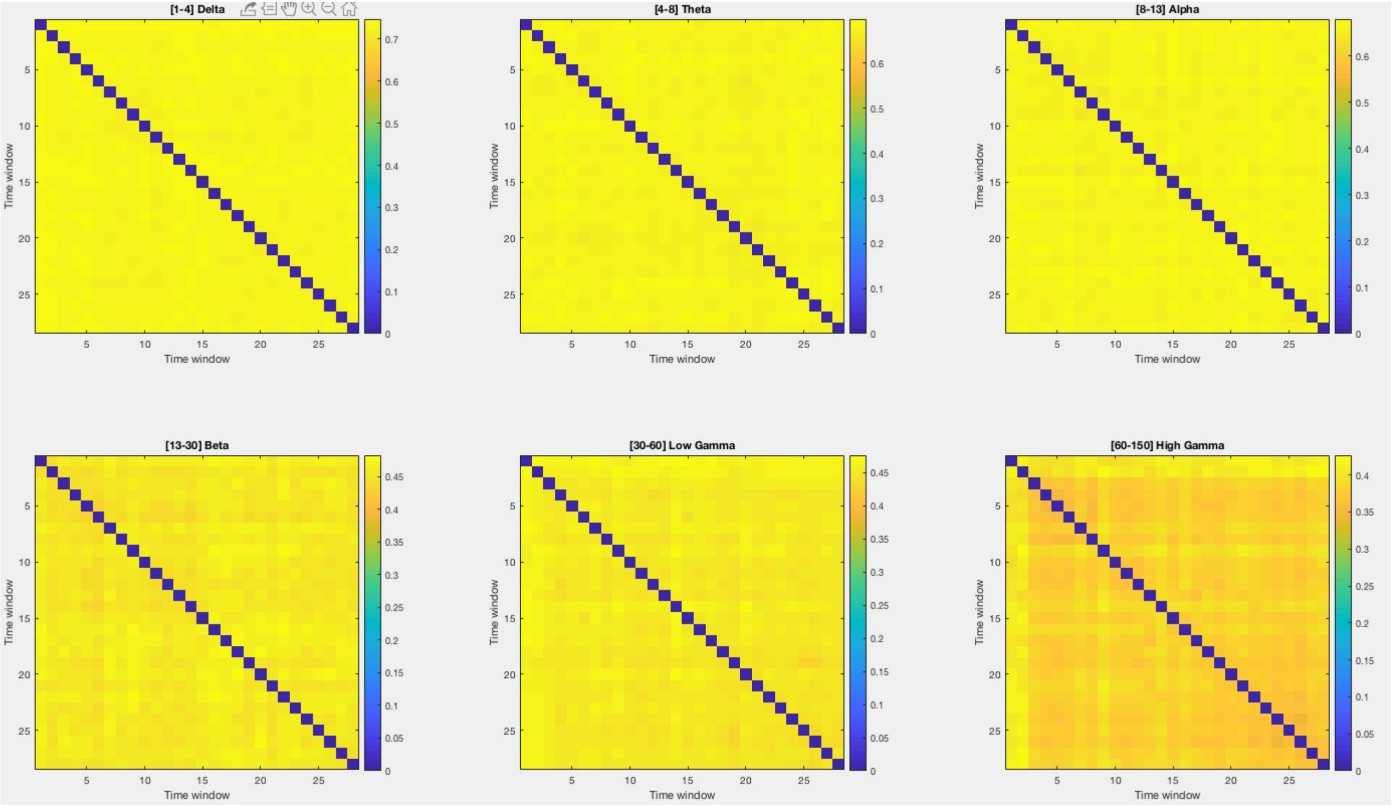
NB: I still need to check I have coded the Ip-distance and centrality metrics correctly, so perhaps this is why they are different to the rest

Local Distances

Hamming distance

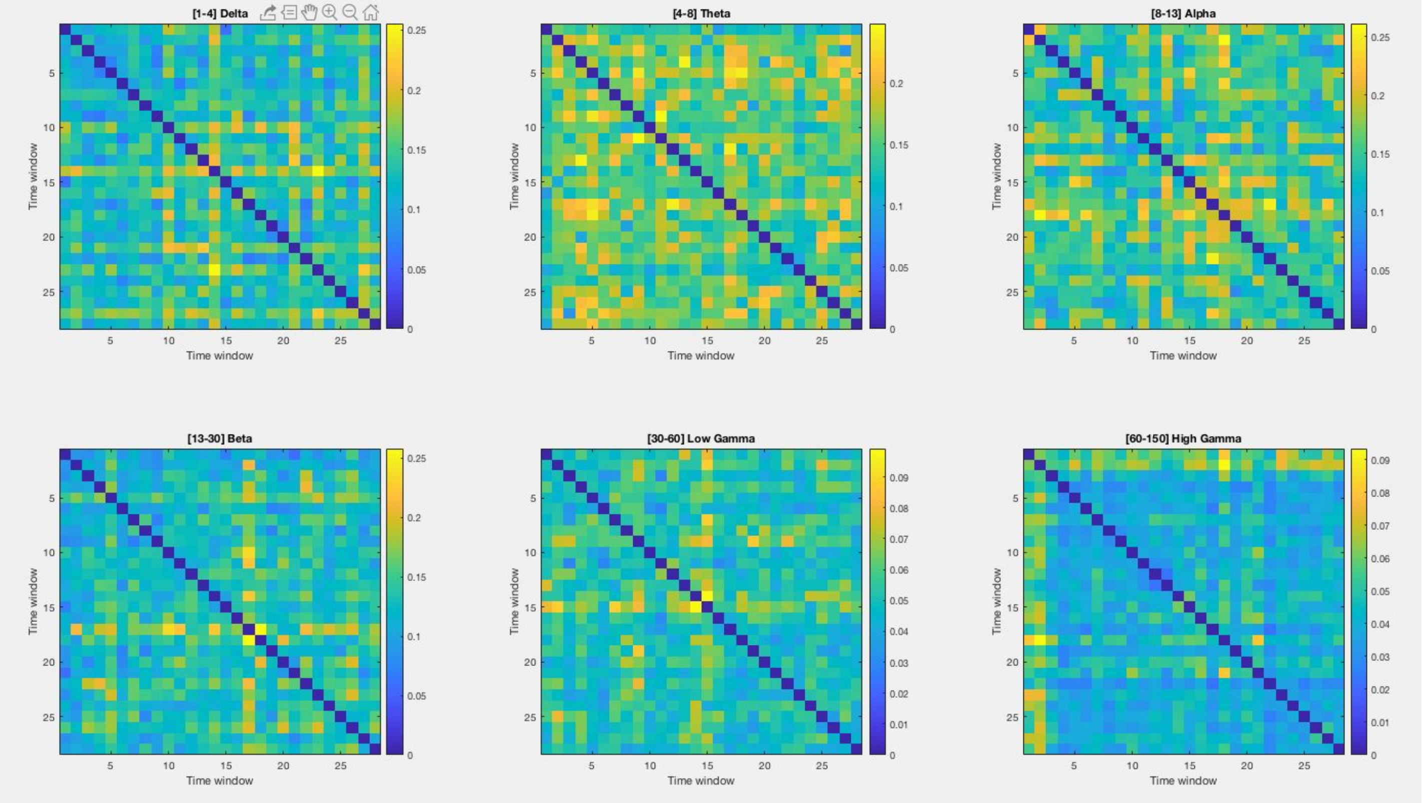


Jaccard distance

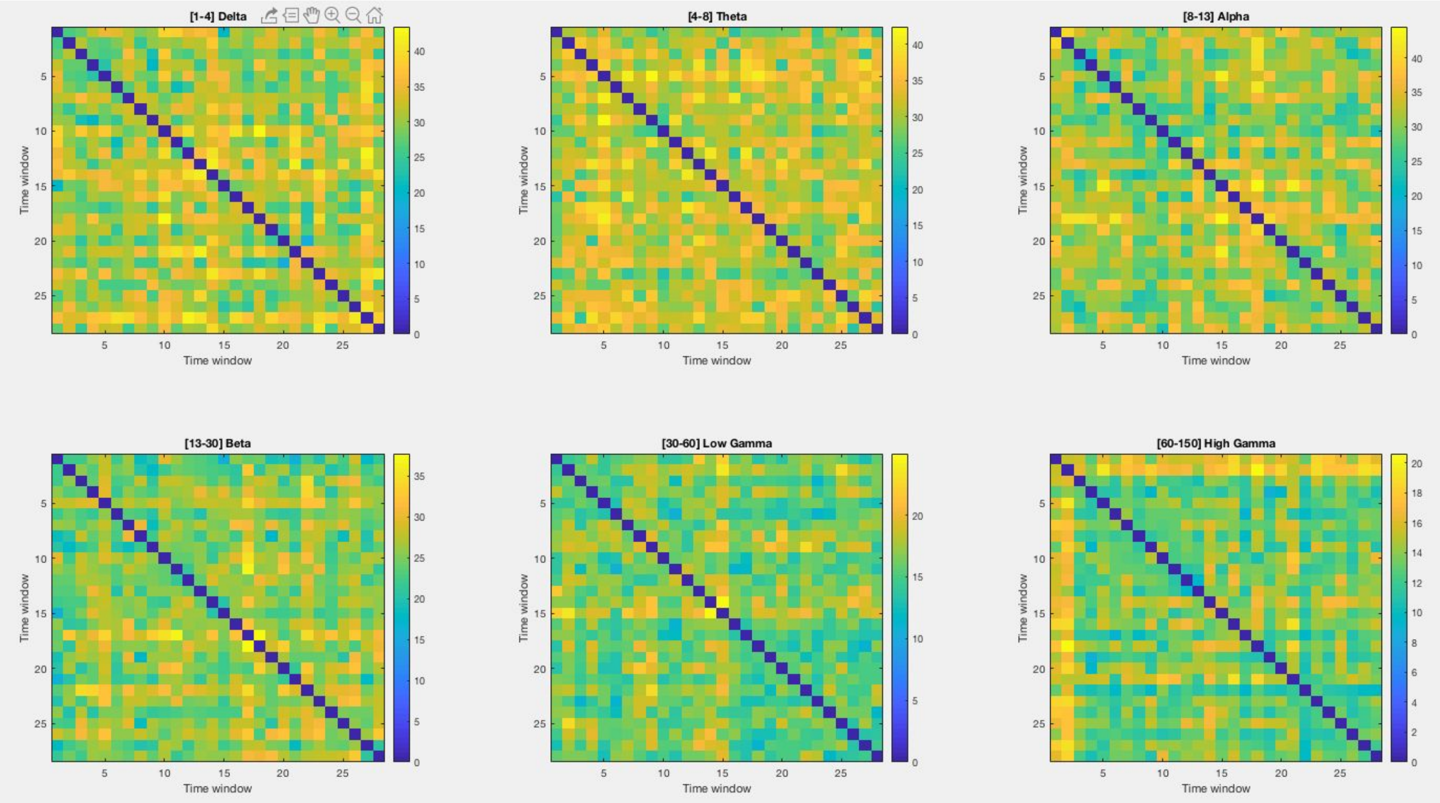


SPECTRAL APPROACHES

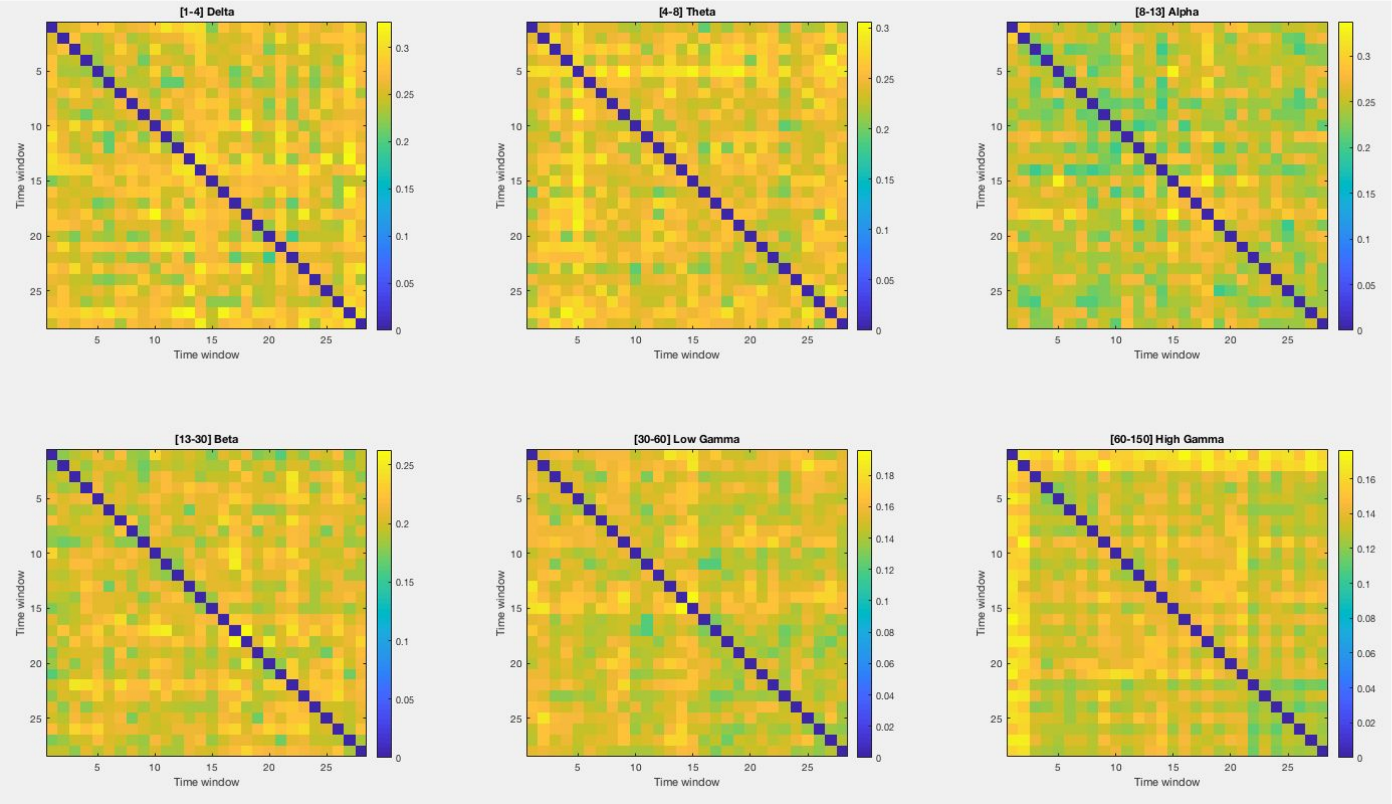
Lp-distance using e^-1.2x



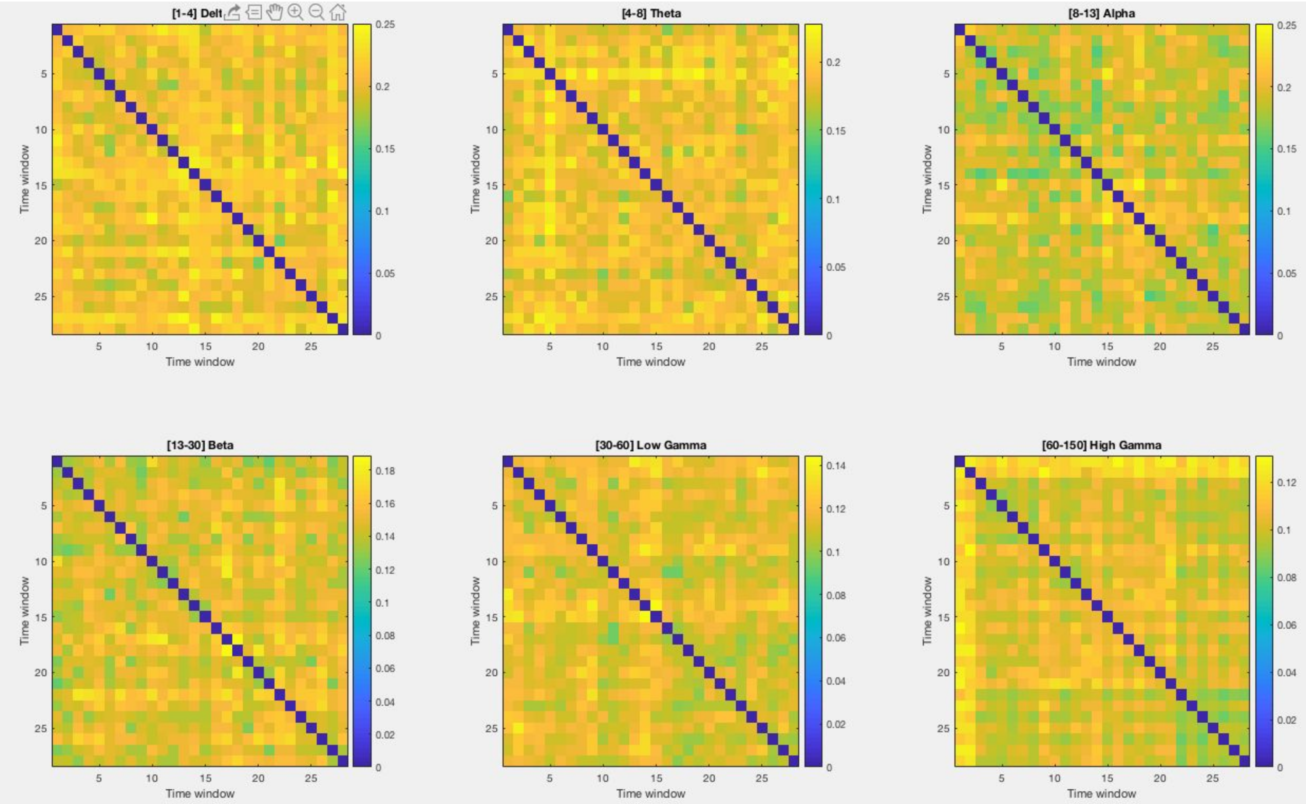
Dissimilarity using spanning trees



Ipsen-Mikhailov distance

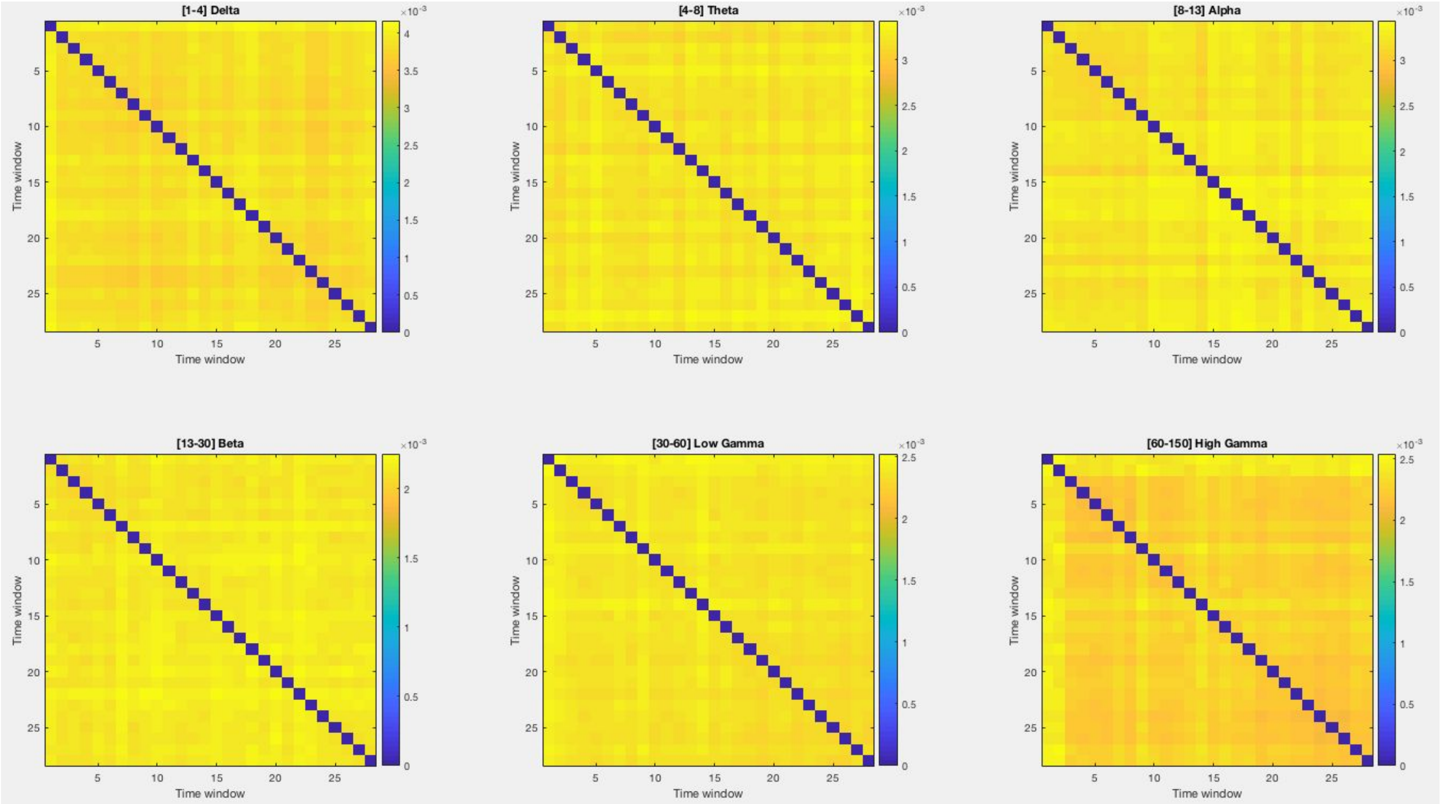


Hamming-Ipsen-Mikhailov distance with ξ = 1



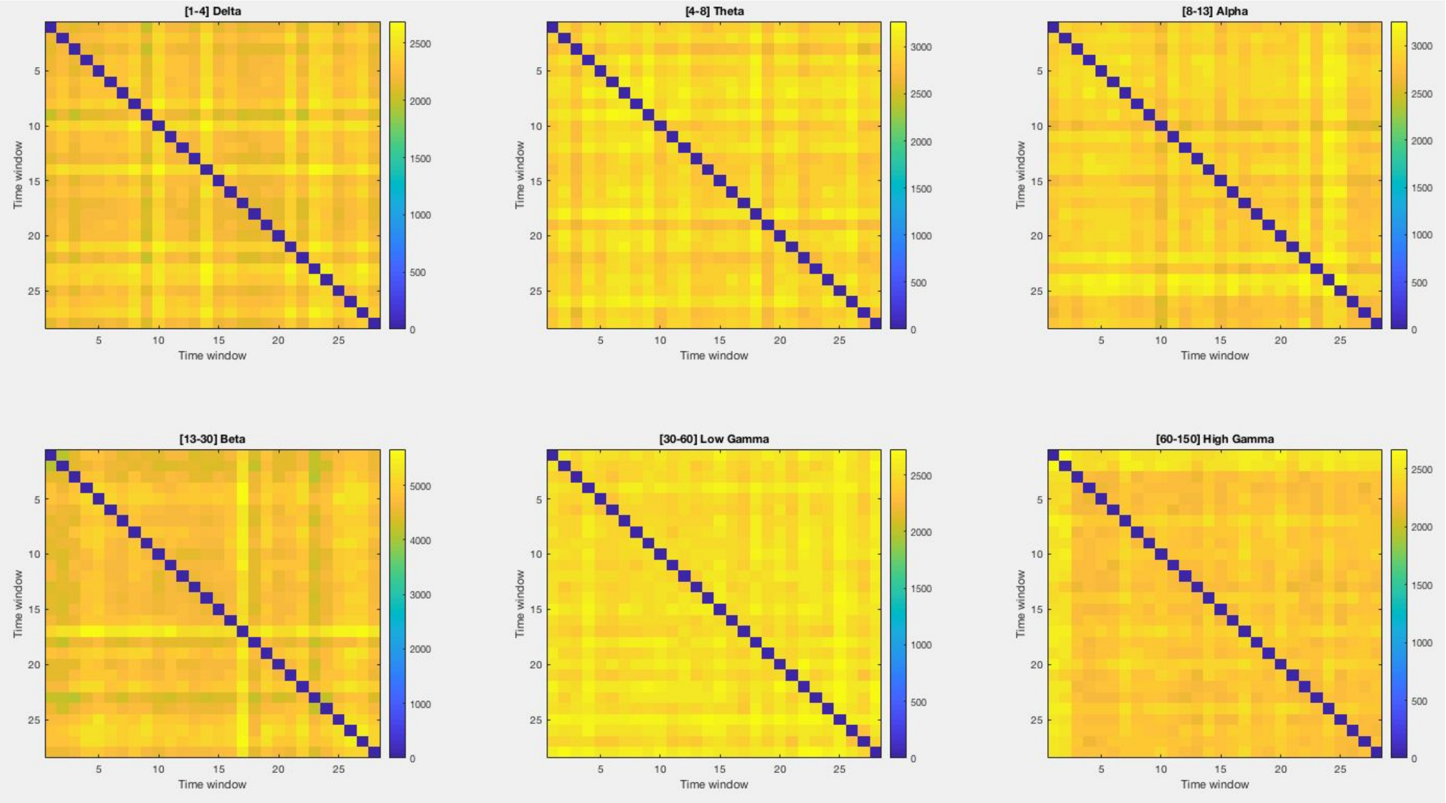
Polynomial Approach

Polynomial distance

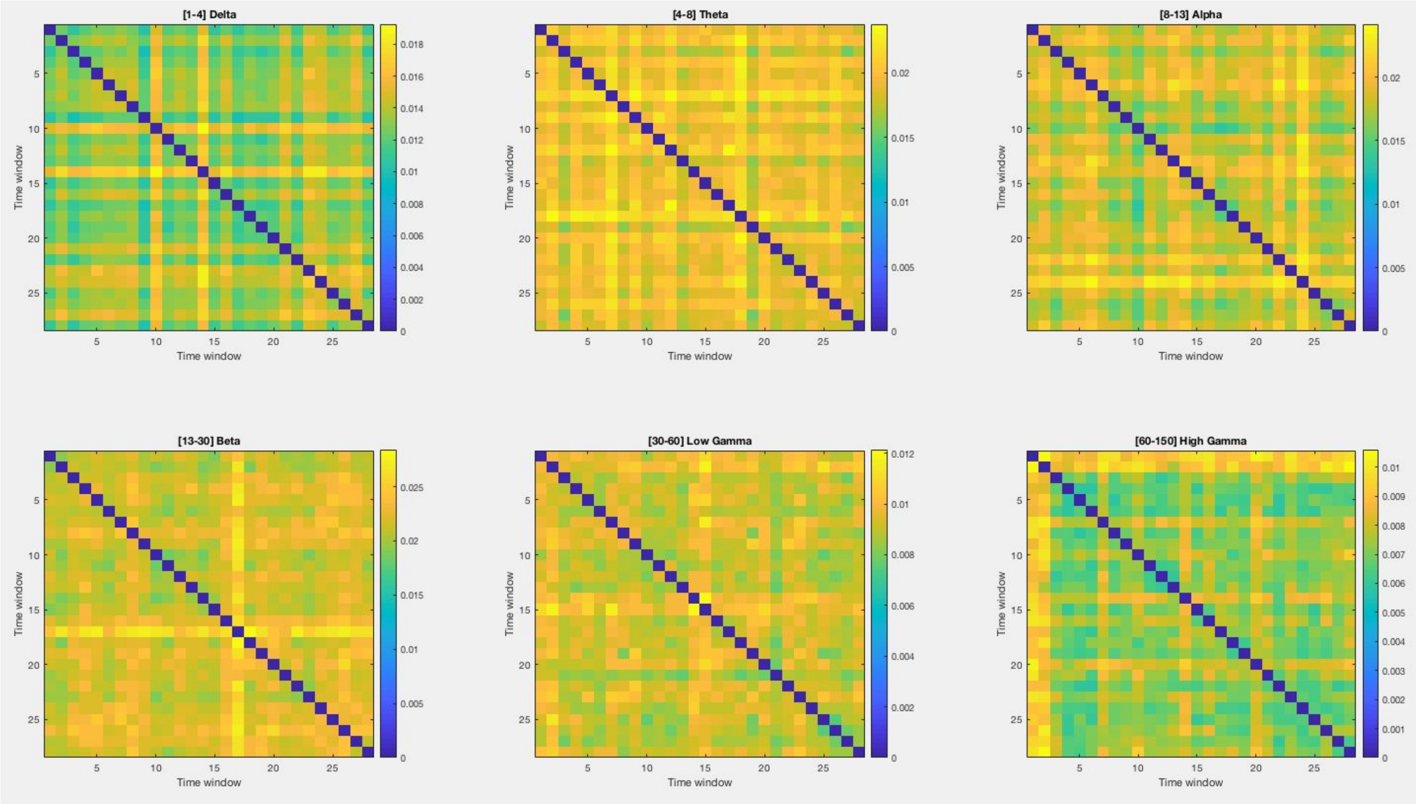


Quantifying Change At Mescoscale

Centrality distance (using betweenness)

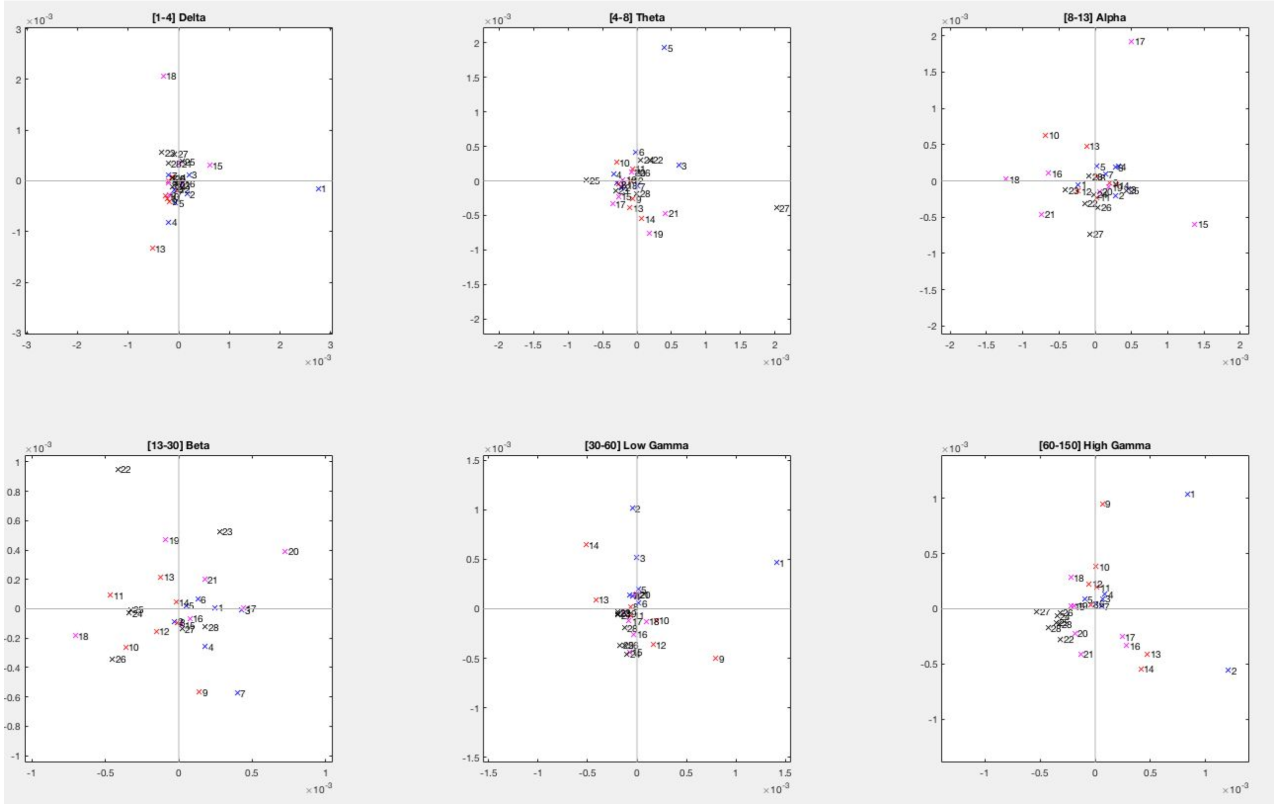


Heat spectral wavelets



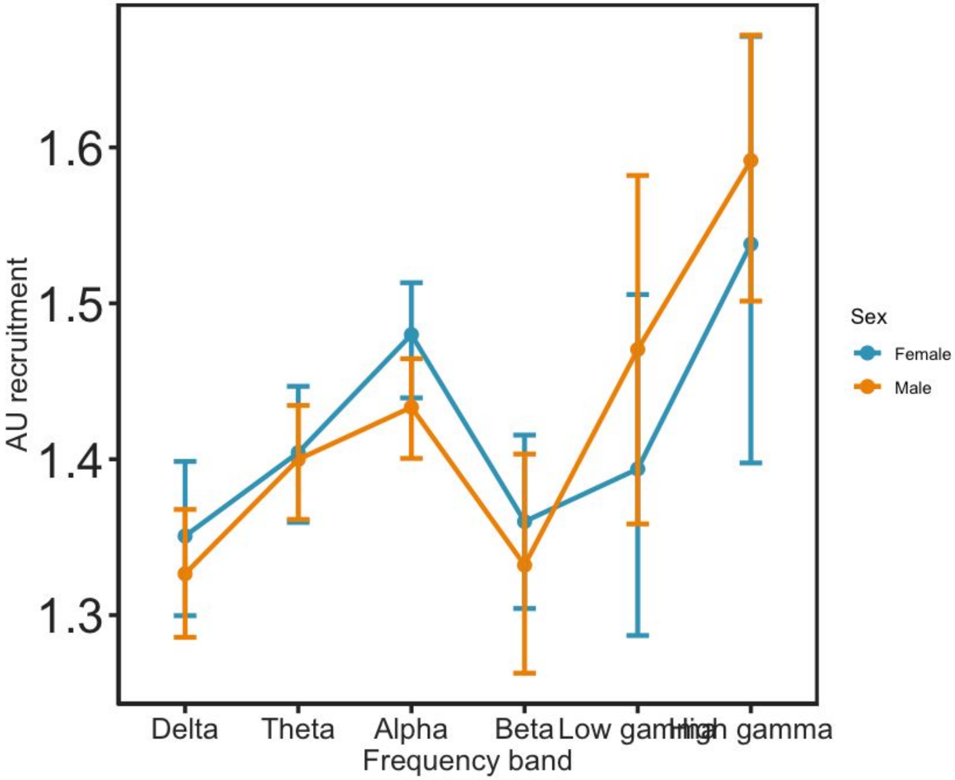
Illustrative Mds Example

Multidimensional scaling example (for polynomial distance) across 30 subjects

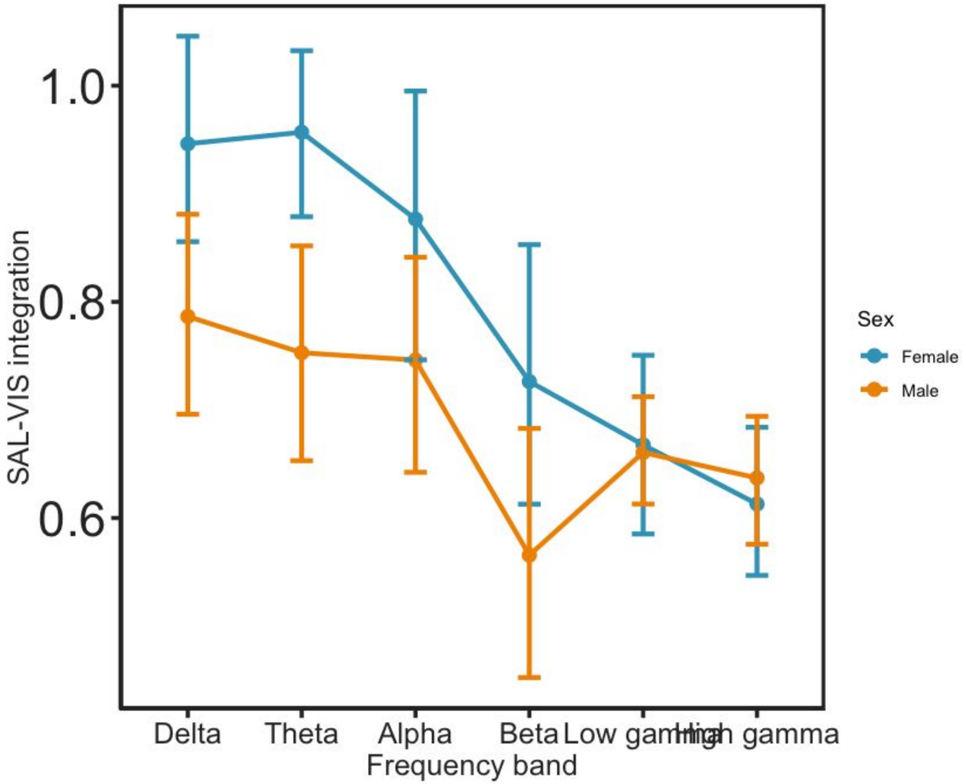


Comparing Females Vs Males

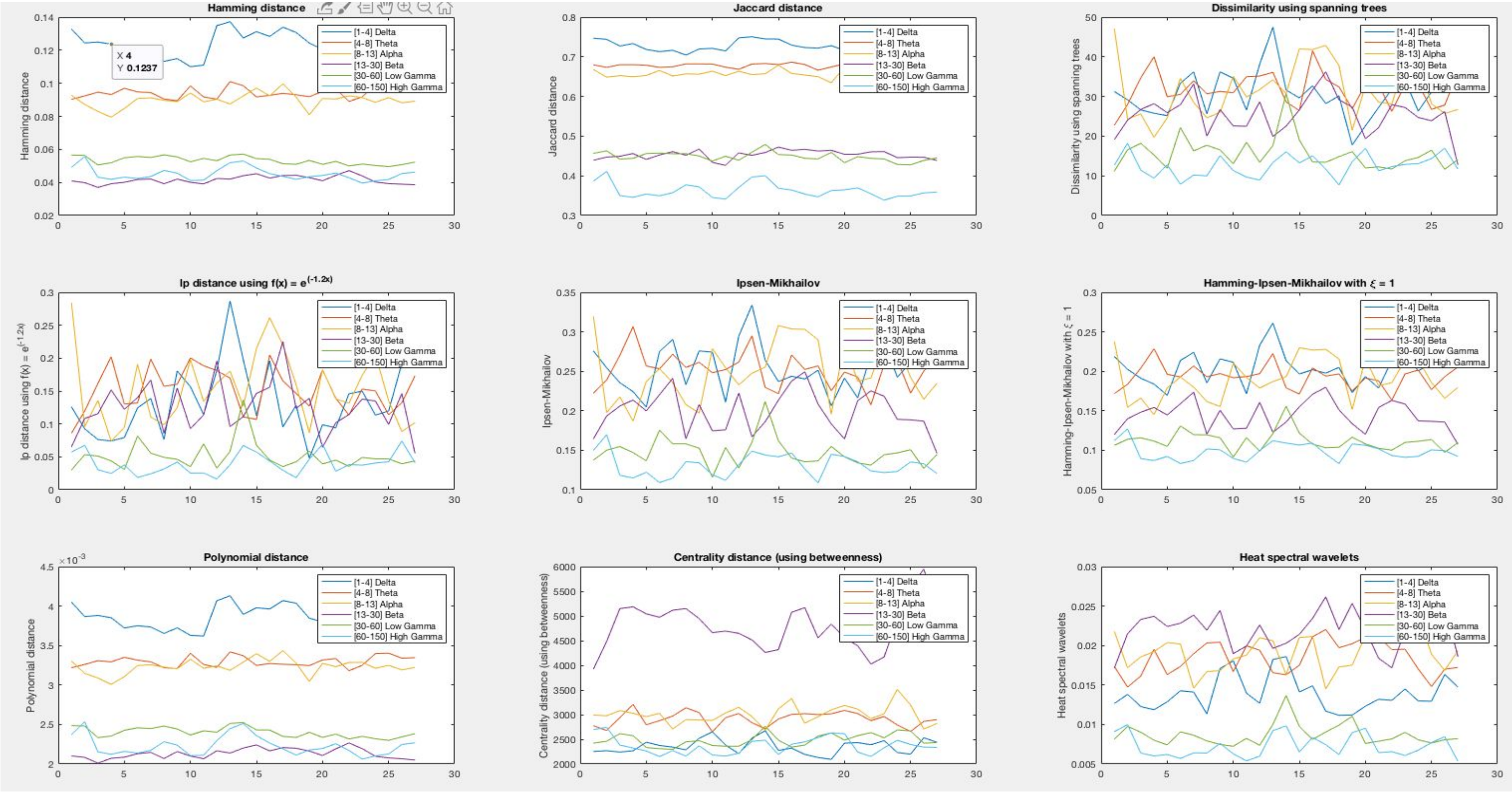
Auditory system recruitment - male vs female



Salient-Visual systems integration - male vs female



‘Distances’ calculated between consecutive time windows



‘Distances’ calculated between consecutive time windows