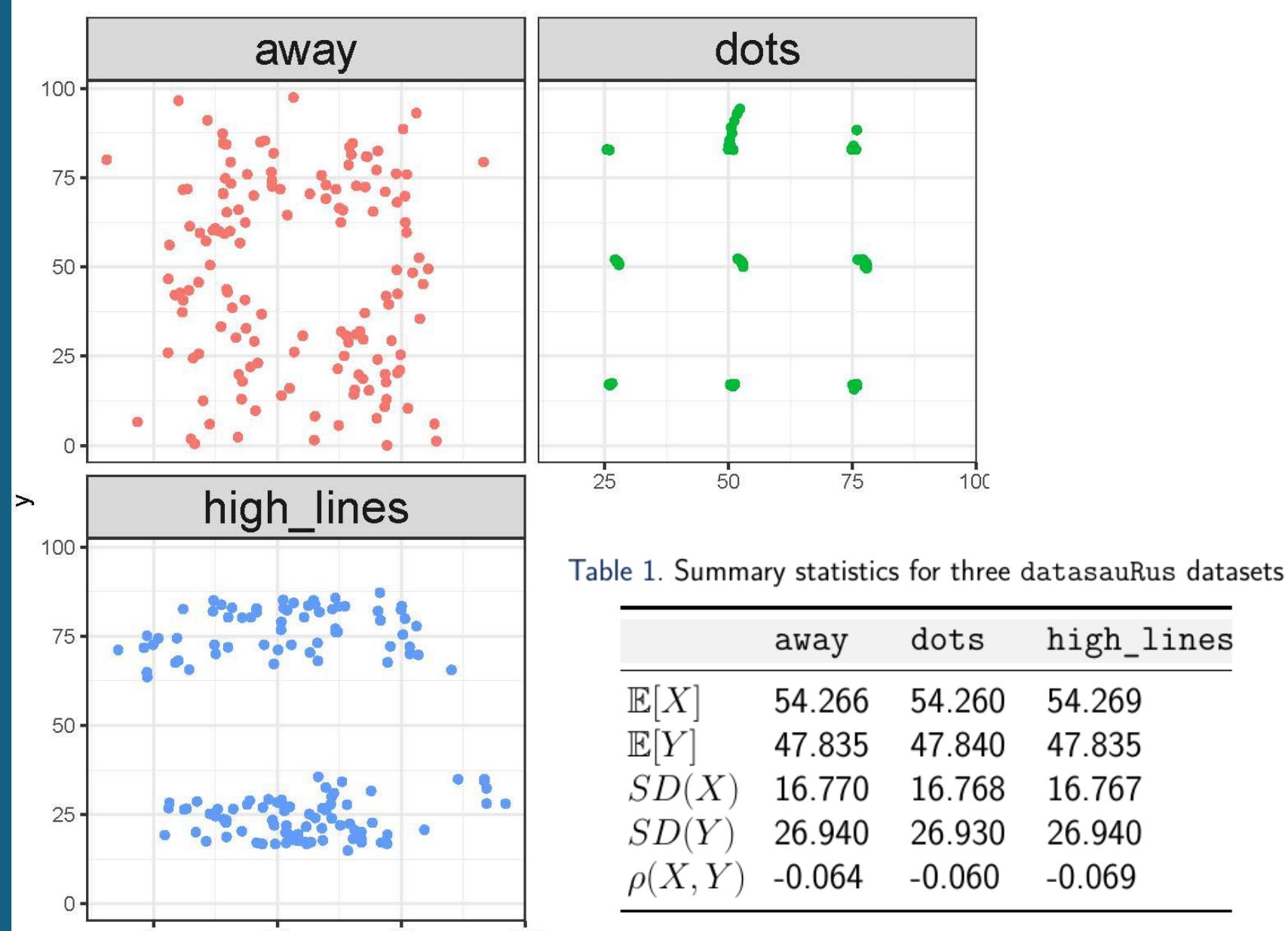




Topological Data Analysis (TDA), Mapper Algorithm and Persistence Diagrams

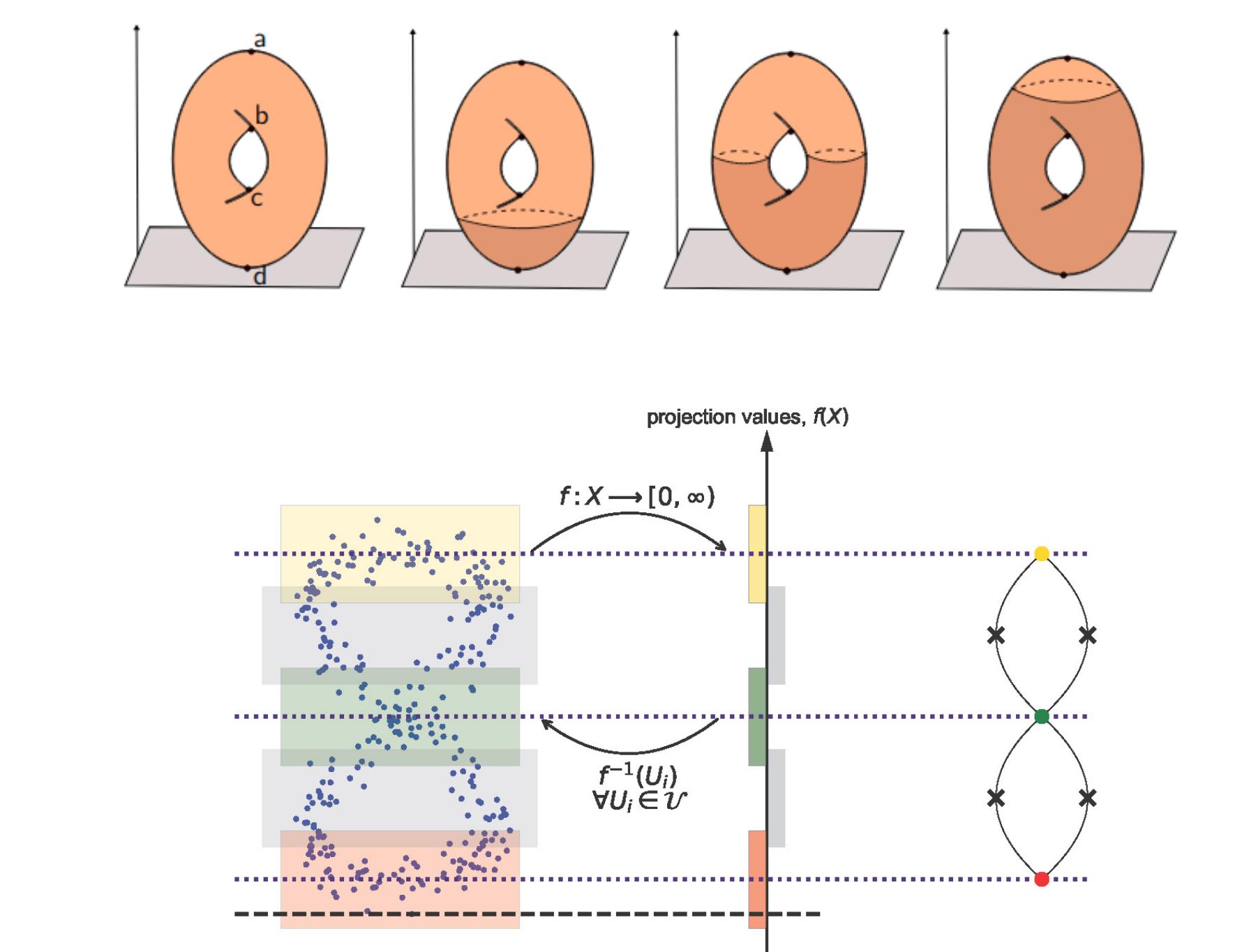
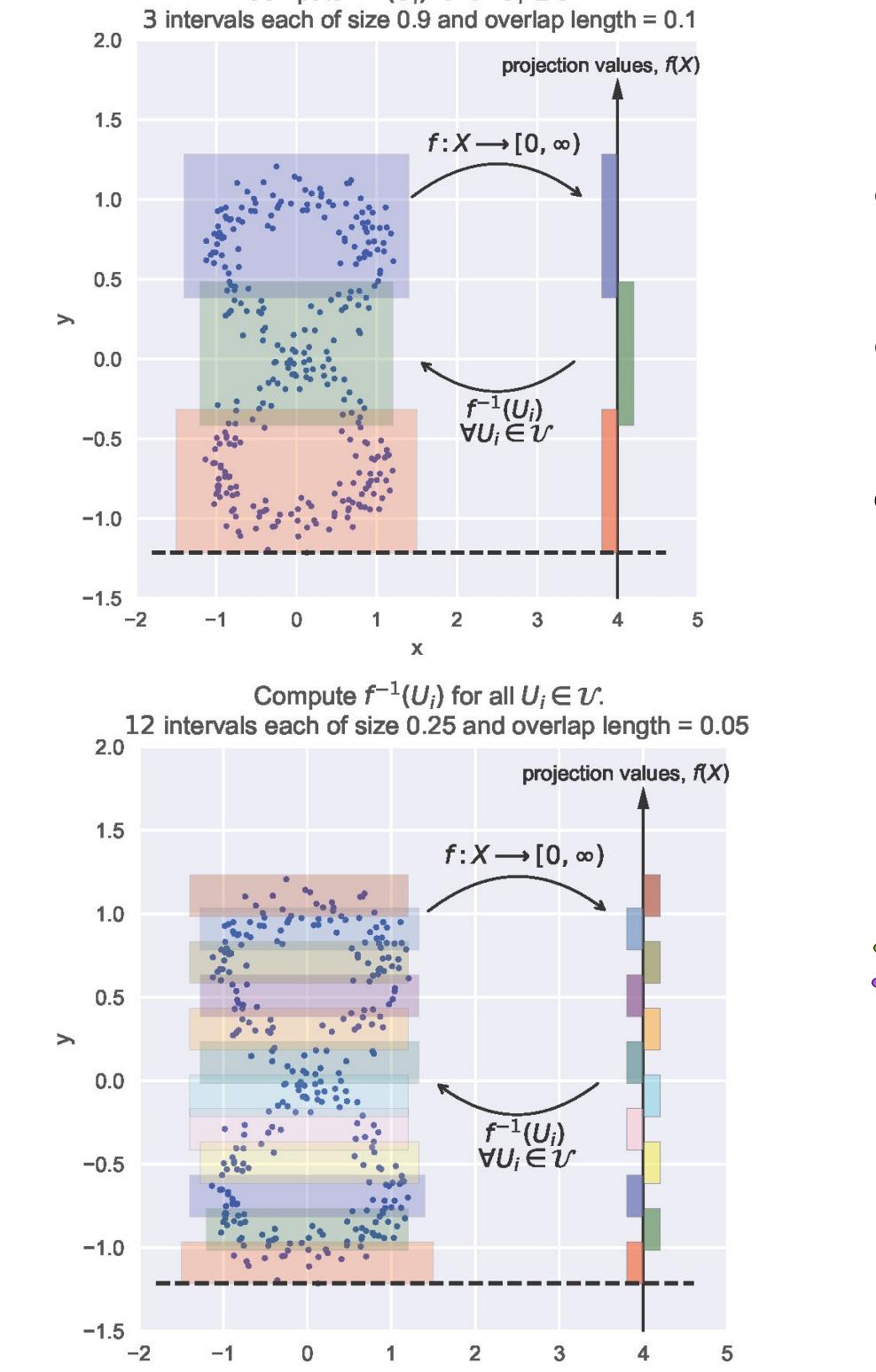
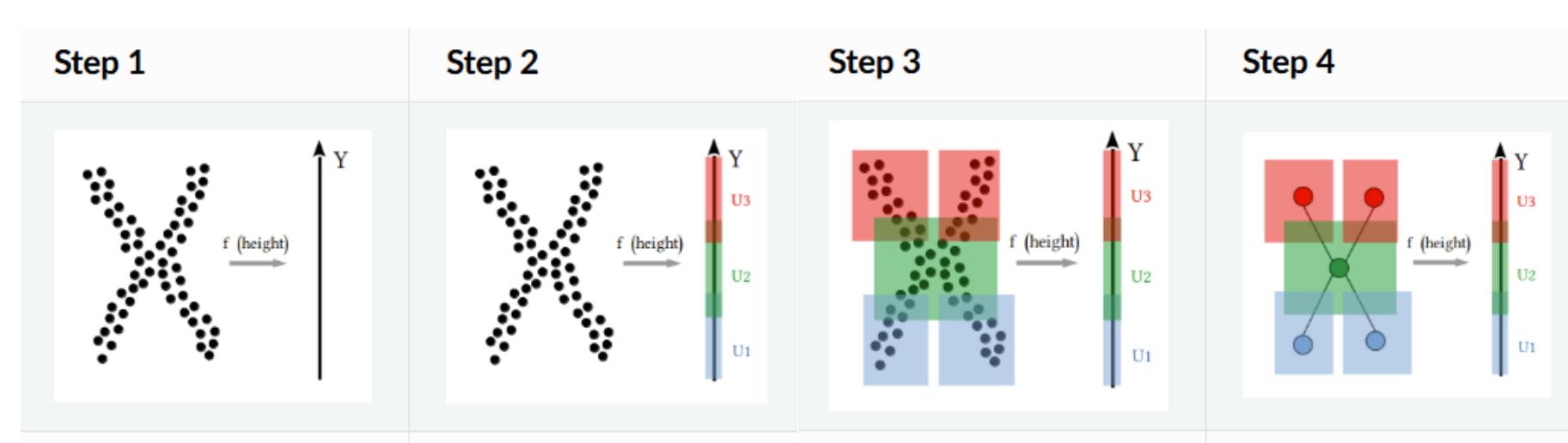
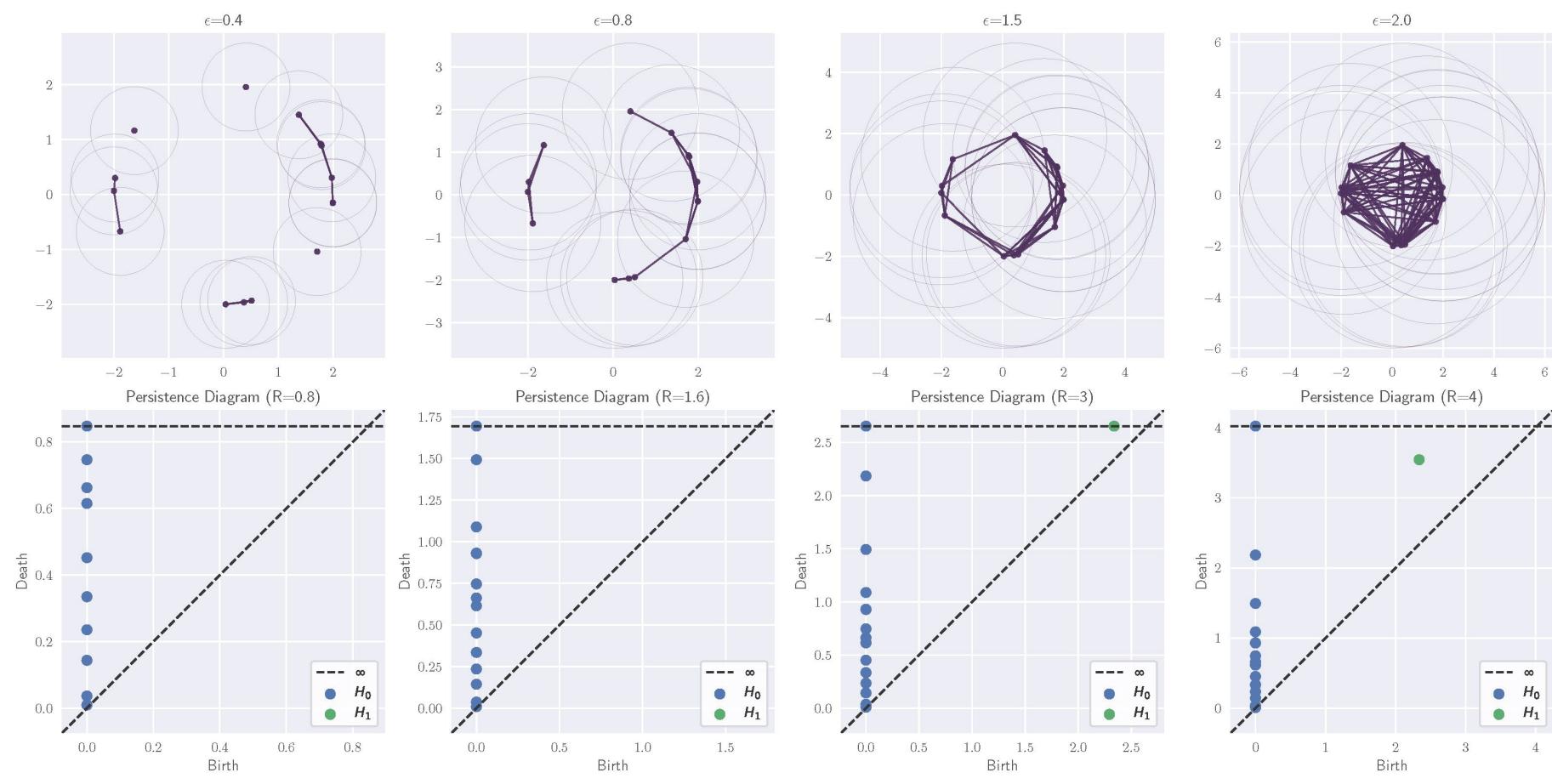
The topological information of interest are of two types:
1. Shape information, i.e., what is the “shape” of the (unknown) space from which the data is sampled?
2. Connectivity information, i.e., how the individual parts interact to form the whole.



Persistence diagrams and **Mapper graphs** are the most used topological summary statistics.

Mapper is a statistical version of **Reeb graph**. Some challenges are

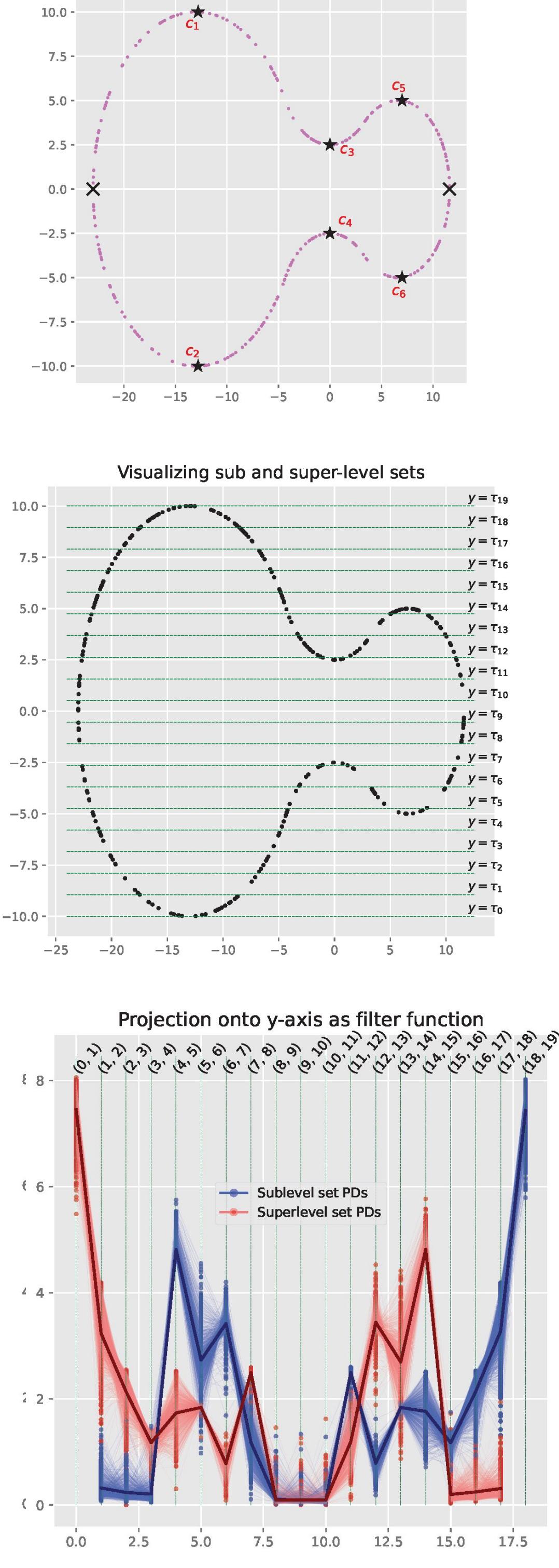
Estimating the locations of **topological changepoints** can improve the accuracy of Reeb graph estimation.



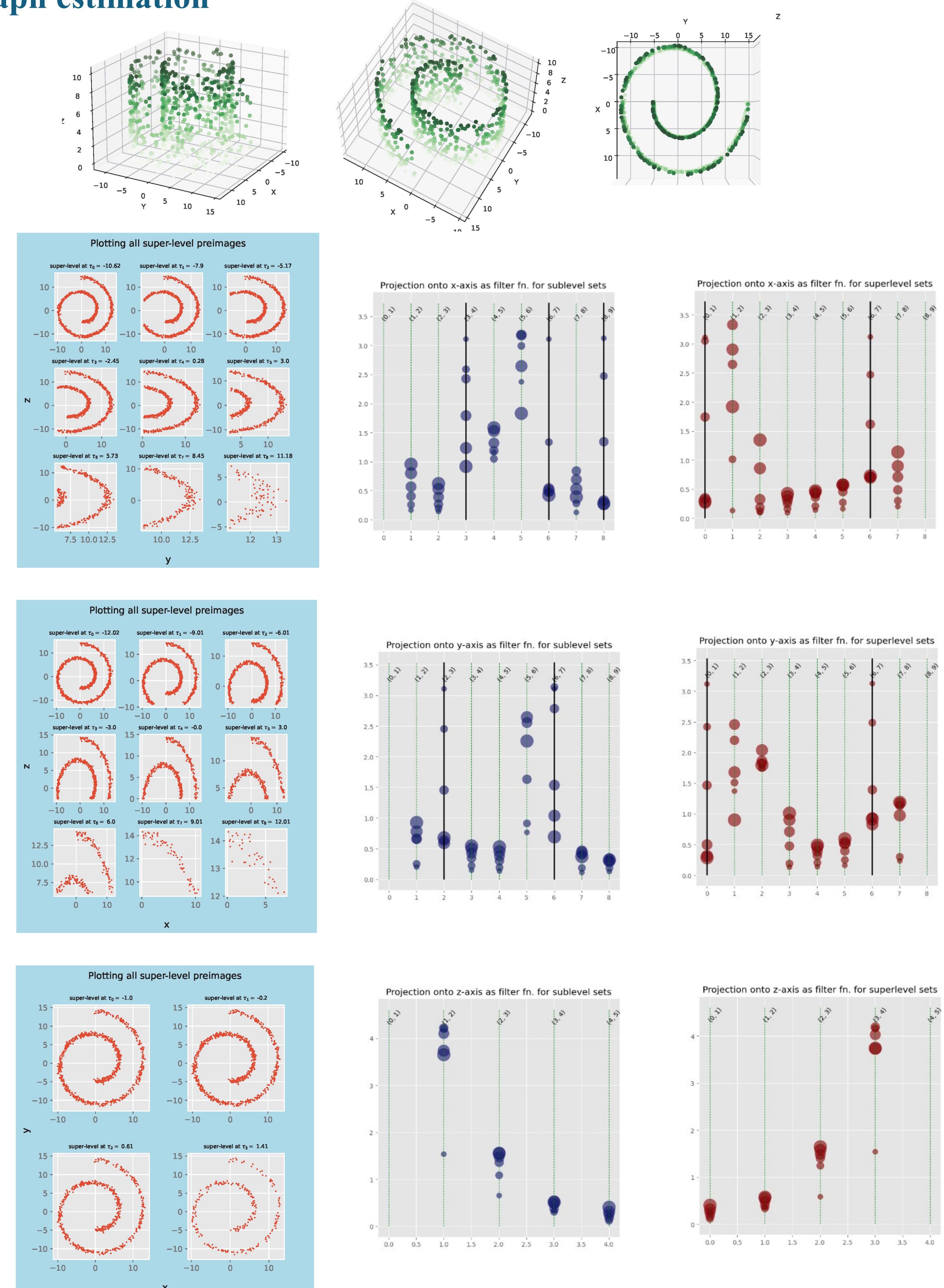
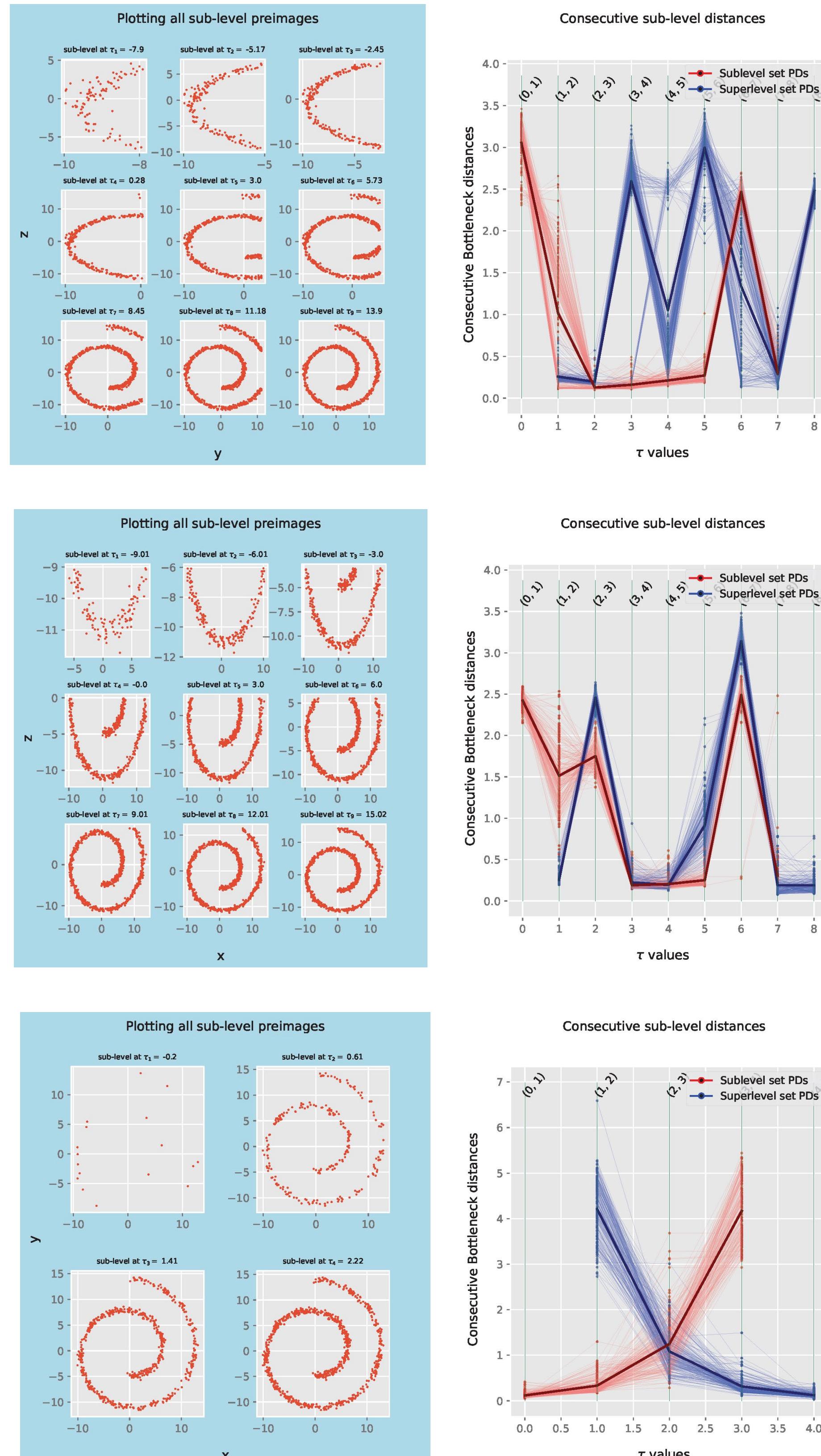
Proposed modifications to Reeb graph estimation

Our analysis of synthetic data suggests that Reeb graph computation in dimensions matching the intrinsic dimension of the data is necessary to capture complete topological information.

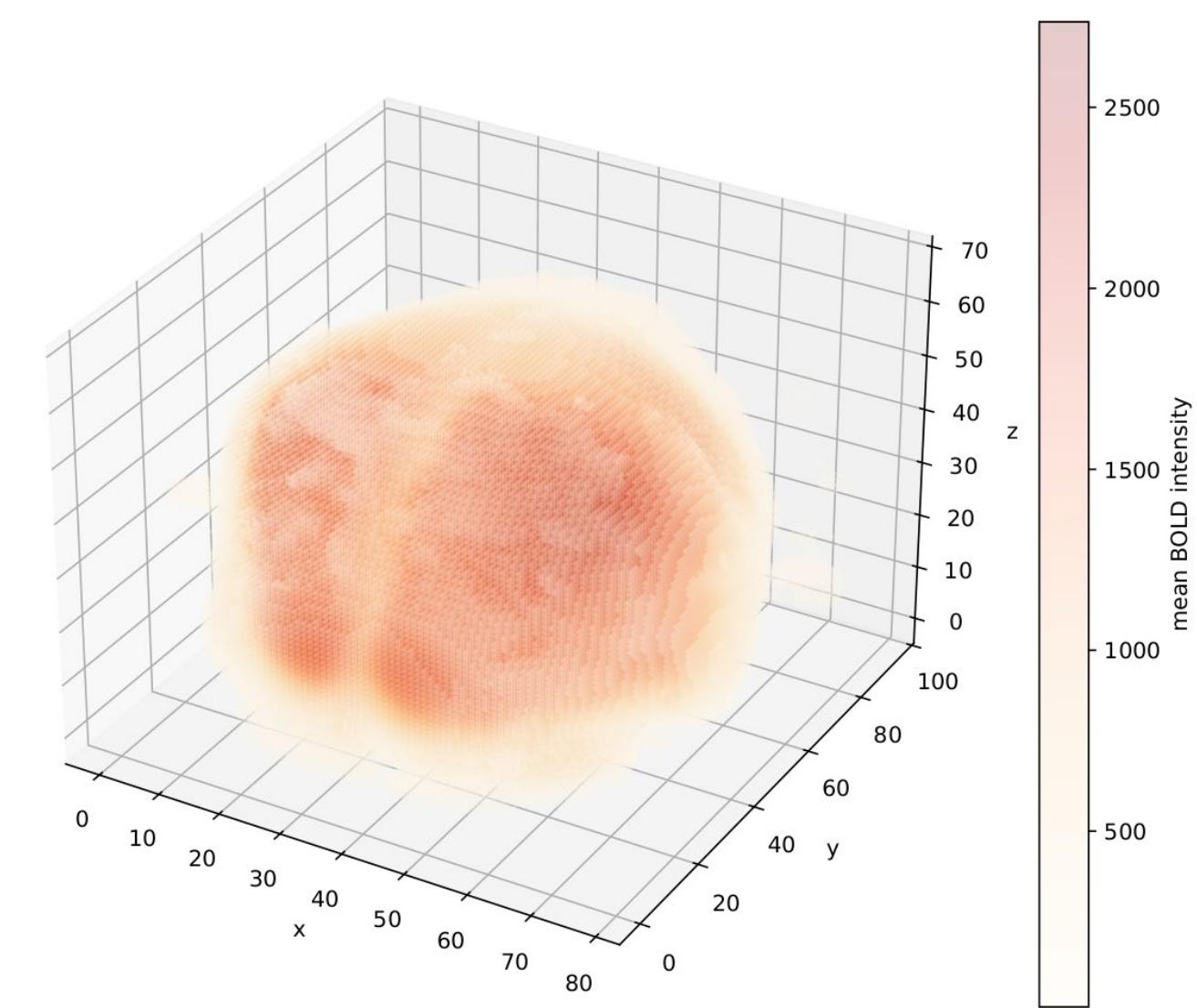
Dataset 1: Visualizing the critical points with respect to projections onto x and y-axis and the distance between consecutive sublevel and superlevel sets when filter function is projection onto y-axis.



Dataset 2: Visualizing the swiss-roll dataset in different directions

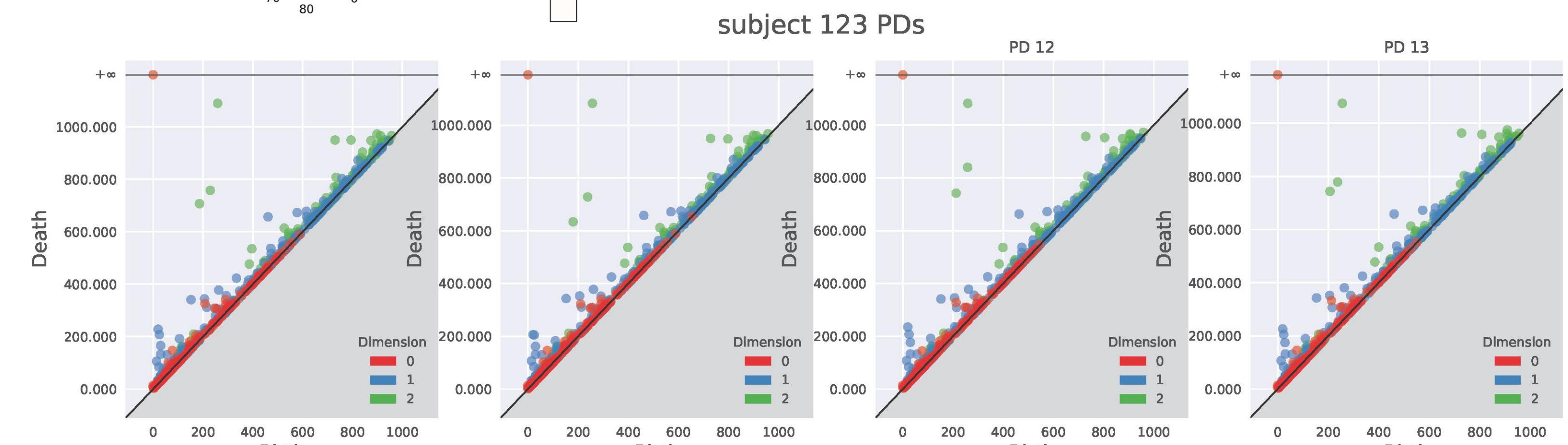


Implementation and future work

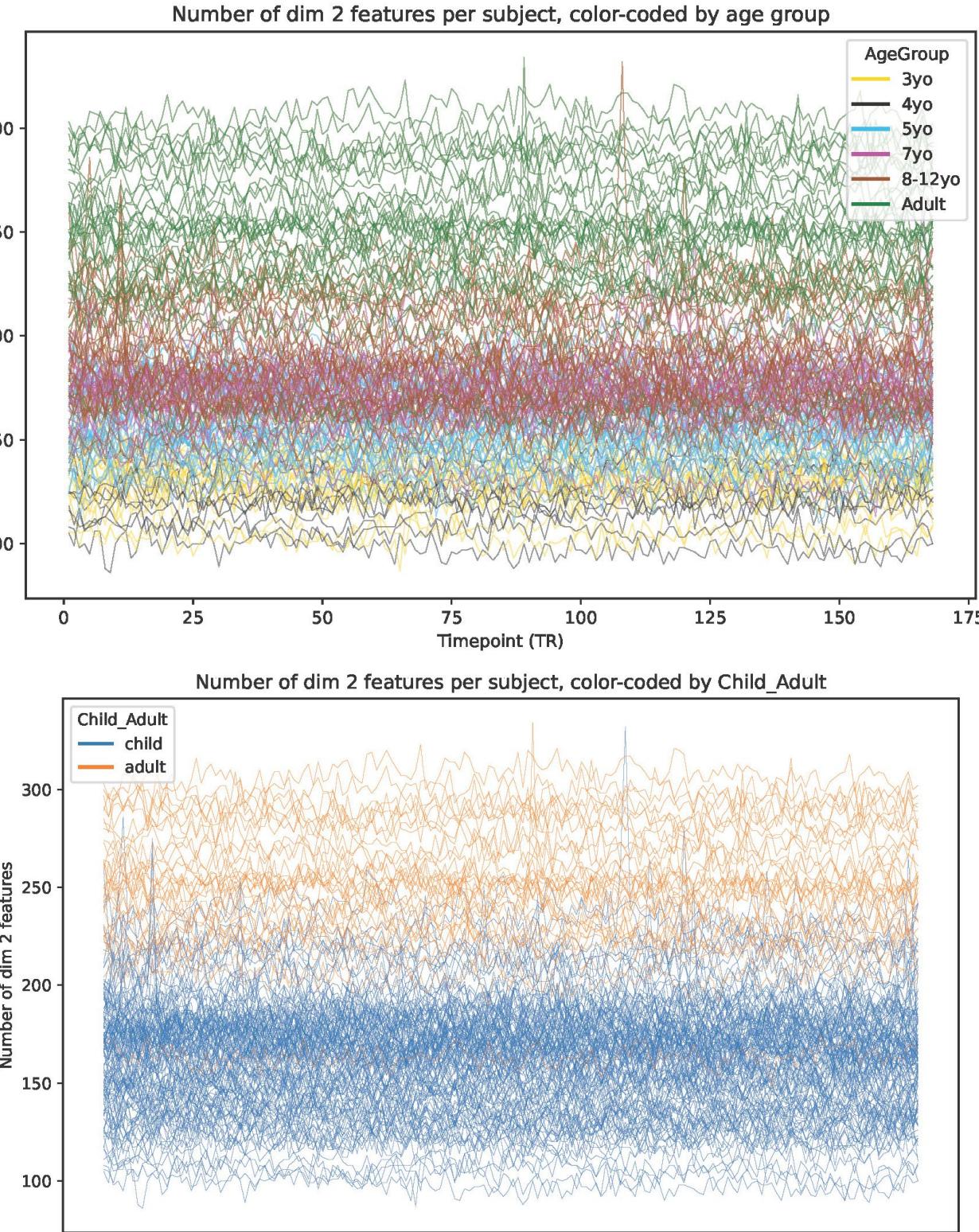


fMRI study design:

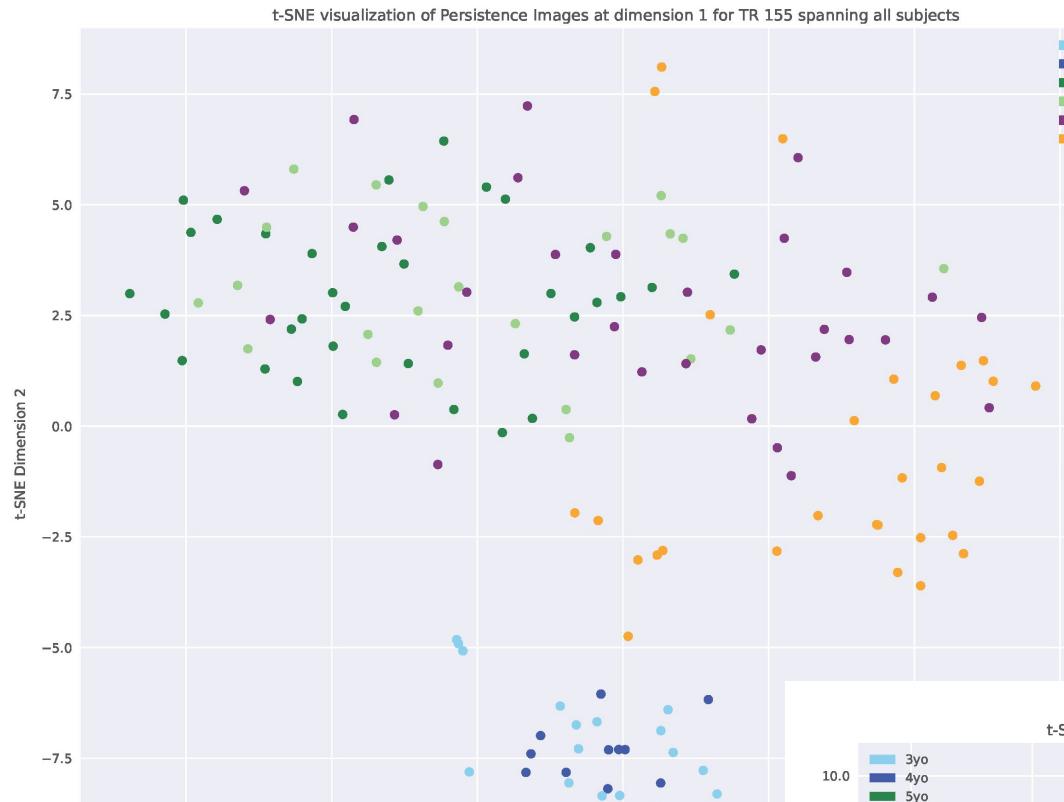
- Study uses a cross-sectional sample of 122 children b/w ages of 3 and 12 years along with a reference group of 33 adults.
- While undergoing fMRI, all the participants watched a Disney film “Partly cloudy” (5.4 min long).
- This movie has been validated as activating ToM brain regions and pain matrix in adults.



The number of dimension 2 features is correlated with the age of the subject being studied.



Persistence images are widely used for vectorizing persistence diagrams, since persistence diagrams themselves do not reside in a Hilbert space suitable for statistical modeling.



Joint work with
Prof. Nicole Lazar

Future Work: Construct estimated mapper graphs for subjects from different age groups to differentiate these groups based on their mapper graph structures.

