1. Title: Advances in Biological and Ecological Data Science

2. Supervisors: Hideyasu Shimadzu and Diwei Zhou

3. About project:

In an era of widespread anthropogenic environmental and (perhaps) climate change, the United Nations advocate an agenda for action "Reversing Biodiversity Loss and Promoting Positive Gains to 2030" (https://www.cbd.int/action-agenda/). Current common approaches in assessing biodiversity are diverse and can often be *ad hoc,* generating a need for a more unified theoretical framework. With new statistical methods to analyse large data, the project will provide the bases for a much better quantitative understanding of the progression of biodiversity. Up to now, traditional approaches are typically population-based or location-based and lacking in spatio-temporal resolution; this may significantly limit our understanding of the situation leading to poor predictions for future developments. The PhD project will take a theoretical approach, whereby imagined ecosystems are simulated using stochastic nonlinear dynamic models, coupled with techniques in information theory, aimed at understanding better the consequence of ignoring spatial distribution. This work will provide a systematic platform by which existing and diverse mathematical and ecological theories can be assessed and reconciled.

Some project goals are:

- The quantification of (spatio-)temporal change in ecological communities;
- Investigating the role of species interactions in communities, in terms of the maintenance and/or the change of biodiversity;
- Investigating the relationship between life-history traits (body growth etc.) and biodiversity changes.

4. Skills required:

MSc or BSc in Statistics or related discipline, Programing skills (e.g. R), Biological and/or ecological knowledge is not essential but beneficial.

5. References

Anderson et al. (2011) Navigating the multiple meanings of β diversity: a roadmap for the practicing ecologist. Ecology Letters, 14: 19-28. https://doi.org/10.1111/j.1461-0248.2010.01552.x

Dornelas et al. (2014) Assemblage time series reveal biodiversity change but not systematic loss. Science, 344(6181): 296-299. https://doi.org/10.1126/science.1248484

Shimadzu et al. (2015) Measuring temporal turnover in ecological communities. Methods in Ecology and Evolution, 6: 1384-1394. https://doi.org/10.1111/2041-210X.12438

Shimadzu (2018) On species richness and rarefaction: size- and coverage-based techniques quantify different characteristics of richness change in biodiversity. Journal of Mathematical Biology, 77: 1363-1381. https://doi.org/10.1007/s00285-018-1255-5

Magurran et al. (2019) Temporal β diversity—A macroecological perspective. Global Ecology and Biogeography. 28: 1949-1960. https://doi.org/10.1111/geb.13026