Multivariate Spatio-Temporal Delineation of Ecoclimatic Regions for Evaluating Sampling Network Sites in Turkey

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Rationale/Motivation

• Turkey hosts a wide variety of ecosystem types and is projected to be one of the regions most vulnerable to climate change in the Mediterranean basin.

• Thus, it is urgent to design a framework of ecoclimatic regions to support an 'ecological observatory network' and initiate long-term ecological monitoring studies in Turkey.

• Our study marks the first ‘ecoregionalization’ study for Turkey based on past conditions and future climate scenarios by integrating several environmental factors.

• Furthermore this is the first endeavor to provide optimal sampling sites for ‘ecological observatory network design’ for Turkey.
Aim of the study

• We present a multivariate representation of ecoclimatic regions for Turkey at several levels of division and map their contemporary and projected future distributions under the A2 emissions scenario from the ECHAM5 model.

• Using ten ecoclimatic variables (integrating topographic and soil attributes with climatic attributes) we applied multivariate spatio-temporal clustering to quantitatively delineate ecoclimatic regions and to provide optimal sampling sites for a design of a prospective ‘ecological observatory network’ for Turkey.
Generation of *Unique* Input Layers

- Using NCL, NCO, CDO and by developing codes in R following 10 variables were generated which are unique to NEON input layers.
- They are based on ‘growing season’(gs) – definition of ECA
Multivariate Spatio-Temporal Clustering—MSTC
(Hargrove and Hoffman, 2004)*

• We applied the MSTC approach to derive ecoregions based on climatic, edaphic and topographic factors for present and future at multiple levels of division.

• This quantitative delineation of ecoregions across space and through time facilitates assessment of the magnitude of change between present and future environmental conditions and enables the evaluation of the ecological implications of climate change scenarios.

• Kumar et al. (2011) extended this approach to a fully distributed, k-means parallel clustering algorithm, which was applied in this study.


Similarity Color Assignments

Factor 1: Cold/Solar
Factor 2: Precipitation in the gs
Factor 3: Precipitation in the non-gs

RGB Color Code assignment

RT-gs
RT-non-gs
Cold/Solar
Similarity Color Map of Ecoclimatic Regions-20 Clusters

Present

21st mid-century (2041-2070)
Random Color Map of Ecoclimatic Regions-10 Clusters

Present

21st mid-century (2041-2070)
Random Color Map of Ecoclimatic Regions-150 Clusters

Present

21st mid-century (2041-2070)
We compared maps of the 20th century and 21st mid-century regionalizations and prepared maps to demonstrate shifts in their spatial location and newly emerging ecoclimatic regions.

Our results revealed that changes in ecoclimatic regions occurred ~40% of the land area of Turkey, 18% of which has no analog in the present.
Maps of Sensitive and Novel Regions

Our results showed that ~50% of the land area of Turkey is changed and, 17% of which were assigned to 2 emerged ecoclimatic regions.
Sensitive and Novel Ecoregions
Magnitude of Change Map
Candidate Sites for the Network Design for Turkey

To propose **optimal sampling sites** for long-term ecological monitoring in a prospective ‘ecological observatory network’ for Turkey,

We are now developing these optimal sites using the “Network Representativeness Analysis” (Hoffman et al., submitted)*.

Conclusion

• In this study we present the application of MSTC to define optimal ecoclimatic regions both across space and through time to support identification of sampling network sites and provide a framework for a prospective ‘ecological observatory network’ for Turkey.

• In areas/countries (that lack long-term ecological monitoring) where the national ecological networks have not been established yet like Turkey, using this well-approved explicit multivariate statistical methodology for delineation of optimal ecoclimatic regions and sampling network sites can be the most efficient strategy to provide a framework for ‘ecological observatory network design’.
THANKS!

QUESTIONS?

COMMENTS…