# SEASONAL VEGETATION-HYDROLOGICAL COUPLING ACROSS LAND COVERS IN EAST AFRICA

RACHEL GREEN[1]

KELLY CAYLOR[1,2,3], CHRIS FUNK[1,4], DAR ROBERTS[1]
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rgreen@ucsb.edu

Department of Geography[1], Bren School of Environmental Science[2] and Management,
Earth Research Institute[3], Climate Hazards Center[4] at University of California Santa Barbara

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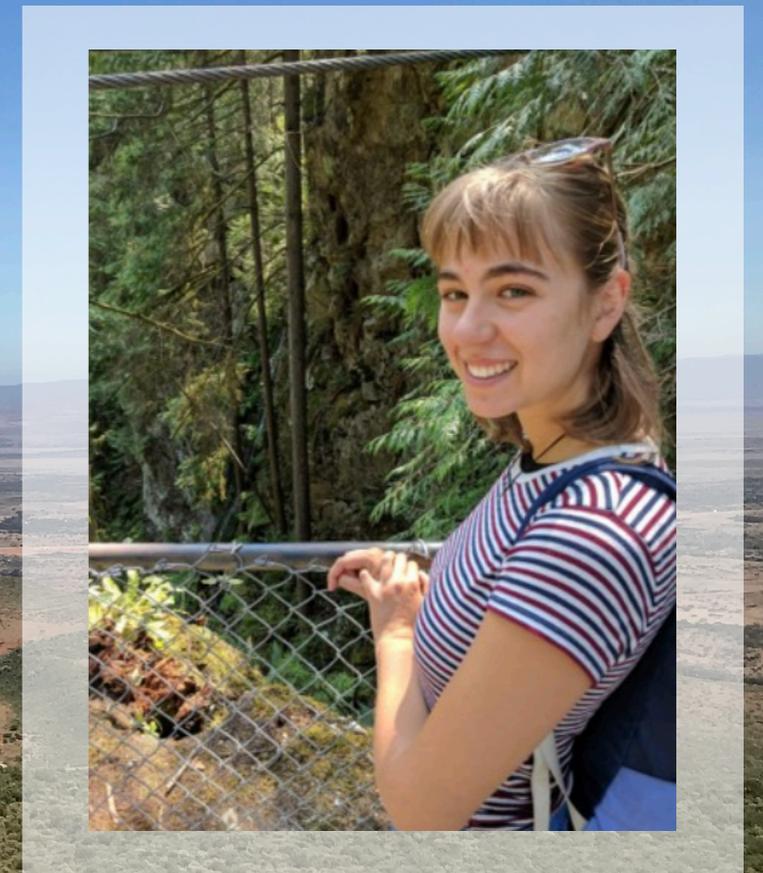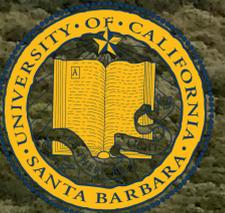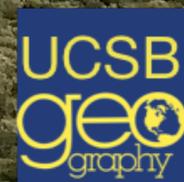
Github: @4rachelgreen | @ecohydro

SEMI-ARID DYNAMICS IN EAST AFRICA

- Droughts impacts more people than any other hazard globally

- East Africa rainfall patterns are extremely heterogenous spatially and temporally, prone to droughts

- Vegetation is largely rain-fed and farming is a major source of livelihood where 90% of production comes from smallholders

- Back to back droughts contribute to severe food insecurity
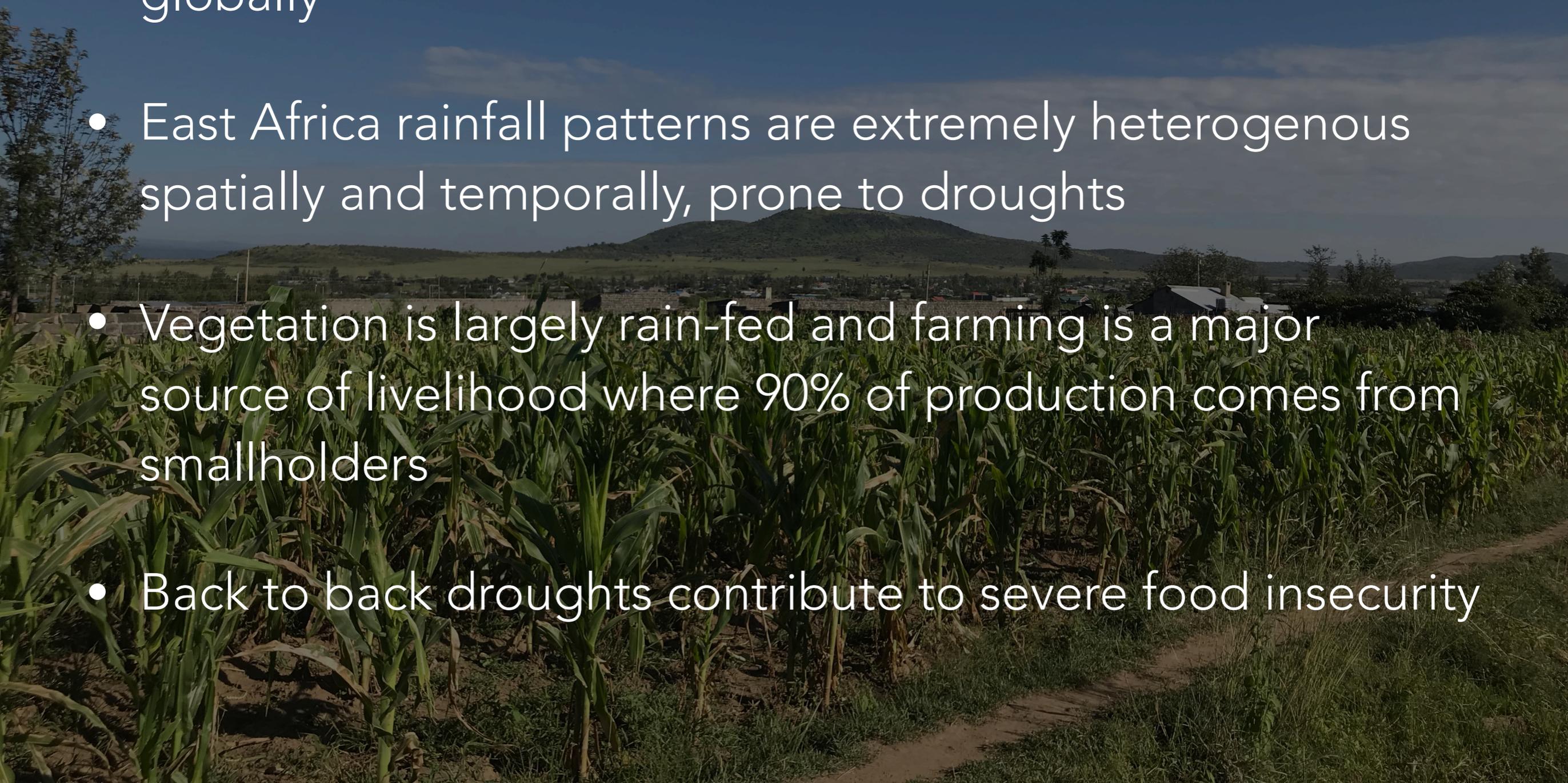
PREDICTING NDVI

- Predictability of NDVI has not been done routinely

- Potential value may include early indicators of drought, crop failure, disease and pest outbreak

- Inform drought relief funding and index-based insurance payouts

- NDVI state dependent on antecedent precipitation and land surface temperature

NDVI Annual Variability Across East Africa
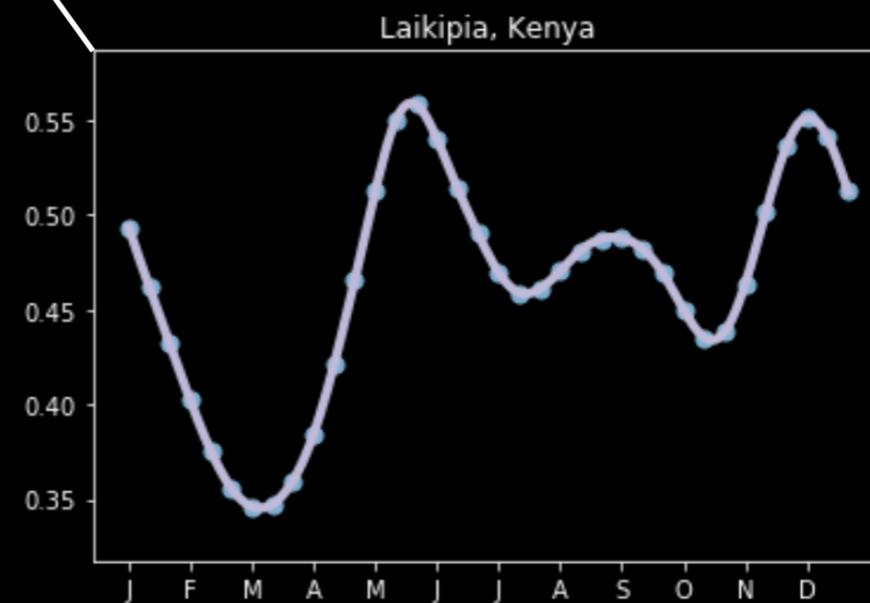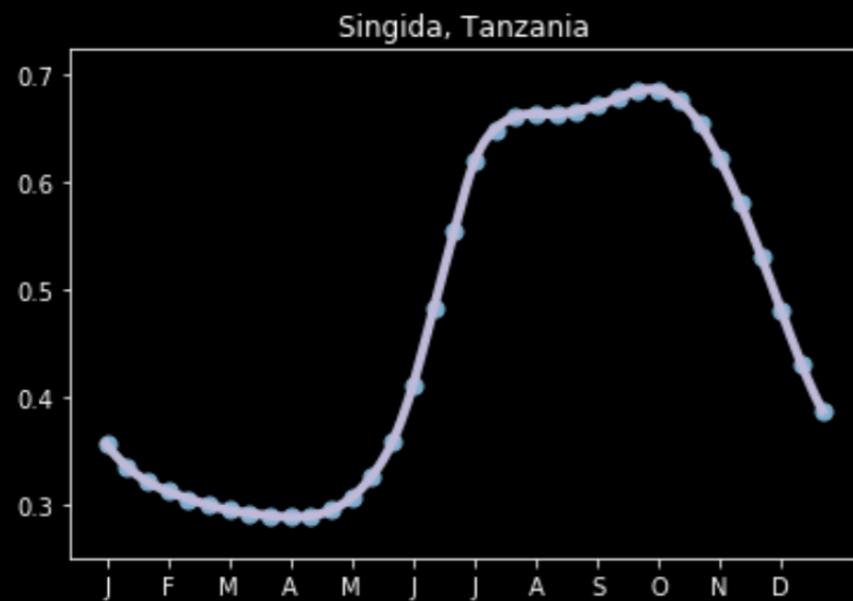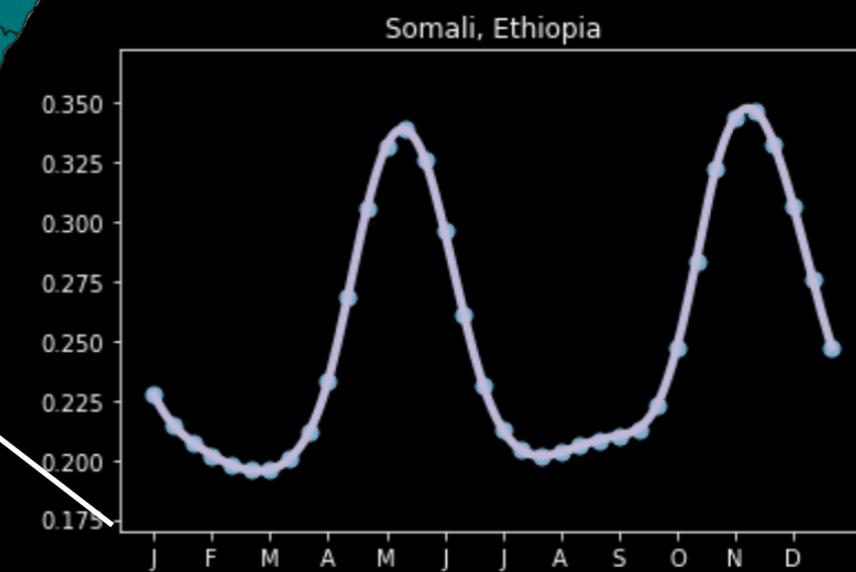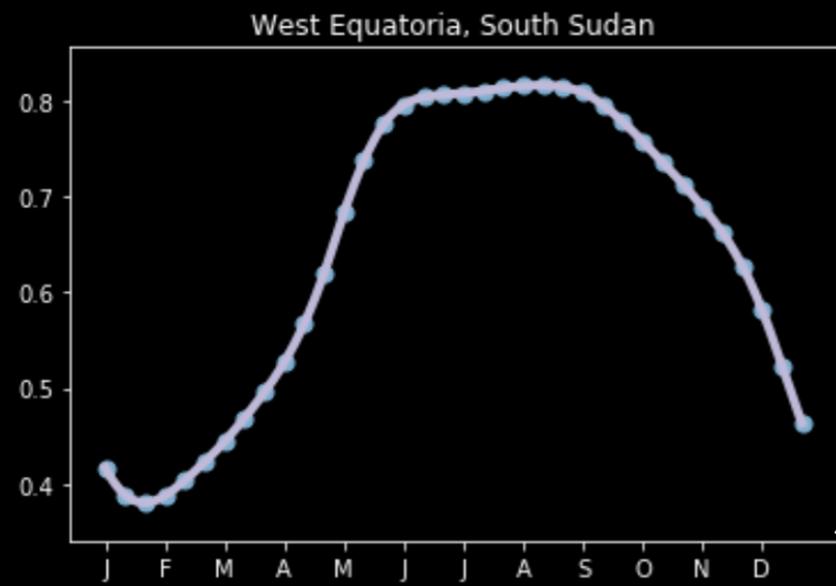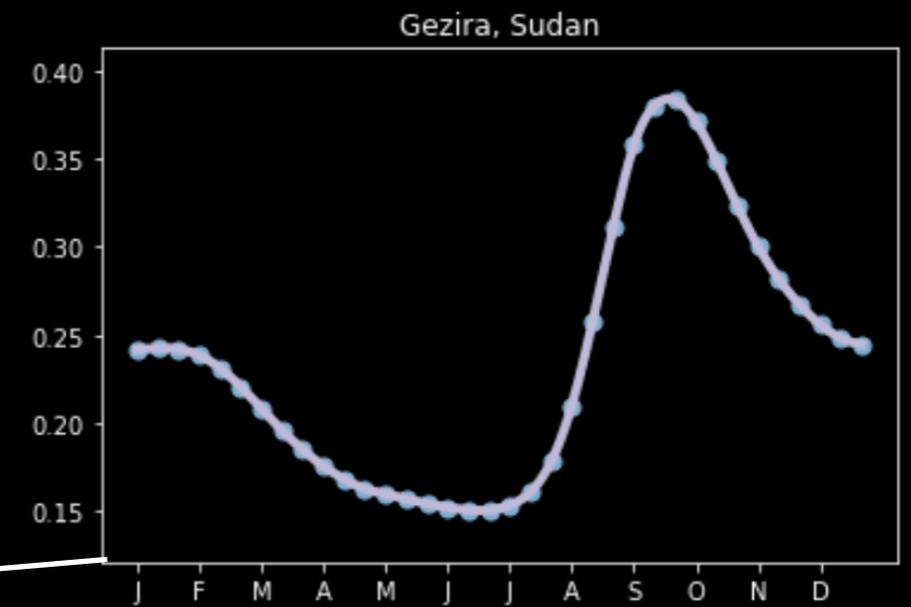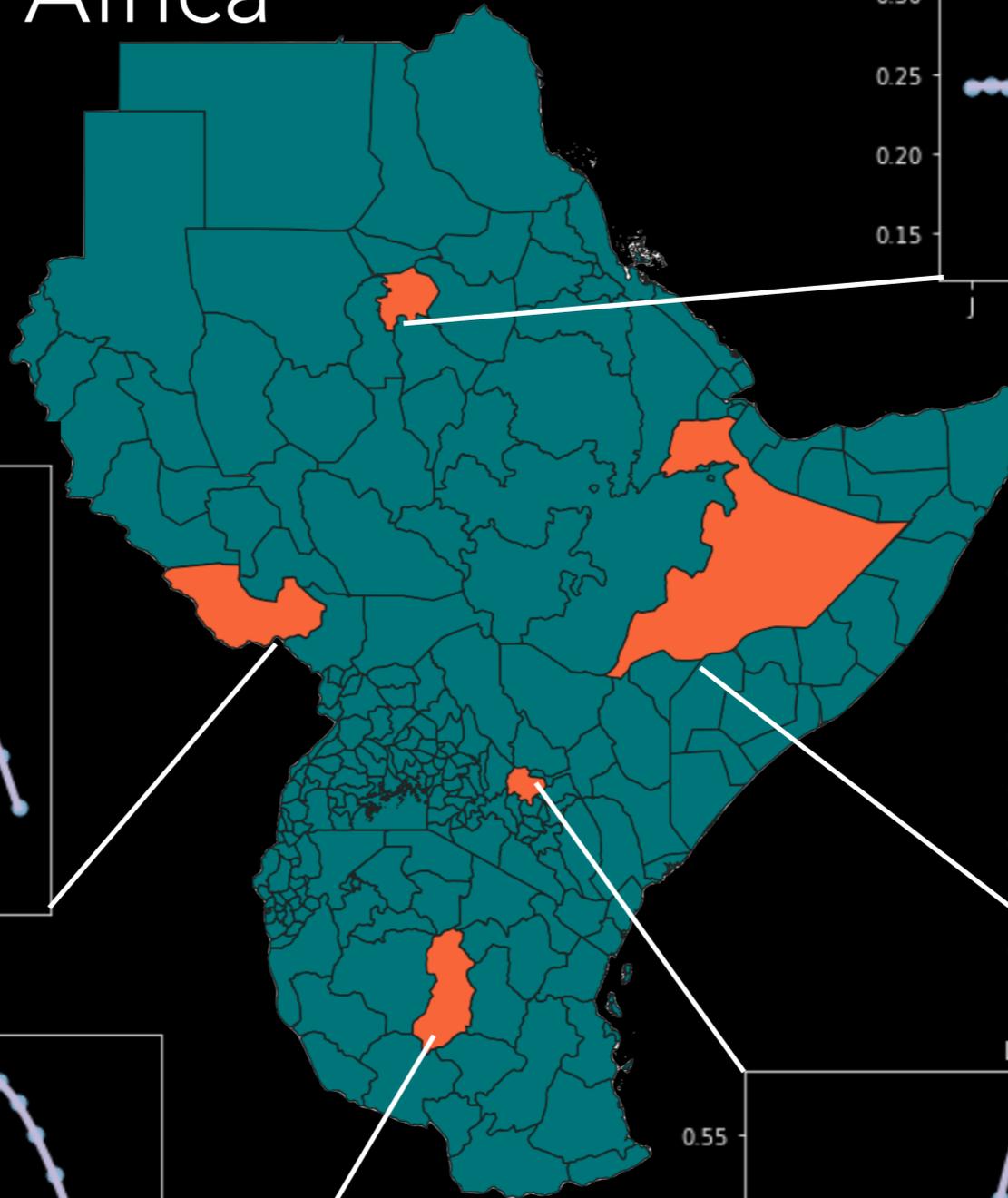
MOTIVATION

- Dynamics of climatic and surface environmental states and how their trajectories propagate over time

- Spatial coherence or sensitivity of different land covers to climatic variability

- Which regions are highly consistent in their trajectories and therefore easier to predict extremes (e.g. drought) and which regions are more dispersive and thus challenging to project?
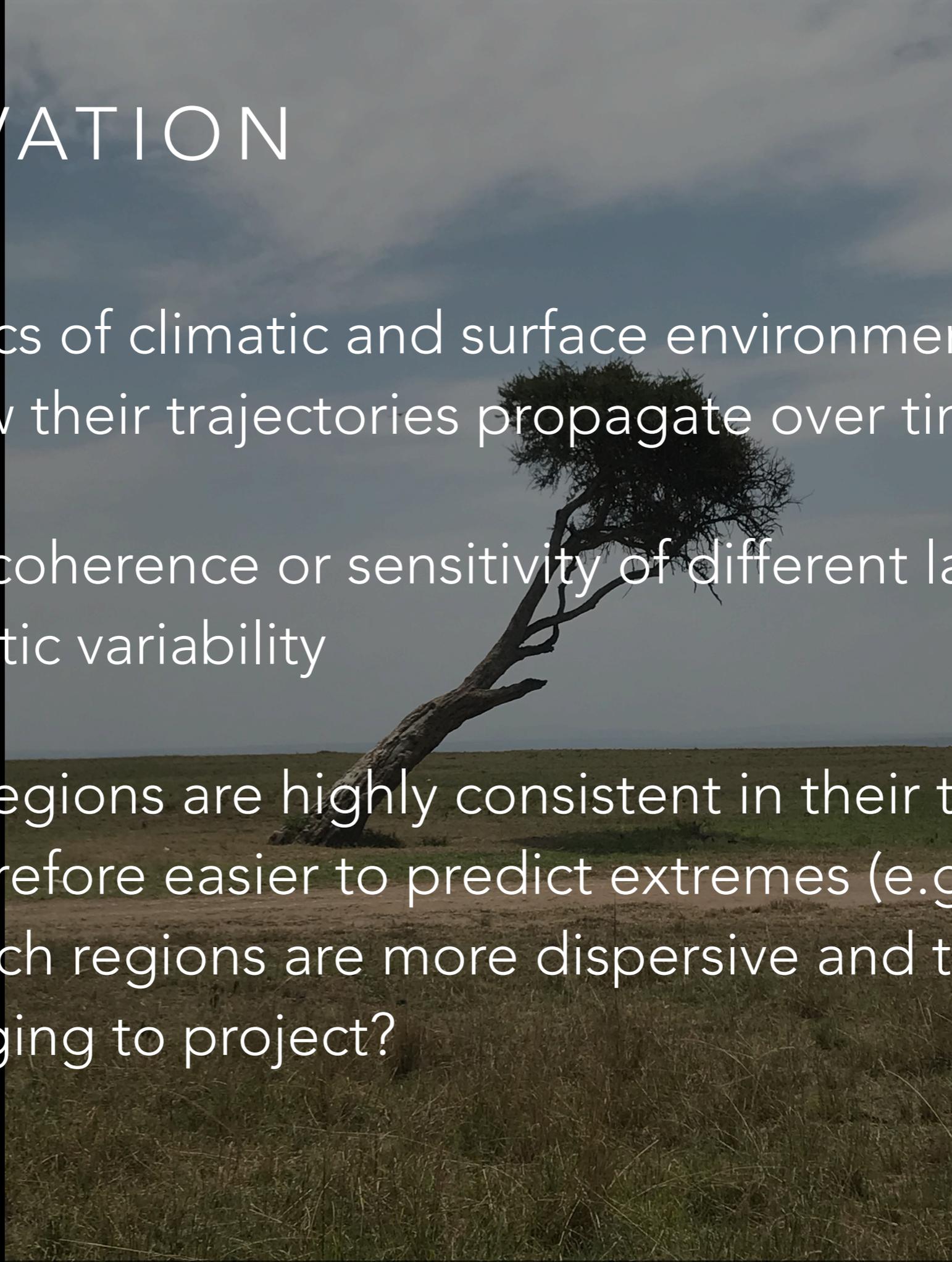
MODELING COUPLED HUMAN-NATURAL SYSTEMS

	Empirical	Process Based
Low Dimensional	Autoregression	• Gravity Models • Agent Based Models
High Dimensional	Machine Learning	System Dynamics General Circulation Models

EMPIRICAL DYNAMIC MODELING

- Model simulations are computationally expensive and only represent an approximation representation of true physical processes

- Rely on correlation based inference
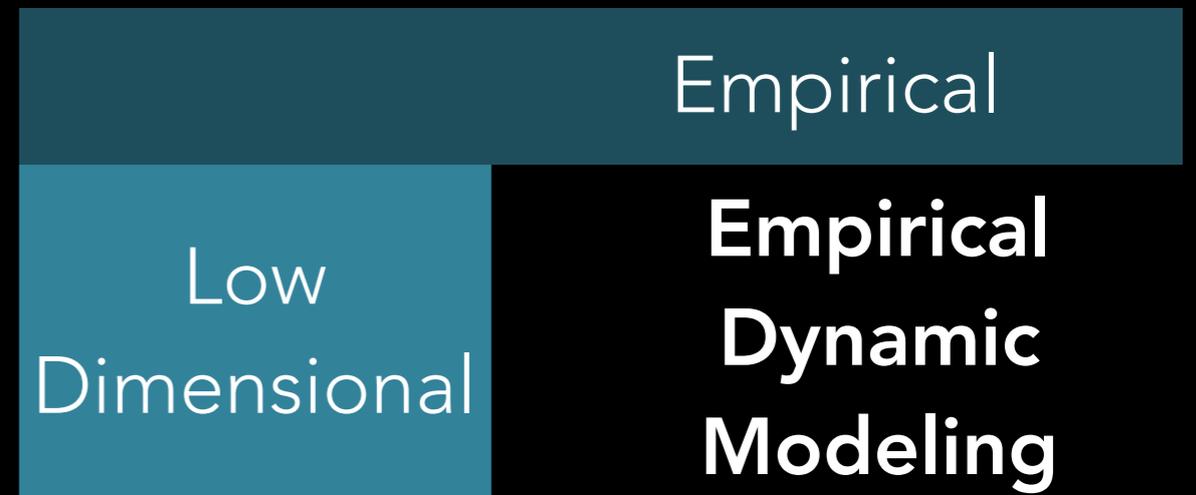
Instead

- EDM does not make any assumptions about relationship between variables

- Lightweight

- Can make inferences of the effects of actions on the observed system

- Prediction skill is therefore constrained by quantity and quality of data rather than imposed hypotheses

Empirical

Low Dimensional

Empirical Dynamic Modeling

EMPIRICAL DYNAMIC MODELING: ATTRACTOR RECONSTRUCTION
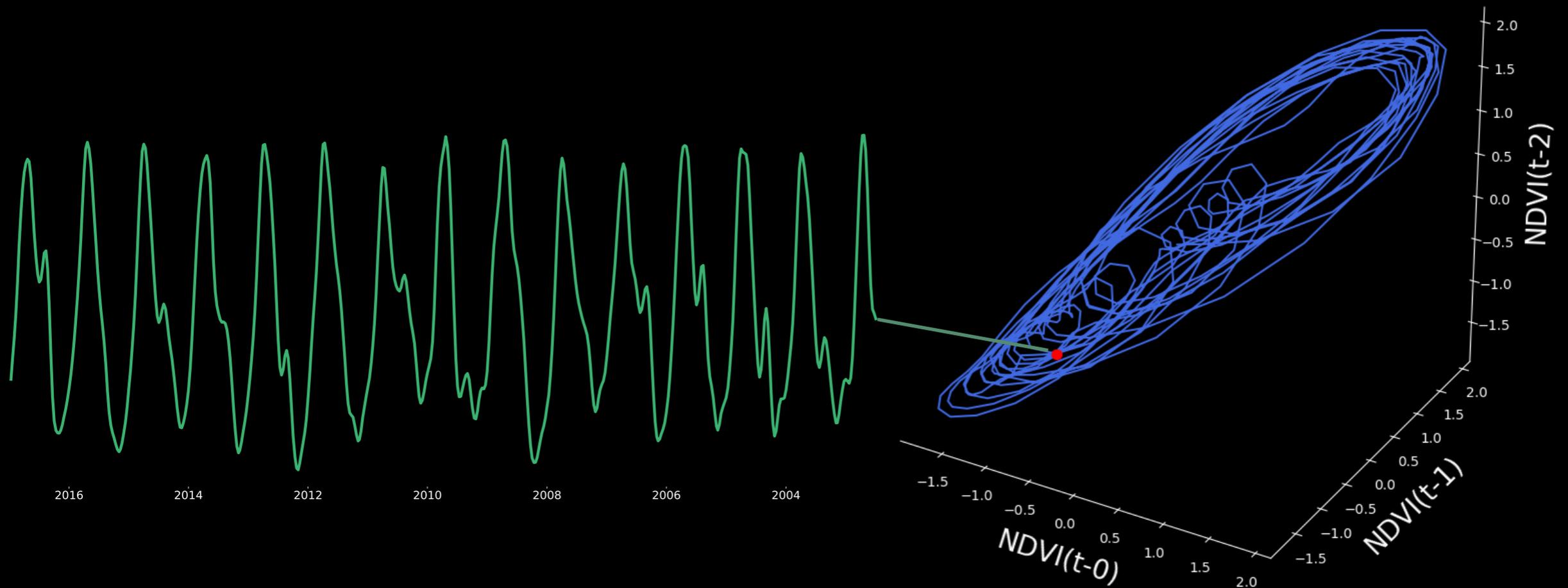
SIMPLEX PROJECTION
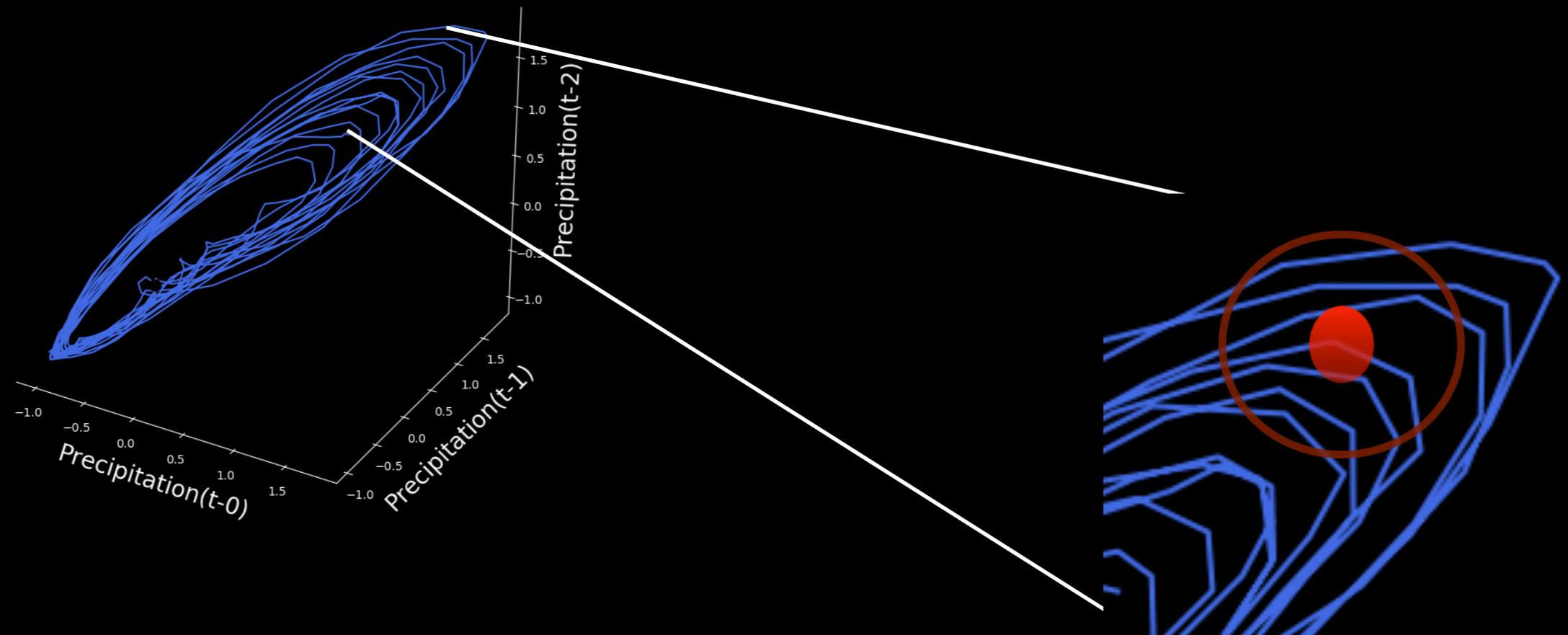
Nearest neighbor forecasting
method using manifold
reconstruction

Land Cover Classes
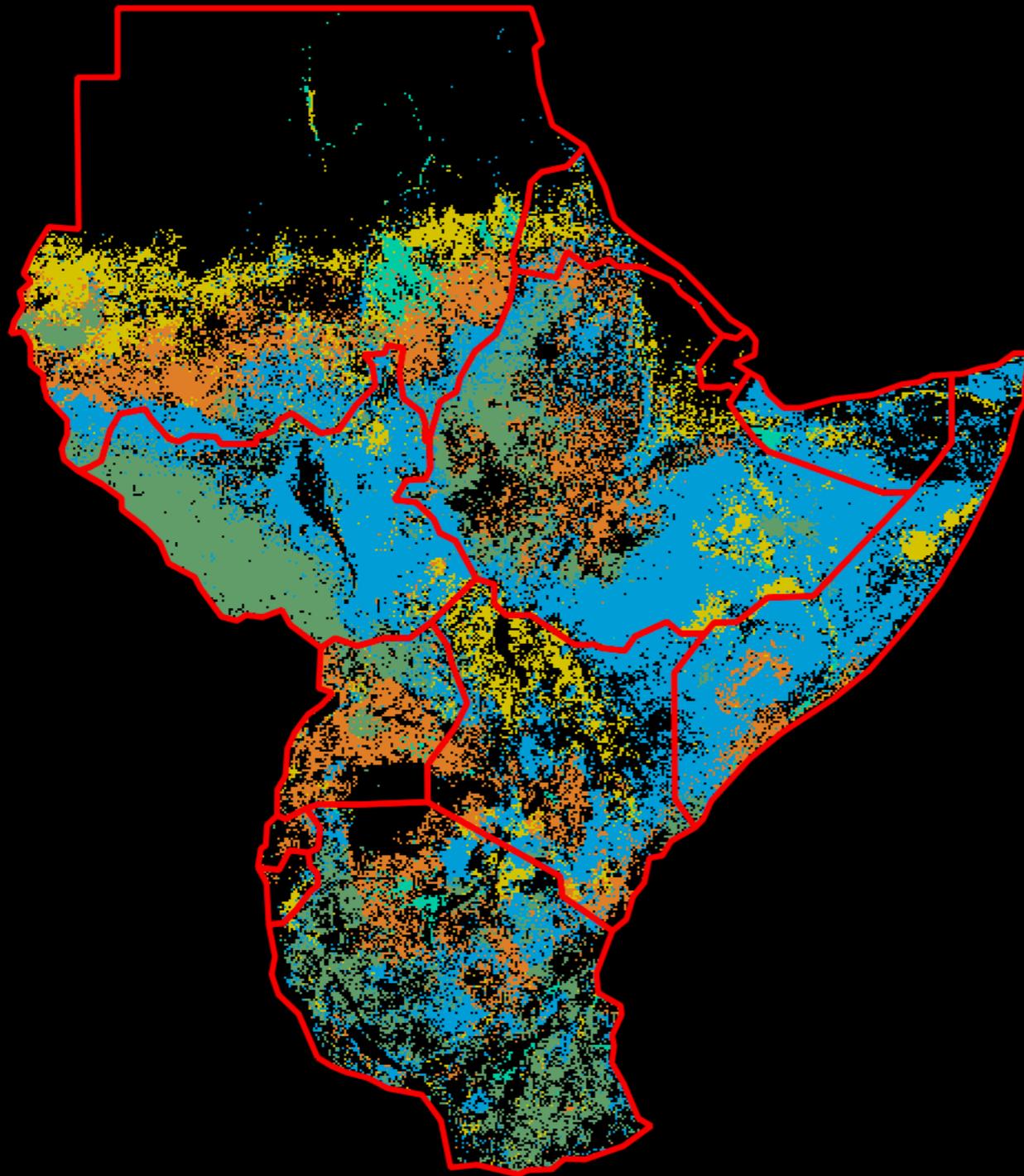
Rainfed Cropland
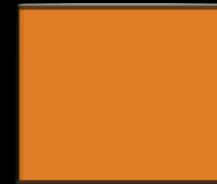
Grassland
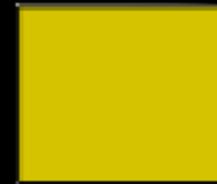
Shrubland

Irrigated Cropland

Woodland
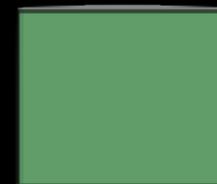
PREDICTION INTERVAL
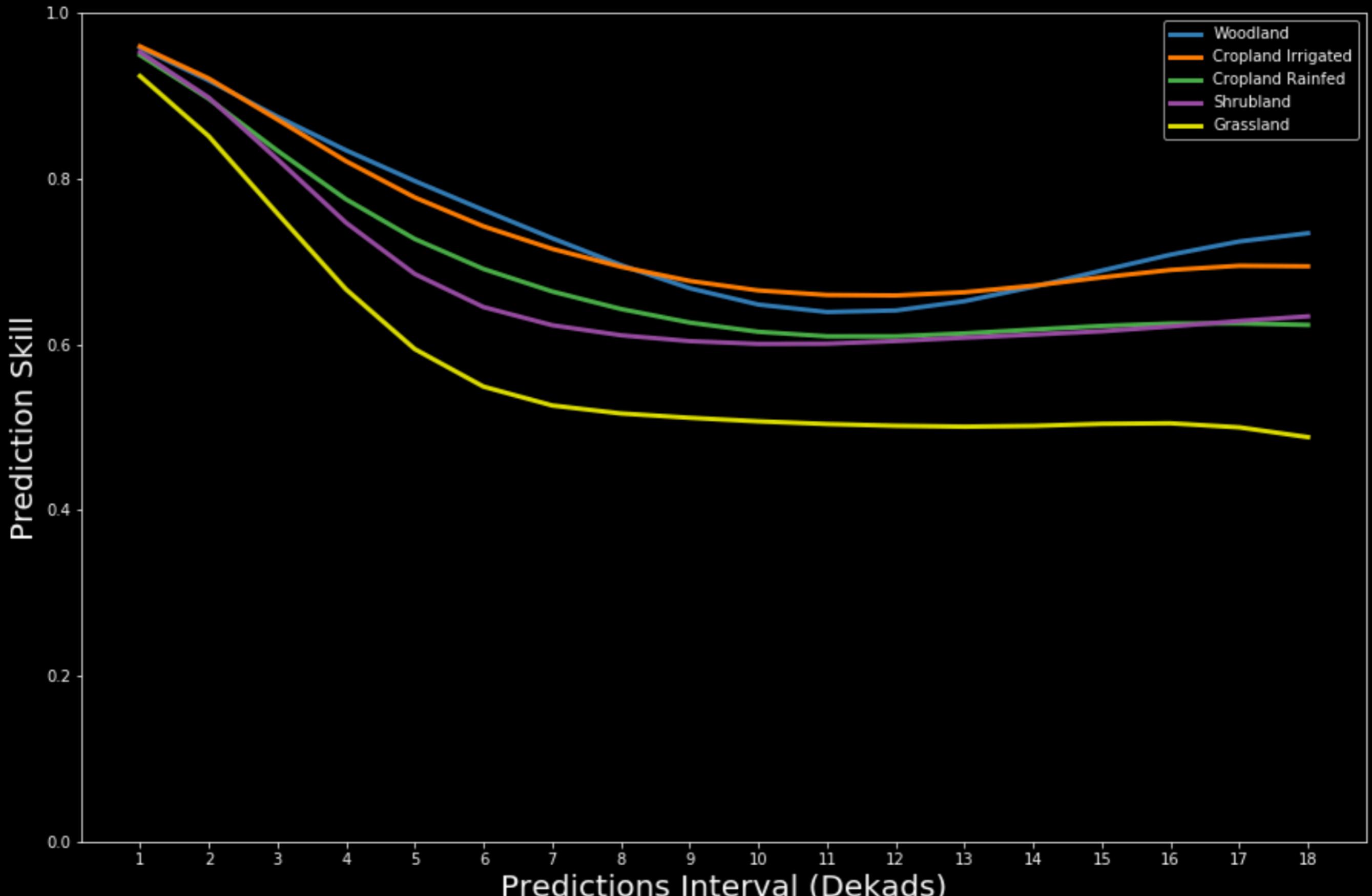
EMBEDDING DIMENSION AND PREDICTION SKILL
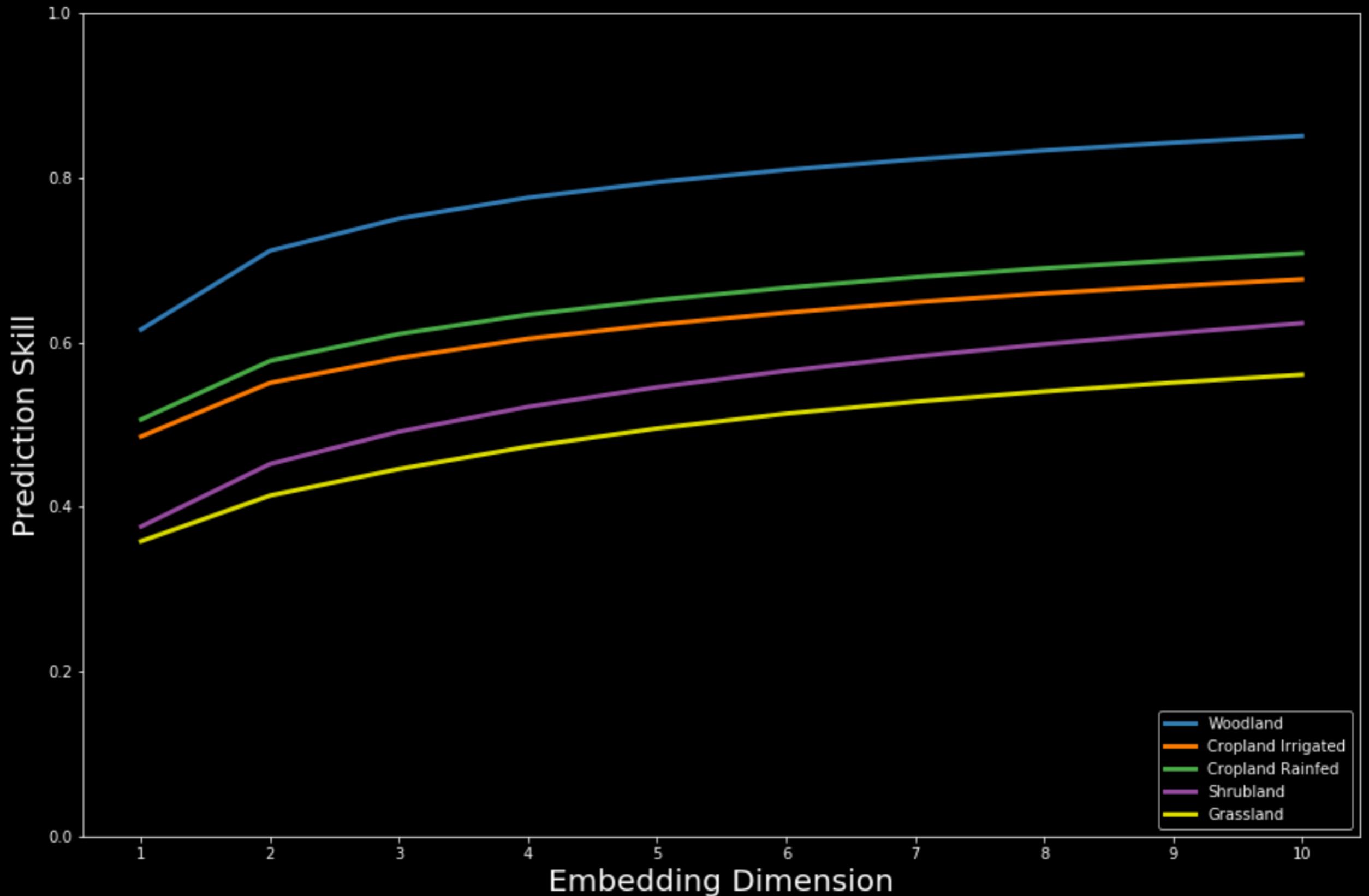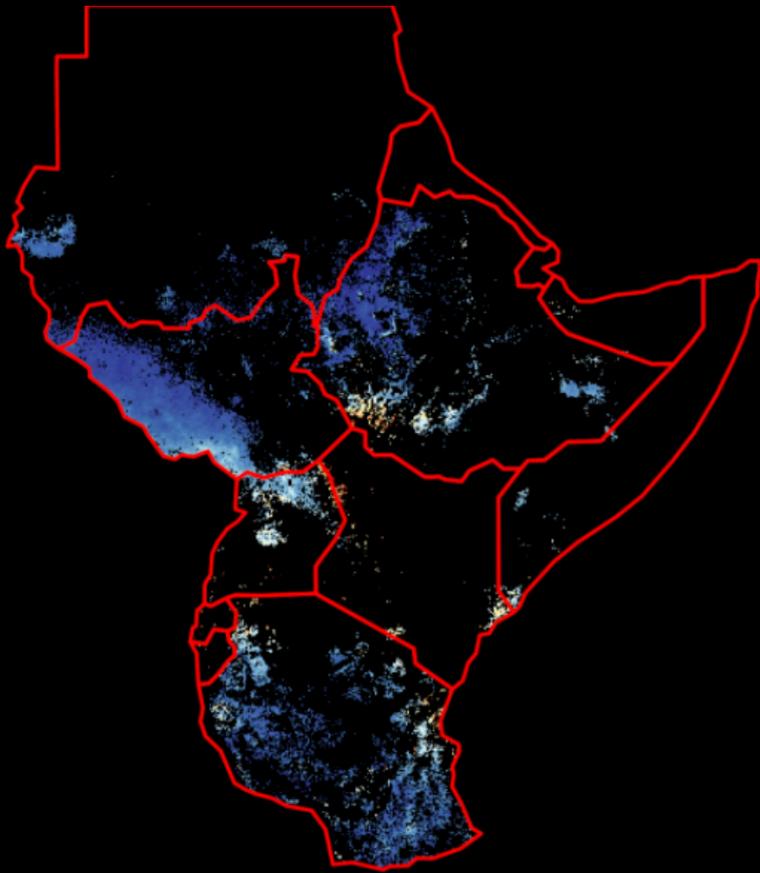
Woodland   Cropland Irrigated   Cropland Rainfed
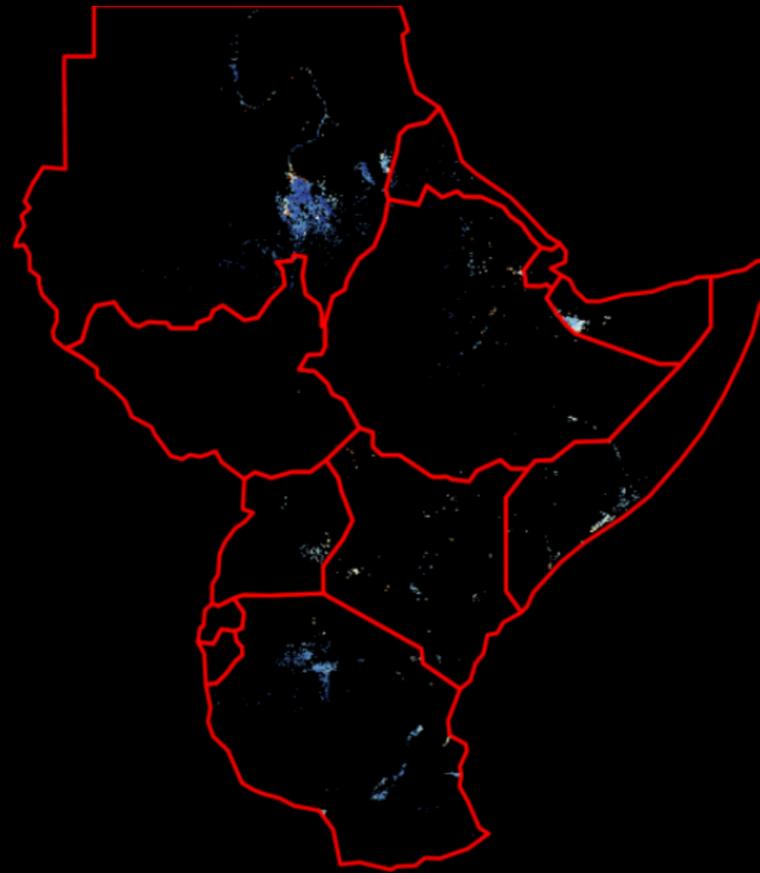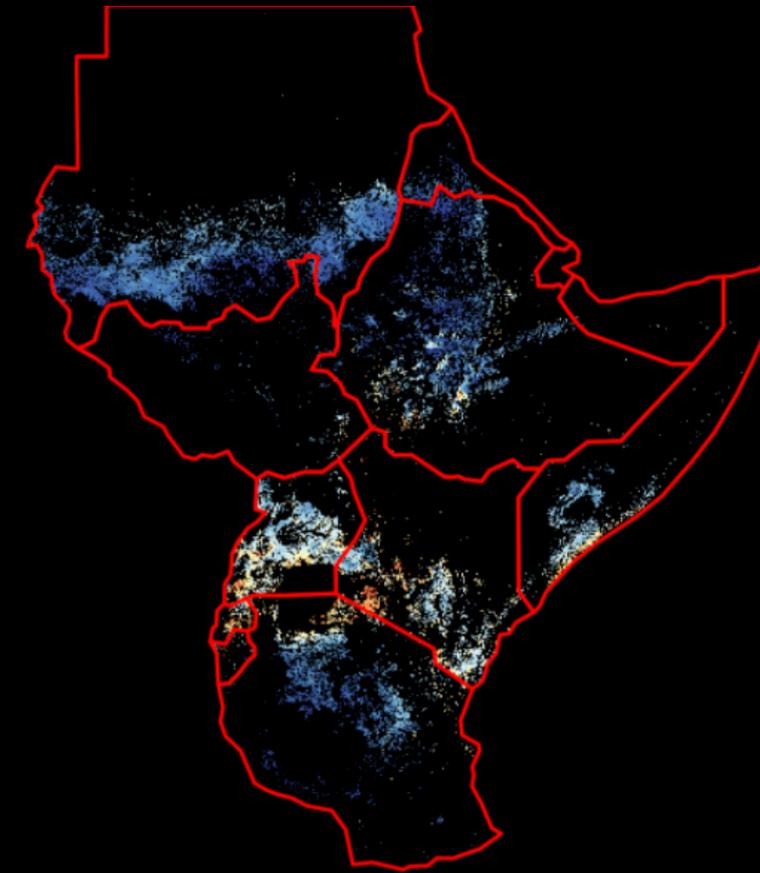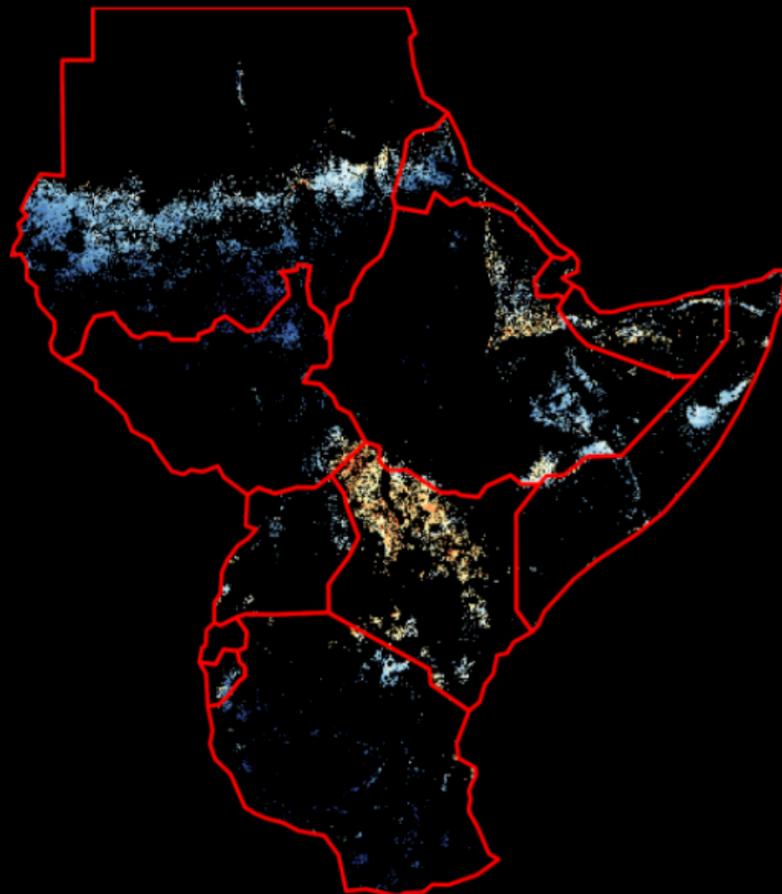
Grassland   Shrubland   6 month Forecast Skill
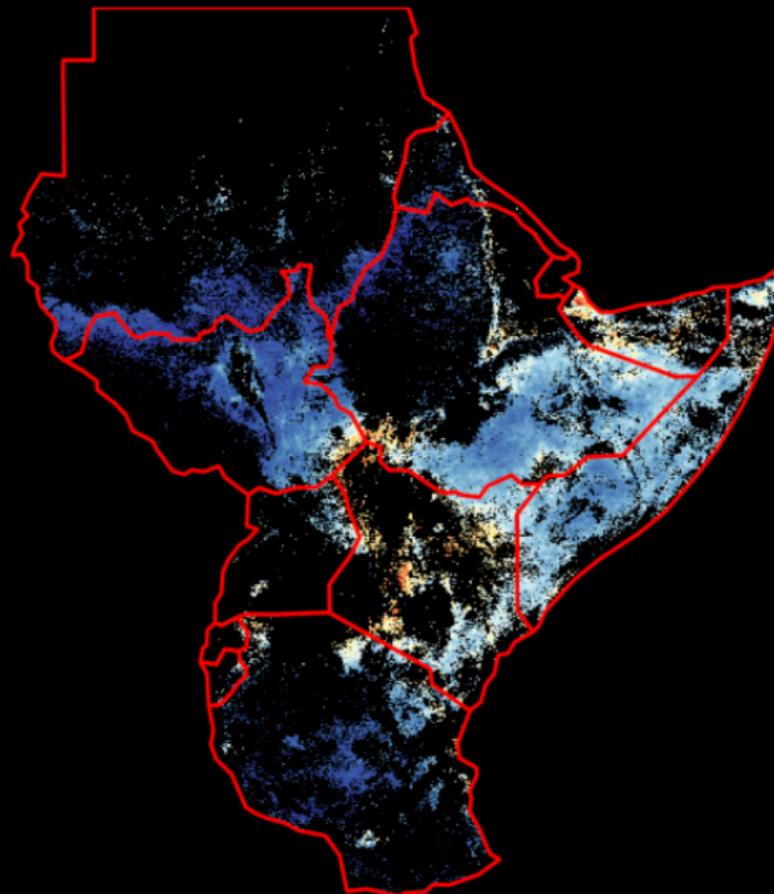
Prediction Skill (p)
0.0   0.2   0.4   0.6   0.8   1.0

# NDVI Time Series in High and Low Predictive Skill Regions
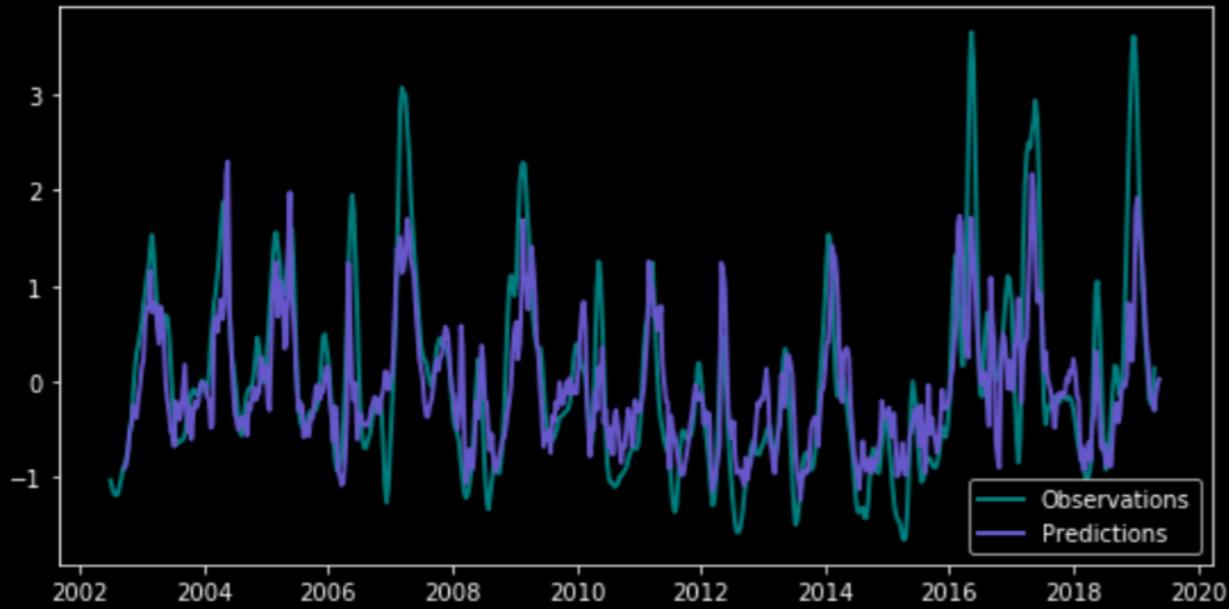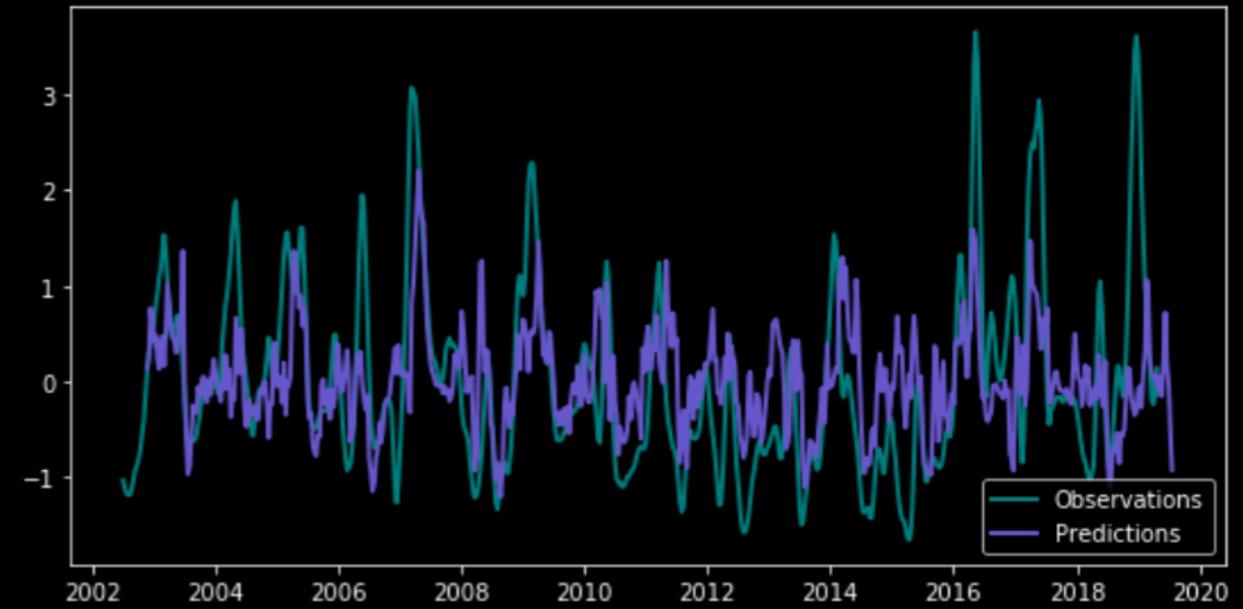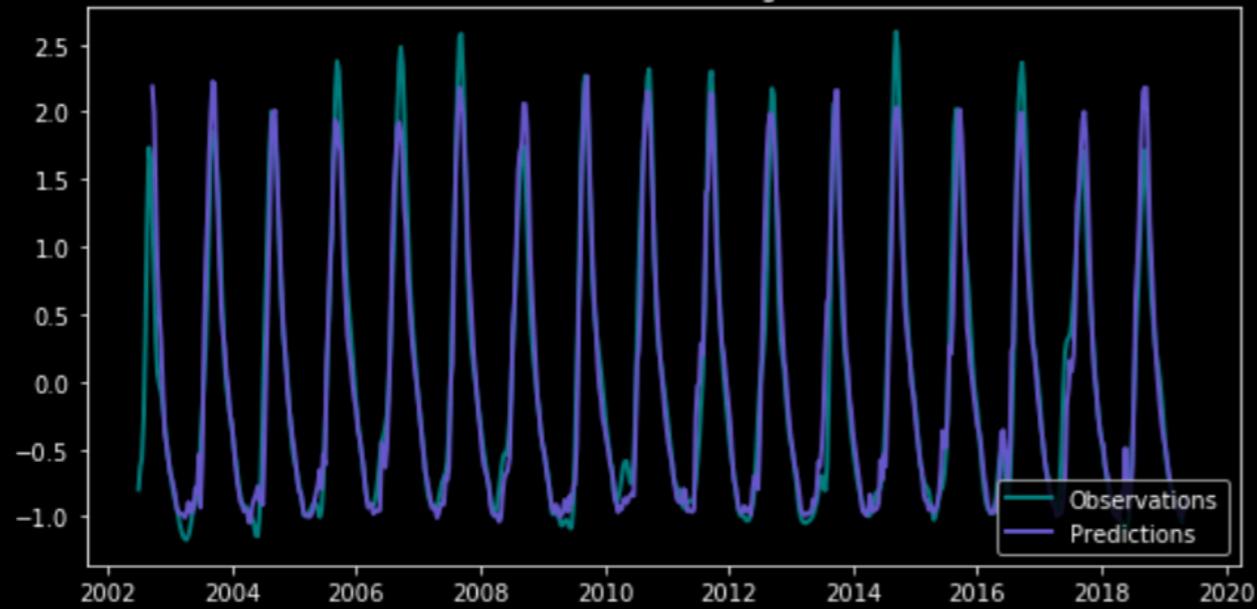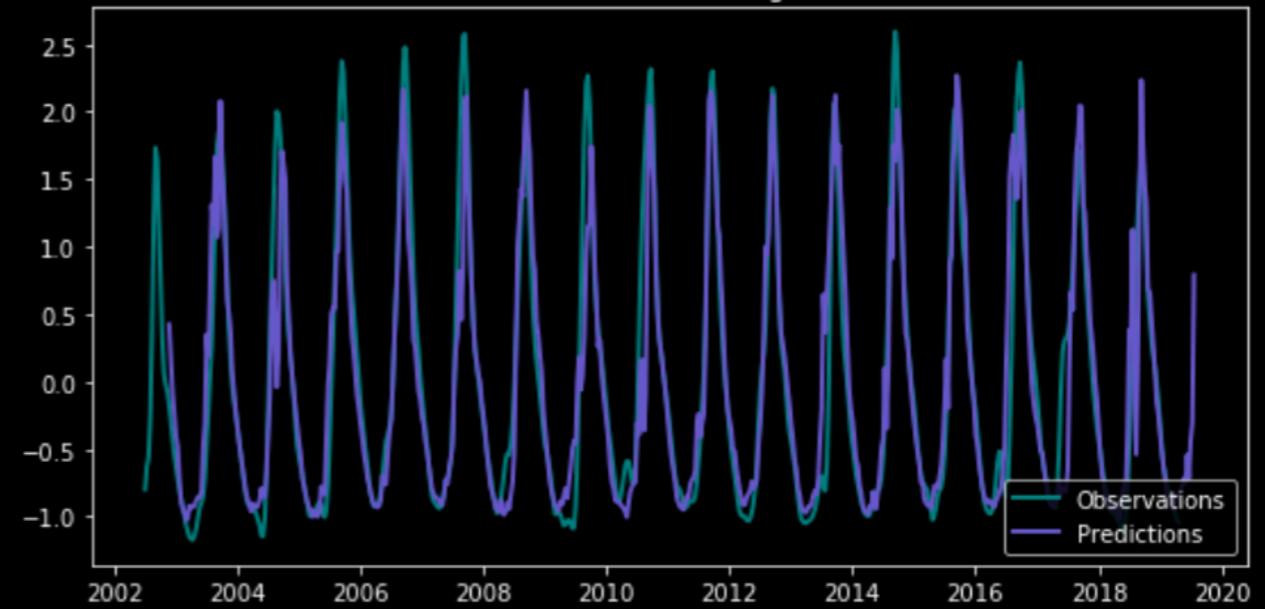
Rainfall Anomalies and Manifolds of High and Low Skill
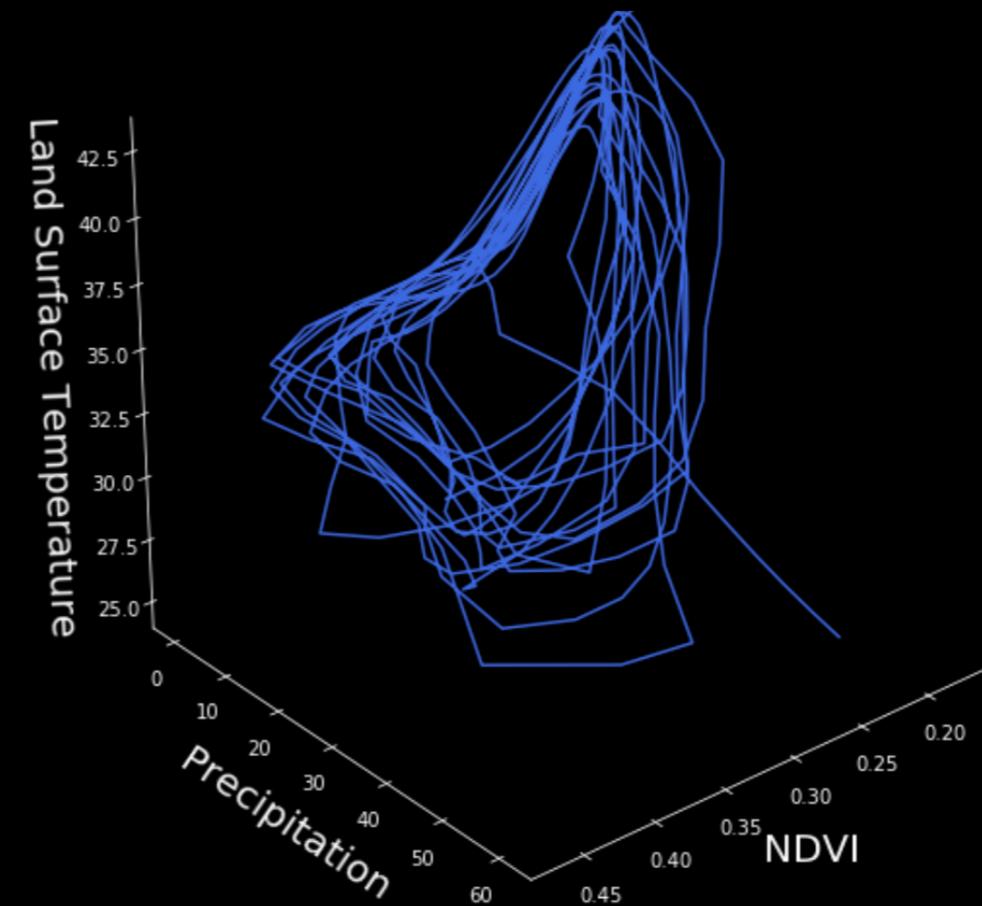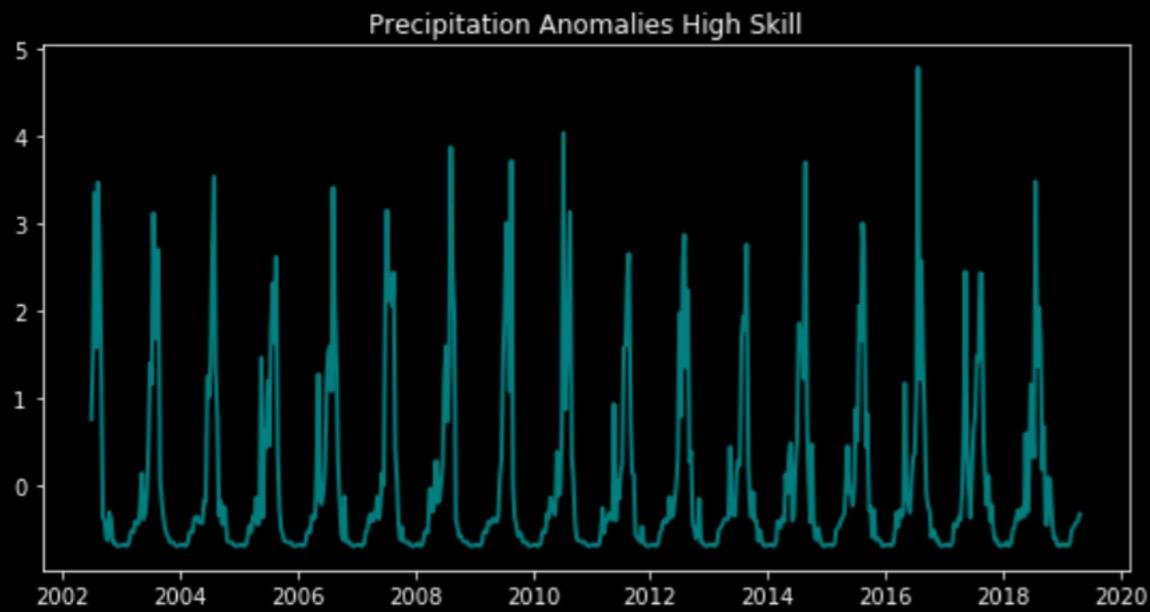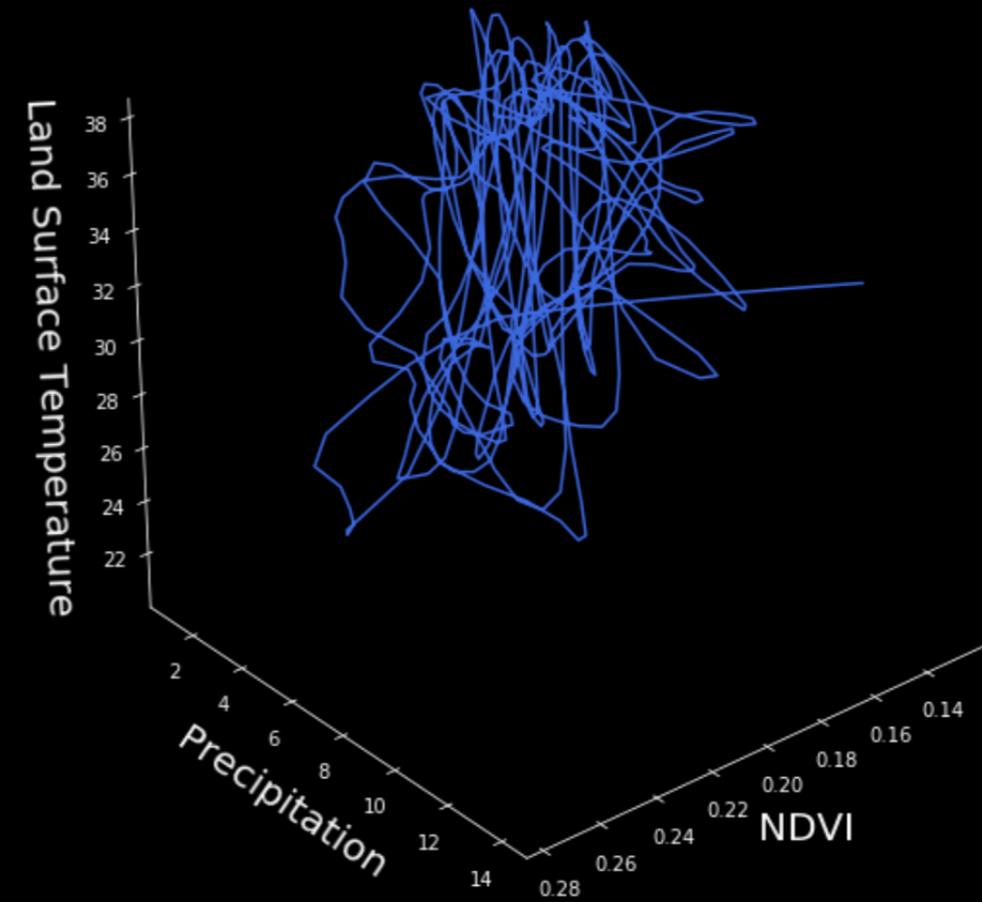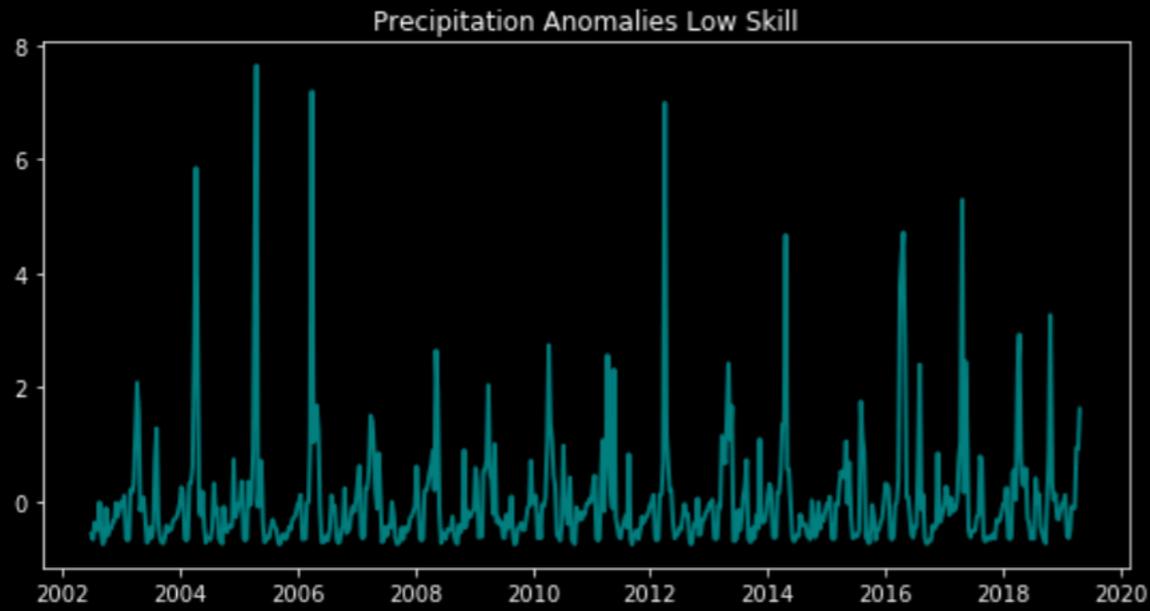
RAINFALL VARIATIONS AND NDVI PREDICTIVE SKILL
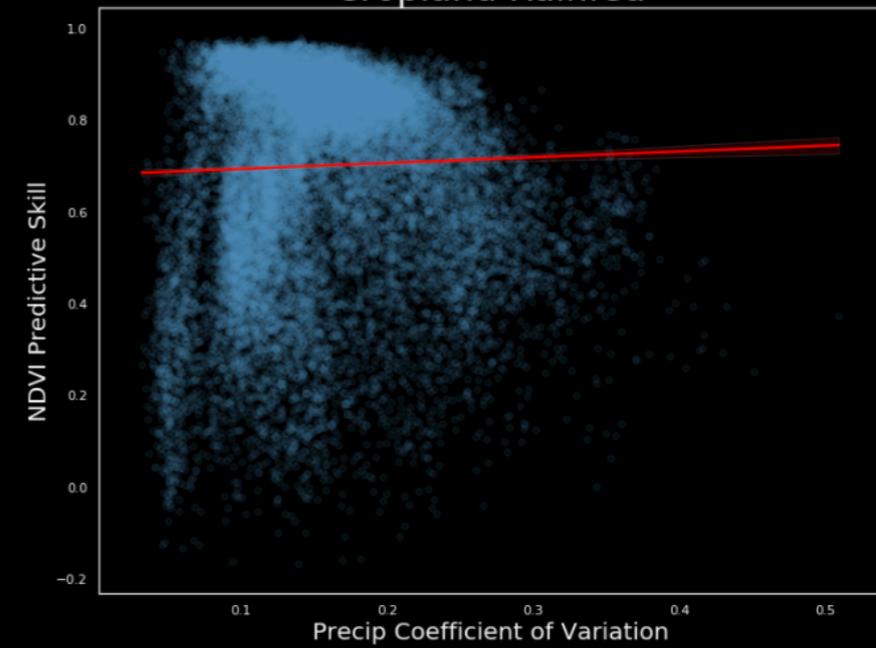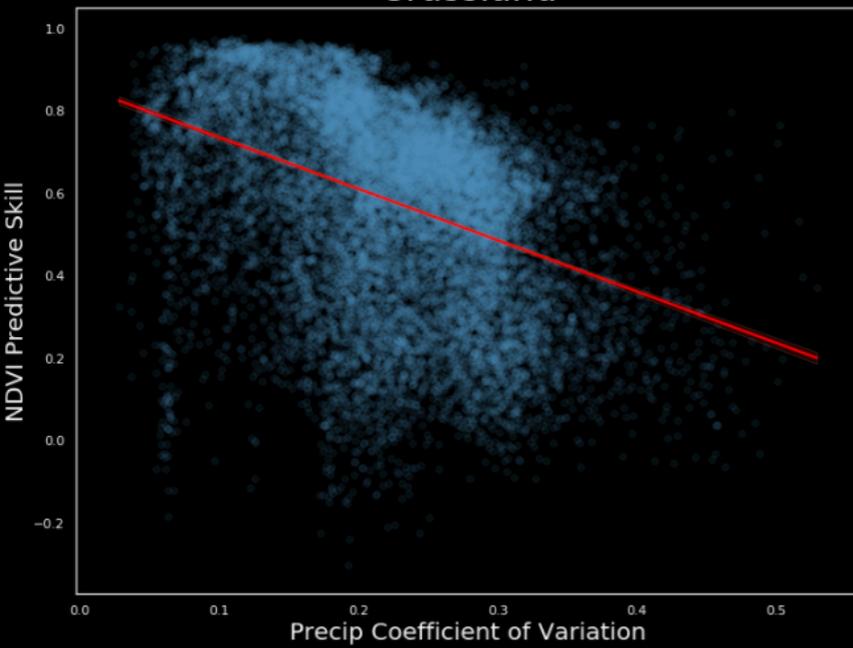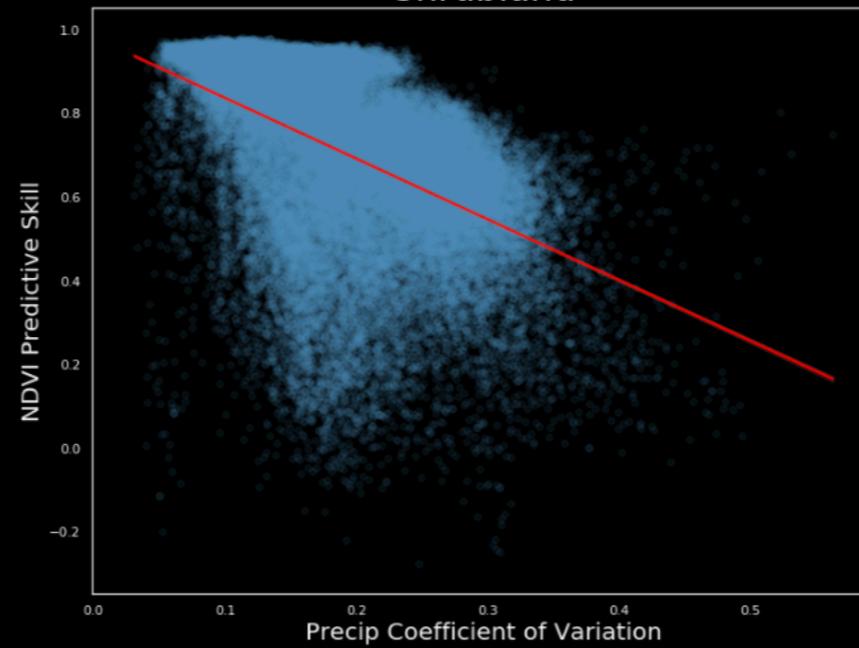
SEASONAL SKILL
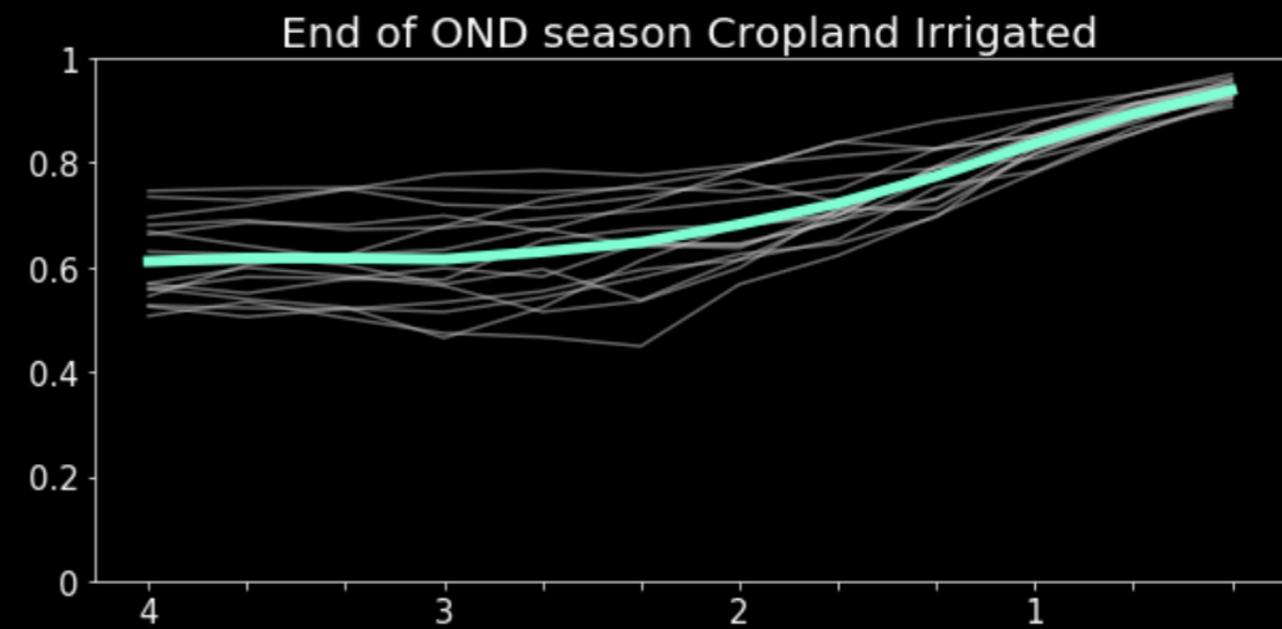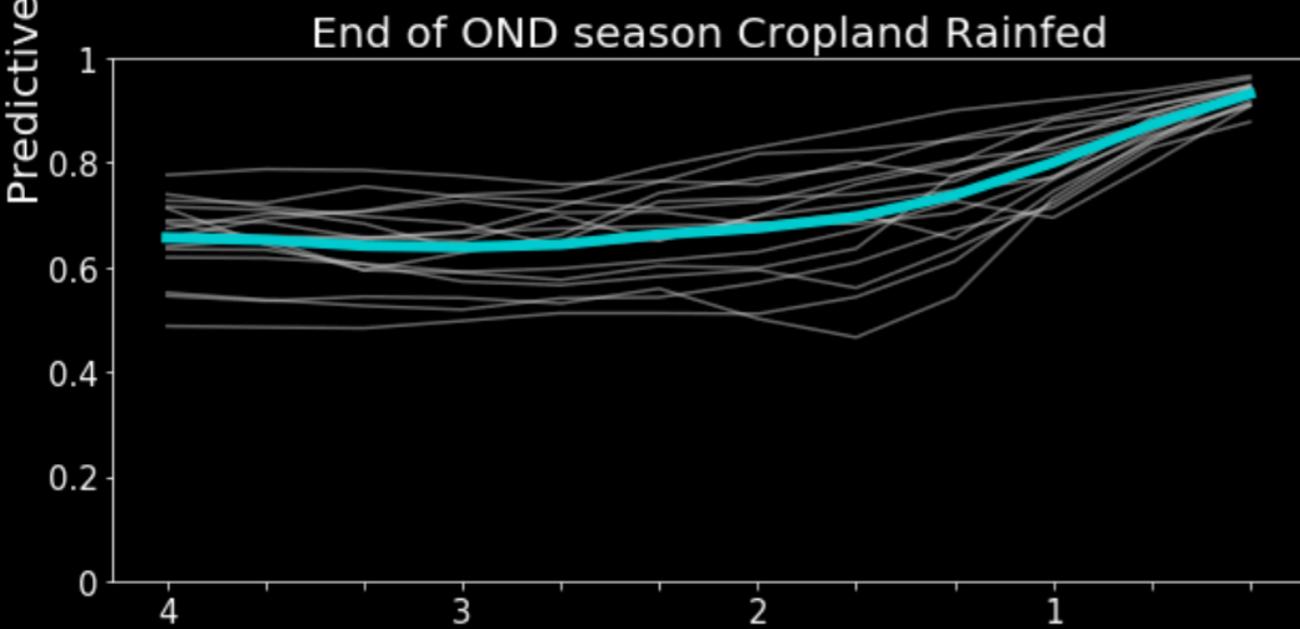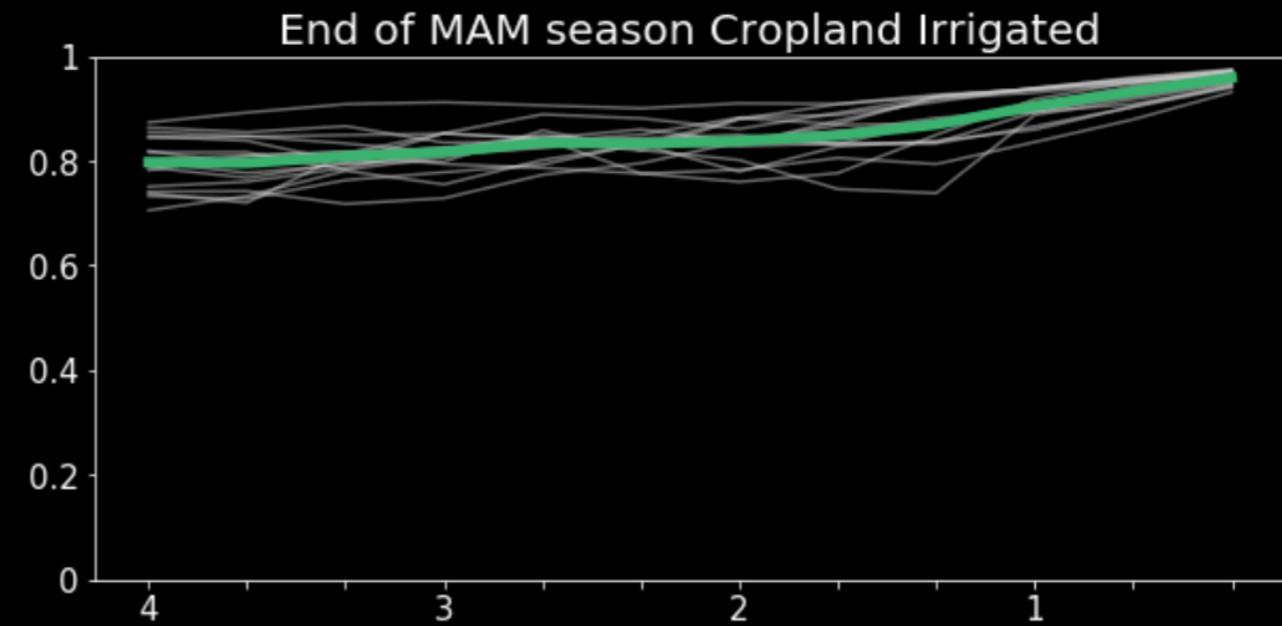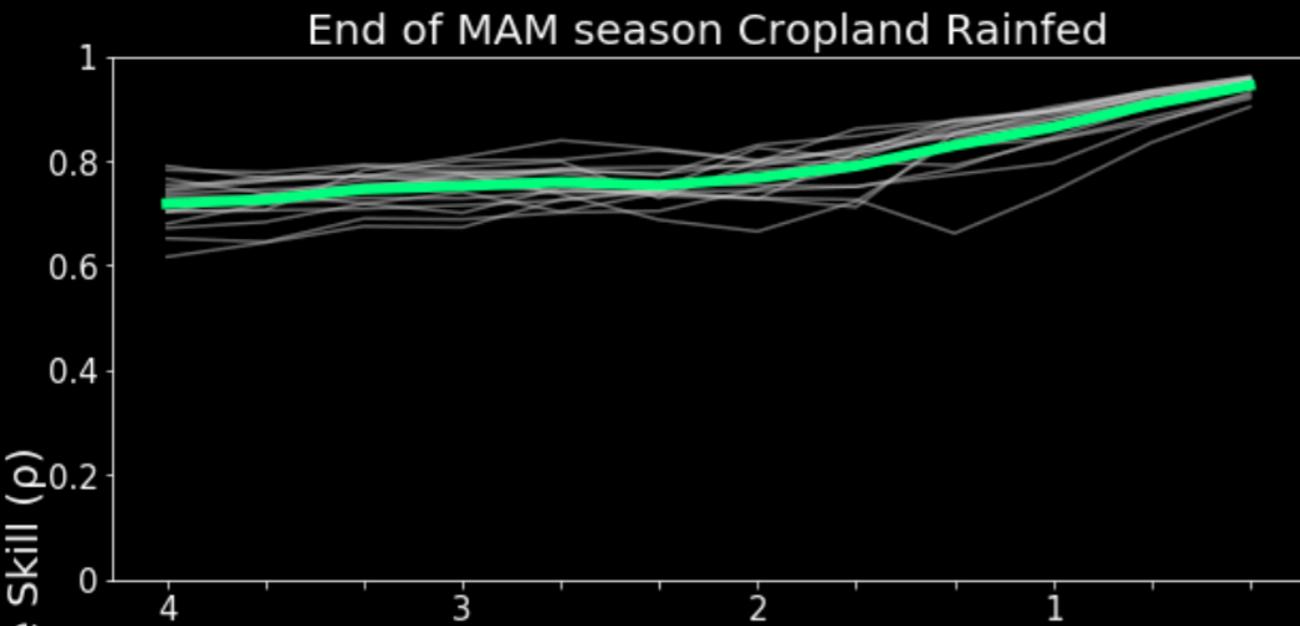
APPLICATIONS

- Proactive decision making

- Implications for food security outcomes

- Understand how semi-arid areas respond to stress from weather

- Bridge observation community with forecast community

- Transform data into actionable guidance for uptake by development organizations

rgreen@ucsb.edu