College of Arts and Sciences, Atmospheric Sciences Program

Land Cover Boundary Orientation

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INTRODUCTION

- Ecotones, or land cover boundaries, mark transitions between natural ecosystems or human-altered land use over a given distance
- Boundaries evolve with human population growth and expansion into natural areas, significant interfaces that humans encounter
- Previous studies have explored ecotones, but only some specifically delve into their orientation
- Southwest-facing meadows in forest-meadow ecotones receive more solar radiation than their northeast-facing counterparts (Owen 2005)
- The orientation of windbreaks relative to wind direction influences wind speed attenuation (Cleugh 1998)

STUDY AREA



Figure 1: Map of our tripod sites in relation to Waterman farm. The red pin is a ClimaVUE50 station. North is to the right.

METHODS

- Two flux tower tripods mounted with:
 - HC2S3 sensor for temperature and humidity
 - 014A cup anemometer for wind speed
- Flux towers were deployed on a forest-field boundary; one along a North-South oriented stretch with field to the south, and the other along an East-West oriented stretch with field to the east



The Ohio State University

- Data collected at 30-minute intervals (November 6th-November 17th, 2023)
- Data compared to nearby weather flow station (ClimaVUE50); analyzed with Python

RESULTS

- Pearson Correlations
- Strongly-positive correlations observed for all measured temperatures and relative humidities
- Wind speed correlations positive, but less linear
- ClimaVUE50 Station Observations
- Temperature range is smallest for the ClimaVUE50 station, then N-S oriented boundary: largest range on E-W boundary
- ClimaVUE50 station had the highest windspeed, the E-W oriented boundary had higher winds on average
- ClimaVUE50 station experienced slightly less extreme humidity range; E-W oriented boundary experienced slightly more extreme humidity
- Temperature
- Diurnal temperature fluctuations
- All stations recorded similar temperatures on average; N-S oriented boundary temperatures *slightly* higher



Figure 4: Time series comparison of relative humidity at all three stations and the difference between maximum and minimum relative humidity values at the boundary stations

Figure 3: Time series comparison of average windspeed at all three stations and the difference in average wind speed at the boundary stations

Relative Humidity

- Diurnal humidity fluctuations
- All stations recorded *similar* humidities on average E-W oriented boundary humidities *slightly* higher

CONCLUSIONS

- E-W oriented boundary: exposed to prolonged sunlight \rightarrow higher daytime temperatures \rightarrow significance of understanding solar exposure
- N-S oriented boundary: sheltered from prevailing westerly winds \rightarrow calmer windspeeds
- Strong correlations observed between temperature and humidity; wind speed relations indicate some complexities, suggesting a need for targeted windrelated management
- Results emphasize the significance of the orientation of the land cover boundary
- Groundwork set for exploring nuanced dynamics in land cover boundaries
- Ever-evolving human interaction with natural ecosystems will further require more-developed land use design, one that will integrate the knowledge of cardinal orientation of a land cover boundary
- As the population grows and scientific knowledge advances, the microclimatological nuances of ecotones become increasingly vital for sustainability and resilient land management

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Valuable insight into the microclimatological impact of the cardinal orientations over land cover boundaries

Impact land use planning and agricultural practices

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