Confronting data with reality: Spatial patterning in simulated ridge and slough landscape from RASCAL everglades modeling

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Introduction

The Florida Everglades have been described as having regular or periodic landscape patterning, yet, the processes that develop and maintain it are not well understood. Quantifying the spatial characteristics of these patterns can provide insight into the processes and provide metrics for model validation. Here we used spatial spectral analyses to compare landscape patterns and frequencies represented in simulated ridges and sloughs from the RASCAL Everglades model to observations from areal imagery.

Figure 1: Google Earth aerial image demonstrating a ridge and slough landscape from the Everglades Wildlife Management Area in southern Florida. Darker colors are ridges dominated by sedge sawgrass and lighter colors are sloughs, containing less dense emergent and floating plants.

Simulations

Everglades ridge and slough landscapes were simulated using the RASCAL model (Larsen and Harvey, 2011).

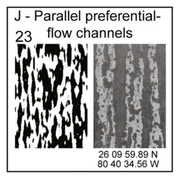

Figure 2: Sample RASCAL model output and aerial image displaying similar ridge and slough landscapes (Larsen and Harvey, 2011).

Empirical Analyses

Casey et al. (in review) analyzed everglades vegetation maps using various spatial statistics to understand the scale of the processes that develop and maintain the ridge and slough landscape.

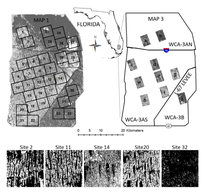

Figure 3: Casey et al. (in review) empirical sites converted to binary images.

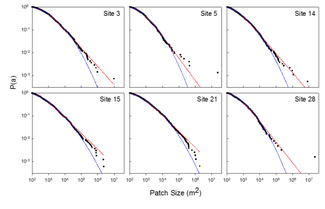

Figure 4: Patch (ridge) area complementary cumulative distribution function (CCDF).

Research Questions:

1. Is there evidence of **regular patterning** in RASCAL everglades landscape images?
2. Is there a **dominant spatial frequency** in RASCAL everglades landscape images?
3. How do these results **compare** to the same analyses on aerial images or vegetation maps?
4. How do these results vary with **different RASCAL parameters**?

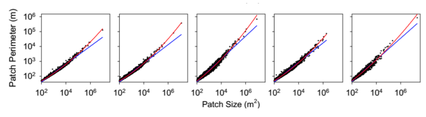

Figure 6: Casey et al. (in review) perimeter to area scaling indicates ridge perimeters increase faster than expected for fractal relationship.

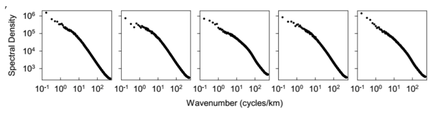

Figure 7: Casey et al. (in review) omni-directional *r* spectrums show no support for periodic behavior (indicated by absence of strong peaks).

Methods

All analyses were performed using Matlab version R2016A under an academic license.

Results

Image Processing

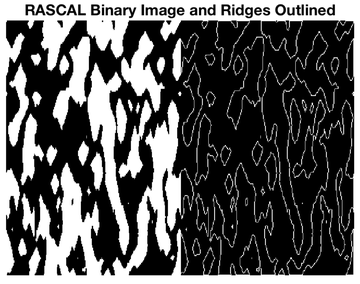

Figure 5: RASCAL model image output (left) and with ridges outlined (right) for perimeter calculations.

Perimeter to Area Scaling

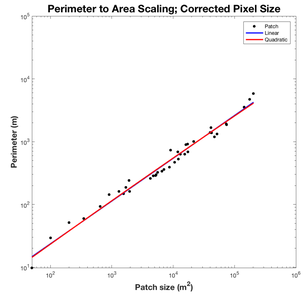

Figure 8: Perimeter to area scaling shows a linear relationship (linear model is shown in blue; quadratic model in red) indicating that ridge perimeter does not increase differently than expected for a fractal relationship.

Area CCDF

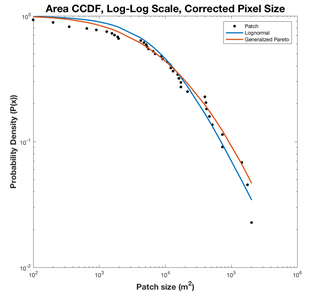

Figure 9: Ridge sizes show strong support for both the generalized Pareto distribution (shown in red) and a lognormal distribution (shown in blue).

Spatial Spectral Analyses

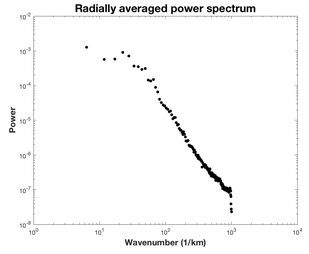

Figure 10: Omni-directional *r* spectrum indicates presence of a strong peak and support for periodic behavior.

Next Steps

- Analyze **ridge elongation** statistics
- Compute **directional *r* spectrum**; perpendicular to flow and find best **fit** for data
- Repeat all analyses with different RASCAL images resulting from **different input parameters**
- **Interpret** results!

References

Casey, S.T., Cohen, M.J., Acharya, S., Kaplan, D.A., and Jawitz, J.W., in review. *Hydrology and Earth System Sciences.*

Larsen, L.G., and Harvey, J.W., 2011. *Geomorphology* 126:279-296.