How well can remote sensing detect biodiversity?

R Wang[a]

[a] *Earth and Atmospheric Sciences, University of Alberta, AB, Canada*

In the face of increasing species extinctions, maintaining biodiversity is of growing concern. Biodiversity affects ecosystem health in terms of production and stability, with many studies suggesting a positive relationship between diversity, productivity and stability. Traditional biodiversity measurements require extensive field work. Remote sensing has the potential to detect plant biodiversity based on optical properties, which vary with species or functional groups ("optical types"). According to the optical diversity hypothesis, plant optical signals can be influenced by leaf traits, canopy structure and phenology, and the scale-dependence of these signals remains unclear.

To address these topics, we tested the optical diversity hypothesis using ground measurements and airborne campaigns at both a prairie ecosystem experiment (Cedar Creek Ecosystem Science Reserve, Minnesota, USA) and a natural prairie grassland (Mattheis Ranch, Alberta, Canada).In this presentation, I review the biodiversity-productivity relationship with remote sensing and investigate the scale-dependence of optical diversity.

Both Cedar Creek and Mattheis studies showed positive relationships between biodiversity and productivity, although the biodiversity-productivity relationship varied with time. In our scaling study, optical diversity showed positive correlations with conventional diversity metrics, but the optical detectability of biodiversity was greatly reduced with decreasing spatial resolution. In experimental prairie plots, the optimal pixel size for distinguishing diversity appeared to be around 1mm to 10cm, a range of spanning the size of herbaceous plant leaves and canopies, and by 1 m, the ability to detect biodiversity with optical diversity was largely lost. Alternatively, airborne studies of prairie landscapes at a 1-m pixel size revealed that optical diversity was still detectable, suggesting that airborne remote sensing can be used to map biodiversity and assess ecosystem health. These experimental studies are helping us to develop an operational approach that can be applied to detect biodiversity and assess ecosystem function over large landscapes with airborne remote sensing.

Corresponding author: rw6@ualberta.ca