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| **Remotely sensed canopy and litterfall trends of longleaf pine plantations in south Georgia, USA** |
| **Introduction/Aim:**  In the southern USA, longleaf pine plantations are valued for a regionally specific non-timber commodity, ‘pine straw’, where recently fallen needles (i.e., annual litterfall) are raked and sold as landscaping mulch. For instance, in 2022 Georgia-produced pine straw was valued at USD $127 million. Due to its value, there is novelty to leverage satellite imagery to understand longleaf pine canopy dynamics to describe how site fertility affects canopy production and to predict future pine straw yields. Here we present a framework to use Landsat 8 and 9 derived vegetation indices to predict longleaf pine plantation litterfall.  **Study background:**  Our study involved 84, 0.04 ha plots on two eleven-year-old high fertility sites and two eleven-year-old low fertility sites in south Georgia. The high fertility sites had greater standing tree volume (20.63 m-3 ha-1) and were at canopy closure, where the low fertility sites had lower standing volume (9.18 m-3 ha-1) and were further away from canopy closure.  **Results:**  Using generalized additive models (GAMs) we determined that predictors like day-of-year (DOY), date, and fertility (high vs. low) explained the most variation in normalized difference moisture index (NDMI, R2 = 0.58) and best represented the biological patterns of litterfall when compared to other popular indices like enhanced vegetation index-2 (EVI-2, R2 = 0.19) or the newer near-infrared reflectance of vegetation (NIRv, R2 = 0.51).  We then used a GAM to relate NDMI values for each plot to ground-collected leaf area index (LAI, 684 total plot-level means) values for growing-season2023. NDMI, LAI collection month, and fertility were used as predictors, and explained 63% of variation in LAI.  Next step was to relate LAI to litterfall biomass, but there was a lag between litterfall and LAI data collection. For example, due to a needle lifespan of ~18-months, collected December2022 litterfall samples (84 plot-level means) represented canopy conditions and LAI from growing-season2021. So, the above LAI model was used to predict LAI2021.  Another GAM was then fitted to predict litterfall2021 biomass using predicted LAI2021 and site fertility as covariates. The GAM explained 75% of the variation in litterfall2021. Partial effects from the model also demonstrated that high fertility litterfall trends were non-linear while low fertility litterfall trends were more linear.  **Conclusion:**  Our workflow provides structure for how longleaf pine plantation managers, who are likely interested in pine straw yields, can leverage current year imagery to predict longleaf pine litterfall in the subsequent year. |