National Aeronautics and Space Administration

DEVELOP

Texas & Georgia Agriculture

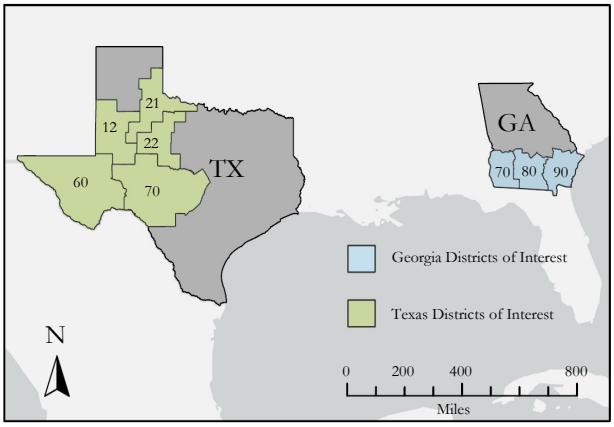
Assessing the Drivers of Cotton Quality and Yield for Improved Crop Forecasting in the Southern United States

Declining cotton quality in major production regions of the United States has raised concerns among growers and producers of this vital commodity crop. To help ensure a sustainable production of cotton that meets international quality standards, the NASA DEVELOP team leveraged multi-satellite Earth observation data to assess the influence of various seasonal environmental conditions on cotton quality and yield across two high cotton-production regions (Southern Georgia and Western Texas), over a ten-year period from 2015 to 2024. Results showed that:

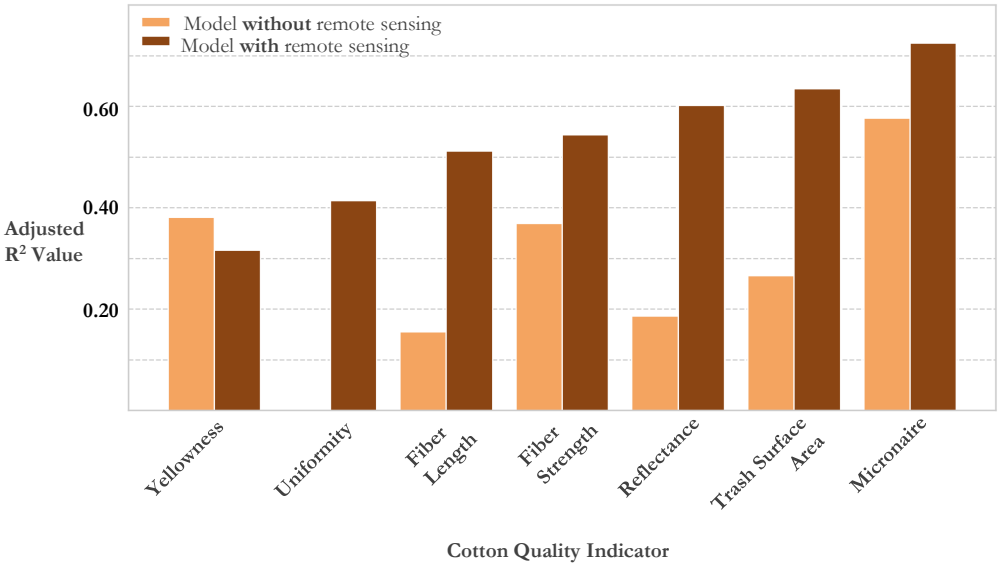
- Environmental variables explained up to **75%** of the variability in cotton's micronaire across Texas.
- **Enhanced vegetation index** (EVI) data derived from satellite observations provided insights into vegetation health and had a high correlation with fiber strength and length.

Cotton-producing regions

Eight National Agricultural Statistics Service (NASS) Districts were included in the original scope of the study; however, two (TX-60 and GA-90) were excluded from the analysis due to insufficient data.



Advantages of Remote Sensing in Cotton Production

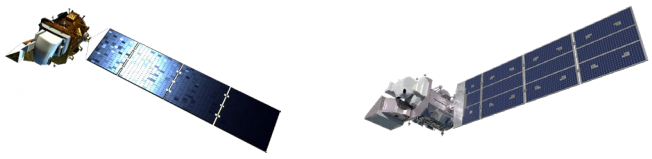


The predictive power of regression models for different quality metrics that incorporated remote sensing observations was compared to those models that used only modeled data from weather stations. For all but one of the primary quality metrics examined, the model for that metric that used predictors based on satellite data outperformed the model without that information–often by a large margin–indicating the promise of incorporating remote sensing observations into predictions for the quality of cotton harvests.

Project Purpose

The United States is one of the leading global producers of cotton. However, the declining quality of cotton in recent years raises concerns about possible disruption in the supply chain, as well as the resulting implications on the economy of Southern states. Local producers, as well as federal agencies such as the US Department of Agriculture's (USDA) Agricultural Research Service and Agricultural Marketing Service units, are interested in understanding the underlying reasons for the observed variability in cotton quality measurements at ginning centers across the South.

While environmental variability has been hypothesized to be the main factor determining cotton quality, the USDA currently lacks tools to identify specific variables that are potentially impacting quality metrics. Traditional cotton quality assessments involve labor-intensive physical testing of cotton bales in designated warehouses. Additionally, in attempting to identify drivers of cotton quality, uncertainty is introduced by the inability to match bales with the specific fields they were grown in (and therefore the environmental conditions they were exposed to). However, with advancements in remote sensing capabilities, especially in capturing cotton's physiological responses to varying conditions, satellite-derived vegetation indices and seasonal climatic data can now be employed within a statistical model to identify factors affecting cotton health.

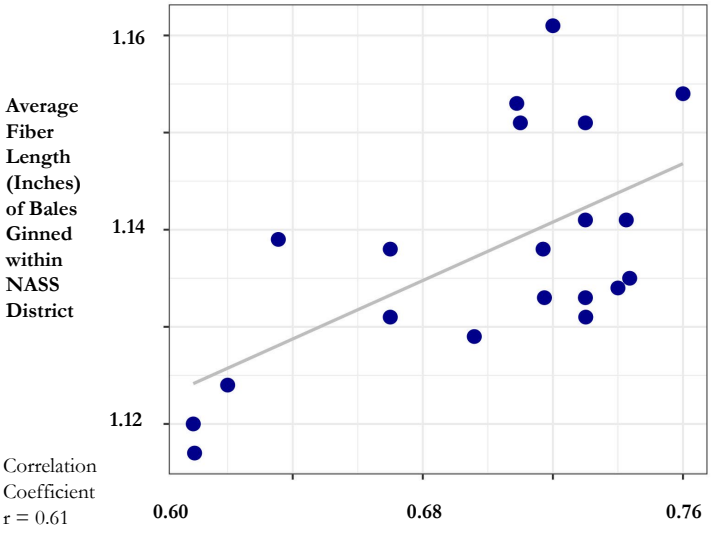


Landsat 8 and Landsat 9 were two of the NASA satellites utilized to obtain spectral readings used to calculate the Enhanced Vegetation Index.

Accurately identifying the important drivers in cotton quality will enable partners to effectively monitor these factors and predict their potential impacts in the future. Findings from the study may aid in informing partners' climate-adaptive decision-making, resource allocation, and strategic intervention efforts to mitigate poor quality bales.

Analysis

In Georgia, EVI values derived from Harmonized Landsat Sentinel-2 mission data in the summer months were predictive of cotton fiber length and strength at harvest. As early as July, EVI readings at the level of NASS districts had a correlation coefficient of 0.60 with the average fiber length of the bales processed in the district at harvest.



While this statistical study offered promising initial findings, to validate and expand upon the associations discovered here, it is recommended that further analysis be done at a finer spatial scale if possible. Knowing the field location of bales (not just the NASS District they were ginned in) would produce a more exhaustive and reliable analysis of environmental factors affecting cotton quality.

Partners

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USDA Agricultural Research Service
Cotton Incorporated

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NP-2025-04-064-LaRC

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