

# Improved Understanding of the Coupled Dynamics of Terrestrial Water, Ecosystems, and Climate over the Contiguous United States Using NU-WRF/Noah-MP

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## Background

Planet Earth has systems and processes working constantly over time, keeping it hospitable. It is quite possible that these systems are not independent of one another: There could actually be dynamic interactions among Earth's processes.

This study looks at possible dynamics and interactions of precipitation in the United States, Temperature, Leaf Area Index, Normalized Difference Vegetation Index, among other aspects; One can observe a decrease of Leaf Area Index in the American South and Texas, as well as an increase in overall precipitation in these areas.

## Methods

This study considered the following:

- Precipitation
- Leaf Area Index
- Normalized Difference Vegetation Index
- Temperature
- Gross Primary Production

This project utilized NCL, a coding language. The algorithm had each code gather satellite collected data, and plot it onto either maps or graphs so that data analysis was possible.

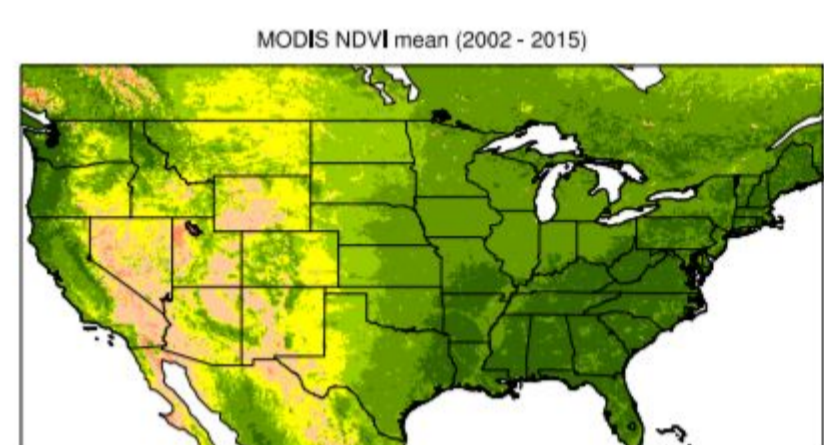


Figure 1: Average normalized difference vegetation index for The United States from 2001 to 2015

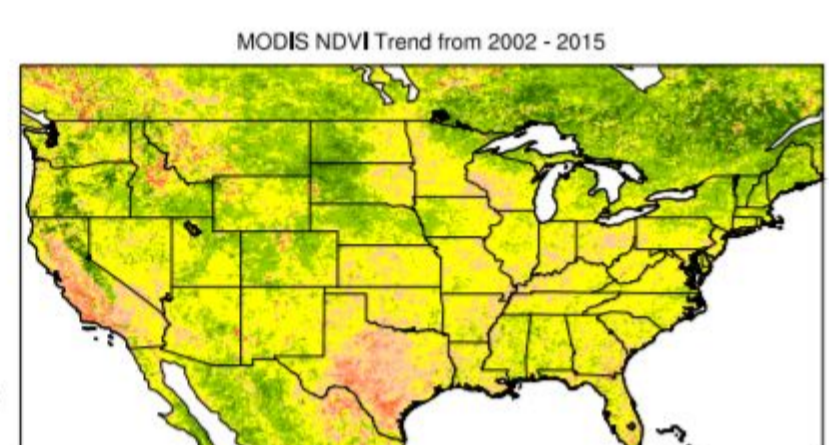


Figure 2: Trend in normalized difference vegetation index in The United States from 2002 to 2015

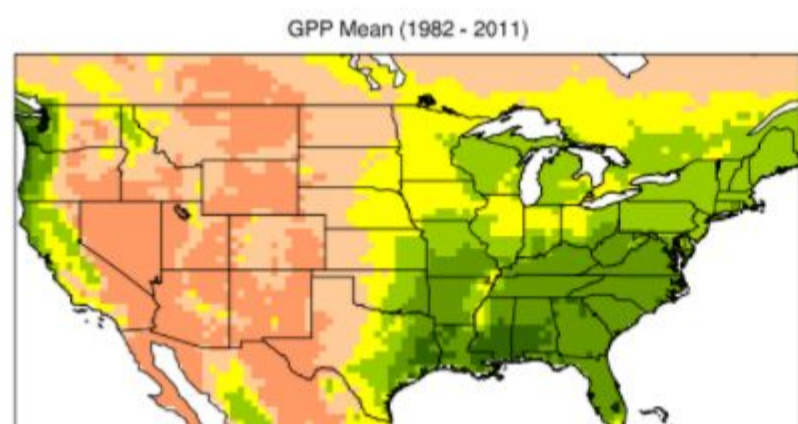


Figure 3: Average gross primary production in The United States from 1982 to 2011

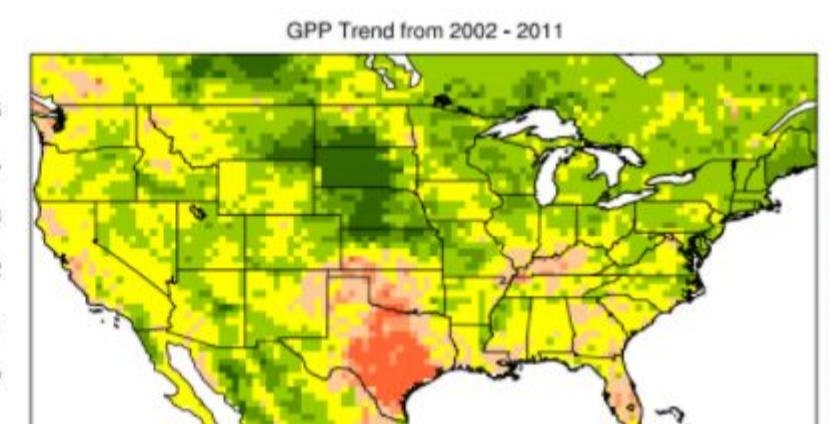


Figure 4: Trend in GPP from 2002 to 2011 in The United States

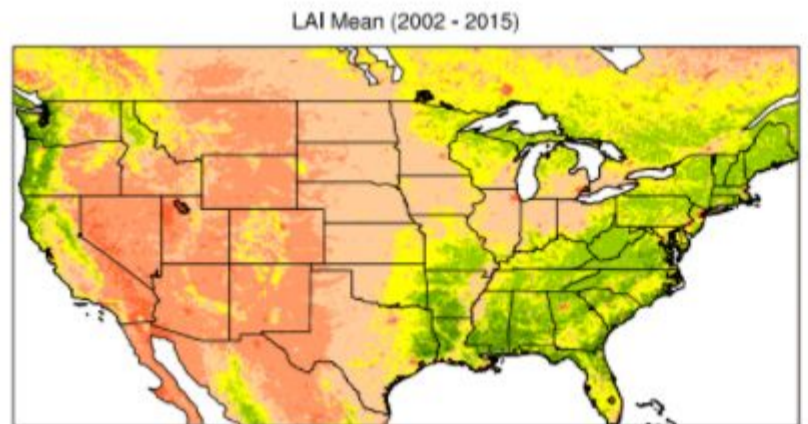


Figure 5: Average leaf area index in the United States from 2002 to 2015 (m²/m²)

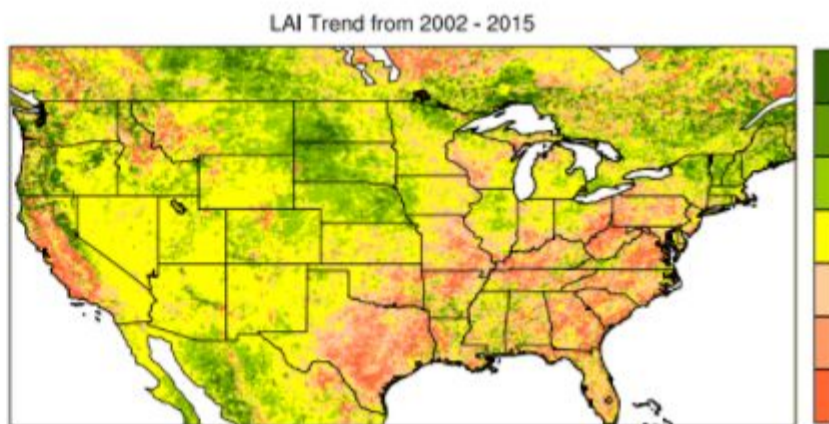
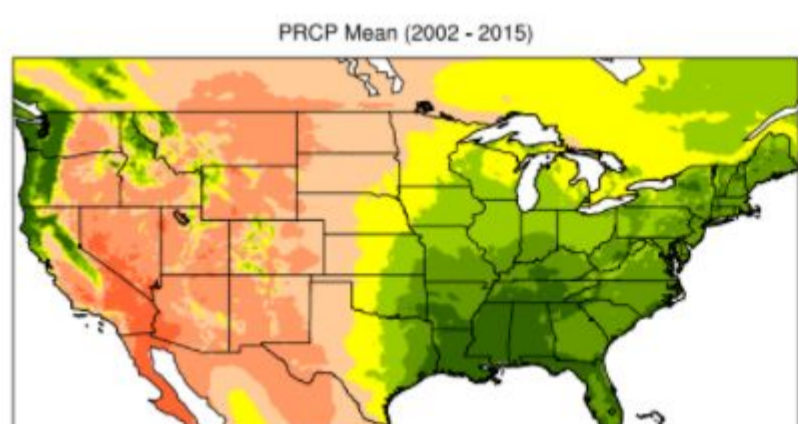
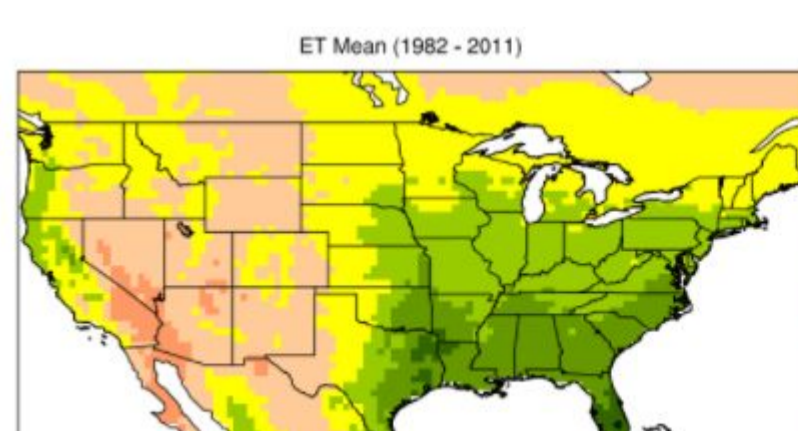
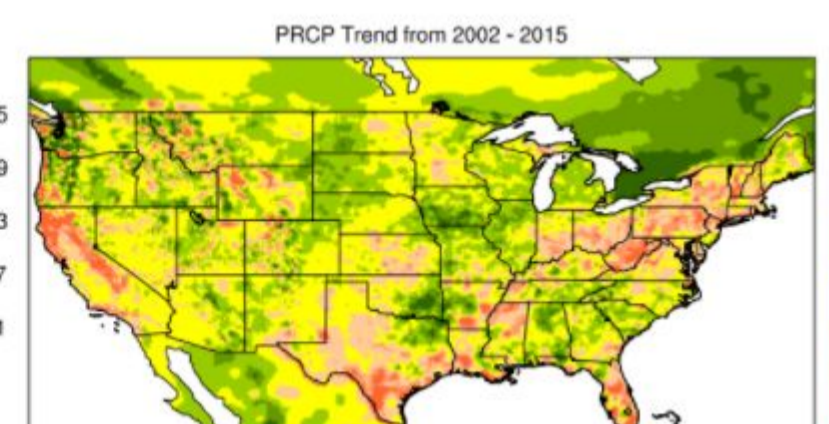


Figure 6: Trend in leaf area index in The United States from 2002 to 2015



Figures 7 & 8: Precipitation average (PRCP: mm) in The United States from 2002 to 2015 (left), and change in precipitation from 2002 to 2015 in The United States (right)



Figures 9 & 10: Evapotranspiration (ET: mm/day) in The United States average from 1982 to 2011 (left), and trend in evapotranspiration in the United States from 2002 to 2011 (right)

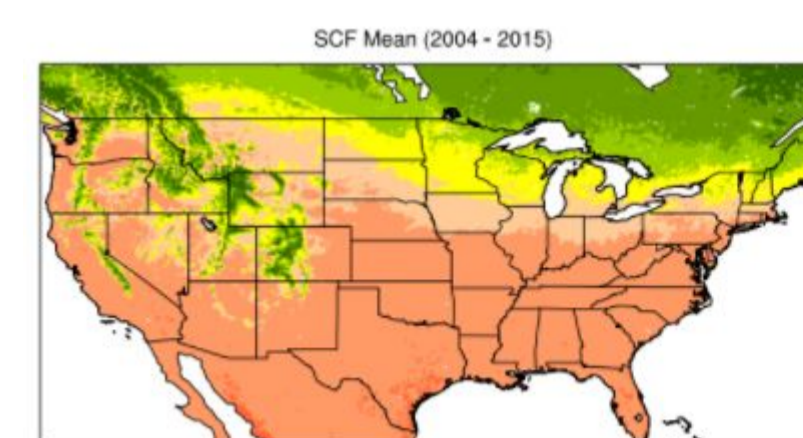
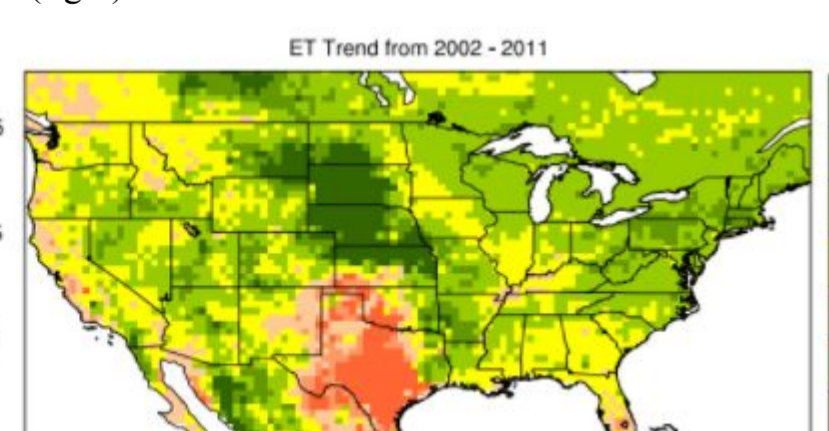


Figure 11: Average Snow Cover Fraction (SCF in %) in The United States from 2004 to 2015

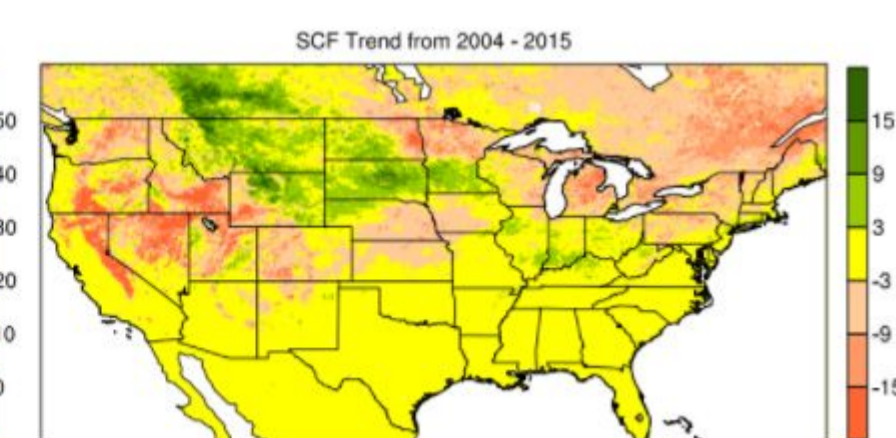
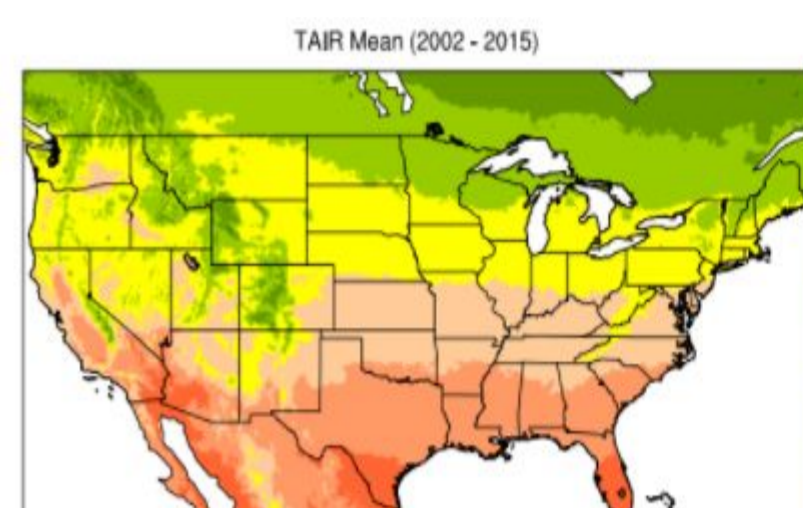
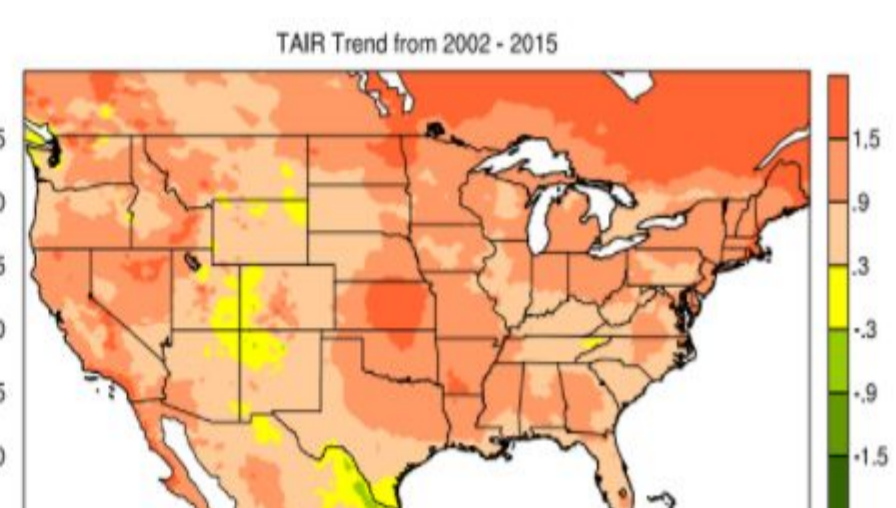


Figure 12: Trend in SCF in The United States from 2004 to 2015



Figures 13 & 14: Average Air Temperature (TAIR in Kelvin) in The United States from 2002 to 2015 (left). Trend in Air Temperature in the United States from 2002 to 2015 (right)



## Findings

- There is a clear decrease in vegetation in the American South and in Western Texas, contrasting a significant increase in precipitation in those areas. The American South is still the area with highest NDVI and GPP.
- The Sonoran Desert has seen an increase in precipitation, though the average precipitation is still almost neglectable.
- The Texas area had significant less ET than the rest of the country
- There is a clear increase in temperature in most of the United States
- The American South is seeing a decrease in Leaf Area Index, while precipitation, GPP, and NDVI are staying somewhat constant.
- There was a decrease in SCF in Northwestern States, while the rest experienced little to no change

## Conclusions

- Temperatures in The United States are getting hotter over time
- Texas is the area with least vegetation production, as well as the driest.
- Further research is required to better understand climate dynamics in North America.

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