

Time series analysis of tree cover in southeastern Queensland, Australia

Based on time series analysis, the tree cover in two pine plantations in southeastern Queensland, Australia, have been steadily increasing over the last 50 years.

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Figure 1: Tuan and Toolara State Forests spatial extents in relation to Australia.

ABSTRACT

The pine plantations of the Tuan and Toolara State Forests located in southeastern Queensland, Australia, cover a significant area and are home to diverse fauna. As deforestation has increased in Queensland over the last 50 years, it is necessary to understand if the forestry industry follows this trend.

A variety of free Landsat imagery for the last 50 years are used to create NDVIs for the area and therefore a time series for tree cover can be generated.

The time series show a stable but upward trend of tree cover gain over the last 50 years, correlated well with the NDVIs.

The increasing trend of tree cover contrasts with the deforestation and decreasing tree cover in naturally occurring forests in Queensland over the last 50 years.

In the future, further research into the tree cover changes in these natural forests and methods for atmospheric processing of older imagery is required.

Introduction and Study Area

The Tuan and Toolara State Forests are plantation forests in southeastern Queensland, Australia, covering an area of approximately 1000 km² (Figure 1; Zabek, 2015). Most of the forests consist of exotic pine species for forestry use in a variety of industries while experiencing a sub-tropical climate (Wang, 2008). The forests are protected under the Nature Conservation Act of 1992 and the Forestry Act of 1959.

Justification of Study

Large-scale deforestation in the state of Queensland has been increasing exponentially since the 1970s (Bradshaw, 2012) and the negative consequences on the Australian flora and fauna are significant. While the forestry industry does not contribute to deforestation, their impacts on the organisms living within their plantations are similar.

Objective

The objective is to identify the extent of tree cover changes in the Tuan and Toolara State Forests from the 1970s to now using a time series analysis. This information can help to show how environmental policy and opinion has changed as well as the altered forestry methods and extent over time.

Data and Methods

Free satellite imagery are used and due to the temporal range, a variety of Landsat Imagery is chosen. For 1975 Landsat-2, 1978 Landsat-3, 1990 Landsat-5, 2000 Landsat-7, 2010 Landsat-5 and 2019 Landsat-8. This imagery is already terrain corrected. Atmospheric corrections are done in QGIS

while NDVI generation and clipping was completed in ArcMap.

1. Input: Landsat imagery
2. Radiometric correction
3. Creation of NDVI
4. Clipping of forest extent
5. Generation of time series

Results

The NDVIs (Figure 2) correlate well to the upward trend of tree cover gain over the last 50 years (Figure 3). There is never significant tree cover loss in low to medium vegetated areas between time slices.

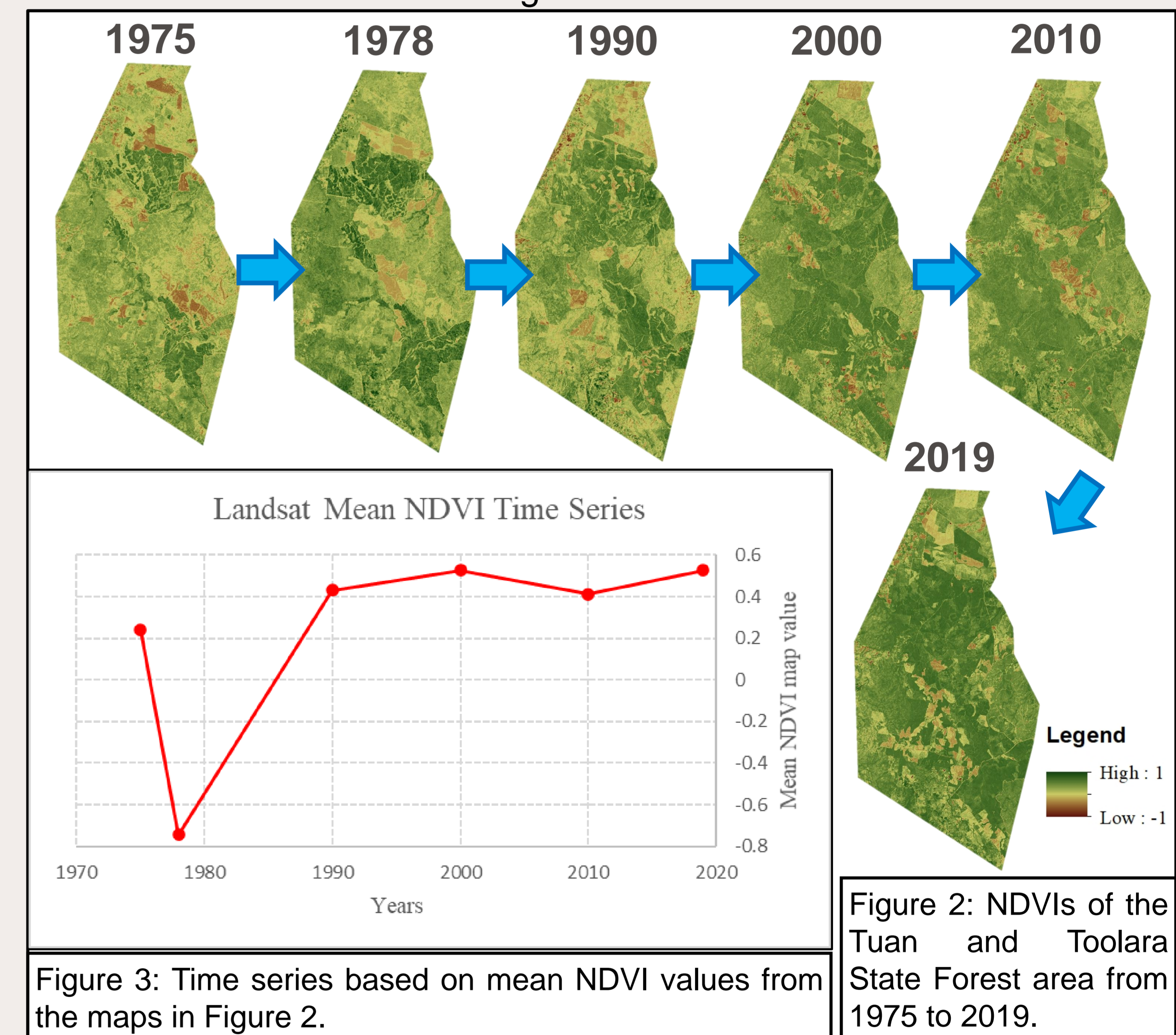


Figure 3: Time series based on mean NDVI values from the maps in Figure 2.

Figure 2: NDVIs of the Tuan and Toolara State Forest area from 1975 to 2019.

Discussion

Results display an upward trend in tree cover for the Tuan and Toolara State Forests over the last 50 years except for an outlier in 1978. This significantly changed value could be a result of no atmospheric correction. However, both 1975 and 1978 were not atmospherically corrected due to Landsat-2 and 3 not being compatible with several modern methods. It could also be that the mean NDVI value is for the whole map and not just for the clipped area.

This trend contrasts with naturally occurring forests as the tree cover over the last 50 years has

been decreasing exponentially due to widespread deforestation (Bradshaw, 2012). The increasing trend could be attributed to more wood being provided from deforestation and/or decreasing industrial demand for wood in Queensland (Bradshaw, 2012).

Conclusion

In conclusion, the tree cover for the Tuan and Toolara State Forests is steadily increasing over time.

The way forward:

- Further methods for atmospheric processing of older imagery
- Additional research into the tree cover trends of naturally occurring forests

REFERENCES

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