Long-term trend analysis of surface wind speeds over the southern United States

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1. INTRODUCTION

Earth's climate is an ever-changing and developing complex system that greatly affects humans, businesses, and physical environment. Wind is an essential component of Earth's climate that help drives local, regional, and global large-scale atmospheric and synoptic circulations. Recent studies have found near-surface and upper-level atmospheric conditions have been affected wind speeds both positively and negatively in the United States[1-4]. Consequently, the present debate among scientists is whether climate variation is the primary factor causing wind trends and speeds to decelerate over time or is it a result of some unknown or misunderstood variable (e.g., changes in large-scale atmospheric circulations, urbanization, etc).

Furthermore, long-term wind trend studies have been conducted to predict or forecast wind energy production for particular regions in the United States. As a result, the goal of this study is to evaluate and determine how surface wind speeds (10 m) have changed over a long-term trend for observation stations located in the southern United States through geographical and temporal analysis from 1975–2010.

2. DATA AND METHODS

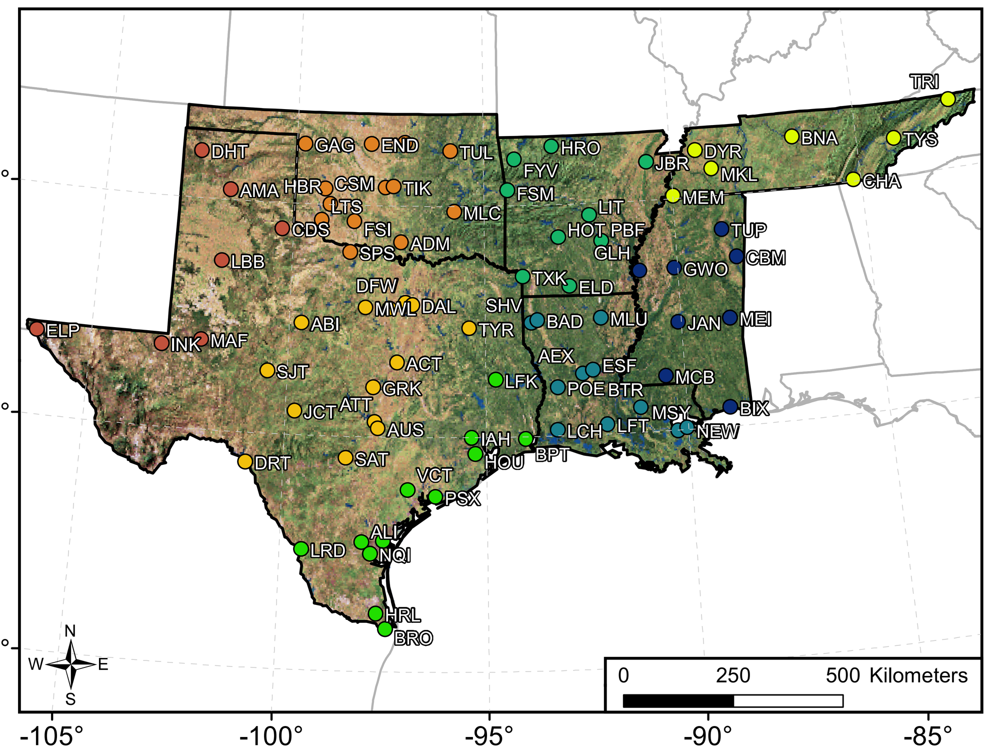

Fig. 1. The spatial distribution of the eighty-one observation stations used in the study. The stations were assigned into eight groups.

Study Flow Diagram

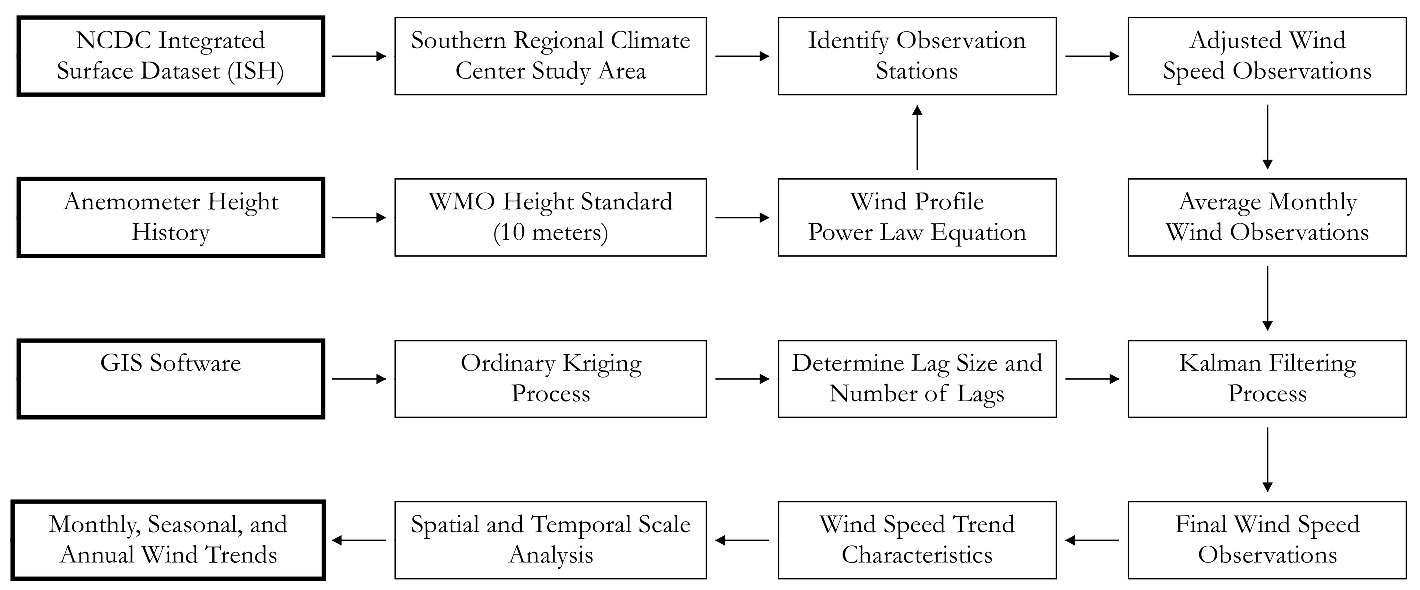

Fig. 2. A flow diagram demonstrating the techniques and methods used to analyze the spatial and temporal wind characteristics of the study area.

3. RESULTS

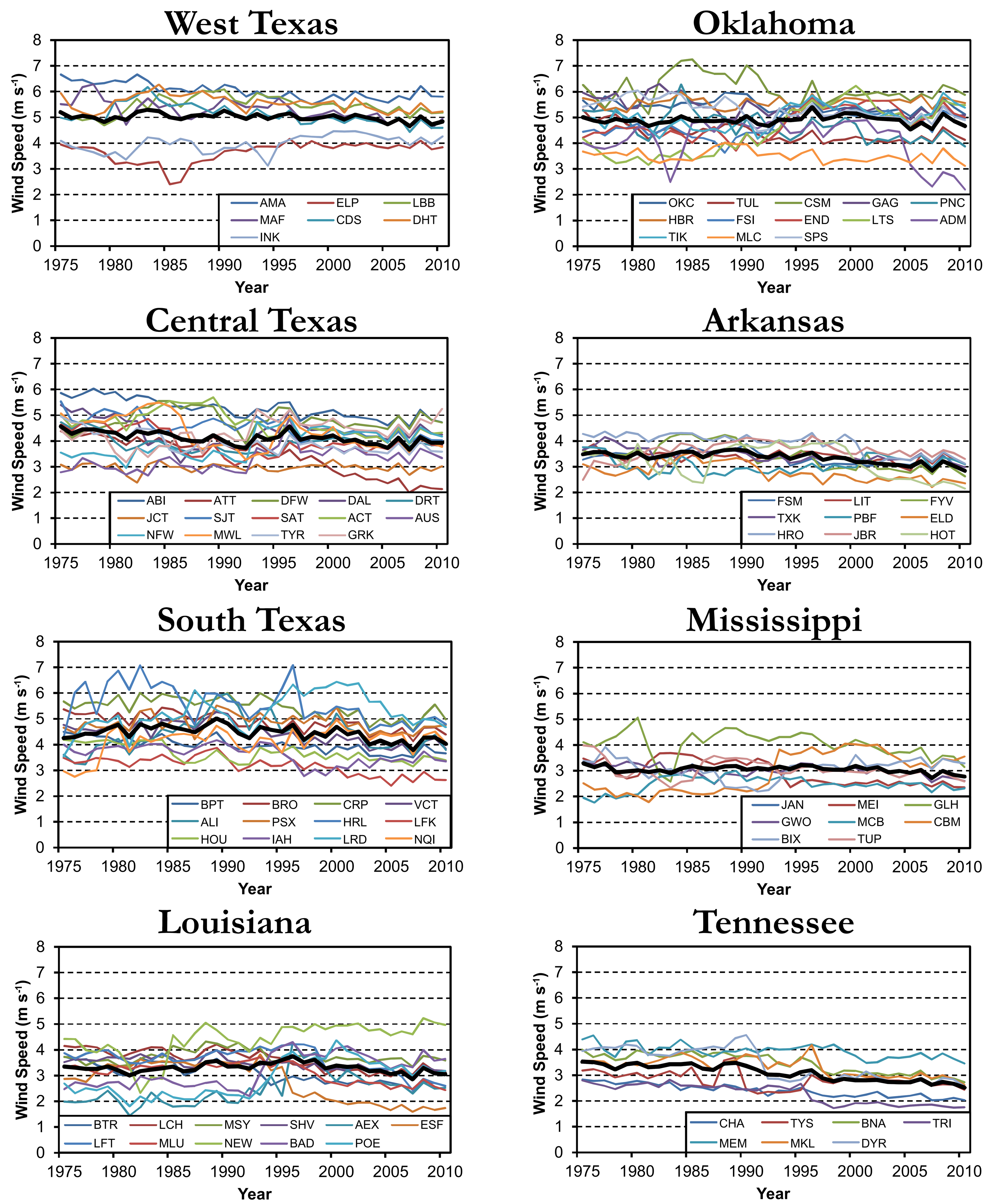

Fig. 3. Regional time series of annual average surface wind speed (m s^{-1}) for each of the stations across the study area from 1975 – 2010. The black line represents the annual wind speed average for each group.

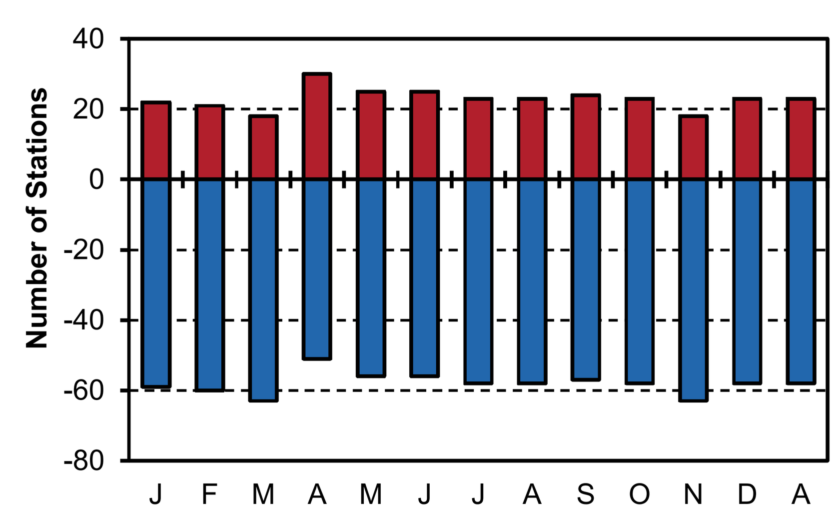

Fig. 4. The number of stations with positive (red) and negative (blue) wind trends.

Month	Average Wind Speed	Average Annual Trend
January	4.15	-0.009
February	4.35	-0.012
March	4.70	-0.017
April	4.61	-0.038
May	4.18	-0.004
June	3.86	-0.007
July	3.55	-0.009
August	3.30	-0.010
September	3.41	-0.010
October	3.64	-0.010
November	3.92	-0.016
December	4.04	-0.011

Table 1: Average monthly wind speed and linear trend (m s^{-1} a^{-1}) of the eighty-one observation stations from 1975 – 2010.

RESULTS Cont.

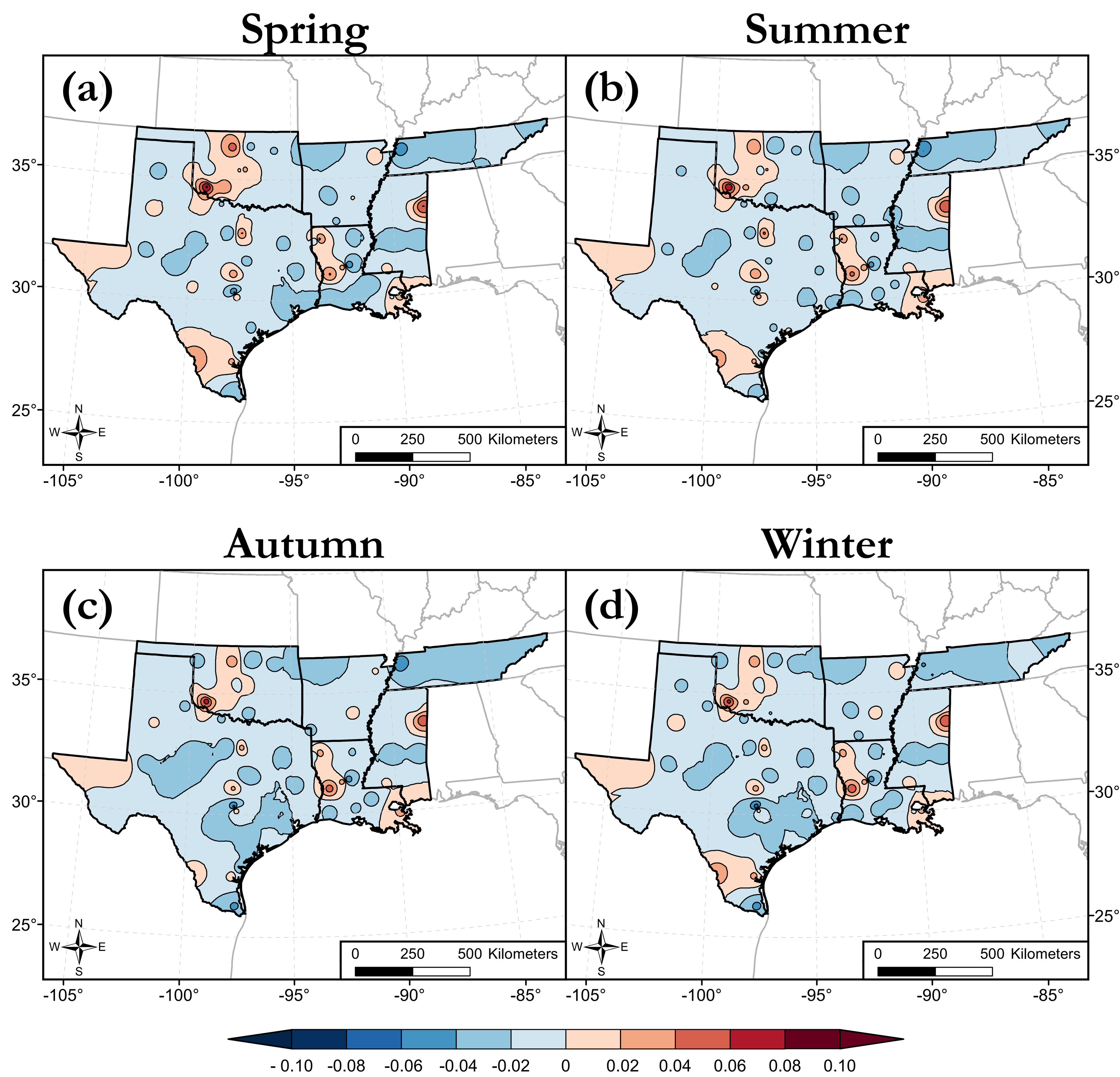

Fig. 5. The spatial distribution of annual wind speed trend magnitude (m s^{-1} a^{-1}) by season: (a) spring, (b) summer, (c) autumn, and (d) winter for the southern United States.

4. CONCLUSIONS

- A regional time series shows negative (positive) annual wind trend for 58 (23) stations during the study period.
- The study found declining wind trends for a majority of the observation sites.
- On average, wind speed magnitudes are slowing at a rate of -0.010 m s^{-1} a^{-1}.
- A seasonal trend analysis shows the spatial variation within the southern United States.

5. REFERENCES

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