



# A Climatology Study of Wildfire Activity in North America with the ERA5 Reanalysis

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## Introduction

Wildfires are large, uncontrollable fires that spread very quickly over woodland, brush, or grassland. Large-scale wildfires are becoming increasingly common and destructive in North America. This study performed a climatological analysis of wildfire activity in the North America with the wildfire indices of Burning Index (BI, ft/ft) and Spread Component (SC, ft/min). The BI index measures the wildfire intensity, and the SC index is a rating of the forward rate of spread of a head fire, in which the effects of wind, slope, and fuel are considered. Through this study the climatological distribution and temporal variation of the wildfire activity in the North America can be better captured.

## Data and Method

The BI and SC indices used in this study are from the fifth generation ECMWF atmospheric reanalysis data (ERA5). Study period covers 43 years from 1979 to 2021. Through using Linux, Python, netCDE operator tools (NCO), and NCAR command language (NCL) we acquired the ERA5 data, calculated the long-term and domain average, and visualized the climatology of wildfire activity in the United States.

## Acknowledgement

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## Climatology of Wildfire Activity in North America

Monthly climatology of the fire indices of Burning Index (BI) and Spread Component (SC) shows that these two indices are closely related. The fire activity is mainly in the southern part of North America during winter, then moves northward to Canada in Spring, though the high activity center is still in the southern part of North America. The fire activity spreads to almost entire North America including Alaska during Summer, and the high activity center moves to the western part of United States. During Fall, the fire activity retreats southward with a high center in the southwestern part of United States. The long-term mean seasonal cycle of domain averaged fire indices shows that the summer fire activity is around three (five) times of winter BI (SC). The annual variation of the fire activity is stronger in spring and fall and relatively weak in winter and summer. The long-term trend of the fire activity shows an increasing trend in all seasons with a relatively strong trend of  $\sim 0.1/\text{decade}$  in winter (BI in winter).

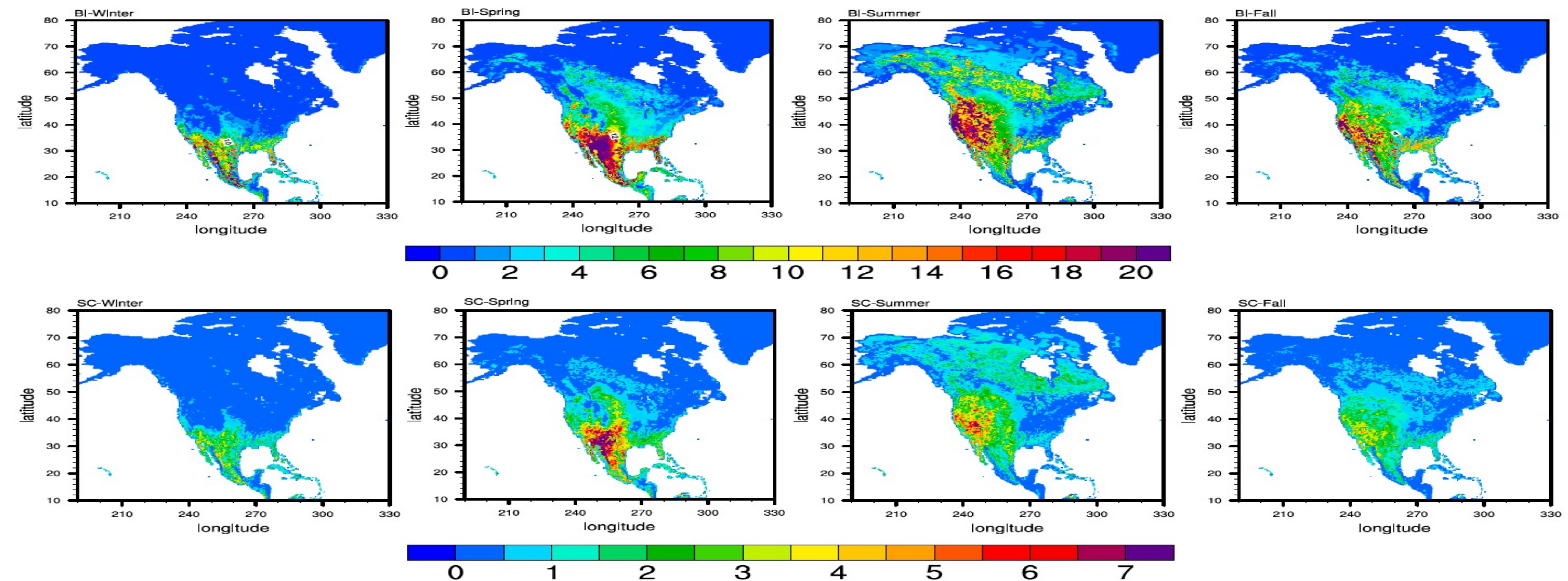


Figure 1 Climatology of the fire indices BI (ft/ft, top) and SC (ft/min bottom) in January, April, July, and October averaged over 1979-2021

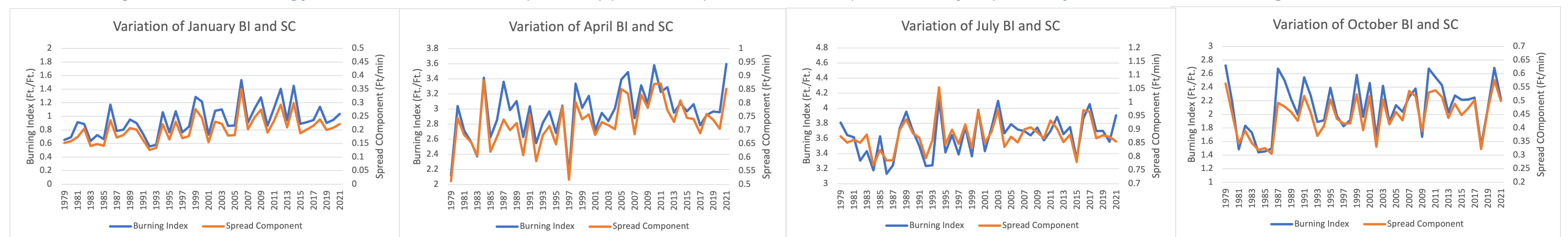


Figure 2 Annual variation of the domain averaged fire indices BI (ft/ft) and SC (ft/min) in January, April, July, and October during 1979 to 2021

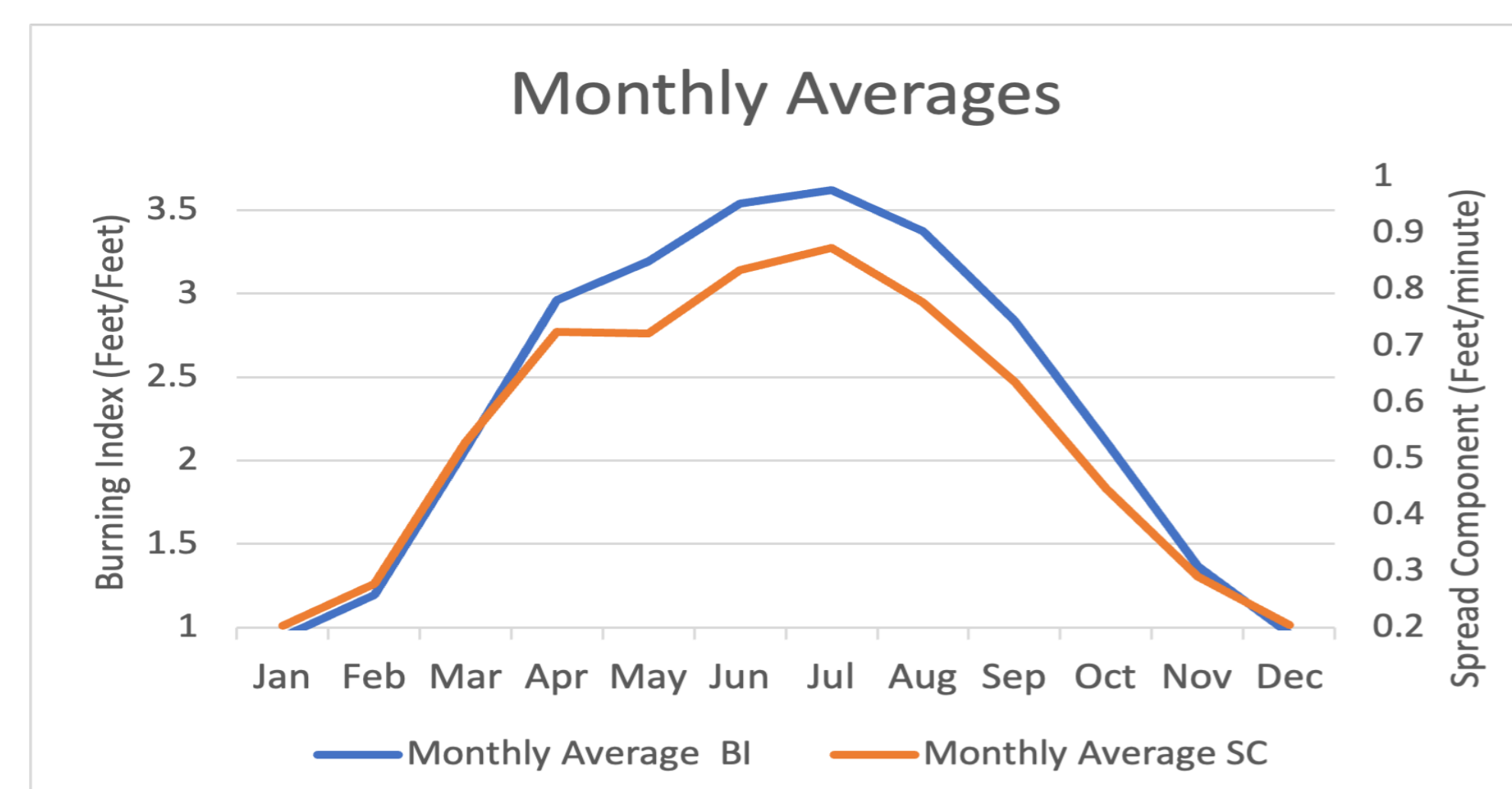


Figure 3 Long-term mean seasonal cycle of domain averaged fire indices BI (ft/ft) and SC (ft/min)

## Summary

Climatology of the wildfire activity in North America has been studied with the ERA5 fire indices of Burning Index (BI) and Spread Component (SC) for the 43-year period from 1979 to 2021. Fire indices of BI and SC are closely correlated in the spatial distribution, seasonal and annual variation. Strong seasonality exists in the coverage of fire activity as well as the location of activity center. Fire activity in North America peaks in summer with a strong activity center over western part of United States. The annual variation of the fire activity is stronger in spring and fall and a relatively strong increasing trend occurs in the winter fire activity.