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LATITUDINAL TRENDS OF SMALL-SCALE WILDFIRES IN EASTERN SIBERIA OBSERVED BY LONG-TERM SATELLITE DATA

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Motivation

Wildfires:

- Cause severe damage to forest ecosystems
- Pollute the atmosphere with combustion products
- Reduce earth's surface albedo and affect the temperature regime of soils

Under the conditions of observed climate change, an increase in the number of fires, their area and, correspondingly, the amount of emissions is expected.

The aim of this study is to analyze current trends in seasonal dynamics of wildfires in Eastern Siberia (ES) utilizing a long-term satellite observational data.

Data and Methods

Study Area

Eastern Siberia is the most fire prone region of Russia.

Over the past two decades almost all parts of Eastern Siberia experienced a rise in mean air temperature during fire season due to global warming.

Data

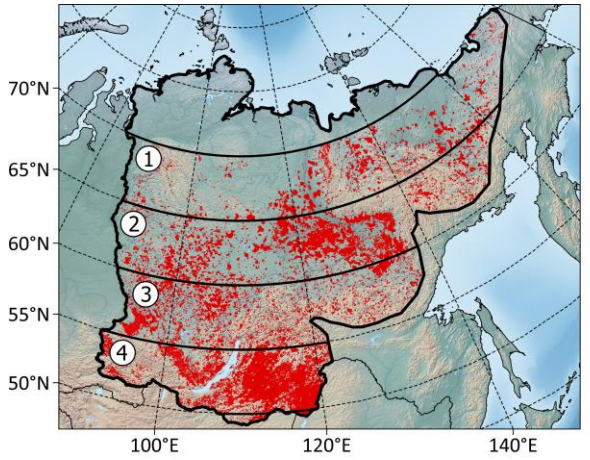
- **Burned Area** → MODIS MCD64A1C6
- **Land Cover Types** → MODIS MCD12Q1C6
- ***T* and *P*** → CRU TS 4.04

Methods

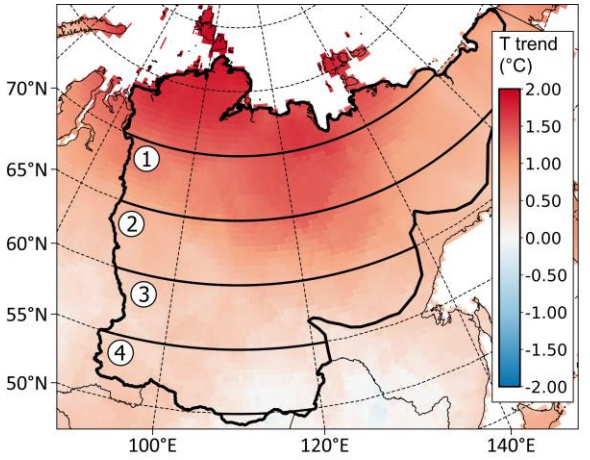
Different climatic and geographical conditions significantly affect fire regime in the region. To take these factors into account, we divided the study area into 4 latitudinal zones

Individual burned pixels of the MODIS product were grouped into clusters (fire patches) which then were attributed to an appropriate class based on their area.

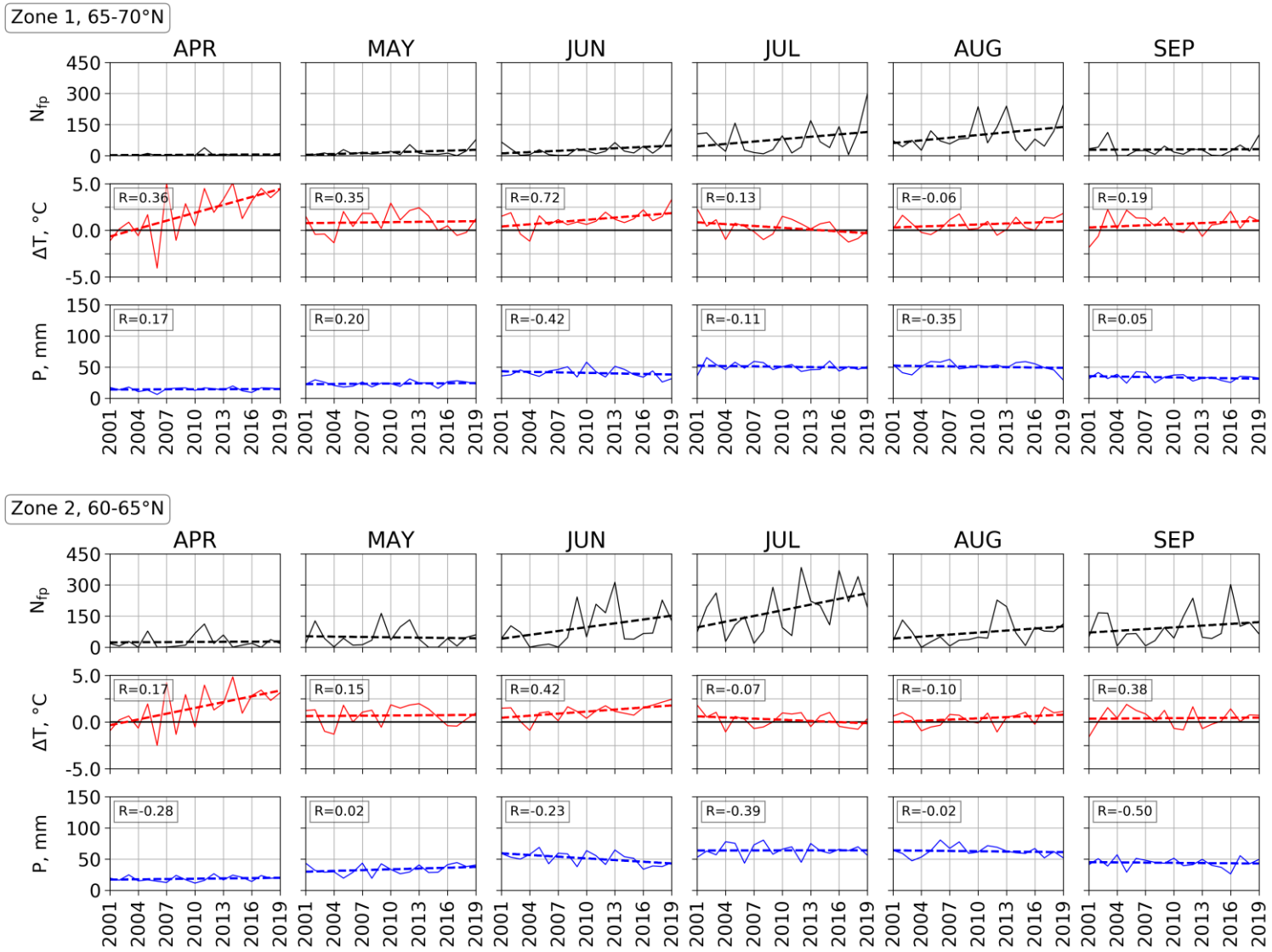
MODIS burned area (red dots)
2001-2019



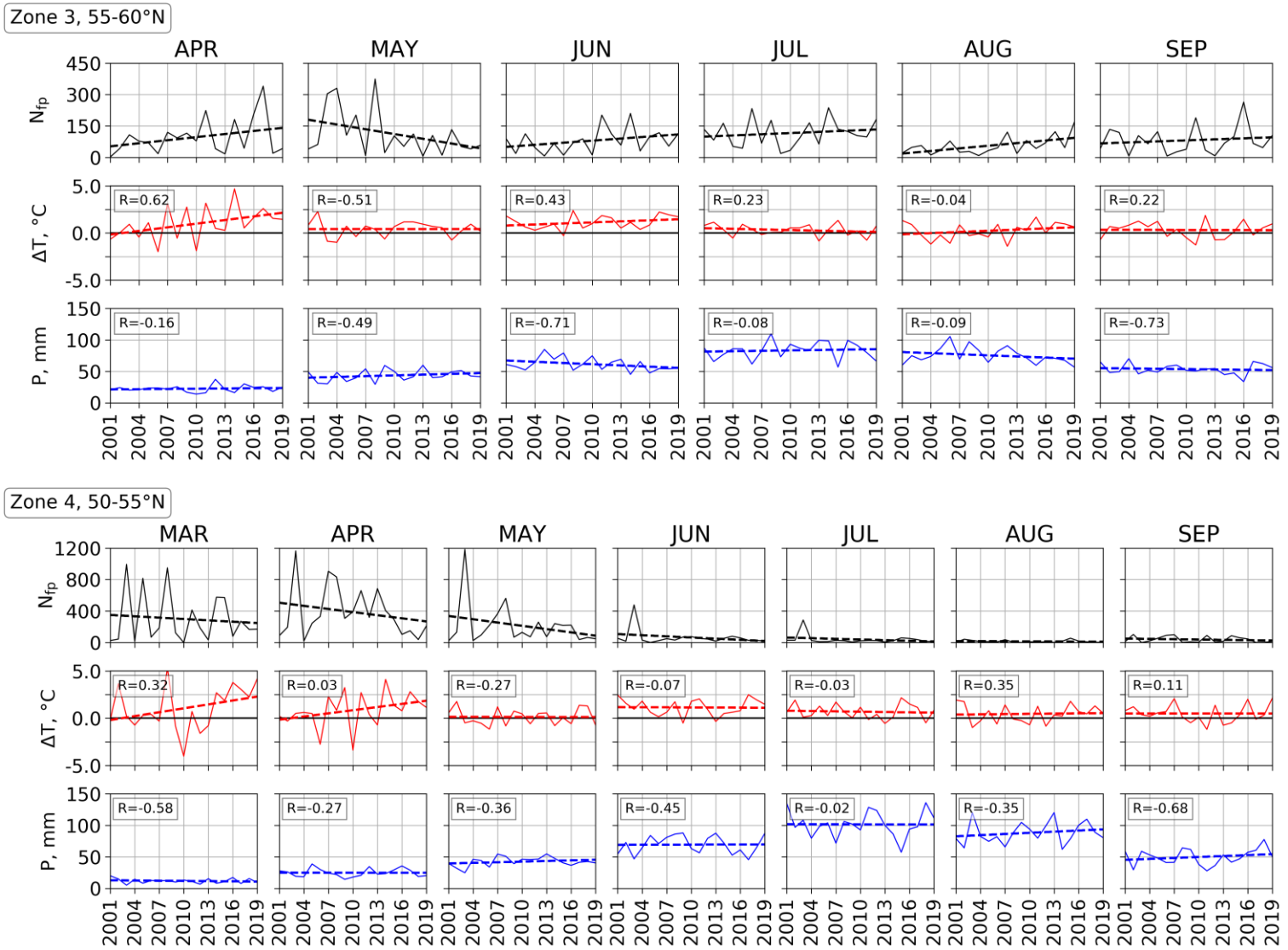
Trend of mean air temperature (Apr-Sep)
2001-2019 (CRU TS 4.04)



Results


Zone 1, 65-70°N
APR
MAY
JUN
JUL
AUG
SEP
N_{fp}
ΔT, °C
P, mm
R=0.36
R=0.35
R=0.72
R=0.13
R=-0.06
R=0.19
R=0.17
R=0.20
R=-0.42
R=-0.11
R=-0.35
R=0.05
Zone 2, 60-65°N
R=0.17
R=0.15
R=0.42
R=-0.07
R=-0.10
R=0.38
R=-0.28
R=0.02
R=-0.23
R=-0.39
R=-0.02
R=-0.50

Results


Zone 3, 55-60°N
APR
MAY
JUN
JUL
AUG
SEP
N_{fp}
ΔT, °C
P, mm
R=0.62
R=-0.51
R=0.43
R=0.23
R=-0.04
R=0.22
R=-0.16
R=-0.49
R=-0.71
R=-0.08
R=-0.09
R=-0.73
Zone 4, 50-55°N
MAR
APR
MAY
JUN
JUL
AUG
SEP
R=0.32
R=0.03
R=-0.27
R=-0.07
R=-0.03
R=0.35
R=0.11
R=-0.58
R=-0.27
R=-0.36
R=-0.45
R=-0.02
R=-0.35
R=-0.68

Summary

- An analysis of trends and correlations of the number of fire patches and temperature anomalies in the northern zone (1) showed the presence of a positive trend in N_{fp} in June, July and August. A positive trend N_{fp} in June is observed along with a positive temperature trend (R=0.72), which may indicate an earlier start of the fire season due to more favorable temperature conditions in the recent years.

- In zone 2, high positive trends in N_{fp} are observed in June and July. Positive temperature trend in June is also observed (R=0.42), which, as in the case of zone (1), can indicate an earlier start of the fire season.

- In zone 3, a positive trend in N_{fp} in April, June and August was detected, and a negative trend in May. A positive trend in N_{fp} in April is observed along with an increase in temperature (R=0.62), which may also indicate the formation of more favorable conditions for the early start of the fire season.

- In zone 4, a negative trend in N_{fp} in March, April and May was detected. A negative trend in March and April is observed despite a positive temperature trend. The correlation between N_{fp} and temperature in March, April and May shows a weak connection (R=0.32, R=0.03 and R=-0.27, respectively). It should be noted that zone 4 has better developed infrastructure and better coverage by air patrols of regional aerial forest protection services. Those factors could possibly contribute to observed reduced number of fire patches in the zone in recent years despite high positive anomalies in air temperature.

- Analysis of precipitation data showed absence of high trends in all considered zones over a last two decades. Correlation between monthly amount of precipitation and N_{fp} was higher in southern zones (3-4), where total amount of precipitation is higher.

- In general, it can be noted that in the northern part of the boreal zone of Eastern Siberia (zones 1, 2) over the past two decades experienced a noticeable increase in wildfire activity in the first half of summer, possibly related to the effects of climate warming. The dynamics of the trends of small-scale fires in the southern part (zones 3, 4) is ambiguous, requiring further research.