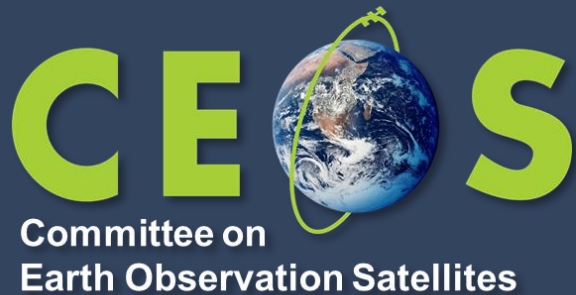


Working Group on Disasters 26 (WGD-26)

Spatio-Temporal and Seasonal Characterization of Global Fire Regimes



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Why characterize global fire regimes?

Fire shapes ecosystems.

It drives vegetation, biodiversity and the carbon cycle. Yet many assessments still describe fire through single characteristics or annual totals, which hides how fire behaves across seasons and regions.

OUR RESPONSE

A global assessment of fire regimes from 2001 to 2024, built from three complementary characteristics:

- **Frequency** number of fire detections per grid cell per month
- **Intensity** fire radiative power (FRP)
- **Extent** burned area of each grid cell

resolved by season.

What defines a fire regime?

Frequency, intensity, extent and seasonality together.

Who drives the change?

Climate, vegetation and human land use.

What is happening now?

Less area burns, but fires run hotter and longer.

Why does it matter?

Burned area alone cannot explain shifting fire behaviour.



SATELLITE INPUTS

Fire frequency

MODIS Active Fire (MCD14ML)

1 km, daily | 2001–2024

Fire intensity (FRP)

MODIS Fire Radiative Power

1 km, daily | 2001–2024

Burned area extent

MODIS Burned Area (MCD64A1)

500 m, monthly | 2001–2024

Vegetation mask

ESA CCI Land Cover

300 m | tree, shrub, grass

PROCESSING WORKFLOW

1 Pre-processing & spatial aggregation

Quality filtering and masking, then aggregation to a 0.25° global grid



2 Seasonal & period compositing

By season (DJF, MAM, JJA, SON) and four six-year periods (2001–06 to 2019–24)



3 Derived fire characteristics

Frequency

fire detections

Intensity

mean FRP

Extent

% area burned



4 Trend analysis

Mann–Kendall test on frequency, FRP and burned area over 2001–2024

5 Regime classification

High / low split on each characteristic at the global median

2×2×2 → 8 fire regimes

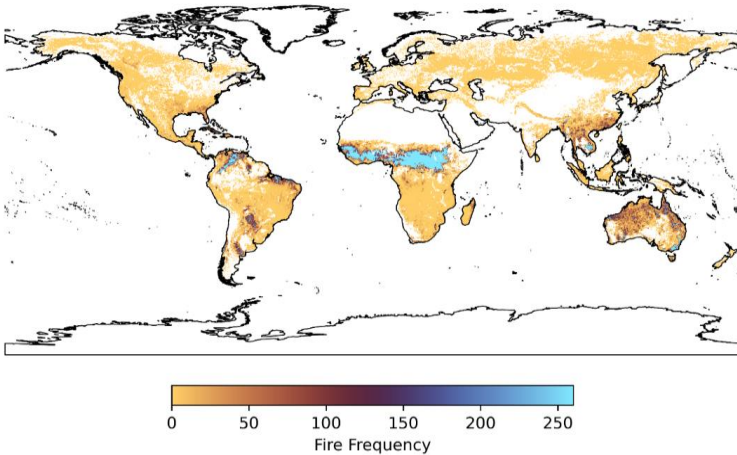
Seasonal fire characteristics - DJF



December-February | 2001-2024 climatology

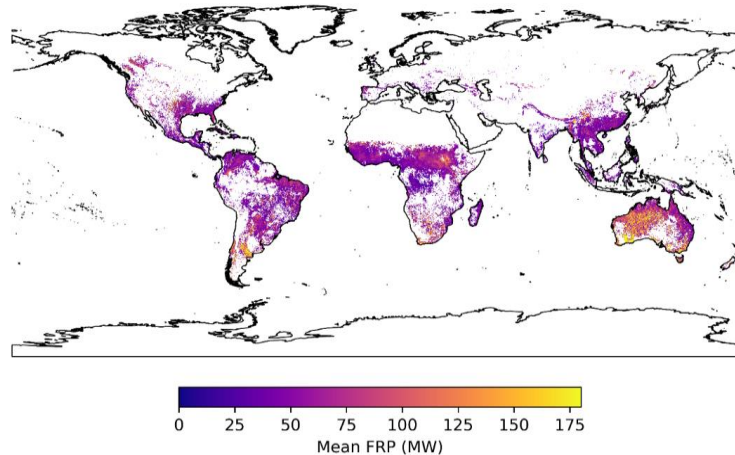
Frequency

Fire Frequency — DJF (2001-2024)



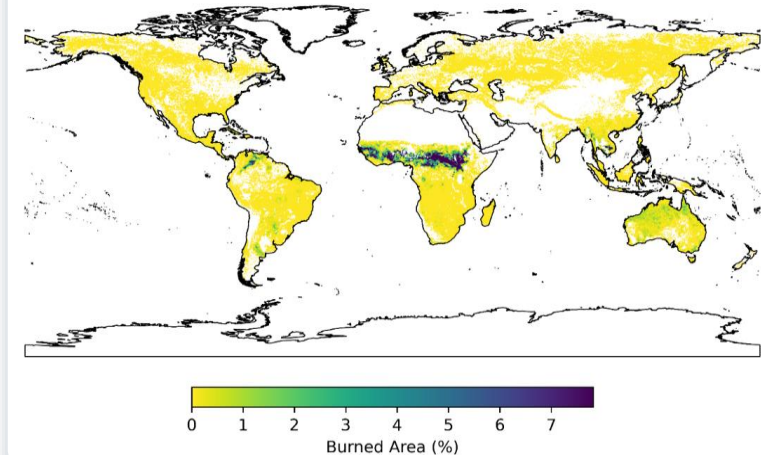
Intensity (FRP)

Fire Intensity (FRP) — DJF (2001-2024)



Extent (burned area)

Fire Extent (Burned Area %) — DJF (2001-2024)



Activity concentrates in the northern-hemisphere dry belt and the Sahel; central Africa shows the most extensive burning.

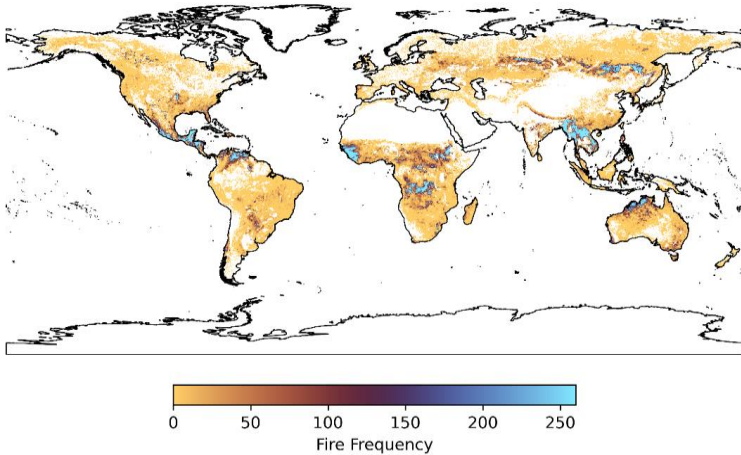
Seasonal fire characteristics - MAM



March-May | 2001-2024 climatology

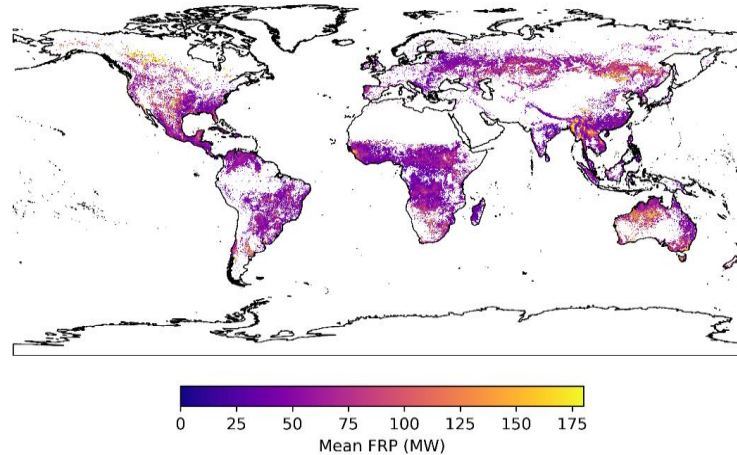
Frequency

Fire Frequency — MAM (2001-2024)



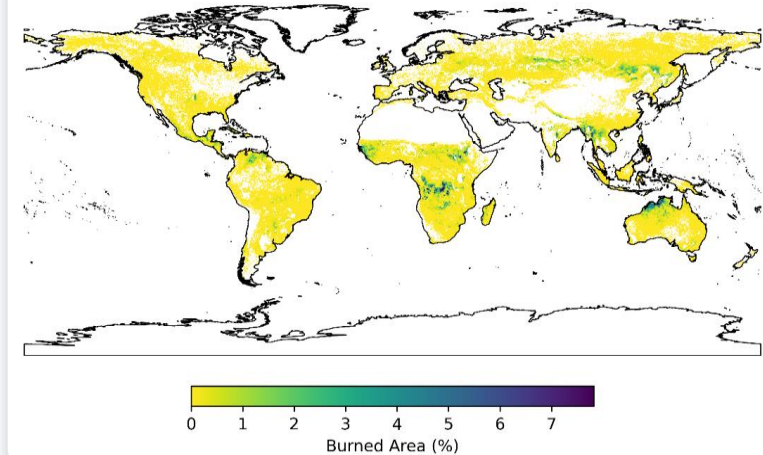
Intensity (FRP)

Fire Intensity (FRP) — MAM (2001-2024)



Extent (burned area)

Fire Extent (Burned Area %) — MAM (2001-2024)



Fire shifts into Southeast Asia, Central America and the northern savannas as their dry season peaks.

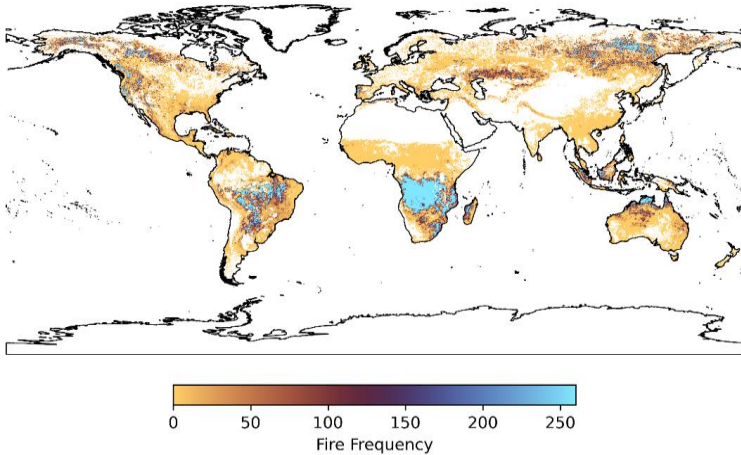
Seasonal fire characteristics - JJA



June-August | 2001-2024 climatology

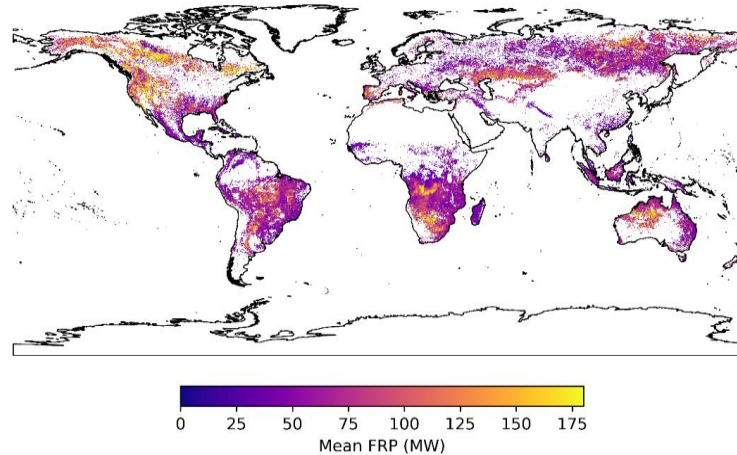
Frequency

Fire Frequency — JJA (2001-2024)



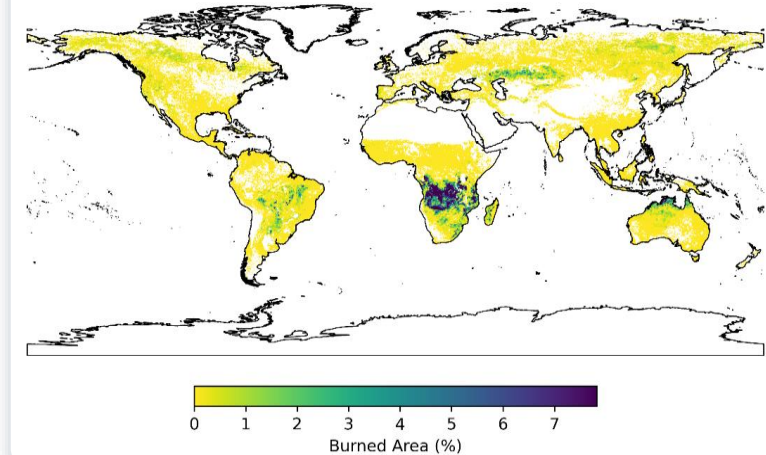
Intensity (FRP)

Fire Intensity (FRP) — JJA (2001-2024)



Extent (burned area)

Fire Extent (Burned Area %) — JJA (2001-2024)



Southern Africa dominates, with intense, extensive burning across the southern savanna belt.

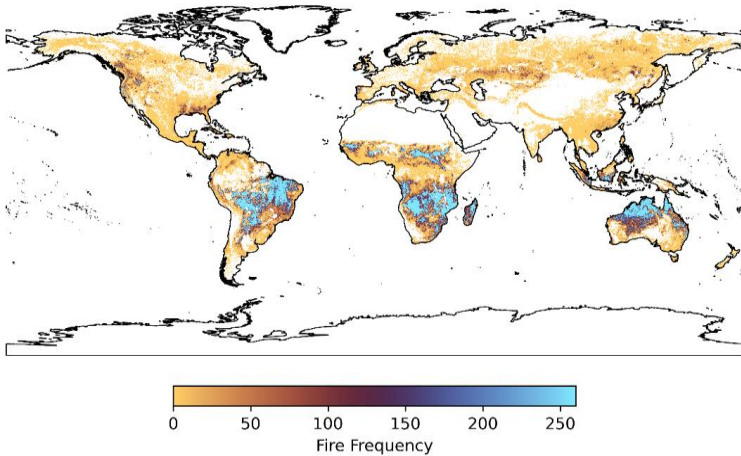
Seasonal fire characteristics - SON



September-November | 2001-2024 climatology

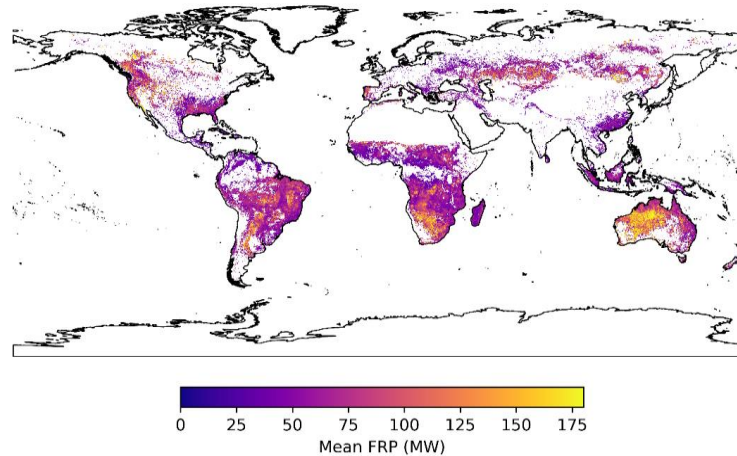
Frequency

Fire Frequency — SON (2001-2024)



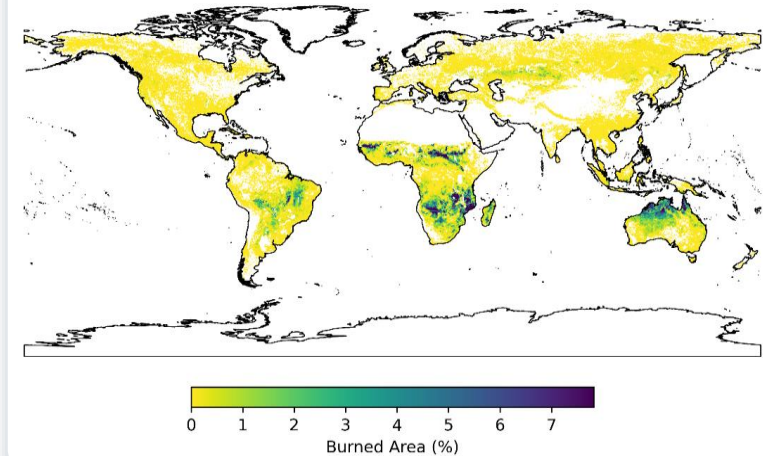
Intensity (FRP)

Fire Intensity (FRP) — SON (2001-2024)



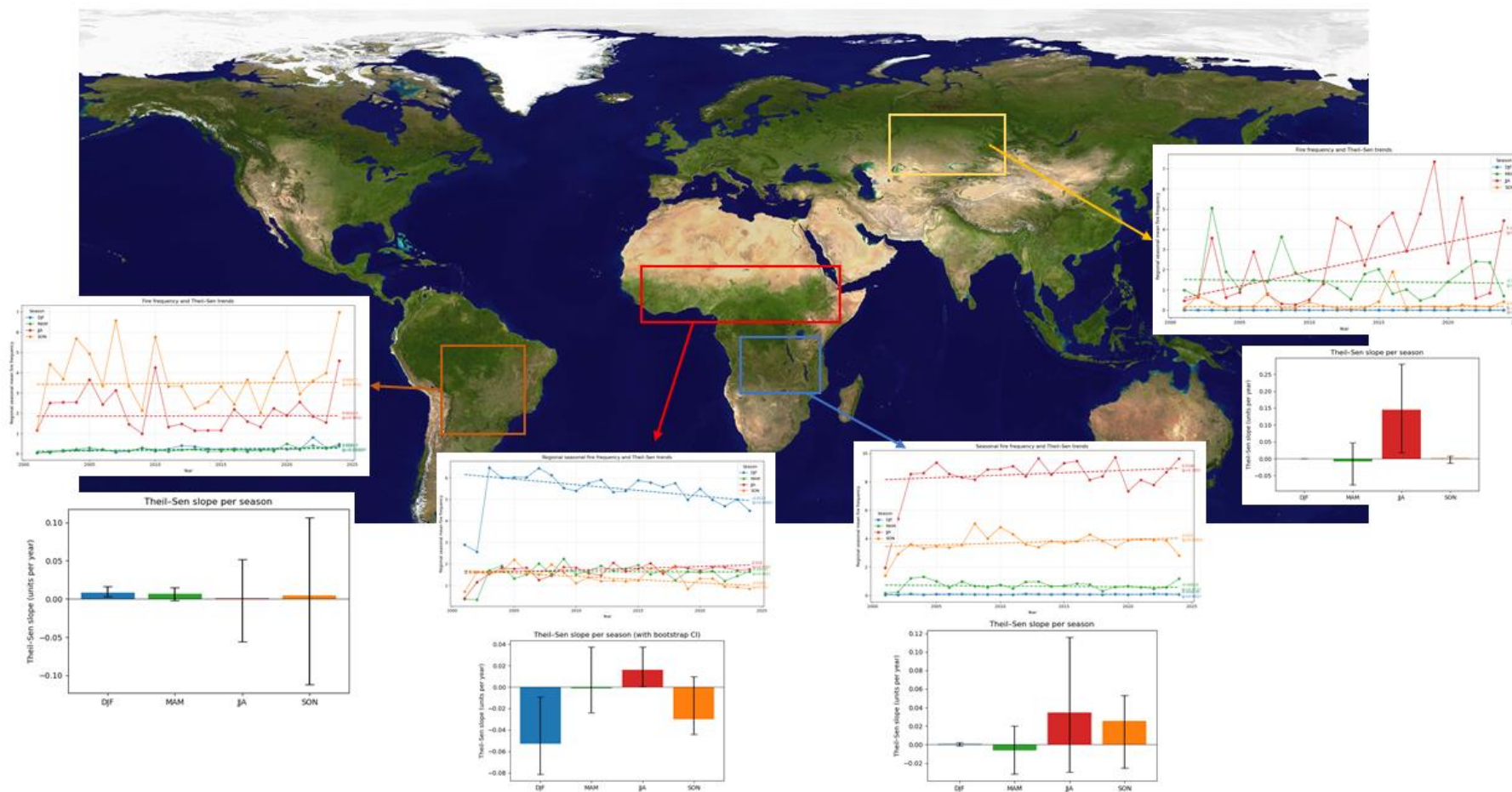
Extent (burned area)

Fire Extent (Burned Area %) — SON (2001-2024)



Southern Africa and northern Australia carry the highest frequency, intensity and extent.

Fire-frequency trends - regional examples



WHAT THE TRENDS SHOW

■ Frequency is rising

Fire frequency increased in several fire-prone regions, notably Africa and Australia.

■ Burned area is falling

Burned extent generally declined after 2007–2012, even where fires persisted.

■ Frequency and area decouple

More fires no longer means more burned land.

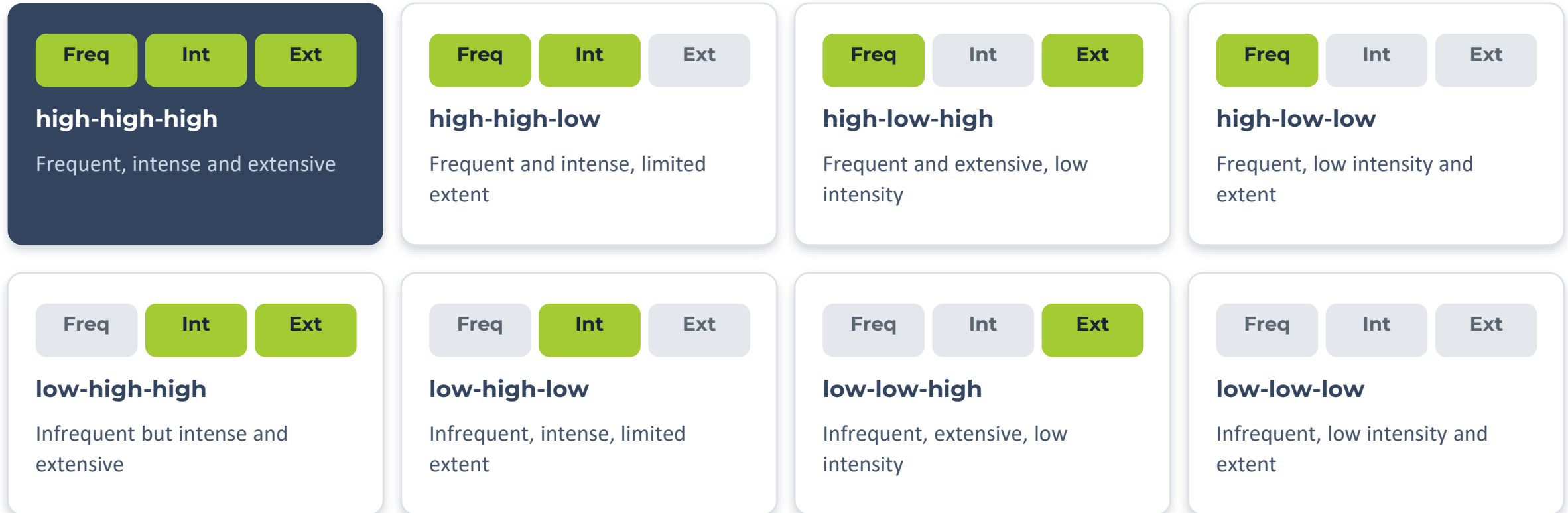
READING THE FIGURE

Panels show fire-frequency time series and Theil-Sen trends for selected regions, not a single global series.

An eight-class fire regime framework



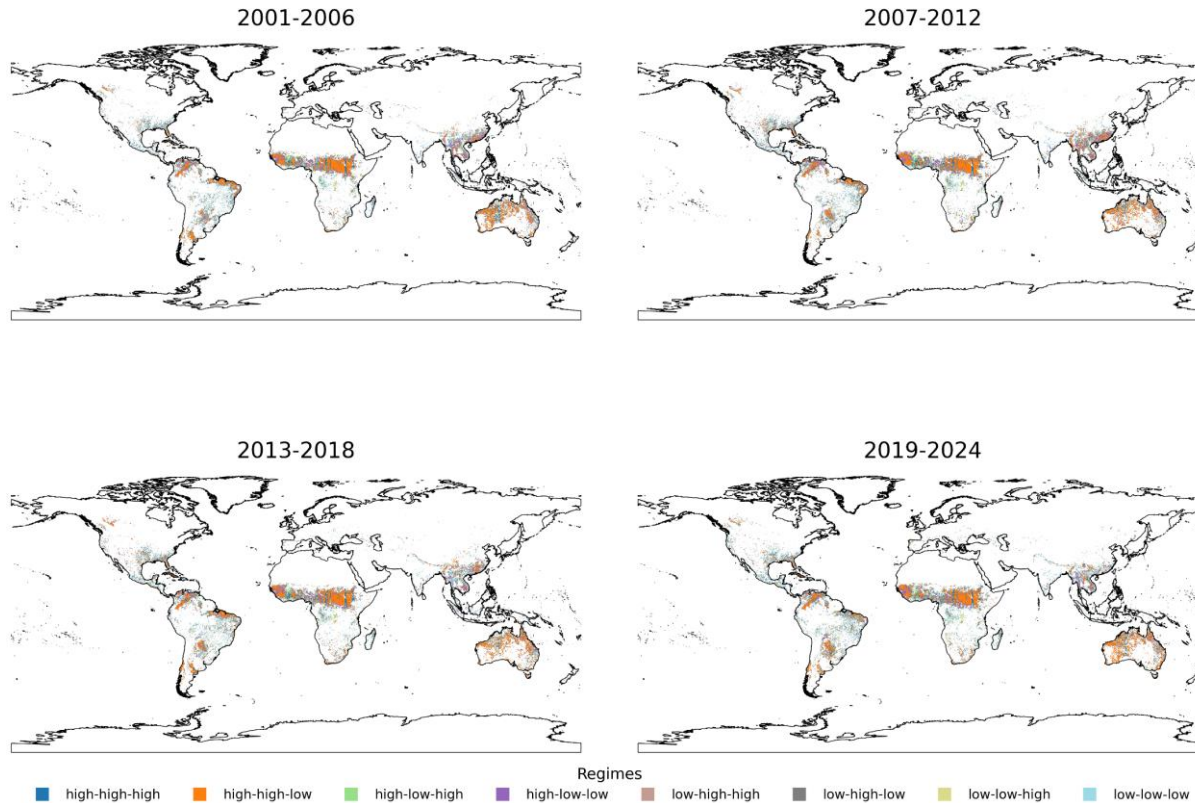
Each grid cell is labelled high or low on frequency, intensity and extent. The three binary axes combine into eight regime classes that describe the full range of fire behaviour.



Fire regime maps - DJF



Fire Regime Maps (DJF)



DJF SEASON

During DJF the most frequent, intense and extensive fire sits in tropical Africa and northern Australia; other classes spread across South America and Southeast Asia.

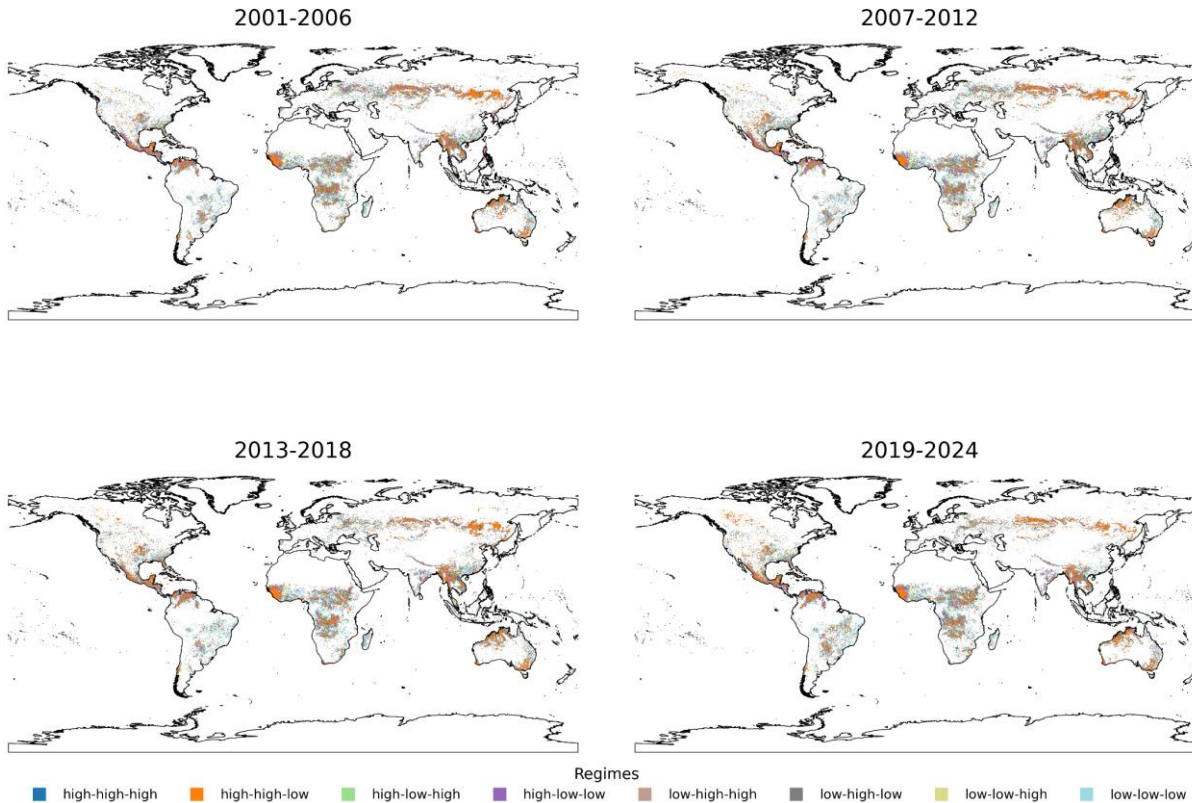
READING THE PANELS

Four maps, one per six-year period (2001–06 to 2019–24). Colour shows the regime class.

Fire regime maps - MAM



Fire Regime Maps (MAM)



MAM SEASON

During MAM high-frequency regimes concentrate in Central America, the boreal belt and parts of Southeast Asia, with mixed classes across the tropics.

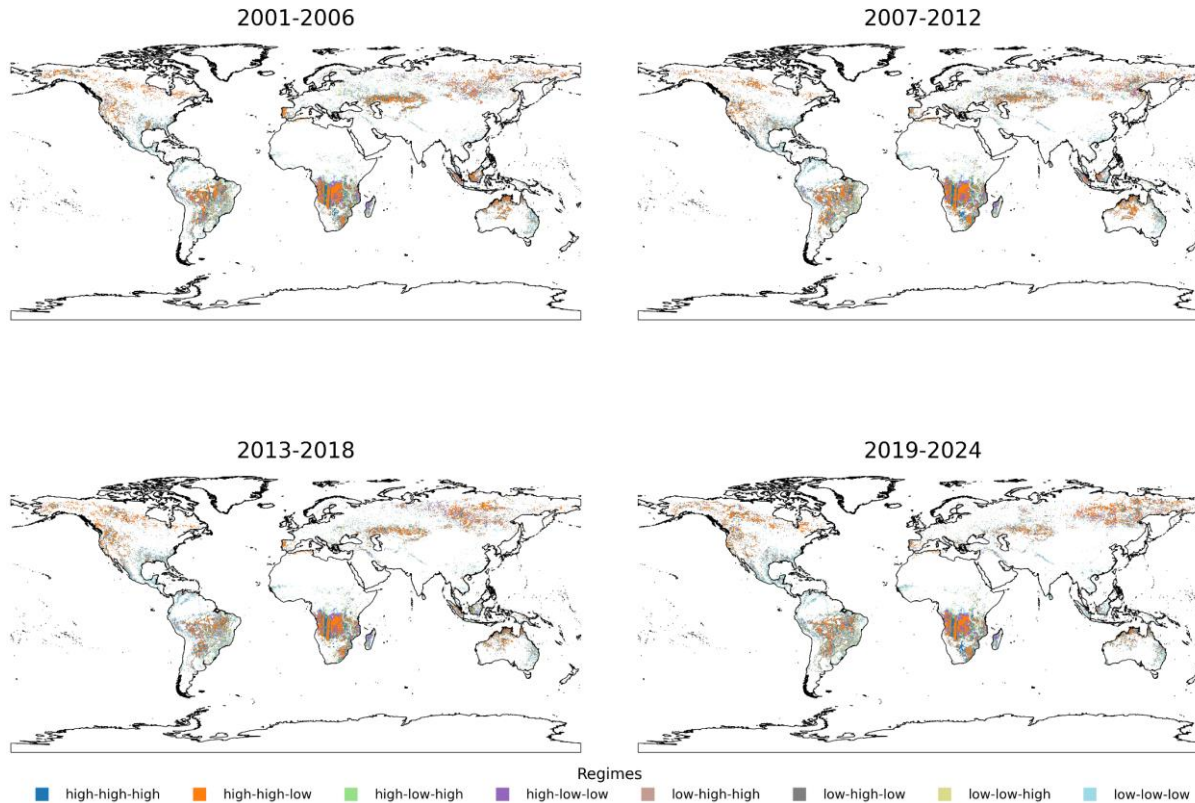
READING THE PANELS

Four maps, one per six-year period (2001–06 to 2019–24). Colour shows the regime class.

Fire regime maps - JJA



Fire Regime Maps (JJA)



JJA SEASON

During JJA frequent, intense fire concentrates in the boreal belt and southern Africa; other classes scatter across the northern hemisphere and South America.

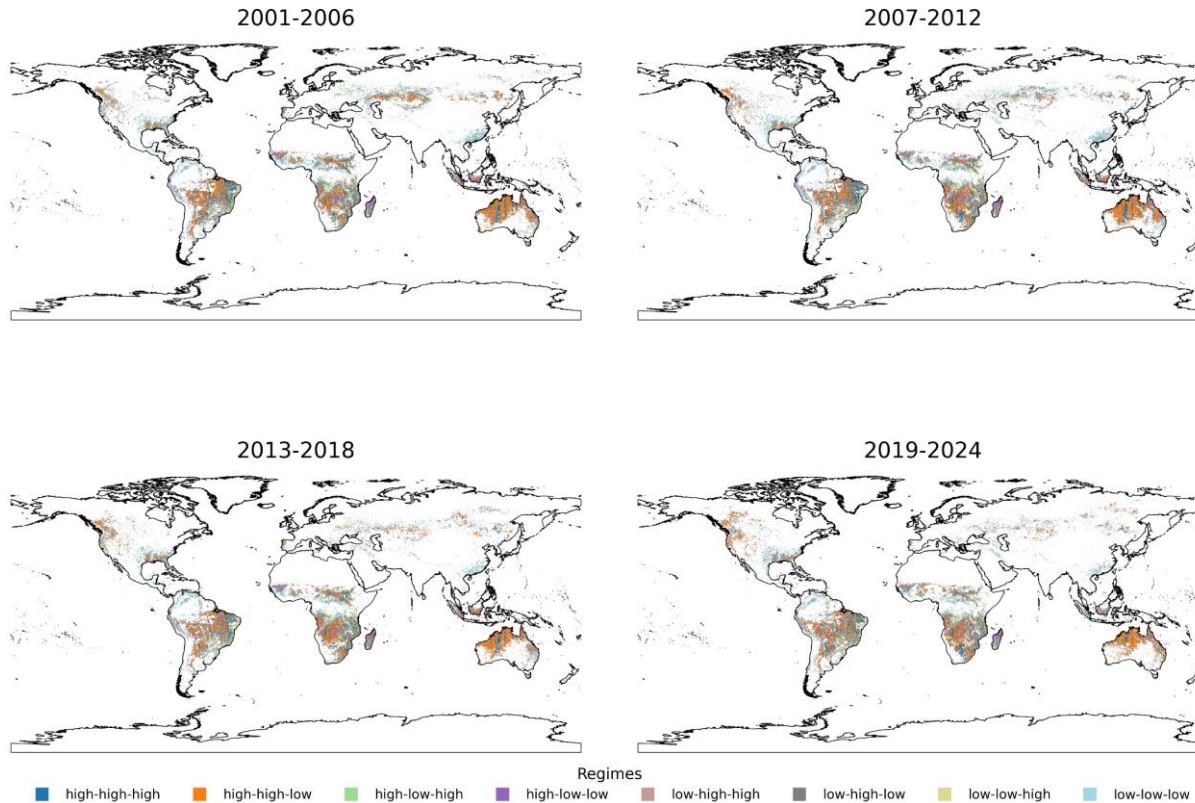
READING THE PANELS

Four maps, one per six-year period (2001–06 to 2019–24). Colour shows the regime class.

Fire regime maps - SON



Fire Regime Maps (SON)



SON SEASON

During SON southern Africa, South America and northern Australia show the most frequent, intense and extensive fire, the seasonal peak of the regimes.

READING THE PANELS

Four maps, one per six-year period (2001–06 to 2019–24). Colour shows the regime class.

A seasonally explicit picture of two decades of global fire



Key finding

Fire follows a strong frequency–intensity–extent structure in dry-season savannas, but frequency and burned area are decoupling: extent falls after 2007 even where fires persist.

Contribution

The eight-regime framework gives a consistent way to characterize global fire behaviour and track how regimes shift across seasons and periods.

Why it matters

Rising fire activity does not mean rising burned area, so risk and emissions cannot be read from fire occurrence alone.

What next

Attribute these shifts to climatic versus human drivers, and extend the framework toward predictive, regime-specific fire management.