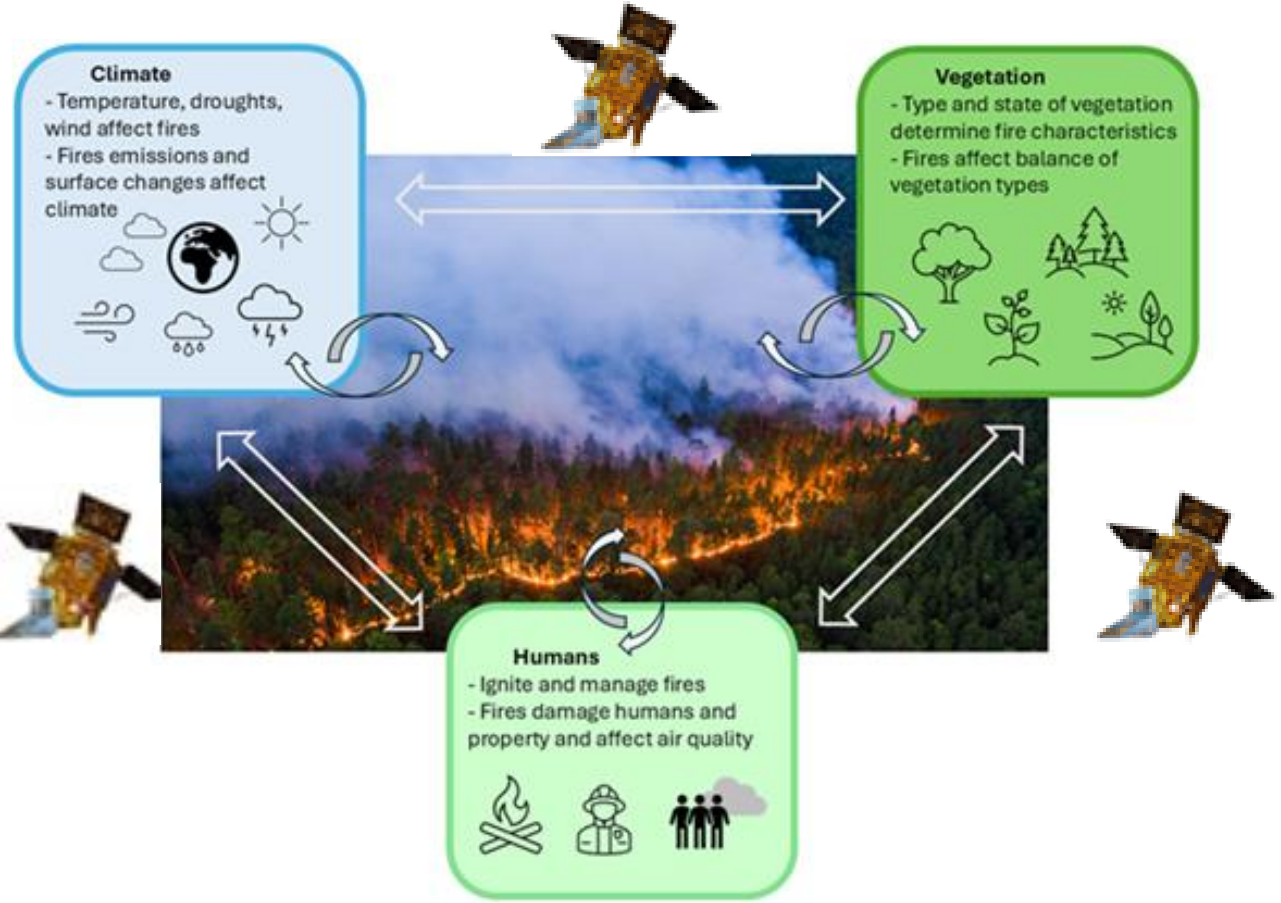
WAGENINGEN UNIVERSITY & RESEARCH
VU
UNIVERSITY OF TWENTE. | ITC
Universiteit Leiden
Institute of Environmental Sciences
Universiteit Utrecht
Copernicus Institute of Sustainable Development
Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment
SRON
Netherlands Institute for Space Research

Gerbrand Koren, *Folkert Boersma, Peter van Bodegom, Martin de Graaf, Otto Hasekamp, Marloes Penning de Vries, Nick Schutgens, Anton Vrieling*

*Announcing **INFLAMES**: the Interdisciplinary Network for Fire research from Low Earth Orbit Atmospheric Measurements*

4TH INTERNATIONAL SMOKE SYMPOSIUM
Tallahassee, Florida - March 23 - 27, 2026
ISS4

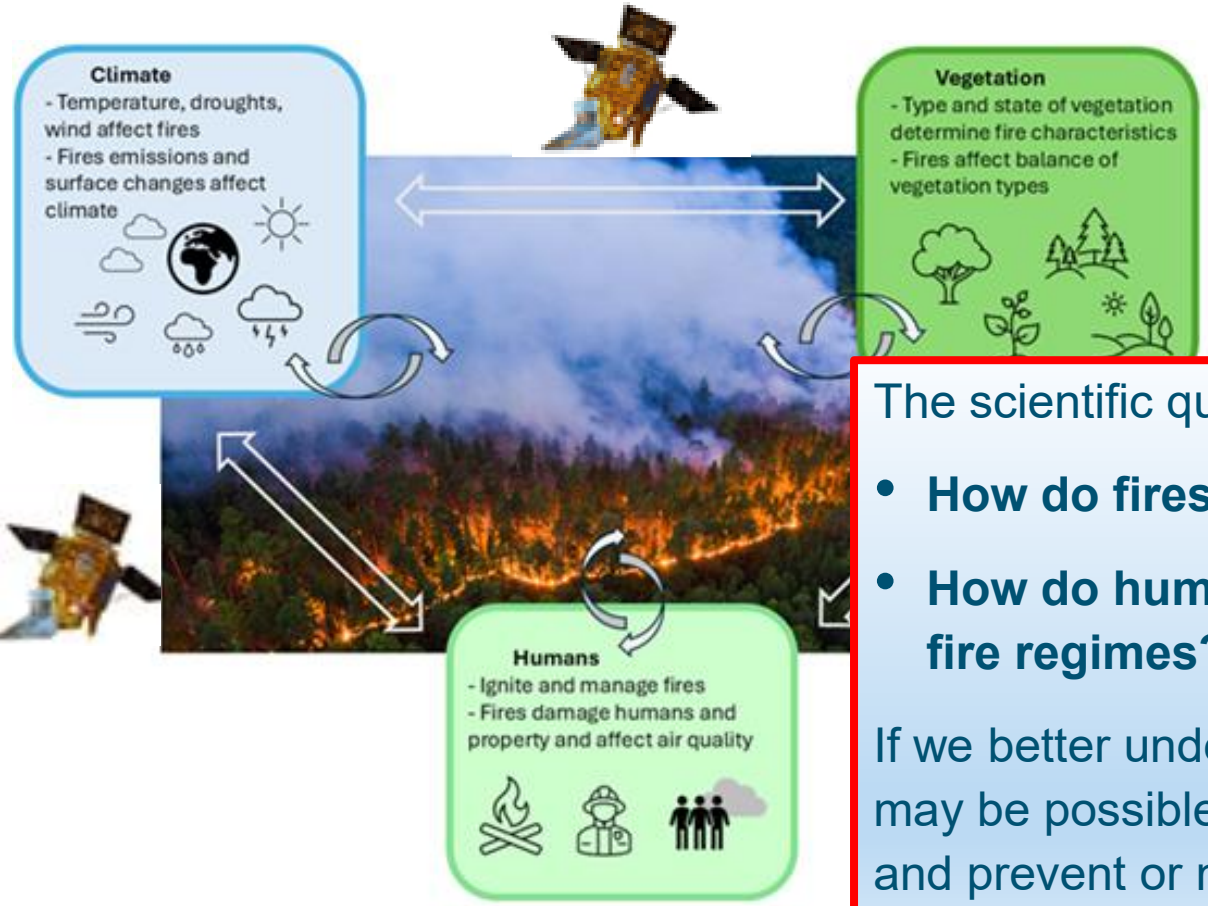
Fires are difficult to predict



The interactions between climate-vegetation and humans determine fire occurrences and impacts.

New (Dutch) satellite measurements allow the synergistic study of these interactions and allow making predictions

Fires are difficult to predict



The interactions between climate-vegetation and humans determine fire occurrences and impacts.

The scientific questions are:

- **How do fires alter air quality and climate?**
- **How do humans and vegetation influence fire regimes?**

If we better understand these interactions, it may be possible in the future to better predict and prevent or mitigate fires and their impacts.

New opportunities from Dutch satellite instruments

TROPOMI

- CO, NO2, HCHO, HONO
- Aerosol:AOD, AAI, ALH
- Surface albedo, SIF

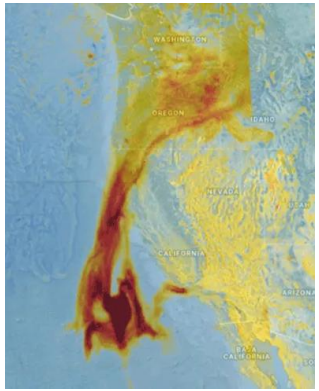
SPEXone

- Optical properties (AOD, SSA, AE)
- Composition (BrC, BC, Sulfate)
- Cloud Condensation Nuclei (CCN)
- ALH

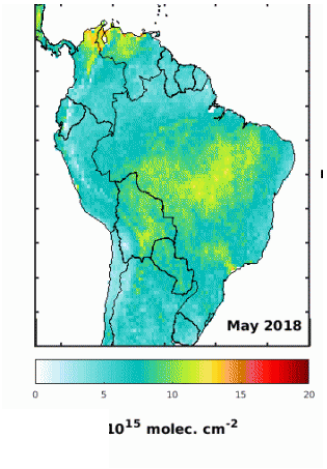
Earthcare

- Vertical exctinction
- Heating rates
- vertical velocity, cloud profile

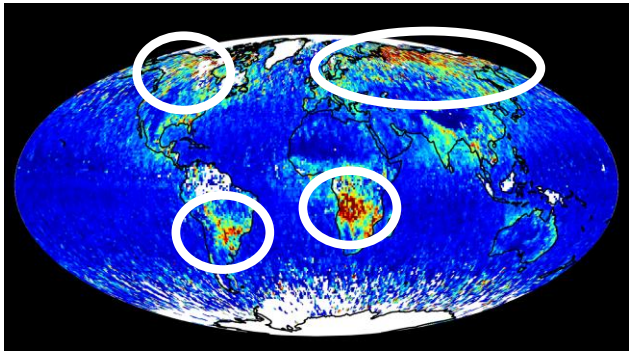
TROPOMI CO



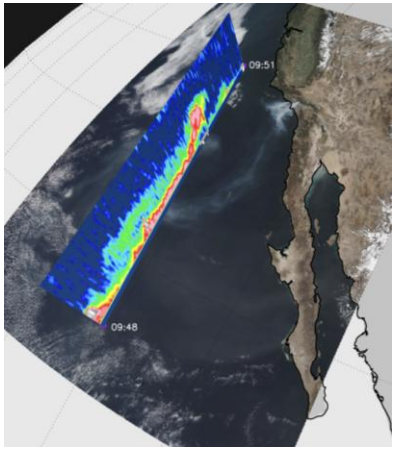
TROPOMI HCHO



SPEXone Black&Brown Carbon



ATLID attn. backscatter



INFLAMES objectives and approach

O1 Quantify and assess how (changing) fires impact air quality
O2 Understand how humans influence fire dynamics
O3 Reveal how climate change drives fire dynamics
O4 Quantify and project fire impacts on climate

Satellite observations

- Emissions and concentrations (AQ)
- Smoke and clouds (climate)
- Surface albedo, SIF (vegetation)

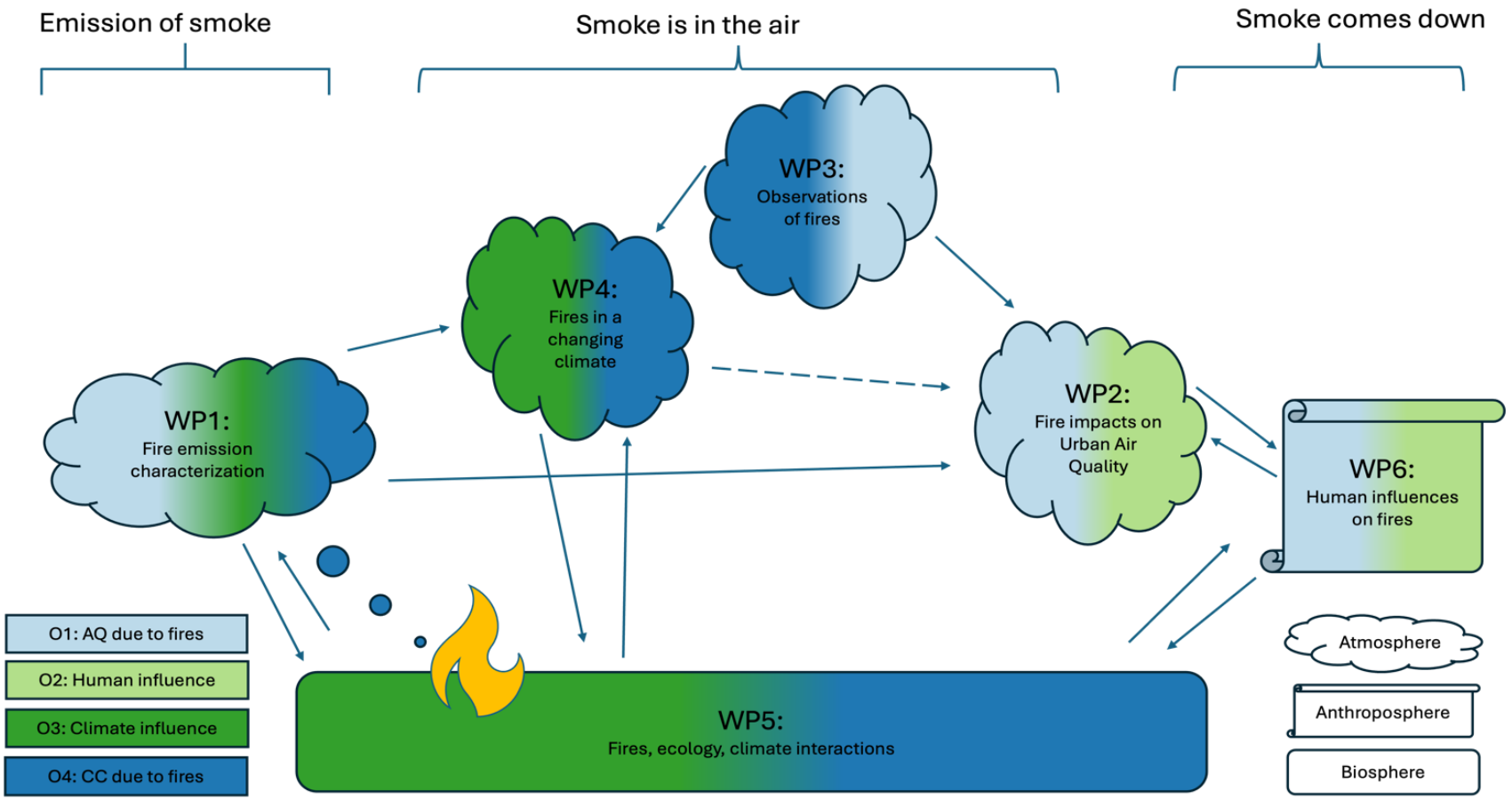
Models

- microHH (local air pollution)
- LOTOS-Euros (regional)
- JSBACH (dynamic vegetation)
- ECHAM-HAM (climate model)

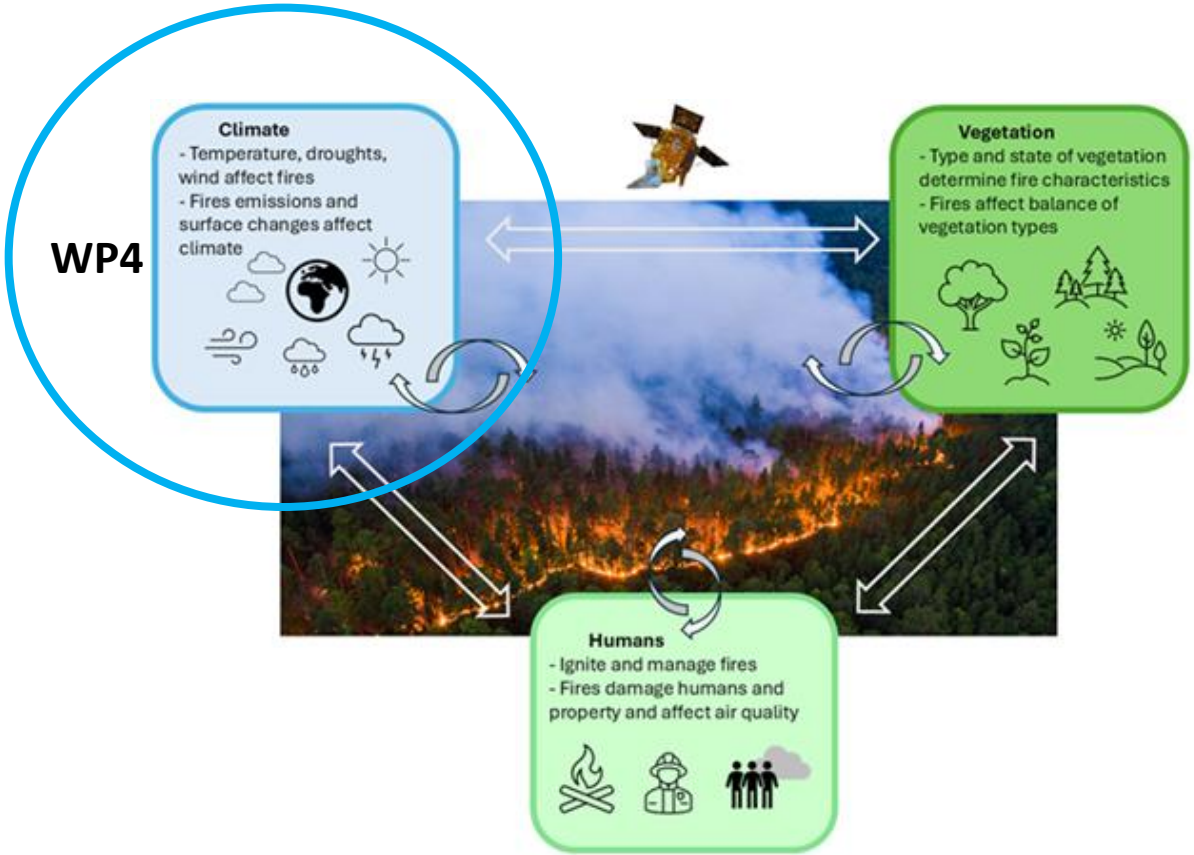
Socio-ecological input

- Land-use change
- Population - ignition
- Landscape fragmentation
- Interviews on the ground

Coherence of the project



WP4 – Fire-climate interaction

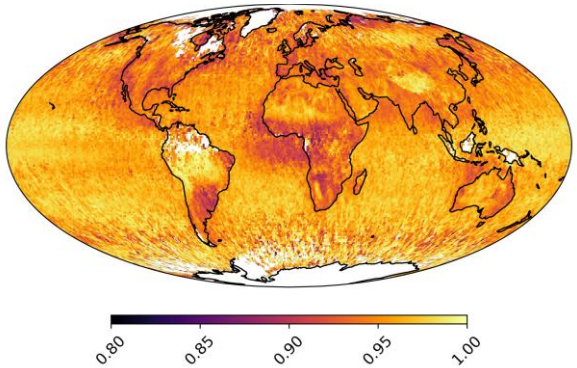


SPEXone instrument on PACE

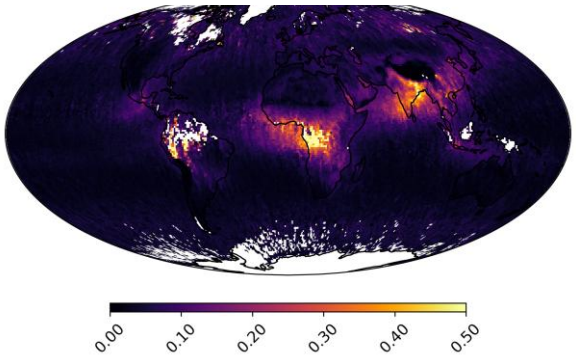
- NASA PACE satellite launched February 2024 with planned mission duration 3-10 years
- SRON instrument SPEXone measures polarization of reflected light (385-770 nm) for detecting aerosol

Smoke Relevant Observations from SPEXone/PACE (2 years)

Single Scattering Albedo

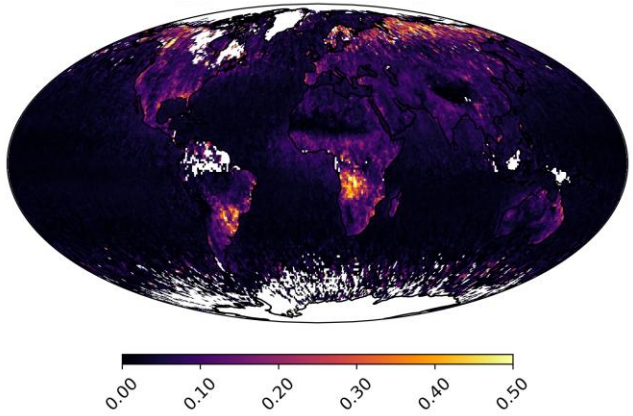


Fine Mode AOD

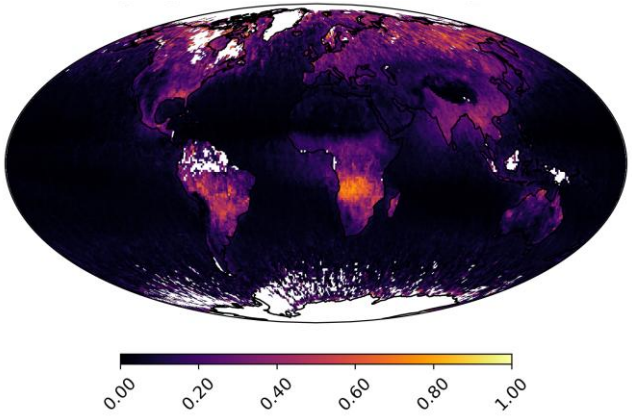


Volume Fractions

Black+ Brown Carbon



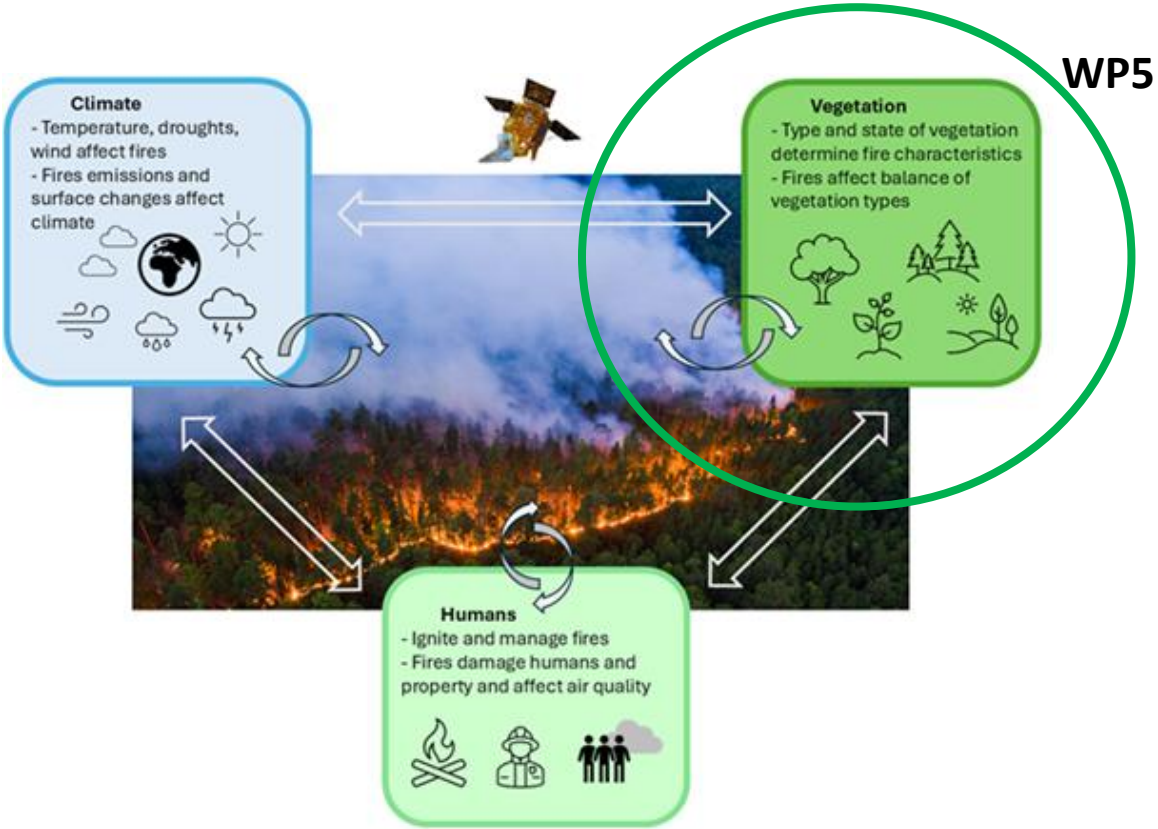
fine secondary aerosol



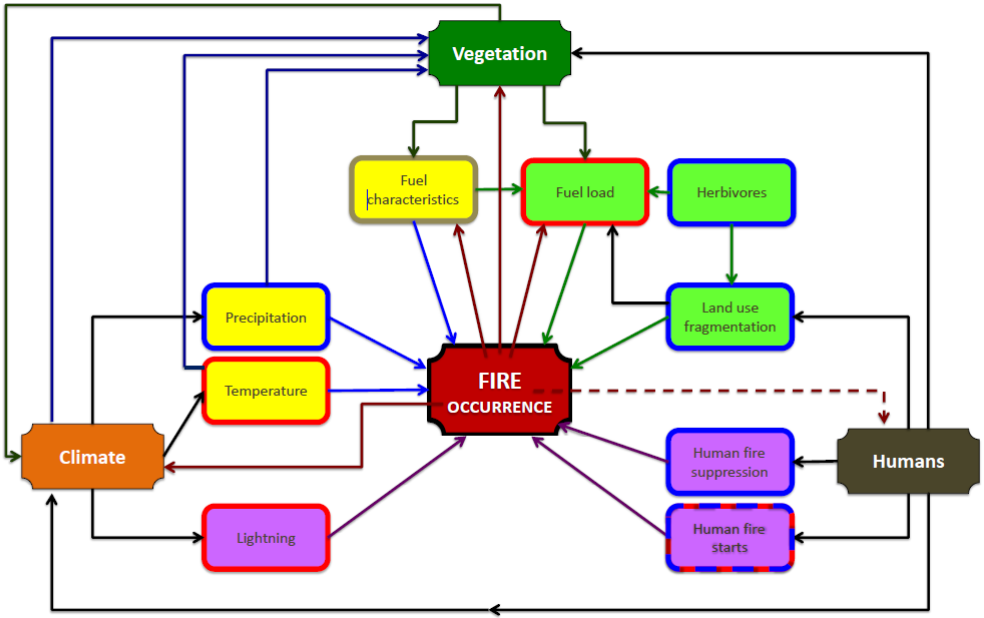
- Strongest absorption for African smoke. Amazon smoke less absorbing
- Relatively more secondary aerosol over Amazon
- Outflow affects absorption over ocean globally

Credits: Dr Otto Hasekamp (SRON)

WP5 – Fire-ecology interaction



Introduction on fire-vegetation modelling



Vegetation is strongly affected by fire, affects fire occurrences and severity as well as the climate.

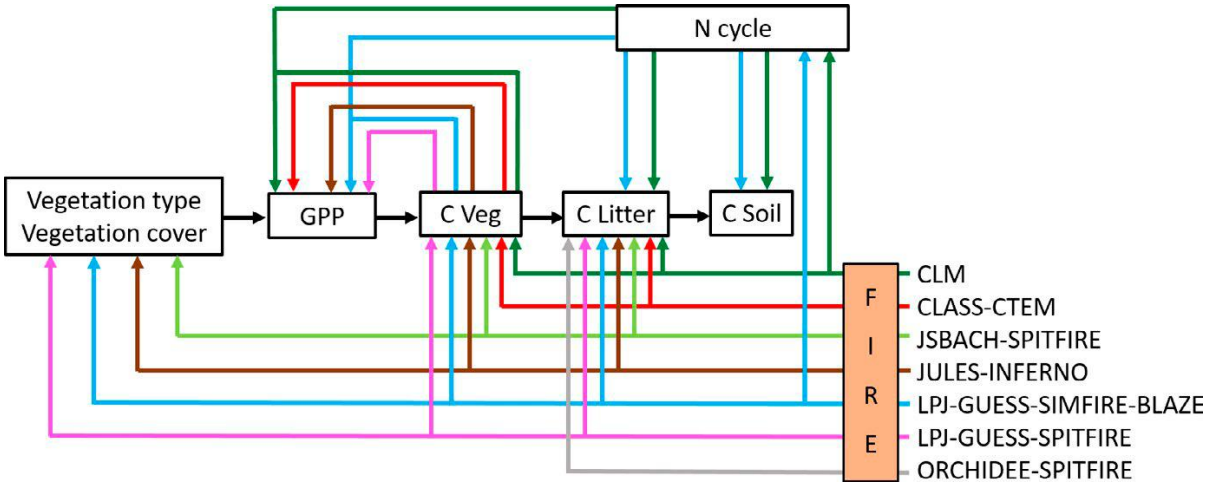
Accounting for and quantifying these feedbacks is therefore critical.

Global fire-vegetation models quantify these interactions and feedbacks

Hantson et al. 2016 Biogeosci

Multiple global fire-vegetation models exist

FireMIP

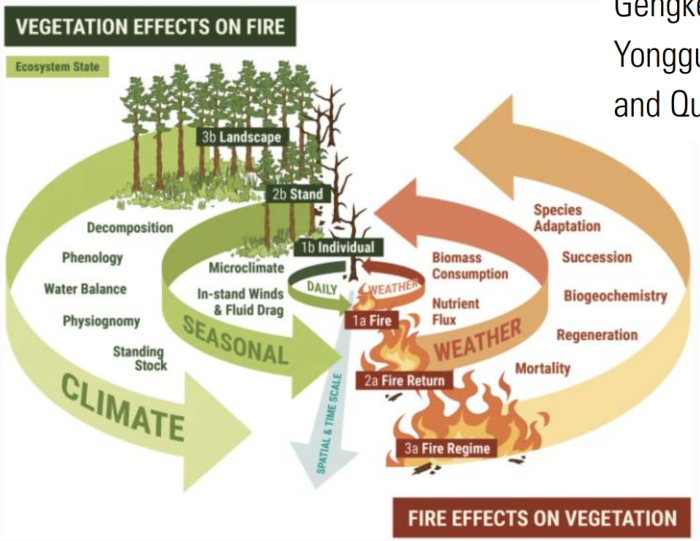


Lasslop et al 2020 Global Change Biol.

Models have different ways of representing vegetation characteristics.

This leads to diverging estimates of vegetation impacts of and on fire.

Wildfires - vegetation feedbacks



EARTH SCIENCES

Earlier peak photosynthesis timing potentially escalates global wildfires

Gengke Lai[1,2,†], Jialing Li[1,2,†], Jun Wang[3,†], Chaoyang Wu[3,*], Yongguang Zhang[1,2,4,5,*], Constantin M. Zohner[6], Josep Peñuelas[7,8,5] and Quansheng Ge[3,*]

Wildfire Smoke Boosts Photosynthetic Efficiency

Wildfires can destroy large tracts of vegetation. But their smoke plumes may help crops and other plants use sunlight more efficiently.

Post-fire recovery

TROPOMI sun-induced fluorescence (SIF) as proxy for photosynthesis

Research article | CC BY | 14 May 2024

Monitoring the impact of forest changes on carbon uptake with solar-induced fluorescence measurements from GOME-2A and TROPOMI for an Australian and Chinese case study

Juliëtte C. S. Anema, Klaas Folkert Boersma, Piet Stammes, Gerbrand Koren, William Woodgate, Philipp Köhler, Christian Frankenberg, and Jacqui Stol

PNAS | RESEARCH ARTICLE | ENVIRONMENTAL SCIENCES SUSTAINABILITY SCIENCE | OPEN ACCESS | Check for updates

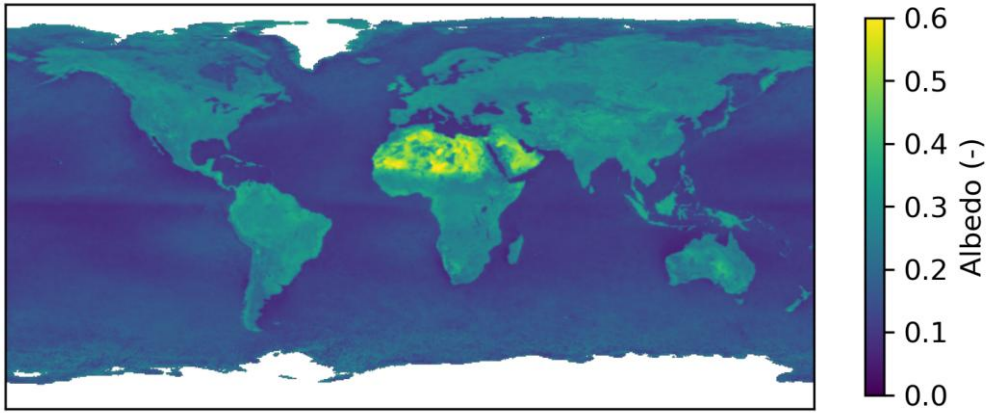
The magnitude and pace of photosynthetic recovery after wildfire in California ecosystems

Kyle S. Hemes[a,1], Carl A. Norlen[b,c], Jonathan A. Wang[b], Michael L. Goulden[b], and Christopher B. Field[a]

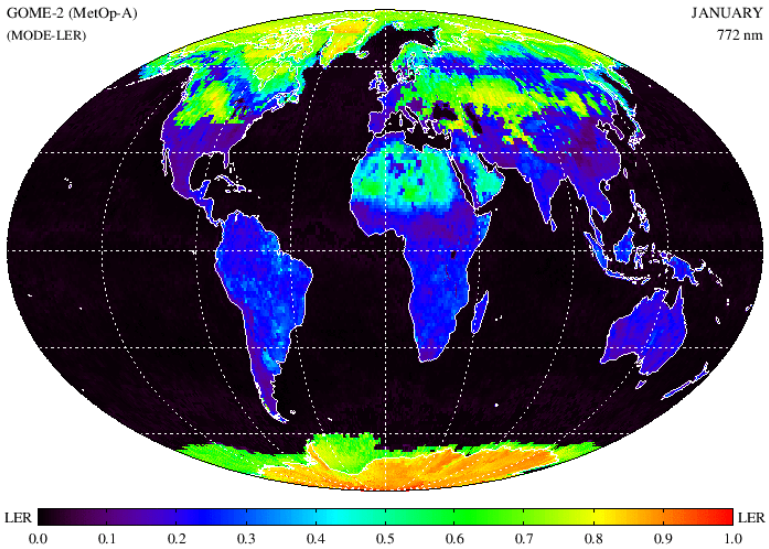
Edited by Janet Franklin, University of California, Riverside, CA; received February 2, 2022; accepted January 26, 2023

Fire effects on surface albedo and vegetation recovery

Albedo is co-retrieved with SIF for GOME-2 and TROPOMI (in development)



Anema et al., KNMI, temis.nl

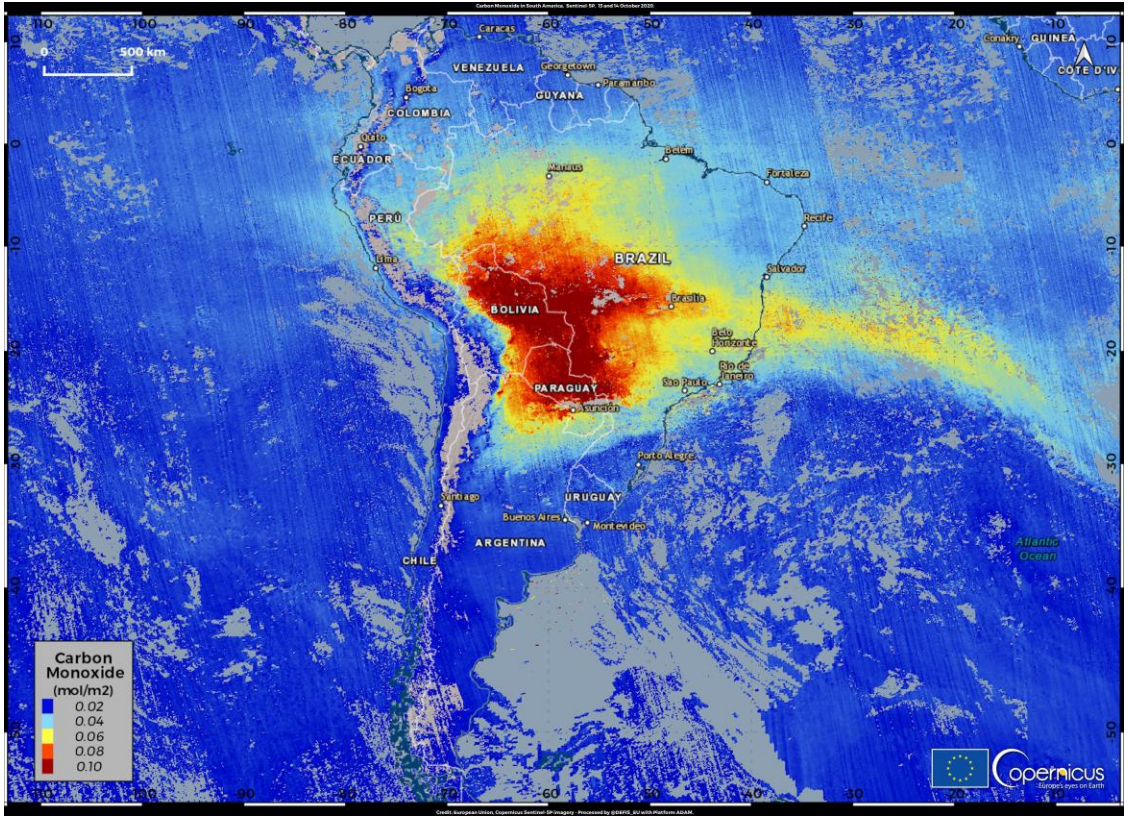


Tilstra et al., KNMI, temis.nl

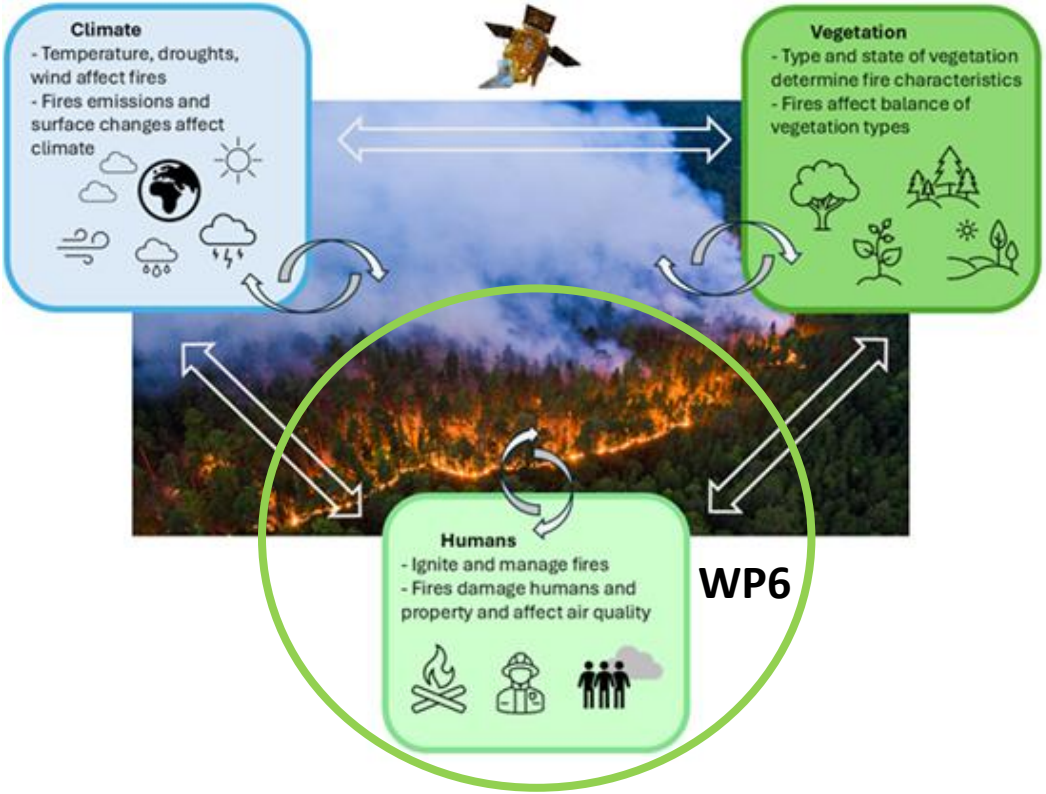
Improving fire emission estimates

Link with WP1 for satellite measurements (CO, NO2, aerosol)

Example: TROPOMI CO

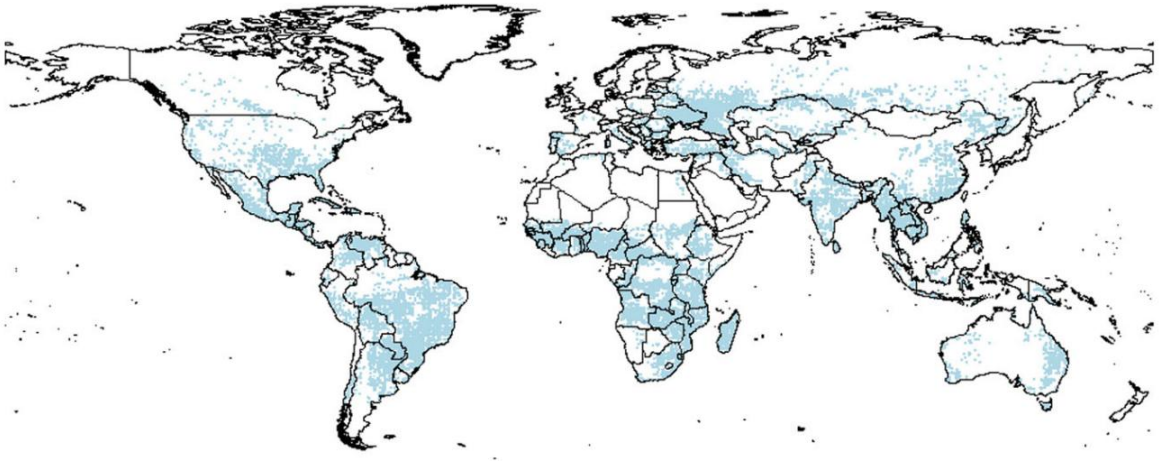


WP6 – Human-fire dynamics



Humans influence fires

- Ignition
  - Accidental
  - To clear forests, manage grassland
  - Crop residue or waste burning
- Fire management
- Landscape manipulation
- Changing climate

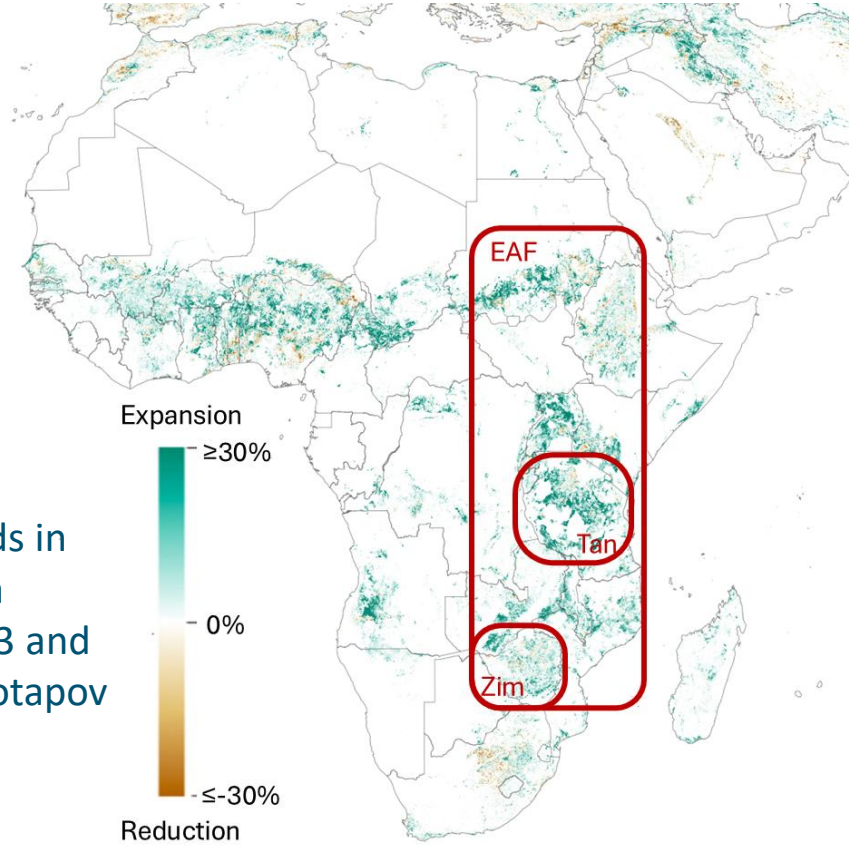


Areas of the world where fire characteristics are largely controlled by human impacts, Archibald et al., 2016

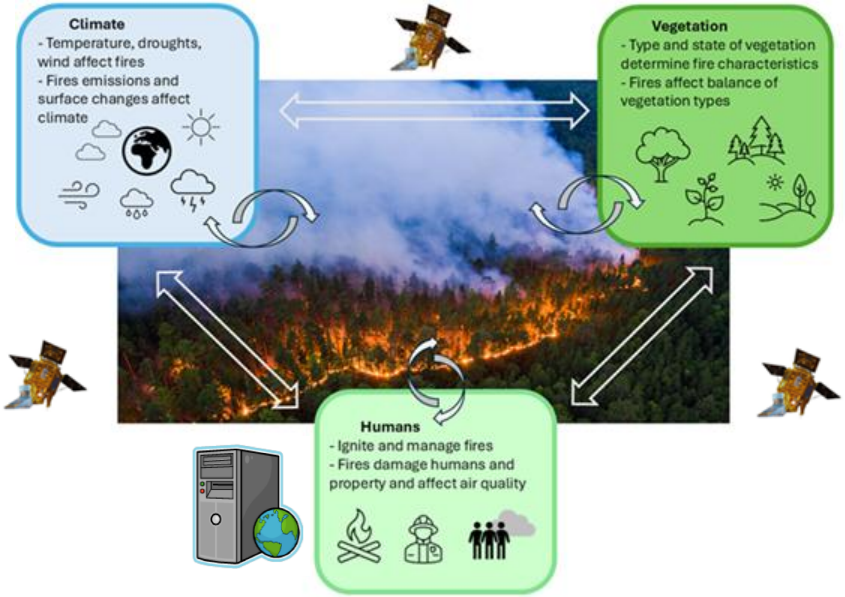
Focus on East and Southern Africa

- Roughly 75% of global burned area in savannahs
- Decreasing trend in burned area
- Crop and urban area expansion
- Currently not well captured by models

Relative trends in cropland area between 2003 and 2019, after Potapov et al. (2022).



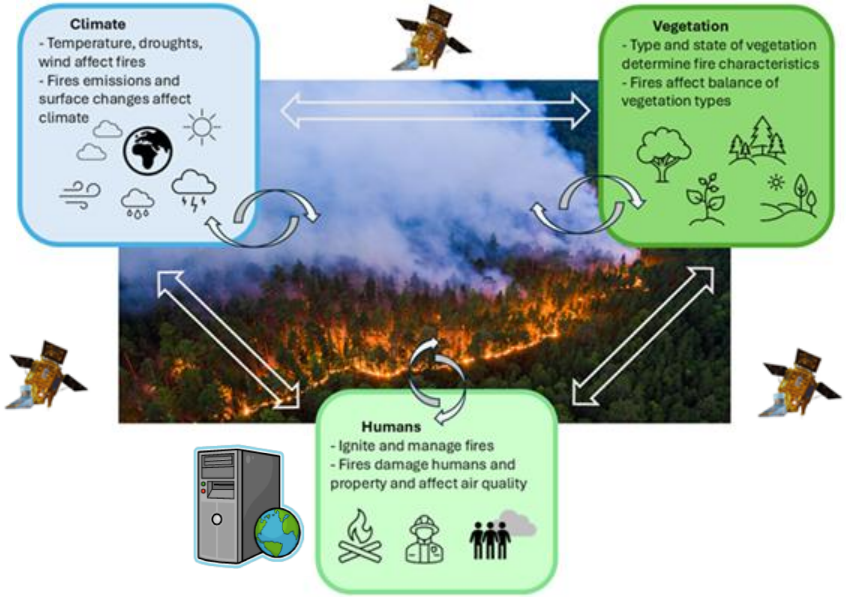
Expected outcomes and interdisciplinary value



Scientific impact:

- Key model improvements
- Better Dutch satellite products
- New generation of RS scientists

Expected outcomes and interdisciplinary value



Scientific impact:

- Key model improvements
- Better Dutch satellite products
- New generation of RS scientists

A new ecological-climate fire framework

- Couples dynamic vegetation modelling (JSBACH) with fire emissions
- Links ecosystem changes to air quality and climate impacts
- Integrated into global climate model ECHAM-HAM

Empowered by new NL satellite sensors

- Uses SPEXone, EarthCare, TROPOMI for aerosols, clouds, radiative forcing, SIF
- Satellite observations inform model updates

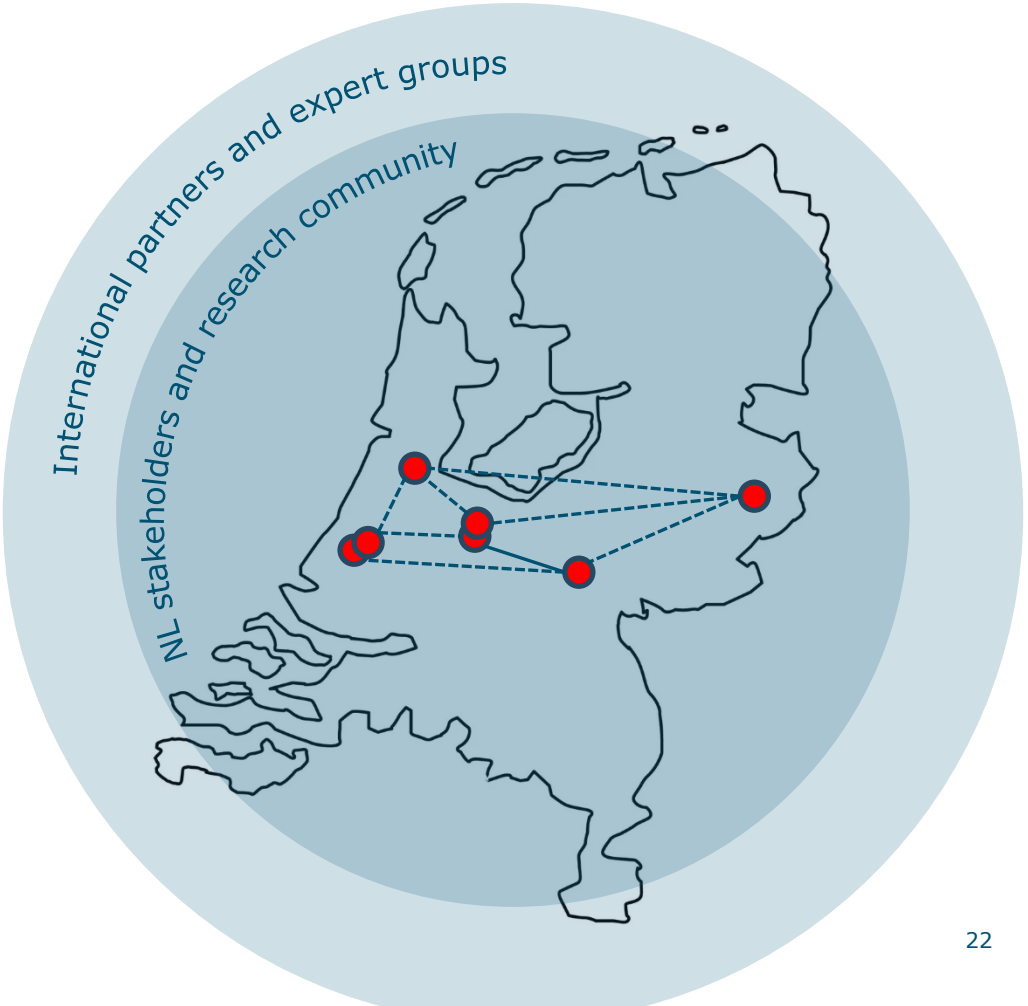
Truly interdisciplinary

- Combines ecology, climate modelling, human behavior & remote sensing
- Aligns with UN SDG 3 & 11 – health and resilient cities

Networking activities

Activities:
- Early-career scientists in Earth Observation networking events
- National networking events with societal stakeholders
- International Summer School on use of EO for fire research
- User workshops with international networks

Goals:
- Strengthening the NL remote sensing community
- Connecting with international efforts
- Empowering early career researchers



WAGENINGEN UNIVERSITY & RESEARCH

VU

UNIVERSITY OF TWENTE. | ITC

Universiteit Leiden
Institute of Environmental Sciences

Universiteit Utrecht
Copernicus Institute of Sustainable Development

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment

SRON
Netherlands Institute for Space Research

- *Climate, vegetation and human dynamics together control fires, and are also affected by fires*
- *The recently started INFLAMES project will investigate these relations using satellite infrastructure and models*
- *We invite you to follow us on https://inflames-project.github.io/ and participate in events that we will organize in the next four years*