**CEOS Wildfire Pilot II – Draft Proposal**

Theme area: Pre-fire risk and ignition potential monitoring

Proposed duration: 2025–2029

Geographic focus: Global terrestrial vegetated landmass

Co-leads: (to be confirmed; suggested: ANU/BRCoE, CSIRO, GA, NRCan, NASA, ESA, FAO)

User Implementation Lead: Fire agencies in Australia, Canada, and Europe, with Indigenous knowledge partners

CEOS Implementation Lead: TBD (likely ESA, NASA, or CSA)

Participants:

Confirmed

* Amici Stefania (Istituto Nazionale di Geofisica e Vulcanologia (INGV), Rome, Italy)
* David Chaparro Danon (CREAF, Barelona, Spain)
* Jane Cawson and Jamie Burton ([Jamie.Burton@unimelb.edu.au](mailto:Jamie.Burton@unimelb.edu.au)) (Universty of Melbourne, Melbourne, Australia),
* Nicolas Younes Cardenas, Nick Wilson, and Yizhi Li (Australian National University (ANU), Australia)

To be contacted (co-authors of Globe- FMC, list of researchers to be confirmed)

**1.Background and motivation**

Extreme wildfires are increasing in frequency and intensity worldwide. Between 2003 and 2023, the number and severity of megafires rose sharply (Cunningham et al., 2024), overwhelming suppression capacity, devastating ecosystems, threatening lives, and causing multi-billion-dollar losses.

Wildfire Earth Observation (EO) science spans the pre-fire, active-fire, and post-fire cycle. However, most operational systems and scientific output remain skewed toward active and post-fire phases. In 2024, more than 1,000 publications addressed burn severity, impact mapping, and active fire monitoring, while fewer than 5% addressed prevention and preparedness (fuel condition, risk modelling, and early warning) (Figure 1).

The first CEOS Wildfire Pilot (2020–2023) provided a roadmap for global active fire monitoring, conducting inventories, gap analyses, and user requirement studies. Building on those outcomes, Pilot II shifts focus upstream: delivering globally consistent, operationally relevant indicators of pre-fire fuel dryness.

Such indicators are essential for:

* Anticipating fire occurrence and intensity under climate change
* Supporting prescribed and cultural burning decisions
* Calibrating fire danger rating systems
* Informing seasonal and strategic bushfire outlooks

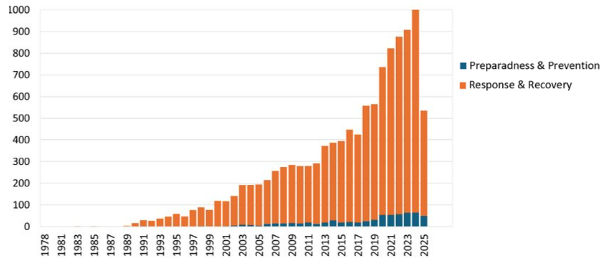


Figure 1. Research output across the wildfire management lifecycle. Post-fire analysis and active fire monitoring (e.g. burn severity mapping, hotspot detection, and surveillance) dominate the literature, with over 1,000 publications in 2024 alone. In contrast, pre-fire studies that support preparedness and prevention (e.g. fuel condition, risk modelling, and early warning) account for fewer than 5% of publications, with only ~50 papers published.

**2. Overarching Objective**

To develop, validate, and operationalize global indicators of vegetation fuel dryness and fire danger using Earth observation, ground data, and Indigenous knowledge, to support anticipatory fire management and preparedness.

**3. Specific Objectives**

1. Review of Dryness Indicators

* Literature review on how live Fuel Moisture Content (LFMC), drought indices, and soil moisture contribute to fire danger rating and early warning systems.
* Develop prototype fusion products linking these indicators with operational fire models.
* Expand Globe-LFMC database, with emphasis on underrepresented regions (Africa, Asia, South America).
* Establish methods for cross-calibrating EO data and traditional indigenous knowledge.

1. Algorithm Benchmarking

* Benchmark EO-based Fuel Moisture Content algorithm performance using harmonized in situ data (Globe-LFMC) published in the literature (e.g. Quan et al., 2021, Forkel et al, 2023, Chaparro et al. 2024, Yebra et al. 2018).
* Recommend global and regional Live Fuel Moisture Content algorithms.
* Support operational delivery of LFMC estimations through existing platforms such as the Global Wildfire Information System (GWIS), Digital Earth Australia, Digital Earth Africa, and Google Earth Engine.

1. Sensor Evaluation

* Compare sensitivity of current and future EO sensors (optical, hyperspectral, radar, thermal) to vegetation flammability traits (e.g. moisture, lignin, cellulose, oils), soil moisture, and other drought indicators.
* Assess the opportunities to generate estimations of pre-fire fuel LFMC and flammability (e.g. moisture, lignin, cellulose, oils) from operational (Sentinel, Landsat), pre-operational (e.g. EnMAP, PRISMA, EMIT), and future fit-for-purpose sensors (e.g OzFuel).

1. Operational Pathways & User Uptake

* Demonstrate pre-fire EO products to fire agencies to gather feedback and encourage use (e.g. case study based- LFMC to inform prescribe burning planning).
* Provide recommendations for EO-based products integration into GWIS and other operational platforms.
* Identify gaps and requirements for future satellite missions (including dedicated flammability missions such as OzFuel).

**4. CEOS Contribution**

Provide technical information on current and planned EO missions with relevance to pre-fire vegetation fuel monitoring (optical, hyperspectral, SAR, thermal, lightning sensors).

Provide **EO Data:** Sentinel-2, Landsat, MODIS, VIIRS, EnMAP, PRISMA, EMIT, SMAP, upcoming hyperspectral missions (e.g. TRUTHS).

Support cross-agency coordination to ensure complementary mission planning and to avoid redundancy.

Provide access to CEOS global platforms (e.g. GWIS) to make products accessible.

**5. Key Outputs**

* Global report on the state of EO for pre-fire risk monitoring (gaps, opportunities, user requirements).
* Open access datasets (fuel moisture, ignition points) for benchmarking.
* Peer-reviewed publications on user requirements and technical readiness of EO systems for pre-fire applications.
* Demonstration projects with regional partners (e.g. Australia, Canada, Mediterranean, Amazon) linking EO, models, and traditional indigenous knowledge.
* Strategic roadmap for CEOS to coordinate a global pre-fire monitoring architecture, feeding into CEOS Virtual Constellations and GEO.

**6. Expected Outcomes**

* A shift in wildfire EO focus from reactive monitoring to anticipatory risk forecasting.
* Clear global requirements for fuel dryness and ignition products.
* Increased uptake of EO by wildfire agencies for prevention and preparedness.
* Stronger integration of Indigenous and traditional cultural knowledge into global EO systems to support traditional and cultural uses of fire.
* A coordinated CEOS pathway to purpose-built pre-fire monitoring satellites and operational services.

## 7. Partners and Engagement

* **CEOS agencies**: NASA, ESA, CSA, CNES, ISRO, JAXA, CSIRO, GA, etc.
* **Scientific networks**: GOFC-GOLD Fire IT, GEO, ANU-led OzFuel consortium.
* **Operational users**: Fire agencies (e.g., NSW RFS, CAL FIRE, Canada CFS, South Africa SANParks, European agencies to be confirmed).
* **Knowledge holders**: Indigenous and local communities, engaged through co-designed projects.

**CEOS Wildfire Pilot II: Executive Summary to circulate**

Wildfires are becoming more frequent, more intense, and more destructive worldwide. Over the past two decades, we’ve seen the rise of “megafires” — events that overwhelm response capacity, devastate ecosystems, threaten lives, and cause billions of dollars in losses.

Earth observation (EO) plays a critical role in fire management, yet most investment and research still focuses on post-ignition activities: mapping burn severity, tracking active fires, or guiding recovery. In contrast, research and tools to support prevention and preparedness — such as fuel condition monitoring, risk modelling, and early warning — make up less than 5% of published work.

CEOS Wildfire Pilot II aims to change this.

Our goal is to deliver globally consistent, operationally relevant measures of fuel dryness and fire danger, using satellite data and ground observations. These indicators will help anticipate when and where fires are likely to occur or intensify, and identify windows of opportunity for prescribed and cultural burning.

Pilot Objectives

* Recommend global and regional methods for monitoring live fuel moisture content (LFMC) and support their integration into operational platforms such as the Global Wildfire Information System (GWIS).
* Compare the sensitivity of existing and upcoming satellite sensors (optical, thermal, microwave, hyperspectral) to vegetation flammability traits like water, cellulose, lignin, and oils.
* Evaluate how LFMC, drought indices, and soil moisture can be combined to improve fire danger ratings and early warning systems.
* Expand and harmonize validation data through Globe-LFMC, the world’s first open, field-based FMC database, while inviting contributions from under-represented regions (Africa, Asia, South America).
* Explore the role of Indigenous knowledge as a complementary source of validation and interpretation.

Why This Matters

By shifting focus from reaction to anticipation, CEOS Wildfire Pilot II will:

* Provide stakeholders with accurate and accessible data for preparedness, prescribed burning, and response.
* Guide future mission design by showing which fuel traits matter most for pre-fire monitoring activities.
* Create open datasets, algorithms, and benchmarks to build confidence in downstream products that enable global collaboration.
* Strengthen integration of science, technology, and Indigenous knowledge in global fire management.

This is a global effort, and every contribution counts — from satellite agencies and research institutions to fire managers and indigenous knowledge holders.

The vision is clear: if we act together now, we can build a global system that not only responds to wildfires, but anticipates them reducing damages and loss.