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DSL-IP Learning Event: Good practices in fire management

Fire Management Principles
Fire Ecology

Context:

1. Materials used today have been drafted for a course on Integrated Fire Management (IFM) that FAO is developing

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2. The topic of Fire Management Principles and the topic of Fire Ecology are

HUGE!

SO – this next few minutes is only an introduction!

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Fire Management Principles

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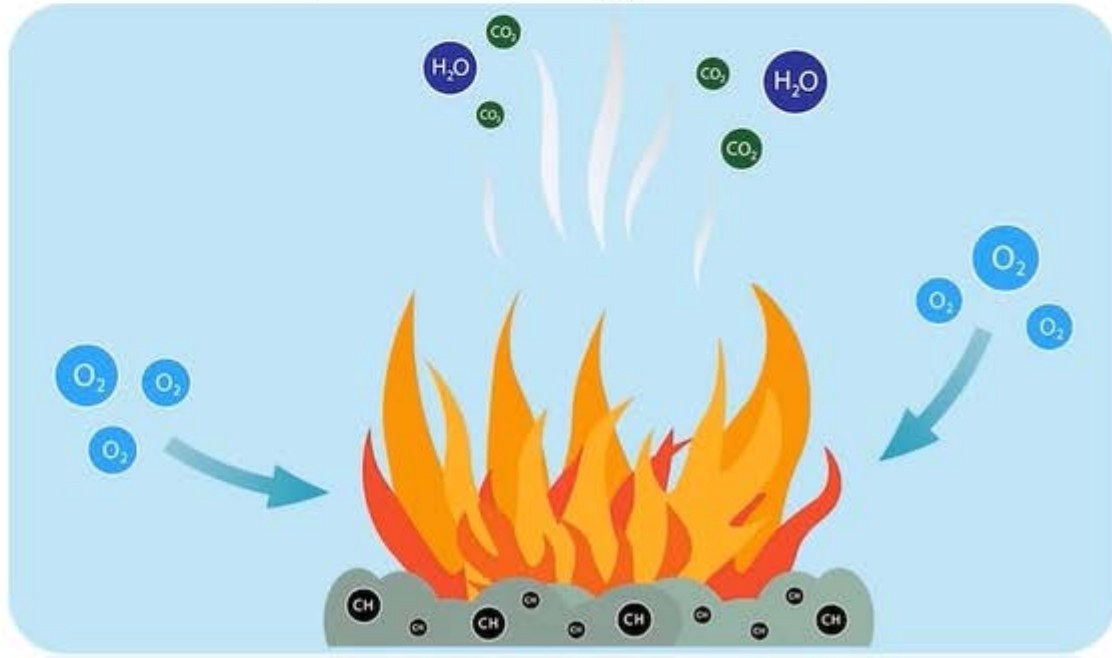
WHAT IS FIRE?

- The fire triangle illustrates that fire requires ***three elements***: heat, fuel, and oxygen.

- The ***absence*** of ***any one*** of them ***prevents*** the fire from ***starting or spreading***!

Fire is a chemical reaction of combustible material in the presence of oxygen and heat.



$(C_6H_{12}O_6)_n + 6n\ O_2 \rightarrow 6n\ CO_2 + 6n\ H_2O$ + energy (heat and light)

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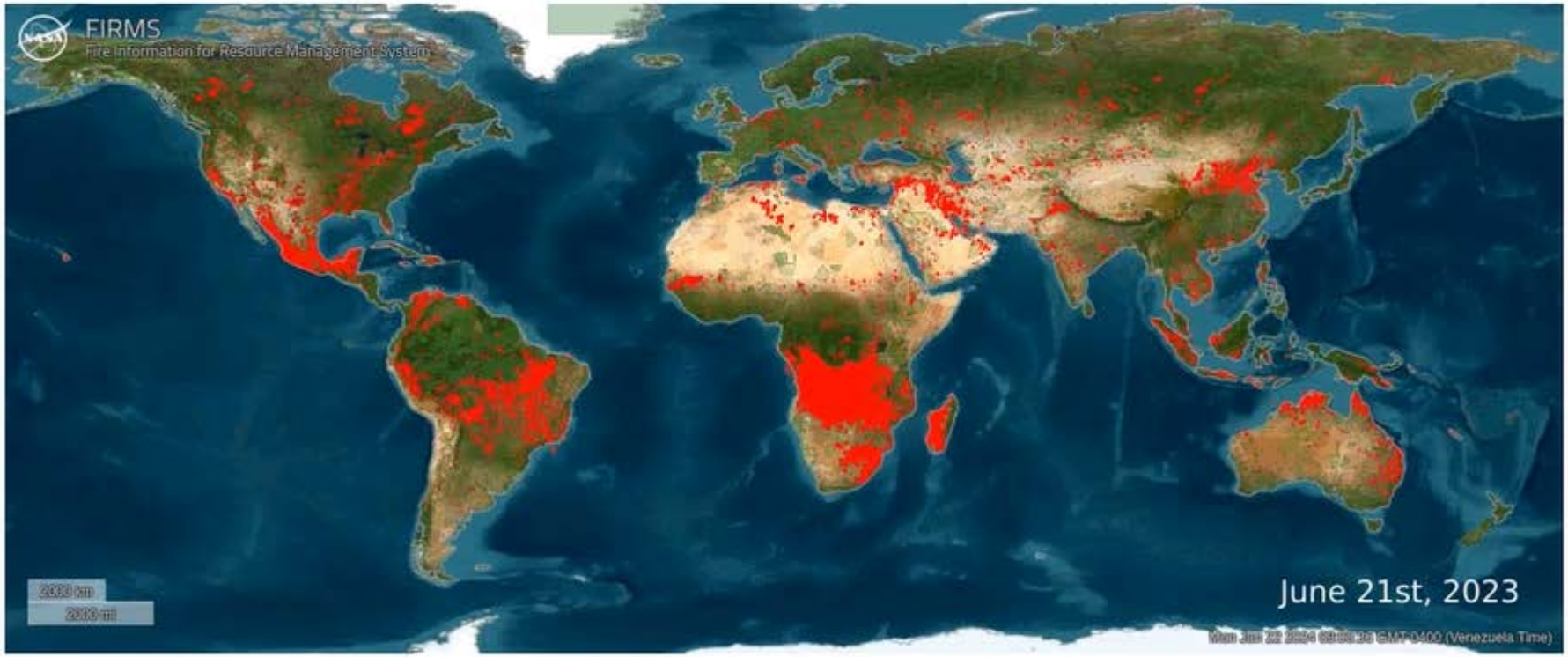
Integrated Fire Management

Where and when does fire ocurr?



Active fires / thermal anomalies imagery from NASA's Fire Information for Resource Management System (FIRMS) (https://earthdata.nasa.gov/firms), part of NASA's Earth Observing System Data and Information System (EOSDIS). Daily NRT/RT (Near Real-Time / Non-Time Critical) active fire detection data acquired by multiple polar-orbiting and geostationary satellite sensors: OLI / Landsat [30m]: VIIRS / NOAA-20 [375m], VIIRS / Suomi NPP [375m], MODIS / Aqua [1km], MODIS / Aqua [1km].

Global Framework

- Sendai Framework for Disaster Risk Reduction 2015-2030 - More people-centred, all-hazards and multi-sectoral approach to DRR
  - First priority action: **Understand disaster risk**
- Wildfires have implications for achieving the Sustainable Development Goals:

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Previous View of Fire Management

A range of possible technical decisions and actions aimed at the prevention, detection, control, containment, manipulation, or use of fire in a given landscape to meet specific goals and objectives.

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Classic View of Fire Management

Use of fire

The New Paradigm of Fire Management

Myers, 2006

Fire Management Framework – 5-Rs

- Integrated approach with emphasis on addressing underlying causes for sustainable solutions:
  - **REVIEW** - Analysis of the fire issue
  - **RISK REDUCTION** - Focus underlying causes
  - **READINESS** – Preparing to fight fires;
  - **RESPONSE** – Suppressing unwanted fires
  - **RECOVERY** – Human welfare, Repair, Restoration
- Critical Needs
  - Resources for fire data collection and analysis
  - Stakeholders & local communities involved

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WHAT IS FIRE ECOLOGY?

- *Fire ecology is the scientific study of the role of fire in the environment and the relationships between fire, ecosystems, and organisms.*

Fire is a critical ecological and evolutionary process of terrestrial ecosystems

- *This field of study seeks to understand the role of fire in maintaining and shaping ecosystems, as well as how it influences the distribution and behaviour of plant and animal species. It also examines the human use of fire and its effects on the landscape (Pyne, 1982).*

- *The ecology of fire can study fire and its relationships with the ecosystem and/or organisms and nom-living environment at various temporal and spatial scales, from microsites (combustion scales) to individual fire or fire regimes (Cochrane and Ryan 2009).*

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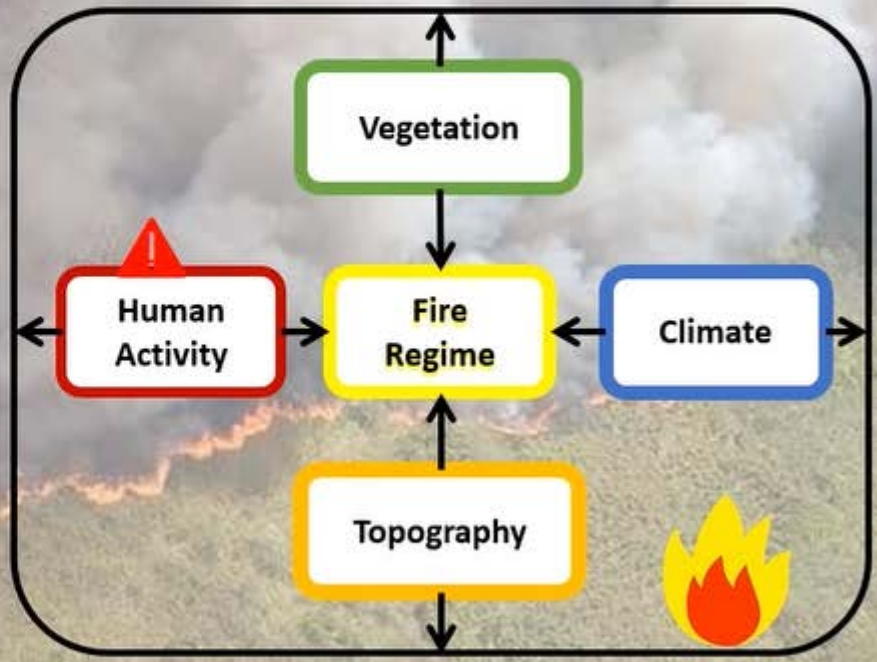
How does fire occur in natural systems?

Fire Regime

- It is the result of spatial and temporal processes:
  - **Fuels consumed**
  - **Frequency of fire**
  - **Fire intensity**
  - **Fire season,**

determined by the cumulative interaction of fire, climate, vegetation, topography, and human activity.

Factors Influencing Fire Regimes



(Modified from Crutzen and Goldammer, 1993 and UNEP, 2022)

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SPECIES ADAPTATIONS TO FIRE

Some plant species have developed adaptive traits that allow them to survive and reproduce in highly fire recurrent ecosystems

Some adaptive traits:

1. Thick Bark
2. Self-Pruning:
3. Serotinous Cones:
4. Fire-Activated Germination:
5. Resprouting:
6. Fire-Stimulated Flowering:
7. Fire-Resistant Leaves:
8. Rapid Growth After Fire:
9. Geophyte Regeneration:
10. Allelopathic Chemical Release:
11. High-Elevation Seed Escape:
12. Protective Ground Positioning:



Fire adaptations help plants not just endure fires but also leverage them to thrive and reproduce by outcompeting others. Recognising these traits is key for managing and conserving fire-adapted environments.



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FIRE REGIMES: FIRE AS AN ECOLOGICAL PROCESS

Fire regimes vary across different ecosystems and influence the types of plants and animals and their interactions.

Modified from Pausas and Keeley, 2022

FIRE ECOLOGY: FIRE REGIMES CATEGORIES
(Not all ecosystems respond equally to fire)

Fire independent
Fire plays almost no role.
Ex. Deserts and tundras

Sensitive to fire
Fire may lead to the loss of native species and habitats.
Ex. Tropical and sub-tropical humid forests.

Fire dependent
They respond favorably to fire.
Ex. Tropical dry forests, bushes and savannas.

Influenced by fire
Fire perturbations play a role in the creation of certain habitats, keeping biodiversity.
Ex. Ecotones, gallery forests, riparian vegetation.

Not all native ecosystems fit neatly into one of these categories, but they provide a way to illustrate and examine the threats, conservation needs and opportunities associated with fire in various vegetation types and how management actions may vary between them

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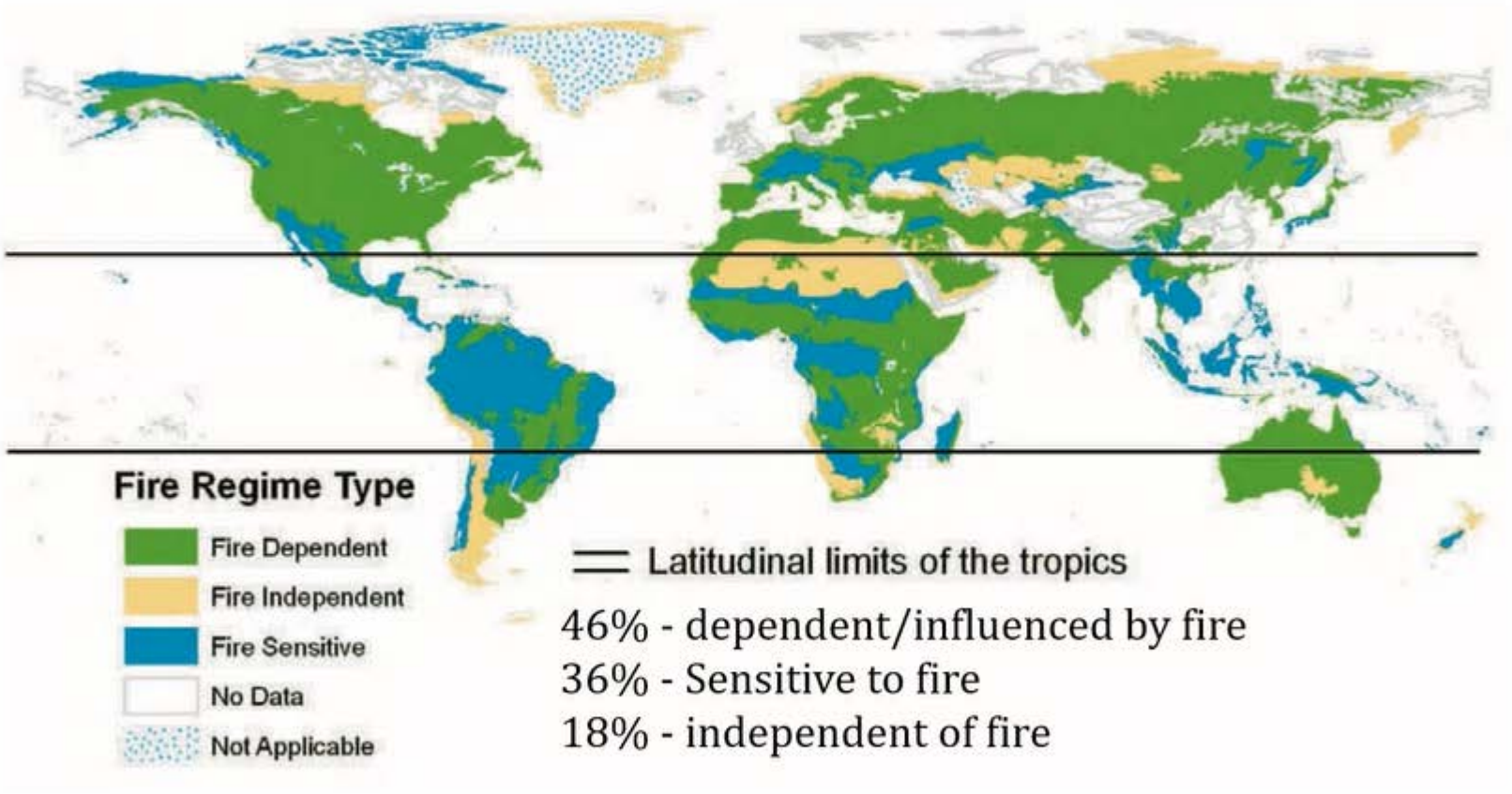
FIRE ECOLOGY
Global distribution of fire regime types



Global distribution of fire regime types (based on 200 priority ecoregions) (Shlisky et al., 2007).

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ALTERATIONS OF FIRE REGIME TYPES

Fire regime	Altered: fire exclusion	Natural	Altered: very frequent fire
Fire-dependent ecosystem (savanna)	 Biodiversity ⬇ Aboveground biomass ⬆	fire 3-6 years between seasons  Biodiversity (very high) Aboveground biomass	fire 1-2 years dry-season  Biodiversity ⬇ Aboveground biomass ⬇
Fire-sensitive ecosystem (rainforest)		"no" fire  Biodiversity (very high) Aboveground biomass	recurrent fires 3-10 years dry-season  Biodiversity ⬇ Aboveground biomass ⬇

Overall, this diagram conveys the importance of maintaining natural fire regimes for the health and sustainability of different ecosystems and the negative impacts of both fire exclusion and very frequent fires on ecosystems that are not adapted to those conditions. *Pivello et al., 2021*

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WHAT IS THE CONTRIBUTION OF FIRE ECOLOGY TO THE IFM?

Fire ecology (FE) is a critical component of Integrated Fire Management (IFM) as it provides essential insights into how fire behaves within different ecosystems and how it affects various plant and animal communities.

FE informs the ecosystem's natural **Fire regimes** (type of fire, frequency, intensity, severity, etc.). This knowledge guides IFM practices to align with ecosystem natural processes.

By incorporating ***fire ecology*** into IFM, managers can create a ***holistic approach*** to fire management that promotes the ***conservation and resilience of natural ecosystems*** protecting human communities and infrastructure in the face of ***changing fire regimes.***

Human activities, as land use changes and fire suppression, can disrupt natural fire regimes with harmful consequences for ecosystems.

FE can predict high-risk zones and periods by understanding how, when, and why areas burn. IFM incorporates this for **Risk Assessment and Mitigation through** fuel reduction, create buffer zones, and develop early warning systems.

FE studies species **Fire Adaptations and Responses** (such as serotiny, resprouting capabilities, etc.). IFM can use this knowledge to support the regeneration and health of these fire-adapted ecosystems.

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Fire Ecology – Some References ;-)

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Thank you for Listening!