Emergence des feux et inflammabilité des forêts des Alpes occidentales

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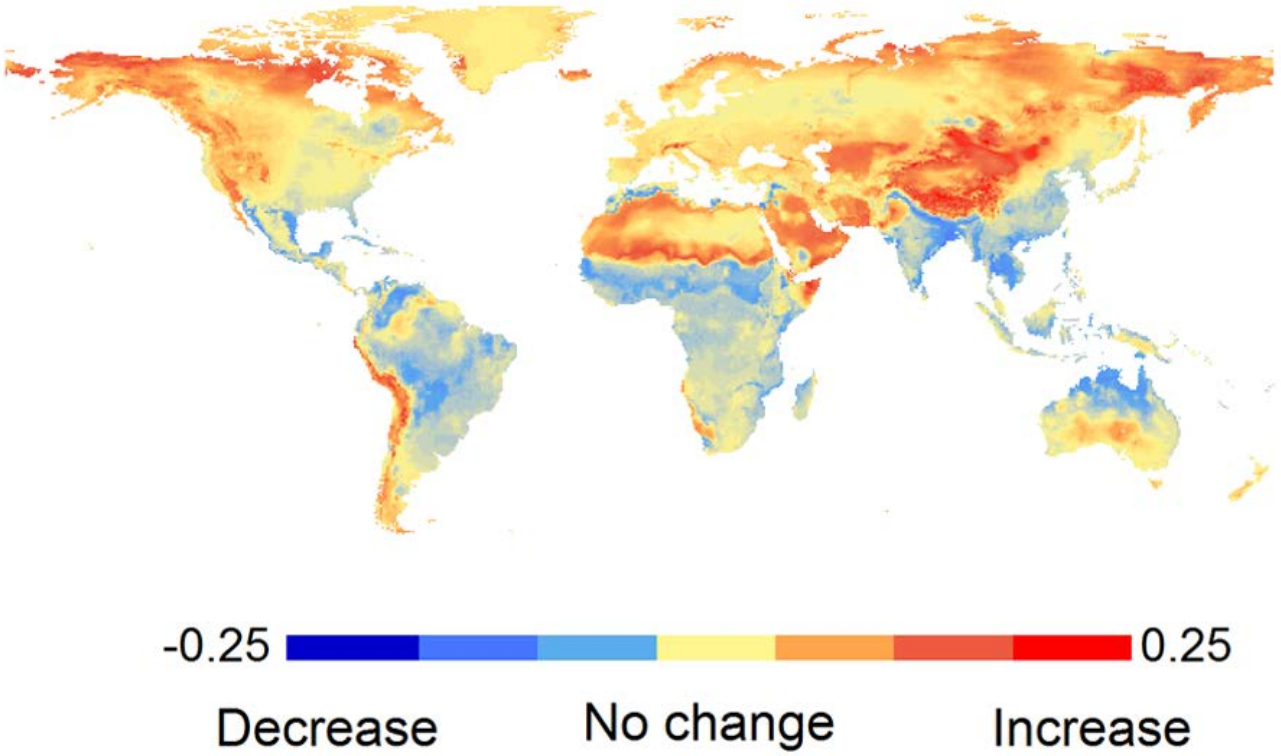
[4] ZA Alpes

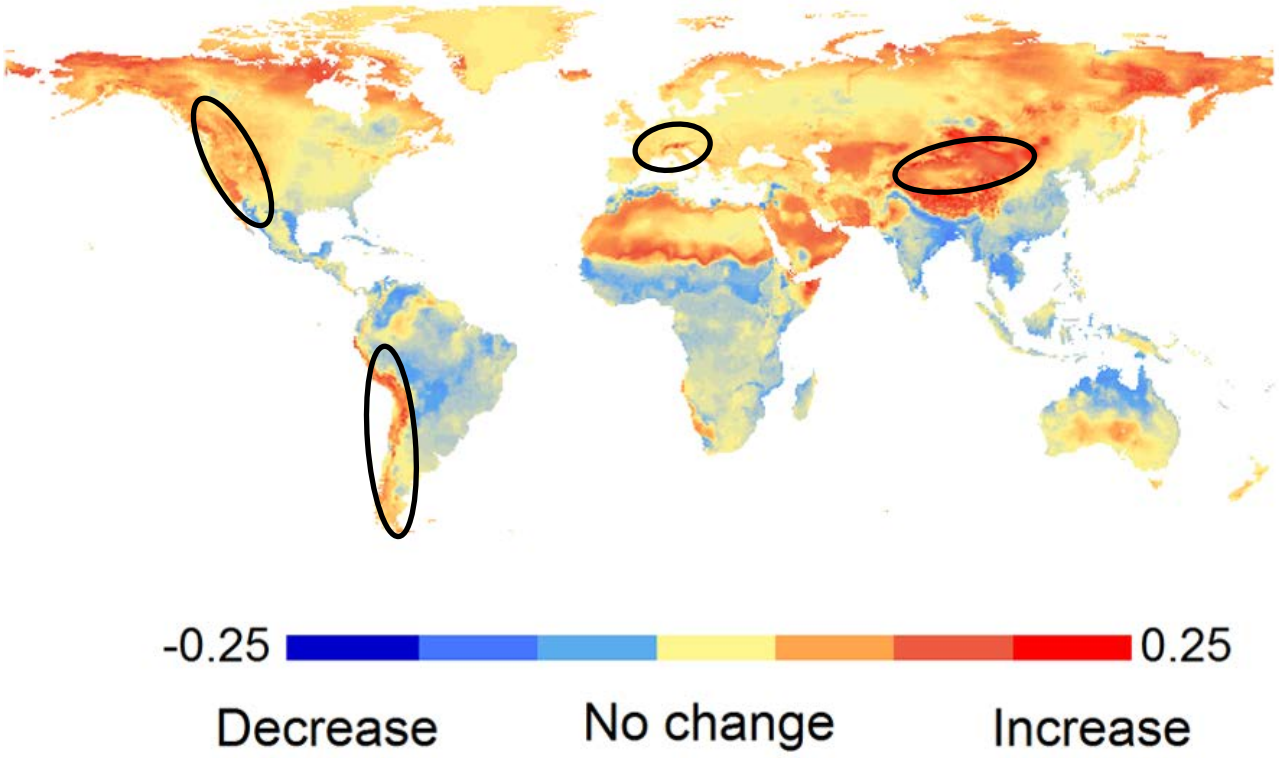
EXPECTED VARIABILITY IN FUTURE FIRES



from Moritz et al. 2012 Ecosphere art49

MOUNTAINS: NEWLY FIRE-PRONE REGIONS

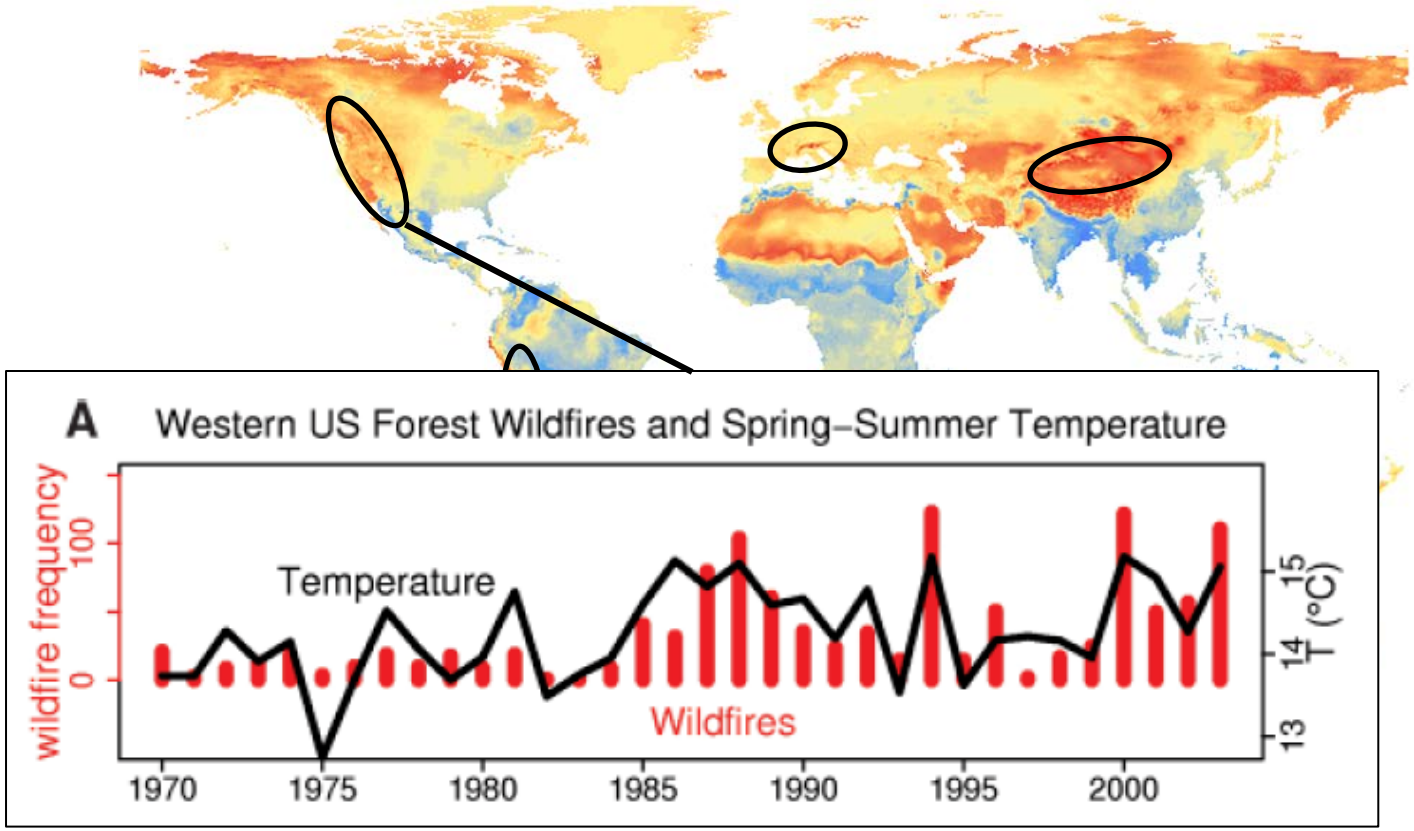
Higher increase of fire activity in mountains



from Moritz et al. 2012 Ecosphere art49

MOUNTAINS: NEWLY FIRE-PRONE REGIONS
HISTORICAL DATA

Higher increase of fire activity in mountains

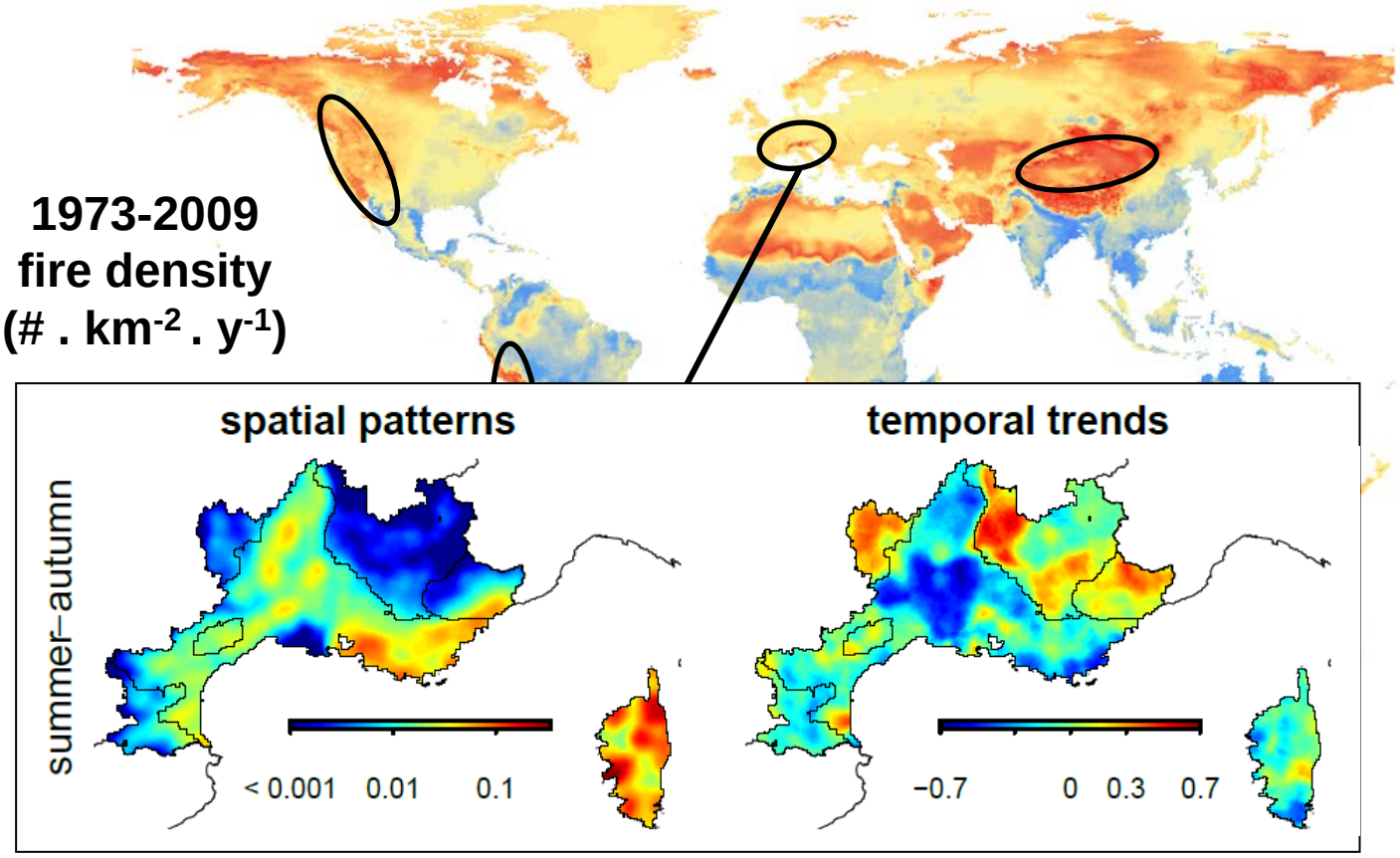


from Westerling et al. 2006 Science 313(5789)

MOUNTAINS: NEWLY FIRE-PRONE REGIONS
HISTORICAL DATA

Strong regional trends

1973-2009
fire density
(# . km^{-2} . y^{-1})



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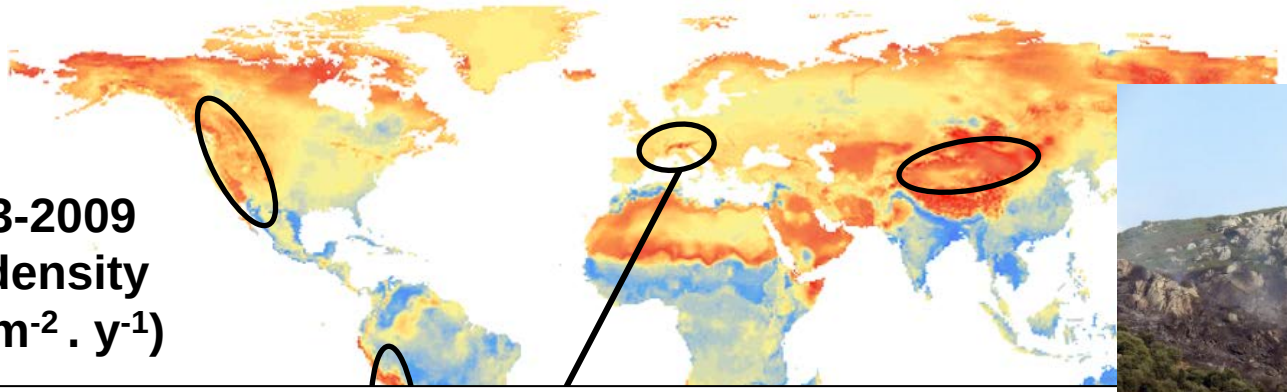
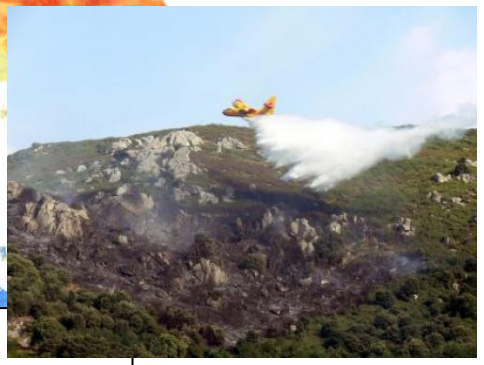
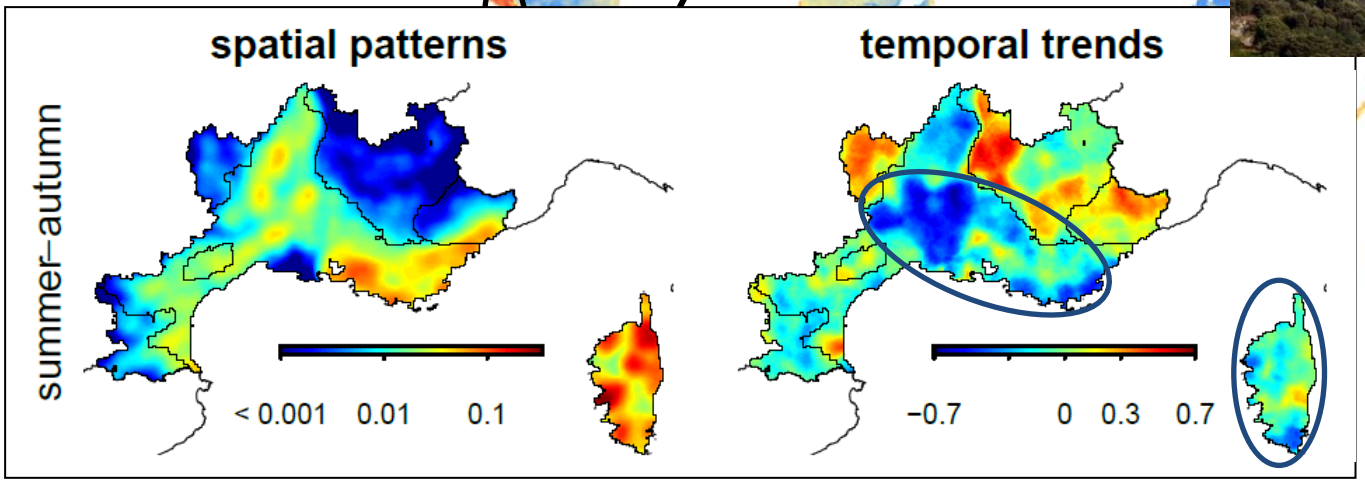
MOUNTAINS: NEWLY FIRE-PRONE REGIONS
HISTORICAL DATA

↘ in Mediterranean ecosystems



1973-2009
fire density
(# . km^{-2} . y^{-1})





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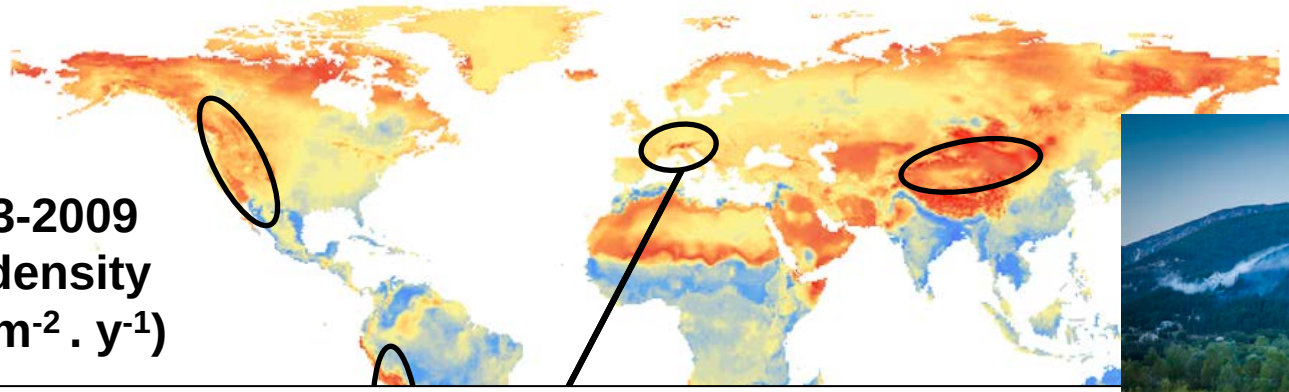
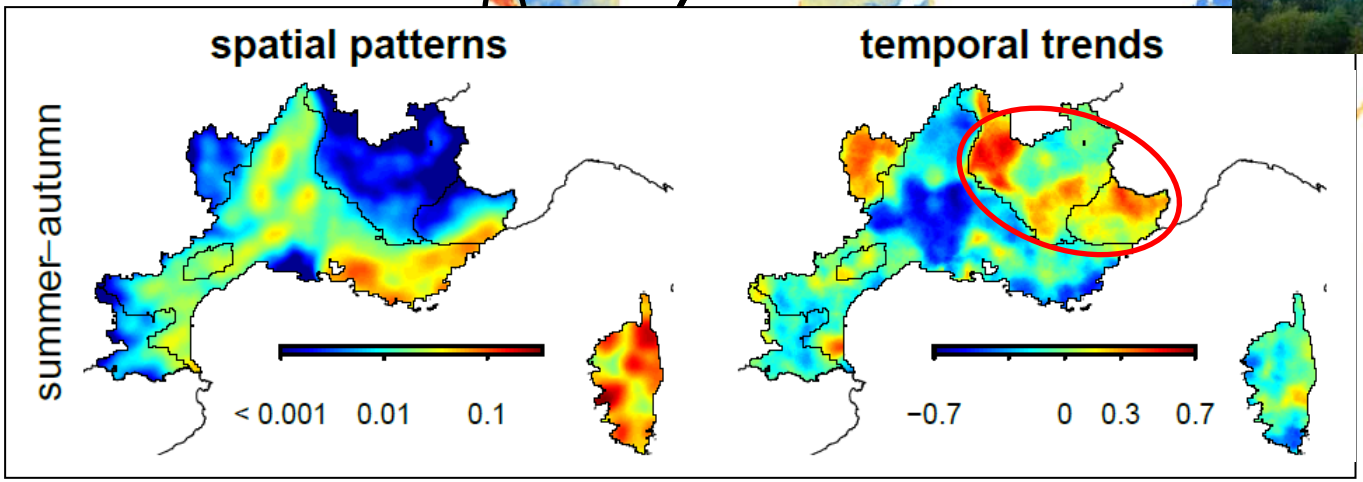
MOUNTAINS: NEWLY FIRE-PRONE REGIONS
HISTORICAL DATA

↗ in mountain ecosystems



1973-2009
fire density
(# . km^{-2} . y^{-1})



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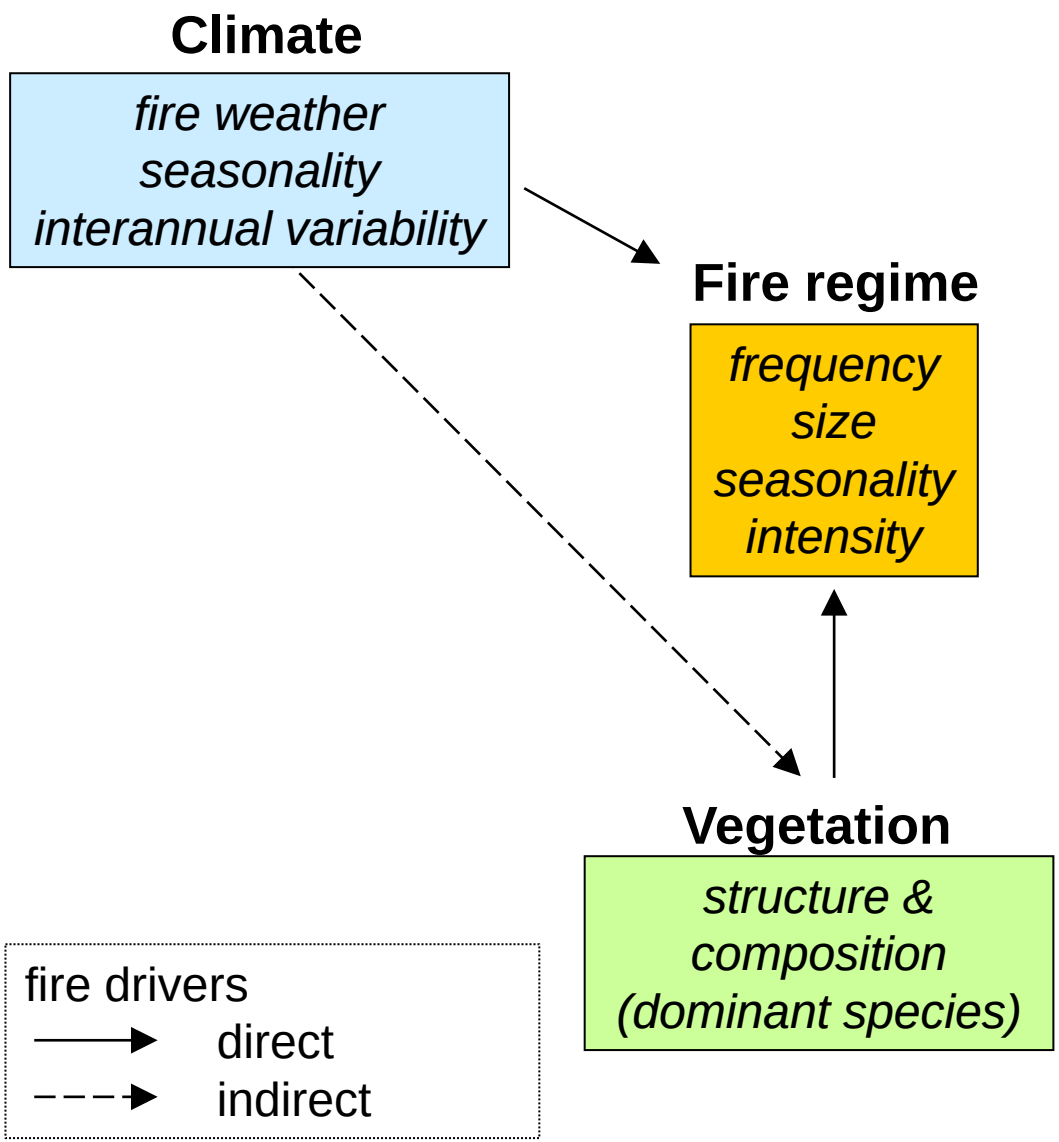
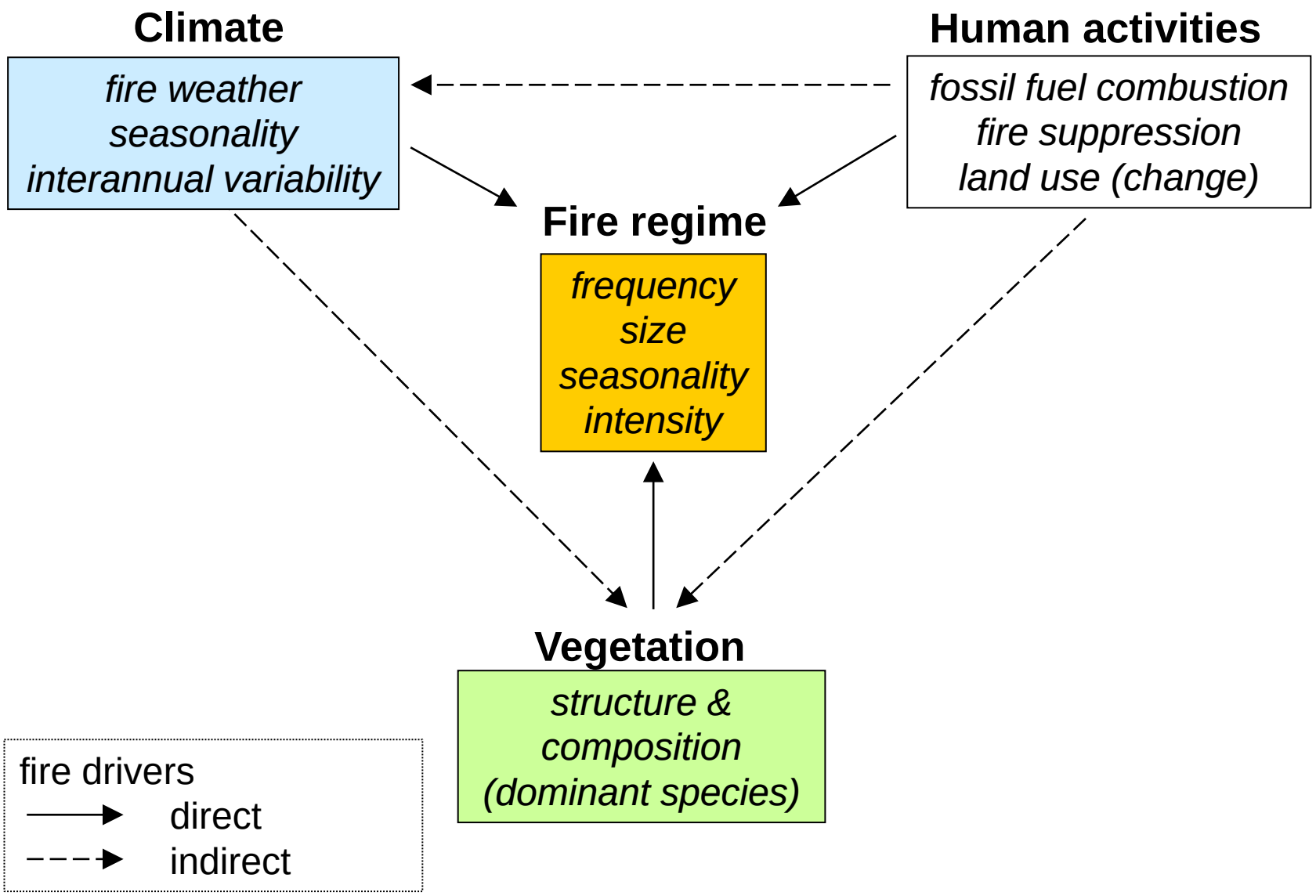
Vulnerability of mountain forests to an increasing fire risk ?

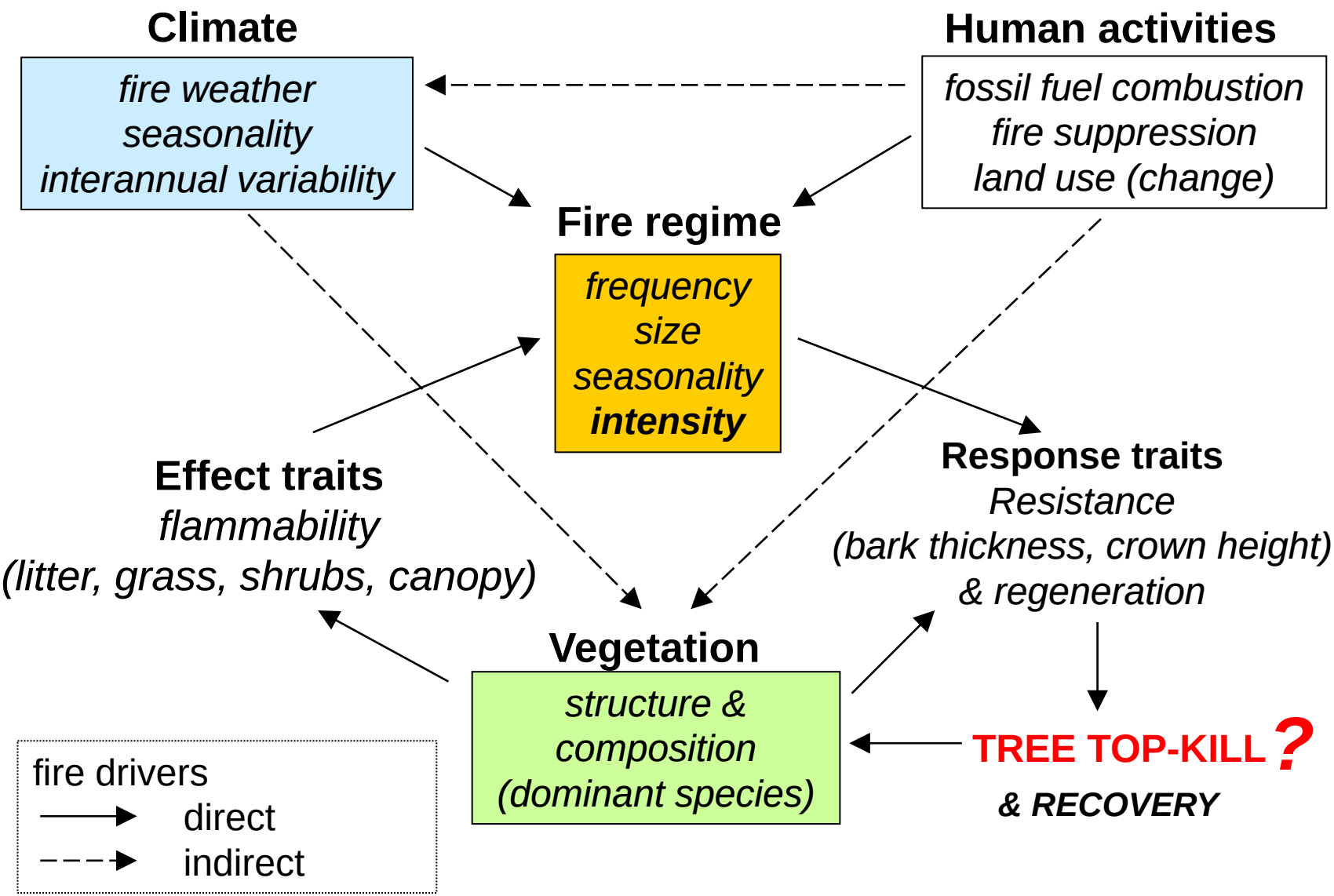
CLIMATE AS THE MAIN FIRE DRIVER



CONTEMPORARY CLIMATE – VEGETATION – FIRE

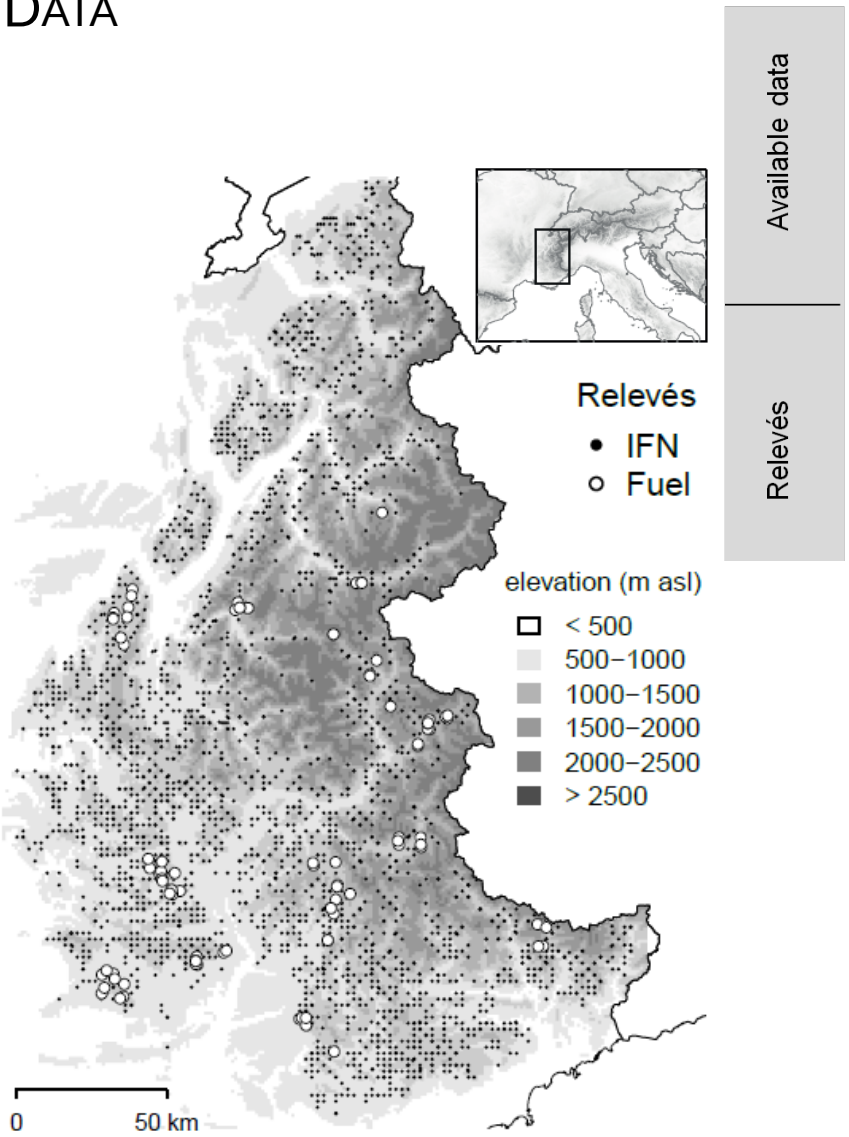


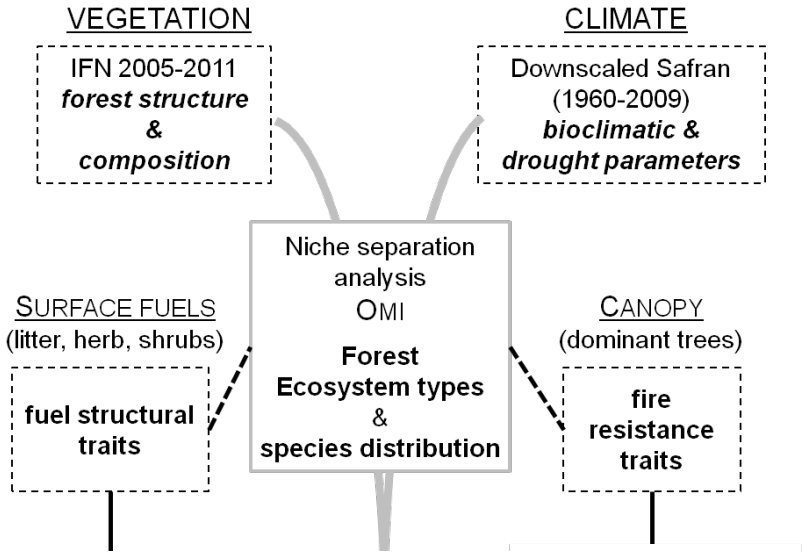
CONCEPTUAL MODEL



MODELLING FRAMEWORK OF FOREST VULNERABILITY TO FIRE

DATA

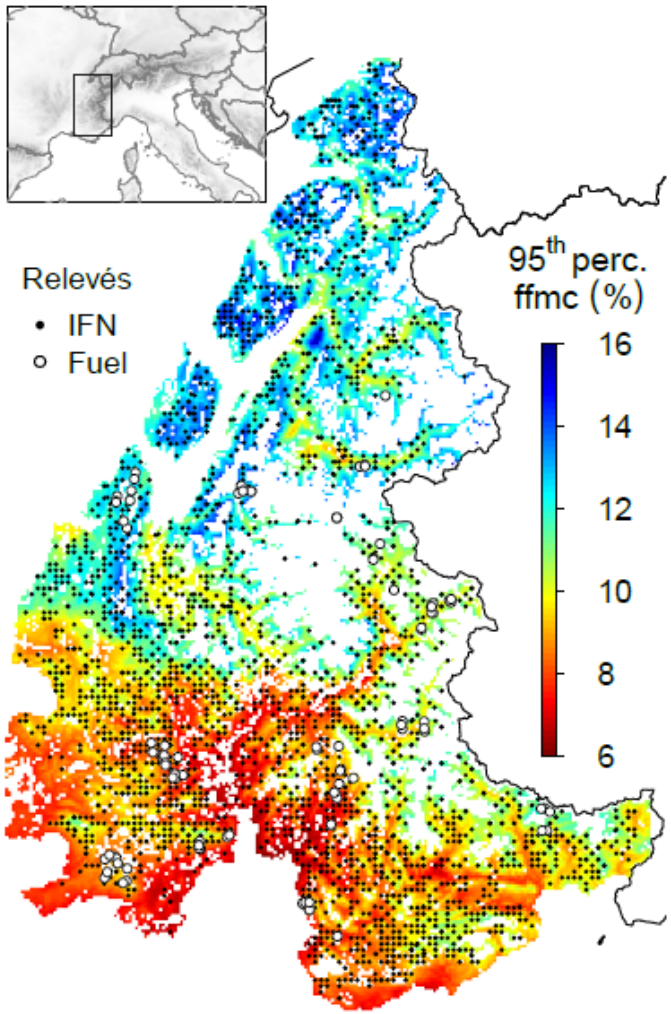




MODELLING FRAMEWORK OF FOREST VULNERABILITY TO FIRE

MODELS

ffmc = f (T, RH, P, wind)
Van Wagner 1987



Available data
Relevés
Modelling
Vulnerability

VEGETATION
IFN 2005-2011
forest structure & composition

CLIMATE
Downscaled Safran (1960-2009)
bioclimatic & drought parameters

Niche separation analysis
OMI
Forest Ecosystem types & species distribution

SURFACE FUELS
(litter, herb, shrubs)
fuel structural traits

CANOPY
(dominant trees)
fire resistance traits

Fuel models

Extreme weather scenario (moisture & wind)

Allometric relationships

Resistance *sensibility*

Fire behaviour
FLAMMAP (Finney 2006)

Meta-model

post-fire tree mortality
PETERSON & RYAN (1986)

Flammability *exposure*

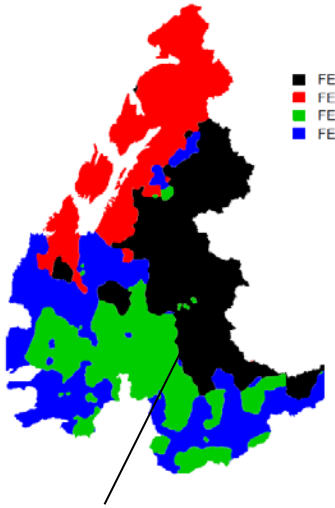
Mortality rates *vulnerability*

$$\overline{V_j} = \frac{1}{N}\sum_{k=1}^{N}\left(\underbrace{\frac{1}{n_k}\sum_{i=1}^{n_k} Pm_{ijk} \geq 0.5}_{community}\right)$$

study area

Forest Ecosystem Types (FET)

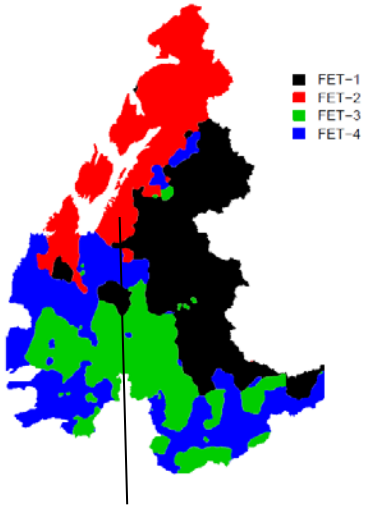
Open and tall forests
with high cover of herb or dwarf shrubs
→ *Larix decidua, Pinus uncinata, P. cembra*



dry-subalpine

FOREST ECOSYSTEM TYPES (FET)

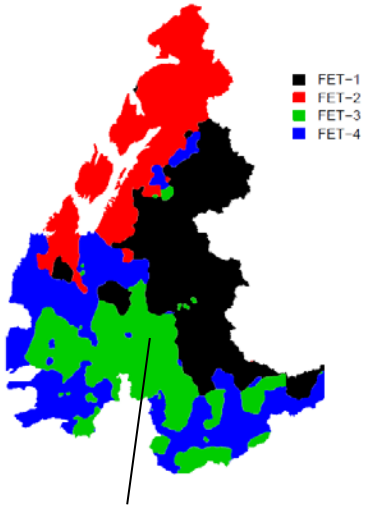
Closed and tall forests
with a poor understory
→ *Abies alba, Picea abies, Fagus sylvatica*



moist-montane

FOREST ECOSYSTEM TYPES (FET)

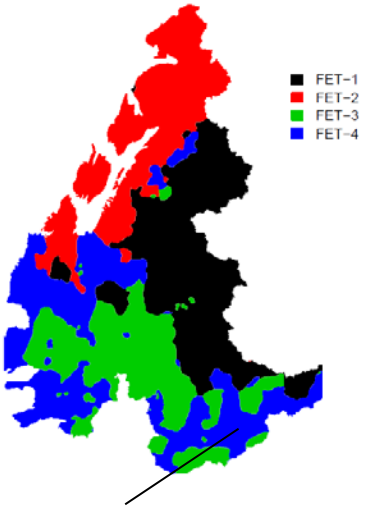
Open and low forests
with a high cover of small shrubs
→ *Pinus sylvestris, P. nigra, Quercus pubescens*



open-Med.

FOREST ECOSYSTEM TYPES (FET)

Closed and low forests
with a high cover of tall shrubs
→ *Pinus sylvestris, P. nigra, Quercus pubescens*

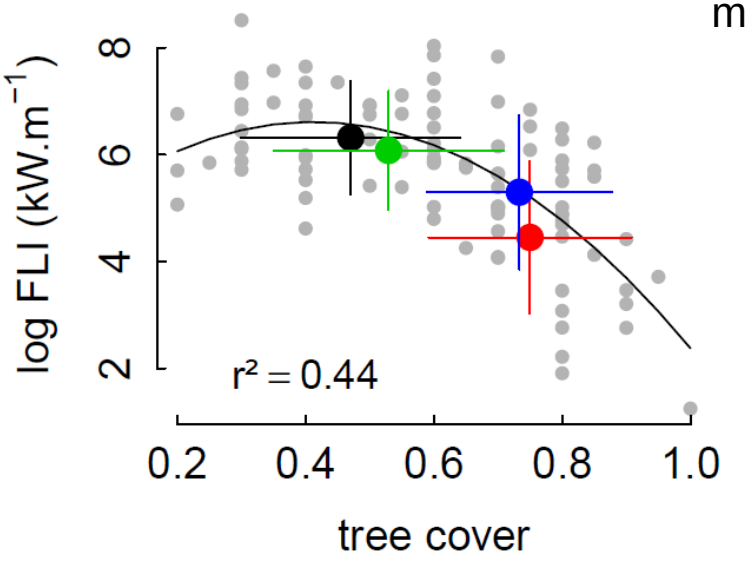


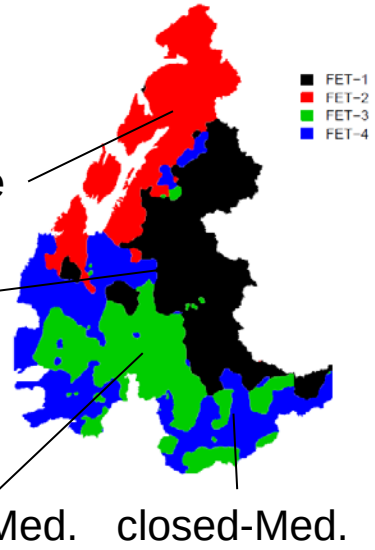
closed-Med.

ENVIRONMENTAL DRIVERS OF FIRE INTENSITY

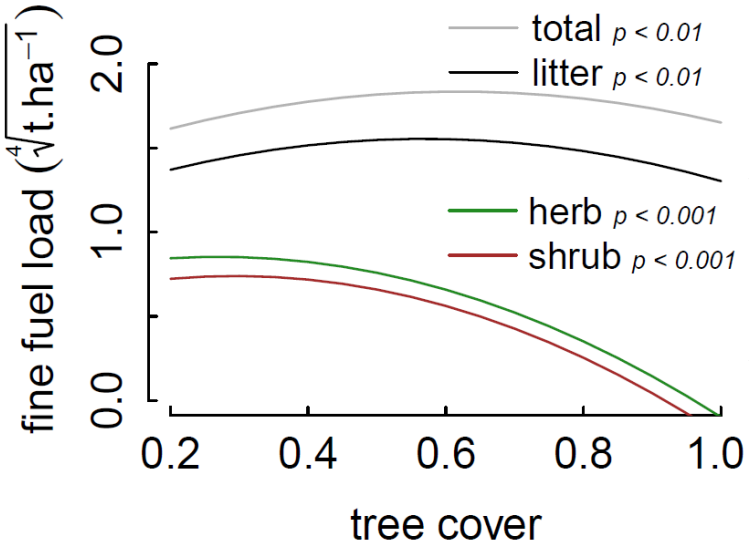
TREE COVER

fire intensity





amount of understory fuel



necromass

live biomass

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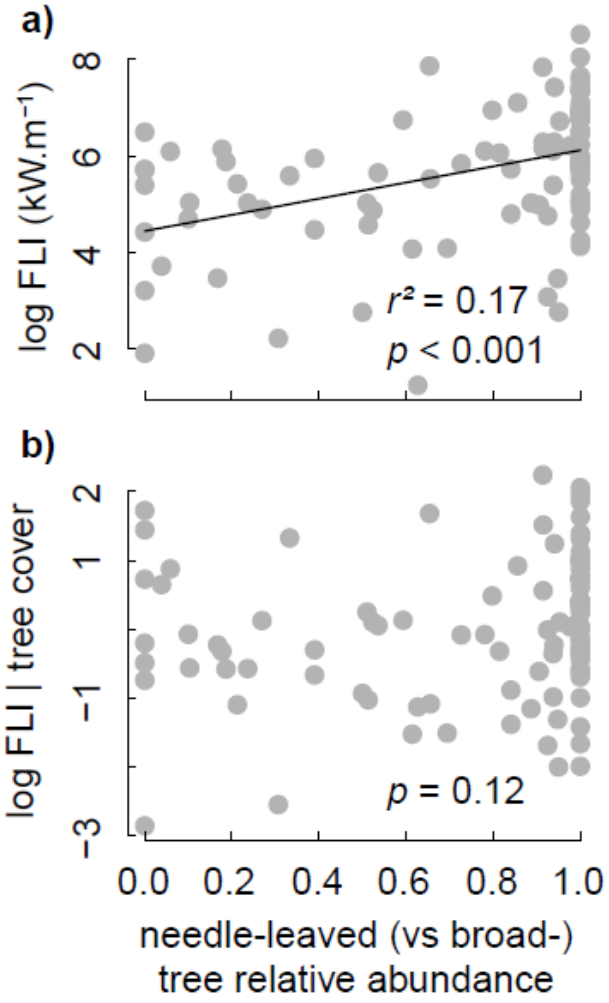
ENVIRONMENTAL DRIVERS OF FIRE INTENSITY
INTERACTION WITH COMPOSITION

fire intensity

fire intensity
after accounting for
tree cover



angiosperms gymnosperms

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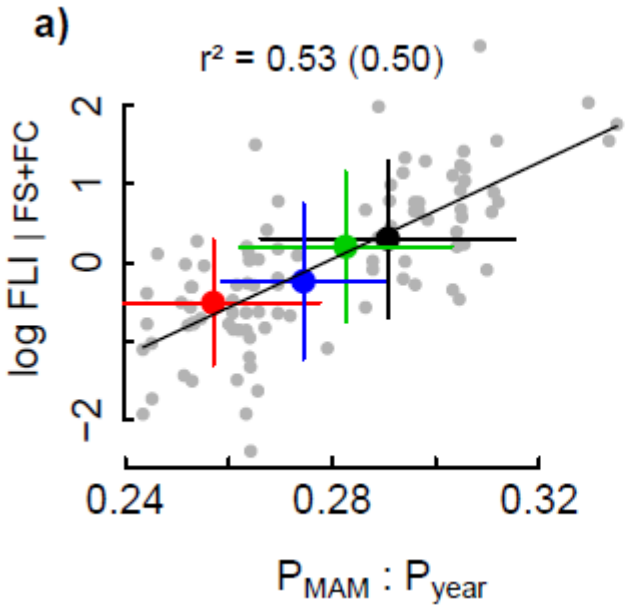
Journal of Biogeography

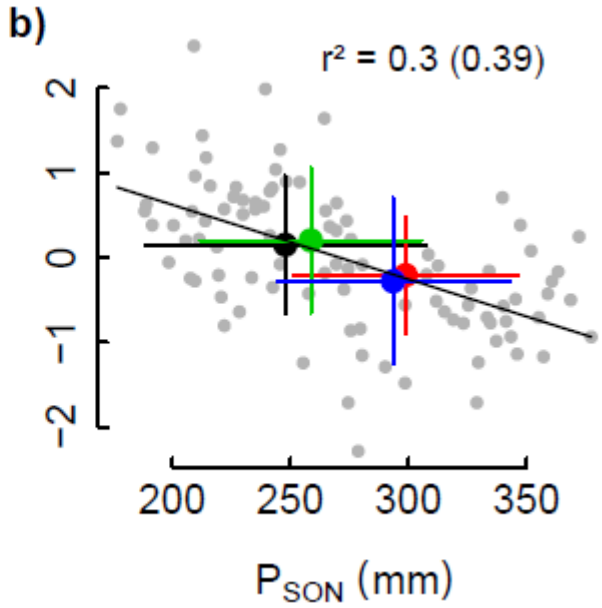
ENVIRONMENTAL DRIVERS OF FIRE INTENSITY
PRECIPITATION SEASONALITY

rainy springs enhance biomass growth

dry autumns limit litter decomposition

fire intensity





spring to annual precipitation ratio

autumn precipitation (mm)

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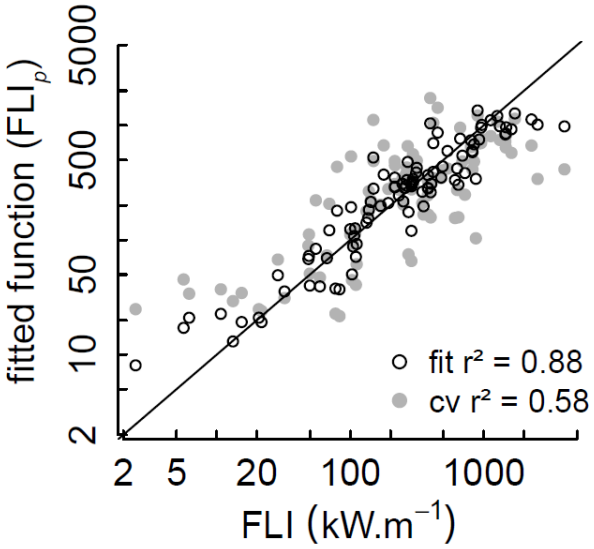
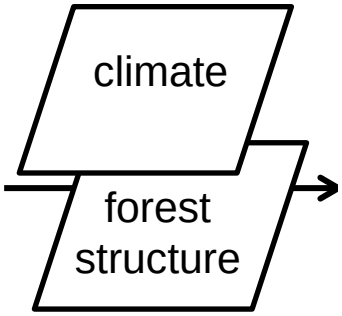
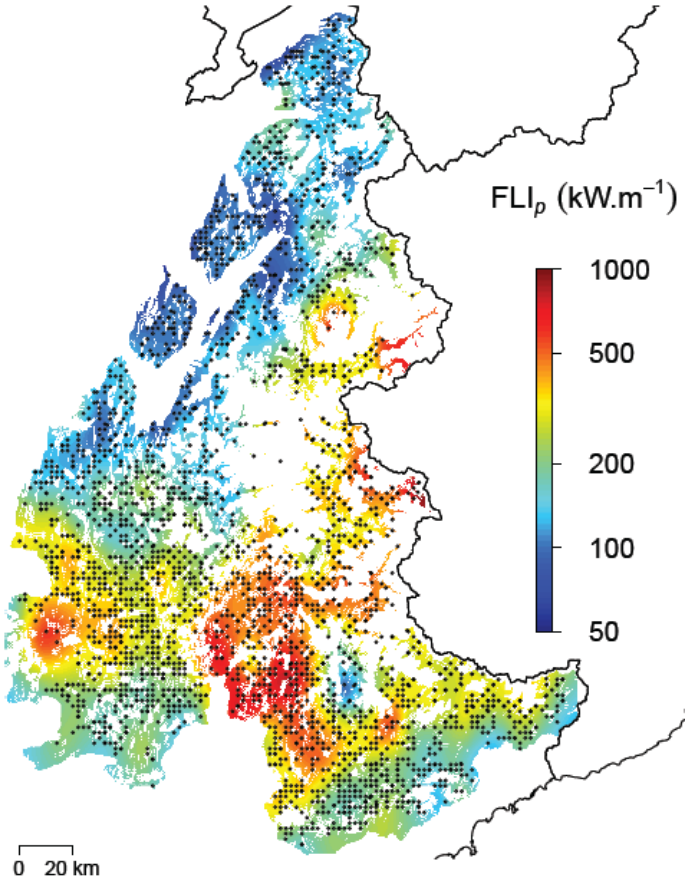
Predicting fire intensity

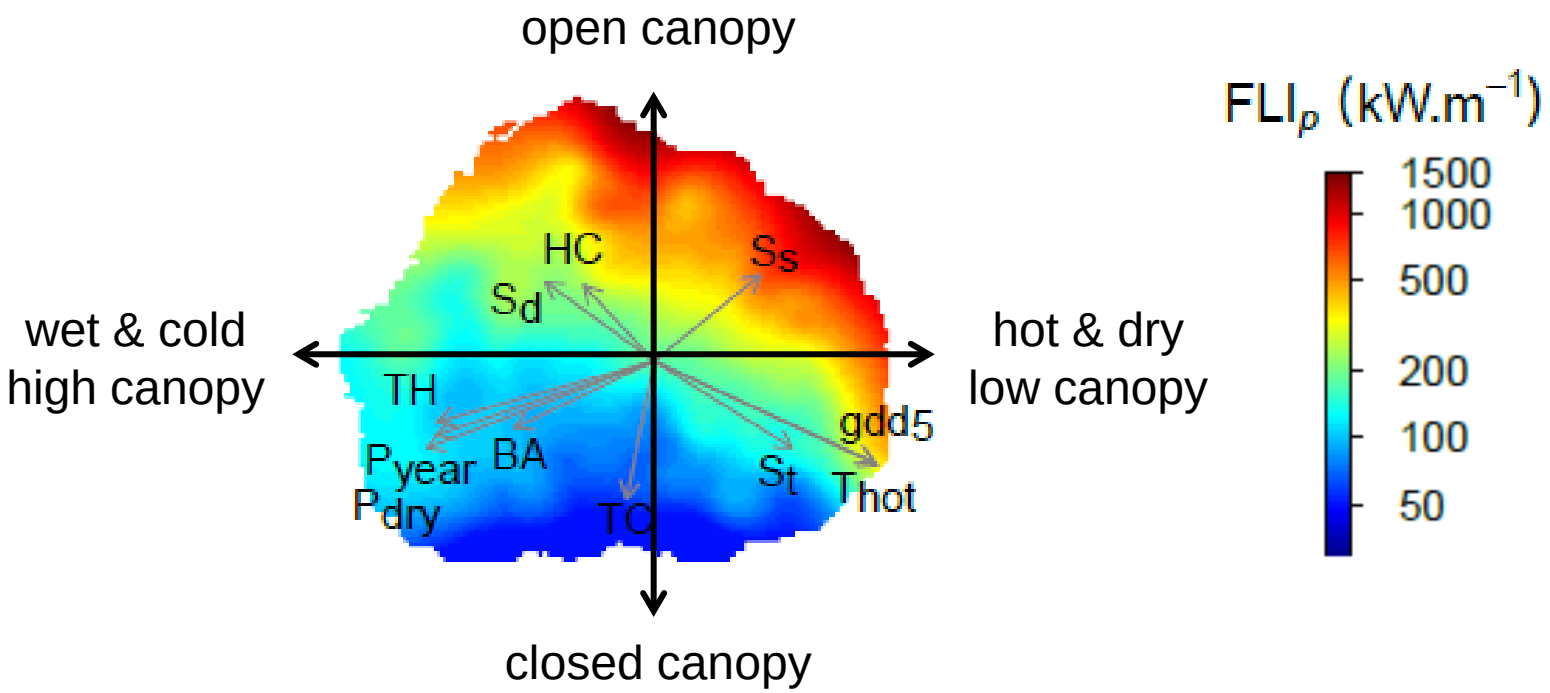






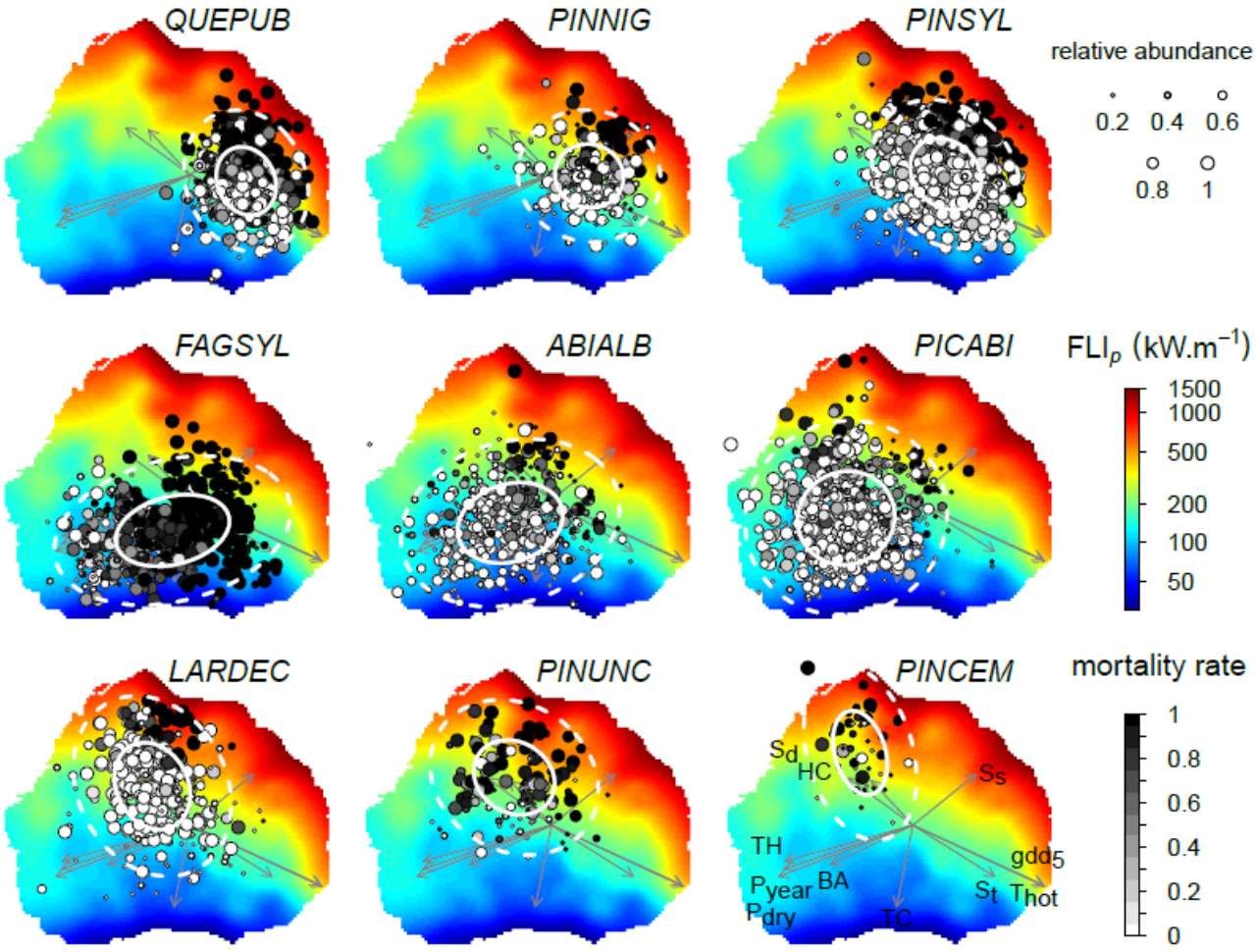
from Fréjaville 2015, PhD thesis

Predicting fire intensity within the environmental space of species distribution



from Fréjaville 2015, PhD thesis

Contrasted responses between species & within species distribution

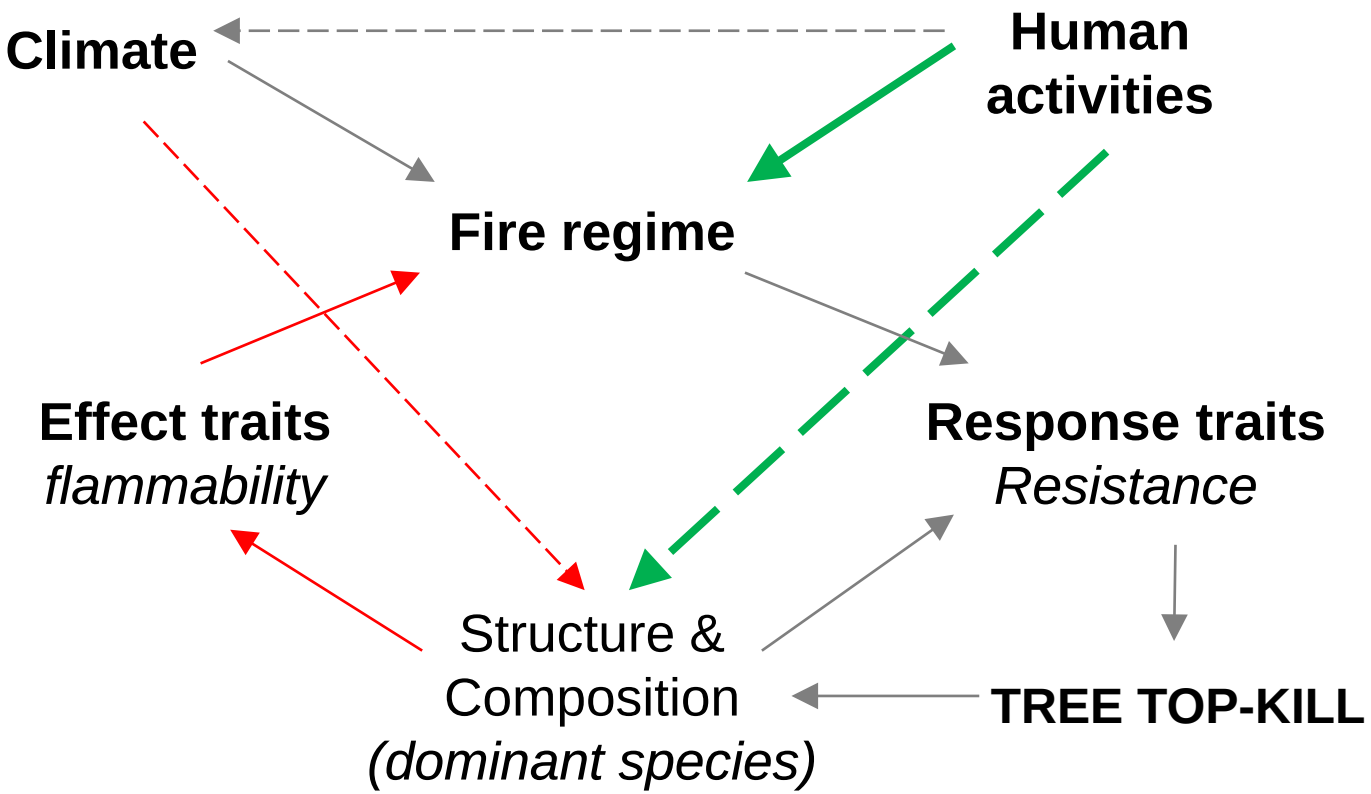


from Fréjaville 2015, PhD thesis

CONCLUSIONS

Tree cover and precipitation seasonality mostly drive fire intensity gradients across Alpine forests

→ Implications for fire prevention and forest management



CONCLUSIONS

Expected mortality rates differ between species and within their distribution with subalpine pines being the most vulnerable to direct (warming) and indirect effects (fire) of climate change

Merci !

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