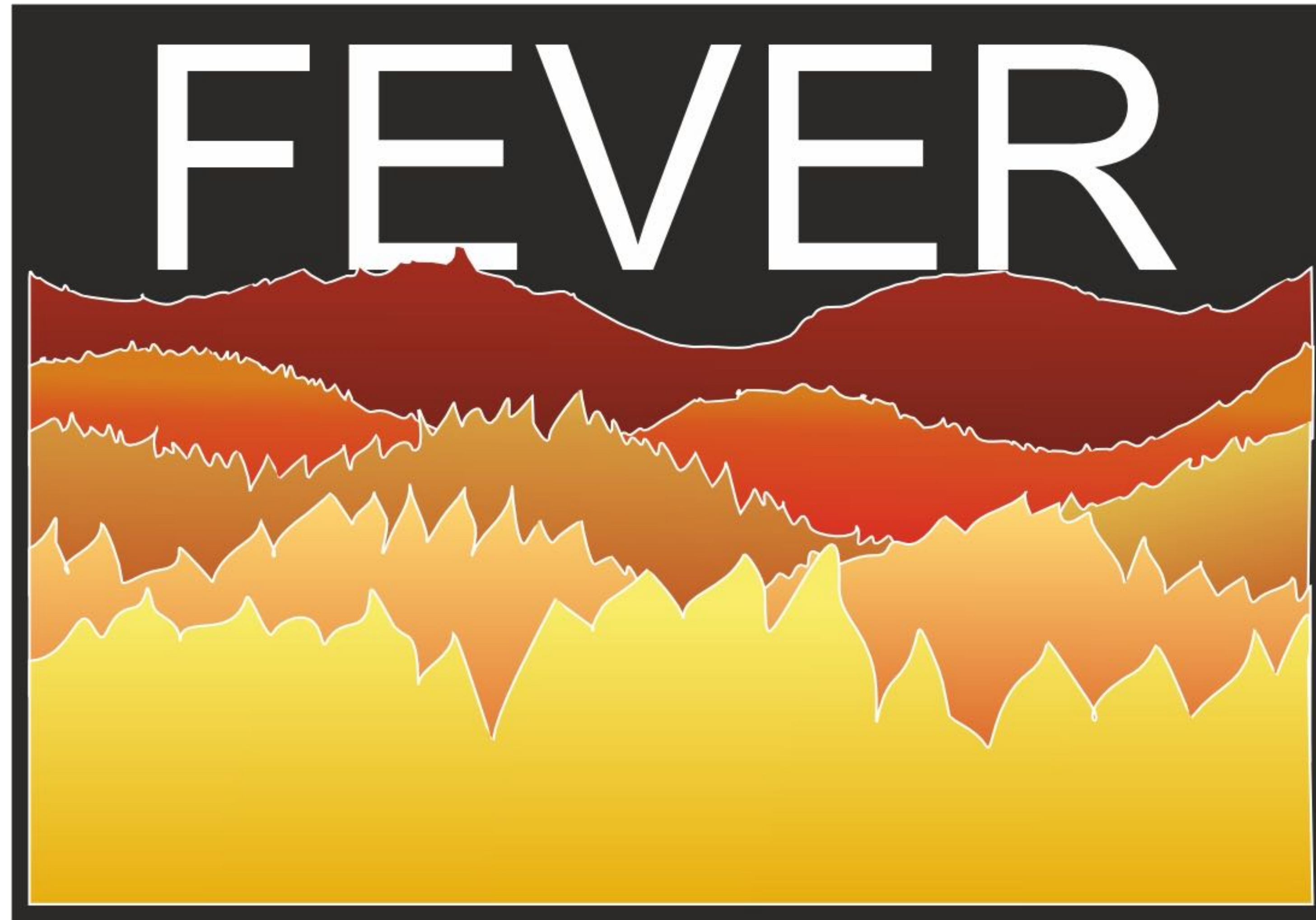
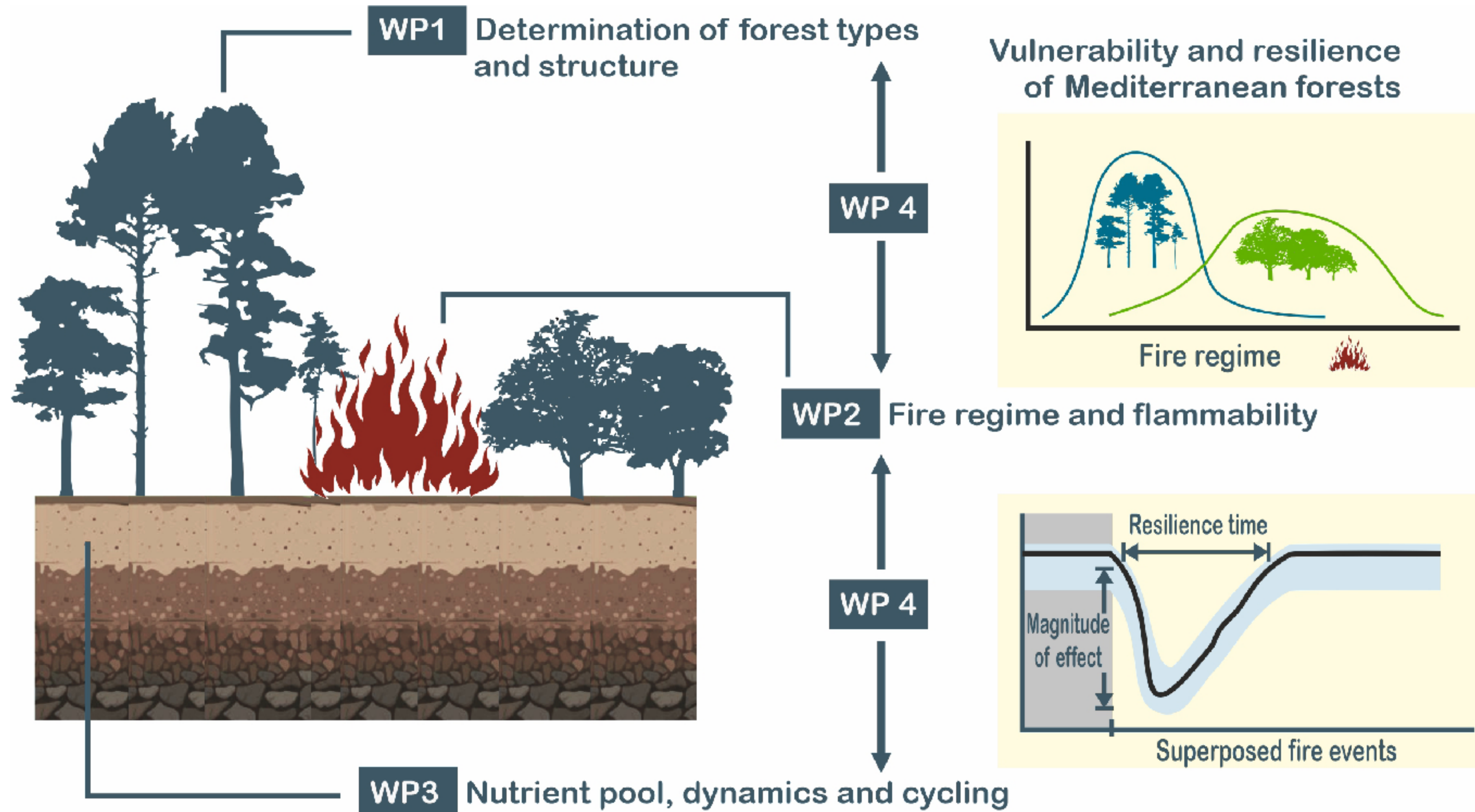


AAP PEPR FORESTT

Fire in mediterranean forested Ecosystems: Vulnerability, Equilibrium and Resilience



Main objectives and WPs



Key goals:

- (i) the effects of repeated fires on vegetation combustibility in four major forest types in southern France,
- (ii) soil responses (nutrient pools and nutrient cycling) after fire and the cumulative effects over long timescales,
- (iii) the influence of different forest formations on litter combustibility,
- (iv) the short- and long-term strategies of these ecosystems.

Academic partners



- **UMR AMAP - CNRS DR13**

- Bérangère Leys - Biogeochemical impacts of fires and vegetation diversity responses
- Tristan Charles-Dominique - Plant architectures and traits in response to disturbances
- Immaculada Oliveras-Menor - Nutrient cycling and water potential in plants in response to fires
- Karim Barkaoui - Mediterranean plant competitions and distribution



- **UMR Recover - INRAE**

- Anne Ganteaume - Mediterranean fire behaviors (ignition and spread) from experimental data
- Maxime Cailleret - Mediterranean forest composition and dynamics from field surveys



- **UMR EPOC - Université de Bordeaux**

- Anne Laure Daniau - Paleofire and vegetation interactions from marine sediment cores



- **UMR Chrono-environnement - CNRS DR06**

- Damien Rius - Paleofire and vegetation interactions from lacustrine sediment cores
- Julien Azuara - Long-term vegetation dynamics and diversity indices



- **UMR CEFE - IRD**

- Florent Mouillot - Spatial and temporal fire size and fire risks from remote data

Non academic partners

- **SDIS 13 - Fire fighters in Bouches du Rhône**



- Vincent Pastor - Unit leader
- Nicolas Rabouin - Prescribed fire leader
- Christophe Garcia - Fire origin and cause investigation



- **Warucène - Forest fires coordinator in South of France**

- Sebastien Lahaye - CEO



- **CEN PACA - Owner and stakeholders of natural areas**



- Axel Wolf - Division manager of the Crau Plaine
- Lionel Quelin - Division manager of the Alpes du Sud

- **Département des Bouches du Rhône - Owner and stakeholders of natural areas**



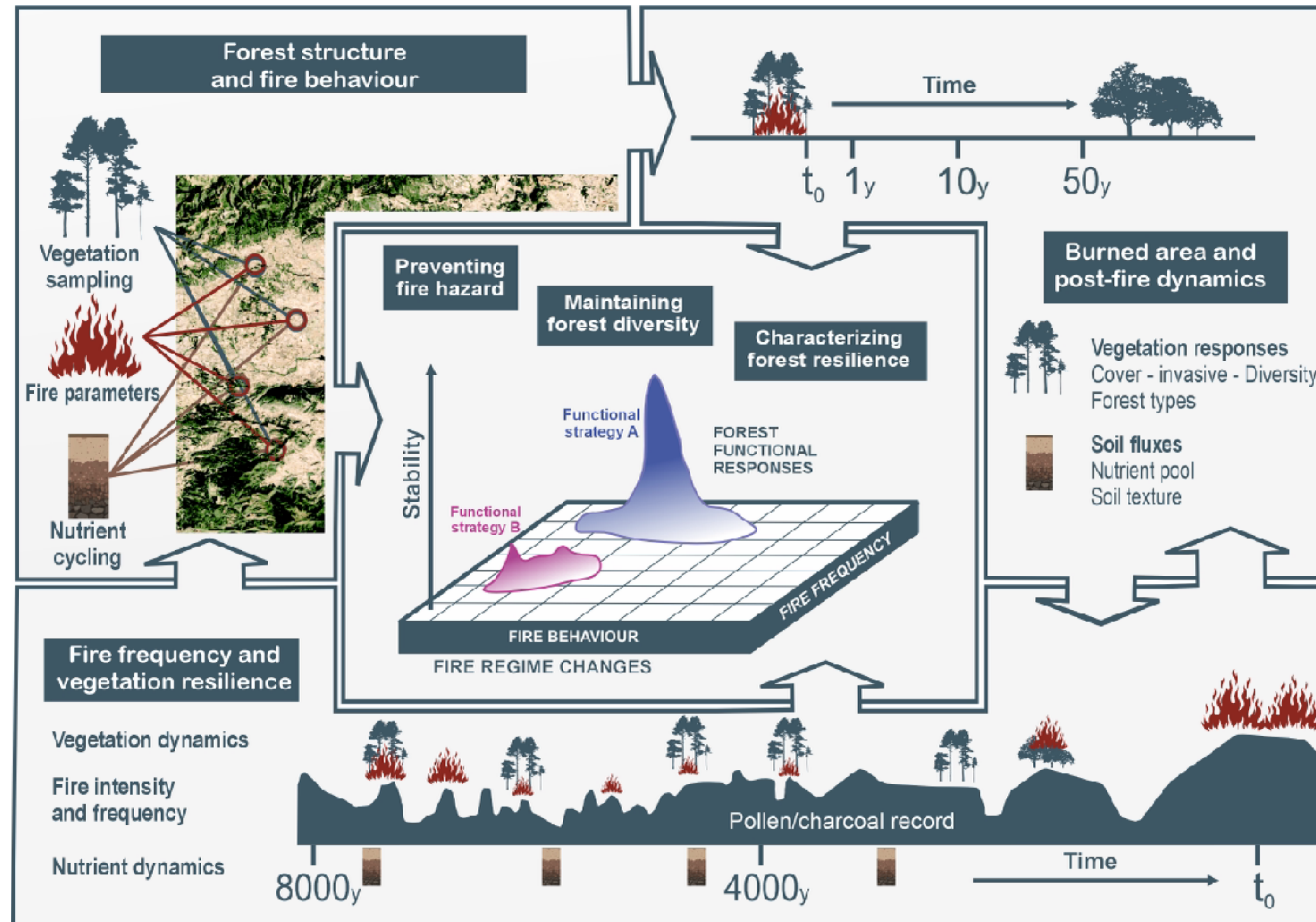
- Lionel Long - Head of the Protected Natural Area department
- Stephanie Bertrand - Manager of Forests and Natural areas department

- **Département du Var - Owner and stakeholders of natural areas**

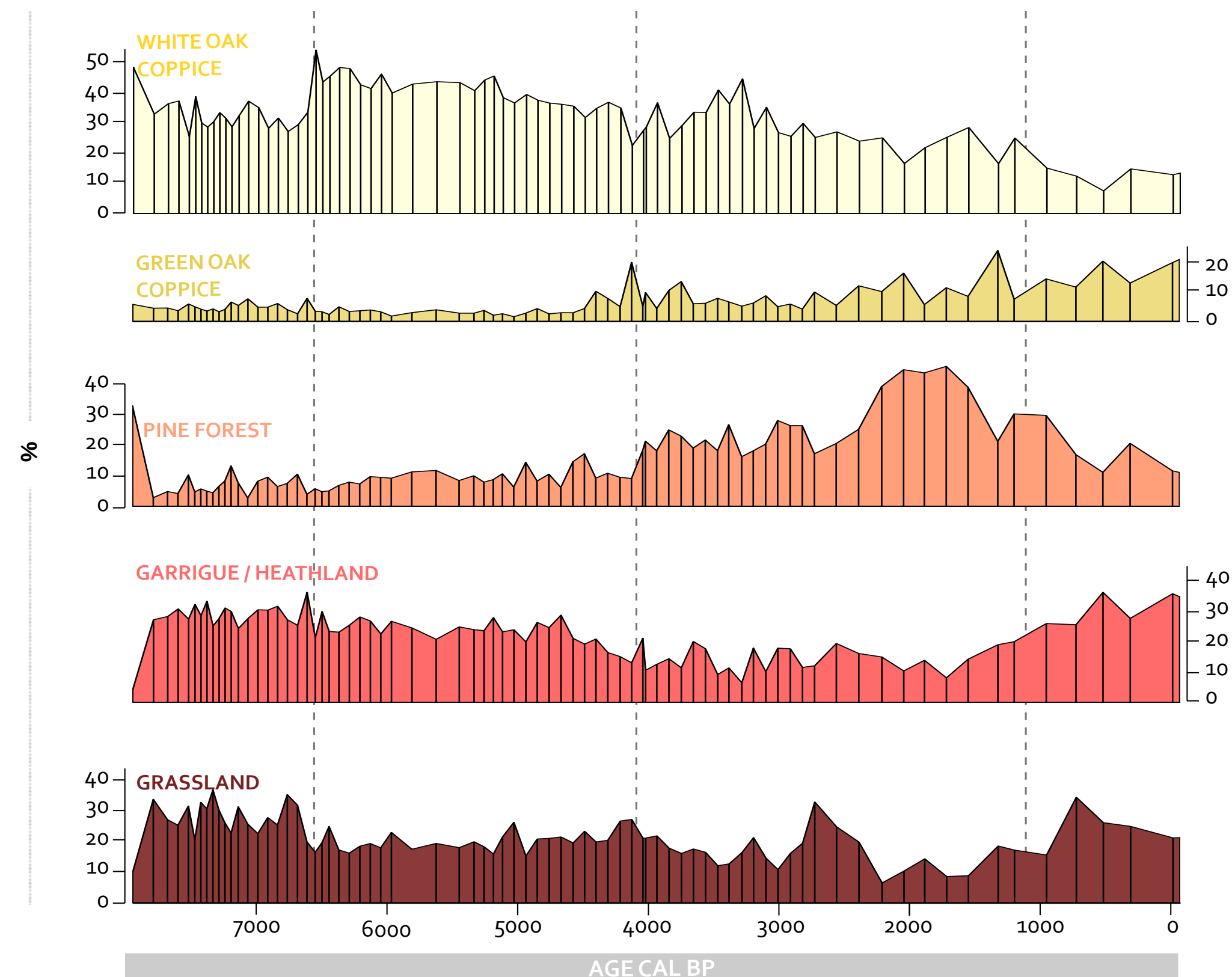


- Gilles Roubaud - Project manager of Protected Natural Areas

Main challenge: Linking different spatio-temporal datasets



WP1 - determining forest structure en dynamics by linking ground truth and long-term records (T. Charles-Dominique, M. Cailleret, CEN, CD13)



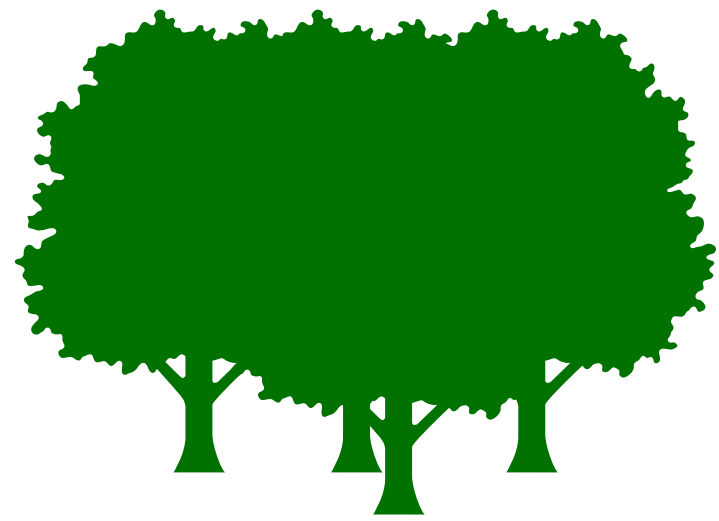
Questions adressed:

- How much precise the definition of black pine, downy oak, green oak and Aleppo pine forests can be settled ?
- What are the structures of each forest types in the Mediterranean area ?
- Is the specific forest type declining or enhancing?
- What is the specific and functional richness of each forest type?

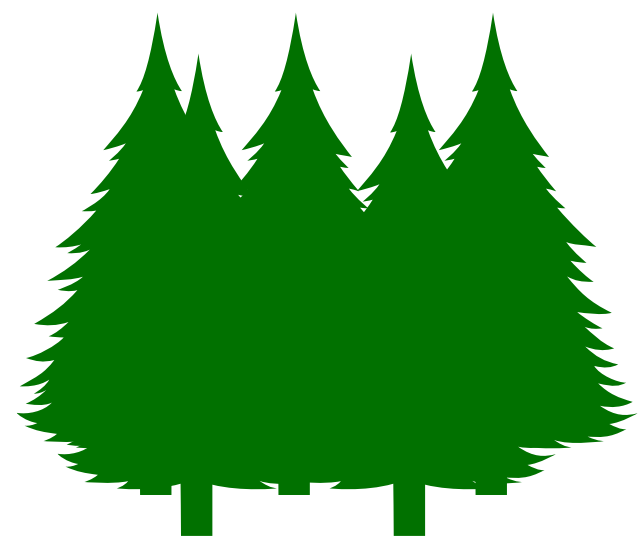
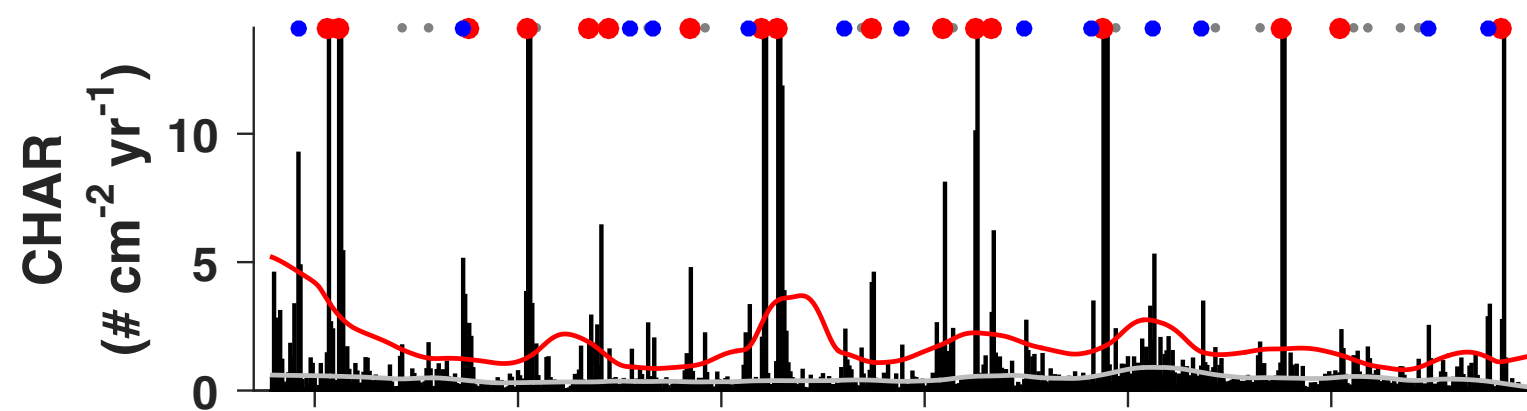
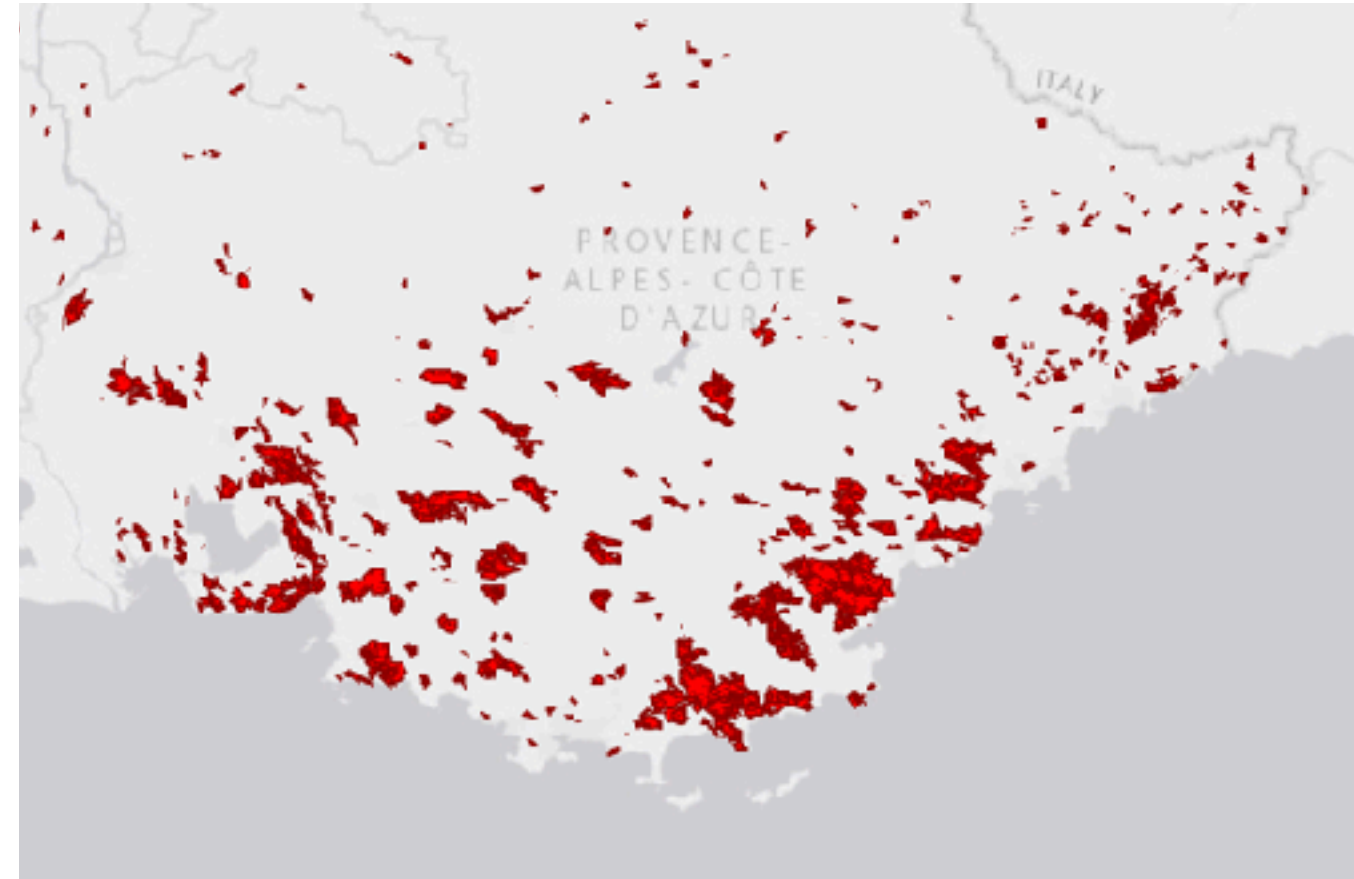
=> Allow drawing general structures of each forest type

=> Allow identifying significant parameters that most define forest stability (random forest, ACP)

WP2 - connecting prescribed fires, remote sensing fire regime and paleo fire frequency and intensity (A.-L. Daniau, F. Mouillot, SDIS 13)



Oak forests



Pine forests



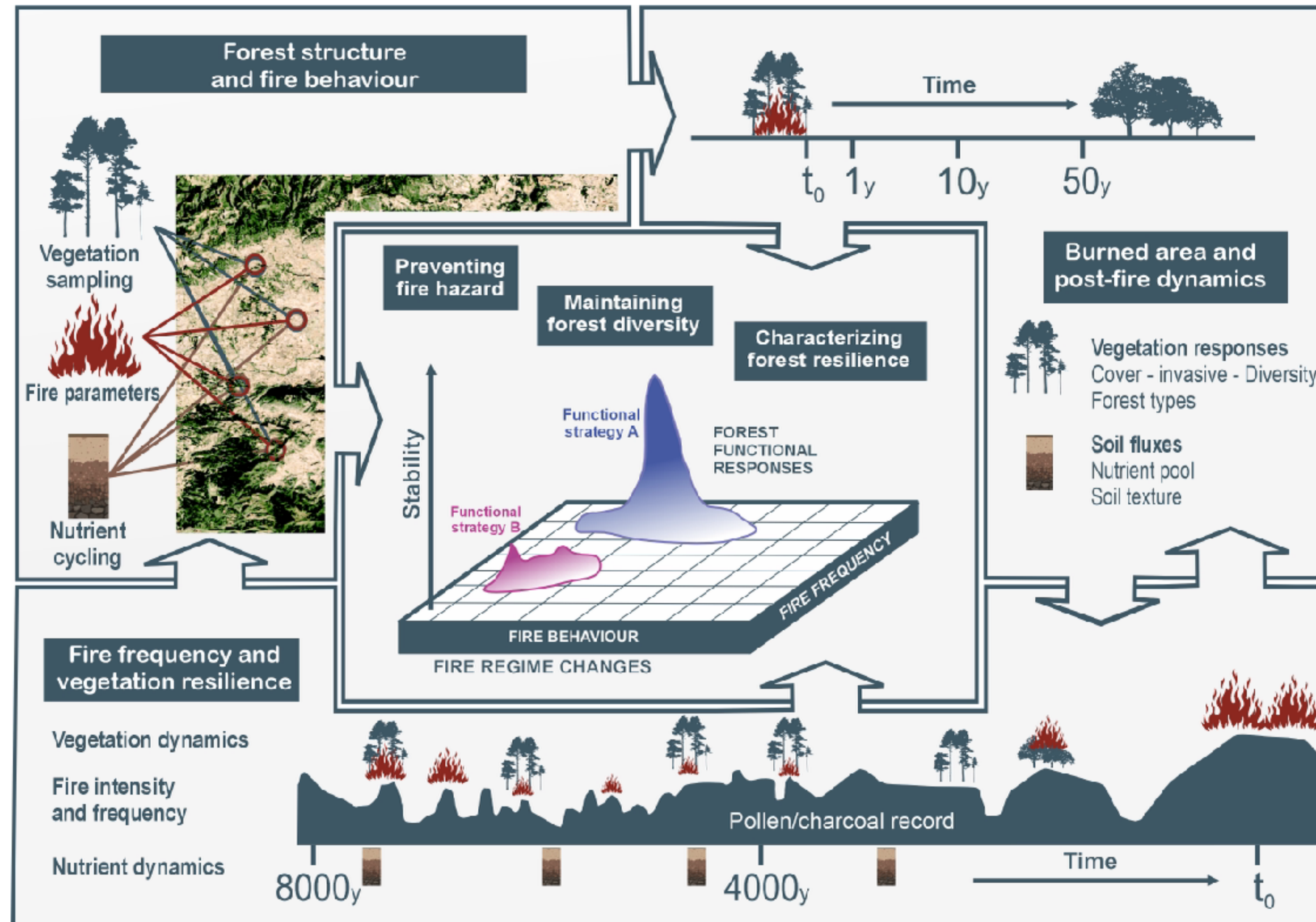
Questions addressed:

- What are the intervals of fire episodes (minimal fire occurrence) experienced by each forest type ?
- Is the specific forest type experiencing fires nowadays?
- How fire size and intensity affect the different forest types?
- How the fire behavior (heat, size of the flame, type of fuel burned) affects the forest cover?

=> Allow drawing general conclusions of fire regime for each forest type

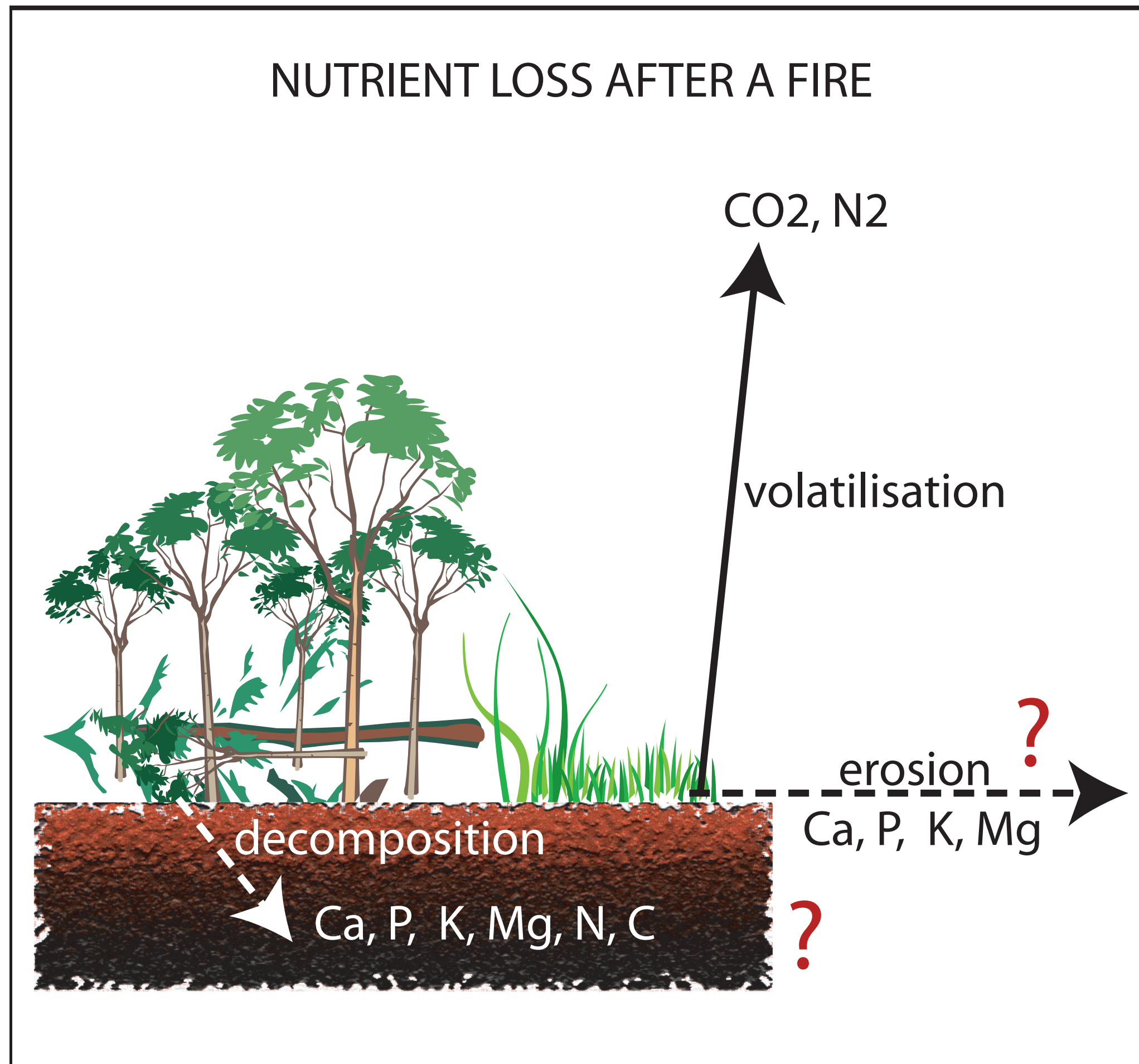
=> Allow identifying significant parameters that most affect forest stability (random forest, ACP)

Main innovation: Deciphering fire impacts on nutrient pools and resilience of Mediterranean forests



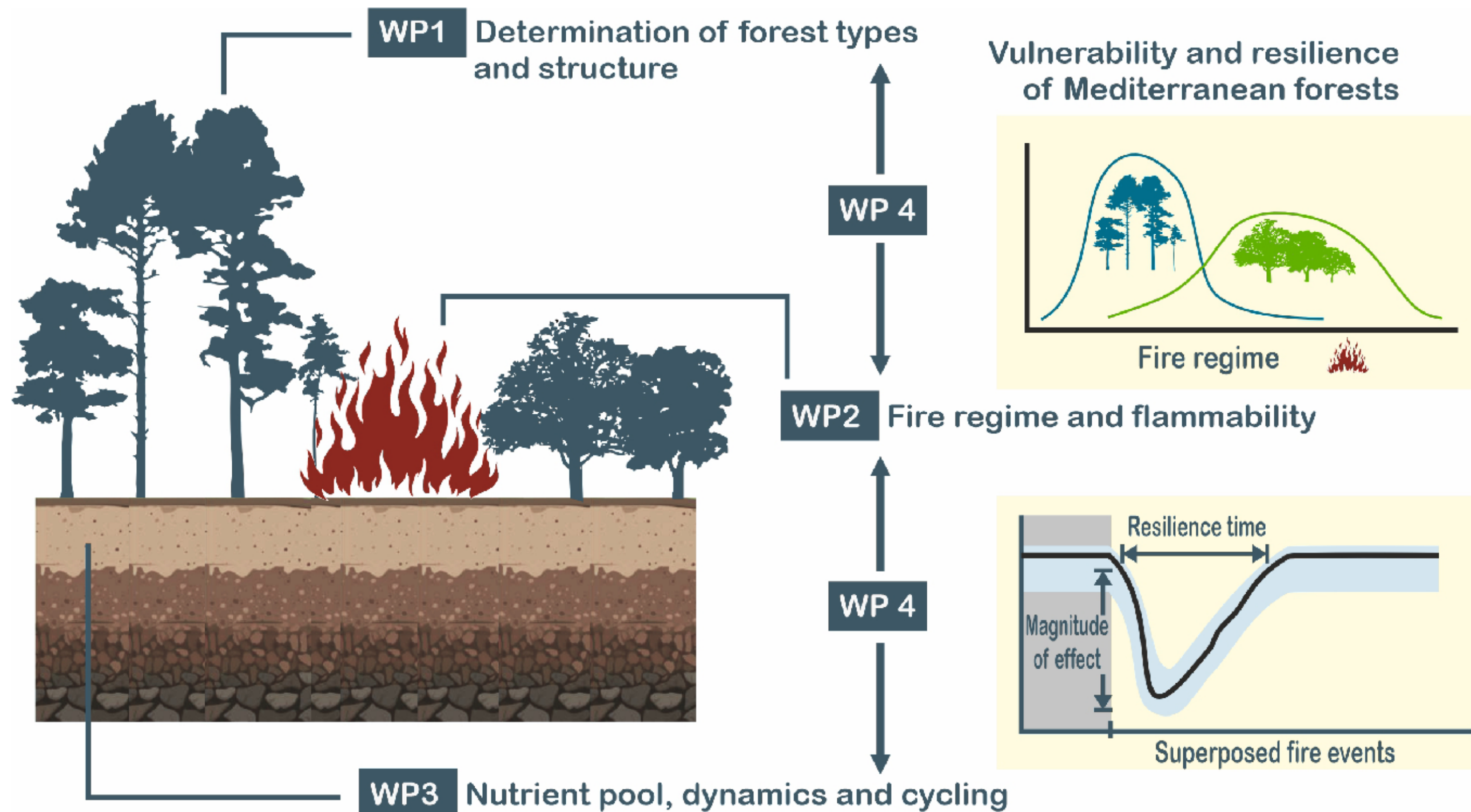
WP3 - Linking fire events and nutrient pool responses and trajectories

(I. Oliveras Menor, B. Leys, CEN PACA)



Trend	Possible Meaning
High soil, low plant	Poor availability / antagonism / blocked uptake
Low soil, high plant	Foliar application / hyperaccumulator behavior
High correlation ($r > 0.7$)	Strong nutrient-soil uptake relationship
Low or negative correlation	Nutrient interactions, mobility differences

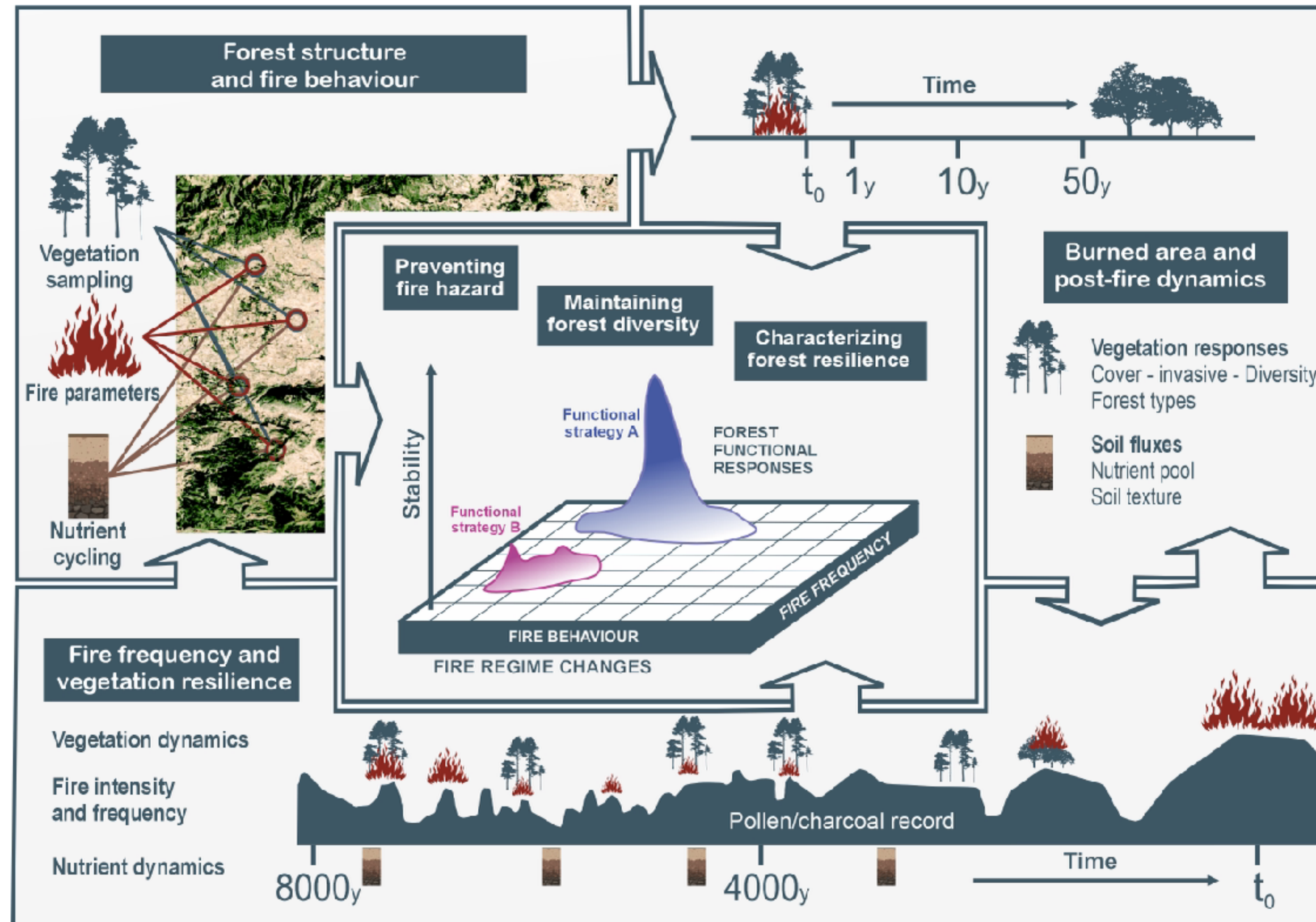
WP4 - Linking fire regime and vegetation dynamics and ecosystem functioning (A. Ganteaume, D. Rius)



Questions addressed:

- How do different forest types respond to varying fire frequencies and intensities?
- What are the ecological thresholds for these responses?
- How do fires impacts on vegetation influence nutrient cycling?
- What are the functional units in the Mediterranean area?

Main outcome: Answering land managers and fire risks concerns



WP0 - outcomes of the project and link with NGOs (B. Leys and Warucène)



Stakeholders and land managers

- co-constructed research questions with land managers
- Involved at each step of the project (sampling, lab, first results...)
- Already flyers and all public courses at Etang des Aulnes

=> Involvement with land managers of sites in FEVER already actives



WP0 - outcomes of the project and link with NGOs (B. Leys and Warucène)

Main questions of SDIS13

- Are prescribed fires impacting the forest dynamics and health?
- Are prescribed fires impacting forest cover at the district level?
- Are prescribed fires impacting forest diversity?
- Are they protected forest from more impacted fires (wild or accidental)?

Main questions of land managers

- Is my system new? Established? Stable?
- What's its relationships with fires?
- Is the configuration of today dangerous regarding fire risks?



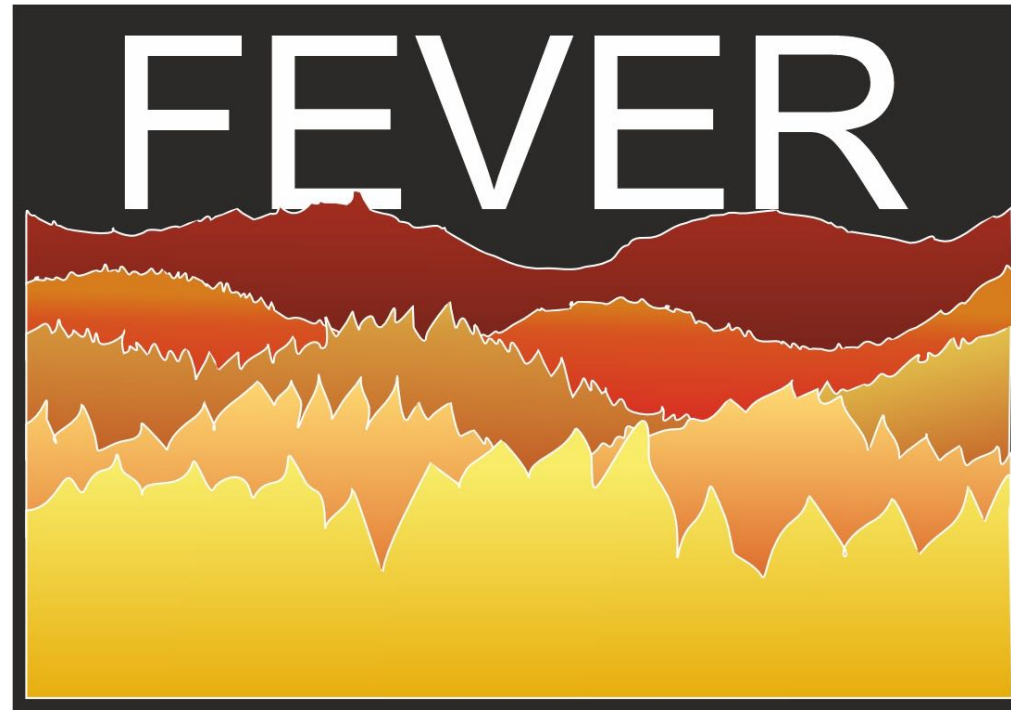
- leads the national fire management network
- 560 members from agriculture, firefighting, and forestry across 39 French districts
- Annual event days on sharing experience in tactical fire, prescribed burnings and stubble burning



PI: I. Oliveras Menor

WP leader biodiversity: T. Charles-Dominique


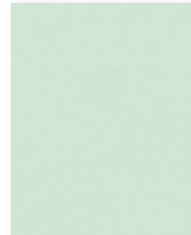

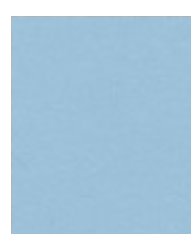
- 24 partners in 10 countries (Europe and Latin America)
- knowledge-sharing: researchers, wildfire management agencies, and non-profit organisations
- Integrated Fire Management Provide impacts on the societal needs
- Develop shared methodologies to plan and execute IFM practices



Fire in mediterranean forested Ecosystems: Vulnerability, Equilibrium and Resilience



WP3 - Linking fire events and nutrient pool responses and trajectories (I. Oliveras Menor, B. Leys, CEN PACA)

-  XRF
-  Nutrients
-  Erosion /
crustal element
-  Pollutants

Periodic Table of the Elements

1 H Hydrogen 1.008																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.933	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.09	35 Br Bromine 79.904	36 Kr Krypton 84.80
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.29
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanides	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103 Actinides	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium unknown	114 Fl Flerovium [289]	115 Uup Ununpentium unknown	116 Lv Livermorium [298]	117 Uus Ununseptium unknown	118 Uuo Ununoctium unknown

57 La Lanthanum 138.906	58 Ce Cerium 140.115	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.966	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]