



New approach to assess wildfire vulnerability of touristic infrastructures

Bruno GUILLAUME, Mohamad EL HOUSSAMI, Gildas AUGUIN, Romane KULESZA, Pascale VACCA, Maria PIPIO, Enrico RONCHI, Cdt Marjorie SAMPSONI, Lt-Col Philippe MERESSE, Elsa PASTOR

Wildland-Urban-Interface fire Touristic Infrastructures Protection Solutions



OUTLINE

- Context of WUTIPS project
- General - Basic information, Main Objectives, Main methodology and tasks
- Specific Task – Guidelines and general methodology to estimate building vulnerability and protection
- Specific Task – Application to a French touristic infrastructure
- Specific Task – Web tool of coarse vulnerability index
- Perspectives

CONTEXT

- **Wildland-urban fires are a large growing threat to WUI Touristic Infrastructures (WUITIs)**
- **The “WUITIs” present a lot of strong vulnerabilities at different spatial scales that are yet poorly addressed:**
 - Tourists have limited knowledge of terrain and local wildfire risk
 - Individuals with diverse cultural backgrounds, spoken languages, and varying risk perceptions
 - Limited temporary refuge areas against wildfire (lightweight constructions, camping cars...)
 - Long evacuation time to protected areas (sports area in city center...)
 - Chaotic nature of evacuation flows impedes firefighting operations
 - Unharmonized protection practices in the concerned EU countries



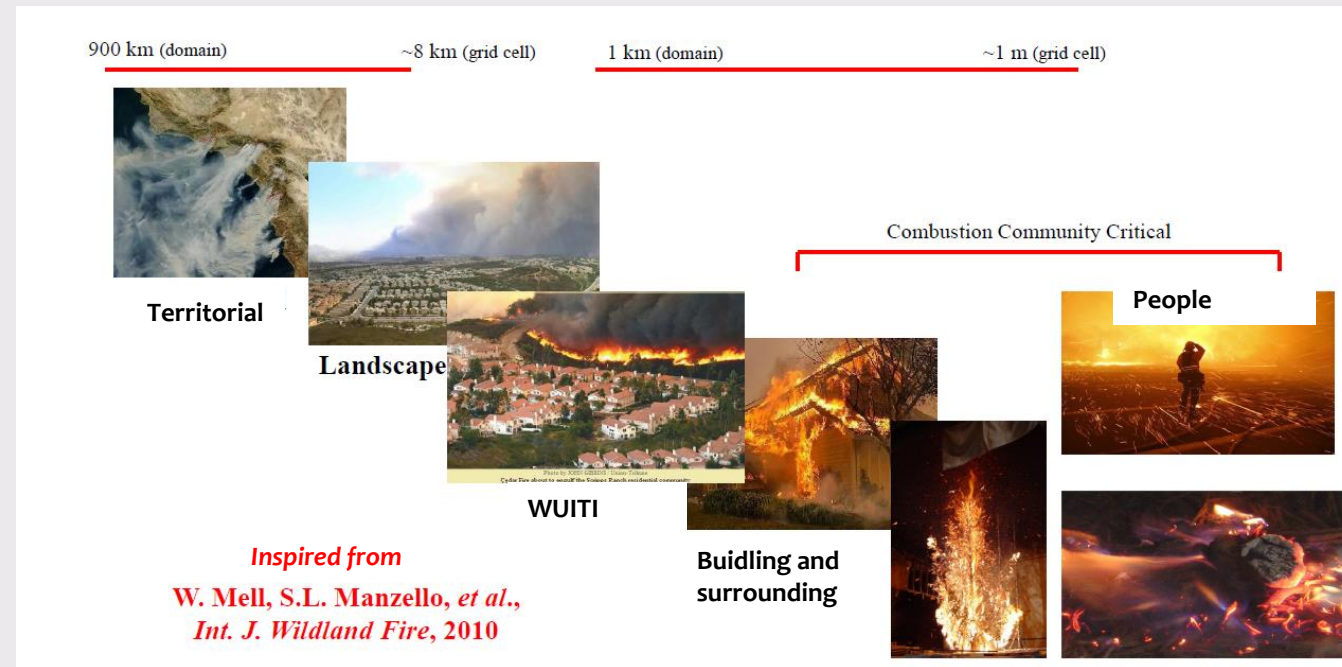
Le Lavandou, (France, 2017) Source: Claude Paris AP



Colera (Spain, 2023) Source: Colera municipality

WUITIPS MAIN OBJECTIVES

- **WUITIPS aims at**
 - Developing Fire Safety Engineering (FSE) decision-support tools and methodologies with a certain level of EU harmonization (inside a dedicated “Living Lab”) helping to
 - diagnose the vulnerabilities at the different scales,
 - test efficiency of suitable protections
 - Demonstrating the approach on case studies in France (Pyrénées-Orientales) and Catalonia regions
- **WUITIPS covers all vulnerability scales to protection against wildland-urban fires:**
 - Large territorial scale (Region-Landscape-Province-Municipality)
 - identifying hot spot risk zones (highly touristic and high wildfire risk)
 - WUITI scale
 - Analyze evacuation flows, and on-site features helping fire-fighters,
 - Building scale
 - Analyze temporary refuge buildings/roads
 - People scale
 - Analyze signalisation/information/alert for tourists, staff task awareness/risk preparedness (roles during event...)



WUITIPS MAIN METHODOLOGY AND TASKS

WP2

State of the art on EU techniques, protocols, methods and regulations
Define harmonization needs

WP1 Management

Phase 1 - Harmonization

WP2
Harmonized understanding of the problem and identification of needs

WP3
Hazard and vulnerability assessment

Phase 2 - Development

WP4
Building envelope vulnerability

WP5
Human vulnerability and protection

Phase 3 - Integration & Implementation

WP6
Integration and implementation

WP6

WUITI scale - Webtool to retrieve coarse vulnerability index based on declarative WUITI data

Building scale - Testing complex vulnerability and protection assessment in pilot sites

WP3

Territorial scale - Harmonised GIS-based methodology to identify high vulnerability spots in regions

WP7 Dissemination and exploitation

WUITI scale - Guidelines and general methodology to reduce people's vulnerability in evacuation

WP5

Focus here on Specific Tasks

Living lab of knowledge transfer and helping harmonization
Disseminate technical and scientific outcomes and communicate results

WP7

SPECIFIC TASKS – BUILDING SCALE METHODOLOGY

- **Specific methodology** developed by UPC and Efectis France:
 - PBD-based, performance criteria harmonized btw FR and CAT regions (models used can differ)
 - Designed for FSE
 - Builds on state-of-the-art scientific models for fire interaction with built environment in WUI
 - Provide guidelines providing assumptions to be used for FSE, and typical protection measures

Campsites



Isolated touristic villas



Hotels



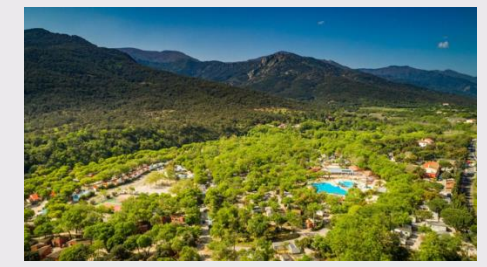
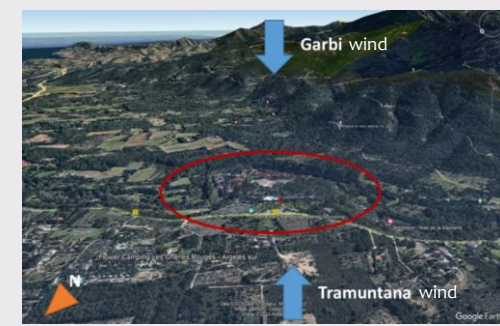
- **Steps:**
 - Identify WUITI typology, then identify inside the WUITI a heavyweight construction able to act as temporary refuge area (welcome, restaurant...)
 - Define quantitative performance criteria for building to act as a refuge (protection against fire, firebrands and smoke toxicity) then use fire, flux and thermal transfer models to diagnose vulnerability
 - Provide guidelines for structural self-protection (review active and passive protection types)
 - Assessment of vegetation cleaning practices for the building surroundings (fuel reduced fringes), for French and Catalonia regulations

	Quantitative PBD criteria (2min)	Quantitative PBD criteria (30min)	Vulnerable items in the pilot sites	Possibility of application to the FR case studies
Non ignition of walls or roof (target = exterior face) (Auguin et al., 2008, French Order of 29/07/2015)	<1800 (kW/m ²) ^{4/3} s	<8kW/m ²	Wood shutters, window wood frames and lintels	Quantitative assessment possible, using WUI flux model
Non explosion of the windows (target = exposed face) (3criteria, Vacca et al, 2020)	<1840 (kW/m ²) ^{4/3} s	<8kW/m ²	Windows and window bays	Quantitative assessment possible, using WUI flux model
	ΔT(middle-edge)<58°C	ΔT(middle-edge)<58°C	Windows and window bays	No knowledge of openings characteristics – If calculation is needed , standardized material properties will be assumed
	<150°C	<150°C	Windows and window bays	No knowledge of openings characteristics – Risk can be estimated as soon as 150°C is the temperature of the plume reaching the window
Tenability in the room for people (target = center of room, or interior face) (Auguin et al., 2008, LCPP 2017)	<60°C	<60°C	Building interior	No knowledge of openings & walls characteristics – If calculation is needed , standardized material properties will be assumed
Firebrands			Pergola with reed roof, lintel debording the facade	Qualitative assessment (NIST recommendations)
Toxicity			Building interior	The different critical thresholds of n50 will be recalled. A way of measuring the n50 will be described. If more etancheity is needed, qualitative measures will be detailed to achieve this goal.

SPECIFIC TASKS – FRENCH CASE OF CAMPSITE “BOIS FLEURI”

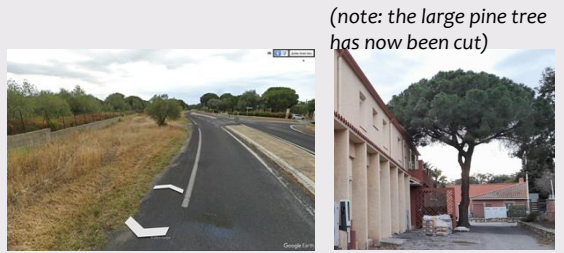
- **Campsite in Argelès city, about 2500 pers., entrance building as a potential refuge**
 - High risk asset under Tramuntana wind, fire can escape in the pre-mountains
 - (Wildfire hit the neighbouring campsite in Aug 2023, mainly under Garbi wind)
 - Efectis + Entente Valabre, in very good contact with local authorities (DDTM66, SDIS66, CS Argelès) , could select “Bois Fleuri” campsite, and made a visit in December 2023, inventorying all **hazard-vulnerability pathways** from combustible materials and vegetation present in the building surroundings (last 100m)
 - Use **WUI flux model** to assess vulnerability

Illustrations of « Bois Fleuri »



Extract of the identified hazard-vulnerability pathways

Hazard item	Exposed vulnerability item	Already existing or ongoing protection measures (incombustible material, protections...)
Unmanaged olive tree plantation in neighbouring campsite (large shrub understory) (before Aug 2023 fire – after fire, no more understory)	Window bays of entrance hall, exposed on Northern façade (10m long) and Western façade) at ground floor - No impact at first floor due to protections	- Masonry balcony cuts the impact to first floor windows - Masonry roof frame, mineral tiles assembly with no openings - Masonry junction btw wall and roof - Aluminium gutters
Cypress hedge at 14m from Northern facade	Window bays of entrance hall, exposed on Northern façade (10m long) at ground floor - No impact at first floor due to protections	- Cypress hedge currently being cut from 5m height down to 2m height - Masonry balcony cuts the impact to first floor windows



WUI flux model



Refuge assessment

	Quantitative PBD criteria (2min)	Quantitative PBD criteria (30min)	Application to case with hedge
Non explosion of the windows (target = exposed face) (3criteria, Vacca et al, 2020)	<1840 (kW/m²)⁴/³s	<8kW/m²	Windows in danger by fluxes up to 26kW/m²
	ΔT(middle-edge)<58°C	ΔT(middle-edge)<58°C	Not evaluated
	<150°C	<150°C	Windows in danger with hot gases much higher than 250°C

The entrance hall cannot be seen as a refuge. However, if wall with fire resistance REI30 can be installed between entrance hall and office, the office and rooms with no window can make compartment.

SPECIFIC TASKS – WEBTOOL OF COARSE VULNERABILITY INDEX

- **Webtool** developed by Efectis France, calibrated by UPC, designed for interviews by UPC/Efectis/Pau Costa Foundation, and hosted on UPC server
- Designed for WUITI managers, local risk management and fire-fighting authorities:
 - WUITI managers store declarative information on their site (questionnaire of 42 questions), and receive feedback as a coarse VI
 - Risk managers access data of all WUITIs in their domain
- 5 initial languages: English, French, Catalan, Spanish, Italian



The screenshot displays the 'Vulnerability Index Calculator' web tool interface. The top navigation bar includes the logo and a language selector set to English. Below the navigation are links for 'Your vulnerability Index', 'Modify the answers', 'Description of the property', 'Areas for improvement', 'Account details', and 'Sign out'. The main content area is divided into two panels:

- Description of the property:** This panel features a map of a property with a 'Pool' label. A legend titled 'Polygon categories' lists: Buildings (green), Shelter building (red), Storage areas (blue), Parking lots (dark green), Continuous natural fuels within the property (purple), Fuel-reduced fringe (orange), and Other (cyan). A sidebar on the left contains a questionnaire with questions like 'Do you have an emergency assembly source?' and 'Is there a fire alarm system?' with 'Yes' and 'No' radio buttons.
- Answers:** This panel shows a map of the same area with a 'Vulnerability index' dropdown menu and a map overlay showing different vulnerability levels (e.g., 0.9, 2.2, 1.0) across the property.

WUITIPS PERSPECTIVES

- WUITIPS will provide knowledge, tools and guidance on how to reduce vulnerability of tourist infrastructure (including structure and human vulnerability) to be used by:
 - Tourist infrastructure managers and staff
 - Local risk management agencies
 - First responders
 - Fire safety engineers
- Some ideas for successful implementation of the WUITIPS toolkit:
 - Engagement of the insurance sector
 - Thoughtful and targeted dissemination strategy through regional tourism organizations and risk management agencies (top-down approach).
 - Financial support secured for implementing risk mitigation measures.



THANKS !

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- EU DG-ECHO
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- LOCAL AUTHORITIES