

# Modelling the fire propagation and fire impacts on buildings in the Wildland-Urban Interfaces

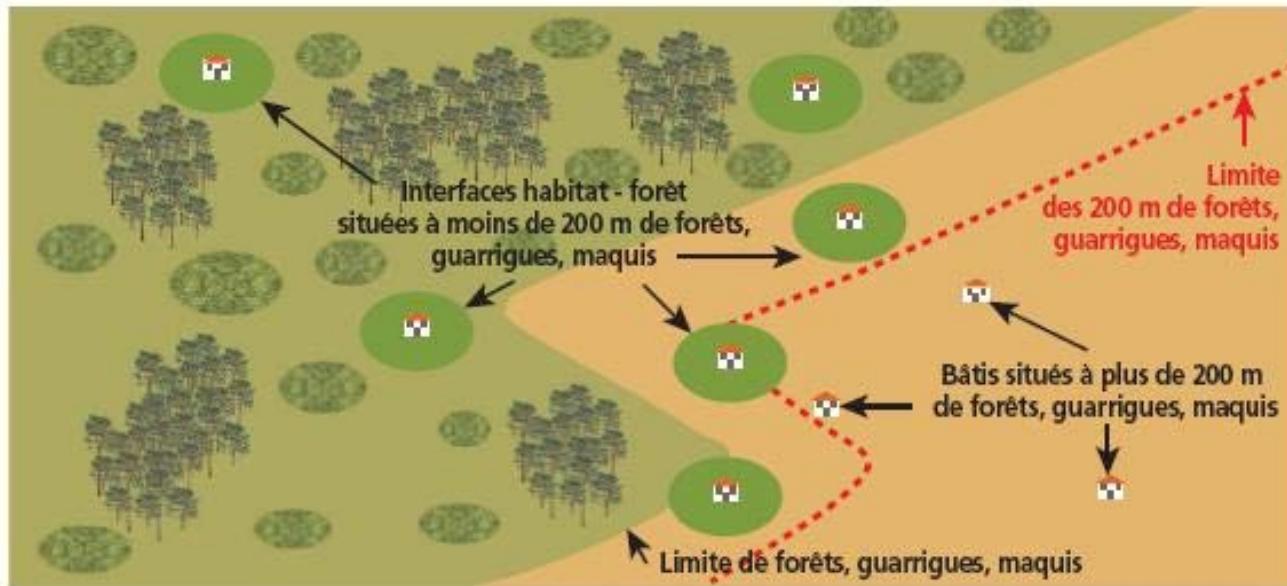


**Anne GANTEAUME**

# INTRODUCTION

## Context

### ➤ Increasing Wildland-Urban Interfaces (WUI) in SE France



# INTRODUCTION

## Context

➤ Increasing Wildland-Urban Interfaces (WUI) in SE France => Increasing fire occurrence



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➤ Increasing WUI in SE France => Increasing fire occurrence



Role of the **ornamental vegetation** as important vector of fire propagation towards housing



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➤ Increasing WUI in SE France => Increasing fire occurrence



Role of the **ornamental vegetation** as important **vector of fire propagation** towards housing



Possible significant damage to structures



# INTRODUCTION

## Context

Ornamental vegetation => Possible **significant damage** to structures

Due to massive firebrand shower ...

...or to heat radiating from the flame front



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Ornamental vegetation => Possible **significant damage** to structures



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Ornamental vegetation => Possible **significant damage** to structures



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Need to better understand the fire behavior in WUI vegetation



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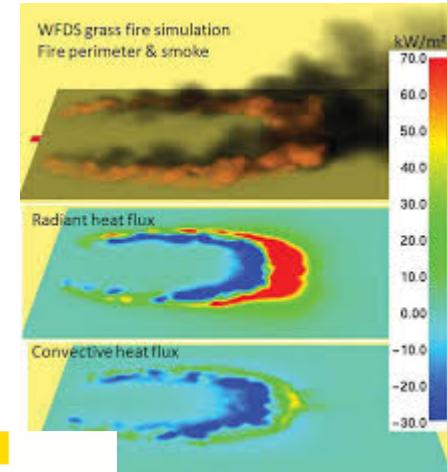
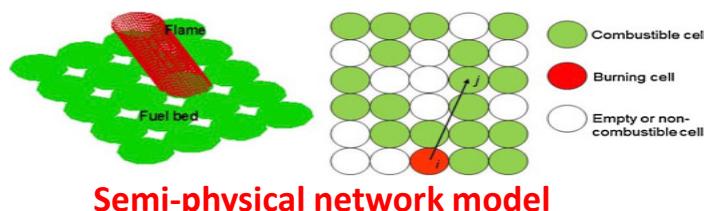
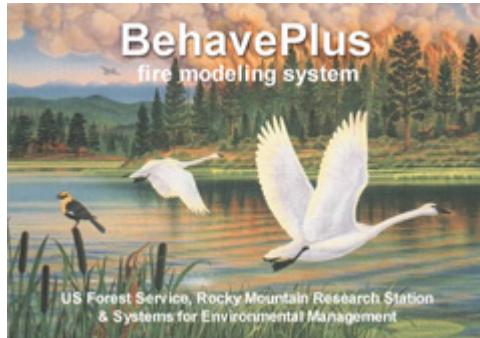
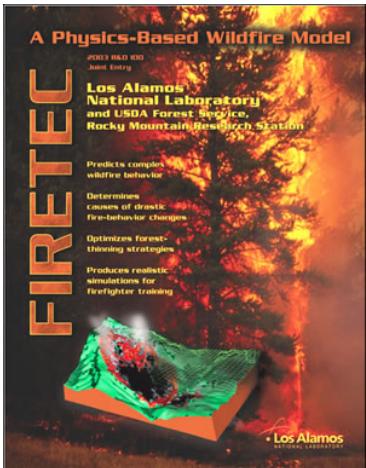
### Modelling the Fire Behavior : What's the status?



# INTRODUCTION

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### Modelling the Fire Behavior : What's the status?



#### Empirical behavior models

- Predict RoS and/or Intensity on the basis of fuel load and meteorology
  - McArthur 1966
    - CSIRO grass fire spread nomogram (humidity, temperature, degree curing, wind speed, slope)
  - Trollope and Potgieter (1985)
    - (fuel load, humidity, wind speed, temperature)

Used for risk prediction and fire control

McArthur, AG 1966 Weather and grassland fire behavior. Dept Forests, Canberra  
Trollope, WSW and Potgieter ALF 1985 Fire behavior in the Kruger National Park.  
J Grassld Soc Sth Af 3:148-52

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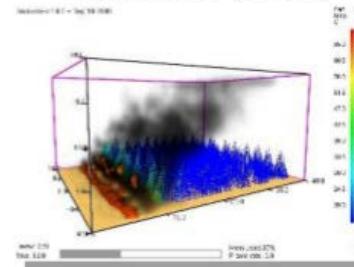
### Modelling the Fire Behavior : What's the status?



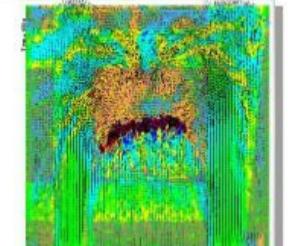
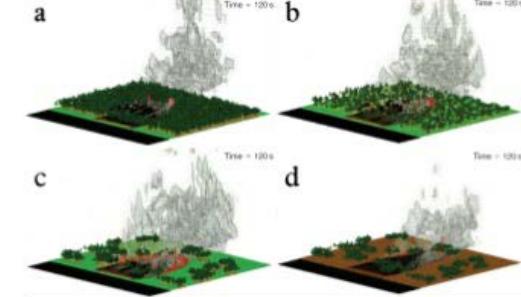
Very efficient modelling in Wildland vegetation



Wildland Fire Dynamics Simulator (NIST)



FIRETEC (LANL)



Common outputs: Fire rate of spread, fireline intensity, flame height, fire perimeter

# INTRODUCTION

## Context

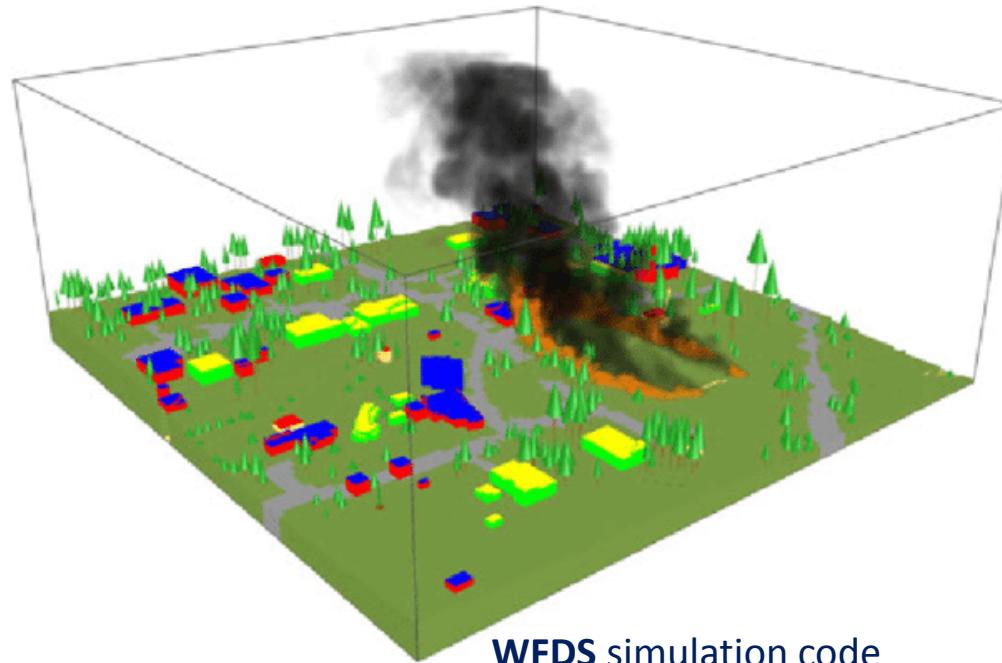
### Modelling the Fire Behavior : What's the status?



Very efficient modelling in **Wildland vegetation**



Some attempts at the WUI



WFDS simulation code

# INTRODUCTION

What do we need now?

Modelling the Fire Behavior in WUI vegetation

→ Adapting models because **more heterogeneous vegetation** in WUI than in wildland



# INTRODUCTION

What do we need now?

Modelling the Fire Behavior in WUI vegetation => impacts on structures



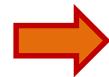
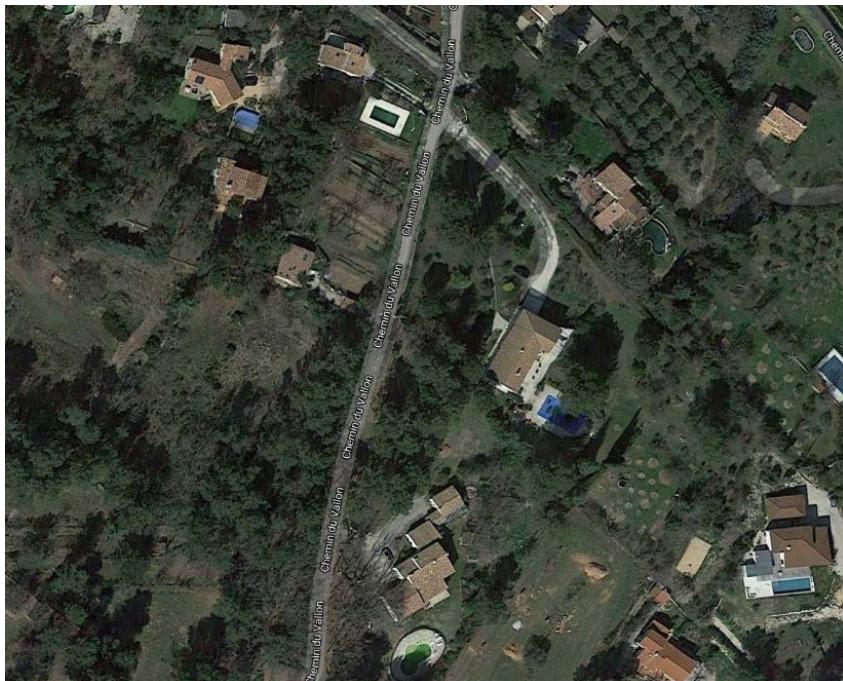
Figure 38 Image showing structure to structure fire spread on primary structures ignited by 18:38.

# METHODOLOGIE

## Modelling the Fire Behavior in WUI vegetation : How?



Generating vegetation scenes (2D & 3D)



Georeferenced plants => spatial distribution of vegetation

Species, crown diameter, crown height, total height



# METHODOLOGIE

## Modelling the Fire Behavior in WUI vegetation : How?



Getting data on **the structure** of ornamental species



Photo: Irstea

**Litter bulk density, litter load, leaf bulk density, leaf SVR, FMC  
% dead fuel, % live fuel**



Photo: Irstea

# METHODOLOGIE

## Modelling the Fire Behavior in WUI vegetation : How?



Getting data on **the flammability** of ornamental species



**Flammability experiments:**  
Time-to-ignition  
Flaming duration  
Ignition temperature  
Flame height,  
Flame temperature, etc.



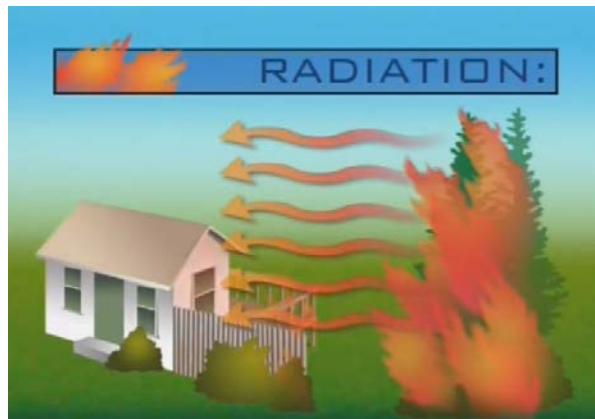
# METHODOLOGIE

## Modelling the Fire Behavior in WUI vegetation : How?



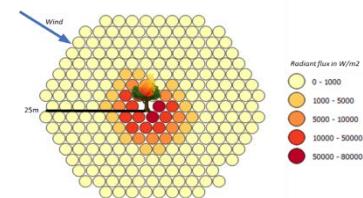
### Selecting the model

- FireWUI



Based on the fire spread model SWIFFT (De Gennaro 2017)

- ⇒ Enhanced combustion scheme
- ⇒ Coupled with a module of fire-induced thermal degradation of structures
- ⇒ Adding a simplified firebrand modelling



# SOME RESULTS

## Modelling the Fire Behavior in WUI vegetation



**SCENARIO 1 :**  
Vitesse- direction de vent fictives (10m/s - Vent origine Sud-Ouest) //  
Terrain plat //

Jardin sous vent dominant // Pelouse sèche non tondue

Jardin brûlé en 252s d'après la simulation.



# SOME RESULTS

## Modelling the Fire Behavior in WUI vegetation



### SCENARIO 2 :

Vitesse/direction de vent fictives (10m/s - **Vent origine Nord-Ouest-**)  
// Terrain plat // Jardin attaqué par le flanc du feu // Pelouse sèche  
non tondue



Jardin brûlé en 238s d'après la simulation.



# SOME RESULTS

Modelling the Fire Behavior in WUI vegetation => impacts on structures



# SOME RESULTS

## Modelling the Fire Behavior in WUI vegetation => impacts on structures



% façade dégradée par le flux thermique

- 0%
- 0,1% - 10%
- 10% - 20%
- 20% - 50%
- 50% - 100%



# SOME RESULTS

Modelling the Fire Behavior in WUI vegetation => impacts on structures



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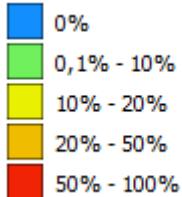


# SOME RESULTS

Modelling the Fire Behavior in WUI vegetation => impacts on structures



% façade dégradée par le flux thermique



# SOME RESULTS

Modelling the Fire Behavior in WUI vegetation => impacts on structures



Vegetation managed around housing



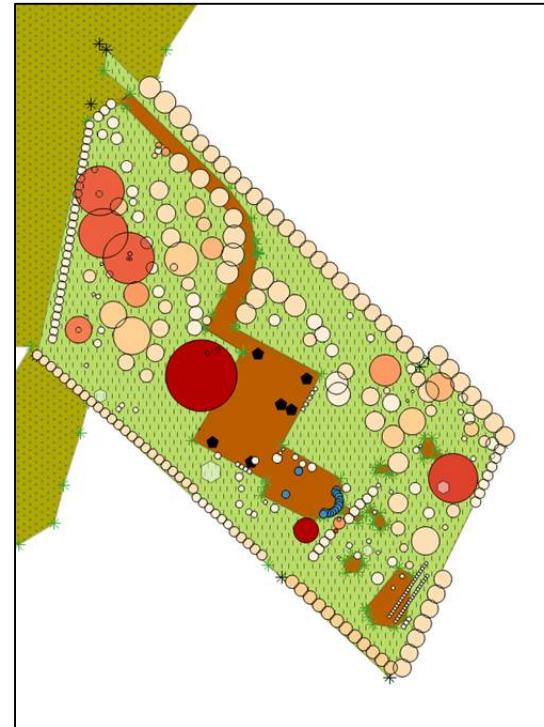
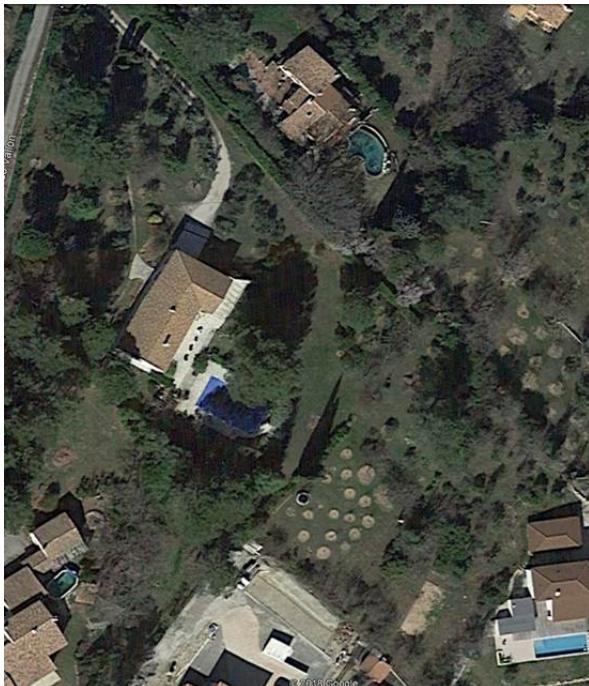
Scenario with unmanaged vegetation around housing

# FUTURE WORKS

**Modelling the Fire Behavior in WUI vegetation => impacts on structures**

➤ **Using WFDS**

=>testing different scenarios of vegetation distribution around the house



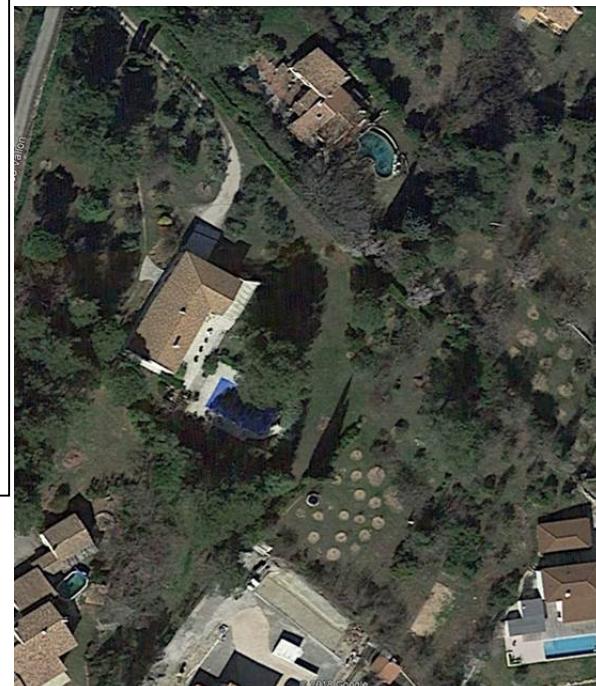
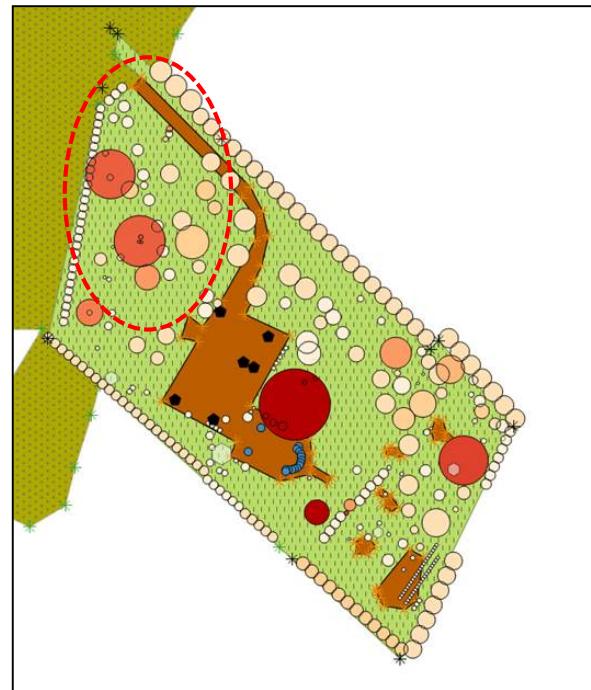
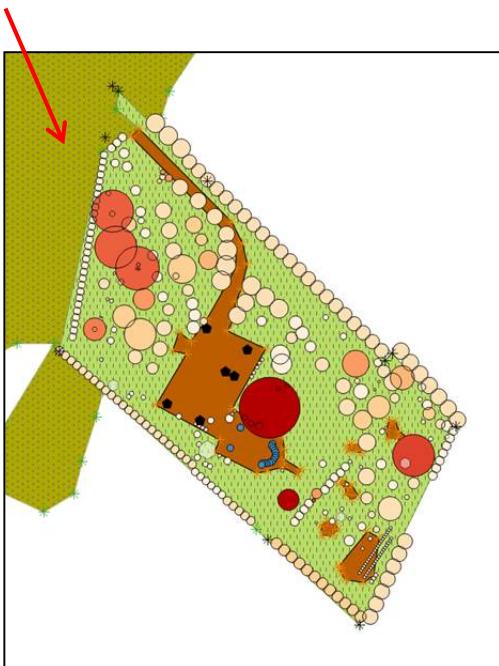
# FUTURE WORKS

**Modelling the Fire Behavior in WUI vegetation => impacts on structures**

➤ **Using WFDS**

=>testing different scenarios of vegetation distribution around the house

Wind direction => most likely fire direction



**Firewise scenario: Thinning**

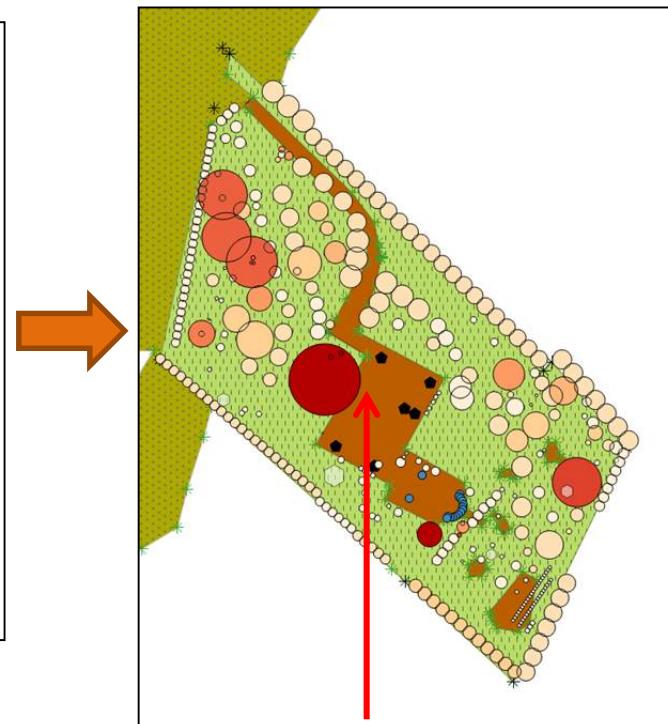
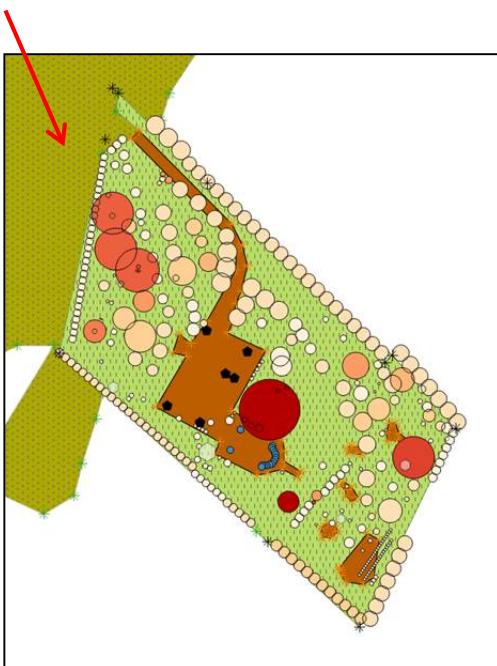
# FUTURE WORKS

Modelling the Fire Behavior in WUI vegetation => impacts on structures

➤ Using WFDS

=>testing different scenarios of vegetation distribution around the house

Wind direction => most likely fire direction



Unfirewise scenario:  
Big tree overhanging the roof

Journées CAQSS 2019





**Thank you for your attention**

