Effet de la teneur en eau sur la propagation d'un feu de surface à travers une strate de végétation

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Paramètres affectant le comportement des feux

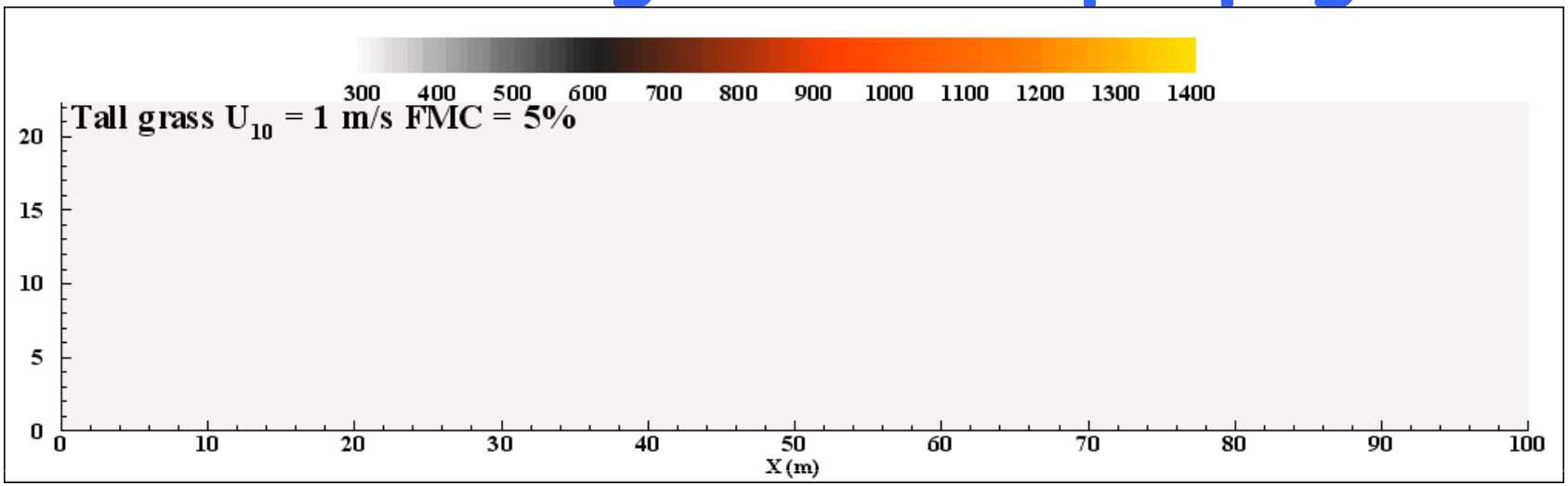
Motivations & contexte

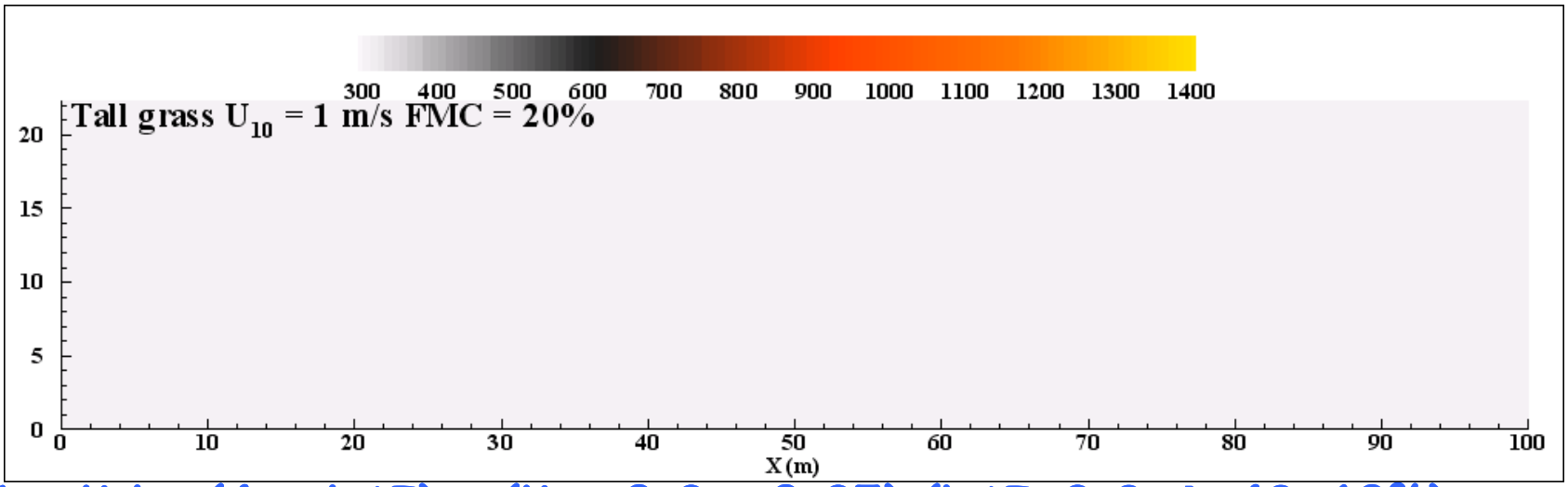
- Gestion du combustible, réduction du risque incendie
- Réduction de la biomasse
- Brûlage dirigé
- Changements climatiques (T°, pluies, réserves en eau des sols …)

Propriétés du combustible

- Densité = 500 kg/m^3
- SA/V = 4000 m^{-1}
- Fraction volumique = 2 x 10^{-3}
- Hauteur de combustible = 0.7 m
- Charge de combustible = 7 t/ha
- LAI = 2.8
- FMC = 5-120 %

Conditions marginales de propagation

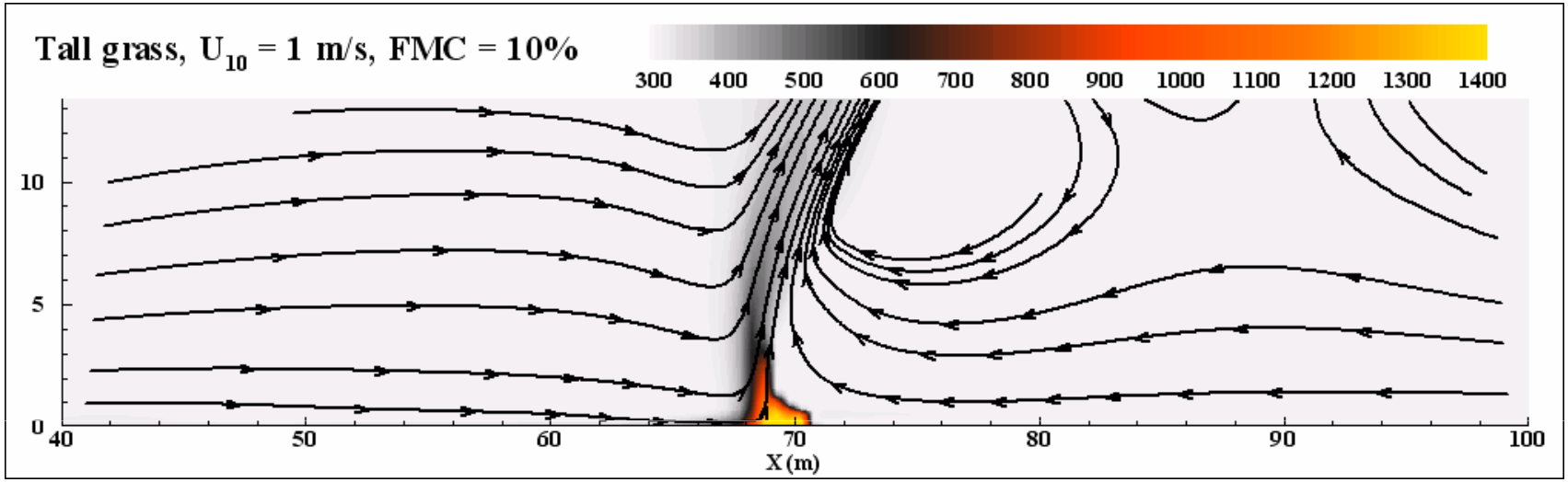


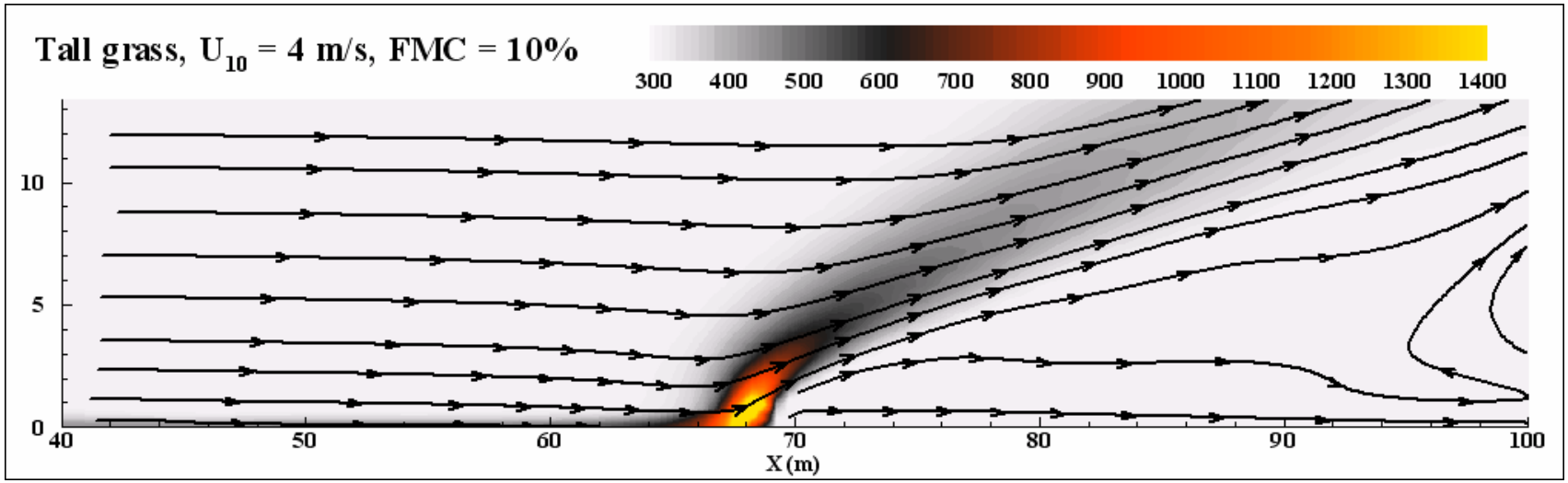


FMC < K Ln (4 x LAI) (K = 0.2 – 0.25) (LAI=2.8 → 48-60%)

R.A. Wilson Combust. Sci. Technol. 1985

Conditions de vent U_{10} = 1 & 4 m/s





Propagation d'un feu de surface
$ROS/ROS_0=f(FMC)$

Cheney & al (1995), Marsden-Smedley (1995), Catchpole & al (1998)

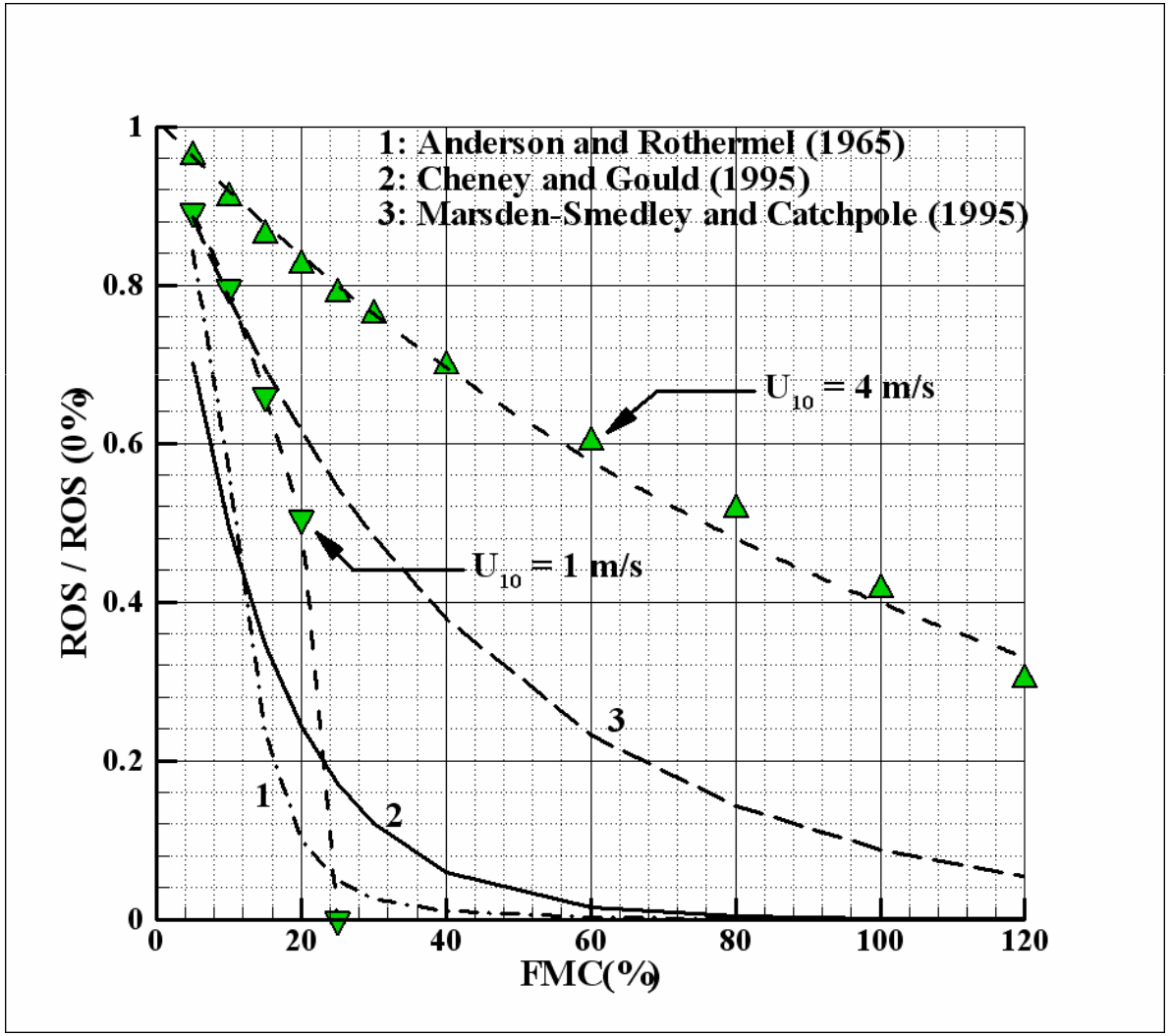
$ROS/ROS_0 = \exp(-A\ FMC)$

Anderson, Rothermel (1965)

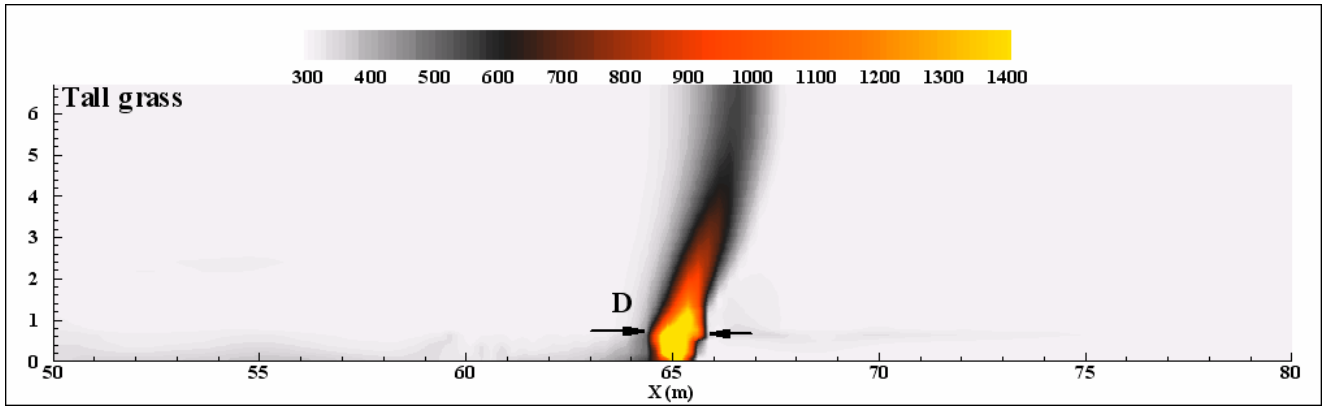
$ROS/ROS_0 = A - B \times FMC$ (without wind)

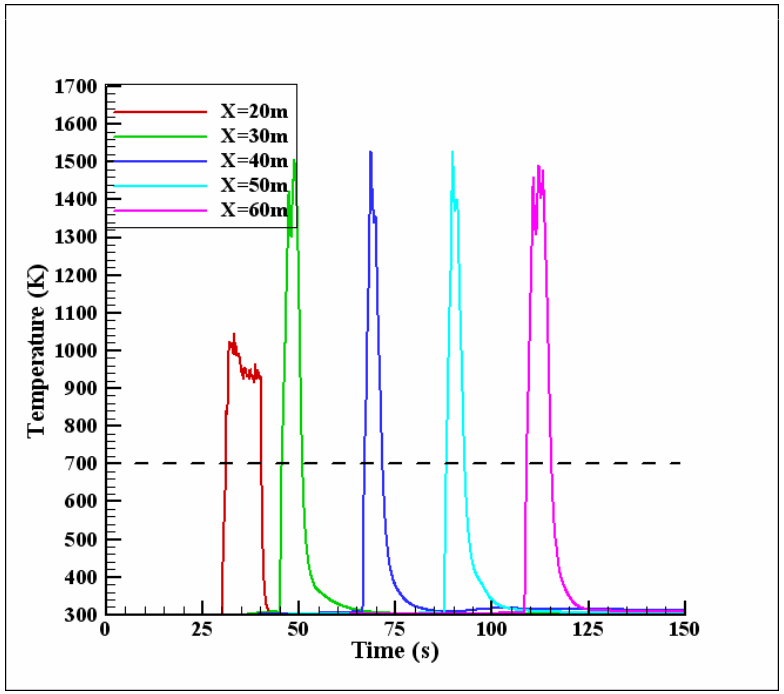
$ROS/ROS_0 = A / (A_0 + A_1\ FMC + A_2\ FMC^2 + A_3\ FMC^3)$ (with wind)

Propagation d'un feu de surface
$ROS/ROS_0=f(FMC)$



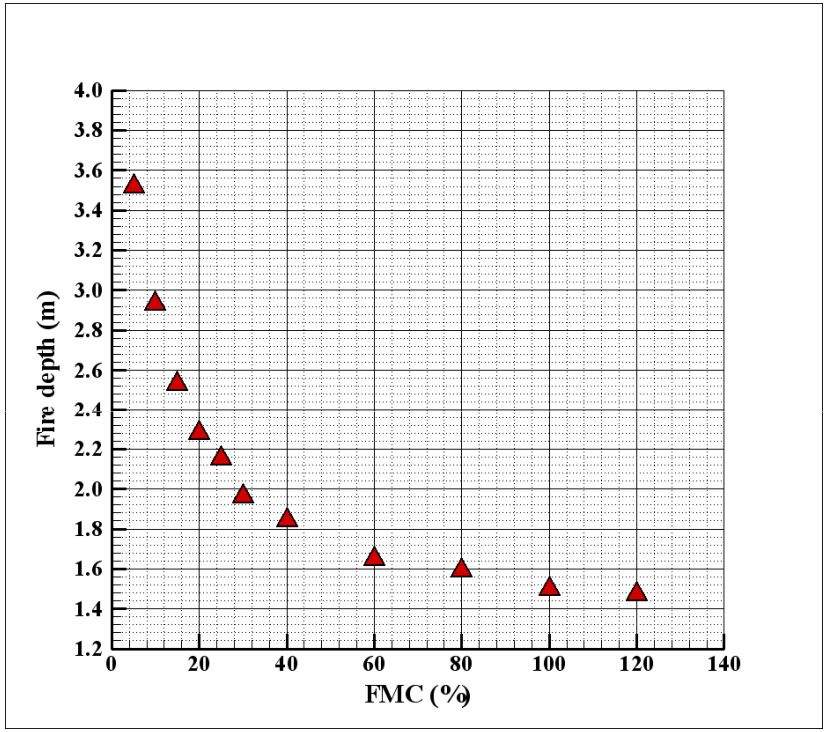
Profondeur du front, temps de résidence

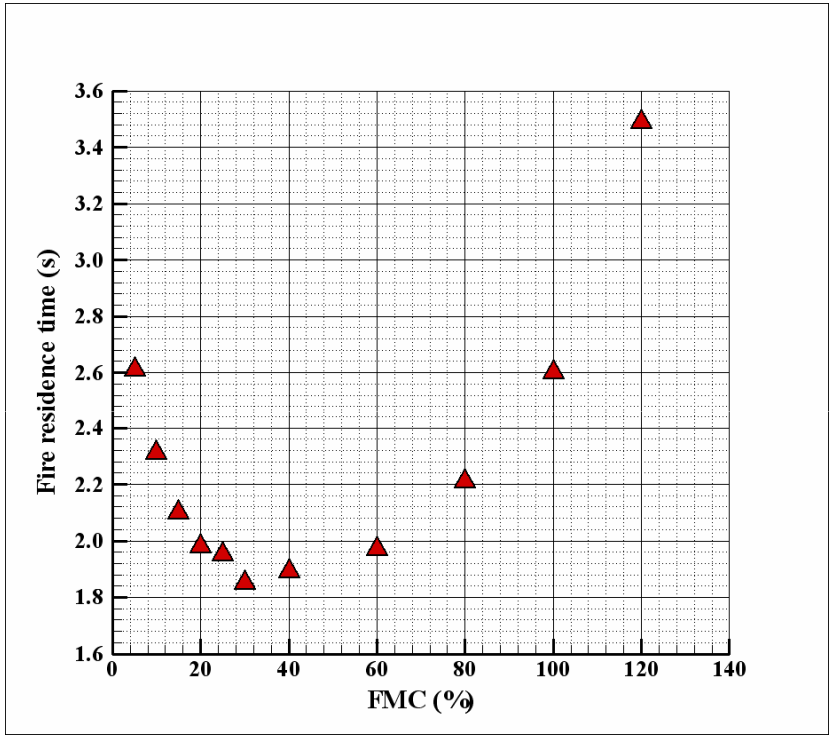




$$D_{Fire} = ROS \times \tau_{Fire}$$

Profondeur du front, temps de résidence

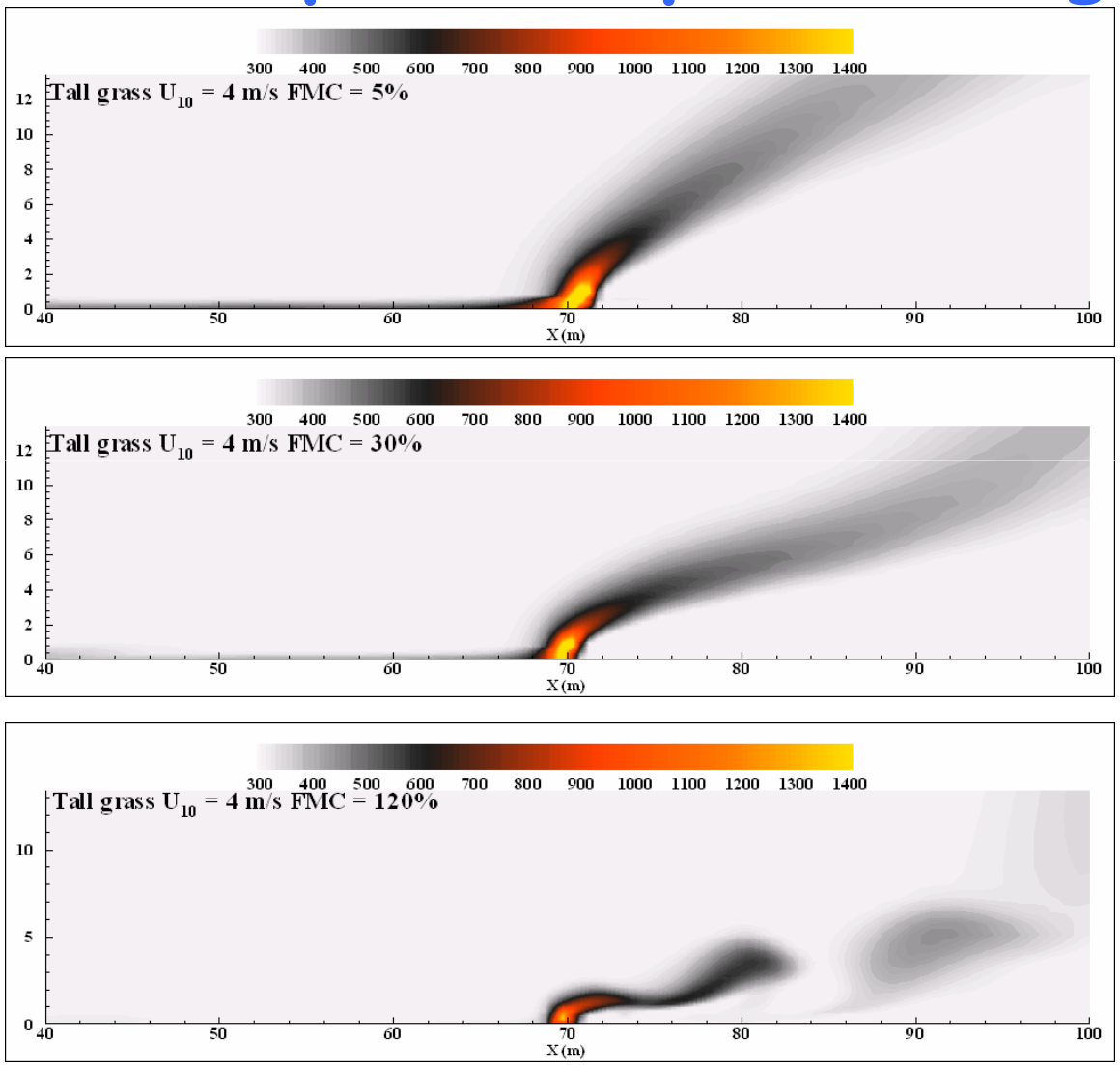




$$\tau_{Fire} = \frac{D_{Fire}}{ROS}$$

(U_{10} = 4 m/s)

Champ de température (gaz)

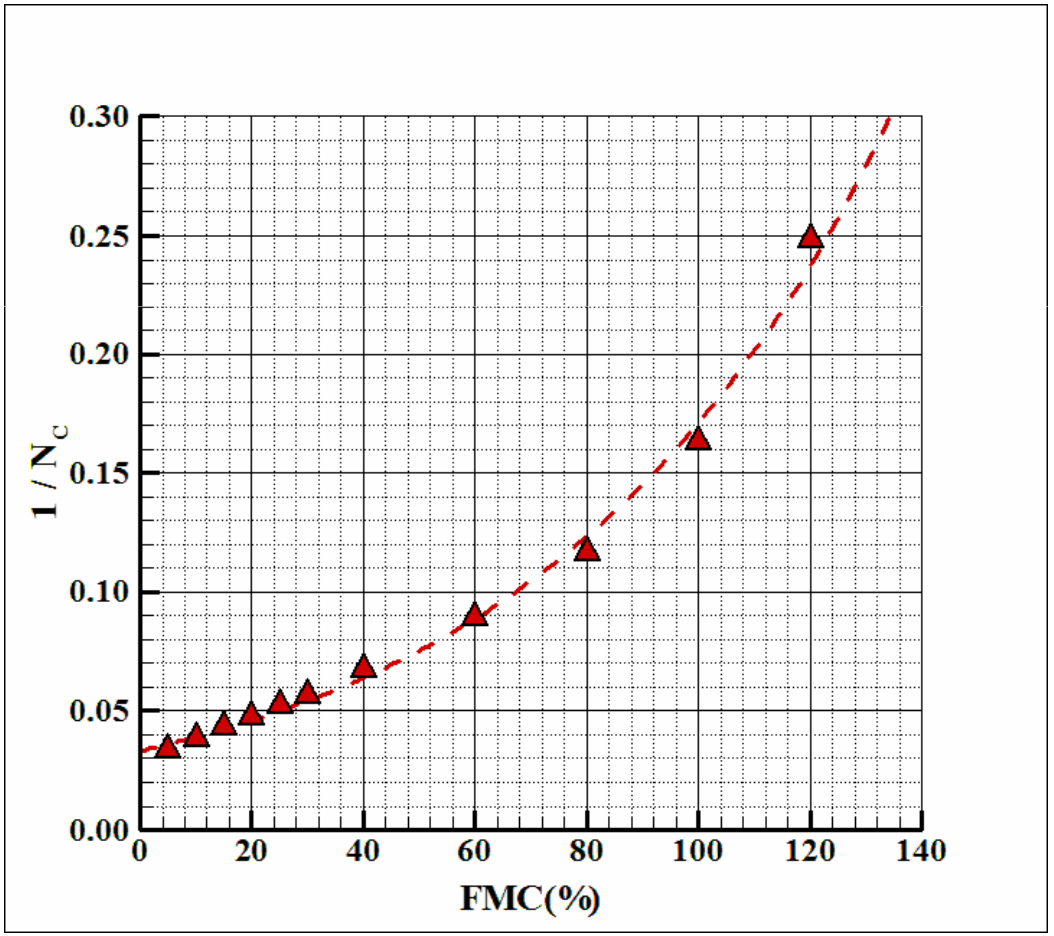


(U_{10} = 4 m/s)

Nombre convectif de Byram (N_c)

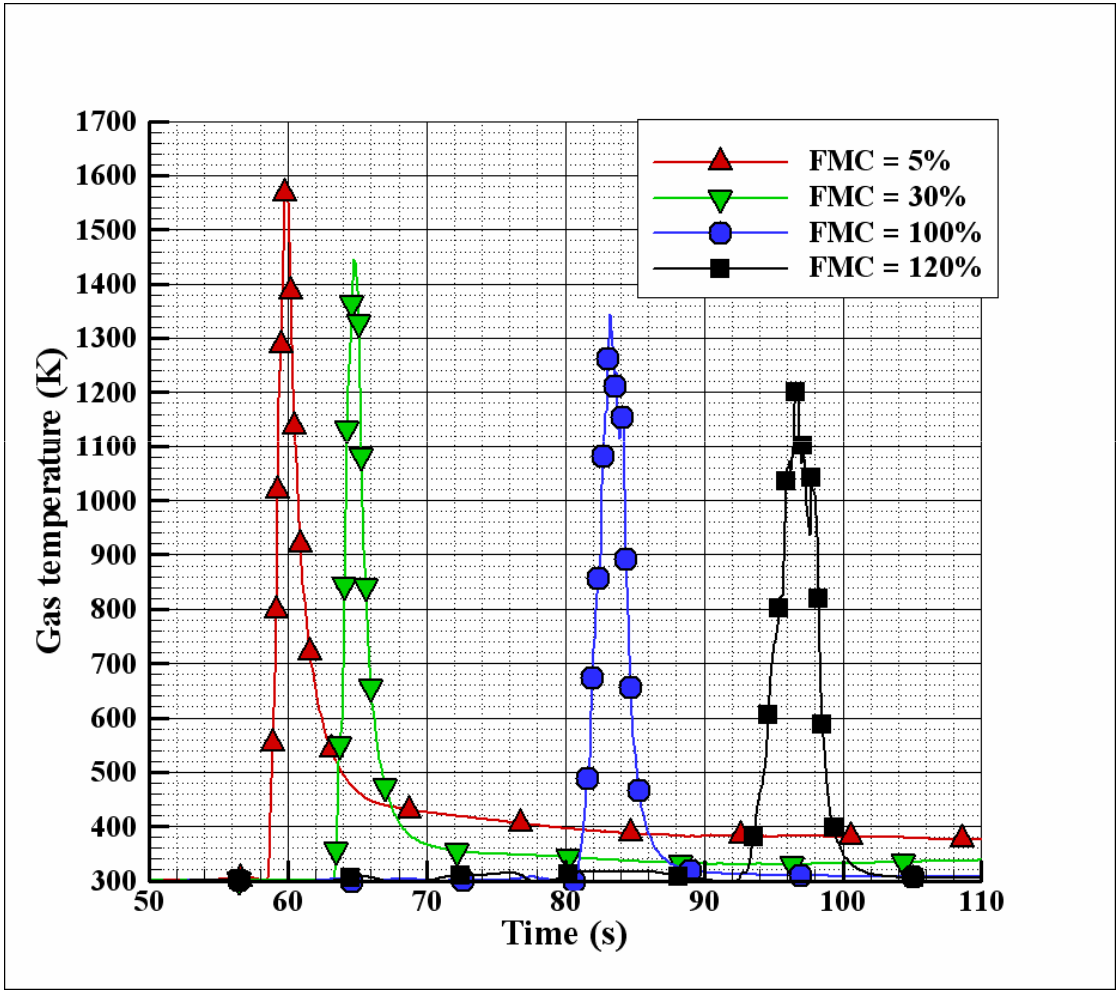
$$\frac{1}{N_C} = \frac{\rho C_P T_0 \left(U_{10} - ROS\right)^3}{2 g I_B} \approx A \times \exp\left(B \times FMC\right)$$

$$A = 0.033 \quad B = 0.016$$



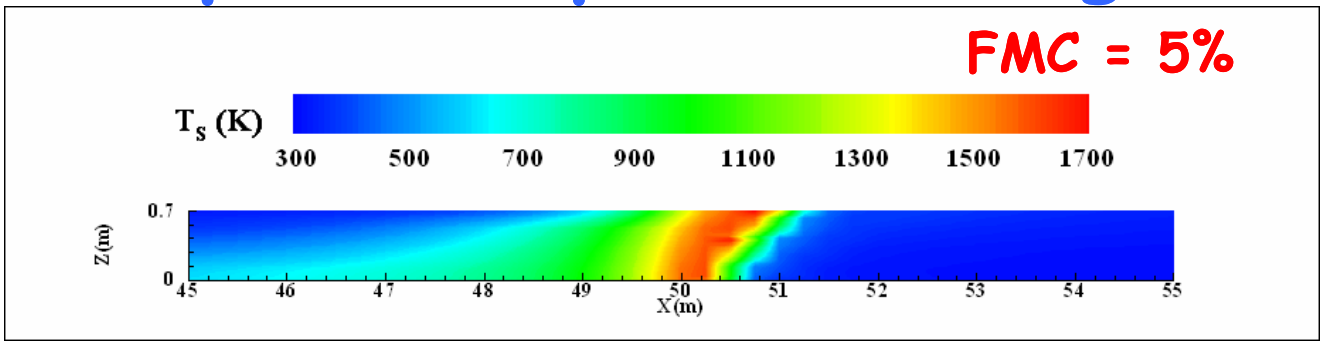
(U_{10} = 4 m/s)

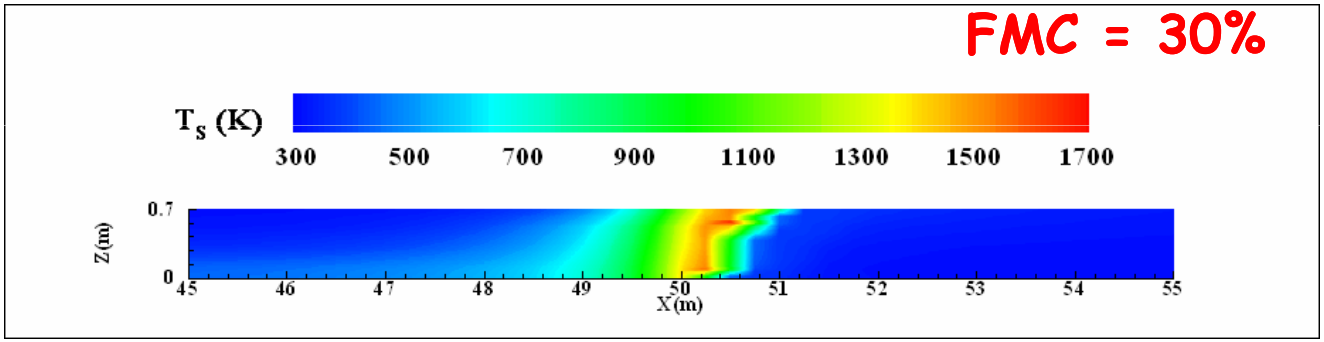
Historique en température (gaz)

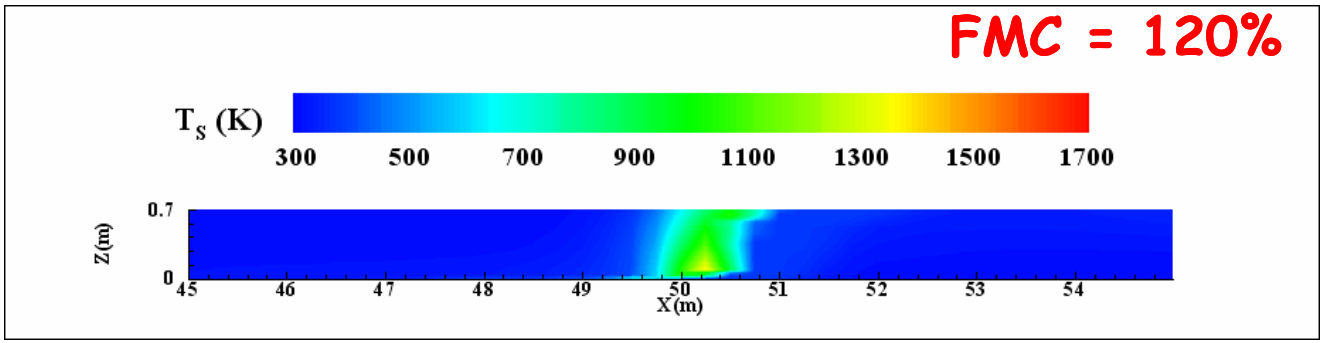


(U_{10} = 4 m/s)

Champ de température (végétation)

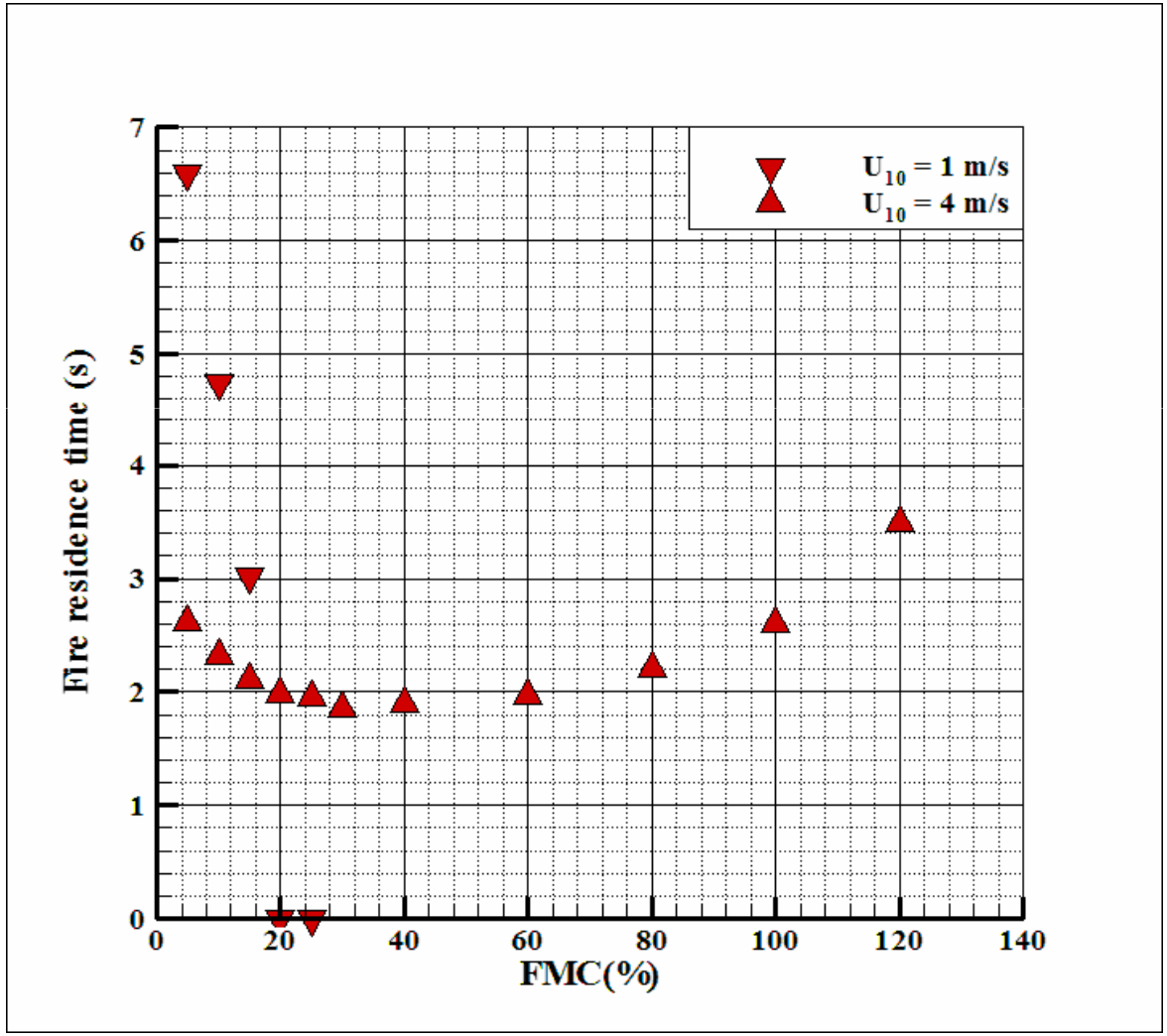




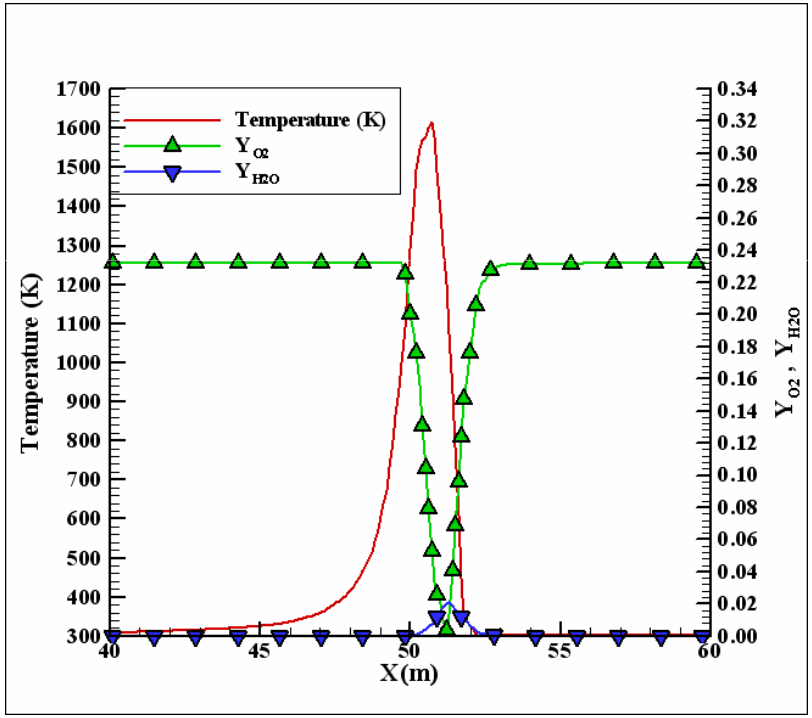


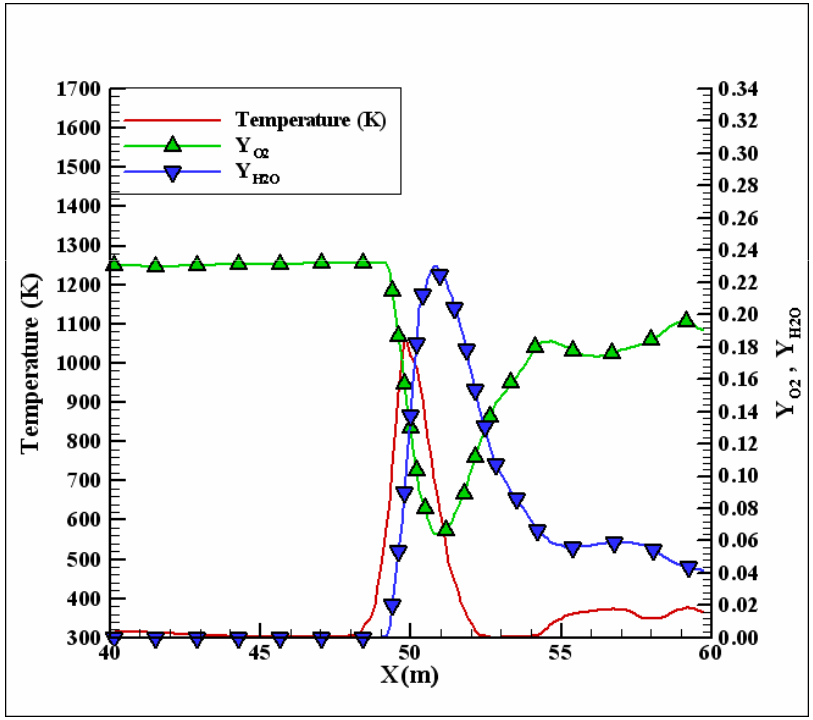
(U_{10} = 4 m/s)

Temps de résidence du front (U_{10} = 1 & 4 m/s)



Profil de température et de fraction massique (H_2O, O_2) (U_{10} = 4 m/s)





(FMC = 5%) (FMC = 120%)

Valeurs prises au sommet de la canopée z = 0.7 m

Conclusions

- Wind affects the marginal conditions of propagation
- For plume dominated fires, FMC affects the propagation in reducing the pyrolysis zone de (fuel limited regime)
- For wind driven fire, FMC affects the propagation in diluting the fresh gas (oxygen limited regime) + increase the radiation losts
- The action of FMC depends on the internal structure of the vegetation
- D. Morvan Fire Safety Journal Vol.58, pp. 121-131 (2013)

Merci pour votre attention.