GHENT
UNIVERSITY

FACULTY OF ENGINEERING
AND ARCHITECTURE

TURBULENT SPRAY COMBUSTION MODELLING

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Supervisors: Prof. Bart Merci
Dr. Ivana Stankovic

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TURBULENT SPRAY JET

Coria Rouen Spray Burner [1]

Dilute spray

Liquid mass flow rate 0.28 g/s

Gaseous mass flow rate 6 g/s

Fuel n-C_7H_{16}

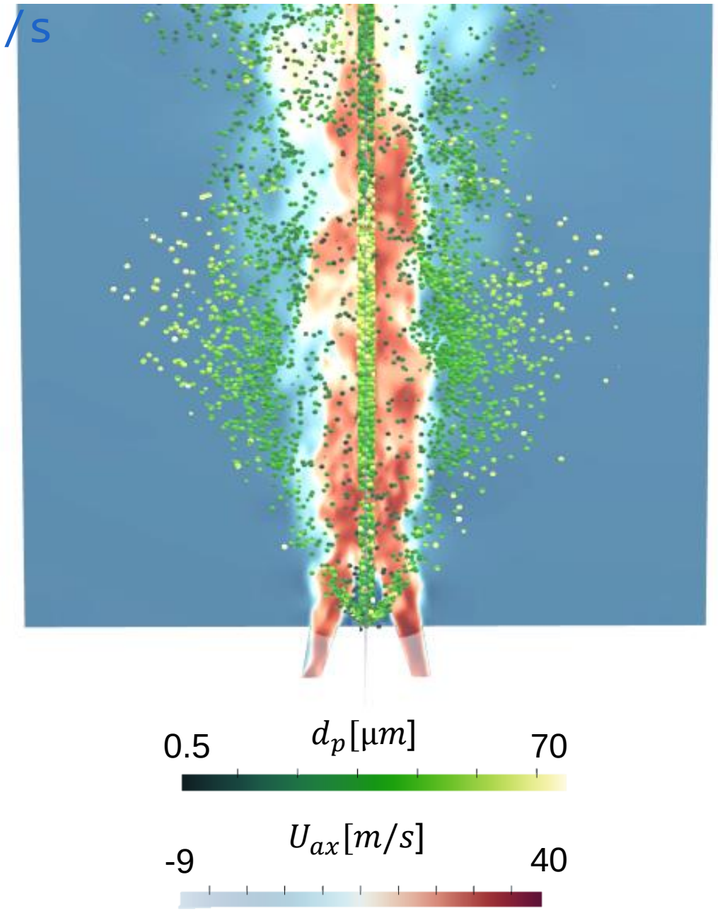
Oxidizer air

Half spray angle 40°

Hollow cone spray

Re 13800

Droplet diameter [0.5–70 µm]



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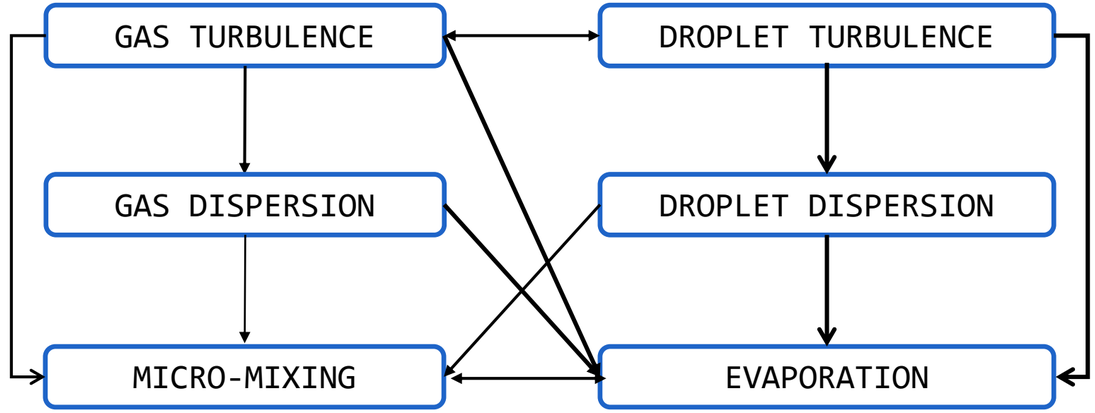
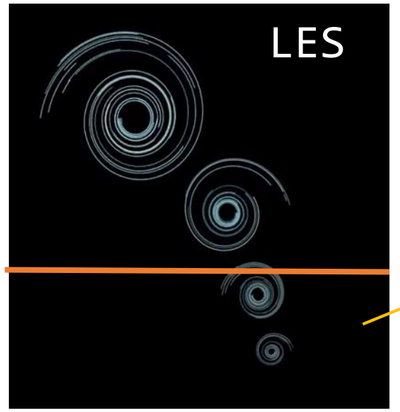
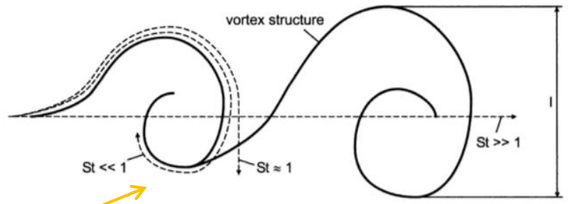


Modelling strategy:

Large Eddy Simulations

Eulerian-Lagrangian Approach





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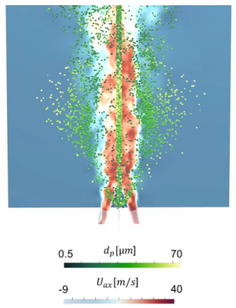
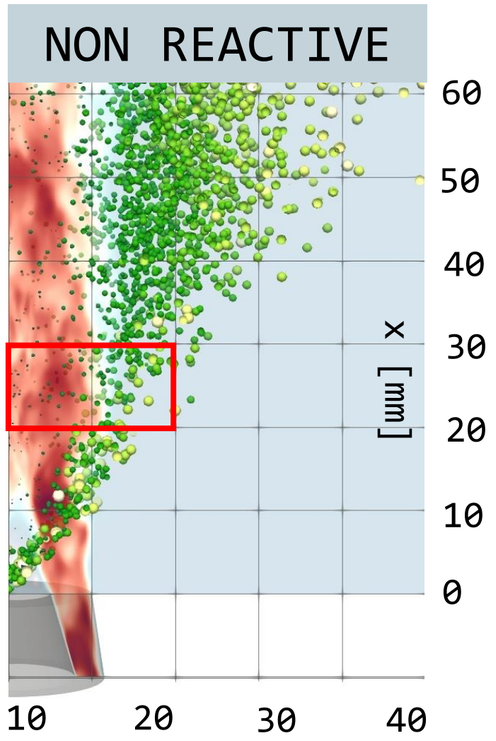
[1] F. Shum-Kivan, J. M. Santiago, A. Verdier, B. Renou and G. Cabot, "Experimental and numerical analysis of a turbulent spray flame structure," Proc. Comb. Inst., vol. 37, pp. 2567-2575, 2017.

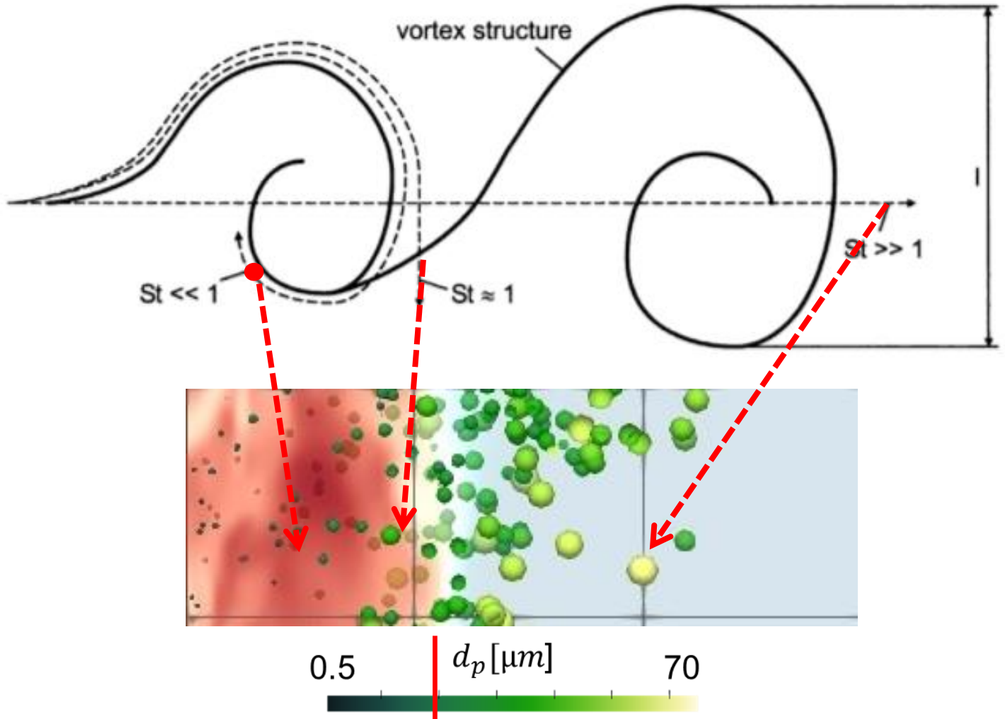
[2] Jenny, P., Roekaerts, D., Beishuizen, N. Modeling of turbulent dilute spray combustion. Prog. Energy Combust. Sci. **38** (6), 846-887 (2012).

TURBULENT SPRAY JETS





Analysis particle Stokes number



Droplets driven by gas phase motion

Droplets with ballistic behavior

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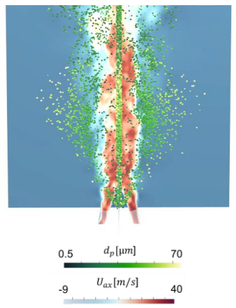
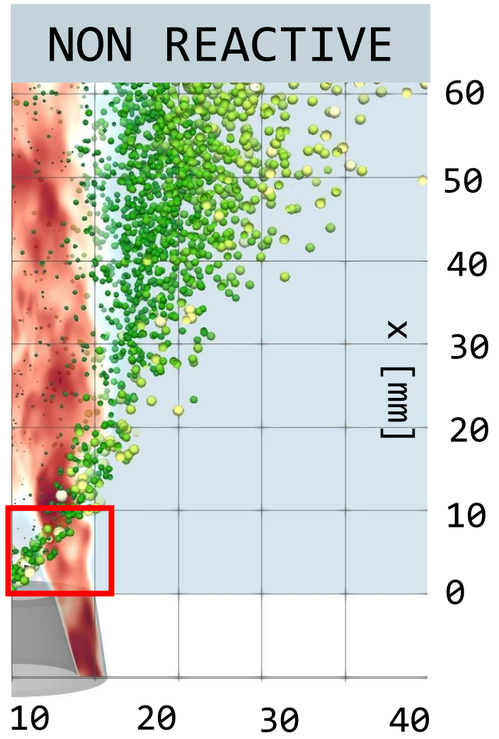
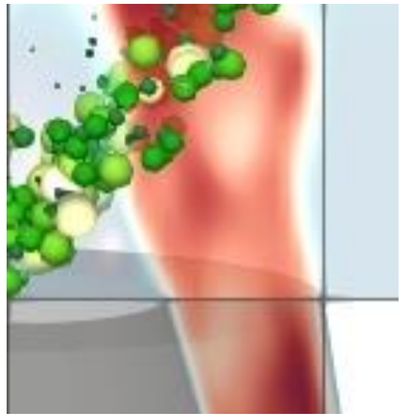
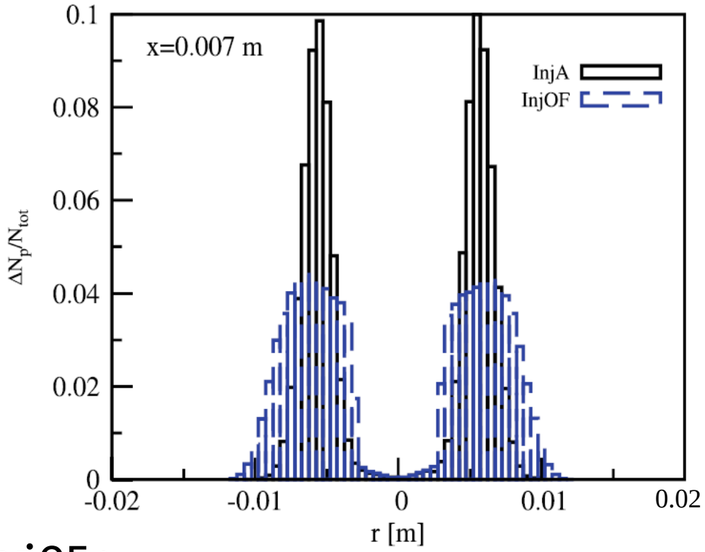




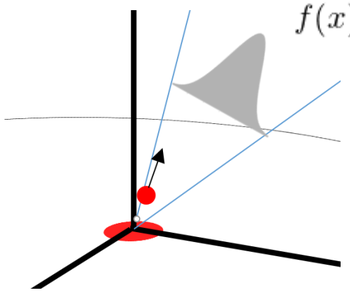
Customized OF injection model



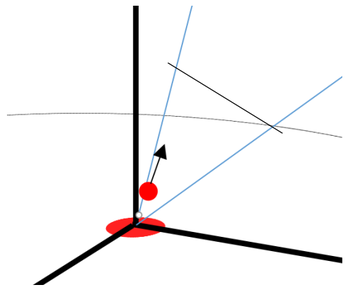


InjA:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}}\, e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$



InjOF:



Direction assigned by randomly choosing an angle between the inner and the outer angle

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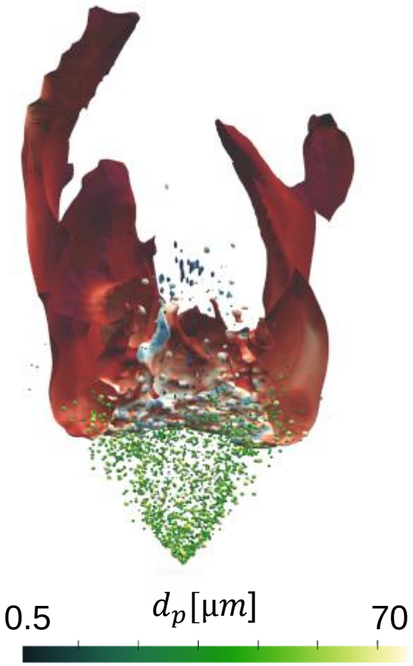
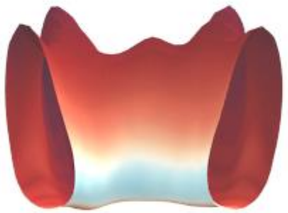
TURBULENT SPRAY FLAME

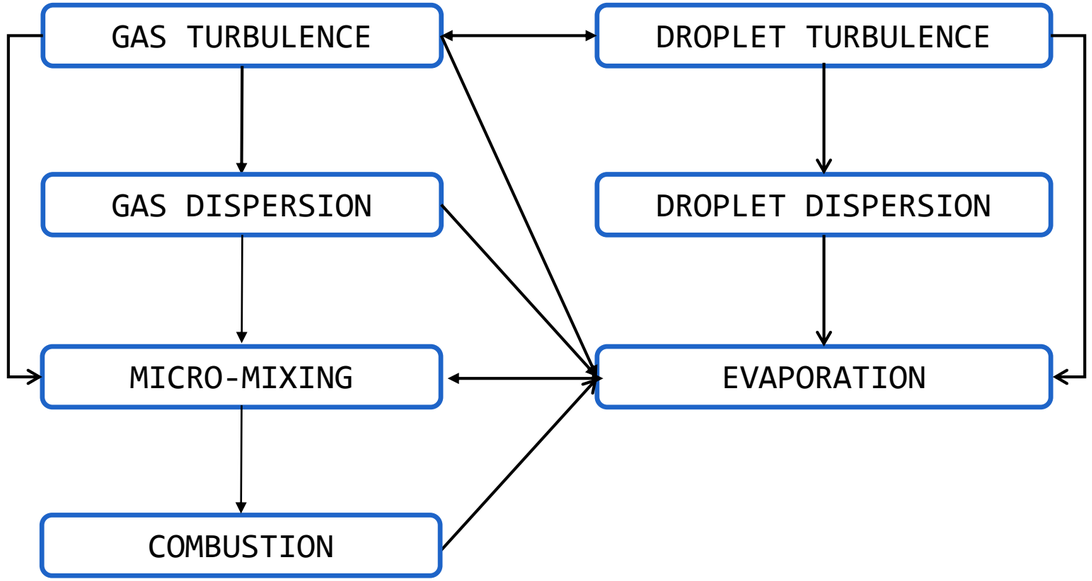
Coria Rouen Spray Burner [1]



Stoichiometric mixture fraction iso-contour colored with the instantaneous Temperature



Mean stoichiometric mixture fraction iso-contour colored with the mean Temperature



Modelling strategy:

Large Eddy Simulations

Eulerian-Lagrangian Approach

Conditional Moment Closure method

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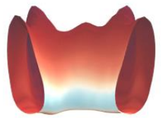
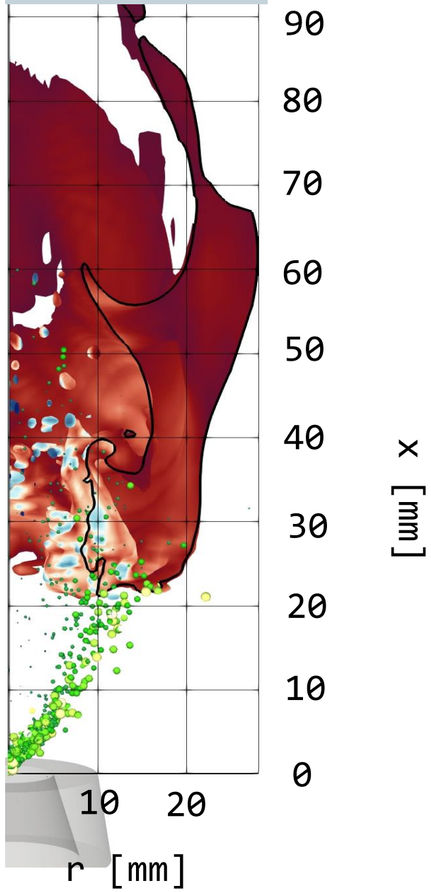
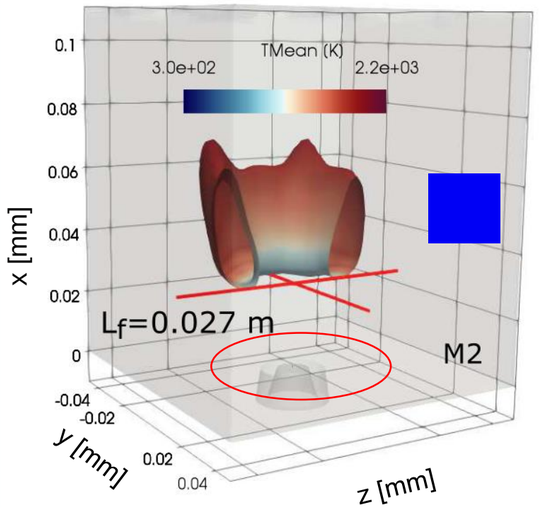
TURBULENT SPRAY FLAME

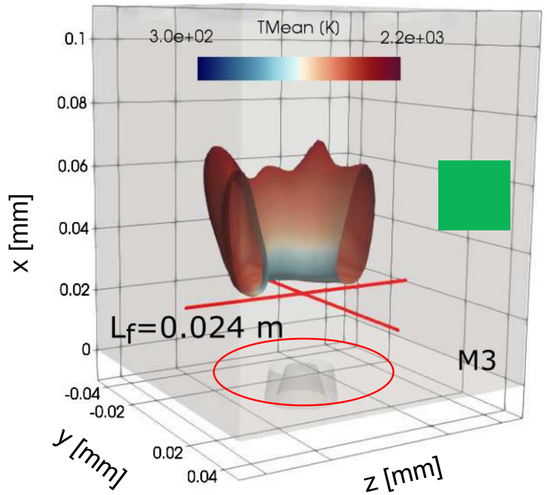


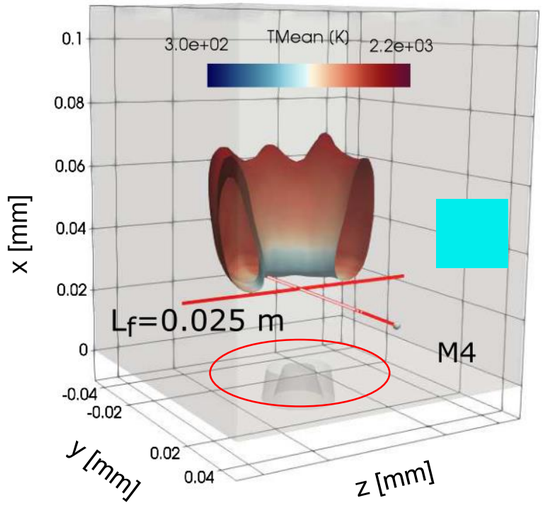
REACTIVE

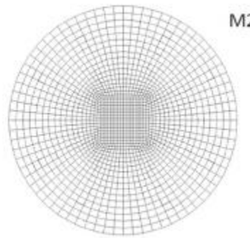


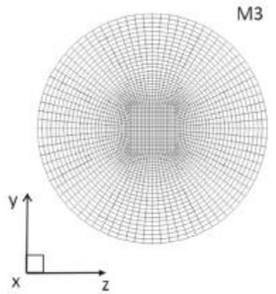
Results: Lift-off height dependence on mesh

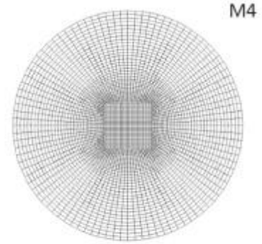












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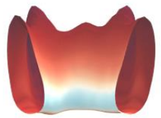
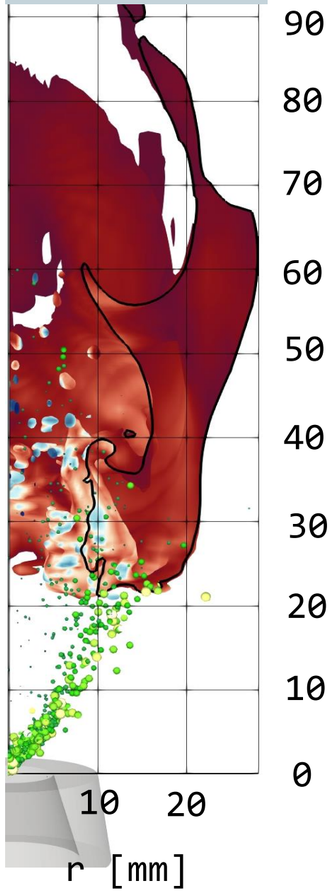
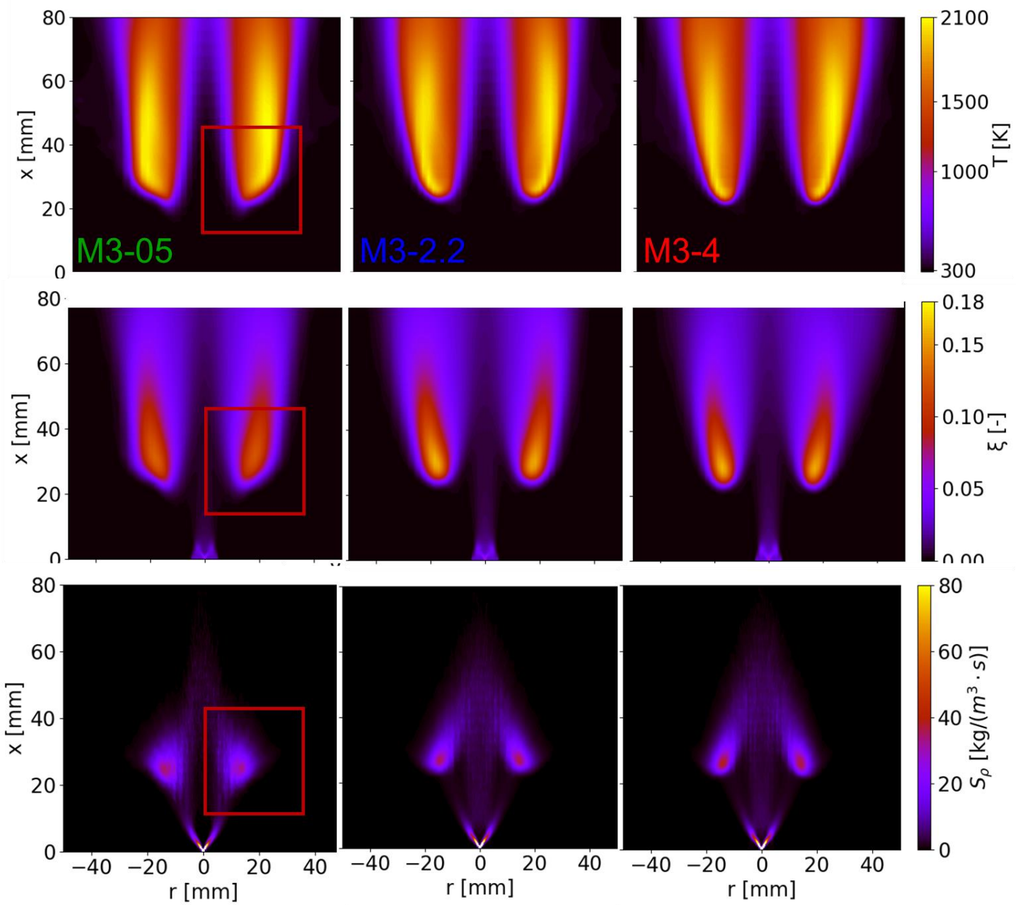
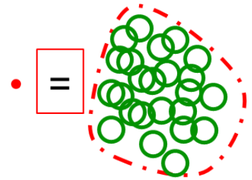


REACTIVE

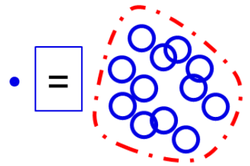


the role of the computational parcels on mixing, evaporation and flame topology

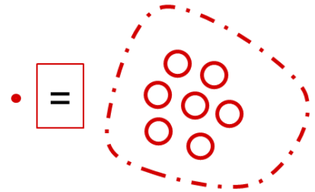




$\dot{N}_p = 0.5 \cdot 10^6\ parcels/s$



$\dot{N}_p = 2.2 \cdot 10^6\ parcels/s$



$\dot{N}_p = 4 \cdot 10^6\ parcels/s$

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PRETREF

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Acknowledgments:

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