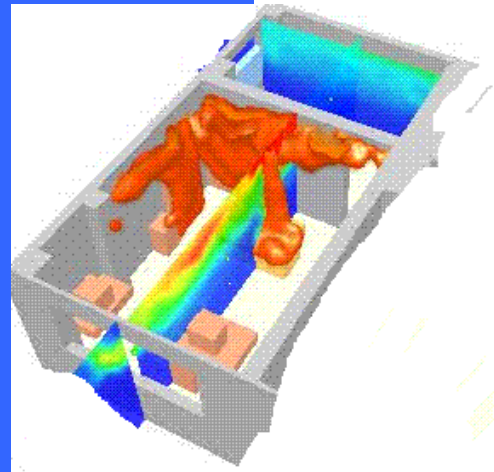


# *A Priori* Modelling of Fire Test One



One Day Symposium on  
**The Dalmarnock Fire Tests:  
Experiments & Modelling**

Wednesday 14th November 2007  
Royal Museum, Edinburgh  
[www.see.ed.ac.uk/FIRESEAT](http://www.see.ed.ac.uk/FIRESEAT)



# Authorship: Brave Users

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Universidad de Cantabria, Spain  
CTICM and Efectis, France  
Packer Engineering, USA  
University of Maryland, USA

# The Art of Fire Modelling

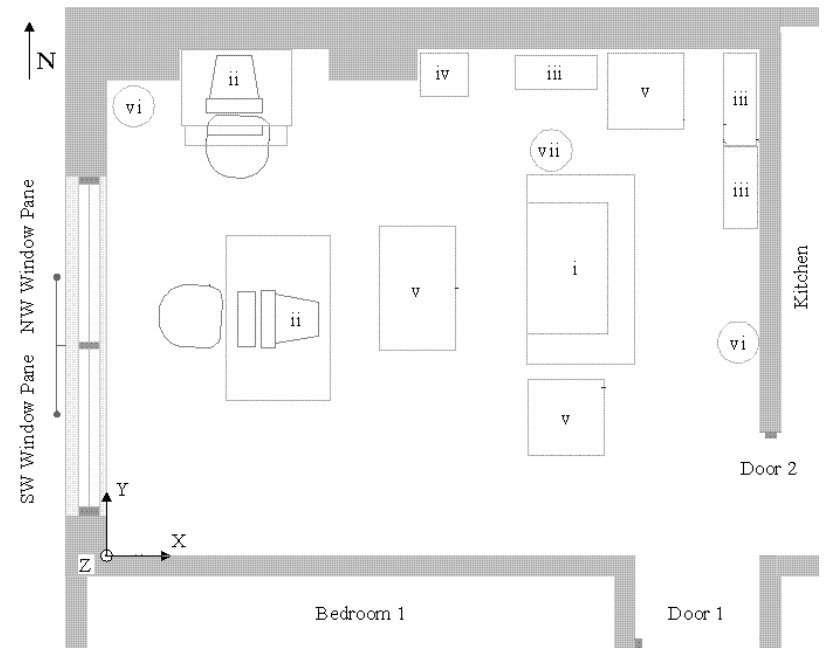
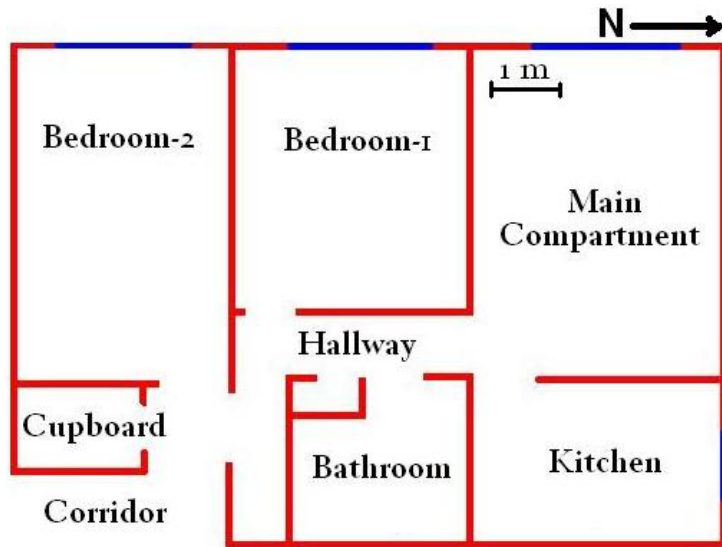
- Fire Modelling is very commonly used now
  - **Where:** Risk, Live safety, Performance based Design, Structural behaviour, Forensic investigations...
  - **What:** Ignition, Flame, Plume, Smoke, Spread, Visibility, Toxicity, Extinction...
- 
- Many papers addressing *validation* of fire models
  - but what about *fire modelling*?
  - Do we really know the Strengths and Limitations of the whole process?

# The need for Round-Robin Studies

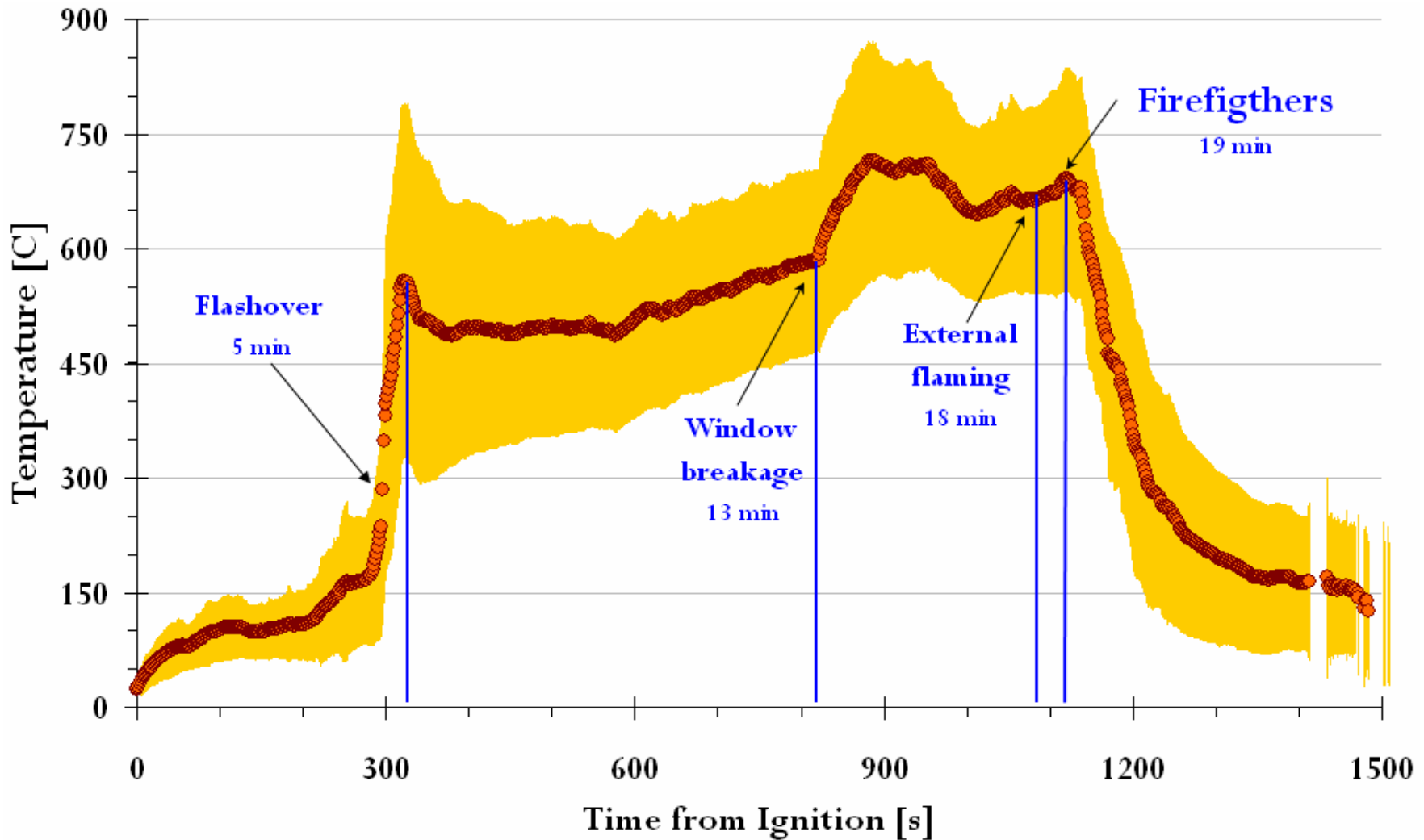
- International pool of experts independently provide *a priori* predictions of a large-scale test (Test One) using a common set of input data.
- **Assessing of the state-of-the-art of fire modelling**
- Very few *a priori* predictions/round-robins have been published
- What is the real use for Fire Engineering of validations conducted *a posteriori*?



# Flat Layout



# Average Temperature

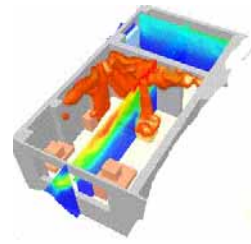


# Information Provided to Teams

- Detailed geometry (plan and dimensions)
- Detailed fuel load (dimensions, locations, photographs, descriptions)
- Ventilation conditions
- 50+ Photographs of final set up in the compartment
- HRR of Ignition source and Sofa as measured in the laboratory
- Assumptions, uncertainties, unknown values, missing information were to be complemented by the team's own decisions: as in any other fire modelling work



# Unity and Diversity



- Predictions in for zones and for fields
- 10 Submitted simulations: 8 Field Models (FDS v4) and 2 Zone models (CFAST v6)

*(unfortunately users of other codes declined our invitation)*

- Out of the 10 simulations, the input file used

Input of HRR:

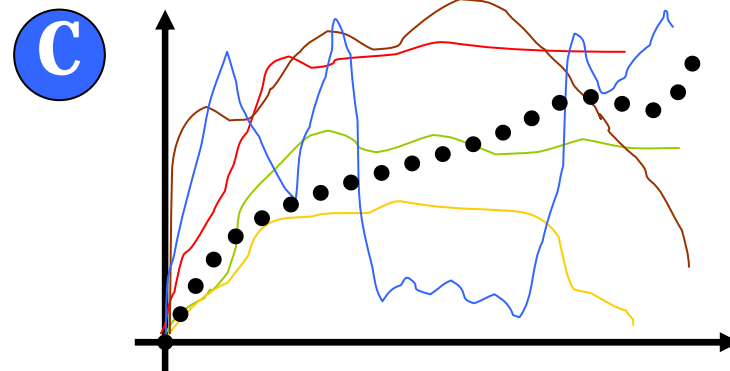
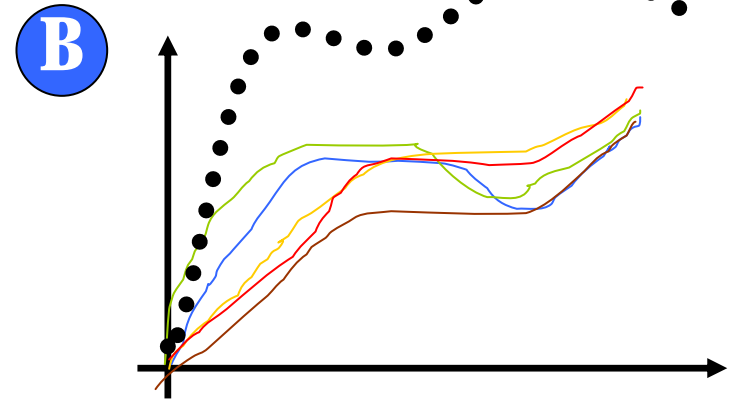
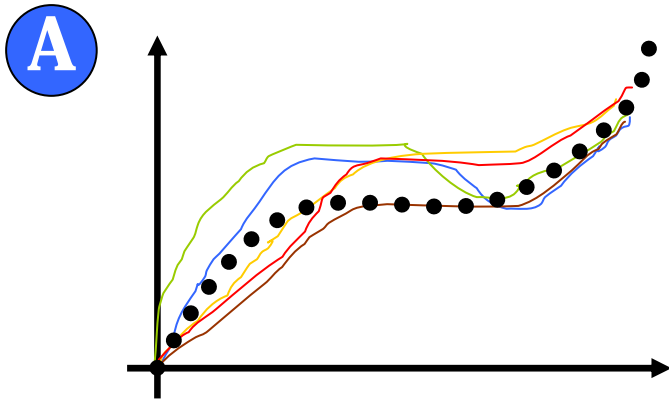
- 2 *fully-prescribed* the HRR
- 7 *partially prescribed* the HRR
- 1 *fully predicted* the HRR

Input of Ignition source:

- 5 *did not* use the Sofa curve measured
- 3 used the Sofa curve measured but *extrapolated*
- 1 used the Sofa curve *as measured*



# Possible Outcomes: *a priori* discussions



Variables shown here:  
HRR, Smoke layer,  
Wall temperature  
and heat fluxes

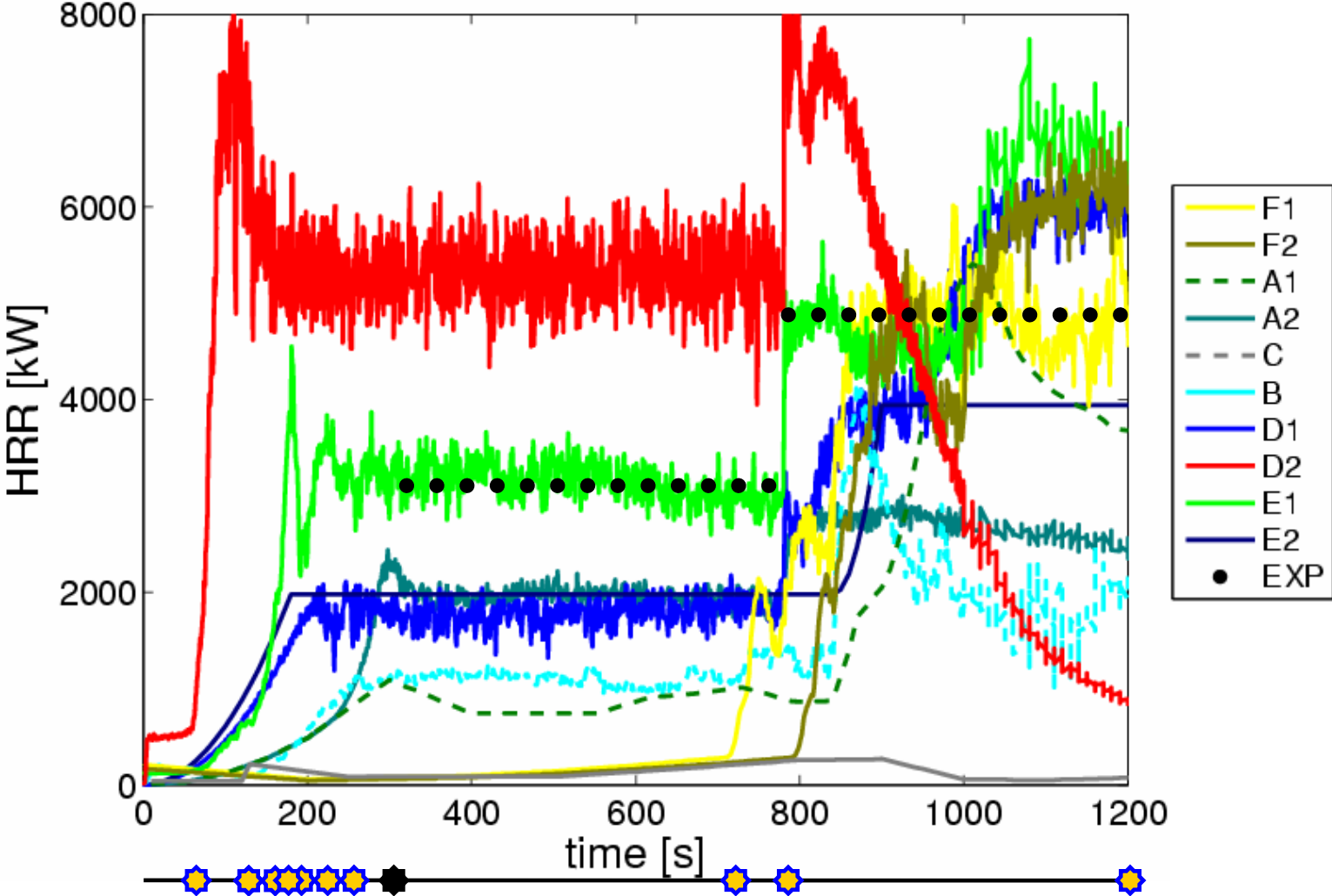
**"I always avoid prophesying  
beforehand**

**because it is much better to  
prophesy after the event has  
already taken place"**

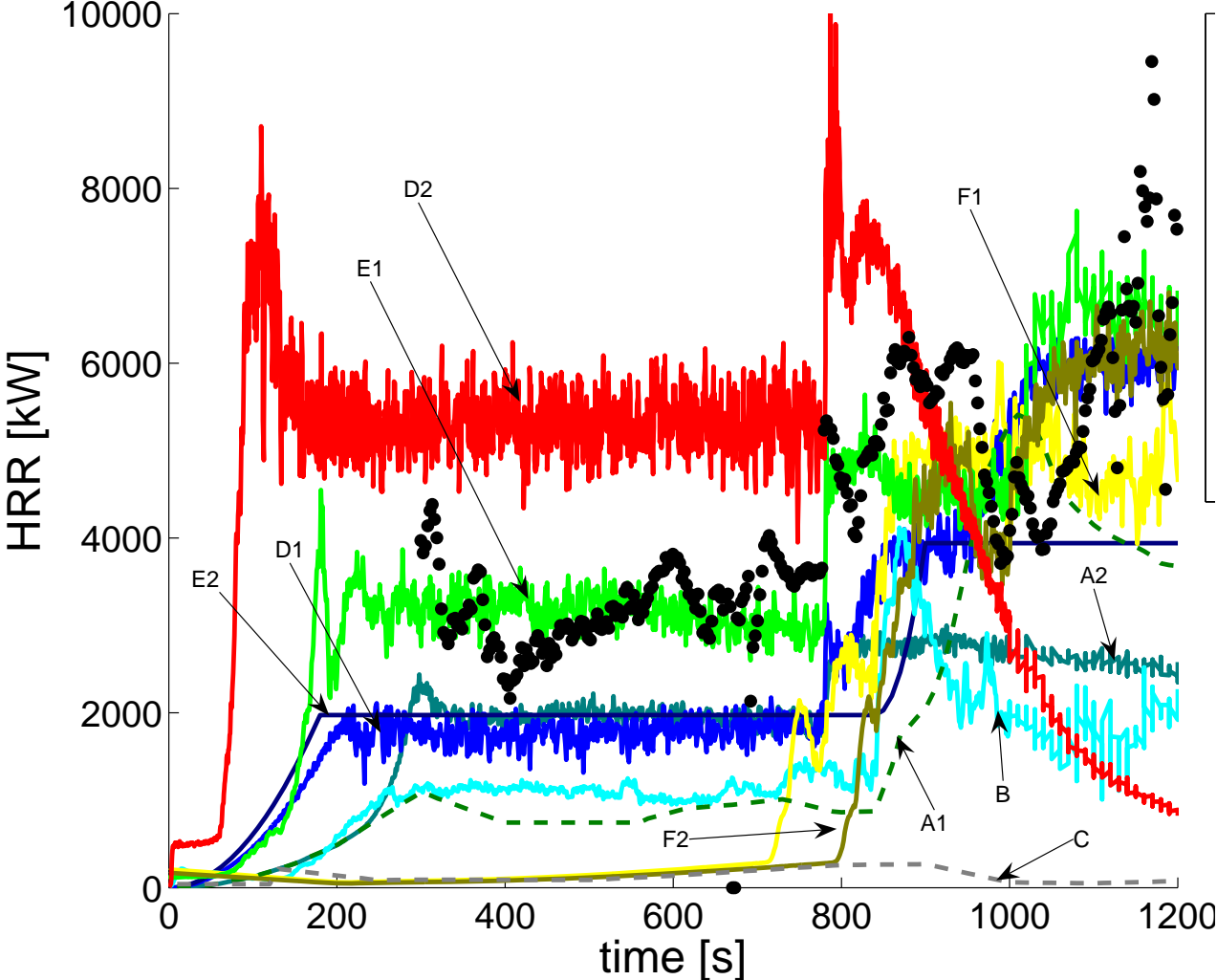
**Sir Winston Churchill, circa 1945**

# Results: HRR

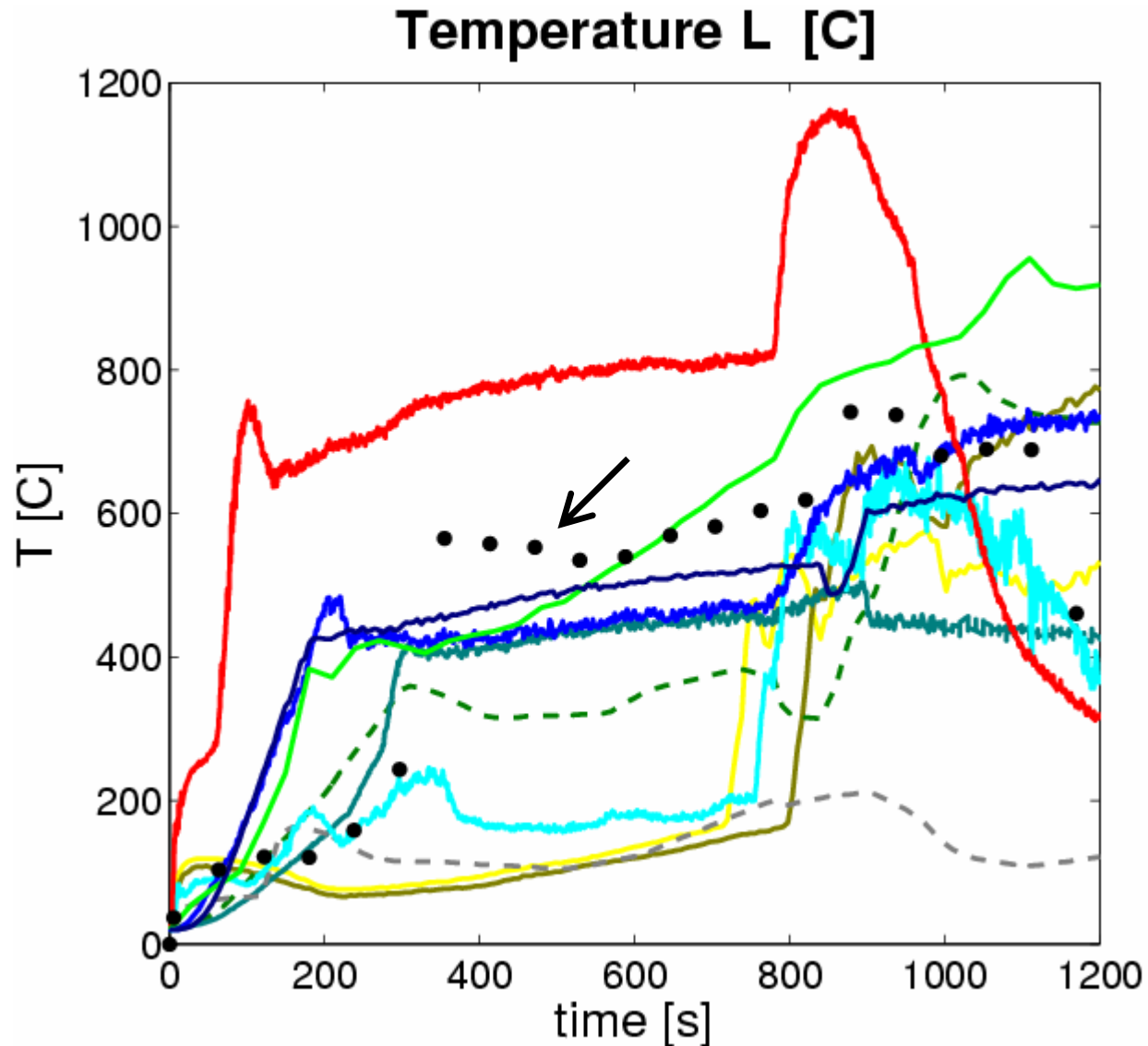
## Heat Release Rate of the Fire (G-files)



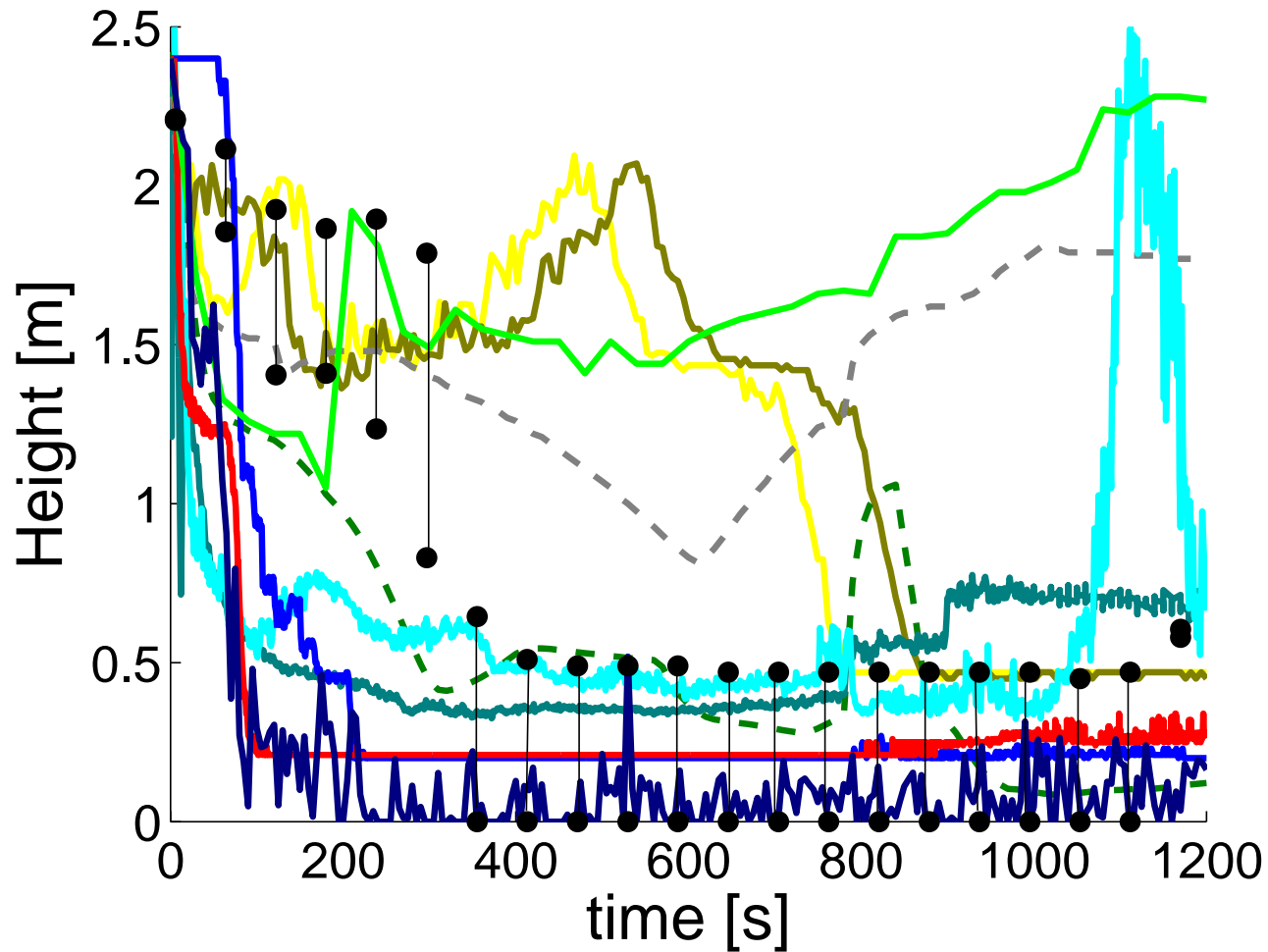
# Results: HRR



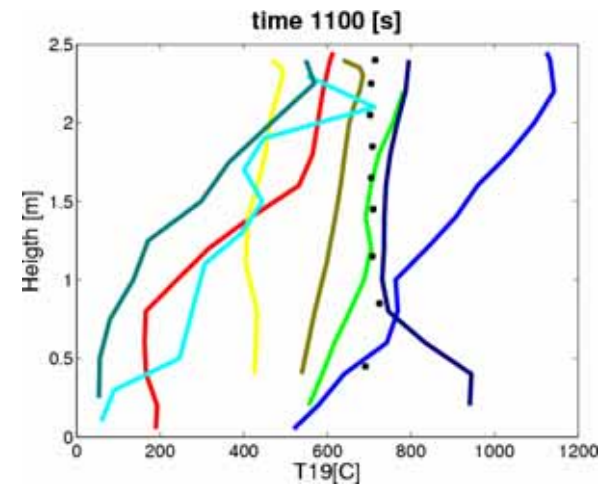
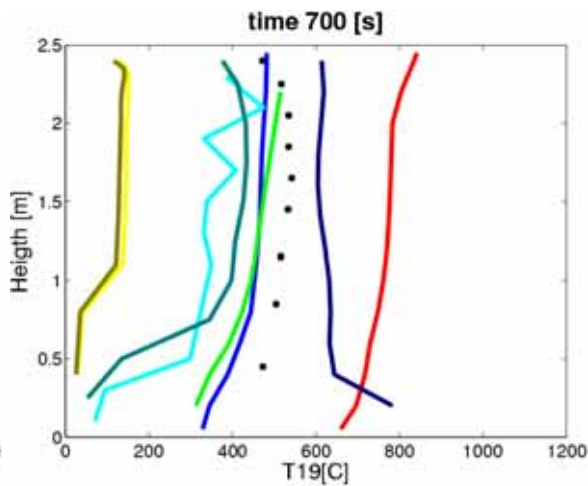
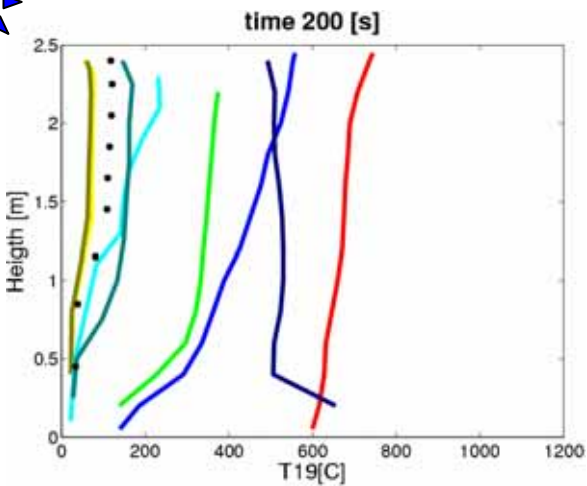
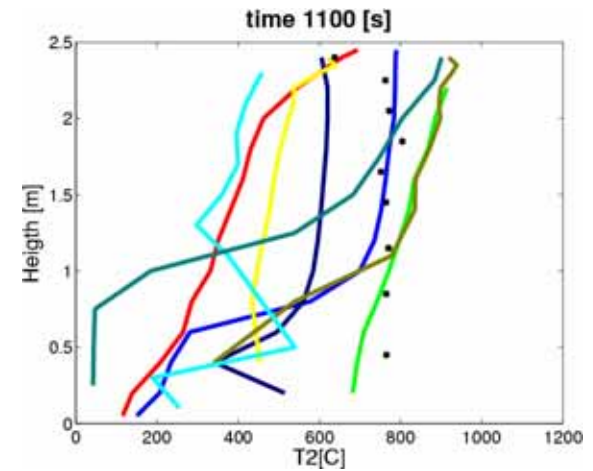
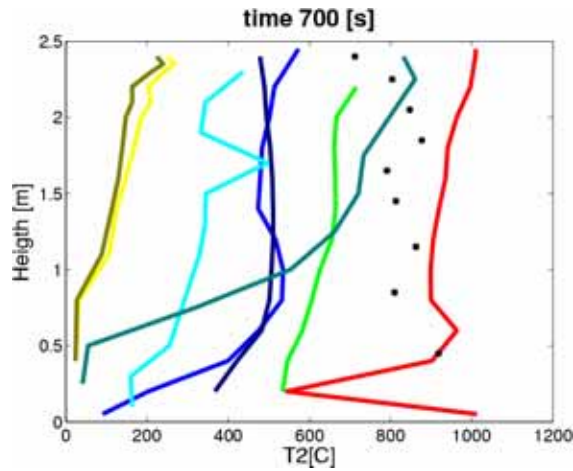
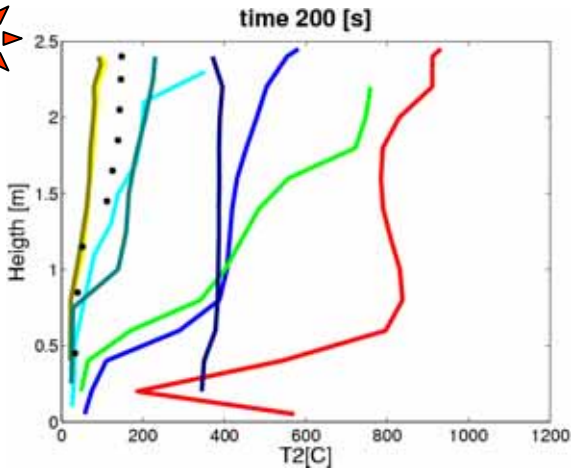
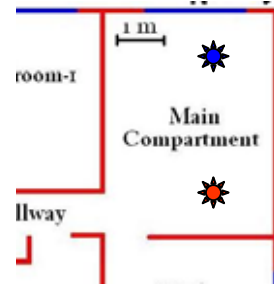
# Results: Hot Layer Temperature



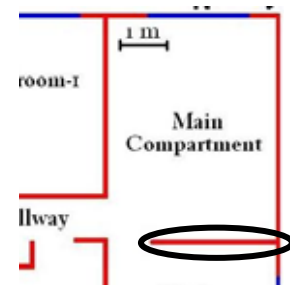
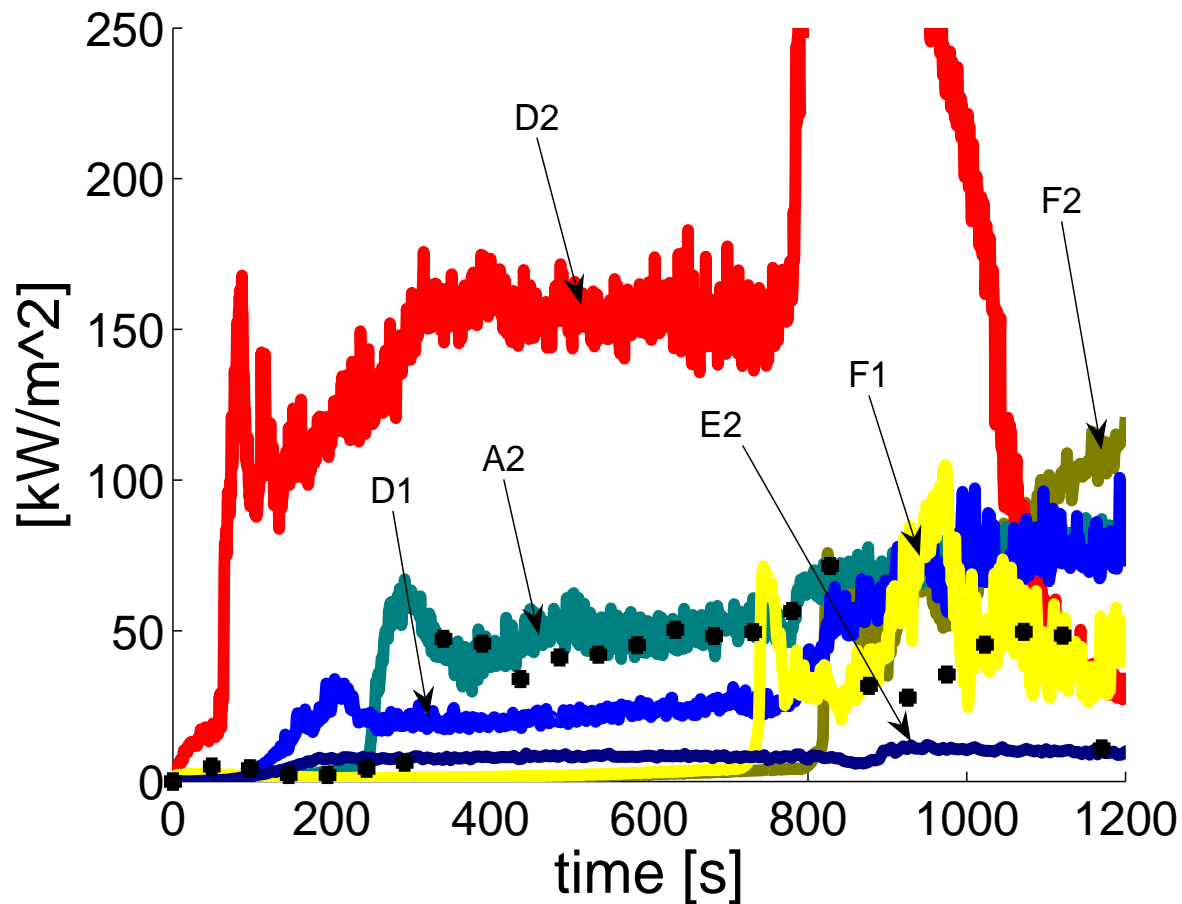
# Results: Hot Layer Height



# Results: Field Temperature

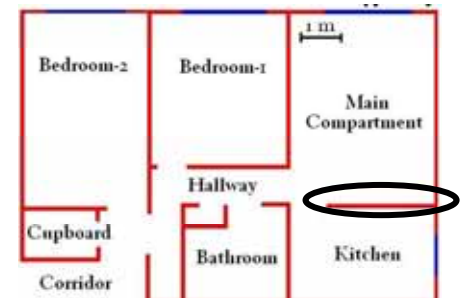
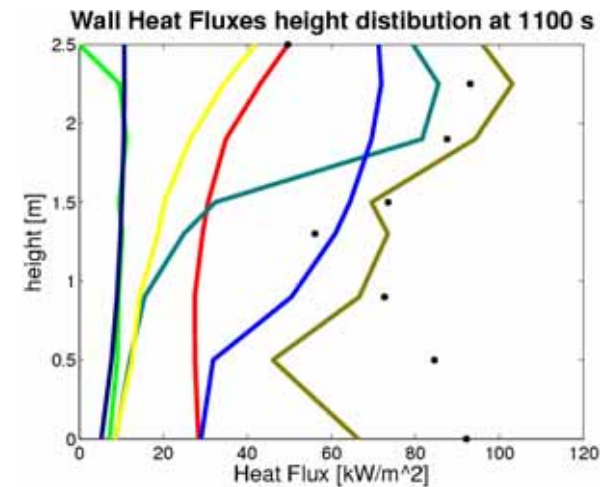
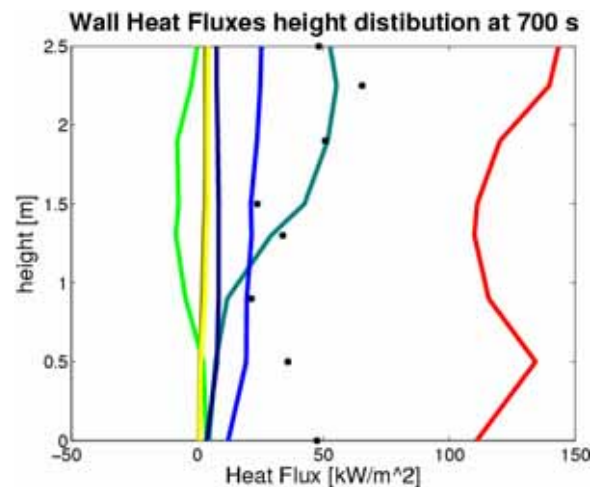
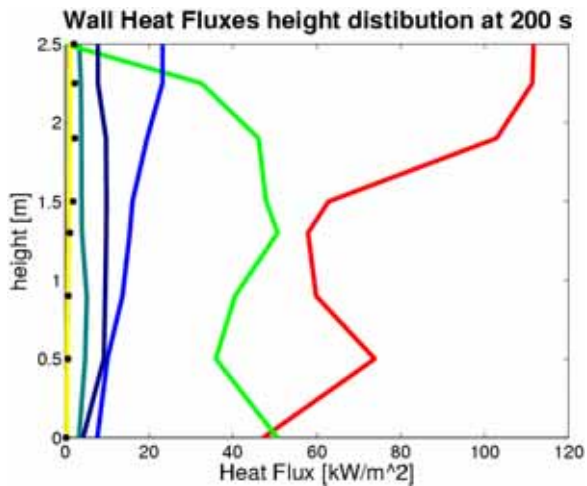


# Results: Wall Heat Flux (vs. time)

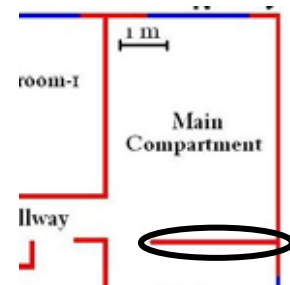
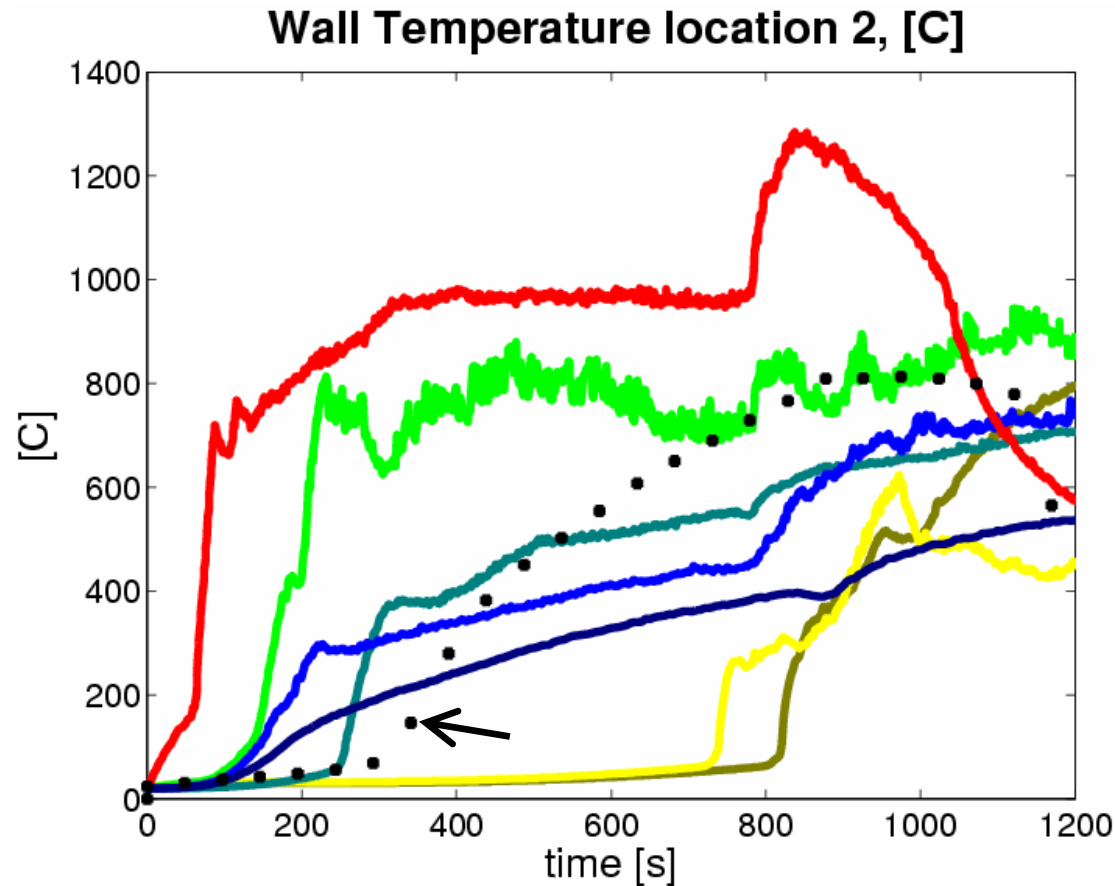




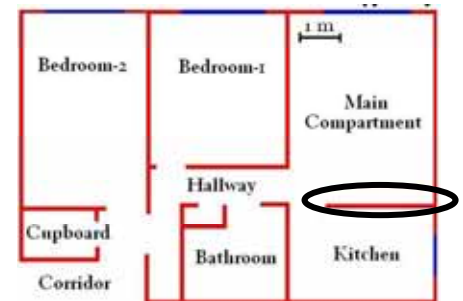
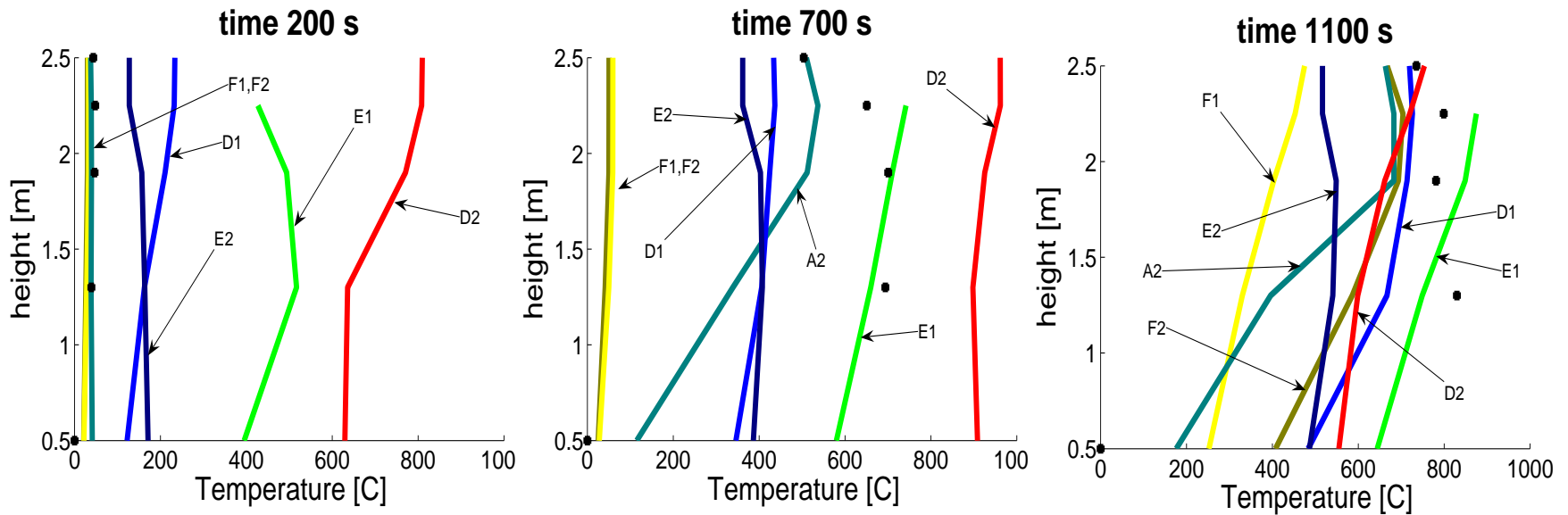
# Results: Wall Heat Flux (vs. height)



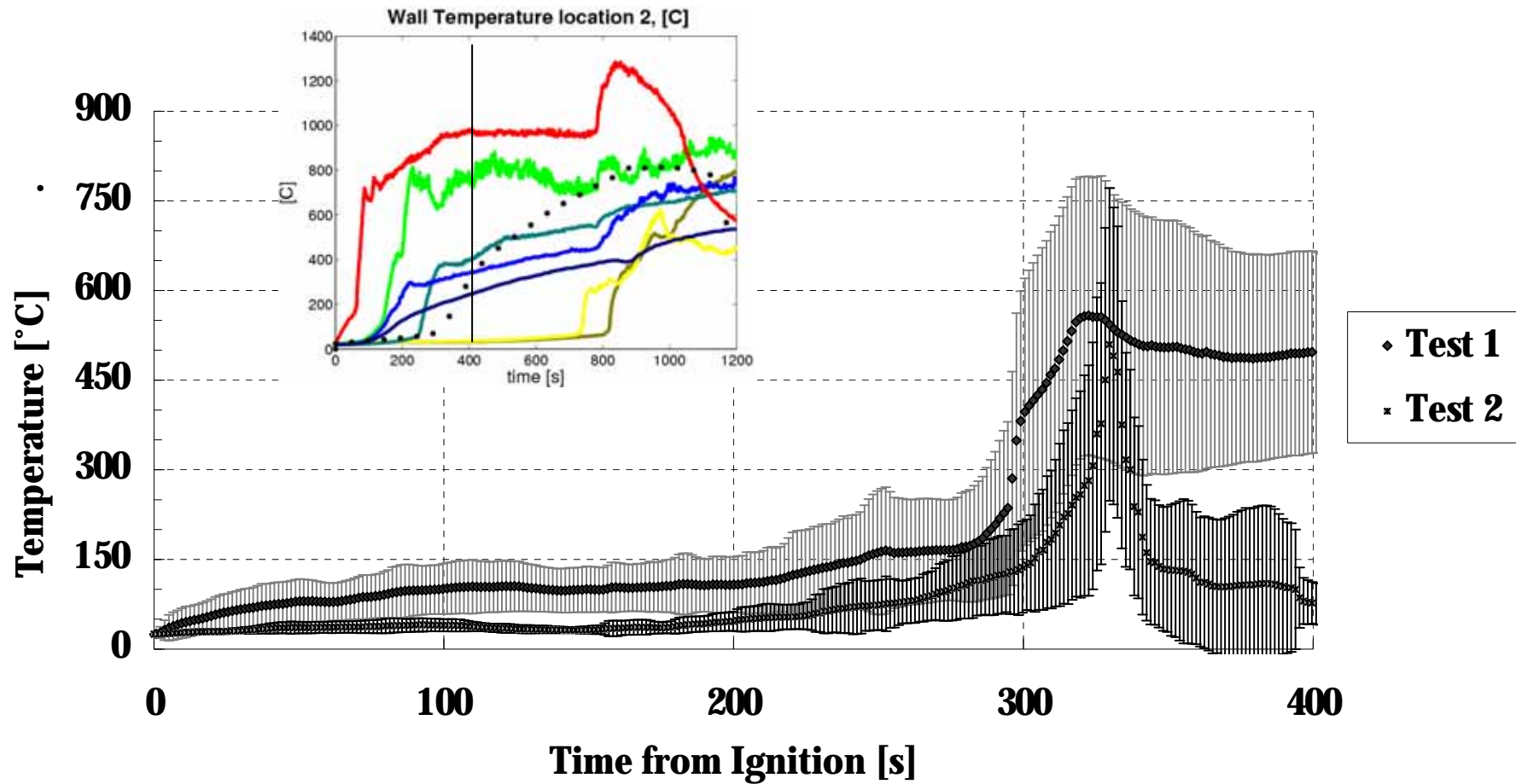
# Results: Wall Temperature (vs. time)



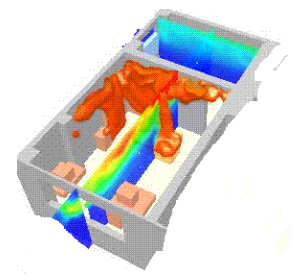
# Results: Wall Temperature (vs. height)



# Repeatability: Tests One and Two

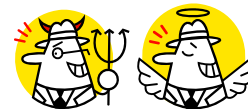


# Conclusions



## assessment of the state-of-the-art for a real scenario

- Large scatter around the measurements (much larger than experimental error)
- Lowest scatter away from the fire and during post-flashover
- Results are very sensitive to *a priori* assumptions of fire growth and ventilation
- It could be said that out of 10 simulation, 1 did well, 3 did decent, 6 did poorly (but not our objective)



# Lessons and Recommendations

- Inherent difficulties of predicting dynamics
- Lessons for Fire modelling (applies to **any** fire model)
- Results give a sense of how far we can go in details...
  
- Main source of scatter is the excess in degrees of freedom (specially material properties)
  
- To encourage the debate and exchange of views on the topic
- Great opportunity for further work and novel contributions



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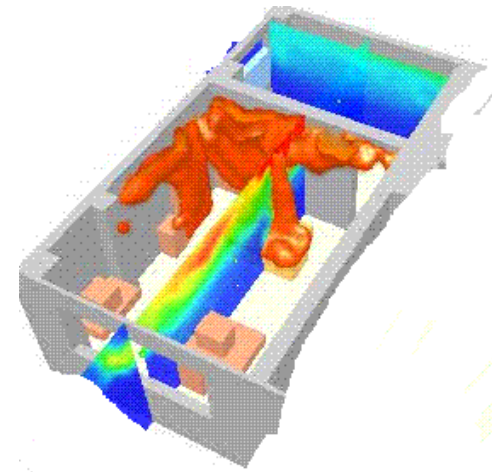
# Summary Results

	growth		post-flashover	
	over	under	over	under
Flashover	30%	60%	-	-
HRR	-	-	10%	<b>60%</b>
Smoke Layer Temperature	40%	20%	<b>50%</b>	10%
Smoke Layer Height	<b>70%</b>	0%	35%	40%
Gas Temperature	0%	<b>50%</b>	<b>45%</b>	5%
Wall Temperature	40%	10%	<b>55%</b>	5%
Wall Heat Flux	0%	<b>50%</b>	<b>45%</b>	5%





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*Gone for Good* 2006  
Acrylic on oil on panel / 122 X 160cm / © the artist /  
courtesy of Magnus Karlsson, Stockholm; Stephen Friedman  
Gallery, London; and David Zwirner, New York



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