

# Fire risk and air pollution assessment during the 2007 wildfire events in Greece using the COSMO-ART atmospheric model

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"Summer 2007 reflects the daily  $T_{\max}$  that are projected to occur in the **latter part of the 21<sup>st</sup> century**"  
Founda & Giannakopoulos., 2009

"This period was an **all time record hot summer**, combined with a prolonged drought period and strong winds" Founda & Giannakopoulos., 2009

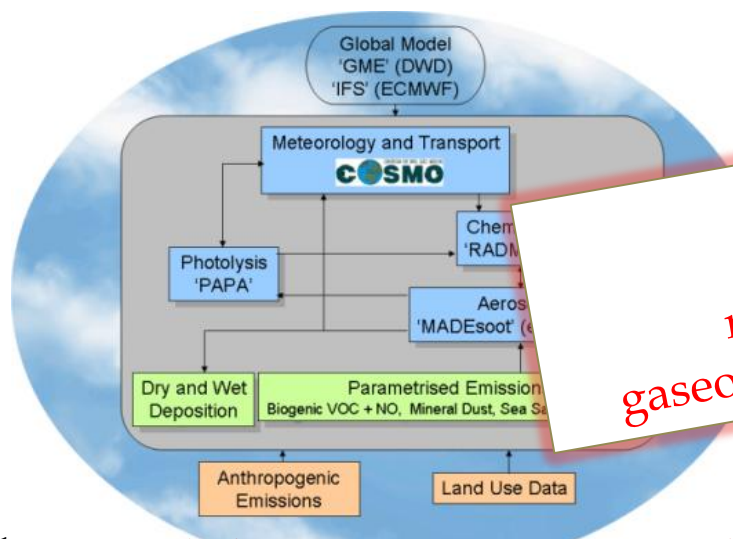
"**64 people** lost their lives"  
Founda & Giannakopoulos.,

"Greece suffered the **worst forest fires** in the past 50 years"  
Liu et al., 2009

"**2700 km<sup>2</sup>** of forest, olive groves and farmland were destroyed by the fires"  
Liu et al., 2009



# COSMO-ART<sup>1,2</sup> application over the Greater Greek area: 15 August – 13 September 2007



Initial and Boundary Meteorological input:  
Coarser COSMO meteorology by DWD  
Initial pollution:

**Model output:**  
Hourly fields of  
**meteorological** parameters and  
**gaseous & aerosol** species concentrations  
Integration scheme, dt = 15"

Horizontal spacing: 2.8 km

Vertical extent: ~20km,

1<sup>st</sup> layer height: ~20m

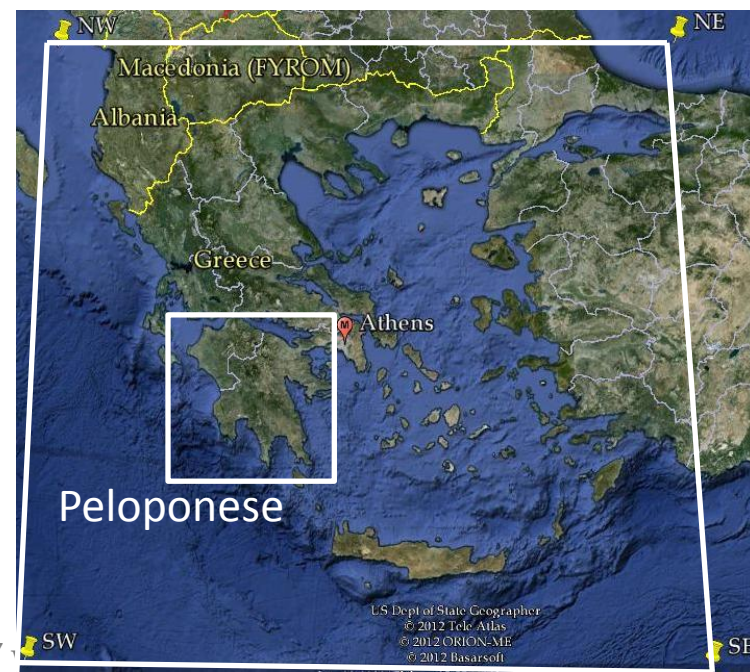
<sup>1</sup> regional chemistry transport model

ART stands for Aerosols and  
Reactive Trace gases

online-coupled to the COSMO regional  
numerical weather prediction and  
climate model (Baldauf et al., 2011)

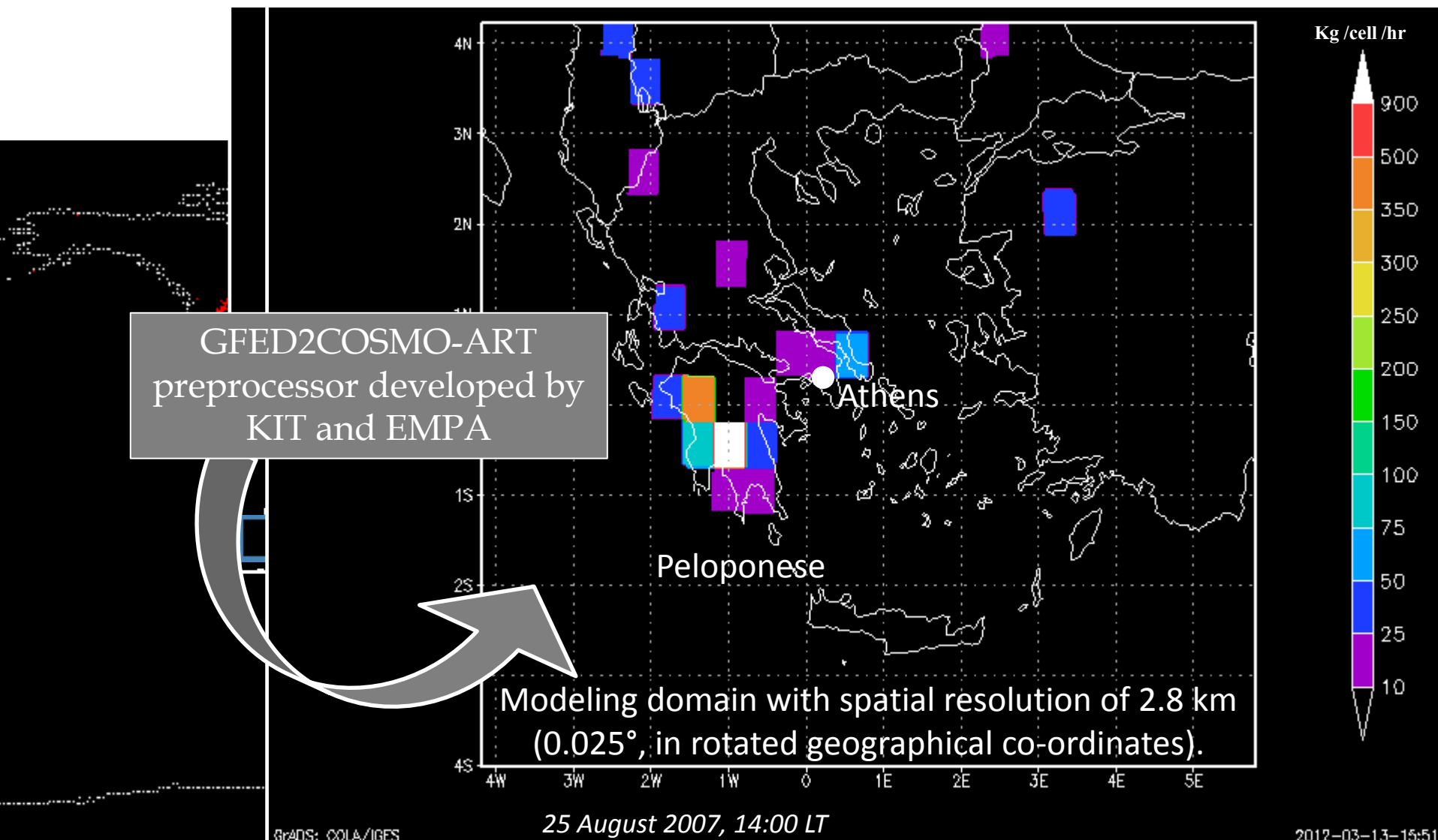
Radiation feedback: aerosols interact with  
radiation and temperature (GRAALS  
radiation scheme)

<sup>2</sup> Developed at the Karlsruhe Institute for  
Technology, Germany (Vogel et al., 2009)



Hourly emission rates in  $0.5^\circ$  spatial resolution for

- **gases**: CO, NO, NH<sub>3</sub>, SO<sub>2</sub>, N<sub>2</sub>O, NMHC (α-pinene, ethane, propane, alkanes, propene, alkenes, ethene, isoprene, toluene, xylene, formaldehyde, higher aldehydes, higher ketones)
- **aerosols (PM1)**: Elemental carbon, Organic carbon





# Canadian Forest Fire Weather Index (FWI)

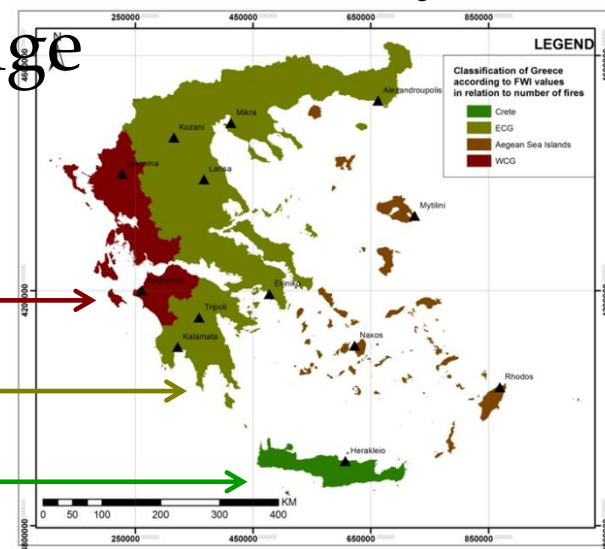
- daily meteorological-based index used worldwide to estimate **fire danger** in a generalized fuel type
- depends on daily noon measurements of **T** dry-bulb **RH**, **U10m** & acc.**Prec.** 24 h

## Evaluation & Calibration of FWI index for Greece

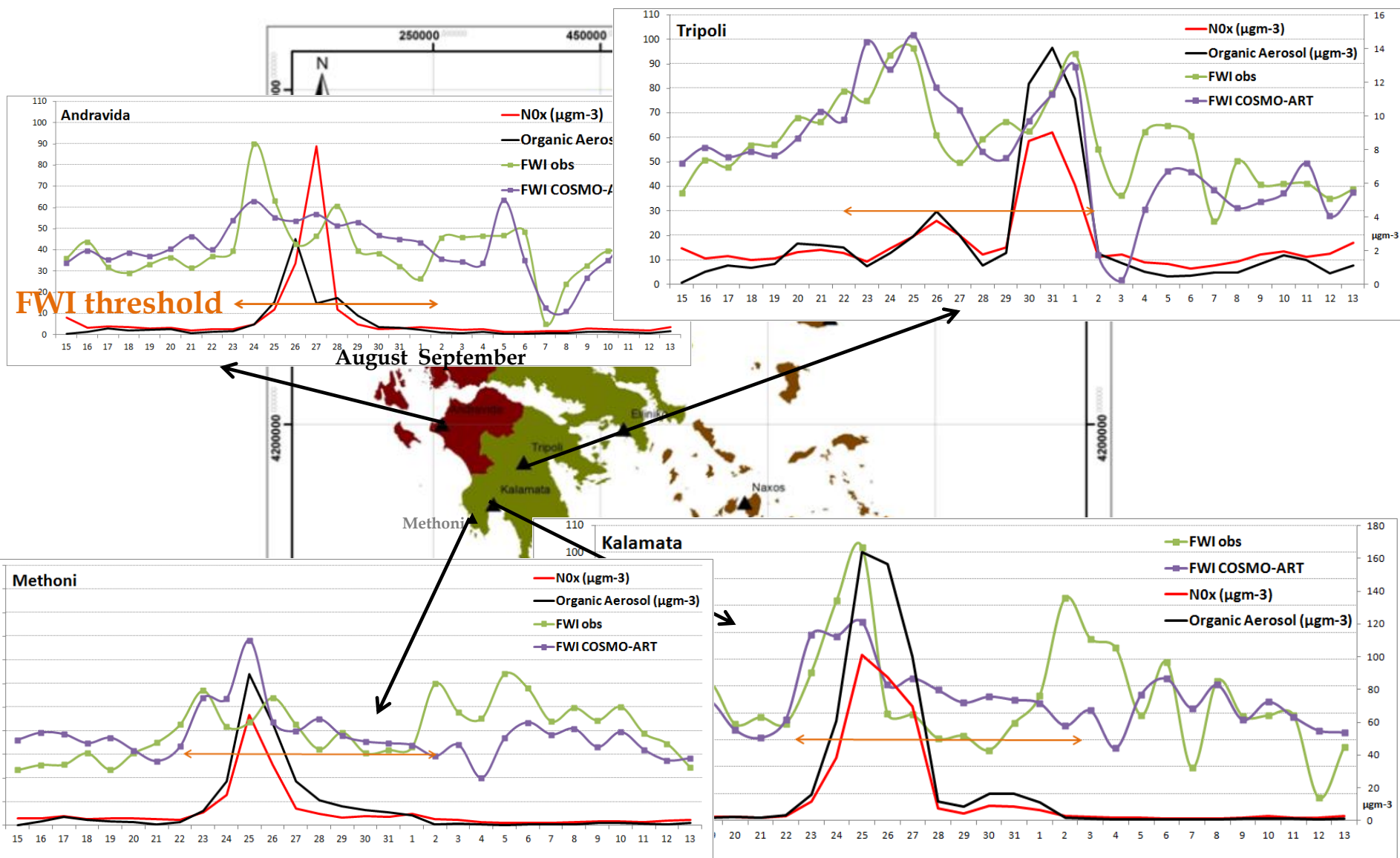
- **Meteorological** data for 11 stations: Hellenic National Meteorological Service
- **Fire** data: Forest Special Secretariat of the Ministry of Environment, Energy & Climate Change
- 15-year period: 1983-1997

## Thresholds of extreme fire risk

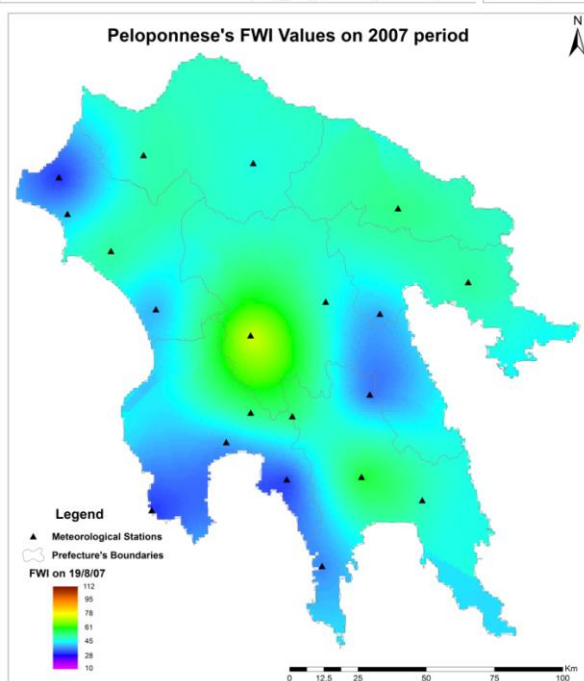
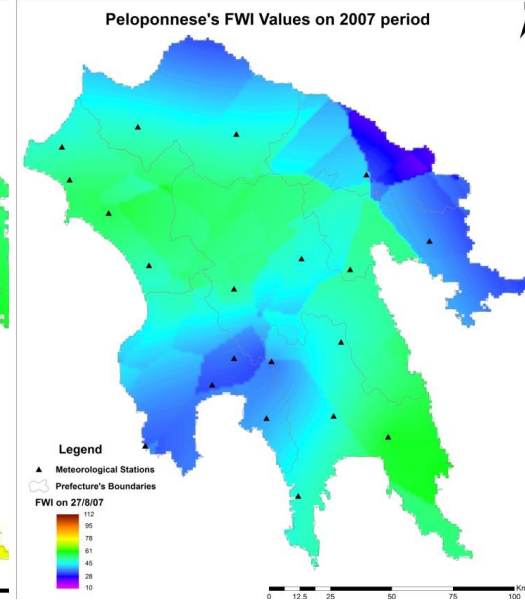
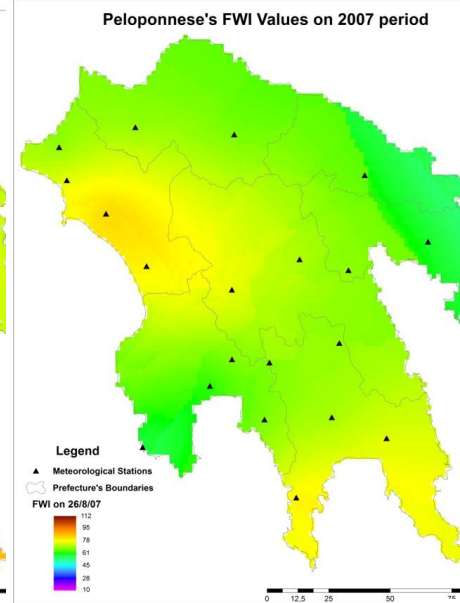
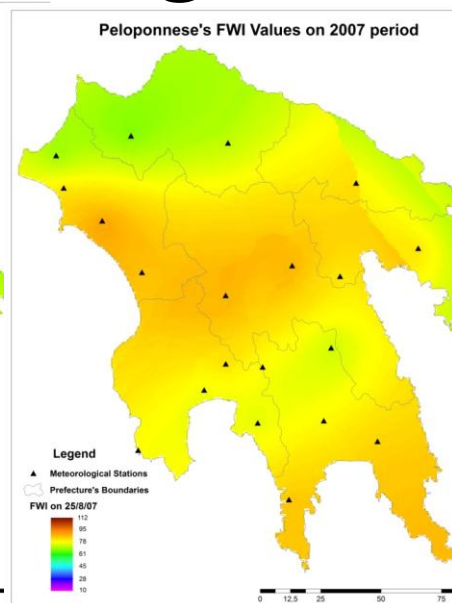
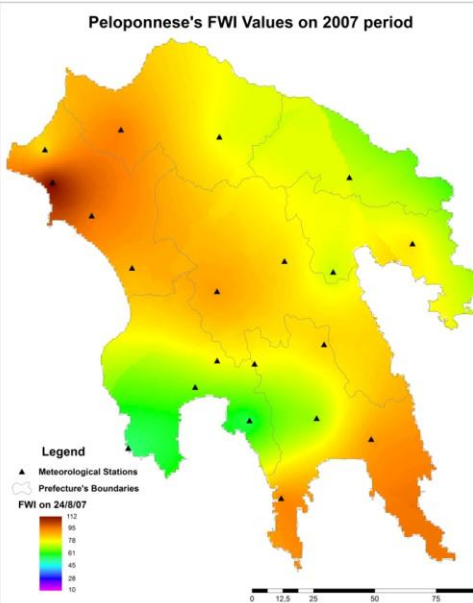
- 1fire/day when FWI>15
- 1fire/day when FWI>30
- 1fire/day when FWI>40



# FWI during the 2007 wildfire events



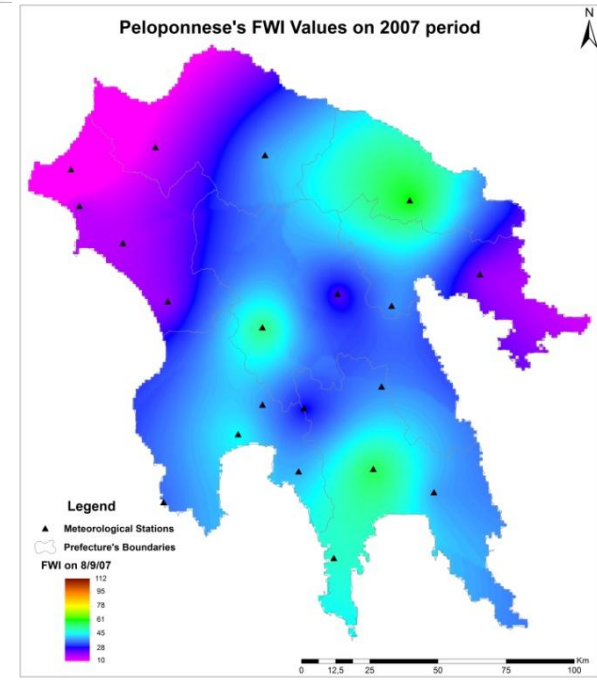
# FWI during the 2007 wildfire events



During

Before

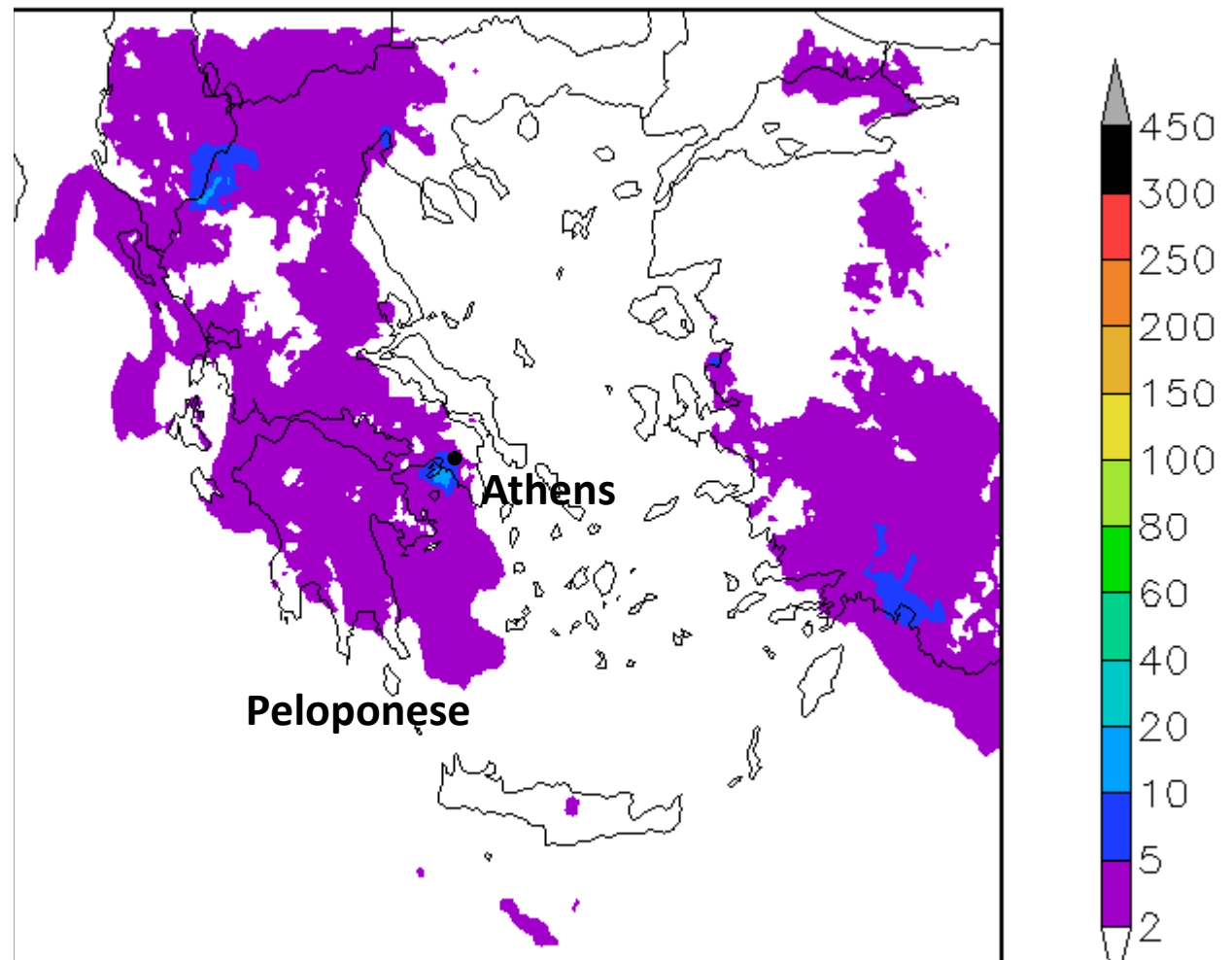
After



# Daily average **Aerosol Total Carbon\*** concentrations ( $\mu\text{gm}^{-3}$ ) during the 2007 wildfire events

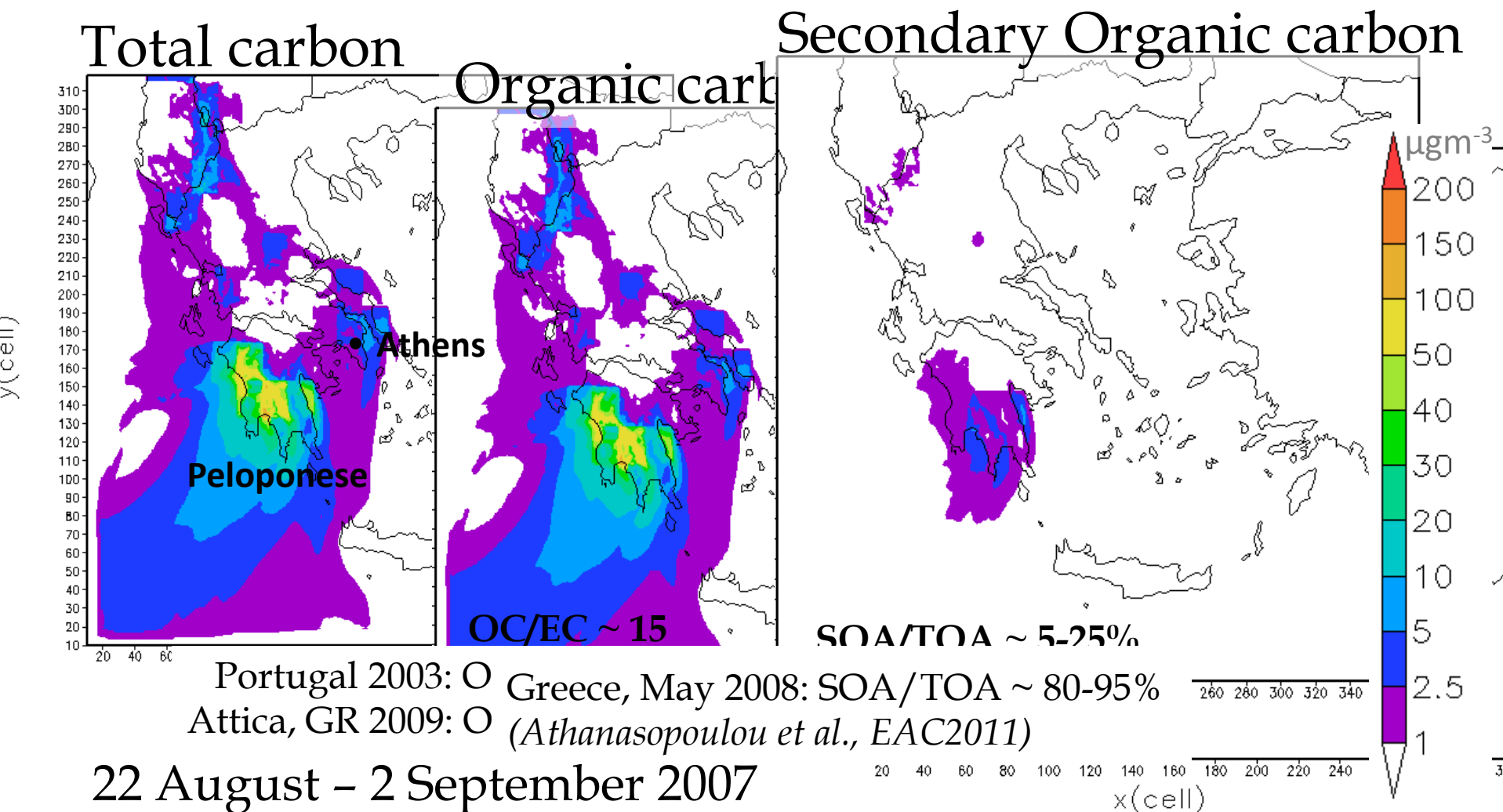
20-AUG2007

\* Primary & secondary organic carbon and elemental carbon

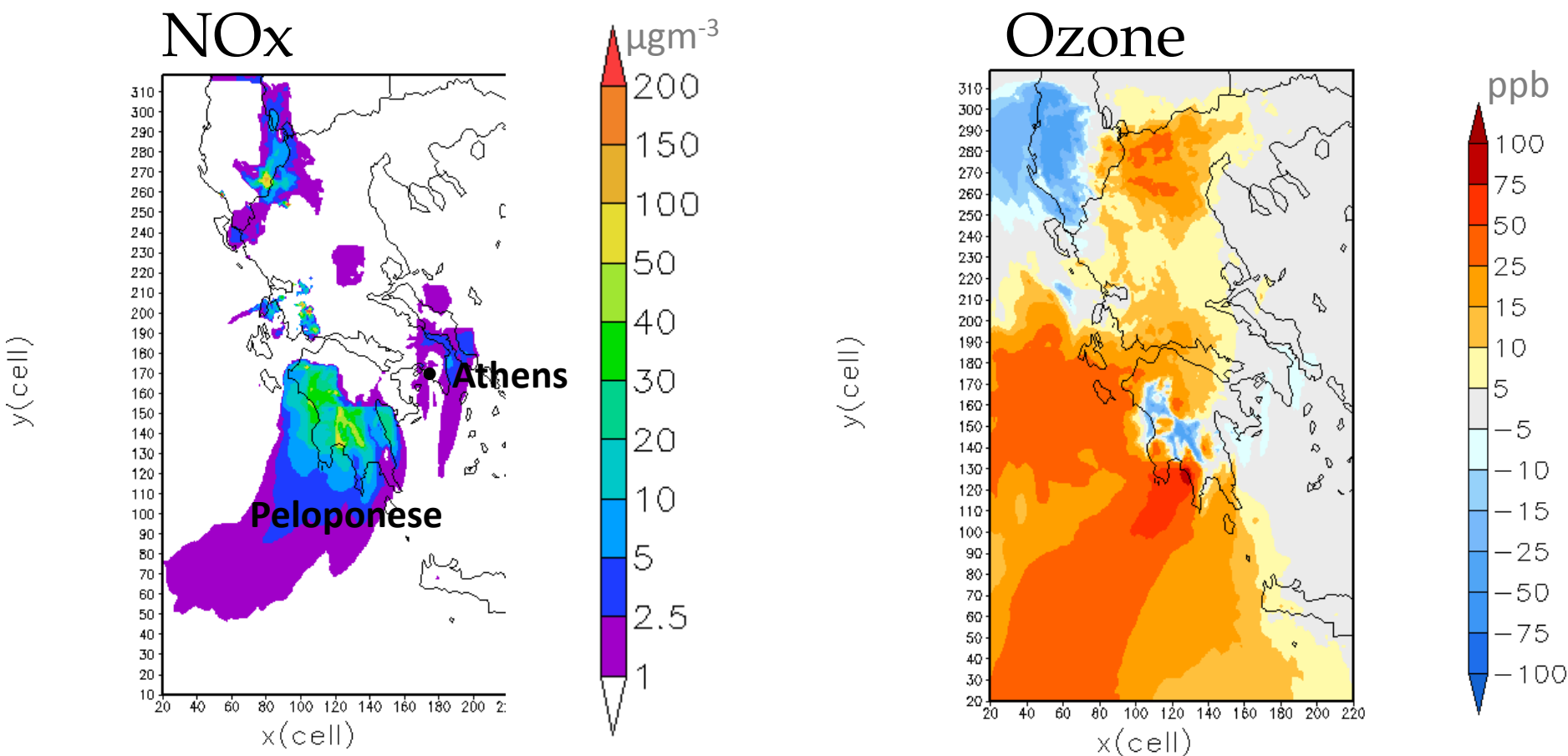




# Spatial distribution of different pollutants: concentration differences from a scenario without fire emissions



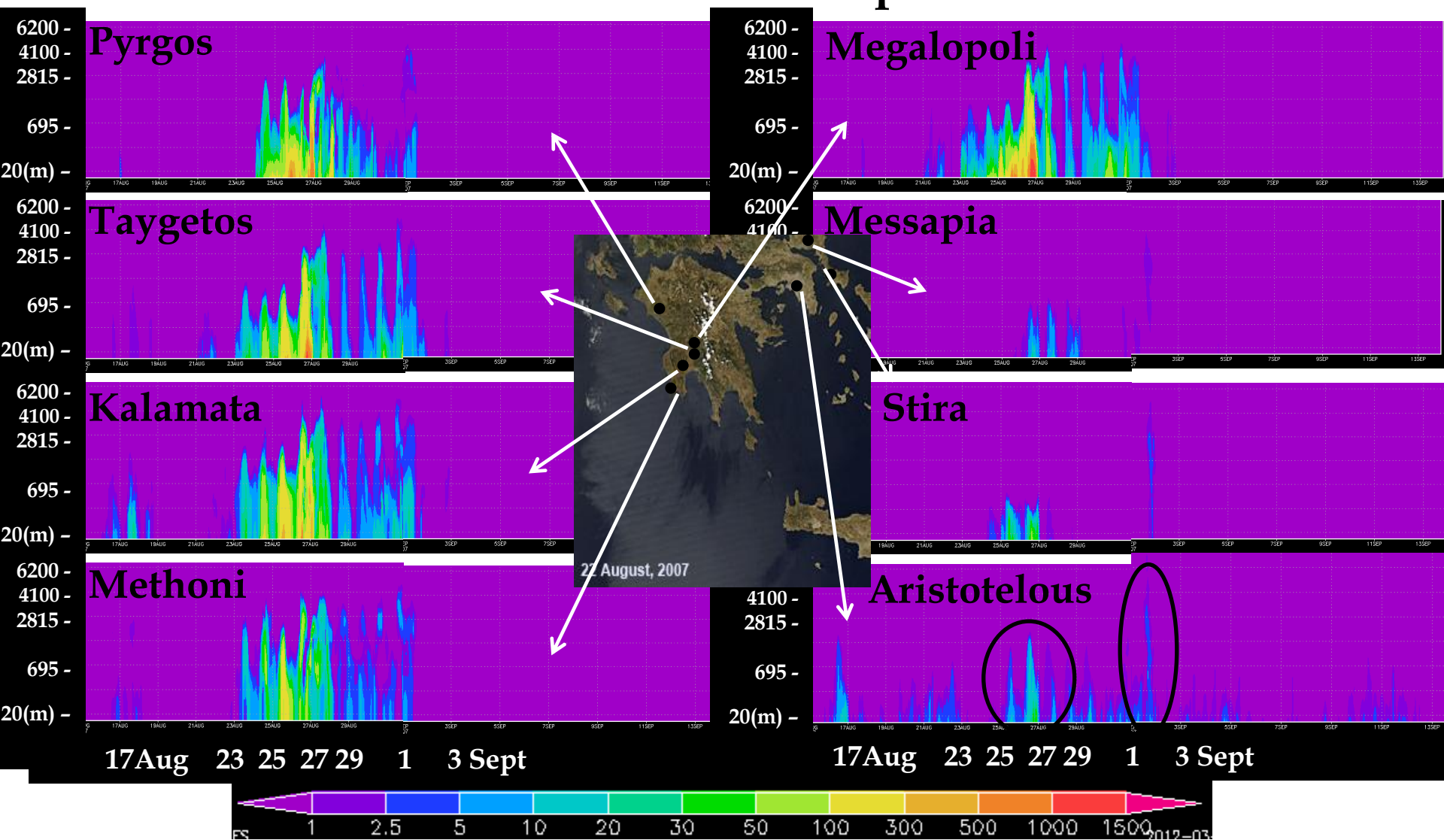
# Spatial distribution of different pollutants: concentration differences from a scenario without fire emissions



22 August – 2 September 2007

# Hourly concentrations of organic aerosol ( $\mu\text{gm}^{-3}$ ) during the 2007 wildfire events

## Vertical extent of fire plumes



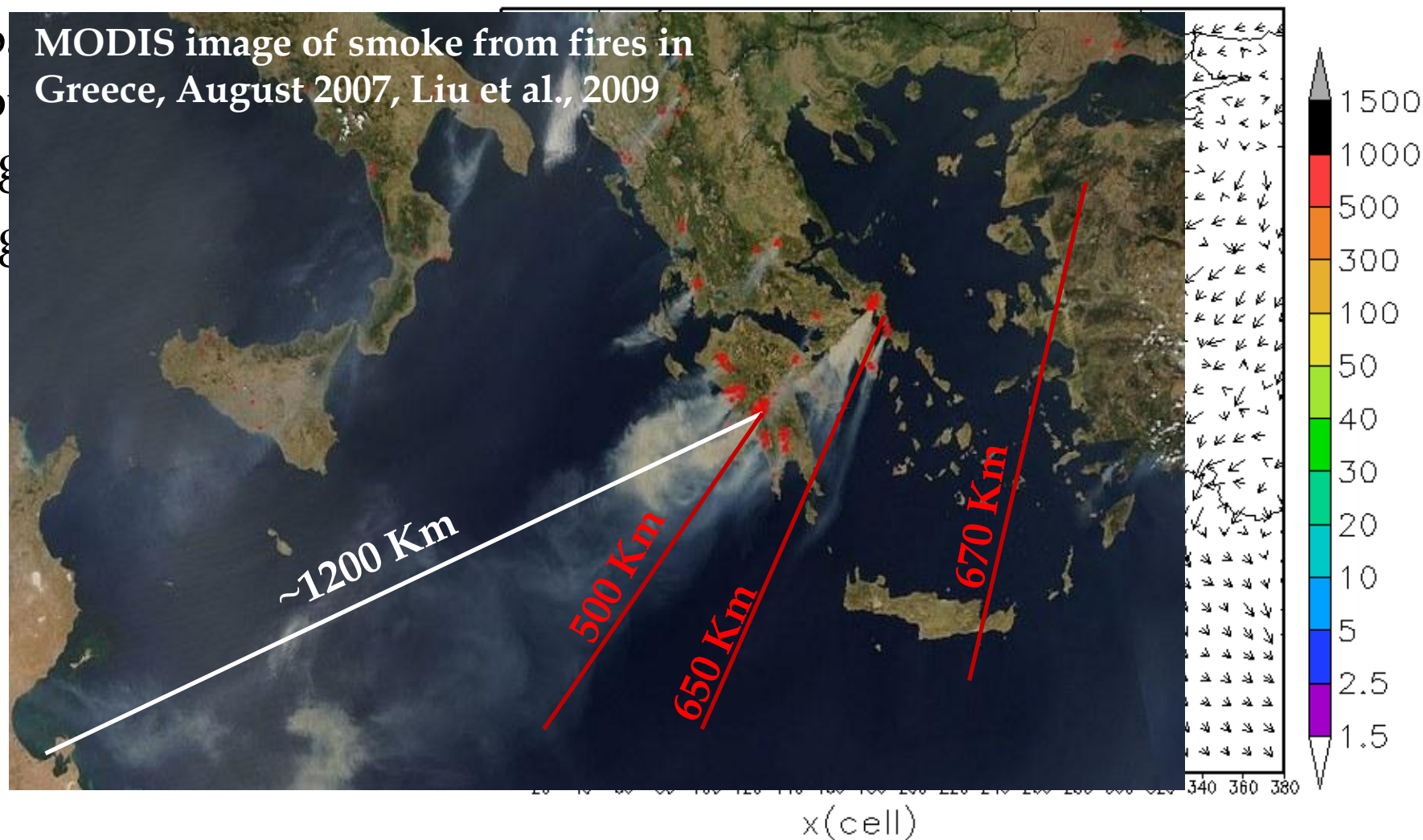
# First pollution episode 24–29 August 2007

## Horizontal extent of fire plumes

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Sp  
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org

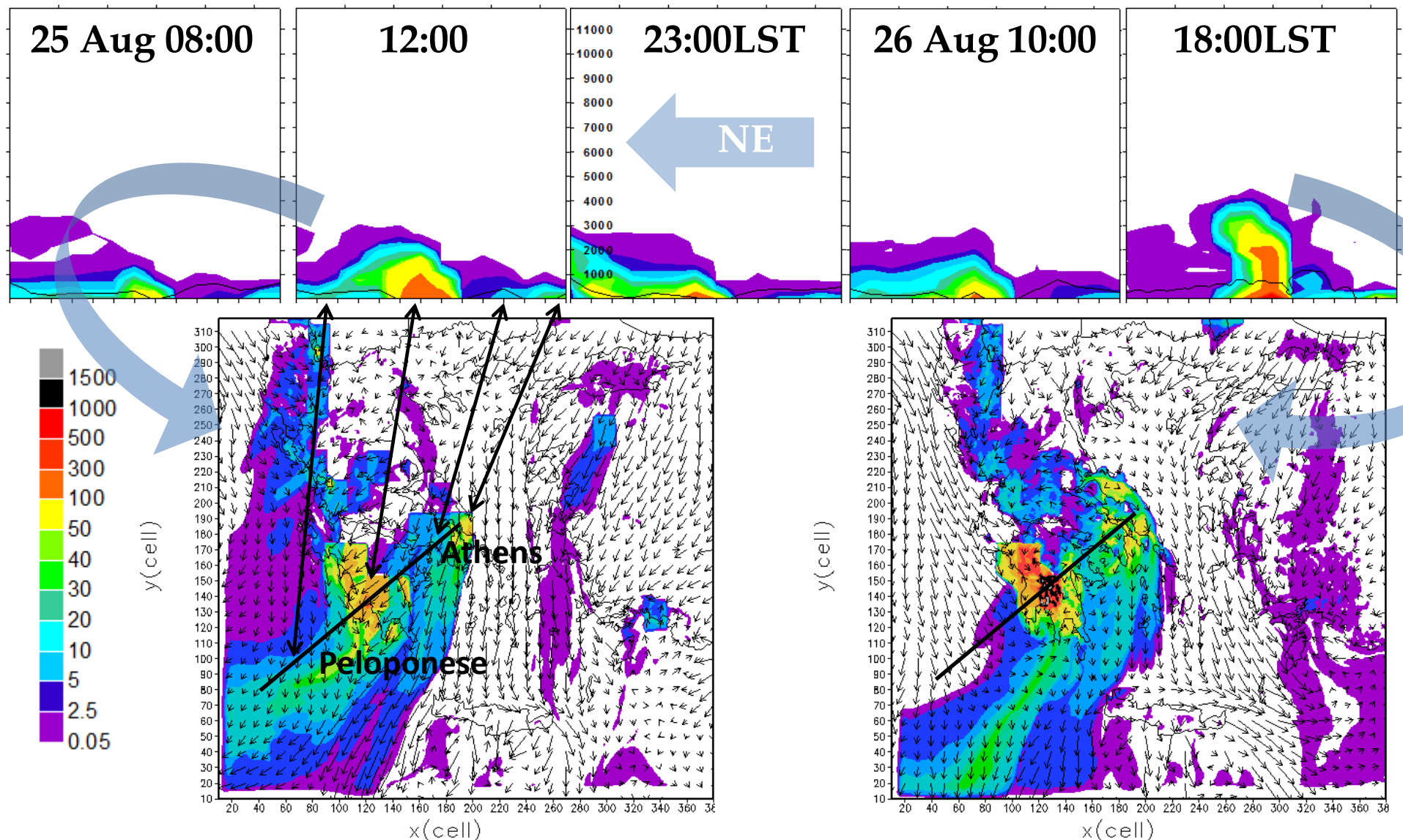
MODIS image of smoke from fires in Greece, August 2007, Liu et al., 2009





# First pollution episode 24–29 August 2007

## Cross sections of hourly concentrations ( $\mu\text{g m}^{-3}$ ) of organic aerosol



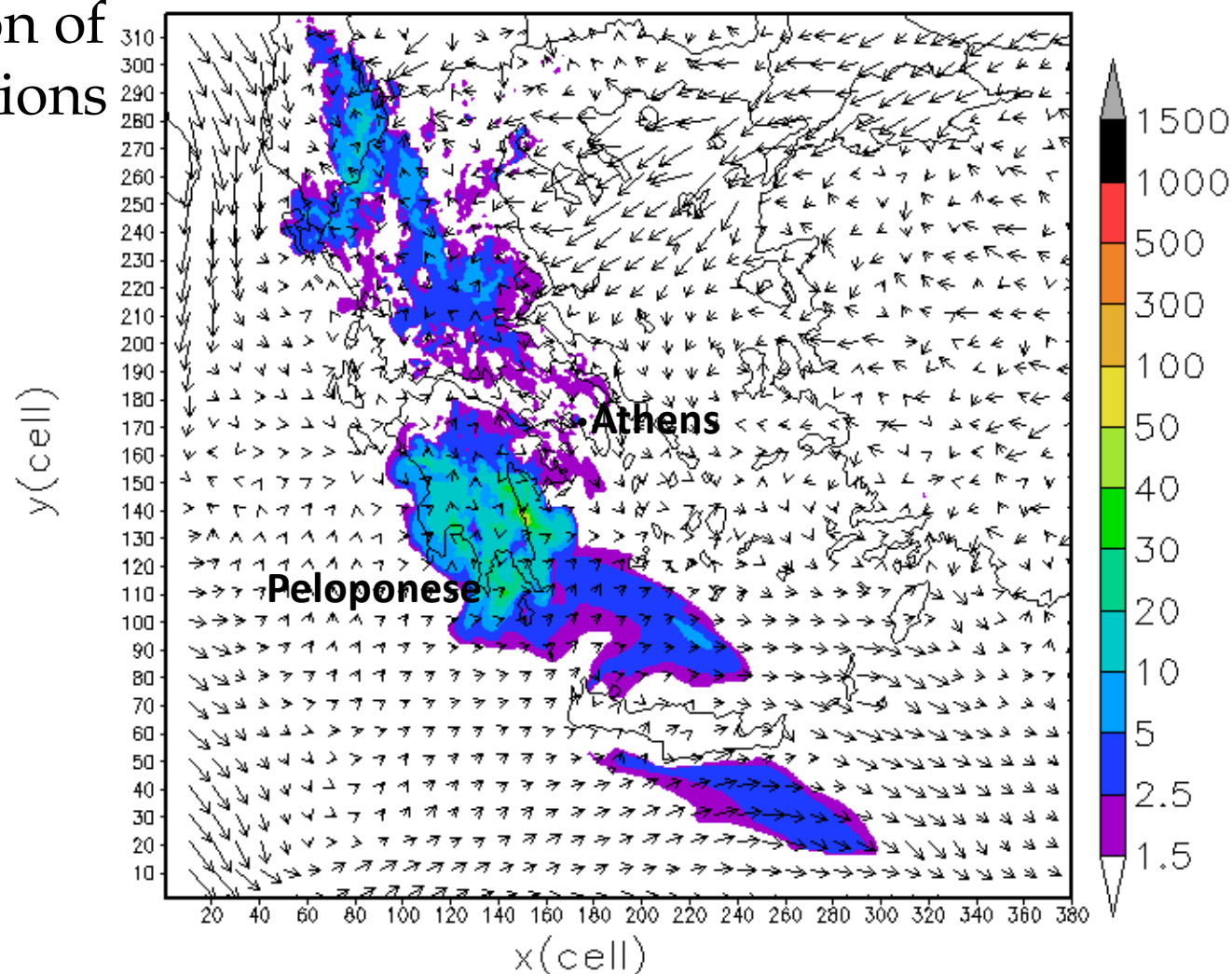
# Second pollution episode

## 30 August – 3 September 2007

**Temporal extent** of fire plumes

07Z01SEP2007

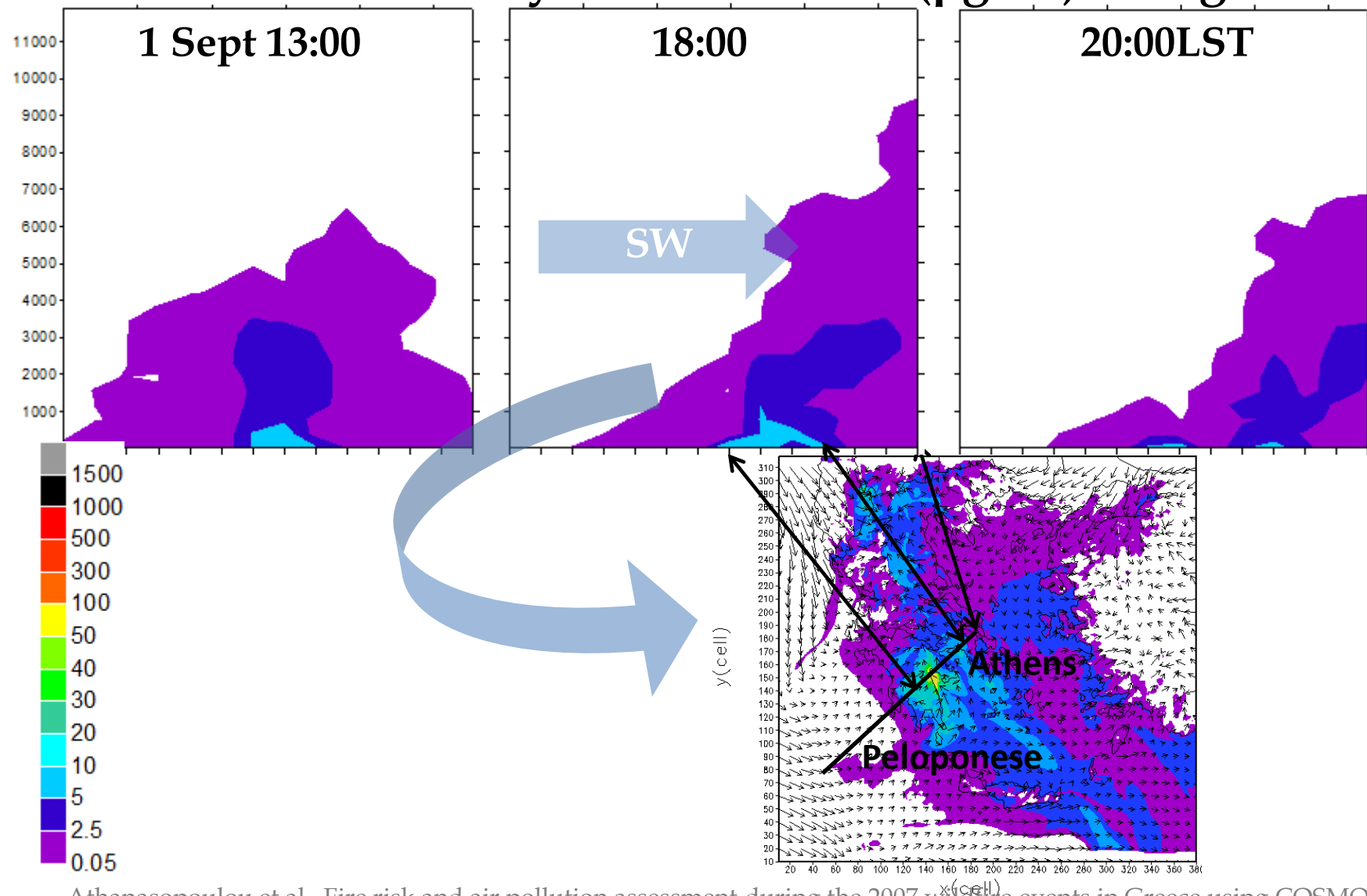
Spatial distribution of  
hourly concentrations  
( $\mu\text{gm}^{-3}$ ) of  
organic aerosol



# Second pollution episode

## 30 August – 3 September 2007

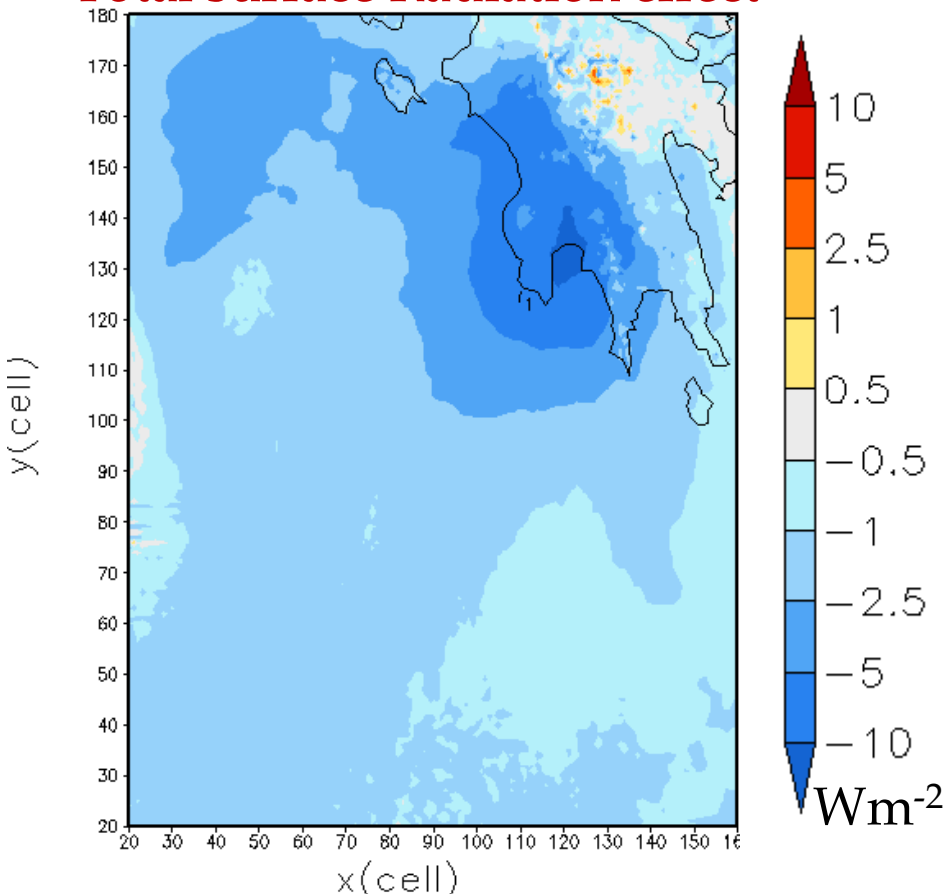
**Cross sections** of hourly concentrations ( $\mu\text{g m}^{-3}$ ) of organic aerosol



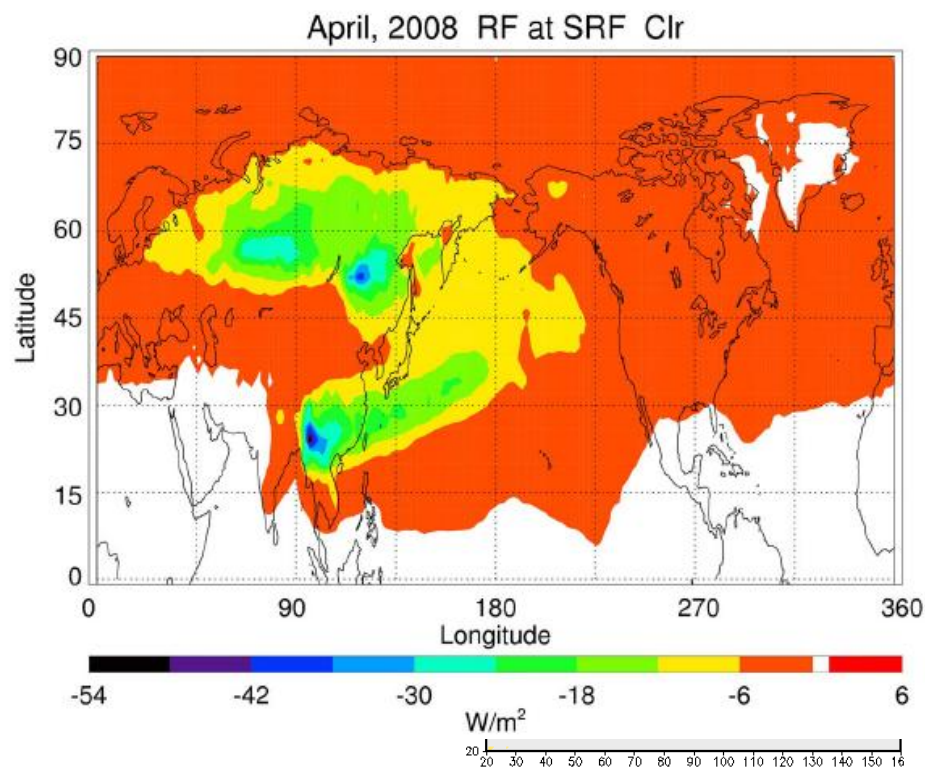
# Direct radiative effect of aerosols from the 2007 wildfire events

Radiation differences from a scenario without fire emissions  
22 August – 2 September 2007

## Total surface Radiation effect



NATARAJAN ET AL.: ASIAN FIRES AND DIRECT RADIATIVE FORCING





# Ongoing & Future work

- Incorporate the **FWI** model in the weather **forecast** service by NOA
- **Downscale fire emissions:** retrieve and process high resolution burnt area data
- Incorporate an algorithm in COSMO-ART, which simulates **air temperature increase during wild fires**
- **Expand the simulation area towards Africa:** identify the real spatial extend of fires – capture the Saharan event
- Project the **impact a future fire event on air quality:** comparative scenario with inputs from future meteorological model outputs

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**Thank you for your attention**

