Transport of the 2017 Canadian wild fire plume to the tropics via the Asian monsoon circulation

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Questions to be answered

1. How and when does the fire plume **reach the Asian monsoon region**?
2. How does it **compare to the ATAL** (Asian Tropopause Aerosol Layer)?
3. How does it interact with the AMA circulation and has it been **transported to the tropics**?

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SAGEIII-ISS aerosol extinction data

OMPS aerosol extinction data

CLaMS simulations

TRACZILLA back-trajectories

Radiative forcing estimation

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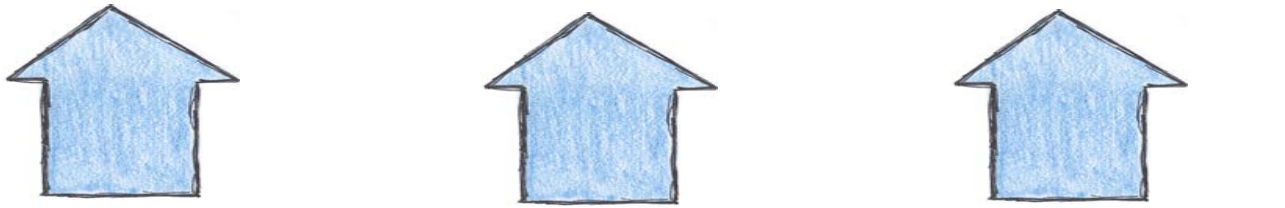
Discussion paper in ACP: acp-2019-204



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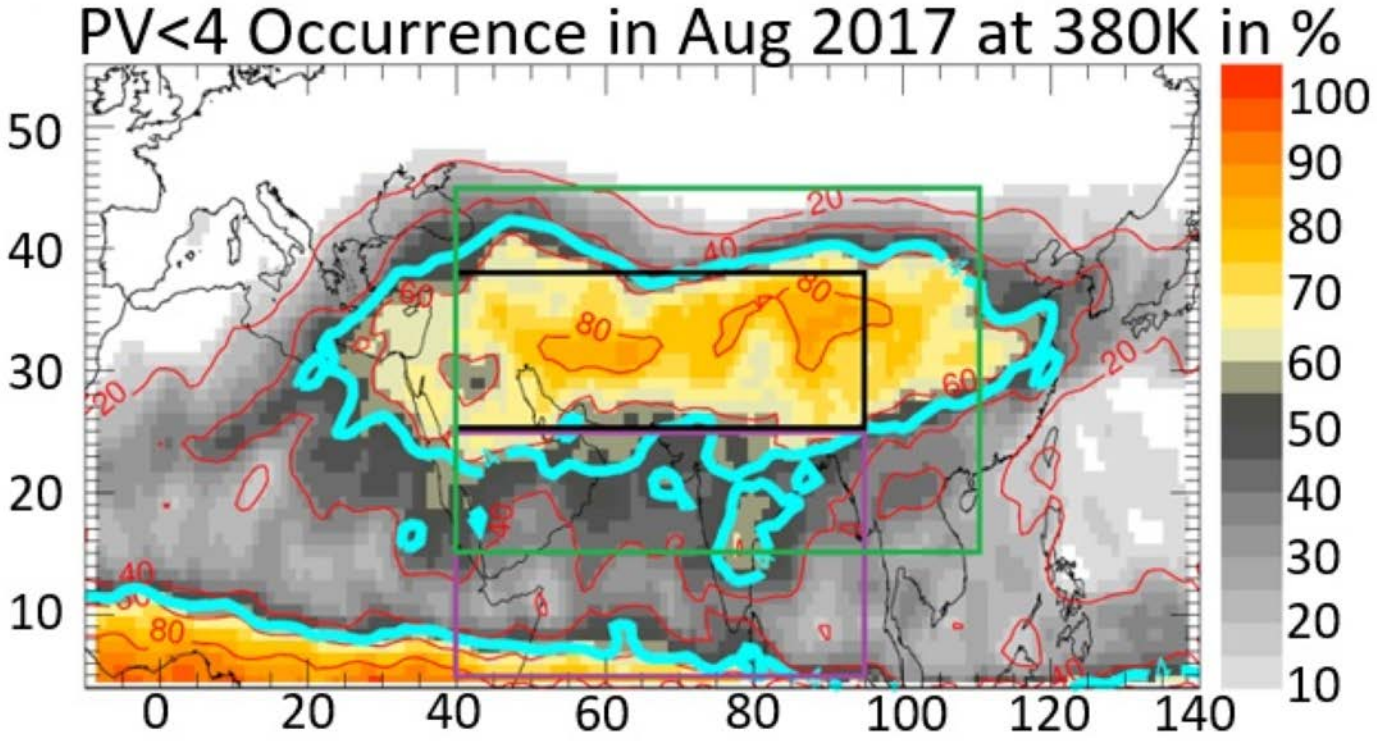
Defining regions in the AMA



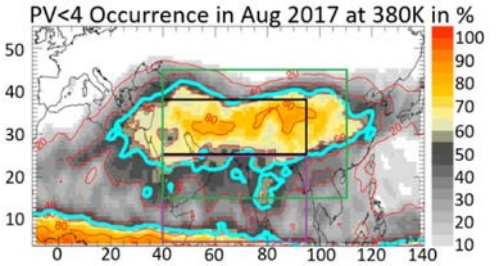
Green: generally used AMA box

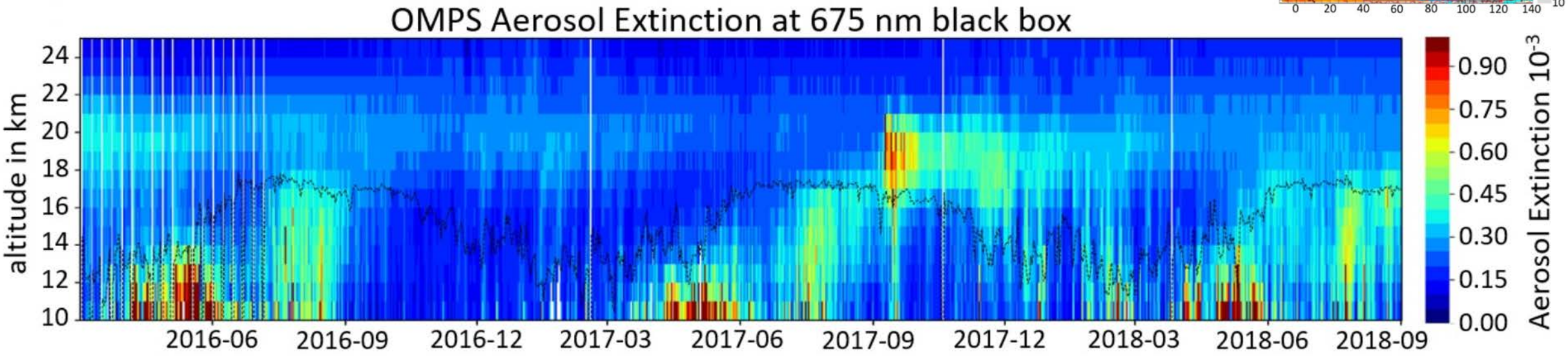
Black: 'core' AMA box according to the PV gradient

Magenta: area chosen south of the 'core'

SAGE III ISS and OMPS observations in those regions

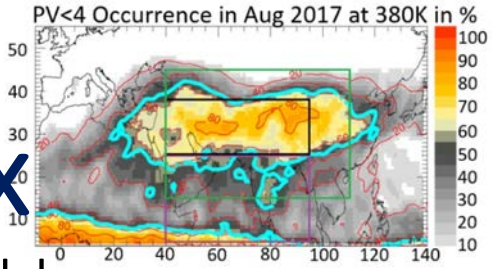
OMPS Aerosol extinction black box

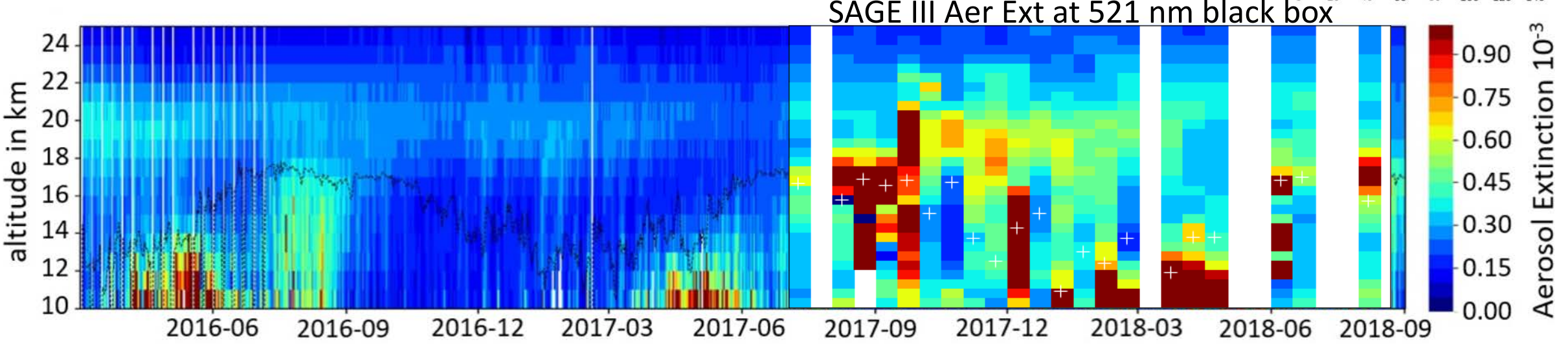




- Clearly **visible ATAL** (for all three years, in July and August up to 18km altitude)
- **ATAL and fire plume are two distinguishable events** in different altitude ranges

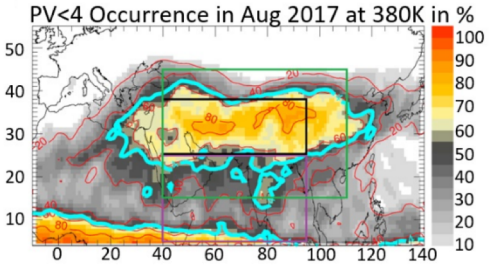
+ SAGE III Aerosol extinction black box

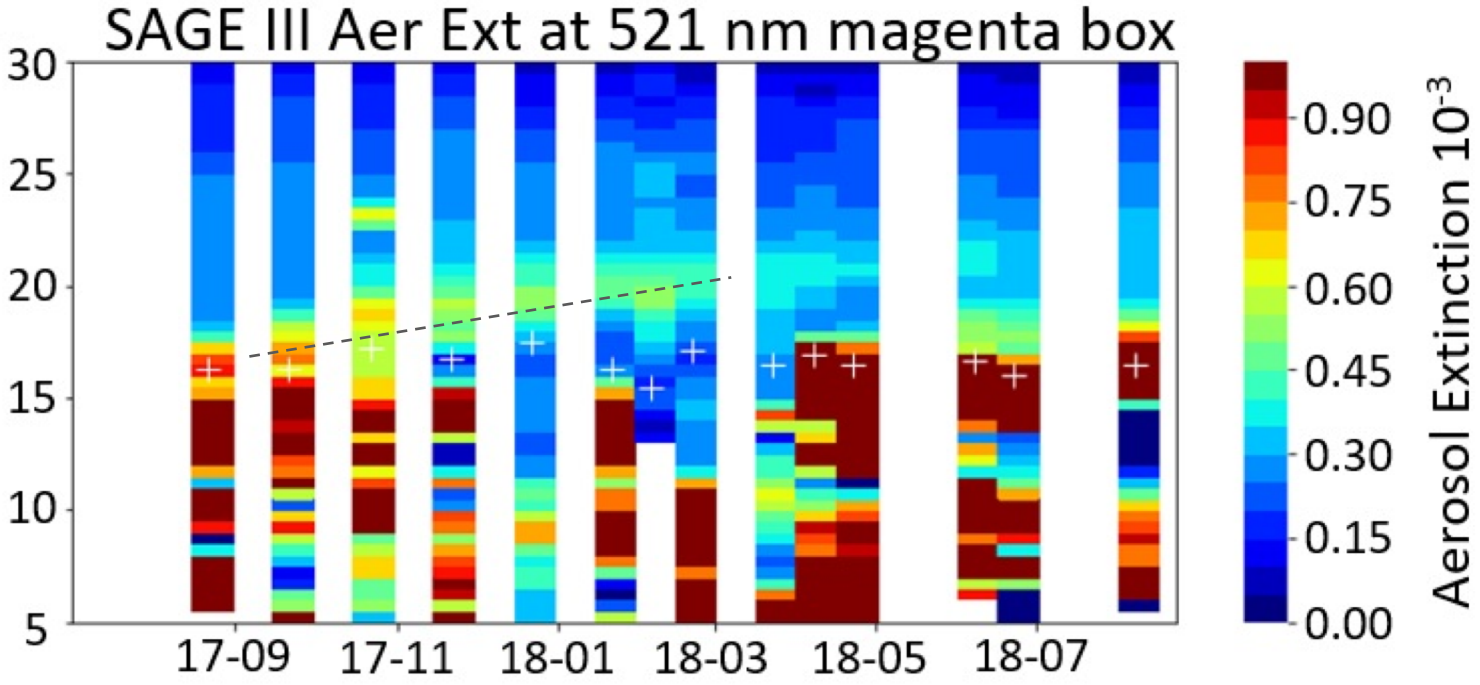




- Clearly **visible ATAL** (for all three years, in July and August up to 18km altitude)
- **ATAL and fire plume are two distinguishable events** in different altitude ranges
- The **fire plume appears in the beginning of September** at 16-21km altitude and is visible until the end of March 2018.

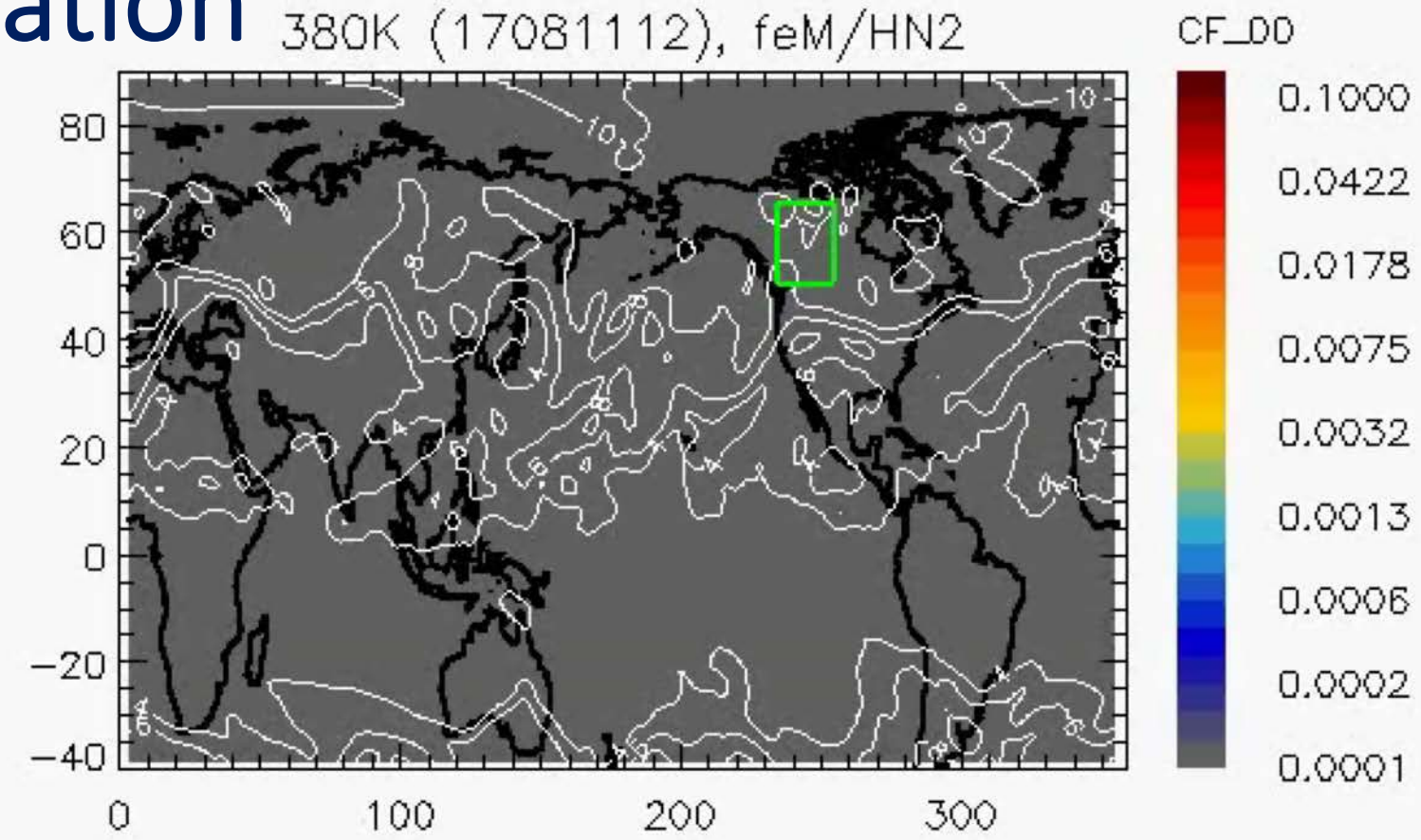
SAGEIII aerosol extinction magenta box (closer to the tropics)



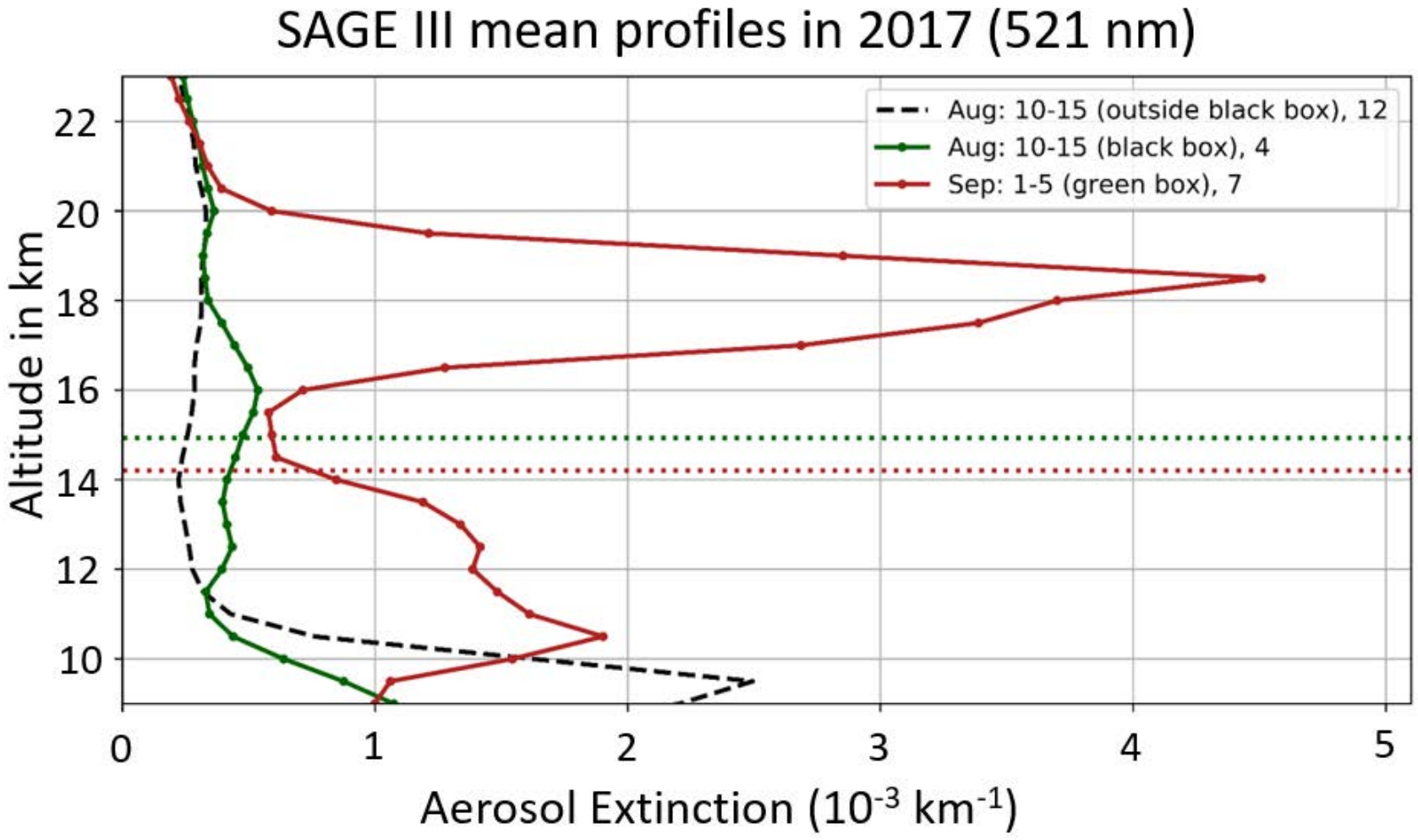


- Rising feature of **~5km in 7 months**
- **AMA: strong connection between the mid-latitudes and the tropics** *(see also Konopka et al. (2010) and Wu et al. (2017) in ACP)*

CLaMS simulation



Plume signal compared to ATAL

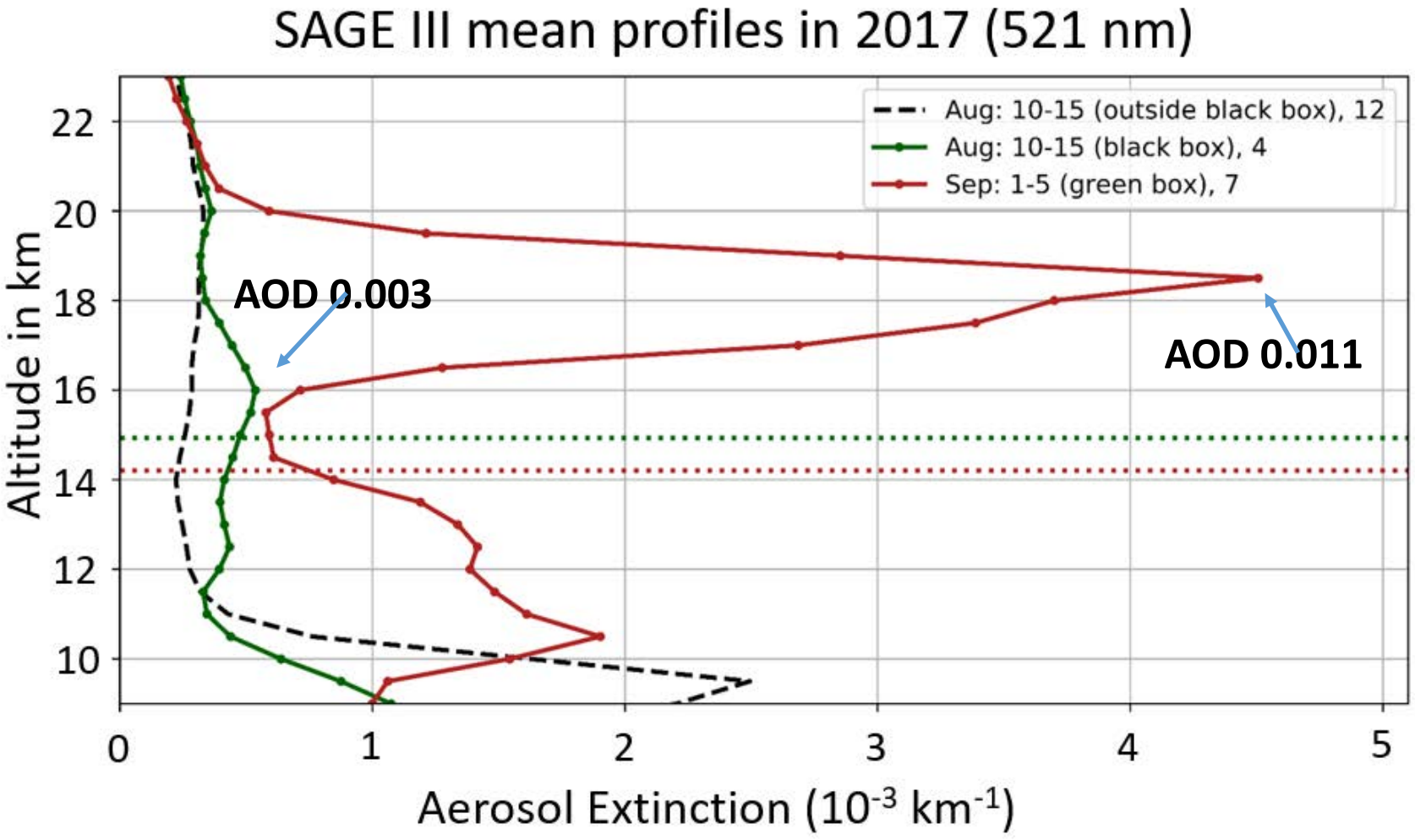


Black dashed: area 15-45°N and 60°W-10°E, background conditions

Green: prior to fire influence, inside the AMA box (black box)

Red: fire plume signal in the wider monsoon area (green box)

Plume signal compared to ATAL



Black dashed: no enhanced aerosol

Green: ATAL signal at ~16km altitude doubling background conditions

Red: enhanced aerosol extinction signal due the fire plume (~18km altitude), higher aerosol extinction by a factor of ~9

Questions → Key points

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Questions → Key points

- Coming from the west, the fire plume reaches the monsoon area **end of August**

2. How does it **compare to the ATAL** (Asian Tropopause Aerosol Layer)?
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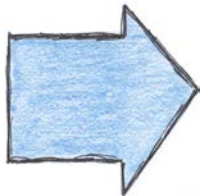
Questions → Key points

- Coming from the west, the fire plume reaches the monsoon area **end of August**
- The fire signal is **a factor of ~9 higher** than the observed ATAL signal in terms of the aerosol extinction.

3. How does it interact with the AMA circulation and has it been **transported to the tropics**?

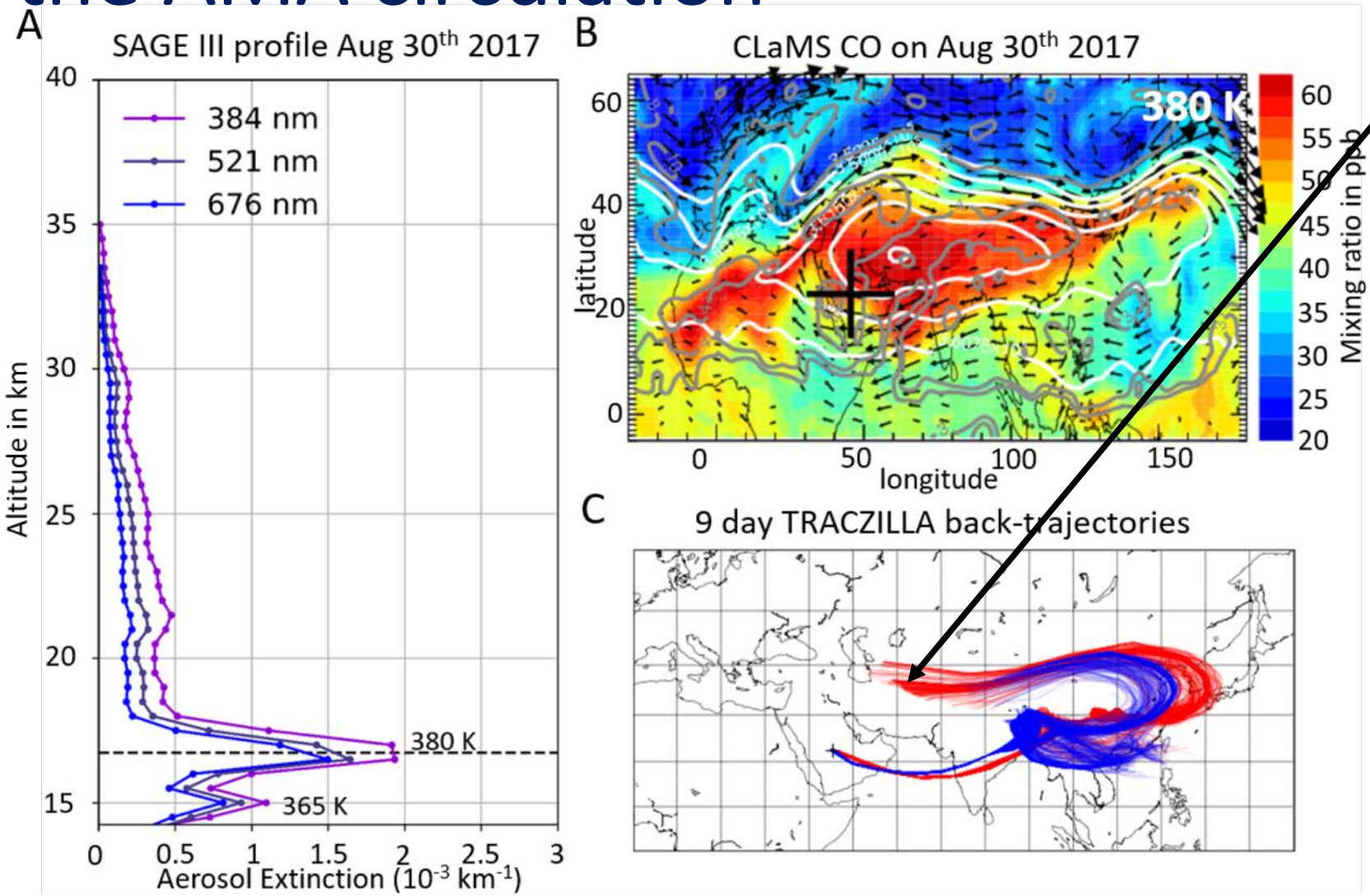
Questions → Key points

- Coming from the west, the fire plume reaches the monsoon area **end of August**
- The fire signal is **a factor of ~9 higher** than the observed ATAL signal in terms of the aerosol extinction.
- Yes, it has been transported **via the eastern flank of the AMA circulation to the tropics**
  - no evidence of bypassing the AMA transport barrier



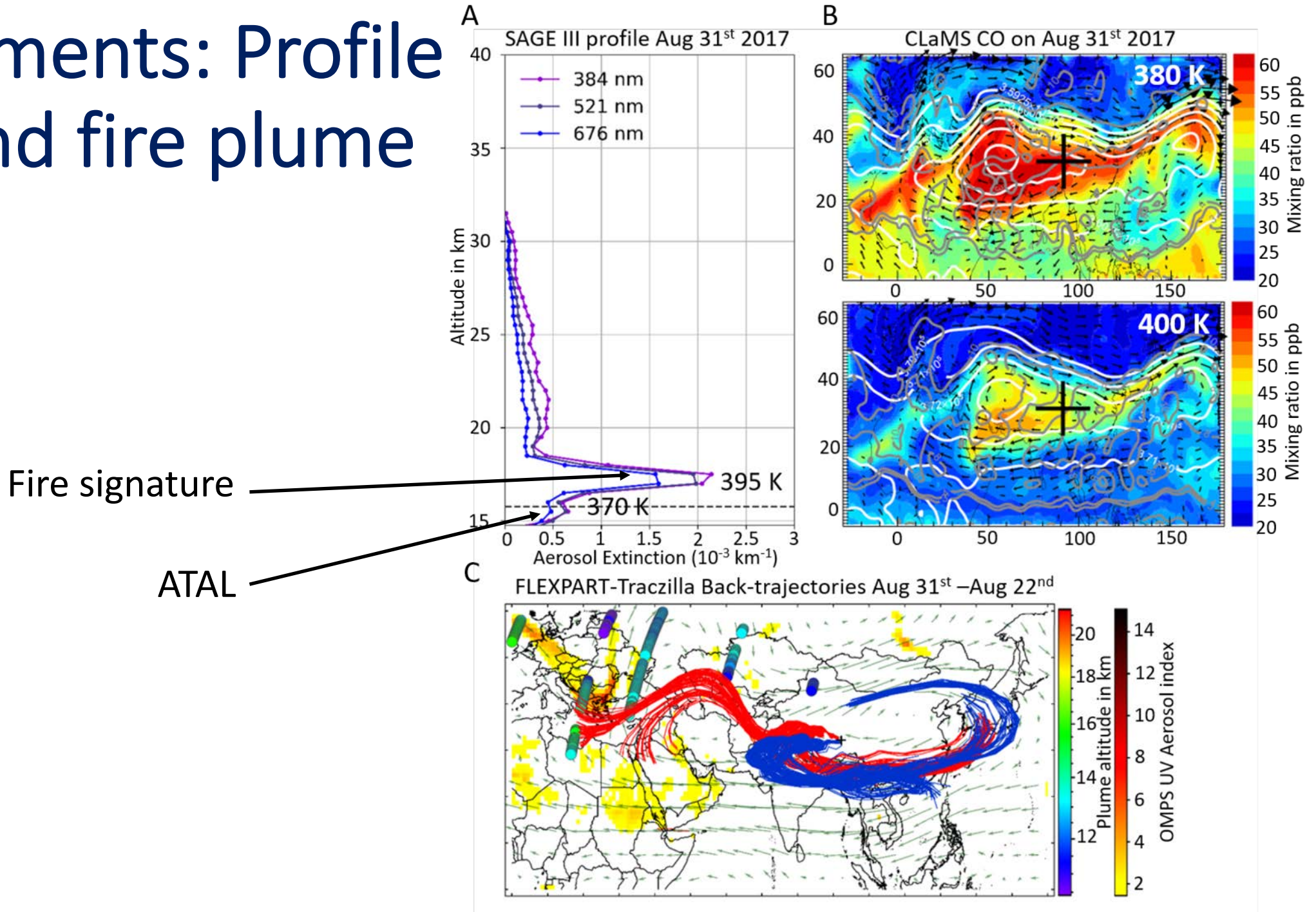
Discussion paper in ACP
https://www.atmos-chem-phys-discuss.net/acp-2019-204/

Supplements: First profile with plume signature transported via the eastern flank of the AMA circulation



Point of observed fire plume signal (Khaykin et al. 2018)

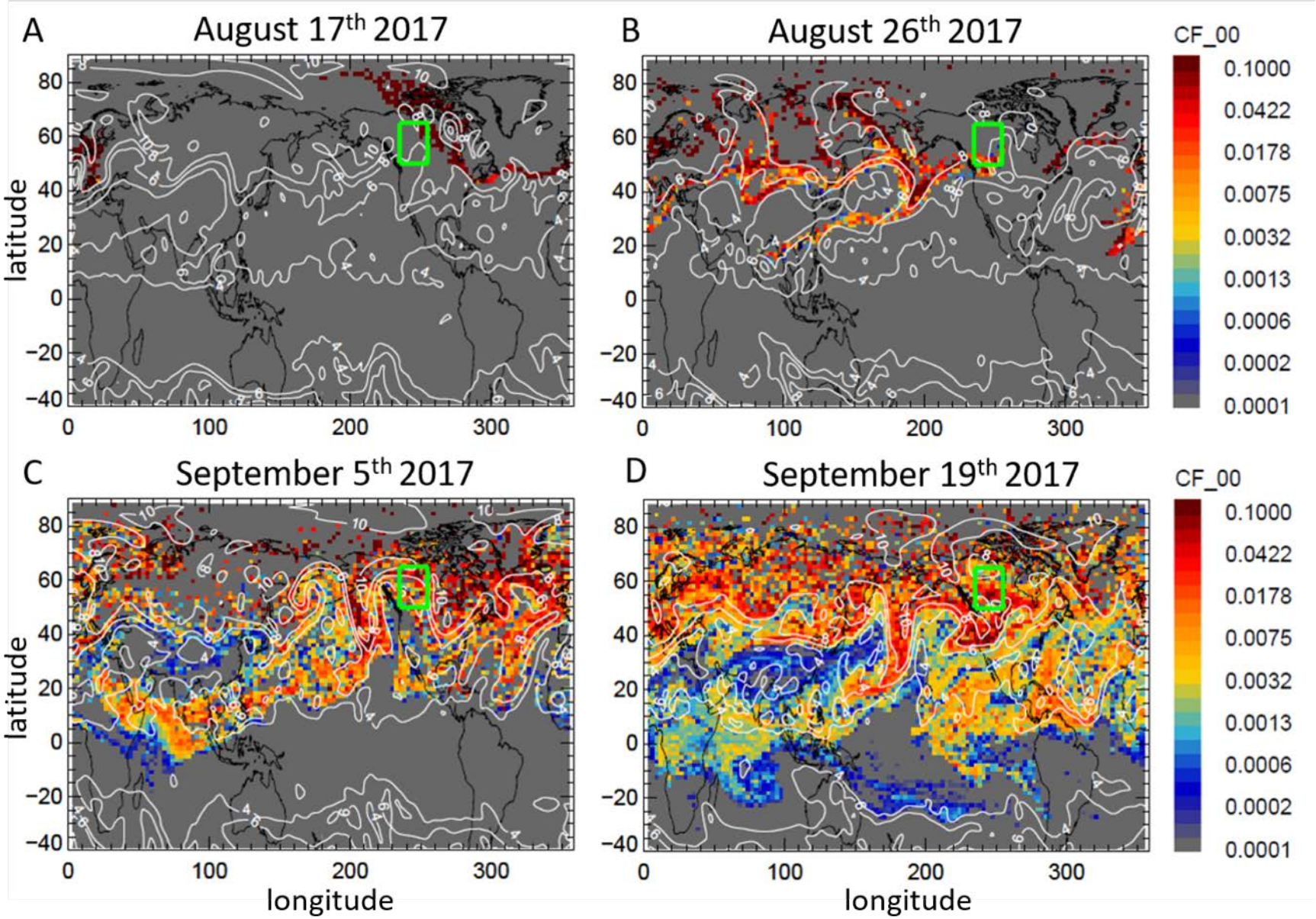
Supplements: Profile ATAL and fire plume signal



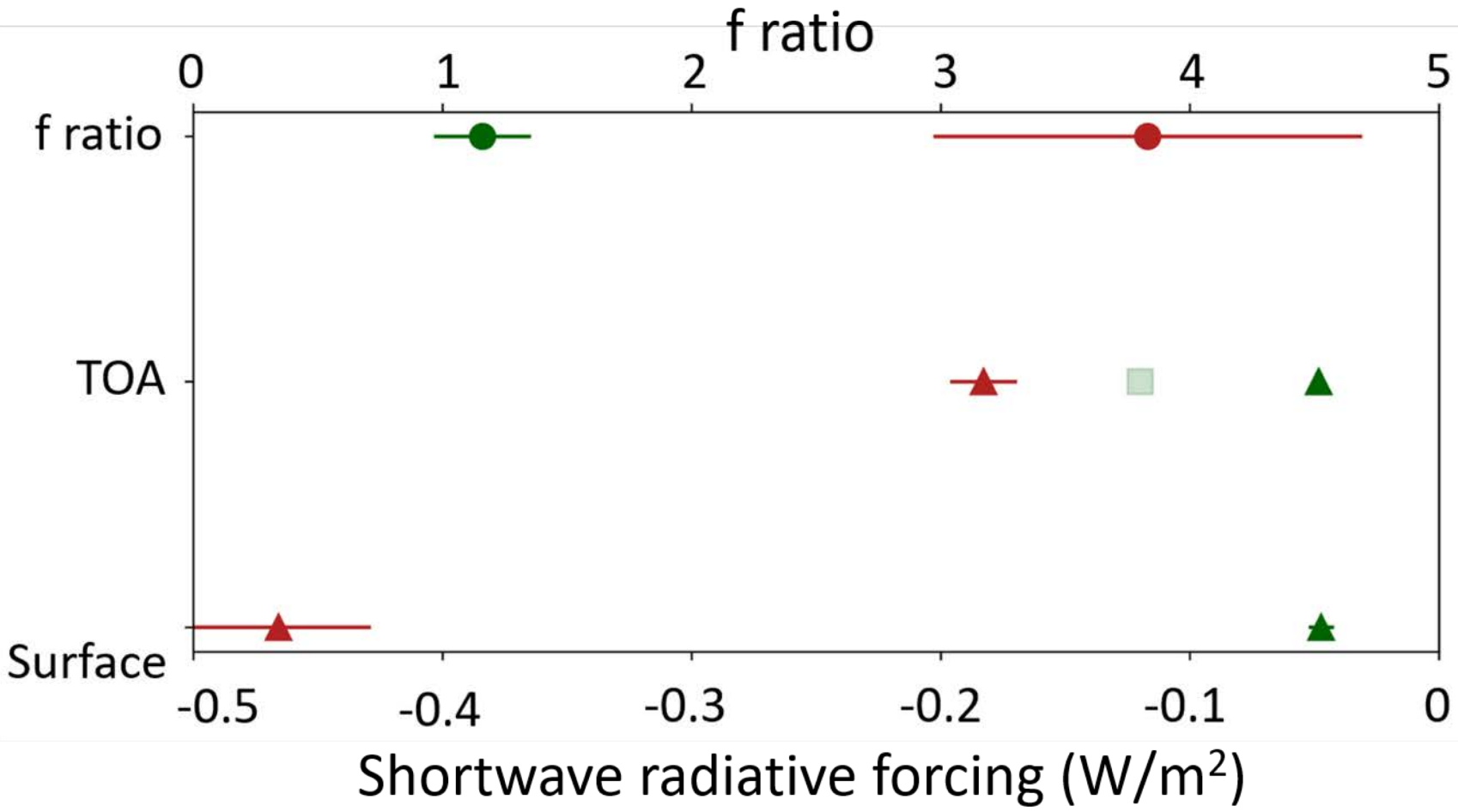
Fire signature

ATAL

CLaMS simulation (if the video does not work)



Regional climatic impact



Climate impact of the fire plume in the Asian monsoon region **2 – 4 times larger than the one of the ATAL**