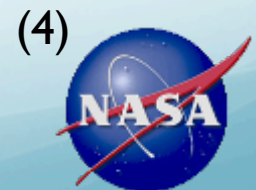


3D distribution of a major desert dust outbreak over East Asia in March 2008 from IASI

Juan Cuesta¹, Maxim Eremenko¹, Cyrille Flamant², Gaëlle Dufour¹, Michael Höpfner³, Johannes Orphal³, Benoît Laurent¹, Gilles Bergametti¹ and Daniel Zhou⁴



Scientific motivation

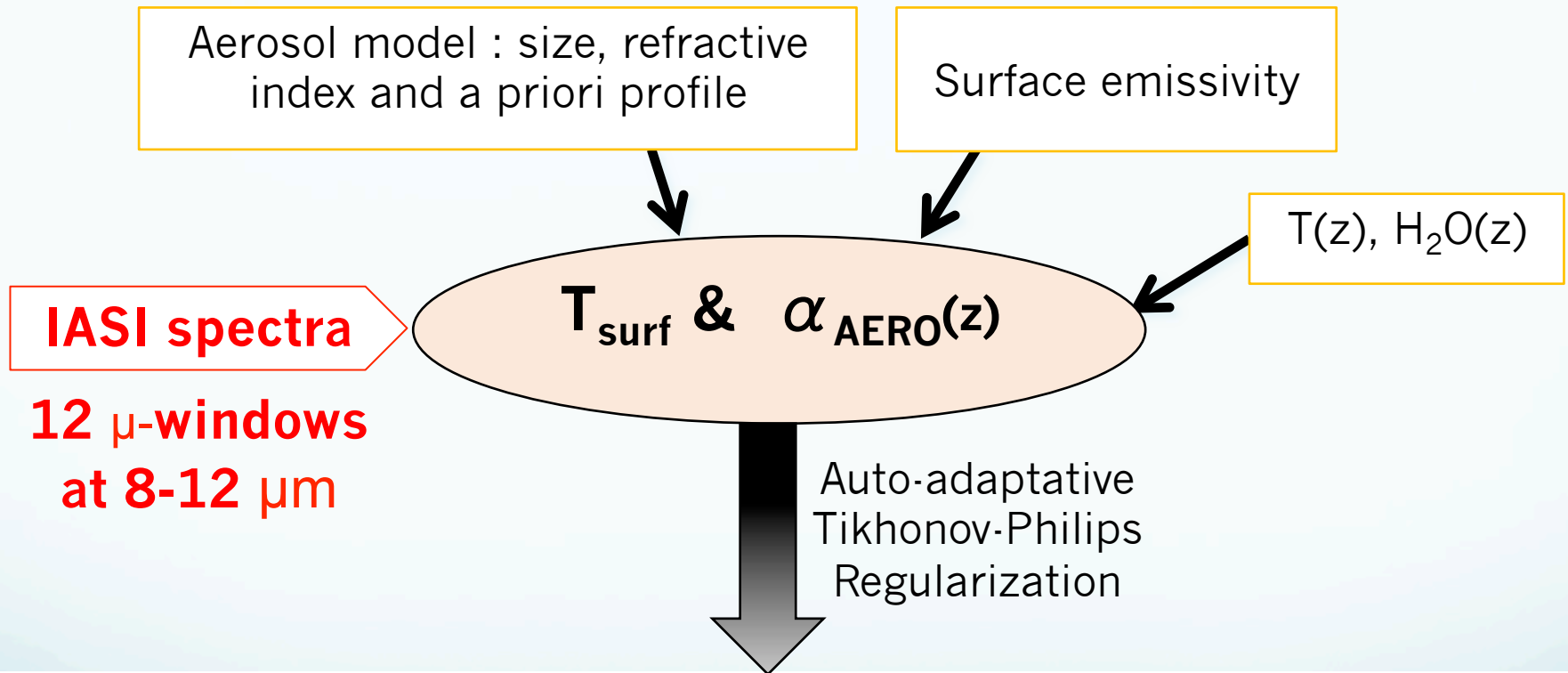
→ Impact of coarse aerosols on the environment which are closely related to their 3D distribution :
Air quality, radiative forcing, deposition, etc.

**Desert
dust**

- 1) **3D distribution** of aerosol layers
- 2) **Aerosol optical depth** (thermal IR)
- 3) **Daily** observation (day and night)
- 4) **Over land and over ocean**

AEROIASI

AEROIASI: a new retrieval of the 3D distribution of coarse aerosols from IASI



Vertical profiles of aerosol extinction at 10 μ m for each cloud-free IASI pixel over land and ocean
→ **3D distribution of coarse aerosols & AOD_{10 μ m}**

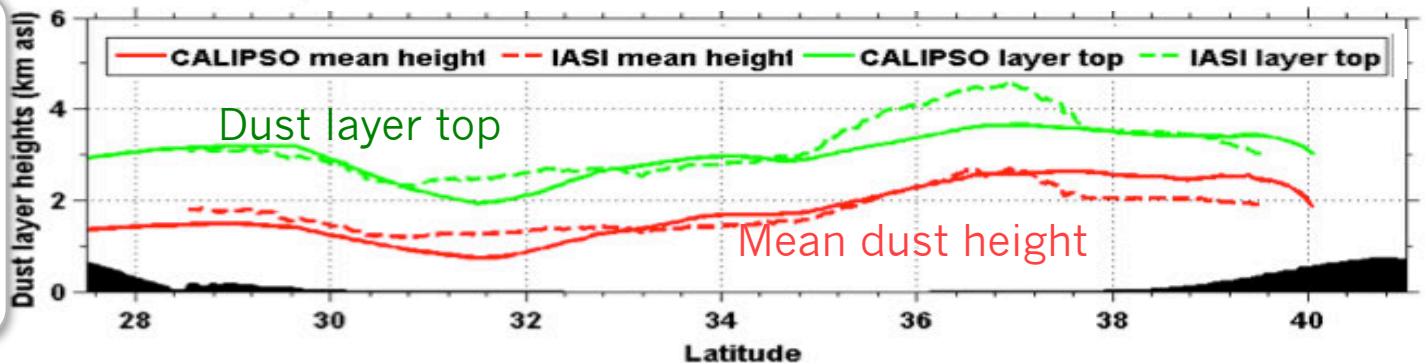
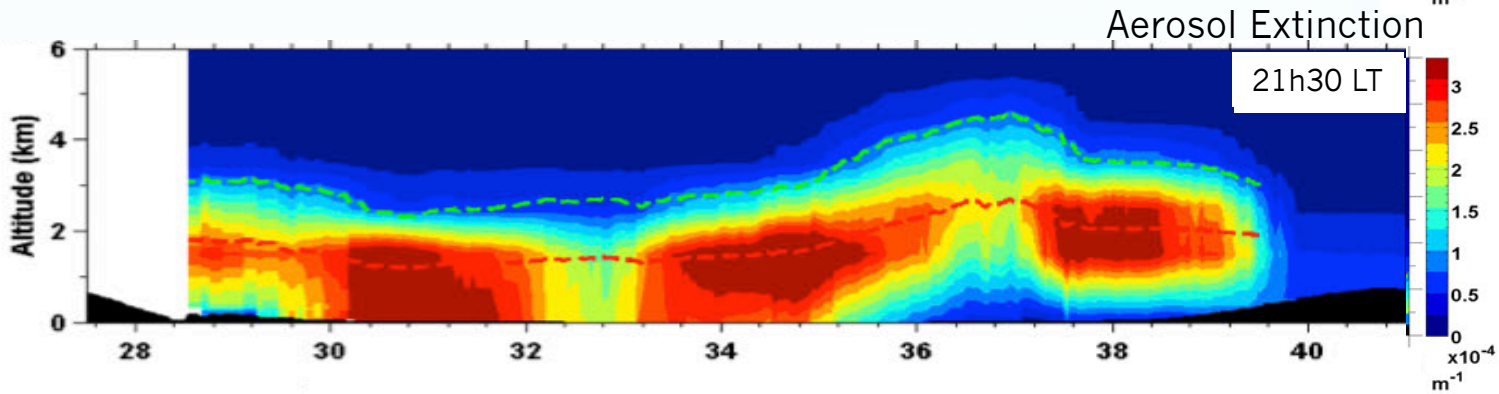
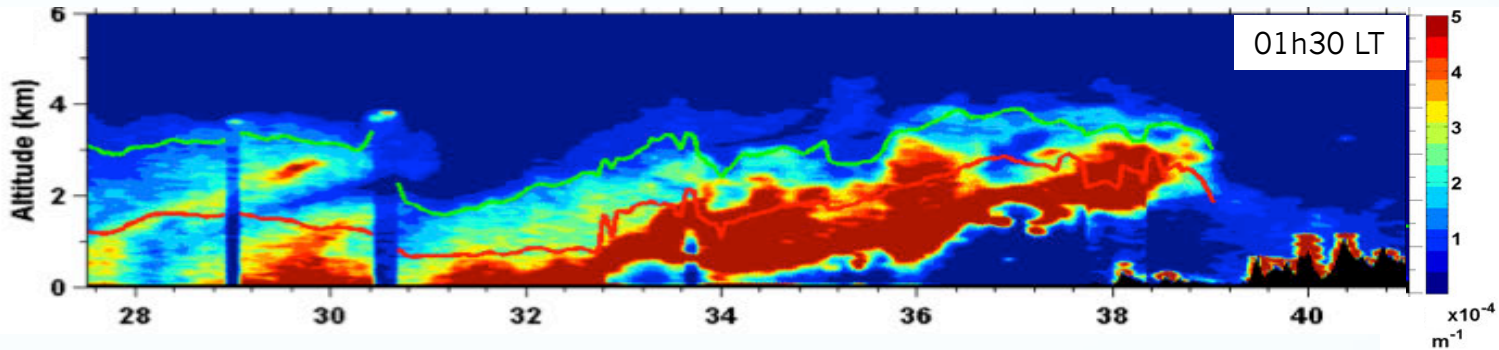
Validation of **Aerosol vertical profiles:** **AEROIASI** vs. **CALIOP** spaceborne Lidar (1/2)

Transect of a dense elevated dust plume over the **Yellow sea**

AEROIASI captures both the altitude and vertical profile of dust layers in agreement with CALIOP

CALIOP

AEROIASI



Good agreement of mean and top dust layer heights:
 Bias $h^{\text{mean}} < 110 \text{ m}$
 & $R=0.95$
 (3 cases)

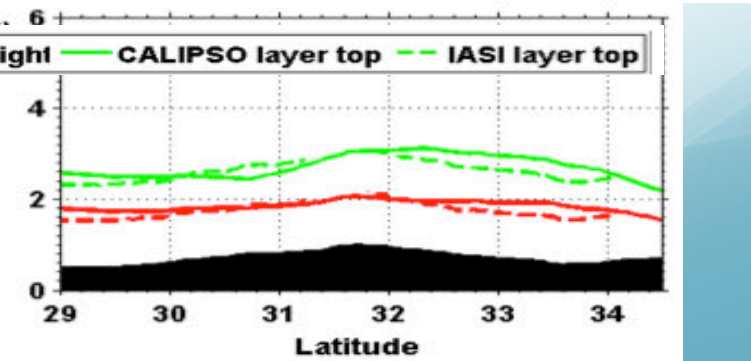
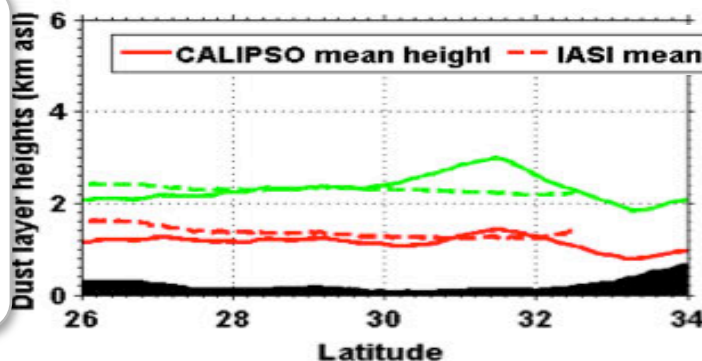
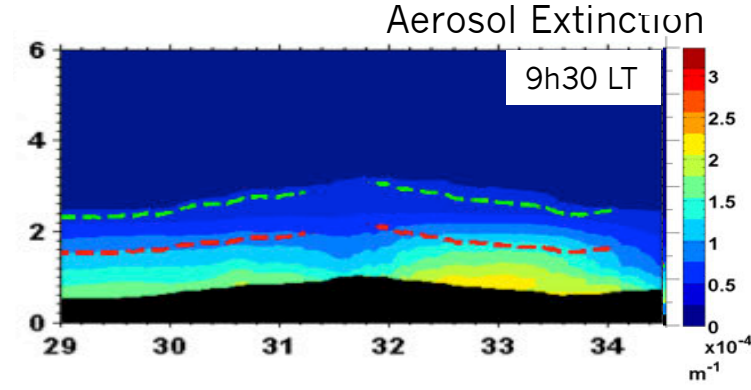
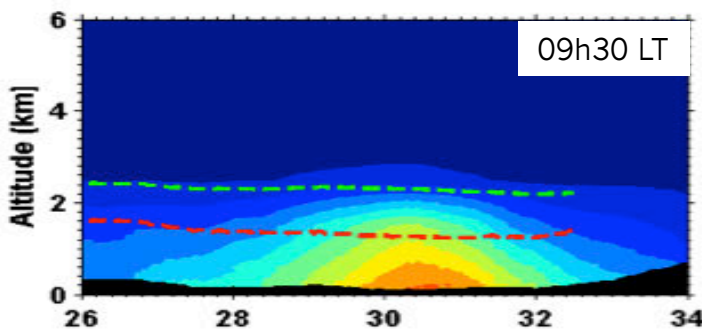
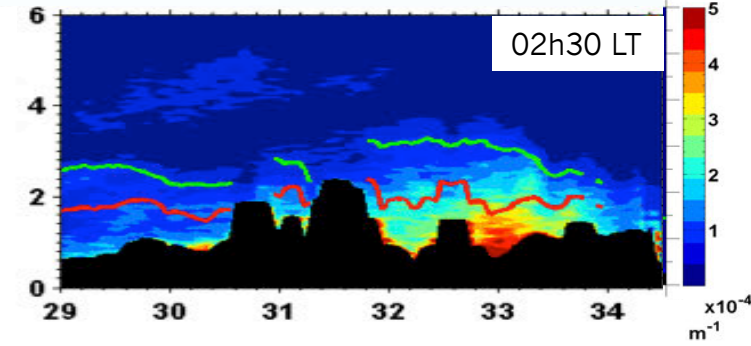
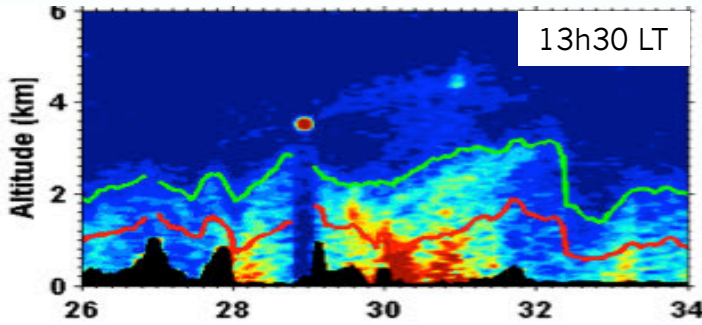
Validation of **Aerosol vertical profiles:** **AEROIASI** vs. **CALIOP** spaceborne Lidar (2/2)

Transect of dense low-levels dust plumes over **Central China**

AEROIASI captures both the altitude and vertical profile of dust layers in agreement with CALIOP

CALIOP

AEROIASI

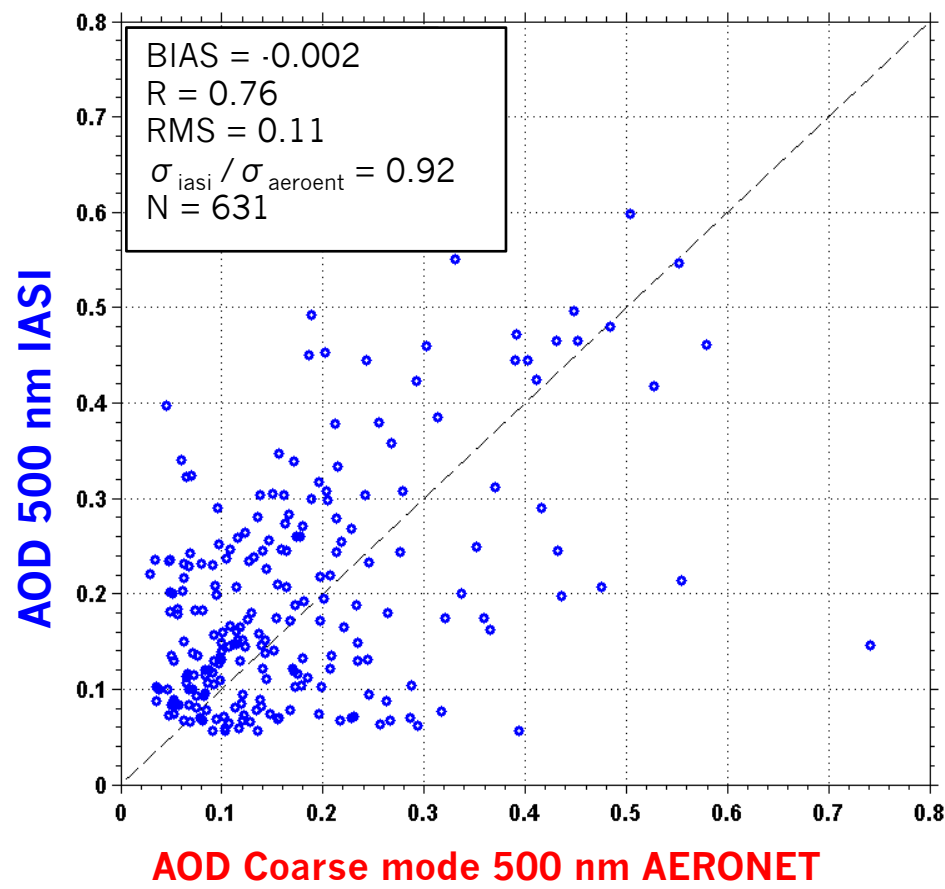
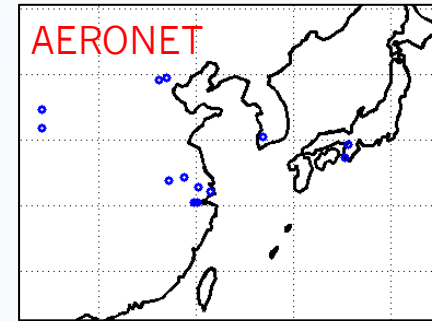


Good agreement of mean and top dust layer heights:
 Bias $h^{\text{mean}} < 110 \text{ m}$
 & $R=0.95$
 (3 cases)

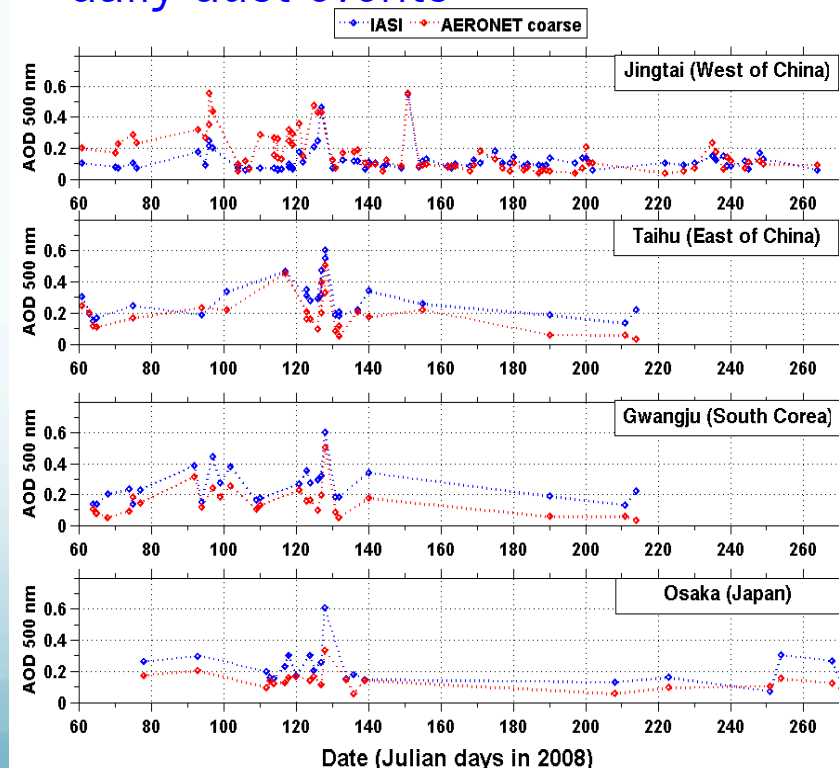
Validation of **Aerosol Optical Depth (AOD):** **AEROIASI** vs. **AERONET** ground-based network

Daily comparison of **AEROIASI** with the **AOD_{coarse}** over 13 sites between March-September 2008

- ✓ Negligible mean bias : <1%
- ✓ Good correlation: $R=0.76$



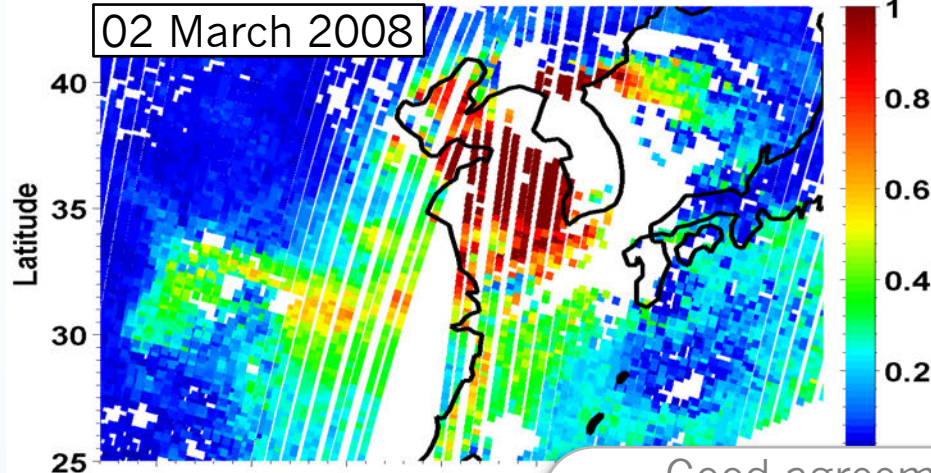
- ✓ Good detection & quantification of daily dust events



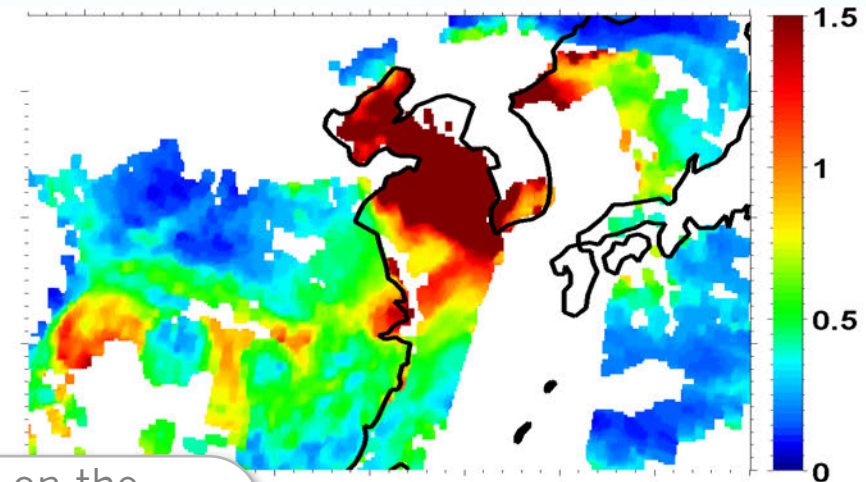
Validation of horizontal distribution of AOD

Coarse AOD from AEROIASI vs. MODIS (Fine+Coarse)

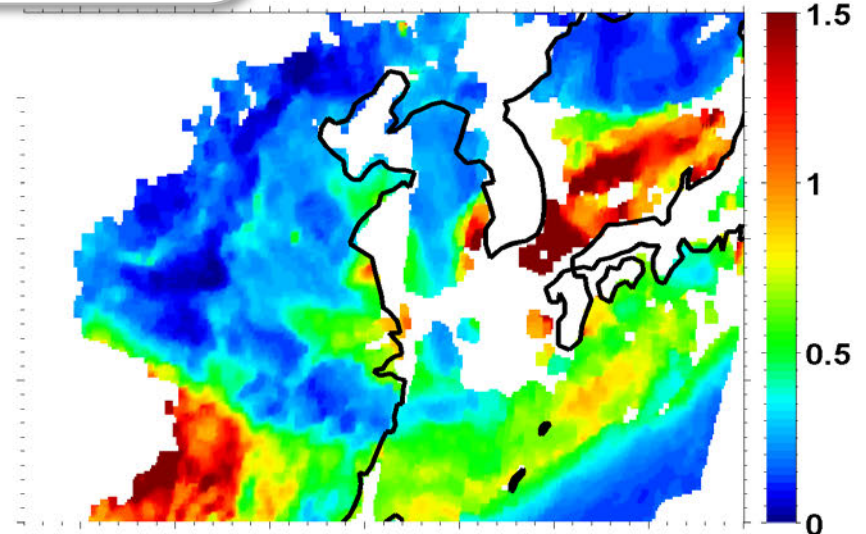
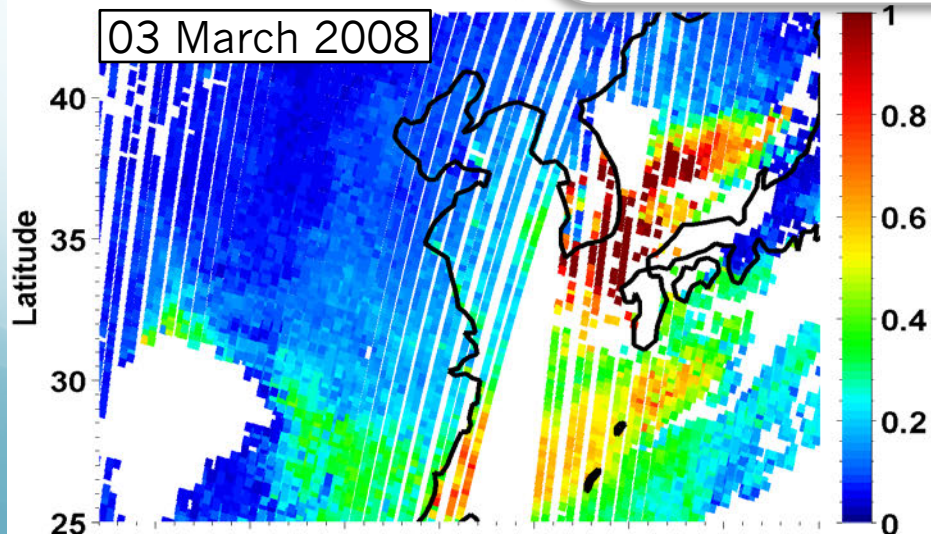
AOD 10 μm IASI



AOD 550 nm MODIS



Good agreement on the aerosol horizontal distribution

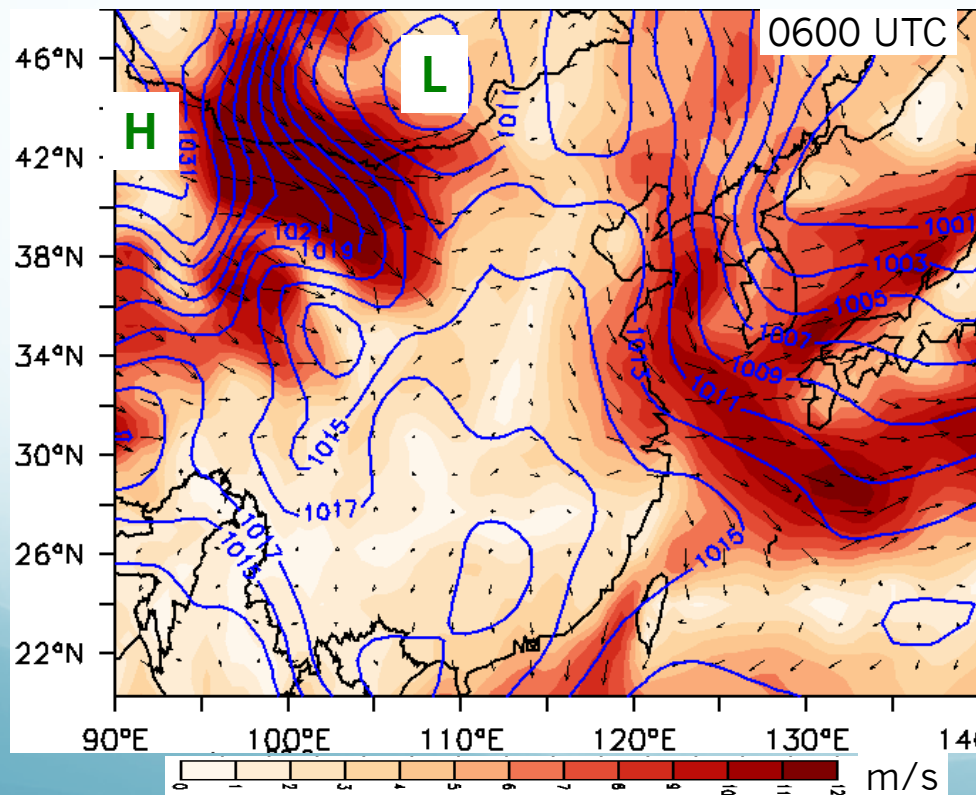


A major dust outbreak over East Asia in March 2008 from the Gobi desert

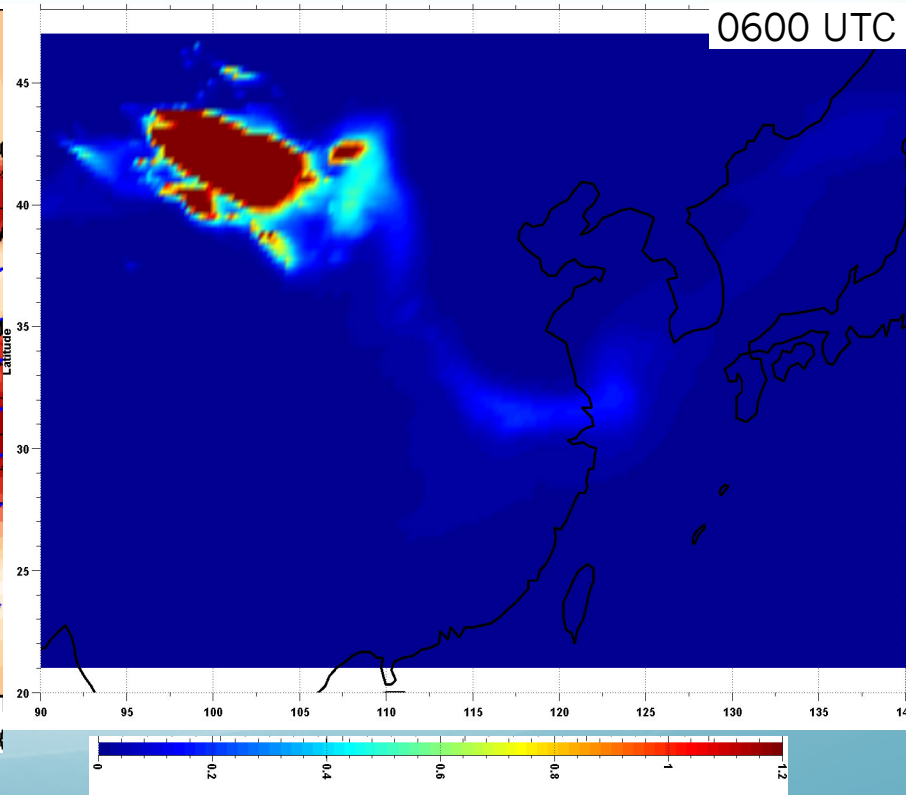
Dust uplift over the Gobi desert
by strong winds, associated to an extra-tropical cyclone

29 February 2008

ERA-Interim (ERA-I) windspeeds at 2 m agl



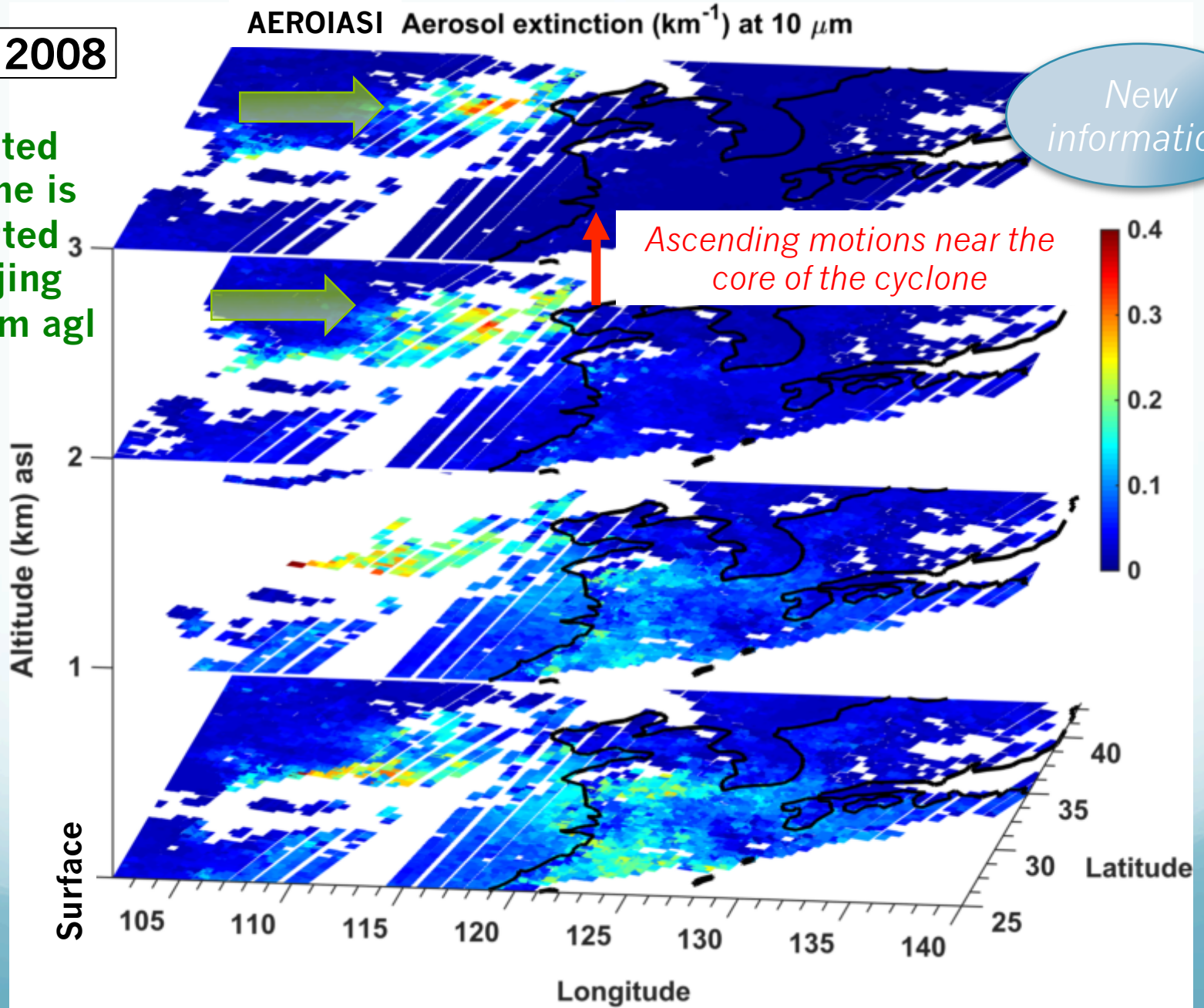
CHIMERE model AOD



3D distribution of dust from AEROIASI

01 March 2008

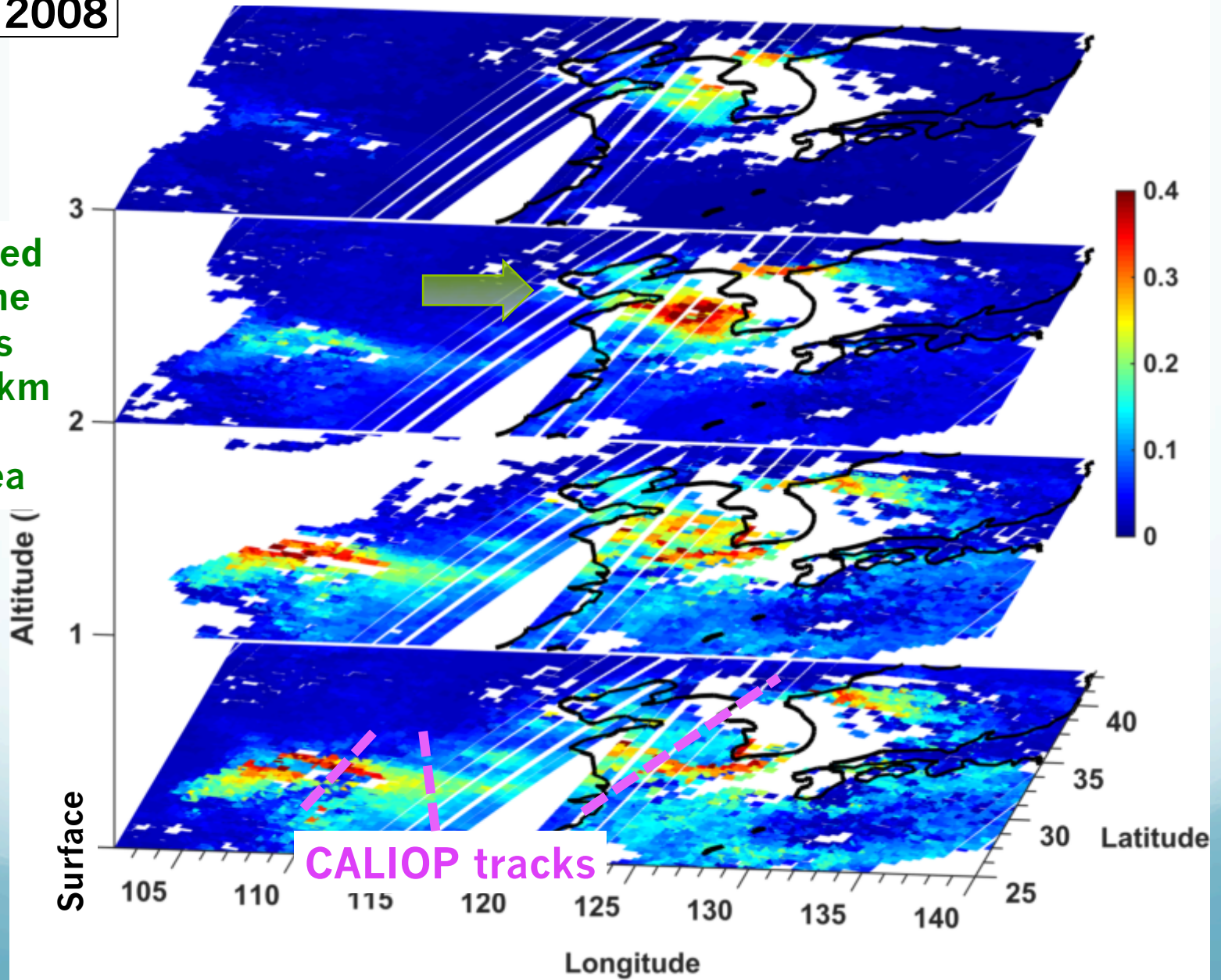
An elevated dust plume is transported over Beijing at 2 to 3 km agl



3D distribution of dust from AEROIASI

02 March 2008

AEROIASI Aerosol extinction (km^{-1}) at $10 \mu\text{m}$

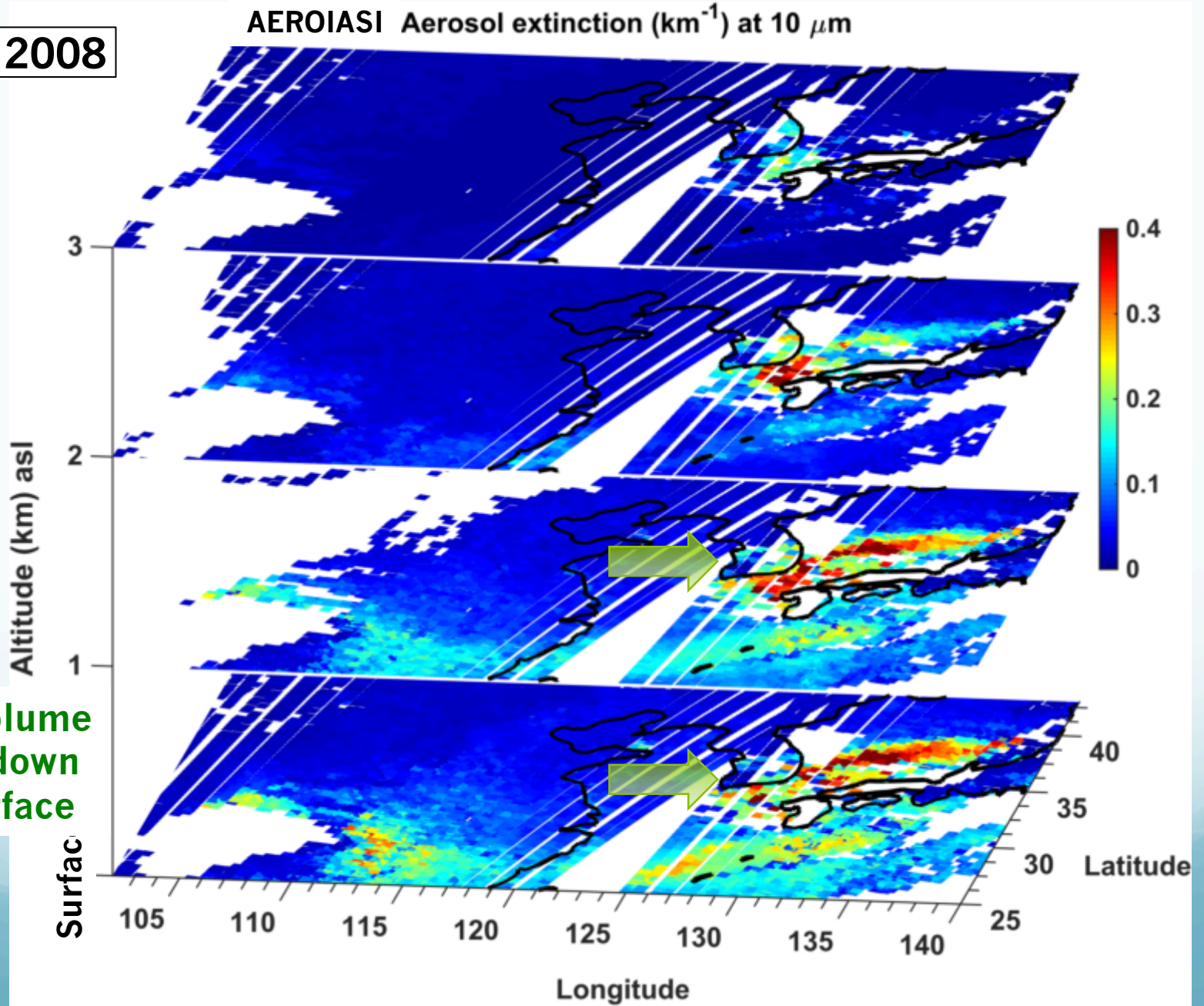


The elevated dust plume descends down to 2 km over the Yellow Sea

CALIOP tracks

3D distribution of dust from AEROIASI

03 March 2008



The dust plume is mixed down to the surface

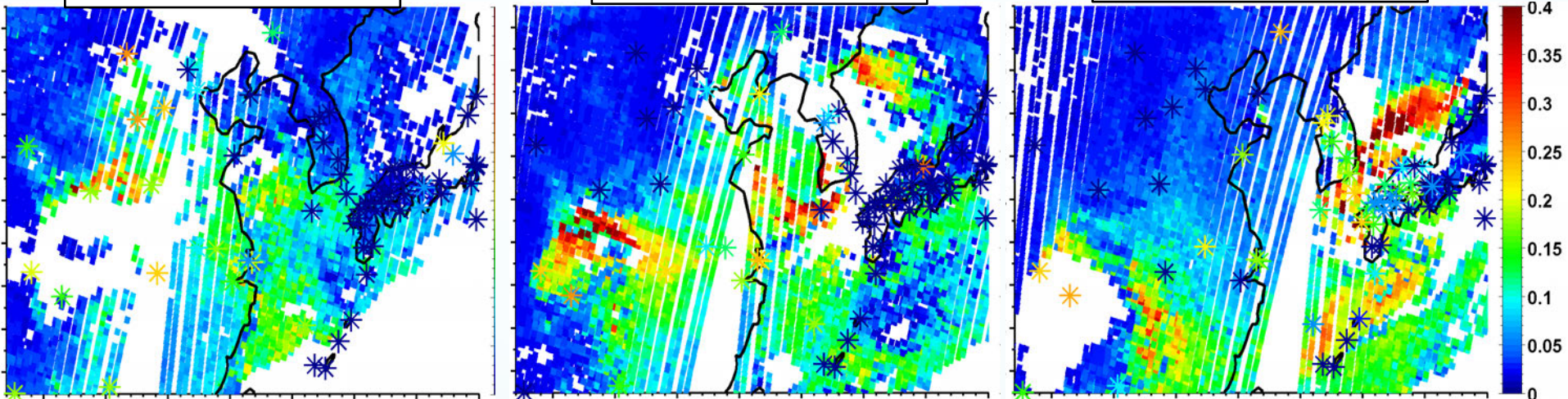
Dust distribution at the SURFACE from AEROIASI vs. Horizontal visibility

New information

01 March 2008

02 March 2008

03 March 2008



AEROIASI aerosol extinction at $10 \mu\text{m}$ the surface (km^{-1})

Visibility: * Low * Medium * High

AEROIASI captures the distribution of DUST AT THE SURFACE in agreement with low horizontal visibility

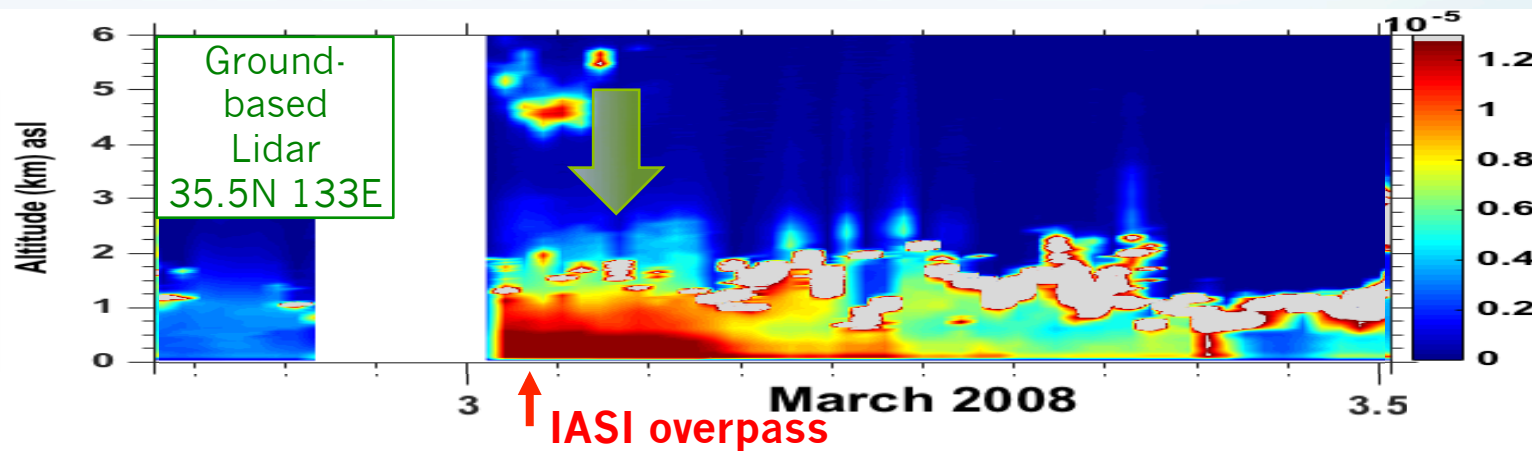
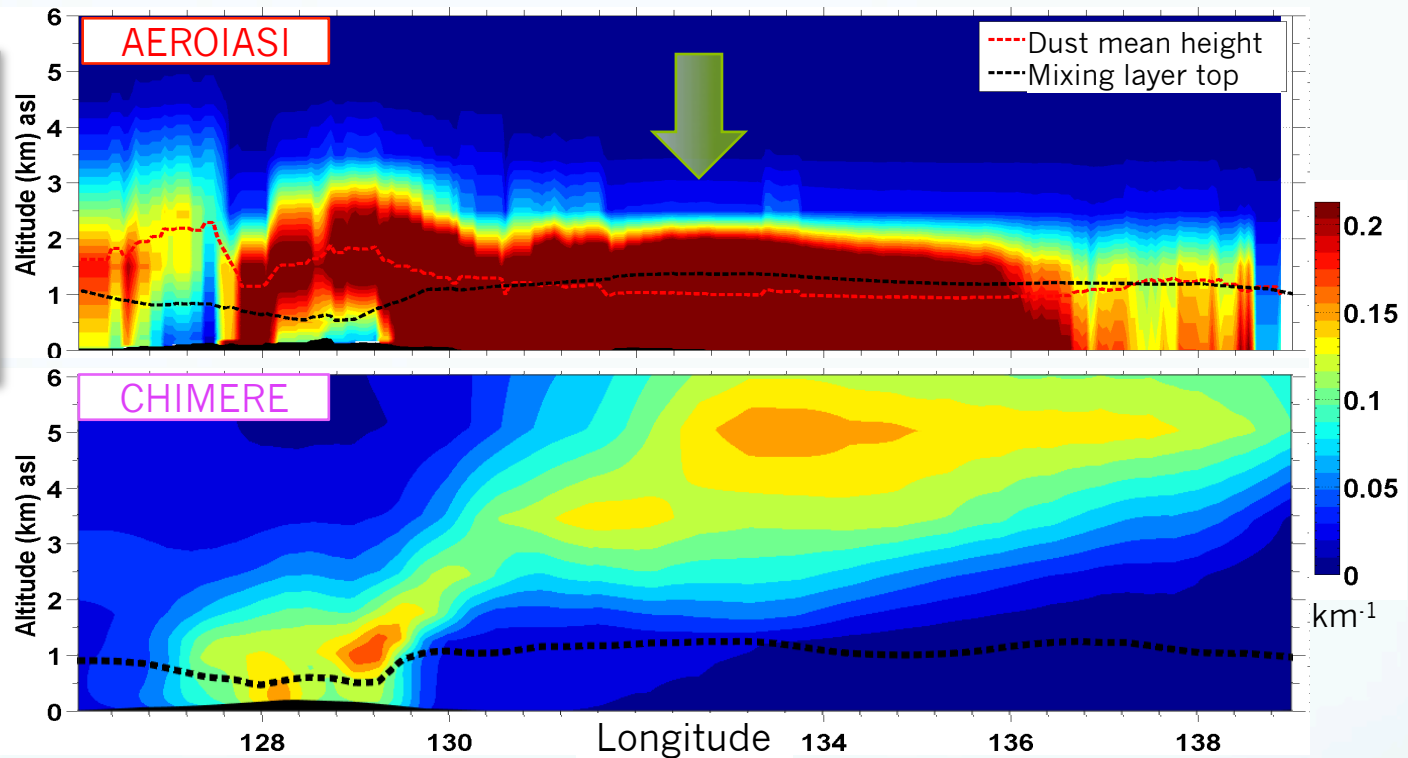
Main dust plume: AEROIASI vs. CHIMERE model

03 March 2008

AEROIASI shows that dust mixes down to the surface when reached by the mixing boundary layer

Dust simulated by CHIMERE is in the free troposphere, not reached by the mixing layer

A ground-based lidar in Japan is in agreement with AEROIASI



Summary

- ✓ AEROIASI: A new approach to observe the 3D distribution of coarse aerosols using IASI spectra
 - ✓ AEROIASI derives aerosol extinction profiles for most IASI pixels (95% of cloud-free pixels) over land and ocean, day and night. AOD and dust layer heights are also calculated.
 - 3D daily evolution of dust plumes over East Asia
 - ✓ Good results from validation for
 - Aerosol profiles vs. CALIPSO lidar: very similar structures
 - AOD vs. AERONET: weak bias and good correlation
 - Aerosol extinction at the surface vs. Visibility
 - Horizontal structure of plumes vs. MODIS → synergism
 - ✓ AEROIASI highlights strengths and weaknesses of the CHIMERE model 3D distribution
- *On-going work: AEROIASI over the Sahara and other regions*

Acknowledgements

