



Institute of Tibetan Plateau Research

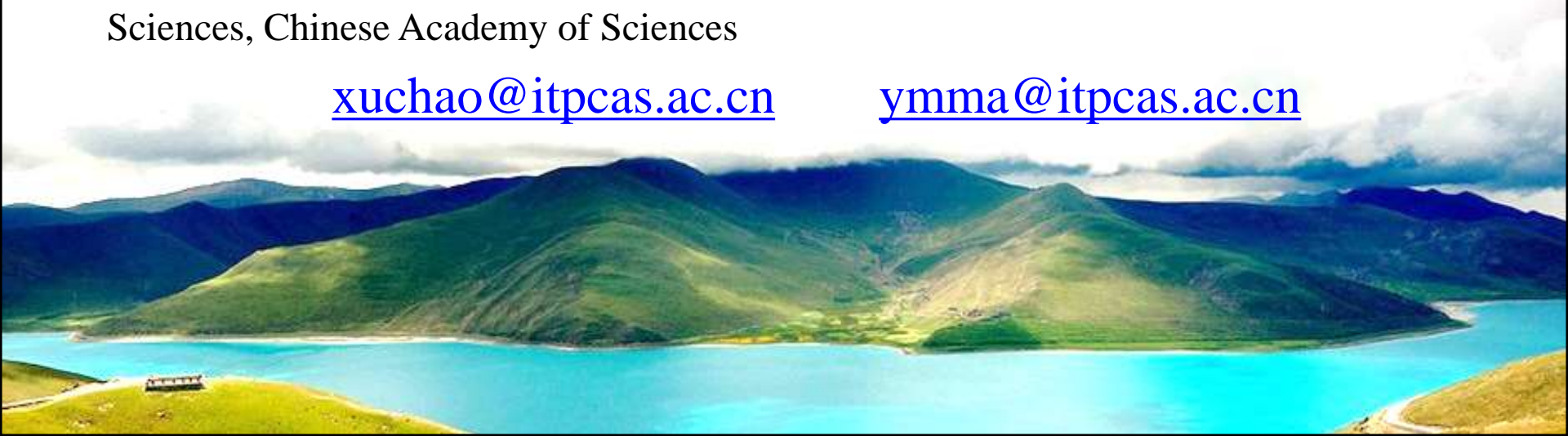
The regional distribution characteristics of aerosol optical depth over the Tibetan Plateau

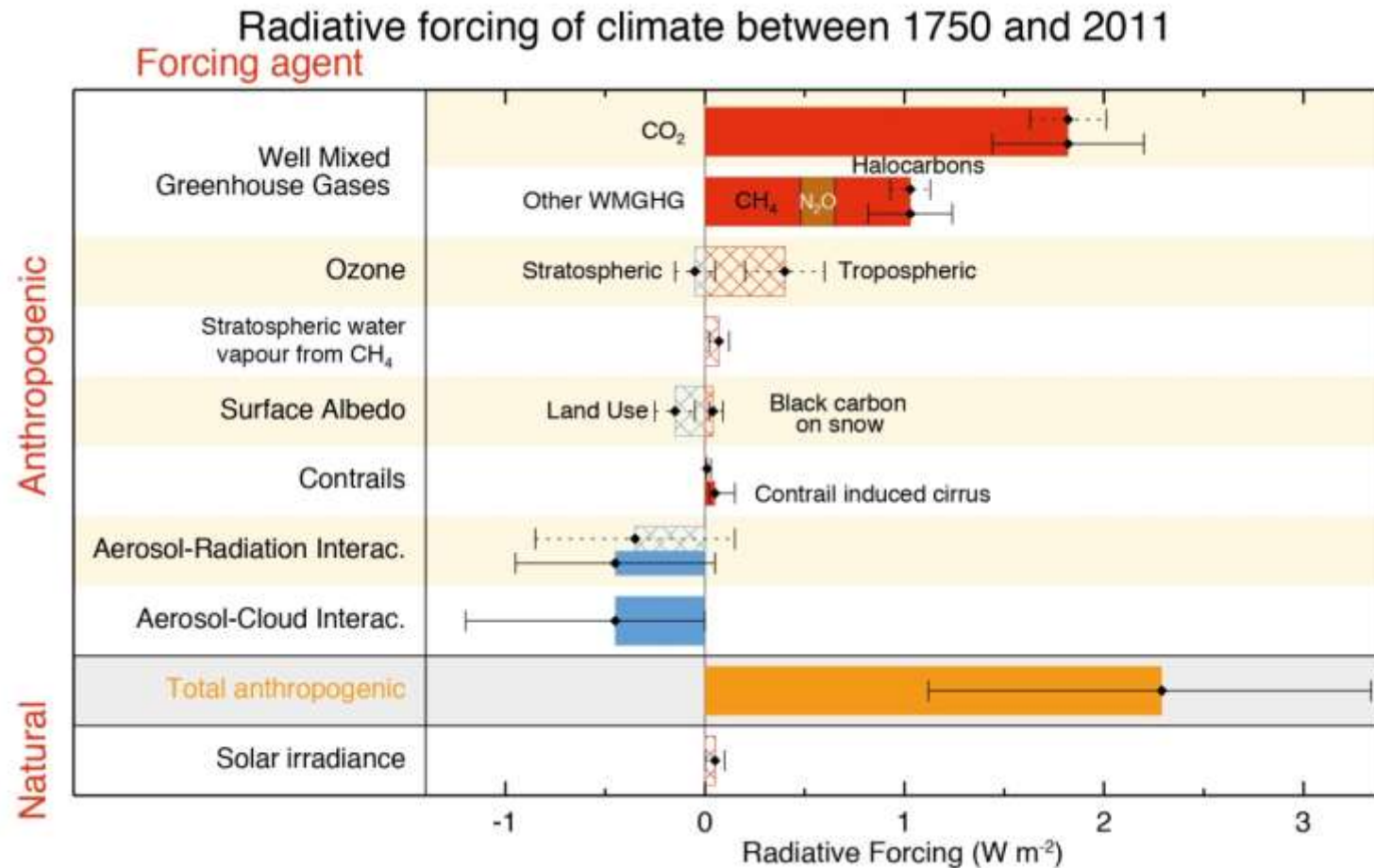
C. Xu, Y. M. Ma

Institute of Tibetan Plateau Research, CAS Center for Excellence in Tibetan Plateau Earth Sciences, Chinese Academy of Sciences

xuchao@itpcas.ac.cn

ymma@itpcas.ac.cn



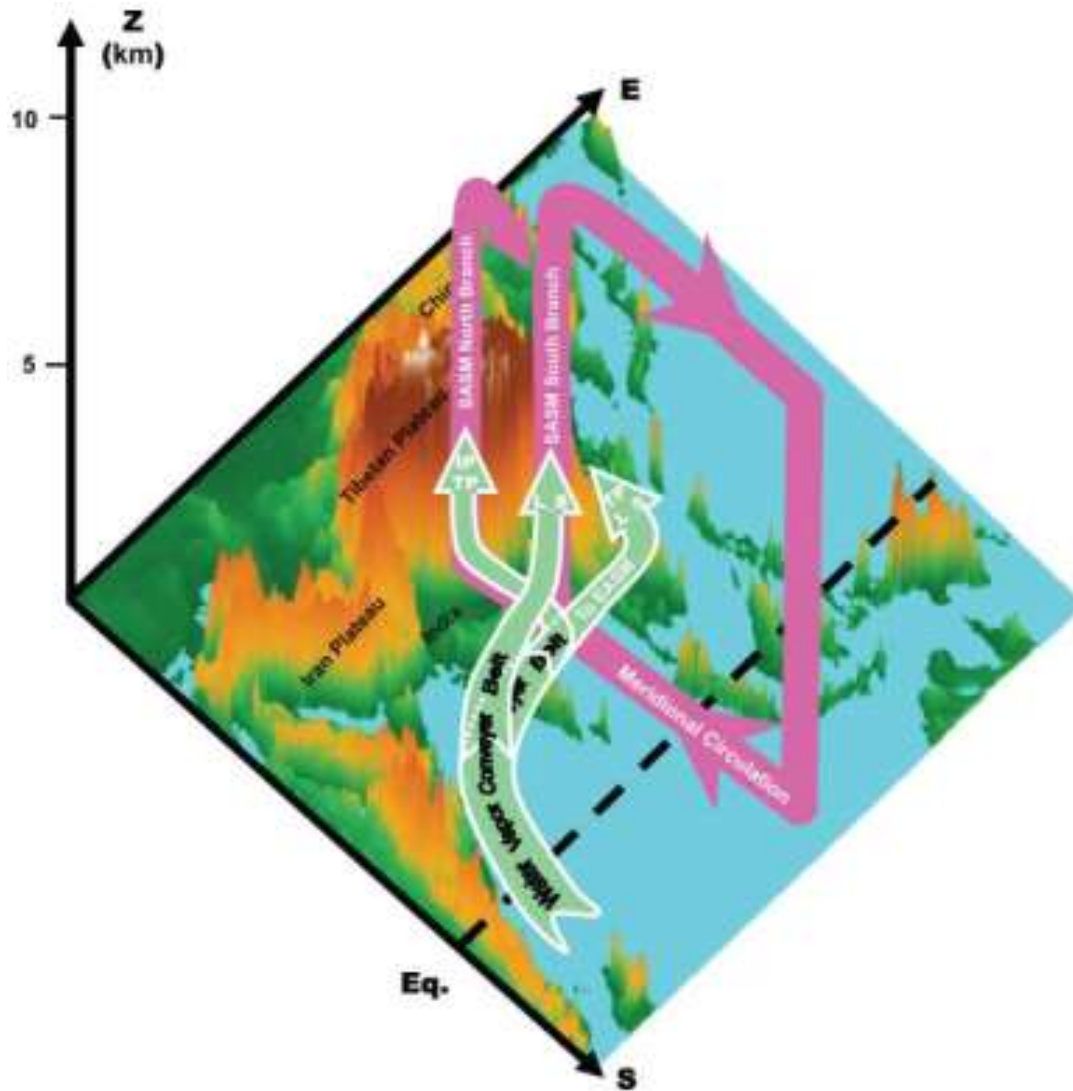


Atmospheric aerosols are among the largest sources of uncertainty in our ability to predict climate change (IPCC, 2007)

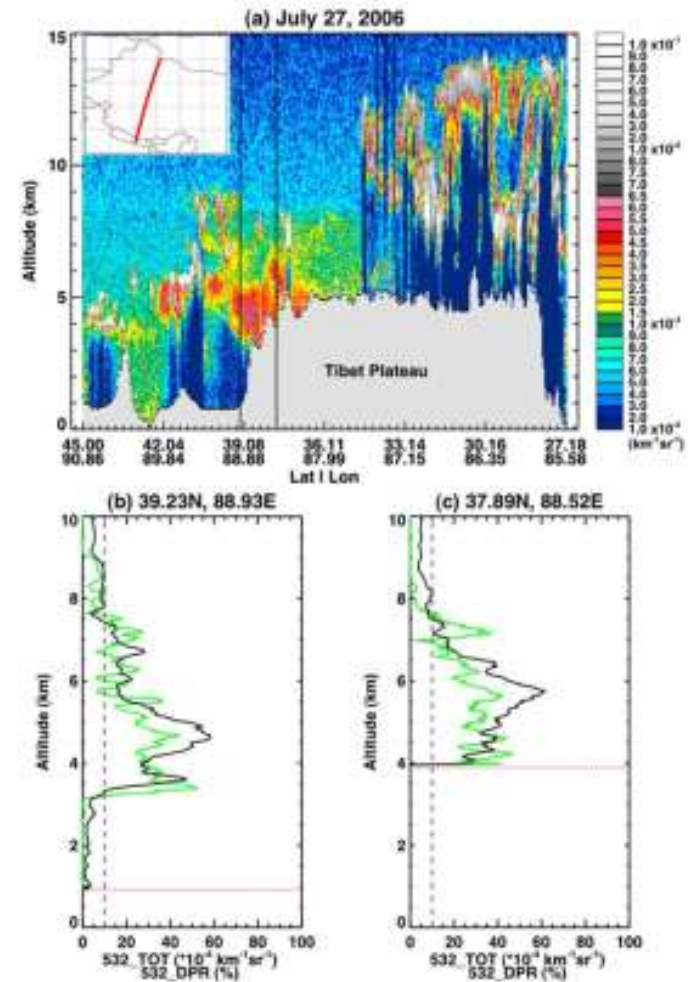
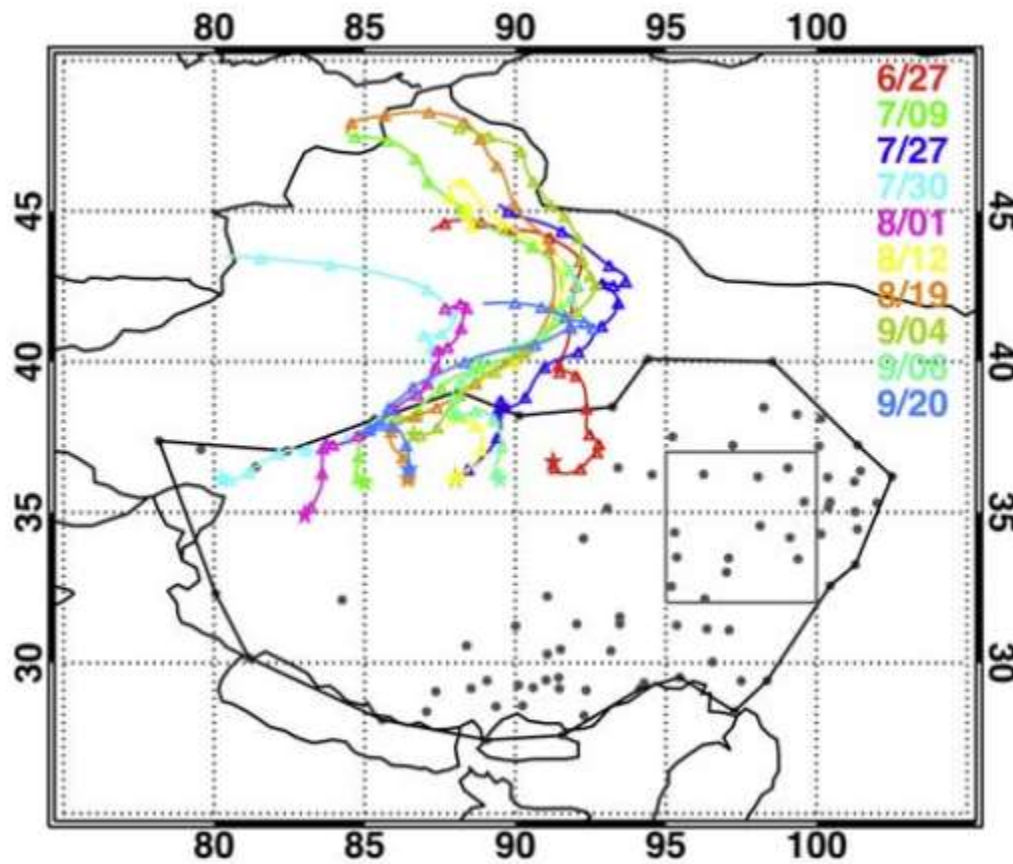


Tibetan Plateau, also called “Third Pole” (Yao et al, 2012)

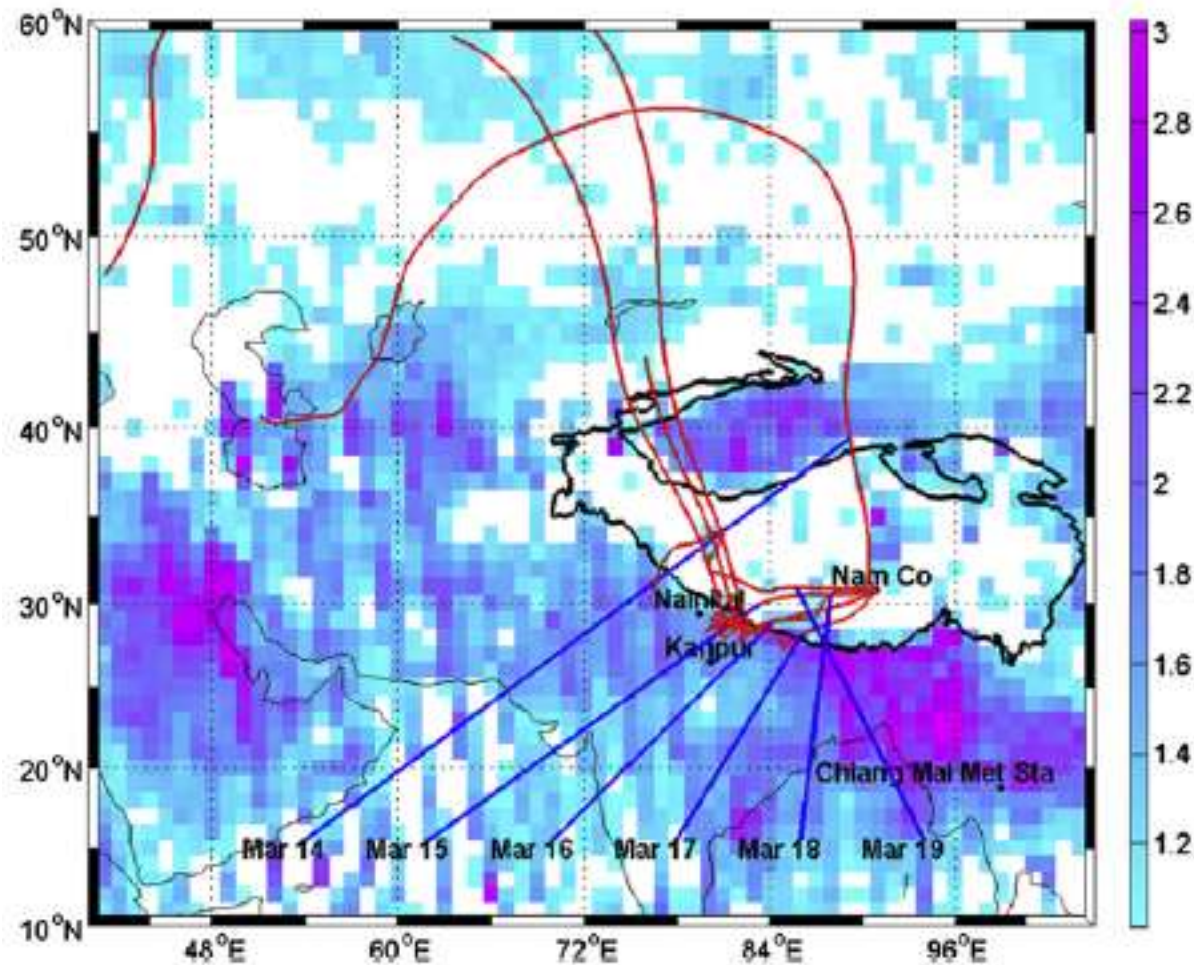
Tibetan Plateau is the most prominent and complex terrain feature on the Earth. It has the world’s highest average elevation (about 4,000 m), with some surface features even reaching into the mid-troposphere



The East Asian monsoon and the eastern part of the South Asian monsoon systems are mainly controlled by the thermal forcing of the TP
(Wu et al., 2012)



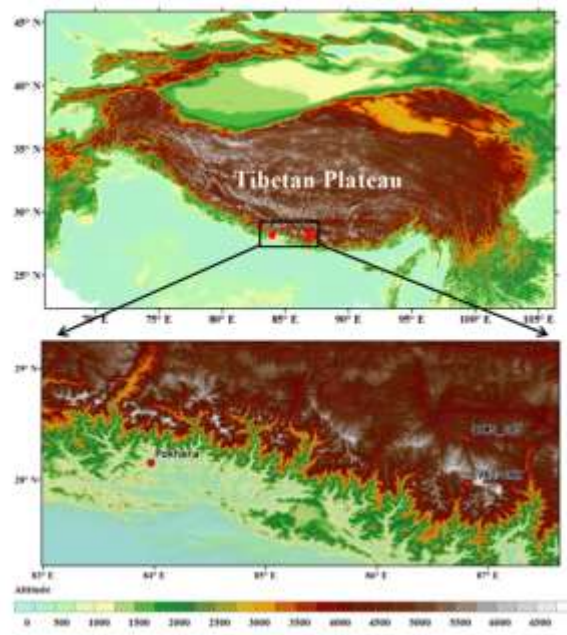
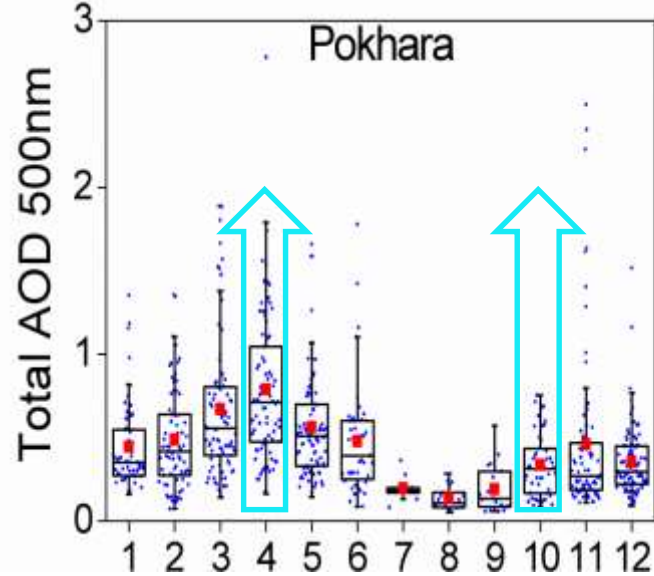
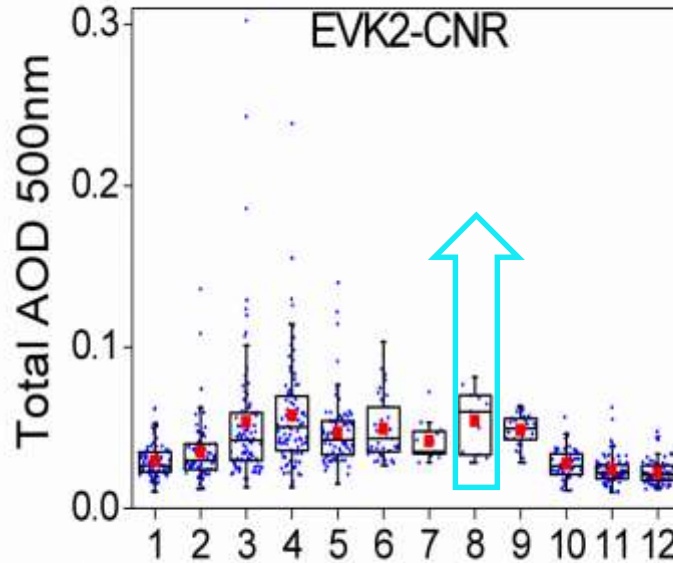
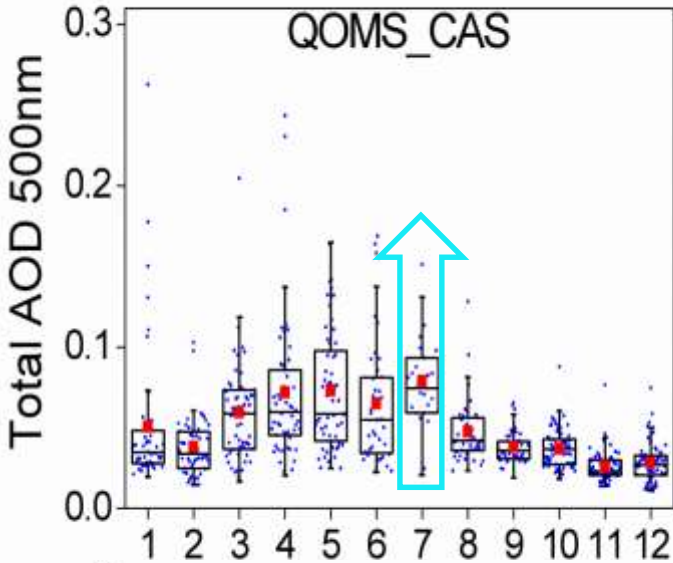
Summertime Tibetan airborne dust plumes were detected from CALIPSO, which suggested the aerosol load in summer over the TP was mainly associated with the Taklimakan desert (Huang et al., 2007)



Anthropogenic emissions from strong pollution events can occasionally be transported to the central TP by prevailing southwesterly winds (Xia et al, 2011)

AOD at mountain sites is greatly different from AOD impacted by human activities.

Xu et al, 2014



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Objective

Although the aerosol load is relatively low

What are the characteristics of aerosols over the TP?



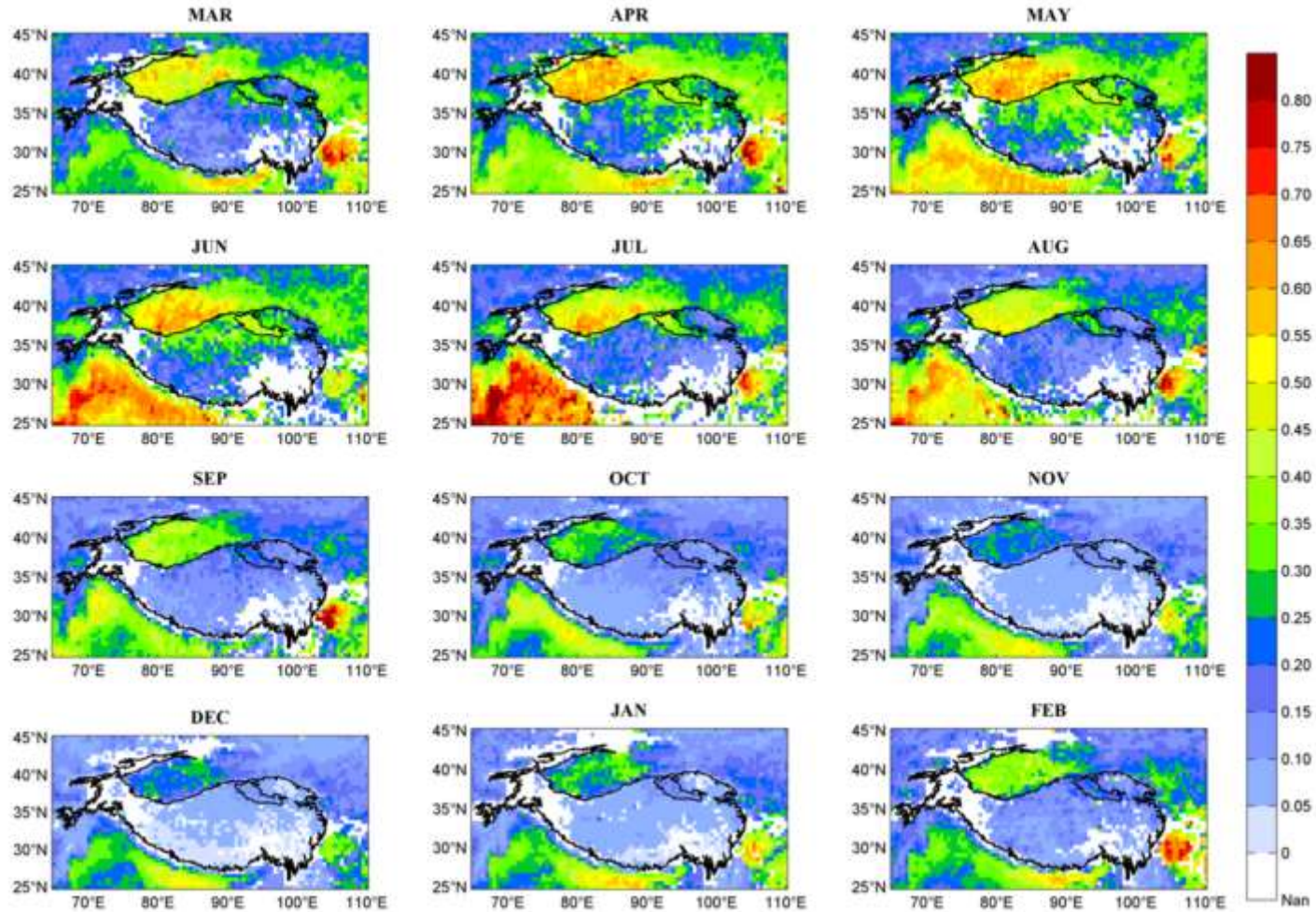
Data

- Satellite data : MISR level 3.0 daily Aerosol optical depth;
CALIPSO Level 3.0 aerosol type
- Wind fields : Monthly ERA-interim data

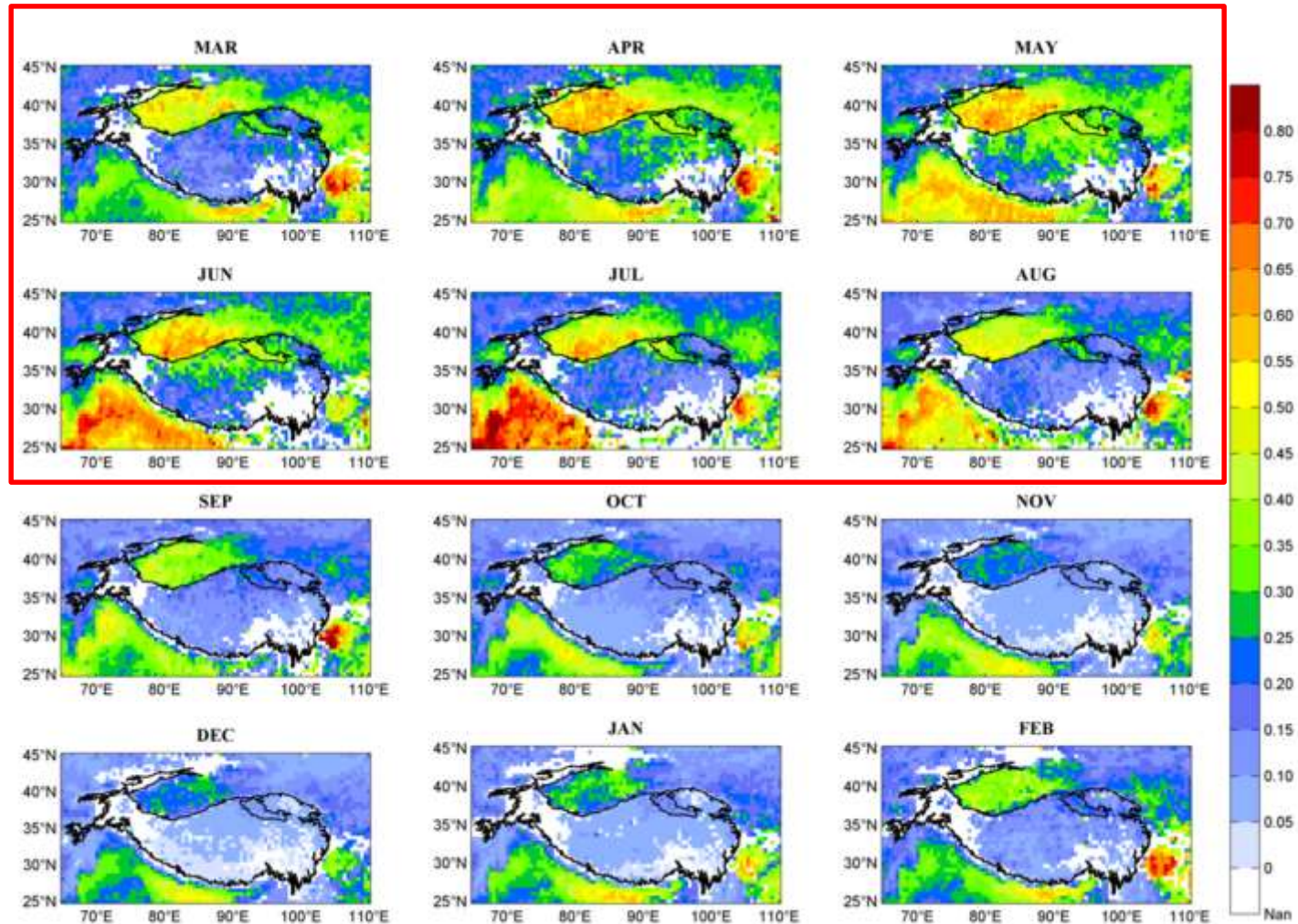


Results

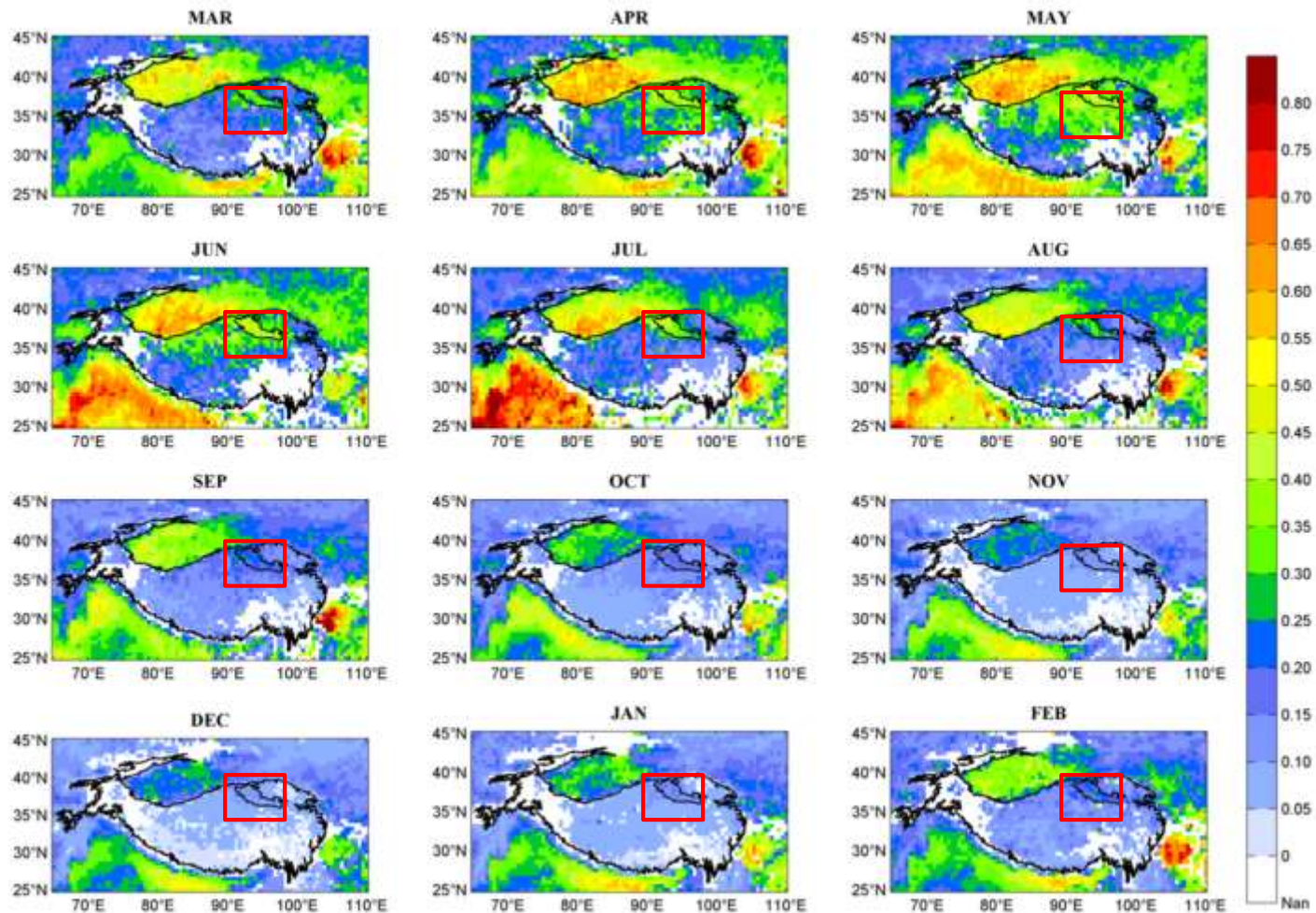
MISR AOD



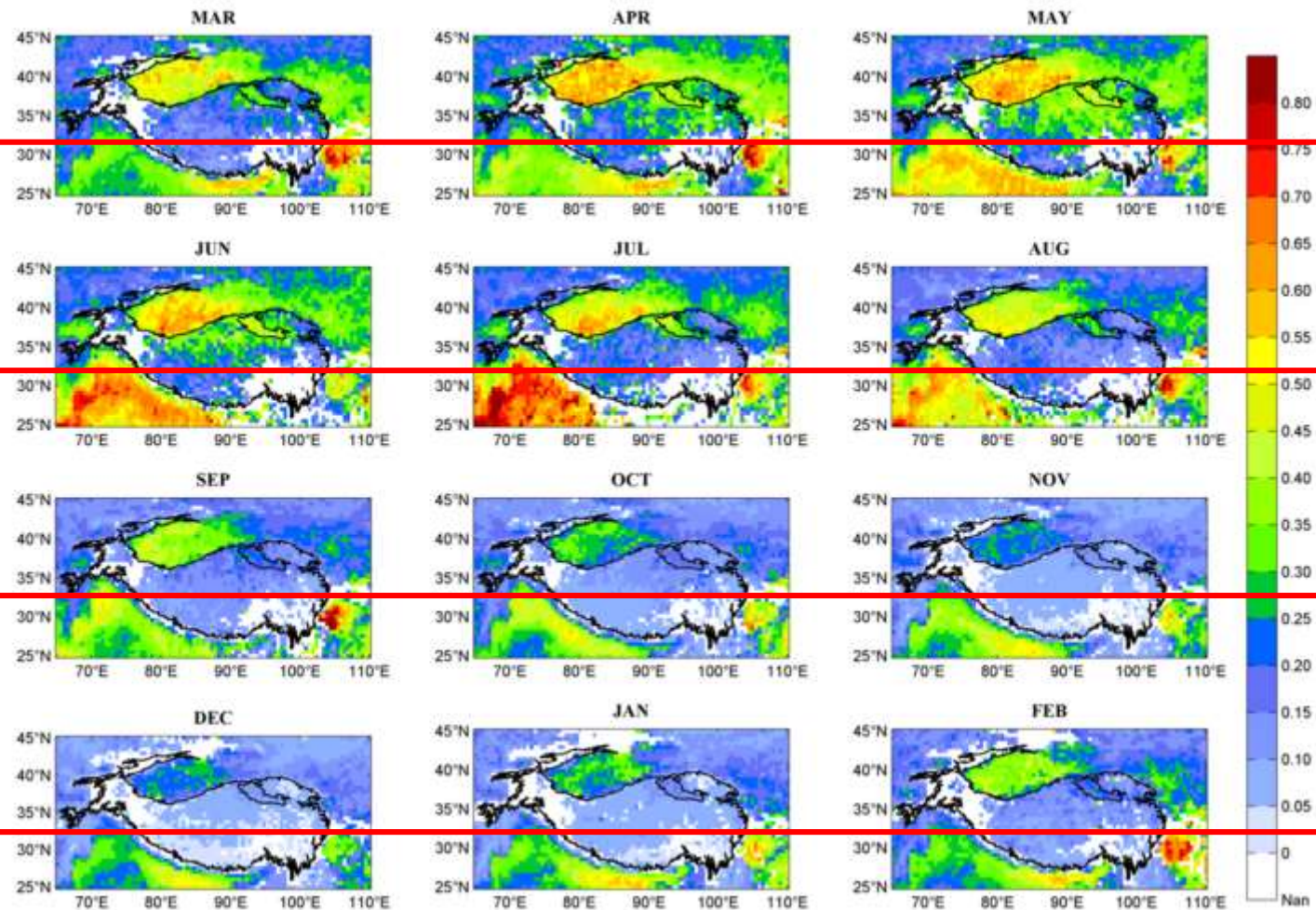
Obvious seasonal variations of AOD are observed over the TP. AOD is higher during spring and summer than that in autumn and winter over the TP.

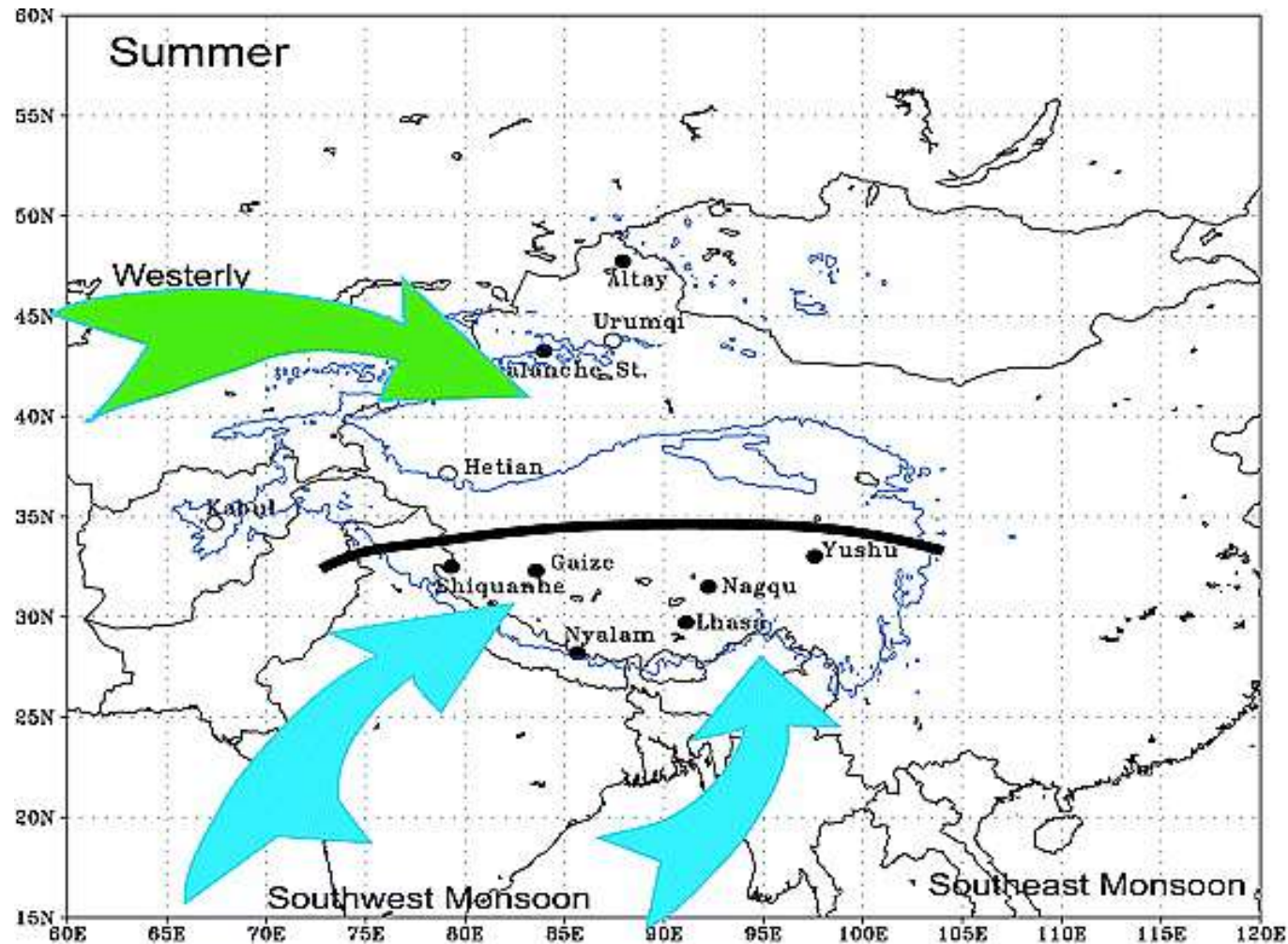


AOD is usually higher over the Qaidam Basin than over the other parts of the TP, throughout the year.



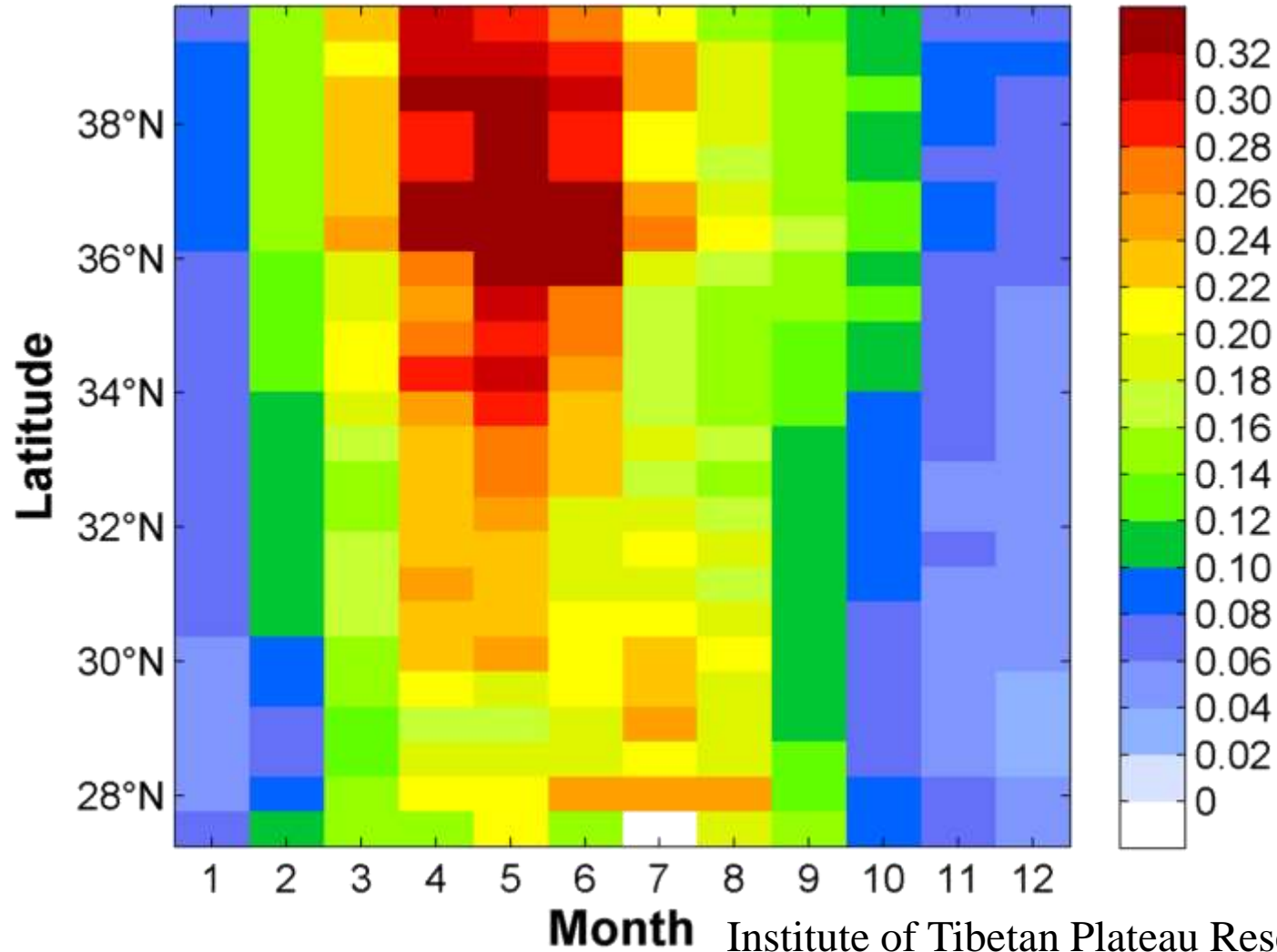
AOD shows clear zonal distributions, and AOD is higher in the northern part of the TP than the southern part.





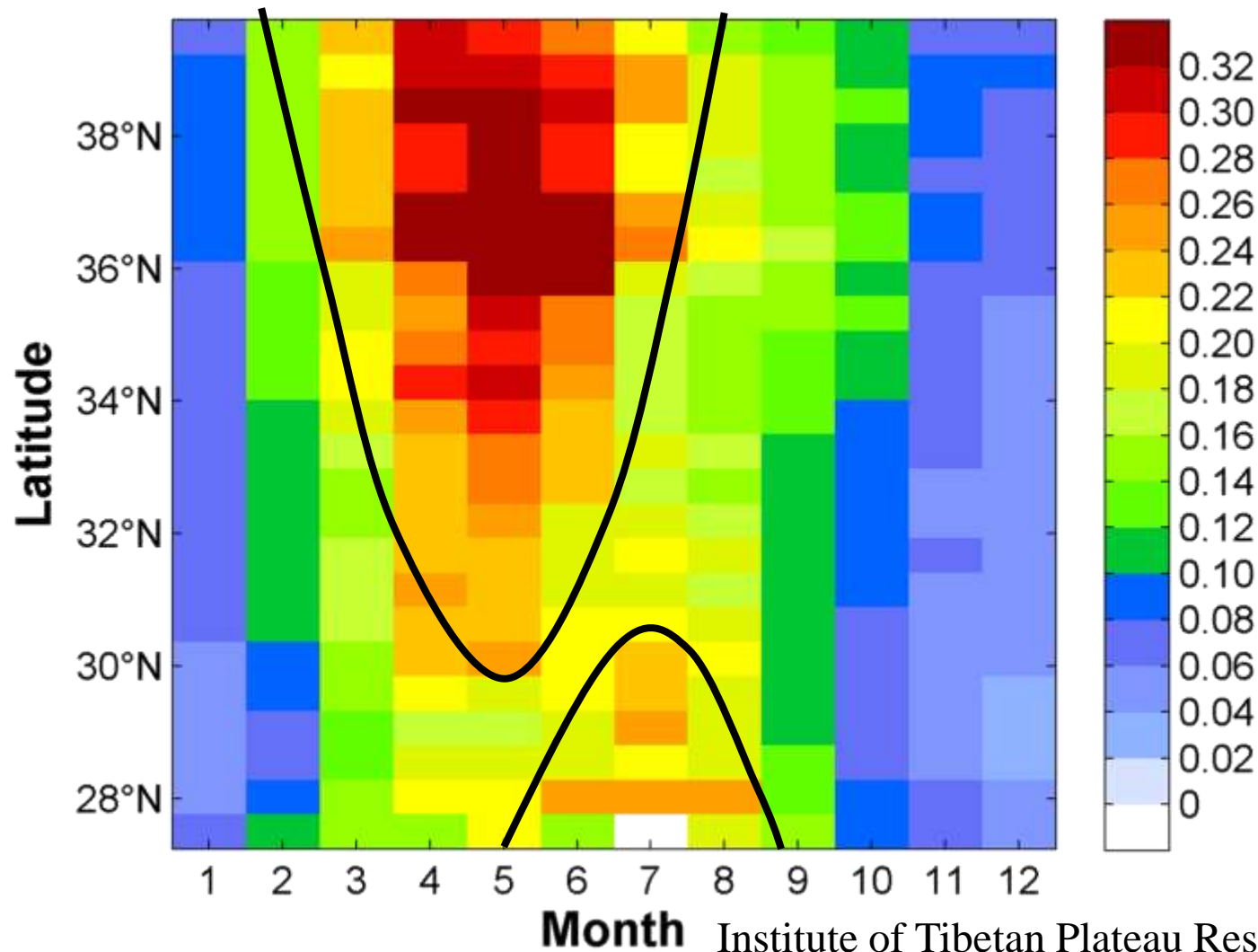
Precipitation isotope observations also show clear differences between the northern and the southern TP (Tian et al., 2007), which is similar to our study.

Zonal means of AOD

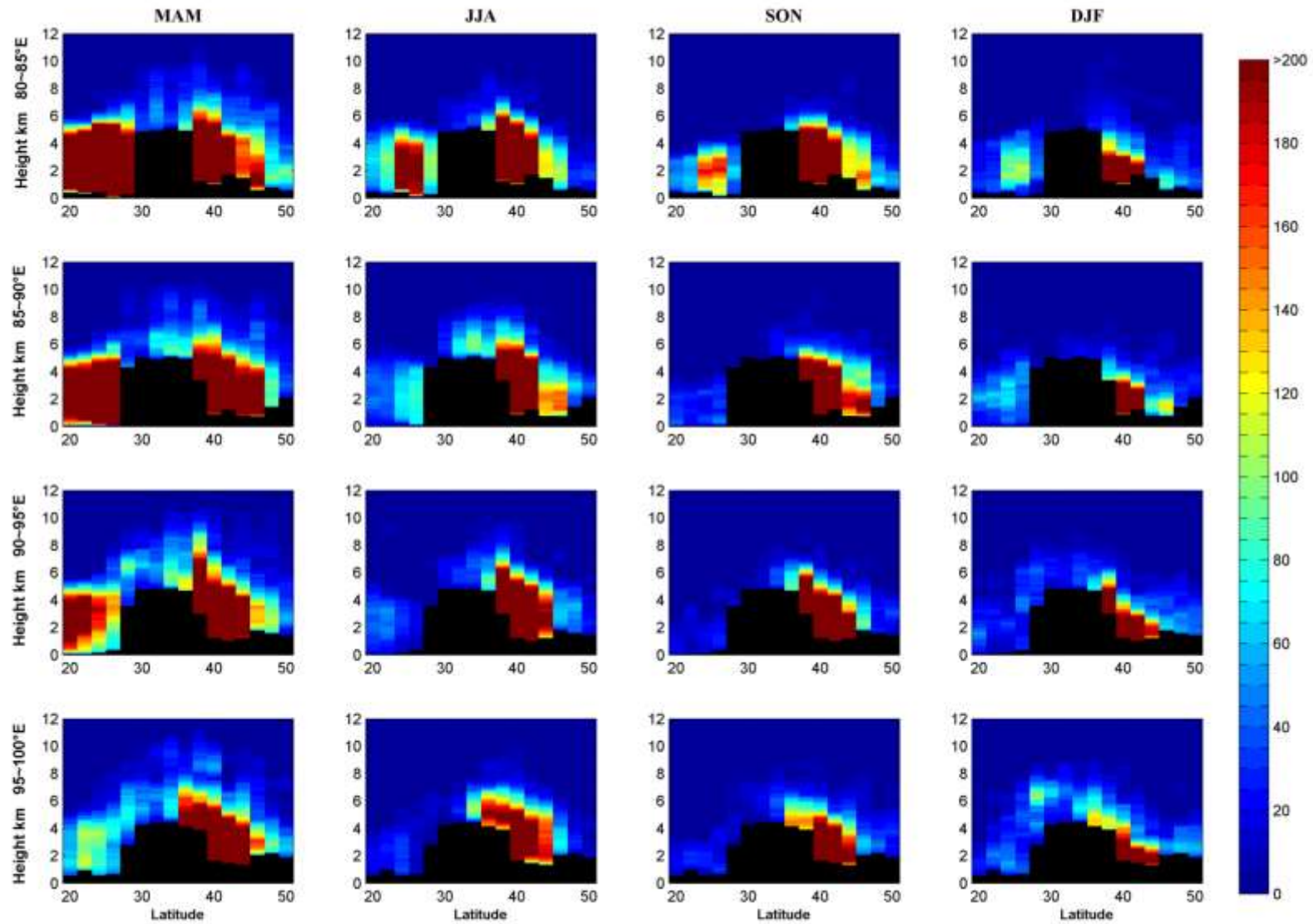


Different monthly variation pattern of AOD is shown in the northern part and southern part of TP.

AOD over the northern TP enhances during April to June, with maximum levels in May. AOD over the southern TP is highest in July.



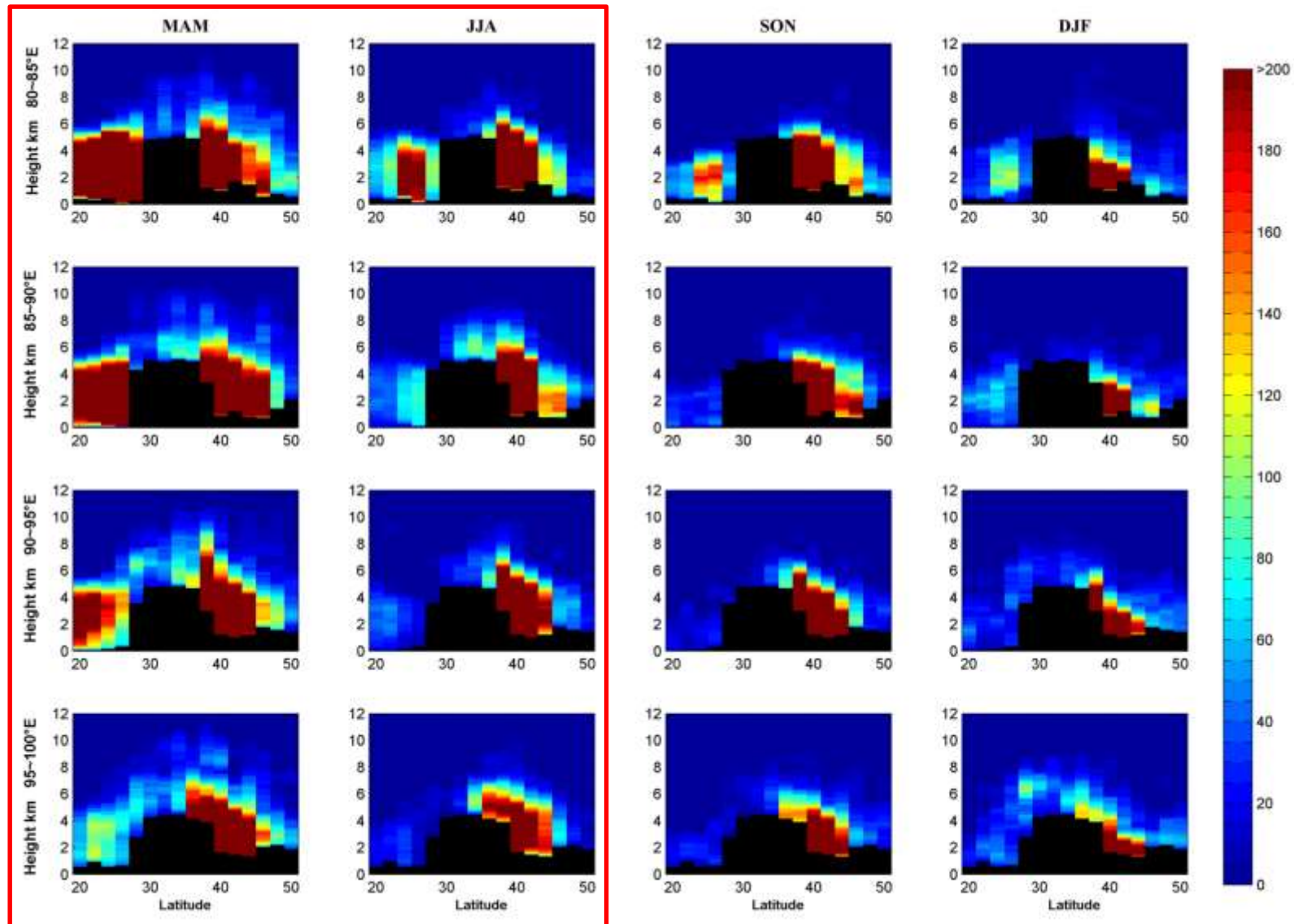
Vertical distributions of aerosols using CALIPSO data



Dust

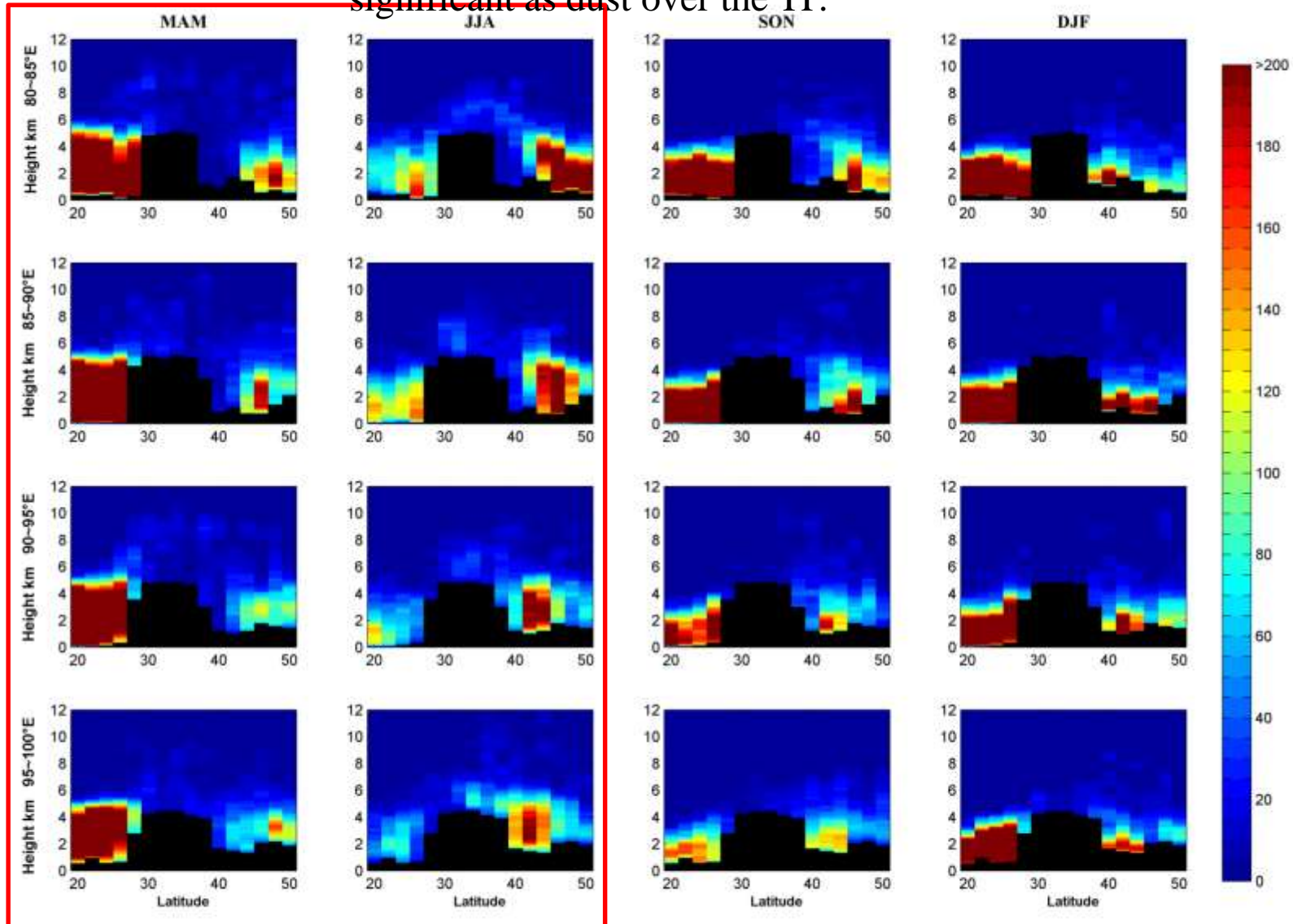
Detected dust over the TP increases significantly in spring and summer.

The demarcation of dust occurrence between the northern and southern TP is located in around 33-35° N during spring.



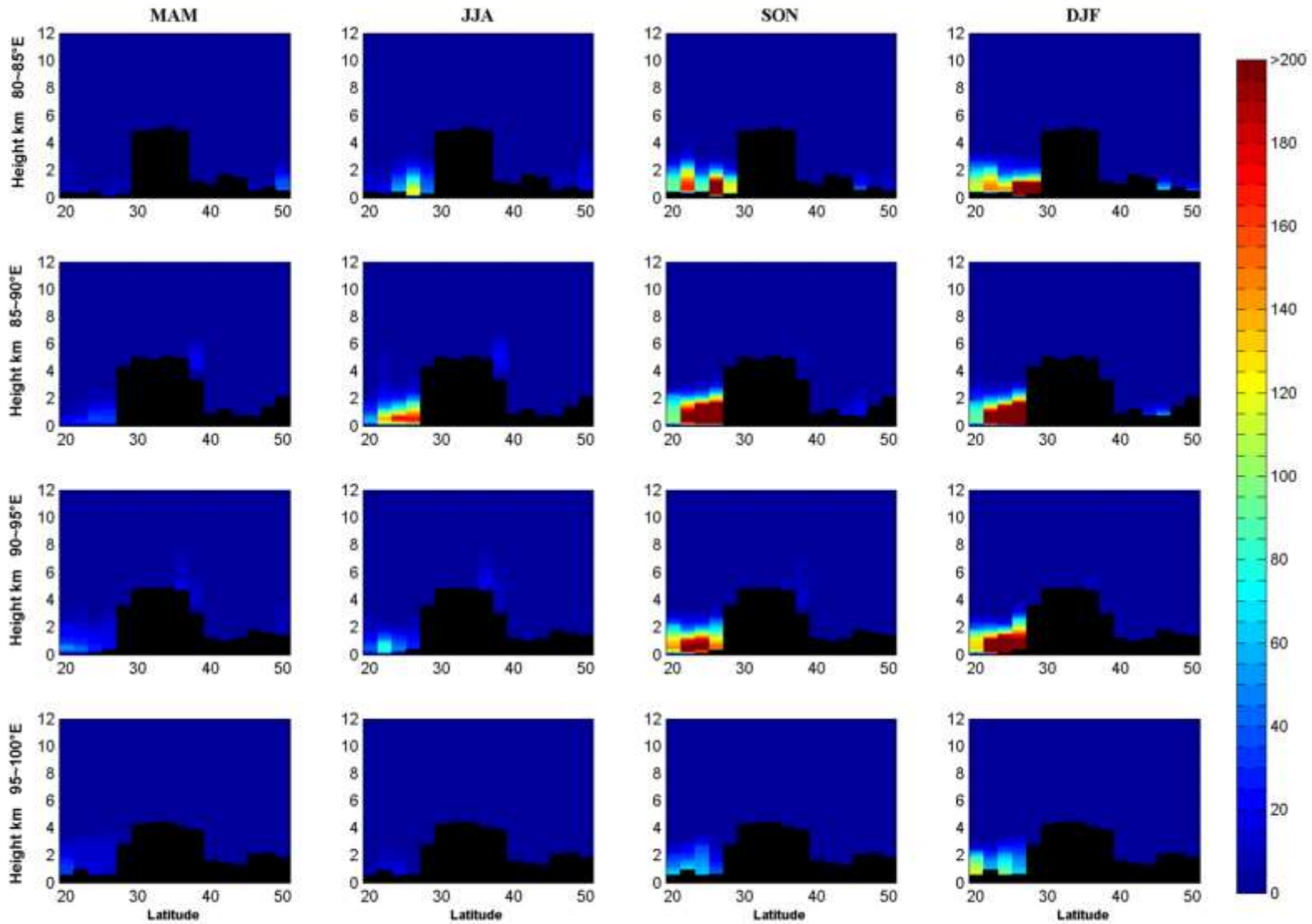
Polluted dust

High occurrence of polluted dust is observed over the northern Indian peninsula. Polluted dust also exhibits higher occurrence frequencies in spring and summer above the TP. The effect of polluted dust is not as significant as dust over the TP.



Polluted continental environment of the TP individually.

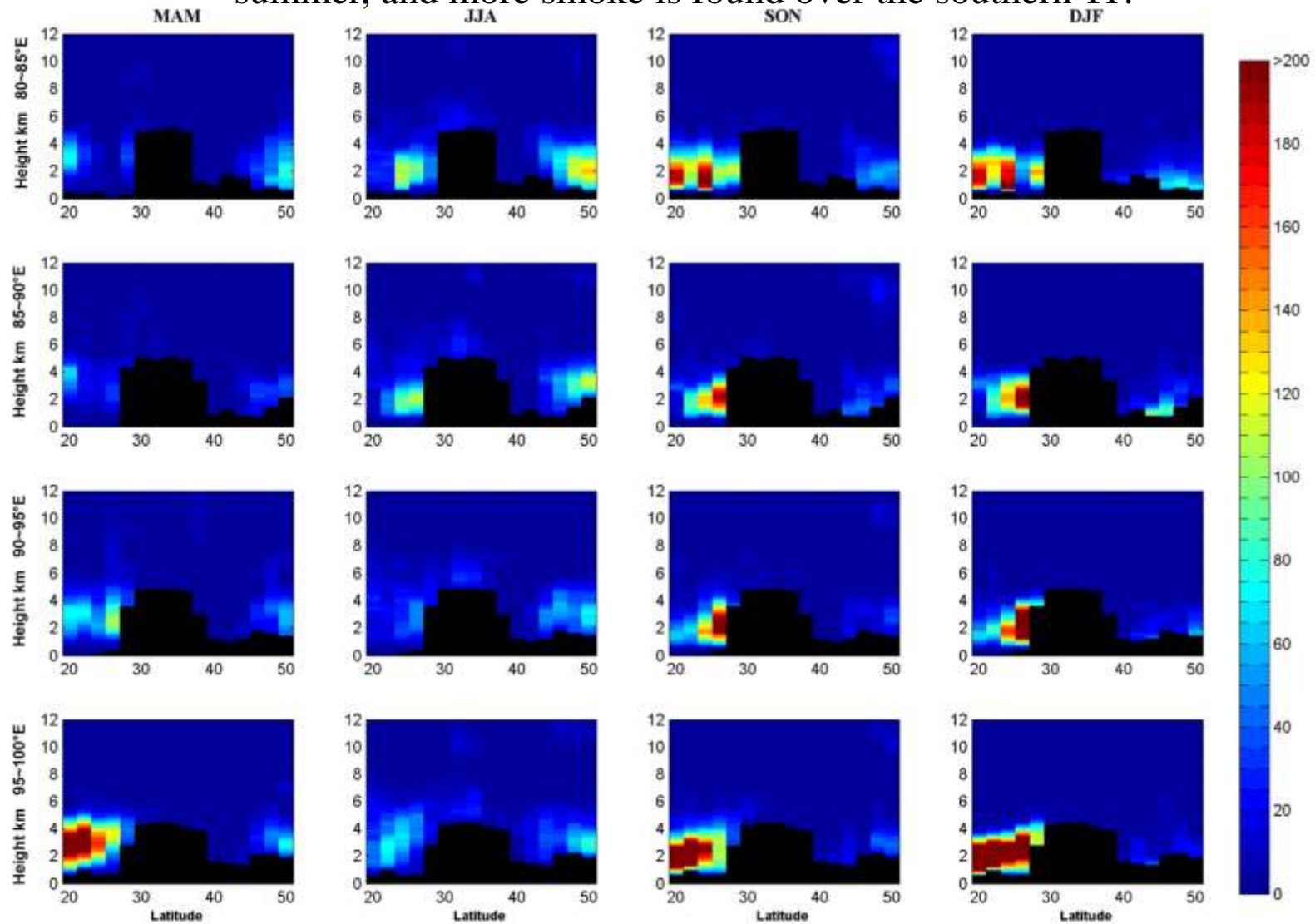
Urban pollutions do not contaminate the



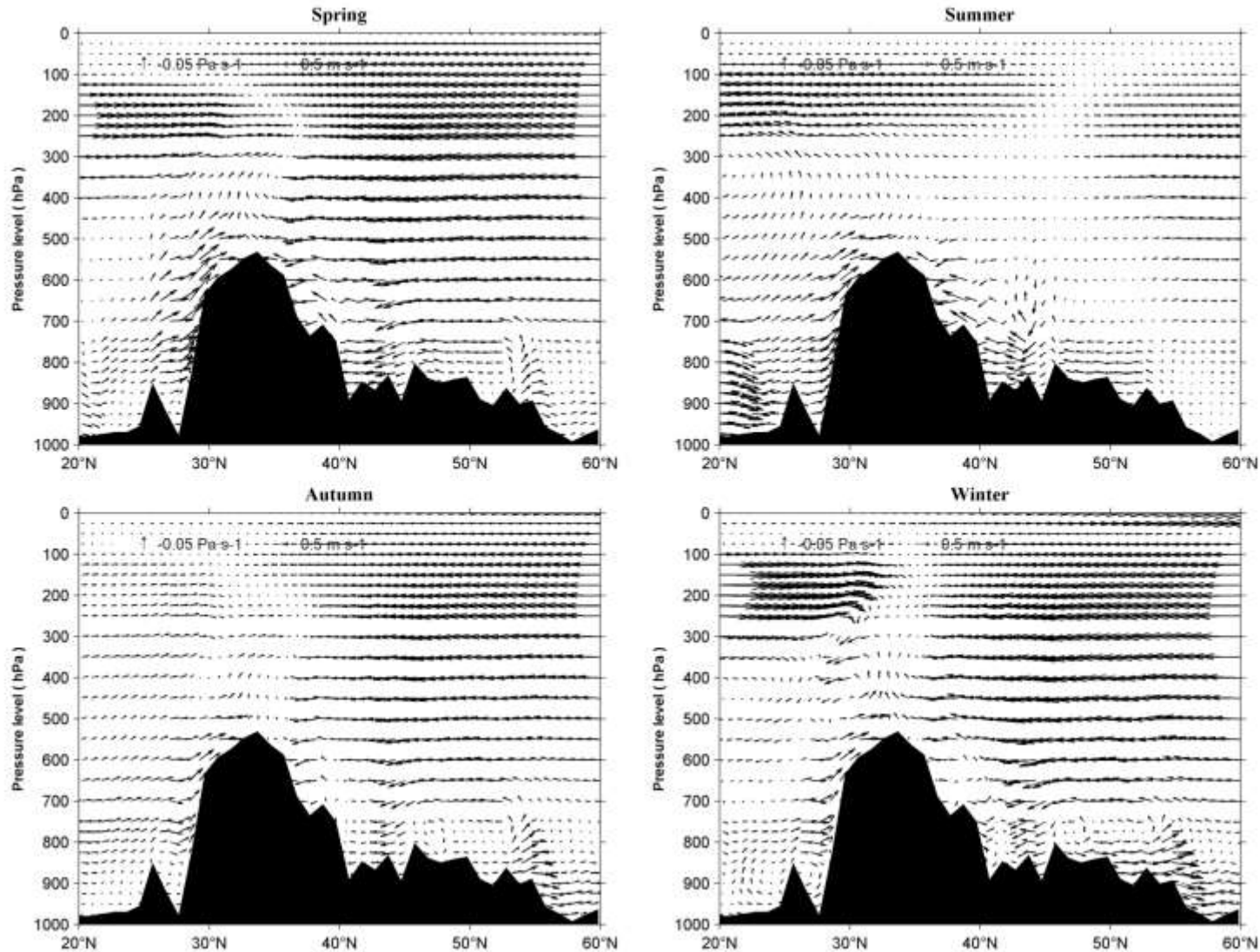
Smoke

More smoke samples are detected over the Indo-Gangetic Plains rather than the areas north of the TP.

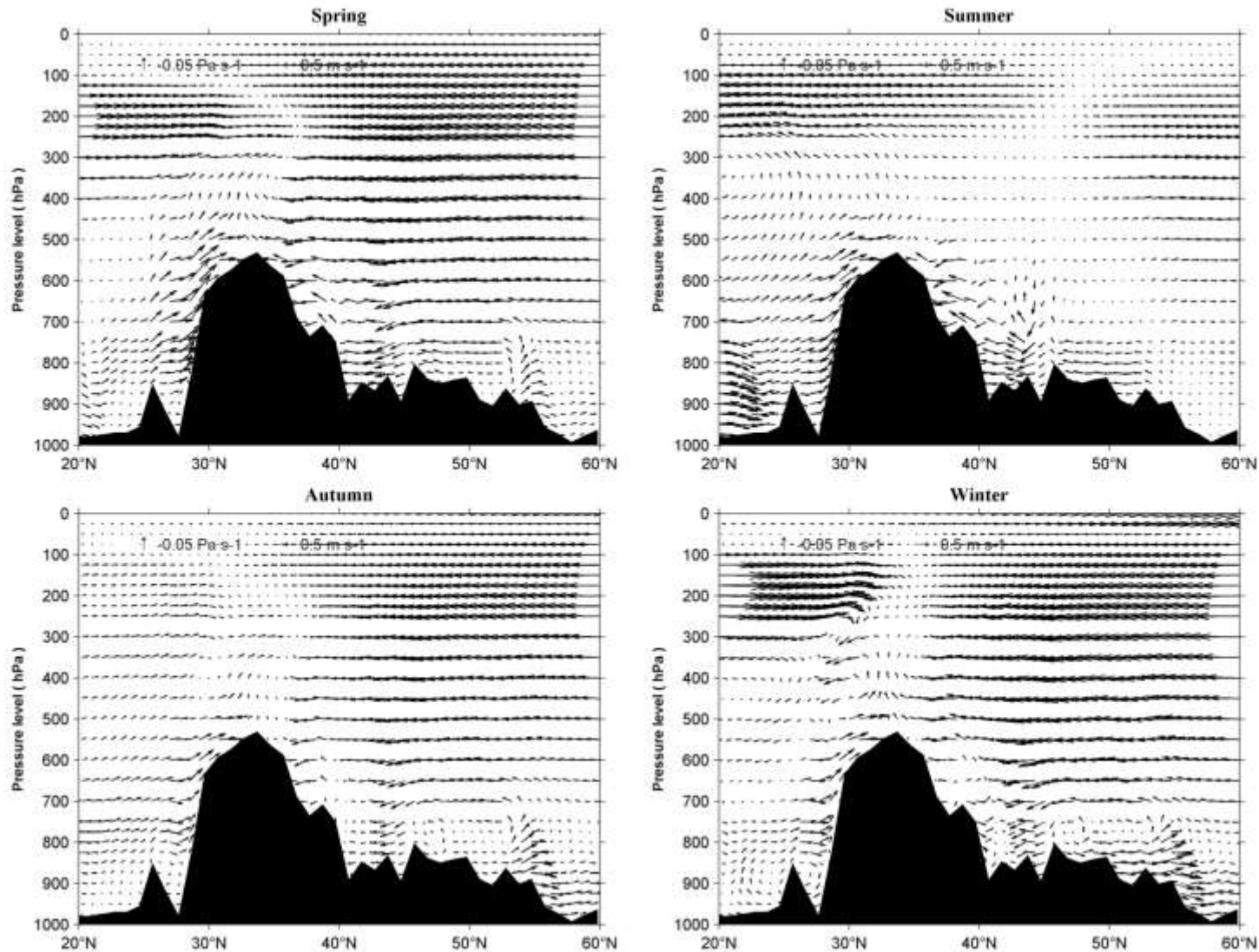
Detected smoke samples increase lightly over the TP during summer, and more smoke is found over the southern TP.



Atmospheric circulation also greatly impacts the seasonal aerosol variations.

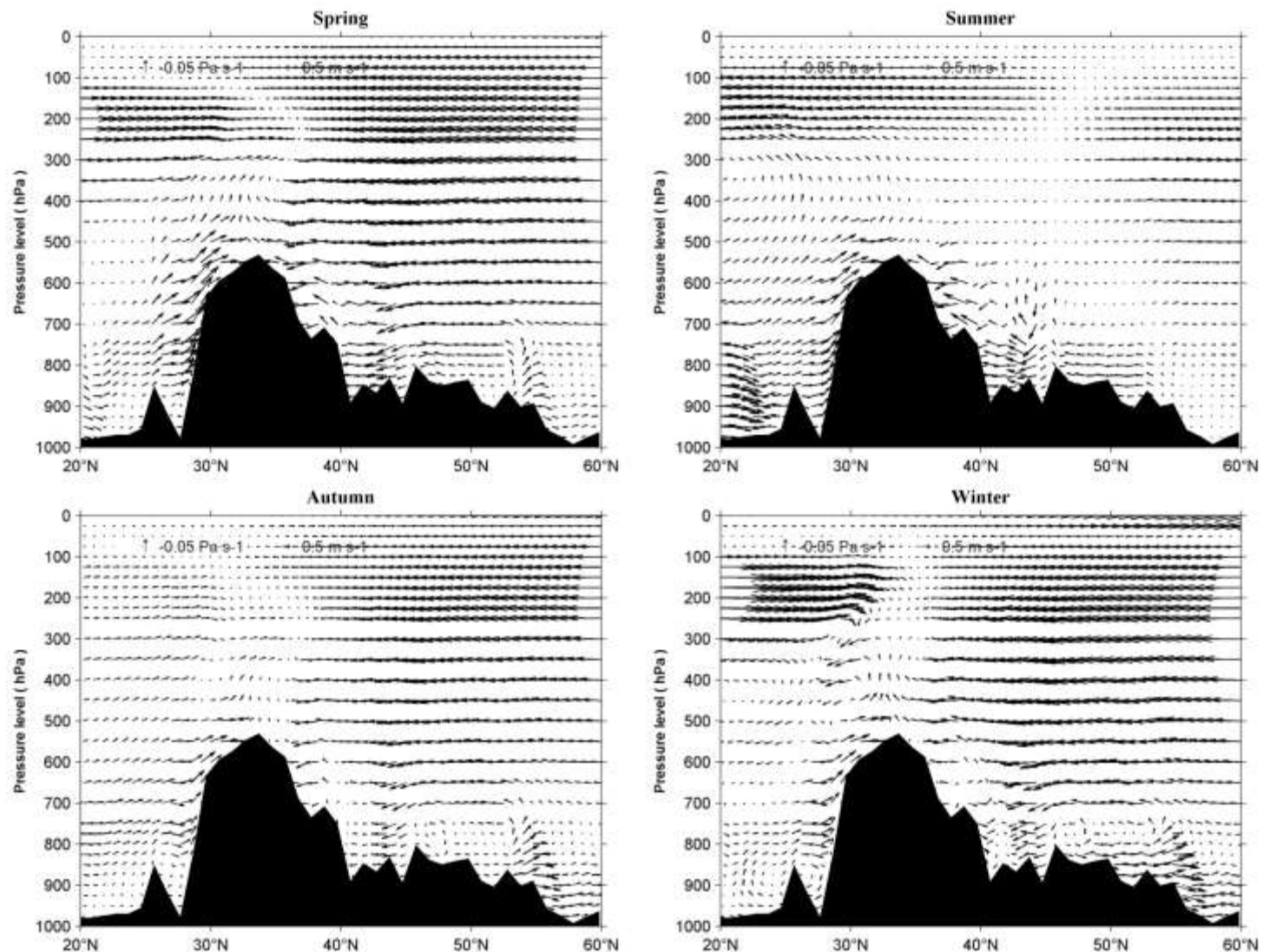


The vertical atmospheric circulations at 95° E

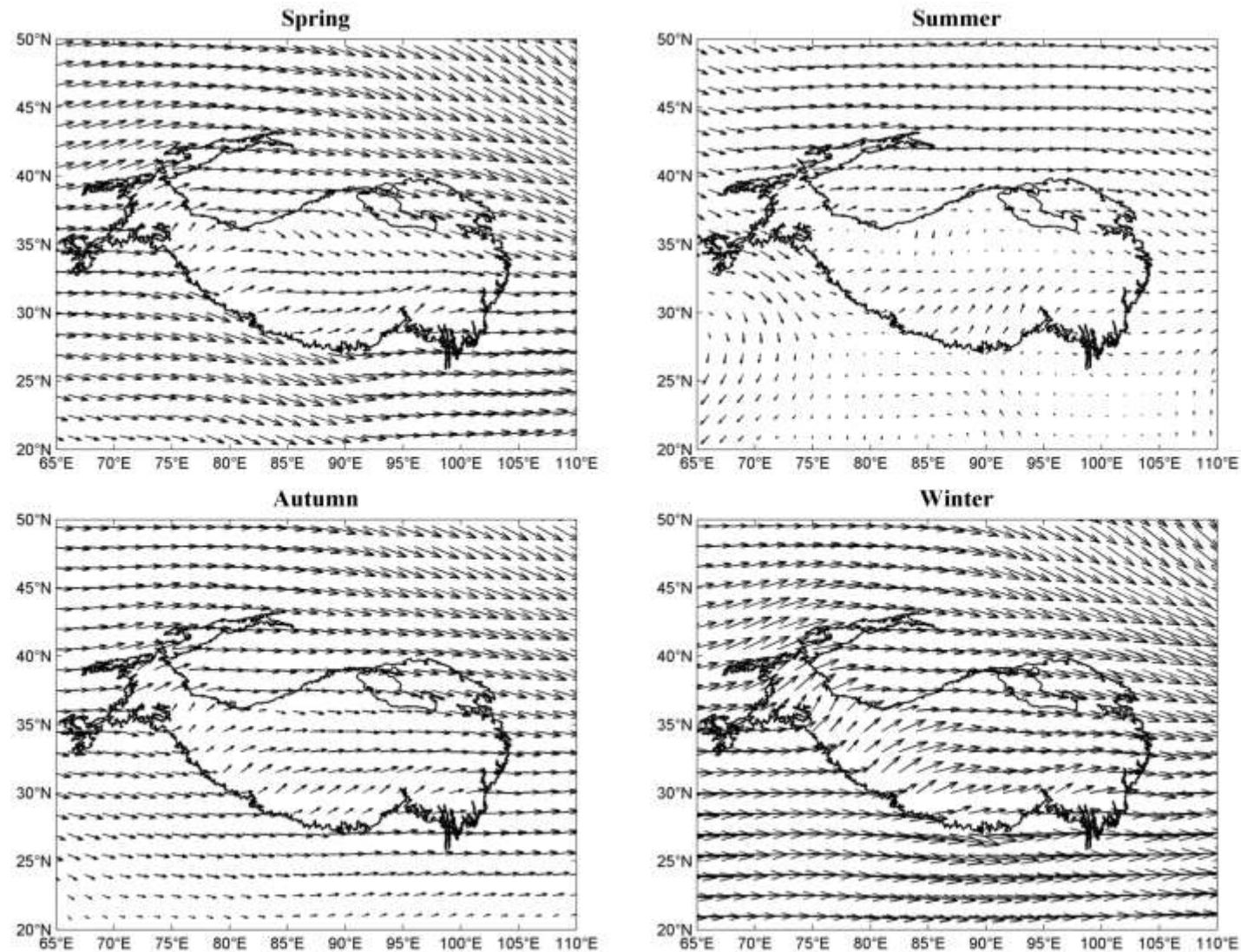


The northern atmospheric circulation system and south Asian monsoonal system intersect 24 around in the middle of the TP.

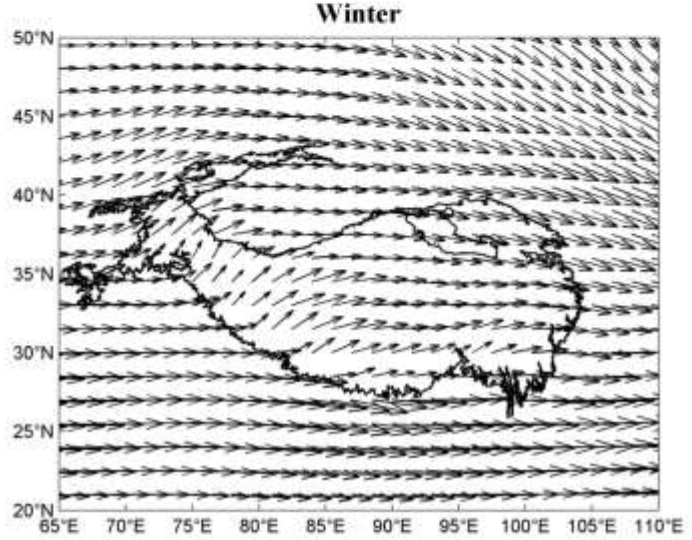
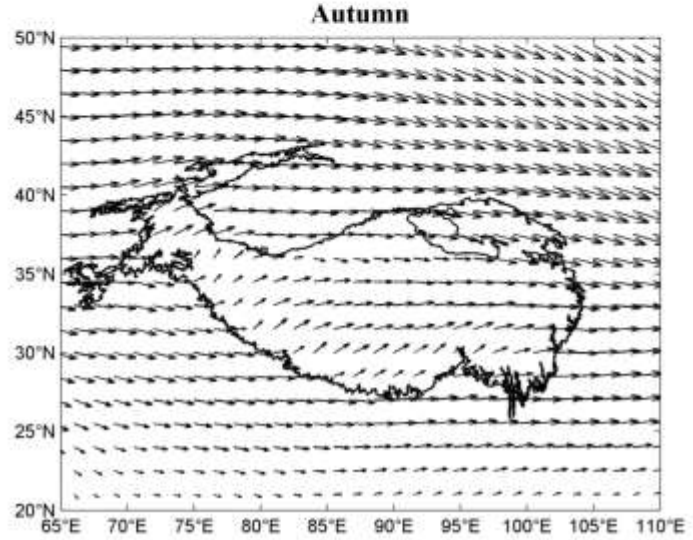
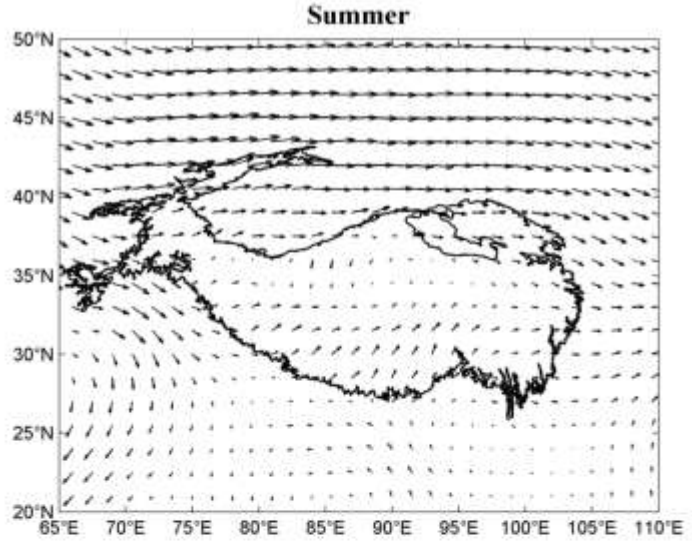
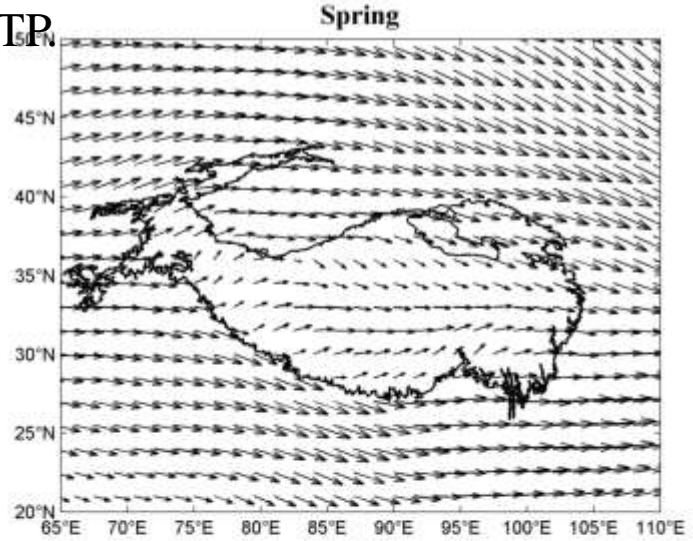
Strong updrafts below 200 hPa to the south of the TP during summer, and it facilitates the transport of aerosols from Northern India to the TP.



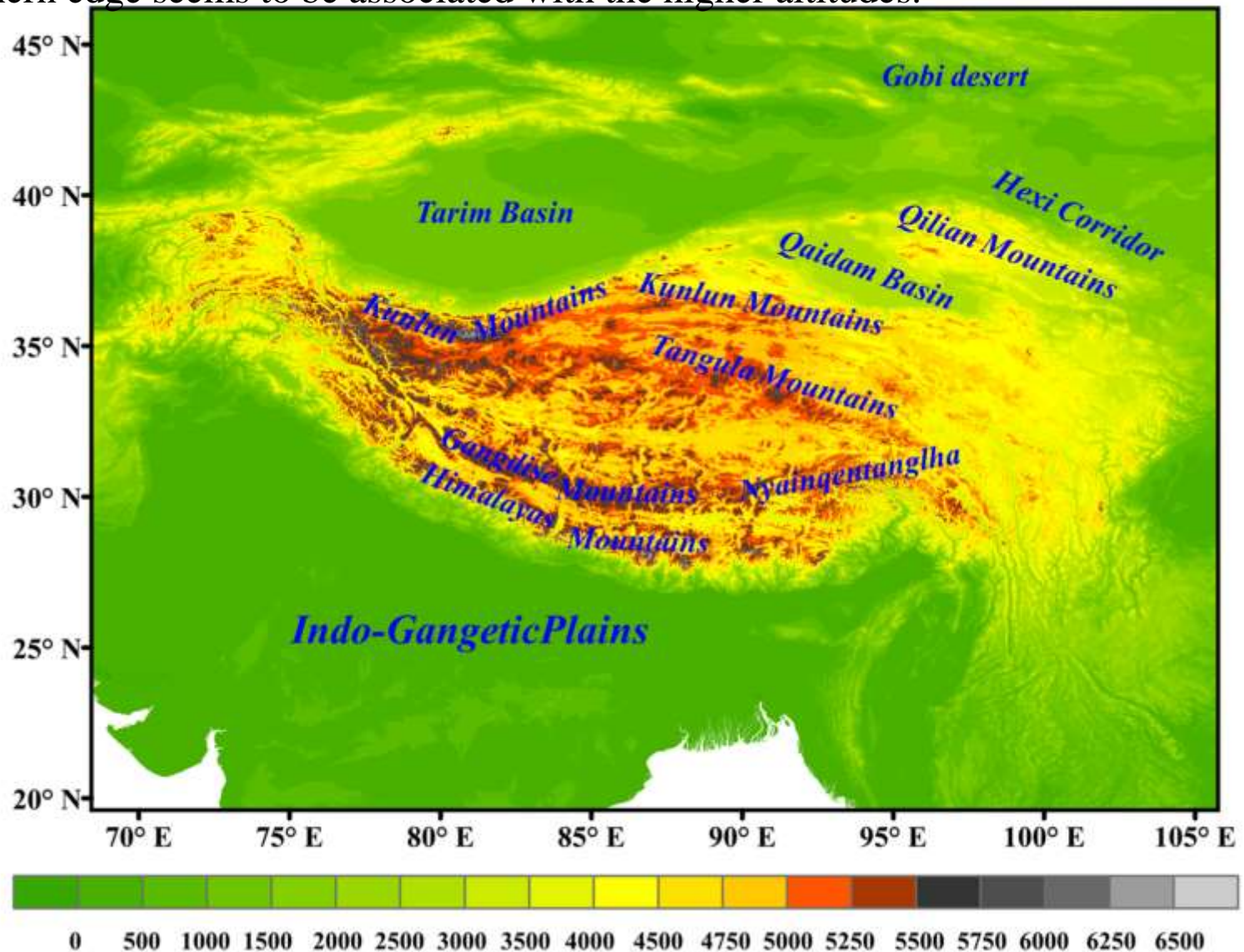
The wind fields at 500 hPa



Northwesterly and westerly winds at 500 hPa prevail over the Indo-Gangetic Plains during spring, autumn and winter. During summer, the southwesterly winds at 500 hPa reach the northward maximum extent over the TP. This also explain why AOD enhances during summer over the southern TP.



The high terrain acts as a natural barrier for the transport of atmospheric aerosols from the surrounding polluted regions to the main body of the TP. The high aerosol load occurring over the northern part seems to be associated with lower altitudes, and a relatively low aerosol load along the southern edge seems to be associated with the higher altitudes.



Summary

- The aerosol load exhibits obvious seasonal variations over the investigated regions, with higher AOD observed during spring and summer. Two different kinds of seasonal patterns of AOD are observed over the TP.
- Dust is found to be the major aerosol type above the TP. Monthly AOD usually shows higher values over the northern TP than the southern TP.
- Different seasonal variations over the northern and southern TP are closely associated with atmospheric circulation system; In addition, the mountains on the TP may effectively block the transport of aerosols.



Read more

Xu, C., Ma, Y. M., You, C., and Zhu, Z. K.: The regional distribution characteristics of aerosol optical depth over the Tibetan Plateau, *Atmos. Chem. Phys.*, 15, 12065-12078, 10.5194/acp-15-12065-2015, 2015.



**Thank you for
your attention!**

