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First simultaneous measurements of peroxyacetyl nitrate (PAN) and ozone at Nam Co in the central Tibet Plateau

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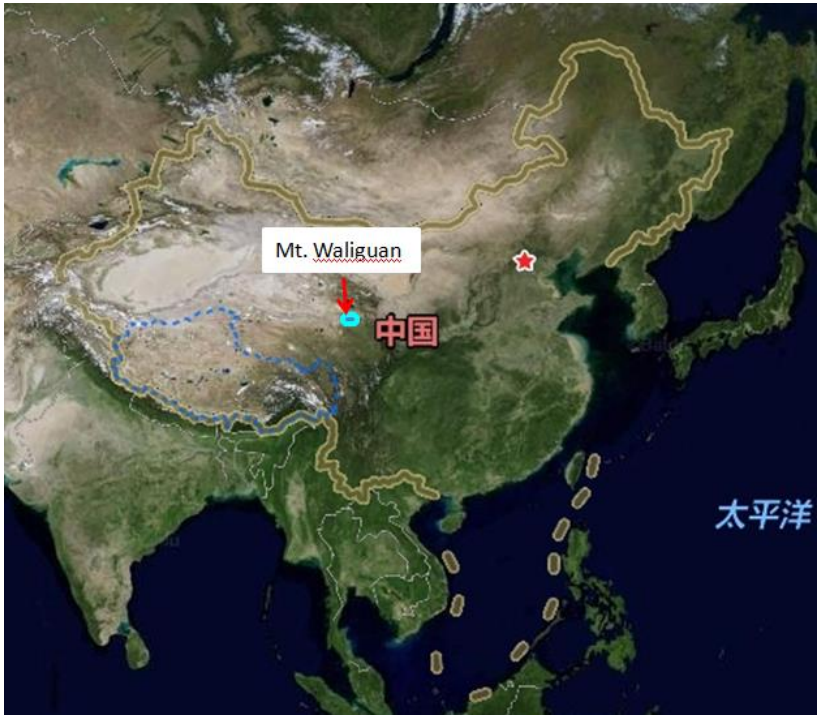
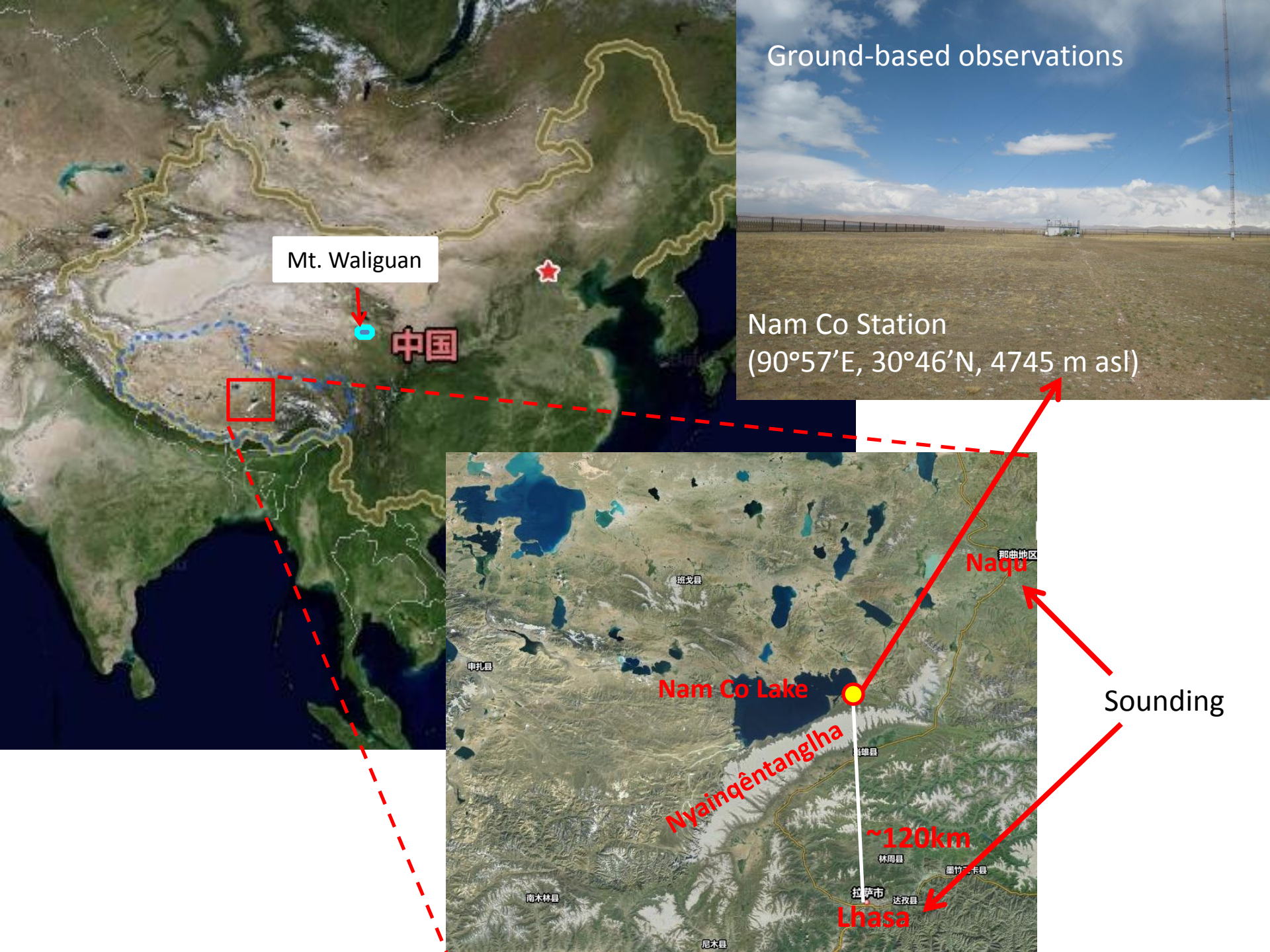
Background

- The Tibet Plateau (TP)：very remote region, nearly no industry and sparsely populated
- What are the processes dominating the variations of atmospheric species over the TP? Their relative contributions?
- WMO/GAW: Mt. Waliguan, global baseline station, established in 1994 at the northeast edge of the Qinghai-Tibetan Plateau.

- What about the rest of the TP? Very limited observational data.

- Some field campaigns were conducted in recent years in the central TP.



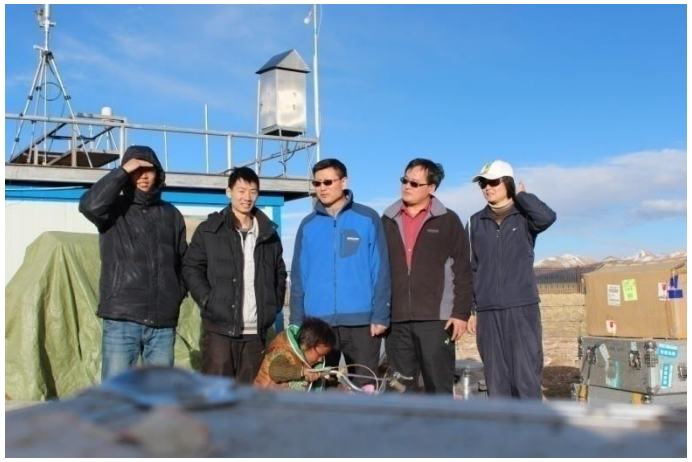

Mt. Waliguan
中国
Ground-based observations
Nam Co Station
(90°57’E, 30°46’N, 4745 m asl)
Naqu
Nam Co Lake
Nyainqêntanglha
~120km
Lhasa
Sounding

Campaign at Nam Co : July-September 2011

O_3
NO_x
NH_3
CO
SO_2

PAN
HCHO
H_2O_2
VOCs
J values
UVB
PM

Campaign at Nam Co : May-July 2012



O_3
PAN
HCHO
NO_x
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CO

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VOCs
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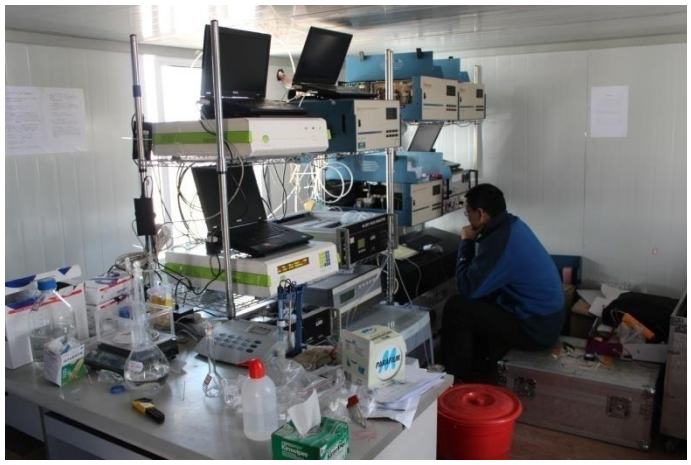
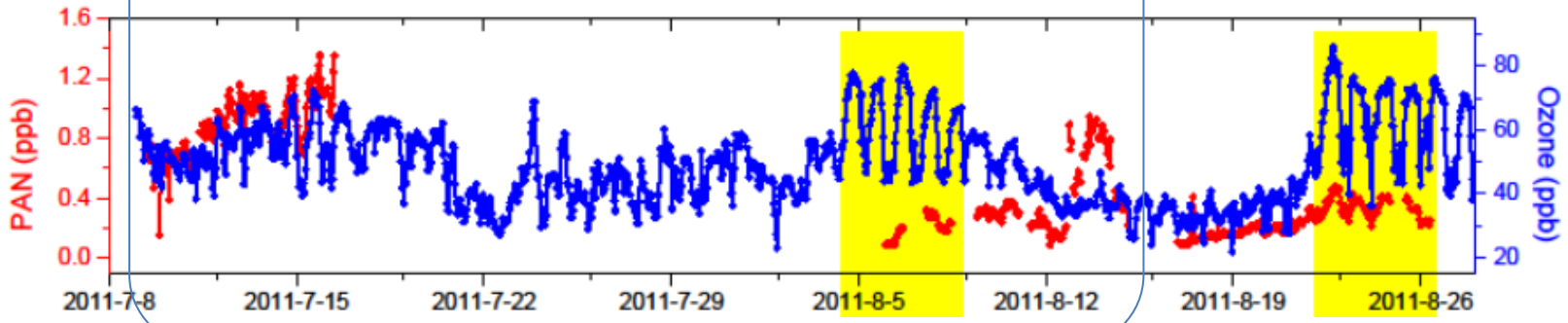


O_3 and PAN ($CH_3COO_2NO_2$)

- Photo-oxidants
- Ubiquitous
- Toxic for human and vegetation
- Tropospheric O_3: RF 0.40 ± 0.20 W m^{-2} (IPCC AR5)
- PAN: reservoir of NO_2, important for photochemistry over remote regions

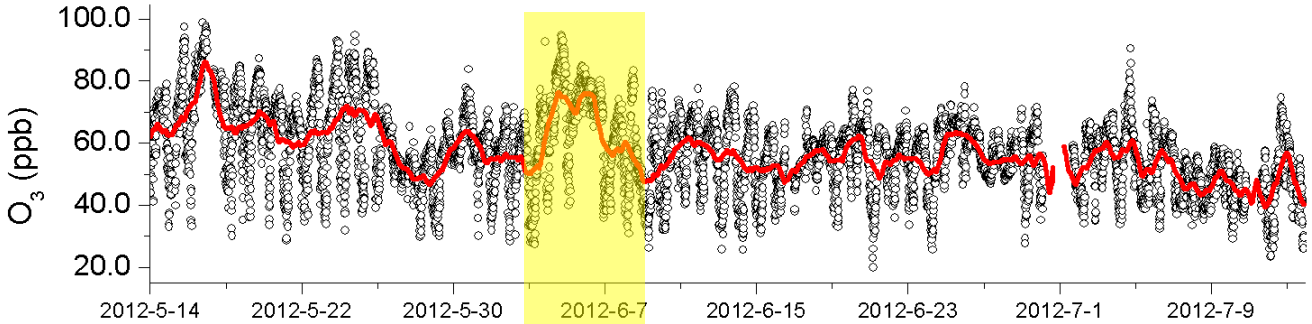
2011

PAN data highly uncertain

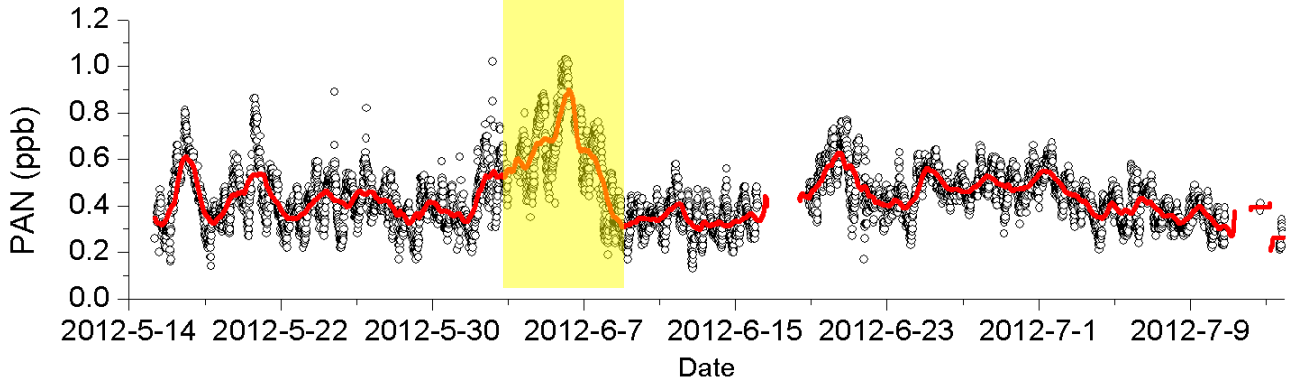


PAN: 0.36 ppb
(0.11-0.76 ppb)

2012



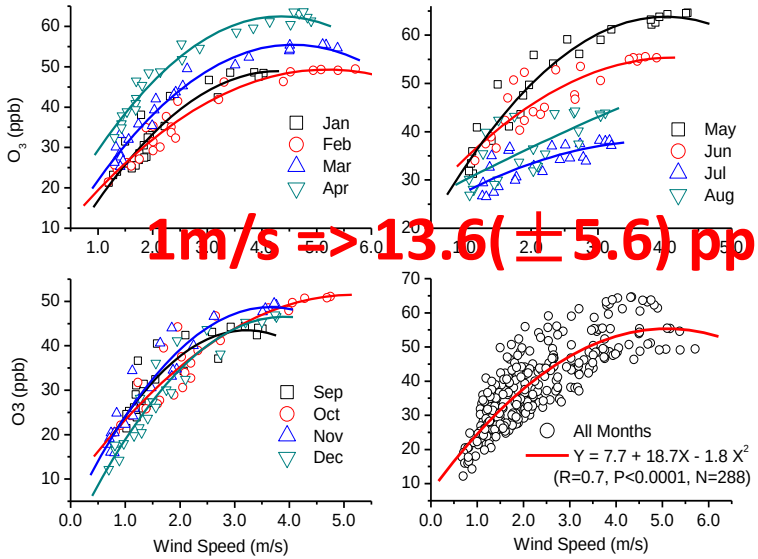
O_3: 60.0 ppb
(27.9-96.4 ppb)



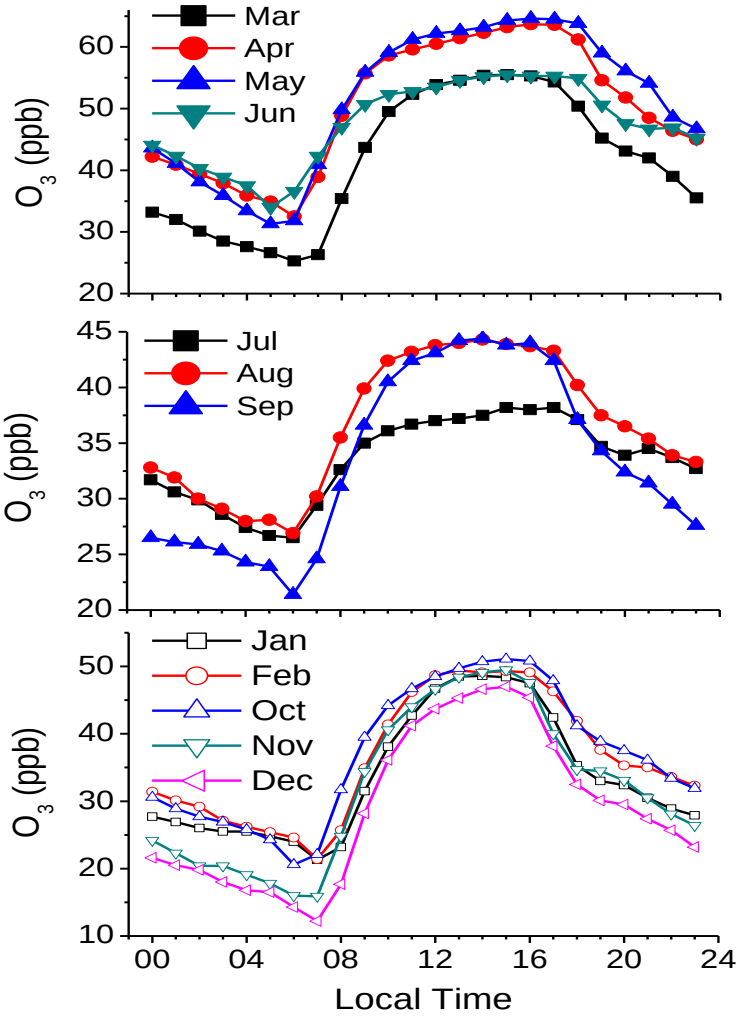
PAN: 0.44 ppb
(0.21-0.99 ppb)

Previous measurement of O_3 at Dangxiong (2009-2011)

Diurnal cycle with a high O_3 platform during daytime ;
Parabolic relationship with wind speed ; Downward mixing of O_3



1m/s => 13.6(±5.6) ppb



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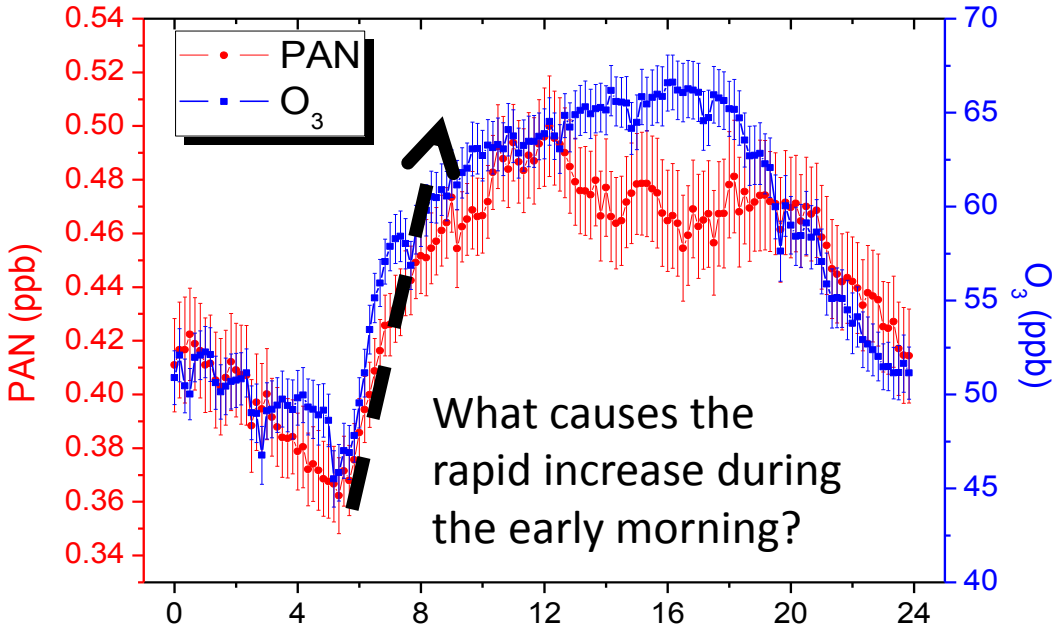
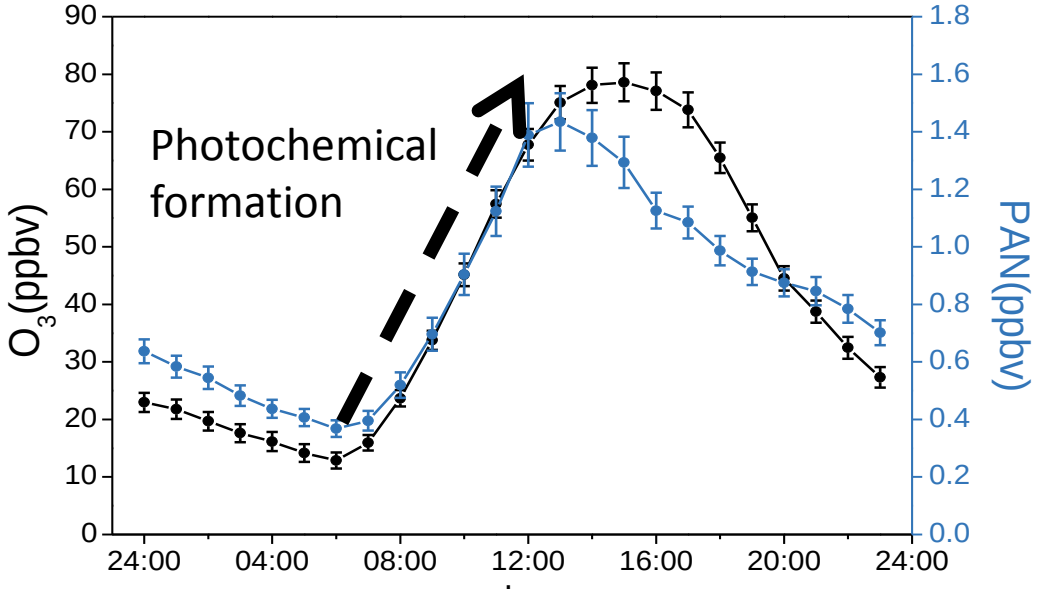
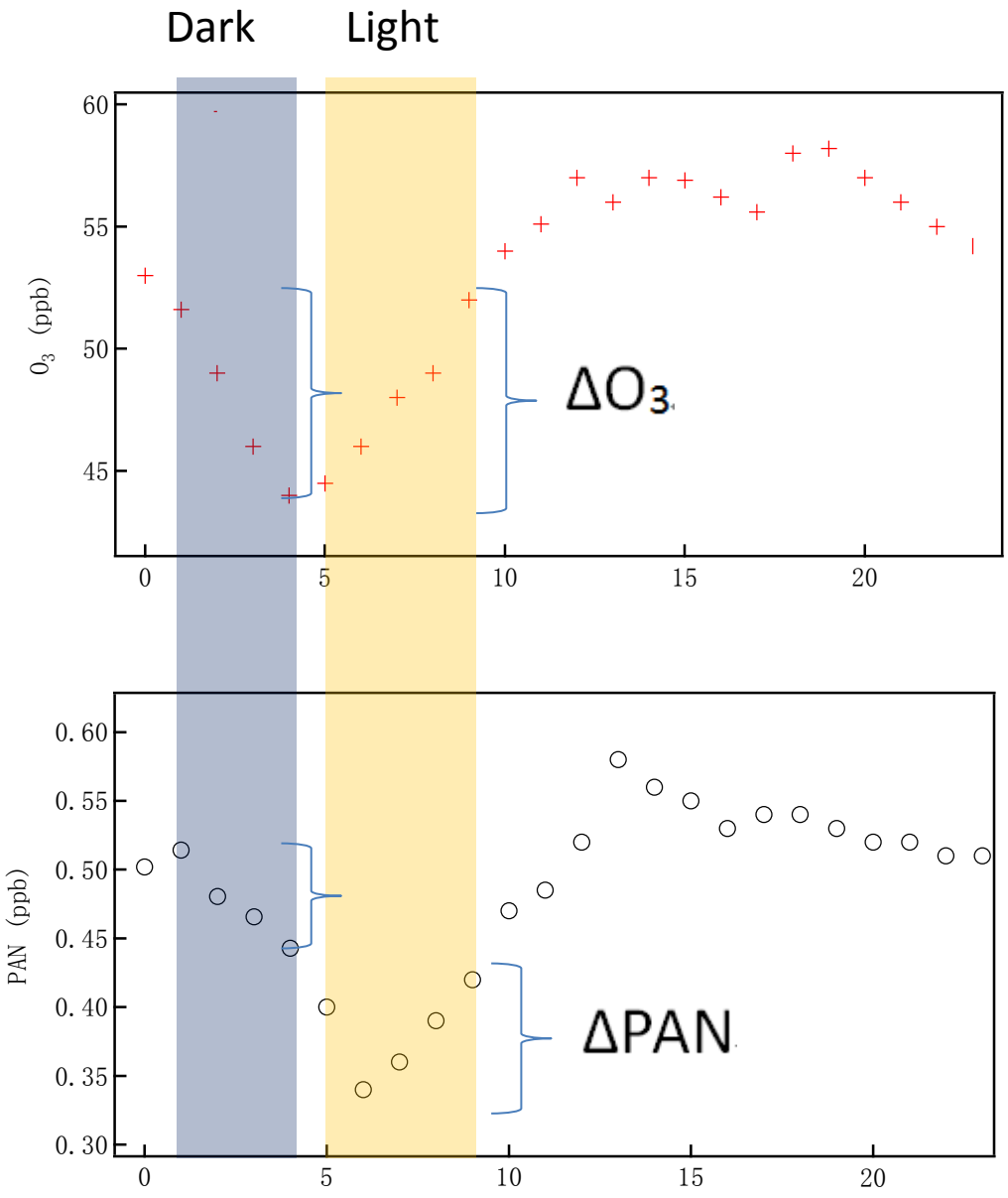
Diurnal variations of PAN and O_3



at Nam Co



at Gucheng

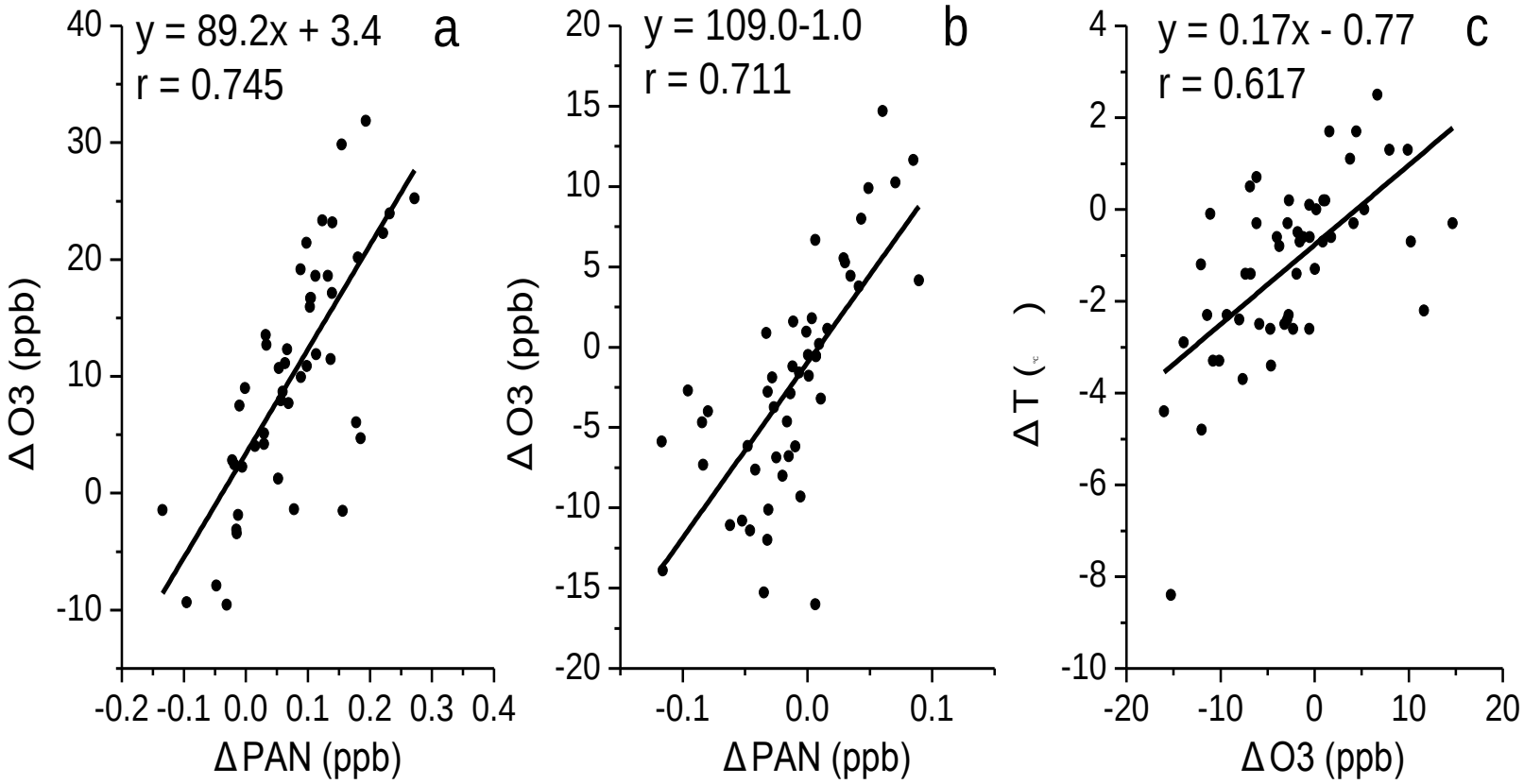


Calculate ΔO3 and ΔPAN for every day

Light
5:00-9:00 LT

Dark
2:00-4:00 LT

Dark
2:00-4:00 LT



Photochemical production?
Maybe.

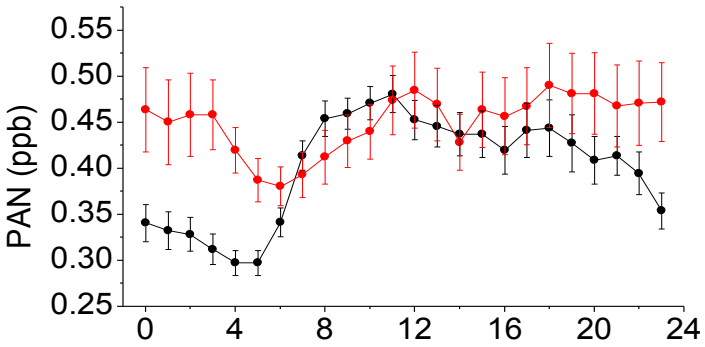
No photochemistry.
Why correlated?

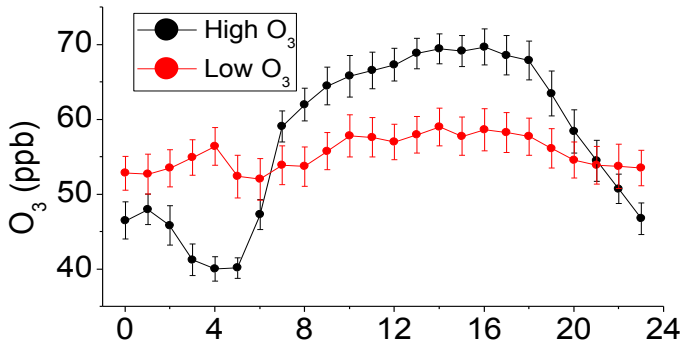
Meteorological processes?
Maybe.

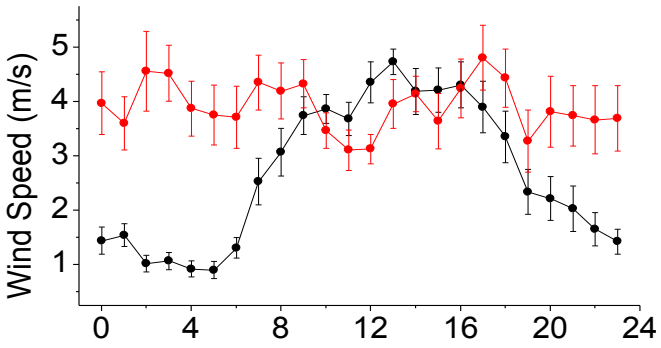
- **O_3 and PAN may be changed purely by some meteorological processes which also influence air temperature.**

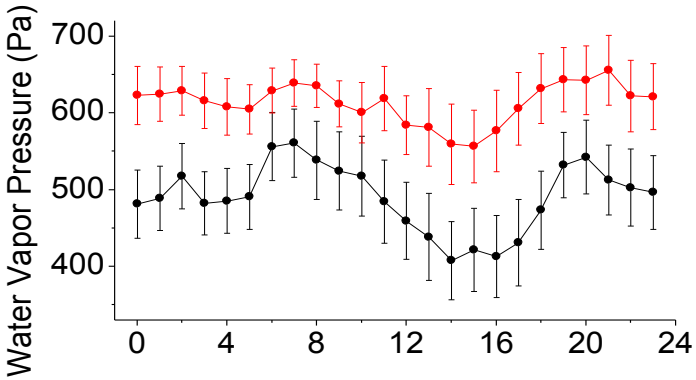
- Vertical gradients of O_3, PAN, and T formed during night.
- The gradients varied from day to day.
- Vertical mixing of air can change the gradients and surface O_3, PAN, and T.
- Vertical mixing is related with the PBL evolution.

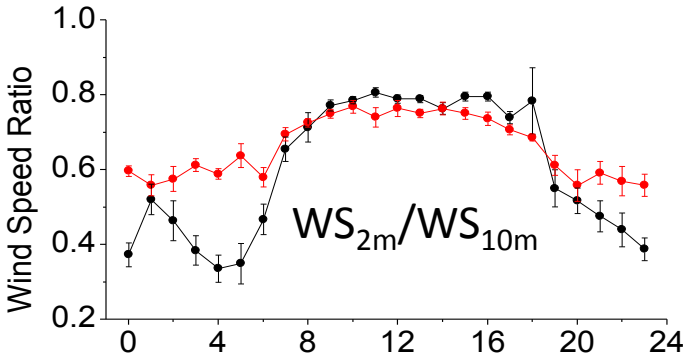
Two groups of days: High ΔO_3 vs Low ΔO_3

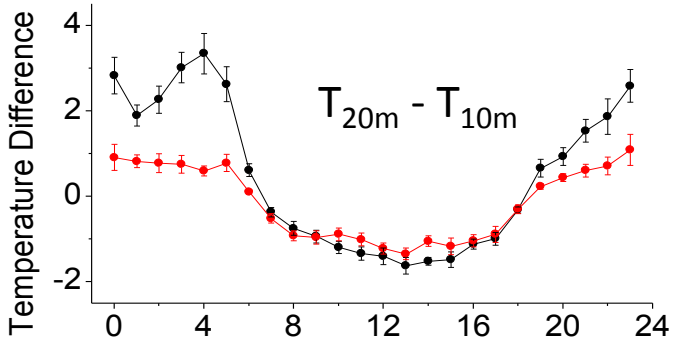


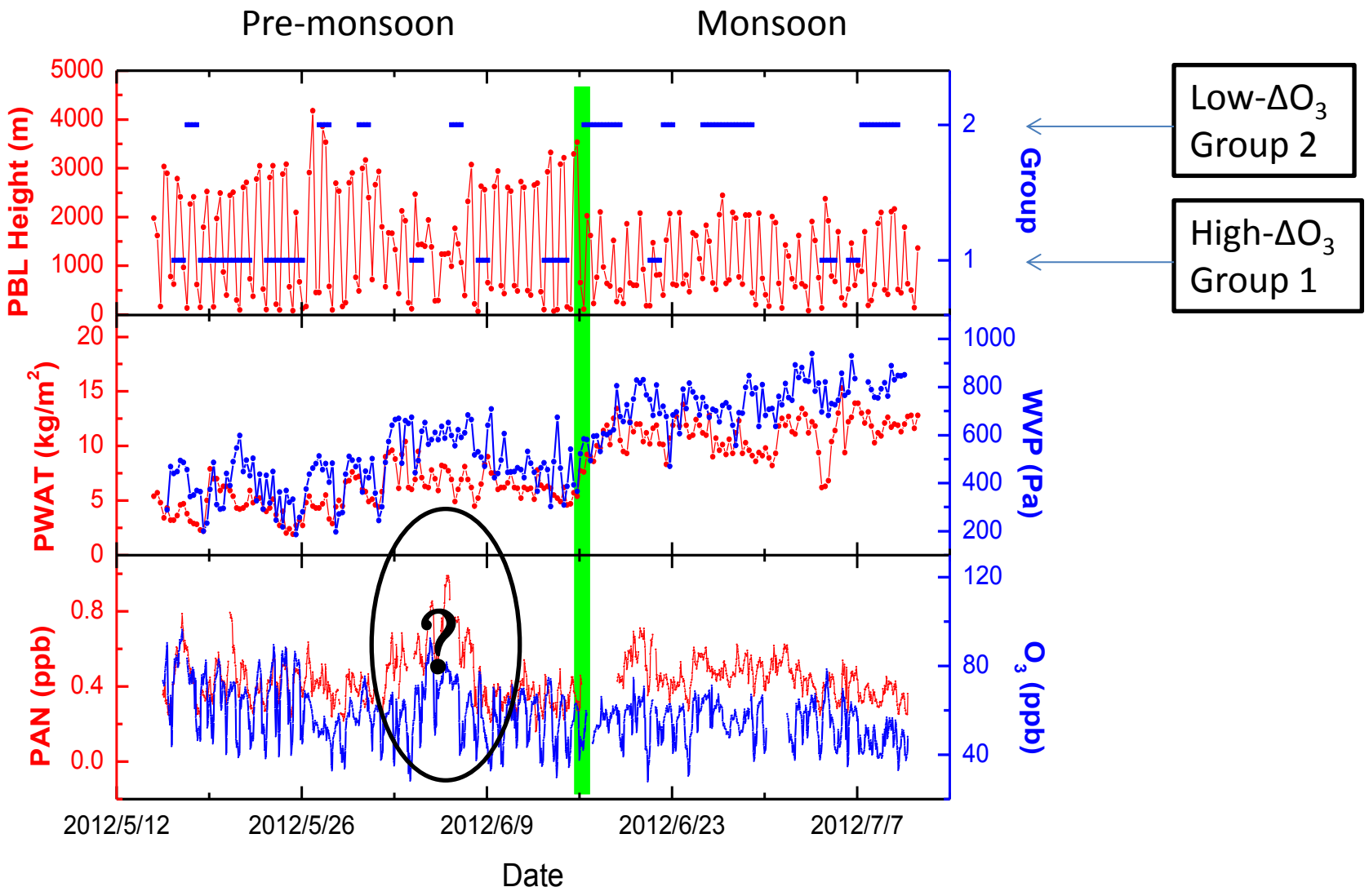








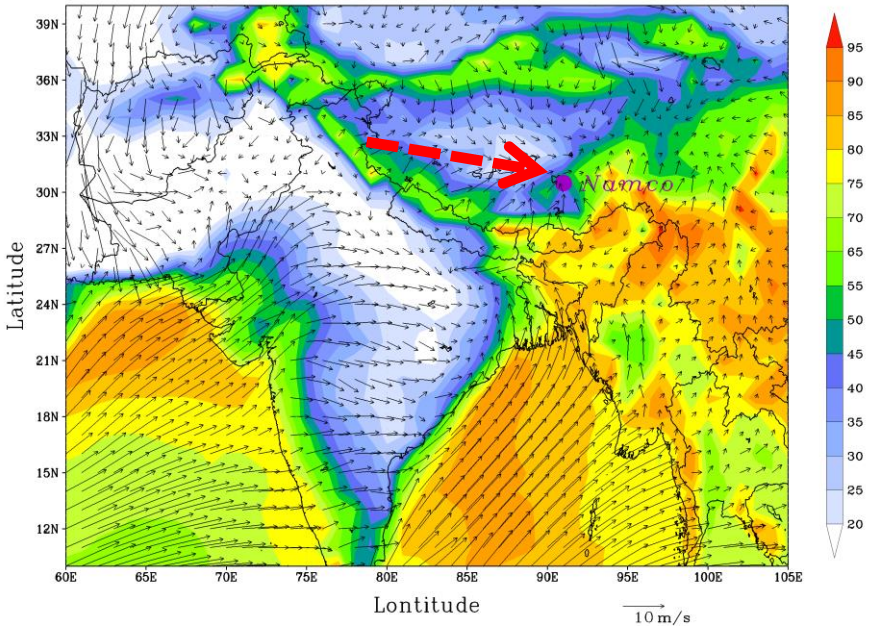




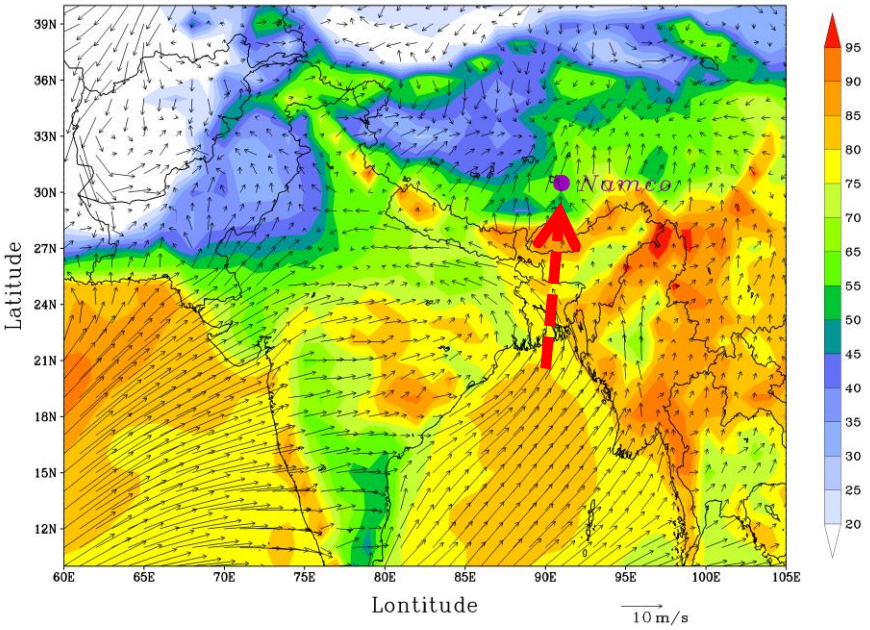
- Rapid increases of O_3 and PAN caused by downward mixing
- Stronger mixing under higher PBL
- More high PBL days during pre-monsoon

Wind vector + RH

1-6 June 2012
PAN plume

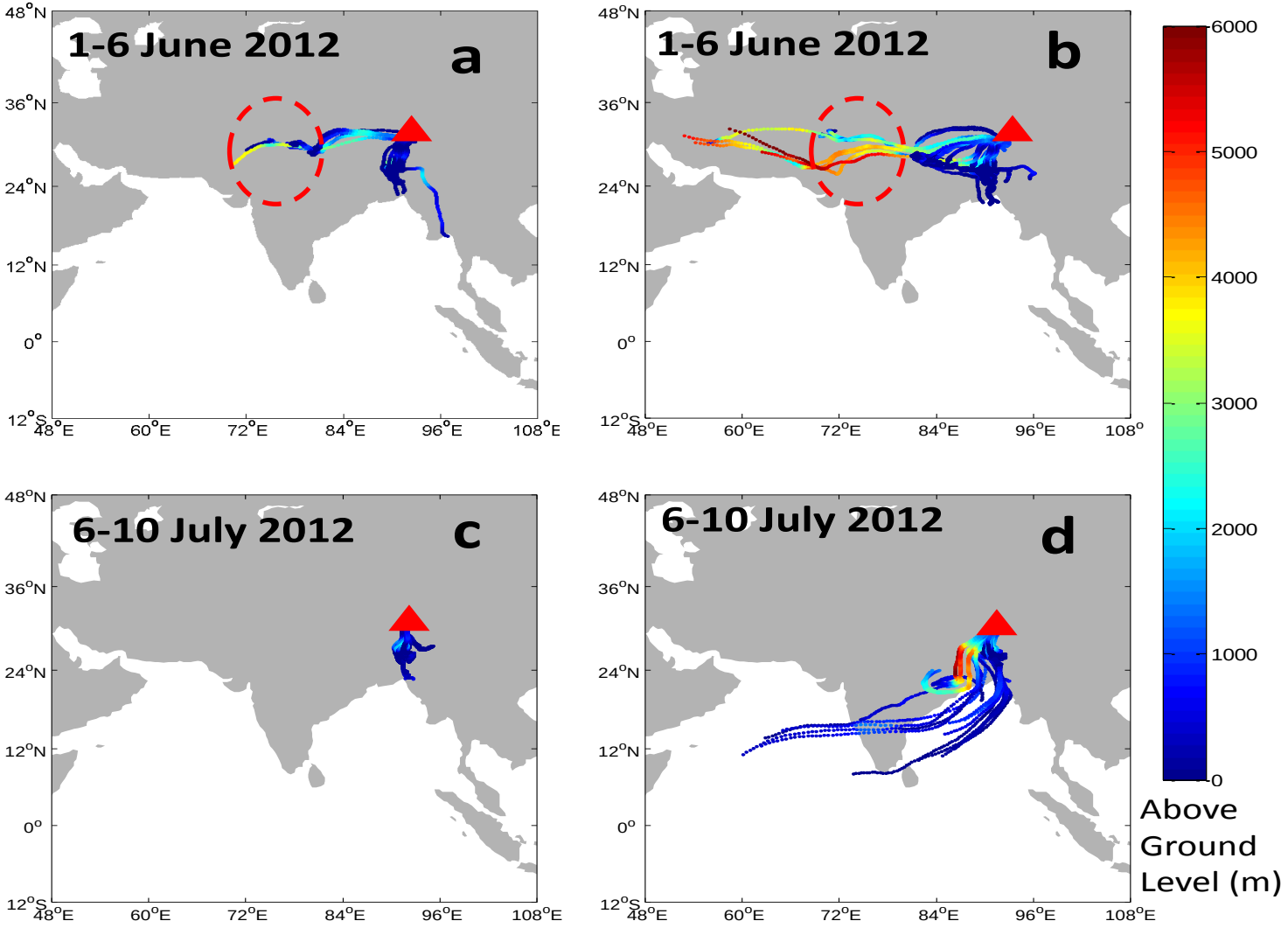


6-10 July 2012
After PAN plume



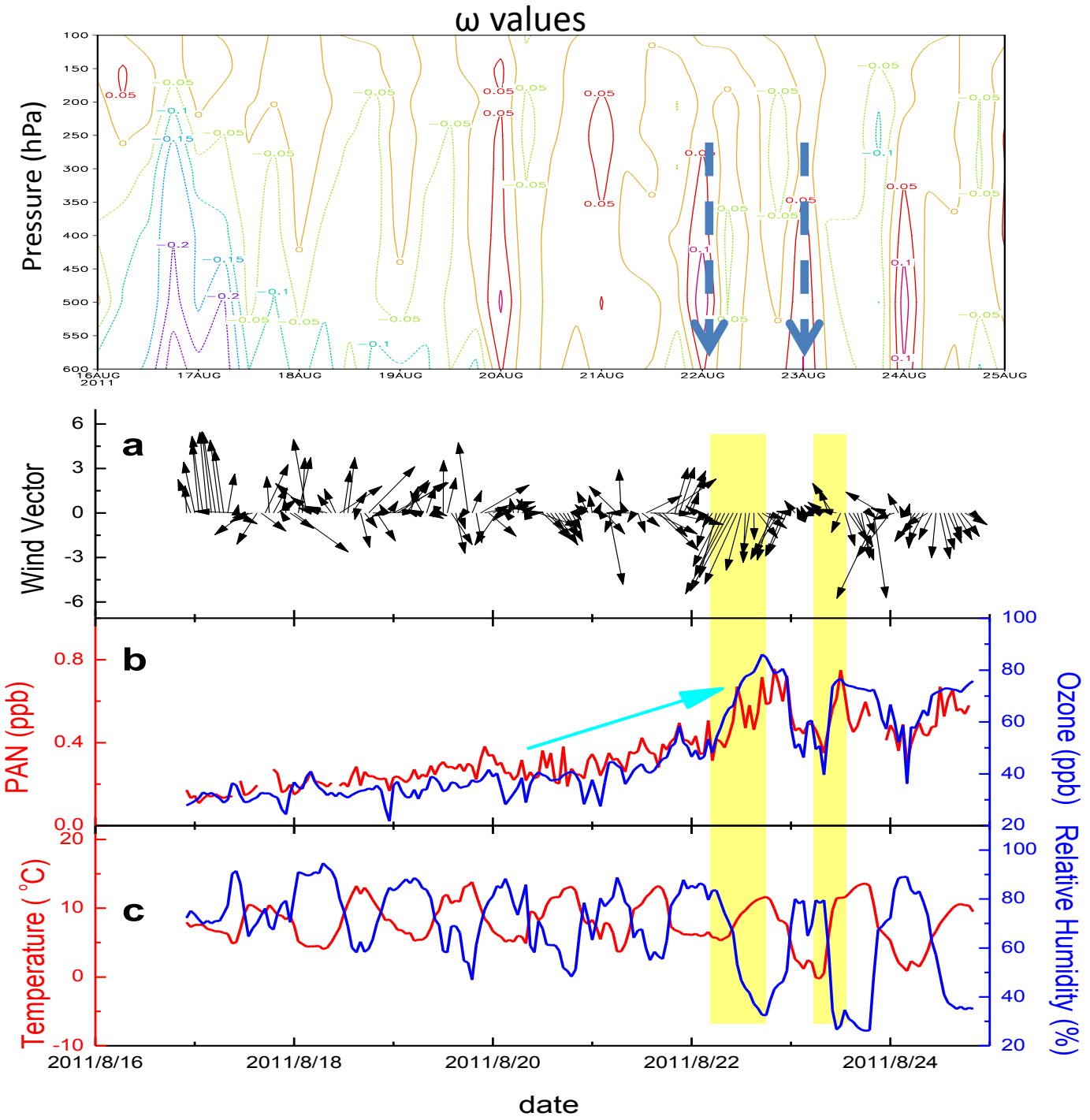
Ending at 500 m

Ending at 1500 m



➢**It is likely that the high PAN levels during 1-6 June 2012 were caused by long-range transport of air pollutants from North India.**

Rapid downward transport enhances the levels of O3 and PAN



Summary

- First simultaneous measurements of O_3 and PAN were made at Nam Co during the pre-monsoon and monsoon periods. The observed levels of O_3 and PAN varied in the range of 27.9-96.4 ppb and 0.11-0.99 ppb, respectively.
- Rapid enhancement of both oxidants was observed in early morning, which was probably caused by downward mixing of air aloft the nocturnal boundary layer.
- High PAN and O_3 episodes were related to long-range transport of air masses from North India or to rapid descending air from the middle/upper troposphere.
- The long-range transport of pollutants may exert impact on tropospheric photochemistry over the TP. Its significance needs to be assessed.

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Thank you!