Suppression of summer ozone formation under high aerosol conditions

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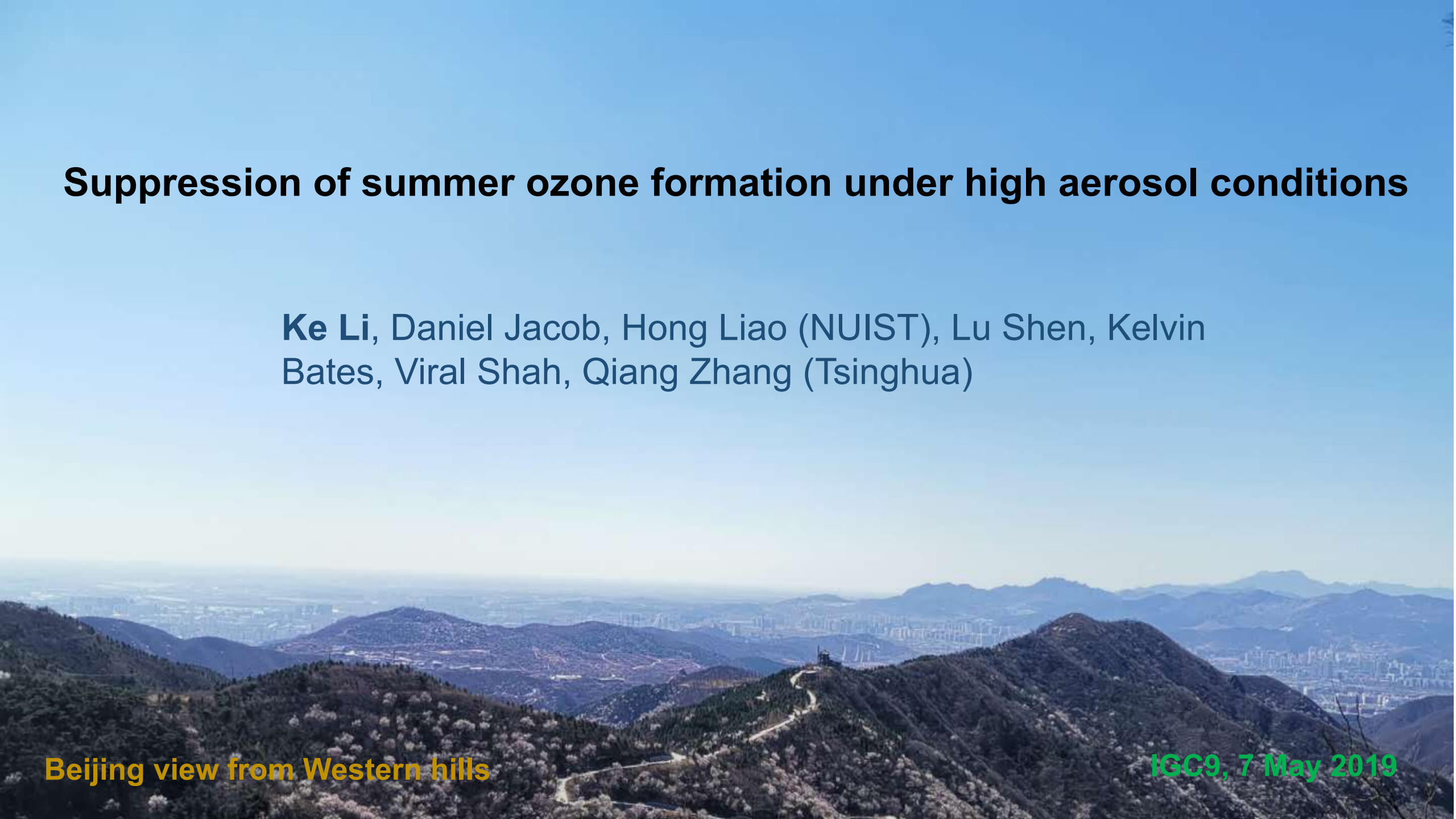
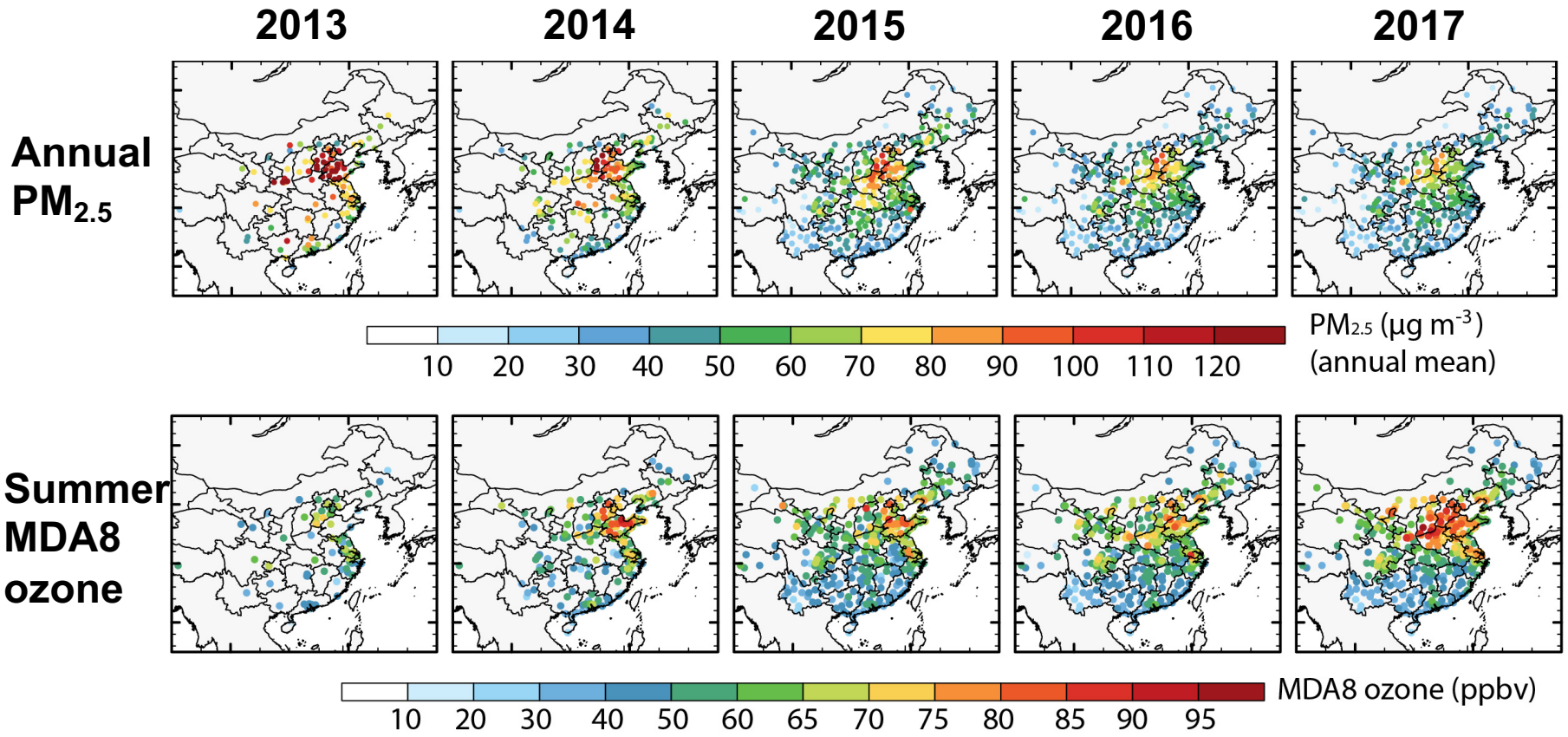
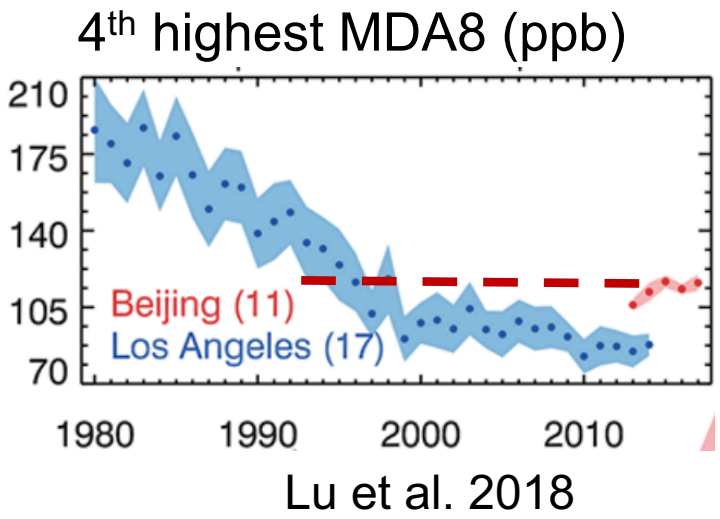


Beijing view from Western hills

IGC9, 7 May 2019

Serious and worsening ozone pollution in China



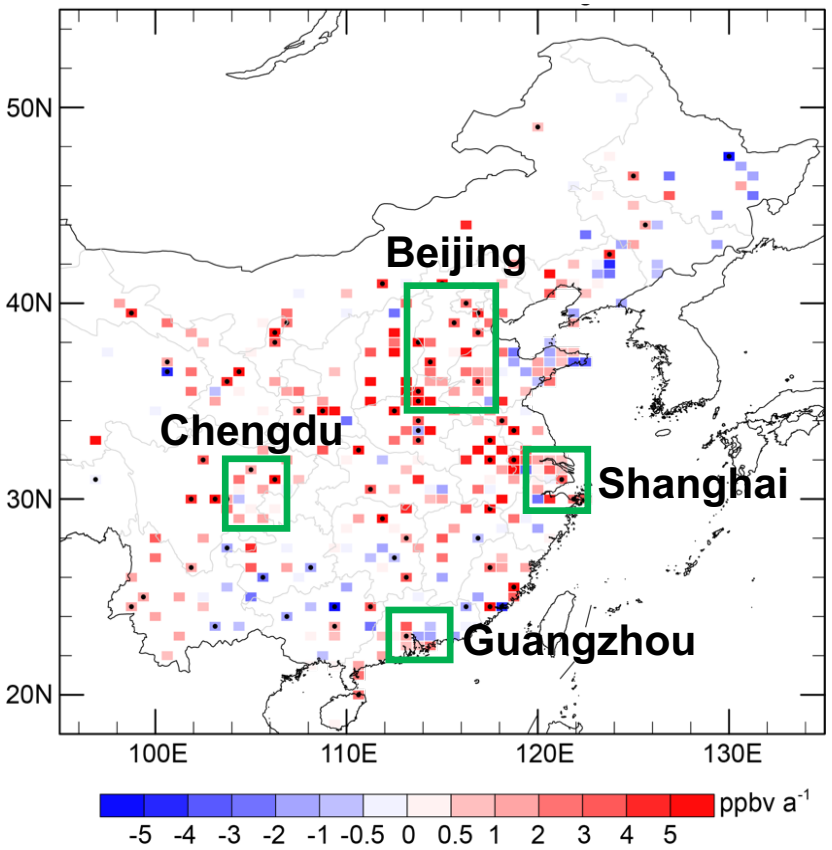


Lu et al. 2018

Hourly data are from the surface network by China Ministry of Ecology and Environment

Spatial distribution of recent ozone trend

Trend of summer MDA8 ozone during 2013-2017

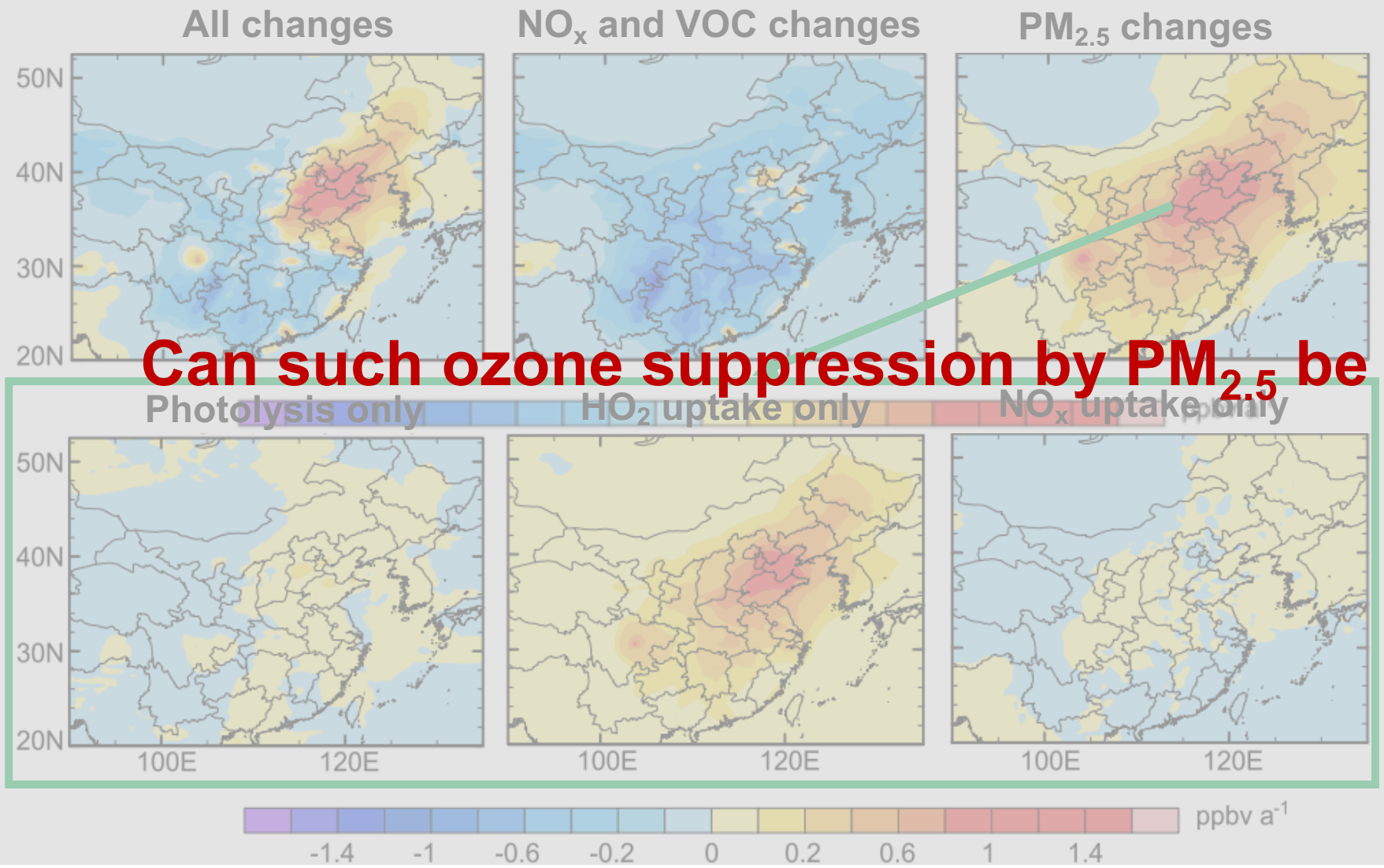


Increasing trend is 1–3 ppb a^{-1} in these megacity clusters

Residual linear trend of summer MDA8 ozone for 2013–2017 after **removal of meteorology** using a regression model.

Li et al. 2019

Anthropogenic drivers of 2013–2017 changes in summer MDA8 ozone



GEOS-Chem

NO_x: 20% ↓

VOC: —

} MEIC by Qiang Zhang's group

$PM_{2.5}$: 30-40% ↓

Can such ozone suppression by $PM_{2.5}$ be 'observed'?

NO_x uptake includes: uptake of N_2O_5, NO_2, NO_3

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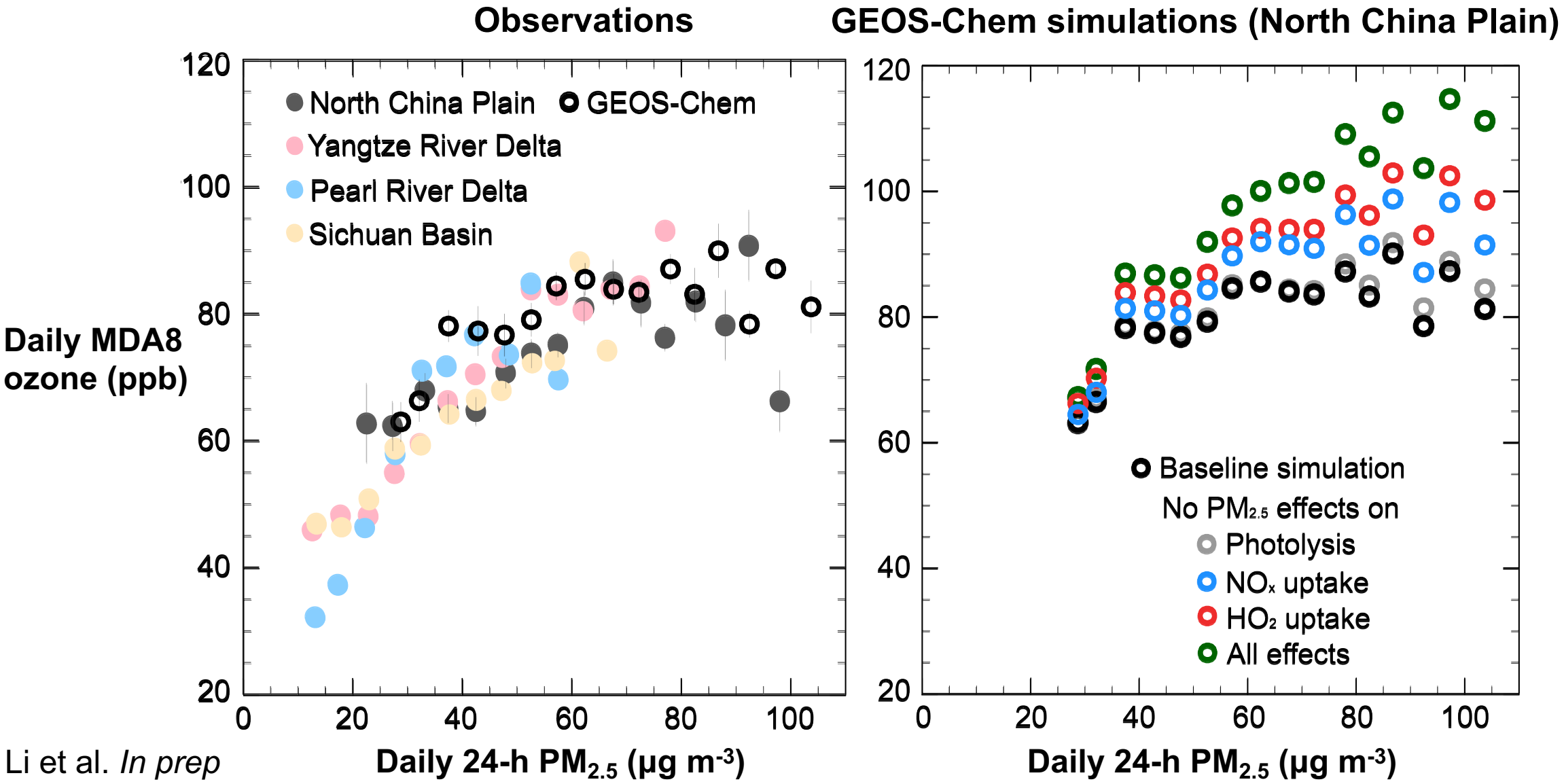
Ozone suppression under high $PM_{2.5}$ conditions



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$PM_{2.5}$ chemistry drives ozone production more VOC-limited

NO_x: N_2O_5, NO_2, NO_3
Updated coefficients in GC simulation on the basis of recent work by Viral Shah's Monday talk and Jaeglé et al. (2018) from the WINTER Campaign.

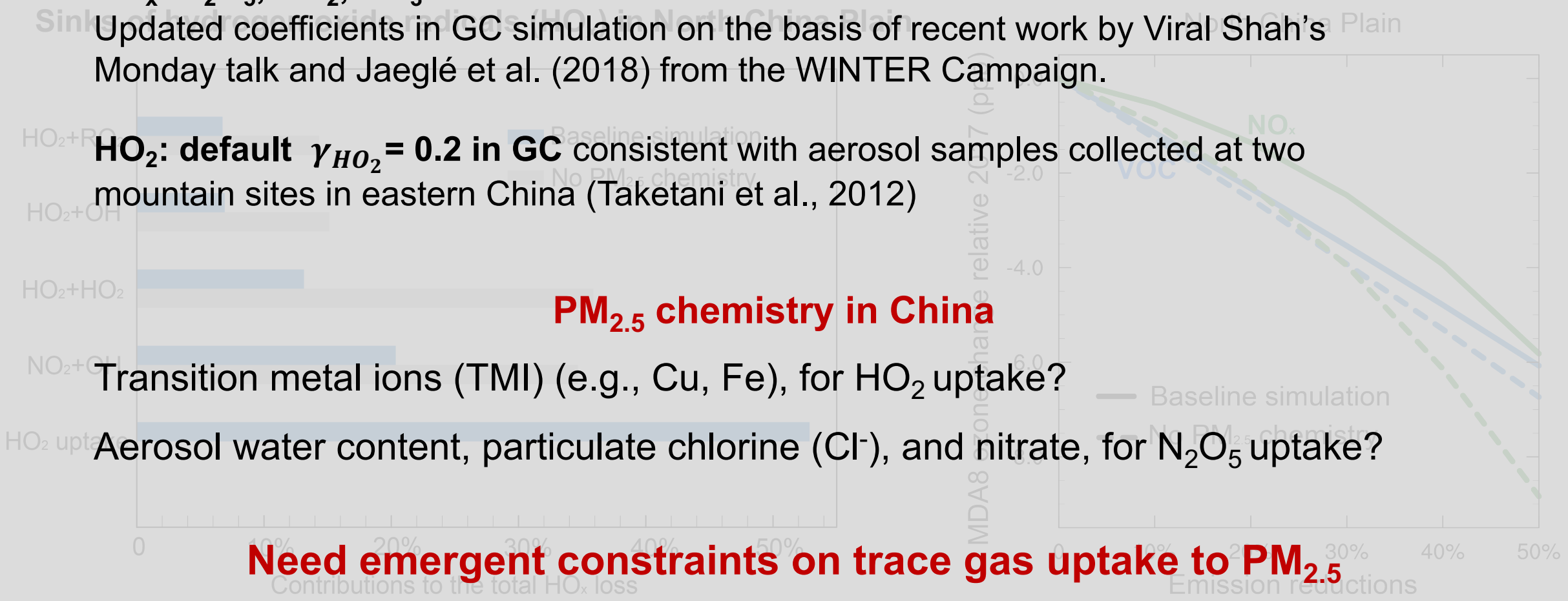
HO_2: default γ_{HO_2} = 0.2 in GC consistent with aerosol samples collected at two mountain sites in eastern China (Taketani et al., 2012)

$PM_{2.5}$ chemistry in China

Transition metal ions (TMI) (e.g., Cu, Fe), for HO_2 uptake?

Aerosol water content, particulate chlorine (Cl^-), and nitrate, for N_2O_5 uptake?

Need emergent constraints on trace gas uptake to $PM_{2.5}$



Li et al. *In prep*

Take home messages

- The increasing trend of 1–3 ppb a^{-1} cannot be simply explained by changes in NO_x/VOC, particularly in North China Plain, where the most important cause appears to be the decrease in $PM_{2.5.}$
- Observations show ozone production is strongly suppressed under high $PM_{2.5}$ conditions through $PM_{2.5}$ chemistry, involving reactive uptake of both HO_x and NO_x radicals.
- $PM_{2.5}$ chemistry tends to make ozone production more VOC-limited.

Acknowledgment:


Joint Laboratory for Air Quality and Climate (JLAQC) between Harvard University and Nanjing University for Information Science & Technology (NUIST)