Impact of Monsoon on the Atmospheric Composition

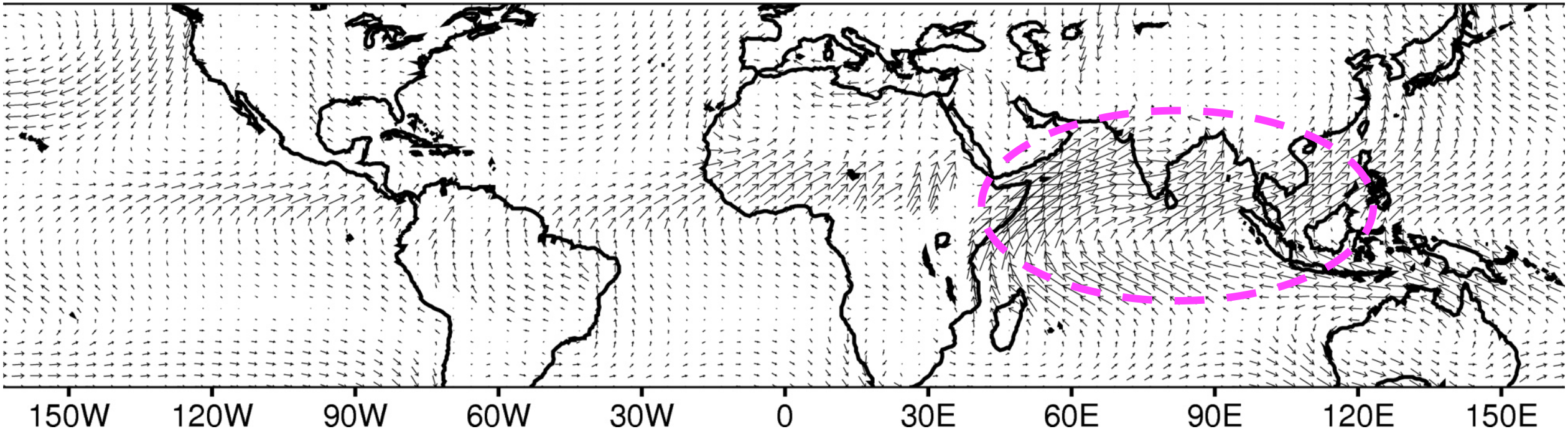
Narendra Ojha
Space & Atmospheric Sciences Division
Physical Research Laboratory (PRL),
Ahmedabad, India

Email: ojha.esm@gmail.com;
ojha@prl.res.in

प्लेटिनम जयंती
1947 2022
PLATINUM JUBILEE

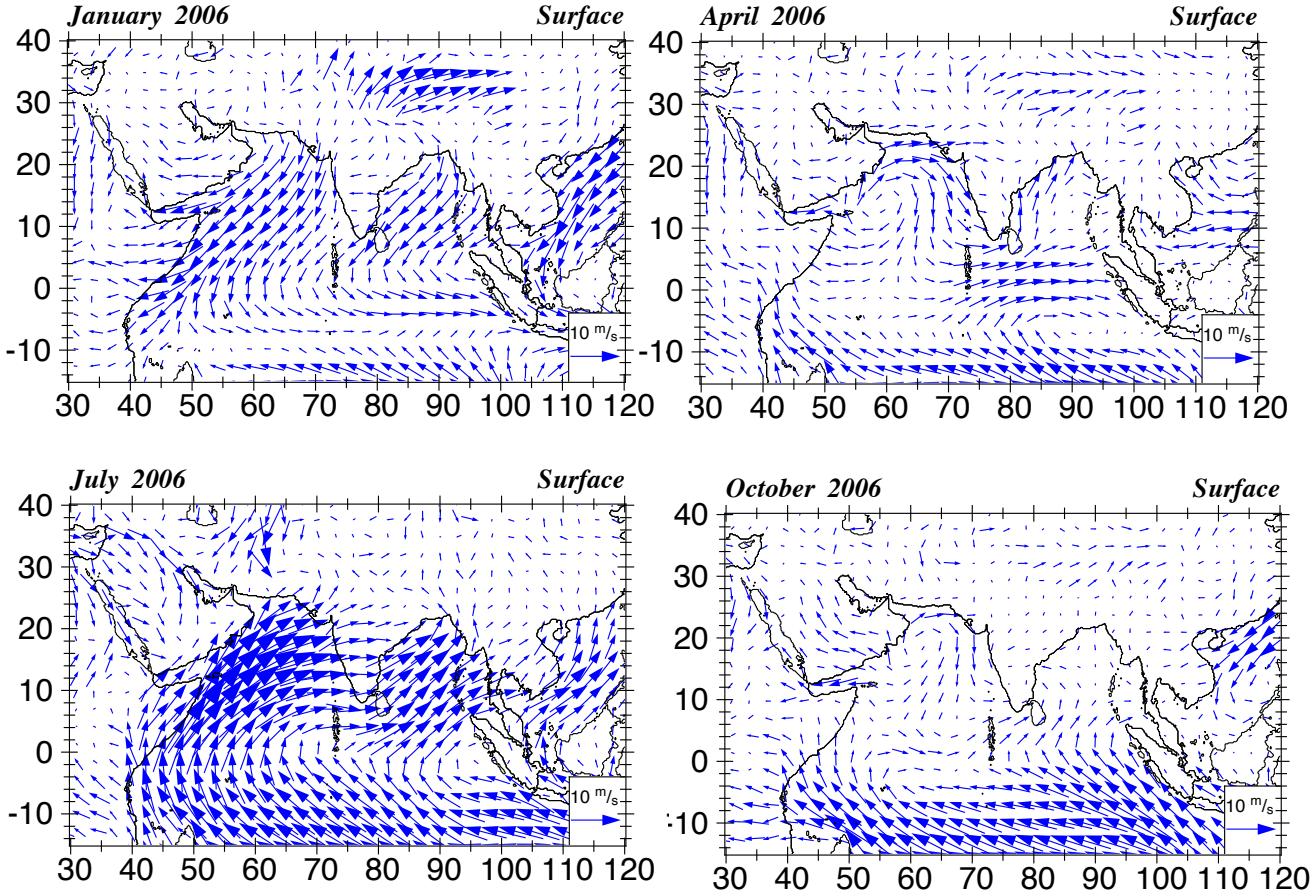
Global Monsoon Systems

Seasonal change in lower tropospheric wind @925hPa [JJA – DJF]



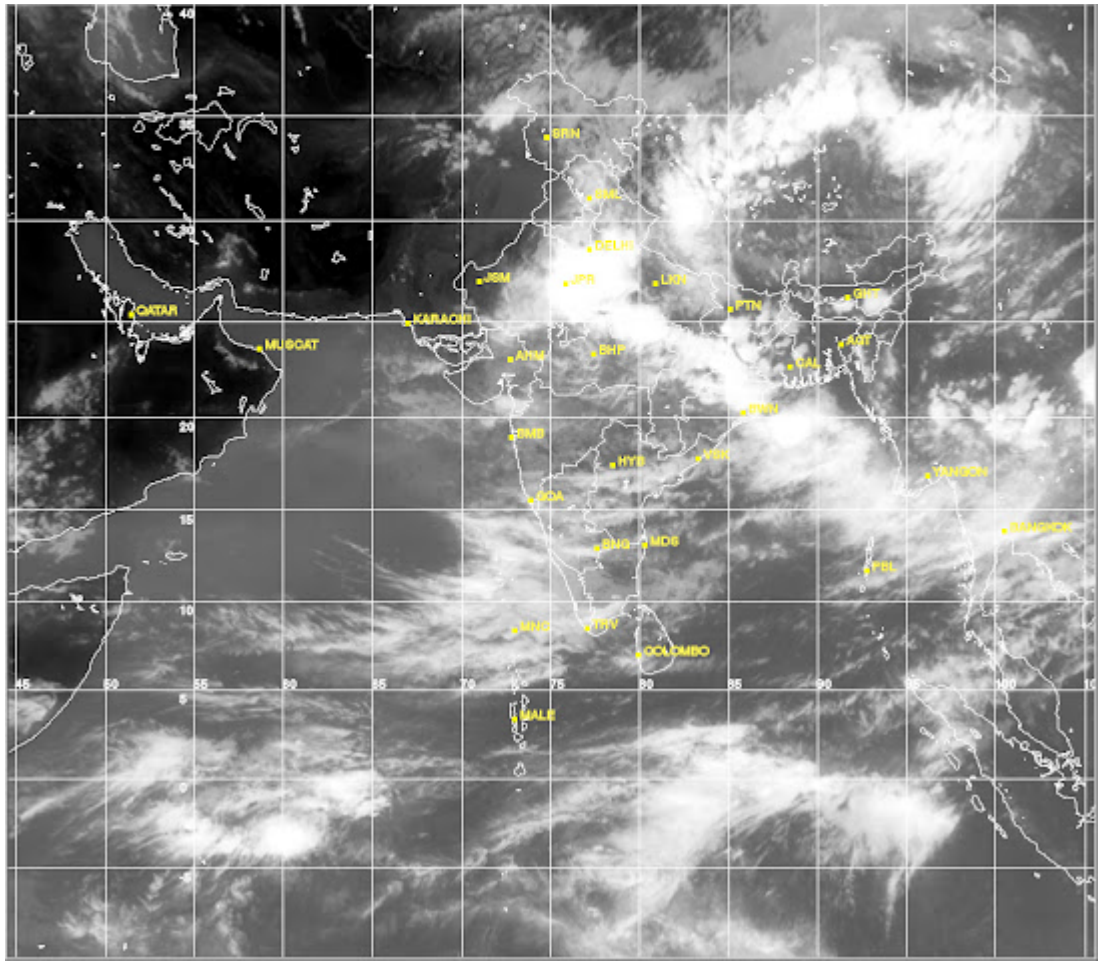
[WCRP; Data from ECMWF; Figure provided by Dr. Andy Turner]

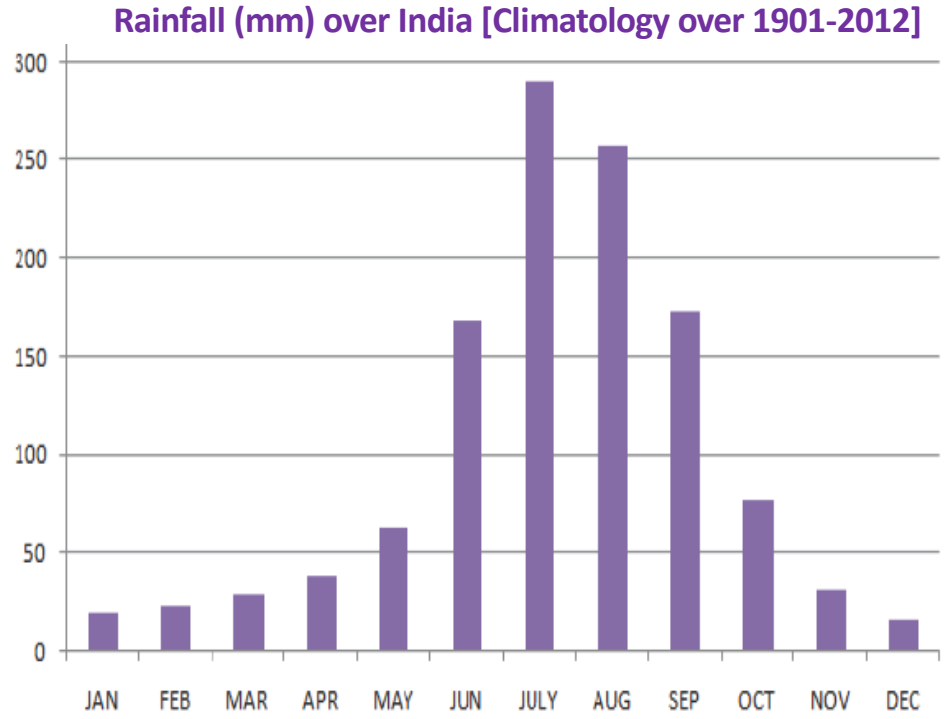
Monsoon over South Asia: Winds



Lawrence and Lelieveld, Atmospheric Chemistry and Physics, 2010

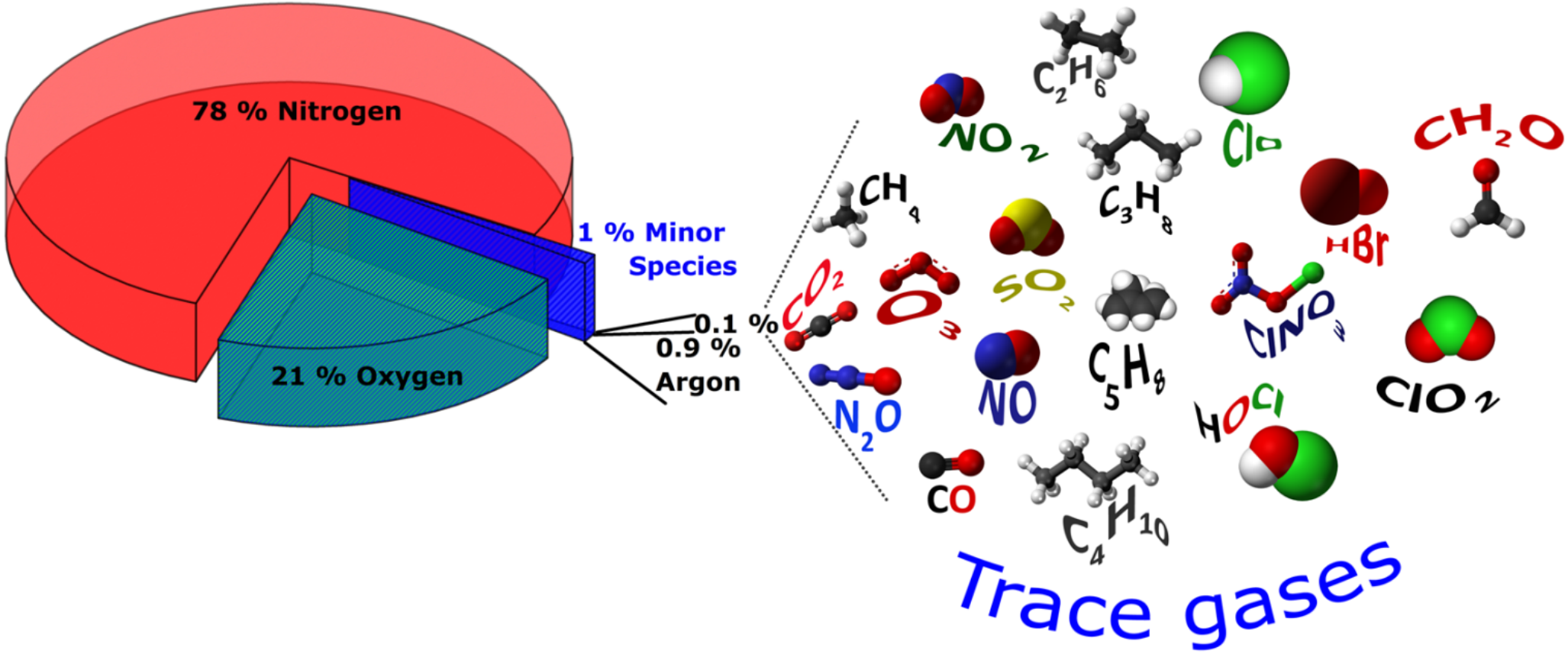
Clouds and Rain





Monsoon changes the dynamics (horizontal wind; convection); leads to widespread thick clouds and heavy rainfall

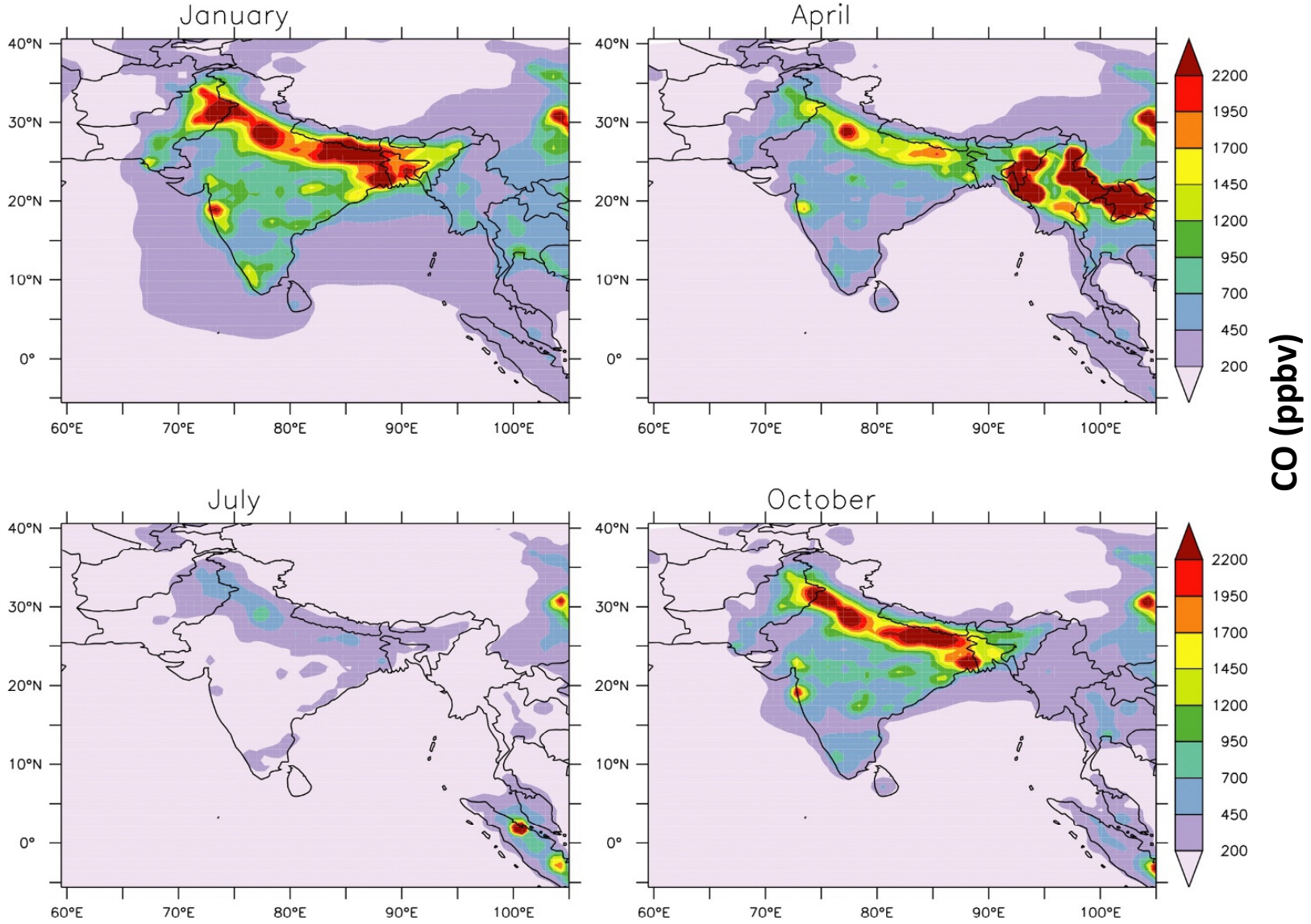
Atmospheric Composition



O_3 is **Not** directly emitted but is formed through VOCs and NOx in presence of sunlight

OH radical – detergent of atmosphere

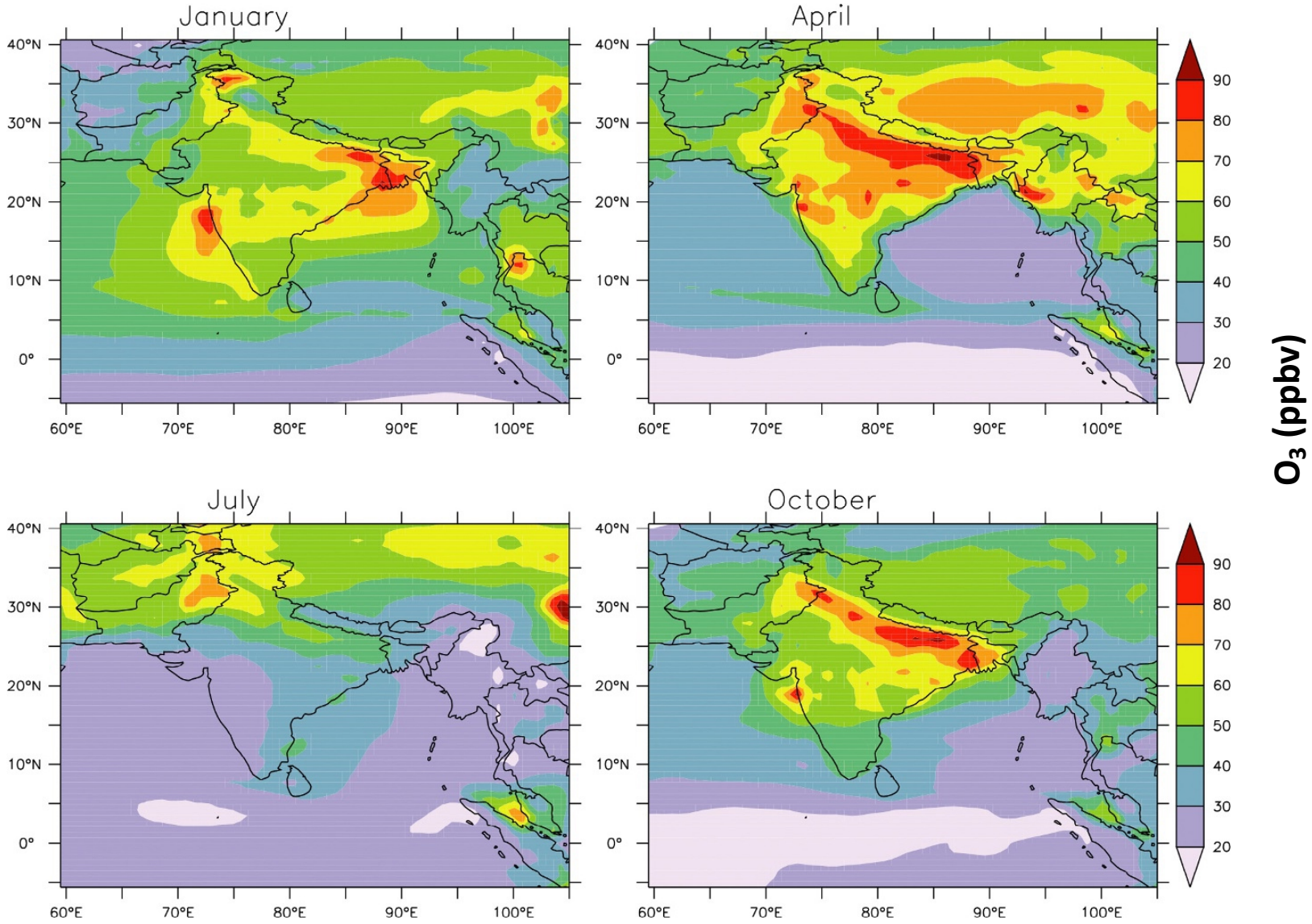
Impact near the surface



Transport of clean Oceanic air dramatically clears the near surface pollution across South Asia

Ojha et al., in Book – "Asian Atmospheric Pollution", 2022

Impact near the surface

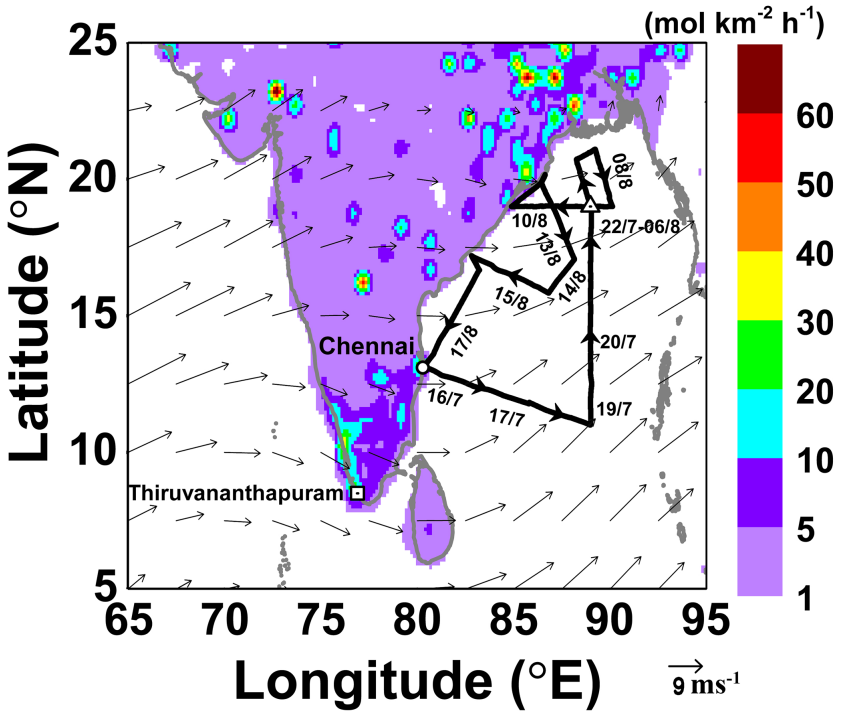


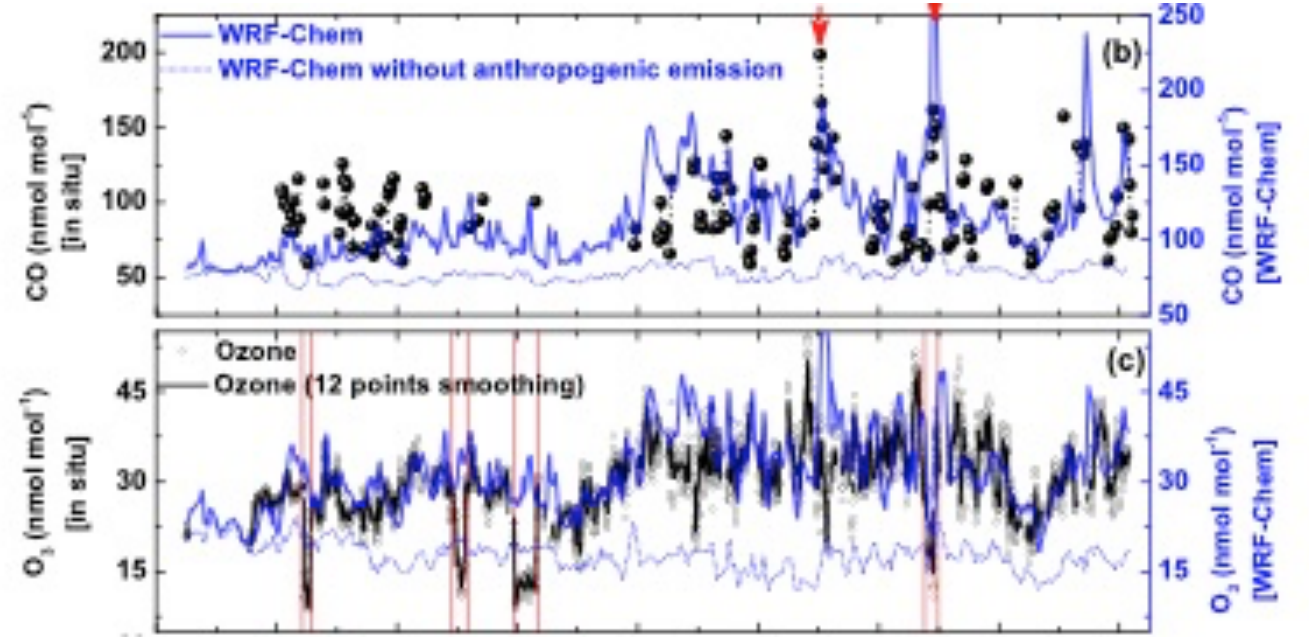
Transport of clean Oceanic air

Cloudy and rainy conditions suppress production of ozone

Ojha et al., in Book – "Asian Atmospheric Pollution", 2022

Impact near the surface

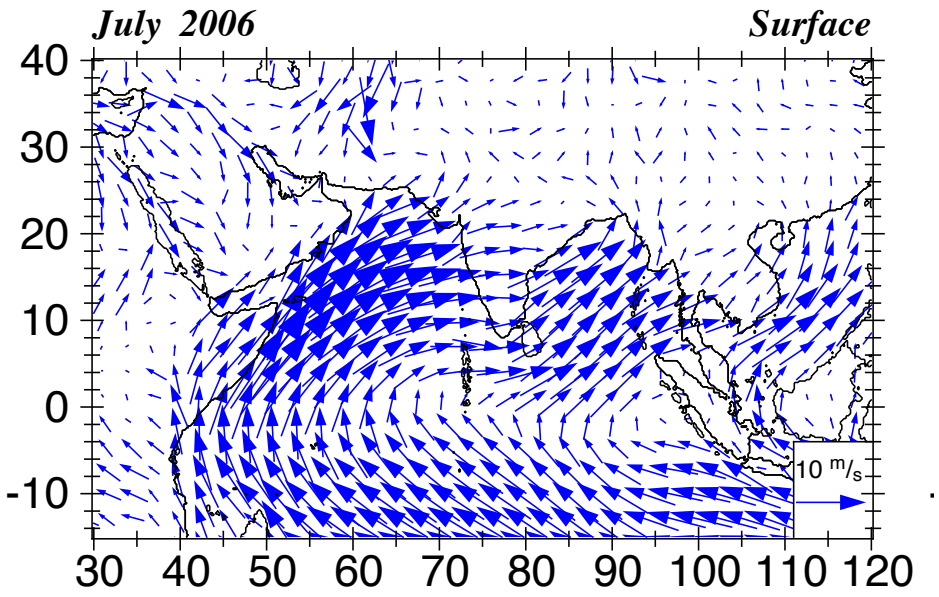




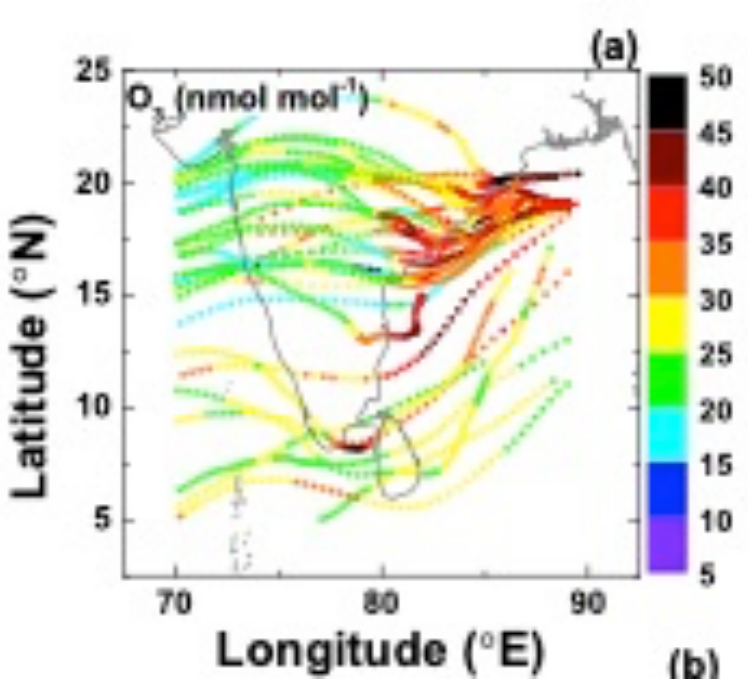
Girach, Ojha et al., Atmospheric Chemistry and Physics, 2017

While ozone is drastically reduced across India, some enhancements were found in the outflow towards the Bay of Bengal

Impact near the surface (Bay of Bengal)



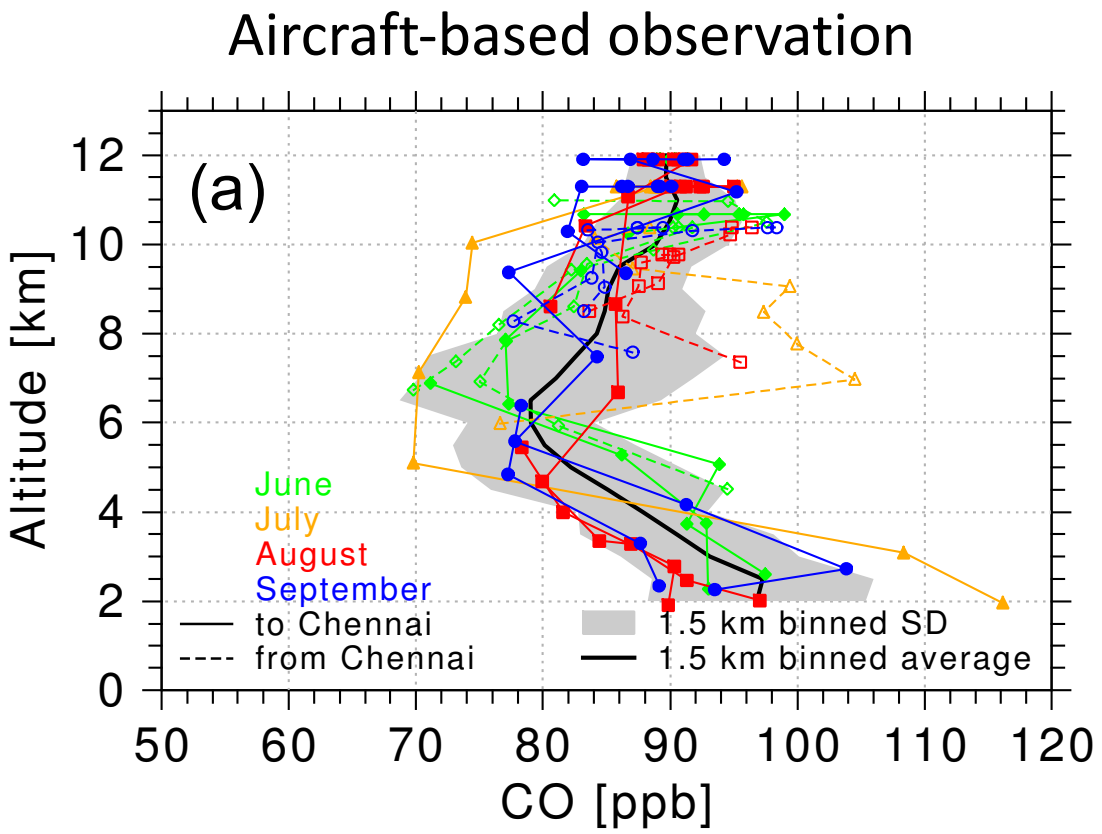
Lawrence and Lelieveld, Atmospheric Chemistry and Physics, 2010



Girach, Ojha et al., Atmospheric Chemistry and Physics, 2017

Photochemical ozone production in the outflow favoured by regional emissions and wind patterns

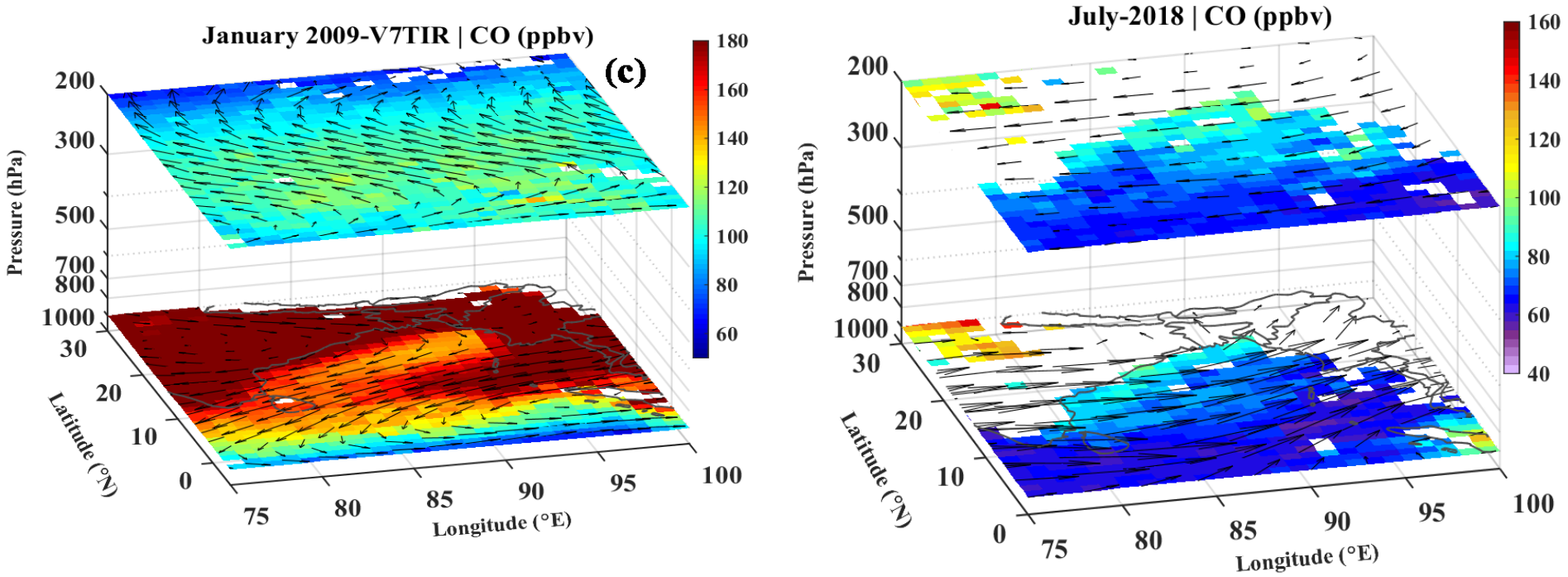
Impact on vertical structure



Armin Rauthe-Schöch et al., Atmos. Chem. Phys., 2016

Impact on vertical structure

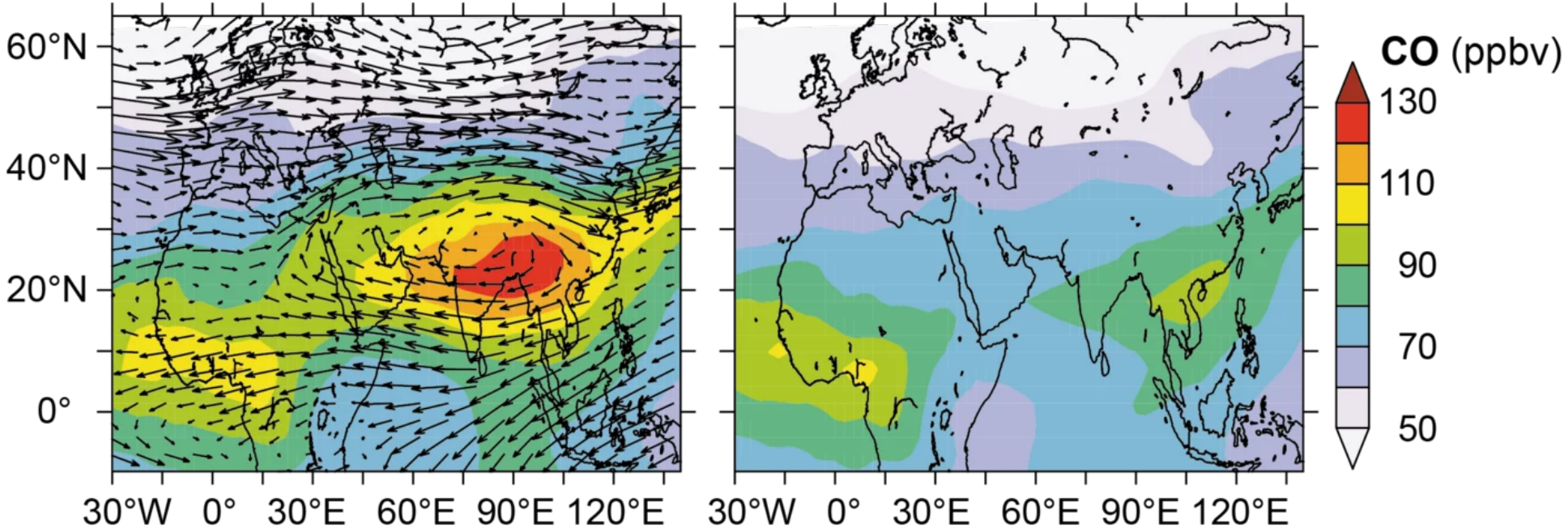
Satellite-based observation



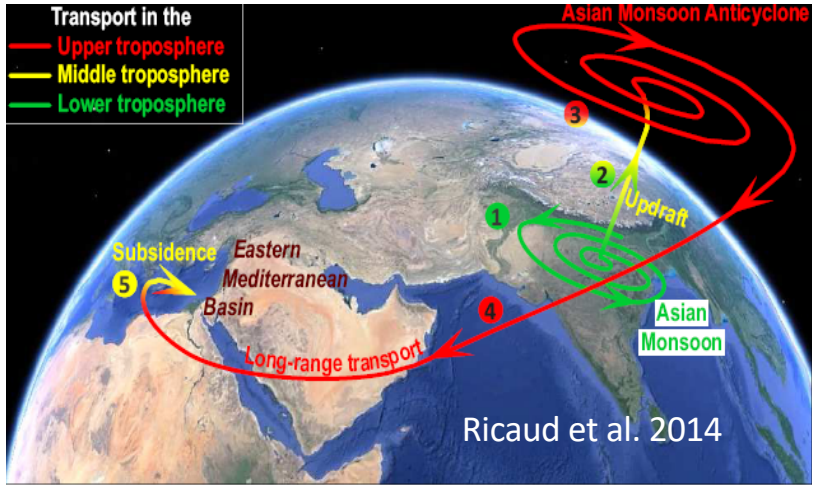
Comparable CO in lower and upper troposphere in Monsoon

Girach et al., 2020; Atmospheric Environment

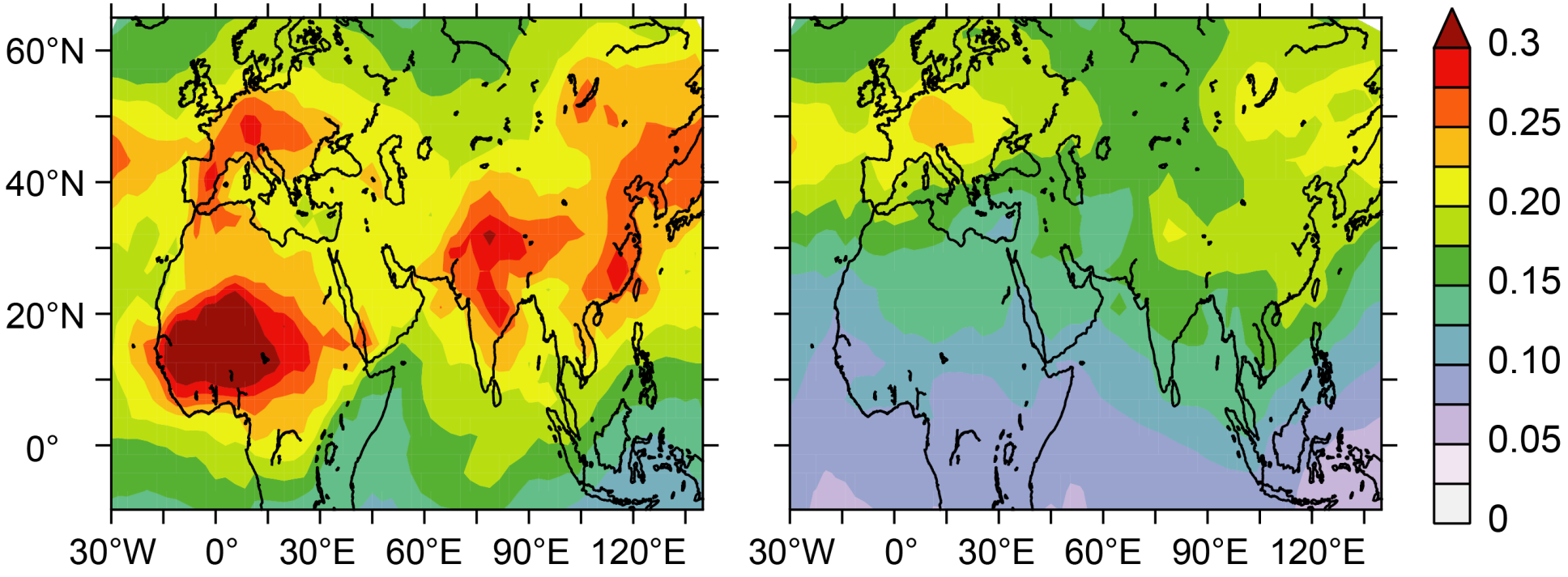
Asian monsoon anticyclone



Lelieveld et al., Science, 2018



Effect of lightning NOx on OH



With LNOx

without LNOx

Lelieveld et al., Science, 2018

Lightning enhances atmosphere's self-cleaning capacity

Summary

- Near surface: Inflow of oceanic air + suppressed photochemistry in cloudy rainy conditions; suppressed biomass-burning
- Convective uplifting of regional pollution; global impacts through anticyclone
- More water vapor and OH in upper troposphere (+ recycling through lightning NOx)