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# Atmospheric Chemistry: A revolution helping people mitigate risks of air pollution

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National Center for Atmospheric Research

# Atmospheric Chemistry: A Revolution

## Societal Issues

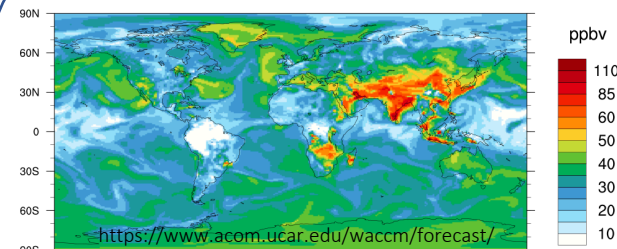


## Atmospheric Chemistry Research

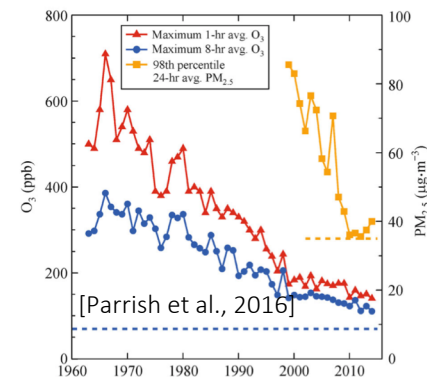


## Solutions

Tomorrow's surface  $O_3$  forecast (09 Z)



Long-term reduction in air pollution



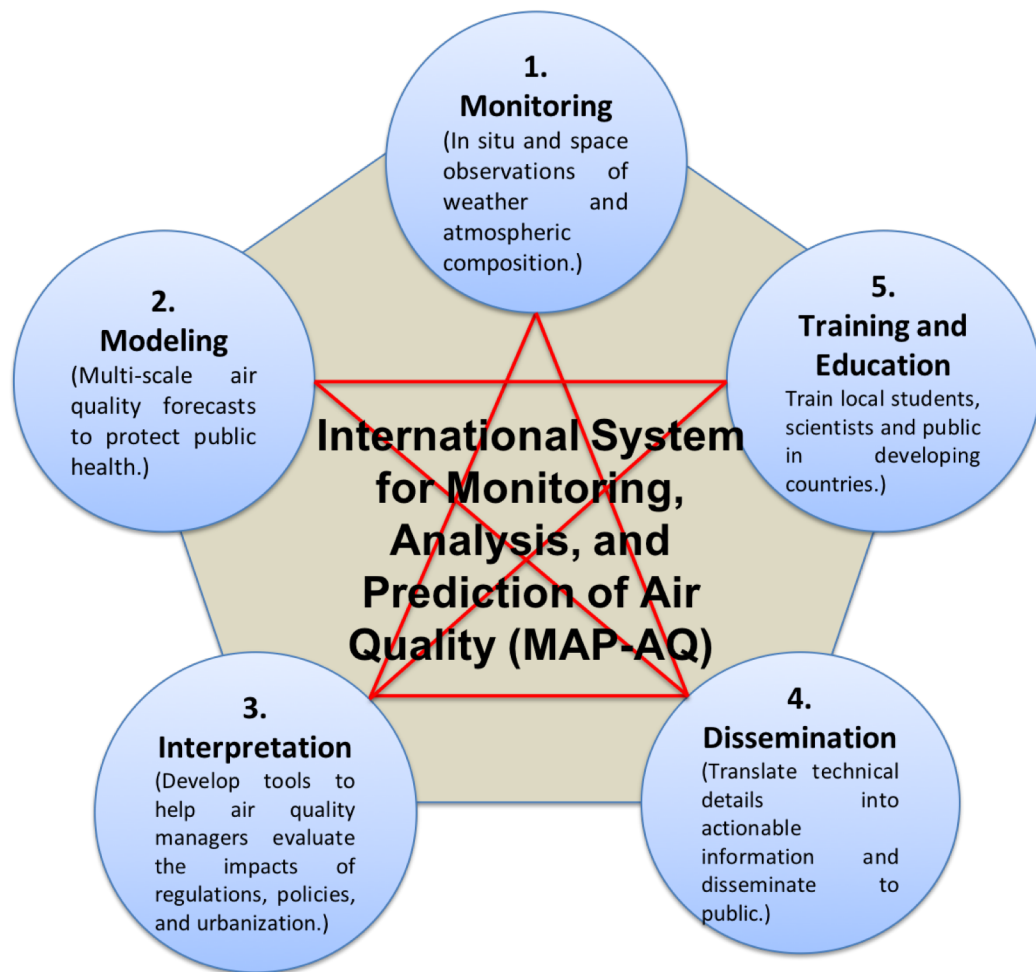
- Air quality alerts help to decrease emergency department (ED) visits by 25% in Canada [Chen et al., 2018]
- Emission regulations in Atlanta avoided 50,000 ED visits in the last 15 years [Russell et al., 2018].

# Air Pollution Continues to be a Global Threat



- 7 million premature deaths related to air pollution [WHO, 2018].
- US\$5 trillion in economic loss related to air pollution [World Bank, 2015].
- 79-121 million tones of lost crop produces globally [Avnery et al., 2011].

# Five Steps to Improve Air Quality Forecasts



<https://www2.acom.ucar.edu/map-aq>

Please stop by:

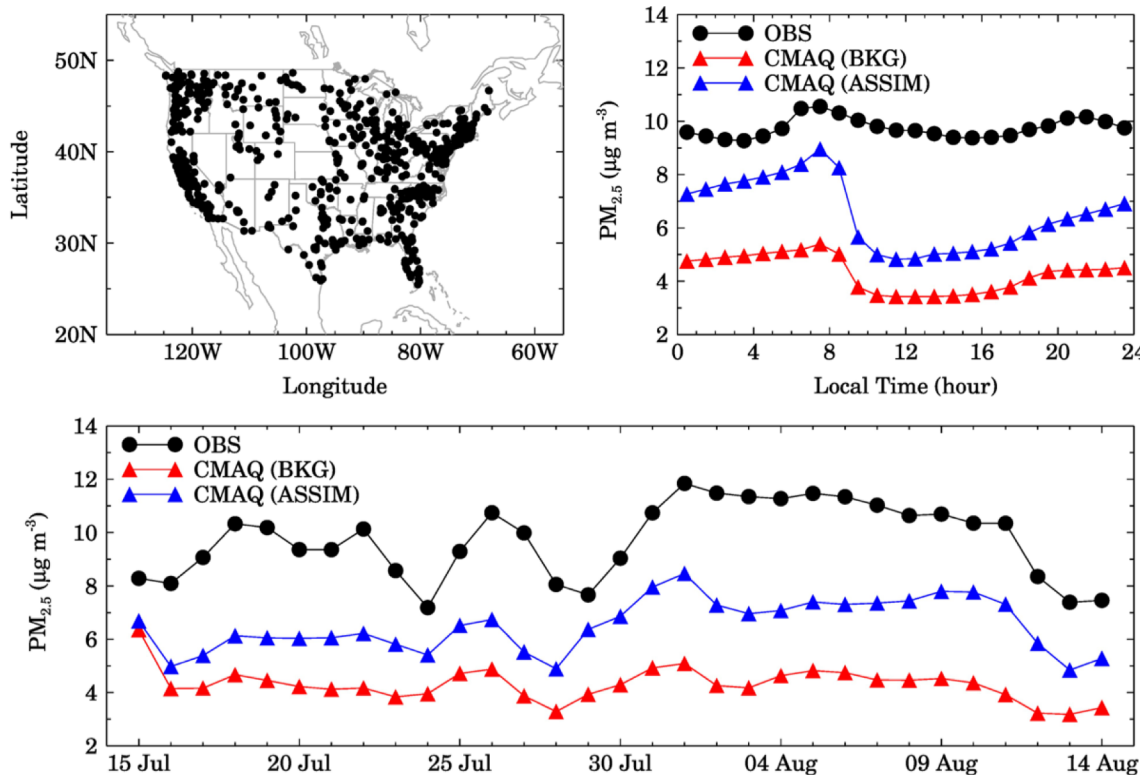
- MAP-AQ Poster
- Side-Meeting (Wednesday, 26 Sep 2018, 7:30-8:30PM, Room 54)

[Kumar et al., Nature, 2018]



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# Improving Air Quality Forecasts over the US



[Kumar et al., under review, JGR, 2018]

- The assimilation of MODIS AOD in Community Multiscale Air Quality (CMAQ) model improves the correlation coefficient between the model and observed  $PM_{2.5}$  by ~67% and reduces the mean bias by ~38% over the CONUS.



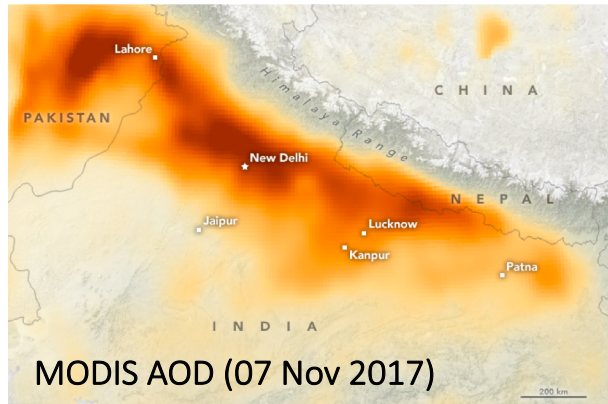
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# Forecasting extreme air pollution events in New Delhi

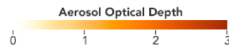
## Delhi doctors declare pollution emergency as smog chokes city

Levels of airborne pollutants are off the scale in parts of India's capital with effects likened to smoking 50 cigarettes a day

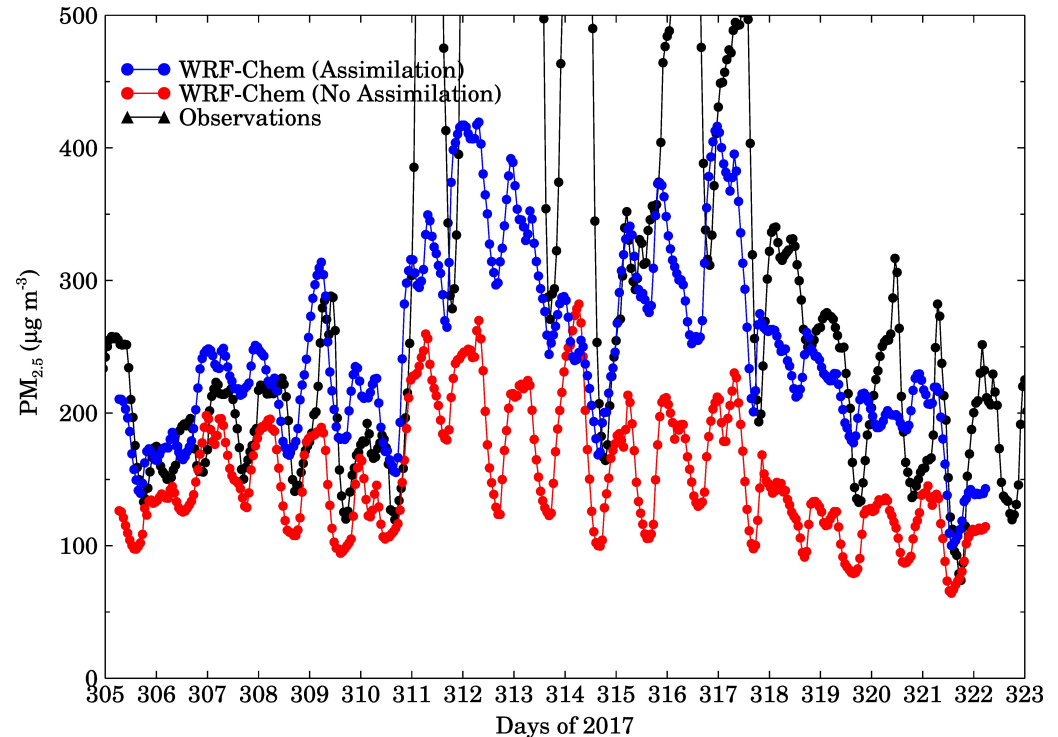
The Guardian (07 Nov 2017)



MODIS AOD (07 Nov 2017)

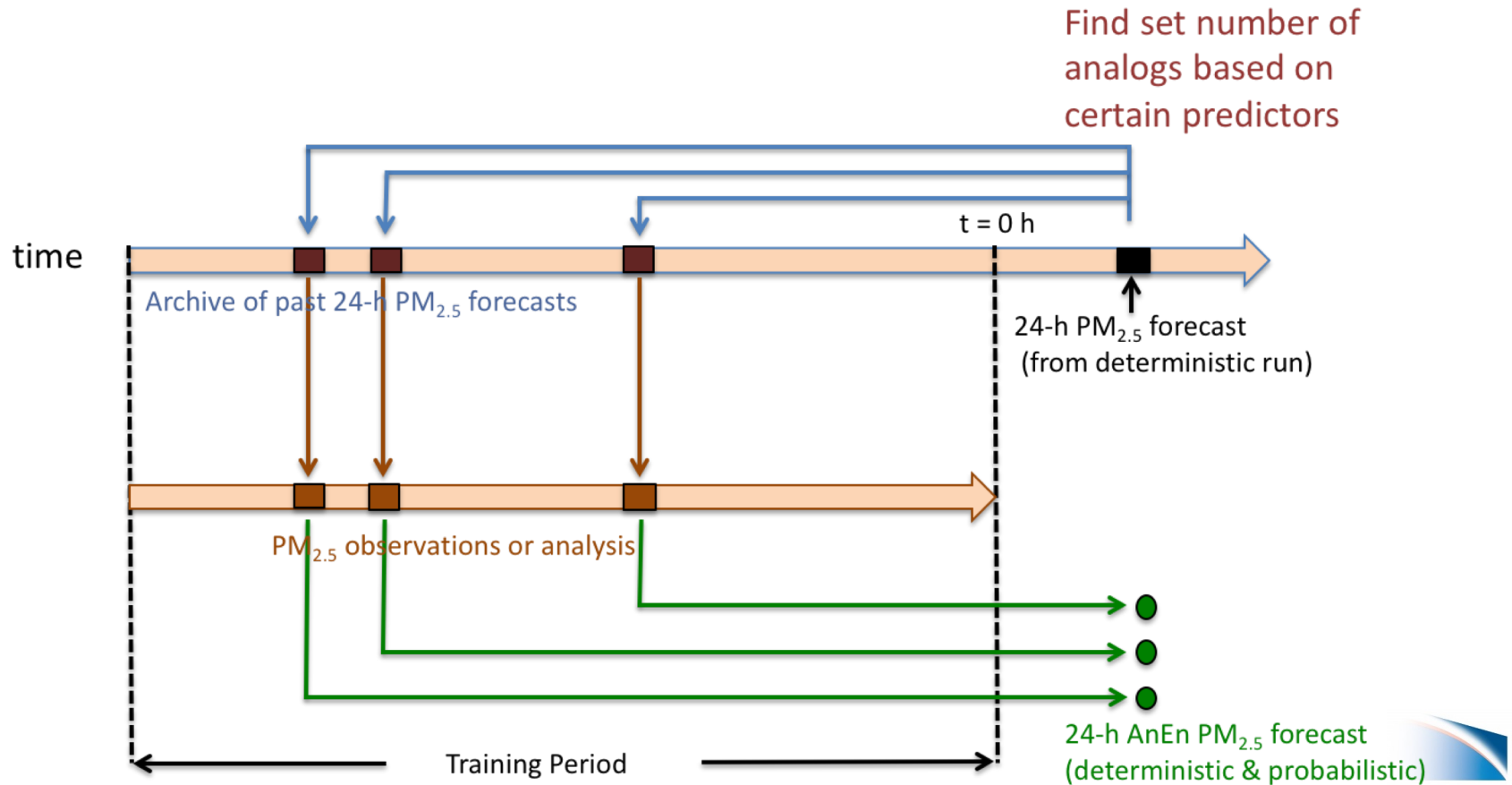


## WRF-Chem forecasts for New Delhi (01-20 Nov 2017)



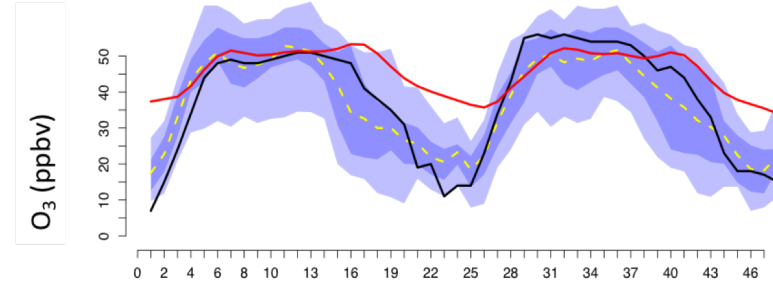
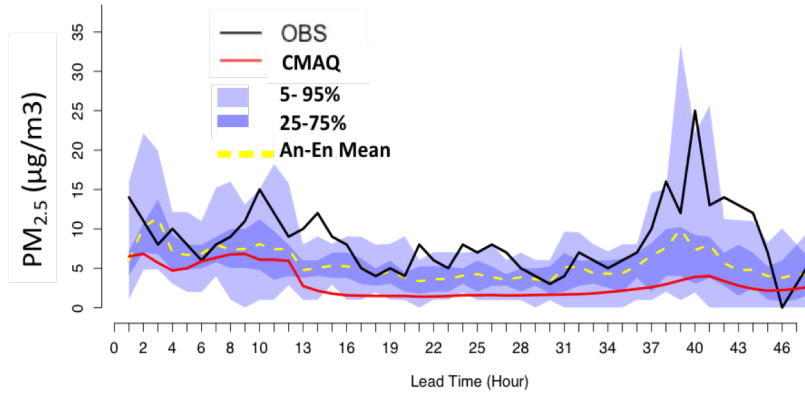
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# Post-processing: Further Improving AQ forecast

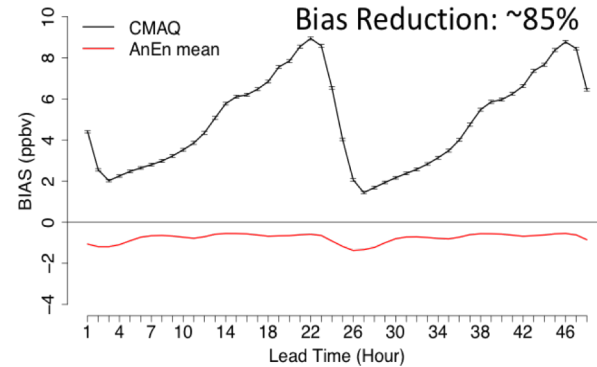
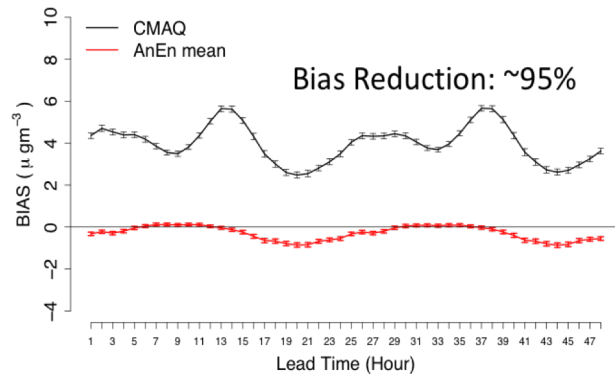


[Adapted from Delle Monache et al., 2013]

# Quantifying uncertainties in AQ forecasts



AnEn generates forecast quantiles that provide uncertainty quantification

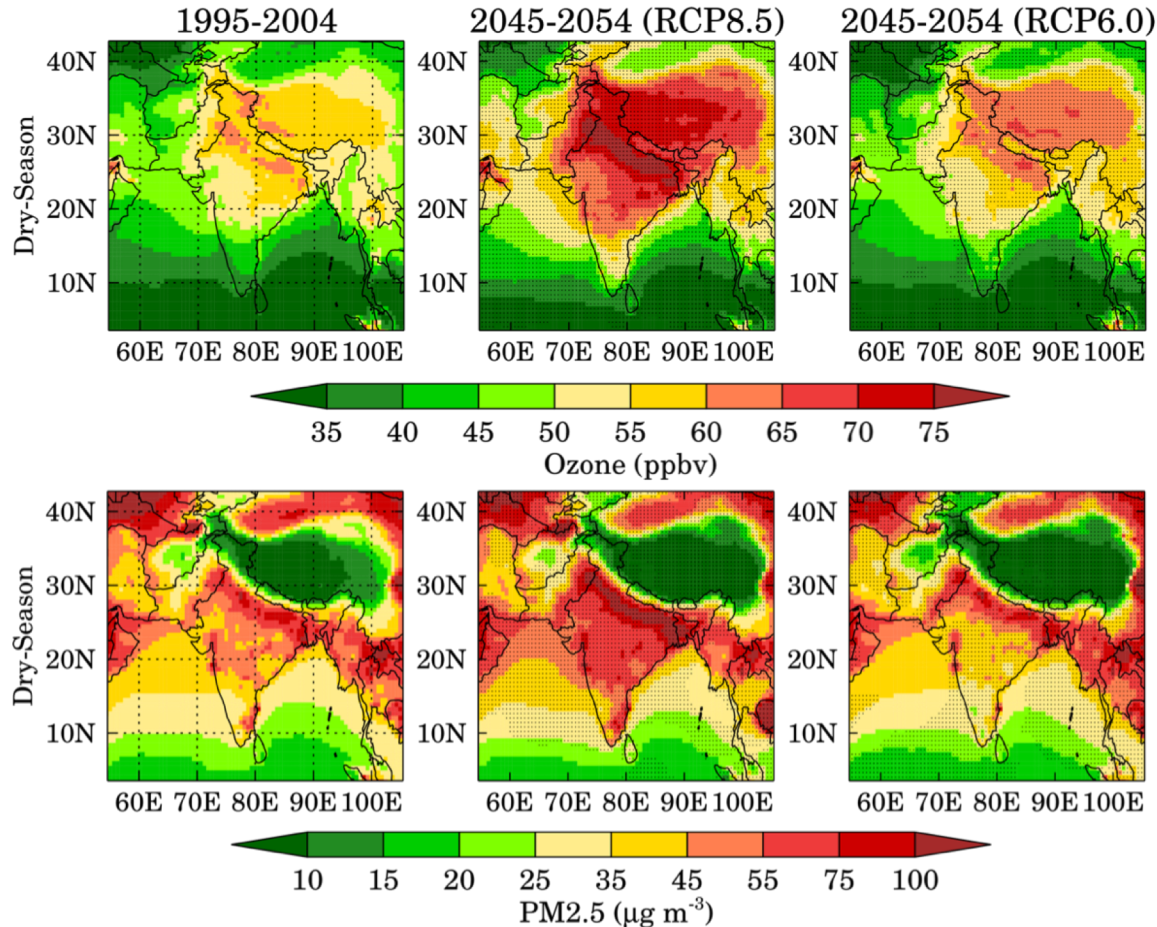


[Delle Monache et al., ACPD, 2018]



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# Projection of Future Air Quality in South Asia



South Asian air quality shows no signs of improvement by mid-century under emission scenarios projected by the Representative Concentration Pathways (RCPs)

[Kumar et al., JGR, 2018]

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# Summary

- Air pollution continues to be a global threat for human health and food security.
- Advances in atmospheric chemistry research has put us in a position to help the public mitigate risks of air pollution.
- Air quality forecasts must be extended to the developing nations with partnerships between the forecasters from the developed and developing nations.
- We must continue to improve our fundamental understanding of atmospheric chemistry (organic atmospheric chemistry, aerosol microphysics, emissions and deposition).

# Thank You!



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