Agenda

Ministry of Environment
National Institute of Environmental Research

<u>Science Team Telecon</u>

Fall AGU Abstracts

KORUS-AQ publications

Science Presentations

- Sarah Benish
- Isobel Simpson

Abstract	Title	Presenter
A11F-0018	Carbon monoxide budget during KORUS-AQ, first joint assimilation of NUCAPS CrIS and MOPITT CO retrievals	Ben Gaubert
A13F-1337	Characteristics of In Situ Fine Fraction Aerosol Spectra from 300-700 nm Observed Around the Korean Peninsula During KORUS-OC	Carolyn Jordan
A14D-05	Secondary Organic Aerosol Production from Local Emissions Dominates OA Budget over Seoul, South Korea, during KORUS-AQ	Jason Schroder
A23M-1790	Sensitivity of Particulate Matter Concentrations in South Korea to East Asian Ammonia Emissions	Eunhye Kim
A23M-1819	New Particle Formation and Diurnal Variations in Number Concentration Downwind of Seoul, Korea	Jisoo Park
A31B-06	Characteristics and Sources of VOCs in the Seoul Region during KORUS-AQ	Isobel Simpson
A31B-07	Improving Bottom-up Emissions Information Based on Air Quality Measurement and Modeling Feedbacks – The KORUS Emissions Inventory	Jung-Hun Woo
A31F-01	Meteorology Influencing Springtime Air Quality and Pollution Transport in Korea	Dave Peterson
A31F-02	Issues with Understanding Atmospheric Oxidation and Ozone Production during KORUS-AQ	Bill Brune
A31F-03	Observational constraints on water vapor sensitivity of glyoxal to formaldehyde ratio (R_{GF})	Dongwook Kim
A31I-0072	Observational Data-Driven Surface Concentrations Derived from Aircraft Profiles and Satellite Total Columns	Kang Sun

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Abstract	Title	Presenter
A33F-04	Issues in air quality modeling for the KORUS-AQ campaign	Rokjin Park
A33I-2096	Improving the Quantification of Fossil Fuel Carbon Dioxide using Radiocarbon Measurements from the KORUS-AQ Field Campaign	Yonghoon Choi
A33I-2107	Short-term CO/CO2 Ratios and Modeled CO Tracers for Assessing Regional Transport Over the Seoul Megacity During the 2016 KORUS-AQ Field Campaign	Hannah Halliday
A33K-2140	Significant contribution of anthropogenic dust to fine aerosol mass during a Chinese haze event as measured by KORUS-AQ observations	Pablo Saide
A33K-2145	Evolution of Acrolein Peroxyacetyl Nitrate (APAN) in Petrochemical and Agricultural Fire Plumes	Yung Ro Lee
A33K-2156	Airborne Formaldehyde Measurements over the Petrochemical & Industrial Complexes on Korea's Northwest Coast During the KORUS-AQ Study: Estimation of Formaldehyde & Precursor Emission Fluxes and Potential Effects on Seoul's Air Quality	Alan Fried
A33K-2177	Assessing atmospheric CH2O abundance and its emission sources using the GEOS-5 model, satellite and aircraft observations	Qing Liang
A41E-08	The Impact of Geostationary Aerosol Observations on the GEOS Aerosol Forecasting System	Arlindo da Silva
A42A-07	Gas-Particle Partitioning of Total Alkyl Nitrates During KORUS-AQ	Hannah Kenagy
A44A-01	Aerosol Property Retrieval and Applications in Air Quality Monitoring from geostationary orbit using GOCI and AHI	Jhoon Kim

Abstract	Title	Presenter
A51A-05	Pandora Ground Based measurements of Total Column NO_2 and HCHO Compared with Satellite and Aircraft Data	Jay Herman
A51A-07	Vertical Divergence of Reactive Trace Gases – Comparisons for three different photochemical environments	Saewung Kim
A51G-0011	The Dark Target aerosol algorithm applied to Himawari-8 Advanced Himawari Imager (AHI)	Shana Matoo
A51G-0013	Understanding different characteristics of multiple LEO and GEO satellite aerosol data over East Asia during 2016 KORUS-AQ campaign	Myungje Choi
A51L-0097	Analysis of AERONET Remote Sensing and LARGE In-Situ Measurements of Aerosol Properties During the KORUS-AQ Campaign with Focus on Pollution Transport Events and the Influence of Cloud/Fog and High RH	Tom Eck
A51L-0115	Towards a satellite - in situ hybrid estimate for organic aerosol abundance	Jin Liao
A52A-06	Tracking Fossil Fuel Emissions in East Asia by Combining Model Simulations, Satellite Observations, and Field Measurements of the CO-to-CO_2 Ratio	Wenfu Tang
A53A-06	A Global Survey of Submicron Aerosol Acidity (pH)	Ben Nault

KORUS-AQ

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Washington, D.C. | 10-14 Dec 2018

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NASA

Abstract	Title	Presenter
A53G-2064	Constraining NOx and NMVOC Emissions using OMPS during KORUS-AQ Campaign and Implications for Ozone Formation	Amir Souri
A53G-2065	Assessment of in-situ and remote sensing NO_2 observations during DISCOVER-AQ and KORUS-AQ field campaigns	Sungyeon Choi
A53G-2066	The pattern of HCHO and NO_2 columns in the downwind area of Seoul during KORUS-AQ campaign	Yeseul Cho
A54D-01	Atmospheric trace gas (NO_2 and ozone) dynamics over coastal waters near polluted urban regions	Maria Tzortziou
A54D-07	Using KORUS-OC Observations for a Feasibility Study on Using Satellite- & Ground-based Data for Offshore Air Quality Monitoring	Deb Kollonige

Publications

Going forward, here are a few requirements that will help us to keep track of science team progress and ensure consistency among the published findings:

1) Anyone in the draft stage of manuscript writing should email their title and full author list to Jim Crawford. We will keep the list updated and shared at each monthly webex.
2) Authors are highly encouraged to present a summary of their analysis and findings during a monthly webex before submitting the paper.
3) Authors should also identify the target journal for their paper. We have not yet decided on whether a special issue will be commissioned, but this information may help us to decide whether to have a special issue or allow our papers to span many journals.
4) Double check to be sure that the most recent data is being used in your analysis (e.g., LARGE-APS size distribution data for DC-8 was updated today).
5) KORUS-AQ data doi's will become available in the near future. Please these doi's to reference the data used in your paper.
6) Intercomparison analyses of measurements are underway and will be presented in a future webex. If you are using variables measured by multiple groups, please be aware of and prepare to cite intercomparison results.

Publications (1)

Authors	Title	Journal	Status
Hwajin Kim, Qi Zhang, Jongbae Heo	Influence of Intense secondary aerosol formation and long range transport on aerosol chemistry and properties in the Seoul Metropolitan Area during spring time: Results from KORUS-AQ	Atmospheric Chemistry and Physics	Published
Najin Kim, Minsu Park, Seong Soo Yum, Jong Sung Park, Hye Jung Shin, Joon Young Ahn	Impact of urban aerosol properties on cloud condensation nuclei (CCN) activity during the KORUS-AQ field campaign	Atmospheric Environment	Under Review
W. Hu, D.A. Day, P. Campuzano-Jost, B.A. Nault, T. Park, T. Lee, P. Croteau, M.R. Canagaratna, J.T. Jayne, D.R. Worsnop, J.L. Jimenez	Evaluation of the new capture vaporizer for Aerosol Mass Spectrometers (AMS): Elemental composition and source apportionment of organic aerosols (OA).	ACS Earth Space Chemistry	Published
W. Hu, D.A. Day, P. Campuzano-Jost, B.A. Nault, T. Park, T. Lee, P. Croteau, M.R. Canagaratna, J.T. Jayne, D.R. Worsnop, J.L. Jimenez	Evaluation of the new capture vaporizer for Aerosol Mass Spectrometers: characterization of organic aerosol mass spectra	Aerosol Science and Technology	Published
Wenfu Tang, A. F. Arellano, J. P. DiGangi, Yonghoon Choi, G. S. Diskin, A. Agustí-Panareda, M. Parrington, S. Massart, B. Gaubert, Youngjae Lee, Dan-bee Kim, Jinsang Jung, Hong Jinkyu, Yugo Kanaya, Mindo Lee, A. M. Thompson, J. H. Flynn, and Jung-Hun Woo	Evaluating High-Resolution Forecasts of Atmospheric CO and CO2 from a Global Prediction System during KORUS-AQ Field Campaign	Atmospheric Chemistry and Physics	In prep
Wenfu Tang, L. K. Emmons, A. F. Arellano Jr., B. Gaubert, C. Knote, S. Tilmes, R. R. Buchholz, G. G. Pfister, D. R. Blake, N. J. Blake, J. P. DiGangi, Yonghoon Choi, G. S. Diskin, Jung-Hun Woo	Source Contribution to Carbon Monoxide during KORUS-AQ Using CAM-chem Tagged Tracers	Atmospheric Chemistry and Physics	In prep

Publications (2)

Authors	Title	Journal	Status
Eric Heim, et al.	Asian Dust Observed during KORUS-AQ Facilitates the Uptake and Incorporation of Soluble Pollutants during Transport to S. Korea; The Hwangsa Anthropogenic Model	TBD	In prep
Dan Goldberg, et al.	A high-resolution OMI NO2 product for Korea during KORUS-AQ and using it to derive NOx emissions in Seoul	TBD	In prep
Myungie Choi et al.	Assessment of aerosol optical properties from GOCI, MODIS, VIIRS, and MISR measurements over East Asia during 2016 KORUS-AQ campaign	TBD	In prep
Myungje Choi, Seoyoung Lee, et al.	Assessment of 3-D aerosol distribution for long-range transport and local emission using GOCI and ground, airborne, and satellite lidar measurement during 2016 KORUS-AQ	TBD	In prep
Heesung Chong, Seoyoung Lee, et al.	PCA-based trace gas retrievals from GeoTASO airborne measurements during KORUS-AQ	TBD	In prep
Heesung Chong, et al.	Surface NO2 volume mixing ratio estimated from total column observations of Pandora spectrometer during KORUS-AQ	TBD	In prep
Seoyoung Lee, Ja-Ho Koo, et al.	Regional transport effect to explain the aerosol concentration and variation in the Korean peninsula	TBD	In prep
Sujung Go, et al.	Imaginary part of refractive index derived from UV-MFRSR in Seoul, and implications for retrieving UV Aerosol Optical Properties for GEMS measurements	TBD	In prep
Hyungkwan Lim, et al.	Aerosol loading height retrieval from AHI using spatiotemporal variability during KORUS AQ	TBD	In prep

Publications (3)

Authors	Title	Journal	Status
Hyungkwan Lim, et al.	Intercomparison of aerosol optical depth data using AHI, GOCI and MI from Yonsei AErosol Retrieval (YAER) algorithm	TBD	In prep
Yeseul Cho, Ja-Ho Koo, et al.	Spatiotemporal properties of O3 and NO2 in the Seoul Metropolitan Area: comparison among total column, vertical profile, and surface patterns	TBD	In prep
Sang Seo Park, et al.	Temporal variation of total ozone without its variations at surface and stratosphere	TBD	In prep
Paul Romer, Ron Cohen, et al.	Constraints on aerosol nitrate photolysis as a potential source of HONO and NOx	TBD	In prep
W. Hu, P. Campuzano-Jost, D. A. Day, B. A. Nault, T. Park, T. Lee, A. Pajunoja, A. Virtanen, P. Croteau, M. R. Canagaratna, J. T. Jayne, D. R. Worsnop, J. L. Jimenez	Size distributions and ambient quantifications for organic aerosol (OA) in aerosol mass spectrometer (AMS) instruments with the new capture vaporizer (CV)	Journal of Aerosol Science	In prep
B. A. Nault, P. Campuzano-Jost, D. A. Day, J. C. Schroder, B. Anderson, A. Beyersdorf, D. R. Blake, W. H. Brune, J. D. Crounse, R. C. Cohen, Y. Choi, C. Corr, J. A. de Gouw, J. Dibb, J. P. DiGangi, G. Diskin, A. Fried, L. G. Huey, M. J. Kim, C. J. Knote, K. D. Lamb, T. Lee, D. D. Montzka, T. Park, A. E. Perring, S. E. Pusede, P. S. Romer, E. Scheuer, J. P. Schwarz, K. L. Thornhill, P. O. Wennberg, A. J. Weinheimer, A. Wisthaler, J. H. Woo, P. J. Wooldridge, and J. L. Jimenez	Secondary Organic Aerosol Production from Local Emissions Dominates the Organic Aerosol Budget over Seoul, South Korea, during KORUS-AQ	Atmospheric Chemistry and Physics	In Review

KORUS-AQ

Publications (4)

Ministry of Environment
National Institute of Environmental Research

NASA

Authors	Title	Journal	Status
B. A. Nault, P. Campuzano-Jost, D. A. Day, J. C. Schroder, D. R. Blake, M. R. Canagaratna, J. A. de Gouw, F. Flocke, A. Fried, J. B. Gilman, T. F. Hanisco, L. G. Huey, B. T. Jobson, W. C. Kuster, B. Lefer, J. Liao, D. D. Montzka, I. B. Pollack, J. Peischl, B. Rappenglueck, J. M. Roberts, T. B. Ryerson, J. Stutz, P. Weibring, A. J. Weinheimer, E. C. Wood, and J. L. Jimenez	Quantification of the Rapid Photochemical Secondary Organic Aerosol Production Observed across Megacities around the World	Nature Geosciences or PNAS	In prep
B. A. Nault, P. Campuzano-Jost, D.A. Day, W. W. Hu, B. B. Palm, J. C. Schroder, R. Bahreini, H. Bian, M. Chin, S. L. Clegg, P. Colarco, J. Crounse, J. A. de Gouw, J. Dibb, M. J. Kim, J. Kodros, F. D. Lopez-Hilfiker, E. A. Marais, A. Middlebrook, J. A. Neuman, J. B. Nowak, J. Pierce, J. M. Roberts, E. Scheuer, J. A. Thornton, P. R. Veres, P. O. Wennberg, and J. L. Jimenez	Global Survey of Submicron Aerosol Acidity (pH)	Nature Geosciences or PNAS	In prep
D. Jeong, R. Seco, D. Gu, Y. Lee, B. Nault, C. Knote, T. Mcgee, J. Sullivan, J. L. Jimenez, P. Campuzano-Jost, D. Blake, D. Sanchez, A. Guenther, D. Tanner, G. Huey, R. Long, B. E. Anderson, S. R. Hall, Y.-J. Lee, D. Kim, J.-Y. Ahn, A. Wisthaler, and S. Kim	Integration of Airborne and Ground Observations of Nitryl Chloride in the Seoul Metropolitan Area and Its Impact on the Regional Oxidation Capacity During the KORUS-AQ 2016 Field Campaign	TBD	In prep
D. Sanchez, R. Seco, D. Gu, A. Guenther, D. Jeong, J. Mak, Y.-J. Lee, D. Kim, D. Blake, S. Herndon, D. Jeong, T. Mcgee, and S. Kim	OH Reactivity Budget Analysis at the Taehwa Research Forest During KORUS-AQ 2016	TBD	In prep

Publications (5)

Authors	Title	Journal	Status
Isobel Simpson, et al.	Characterization and source apportionment of VOCs in the Seoul Metropolitan Area	TBD	In prep
Kara Lamb, et al.	Regional influences on the direct radiative forcing from black carbon observed over S. Korea	JGR-Atmospheres	In prep
Jinkyul Choi, Rokjin J. Park, Hyung-Min Lee, Seungun Lee, Duseong S. Jo, Jaein I. Jeong, Daven Henze, Jung-Hun Woo, Soo-Jin Ban, Min-Do Lee, Cheol-Soo Lim, Mi-Kyung Park, Hye J. Shin, Seogju Cho, and David Peterson	Source attribution of PM2.5 for Korea during the KORUS-AQ campaign using GOES-Chem adjoint model	TBD	In prep
Yujin Ok, Rokjin J. Park, D. Blake, W. Brune, A. Weinheimer, A. Fried, J. Crawford, and J. Schroeder	Evaluation of simulated VOCs during the KORUS-AQ campaign and their effect on ozone production in Korea	TBD	In prep
Hyeonmin M. Kim, Rokjin J. Park, Jaein I. Jeong, Daun Jeong, Saewung Kim, and Seogju Cho	Effect of nitryl chloride chemistry on oxidation capacity in East Asia	TBD	In prep
Hyung-Min Lee, Rokjin Park, Hyeong-Ahn Kwon	Top-down estimate of isoprene emissions in East Asia using inverse modeling: implication of satellite retrievals from GOME-2 and OMI formaldehyde with KORUS-AQ aircraft observations	TBD	In prep
David Peterson, et al.	Meteorology Influencing Pollution Regimes and Transport during KORUS-AQ	TBD	In prep

Publications (6)

Authors	Title	Journal	Status
K. Miyazaki, T. Sekiya, D. Fu, K. Bowman, S. Kulawik, K. Sudo, T. Walker, Y. Kanaya, M. Takigawa, K. Ogochi, H. Eskes, F. Boersam, B. Gaubert, J. Barre, and L. Emmons, and the KORUS-AQ team	Evaluation of a multi-constituent chemical reanalysis during KORUS-AQ: Role of dynamics and emissions	JGR-Atmospheres	In prep
Changmin Cho, J. St. Clair, G. Wolfe, Jin Liao, Sukhan Jung, Dae il Kang, Jinsoo Choi, Myung-Hwan Shin, Jinsoo Park, T. Hanisco, Kyung-Eun Min	Top-down estimation of volatile organic compounds (VOCs) emission rates in petrochemical complex using airborne in-situ formaldehyde (HCHO) observation	Atmospheric Environment or ACP	In prep
Minsu Park, Najin Kim, Seong Soo Yum, Lee Thornhill, Bruce Anderson, Dong-Su Kim, Hyun-Jae Kim, Ha-Eun Jeon, Yun-Seo Park, Sang-Bo Lee	On the submicron aerosol distributions and CCN activity in and around the Korean Peninsula measured onboard the NASA DC-8 research aircraft during the KORUS-AQ field campaign	TBD	In prep
Jin Liao, T. Hanisco, G. Wolfe, J. St. Clair, J. Jimenez, P. Campuzano-Jost, B. Nault, A. Fried, E. Marais, G. Gonzalez Abad, K. Chance, H. Jethva, T. Ryerson, C. Warneke, A. Wisthaler	Towards a satellite-in situ hybrid proxy for organic aerosol abundance	ACP	In prep
Mark F. Lunt, Sunyoung Park, Shanlan Li, Stephan Henne, Alistair J. Manning, Anita L. Ganesan, Isobel J. Simpson, Donald R. Blake, Qing Liang, Simon O'Doherty, Christina M. Harth, Jens Muhle, Peter K. Salameh, Ray F. Weiss, Paul B. Krummel, Paul J. Fraser, Ronald G. Prinn, Stefan Reimann, and Matthew Rigby	Continued emissions of the banned ozone-depleting substance - carbon tetrachloride - from East Asia	GRL	Submitted

Publications (7)

Authors	Title	Journal	Status
Herman, Jay, Elena Spinei, Jhoon Kim, Jae Kim, Woogyung Kim, Nader Abuhassan, Michal Segal-Rozenhaimer, Alexander Cede	NO2 and HCHO Measurements in Korea from 2012 to 2016 using a network of Pandora Spectrometer Instruments	AMT	Submitted
Spinei, E., N. Abuhassan, A Cede, M. Tiefengraber, M. Mueller, J. Herman, N. Nowak, B. Poche, S. Choi7, A. Whitehill, J. Szykman, V. Lukas, D. Williams, R. Long, Jin Liao, Jason St. Clair, Glenn Wolfe, Thomas Hanisco, Changmin Cho, Alan Fried, Petter Weibring, Dirk Richter, Robert Swap, James Walega	Pandora formaldehyde measurements during KORUS-AQ over Olympic Park and Taehwa (South Korea, April-June 2016)	AMT	Submitted
KORUS-AQ Leadership	KORUS-AQ Overview Paper	BAMS?	In prep

Observations of Nitrous Oxides and Volatile Organic Compounds over Hebei Province in Spring 2016

Sarah Benish[1] ,Xinrong Ren[1,2], Hao He[1], Fei Wang[3], Yuying Wang[3], Zhanqing Li[1], and Russell Dickerson[1]

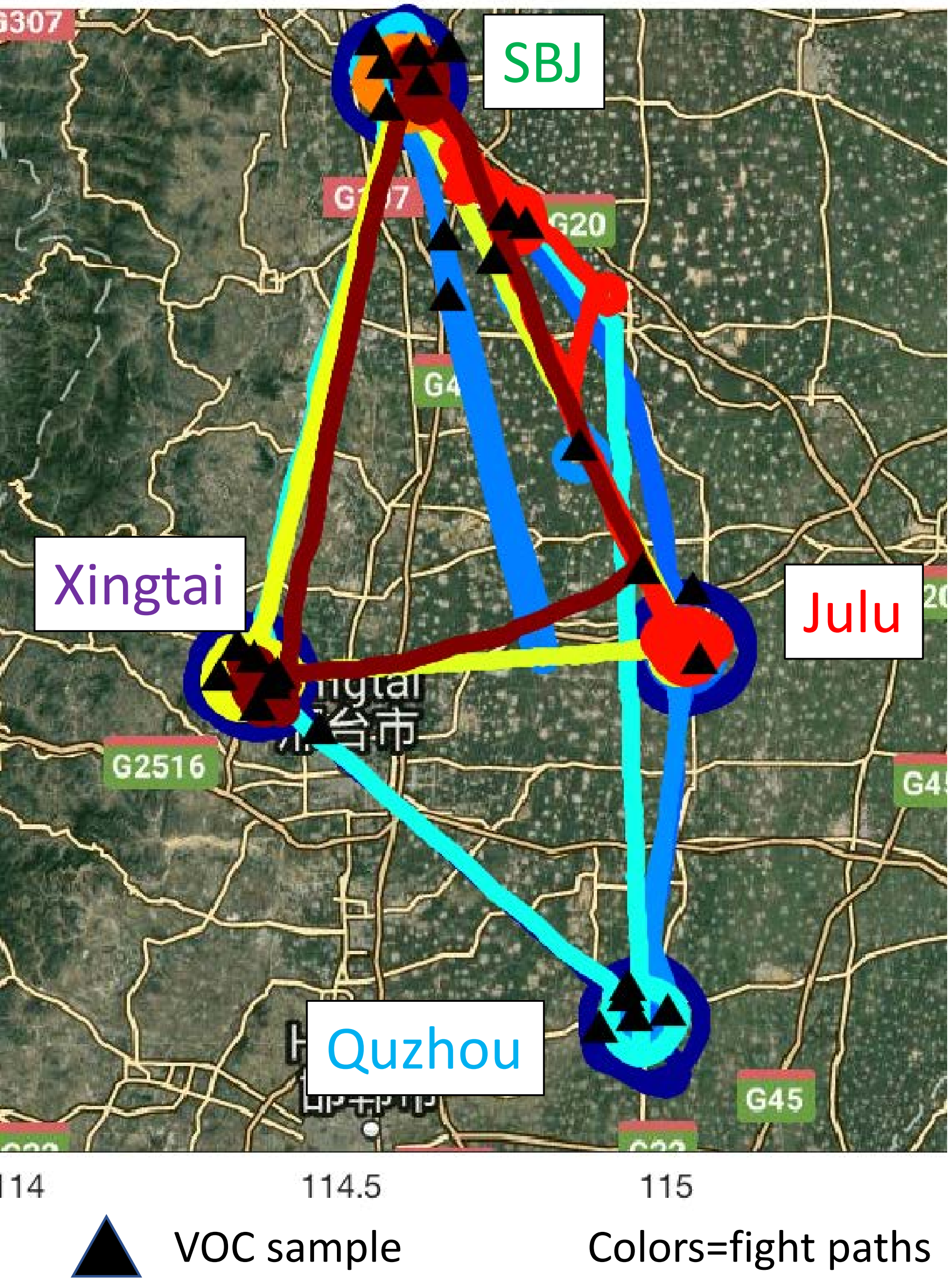
1. Department of Atmospheric and Oceanic Science, (AOSC) University of Maryland (UMD), College Park, MD 20742

2. Air Resources Laboratory, National Oceanic and Atmospheric Administration (NOAA), College Park, MD 20740

3. State Key Laboratory of Earth Surface Processes and Resource Ecology, College of Global Change and Earth System Science, Beijing Normal University, Beijing, 100875, China

Objectives

- Assess O_3 precursor concentrations in the North China Plain in spring.
- Identify what VOCs should be targeted for successful O_3 reduction.
- Understand the potential sources of VOCs in the North China Plain.

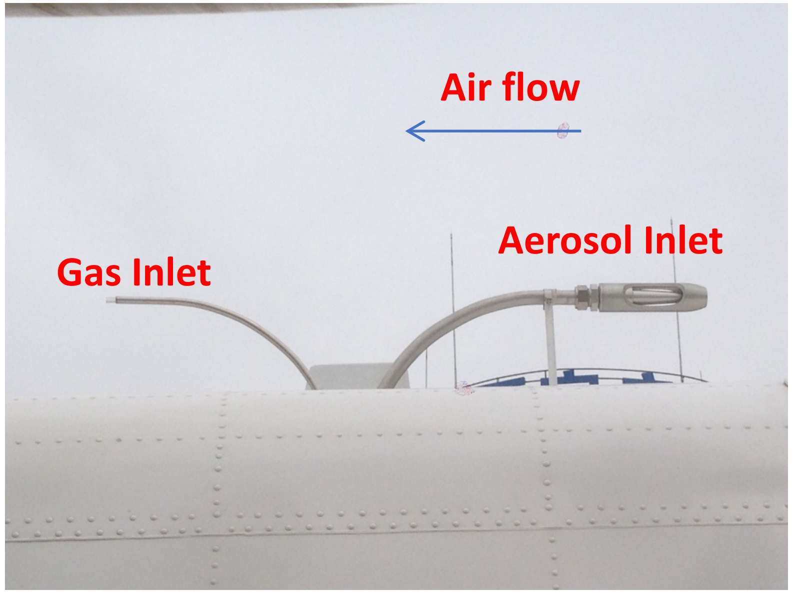


Background

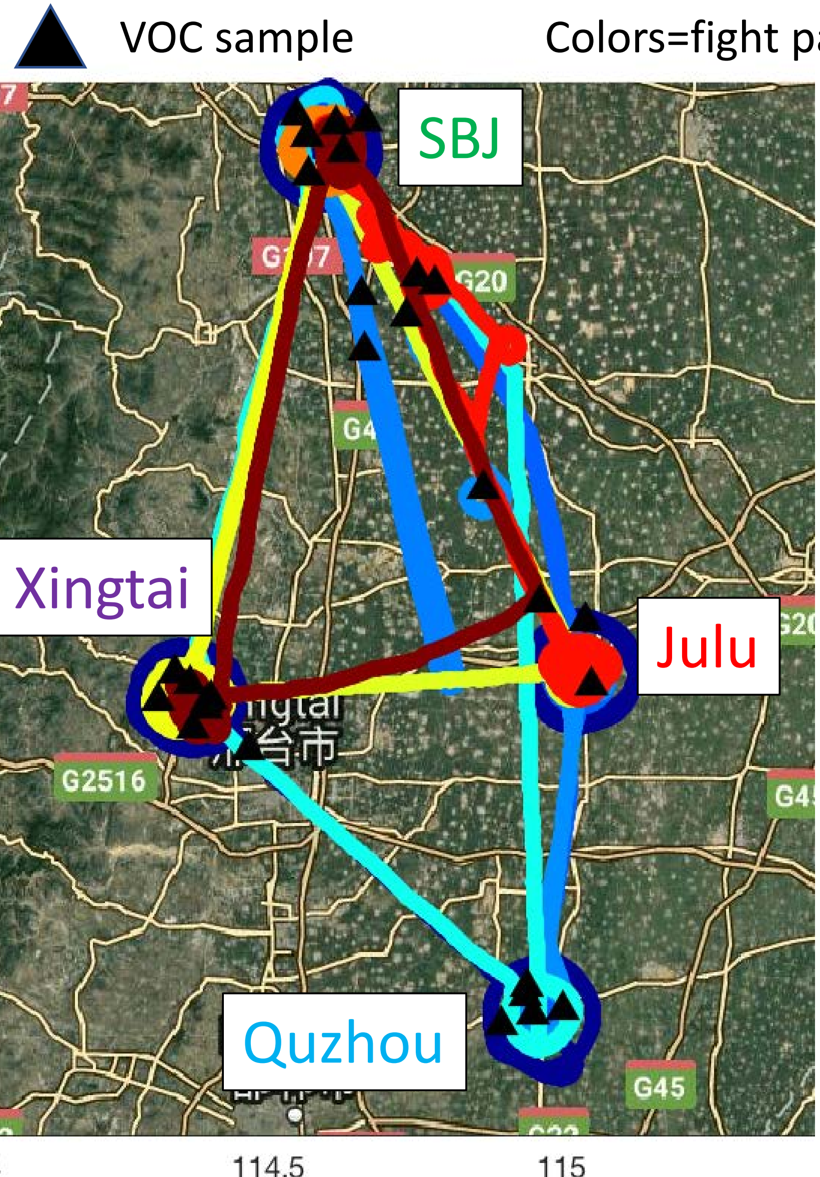
- Air Chemistry Research in Asia (ARIAs) campaign
- 11 research flights, ~3 hrs
- 28 Whole air samples taken
- May-June 2016 in Hebei Province
- Purpose: Lagrangian study of trace gases & aerosols, comparison with KORUS-AQ
- See Wang *et al.* (2018) in ACP for evaluation of aerosol properties

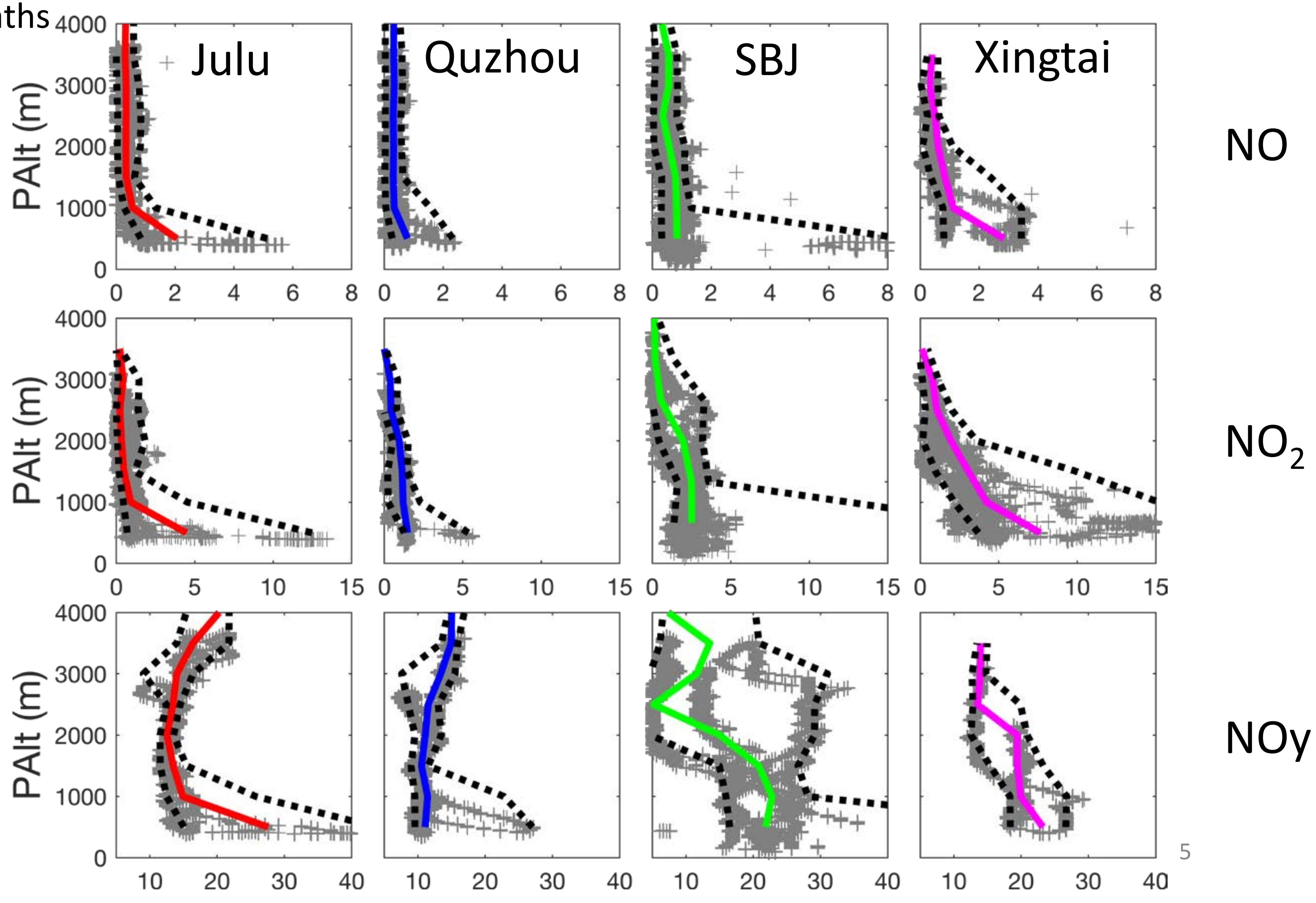
Aircraft Instrumentation

Variable	Method
Aircraft Position	Global Positioning System (GPS)
Meteorology (Temperature, Relative humidity, Pressure, 2-D Wind)	Thermistor Hygristor, Capacitance Manometer, Garmin G600 system
Greenhouse Gases ($CO2/CH_4/CO/H_2O$)	Cavity Ring Down Spectroscopy Picarro Model G2401-m
Ozone	UV-absorption, modified TECO
Sulfur dioxide	Pulsed fluorescence, modified TECO
Nitrogen dioxide	Cavity enhanced absorption spectroscopy, Los Gatos
NO/NOy	Chemiluminescence, TECO 350° Molybdenum
Aerosol Scattering, b_{scat} (450, 500, 700, nm)	Nephelometer
Aerosol Absorption, b_{abs} (565 nm)	Particle Soot Absorption Photometer (PSAP)
Black Carbon (370, 470, 520, 590, 660, 880, 950 nm)	Aethalometer
VOCs	28 Grab Canisters/GC-FID



Nitrogen Oxide Observations





Volatile Organic Compounds Observations

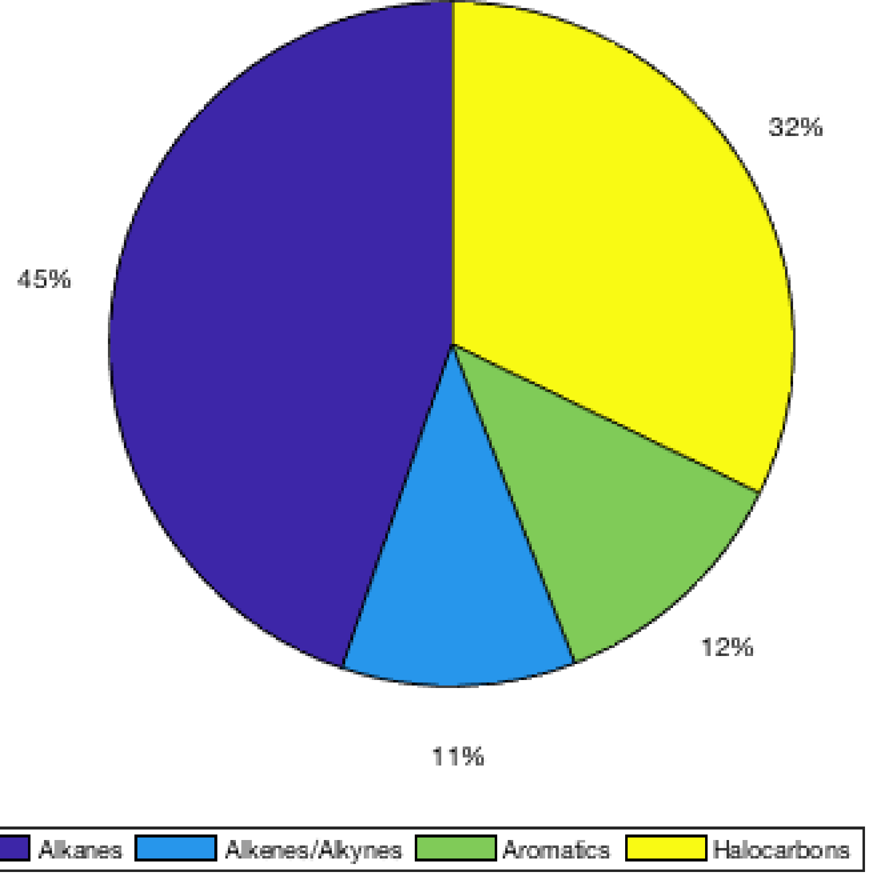
Alkanes (27)		**Alkenes/Alkynes (11)**	**Aromatics (16)**	**Halocarbons (29)**	
Ethane	Cyclopentane	Ethylene	1,2,3-Trimethylbenzene	1,1,1-Trichloroethane	Freon12
n-Nonane	3-Methylpentane	Acetylene	1,3-Diethylbenzene	Carbontetrachloroide	Freon22
Octane	2,3-Dimethylbutane	1-Hexene	1,4-Diethylbenzene	1,2-Dichloroethane	Freon114
Propane	n-Hexane	1-Pentene	Isopropylbenzene	Trichloroethylene	Chloromethane
n-Pentane	2,4-Dimethylpentane	Propylene	n-Propylbenzene	1,2-Dichloropropane	Vinylchloride
Isobutane	Methylcyclopentane	trans-2-Pentene	3-Ethyltoluene	Bromodichloromethane	Bromomethane
Methylcyclohexane	2-Methylhexane	Isoprene	4-Ethyltoluene	trans-1,3-Dichloropropene	Chloroethane
n-Butane	Cyclohexane	cis-2-Pentene	Toluene	cis-1,3-Dichloropropene	Freon11
n-Decane	2,3-Dimethylpentane	trans-2-Butene	1,3,5-Trimethylbenzene	1,1,2-Trichloroethane	Freon113
2-Methylpentane	3-Methylhexane	cis-2-Butene	2-Ethyltoluene	Tetrachloroethylene	1,1-Dichloroethylene
Isopentane	3-Methylheptane	1-Butene	1,2,4-Trimethylbenzene	1,2-Dibromoethane	1,1-Dichloroethane
2,2-Dimethylbutane	2,2,4-Trimethylpentane		m/p-Xylene	Chlorobenzene	Cis-1,2-Dichloroethylene
2-Methylheptane	n-Heptane		o-Xylene	1,1,2,2-Tetrachloroethane	Chloroform
2,3,4-Trimethylpentane			Styrene	1,3-Dichlorobenzene	1,4-Dichlorobenzene
			Ethylbenzene	1,2-Dichlorobenzene	
			Benzene		

Methods to Assess Reactivity

- Volume Mixing Ratio
- OH reactivity
  - Rate constants from MCM3.3.1 and NIST Chemical Kinetics Database
  - Does not take into account more reactive intermediates formed
- O_3 Formation Potential
  - Maximum incremental reactivity (MIR, g O_3 formed/g VOC) from Carter *et al.* (2010).
  - Dependent on NO_x concentrations
- Photochemical O_3 Creation Potential (POCP)
  - POCP values from Cheng *et al.* (2010) in reference to ethylene in the Pearl River Delta

Volume Mixing Ratio

Rank	Species	Mean Mixing Ratio, ppbv	Standard Deviation, ppbv	Mean Concentration, $\mu g/m^3$	% Contribution to Total Mixing Ratio	% Contribution to Speciated Mixing Ratio
1	1,1-Dichloroethylene	5.05	3.00	21.88	15.42	41.83
2	Isopentane	2.84	11.22	9.14	8.66	20.79
3	Ethane	2.73	0.74	3.66	8.32	19.98
4	1,2-Dibromoethane	2.34	0	19.62	7.14	19.37
5	Toluene	2.25	7.70	9.26	6.87	61.63
6	Isobutane	1.57	5.04	4.07	4.79	11.50
7	Propane	1.44	0.25	2.84	4.40	10.56
8	Vinylchloride	1.30	0.51	3.62	3.96	10.74
9	2,2,4-Trimethylpentane	1.12	3.93	5.73	3.43	8.23
10	Chloromethane	1.09	0.32	2.45	3.31	8.99
11	Ethylene	1.05	1.13	1.31	3.20	30.95
12	Acetylene	1.01	0.74	1.17	3.07	29.70
13	2-Methylheptane	0.96	3.20	4.91	2.94	7.05
14	1-Butene	0.76	2.19	1.91	2.33	22.53
17	2,3,4-Trimethylpentane	0.56	1.88	2.88	1.73	4.14



Isopentane, ethane, and isobutane make up ~50% of the total alkane volume mixing ratio.

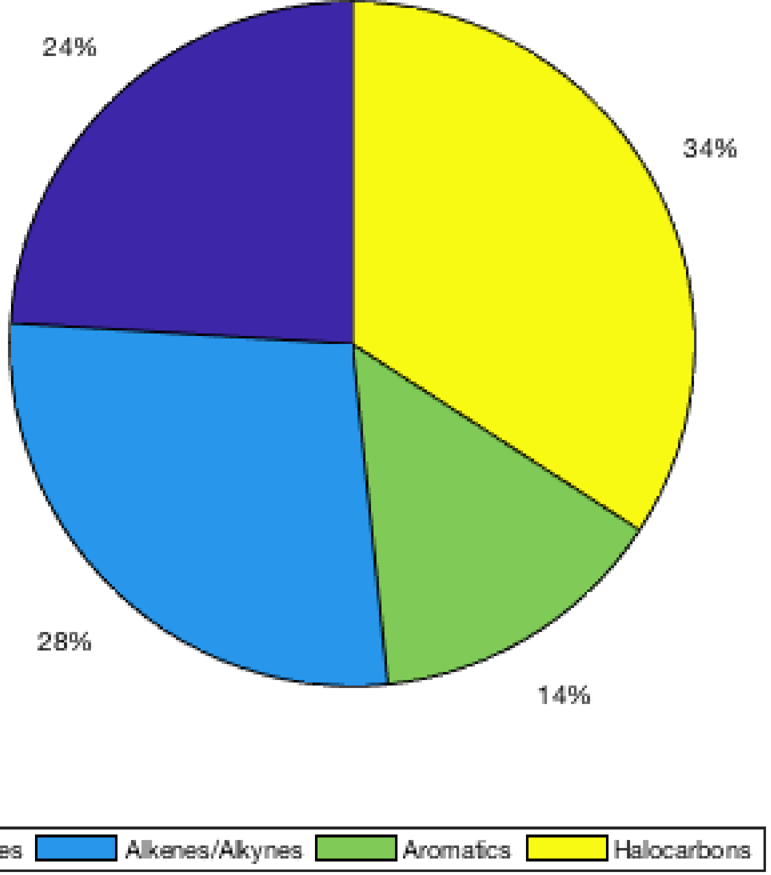
Ethylene contributed 30% to total alkene/alkyne volume mixing ratio.

Toluene accounts for ~60% of the total aromatic volume mixing ratio.

1,1-Dichloroethylene contributes ~40% to total halocarbon volume mixing ratio.

OH Reactivity

Ranking	Species	Mean OH Reactivity, s^{-1}	Standard Deviation, s^{-1}	% Contribution to Total OH reactivity	% Contribution to Speciated OH reactivity
1	1,1-Dichloroethylene	1.30	0.74	28.32	83.06
2	1-Butene	0.58	1.68	12.74	45.66
3	Propylene	0.31	0.06	6.80	24.37
4	Toluene	0.31	1.05	6.67	47.25
5	Isopentane	0.25	1.00	5.45	22.81
6	Vinyl chloride	0.25	0.11	5.43	15.93
7	2-Methylheptane	0.23	0.76	4.92	20.60
8	Ethylene	0.21	0.22	4.57	16.39
9	m/p-Xylene	0.14	0.48	3.02	21.41
10	2,2,4-Trimethylpentane	0.09	0.31	1.89	7.92
11	2,3,4-Trimethylpentane	0.09	0.29	1.88	7.89
12	Isoprene	0.09	0.10	1.82	6.55
13	Isobutane	0.08	0.26	1.73	7.25
14	2-Methylpentane	0.04	0.15	0.94	3.91
15	n-Hexane	0.04	0.12	0.84	3.50



Isopentane contributed 20% to total alkane OH reactivity

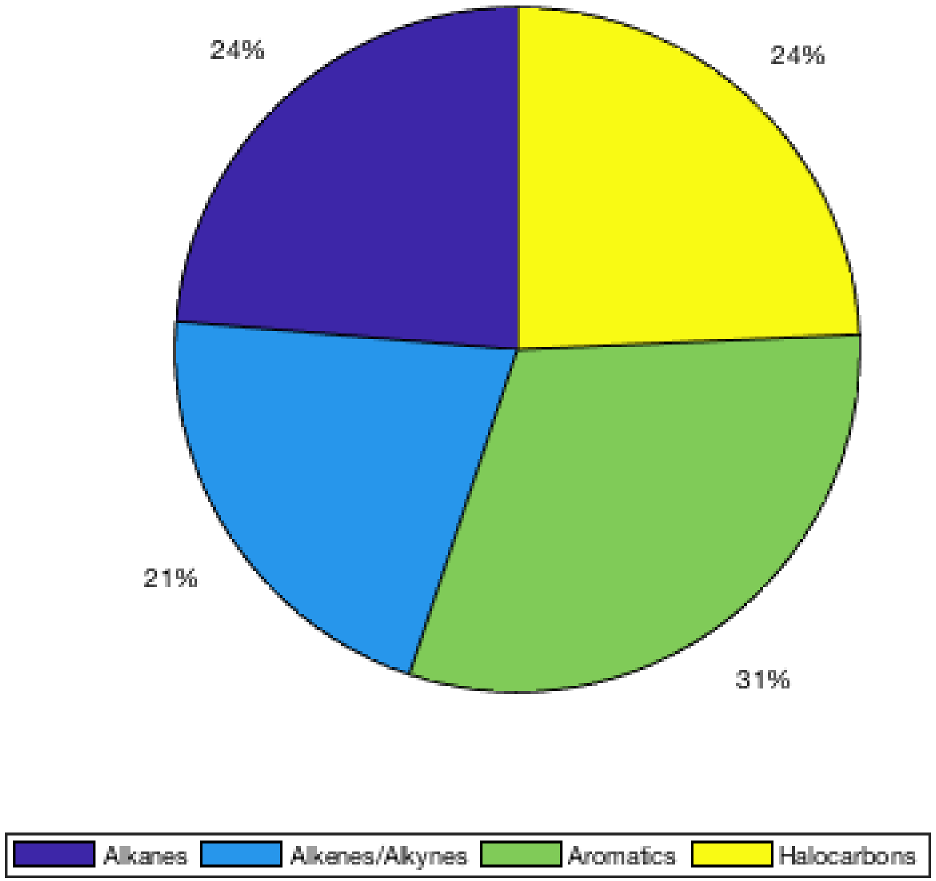
1-Butene accounted for ~45% to total alkene OH reactivity.

Toluene accounted for nearly half of the OH reactivity for total aromatic species.

1,1-Dichloroethylene and vinyl chloride together accounted for 96% of the total hydrocarbon OH reactivity.

Ozone Formation Potential

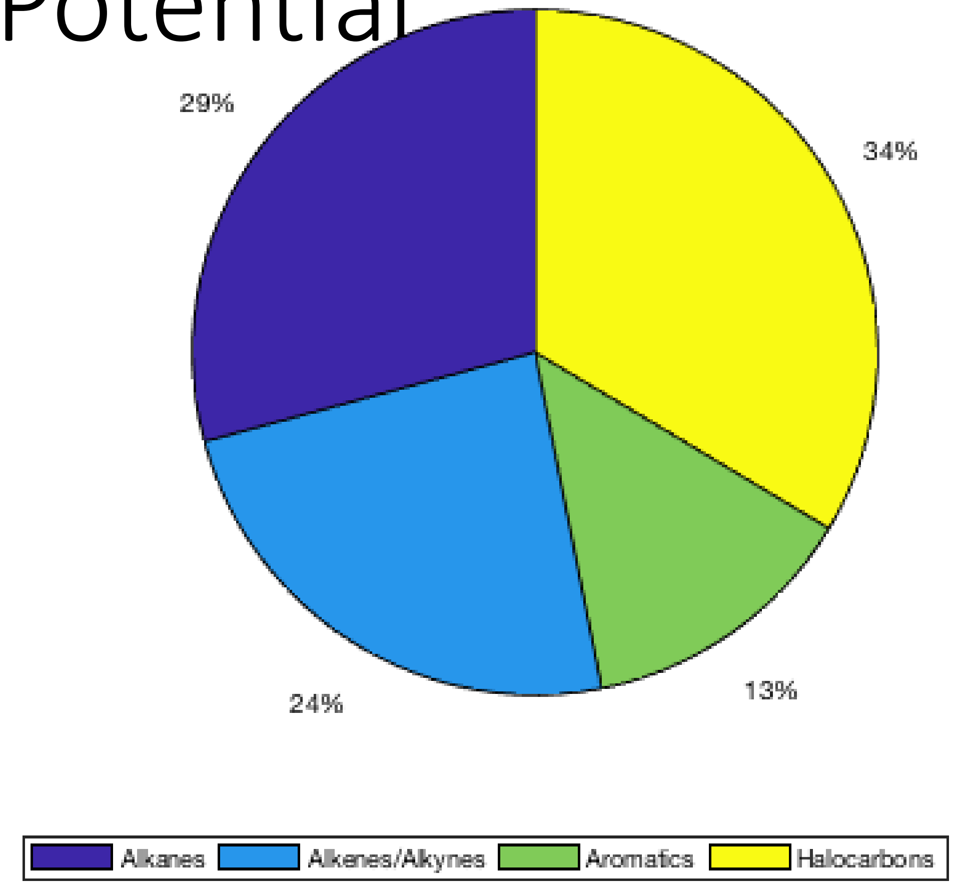
Ranking	Species	Average Ozone Formation Potential, ppbv O_3	Standard Deviation, ppbv O_3	% Contribution to Total OFP	% Contribution to Speciated OFP
1	1,1-Dichloroethylene	18.27	10.86	18.55	74.26
2	Toluene	17.28	59.10	17.54	57.61
3	1-Butene	8.68	24.95	8.81	41.65
4	Isopentane	6.19	24.47	6.28	26.83
5	Ethylene	5.51	5.95	5.60	26.46
6	m/p-Xylene	5.40	18.46	5.49	18.02
7	Propylene	4.80	0.92	4.88	23.04
8	Vinylchloride	4.78	1.88	4.86	19.44
9	2,2,4-Trimethylpentane	3.37	11.78	3.42	6.01
10	2-Methylheptane	2.45	8.15	2.49	10.63
11	Isobutane	2.34	7.50	2.37	10.14
12	o-Xylene	1.90	6.07	1.92	6.33
13	2,3,4-Trimethylpentane	1.39	4.61	1.40	6.01
14	Ethylbenzene	1.33	3.95	1.35	4.43
15	1,2-Dibromoethane	0.93	0.00	0.95	3.80



Top 4 VOCs accounted for approximately half the top 15 species to total Ozone Formation Potential.

Photochemical Ozone Creation Potential

Ranking	Species	Average POCP-weighted Mixing Ratio, ppbv	Standard Deviation, ppbv	% Contribution to Total POCP weighted Mixing Ratio	% Contribution to Speciated POCP weighted Mixing Ratio
1	1,1-Dichloroethylene	2.93	1.74	25.29	75.13
2	Ethylene	1.05	1.13	9.05	37.69
3	Isopentane	0.99	3.93	8.57	29.46
4	Vinylchloride	0.88	0.35	7.61	22.62
5	Toluene	0.81	2.77	6.99	52.75
6	1-Butene	0.78	2.24	6.72	27.99
7	Propylene	0.75	0.14	6.48	27.02
8	Isobutane	0.44	1.41	3.79	13.03
9	2-Methylheptane	0.33	1.09	2.82	9.70
10	m/p-Xylene	0.32	1.08	2.73	20.61
11	Ethane	0.25	0.07	2.12	7.28
12	2,2,4-Trimethylpentane	0.20	0.70	1.73	5.93
13	Propane	0.19	0.03	1.62	5.56
14	2-Methylpentane	0.13	0.44	1.13	3.89
15	n-Hexane	0.11	0.34	0.93	3.19



Top 4 VOCs accounted for approximately half the top 15 species to total Photochemical ozone creation potential.

Comparison of MIR and POCP

MIR (g VOC/g O_3)	
Compound	MIR, Carter 2010
Trans-2-Butene	**15.16**
Cis-2-Butene	14.24
1,2,3-Trimethylbenzene	11.97
1,3,5-Trimethylbenzene	11.76
Propylene	11.66
Isoprene	**10.61**
Trans-2-Pentene	10.56
Cis-2-Pentene	10.38
1-Butene	9.73
Ethylene	9.0
1,2,4-Trimethylbenzene	8.87
m/p-Xylene	7.80
o-Xylene	7.64
3-Ethyltoluene	7.39
1-Pentene	7.21

POCP (unitless)	
Compound	POCP, Cheng et al. 2010
Trans-2-Butene	**229**
Cis-2-Butene	216
1,3,5-Trimethylbenzene	198
1,2,4-Trimethylbenzene	179
Isoprene	**171**
1,2,3-Trimethylbenzene	165
Trans-2-Pentene	161
Cis-2-Pentene	161
Propylene	160
1,4-Diethylbenzene	158
1,3-Diethylbenzene	158
1-Butene	102
m/p-Xylene	101
Ethylene	100
o-Xylene	91

Top 15 species ranked by MIR and POCP values contribute nearly 30% to total O_3 formation but only represent ~10% of the total volume mixing ratio.

Trans-2-butene most reactive in terms of MIR and POCP

- MIR: 0.07 ppbv O_3, 0.07% of total
- POCP: 0.01 ppbv, 0.08% of total

Isoprene is highly reactive in terms of MIR and POCP, but only contributes ~0.5% to total ozone formation using both scales.

This suggests species with either high reactivity or large emissions do not necessarily have high contributions to O_3 formation.

VOC Sources

- Correlations among a variety of hydrocarbons used to identify sources of NMHCs and halogenated halocarbons.
- Isopentane correlates with a variety of alkane and aromatic species (p=0.05), indicative of **gasoline evaporation**.
  - The isopentane to n-pentane ratio was ~3 and uncorrelated with CO, reflecting strong vehicular emissions in Hebei.
- Correlations with a variety of halocarbons suggests colocation of VOC sources with **petrochemical** and chemical facilities.
  - 1,1-Dichloroethylene is used as an intermediate in chemical synthesis and to produce polyvinylidene chloride, which is used to produce food packaging wraps (Saran wrap).
  - 1,1-Dichloroethylene correlates well with other petrochemical industry VOCs.

1,1-Dichloroethylene R^2 (p=0.05)			
Freon 11	0.33	1-Butene	0.33
Freon 114	0.38	Styrene	0.32
Toluene	0.37	nHexane	0.32
m/p-Xylene	0.35	Cyclopentane	0.33

Isopentane R^2 (p=0.05)			
n-Heptane	0.982	Cyclopentane	0.999
n-Pentane	0.994	n-Hexane	0.981
2-Methylhexane	0.999	Octane	0.990
2-Methylpentane	0.998	Isobutane	0.978
2,2-Dimethylbutane	0.981	Methylcyclohexane	0.895
2,2,4-Trimethylpentane	0.941	Methylcyclopentane	0.991
2,3-Dimethylbutane	0.999	1-Butene	0.997
2,3-Dimethylpentane	0.995	Ethylbenzene	0.981
2,4-Dimethylpentane	0.996	Toluene	0.993
3-Methylheptane	0.986	m/p-Xylene	0.998
3-Methylhexane	0.998	o-Xylene	0.997
3-Methylpentane	0.999	Freon 114	0.983
Cyclohexane	0.906	1,1,2-Trichloroethane	0.836

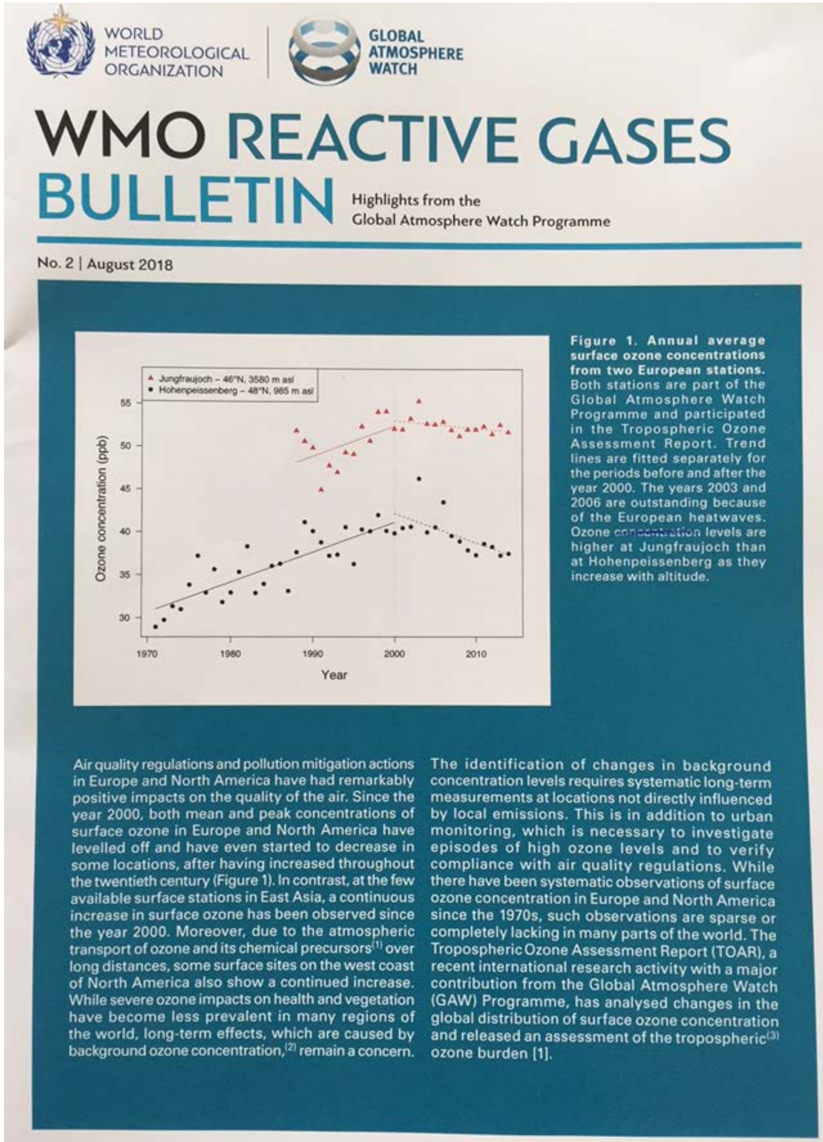
Summary

- **Measurements of 83 NMHC and HHs** compounds and trace gases were made in **Hebei Province in May and June 2016**.
- The VOC composition throughout Hebei is **dominated by alkanes**.
- **Halocarbons** contributed most to the **total OH reactivity**.
- **Aromatics were the largest contributor to ozone formation potential** using maximum incremental reactivity but were closely followed by alkanes and halocarbons.
- **Halocarbons** had the largest influence on **photochemical ozone creation potential.**
- **1,1-Dichloroethylene** and **toluene** are largely responsible for most of the **O_3 formation** using both reactivity scales, accounting for ~36% of the total ozone formation potential and ~31% of the total photochemical ozone creation potential.
- Correlations between many VOCs indicates strong **gasoline evaporation** and **petrochemical** emissions in Hebei, among other sources.

Thank you!

- Contact: sebenish@umd.edu
- Manuscript in prep.

WMO Reactive Gases meeting



WORLD METEOROLOGICAL ORGANIZATION | GLOBAL ATMOSPHERE WATCH

WMO REACTIVE GASES BULLETIN

Highlights from the Global Atmosphere Watch Programme

No. 2 | August 2018

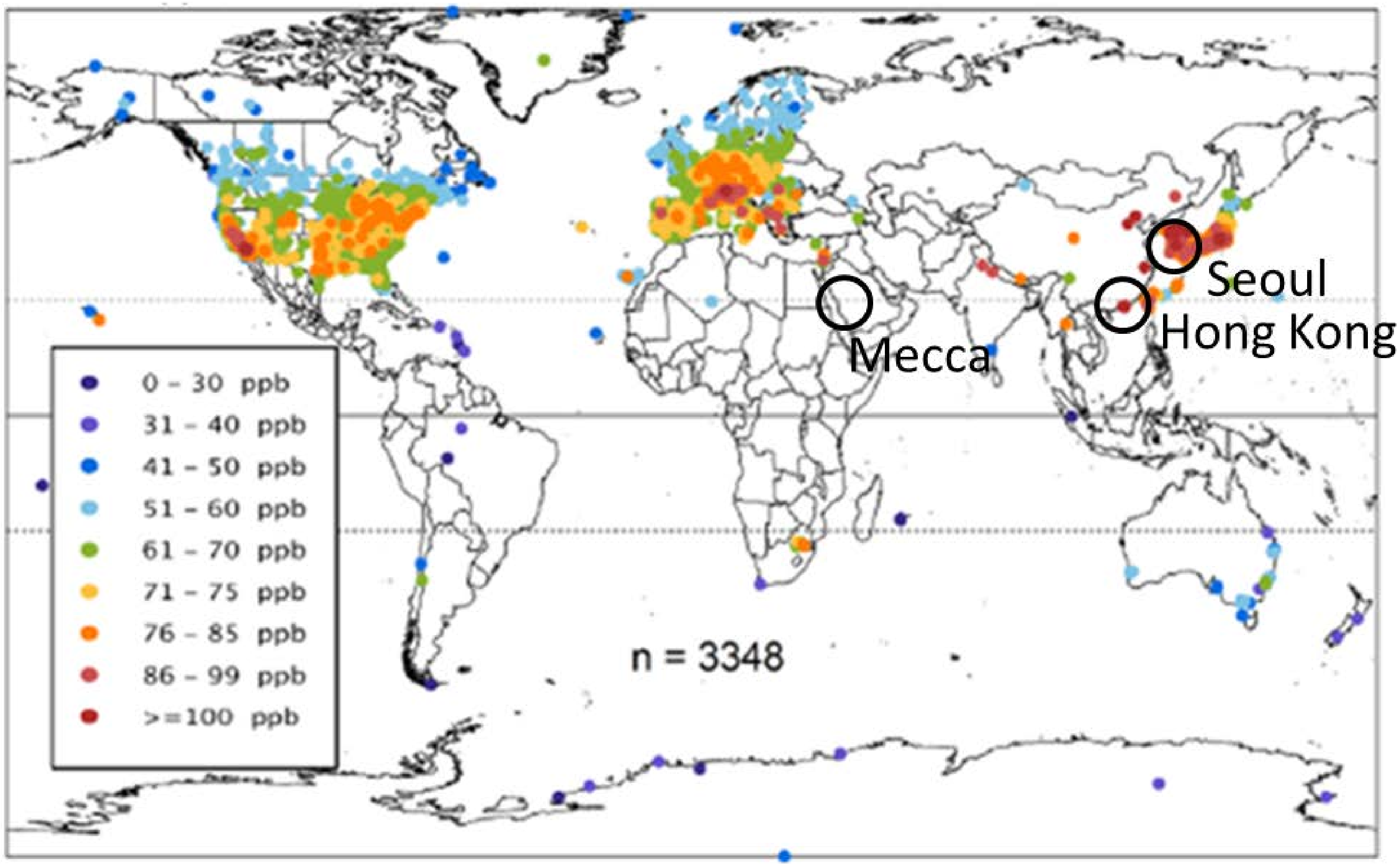
Figure 1. Annual average surface ozone concentrations from two European stations. Both stations are part of the Global Atmosphere Watch Programme and participated in the Tropospheric Ozone Assessment Report. Trend lines are fitted separately for the periods before and after the year 2000. The years 2003 and 2006 are outstanding because of the European heatwaves. Ozone concentration levels are higher at Jungfraujoch than at Hohenpeissenberg as they increase with altitude.

Air quality regulations and pollution mitigation actions in Europe and North America have had remarkably positive impacts on the quality of the air. Since the year 2000, both mean and peak concentrations of surface ozone in Europe and North America have levelled off and have even started to decrease in some locations, after having increased throughout the twentieth century (Figure 1). In contrast, at the few available surface stations in East Asia, a continuous increase in surface ozone has been observed since the year 2000. Moreover, due to the atmospheric transport of ozone and its chemical precursors(1) over long distances, some surface sites on the west coast of North America also show a continued increase. While severe ozone impacts on health and vegetation have become less prevalent in many regions of the world, long-term effects, which are caused by background ozone concentration,(2) remain a concern.

The identification of changes in background concentration levels requires systematic long-term measurements at locations not directly influenced by local emissions. This is in addition to urban monitoring, which is necessary to investigate episodes of high ozone levels and to verify compliance with air quality regulations. While there have been systematic observations of surface ozone concentration in Europe and North America since the 1970s, such observations are sparse or completely lacking in many parts of the world. The Tropospheric Ozone Assessment Report (TOAR), a recent international research activity with a major contribution from the Global Atmosphere Watch (GAW) Programme, has analysed changes in the global distribution of surface ozone concentration and released an assessment of the tropospheric(3) ozone burden [1].

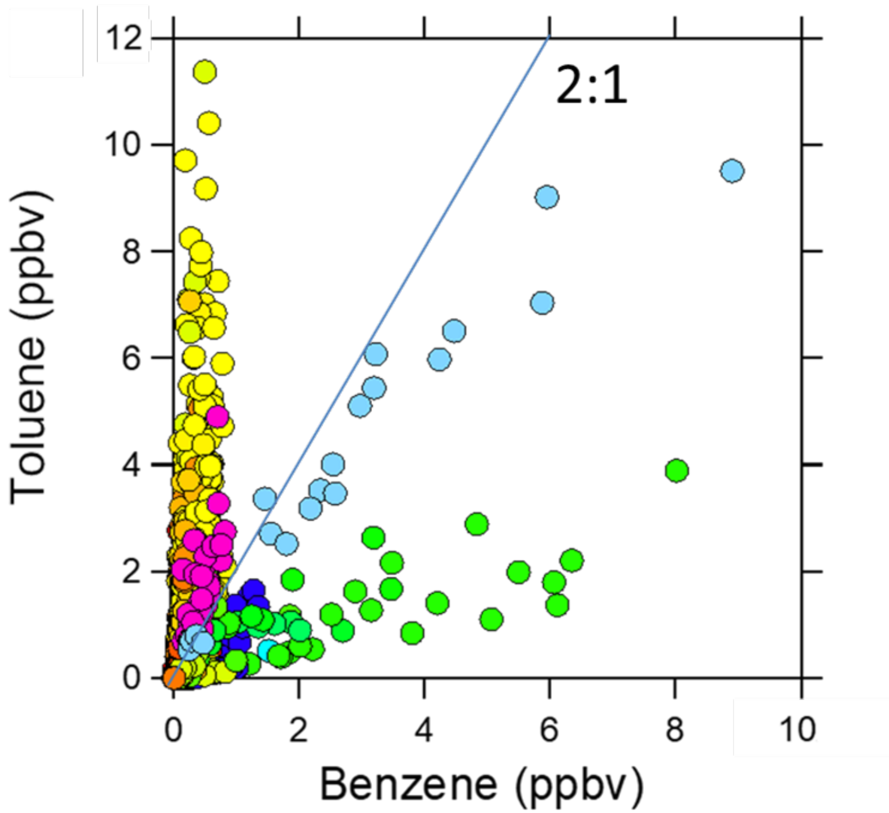
- WMO Global Atmosphere Watch (GAW) Program
  - Scientific Advisory Group (SAG) on Reactive Gases
  - Osaka, Japan (Oct 2-4, 2018)
- Isobel Simpson & Meehye Lee
  - Presented KORUS-AQ data and other urban air quality studies (Mecca, Hong Kong)
  - We were asked to write the 2019 WMO Reactive Gases Bulletin
  - Good opportunity to promote KORUS-AQ findings

Surface O_3 maximum (2010-2014)



4MDA8 = 4th highest daily maximum 8-hr O_3, non-urban sites (*Fleming et al., Elem. Sci. Anth., 2018*)

VOC correlations and ratios



Toluene/Benzene

- Solvents >2
- Traffic ~2
- Industry <2

Seoul:	6.09 ± 0.26
Hong Kong*:	3.30 ± 0.66
Mecca*:	1.59 ± 0.08
Daesan:	0.25 ± 0.04

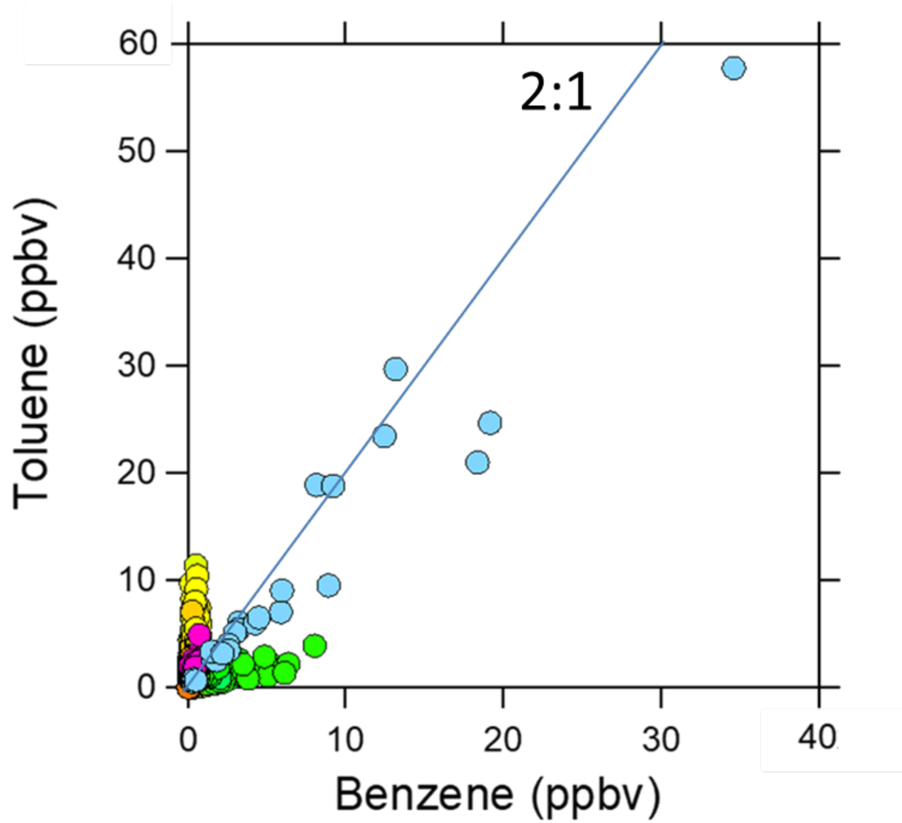
Seoul:	Solvents (toluene-rich)
Hong Kong:	Solvents (toluene-rich)
Mecca:	Traffic
Daesan:	Industry (benzene-rich)

** Mecca data from April 2013*

** Hong Kong data from May-June 2014*

Simpson et al., 2013; Barletta et al., 2016

VOC correlations and ratios



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