KORUS-AQ

Agenda

Ministry of Environment
National Institute of Environmental Research

NASA

<u>Science Team Telecon</u>

AOGS 2018

Second KORUS-AQ Science Team Meeting

KORUS-AQ publications

Updated KORUS-AQ DC-8 Merge

Science Presentations

- **Ryan Stauffer**
- **Dan Goldberg**

February's Contest Question

Session AS40: Results from the 2016 KORUS-AQ and Related Field Studies in Asia

23 Abstracts were received and accepted (full list is provided)

Thanks to all who submitted!

Oral/Poster assignments are pending

KORUS-AQ

AOGS 15th Annual Meeting Asia Oceania Geosciences Society 03-08 Jun 2018 Honolulu, Hawaii Aloha

Ministry of Environment National Institute of Environmental Research

NASA

AS40-A001	Production and Loss of Sulfate on the Sea Surface During Its Transport from Eastern China to South Korea	Wonbae Jeon (*Pusan National University),* Hwa Woon Lee, Yunsoo Choi, Jeonghyeok Mun
AS40-A002	Characterization of the NO2 Artifact Associated with the Chemiluminescence Technique Equipped with Molybdenum Converter During KORUS-AQ Campaign	Jinsang Jung, (*Korea Research Institute of Standards and Science),* Meehye Lee, Seogju Cho, Jaeyong Lee
AS40-A004	CO Source Contributions and Combustion Characteristics During KORUS-AQ	Wenfu Tang (*University of Arizona),* Avelino Arellano, Louisa Emmons, Benjamin Gaubert
AS40-A005	Assessing How Aerosols Effect OMI NO2 Retrievals During KORUS-AQ	Michal Segal Rozenhaimer (*Bay Area Environmental Research Institute/NASA Ames Research Center),* Daniel Goldberg, Yohei Shinozuka, Samuel LeBlanc, Connor Flynn, Jens Redemann, Jay Herman, Alexander Cede, Nader Abuhassan, Lok Lamsal
AS40-A006	Introduction of Stray Light Correction Algorithm with the Characterization of Point Spread Functions for Better Improvement of GeoTASO Measurements	Mina Kang (*Ewha Womans University),* Matthew Kowalewski, Myoung Hwan Ahn
AS40-A007	Evaluation of Simulated VOCs During the KORUS-AQ Campaign and Their Effect on Ozone Production in Korea	Yujin Ok (*Seoul National University),* Rokjin J. Park, Donald Blake, William Brune, Andrew Weinheimer, Alan Fried, James Crawford, Jason Schroeder
AS40-A008	Air Chemistry Modeling Issues That We Have Learned from the KORUS-AQ Campaign	Prof. Rokjin J. Park (*Seoul National University)*
AS40-A009	Effect of Nitryl Chloride Chemistry on Oxidation Capacity in East Asia	Hyeonmin Kim (*Seoul National University),* Rokjin J. Park, Jaein Jeong, Daun Jeong, Saewung Kim, Seogju Cho

AS40-A010	Chemistry of New Particle Growth During Spring Time in the Seoul Metropolitan Area, Korea	Hwajin Kim (*KIST)*
AS40-A011	Investigating the Contributions of Trans-boundary Transport and Local Emissions to Air Quality in South Korea During KORUS-AQ	Seoyoung Lee (*Yonsei University),* Ja-Ho Koo, Jaemin Hong, Myungje Choi, Jhoon Kim, Hyunkwang Lim, Brent Holben, Thomas Eck, Jun-Young Ahn, Jeong-Hoo Park, Sang-Kyun Kim
AS40-A012	Surface NO2 Volume Mixing Ratio Estimated from Total Column Observations of Pandora Spectrometer during KORUS-AQ	Heesung Chong (*Yonsei University),* Ja-Ho Koo, Jhoon Kim, Hana Lee, Woogyung Kim, Ukkyo Jeong, Jay Herman, Nader Abuhassan, Seungun Lee, Rokjin J. Park, Junhong Lee, Je-Woo Hong, Jinkyu Hong, Jun-Young Ahn, Jeong-Hoo, Sang-Kyun Kim
AS40-A013	Observation-based Modelling and Analysis of Ozone Production in the Seoul Metropolitan Area During KORUS-AQ	Jason Schroeder (*NASA)*
AS40-A016	Developing a Procedure for Estimating Aerosol Number Density Trend Based on Routine Measurements of Meteorological Parameters in Seoul, Korea from 1980 to 2017	Youngwoo Ji (*Gwangju Institute of Science and Technology),* Hye Jung Shin, Kyung-Eun Min,
AS40-A017	Airborne Glyoxal Measurements and Its Contribution to Secondary Organic Aerosol Foramtion Over the Korea Pennisula	Kyung-Eun Min (*Gwangju Institute of Science and Technology),* Dongwook Kim, Seokhan Jeong, Changmin Cho, Soojin Lee

AS40-A018	Analyzing Ozone Production Sensitiveness in South Korea Using Air-monitoring Network Measurements from 2001 to 2016	SuKyong Yun (*Gwangju Institute of Science and Technology)*, Kyung-Eun Min
AS40-A019	Integrated Assessment of Air Quality Improvement Plan for Korea and China	Younha Kim (*Konkuk University)*, Jung-Hun Woo, Zbigniew Klimont, Markus Amann, Jinsu Kim
AS40-A020	Evaluation of the Large Point Source Emissions in the Korus-aq Version 2.0 Emissions Inventory	Jung-Hun Woo (*Konkuk University)*, Younha Kim, Minwoo Park, Rokjin J. Park, Louisa Emmons
AS40-A021	Contribution of Local Emissions of Aromatic Compounds to Secondary Organic Aerosol Formation Over the Korean Peninsula	Christoph Knote (*Ludwig-Maximilians-Universität München)*, Benjamin Nault, Pedro Campuzano-Jost, Jose-Luis Jimenez, JinSeok Kim, Yungu Lee, Jung-Hun Woo, Soojin Lee, Dongwook Kim, Changmin Cho, Kyung-Eun Min
AS40-A022	Long-range Transport and Vertical Structure of Air Pollutants During the 2016 KORUS-AQ Field Study : Meteorological Controls on Transport Pathway and Air Quality in Downwind Regions	Hyo-Jung Lee (*Pusan National University)*, Hyun-Young Jo, Shin-Young Park, Yu-Jin Jo, Sang-Woo Kim, Taehyoung Lee, Jun-Young Ahn, Si-Wan Kim, Jung-Hun Woo, Cheol-Hee Kim
AS40-A023	Evaluation of a multi-constituent chemical reanalysis during KORUS-AQ: role of dynamics and emissions	Kazuyuki Miyazaki (*Japan Agency for Marine-Earth Science and Technology)*, Takashi Sekiya, Dejian Fu, Kevin Bowman, Susan Kulawik, Kengo Sudo, Yugo Kanaya, Masayuki Takigawa, Koji Ogochi, Henk Eskes, Benjamin Gaubert, Jerome Barre, Thomas Walker, Louisa Emmons

AS40-A024	Urban and Industrial VOC Signatures in the Seoul Region during KORUS-AQ	Isobel Simpson (*University of California, Irvine),* Donald Blake, Nicola Blake, Simone Meinardi, Barbara Barletta, Louisa Emmons, Jason Schroeder, David Peterson, Christoph Knote, Jung-Hun Woo
AS40-A027	Tropospheric Ozone Profile Maps from the Synergic Observation of AIRS and OMI: Updates on Validation and Science Application for KORUS-AQ	Dejian Fu (*Jet Propulsion Laboratory, California Institute of Technology),* Kazuyuki Miyazaki, Susan Kulawik, Kevin Bowman, John Worden, Robert Herman, Greg Osterman
AS40-A028	Factors Influencing Ozone Variability in Major Cities in Korea	Limseok Chang (*National Institute of Environmental Research, Korea),* Jeong-Soo Kim, Deok-Rae Kim, Yonghee Lee, Ara Cho, Hyunju Park, TaeHee Kim

Second KORUS-AQ Science Team Meeting

27-31 August 2018 (Save the dates on your calendar)

The Beckman Center at UC-Irvine:
www.thebeckmancenter.org

Similar to the discussion at the first meeting, we will need to assess progress and establish important findings for the Final Science Synthesis Report to the Korean Ministry of the Environment scheduled for release in early 2019.

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	Under Review
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	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: characterization of organic aerosol mass spectra	Aerosol Science and Technology	Under Review
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 over Seoul, South Korea, during KORUS-AQ	Atmospheric Chemistry and Physics	In prep

Publications (4)

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, Donald R. Blake, William H. Brune, Andrew J. Weinheimer, Alan Fried, James Crawford, and Jason 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

DC-8 Merge Update

- Updated versions of the DC-8 merges (revision R4) are now available on the archive (https://www-air.larc.nasa.gov/cgi-bin/ArcView/korusaq?MERGE=1).
- These merges incorporate all data available as of February 07, 2018, including updated LARGE-SMPS, LARGE-APS, DACOM, HDSP2-BC-fRH, and PTRMS-NMHCs datasets.
- Users are strongly encouraged to consult the readme for more detailed information about the merges, including comments/changelogs for all the merges so far, a list of variables included in the current merge and their sources, and a list of all files used for the current merge

Air Pollution Regimes near South Korea Identified with KORUS-OC Cruise and Satellite Data

Tyler P. Boyle [1,2]

Ryan M. Stauffer [2]

Anne M. Thompson [2]

Debra E. Kollonige [1,2]

[1] University of Maryland
[2] NASA/Goddard

Research Update- 12 February 2018

KORUS-AQ Data Used in Study

KORUS-AQ Archive

AVDC Pandora Archive

Pandora Spectrometer

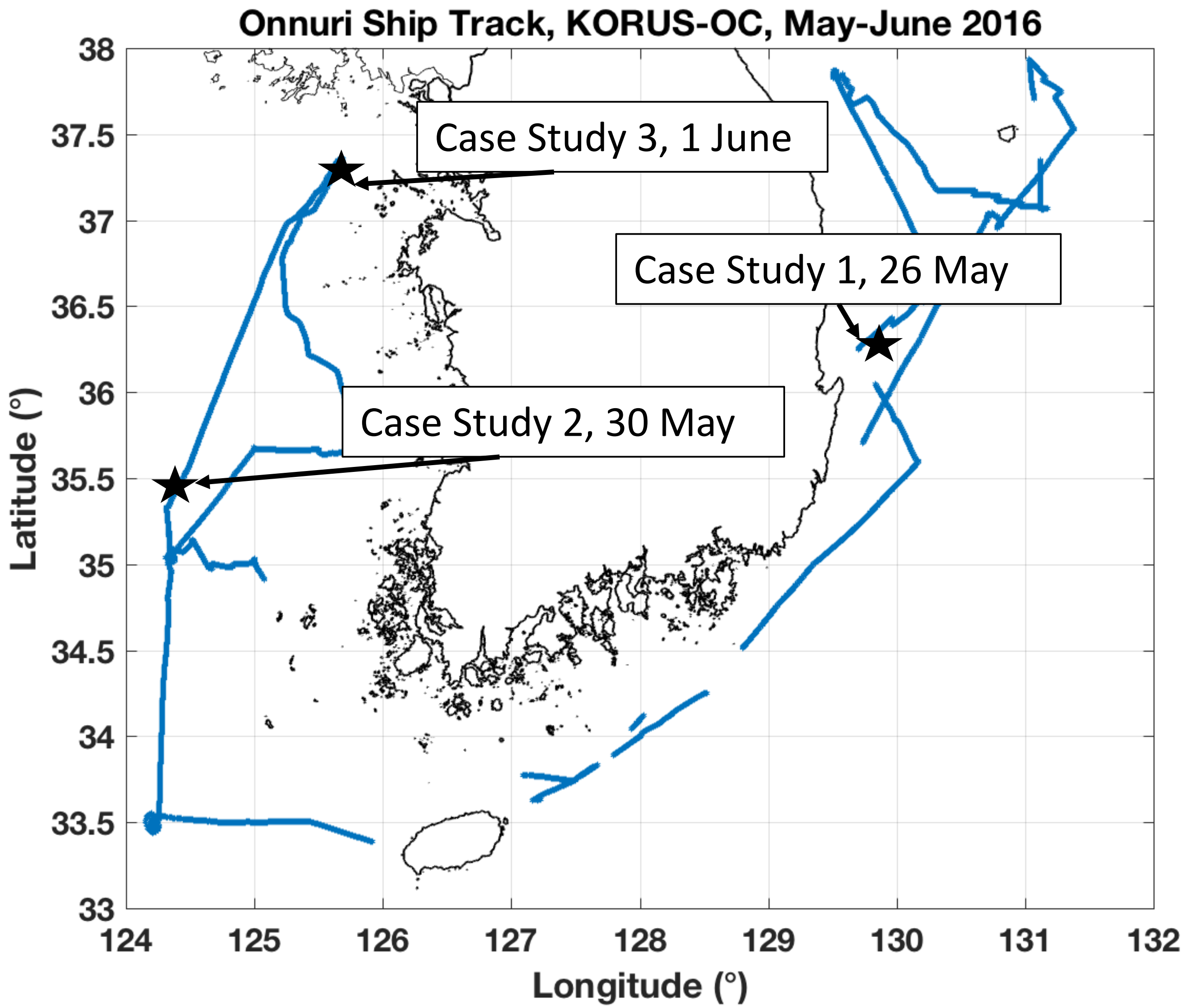
NATIVE Analyzers

Instrument	Data	Platform
Pandora	Total Column O_3 and NO_2	R/V Onnuri and Busan
NATIVE Analyzers	Surface O_3 and NO_2	R/V Onnuri
In Situ Analyzers	Surface O_3 and NO_2	DC-8
NIER Analyzers	Surface O_3 and NO_2	Busan

KORUS-AQ: https://www-air.larc.nasa.gov/cgi-bin/ArcView/korusaq?DC8=1
AVDC: https://avdc.gsfc.nasa.gov/pub/DSCOVR/Pandora/DATA/KORUS-AQ/Onnuri/

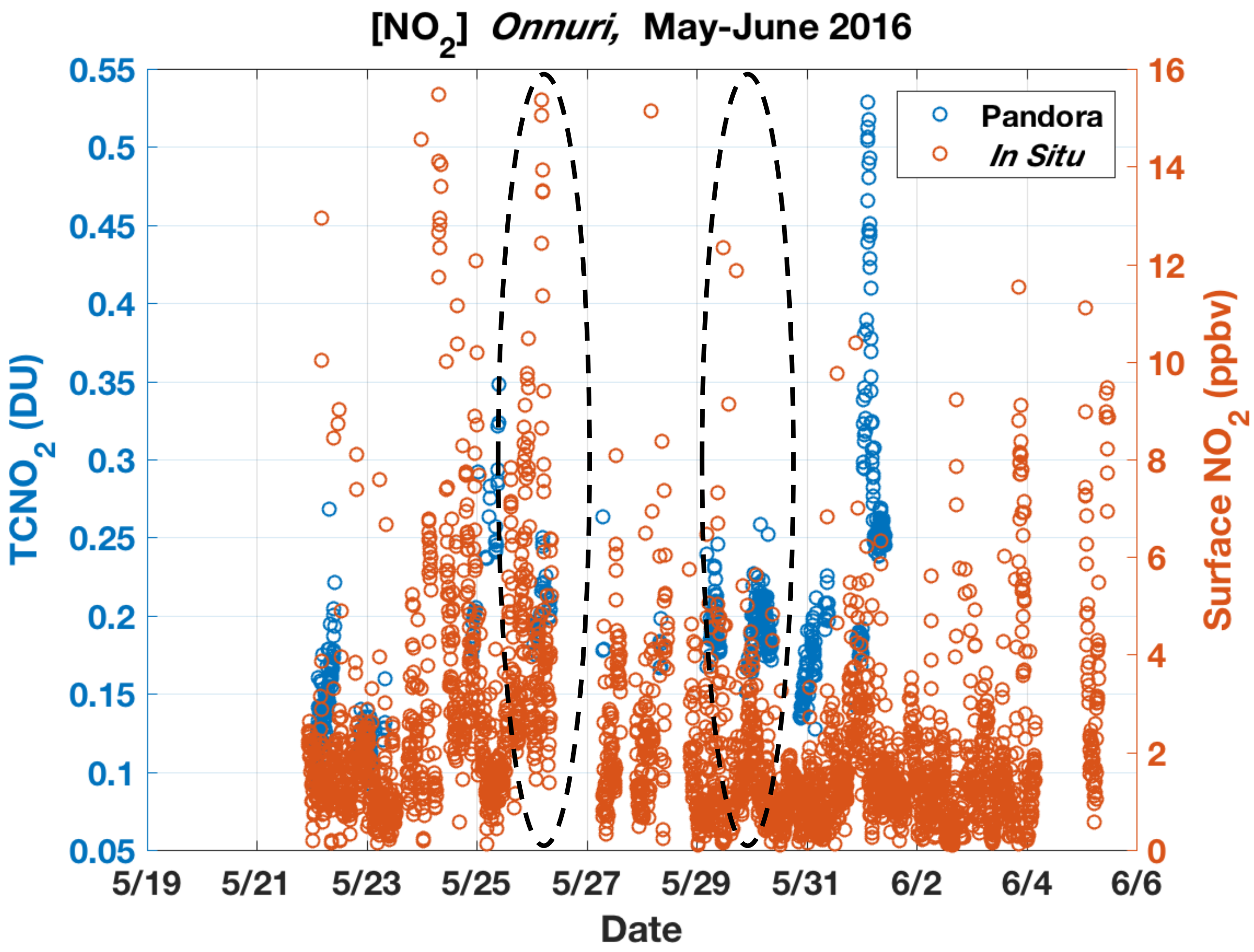
NATIVE: Nittany Atmospheric Trailer and Integrated Validation Experiment
NIER: National Institute of Environmental Research

Research Goals



- Perform 3 case studies during KORUS-OC
- Case Study Goals:
  - Determine usefulness of ground-based remote sensing instruments (Pandora Spectrometers) for measuring surface pollution
  - Do total column (TC) NO_2 observations follow similar patterns as surface NO_2?
  - Understand causes of occasional disagreement among surface and total column observations
  - Identify sources of pollution along the ship track

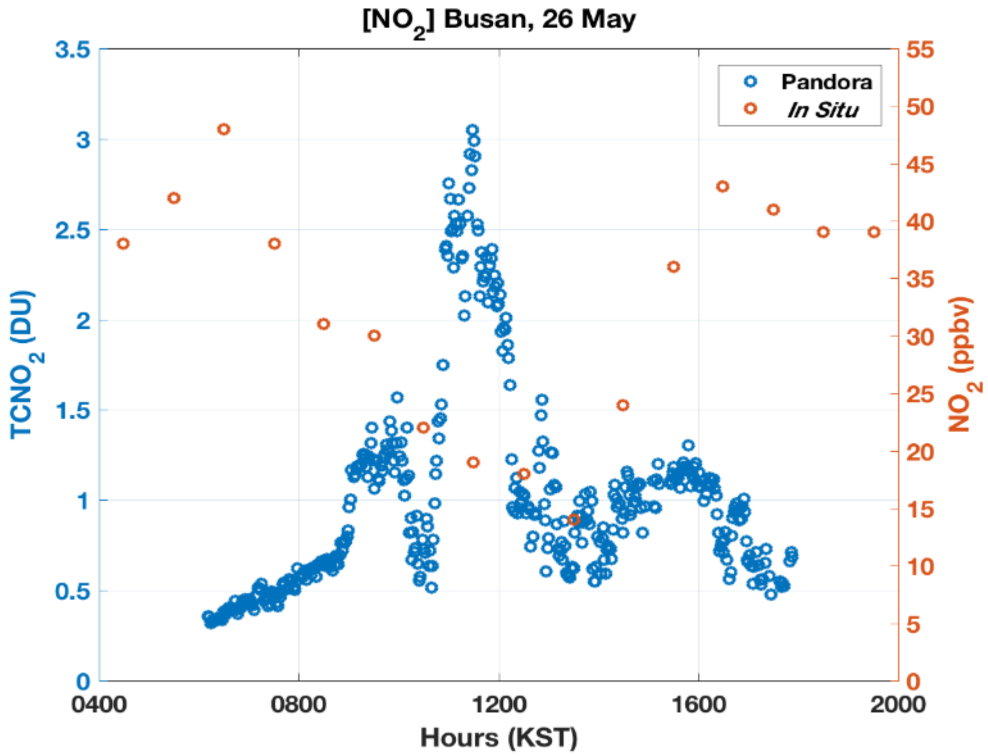
Case Study Overview

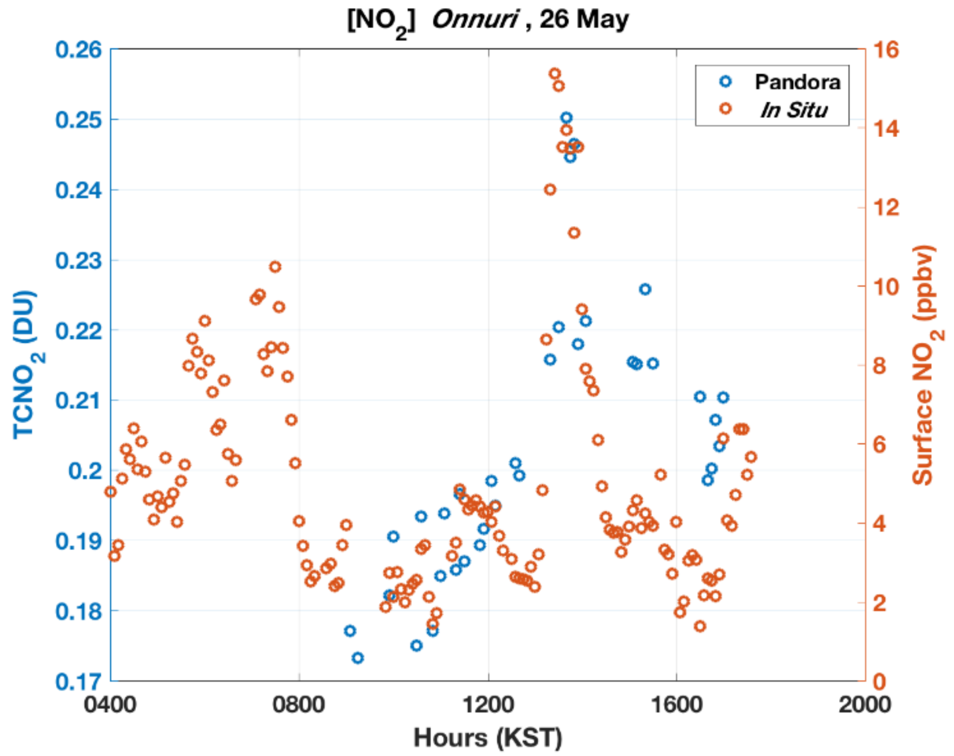


Case Study 1   Case Study 2

- Case Study 1 (**26 May**)
  - O_3 concentrations exceeded both 1hr (100 ppbv) and 8hr (60 ppbv) S. Korean standards
  - Highest O_3 concentrations over entire mission on this day. Max = ~160 ppbv
- Case Study 2 (**30 May**)
  - DC-8 spiral above and overpass of the *Onnuri* of 130 m
  - Strong gradients of trace gases observed between the ship and the plane
    - Much greater pollution observed by the DC-8
    - Temperature gradients and surface decoupling

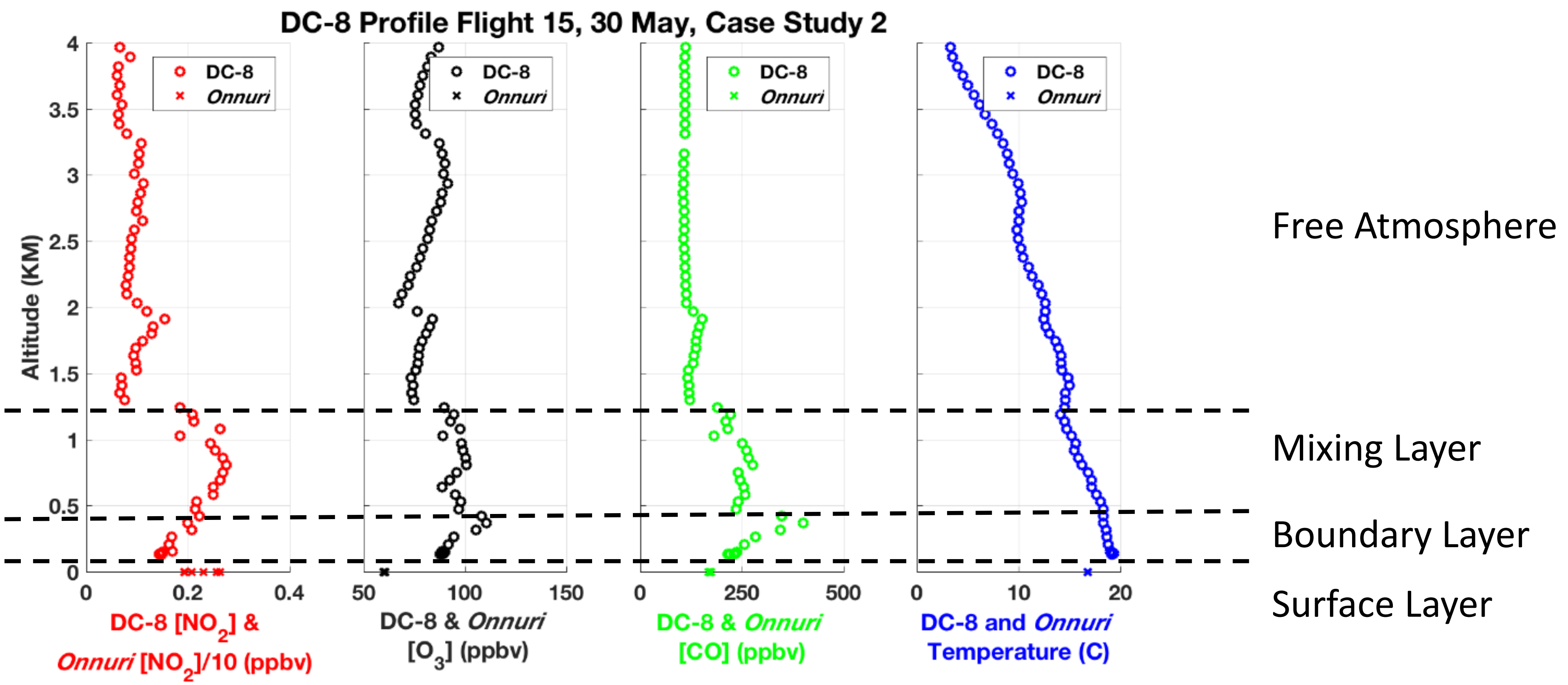
Case Study 1 Results





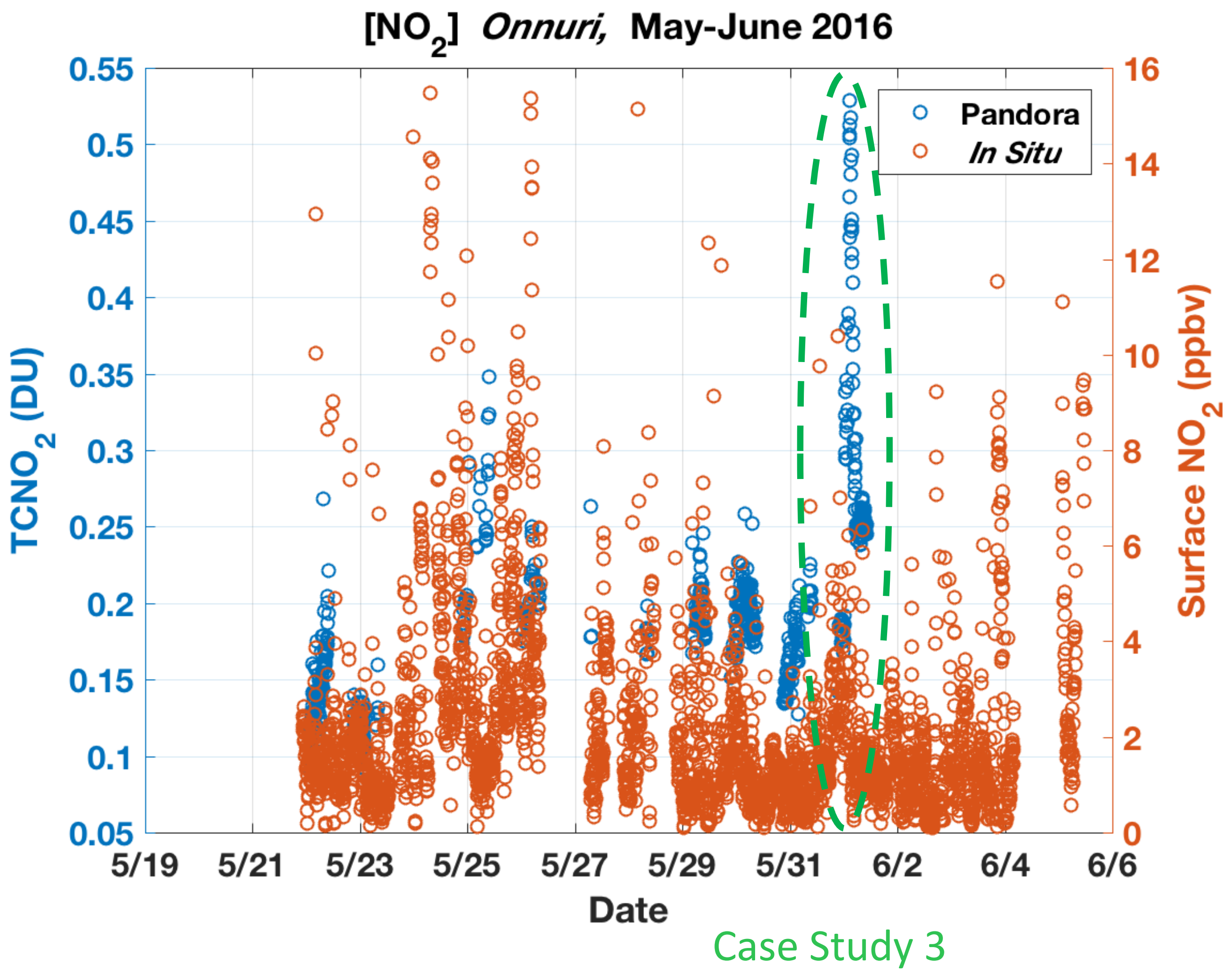
- Episodes seen at Busan and the *Onnuri* were part of regional pollution episode
  - NO_2 rich air near the source at Busan (**left**)
  - O_3 rich air near the *Onnuri* (not shown)
- Surface and atmosphere above appear disconnected at Busan. Better surface/column correspondence at *Onnuri* (**right**)
- Chemical conversion of NO_2 to O_3 as the air mass advected northward

Case Study 2 Results



- Strong gradients of trace gases observed between ship and DC-8 during spiral
  - Large NO_2 concentrations at the surface
  - Large O_3 and CO concentrations aloft
- Temperature inversions led to a decoupling of the atmosphere, separating near-surface air into layers

Preliminary Conclusion and Future Work



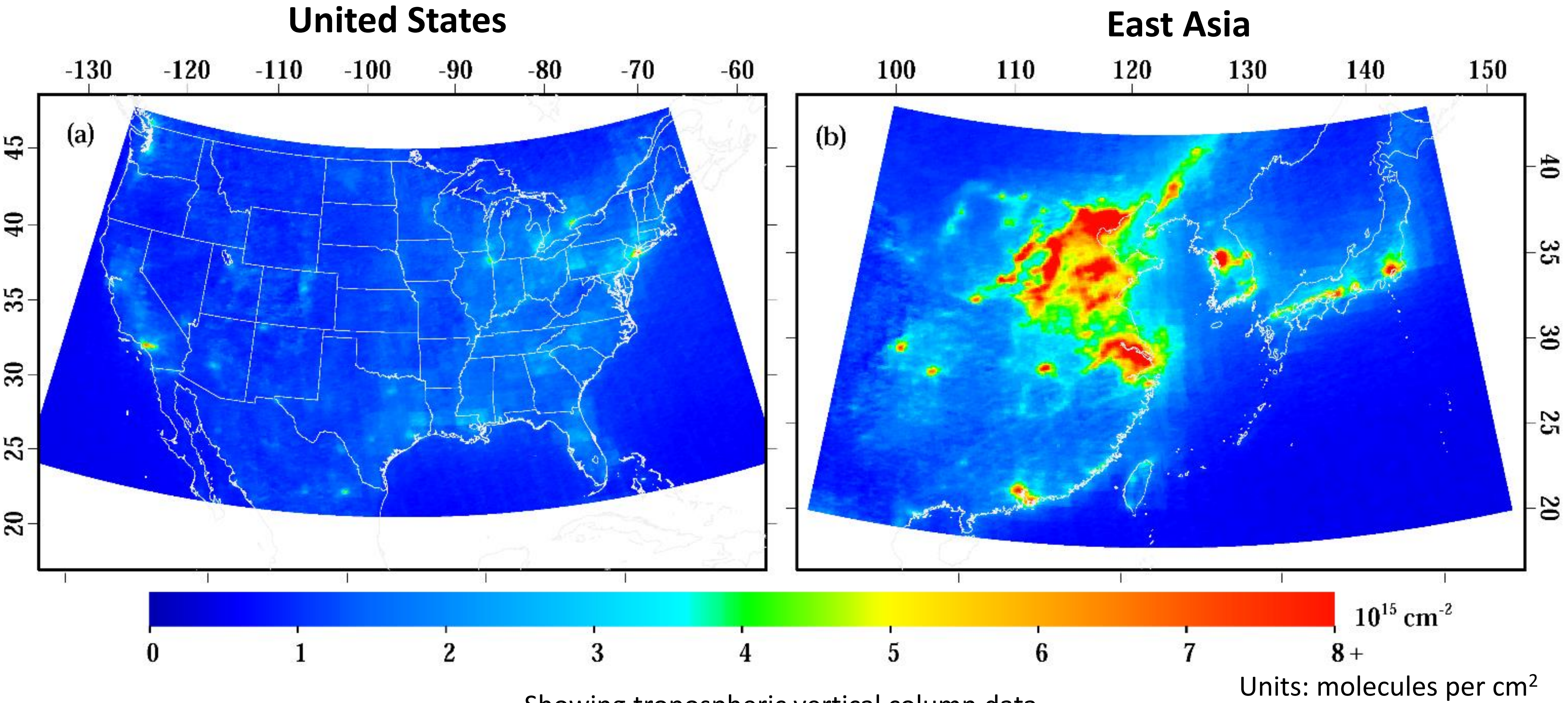
- Case studies illustrate the complexity of interpreting sources when surface observations do not correlate with observed pollution aloft
- Future work will be Case Study 3 (1 June) which suggests another case of disconnect between surface and column observations

A high-resolution OMI NO_2 product for Korea during KORUS-AQ and using it to derive NOx emissions in Seoul

Presentation by: Dan Goldberg, Argonne National Laboratory
KORUS-AQ Monthly Telecon: February 12th, 2018

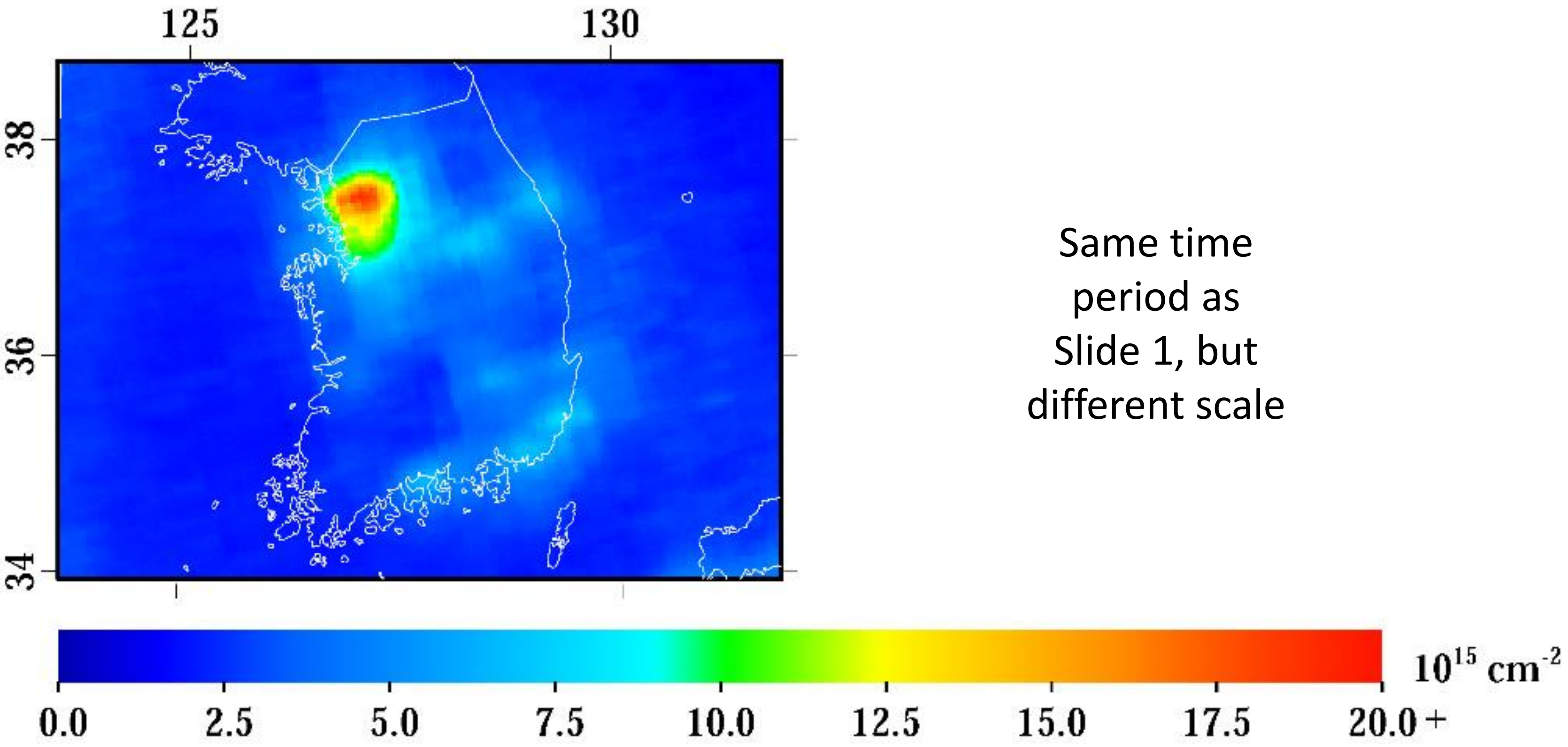
With lots of help from: Pablo Saide, Zifeng Lu, Greg Carmichael, David Streets
Bottom-up emissions inventory developed by: Jung-Hun Woo and group
In situ Aircraft NO_2 data provided by: UC-Berkeley group
Pandora NO_2 data provided by: Pandora project team

OMI NO_2: May – Sept, 2015 – 2017



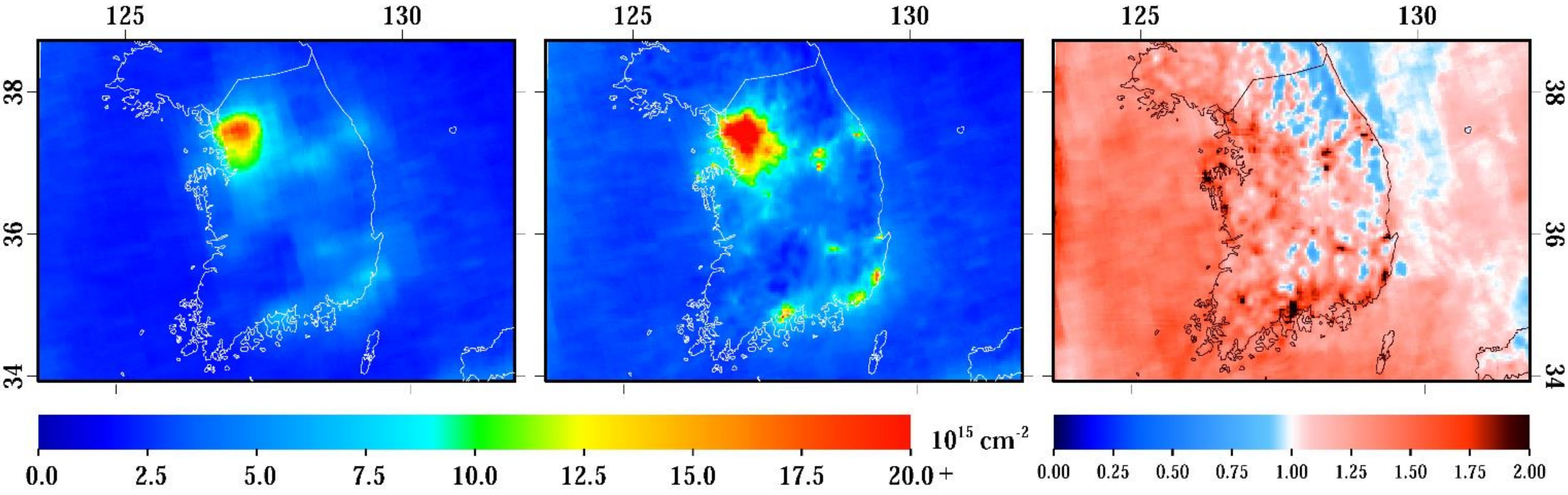
Showing tropospheric vertical column data

OMI NO_2 standard product



Same time period as Slide 1, but different scale

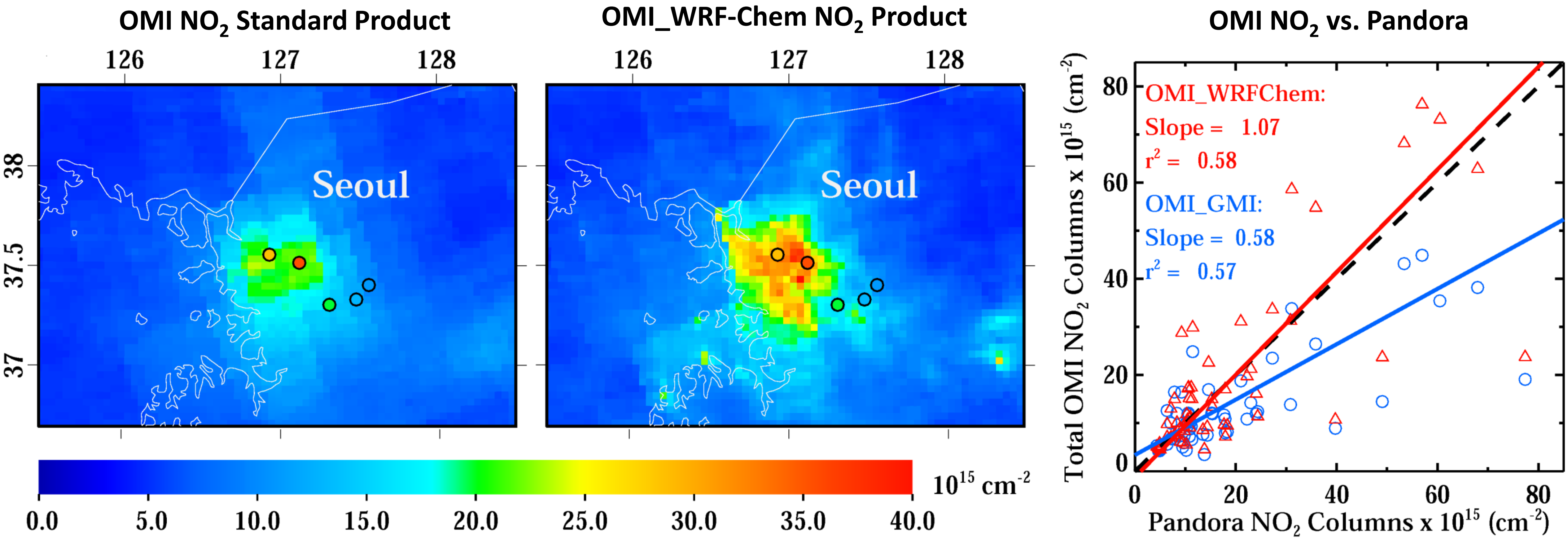
OMI NO_2 standard product | **OMI_WRF-Chem NO_2 product** | **Ratio: OMI_WRF-Chem NO_2 / OMI NO_2**



For more info on the methodology see:
Goldberg et al., 2017; ACP

Re-calculate the Air Mass Factor (AMF) to develop a higher resolution satellite observation
Also, we spatially weight the retrieval based on the model variability (H.C. Kim et al., 2016; AMT)

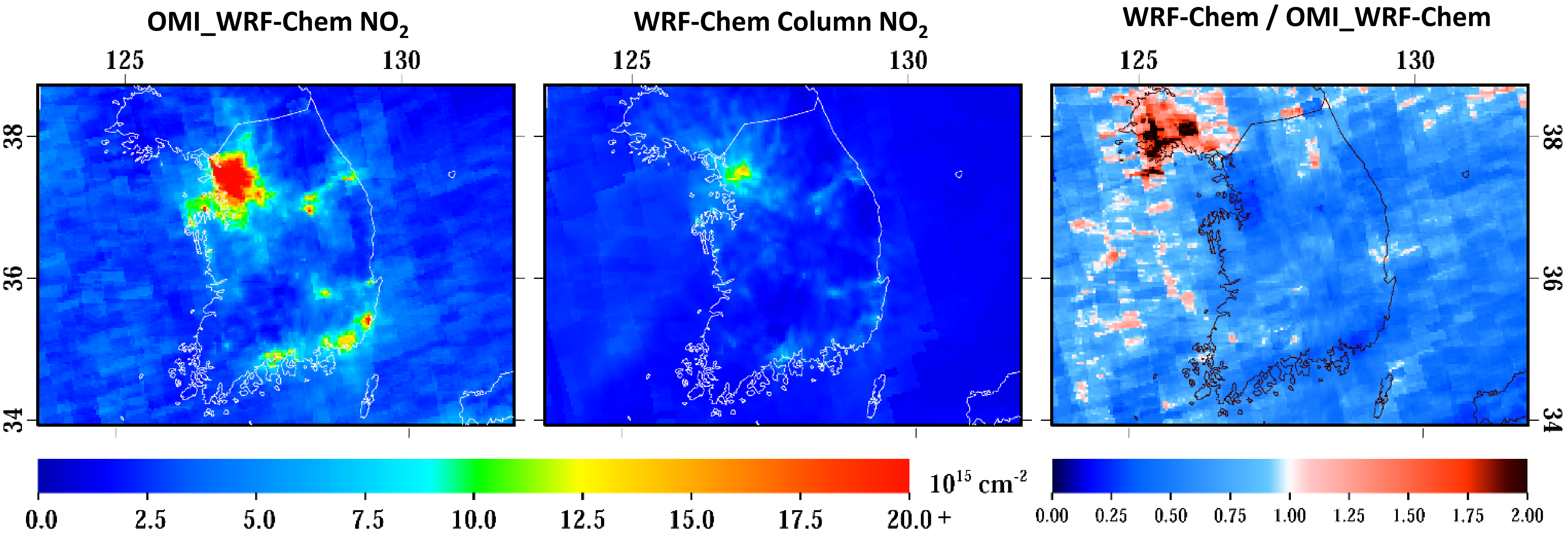
Same time period as Slide 1



Pandora 2-hour means co-located to valid daily OMI overpasses. New OMI product shows much better agreement with total column measurements from Pandora NO_2 (slope near unity).

Showing **total** vertical column data

Model (WRF-Chem) vs. Satellite (OMI)



Model is low throughout most of Korea, but especially so near Seoul.
Perhaps North Korean NOx is overestimated.

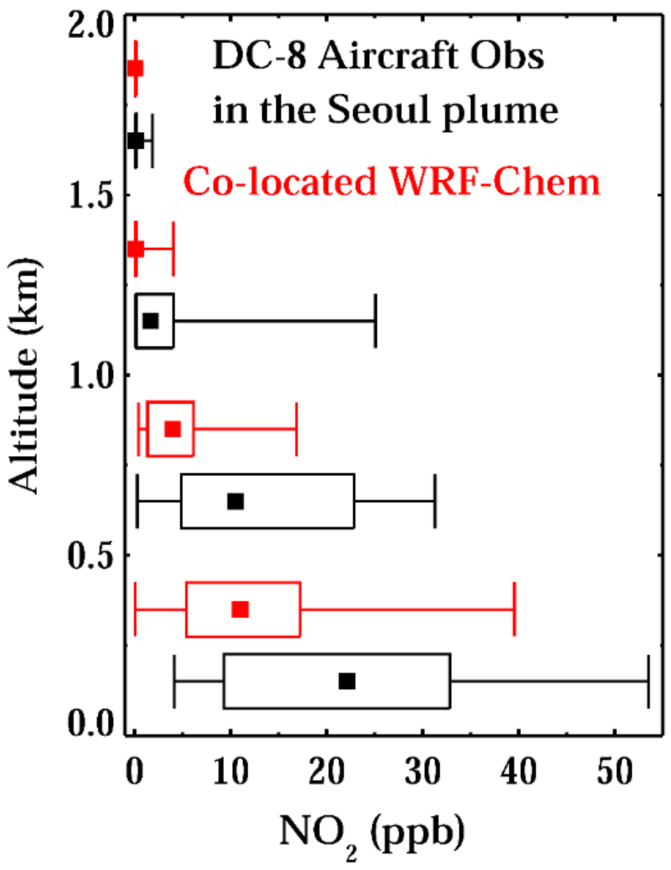
WRF-Chem model details

- Model simulation is a "forecast" simulation that was used during KORUS-AQ
- Model spatial resolution: 4 km
- Emissions inventory: Version 1 developed for the campaign
- Simplified chemistry mechanism

Ask Pablo Saide for more details

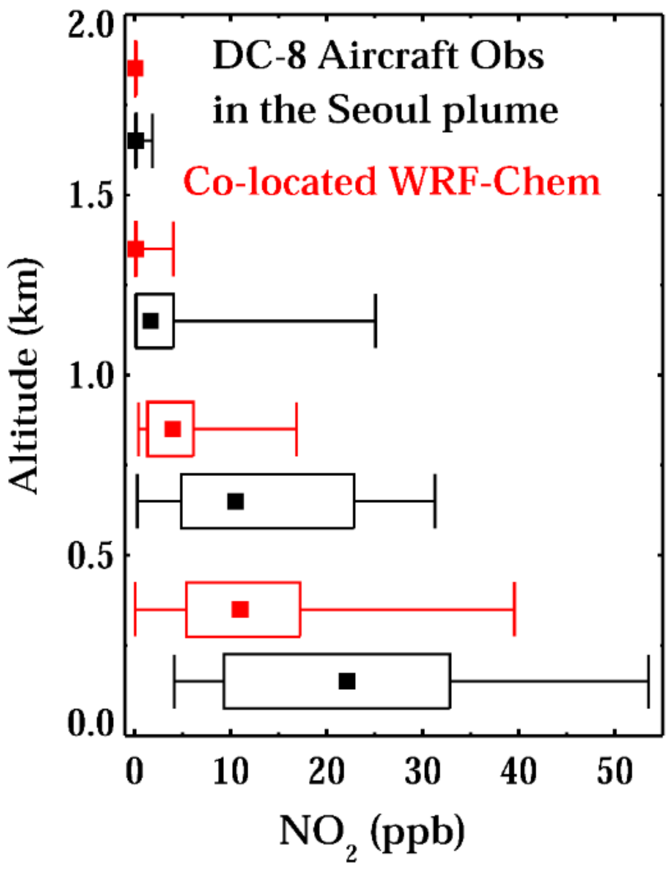
WRF-Chem compared to DC-8 observations

Original simulation

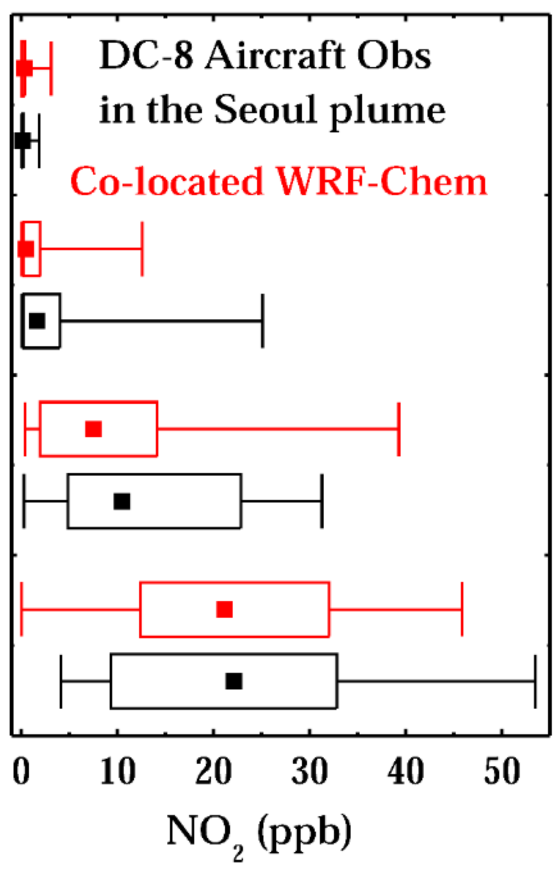


WRF-Chem compared to DC-8 observations

Original simulation



2 × NOx simulation



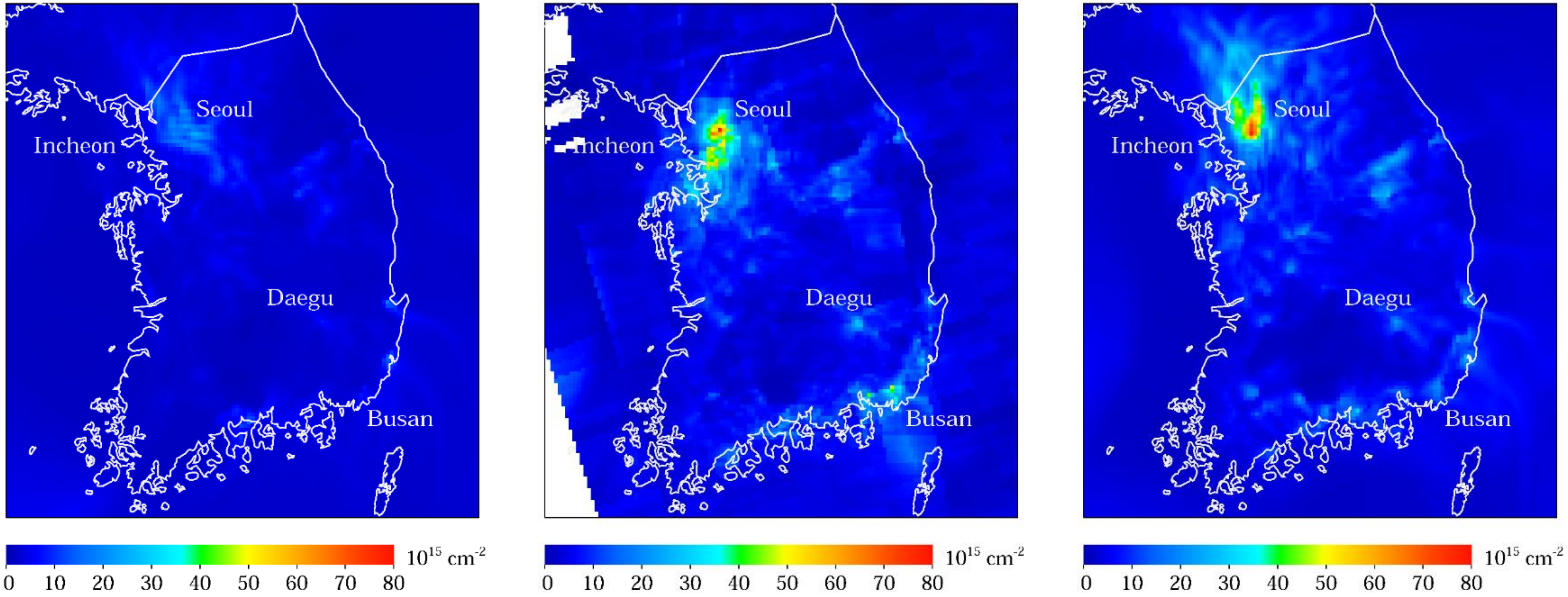
Showing results for May 17th and May 18th in Seoul Metro Area only

- 2 × NOx simulation has better agreement near the surface

WRF-Chem now better agrees with OMI NO_2

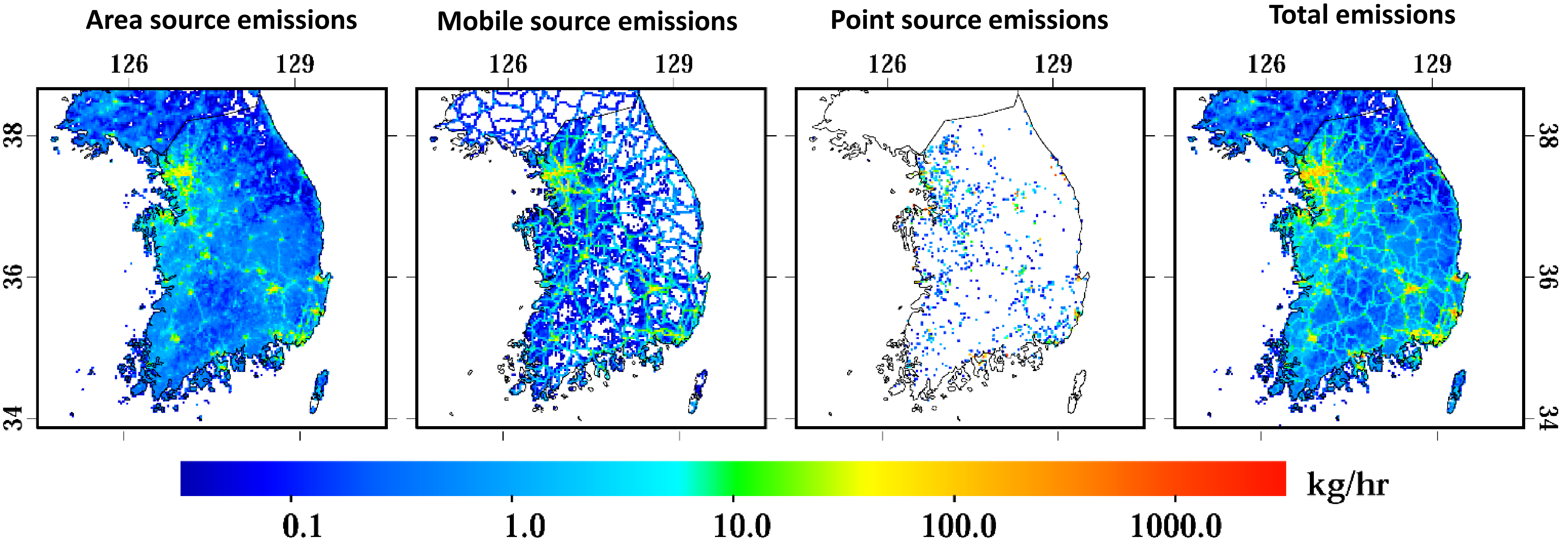
Showing results for May 17th and May 18th only

Original WRF-Chem simulation | Hi-res OMI NO_2 product | 2 × NOx WRF-Chem simulation



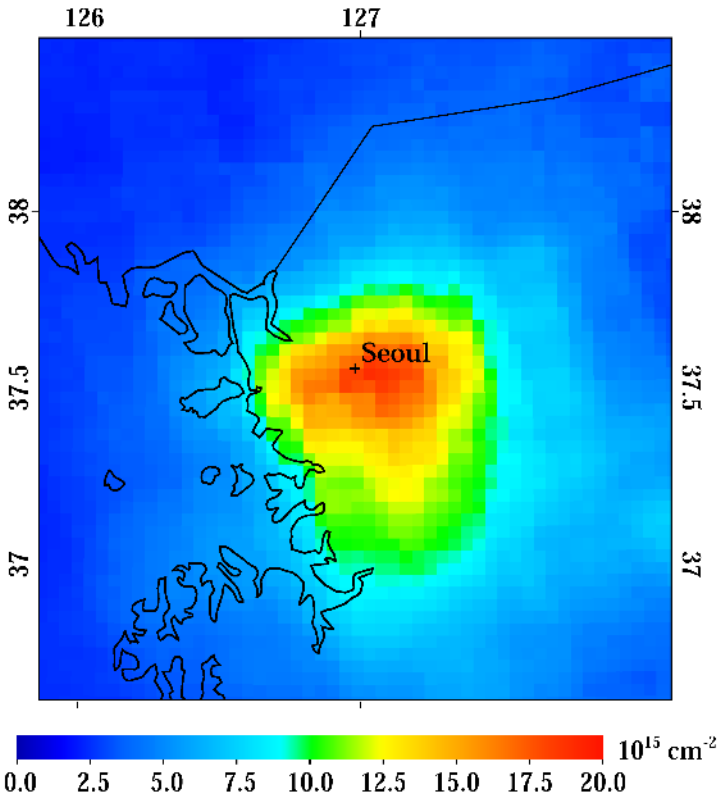
- Showing tropospheric column contents
- Perhaps 2 × NOx is a bit too high, but it is much closer to reality

Bottom-up NOx emissions inventory Version 2; Showing Apr – Jun 2015 average



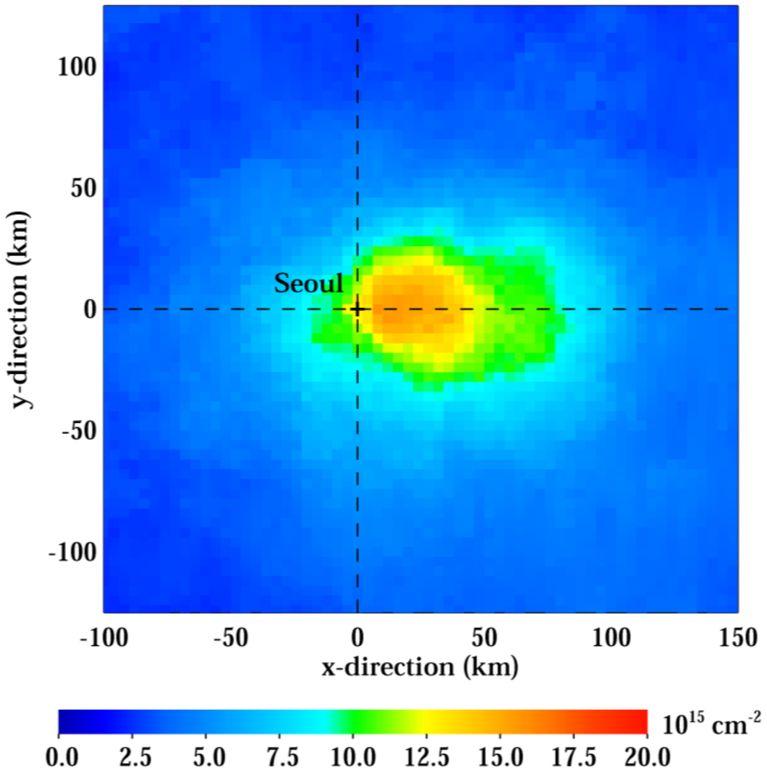
Area source	Mobile source	Point source	Total
Seoul: 9.2 Mg/hr 32.2% of total	Seoul: 9.2 Mg/hr 32.1% of total	Seoul: 10.2 Mg/hr 35.7% of total	Seoul: 28.6 Mg/hr
In USA: 25% of total	61% of total	14% of total	based on 2011 NEI

Deriving NOx emissions using a top-down exponentially modified Gaussian (EMG) fit



Rotate based on wind direction

*Only include days when wind > 3 m/s



Calculate NO_2 Burden and Lifetime based on an exponentially modified Gaussian fit:

$$E = 1.32 \cdot \alpha / \tau_{\text{effective}} = 1.32 \cdot \alpha \cdot w / x_0$$

NO_x emissions

NO_x/NO_2 ratio

Burden (Mg)

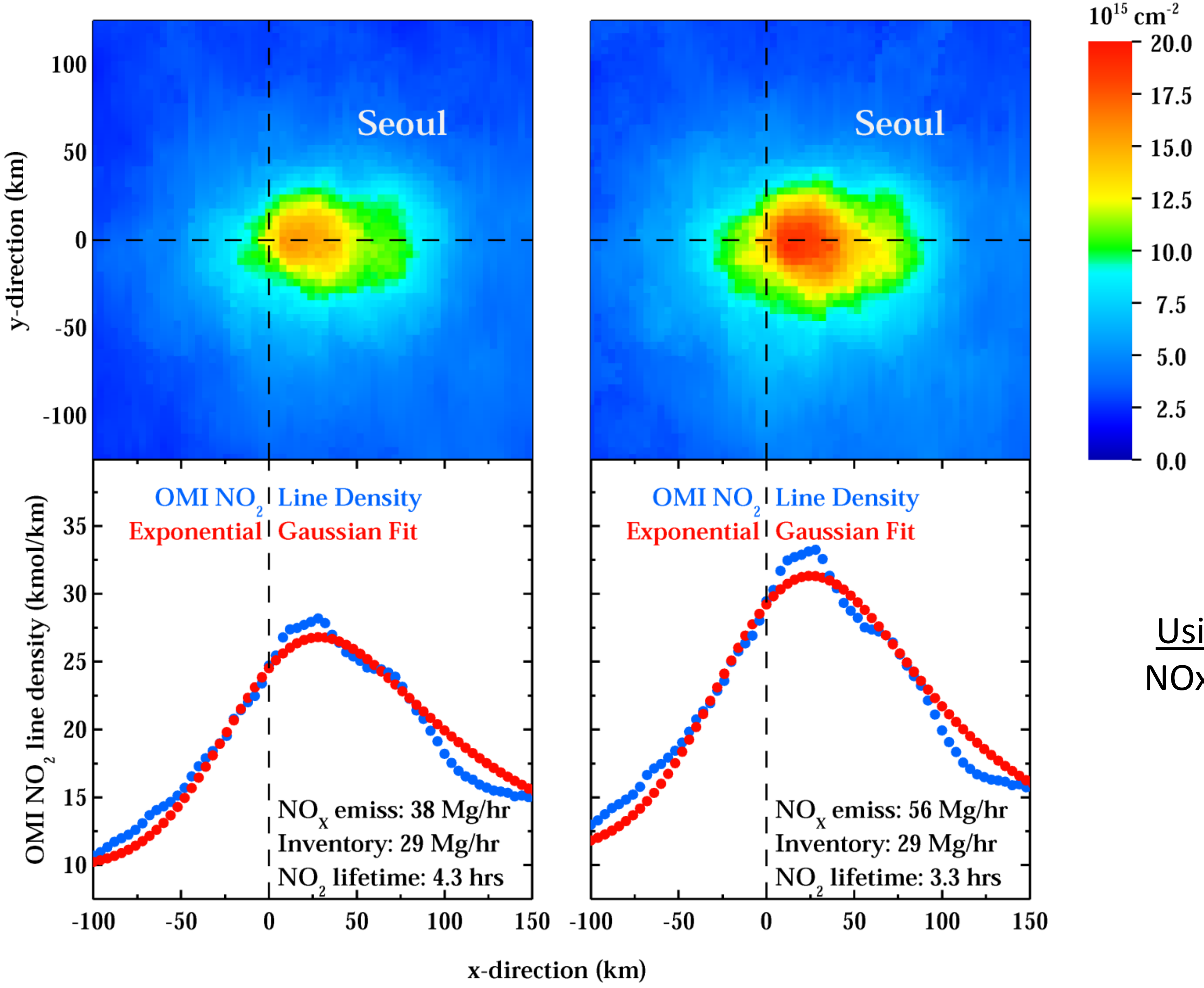
Wind speed (km/hr)

Decay distance (km)

See Lu et al., 2014; ACP, for methodology

NOx emissions estimates for Seoul, Korea

Using standard product:
NOx emissions should be increased by 1.3



Using our new product:
NOx emissions should be increased by 1.9

Conclusions

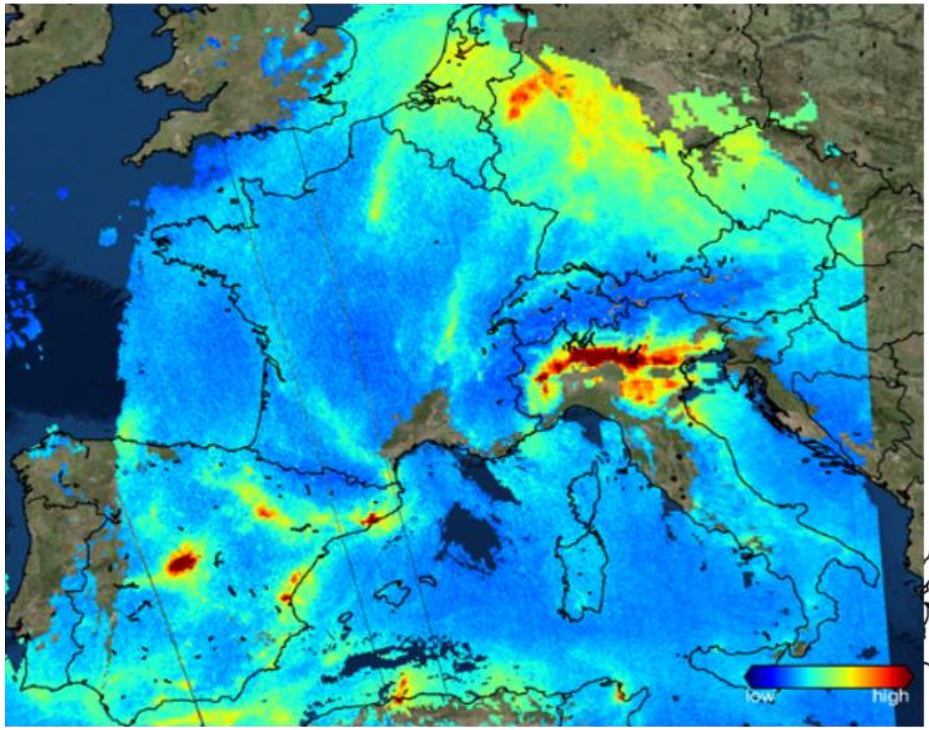
- NOx emissions from cities in east Asia, including Seoul, are (still) quite a bit larger than big US cities (e.g., Los Angeles & New York City)

- Our new OMI NO_2 product shows much better agreement with Pandora NO_2

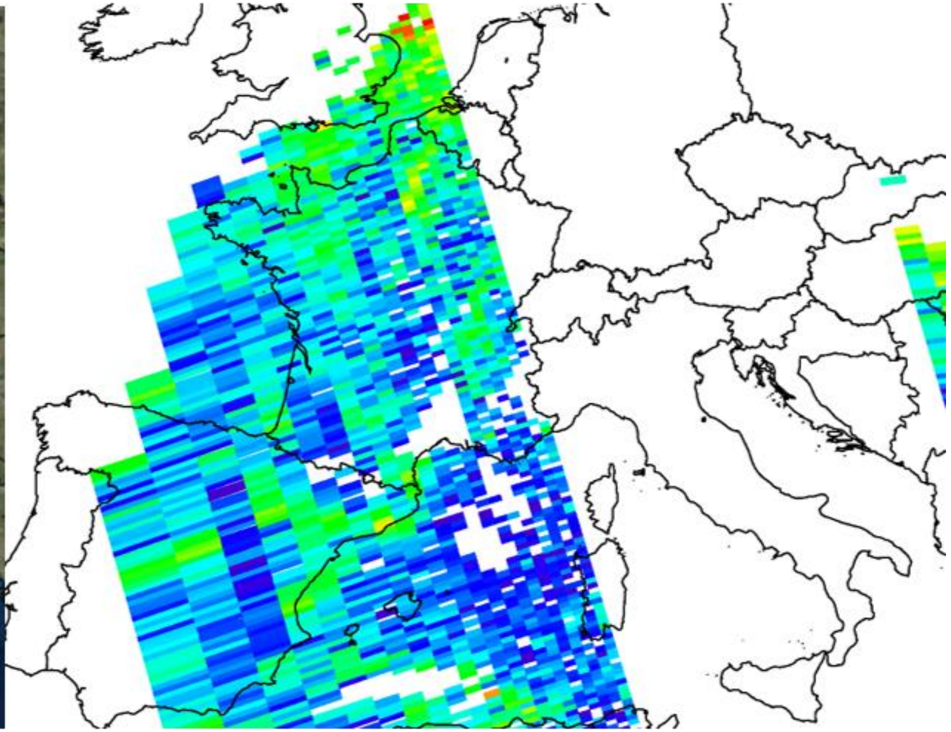
- All evidence points towards a current underestimate of NOx emissions in Seoul
  - Our estimate is that an increase of 1.9 × is sufficient

Hopefully further advances can be made by TROPOMI

TROPOMI NO_2



OMI NO_2



Column NO_2 (an air pollutant) over western Europe on November 22, 2017

Tropomi data is preliminary; colors represent relative concentrations: blue are low, red are high

Missing OMI data over central Europe is due to an artifact blocking the instrument detector (i.e., row anomaly)

KORUS-AQ CONTEST QUESTION FOR FEBRUARY

By the end of the Olympics, how many medals will Korea win?

Tiebreaker question: During the closing ceremony on 25 February, what will the air measurement vehicle station in the Olympic Village report for PM10 at 9 pm (KST)

The answer to the tiebreaker question will be taken from the following website: https://www.pyeongchang2018.com/en/sustainability/egis/airquality

To enter the contest, answers must be emailed to James.H.Crawford@nasa.gov by midnight tonight for those in the US or by 2 pm today for those in Korea.
If you are in another time zone, do the math…

PyeongChang 2018