New Ground-based Environmental Remote Sensing Stations, Aircraft and Ship-borne Campaigns and Satellite Products in Southeast Asia

"You can't manage what you can't measure."
- Peter Druker

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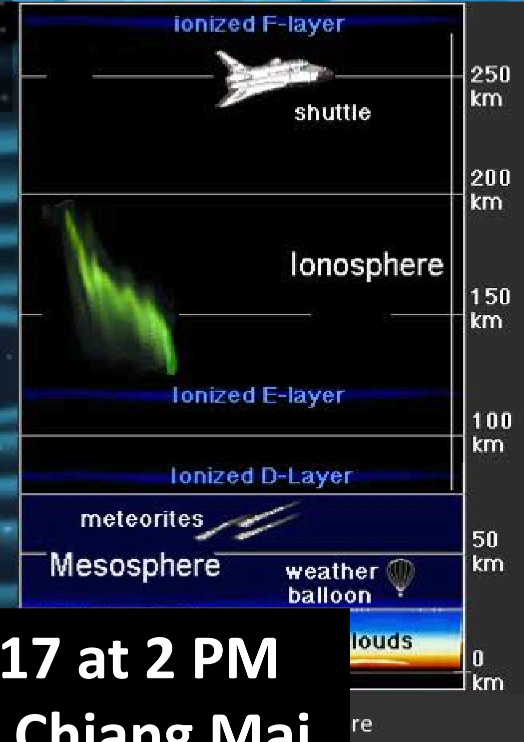
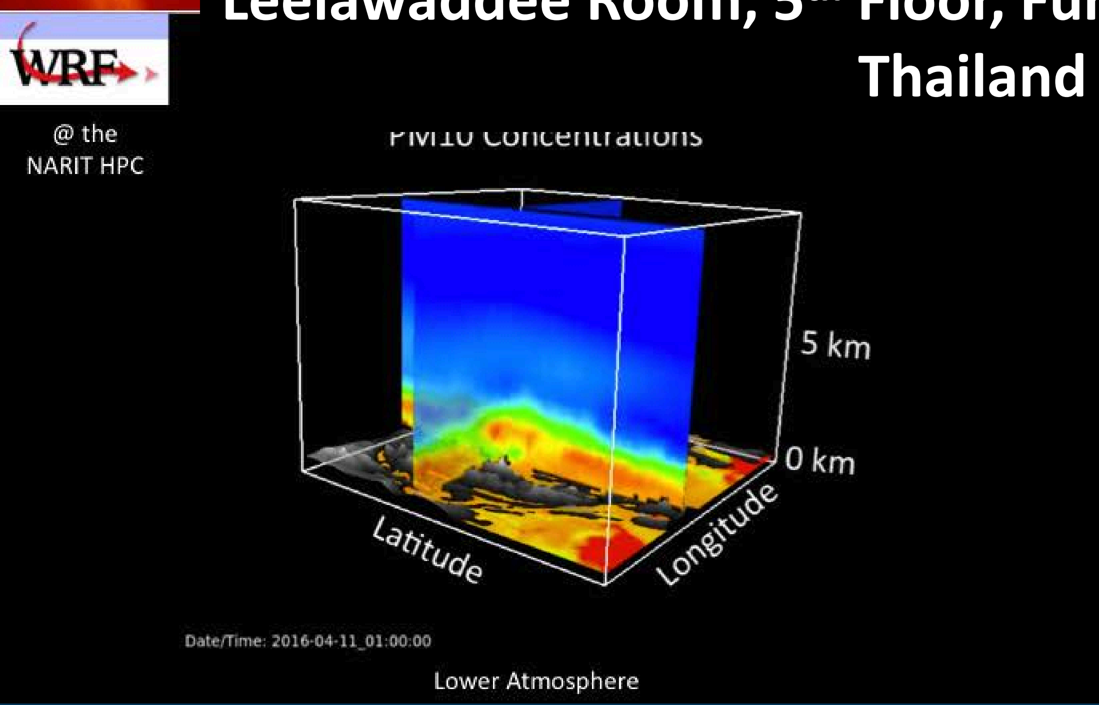
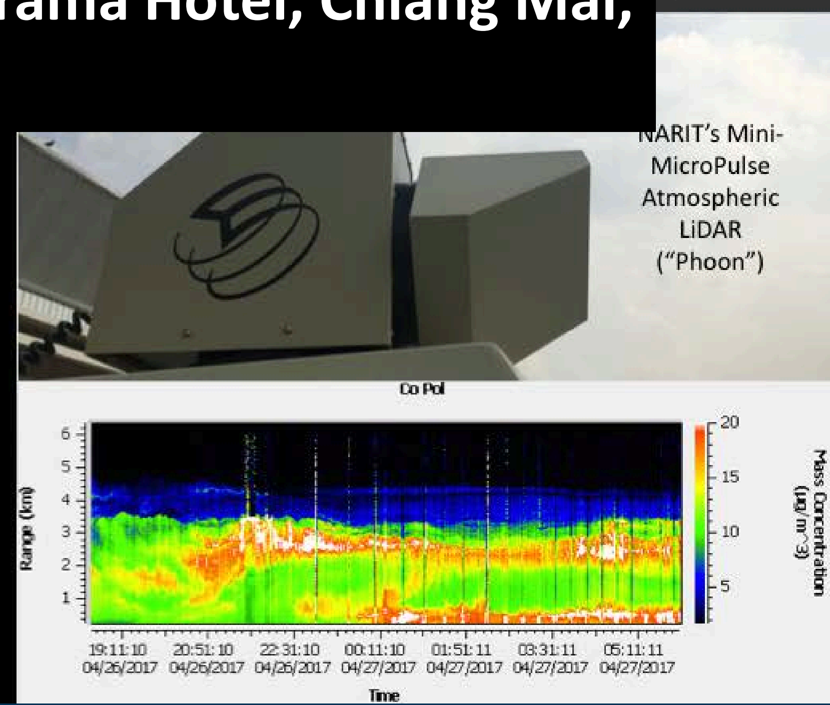
Yunhui Zheng, Thiranan Sonkaew, Gerry Bagtasa, Raman Solanki, Sherin Hasan Bran, Vichawan Sakulsipich, Voltaire Velazco, Isamu Morino, David Griffiths, Florian Schwandner, Lola Andres Hernandez, John Burrows, Kim Oanh, Mylene Cayetano, Edgar Vallar, Ma. Cecilia Galvez, Gemma Narisma and the CAMP^{2}EX Team, Olive Cabrera and the YMC Team, and Maki Kikuchi and the JAXA Himawari Team

NARIT Establishment of a National Research Center for Atmospheric Science (Oct 2016)

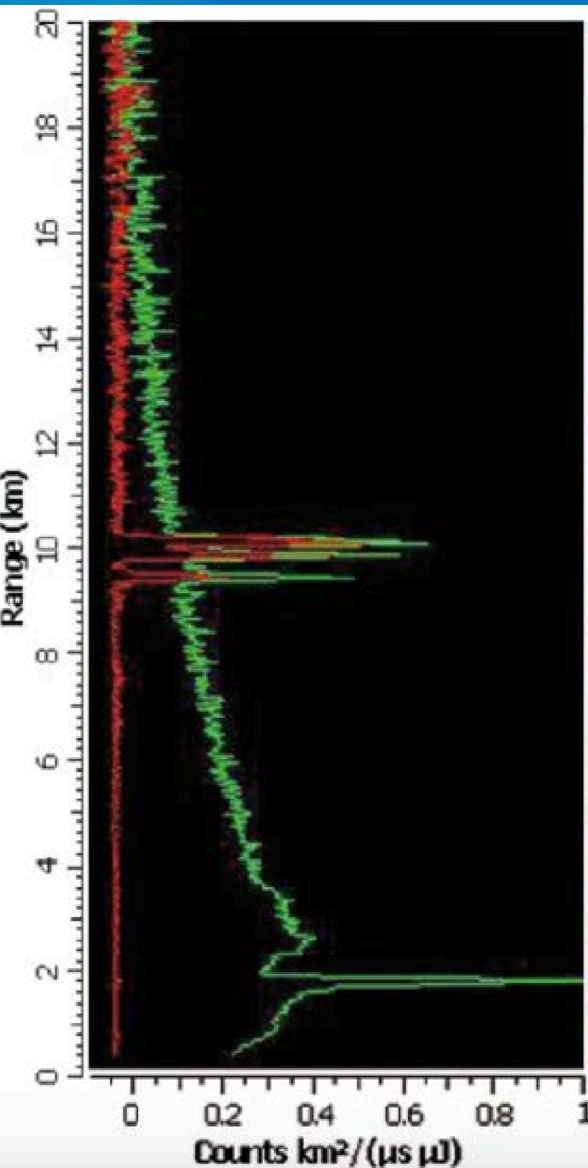


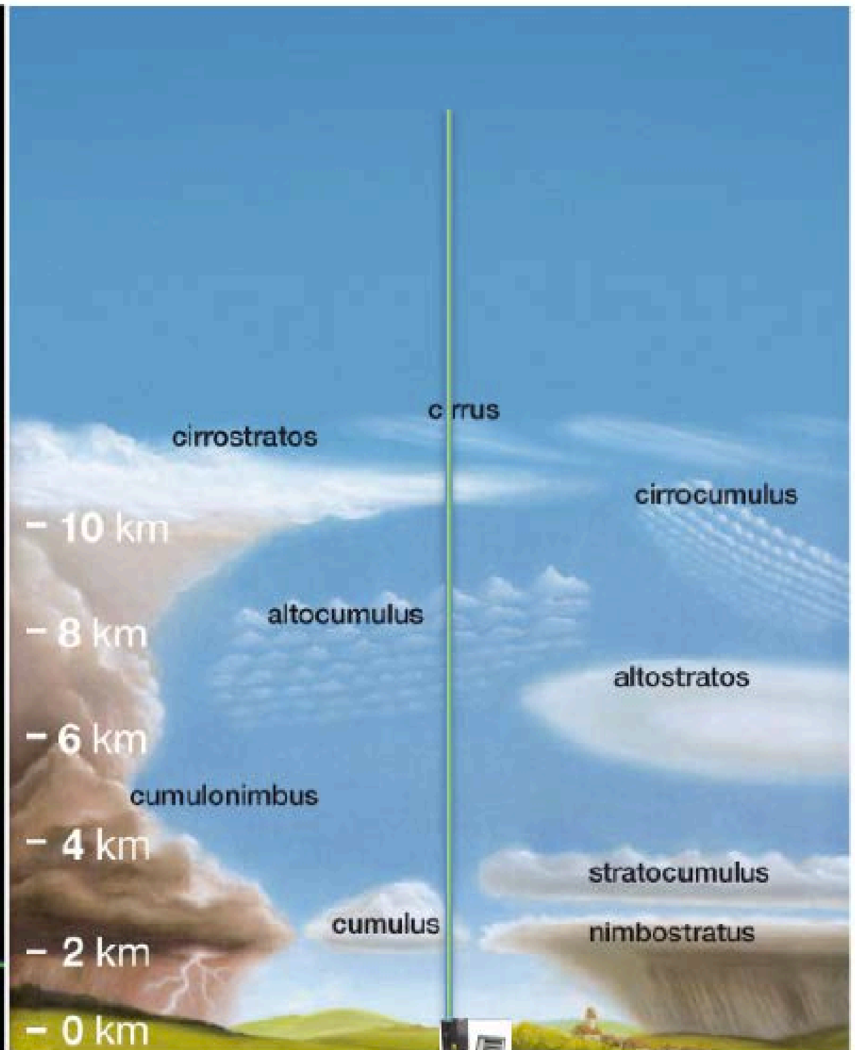
Road Mapping Side Meeting on July 18, 2017 at 2 PM Leelawaddee Room, 5th Floor, Furama Hotel, Chiang Mai, Thailand

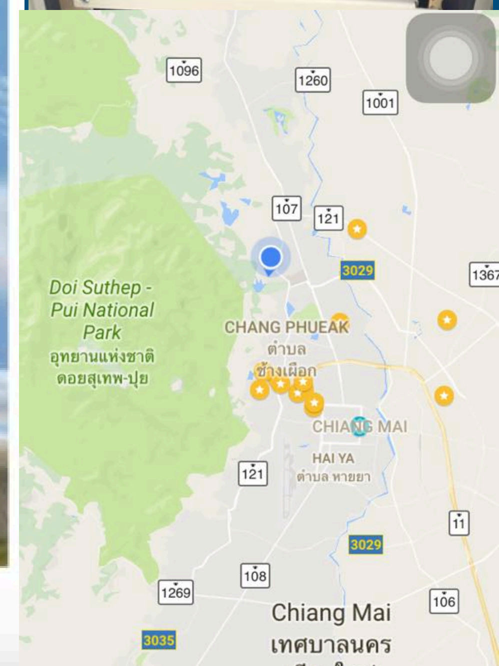




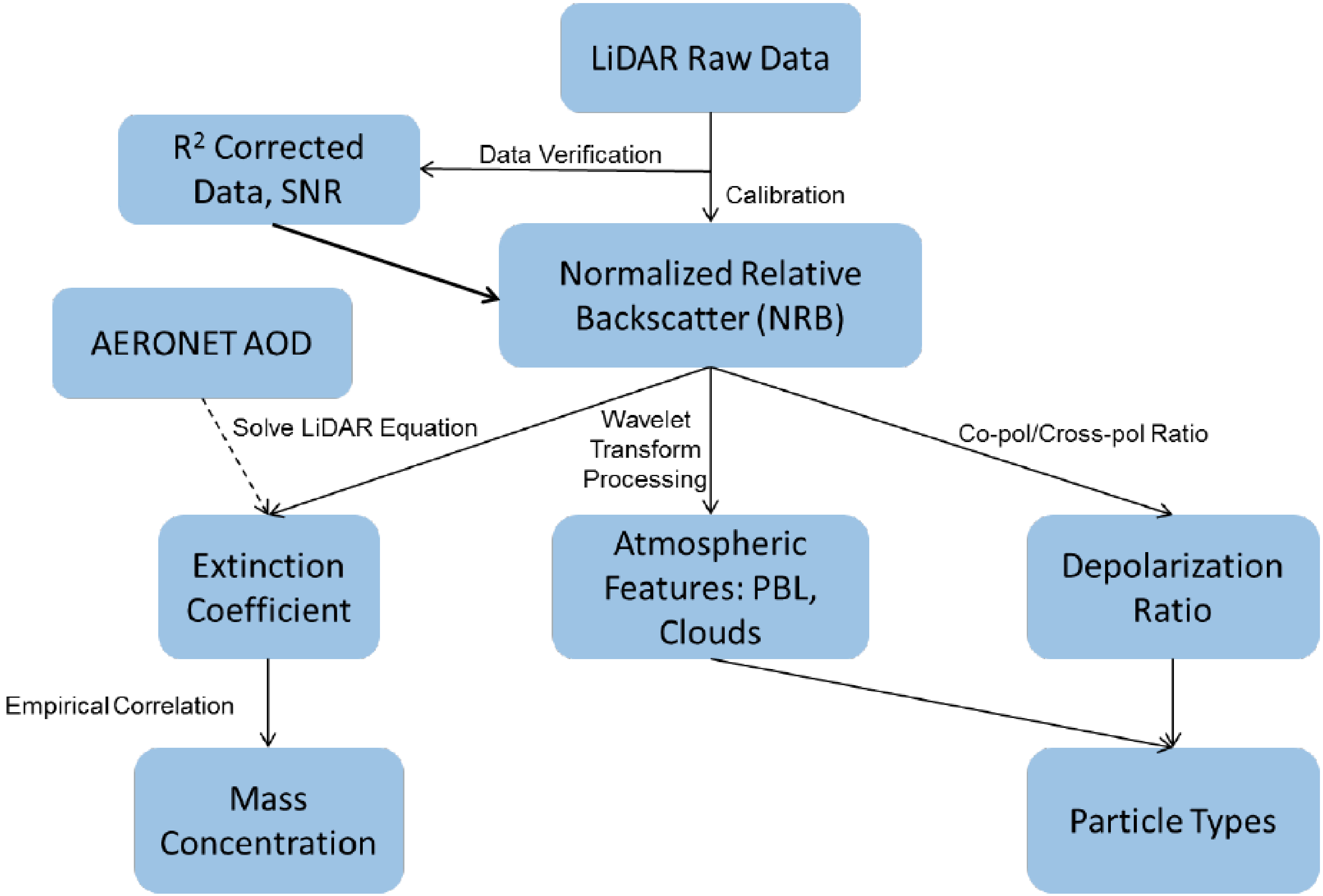
NARIT mini-Micropulse LiDAR (“Phoon” = “Dust”)



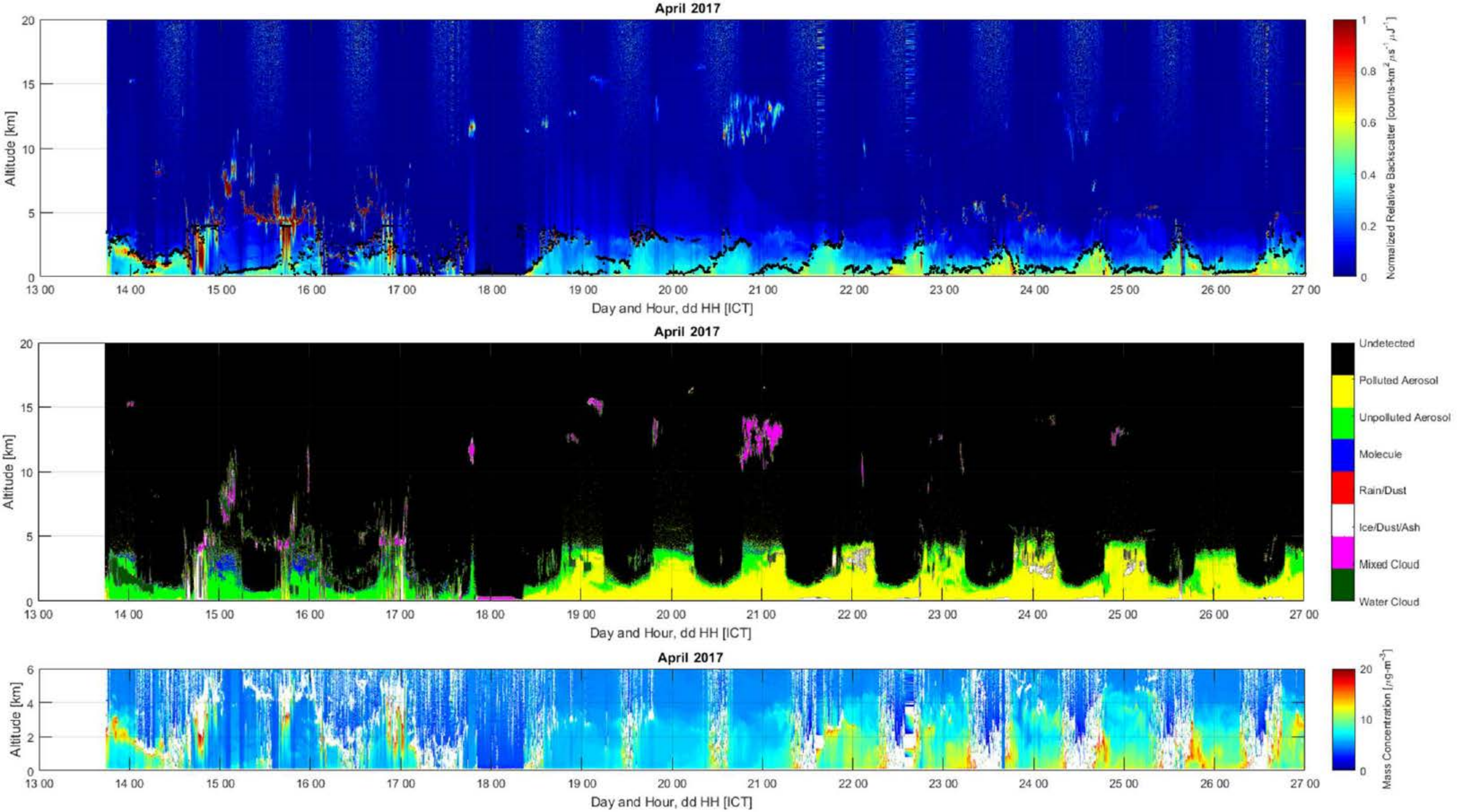




LiDAR Signals

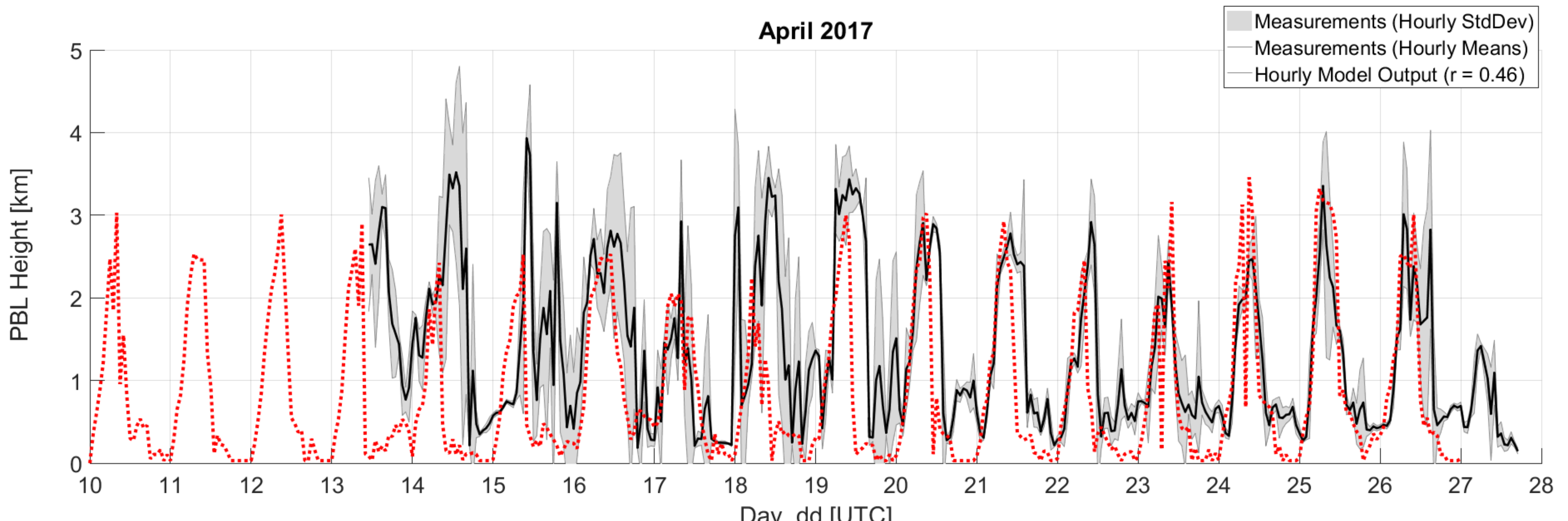


Normalized Relative Backscatter (NRB), Boundary Layer Heights, Depolarization Ratio and Extinction Coefficient



Evaluation of WRF's YSU PBL Scheme Using LiDAR Derived Mixing Heights

- WRF v. 3.7 (9 km, 3 km and 1 km nested domains)
- 0.25 deg NCEP GDAS/FNL lateral boundary conditions
- MODIS Land Use Dataset
- 3-Category Urban Canopy Model (roof, wall, road)
- Yonsei University (YSU) PBL Scheme
- Thompson Aerosol-Aware Microphysics (2001-2007 GOCART Climatology)
- Kain-Fritsch Convective Parameterization



Evaluation of WRF's YSU PBL Scheme Using LiDAR Derived Mixing Heights

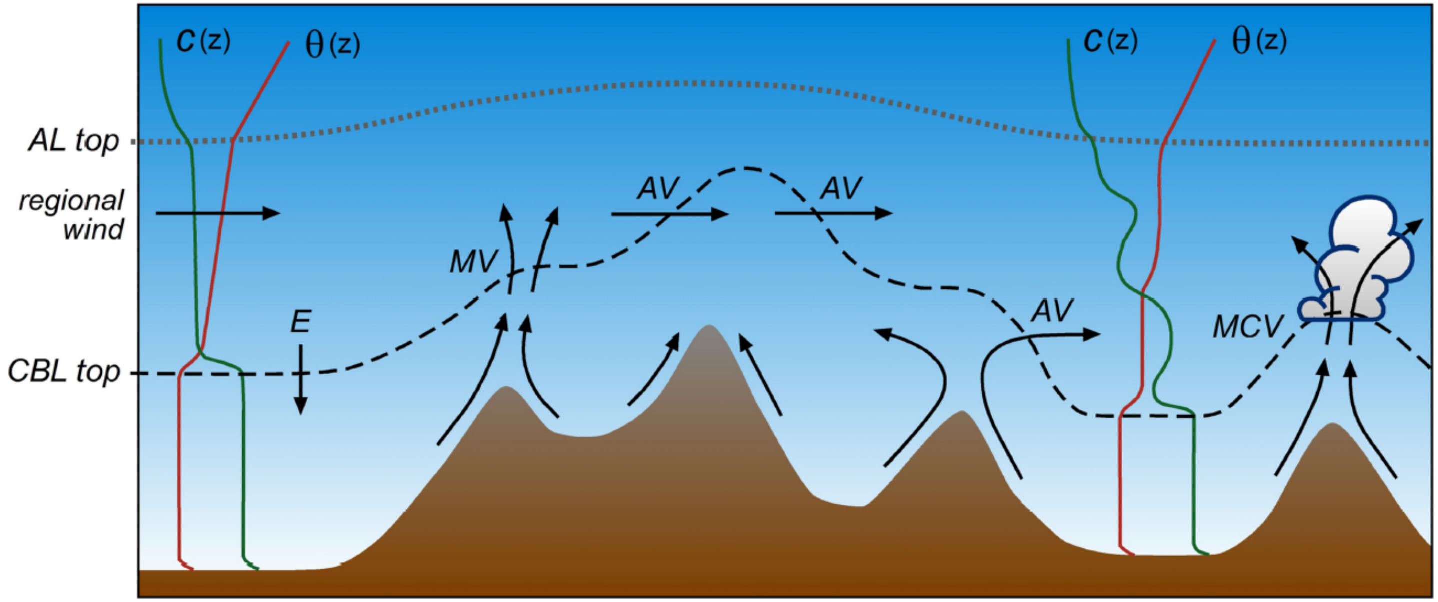


FIGURE 11 | Schematic illustration of mountain induced exchange processes between the convective boundary layer and the overlying atmosphere. E, entrainment; AV, advective venting; MV, mountain venting; and MCV, mountain-cloud venting. Vectors indicate airflow while c(z) and θ(z) indicate vertical profiles of pollutant concentration and potential temperature, respectively. The dotted and dashed line indicate the top of the aerosol layer (AL) and the CBL, respectively (after Kossmann et al., 1999; De Wekker, 2002; De Wekker et al., 2004).

Figure from De Wekker and Kossmann, 2015

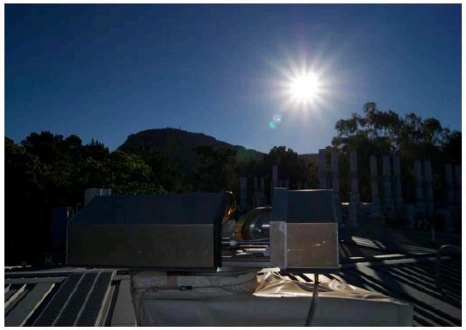
The Next NARIT LiDAR (“Fon” = “Rain”)

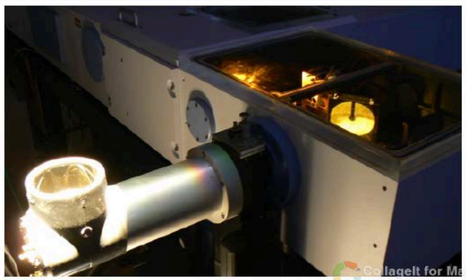
Ground Breaking Ceremony of the Regional Observatory for the Public, Songkla (Southern Thailand), 23 September 2015

Total Carbon Column Observing Network (TCCON)

Figure courtesy of D. Feist, Max Planck Institute, Jena, Germany

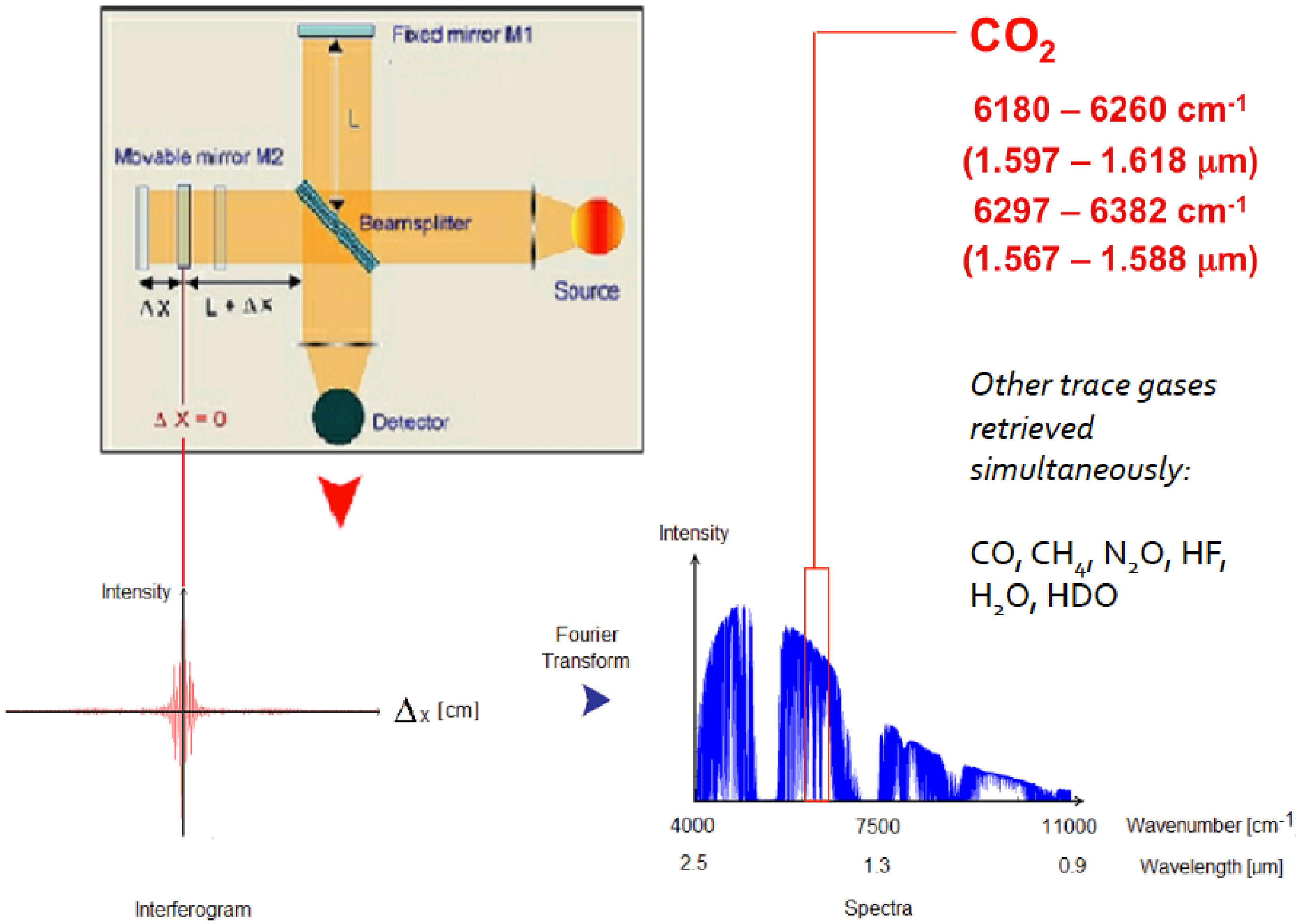
The Heart of TCCON





Ground-based Solar Absorption Measurements

Fourier Transform Infrared (FTIR) Spectrometry

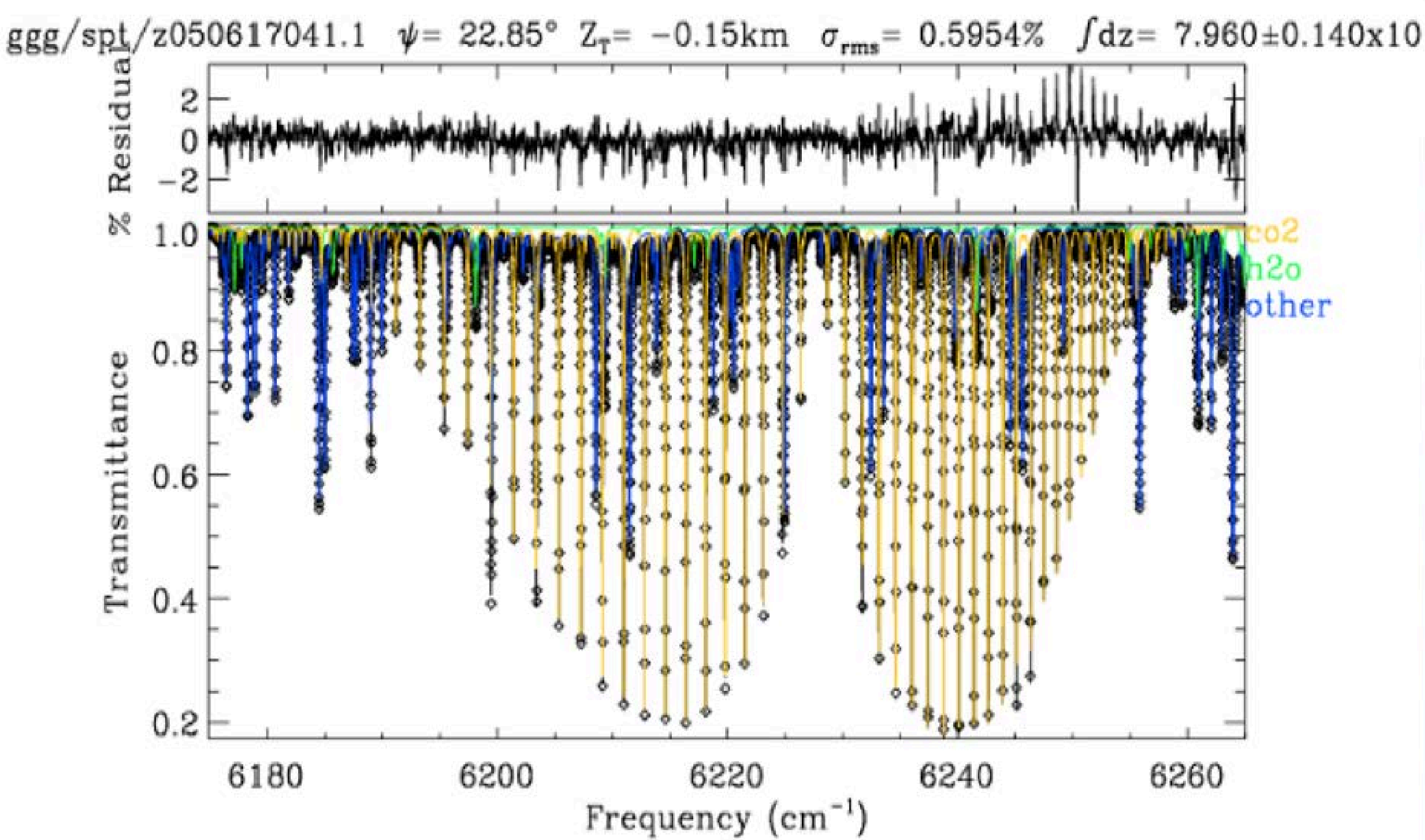


Other trace gases retrieved simultaneously:

CO, CH_4, N_2O, HF, H_2O, HDO

From Spectra to Column Abundances

Retrieval / Inverse Methods



TCCON Philippines

Figure from V. Velazco et. al, 2017

Why TCCON Philippines?

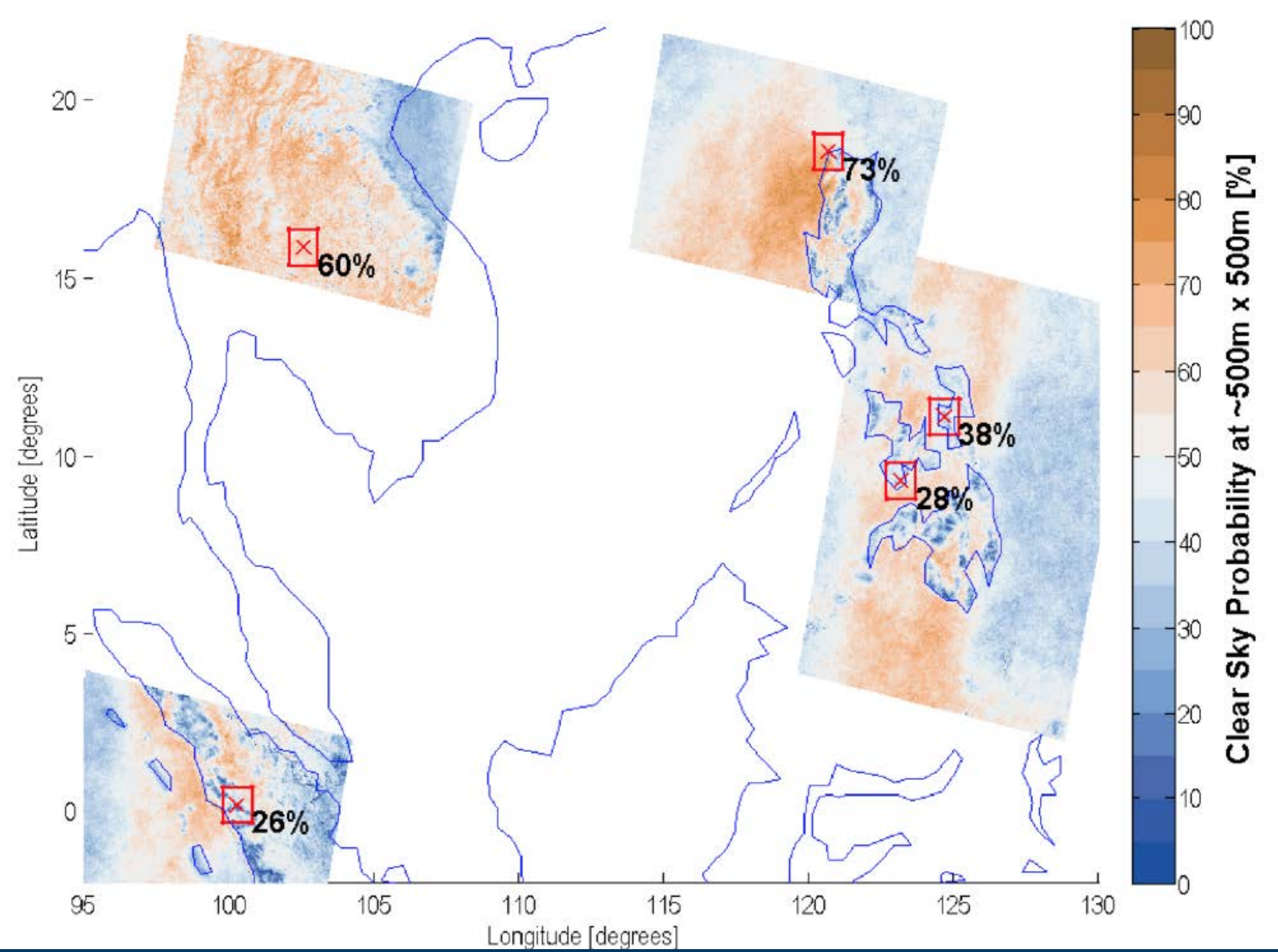


Figure from V. Velazco et. al, 2017

TCCON Philippines Footprint

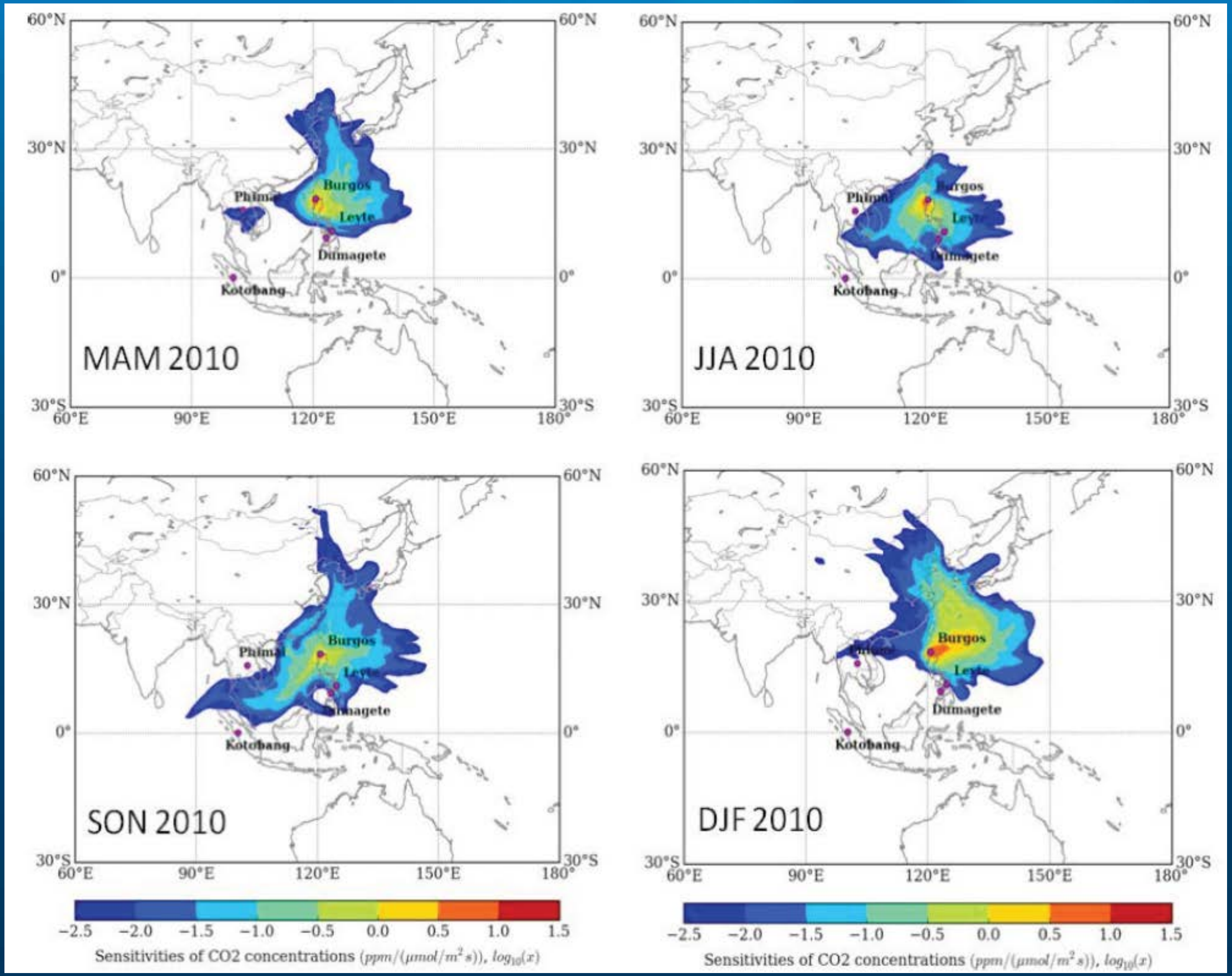
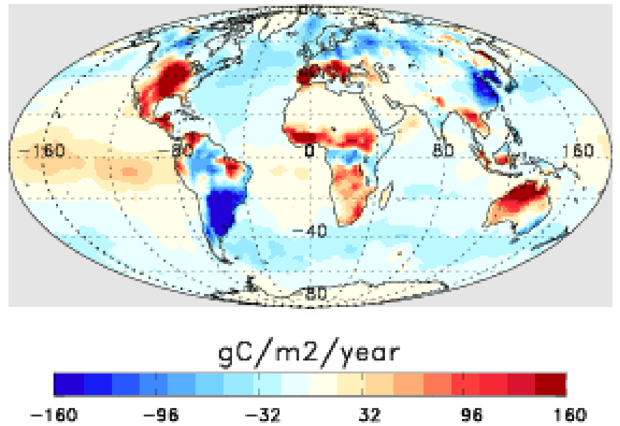
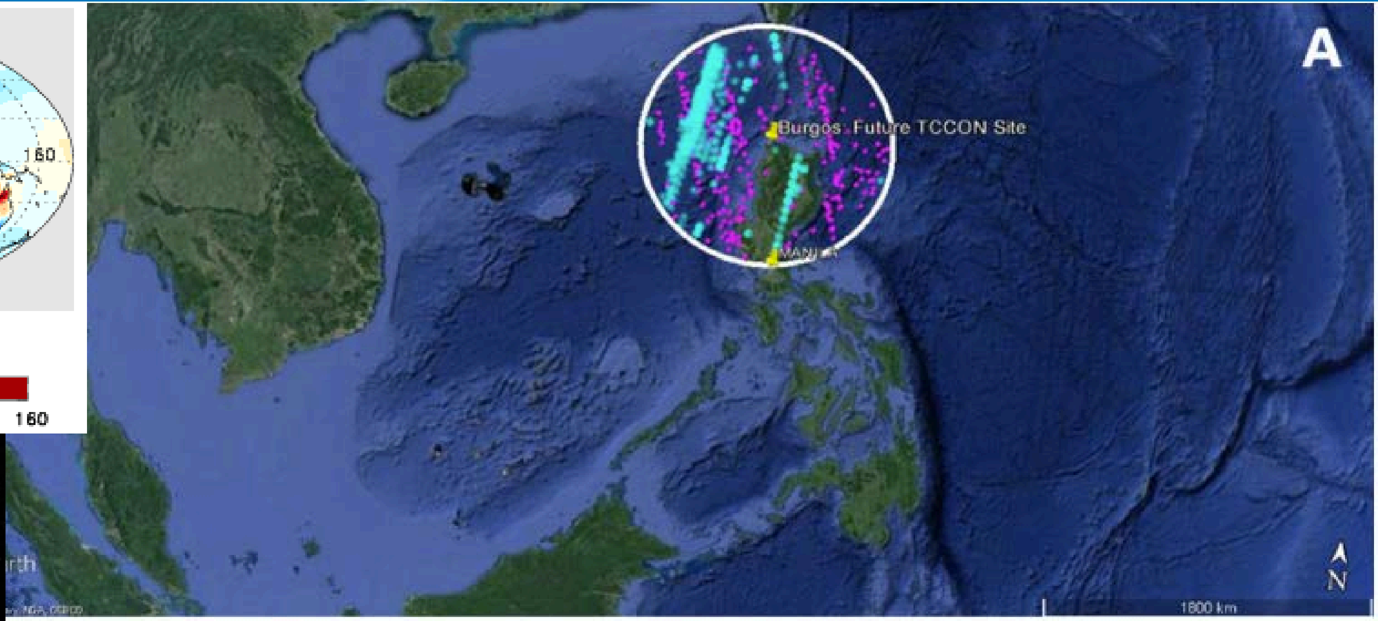


Figure from V. Velazco et. al, 2017

TCCON Philippines Applications





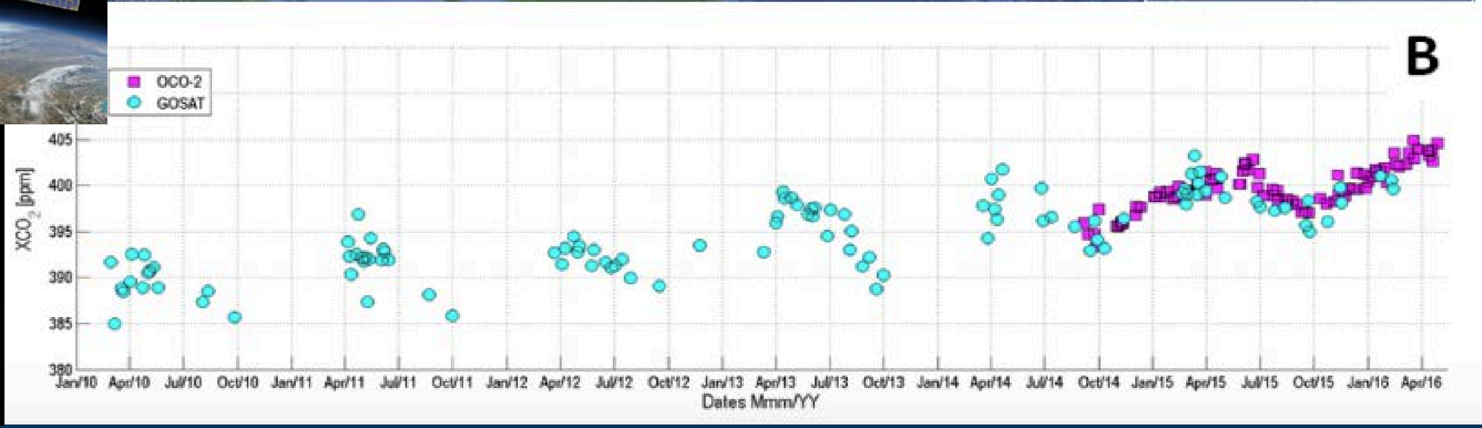
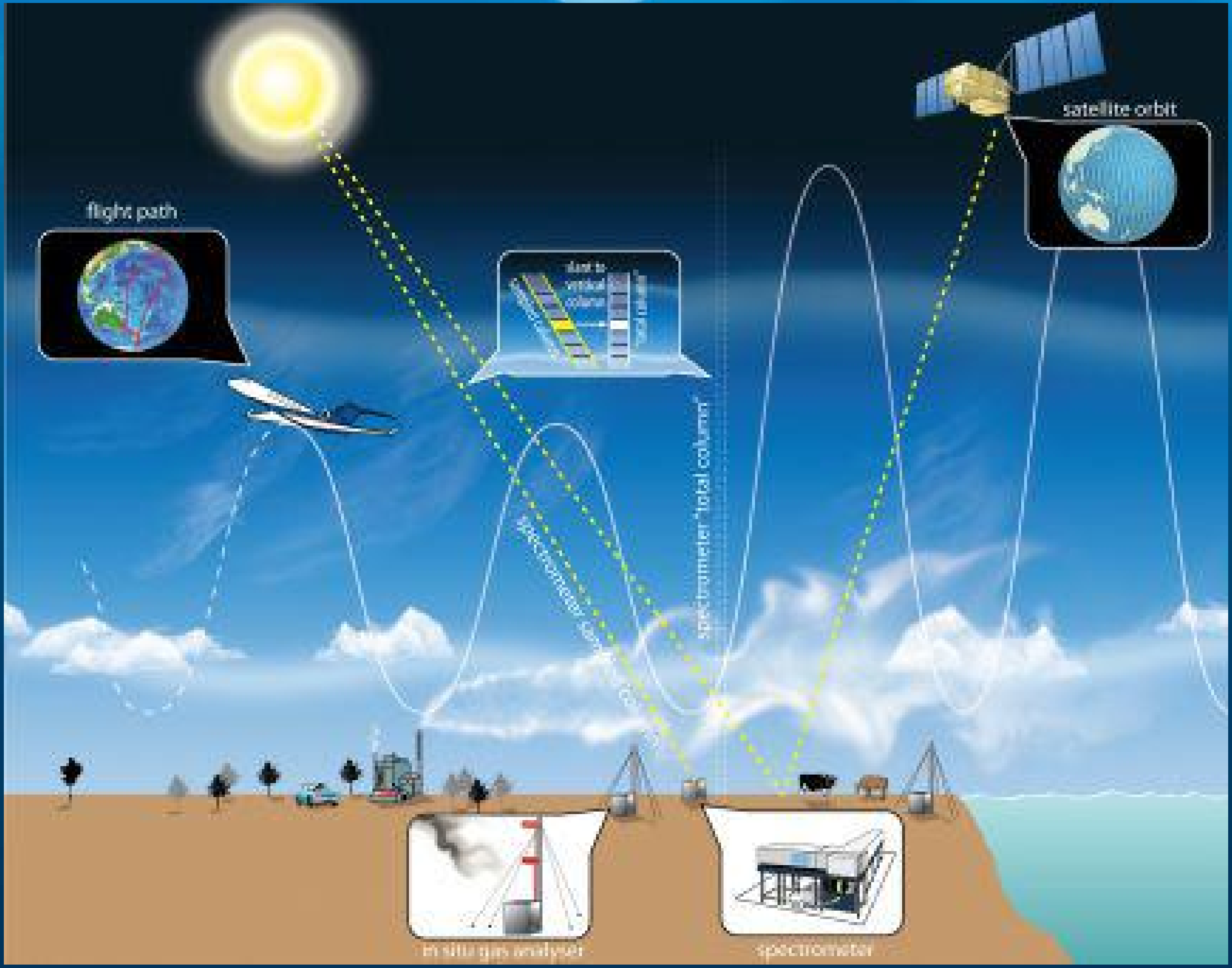
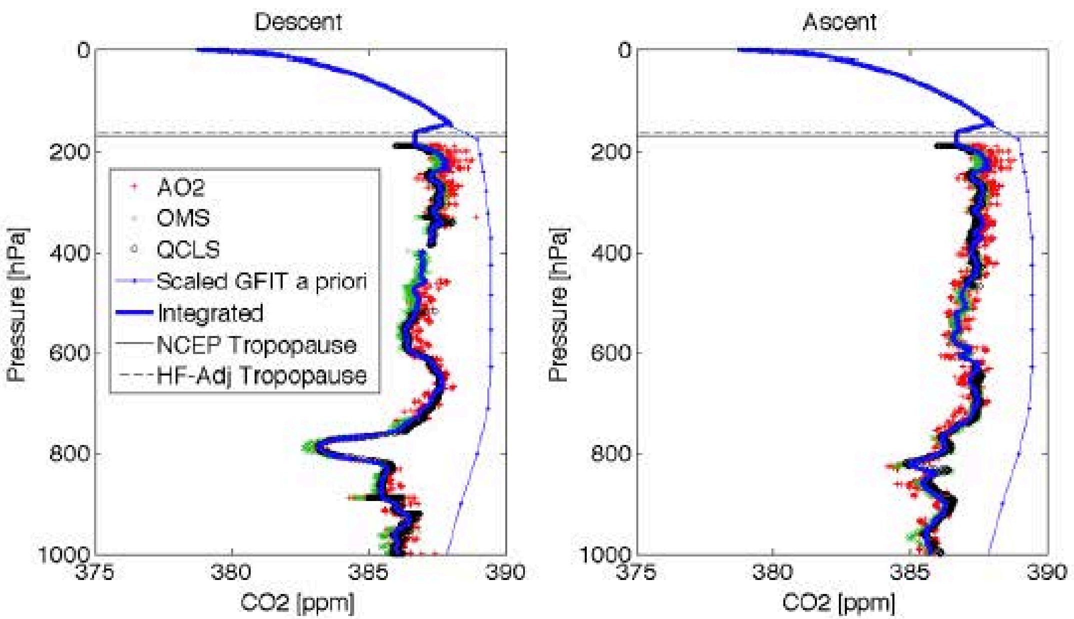


Figure from V. Velazco et. al, 2017

TCCON Philippines Calibration



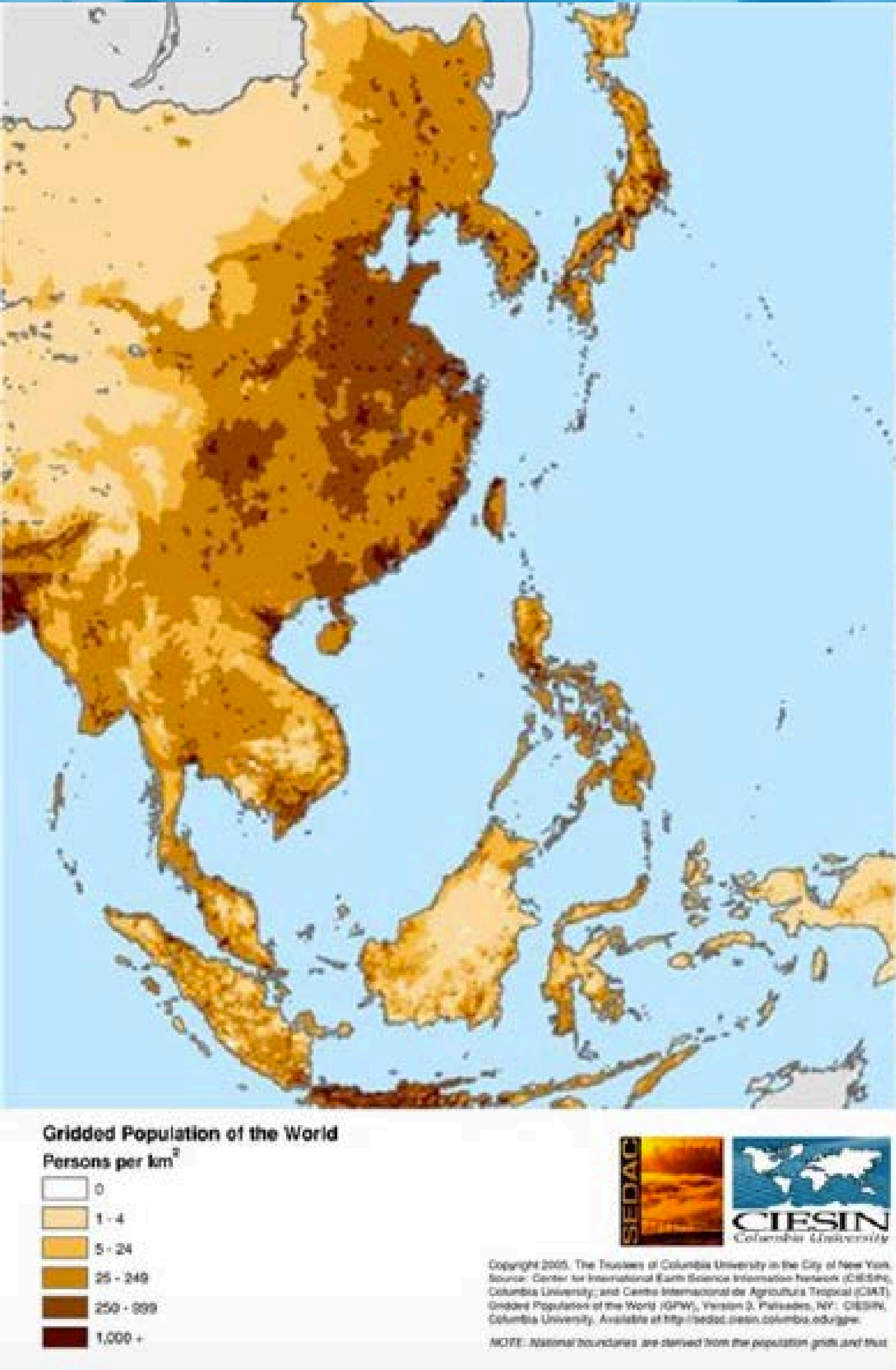
HIPPO-II Overpass



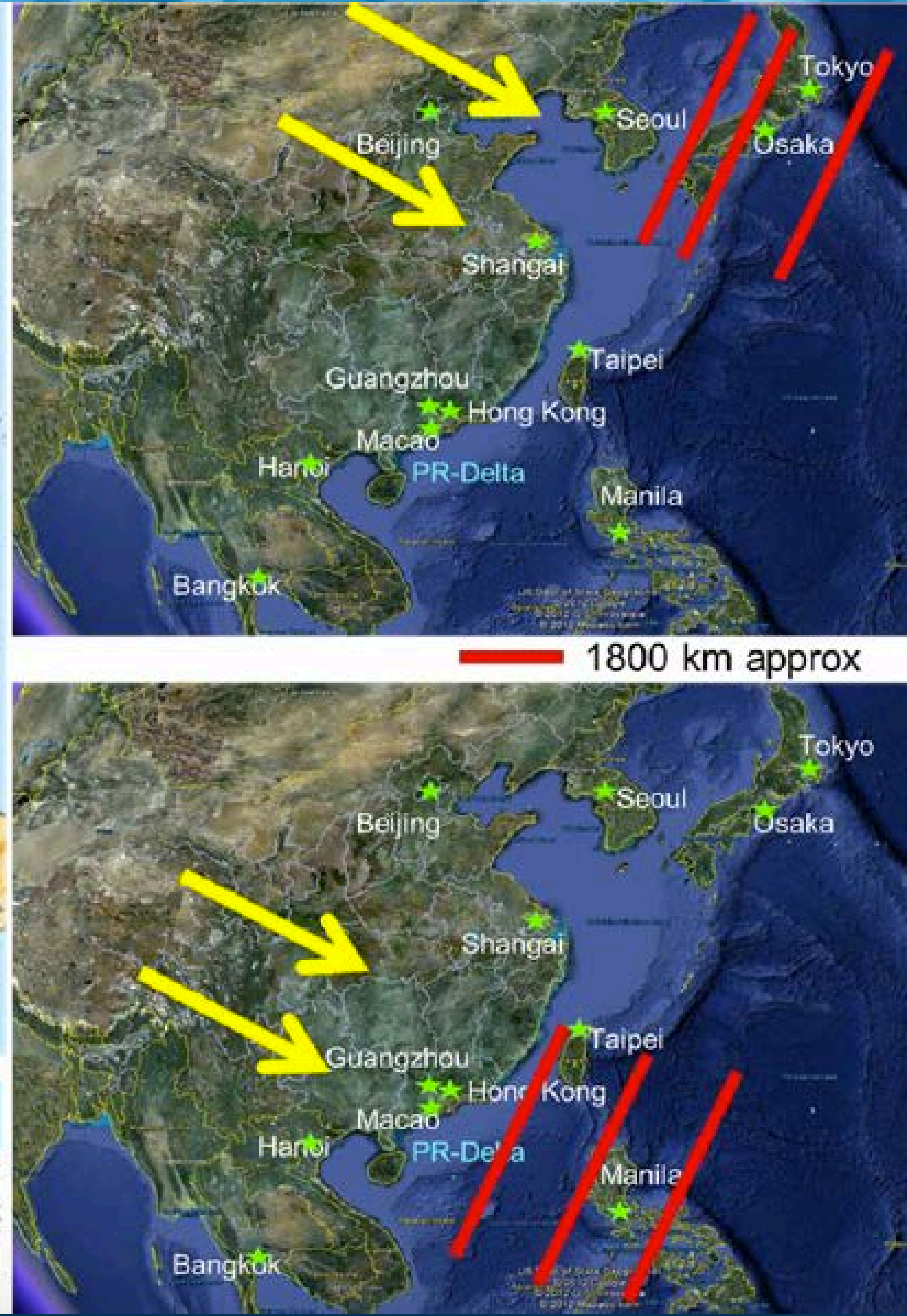
HALO-EMeRGe Phase II: Asia (March 2018)

Deutsches Zentrum für Luft- und Raumfahrt;
German Aerospace Center

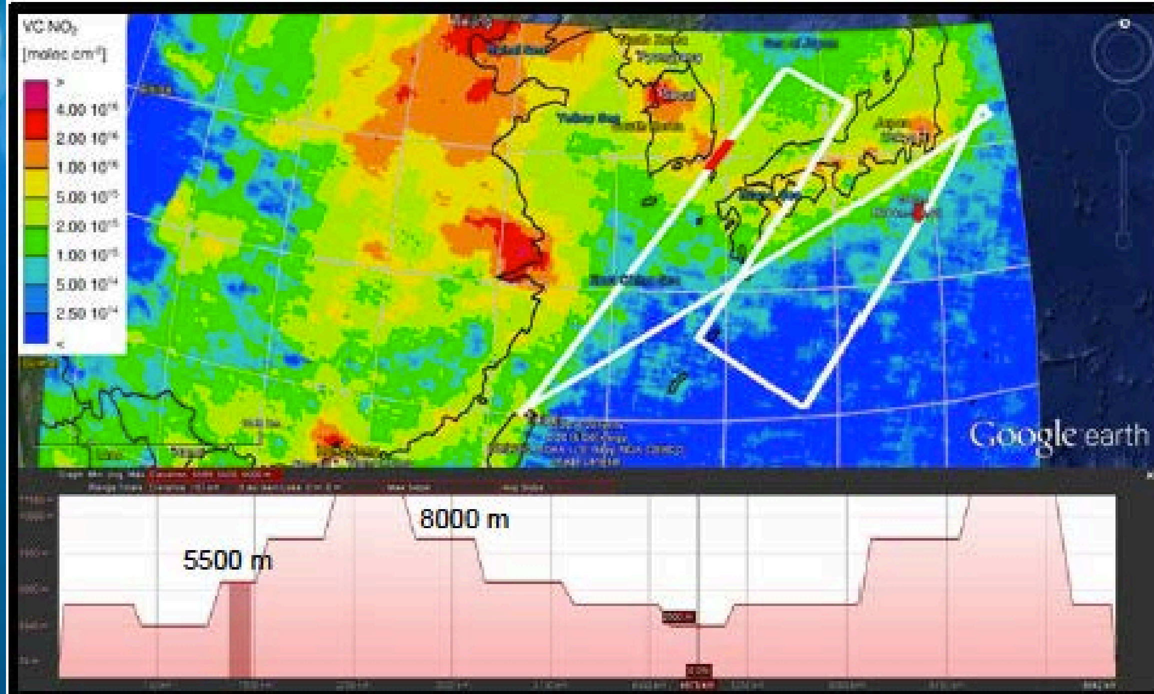
Effect of Megacities on the Tranport and Transformation of Pollutants on the Regional and Global Scales

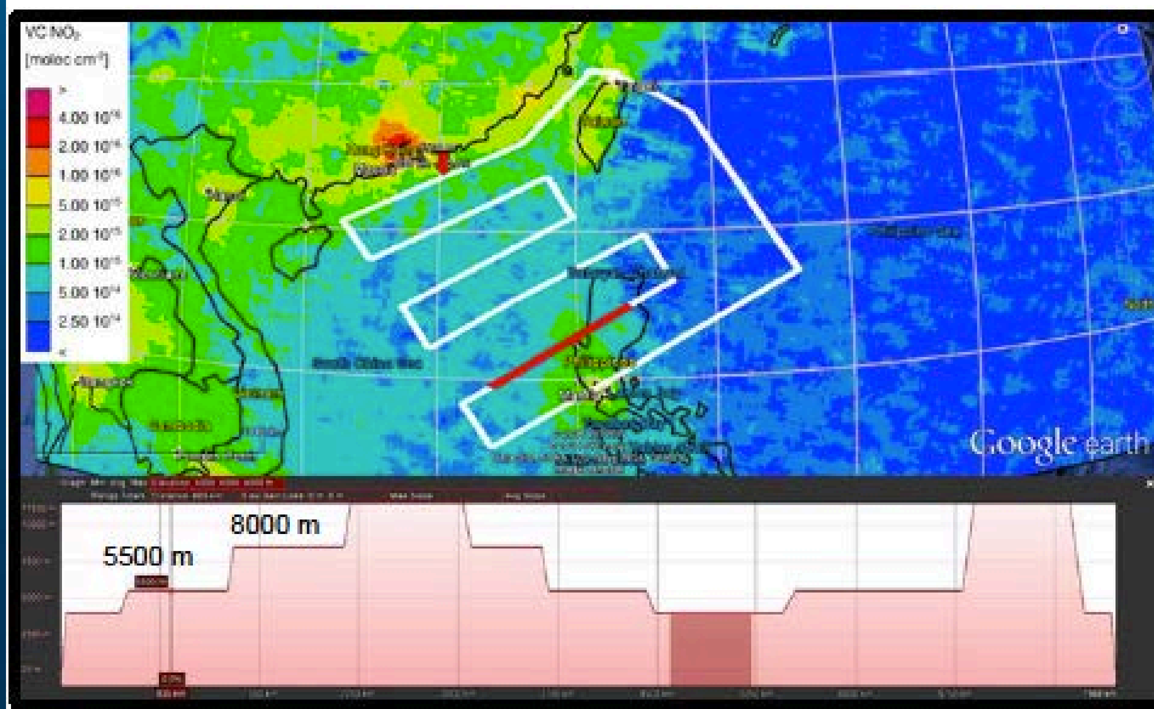


Gridded Population of the World
Persons per km²
0
1 - 4
5 - 24
25 - 249
250 - 999
1,000 +
SEDAC
CIESIN
Columbia University
Copyright 2005. The Trustees of Columbia University in the City of New York. Source: Center for International Earth Science Information Network (CIESIN), Columbia University; and Centro Internacional de Agricultura Tropical (CIAT). Gridded Population of the World (GPW), Version 3. Palisades, NY: CIESIN, Columbia University. Available at http://sedac.ciesin.columbia.edu/gpw.
NOTE: National boundaries are derived from the population grids and thus



Tokyo
Seoul
Osaka
Beijing
Shangai
Taipei
Guangzhou
Hong Kong
Macao
Hanoi
PR-Delta
Manila
Bangkok
1800 km approx
Tokyo
Seoul
Osaka
Beijing
Shangai
Taipei
Guangzhou
Hong Kong
Macao
Hanoi
PR-Delta
Manila
Bangkok


VC NO2
[molec cm-2]
4.00 10^16
2.00 10^16
1.00 10^16
5.00 10^15
2.00 10^15
1.00 10^15
5.00 10^14
2.50 10^14
Google earth
8000 m
5500 m


VC NO2
[molec cm-2]
4.00 10^16
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1.00 10^16
5.00 10^15
2.00 10^15
1.00 10^15
5.00 10^14
2.50 10^14
Google earth
8000 m
5500 m

Institution	PI	Gas/Parameter	Instrument / Model
Institute for Environmental Physics-University of Bremen (UB-IUP)	J.P. Burrows / M.D Andrés Hernández	HO_2+RO_2	PeRCEAS
University of Wuppertal (BUW-IAU)	R. Koppmann / M. Krebsbach	VOC / carbon isotope ratios	MIRAH
Institute for Environmental Physics-University of Heidelberg (UH-IUP)	K. Pfeilsticker	O_3, NO_2, HONO, CH_2O, $C_2H_2O_2$, O_4, BrO, ClO, IO	mini-DOAS
	U. Platt / D. Pöhler	NO_2, CH_2O, $C_2H_2O_2$, H_2O, O_4, SO_2, IO, BrO, O_3	2D/3D HAIDI
Forschungszentrum Jülich (FZJ-IEK-8)	B. Bohn	UV radiation, $J(O_3)$, $J(NO_2)$	HALO-SR
Particle Chemistry - Department MPIC/ University of Mainz (JGU-IPA)	S. Borrmann / J. Schneider	Aerosol particle composition Fine aerosol	C-ToF-AMS AMETYST
Multiphase Chemistry Department MPIC- Mainz (MPIC)	U. Pöschl / M.O. Andreae	CCN, soot, aerosol microscopic properties	HALO-CCN
Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology (KIT-IMK)	A. Zahn	O_3, 5-10 VOCs	FAIRO / HKMS
Institute of Atmospheric Physics, Deutsches Zentrum für Luft und Raumfahrt (DLR-IPA)	H.Schlager / H. Ziereis	CO, CO_2, CH_4, PFC tracer	AMTEX / PERTRAS
		SO_2, HNO_3, HONO, organic acids NO, NO_2, NOy	CI-ITMS AENEAS
University of Bremen /Atmospheric Chemistry, MPIC Mainz (UB, MPIC)	M.Vrekoussis / A. Pozzer	Modelling	TM5/Flexpart/EMAC

Calibration of TCCON FTSs in Japanese and Philippines sites and GOSAT validation

Isamu Morino, NIES, morino@nies.go.jp

Calibration of TCCON FTSs at Rikubetsu, Tsukuba, Saga in Japan and Burgos in Philippines (https://tccon-wiki.caltech.edu) will be made using the HALO aircraft data. Then we also compare the GOSAT data (http://www.gosat.nies.go.jp/en/) with them.

Measured species	*instruments/model*
XCO_2, XCH_4, XCO, XN_2O, XH_2O, etc.	TCCON FTS at Rikubetsu, Tsukuba, Saga in Japan and Burgos in Philippines
Profiles of aerosol and cloud	Lidars at Rikubetsu, Tsukuba, Saga in Japan and Burgos in Philippines
Profile of H_2O	Lidar at Burgos in Philippines
Profile of O_3	Lidar at Tsukuba and Saga in Japan
XCO_2, XCH_4, XH_2O	GOSAT TANSO-FTS SWIR and TIR

Publication: Wunch et al., AMT, 3, 1351-1362, 2010; Yoshida et al., AMT, 6, 1533-1547, 2013; Inoue et al., AMT, 9,3491-3512,2016; Eric et al., Remote Sens.,8, 414, 2016, correction, 8, 982,2016.

Objective during EMeRGe:
Calibration of TCCON FTSs and validation of the GOSAT data.

Deliverable to EMeRGe:
TCCON data, profile data of liadrs, GOSAT data upon request and agreement by data owners.

Synergy with EMeRGe:
Data set from EMeRGe, ground-based and satellite measurements would be useful for evaluating model simulation

TCCON sites in East Asia and

TCCON Calibration Curve

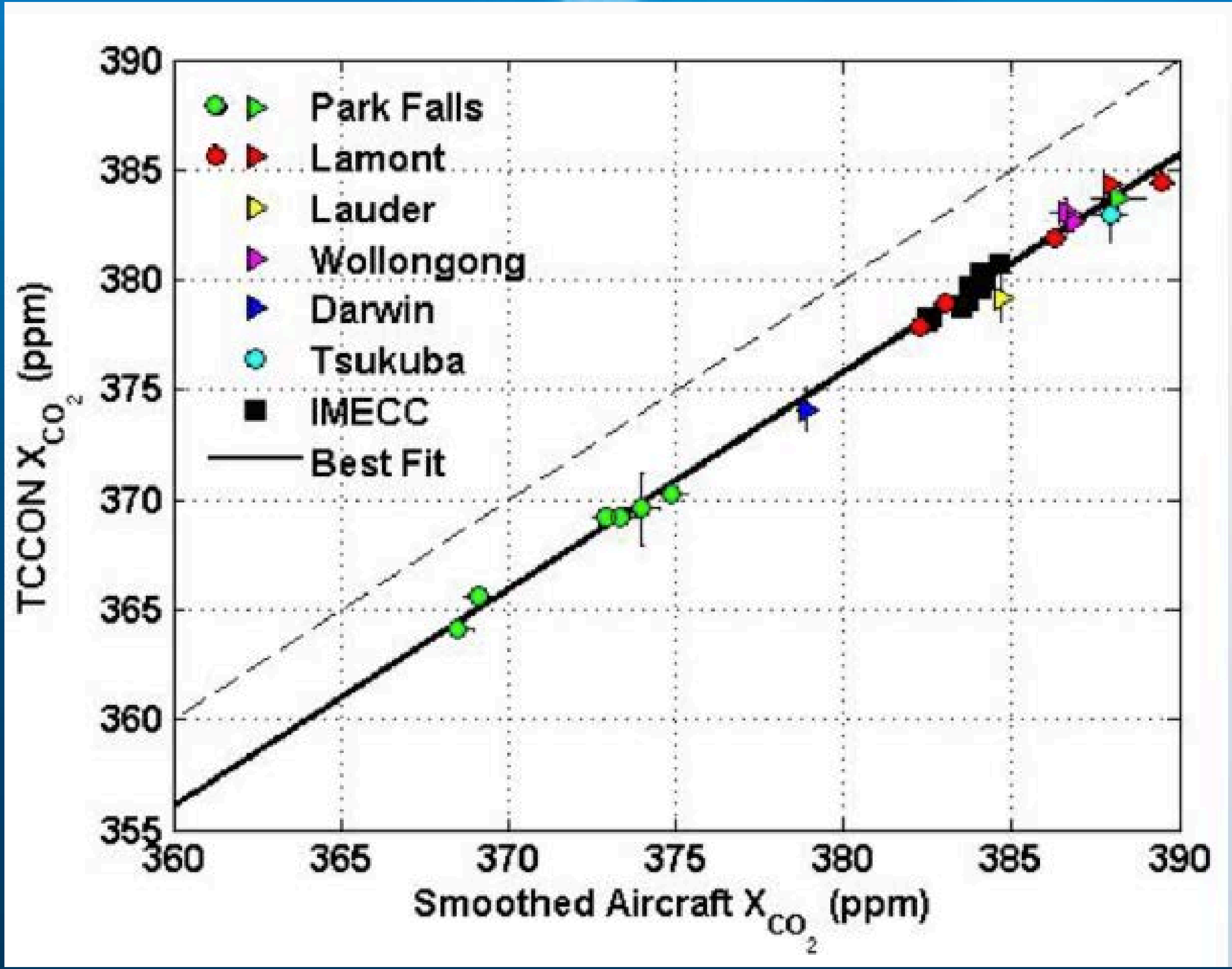
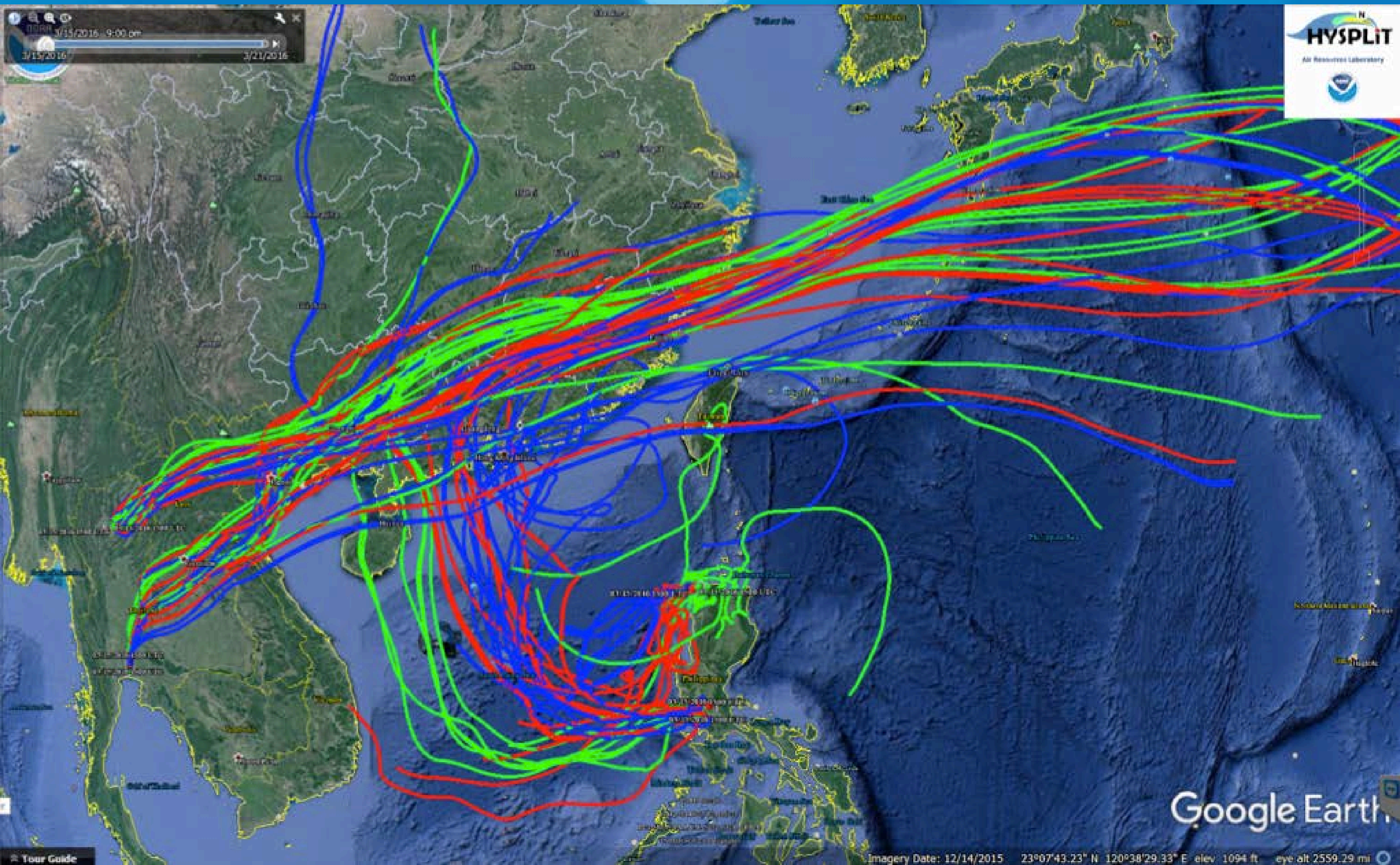
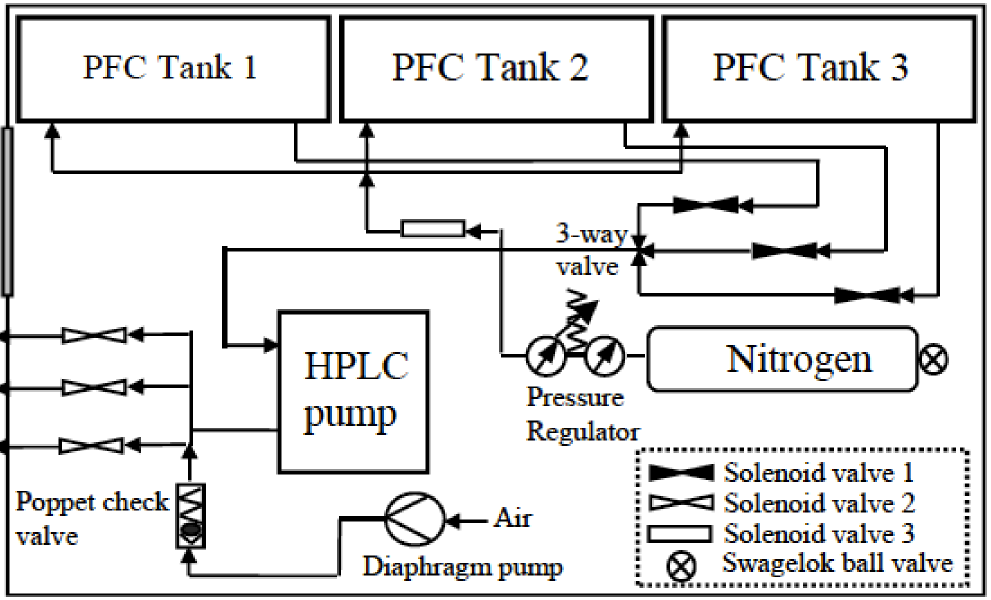


Figure from Wunch et. al, 2010
https://tccon-wiki.caltech.edu/Network_Policy/Data_Use_Policy

Role of Southeast Asia in HALO-EMeRGe (EMeRGe International)



Plume Tracer Release and VOC Cannister Sampling



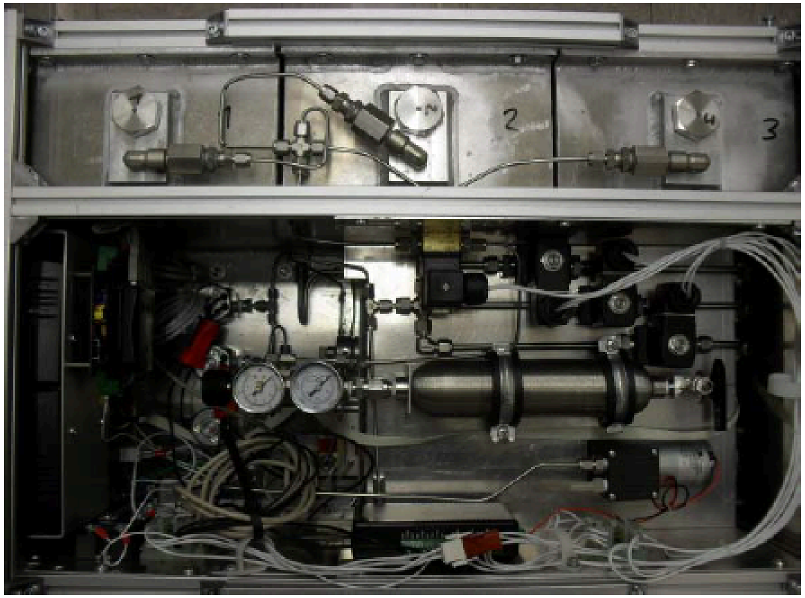


Figure from Ren et. al, 2015

Plume Tracer Release and VOC Cannister Sampling

Figure from Ren et. al, 2015

Cloud and Aerosol Monsoonal Processes-Philippines Experiment ($CAMP^2Ex$)

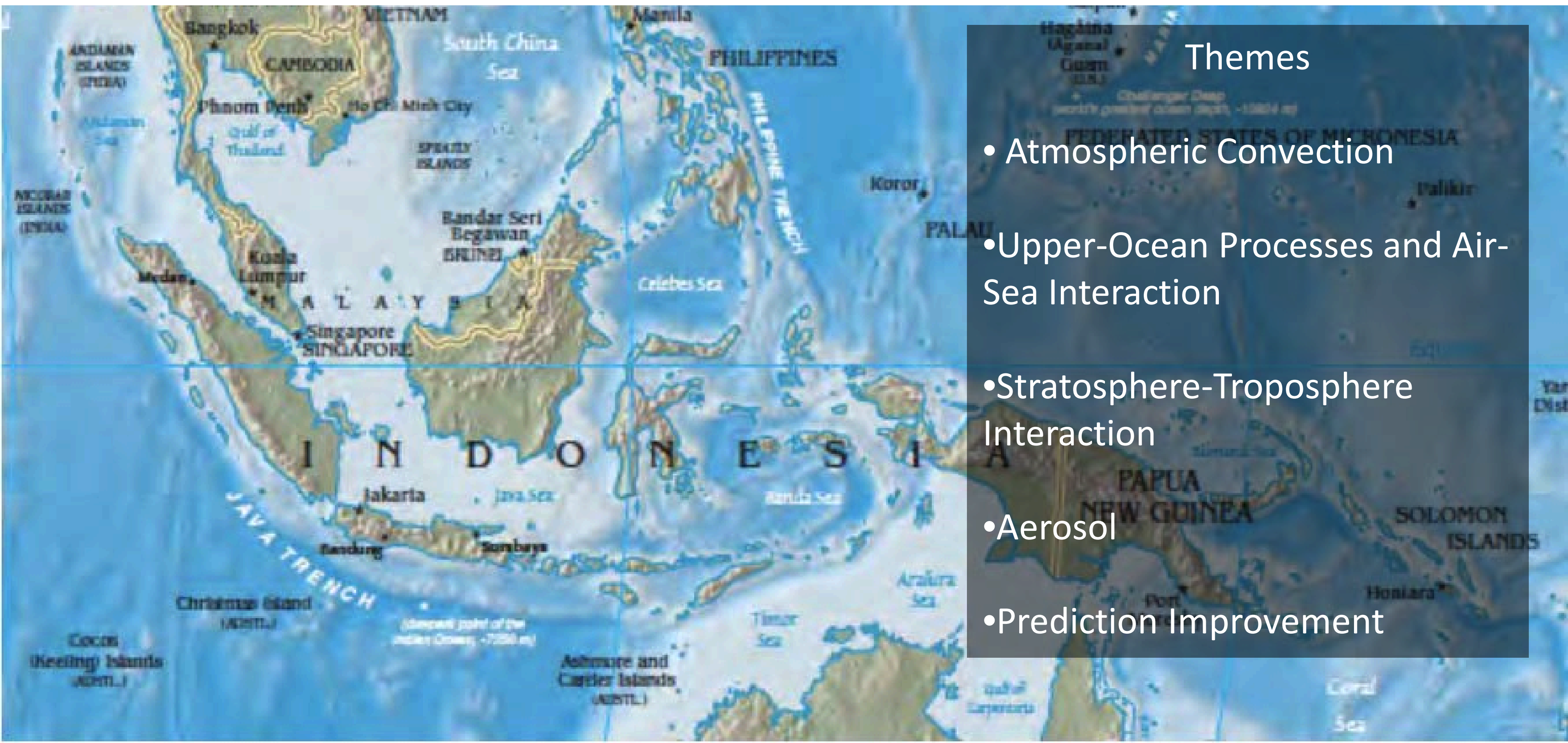
A proposed joint US-Philippine airborne mission to study aerosol and land use impacts on monsoonal precipitation during late summer 2018

US Participants in the Study Team:
Larry Di Girolamo, Robert Holz, Jeffrey Reid, Simone Tanelli, and Sue van den Heaver

Philippine Participants in the Study Team:
Gemma Narsma and James Simpas

YEARS OF THE MARITIME CONTINENT (July 2017 – July 2019)

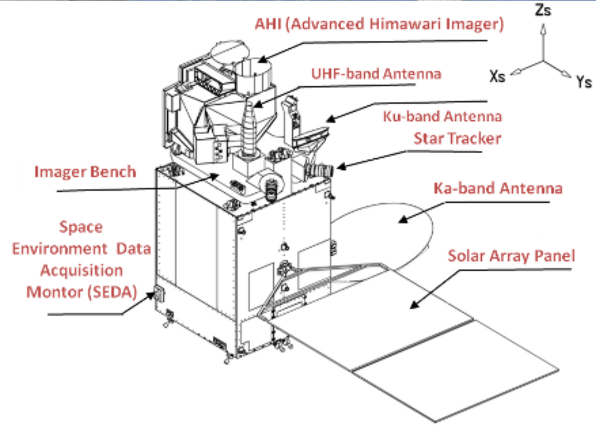
– *Observing the weather-climate system of the Earth's largest archipelago to improve understanding and prediction of its local variability and global impact*

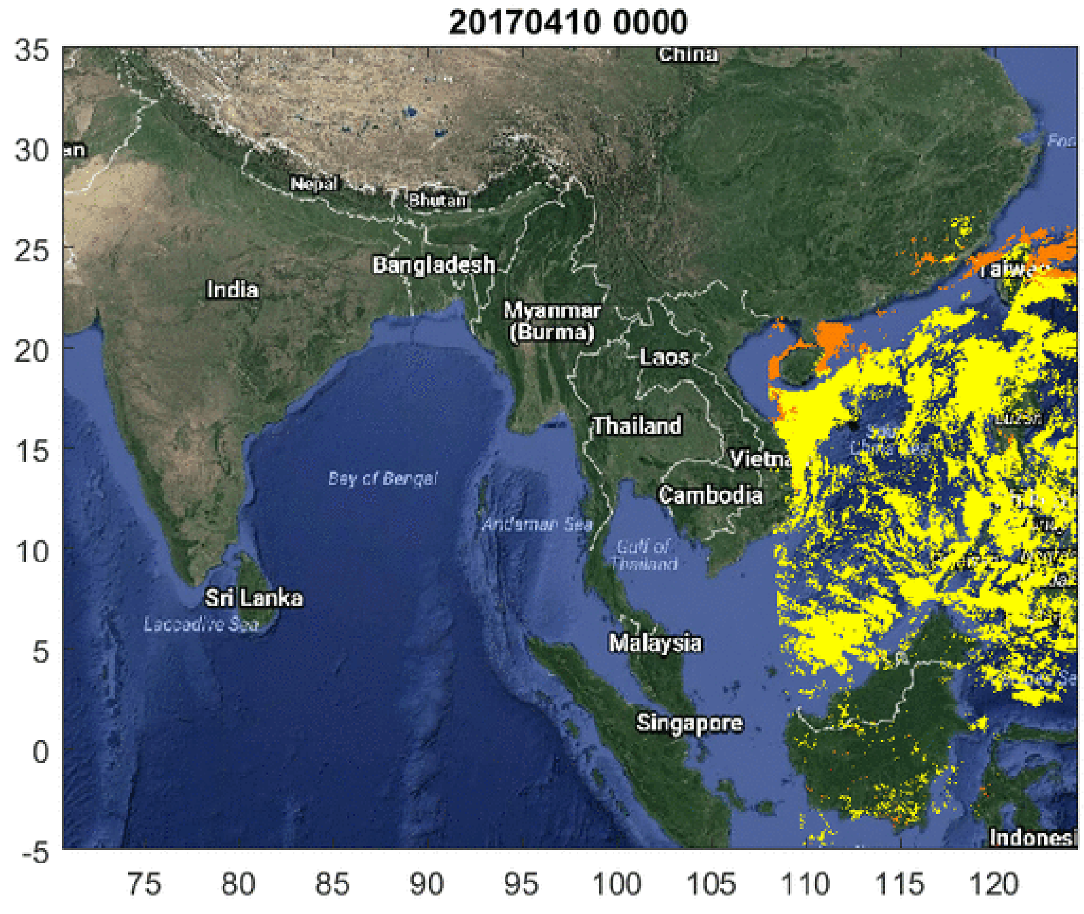


Themes

- Atmospheric Convection
- Upper-Ocean Processes and Air-Sea Interaction
- Stratosphere-Troposphere Interaction
- Aerosol
- Prediction Improvement

Himawari-8 Aerosol Optical Thickness Product





Derived from Himawari-8/9 visible and near-infrared data. It provides information on aerosol optical thickness at 500 nm and the Angstrom index (a metric of aerosol particle size) for areas over oceans during the daytime and on aerosol optical thickness over land. The algorithm references a look-up table with values calculated on the basis of an assumed spheroid-particle aerosol model.

Thank you!

What is LiDAR?

Topographic vs. Atmospheric LiDAR

What is LiDAR?

Topographic vs. Atmospheric LiDAR

What is LiDAR?

Types of Atmospheric LiDAR Systems

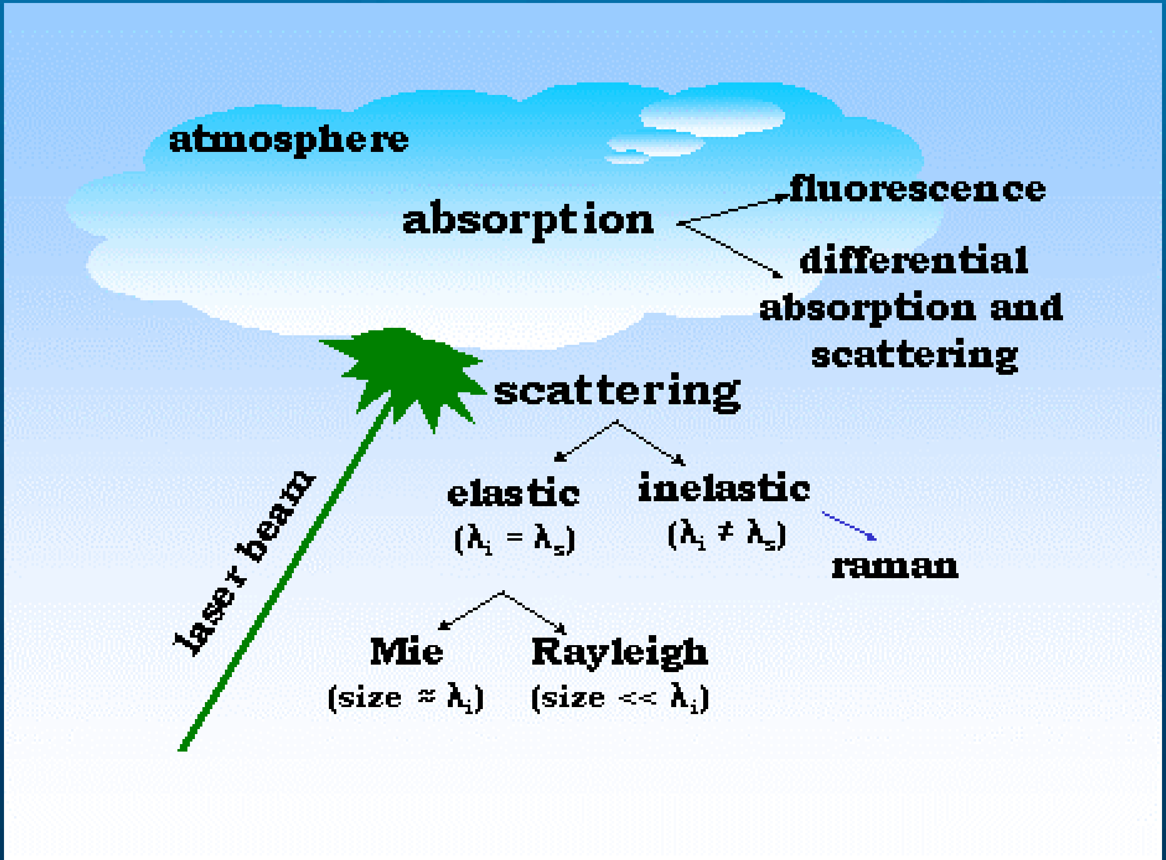
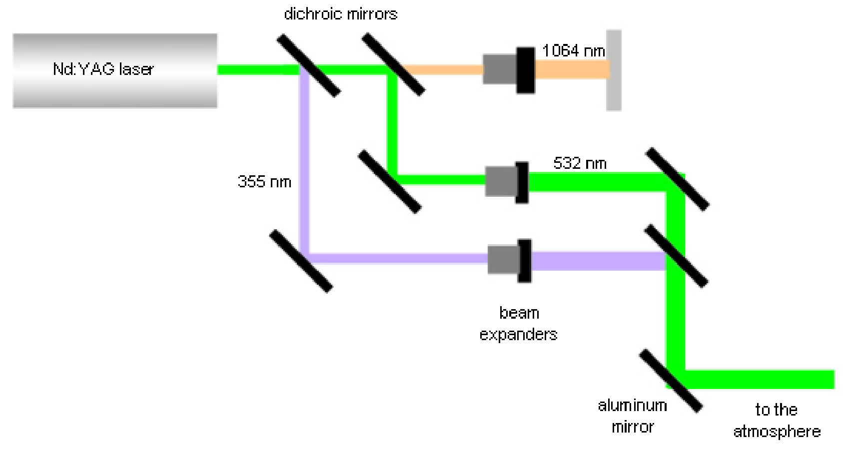
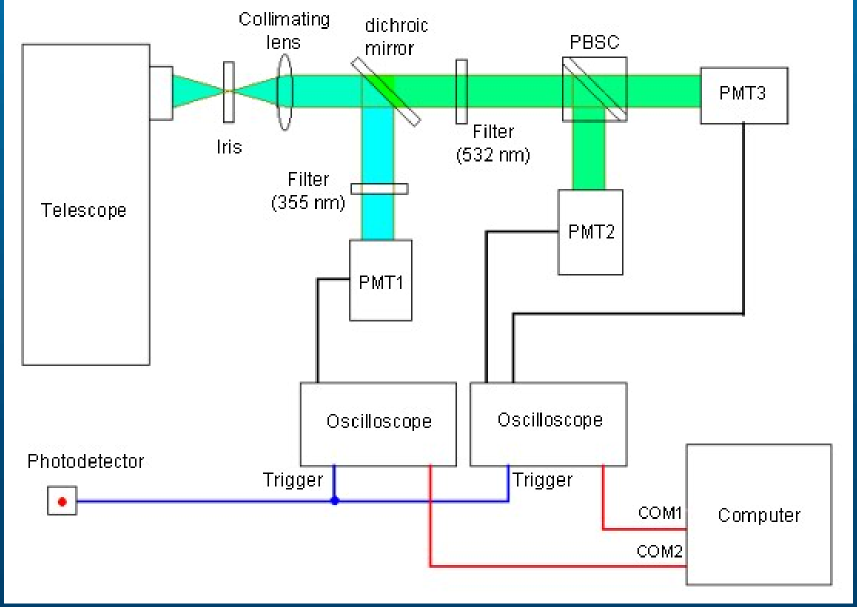


Figure from the DLSU Environment and Remote Sensing Research Group (EARTH)
https://sites.google.com/a/dlsu.edu.ph/earth/home

What is LiDAR?

Components of an Atmospheric LiDAR System





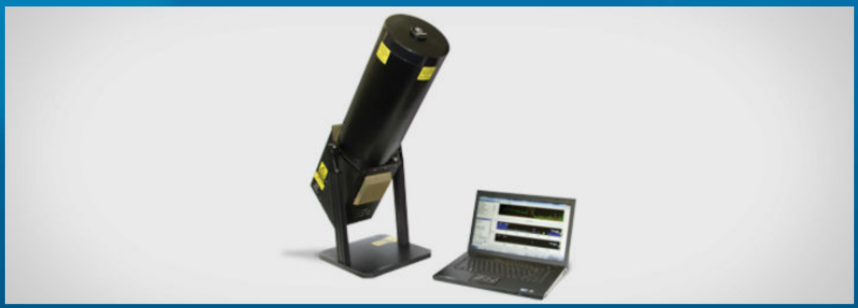
Transmitting System

Receiving System

Figure from the DLSU Environment and Remote Sensing Research Group (EARTH)
https://sites.google.com/a/dlsu.edu.ph/earth/home

What is LiDAR?

Commercial Mie LiDAR Systems (Single Wavelength = 532 nm)



Micropulse LiDAR

Mini-Micropulse LiDAR

Images from SigmaSpace
http://www.micropulselidar.com/

Applications

Clouds

Aerosols

Microphysics

Volcanic Ash

Dust

Pollution

Boundary Layer

Evaluation of WRF's YSU PBL Scheme Using LiDAR Derived Mixing Heights

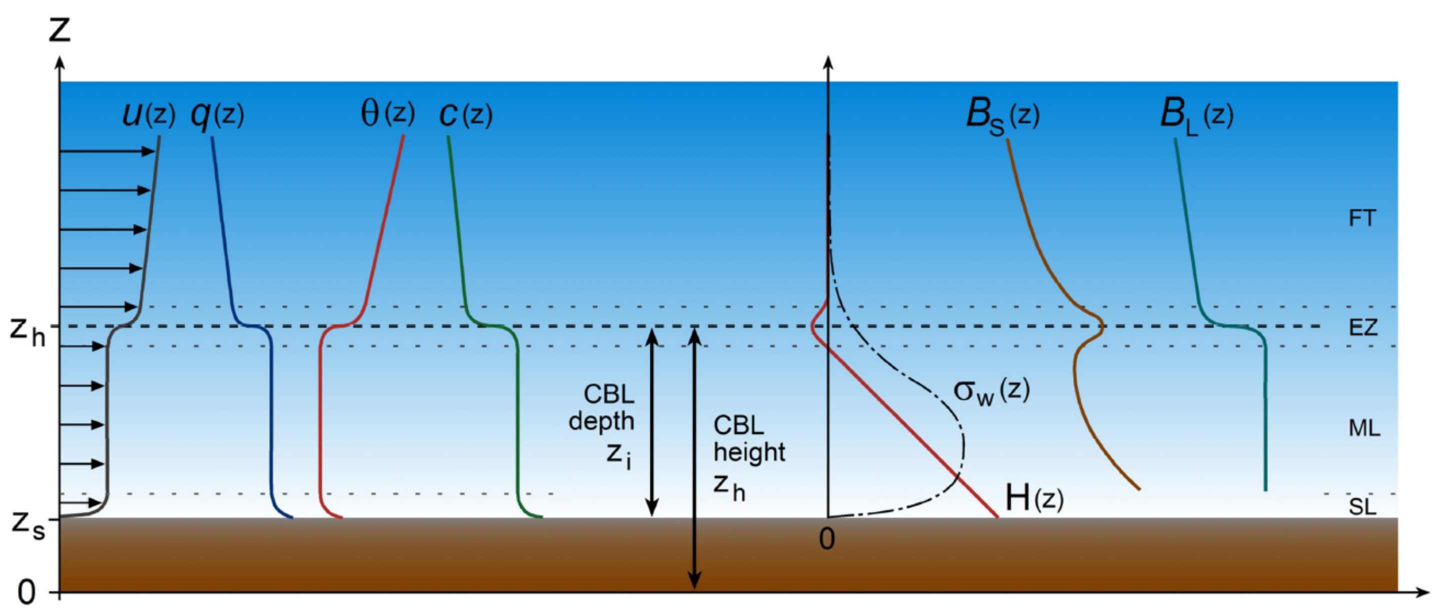


FIGURE 2 | Idealized vertical structure of the lower troposphere under daytime convective conditions over flat and homogeneous terrain, subdivided into the surface layer (SL), the mixed layer (ML), the entrainment zone (EZ), and the free troposphere (FT). The vertical profiles represent wind velocity u(z), specific humidity q(z), potential temperature θ(z), air pollutant concentration c(z), vertical turbulent sensible heat flux H(z), standard deviation of turbulent vertical velocity fluctuations $\sigma_w(z)$, and backscatter signal intensities $B_S(z)$ from a sodar and $B_L(z)$ from a lidar. z_s is the terrain height while z_i and z_h are the depth and the height of the CBL, respectively.

Figure from De Wekker and Kossmann, 2015