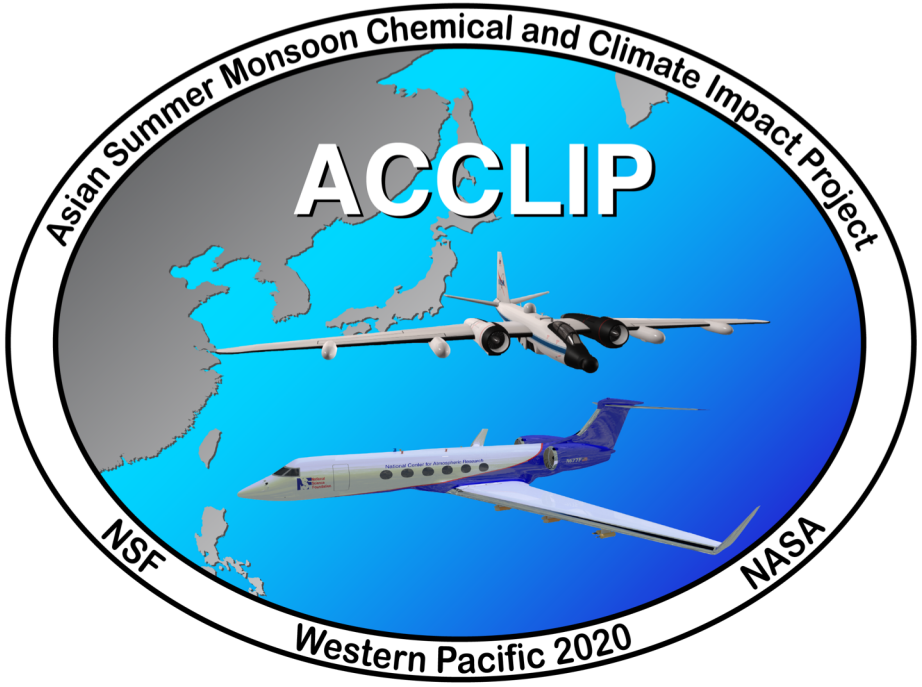
Asian Summer Monsoon Chemical and Climate Impact Project (ACCLIP)

Laura Pan

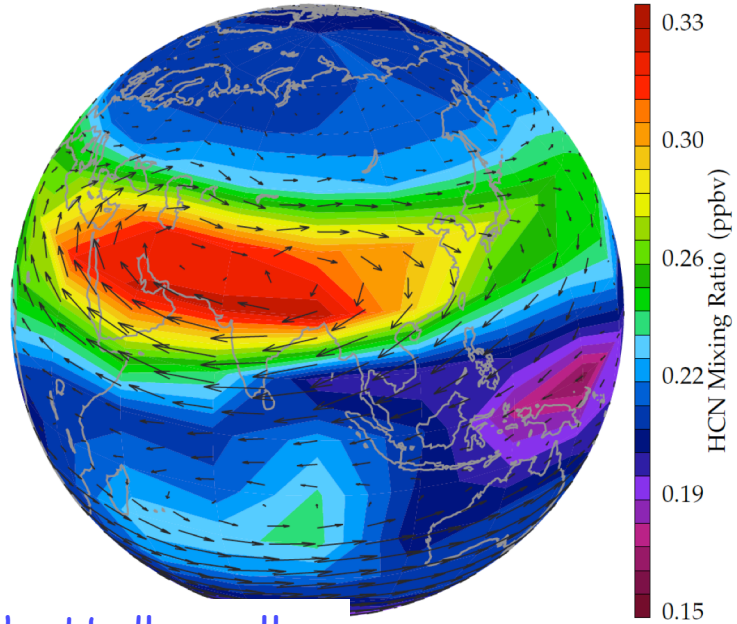
National Center for Atmospheric Research (NCAR), USA

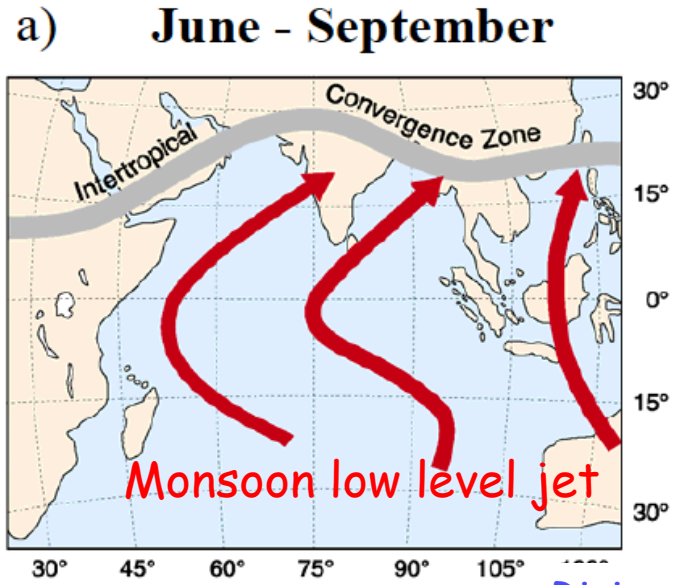


Asian Emissions, Air Quality ↔ Monsoon ↔ Climate

Asian Summer Monsoon transport: a **"perfect storm"**

HCN from Space

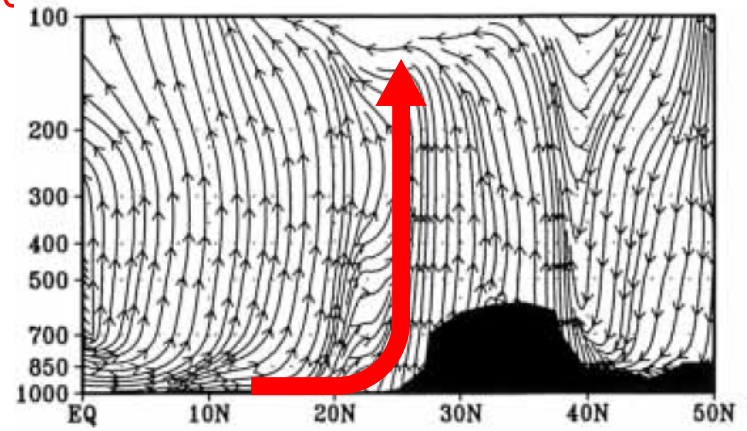




Widespread pollution in Asia

Lawrence and Lelieveld, 201(

Rising branch of the Hadley cell



Zhang et al., 2002

Randel, Park, Emmons, Kinnison et al. 2010, Science

Asian Summer Monsoon Chemical and Climate Impact Project (ACCLIP)

Co-Principal Investigators:

Laura Pan (NCAR), Paul Newman (NASA)

Co-Investigators:

Elliot Atlas (Univ. Miami), William Randel (NCAR), Brian Toon (CU), Troy Thornberry (NOAA)

Members of Scientific Steering Committee:

Ru-shan Gao (NOAA), Eric Jensen (NCAR), Karen Rosenlof (NOAA), Michelle Santee (JPL), Stephan Borrmann (MPI), Markus Rex (AWI), Masatomo Fujiwara (Japan)

Location: Western Pacific (Flight Operations from Japan)

Dates: July 15 – August 31, 2020

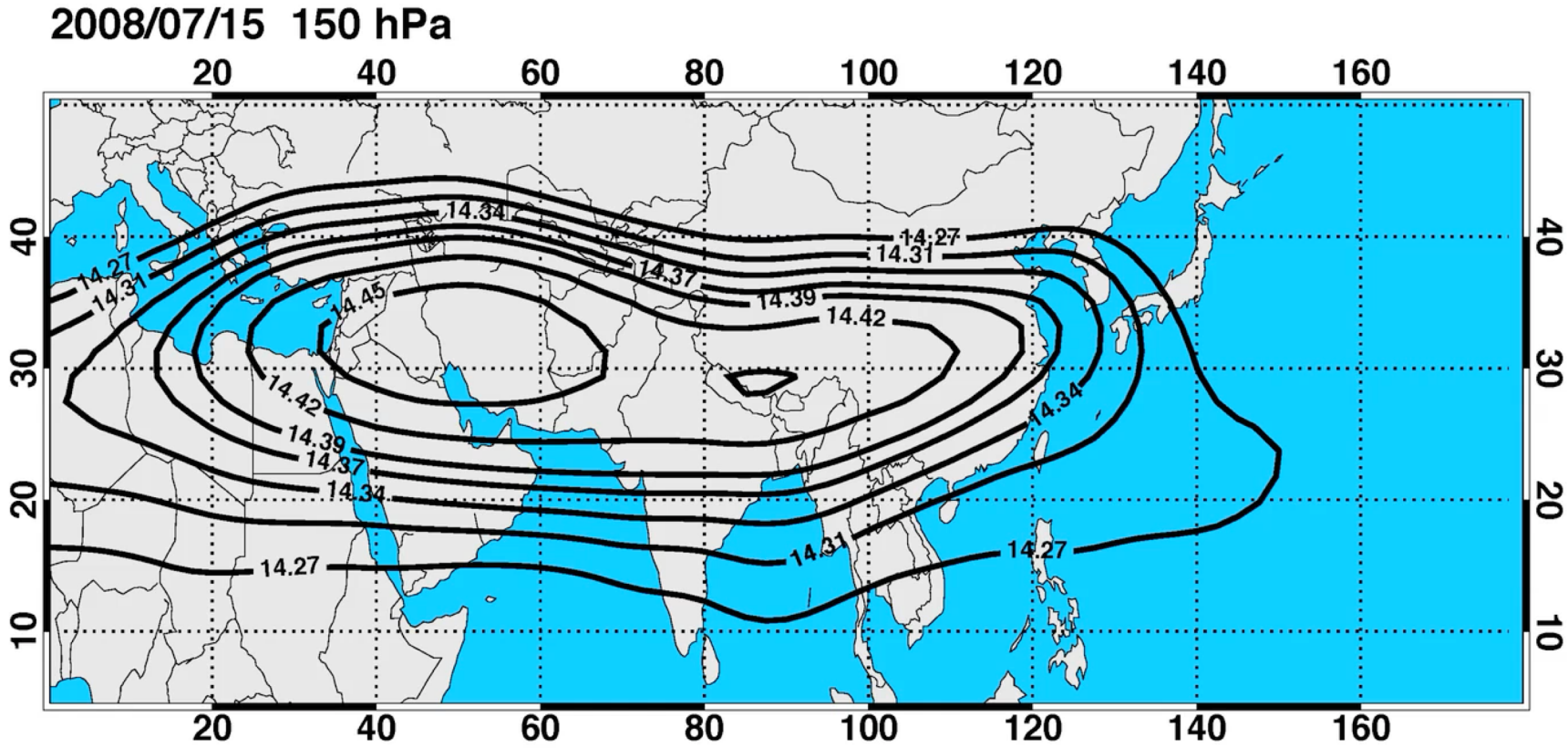
Project Goals, Objectives & Hypotheses

Primary Goal: **To investigate the impacts of Asian gas and aerosol emissions on global chemistry and climate via the linkage of Asian Summer Monsoon (ASM) convection and associated large-scale dynamics**

Scientific Objectives: Obtain a comprehensive suite of dynamical, chemical and microphysical measurements in the region of ASM anticyclone to address:

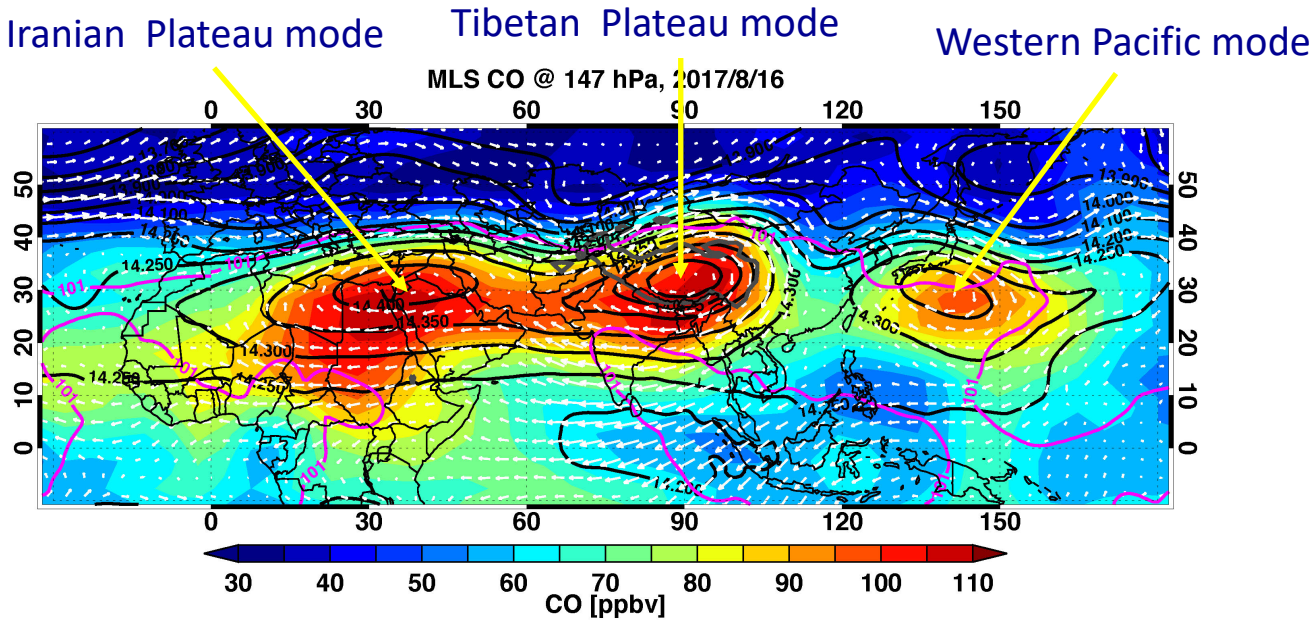
1) the **transport pathways** (vertical range, intensity, and time-scale) of the ASM uplifted air from inside of the anticyclone to the global upper troposphere and lower stratosphere (UTLS)
2) the **chemical content** of air processed in the ASM for UTLS ozone chemistry, and short-lived climate forcers
3) the information on **aerosol** size, mass and chemical composition for determining the radiative impact
4) the **water vapor** distribution associated with the monsoon dynamical structure

Sub-seasonal scale dynamical variability of the anticyclone & the western Pacific Mode



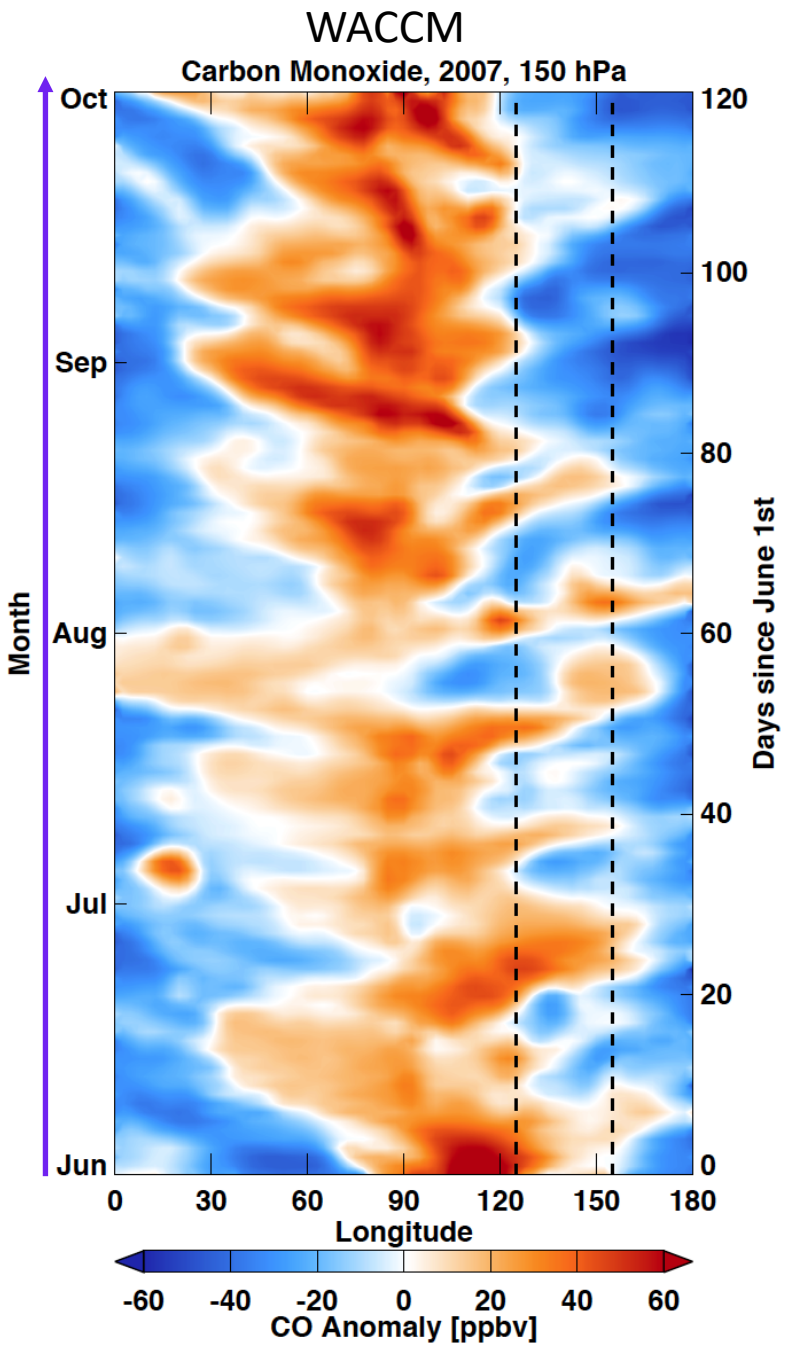
The Western Pacific Anticyclone and eastward "eddy shedding"

Sub-seasonal scale variability of the ASM

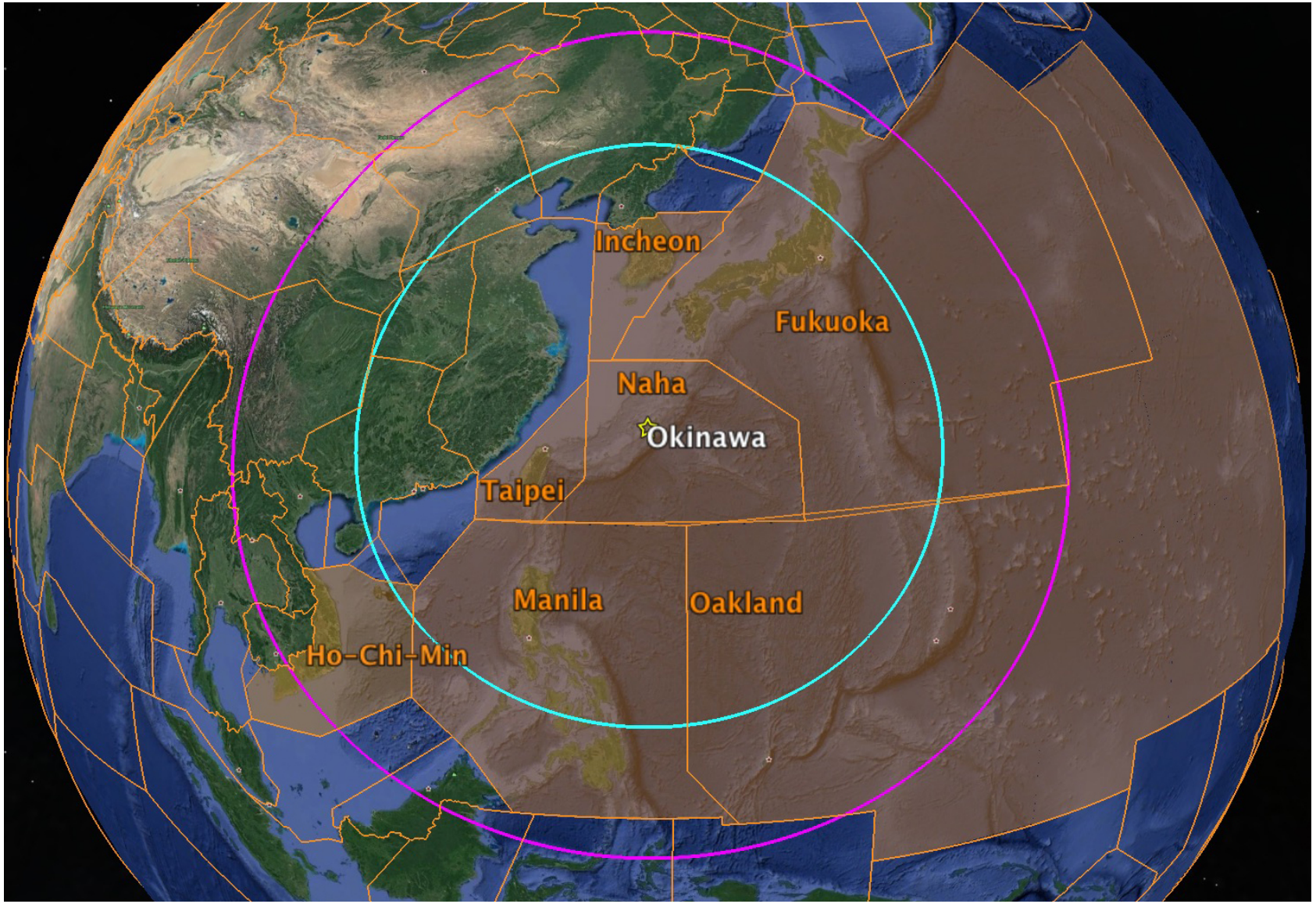


The path to impact global UTLS

Honomichl and Pan, to be submitted



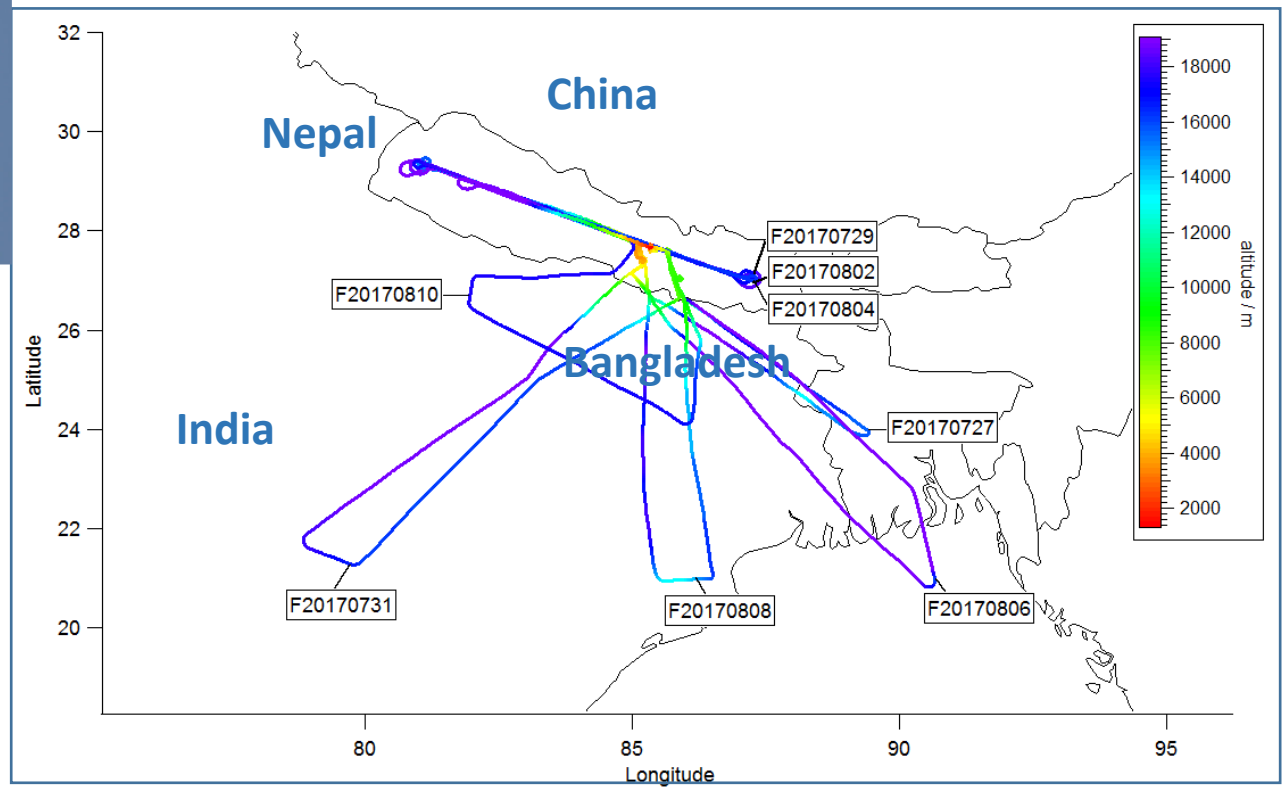
Map of Flight Operations



- Base of the flight operation TBD, likely Okinawa
- Aim to operate in 7 FIRs
- Nominal flight ranges of the GV (purple) and WB-57(cyan)

The First Successful Field Campaign focus on the ACAM Core UTLS Science Issues

8 Science Flights, 2017, Exciting data on water vapor and aerosol composition



The GV payload and investigators

Trace gas measurements

FASTO$_3$ + NO/NO$_{x,y}$	Weinheimer, ACOM
Aerodyne CO (CO, N_2O)	Campos/Flocke, ACOM
Picarro (CO_2, CH_4)	Campos, ACOM
GT-CIMS (SO_2/HCl/HNO_3/HO_2NO_2/ CH_3COOH /HCOOH)	Huey, GT
TOGA	Apel, ACOM
AWAS	Atlas, U Miami
VCSEL (H_2O)	RAF

Radiation

HARP (actinic flux)	Hall, ACOM

Aerosol

Size:

NMASS (3-60 nm)	Williamson/Brock, NOAA
UHSAS (cabin) (60 nm – 1 μm)	
UHSAS (wing)	RAF

Composition:

SP2 (BC)	Schwarz, NOAA
ERICA (particle types and elemental composition)	Borrmann, MPIC

Cloud

2DC	RAF
CDP	RAF
MTP (Temperature profile)	RAF

The WB-57 payload wish list

Trace gas measurements:

O_3, CO, H_2O, SO_2, NO/NOy IWC (NOAA ESRL)

CO, CO_2, CH_4, N_2O (NASA/AMS)

Whole Air Sampler (Miami)

H_2O Isotopes (?)

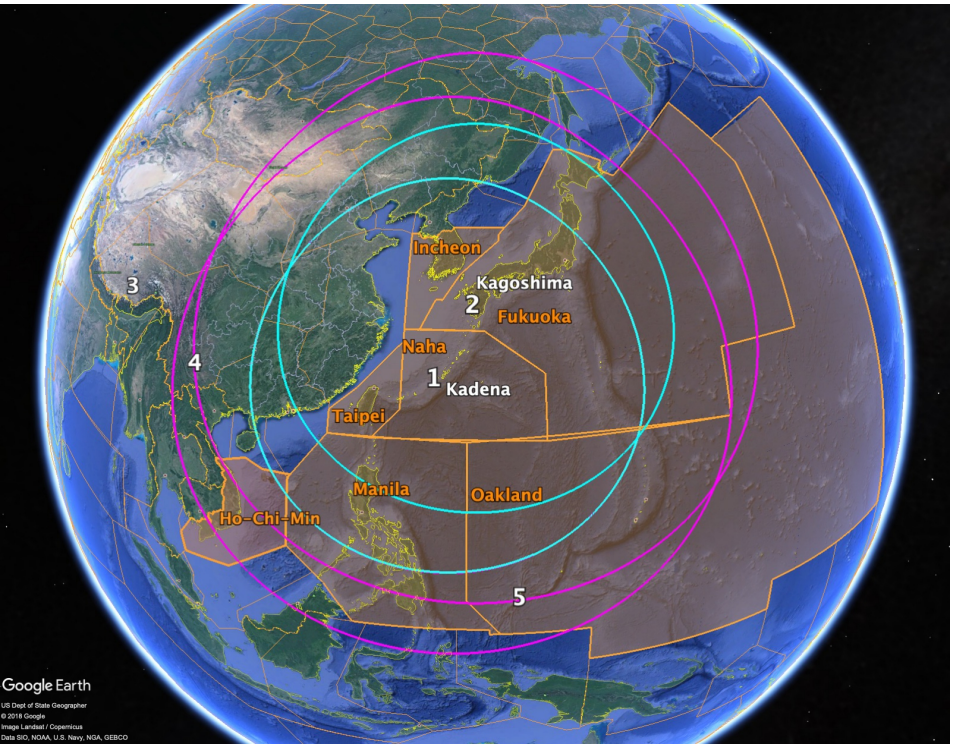
Aerosols:

Size distribution (NMASS)
Aerosol chemical composition (PALMS, NOAA)
Backscatter (LIDAR TBD)

Possible Collaborations

ALI (aerosol)/ SHOW (H_2O) – Adam Bourassa, U Saskatchewan, Canada
Cloud Probes – Martina Krämer, FZ Jülich

Ground-based measurements



- **Ru-Shan Gao** (NOAA): Coordinator between Airborne and multiple sites

1) Lars Kalnajs & Doug Gontz (CU): Funded by ACCLIP NSF proposal

Table 2. Instruments and instrument characteristics for balloon profiles.

Measurements	Instrument	Specification	#	Reference
Aerosol size distribution	POPS	0.15-3 µm; 3 cm^3s^{-1}	12	*(Gao et al., 2016)*
	LOPC	0.25-10 µm; 250 cm^3s^{-1}	2	*(Deshler et al., 2003)*
Aerosol number concentration	CNC	>0.01 µm	6	*(Campbell & Deshler, 2013)*
Water vapor	CFH	>25000 ppmv to <0.8 ppmv	12	*(Vömel et al., 2007)*
Meteorological Parameters	iMet	Temperature: -95 to 50°C Pressure: 2 to 1070 hPA Humidity: accuracy 5% RH	12	

2) Masatomo Fujiwara (Japan PI): A large team collaboration

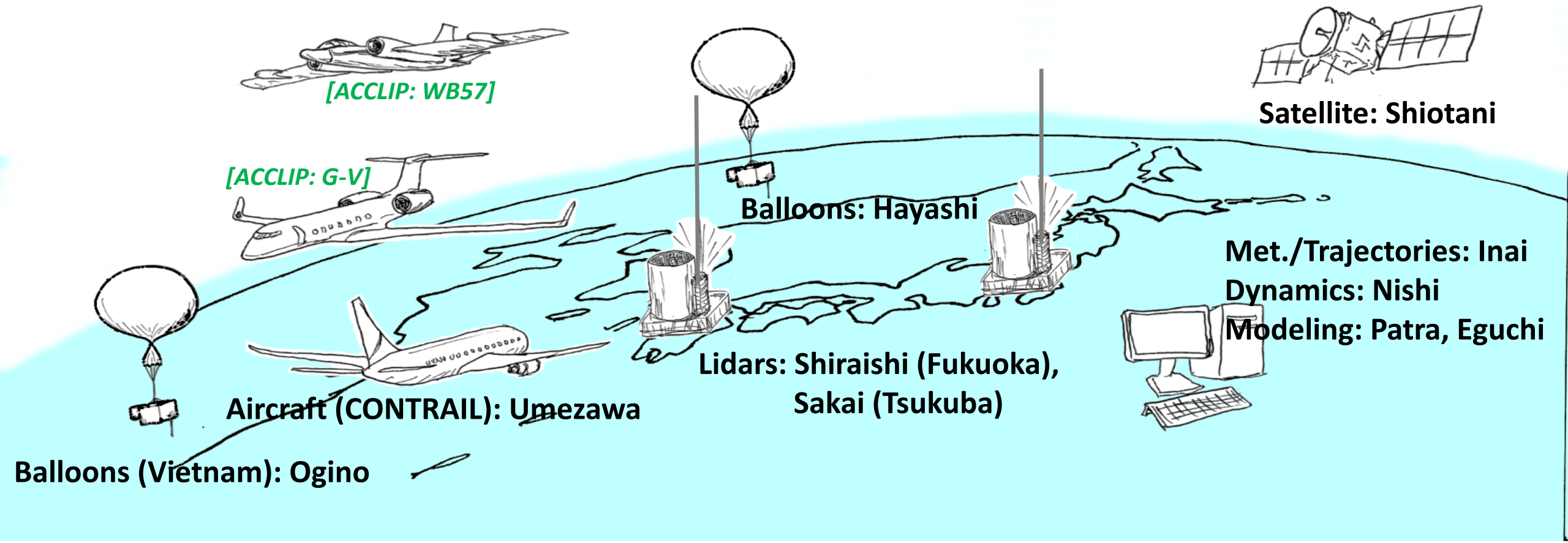
3,4) Jianchun Bian (IAP/CAS): Balloonborne measurements on the Tibetan plateau

5) Markus Rex (AWI/Germany): Ground based station Palau, TWP

International Collaborations I – Japanese team

Investigation of the transport processes dur to Asian Summer Monsoon by balloon, lidar, and aircraft observations

PI: Masatomo Fujiwara, Hokkaido University



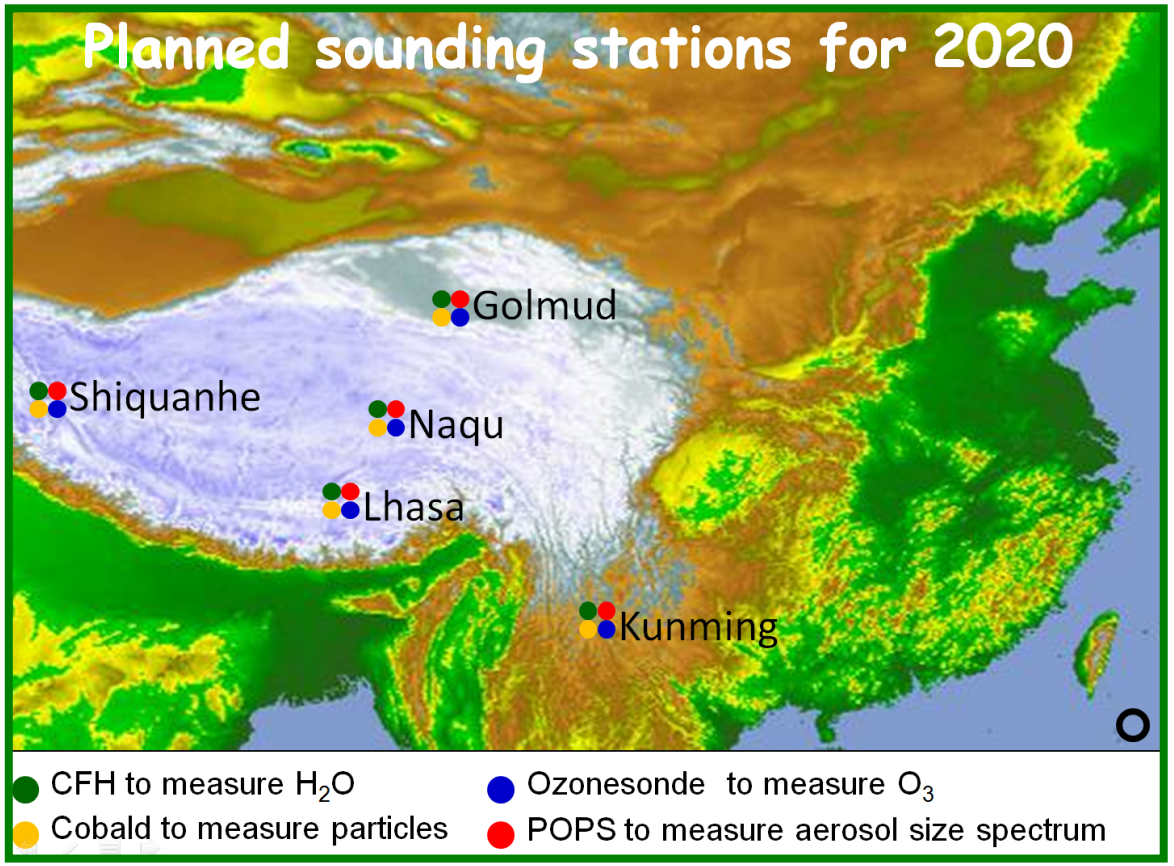
International collaborations II – Chinese Proposal :

Troposphere-stratosphere exchange of atmospheric compositions over the Tibetan plateau and its climate effect

PI: Jianchun Bian, Institute of Atmospheric Physics, Chinese Academy of Sciences

- Ground Based sounding program with O_3, H_2O, aerosols and cirrus clouds

- Spatial and temporal evolution of the ATAL layer:
  - Five stations over the Tibetan Plateau
  - May-September, 2020, every 10-15 days



ACCLIP Collaboration Opportunities

In addition to collaborations in Japan, China, and Korea:

- Invite interests of collaboration in *ACAM* community
- Regional observational and modelling studies on the season's emission signature and deep convective activities are highly relevant
- Collaborations coordinated through working group – to be discussed in breakout session tomorrow