

# PHILEAS CAMPAIGN GOALS

**Probing High Latitude Export of air from the Asian Summer Monsoon** 

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# **PHILEAS CONSORTIUM**



















BERGISCHE UNIVERSITÄT WUPPERTAL





- Background
- Research questions
- Payload
- Campaign location and duration
- Phases / Example flight paths





### **CONFINEMENT OF POLLUTION BY THE ASM ANTICYCLONE**



June 2023





### MOISTENING OF THE SUBTROPICAL UT BY CONVECTIVE UPLIFT



MLS water vapour climatology at 360K (Plöger et al., 2013)





June 2023

## SIMULATED LIFE CYCLE OF EASTWARD EDDY SHEDDING (CLAMS)



Second anticyclone: intact transport barrier between subtropics and midlatitudes (7.2PVU@380 K, Kunz et al., 2015) Long filament: signs of mixing into midlatitudes (PHILEAS objective) Mixing into the midlatitude LS: thin filaments over Northern Atlantic (e.g. Vogel et al., 2014; Müller et al. 2016)

Eastward migrating anticyclones break off several times during summer!







What are the **pathways**, **time scales and dynamical processes** of air mass transport from the ASM into the extratropical UTLS and LMS?



**Q-D1:** What is the relative importance of **different transport pathways** of air masses from the region of the Asian summer monsoon **into the extratropical UTLS**, their associated time scales and the related inter-annual **variability**?

**Q-D2:** Which **dynamical processes** control the **life cycle of eddies** shed from the Asian summer monsoon over the northern Pacific?







How do gas-phase and particulate constituents evolve in large-scale eddies which are shed from the monsoon anticyclone?



**Q-A1:** What is the state of processing of the **aerosol particles** (composition, size-distribution) as well as gasphase aerosol precursors (e.g. NH3, HNO3) and pollutants in the western part of the monsoon anticyclone?

*Q-A2:* How are these species affected after experiencing **long-range transport** through eastern outflow and during transport into the lowermost stratosphere?





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How does eddy shedding from the monsoon **impact on extratropical LMS composition** in particular the water vapor and radiatively active species?



Q-C1: How does eddy shedding impact the depth of the ExTL and of the NH-LMS? Q-C2: Which microphysical processes determine the water vapor transport during eddy shedding into the LMS?







How does eddy shedding from the monsoon **impact on extratropical LMS composition** in particular the water vapor and radiatively active species?



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Instrument	Target Parameter	Technique	Institution
GLORIA	Ammonium nitrate, $NH_3$ , $O_3$ , $H_2O$ , $HNO_3$ , PAN, $C_2H_6$ , $C_2H_2$ , HCOOH,, temperature	Imaging IR Limb Sounder	KIT / FZ Jülich
AMICA	COS, CO, CO <sub>2</sub>	OA-ICOS	FZJ
AIMS	HCI, HNO <sub>3</sub> , CIONO <sub>2</sub> , SO <sub>2</sub>	Mass spectrometer	DLR-IPA
BCPD	cloud droplet size distributions.	Back-scatter with Polarization Detection	U Mainz
BAHAMAS	meteorological and avionic data	BAsic Measurement And Sensor System	DLR-FX
FAIRO	O <sub>3</sub>	UV/Chemilumincscence	KIT
FISH	(total)/gas-phase H <sub>2</sub> O	Lyman-Alpha Hygrometer	FZ Jülich
GhOST-MS	SF <sub>6</sub> , CFC-12, wide range of halogenated species (e.g. $CH_2Br_2$ , CHBr <sub>3</sub> , halons, $C_2Cl_4$ , $C_2HCl_3$ , CHCl <sub>3</sub> , $CH_2Cl_2$ , $CH_3Cl$ )	GC-MS	U Frankfurt
HAGAR-V	CO2 SF6, CFCs, Halon-1211 NMHCs, short- and long-lived chlorocarbons, HFCs	NDIR GC-ECD GC-MS	U Wuppertal
AENEAS	NO, NO <sub>y</sub>	Chemiluminescence	DLR-IPA
FASD-Rack	Ultra-High Aerosol Spectrometer (UHSAS) Aerosol size distribution	Particle spectrometer	TROPOS/ MPIC-Mainz
ERICA	Aerosol composition and size distribution	Mass spectrometry	U Mainz/ MPIC-Mainz
UMAQS	CO, N <sub>2</sub> O, CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub>	QCL Absorption Spectrometer	U Mainz

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### **CAMPAIGN PHASES AND LOCATIONS**



adapted from Vogel et al., 2016

I : August 2023 (2.5 weeks), Europe (OP), ExLS background, undiluted ASM air (westerly outflow)
II : August /September 2023 (5 weeks), Alaska (Anchorage), mixing into ExLS (up to 390K)
III: October 2023 (1 week), Europe (OP), ExLS background changes









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## **PHASE 1: CAMPAIGN PHASES AND LOCATIONS**





I : August 2023, Europe, ExLS background, undiluted ASM air, coordinate flight with LearJet (TPChange)



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### PHASE 1: EXAMPLE FLIGHT PATHS







### **PHASE 2: CAMPAIGN PHASES AND LOCATIONS**



II : August /September 2023, Alaska, mixing into ExLS (up to 390K)





### **PHASE 2: EXAMPLE FLIGHT PATHS**





### **PHASE 3: CAMPAIGN PHASES AND LOCATIONS**





#### III: October 2023, Europe, ExLS background changes





Mitglied der Helmholtz-Gemeinschaft

## **THANKS FOR YOUR ATTENTION!**





