

# Status of COPS

## From Scientific Preparation Towards Operation

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+ ISSC

+ Participants of 1st and 2nd COPS Workshop

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# COPS

A field experiment within the German QPF Program PQP

**Goal:** Advance the quality of forecasts of orographically-induced convective precipitation by 4D observations and modeling of its life cycle



**Region:** Southwestern Germany, eastern France

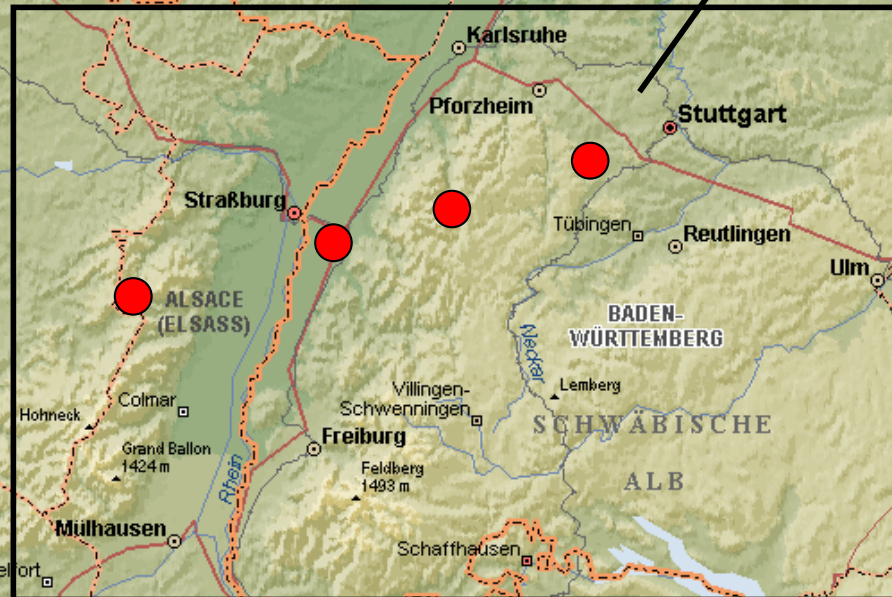
**Duration:** 3 months

**Date:** Summer 2007

**Features:** Severe thunderstorm activity but low QPF skill

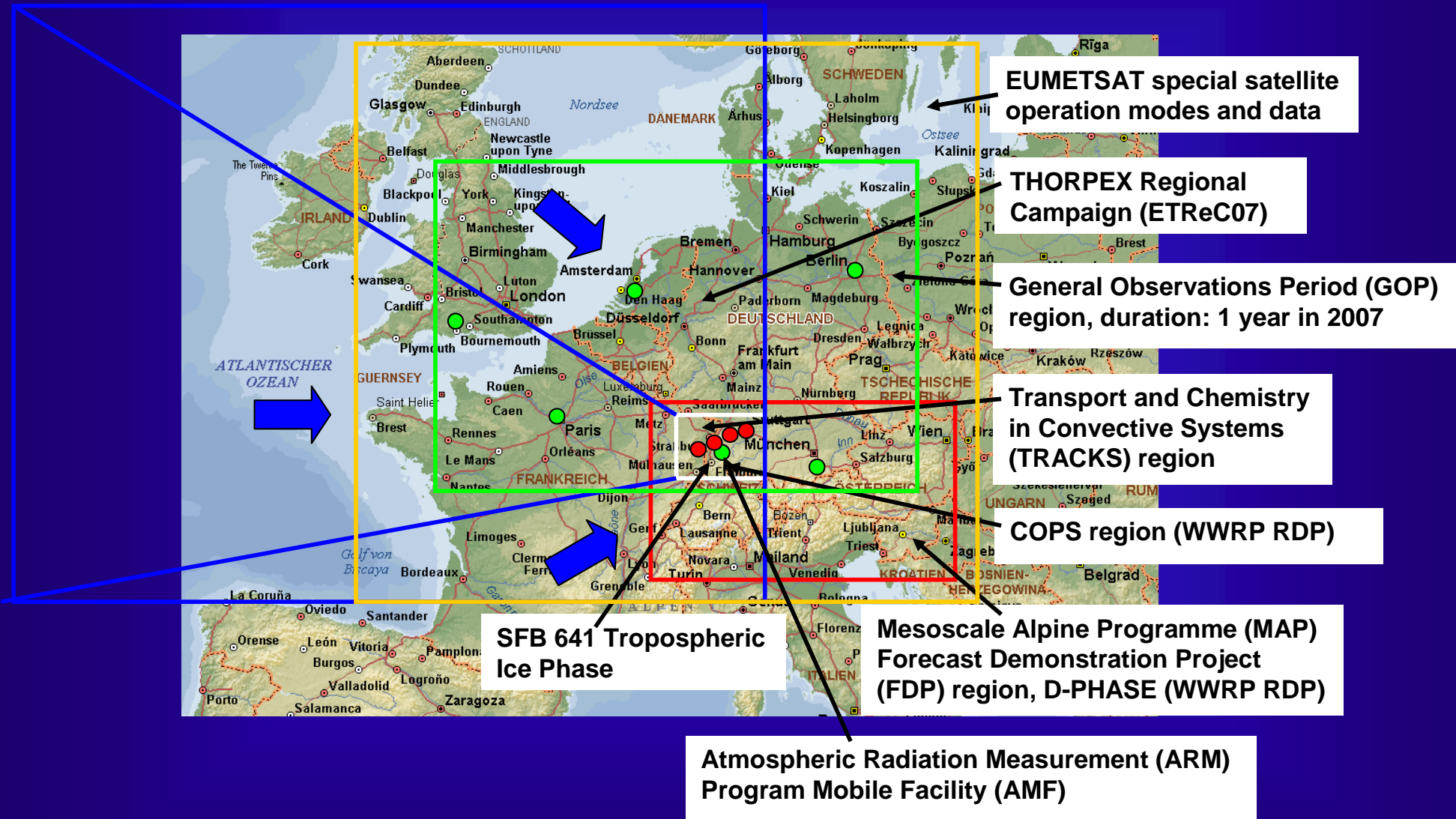
**Information:** [www.uni-hohenheim.de/spp-iop/](http://www.uni-hohenheim.de/spp-iop/)

COPS „Natural convection laboratory“  
Suggested area (270 x 150 km<sup>2</sup>)

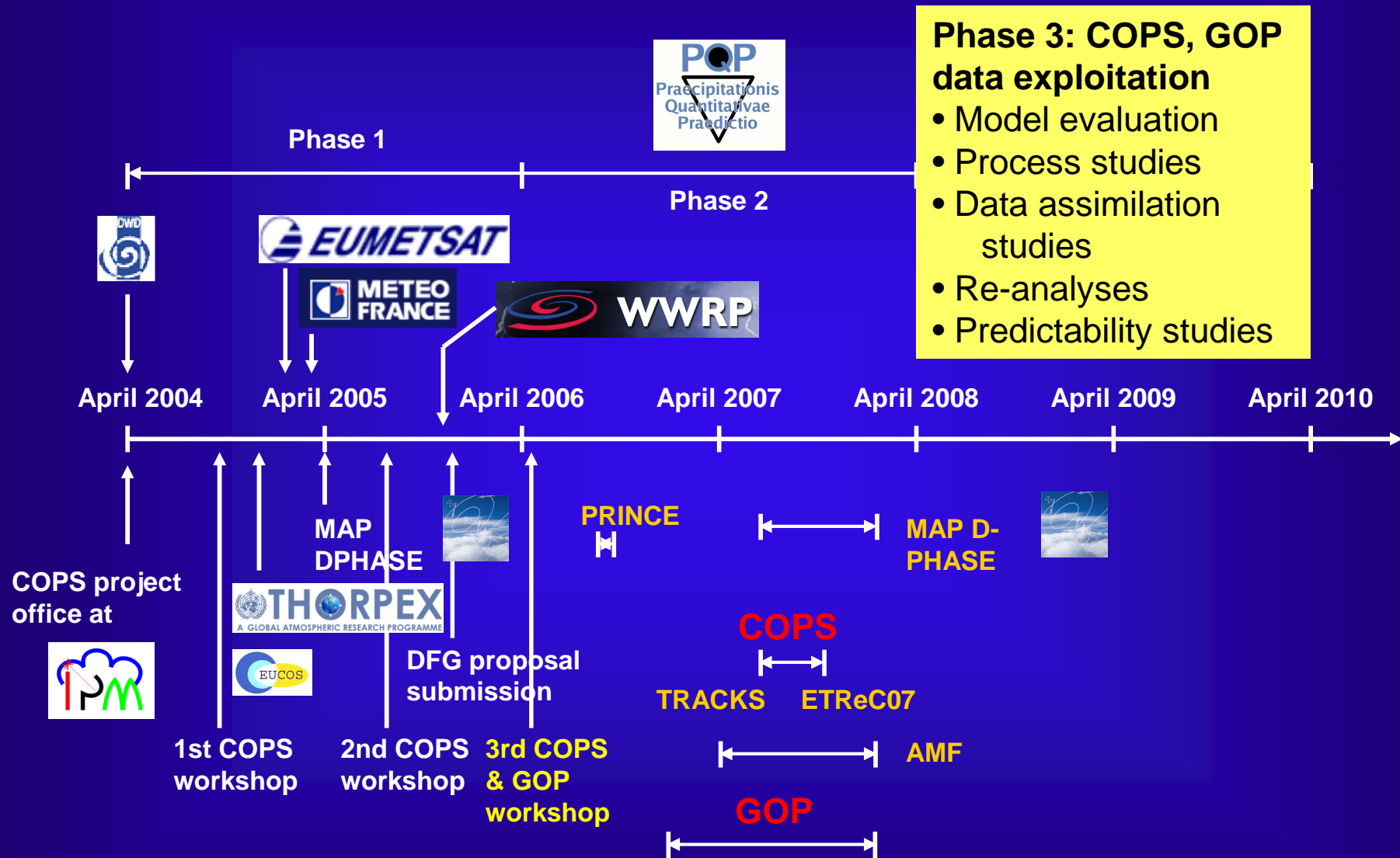


● Supersite

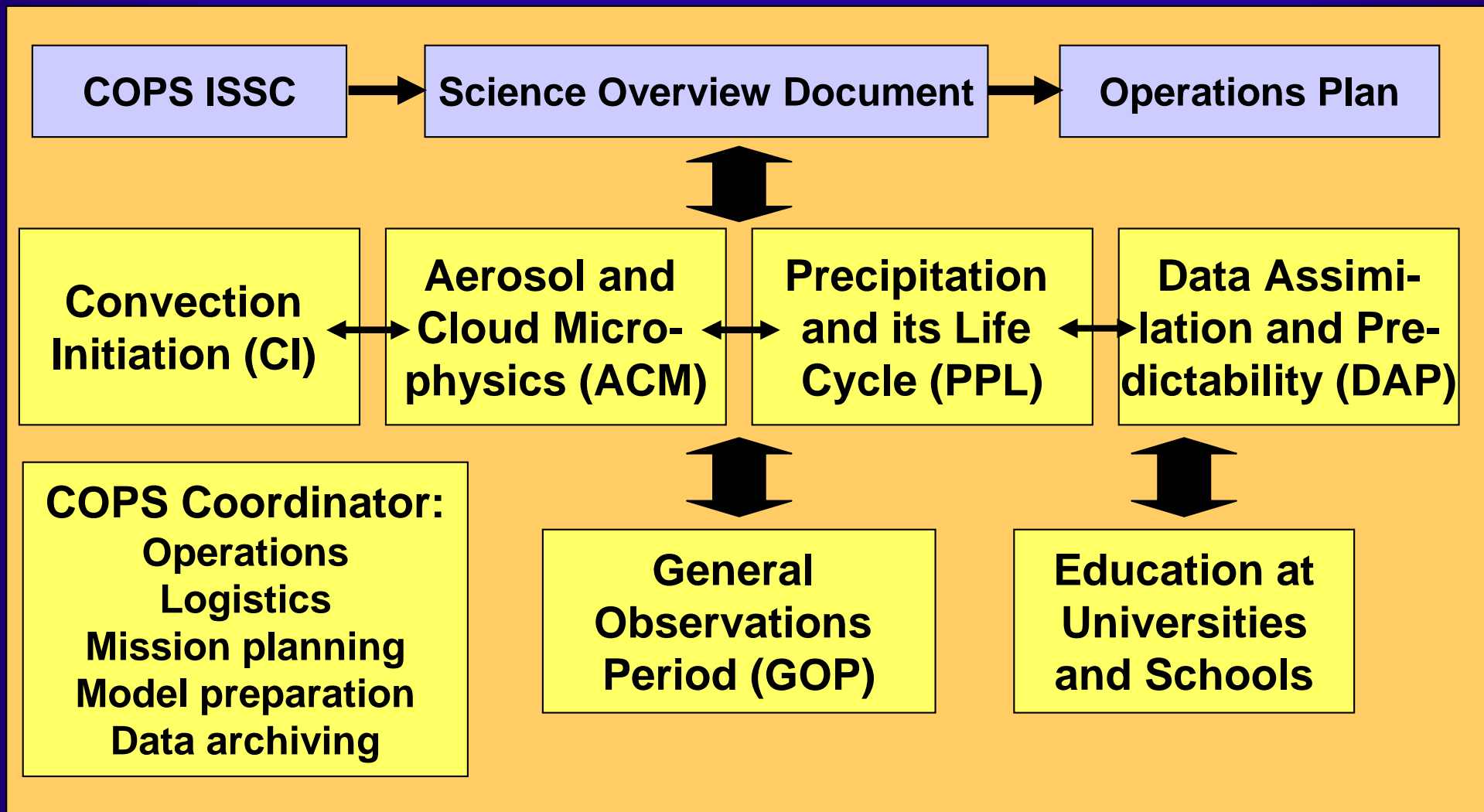
# International Collaboration: European Summer Experiments 2007



# Timeline



# PQP field programs organizational structure



# COPS science hypotheses

- Upper tropospheric features play a significant but not decisive role for convective-scale QPF in moderate orographic terrain. ⇒ **ETReC07, CI, GOP, DAP**
- Accurate modeling of the orographic controls of convection is essential and only possible with advanced mesoscale models having a resolution of the order of a few kilometers ⇒ **D-PHASE, CI, ACM, PPL, DAP**
- Location and timing of **CI** depends critically on the structure of the humidity field in the planetary boundary layer
- Continental and maritime aerosol type clouds develop differently over mountainous terrain leading to different intensities and distributions of precipitation ⇒ **TRACKS, SFB 641, ACM, PPL**
- Novel instrumentation during COPS can be designed so that parameterizations of sub-grid scale processes in complex terrain can be improved (**ALL**)
- Real-time data assimilation of key prognostic variables such as water vapor and dynamics is routinely possible and leads to a significant better short-range QPF (**CI, DAP, GOP**)

This shall be achieved by combining:

- 1) A synergy of unique in-situ and remote sensing instruments,
- 2) Advanced high-resolution models optimized for operation in complex terrain,
- 3) Data assimilation and ensemble prediction systems.

# Observation strategy

Transect with supersites

Optimization of radar coverage

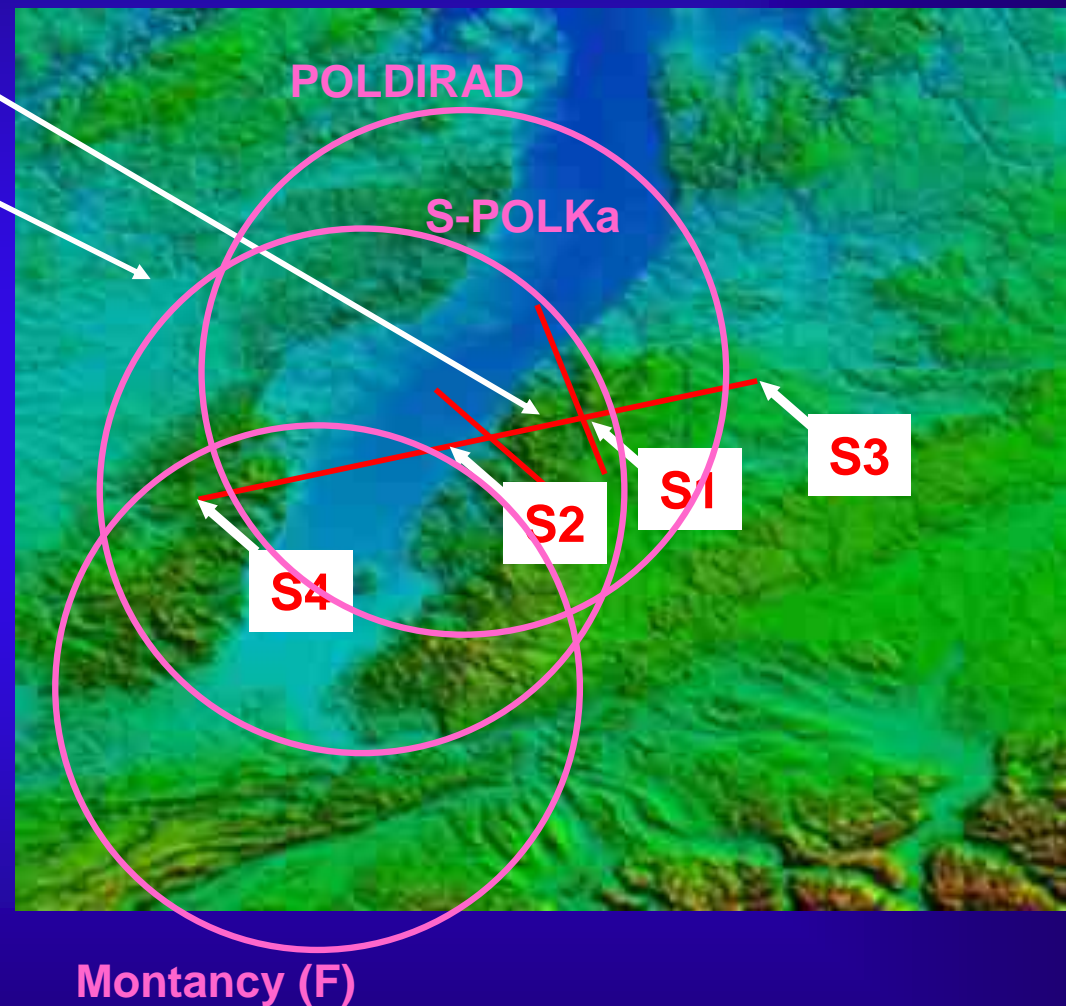
Large-scale and mesoscale observations provided by DLR Falcon aircraft.



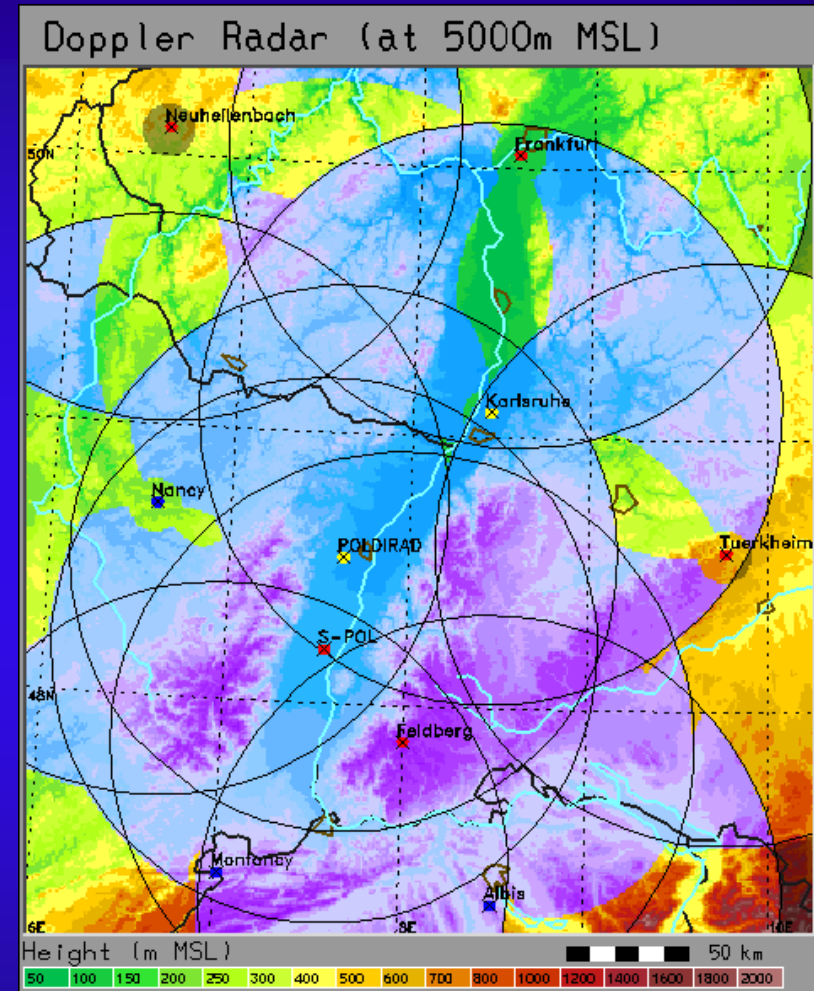
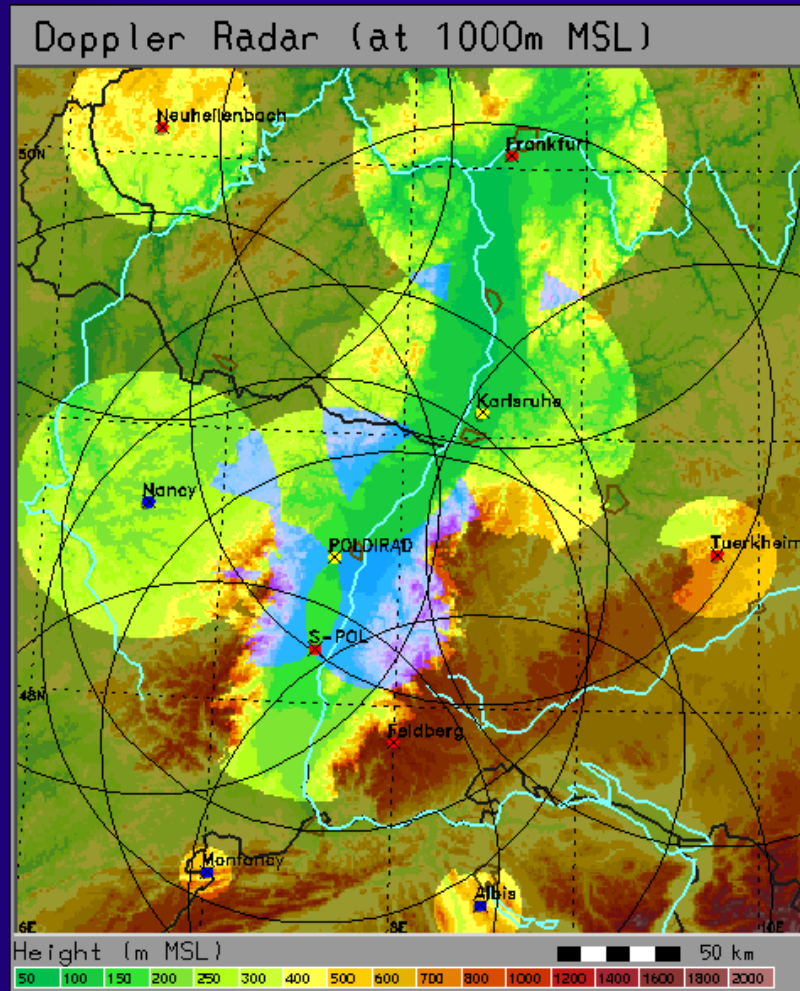
Regional observations between supersites performed by Do-128, Safire F20, and UK Cessna aircrafts.



Cloud microphysics with UK BAE 146.



# Radar Coverage



Radar coverage considering orographic shielding. Bright colors: Doppler radar coverage; blue colors multiple-Doppler analysis is possible at 1000 m and 5000 m MSL



# Supersites

Lidars  
 Cloud radars  
 Precip. radars  
 Radiometers

**S1**

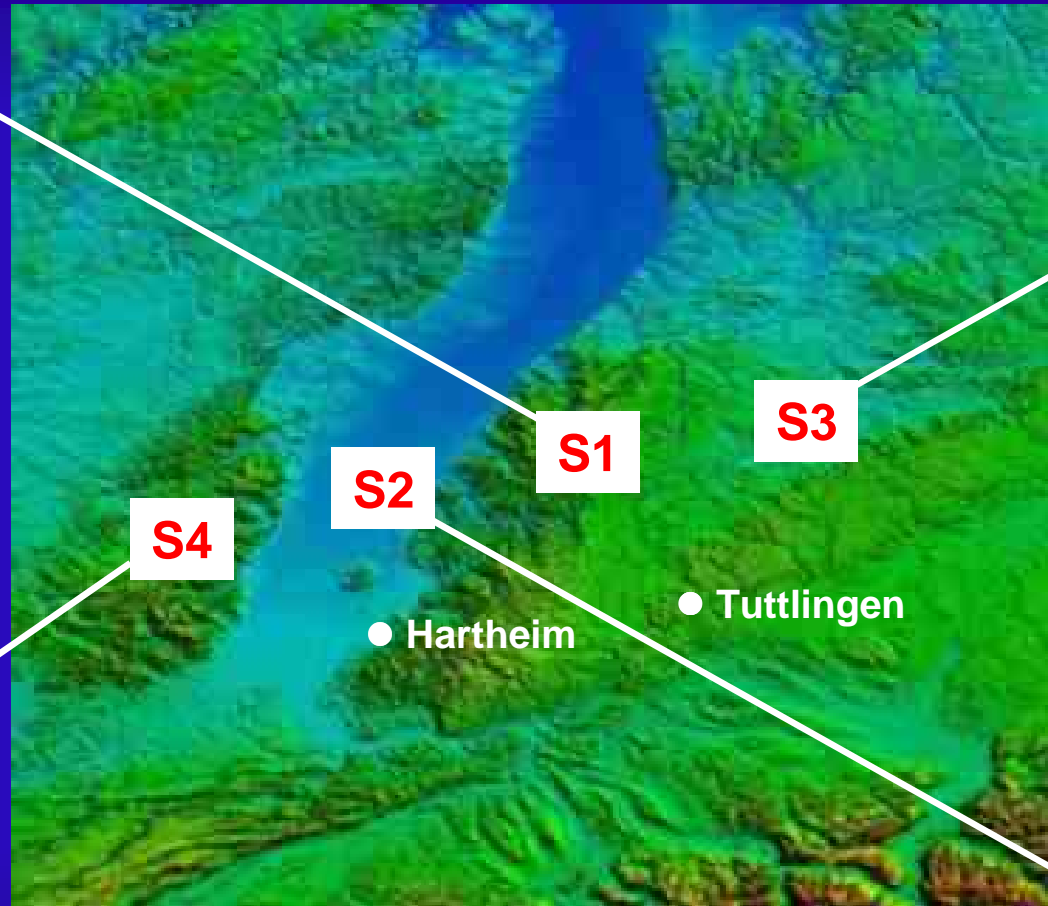
- AMF
- WV DIAL
- RR Lidar
- WindTracer
- MWL & WiLi
- HATPRO
- FZK Cloud Radar
- UHOH X
- Radiosondes

**S3**

- CNR Raman Lidar
- CNR Radiometer
- UHH Cloud Radar
- WTR
- Sodar/RASS

## Rhine valley

- RS Station (mobile)
- DOW



**S4**

**S4**

- CNRS Raman lidar
- CNRS Doppler lidar
- ASMUWARA
- Cloud radar

## Black-Forrest valley entrances

- 2 FZK Sodars
- UF Sodar

**S3**

**S1**

**S2**

**S2**

- UNIBAS Raman lidar
- UK Doppler lidar
- UK Ozone an Aerosol Lidar
- MICCY -TARA

## Between S1 and S3

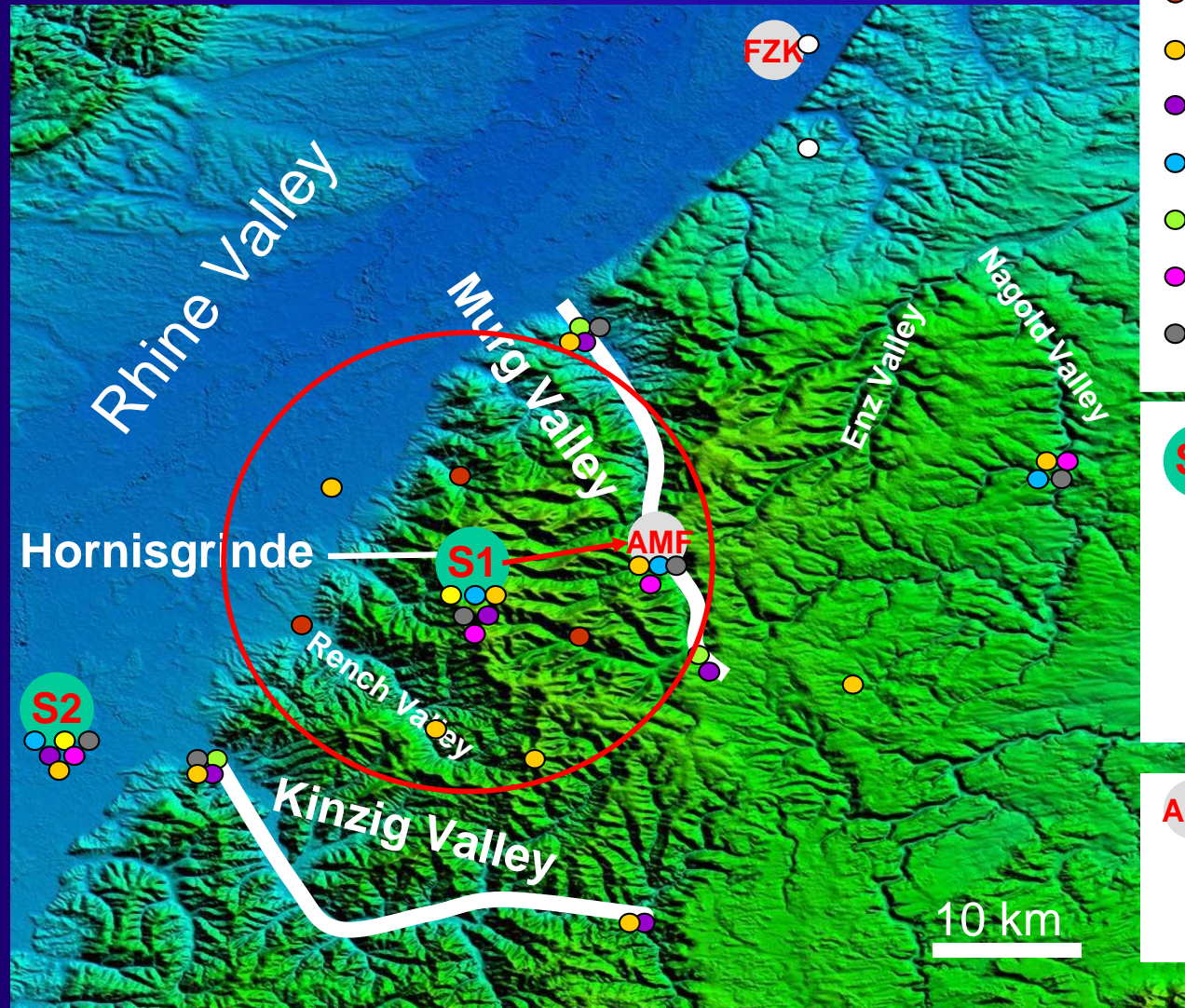
- RS Station (mobile)
- DOW

# Zoom in view in Northern Black Forest

- Energy balance stations
- Flux stations (turb. towers)
- Radiation turbulence clusters
- Soil moisture sensors
- Mesonet
- Radiosonde stations (RS)
- Sodars
- MRRs
- GPS

**S1** UHOH WV DIAL  
UHOH RRL  
Windtracer  
UHOH X-band  
FZK cloud radar

**AMF** AMF  
HATPRO + 90/150 GHz  
MWL & WiLi (incl. RS)



# The Black Forest AMF Site

AMF Core instruments	
SKY Rads	Radiometer
SKY IRT	IR Therm
GRD Rads	Radiometer
GRD IRT	IR Therm
MFRSR	Radiometer
SMET WD	Anemometer
SMET T/RH	Temp/humid
SMET BAR	Barometer
SMETORG(815)	Rain gage
PWD	Present Weather Detector
TSI	Camera
ECOR	Eddy Correlation
BBSS Digi/Ant	Up air sonde
CEIL	Lidar
MPL	Lidar
MWR	Radiometer
MWRP	Radiometer
NFOV	Radiometer
AERI	Interferometer
WACR (94Ghz)	Radar
CIMEL	Photometer
RWP (1290Mhz)	Radar Wind Profiler
CIMEL	Sun Photometer



AOS Core Instruments	Aerosols
TSI neph x 2 Dry	TSI 3563 Nephelometer at low RH
TSI neph + humidograph	Nephelometer + humidograph system for scanning RH
RR PSAP	Radiance Research 3 wavelength Particle soot absorption photometer
CPC (or CNC?) CPC=CNC	TSI 3010 Condensation nuclei counter
CCNC	DMT Cloud condensation nuclei counter

# The Black Forest AMF Site



- + 14 channel scanning microwave radiometer HATPRO (LMU)
- + 90/150 GHz radiometer (LMU)
- + Online implementation for Integrated Profiling Technique (IPT) Löhnert et al. 2004 & COST 720:
  - Profiles for T and q, LWP, IWV,  $r_{\text{eff}}$
  - Online model evaluation for AMF and Cloudnet stations
- + Micro rain radar (UHH)
- + Multi-wavelength lidar (IfT)
- + Doppler lidar (IfT)
- + Scanning water vapor DIAL (UHOH)
- + Scanning rotational Raman lidar (UHOH)
- + Scanning Doppler lidar (FZK)
- + 36-GHz scanning cloud radar (FZK)

# DFG Budget and its distribution

- COPS/GOP: **2 Mio€**, separate from general PQP budget
- Allocated for transportation, operation, staff for operation (largely internal funding!), data archiving, workshops, coordination, logistics, data management, educational component

**>2 Mio€** additional internal funding of COPS participants

Data exploitation in phase 3 of PQP

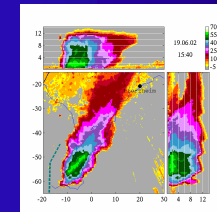
# German Research Observation Systems Funded for COPS (part 1)

- Radiation-turbulence-stations & towers (energy balance stations, scintillometers,...)
- Soil moisture sensors
- Weather stations
- Rain gauges, disdrometer, tipping buckets
- GPS receivers
- Radiosonde stations, drop-up sondes

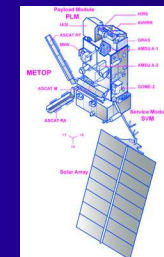


## Continuously operating, fixed-mode remote sensing instruments

- Karlsruhe Radar
- Ceilometers
- FTIR & MW Radiometers
- Micro-rain-radars



## Additional satellite products for COPS (e.g., MSG rapid scans)



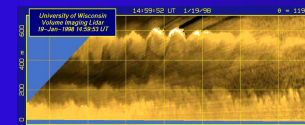
# German Research Observation Systems Funded for COPS (Part 2)

... mobile, adaptive-mode-scanning, and partly not operated continuously

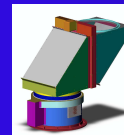
- DLR Falcon with H2O DIAL, Doppler Lidar, dropsondes
- DO 128



- Scanning H2O DIAL
- Scanning RR Temperature Lidar
- Scanning Doppler Lidars WindTracer & WiLi
- Multi-Wavelength Raman Lidar IfT

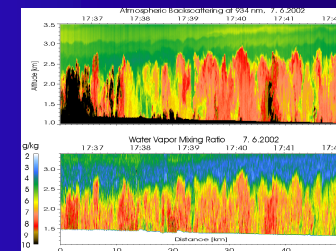


- FZK Cloud Radar
- UHH Cloud Radar

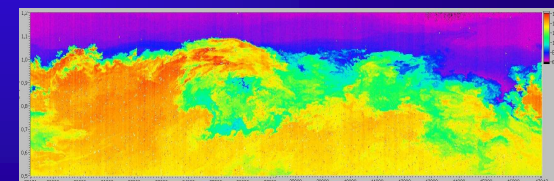


- POLDIRAD

- 2 FZK Sodars, 1 UF Sodar
- UB Sodar/RASS
- FZK WTR



- Scanning MW Radiometers HATPRO & MICCY



**The German instruments form the basis for additional international participation...**

# Foreign Research Observation Systems Requested for COPS

## France

- Falcon 20 aircraft with WV DIAL, dropsondes, turbulence instr.
- Polarization-Doppler Radar
- Raman lidar
- X-band radar
- UHF BL radar
- GPS Receivers



## UK: CATICT

- Cessna aircraft
- BAE 146 aircraft
- 3 Doppler lidars
- Ozone & Aerosol lidar
- Wind profiler
- 3 sodars
- 3 radiosonde stations
- Tether balloon with sondes
- New flux masts
- 5 Energy balance st.
- Aerosol instruments
- Gas Chromatographs



## US

- ARM Mobile Facility ☺
- SPoIKa
- DOWs
- ...?



## Italy

- UNIBAS Lidar
- CNR Lidars
- CNR Radiometer

## Austria

- U. Vienna instruments

## The Netherlands

- TARA

## Switzerland

- TROWARA



# Envisioned airborne platforms during COPS

✈ MPIC Learjet (max. 13 km): Chemistry + ?



✈ DLR Falcon (6 – 10 km AGL): WV DIAL, Doppler lidar (conical scanning), dropsondes, turb. fluxes

✈ SAFIRE F20 (6 – 10 km AGL): VW DIAL/RaLi?, dropsondes, p, T, q, u, v, w



✈ BAE 146 (max. 4 km), aerosol + cloud microphysics instrumentation



✈ Do128 (0.3 – 3 km AGL): T surface, upwelling & downwelling radiation and turb. fluxes

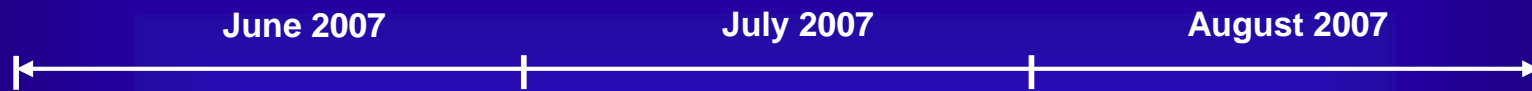
✈ UK Cessna (PBL) T, WV, wind, aerosols



○ FZJ Zeppelin NT (max. 2 km): Chemistry + ?



Flight coordination & communication with Air Safety Control: Heinz Finkenzeller, DLR



### **DLR Falcon**

30 allocation days (weekends do not count unless IOP)  
45 flight hours  
+ additional operation by EUFAR?

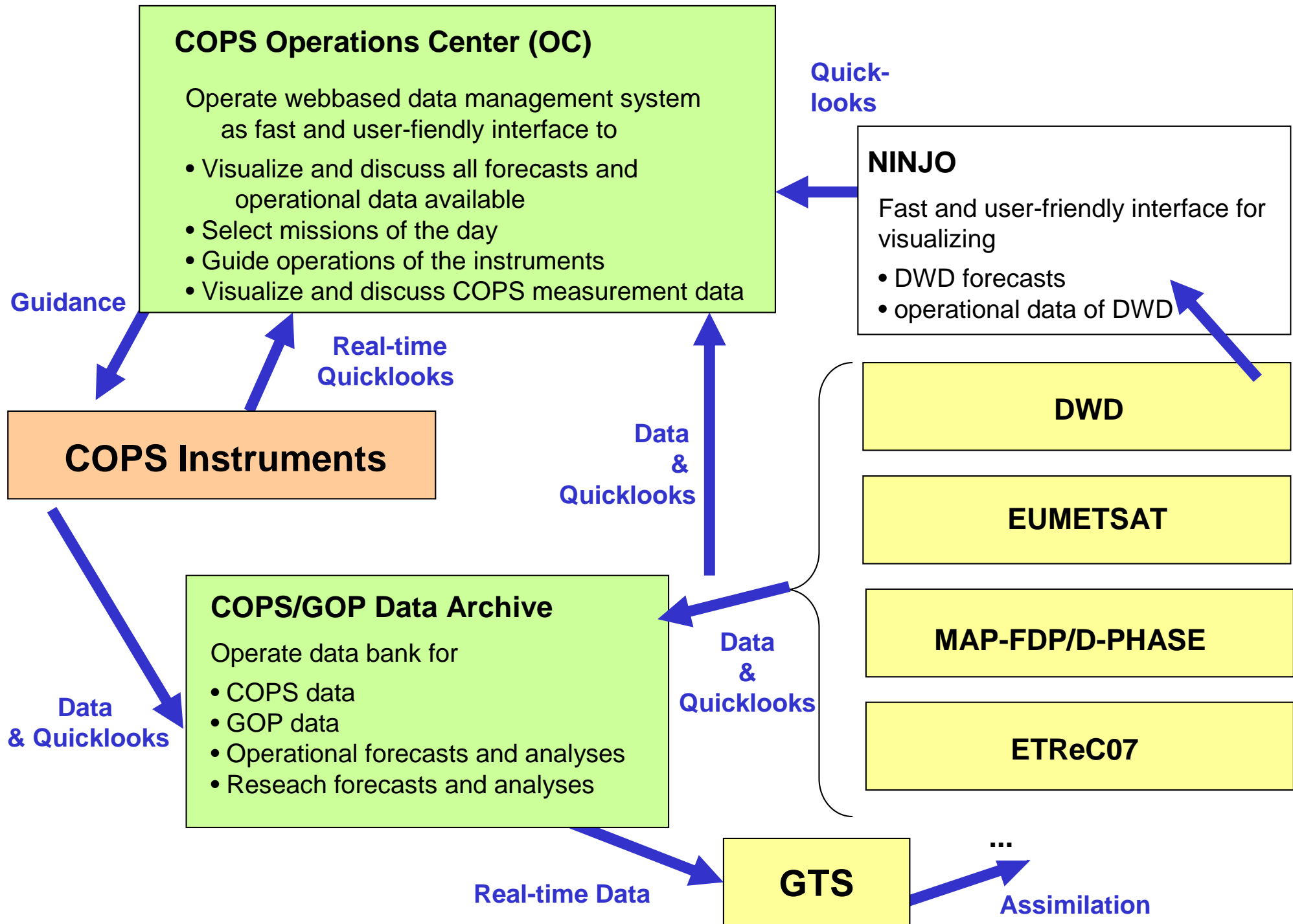
#### Reservation:

11 June: implementation of instruments  
18 June - 29 July: COPS deployment



### **DO128**

35 allocation days  
100 flight hours  
+ additional operation by EUFAR?



# Operations Plan

- Descriptions of the COPS missions with typical meteorological situations,
- Description of all instruments with measured parameters, operation modes, logistical requirements  
(for the proposed German instruments, this information has already been collected),
- Briefing and debriefing procedures,
- Communication plan for sites, operation center, airbase, aircraft, and scientists,
- Communication plan for data flow (operational and COPS-specific data),
- Forecasting system, responsible forecasters,
- Air traffic control issues,
- Alerting procedures for the investigators in the field,
- Names and responsibilities of operation manager, missions leaders, supersite managers,
- Details of the Operation Center Data Management System,
- Procedures for decision making.

Aims of this workshop:

Which setup for ground-based instrumentation?

Missions for airplanes & flexible instruments?

Data and information flow?

Responsibilities?