

# COPS and TRACKS Airborne Platforms

## “Mission Scenarios”

- Overview and general aspects
- “Forced Convection”
- “High Pressure Convection”
- “Targeted Observations”
- “City Plume”
- “Stratus Cloud-Physics”

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# COPS and TRACKS Airborne Platforms

## Mission Scenarios

### Overview and General Aspects

- Goals of the projects
- Scientific background
- Areas of operation
- Participating platforms
- Mission scenario overview

# **COPS** and **TRACKS** scientific goals

**Convection Initiation (CI) → Precipitation → Prediction**

**Trace gas emissions → conversion/transport → 3-d-redistribution**

**Convection initiation** and subsequent **mass redistribution**  
depends on atmospheric and soil surface factors

- differential surface energy balance caused by various reasons  
(surface forcing)
- fronts, gust fronts and convergence lines  
(lower tropospheric forcing)
- advection of vorticity/upper level troughs, advection of air masses  
(upper tropospheric forcing)

500 hPa:

Trough



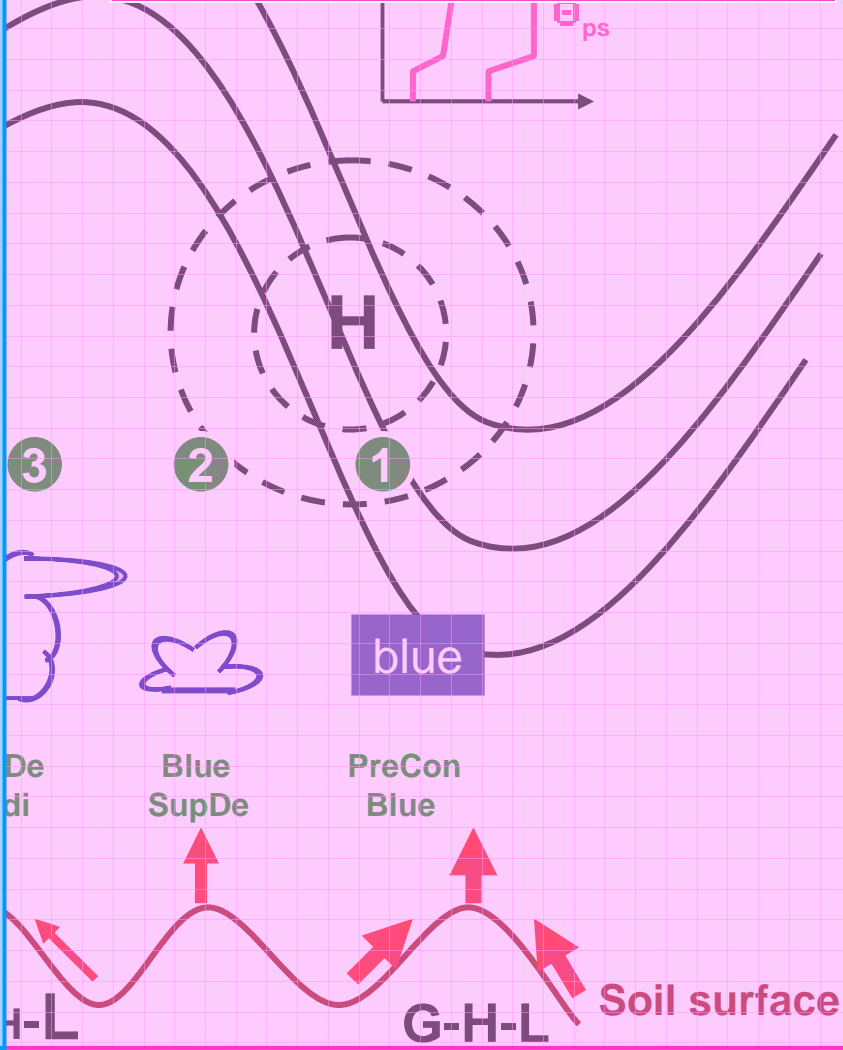
Ridge

NVA, CAA  
Subsidence

Trough

Mission Scenario  
„Forced Convection“

Mission Scenario  
„High Pressure Convection“



# CI forcing processes and trace gas re-distribution within synoptic scale weather development

- ① ② Surface/boundary layer triggered air mass convection  
(non-forced/non-frontal)
- ③ ④ Large-scale lifting, no surface front; convection breaking out  
over a wider area (forced/non-frontal)
- ⑤ Embedded convection along a surface front in a region of  
large-scale lifting (forced and frontal)

## Mission scenarios:

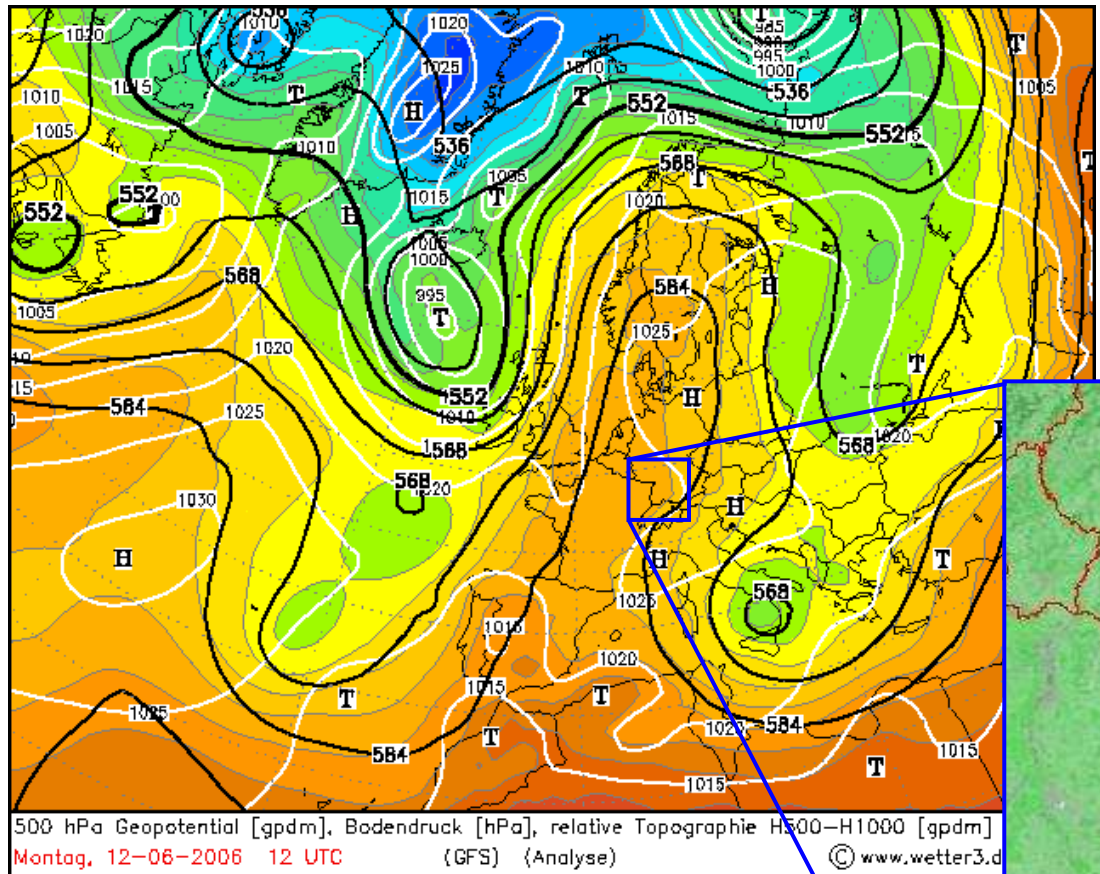
Scenario “High Pressure Convection” addresses cases ① to ③

Scenario “Forced Convection” addresses cases ③ to ⑤

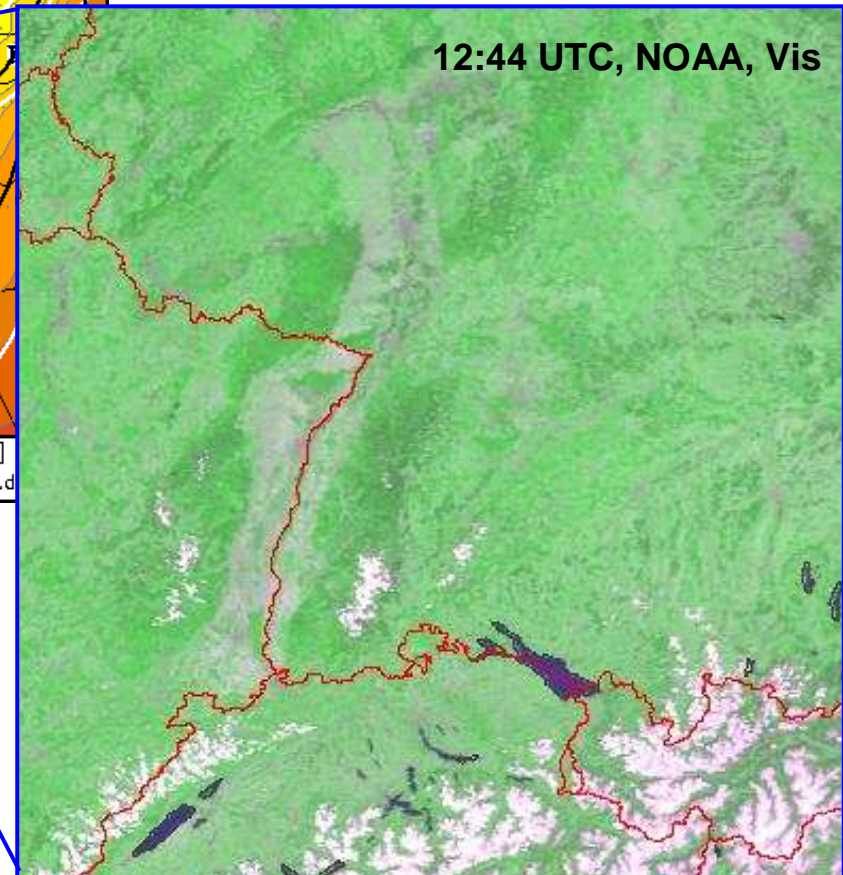
Scenario “Targeted Observations”

Scenario “City Plume”

# Example of slow convective development, June 12-15, 2006



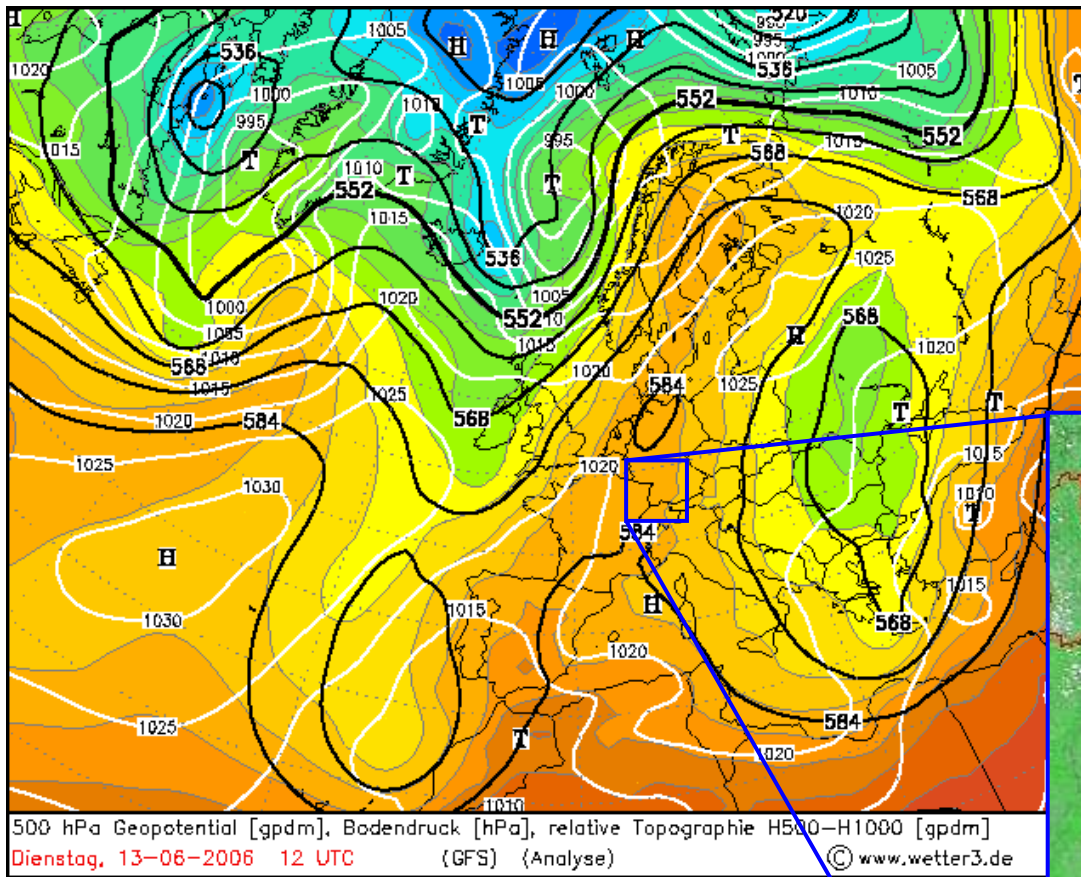
➤ Blue sky



June 12, 2006, 12 UTC

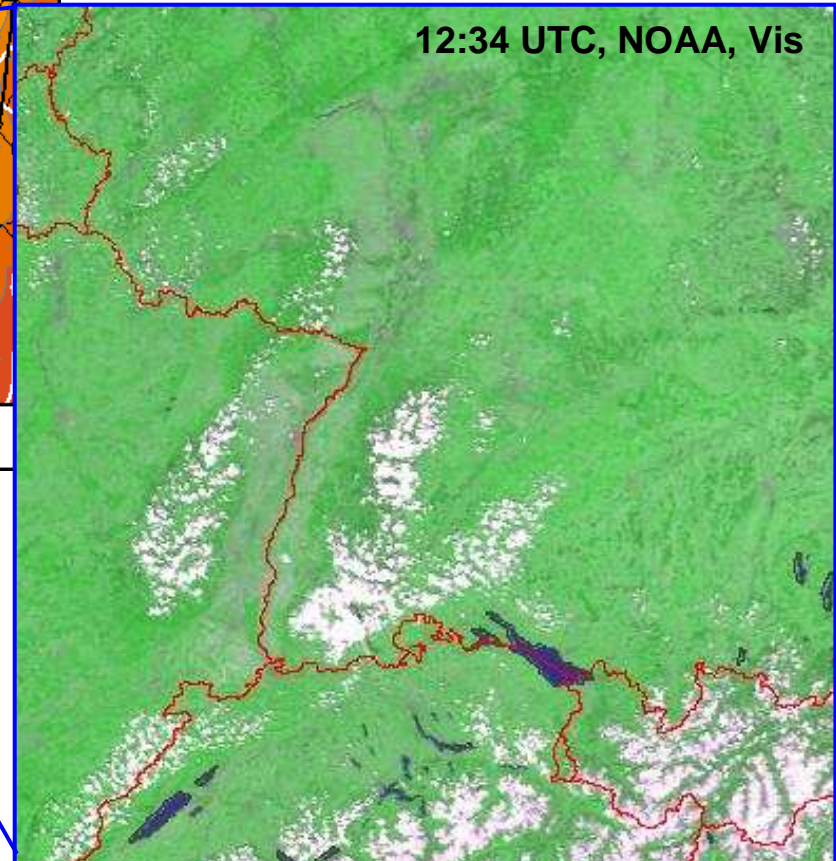
500 hPa Geopotential  
surface pressure  
RelTop

# Example of slow convective development, June 12-15, 2006



➤ Suppressed development

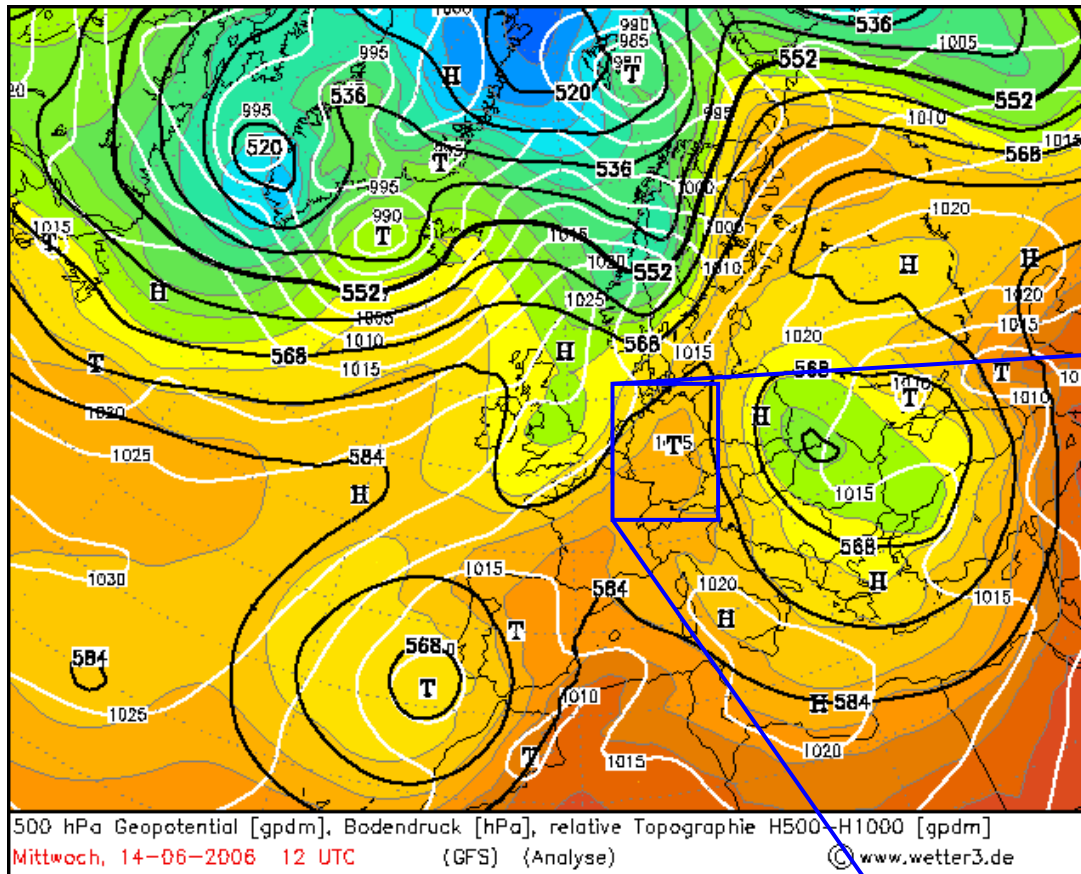
12:34 UTC, NOAA, Vis



June 13, 2006, 12 UTC

500 hPa Geopotential  
surface pressure  
RelTop

# Example of slow convective development, June 12-15, 2006



➤ Suppressed development

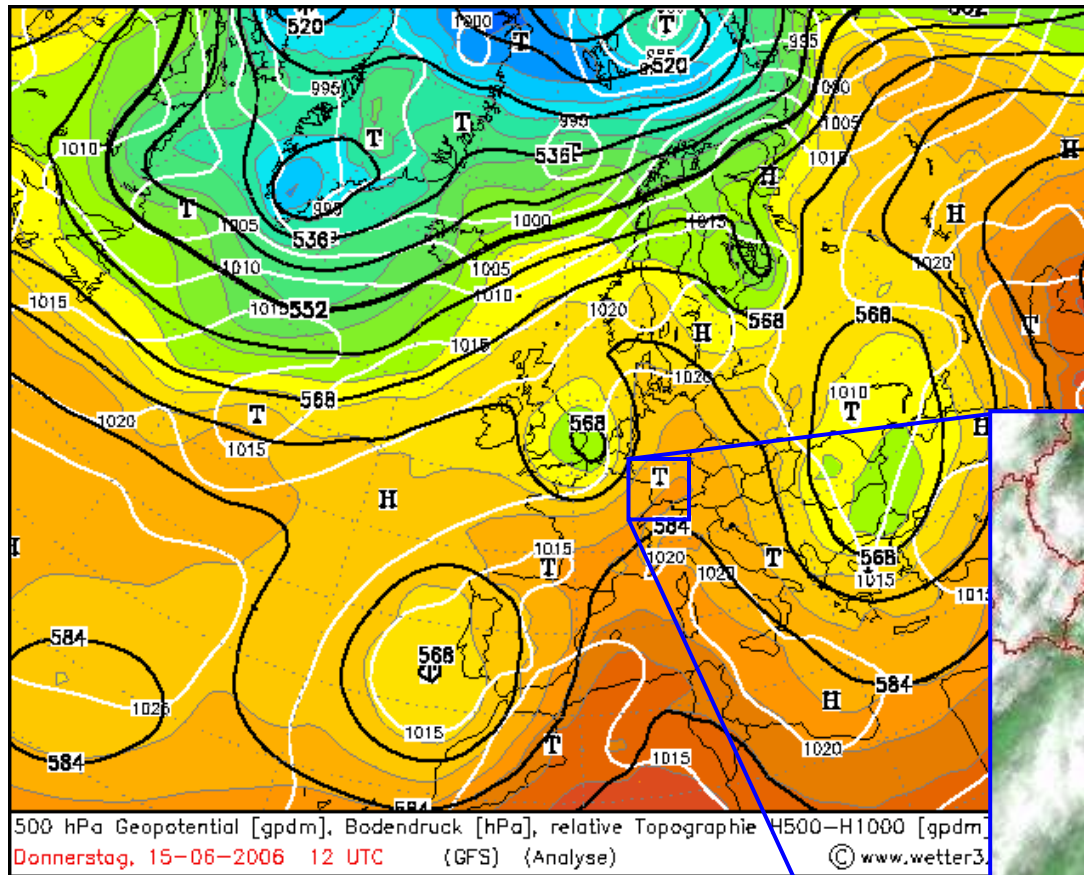


June 14, 2006, 12 UTC

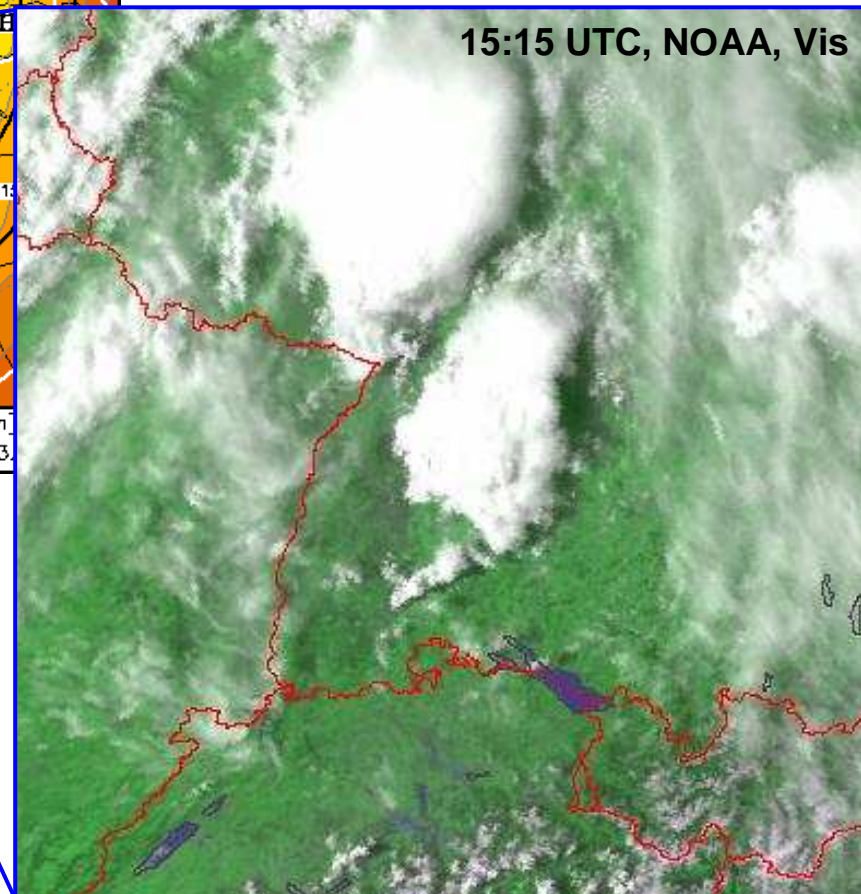
500 hPa Geopotential  
surface pressure  
RelTop



# Example of slow convective development, June 12-15, 2006



➤ deep development



June 15, 2006, 12 UTC

500 hPa Geopotential  
surface pressure  
RelTop

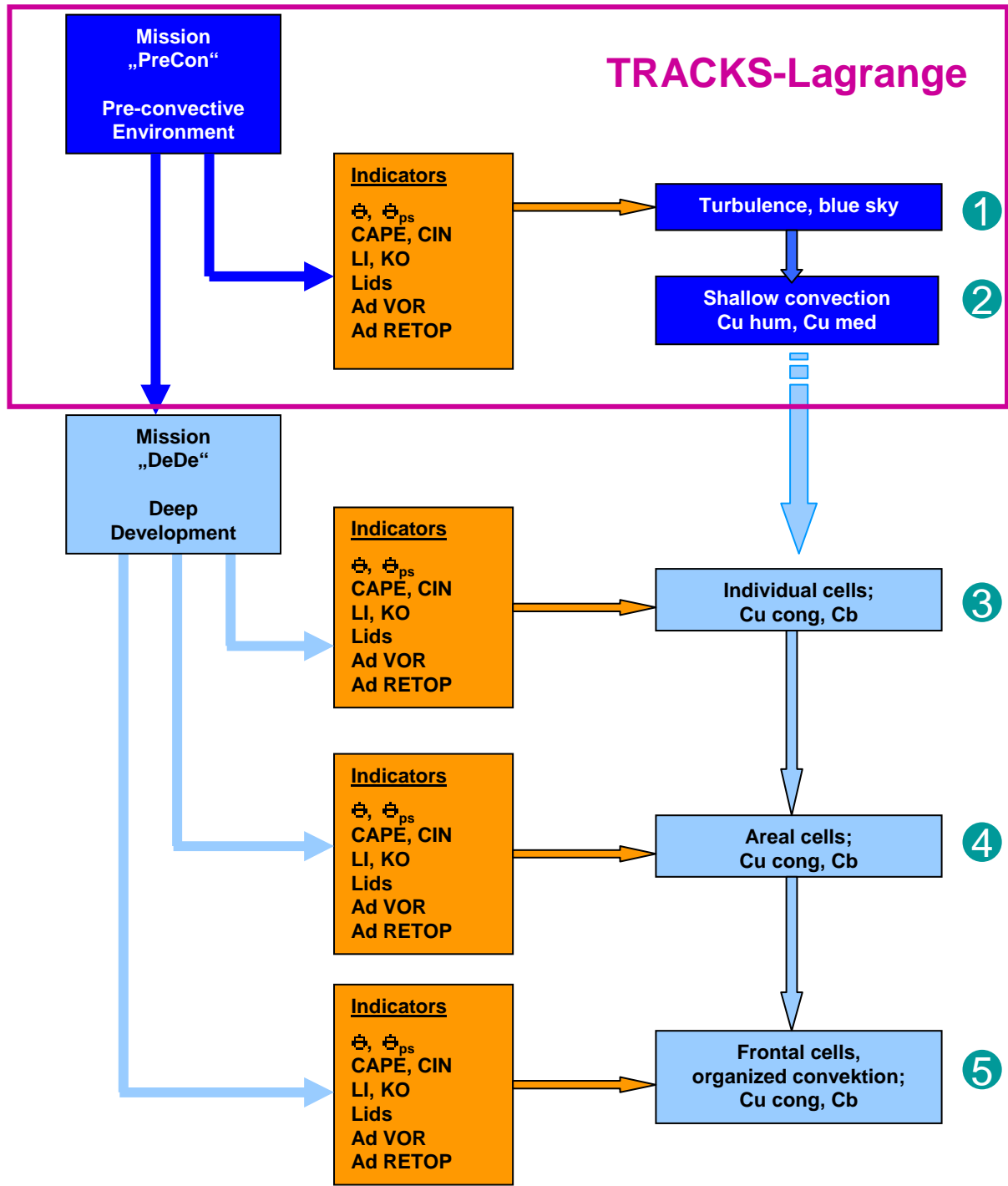
## Convective cases in June, July 2006 (compiled by IMK, FZK)

June 12-15, 2006 (slow development)  
June 28, 2006 (moderate development)  
July 11 - 13, 2006 („normal“ development)  
July 21, 2006 (fast development)

Agreement  
No agreement

## Convective development in 2005/06 (compiled by IPM, Uni Hohenheim)

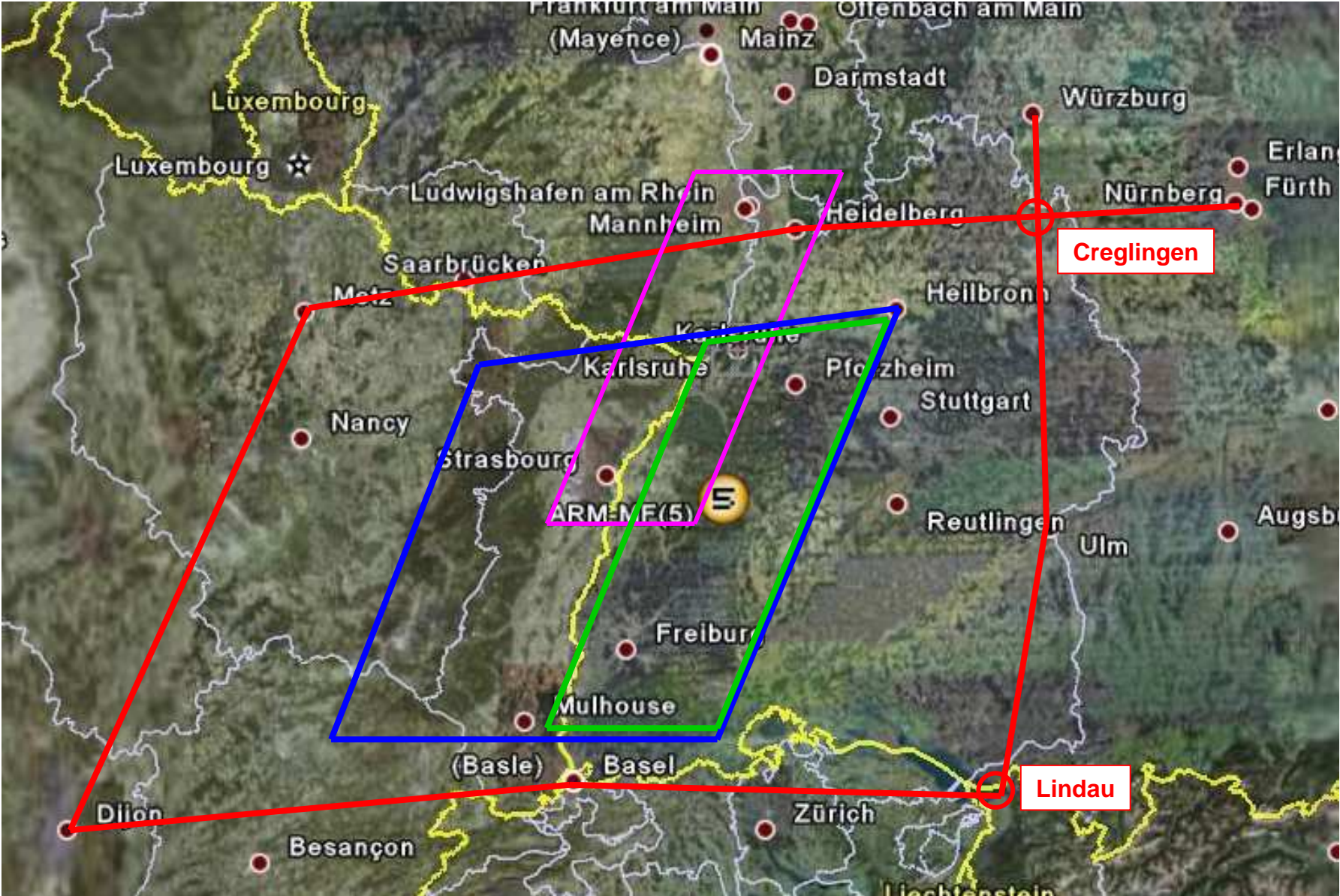
29.05.05 Forced/non frontal  
24.06.05 Airmass convection  
25.06.05 Forced non-frontal  
29.06.05 Forced frontal  
04.07.05 Forced frontal  
10.07.05 Forced/non frontal  
12.07.05 Airmass convection  
18.07.05 Forced/non-frontal  
25.07.05 Forced frontal  
29.07.05 Forced/non-frontal  
19.08.05 Forced/non-frontal  
or partly frontal  
09.09.05 Forced frontal +  
forced non-frontal  
  
28/06/06 Likely forced  
non-frontal  
13/07/06 Airmass convection  
31/07/06 Forced frontal  
28/08/06 Forced non-frontal



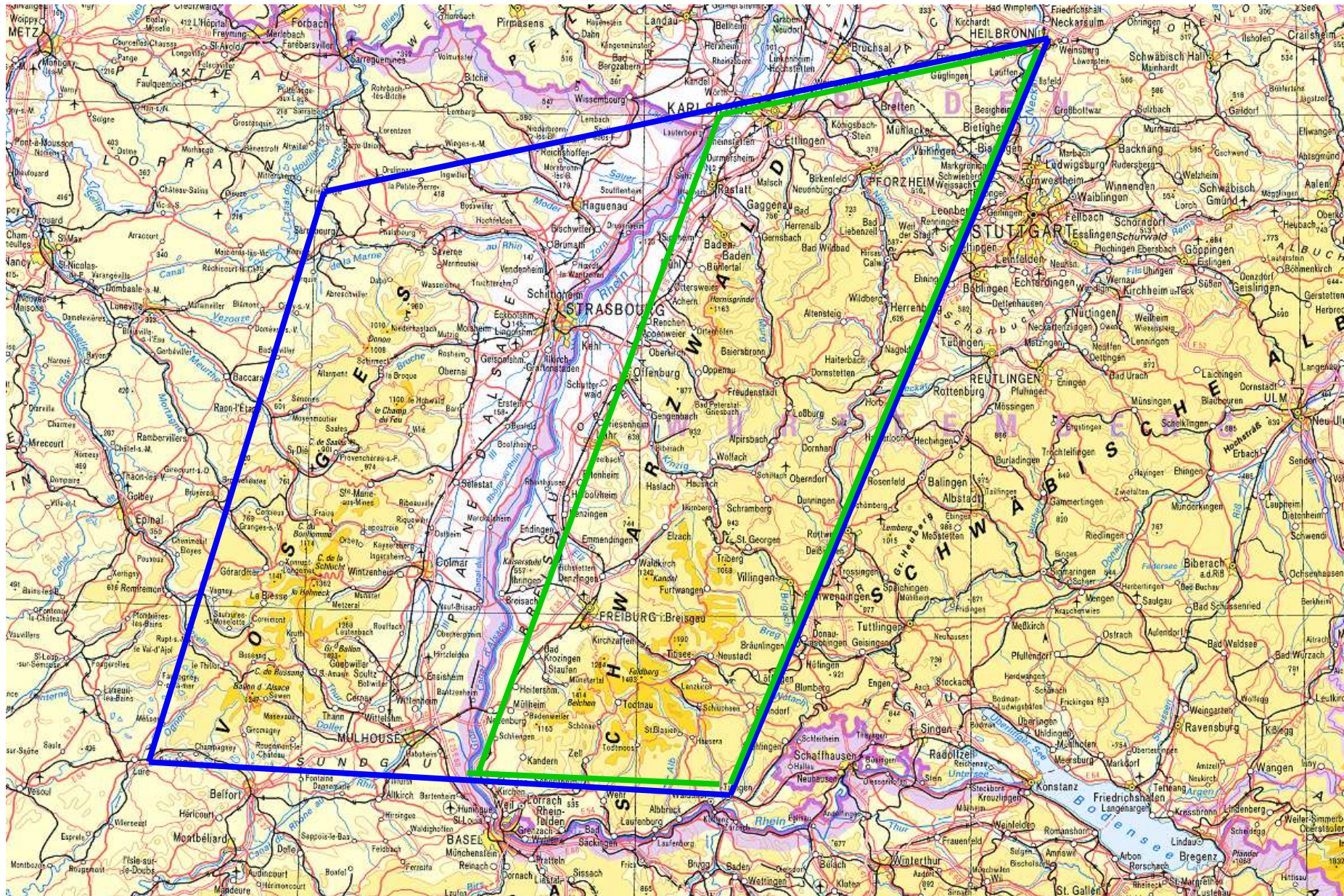
# COPS and TRACKS

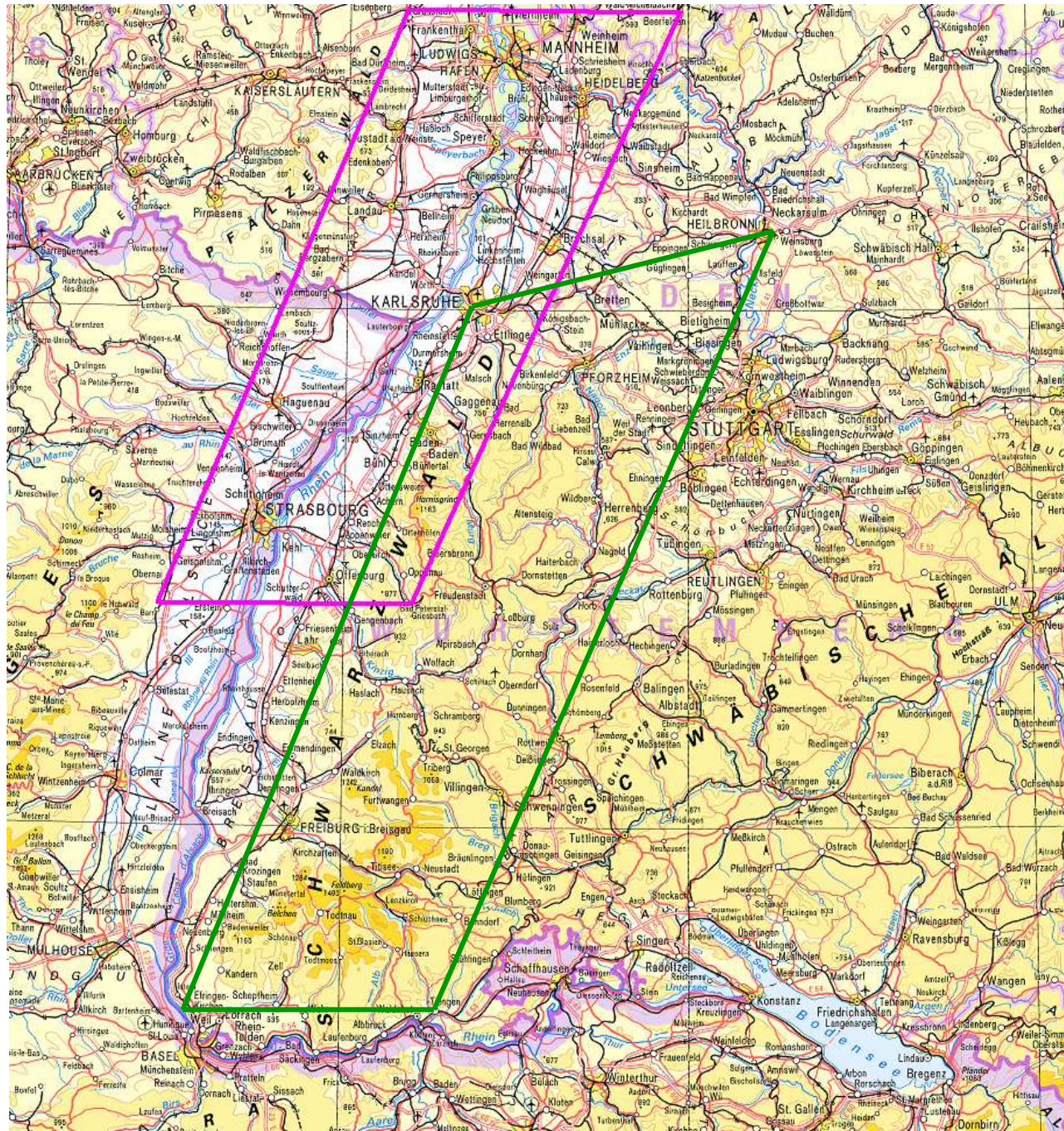
Scenarios for operation of airborne platforms in case of “High Pressure Convection” “Forced Convection” and “City Plume – Lagrange”

Area under Investigation: **COPS area** with sub areas **blue** and **green**  
**TRACKS areas green** and **pink**



# COPS sub areas (blue, green)





**TRACKS areas**  
**„City Plume“ (pink)**  
**and**  
**„Convective Transport“ (green)**

Coordinates of **COPS area** with sub-areas **blue** and **green**  
and  
Coordinates of TRACKS areas **green** and **pink**

Area	NW (N)	NE	SE (S)	SW
<b>RED</b>	6.1622 E, 49.1143 N Metz  (8.6842 E, 49.4140 N Heidelberg)	10.0327 E, 49.4772 N Creglingen	9.6721 E, 47.5532 N Lindau  (7.5795 E 47.5553 N Basel)	Dijon
<b>BLUE</b>	7.0206 E, 48.8433 N Fenetrange	9.2248 E, 49.1523 N Heilbronn	8.2709 E, 47.6383 N Tiengen	6.4996 E 47.6847 N Lure
<b>GREEN</b>	8.2273 E, 49.0005 N Karlsruhe	9.2248 E, 49.1523 N Heilbronn	8.2709 E, 47.6383 N Tiengen	7.5092 E 47.6624 N Efringen- Kirchen
<b>PINK</b>	8.1769 E, 49.5700 N Grünstadt	8.9476 E, 49.5678 N Beerfelden	8.1667 E, 48.4329 N Bad Peterstal	7.4662 E, 48.4162 N Barr

# Overview of COPS and TRACKS Airborne Platforms

(all mission scenarios)

Ac-No.	Aircraft and location	Principal Investigator	Range km	Height km	Operation times, flight hours	Endurance h Speed m/s	Key instruments except standard met.	Project
1	Learjet 35A, Hohn	Horst Fischer, Mark Lawrence <a href="mailto:hofi@mpch-mainz.mpg.de">hofi@mpch-mainz.mpg.de</a> , <a href="mailto:lawrence@mpch-mainz.mpg.de">lawrence@mpch-mainz.mpg.de</a>	tbd	up to 13 (FL 400)	<b>16.07.-28.07.</b> 4 flights	3,5 (4 h prep. time) tbd	Photochemistry	<b>TRACKS</b>
2	G - Falcon, Oberpfaffenhofen	Gerhard Ehret, Christoph Kiemle <a href="mailto:Gerhard.Ehret@dlr.de">Gerhard.Ehret@dlr.de</a> <a href="mailto:Christoph.Kiemle@dlr.de">Christoph.Kiemle@dlr.de</a>	2100 - 3700	4 -12	<b>28.06.-05.08.</b> 45 h	4 -5 120	WV DIAL, Doppler lidar, dropsondes	<b>COPS</b>
3	F- Falcon, Baden-Airpark	Cyrille Flamant <a href="mailto:Cyrille.Flamant@aero.jussieu.fr">Cyrille.Flamant@aero.jussieu.fr</a>	2000	5 - 6	<b>10.07.-02.08.</b> 35 h	4 200	WV DIAL, dropsondes	<b>COPS</b>
4	BAE 146, Baden-Airpark	Stephen Mobbs <a href="mailto:Stephen@env.leeds.ac.uk">Stephen@env.leeds.ac.uk</a>	tbd	up to 8	<b>09.07.-27.07.</b> 84 h	tbd 100	Aerosol, cloud micro-physics, trace gases	<b>COPS TRACKS</b>
5	DO-128, Baden-Airpark	Ulrich Corsmeier <a href="mailto:Ulrich.Corsmeier@imk.fzk.de">Ulrich.Corsmeier@imk.fzk.de</a>	800	up to 7	<b>11.06.-31.07.</b> 125 h	3.5 65	Tracer, fluxes, radiation	<b>COPS TRACKS</b>
6	Dimona HK-36, Baden-Airpark	Bruno Neiningen, Heiner Geiß <a href="mailto:bruno.neiningen@metair.ch">bruno.neiningen@metair.ch</a> <a href="mailto:h.geiss@fz-juelich.de">h.geiss@fz-juelich.de</a>	800	up to 4	<b>16.07.-31.07.</b> (4 days)	4 – 5 40	Photochemistry tracer, wind, turbulence	<b>TRACKS</b>
7	FZJ Zeppelin NT, Friedrichshafen, Baden-Airpark	Frank Holland, Andreas Hofzumahaus <a href="mailto:F.Holland@fz-juelich.de">F.Holland@fz-juelich.de</a> <a href="mailto:A.Hofzumahaus@fz-juelich.de">A.Hofzumahaus@fz-juelich.de</a>	550	0.02 – 1.0	<b>16.07.-31.07.</b> tbd	10 0-25	Photochemistry	<b>TRACKS</b>
8	UL Enduro, Baden-Airpark	Wolfgang Junkermann <a href="mailto:Wolfgang.Junkermann@imk.fzk.de">Wolfgang.Junkermann@imk.fzk.de</a>	500	0.02 - 4.5	<b>15.06.-30.06.</b> ~ 4-5h /day	6 25	Radiation, aerosol, turbulence	<b>COPS</b>
9	Partenavia P68,	Christine Brandau <a href="mailto:C.Brandau@irctr.tudelft.nl">C.Brandau@irctr.tudelft.nl</a>	800	up to 4	<b>July-August</b> 10 h	4 65	Aerosol, cloud micro-physics	<b>COPS</b>







## Areas and Layers of Operation of Airborne Platforms

### Mission Scenario “Forced Convection”

Aircraft No.	Aircraft	Area	Flight level (Flight layer)	IFR/VFR Operation
1	Learjet	GREEN	~ FL 400	IFR
2	G-Falcon (D-CMET)	RED	FL 250/400	IFR
3	F-Falcon	RED	FL 150	IFR
4	BAE 146	RED	< FL 100 FL 100/300	VFR IFR
5	DO-128 (D-IBUF)	BLUE	< FL 100 FL 245	VFR IFR
6	Dimona	GREEN	< FL 100	VFR
7	Zeppelin NT	GREEN	< FL 100	VFR
8	UL Enduro	GREEN	< FL 100	VFR
9	Partenavia	No participation in “Forced Convection”		

# Mission Scenario “Forced Convection”

\*: VFR

Blue Sky --- > Shallow Convection -- > Deep Convection-- > Dis. Convection

forced, non frontal/frontal

07—08--09---10---11---12---13---14---15---16---17---18---19---20---21---22 local

Learjet -----BOX pattern, tropopause -----BOX pattern, outflow anvil-----  
-----FL 330/400, low appr. EDSB ---- FL 330/400, low appr. EDSB -----

G-Falcon -----MAP pattern (2 MAPs) -----→Box pattern CuCong, Cb -----  
-----FL 250/400, Drops -----→FL 250/400, Drops -----

F-Falcon -----MAP pattern (1 MAP) -----→BOX pattern CuCong, Cb-----  
-----FL 150, Drops-----→FL150, Drops -----

(\*)BAE 146-----LONG-LEGS-----→BOX pattern-----  
-----VFR < FL 100----→FL 100/270 -----

(\*)DO 128-----PreCon pattern----SupDe pattern (3x)-----BOX pattern (DeDe)-----  
-----low PBL (VFR)-----low, mid PBL, BL-Inv ---up to FL 245 (IFR) -----

\*Zeppelin--Valley pattern (Rhine-Kinzig-Murg-Nagold)-----Valley pattern (R-K-M-N)--→CuCong---  
---lowest level, VFR-----lowest level, VFR-----→on request-

\*Dimona-----MAP (2 MAPs) or Valley-----MAP (2 MAPs) or Valley-----  
-----lowest level PBL (VFR)-----lowest level PBL (VFR)-----

\*Enduro-----Triangle or Cross-Sec., profiles -----Triangle or Cross-Sec., profiles -----  
-----low PBL, FL100 (VFR)-----low PBL, FL100 (VFR)-----

## Areas and Layers of Operation of Airborne Platforms

### Mission Scenario “High Pressure Convection”

Aircraft No.	Aircraft	Area	Flight level (Flight layer)	IFR/VFR Operation
1	Learjet	No participation in “High Pressure Convection”		
2	G - Falcon (D-CMET)	RED	FL 100/130 or 170	IFR
3	F - Falcon	RED	FL 150	IFR
4	BAE 146	RED	< FL 100 FL 100/300	VFR IFR
5	DO-128 (D-IBUF)	BLUE	< FL 100 FL 245	VFR IFR
6	Dimona	GREEN	< FL 100	VFR
7	Zeppelin NT	GREEN	< FL 100	VFR
8	UL Enduro	GREEN	< FL 100	VFR
9	Partenavia	No participation in “High Pressure Convection”		

Mission Scenario A “High Pressure Convection”

\*: VFR

Blue Sky --- > Shallow Convection -- > Deep Convection-- > Dis. Convection  
non frontal / non forced

07—08--09---10---11---12---13---14---15---16---17---18---19---20---21---22 local

Learjet -----

G-Falcon -----FLUX pattern (up to 3 times) ----? switch to BOX pattern ?-----  
-----FL 100/130 or FL 170 -----

F-Falcon -----MAP pattern (1) -----→BOX pattern CuCong, Cb-----  
-----FL 150, Drops-----→FL150, Drops -----

(\*)BAE 146-----LONG-LEGS---→BOX pattern-----  
-----VFR < FL 100-→FL 100/270 -----

(\*)DO 128-----FLUX pattern (2 to 3)-----→BOX pattern (DeDe)-----  
-----mid/upper PBL (VFR)-----→up to FL 245 (IFR) -----

\*Zeppelin--Valley pattern (Rhine-Kinzig-Murg-Nagold)-----Valley pattern (R-K-M-N)--→CuCong---  
---lowest level, VFR-----lowest level, VFR-----→on request-

\*Dimona-----MAP (2 MAPs) or Valley-----MAP (2 MAPs) or Valley-----  
-----lowest level PBL (VFR)-----lowest level PBL (VFR)-----

\*Enduro-----Triangle/Cross-Section/Slope-----Triangle/Cross-Section/Slope-----  
-----low PBL, FL100 (VFR)-----low PBL, FL100 (VFR)-----

# Mission Scenario B “High Pressure Convection”

\*: VFR

Blue Sky --- > Shallow Convection -- > Deep Convection-- > Dis. Convection  
non frontal / non forced

07—08--09---10---11---12---13---14---15---16---17---18---19---20---21---22 local

Learjet -----

G-Falcon -----

F-Falcon -----

(\*)BAE 146-----LONG-LEGS-----→BOX pattern-----  
-----VFR < FL 100-----→FL 100/270 -----

(\*)DO 128-----SS-QC-----CHAFF R/SVs/HL-----SS QC-----  
-----VFR < FL 100-----PBL, very low-----VFR < FL 100-----

Alternative

(\*)DO 128-----SS-MET-----CHAFF R/SVs/HL-----SS MET-----  
-----VFR < FL 100-----PBL, very low-----VFR < FL 100-----

\*Zeppelin--Valley pattern (Rhine-Kinzig-Murg-Nagold)-----Valley pattern (R-K-M-N)--→CuCong-----  
---lowest level, VFR-----lowest level, VFR-----→on request-----

\*Dimona-----MAP (2 MAPs) or Valley-----MAP (2 MAPs) or Valley-----  
-----lowest level PBL (VFR)-----lowest level PBL (VFR)-----

\*Enduro-----Triangle/Cross-Section/Slope-----Triangle/Cross-Section/Slope-----  
-----low PBL, FL100 (VFR)-----low PBL, FL100 (VFR)-----

## Areas and Layers of Operation of Airborne Platforms

### Mission Scenario “Targeted Observations”

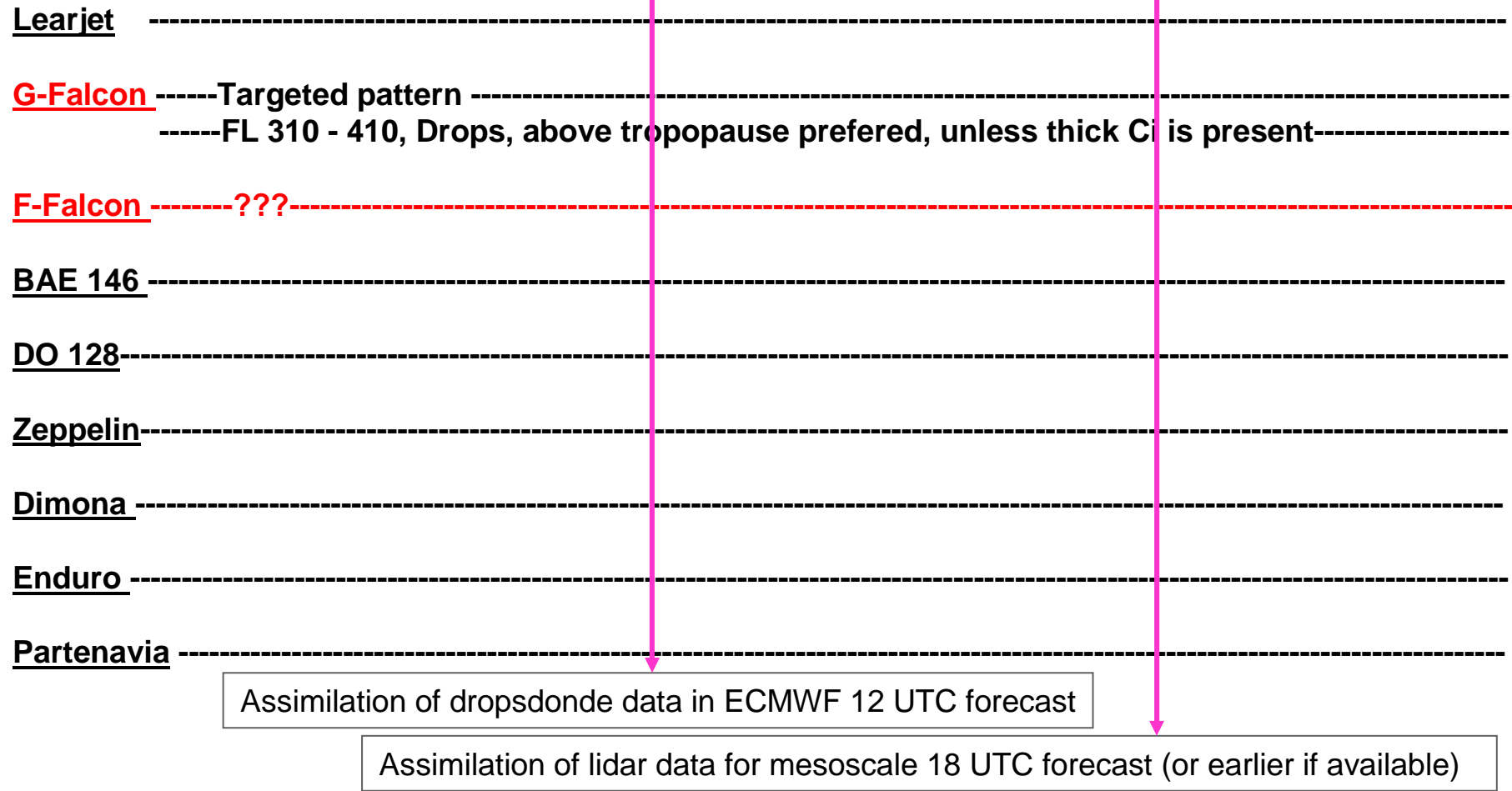
Aircraft No.	Aircraft	Area	Flight level (Flight layer)	IFR/VFR Operation
1	<b>Learjet</b>	No participation in “Targeted Observations”		
2	<b>G - Falcon (D-CMET)</b>	<b>&gt; RED</b>	<b>FL ???</b>	<b>IFR</b>
3	<b>F - Falcon</b>	No participation in “Targeted Observations”		
4	<b>BAE 146</b>	No participation in “Targeted Observations”		
5	<b>DO-128 (D-IBUF)</b>	No participation in “Targeted Observations”		
6	<b>Dimona</b>	No participation in “Targeted Observations”		
7	<b>Zeppelin NT</b>	No participation in “Targeted Observations”		
8	<b>UL Enduro</b>	No participation in “Targeted Observations”		
9	<b>Partenavia</b>	No participation in “Targeted Observations”		



**Mission Scenario "Targeted Observations"**  
with forced convection predicted on next day

**Blue Sky --- > Shallow Convection -- > Deep Convection-- > Dis. Convection**

**07—08--09---10---11---12---13---14---15---16---17---18---19---20---21---22 local**



**! Mission Scenario "Forced Convection" following on next day !**

## Areas and Layers of Operation of Airborne Platforms

### Mission Scenario “City Plume - Lagrange”

Aircraft No.	Aircraft	Area	Flight level (Flight layer)	IFR/VFR Operation
1	<b>Learjet</b>	No participation in “City Plume - Lagrange”		
2	<b>G - Falcon (D-CMET)</b>	No participation in “City Plume - Lagrange”		
3	<b>F - Falcon</b>	No participation in “City Plume - Lagrange”		
4	<b>BAE 146</b>	No participation in “City Plume - Lagrange ”		
5	<b>DO-128 (D-IBUF)</b>	<b>pink</b>	<b>&lt; FL 100</b>	<b>VFR</b>
6	<b>Dimona</b>	<b>pink</b>	<b>&lt; FL 100</b>	<b>VFR</b>
7	<b>Zeppelin NT</b>	<b>Pink</b>	<b>&lt; FL 100</b>	<b>VFR</b>
8	<b>UL Enduro</b>	No participation in “City Plume - Lagrange ”		
9	<b>Partenavia</b>	No participation in “City Plume - Lagrange ”		

Mission Scenario B “City Plume - Lagrange”

\*: VFR

-----Blue Sky -----> Shallow Convection ----- >Dis. Convection-----

07—08--09---10---11---12---13---14---15---16---17---18---19---20---21---22 local

Learjet -----

G-Falcon -----

F-Falcon -----

(\*)BAE 146-----

(\*)DO 128-----Lee Cross Sections (6, N/S)----- Lee Cross Sections (6, N/S)-----  
-----FL 1000 ft, 3000 ft agl-----FL 1000 ft, 3000 ft agl-----

\*Zeppelin-----Lee Zick-Zack pattern—(long time, N/S)-----  
-----FL 1000 ft agl, up to 7 hours duration-----

\*Dimona-----Lee Cross Sections (3, N/S)-----  
-----FL 1000 ft, 2000 ft agl-----

\*Enduro-----

Partenavia -----

## Areas and Layers of Operation of Airborne Platforms

### Mission Scenario “Stratus- Cloud Physics”

Aircraft No.	Aircraft	Area	Flight level (Flight layer)	IFR/VFR Operation
1	<b>Learjet</b>	No participation in “Stratus – Cloud Physics”		
2	<b>G - Falcon (D-CMET)</b>	No participation in “Stratus – Cloud Physics”		
3	<b>F - Falcon</b>	No participation in “Stratus – Cloud Physics”		
4	<b>BAE 146</b>	No participation in “Stratus – Cloud Physics”		
5	<b>DO-128 (D-IBUF)</b>	No participation in “Stratus – Cloud Physics”		
6	<b>Dimona</b>	No participation in “Stratus – Cloud Physics”		
7	<b>Zeppelin NT</b>	No participation in “Stratus – Cloud Physics”		
8	<b>UL Enduro</b>	No participation in “Stratus – Cloud Physics”		
9	<b>Partenavia</b>	<b>green</b>	<b>up to FL 120</b>	<b>IFR/VFR</b>

Mission Scenario B “Stratus- Cloud Physics”

-----stratus-----stratus-----stratus-----stratus-----

07—08--09---10---11---12---13---14---15---16---17---18---19---20---21---22 local

Learjet -----

G-Falcon -----

F-Falcon -----

BAE 146 -----

DO 128 -----

Zeppelin -----

Dimona -----

Enduro -----

Partenavia -----slant profiles above Murg valley and AMF-----

-----Sicherheitsmindestflughöhe up to FL 120, below and within stratus-----