NEPTUN

The Western Mediterranean as a Sensitive Region for High Impact Weather

A HALO Demonstration Mission

proposed by

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Mediterranean cyclogenesis and HIW

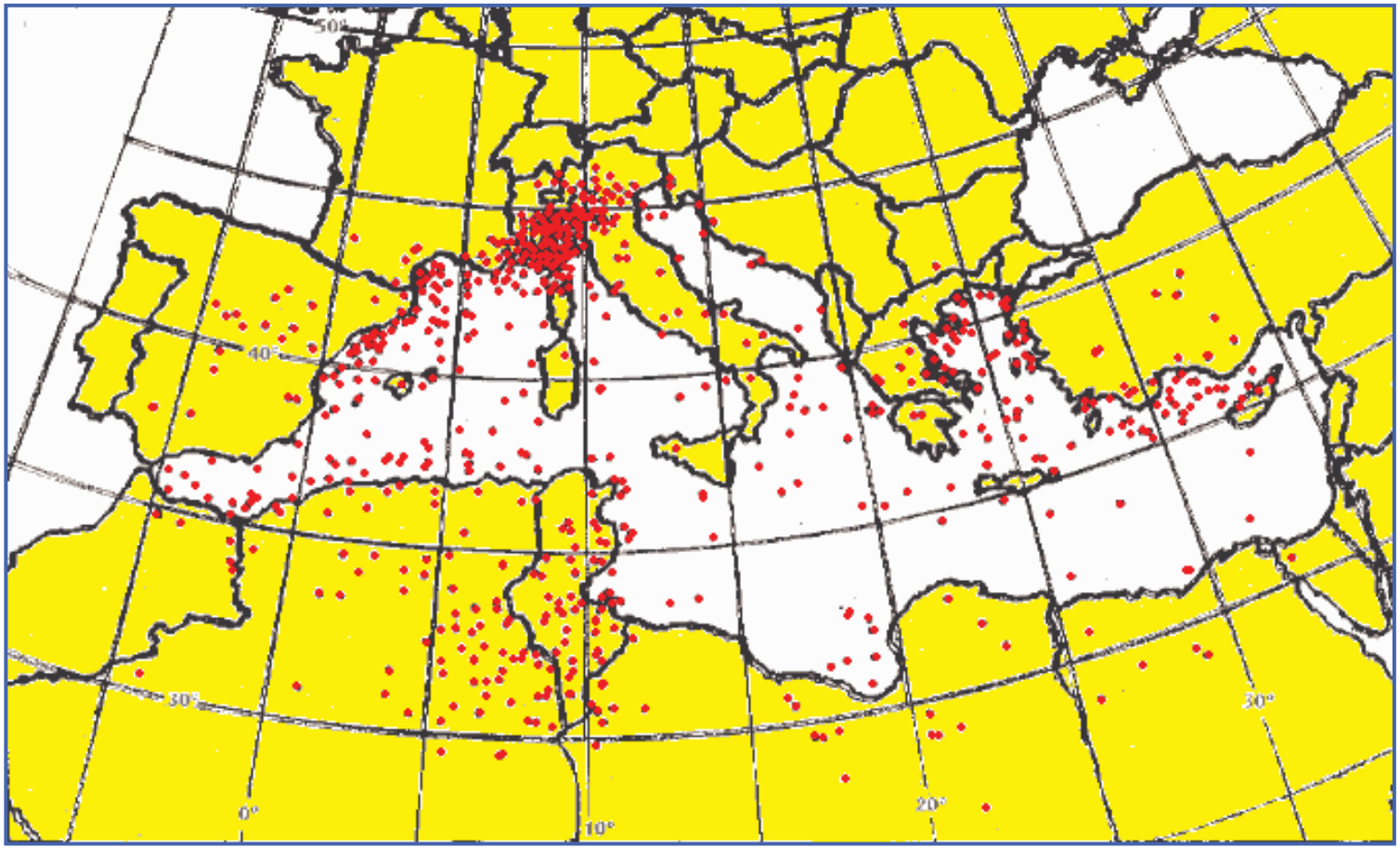
Severe cases of Med. cyclogeneses with heavy flash floods

Episode	Country	Date	Max. precipitation in 24 hours
Vaison-la-Romaine	France	22.-23. 09. 92	300 mm at selected sites
Brig	Switzerland	23.-25. 09. 93	120 mm (23.09), 220 mm (24.09.)
Piedmont	Italy	04.-06. 11. 94	314 mm, 250 at several sites
Ticino	Italy	12.-13. 09. 95	186 mm in 12 h, 327 mm in 36 h
Friuli	Italy	19. 09. 95	180 mm
Friuli	Italy	05.-07. 10. 98	~ 250 mm in 48 h
Thyrrenian Sea		26.-27. 03. 99	

In autumn 2008 a series HIW cases took place with severe flooding in Spain, France, Switzerland and Italy.

Mediterranean cyclogenesis and HIW

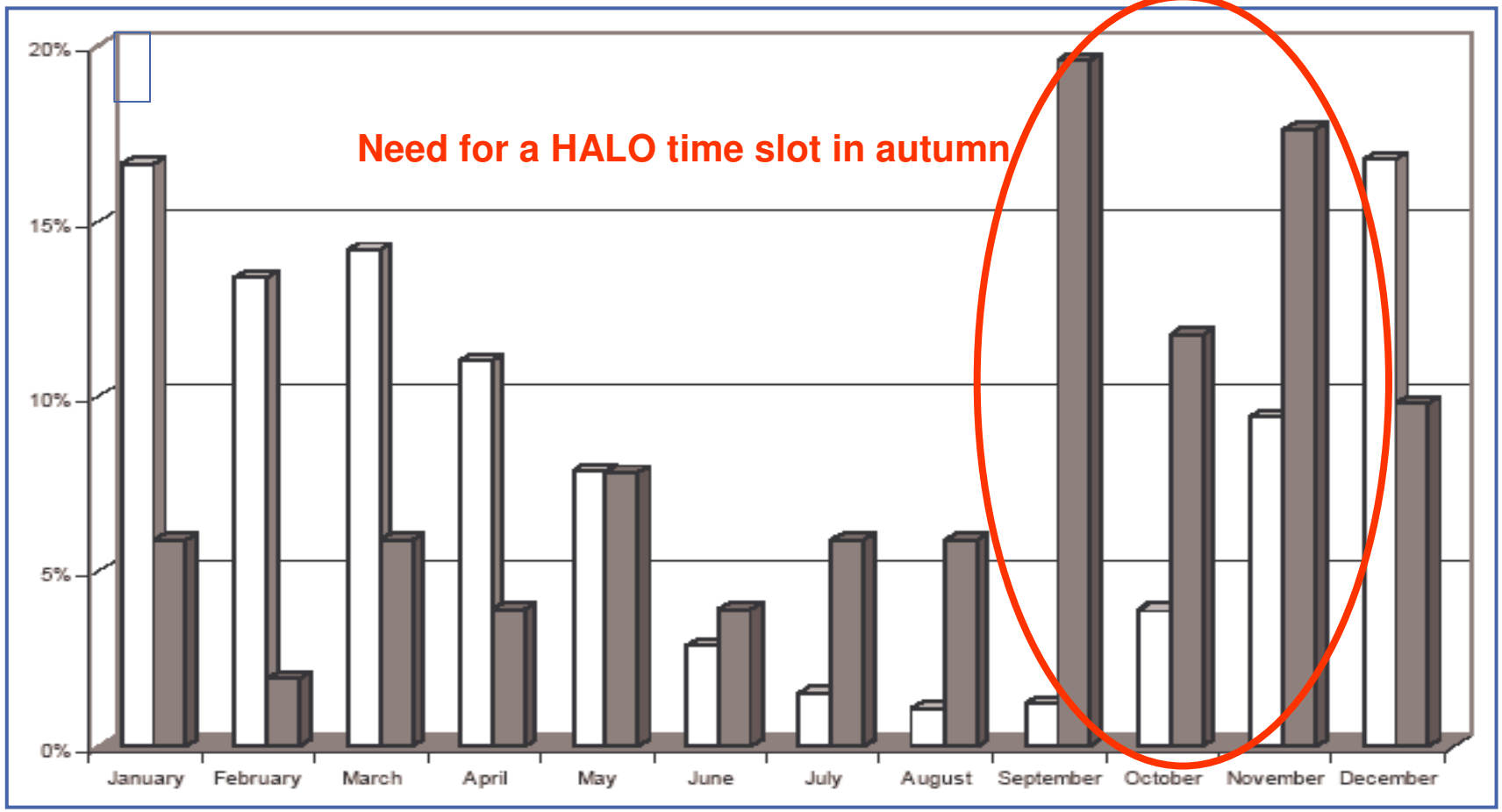
Location of cyclogenesis in the Mediterranean area



Each dot indicates a LOW developed at that specific point (Reiter, 1975).

Mediterranean cyclogenesis and HIW

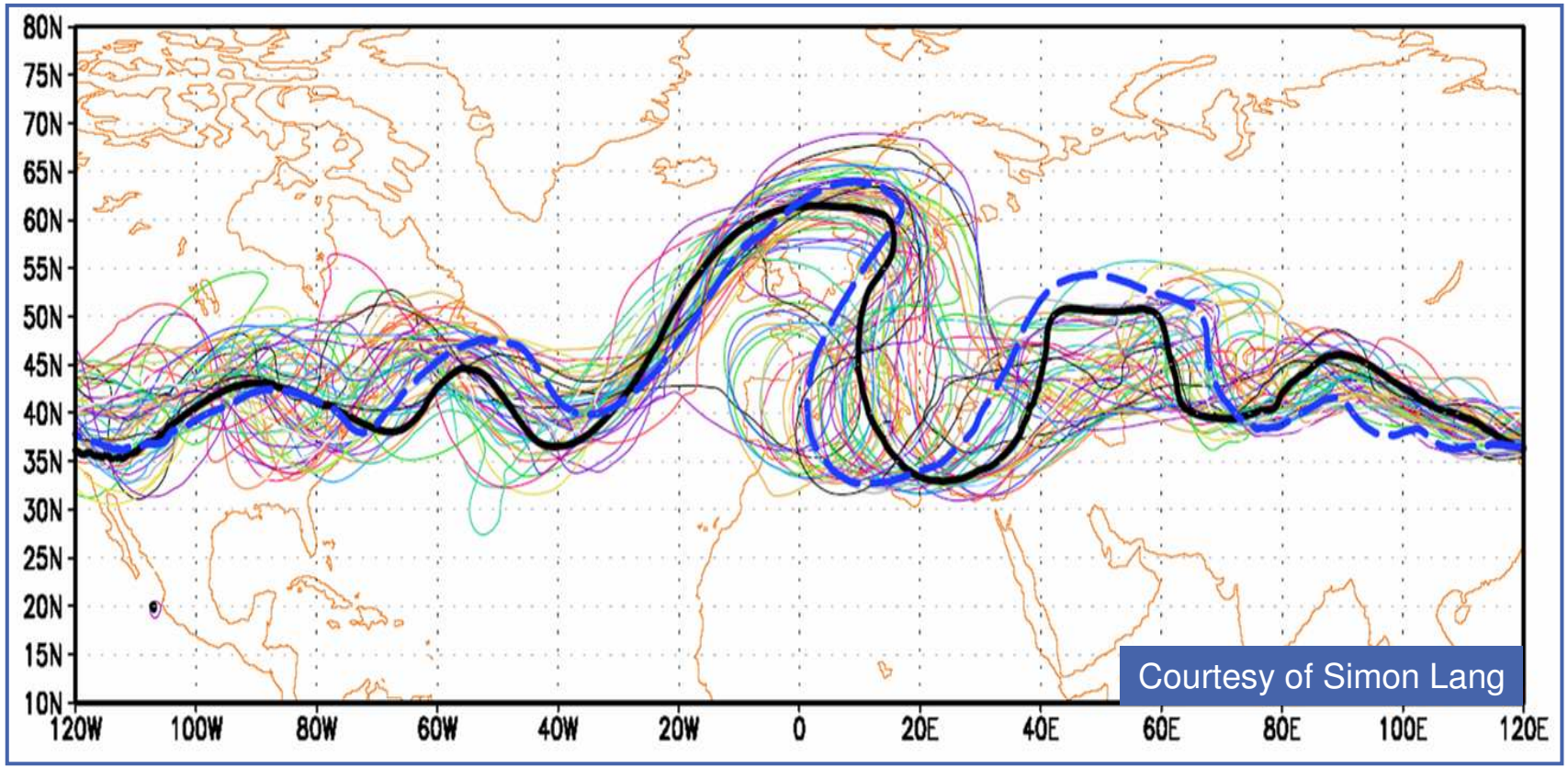
Statistics of historical cyclogeneses and HIW cases



Frequency of intense cyclones between 1957 and 2002 (white) and distribution of HIW (grey) characterized by, storm, heavy rain and flash floods (Homar et al., 2006).

Mediterranean cyclogenesis and HIW

Sensitivity studies with ECMWF-model



Six day 50 member ensemble forecast of 560 gpdm on 500 hPa valid for Oct. 21, 2007, starting at Oct. 15, 2007. Thick black line: deterministic forecast, dashed blue line: analysis for Oct. 21, 00 UT.

Mediterranean cyclogenesis and HIW

Typical synoptic scenarios causing HIW in the Mediterranean basin

high amplitude trough approaching Med Sea from the west

remnant lower tropospheric circulation activated by upper level trough

lee-cyclogenesis generated south of the Alps

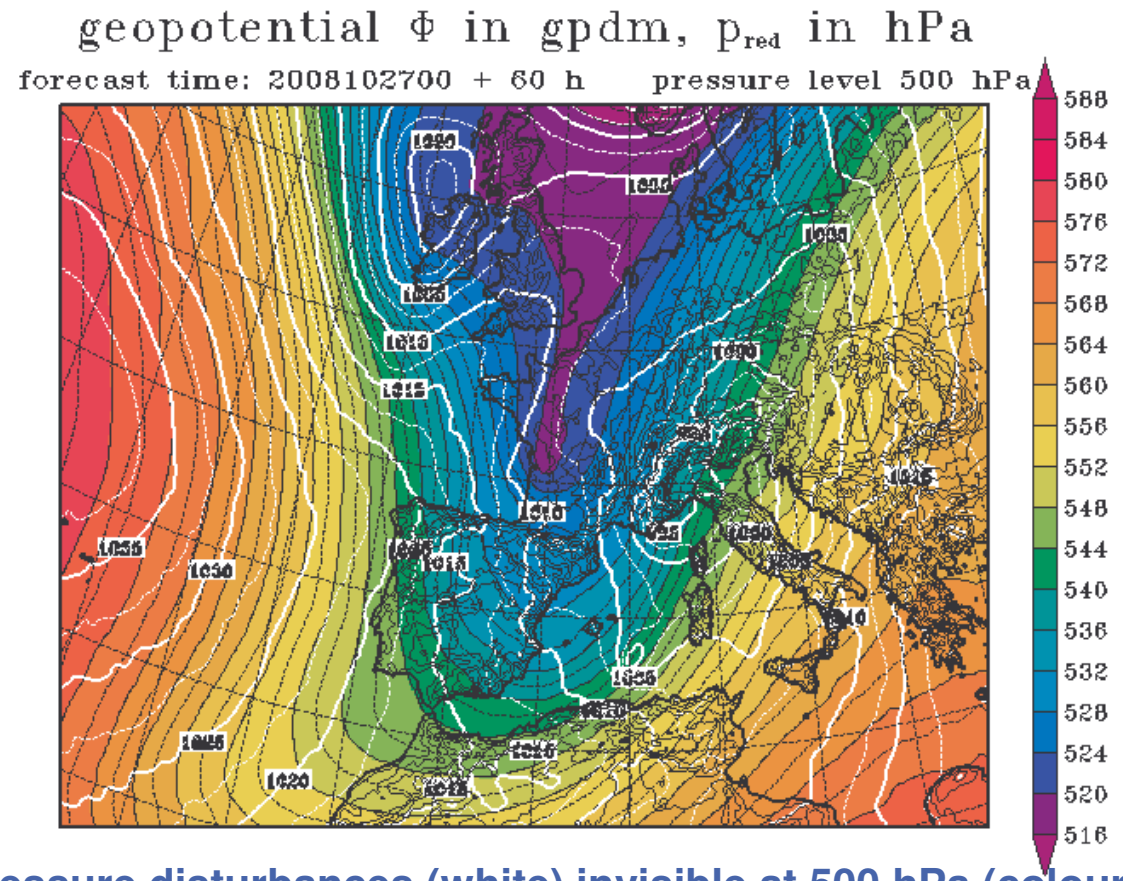
and some other – untypical, rare – cases

- ET affecting Mediterranean HIW
- westward moving upper level cut-off low
- storms within westerly Mediterranean flow (storm Klaus: 24 Jan. 2009)

High amplitude trough and HIW

High amplitude trough approaching Med Sea from West

27 (00) -30 (00) October, 2008; 500 hPa and surface pressure

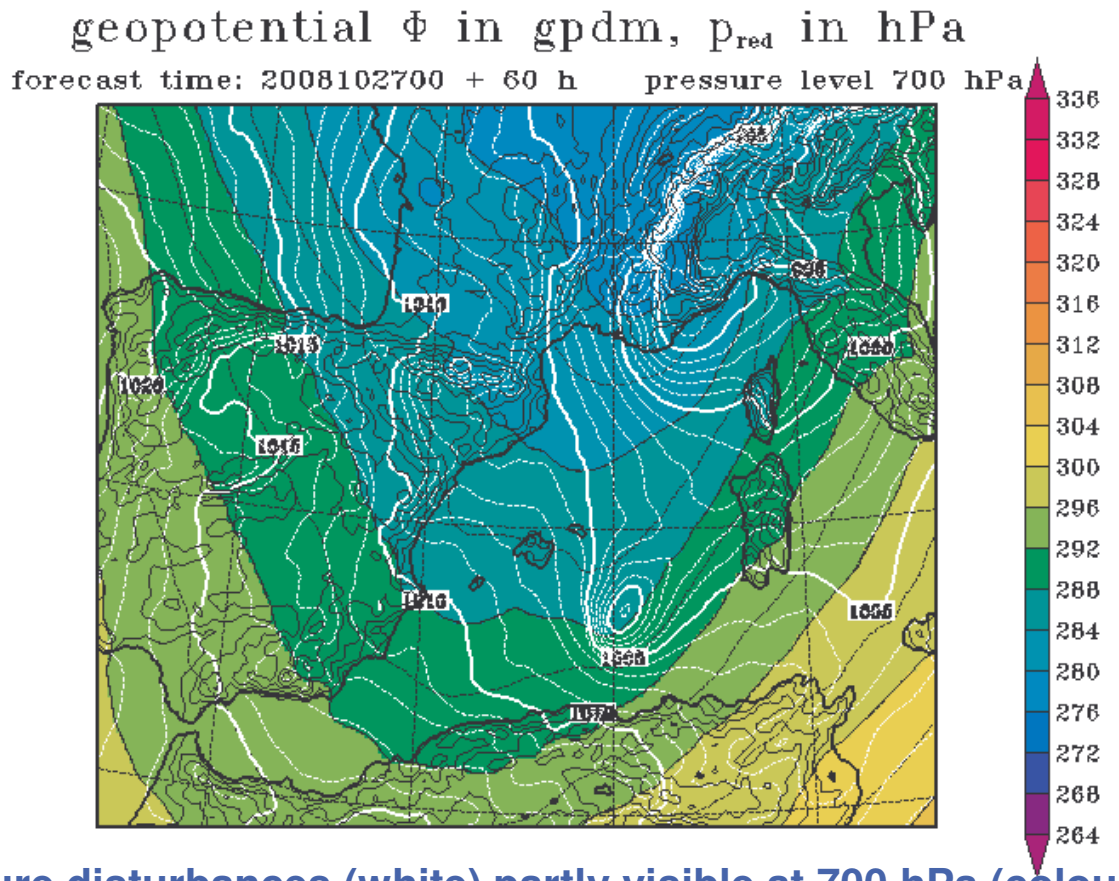


Surface pressure disturbances (white) invisible at 500 hPa (colour code).

High amplitude trough and HIW

High amplitude trough approaching Med Sea from West

29 October, 18 UTC, 2008; precipitation

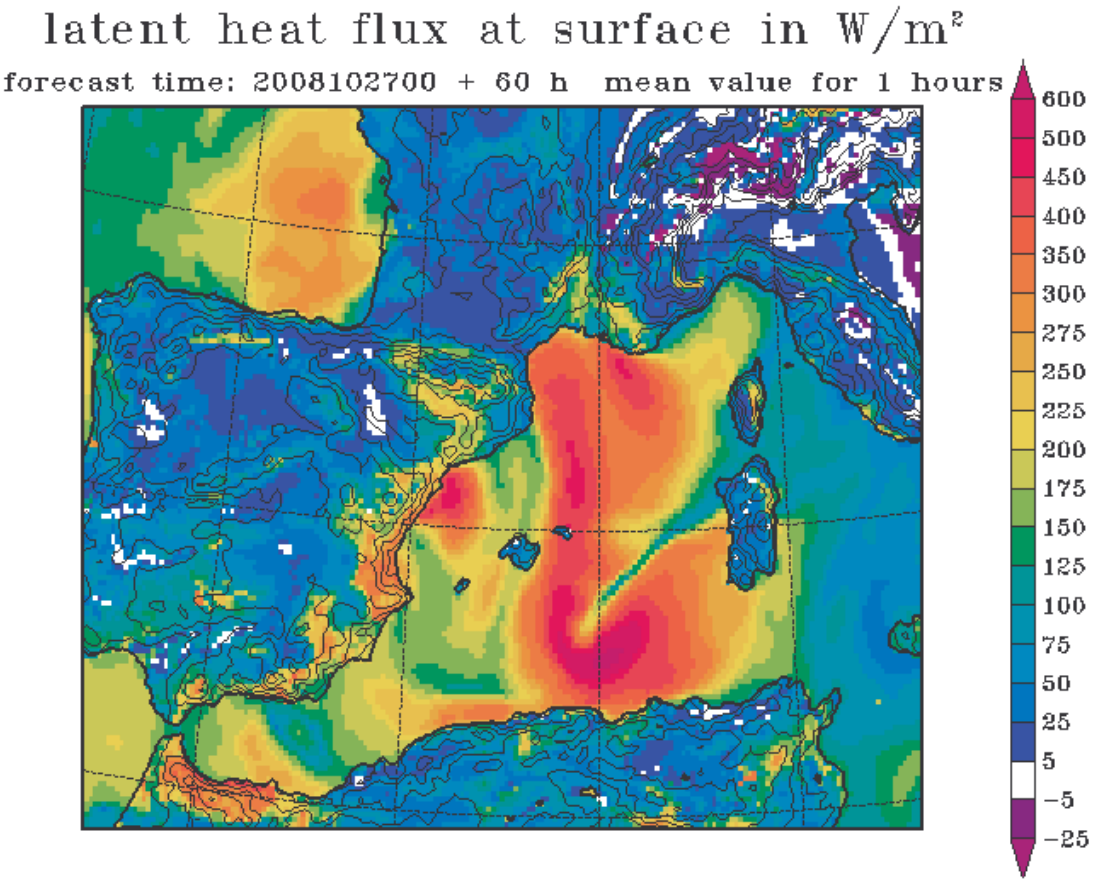


Surface pressure disturbances (white) partly visible at 700 hPa (colour code).

High amplitude trough and HIW

High amplitude trough approaching Med Sea from West

29 October, 18 UTC, 2008; 500 hPa and vertical motion

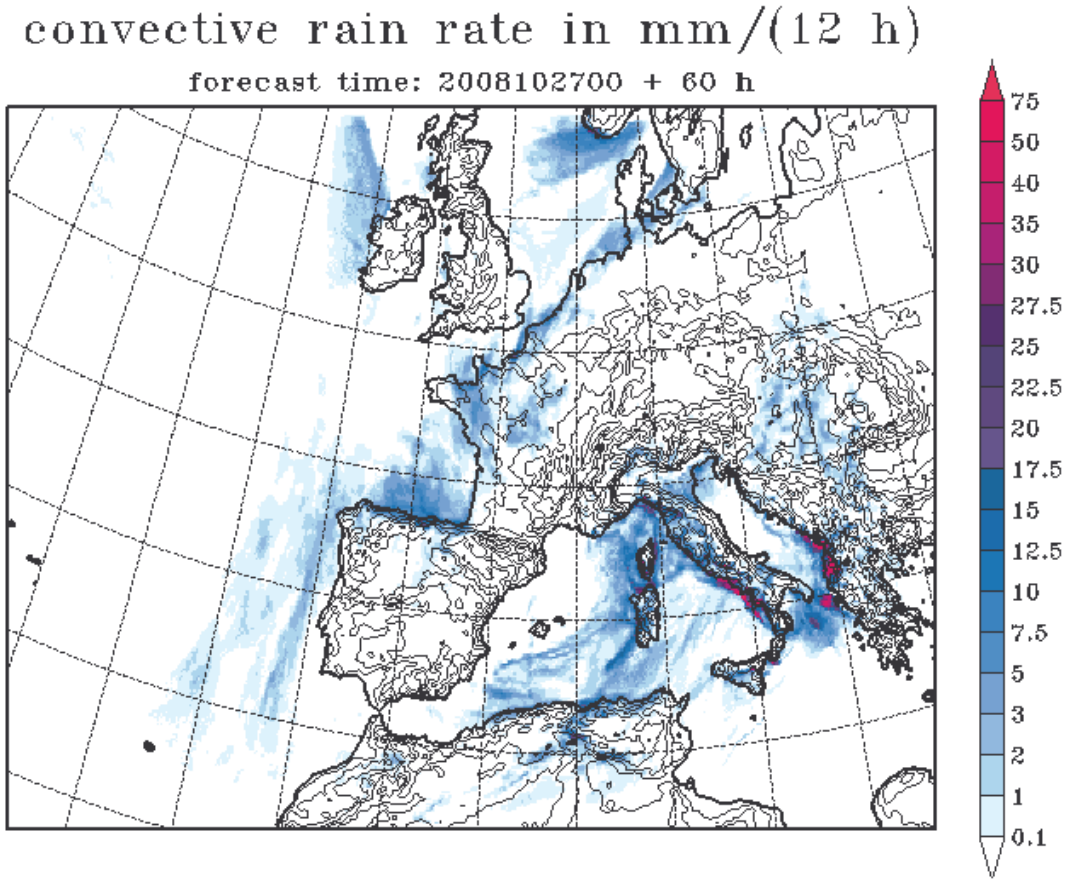


Surface latent heat flux very high over sea and related to surface presssure systems.

High amplitude trough and HIW

High amplitude trough approaching Med Sea from West

29 October, 18 UTC, 2008; precipitation



Convective rain rate coupled to lower troposheric presssure systems.

NEPTUN objectives

Forecast of large scale features of cyclogenesis and the amount of precipitation connected with lifting is often quite satisfying, while
the prediction of rainfall caused by embedded pre-frontal rain bands and convective cells triggered by orography and air–sea interaction shows poor results.

The reasons mentioned therefore are:

1. **missing highly resolved data of the structure of the 3-dimensional humidity distribution,**
2. **missing information about the sea and land surface fluxes of latent and sensible heat and**
3. **little information about the flow modification caused by the orography.**

NEPTUN Scientific Plan

(may be coordinated with other projects, e.g. HyMeX…)

Airborne measurements provide data for the analysis of the multiscale processes governing the development of Mediterranean cyclogeneses with embedded convective rain bands.

Flight plans will address the synoptic scale baroclinicity, convergence, and trough lines.

The upper tropospheric horizontal wind, the vertical structure of temperature, humidity and wind as well as the sea and land surface fluxes of latent and sensible heat and the modification of the near surface wind field by the orography are to be observed by coordinated measurements (HALO, PBL-aircraft, radiosonde network, surface based remote sensing and in-situ stations).

The HALO demonstration mission NEPTUN

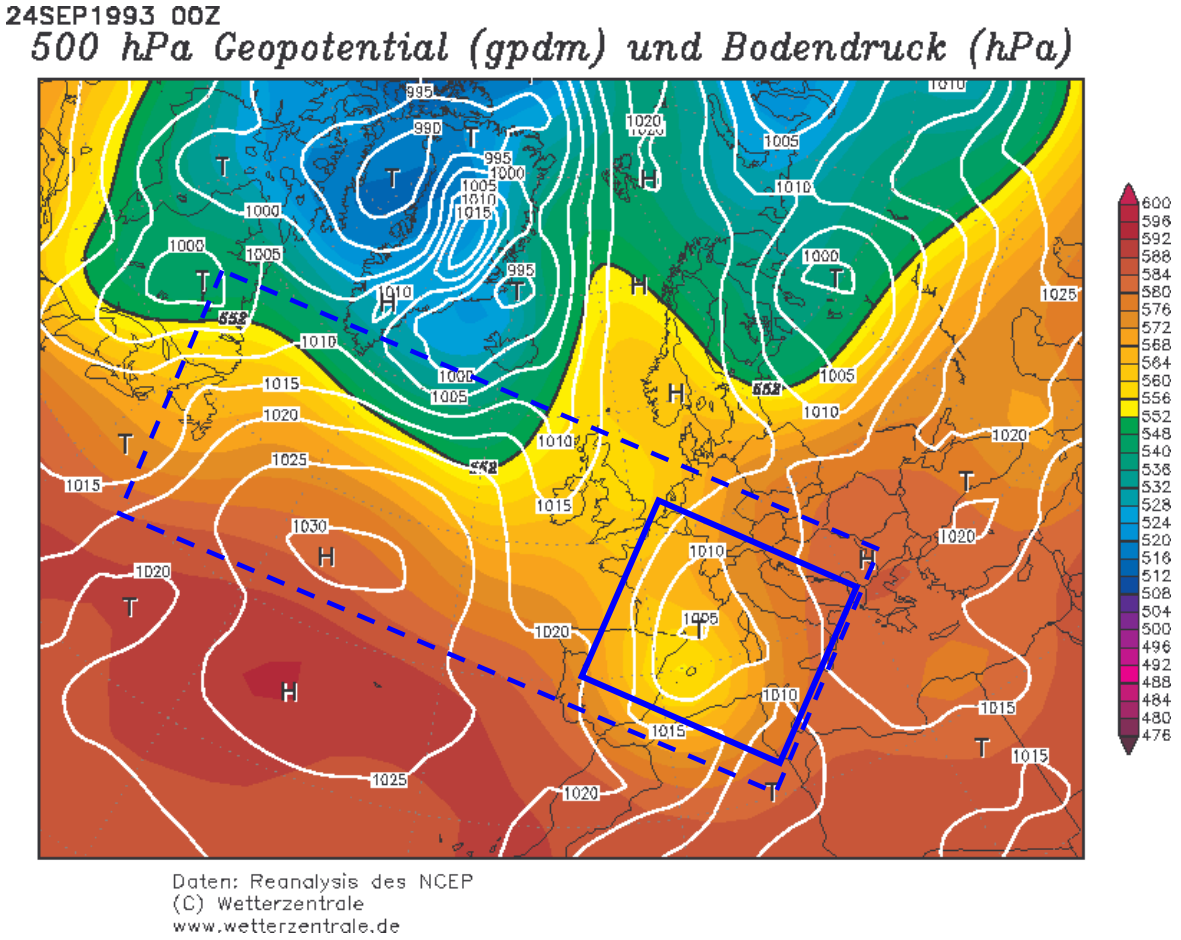
The proposed NEPTUN area of investigation

Mediterranean cyclone causing the Brig flood September 23-24, 1993.

HALO
upper troposphere, Med Sea and upstream

simultaneously

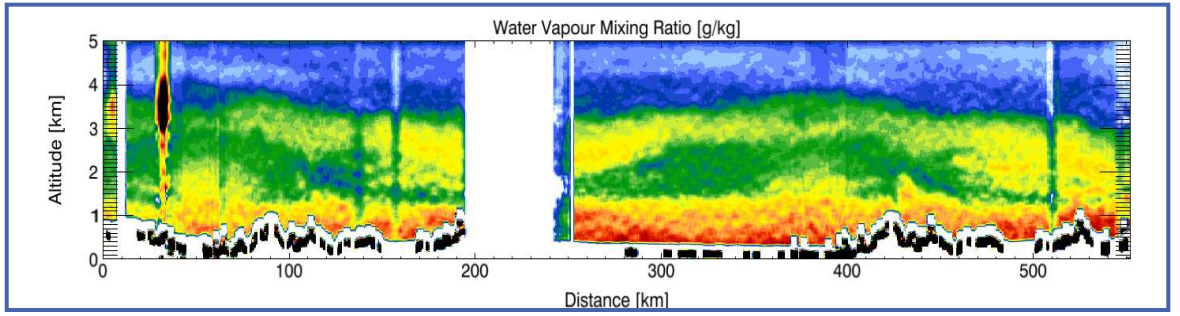
DO-128
lower troposphere, very close to the sea and land surface in the pre-frontal areas of convective activity.



The HALO demonstration mission NEPTUN

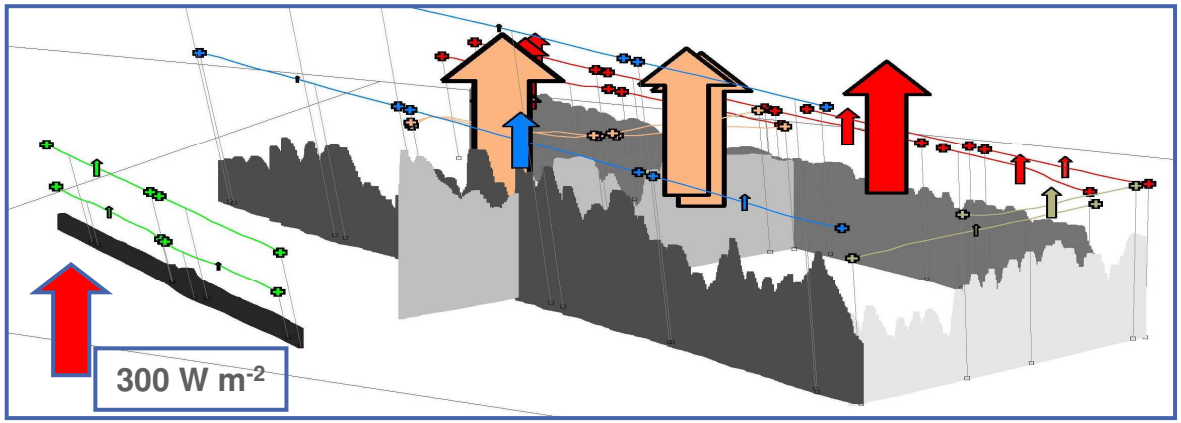
NEPTUN key airborne platforms

HALO



COPS, 2007

DO 128



VERTIKATOR, 2002

The HALO demonstration mission NEPTUN

NEPTUN key instruments onboard HALO

In-situ turbulence probing system at nose boom *(basic equipment)*

KIT multi-sensor dropsonde system ***(funded within DFG SPP 1294, A. Wieser)***

DLR-IPA 2 μm scanning wind LIDAR *(to be converted from FALCON)*

DLR-IPA water vapour DIAL *(to be converted from FALCON)*

UHOH scanning rotational Raman LIDAR for temperature, aerosol measurements

 # Instrument under development, combined with the DLR water vapour DIAL
 # An application for funding will be made by IPM-UHOH within DFG-SPP1294

DLR-DFD instrument GRIPS: Ground-based infrared P-branch spectrometer

 # new partner with new instrument (airborne version)

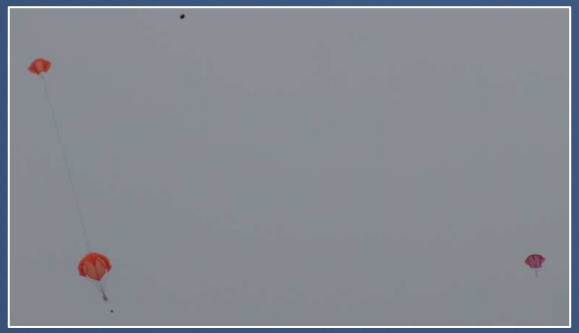
Ground truth station at CAP CORSE including KITcube, WV-DIAL and RRL

Design goals

- Dense measurements with up to 30 airborne sondes
- Free combination of different sondes
- Launch of up to 4 sondes at the same time
- Telemetry link to the launching aircraft (400 MHz)
- Satellite telemetry optional (Iridium)
- Same dimensions as Vaisala system
- Economically priced and modular design
- Easy adaption to future sensor developments

The modular multi-sensor dropsonde for HALO

Dropping of release container with sondes



Airborne Scanning 2-µm Doppler-Wind-Lidar

Transceiver Specs:

wavelength	2.022 µm
repetition rate	500 Hz
pulse energy	1.0 mJ
pulse length	0.5 µs
range gate	100 m
first range gate	400 m
Off-axis telescope:	
aperture	10 cm
Double Wedge Scanner:	
elevation sector	+/- 30 °
scan speed	variable
Data acquisition:	
early digitising	500 MHz
with quick-look	

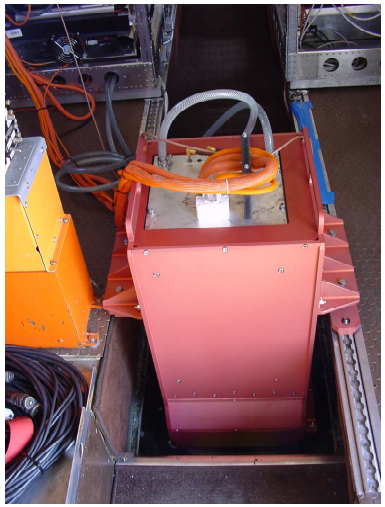
Accuracy: 0,2 m/s LOS with ground return at good SNR

Status

Viele erfolgreiche Einsätze auf der Falcon

Portierung auf HALO in 2010 durch DLR/IPA geplant

Komponenten des 2 µm Doppler Wind Lidars für die Windprofilmessung auf der Falcon



2-µm Transceiver auf der Falcon

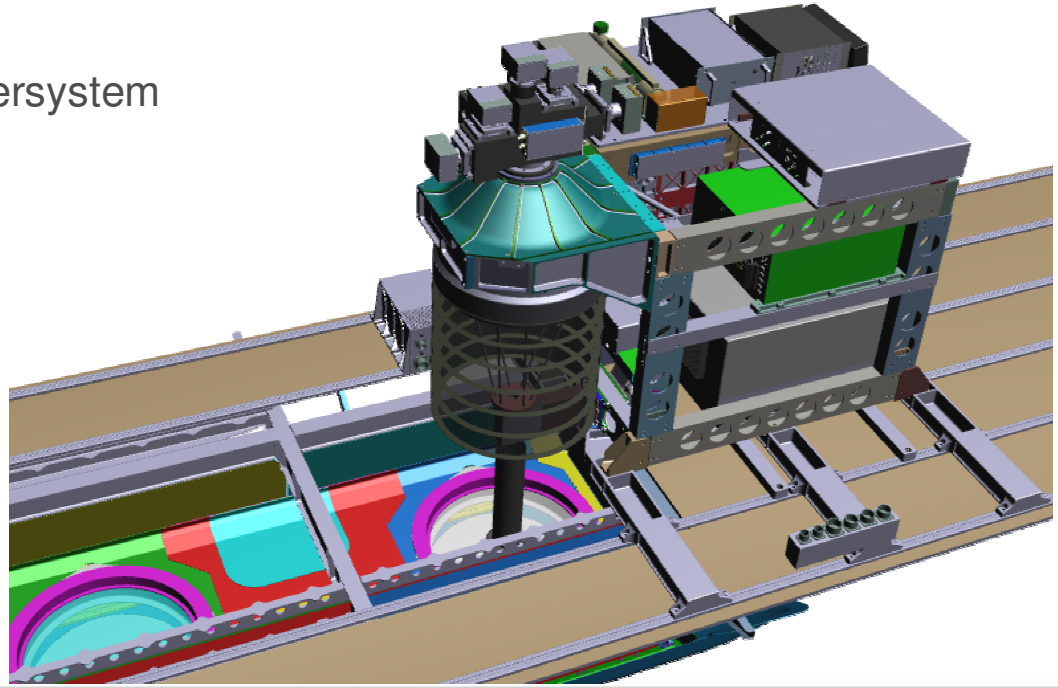
WALES auf HALO

Mehrwellenlängen LIDAR *WALES*

(Demonstrator für die Weltraummission Water vApor Lidar Experiment in Space)

Instrument Features:

- Wasserdampfmessung bei vier Wellenlängen simultan (Abdeckung von Grenzschicht bis untere Stratosphäre, Messung von Feuchte in Zirren)
- Aerosolcharakterisierung: Rückstreuung, Extinktion (HSRL), Depolarisation, Farbverhältnis
- Hocheffizientes Festkörperlasersystem
- Kompakter Aufbau
- Flugerprobt auf Falcon F20 !
- Unabhängig von kritischen Außenanbauten



Status

Zulassungsdokumente für HALO

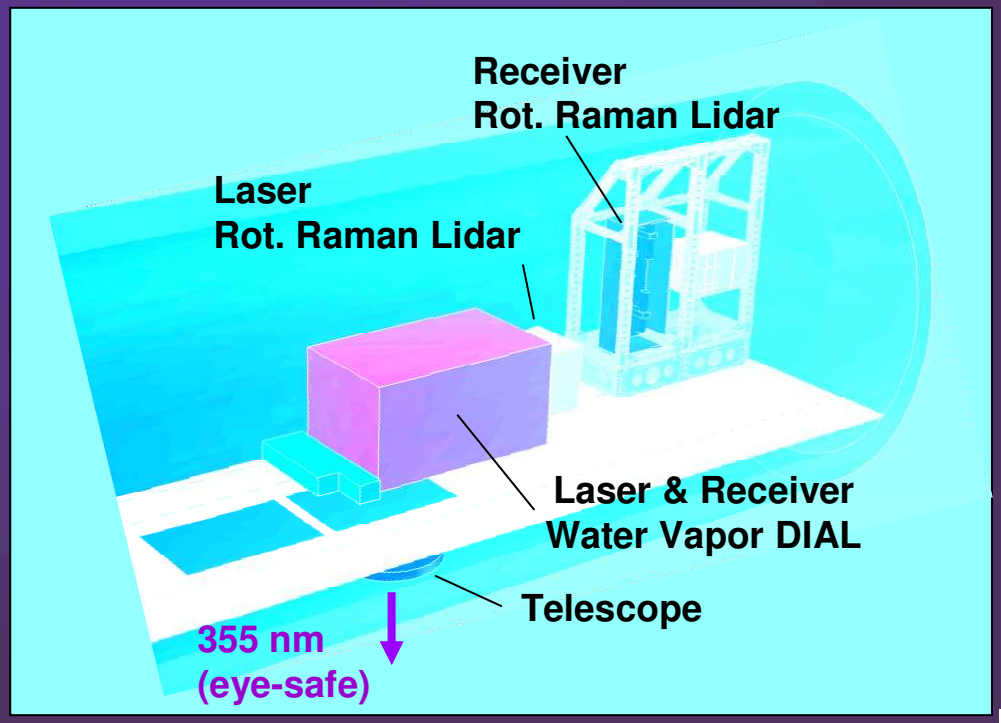
erstellt und zur Prüfung eingereicht

HALO Rotational Raman Lidar

Measurement of high resolution **temperature** and **aerosol/cloud** profiles down to the ground
without a-priori assumptions
(note: MTP retrieval, e.g., assumes horizontal temperature stratification)
with exact error assessment (precision from signal intensities)

Synergies: RH, θ_v , buoyancy, CAPE/CIN, aerosol optical properties

Combined measurements will be very beneficial for investigating atmospheric (in)stability and for detecting regions with extreme values of CIN and CAPE and the corresponding vertical lid-structure



Implementation into HALO together with DLR Water Vapor DIAL

Proposed HALO flight plan for NEPTUN

Day 1: ***Upper tropospheric trough developing over or reaching the western Mediterranean Sea***

Take off: 08 local (OP)

Touch down: 18 local (OP)

Pattern length: 8000 km – 9000 km (depending on trough position)

Flight hours: 8 h – 9 h

Flight levels: Between 500 hPa and below the tropopause, changing altitudes for individual flight legs with few selected "cross trough legs" in the tropopause.

Measurements:

Temperature, humidity, wind, pressure
in-situ, standard instrumentation (turbulence)

Vertical water vapour profiles
DLR WV-DIAL

Vertical wind profiles
DLR Doppler wind lidar

Vertical profiles of temperature, particle backscatter, extinction coefficients
UHOH Rotational Raman lidar receiver

Temperature, humidity, wind, pressure
in-situ profiling by IMK dropsondes

Proposed HALO flight plan for NEPTUN

Day 2: ***Lower tropospheric cyclone developing downstream the trough between the Balearic Islands and the Gulf of Genoa***

Program: Same as "**Day 1**", but possible displacement of the flight pattern of "Day 1" according to the development and relocation of the synoptic systems. Modification of the fight pattern according to the tilting of the axis of the trough. Overall flight hours are approx. the same as "Day 1".

Day 3: ***Lower tropospheric cyclone fully developed downstream the trough over the Gulf of Genoa – heavy precipitation event south of the Alps***

Program: Same as "**Day 1 and 2**", but possible displacement of the flight pattern "Day 1" according to the development and relocation of the synoptic systems. Modification of the horizontal axis of the fight pattern is a probable modification of the pattern. Shortening of the length of the individual legs by about 35 % and focussing of the pattern above the Gulf of Genoa and the Guly of Lyon. Flight time is approx. 6 hours in this case.