

The Geodetic-Geophysical Flight Mission GEOHALO on the HALO Aircraft

Christoph Förste¹, Mirko Scheinert², Franz Barthelmes¹, Svetozar Petrovic¹ & Maximilian Semmling¹

¹*Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum GFZ, Potsdam, Germany*
(foer@gfz-potsdam.de)

²*Technische Universität Dresden, Institute für Planetare Geodäsie, Dresden, Germany*
(mirko.scheinert@tu-dresden.de)

Abstract

The new German research aircraft HALO was equipped with an ensemble of geodetic-geophysical instrumentation to carry out geoscientific research in the tectonically active region of the Mediterranean. The instrumentation comprised two airborne spring-type gravimeters, scalar and vector magnetometers, GNSS zenith, sideward and nadir antennas, and a Laser altimeter. This HALO flight mission called GEOHALO could be carried out in June 2012. The mission flights took place over Italy and the adjacent seas, comprising seven parallel profiles from north-west to south-east over the Italian peninsula in a height of about 3,500 m with a length of about 1,000 km each and a line spacing of about 40 km. This presentation contains an overview on the challenges to integrate the scientific instrumentation onboard HALO. We discuss the feasibility and the performance of this instrumentation and present preliminary results from the measurements of the gravity field, of GNSS reflectometry, scatterometry and radio occultation, and of laser altimeter distances over the ocean. Altogether, GEOHALO is the first geoscientific mission on the HALO aircraft. Its success was possible only by the joint efforts of the group of German, Swiss and Spanish universities and research institutions, Italian authorities and institutions as well as by the financial and logistic support of the German Research Foundation, the Helmholtz Association of German Research Centers, the German Aerospace Center and further national and international partners.

HALO – a new German research aircraft for atmospheric and earth system research

The German aircraft HALO (High Altitude and LOng Range Research Aircraft) HALO is a new research aircraft for atmospheric and geosciences research. This airplane is based on a Gulfstream G550 commercial business jet (fig. 1). Its maximum range and altitude are more than 8.000 km resp. 15.000 m. HALO can carry payload of maximum 2.800 kg. This airplane is maintained and operated by the German Aerospace Center (DLR) from its operation basis Oberpfaffenhofen, Germany.



Figure 1: The HALO aircraft – take-off in Oberpfaffenhofen (Munich)

Research with HALO, especially for university groups, is supported by the Priority Program 1294 of the German Research Foundation (DFG) “Atmospheric and Earth System Research with HALO”. The first period was 2008–2013. The application for a second period 2014–2019 is currently under review.

GEOHALO – a geoscientific flight mission over the Mediterranean

GEOHALO is a geodetic and geophysical missions onboard HALO. It was the very first geoscientific HALO mission and has been carried out in 2012 over Italy and adjacent sea areas (Adriatic Sea, Tyrrhenian Sea, Ionian Sea). The mission contained four mission flights and two test flights during the time span 2 till 12 June 2012. The flight tracks comprised seven parallel profiles directing from north-west to south-east, in a height of about 3,500 m, with a length of about 1,000 km each and a line spacing of about 40 km (c.f. fig. 2), flown at a velocity of 425 km/h. These long profiles were complemented by four crossing profiles (< 1.000 km) and one profile at an altitude and velocity of approx. 10 km resp. 600 km/h along the same track as the center long profile.

For the GEOHALO mission the HALO aircraft was equipped with an ensemble of geodetic-geophysical instrumentation to carry out geoscientific research in the tectonically active region of the Mediterranean and to demonstrate the feasibility and performance of this instrumentation. This comprised two airborne spring-type gravity meters, scalar and vector magnetometers, GNSS zenith, sideward and nadir antennas, and a laser altimeter. That means a complete suite of geodetic / geophysical instrumentation to investigate the geopotential fields (gravity and magnetic field), ocean surface heights (and mean sea-surface topography) as well as further parameters like waves, roughness, salinity, ice-surface heights and small-scale features.

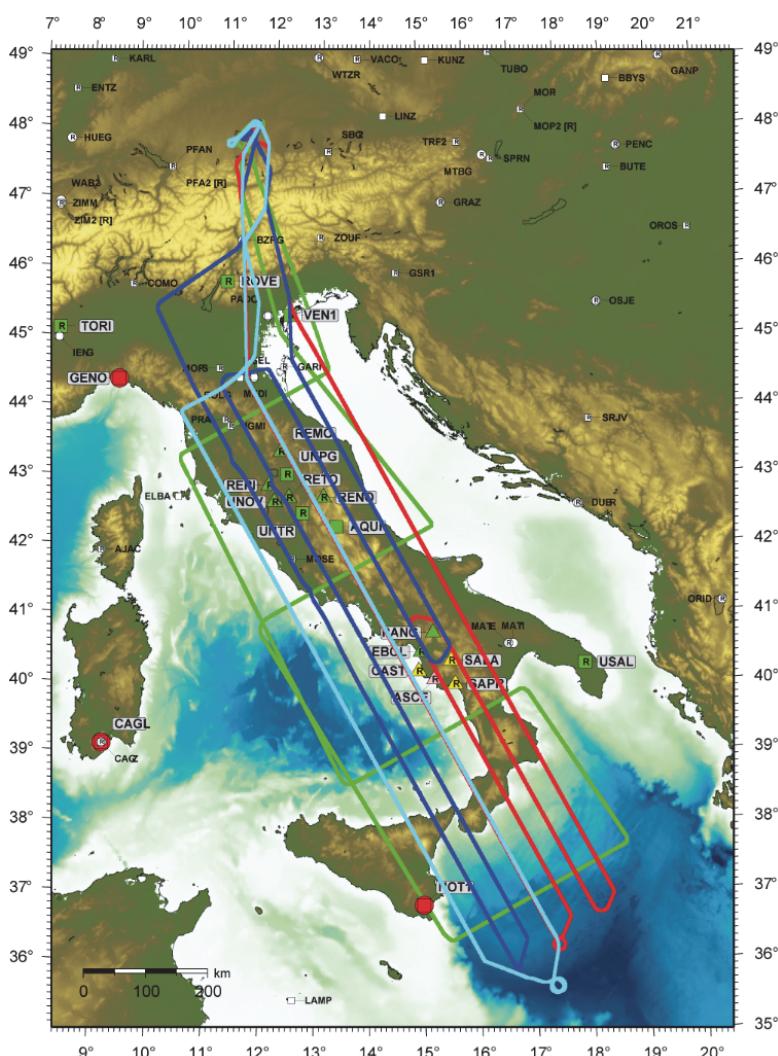


Figure 2: The GEOHALO flight pattern.

Profiles were flown on June 6 (green), June 8 (red), June 11 (blue) and June 12 (cyan), 2012. The general flight altitude was 3,500 m. Only the last central (cyan) profile was flown in an altitude of about 10,000 m, following the same track as the lower (red) profile. Special patterns were followed on the ground as well as during the flight (orbits) to enable the calibration of the magnetometers.

In this presentation we discuss the performance of the GEOHALO instrumentation and present preliminary results from the measurement evaluations of the gravity and magnetic fields, of GNSS reflectometry, scatterometry and radio occultation, and of laser altimeter distances over the ocean. The gathered data shall finally be used to investigate the lithospheric structure in

the working area, which is characterized by a puzzle of tectonic microplates, yielding to an increased georisk of earthquakes and volcanism. Altogether, GEOHALO is the first geoscientific mission utilizing HALO. Its success was possible only by the joint efforts of the group of German, Swiss and Spanish universities and research institutions, Italian authorities and institutions as well as by the financial and logistic support of the German Research Foundation, the Helmholtz Association of German Research Centers, the German Aerospace Center and further national and international partners.

Outlook

In the future HALO should be used to survey vast areas which are otherwise difficult to access, to close data gaps, to gain new near-surface data as well as data on different altitude levels up to the maximum flight altitude, to provide linkages of detailed yet isolated airborne surveys to check e.g. for biases, consistency and reference system issues (like the gravity datum). An outlook is the ANTHALO project, a planned HALO mission over Antarctica, especially to close polar gaps in (near-surface) gravimetric and magnetic data.