SCOUT-O3

Intermediate report on the MIPAS-STR measurements during the forward transfer flights between Oberpfaffenhofen, Germany, and Darwin, Australia

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Summary

The MIPAS-STR was operated from the high-altitude aircraft M55-Geophysica during one test flight and six following transfer flights between Oberpfaffenhofen and Darwin as part of the EU project SCOUT-O3. During all flights the instrument performed perfectly without any interruptions or technical problems. This series of seven flights has been the longest ever made by the MIPAS-STR instrument. During all flights limb and upward measurements were made. The lowest tangent point for the limb measurements was set to 6 km altitude.

The instrument was monitored in-flight via the Iridium satellite telephone link to the MIPAS-STR onboard computer. Because of the automatic flight program and the perfect behavior of the instrument there was no need to step in with telecommands, except for the very last part of the last leg, when a long delay at Brunei forced us to give a few commands to start the special mode for nonlinearity measurements.

The intermediate stops at Dubai (UAE), Hyderabad (India) and U-Tapao (Thailand) gave us the chance to refill the cryogenics (liquid helium and dry ice), to flush and dry the instrument, and to download the data. The work at all intermediate stops was a challenge and required a large workload and improvisation skills despite of the logistical preparations made in advance.

This short report gives an overview of the flights and the schedule of the MIPAS-STR measurements. It also gives a flavor of what working at these intermediate bases meant.

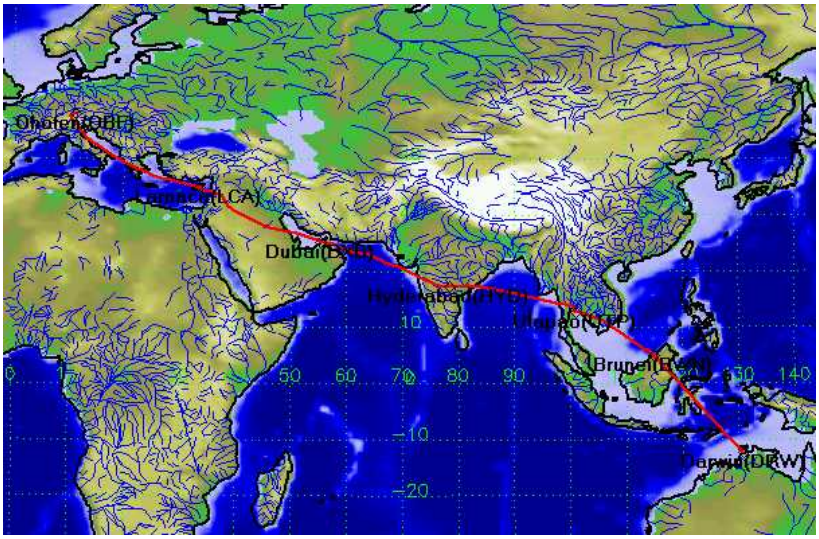

Fig.1. Forward transfer flights from Oberpfaffenhofen to Darwin.

Oberpfaffenhofen: Integration of the instrument and test flight (24 - 31 October)

Integration of MIPAS-STR and other instruments took place at the RUAG airbase at Oberpfaffenhofen, Germany. The team arrived October 24th, prepared the instrument and made final tests and calibrations (FOV and LOS) during the following days. On October 29th, the day after the arrival of the aircraft, MIPAS-STR was mounted in the dorsal bay. A ground EMC test and a short test flight on October 31st were required before the Geophysica could take off for the first part of the transfer flights. During the test flight MIPAS-STR made atmospheric measurements above Germany from 11:32 UTC until 14:30 UTC.

Oberpfaffenhofen – Larnaca – Dubai (4 November)

Take-off on November 4th at Oberpfaffenhofen in front of the DLR-IAP building.

With one hour delay the Geophysica took off on November 4th at 6:00 UTC in Oberpfaffenhofen for the first leg of the transfer. The weather conditions for the MIPAS limb measurements were quite good, as can be seen from the DC plot (Fig. 2). We show these plots for all transfer flights to give an indication of what can be expected regarding the retrieval of MIPAS-STR profiles. Except for the first hour, the DC plot shows regular patterns down to tangent heights of approximately 8 km.

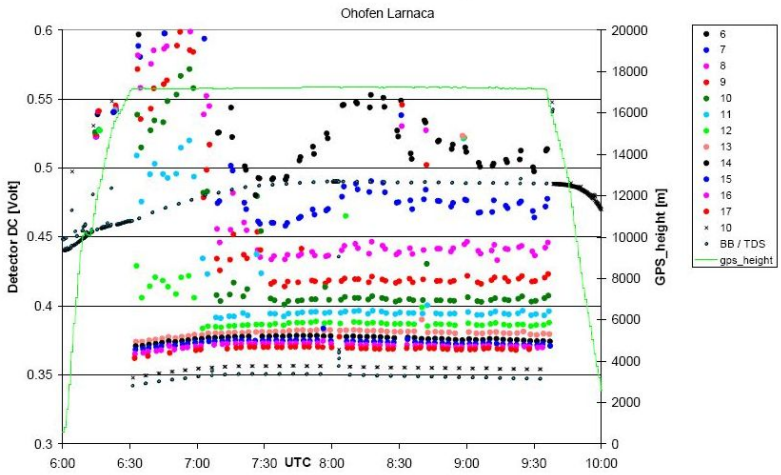

Fig.2. DC plot for the flight from Oberpfaffenhofen to Larnaca.

Without additional delay the Geophysica took off from Larnaca at 13:48 UTC and landed in Dubai 18:00 UTC. Atmospheric measurements by MIPAS-STR were made continuously with an approximately 20-min interruption starting at about 14:30, when the MIPAS-STR onboard software stopped the limb scanning to avoid direct sunlight entering the instrument. The DC-plot (Fig.3) shows good conditions for the MIPAS-STR limb measurements for the entire flight. In-flight monitoring of the instrument via the Iridium link for both legs was made from the Oberpfaffenhofen airport.

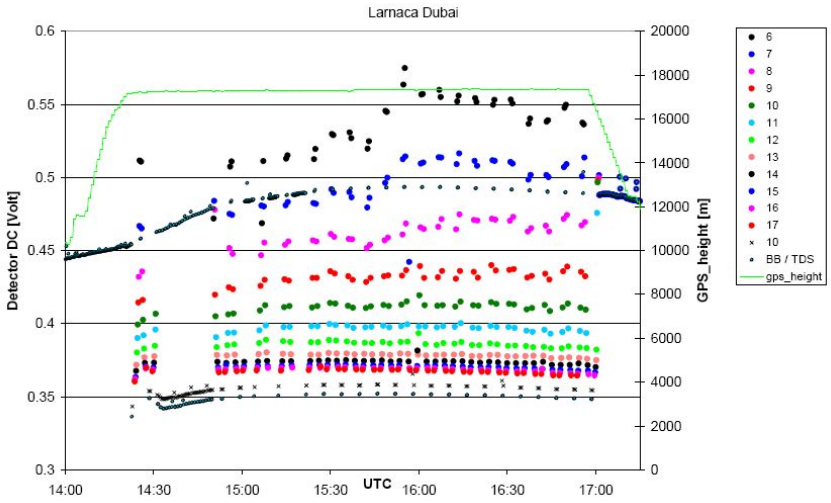

Fig.3. DC plot for the flight from Larnaca to Dubai.

Dubai (4 -7 November)

The Geophysica was hosted in the Jet-Aviation hangar at the commercial Dubai airport, a well protected clean hangar. It was difficult to get in and even out, especially during the weekend. For some it took 2 hrs each way, but experienced team members found legal shortcuts. Unfortunately, no cameras were allowed on the airfield. Therefore, please enjoy a few pictures of down-town Dubai. Most of the impressive skyscrapers are brand-new, but there are some as old as 30 years.

Dubai: hotels and harbor

Dubai – Hyderabad (7 and 8 November)

Just after mid-night on November 7th after "hands-off" the flight was delayed due to serious problems with one of the instruments. After fixing this problem the fuel truck did not show up and the start was delayed further. Shortly after take-off to Hyderabad, the aircraft returned because of problems with the transponder. In the end, it headed for Hyderabad in the early morning of November 8th with a delay just within the permitted 24 hrs.
Parking the Geophysica during the day on the apron under the Arabic sun was risky for the instrument, but did not cause any problems. Repeating the flight preparation in the dark night was a not-to-miss adventure. Observing the instrument via the Iridium link, as it was working reliably and pointing at the almost cloud-free sky, compensated for all troubles (Fig. 4).

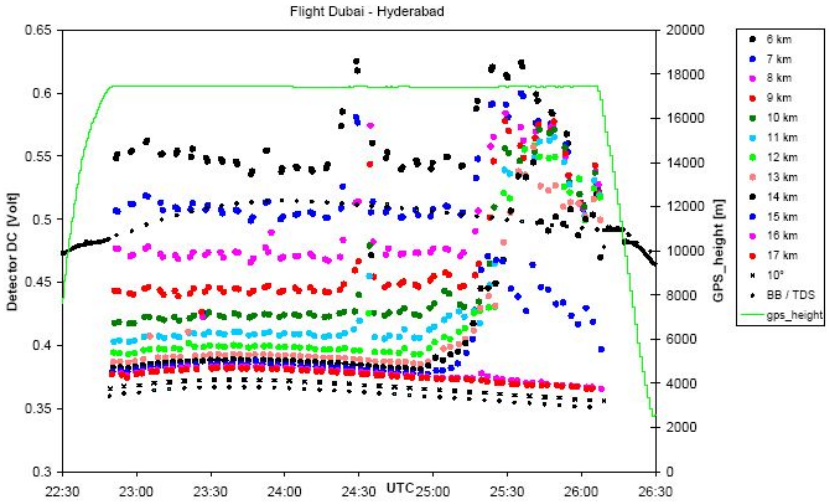

Fig.4. DC plot for the flight from Dubai to Hyderabad.

Hyderabad (7 - 9 November)

The delay of one day in Dubai solved many problems on the subsequent intermediates, as there was also a delay in the delivery of liquid helium in Hyderabad and U-Tapao. Arrival of the frozen instrument in Hyderabad was in the morning of the 8th at 7:30 local time. The parking position was on the old runway about 100 meters from the big airport radar antenna. The sun and the wind did a good job in drying the instrument. During day we protected the instrument with aluminium foil against the sun.
We obtained liquid nitrogen and dry ice with help of the local balloon facility and Prof. Manchanda in Hyderabad. A short test showed that the ice was not ice cream but pressed CO_2 snow packed in newspapers. Late in the night but just in time the liquid helium arrived by truck from Bombay. Because of the late arrival it needed the rest of the night on the back of the aircraft to refill the cryostat. In the darkness in front of this radar antenna, the only help we got was from the thousands of mosquitoes around us - hopefully without malaria. Early in the morning at about 8:00 LT the aircraft departed from this crowded city with its charming people. It was really exiting to pass through town with one of these typical three-wheel rickshaws in this loud and chaotic traffic.

Transfer of liquid helium in Hyderabad

Hyderabad – U-Tapao (9 November)

Take-off at Hyderabad on November 9th was at 02:55 UTC, landing in U-Tapao at 07:15 UTC. The DC-plot made shortly after the flight (Fig. 5) shows that flying at just 17 km pressure level was not high enough to have more than one single tangent point above the clouds.

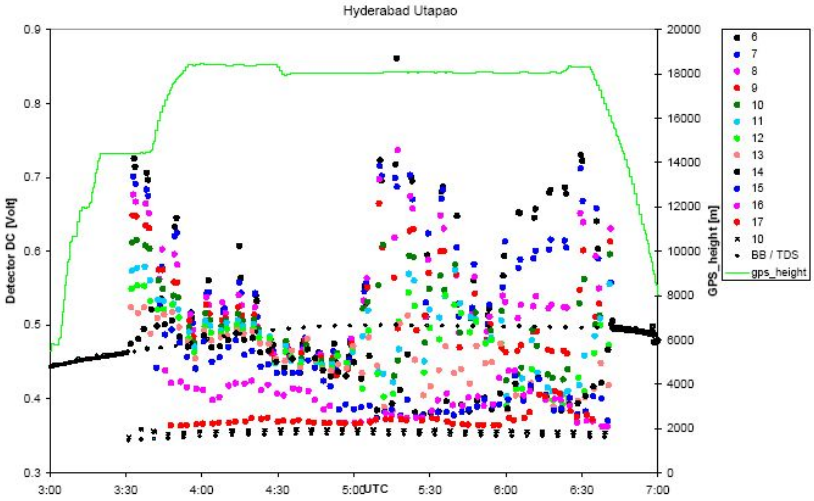

Fig.5. DC plot for the flight from Hyderabad to U-Tapao.

U-Tapao (8 - 11 November)

On the 8th we inspected on the military part of the airport an empty hangar that contained most of our stuff. However, with the aircraft arriving from Hyderabad there was still no official letter that we could use it. The arrival of the Geophysica in U-Tapao on the 9th at about 14:00 LT coincided with the arrival of the second half of the MIPAS-team that got some sleep on their flight from Dubai to Bangkok and during the 3 hrs taxi drive to U-Tapao. Fortunately, Heinz Finkenzeller managed to host the Geophysica in the Thai service hangar close to two aircraft which were serviced night and day. The site was dry but terribly noisy and sometimes during the night the use of masks was required. Since the measurements were going according to plan, we just did the 'normal' program of filling cryogenics twice a day, downloading data and preparing the instrument for the last two legs.

The Falcon and the Geophysica in U-Tapao and the big Buddha in Bangkok.

U-Tapao – Brunei - Darwin (11-12 November)

As the leg to Brunei was short, the flight profile was changed to three subsequent flight pressure levels of 17, 18 and 19 km. The leg from Brunei to Darwin was again too long - or the aircraft too heavy - so the planned flight level of 17 km had to be kept.
The data received via satellite link gave the impression that the agreed flight levels were not flown. This was confirmed in Darwin after downloading the data (Fig 6 and 7).

Checking the MIPAS-STR on November 12th via the Iridium satellite link from the roof of our hotels in U-Tapao (left) and Bangkok (right) and 'en-route' (middle).

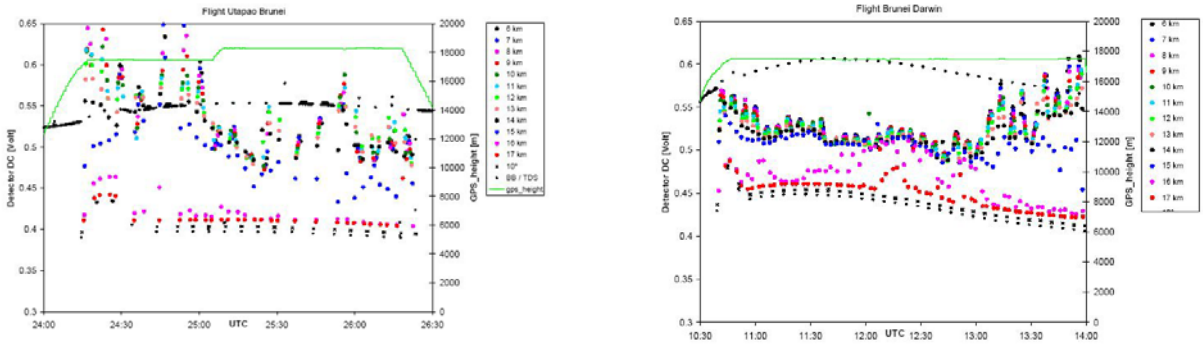

Fig.6 and 7. DC plots for the flights from U-Tapao to Darwin.

Unfortunately, the stopover in Brunei took five hours longer than planned because of a tropical thunderstorm, which prevented the pilot from taking off. The Geophysica with MIPAS-STR in its dorsal bay stayed outside during the heavy rain.

Darwin (13 - 16 November)

The Geophysica arrived in Darwin on the night of Sunday, November 13th at about 0:15 hrs local time. During the landing there was a lot of lightning far-off Darwin, but nevertheless the Russian pilot and his baggage were carefully checked by an Australian custom officer. Two hours later, just before the heavy rain and lightning reached Darwin, the aircraft was parked in its new home, a big hangar of the RAAF airbase on the far end of Darwin airport. In the MIPAS dome we found a big piece of ice, which probably resulted from the heavy rains at Brunei.

Post-flight tests and calibration measurements completed this long trip around half the world. On Monday 14th November MIPAS was dismounted. It took about two more days to defrost

the cryogenic cooled optics in the wet and humid Darwin hangar to avoid the risk of condensation of water on the hygroscopic beam splitter.

Conclusion and lessons

Table 1 gives an overview of the forward transfer flights as well as the time and location of the MIPAS-STR measurements.

UTC	**4 Nov O'hofen Larnaca**	**4 Nov Larnaca Dubai**	**7/8 Nov Dubai Hyderabad**	**9 Nov Hyderabad U-Tapao**	**11/12 Nov U-Tapao Brunei**	**12 Nov Brunei Darwin**
Take-off	06:00	13:48	22:22	02:55	23 :40	10 :13
Landing	10:08	18:00	02:42	07:15	03 :06	14 :28
MIPAS-STR profiles						
From (Lat./Lon.)	06:31 (46.68/11.08)	14:23 (33.88/36.76)	22:49 (24.92/57.36)	03:47 (17.41/82.17)	00:15 (12.26/103.0)	10:39 (3.90/115.95)
Until (Lat./Lon.)	09:38 (35.48/31.45)	17:00 (26.06/53.31)	02:08 (17.37/76.93)	06:40 (13.98/99.75)	02:23 (5.86/113.81)	14:00 (-11.3/129.8)

Table 1: Overview of flight times and MIPAS-STR measurements

From table 1 and figures 2-7 we conclude that

- MIPAS-STR worked excellently in all flights between Oberpfaffenhofen and Darwin.
- The new in-flight downlink via the Iridium telephone was successful for monitoring the instrument from everywhere we tried. The uplink was used once in order to account for the long delay in Brunei.
- From Hyderabad to Darwin MIPAS-STR measured a great variety of clouds in altitudes just below the aircraft, but for gases no profile will be retrievable.
- Even with the 17 km flight altitude between Oberpfaffenhofen and Hyderabad it should be possible to retrieve profiles for these first three flights.

A big 'thank you' to:

The coordinators of the SCOUT-O3 project, especially to Cornelius Schiller responsible for the Geophysica activities.
Heinz Finkenzeller and Stefano Balestri, the team responsible for the logistics on the transfer flights.
Fred Stroh for sharing the task of providing cryogenics 'around the world'.
Prof. Manchanda, Dept. of Astronomy and Astrophysics in Bombay, and S. Sreenivasan from TIFR balloon facility in Hyderabad for supporting us in India.
The Institute of data Processing and Electronics at the Forschungszentrum Karlsruhe for reliable on-board electronics.
Alexander Streili and Stefan Gräbner for making MIPAS-STR resistant to tropical conditions.
The MDB pilots and ground crew, who brought the Geophysica safely to Darwin.
And finally all those we forgot to mention!

October 2005 The 'in-flight'MIPAS-STR team