

BALLOON NEWS

Sous-Direction Ballons

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In	this	second	issue	of	the	
"Ra	alloon	Nows"	VOU	will	find	
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information on :						

- The AMMA and SCOUT african Balloon campaigns.
- The preparation of the VASCO campaign.
- The PILOT project wich is planned for a first flight beginning of 2009.
- The last results on the envelopes and the gondolas.

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NEXT EVENTS

- IASI validation campaign in Kiruna February - March
- VASCO campaign in Seychelles January - February
- Flight tests of the new BSO envelope deflation system

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VASCO 2007

VASCO

During the VASCO 2007 campaign, the wind speed was higher than expected inducing mechanical conditions above the envelope design limit and all the AeroClipper flights were shorter than planned. With laboratory tests it was possible to reproduce the phenomenon on mock-up balloons, the material of the balloon envelope being degraded mechanically under the effect of the relative wind (shivering).

The VASCO main campaign is planned in January, and is especially coupled with the CIRENE campaign, for which an océanographical ship (the Suroît) will be operated in the western part of Indian Ocean to measure various atmospheric and oceanographic parameters. Due to planning constraint, the development of a new specific balloon with a new material for the AeroClipper not being possible, it was decided to use commercial balloons of airship type.

Two balloons (80 m³ & 110 m³) of the TRFD family of Aerostar were supplied. The results of the helium leakage tests (June & August 2006) showed that this type of balloon could meet VASCO requirements for duration flights from 2 to 3 weeks. Moreover, the dynamic behavior of the AeroClipper, in VASCO configuration, was validated by a series of tests (July 2006) on the Lake of Cazaux. These tests showed that this type of balloon has a positive dynamic lift which increases with wind speed. allowing a satisfying behavior of AeroClipper with high wind speed.



PILOT

SCIENCE OBJECTIVES

PILOT is a project of a balloonborne astronomy experiment to the polarized emission study arising from dust grains present in the diffuse Inter-Stellar medium in our Galaxy. These measurements will allow to map the direction and intensity of the magnetic field in our Galaxy, as well as to learn about the magnetic properties of interstellar dust grains. It will also be possible to detect polarization towards very diffuse regions in high galactic latitude interstellar clouds. These informations will be very useful in order to define subtract methods to the contribution of polarized foreground emission for future cosmology missions which will aim measuring extensively the at of polarization the Cosmic Microwave Background.



Example of mapping of the galactic plane that will be possible with PILOT in the "Large Survey" mode

INSTRUMENT

The PILOT instrument will carry a 1m primary mirror and a photometer allowing observations in two photometric channels at wavelengths of 240 and 550 microns at an angular resolution of a few arcminutes. We will make use of bolometer arrays, newly developped for the PACS intrument on board the Herschel sattelite. The large number of detectors per photometric channels (1024 for PILOT) and the wavelengths adapted to measure dust emission contribute to make PILOT the most sensitive experiment for this type of measurements. An inovative method to measure polarization using arrays has been proposed. It will be validated with complete end to end simulations in the following months.



General view of the PILOT gondola and pointed instrument

SCIENTIFIC AND TECHNICAL COLLABORATION

PILOT is a international project which involves 3 laboratories in France (CESR Toulouse, IAS Orsay, CEA Saclay) and with participations from 2 main European laboratories (Cardiff University UK, La Sapienza Rome).

The CNES is in charge of the stabilized gondola which carry the instrument and also responsible for the flight operations.

SCHEDULE

3 flights are planned in 2009 and 2010 to cover the galactic plane.

AMMA BPCL

AMMA BPCL

During the 2nd Special Observation Period (SOP) of AMMA project, the balloon campaign with Boundary Layer Pressurised Balloons (BLPB) took place from Cotonou, the capital of Benin, from mid-June to mid-July. BPCL campaign to document the monsoon flow together with the monsoon onset.

Balloons, inflated with helium, are spherical with a 2.5 meters diameter. The scientific and technical gondola is located inside the balloon, the total flying weight being about 8 kg. Except for water loading under heavy rains, the constant volume balloons drift with air masses at a pre-set constant density level, their diurnal cycle over the continent is estimated to be within ± 10 hPa. The balloon position given by an onboard GPS receiver and the atmospheric measurements of pressure, temperature and humidity are transmitted through the ARGOS satellite system. data being collected every 10 minute.

15 balloons, launched from Cotonou drifted according to the southwesterly monsoon winds over the African continent at levels between 850hPa and 880hPa. They traversed a total distance of 25419 km in 64 days of flight.

SCOUT AMMA

SCOUT /AMMA CAMPAIGN AT NIAMEY (NIGER)

After a first campaign in november 2005 to validate all the logistics and operational process and after 6 months of preparation of the operational accomodation with the support of IRD at Niamey, the SCOUT/AMMA campaign began without delay on 18th of july.

11 flights with small BSO and 10 backscatter sonding were scheduled during the 30 operational days.

On this 11 BSO flight ; 1 was managed by Whyoming University and 10 by CNES ; the sounding were operated by DMI During the period, CNES launched 8 ballons with 1 failed flight due to a leak in the balloon which have not be detected during the inflation.

The most of the scientific mission requiered flights near active convective system so all the launches were tight in meteo conditions with winds extremly variable in speed and in direction.

Concerning the recovery, in spite of the support of the nigerien army, but without avalaible helicopter, all the recoveries have been longer than forseen and very difficult ; the 4X4 were not enough efficient during the rain season.

For this campaign we were mainly supported by the IRD for the logistics and for the interfaces with the different Nigerien authorities and by the Nigerien Army for the recovery which were very difficult to operate. We want to thanks these support in Niger and all the others who allow to work in excellent spirit of cooperation.







AMMA DRIFTSONDE

In a unique collaboration, U.S. and French engineers and researchers from National Center for Atmospheric research (NCAR), CNES, and Centre National de la Recherche Scientifique CNRS), have launched superpressure balloons into the stratosphere to drop nearly 300 instrument packages over wide swaths of Africa and the Atlantic Ocean in August/September 2006. The stratospheric balloons and flight control systems were developed by CNES whereas the scientific payloads were designed by scientists and technicians at NCAR. The packages gathered detailed data from late August to end of September from critical regions of the atmosphere where some of the most dangerous U.S. hurricanes develop.

The concept of using balloon-driftsondes to take measurements over remote, but scientifically important locations around the globe came from THORPEX, a 10-year global program to accelerate improvements in the prediction of high-impact weather. The Niger launches this year are in conjunction with the international African Monsoon Multidisciplinary Analysis (AMMA) project. This is the first time scientists have used balloon-driftsondes in weather research and prediction.

After being launched from Zinder in Niger, each balloon drifted from Africa toward the Caribbean islands at heights of around 20000 meters, where light easterly winds prevail. Twice per day, each gondola release an instrument known as a dropsonde that falls by parachute, sensing the weather conditions during its 20-minute descent and radioing data back to the gondola and then, by satellite, to the researchers. Scientists controlled the process from an operations center in Paris. If a promising weather system develops, they could signal the gondola to release additional dropsondes as often as once per hour.

In addition to tracking potential hurricanes, the balloon-driftsondes gathered bird's-eye data on surges of hot, dry air that cascade into the Atlantic from the Sahel region of Africa. These surges carry huge amounts of dust as far west as Florida, influencing air chemistry, upper-ocean biology, and Atlantic weather systems.

In order to make the driftsonde concept practical, NCAR developed a highly compact instrument package, roughly the size of a small bottle of water but weighing only 150 grams. Called MIST (Miniature In-situ Sounding Technology), it weighs less than half as much as older dropsondes, which were designed at NCAR in the 1990s. Each gondola could carry up to 40 dropsondes.

The balloons systems are superpressure balloons and flight control packages newly developed by CNES. The balloon are 12meter diameter developed as an extension of the previous balloons developed for the Strateole project. For this campaign the suspended mass was 40 kg. The balloons were fitted with a new gas release system, in order to compensate for the mass decrease of the payload as dropsondes were released. New flight control sytems "ISBA" were used, offering a direct real time control capacity, based on the iridium communications.



The first launch of the balloon-driftsonde system on August 28th

Further uses of these balloon-driftsonde systems are already planned. They include the Concordiasi project in Antarctica, aiming at improving the interpretation of the meteorological satellite data gathered over polar regions, in particular for the IASI instrument carried onboard METOP spacecraft. They include also measurement campaigns in the frame of the Thorpex program, and in the frame of the study of the dynamics of the equatorial stratosphere.

Driftsonde trajectories and dropsonde locations on October 4th 2006



BALLOON ENVELOPES

BALLOON ENVELOPE MANUFACTURING

The automatic system allowing to control the dimension of the gore cut and examine the polymeric film surface to identify surface defect such as hole, glue, impurity a.s.o. is being developed and shall be installed on the gore cutting machine during the second semester of 2006.

A prototype of the balloon technical database is implemented on a dedicated network at Zodiac, it is now being fed with the formats and data for actual use in the manufacturing process in order to be fully operational in January 2007.

The mechanical design of the new assembly machine is completed ; an invitation to tender was emitted during summer for the manufacturing and implementation of the new machine. The contract shall be placed before the end of the year.

PHYSICS OF FLIGHT AND MISSION ANALYSIS

The aerothermics of the Montgolfière InfraRouge (MIR) was continued analysing more severe conditions (occurrence of cold high altitude clouds). The suspected aero-mechanical coupling leading to a deformation of the MIR envelope was confirmed by the computations. This tool is used to characterize the impact of the modification of the MIR inlet/outlet in particular in these severe conditions. As a result, the CFD calculations show that the possible deformation of the envelope is likely to be significantly reduced by the modification brought. The modified MIR envelopes will be manufactured starting Fall 2006.

The finite element tool in development since several years is now available. It allows to compute the mechanical stresses for zero pressure (BSO) and super- pressure (BPS) balloons. It was tested for BSO design during summer 2006.



Pressure field at maximum descent velocity for standard (left) and increased (right) opening of the MIR envelop for a low IR flux case (computations by R-Tech)



Verification of the stress analysis about a 100Z BSO

ENVELOPE MATERIAL AND ASSEMBLY TECHNIQUES

A study on the tapes used for the gore assembly was initiated end of last year with the objective of developing a tape that improves the performance of the present tape in particular with respect to the ageing before and after use in storage and transport conditions. In addition to the PhD thesis initiated last October, a R&T activity with the objective of selecting the appropriate glue and deposition process was also initiated in Spring 2006. It shall come to an end by Winter 2007/2008.

IMPROVEMENT OF THE EFFICIENCY OF THE BSO ENVELOPE DEFLATION SYSTEM

In order to improve the deflation of the BSO envelope, a study was initiated to define more appropriate systems of destruction of the envelope. An assessment of the mechanical load required to open the envelope at separation with the flight train is under process for all types of destruction panels used so far on BSO. According to the results, the number of destruction panels will be increased in order to facilitate the deflation of the balloon and avoid the possibility of having a buble of gaz large enough to maintain the envelope in flight. In parallel, analyses are made to determine the flight regime of the envelope after separation. The modification of the panels shall start before the end of 2006, with verification flights foreseen in Kiruna beginning of 2007.

QUALIFICATION OF THE BPS 12 M BALLOON

The long duration(up to 3 months) BPS 12 m system was qualified for 40 kg suspended mass at float altitude during Teresina (Brazil) and Kiruna (Sweeden) flights. The BPS 12 m includes a long duration gondola operated with the Irridium satellite constellation. It also incorporates a gas management system that allows monitoring the gas pressure inside the envelope when some payload mass is released.

Preparation for a release of a BPS 12 m balloon in Kiruna



Preparation for future developpments

EXTENSION OF THE LONG DURATION PRESSURIZED BALLOON CAPABILITIES

Scientific gondola requirements in terms of mass, energy, attitude and data management shall be provided as input by the scientific community in order to evaluate the feasibility of such a balloon, its cost of operation, and to initiate if required the ad hoc R&T activities.

BALLOON GONDOLAS

■ FLIGHT SERVITUDES : GONDOLAS AND FLIGHT CHAINS

BSO gondolas : System Design Review for the future TM/TC system has been held in October 2006. System Specifications, Development Plan and Management Plan have been validated and the development is starting within SYBOS project (SYstème BOrd Sol). Availability of a qualified complete system (on-board and ground segments) is expected by 2009.

BPS-MIR gondolas : Isba flight servitude gondola (Iridium System for Balloons) has been qualified before (ground and fight tests) and has been used for the 10 BPS flights of the AMMA campaign (Zinder – Niger – August 2006). This gondola is used to control the BPS balloon communicating with the ground (TM + TC) via the Iridium satellites system. Minor improvements are to be developed within next months to ensure adaptability to MIR/SCOUT and CONCORDIASI missions.

BPCL-Aeroclipper gondolas : Minor improvements have been performed on Dollfus (BPCL) and Nowave (Aeroclipper) gondolas. The major part of the period has been devoted to preparation, realization and exploitation of VASCO and AMMA campaigns.

Mechanical certifications : MICROSDLA, MIPAS OBG, MINISAMPLER and FIREBALL gondolas have been studied and certified. Other analyses are on progress : TRIPLE, O3 SAMPLER, TWIN SAMPLER and LPMA-IASI.

R&D :

- TCP/IP studies have been finalized, on-board and ground equipments have been tested and have flown at Aire sur l'Adour in October 2006. The TM/TC capabilities are very interesting and shall be integrated in SYBOS development.
- 2 R&D studies are on progress and shall be finalized by the end of the year :
 - ✓ On-board management of TM/TC data
 - ✓ "Micro gondolas"
- Other themes (digital short waves, high TM flow with satellite links) have been delayed to 2007.

FINE AXIS POINTING

Fireball : End of provisioning of the major parts of the gondola. Primary structure is integrated and new MPF (precise pointing module) has been received. Global integration and validation tests are foreseen by the end of the year.



