

A family of Balloons to study Earth atmosphere

- *Pasadena, June 27-30, 2006*
- *4th International Planetary Probe Workshop*
- Christian Cazaux – CNES

CNES Balloon activity

- **The CNES Balloon activity is lead by the Toulouse technical center with :**
 - ◆ System analysis, design, assembly, integration and test in Toulouse,
 - ◆ Operational means on the launch site of Aire sur l'Adour (south of France),
 - ◆ Additional launch capabilities in Gap (French Alps),
 - ◆ Cooperation agreements for launches in polar and tropical areas.

- **A Balloon family has been developed and is now on the shelf**

Launch site in Aire sur l'Adour

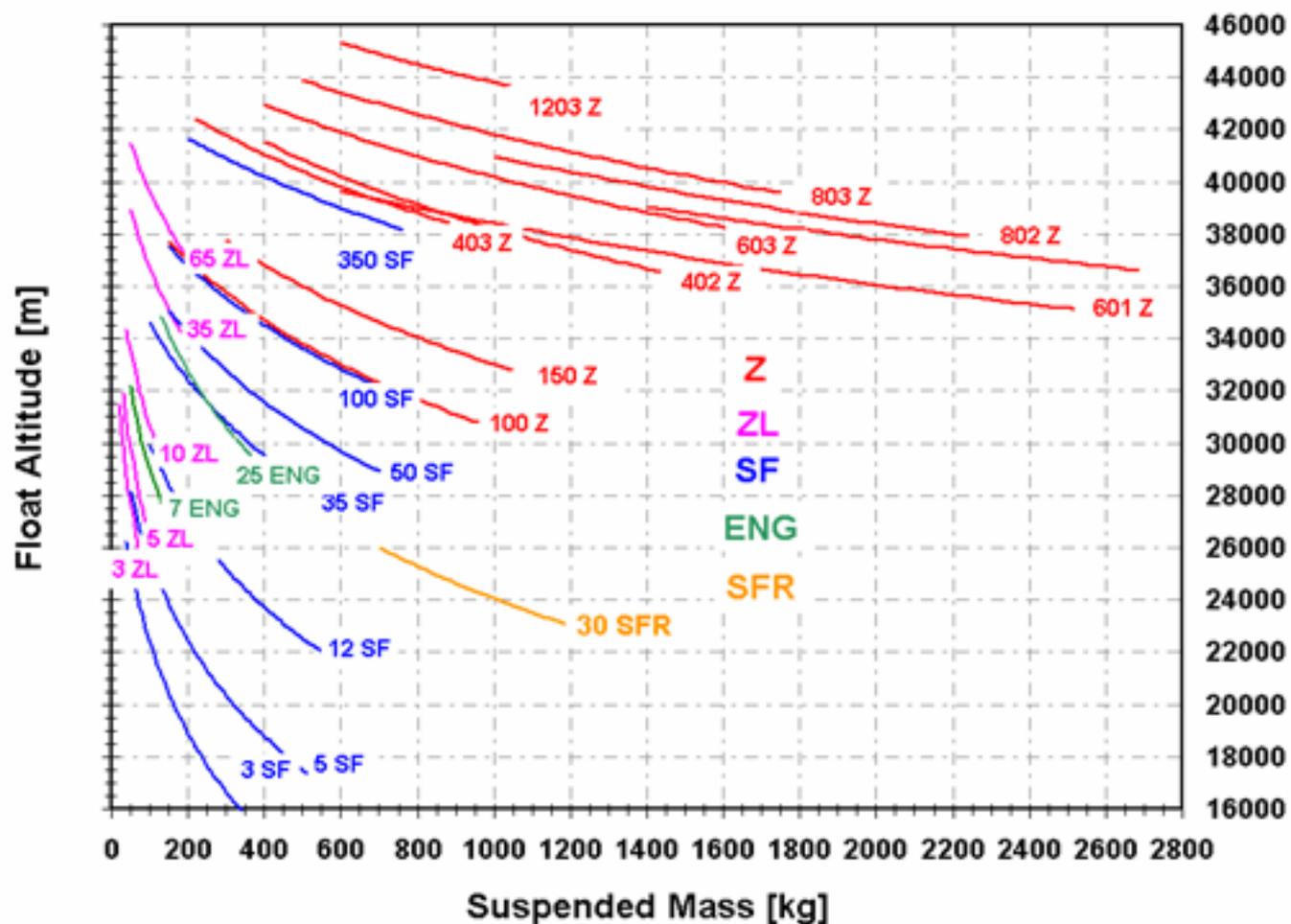


Zero pressure Stratospheric Balloons (BSO)

- Volume 3 000 to 1 200 000 m³
- Flight level 20 to 40 Km
- Flight duration hours to days (ballast and flight conditions management)
- Payload mass up to 3 T
- Material low density polyethylene
- Recovery of payload



Zero pressure Stratospheric Balloons (BSO)

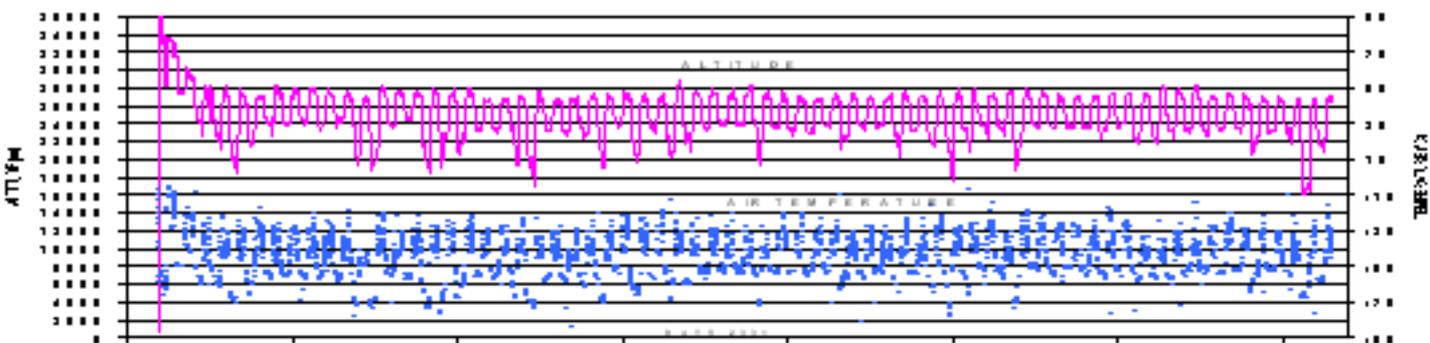
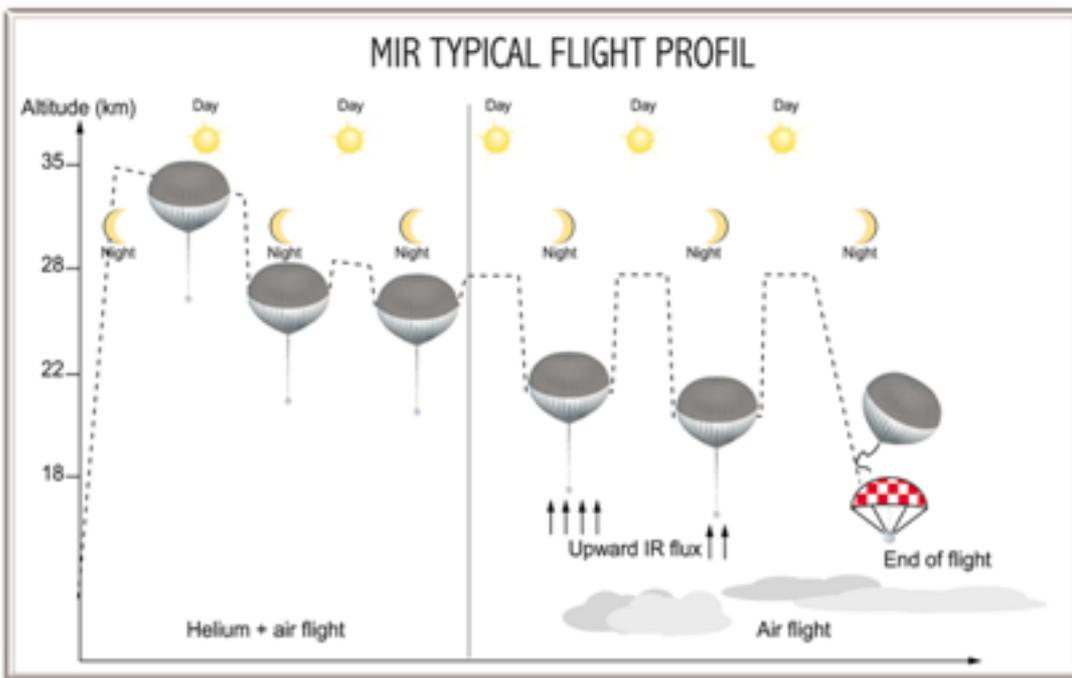
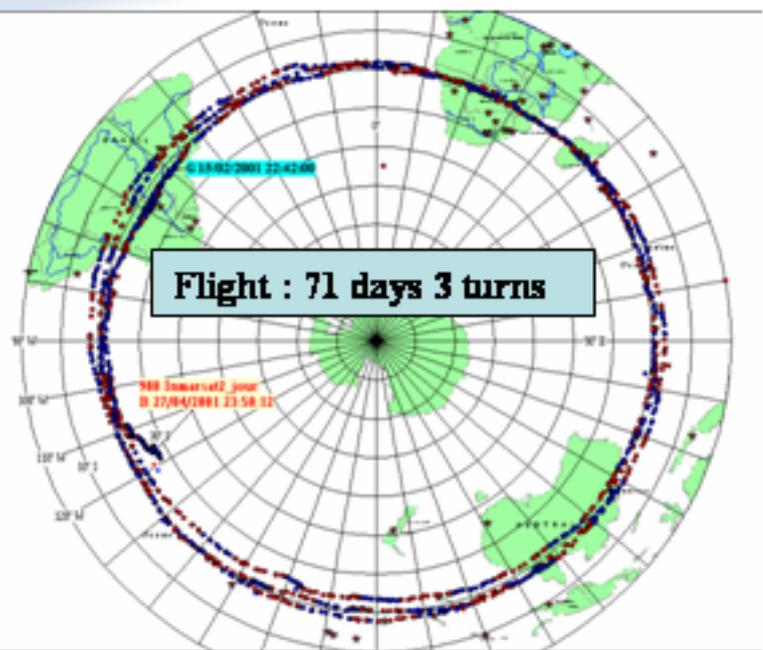


InfraRed Montgolfiere (MIR)

- ◆ Volume: 45 000 m³
- ◆ Payload mass: up to 50 kg
- ◆ Flight duration: weeks (71 days in 2001)
- ◆ Day/night excursions (18 to 30 km)



InfraRed Montgolfiere (MIR)



Superpressure balloons (BPS)



- ◆ **For long duration flights at constant air density**
 - Several months at float,
 - Quasi Lagrangian observation of the air parcels,
- ◆ **Present capability**
 - 2 balloon types (10 m-diam, and 8.5 m-diam)
 - More than 3 months at float,
 - Flight level fixed in the range : [90, 130] g/m³ corresponding to 18-20 km
 - Maximum suspended weight: 30 kg,
 - Any region, any season,
- ◆ **On going development**
 - 12 m-diam balloon,
 - Flight level range of the BPS system extended to [65, 130] g/m³ , corresponding to 18-22 km
 - Maximum suspended weight: 50 kg,
 - Extension of the BPS system lifetime to 6 months,

Atmospheric Boundary Layer Pressurized Balloons (BPCL)

■ Mission

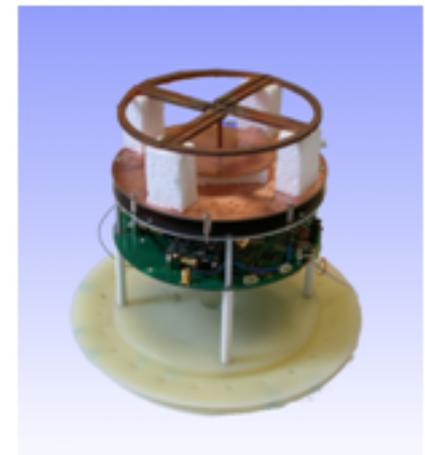
- ◆ Planetary boundary layer study
- ◆ Typical mission duration : 1 month
- ◆ Typical ceiling : 850 hPa (1 to 2 km)

■ Envelope

- ◆ Pressurized 2,5 m diameter Envelope

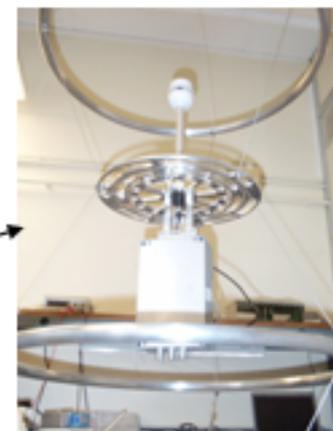
■ Gondola

- ◆ GPS localization
- ◆ ARGOS data transmission (ephemerides)
- ◆ Scientific measurements (Pressure, Temperature, Humidity, Wind)



Aeroclipper

- Balloon in lift deficit with a guide rope of which a part floats on the sea surface, the whole in an Archimedean balance
- The balloon drifts above the sea surface following the wind direction at a lower speed than wind
- Deployment from the coast to explore (30 days) large oceanic regions
- The atmospheric and oceanic gondolas allow to measure surface air and sea physical parameters to study atmosphere / sea interactions



atmospheric gondola



oceanic gondola

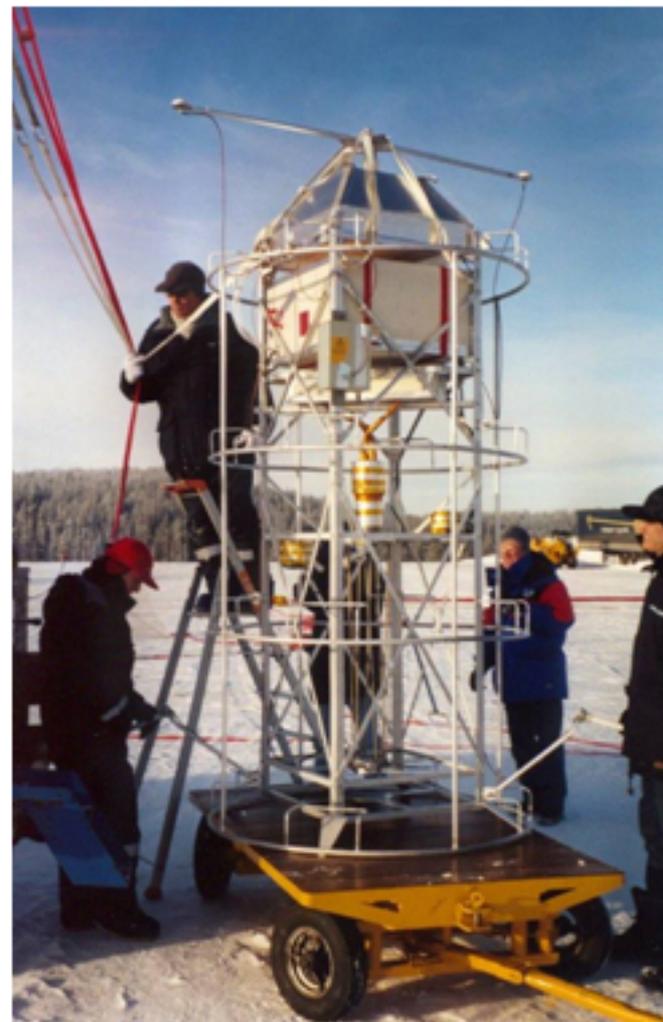
Example of scientific payload SALOMON

- SALOMON , light balloonborne UV-visible spectrometer, performs nighttime measurements of stratospheric trace-gas species using the Moon as a light source.
- It gives vertical profiles of ozone, NO₂ NO₃, aerosols, and OBrO.



Example of scientific payload SDLA

- **SDLA (Spectromètre à Diodes Laser Accordables)** spectrometer performs in situ measurement of CH₄ and H₂O in the atmosphere;
- **It uses commercial distributed-feedback InGaAs laser diodes in combination with differential absorption spectroscopy.**



Example of scientific payload SIRALE

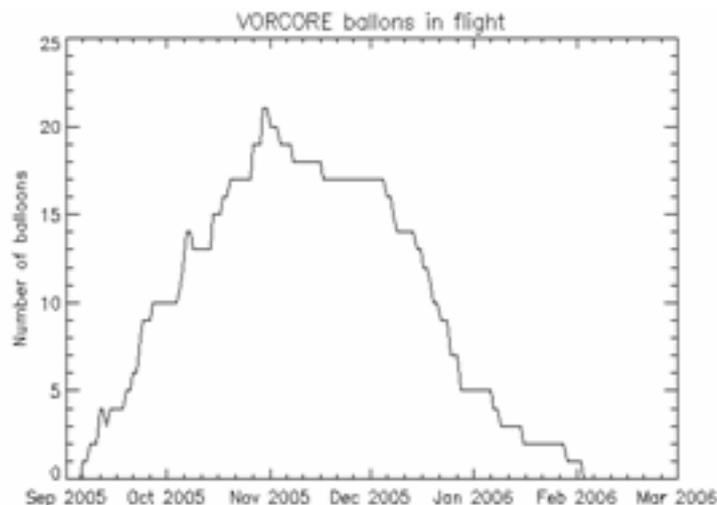
- **SPIRALE (Spectroscopie Infrarouge par absorption de Lasers Embarqués) spectrometer performs in situ measurement of molecular trace species;**
- **It uses 6 laser diodes which operate as light sources; concentrations are derived from absorption of the laser beam.**
- **It gives vertical profiles of CO, O₃, CH₄, NO, NO₂, N₂O, HCl, HNO₃ and aerosols.**



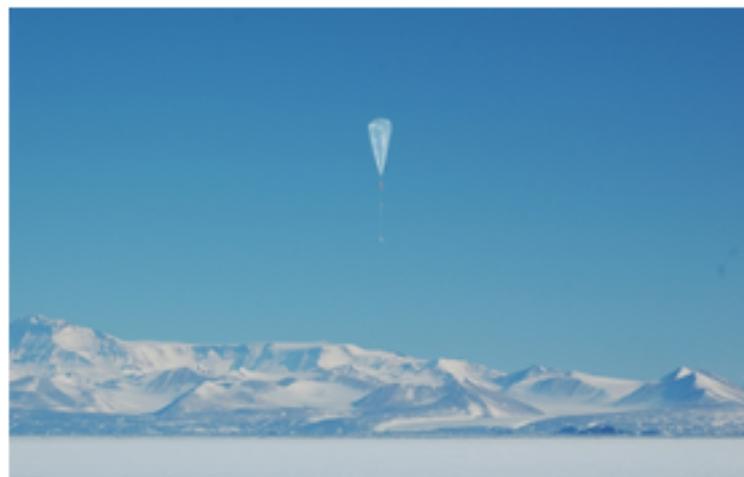
Balloon campaigns to study atmosphere

VASCO 2005 Seychelles	4 Aeroclipper 5 BPCL	Ocean/atmosphere interaction analysis in Indian Ocean
Aire sur Adour Spring 2005	1 BSO flight	Envisat validation and atmosphere analysis
Aire sur Adour Autumn 2005	3 BSO flight	Tropical intrusion analysis
Teresina 2005 Brazil	7 BSO	Envisat Iasi/Metop validation and atmosphere analysis
Strateole 2005 Mac Murdo	27 BPS	Analysis of stratosphere dynamics and ozone chemistry in South pole
VASCO 2006 Seychelles	7 Aeroclipper 4 BPCL	Ocean/atmosphere interaction analysis in Indian Ocean
Kiruna 2006 Sweden	3 BSO	Envisat and Iasi / Metop validation and atmosphere analysis
Benin AMMA 2006	10 to 15 BPCL	African Monsoon Multidisciplinary Analysis
Niamey Niger SCOUT AMMA 2006	10 BSO	Analysis of composition of upper troposphere and lower stratosphere and corresponding exchanges
Zinder Niger AMMA 2006	10 BPS with driftsondes (NCAR)	African Monsoon Multidisciplinary Analysis and cyclone genesis

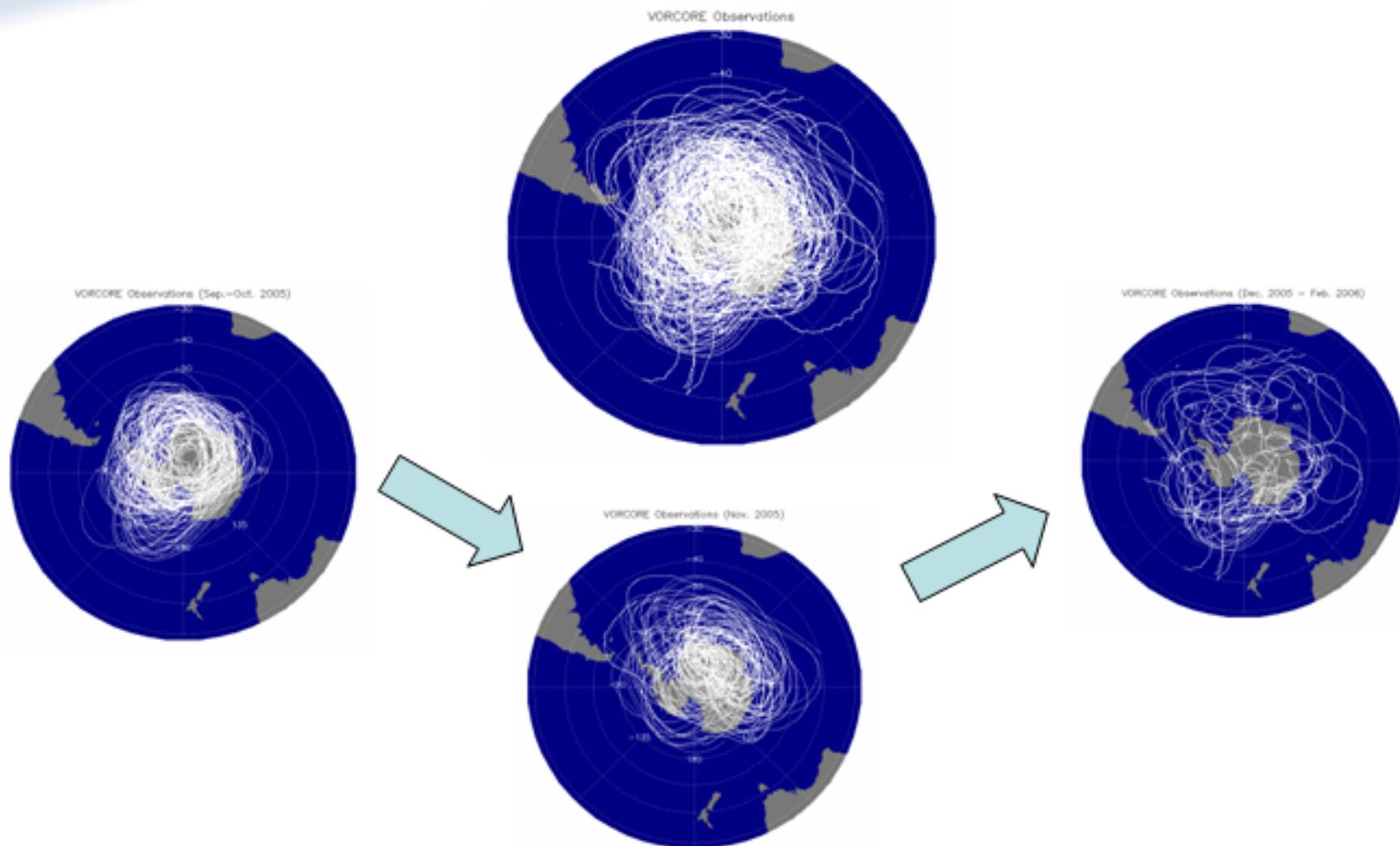
Strateole Mc Murdo : Flotilla history and data collection



- Total flight duration: 1575 days,
- Average flight duration per payload: 63 days,
- Maximum duration 109 days,
- 15 balloons simultaneously from mid-October to mid-November



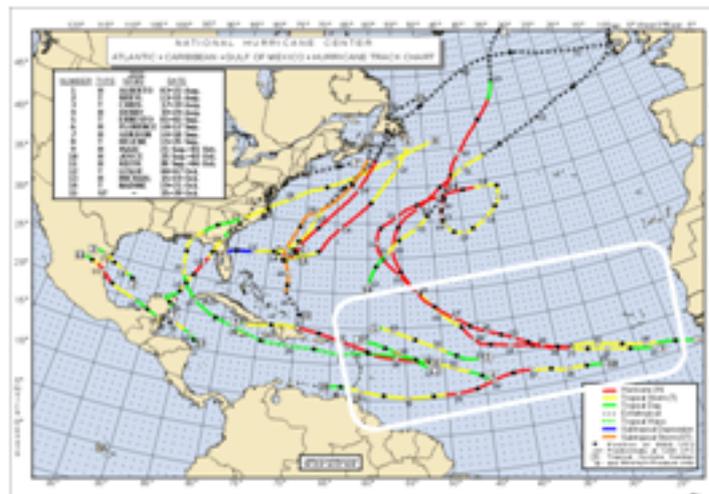
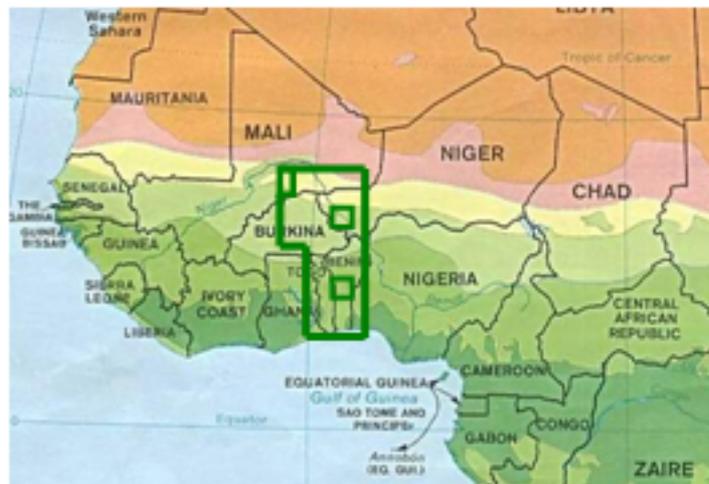
Strateole Mc Murdo Trajectories



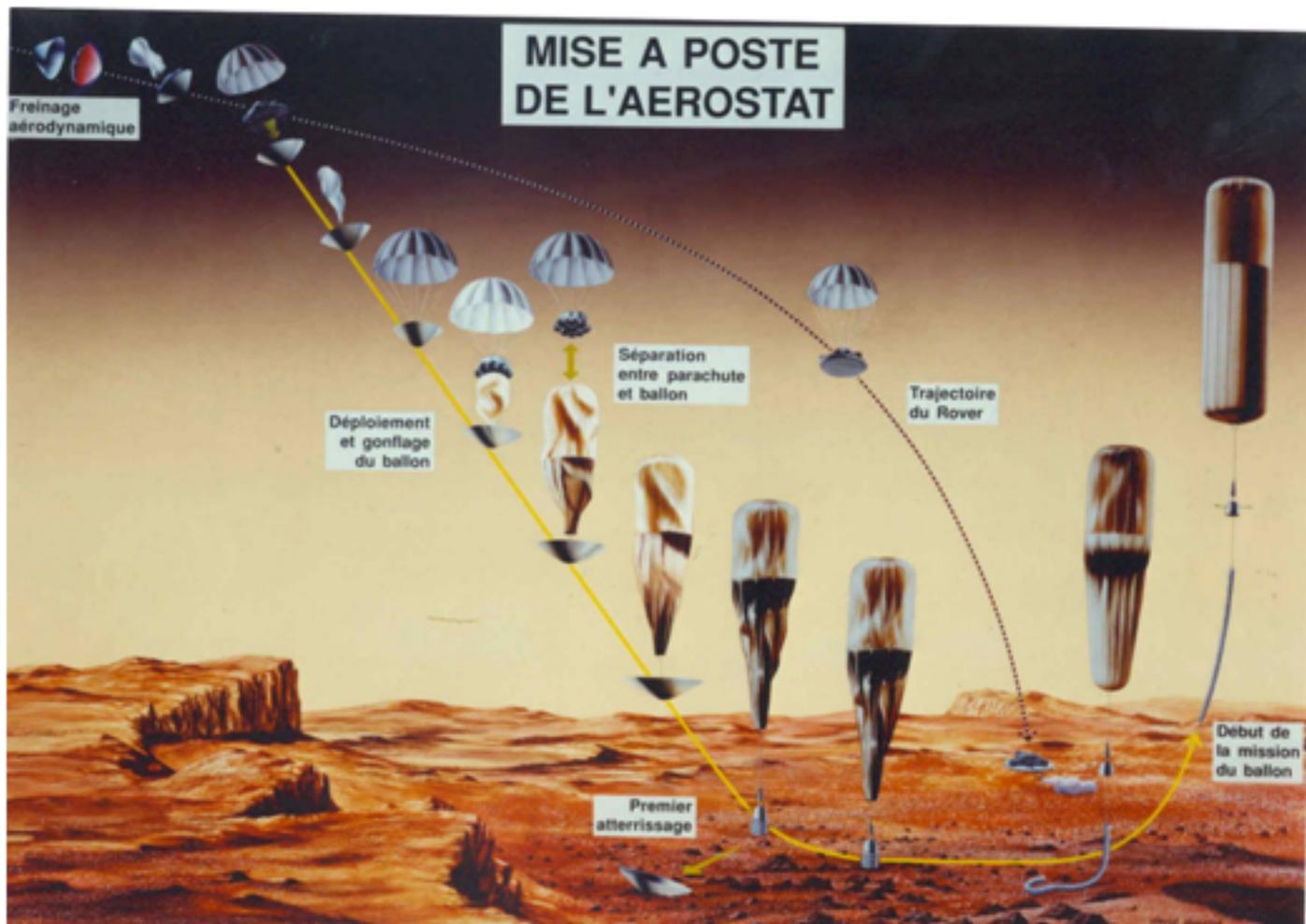
AMMA Driftsonde, West Africa Aug./Sept. 2006

- Phase 1, August:
- Reinforcement of the radio-sounding network in the AMMA Catch Zone

- Phase 2, September:
- Complement the radio-sounding observation in the cyclone genesis area, not accessible to other systems



Mars 94 – 96 Mission



Mars 94 – 96 Mission

- **Balloon concept defined for a Mars mission in cooperation with Russia**

- **Two flight levels :**
 - ◆ 2 to 4 km during day
 - ◆ Close to the ground during night

- **Scientific payload in the gondola and in the guide rope**

- **Mission cancelled in 1995**



Mars 94 – 96 Mission

