



# Stratéole-2 Status March 2015

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- FRENCH-US COLLABORATIONS IN OBSERVATION OF THE LOWERMOST STRATOSPHERE USING CNES ULTRA-LONG-DURATION BALLOON SYSTEM
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# French-US collaborations in observation of the lowermost stratosphere using CNES Ultra-Long-Duration Balloon System

## STRATEOLE-VORCORE 2005: Antarctica (McMurdo)

- Agreement CNES-IPEV / NSF-OPP for logistical support to CNES

## AMMA-Driftsonde 2006: West Africa / Atlantic Ocean

- Result of the start of the CNES-NCAR collaborative effort for the Driftsonde System
- First flights of the Driftsonde system

## T-PARC 2008 : Hawaii / West Pacific Ocean

- CNES-UCAR MOU with NSF agreement
- (actually small zero-pressure balloons)

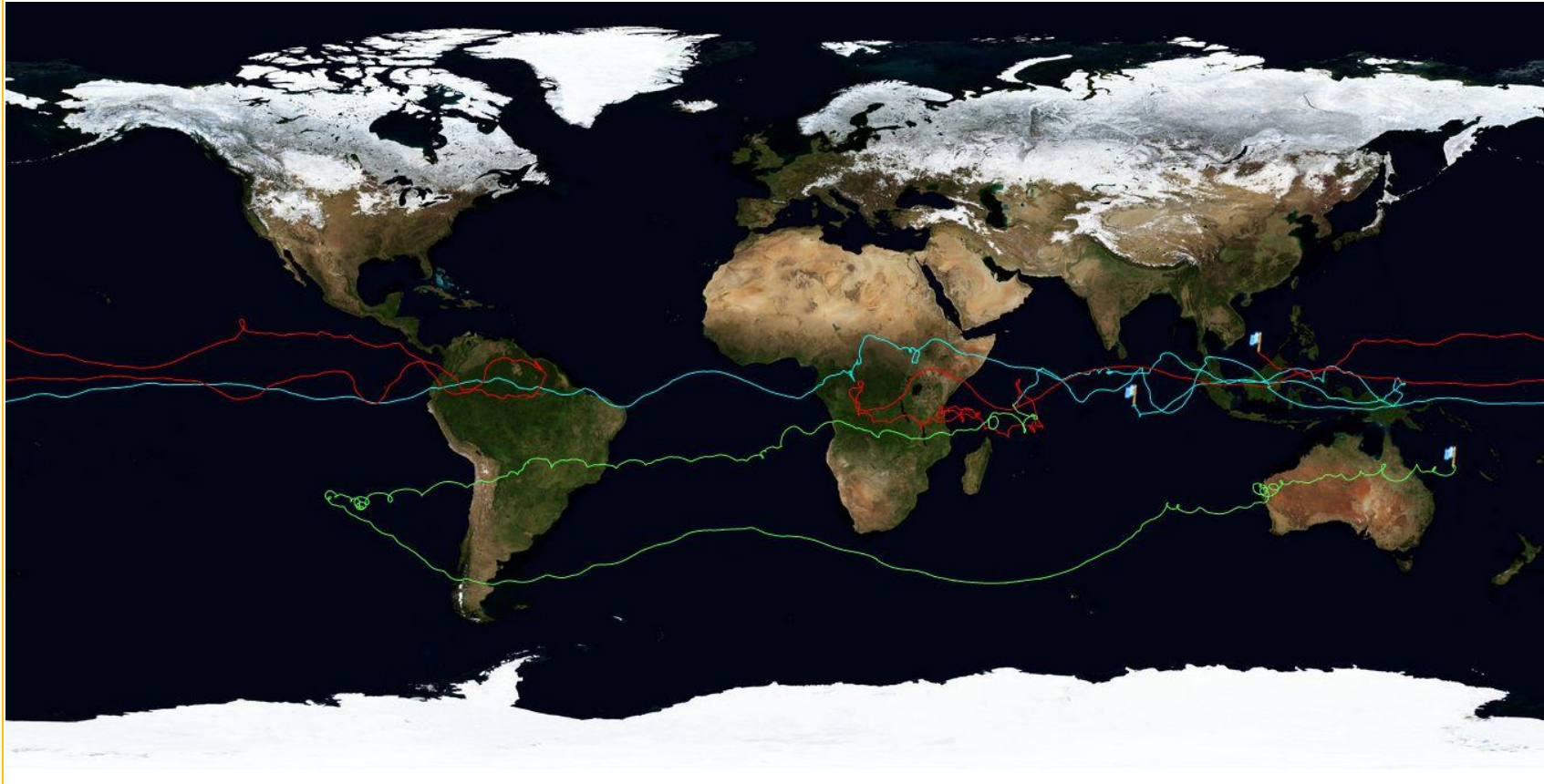
## CONCORDIASI 2010 : Antarctica (McMurdo)

- CNES-UCAR MOU
- NSF funding of US partners
- NSF-OPP logistical support to CNES

*Nota : payload carrying capability (mass allocated to the scientific instruments as such) has progressively increased from 2-3 kg (Vorcore) to currently 11-12 kg (Stratéole-2)*

# French-US collaborations in observation of the lowermost stratosphere using CNES Ultra-Long-Duration Balloon System

From Seychelles Islands, early 2010: Pre-Concordiasi



3 flights 3-month long

<http://tinyurl.com/strateole>

# Strateole-2 Program overview

## Two flight campaigns :

- 22 -24 flights each, 3-month long
- Scheduled about one year apart during Austral Summer
- Each campaign includes:
  - ~8 flights for In-situ measurements  
Air density flight level ~120/130 g/m<sup>3</sup>, (~70/75 hPa pressure flight level)
  - ~14-16 flights, for remote measurements or Dropsounding  
Air density flight level ~90/100 g/m<sup>3</sup>, (~50 hPa pressure flight level)

## Flight domain:

- Latitude range : [20° S, 15° N],

## Campaigns :

- Launch site TBD in the [5° S, 0°]
- During well established QBO wind regime in the flight altitude range (avoid QBO phase shift situations),

***A preliminary Mission Specification has been edited: STR2-SPM-0-5093-CN***

# Strateole-2 Organization Main Lines

## Flight control hardware and operations by **CNES**:

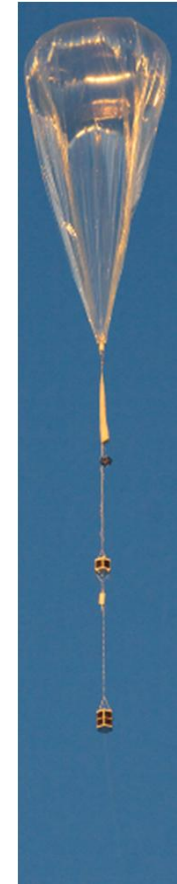
- Balloon, flight train and FCS gondola “Euros”
- Control Centers (Launch center and Toulouse Space Center)
- Operations (launch and conduct of the flights)

## Payload hardware and operations by **LMD and Partners** :

- Payload gondolas “Zephyr” (LMD, LATMOS, DT-INSU)
- Instruments on board Zephyr (Partners)
- Control Center (in Palaiseau)
- Operations (launch preparation and conduct of the mission)

## Driftsonde hardware and operations by **NCAR** :

- Gondolas “Driftsonde”
- Control Center (in Boulder)
- Operations (launch preparation and gondola monitoring)



## Status of the project in France

ST-2 initiated in 2008 in the frame of the “Balloon Program”, has since been repeatedly positively reviewed

- Funds have since been allocated for preliminary work by the Science Team
  - Development of scientific instruments, several ones already flight tested
  - Scientific program building upCumulating so far (end of 2014) at ~500 k€ for external expenses
- Work by CNES, for upgrading the FCS put on hold until:
  - Completion of Concordiasi flights analysis
  - Completion of a lengthy renewal of the flight systems for heavy payload short duration flights, finally completed mid 2014
  - However long term developments initiated (solar panel, Iridium modems, technical surveys for lighter solutions, ...)

2013, new funding rule: a dedicated funding is needed

- ST-2 must then compete for funding with other space programs
- ST-2 must follow the space programmatic process: first step is a **phase A** study.

# Phase A

- Decision for Stratéole-2 phase A has been withheld, subject to overall Space Science Plan review by the French Science Community (Séminaire de Programmation Scientifique, “SPS”) which took place **late March 2014**
  
- **SPS** outcome, April 2014, has been positive for Strateole-2
  - ◆ Authorization To Proceed with phase A in CNES and LMD was then further delayed, waiting for better visibility over the following years CNES funding capability.
  - ◆ ATP finally given early October 2014 with a **special request from program Directorate:**
    - » To define several mission scenarios,
    - » To perform cost estimates and scientific value analysis of these scenarios

## Development phase

- ◆ At completion of phase A (Dec. 2015), ST-2 revised proposal will be submitted internally at CNES, it will compete with other space programs to obtain final approval





# Phase A schedule, overall

	2014			2015												
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
<b>MAN VLD-BPS : Phase A-B</b>																
Définition de l'architecture, bilans techniques							Archi Prélim.		Archi finale							
Analyse préliminaire de risque et DSS phase 0																
Exigences générales conception / environnement																
Plan d'Assurance Produit																
Consultations et dépouillement													D. Consult.		Dépouil.	
DJD, P Dev.																
Organisation et Coûts																
<b>Revue</b>																
<b>STRATEOLE - 2 : phase A</b>																
<b>Conduite du projet</b>																
Sélection des instruments / composition charges utiles																
Synthèse performances mesures attendues																
Edition préliminaire du DCI TSEN-NSO																
Edition préliminaire des DCI instruments-NCU																
Mise à jour estimation du coût à achèvement																
Contribution pour le choix du site de lâcher																
<b>Développement Nacelle Charge Utile et CCM</b>																
Architectures mécanique et électrique																
Aménagement différentes configurations / faisabilité thermique																
Bilan masse-énergie																
Définition préliminaire boîtier central gestion-TMTC-Loc																
Règles conception électrique et protocoles de com																
Contribution définition préliminaire boîtier gestion énergie renouvelable																
Concept opérations CCM																
Définition fonctionnelle et stratégie sécurité informatique CCM																
Mise à jour plan de développement NCU et CCM																
<b>Instruments (France)</b>																
TSEN-Mk2																
Exploitation vol, adapt. pour VLD																
Appro et Essais complémentaires																
BBOP-Mk2																
Exploitation vol, adapt. pour VLD																
Perfo et endurance																
Appro pour protocols																
SAW/PHY																
Exploitation vol, adapt. pour VLD																
Perfo et endurance																
Appro pour protocols																
LOAC-VLD																
Validation pompe LD																
Validation instrument LD																
Adaptation gestion ST-2																
Appro pour protocols																
Pico-SDLA-VLD																
Définition version LD																
Réalisation protocole (compatible vol sous BSO)																
Validation sol																
<b>Instruments (foreign partners)</b>																
Proposal submission																
Prop. Review by NSF																
<b>Dossier de fin de phase A: PDD, Org, Coût à achèvement</b>																

# Stratéole-2 Overall Schedule

STRATEOLE - 2 version 6	2013				2014				2015				2016				2017				2018				2019				2020																																																
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N
<b>Development: design and ground validation</b>																																																																													
CIASI lessons learnt	[Yellow]																																																																												
Solar pannels techno improvement	[Yellow]																																																																												
<b>CNES Flight systems &amp; groud segment</b>																																																																													
Architecture/Preliminary Design	[Yellow]																																																																												
Detailed design																									[Yellow]																																																				
Manufacturing/Assembly																									[Yellow]																																																				
Ground validation																									[Yellow]																																																				
<b>Payload gondola (LLBB)</b>																																																																													
Architecture/Preliminary Design																									[Yellow]																																																				
Detailed design																									[Yellow]																																																				
Manufacturing/Assembly																									[Yellow]																																																				
Ground validation																									[Yellow]																																																				
<b>Instruments (France)</b>																																																																													
TSEN: flight test Timmins 2013 2014	[Fl. T]	[Final design]	[Fl. T]	[Complimentary tets]												[Man QM]																																																													
BBOP: flight test Timmins 2014	[Upgrade]	[G.Test]	[Fl. T]	[analyse et adapt. VLD]	[Perfo and life test]	[Man QM]																																																																							
SAWPHY flight test Timmins 2014	[Proto]	[G test (Antarct.)]	[Fl. T]	[analyse et adapt. VLD]	[Perfo and life test]	[Man QM]																																																																							
Pico-SDLA optimisation basse strato flight test Timmins 2014	[Pre-Def.]	[Fl. T]	[analyse et adapt. VLD]	[Perfo and life test]	[Man QM]																																																																								
LOAC durcissement durée de vie, flight test Timmins 2014	[Upgrade]	[Grd test]	[Fl. T]	[analyse et adapt. VLD]	[Perfo and life test]	[Man QM]																																																																							
<b>Instruments (foreign partners)</b>																																																																													
<b>Development: in-flight validation</b>																																																																													
Flight trains and NSO procurement and ass. X 6																									[Yellow]																																																				
Payload gondolas procurements: LLBB x3 (+ spare items)																									[Yellow]																																																				
LLBB + instruments Assembly and Test:																																																																													
TTL-1: MQV 1 + spare unit																									[Yellow]																																																				
TTL-2: MQV 1 + spare unit																									[Yellow]																																																				
STRAT-1: MQV 1 + spare unit																									[Yellow]																																																				
STRAT-2 Driftsonde gondolas x 2																									[Yellow]																																																				
<b>Validation flights (one of each configuration)</b>																																																																													
<b>Flight Mod. Procurement, assembly and test</b>																																																																													
TTL-1: MV 1, 2, 3 & 4																									[Yellow]																																																				
TTL-2: MV 1, 2, 3 & 4																									[Yellow]																																																				
STRAT-1: MV 1, 2, 3 & 4																									[Yellow]																																																				
STRAT-2: MV 1 to 10 or 12 (Driftsondes)																									[Yellow]																																																				
TTL-1: MV 5,6, 7 & 8																									[Yellow]																																																				
TTL-2: MV 5,6, 7 & 9																									[Yellow]																																																				
STRAT-1: MV 5,6, 7 & 9																									[Yellow]																																																				
STRAT-2: MV 13 to 23 or 24 (Driftsondes)																									[Yellow]																																																				
<b>Scientific campaigns</b>																																																																													

# After Phase A

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## Phase A outcome

- Technical feasibility,
- Consolidation of the schedule to completion, associated development plan,
- Consolidation of the mission (with options),
- Consolidation of the cooperation USA, Italy, ...
- Cost to completion (with options)

## Phase A file to be completed in December 2015

- Proposal to proceed to the realization of ST-2 up to completion
- Decision expected early 2016