



Funded by the Horizon 2020 Framework  
Programme of the European Union

# HEMERA

An opportunity for science using  
stratospheric balloons

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**on behalf of the HEMERA team at**

**CNES, Rymdstyrelsen, ASI, DLR, CSA, SSC, ASC, Airstar, CNRS, KIT,  
Cranfield University, INAF, Heidelberg University**



# What is HEMERA?

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- **European Infrastructure for scientific ballooning**
  - Funded by the Horizon 2020 framework program of the European Union
- Partners are space agencies and space access providers, scientific bodies (research centers and universities) and industry
- HEMERA has three major elements:
  - Provision of Trans-National Access to balloon flights
  - Networking
    - to strengthen and enlarge the user community
  - Joint Research
    - to improve ballooning technology and scientific instrumentation



# HEMERA Partners

Participant number	Organisation name	Organisation short name	Country
1	Centre National d'Etudes Spatiales (coordinator)	CNES	France
2	Swedish National Space Board	SNSB	Sweden
3	Agenzia Spaziale Italiana	ASI	Italy
4	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DLR	Germany
5	Canadian Space Agency	CSA	Canada
6	Swedish Space Corporation	SSC	Sweden
7	Andoya Space Center	ASC	Norway
8	AIRSTAR Aerospace	AA	France
9	Centre National de la Recherche Scientifique	CNRS	France
10	Karlsruhe Institut für Technologie	KIT	Germany
11	Cranfield University	CU	United Kingdom
12	Istituto Nazionale di Astrofisica	INAF	Italy
13	Heidelberg University	UHEI	Germany



# Objectives of HEMERA

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HEMERA will coordinate European activities in the field of ballooning in order to:

1. Provide better and coordinated balloon access to the troposphere and stratosphere for scientific and technological research
2. Attract new users to enlarge the community accessing the balloon infrastructure and foster scientific and technical collaboration
3. Enlarge the fields of science and technology research conducted with balloons
4. Improve the balloon service offered to scientific and technical users through innovative developments
5. Favour standardization, synergy, complementarities and industrialization through joint developments with greater cost-effectiveness.



# What can HEMERA offer to you?

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## Balloon flights:

- a possibility to fly small to medium payloads at no cost
- on CNES or SSC gondolas under Zero Pressure Balloons (ZPB) and sounding balloons (SB)
- **The cost for the development and construction of the payload is not included !**

## Virtual Access:

- the data acquired during those flights will be collected and made publicly accessible on a dedicated web portal



# What can you achieve with a stratospheric balloon payload?

➤ Win the Nobel prize!



## Paul Crutzen, Nobel speech, 1995

John Houghton, hearing of my idea on the potential role of  $\text{NO}_x$ , handed me a solar spectrum, taken on board a balloon by Dr. David Murcay and coworkers of the University of Denver, and indicated to me that it might reveal the presence of  $\text{HNO}_3$ (10). After some analysis I could derive the approx-

above 18.8 km. With this information I knew that  $\text{NO}_x$  should also be present in the stratosphere as a result of the reactions,



This gave me enough confidence to submit my paper (12) on catalytic ozone destruction by  $\text{NO}$  and  $\text{NO}_2$ , based on the simple catalytic set of reactions:



Crutzen, Science, 1970

## Discovery of $\text{HNO}_3$ in the stratosphere

D. Murcay et al. 1967

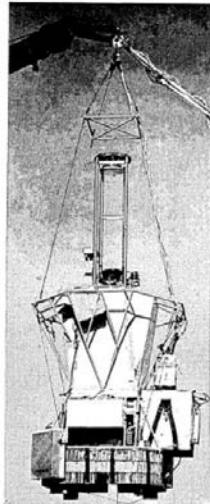
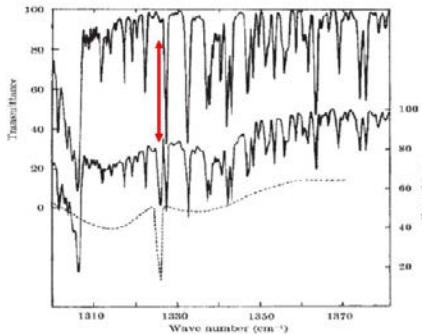


Fig. 2. Photograph of the balloon payload in flight configuration.



# What can you achieve with a stratospheric balloon payload?

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- useful in all science fields where a **stratospheric** vantage point is needed
- Contribute to Earth observation
  - e.g. to atmospheric science in the fields of
    - stratospheric chemistry and dynamics
    - Upper Troposphere and Lower Stratosphere (UTLS) chemistry and dynamics
    - lower atmosphere & remote boundary layer
- Contribute to astronomy and astrophysics in the fields of e.g.
  - solar physics and cosmic ray physics
  - infrared and microwave (CMB) measurements
  - gamma ray astronomy
  - ....



# Technical boundary conditions



- 6 flights with ZPBs for up to 150 kg payload
  - 3 flights will be performed by SSC from Esrange near Kiruna, Sweden
  - 3 flights will be performed by CNES ( 1 x Esrange, 1 x Timmins, Canada, 1 x TBD)
- 20 flights with SBs for up to 3 kg payload
  - performed by CNES from Aire sur l'Adour, France
- Gondolas will be provided by CNES/SSC
  - several instruments will fly on one gondola
  - light instruments are preferred to allow more users to fly
  - all instruments/gondolas will be recovered
- Flight levels from 38 km down to 15 km can be reached
  - depends on total mass of payload and gondola



# HEMERA Launch Sites



Esrange (ZPB)

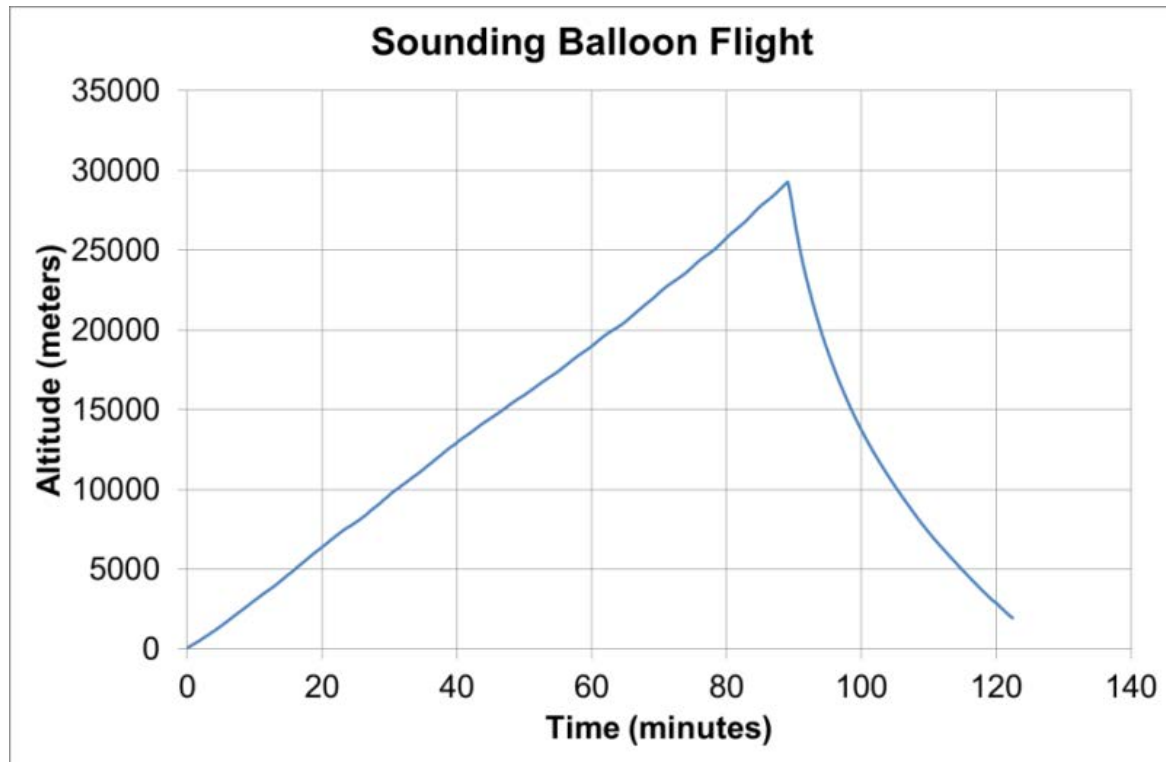
Timmins (ZBP)

Aire sur l'Adour (SB)

OpenStreetMap



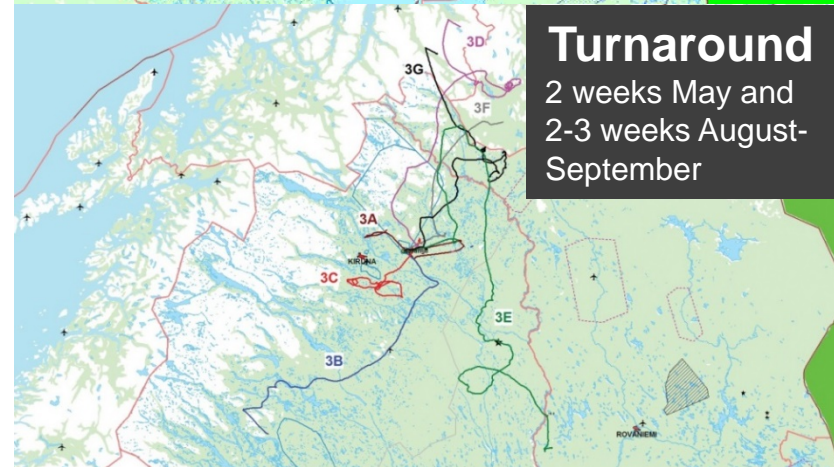
# SB flight characteristics





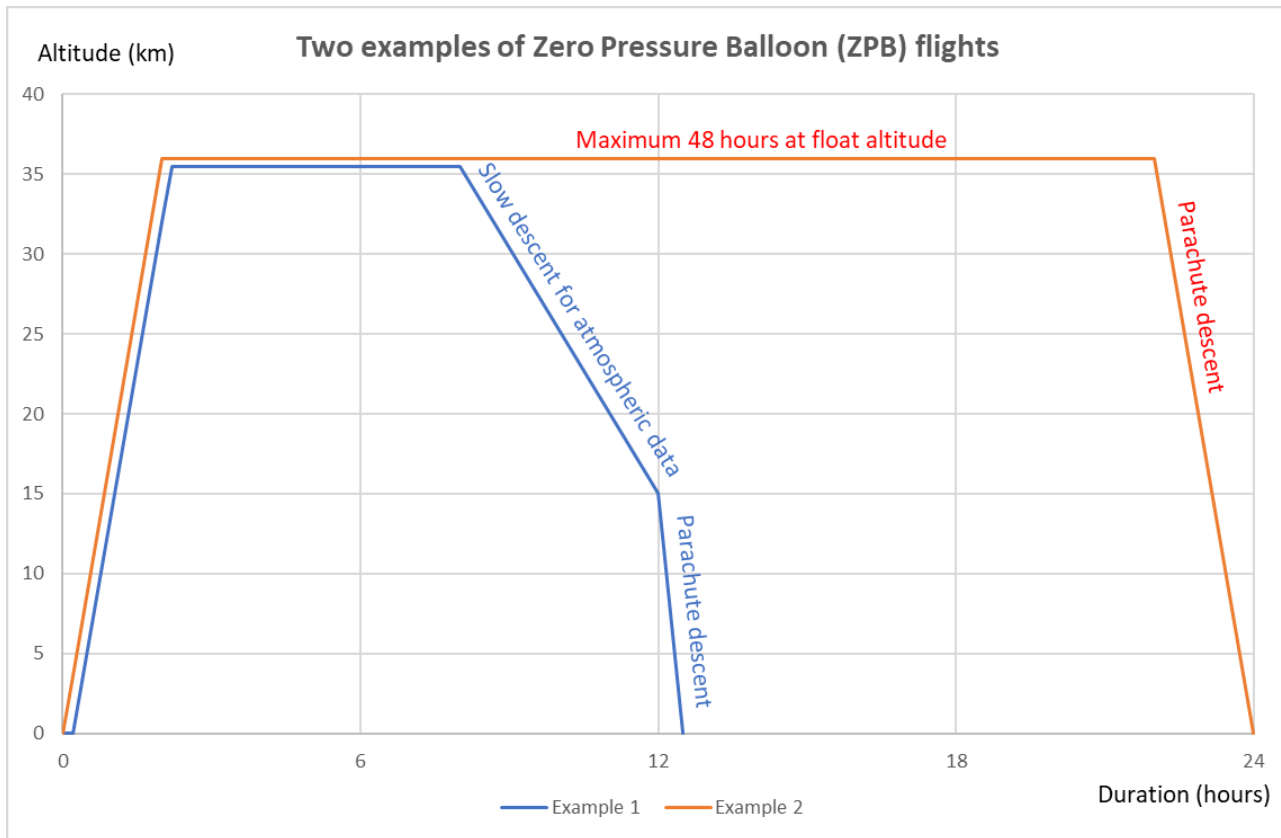
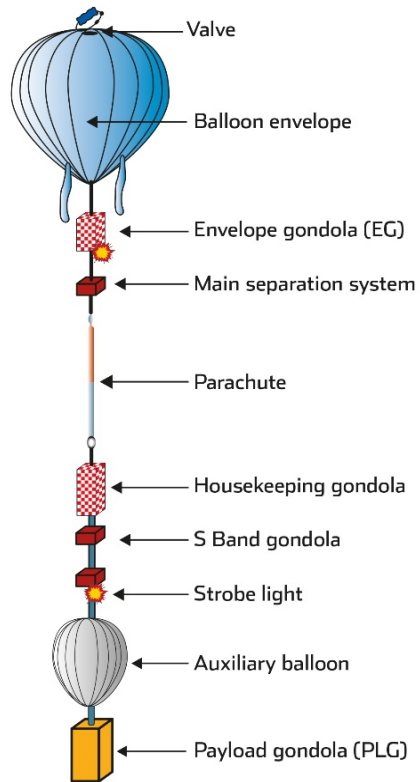
# Technical boundary conditions for ZPB - 1

- Flight season
  - CNES: (late) summer
  - SSC: all year
- Flight profiles
  - ascent: typically 4-5 m/s
  - constant ceiling for several hours
    - up to 48 h in special meteorological situations (turnaround)
  - fast or slow descent (1-5 m/s) feasible
  - touch-down velocity: 5-7 m/s





# ZPB flight train and flight characteristics



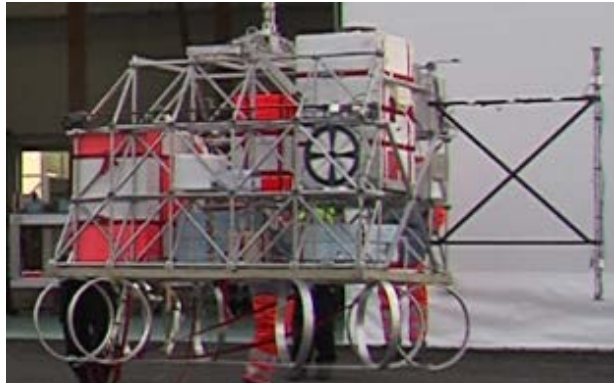


## Technical boundary conditions for ZPB - 2

Interface	CNES	SSC
Telemetry / Telecommand	TM: up to 1.5 Mbit/s TC: up to 70 kbit/s Ethernet (TCP/UDP) 4 asynchronous links 12 ON/OFF switches	Up to 2 Mbit/s duplex total Ethernet (TCP/UDP) 3 asynchronous links
Power / Batteries	Li-Ion: 28 V, max. 1 kW	Needs to be included in instrument
Pointing	Attitude sensors (INS & stellar) Azimuth and elevation	Not available
Additional services	Actuator control, thermal monitoring, GPS & time sync.	On/Off of instrument GPS, accelerometer

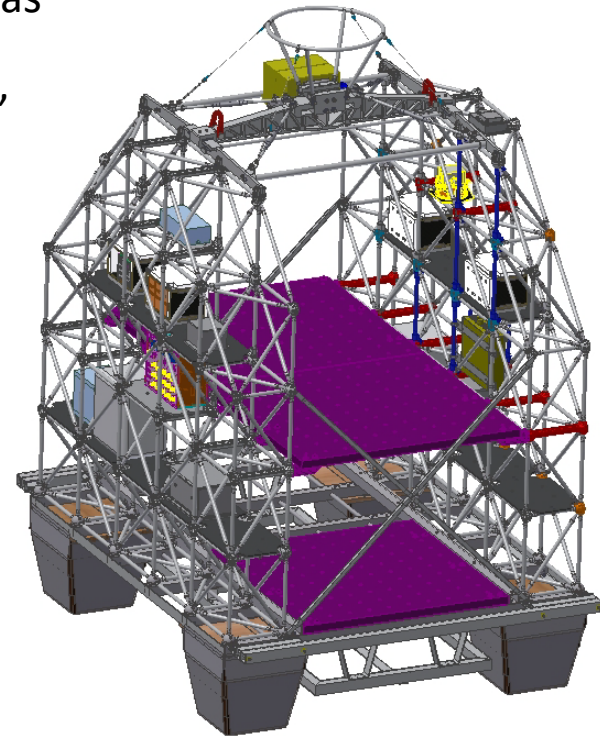
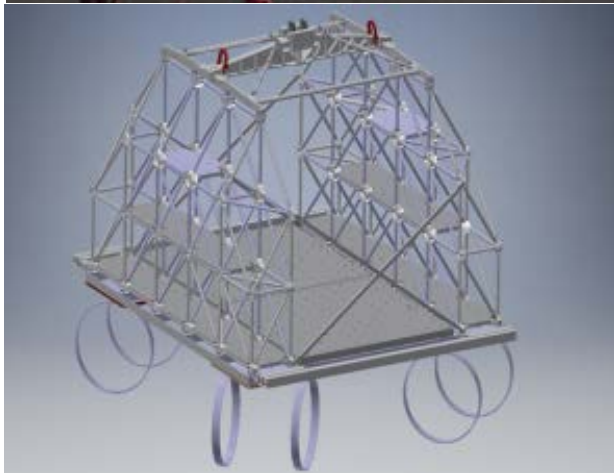


# Technical boundary conditions for ZPB - 3



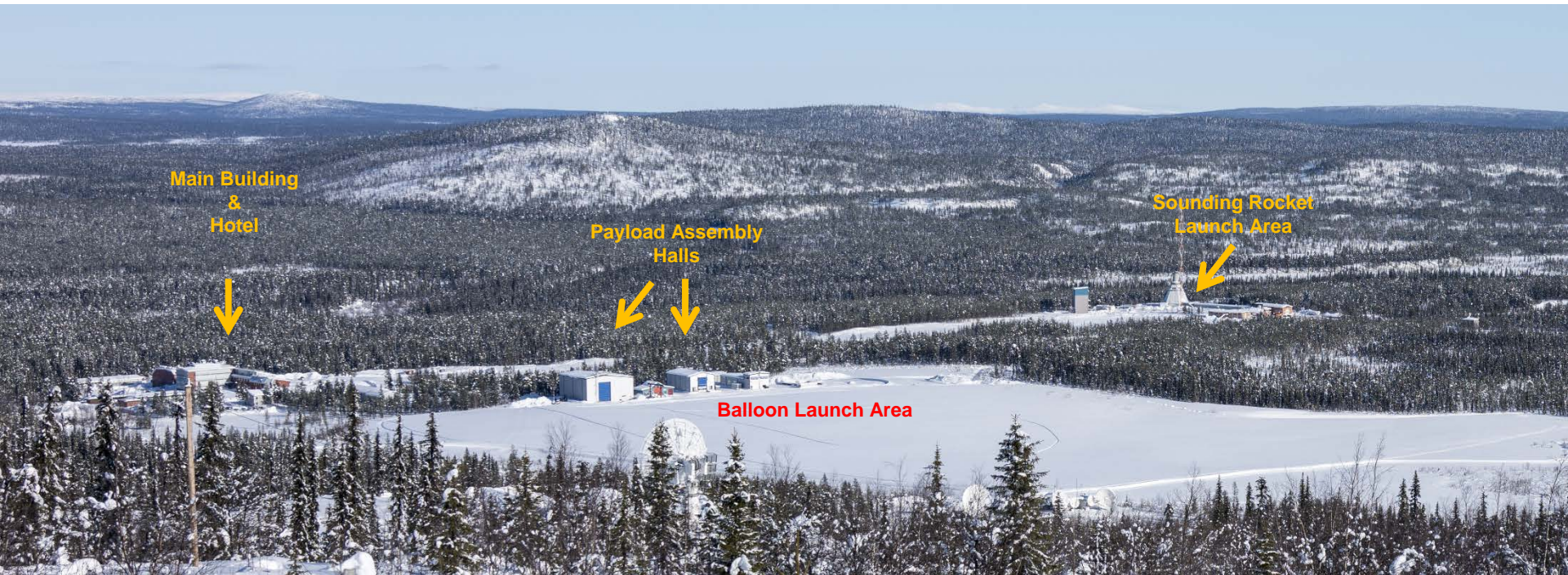
CNES gondolas

“flying racks”





# Esrange Launch Site





# Esrange "Cathedral": Payload Assembly Hall



one out of two payload assembly halls



# Timmins, Ontario, Canada





# Aire-sur-l'Adour, France

only for SB



© Anne Laure Haet CNES 1997



## Aire-sur-l'Adour :

- Operational base for SB
- Facilities available for scientists
- Flights are performed all the year
- Compliant with safety rules
- Flight monitoring
- Recovery for all the experiments
- Actually, 2 scientific flights per month





# HEMERA Timeline 1

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- February 2018: Call for Ideas – **Open!**
- July 2018: 1. Call for Proposals
- October 2018: Submission of Proposals
- January 2019: Selection of Payloads
- From January 2019: First flight possibility with SSC from Esrange
- in August/Sept. 2019: First flight possibility with CNES from Timmins



## HEMERA Timeline 2

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- December 2019: 2. Call for Proposals
- From Jan. 2020: Second flight possibility with SSC  
(Flight will be launched from Esrange)
- February 2020: Submission of Proposals
- May 2020: Selection of Payloads
- August 2020: Second flight possibility with CNES  
(Flight will be launched from Esrange or Timmins)
- From Jan. 2021: Third flight possibility with SSC  
(Flight will be launched from Esrange)
- Summer 2021: Third flight possibility with CNES  
(Flight either launched from Esrange or from tropical base)



# Why do we issue a Call for Ideas (Cfi)?

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- Market research - test scientific response to
  - assess users and needs
  - allow information exchange and clarifications
  - tailor Call for Proposals (CfP)
  - choose the appropriate reviewers
- Response to Cfi
  - is not mandatory for submission of a proposal, but it will help you and us!
  - does not generate any obligation to submit a proposal



## Information requested from User in Cfl:

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- Details on PI, Institute, country etc.
- Brief description of the
  - experiment and
  - science / technology question addressed
- Status of the experiment
  - existing, under development, to be developed
  - timeline: when are you ready for a flight?
- Availability of funding for the experiment
- Flight requirements
- a template can be found under: [hemera-h2020.eu](http://hemera-h2020.eu)

**Please submit this information until April 27 to: [hemera@snsb.se](mailto:hemera@snsb.se)**



## Call for Proposal (CfP)

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- First Call will be issued in July 2018
- Will be complemented by comprehensive information package
- Proposal shall allow review panel to judge
  - Scientific quality
  - Feasibility and maturity
  - Novelty
    - science, scientific field, user community
  - requested until Mid October 2018



# Common Data Base

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- Free virtual access to the data collected during balloon flight campaigns will be available for all researchers. The main objective is to make all the scientific and technological data collected during the flights accessible to the whole European scientific community, upon request to the data centre.
- The data center will be hosted by AERIS/CNRS: <http://www.aeris-data.fr>
- Registration and acceptance of a data use agreement will be requested



# Innovation for Balloon Infrastructure

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## ➤ Aims:

- Provision of a comprehensive user manual for the European infrastructure
- Improvement of service
- Reduction of cost by use of synergies and standardization

## ➤ Activities:

- Development of a light weight flight train
- Development of a telemetry system for the users based on satellite communication
- Development of larger balloon envelopes
- Simplification of launch methodologies



## Innovation on sensors and algorithms for balloon-borne research

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- Definition of a Set of Lightweight Innovative Instruments (SLII) to provide key atmospheric data for users of the Trans National Access
  - SLII shall provide essential climate variables  
*P, T, wind, O<sub>3</sub>, H<sub>2</sub>O, CH<sub>4</sub>, CO<sub>2</sub>, Aerosols and altitude, Gamma-ray atmospheric background*
  - Instruments will be calibrated/validated in atmospheric chambers so they can serve as reference instruments
- Visualization and interpretation software will be provided
  - for SLII instruments
  - for atmospheric data generated by balloons in general
- Define at European level synergy options and common tools for the infrared hyperspectral imaging technique
  - preparatory work for future balloon and satellite missions



# New Launch Sites

- Analysis of feasibility to offer flights in the following regions
  - Tropics: Brazil, Seychelles, Africa
  - Mid-Latitudes: Italy
  - Arctic: Svalbard, Canada
- Criteria will be
  - Meteorological conditions
  - Accessibility and available infrastructure
  - Safety and flight limitations/constraints
  - Cost





# Outreach Events

- Summerschool in **Heidelberg**, Sept. 9 to 13, 2019
  - for Students, Scientists and Engineers
  - Themes:
    - Fundamental aspects of relevant atmospheric physics & meteorology
    - Balloon-related technology and safety
    - Scientific and industrial applications
      - astronomy, meteorology, air chemistry and physics
      - material design and space qualification of instrumentation
  
- HEMERA Workshop in Autumn 2020 in **Rome**





## Conclusion

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- HEMERA is a new European Infrastructure for scientific ballooning
- It offers stratospheric flights for small to medium payloads at no cost
- Call for Ideas is Open: Please respond if you're interested!
- Call for Proposal will be issued in July 2018
- First flight opportunities in 2019



# Questions?



Image: ASI



Image: SSC



Image: CNES



## Further information

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- Information booth for HEMERA and EUROPLANET infrastructures:  
**X2D05** (Hall X2, level -2)  
close to NASA, ESA, Google
- HEMERA web page:  
**[hemera-h2020.eu](http://hemera-h2020.eu)**