Call for Ideas for Balloon Experiments within the HEMERA project

HEMERA is a balloon infrastructure project, funded by the European Commission within its programme Horizon 2020. The project is coordinated by the French space agency CNES and involves 13 partners from several European countries and Canada.

The **HEMERA** project will offer free of charge balloon flights to the user community. Six zero pressure balloon flight campaigns and several smaller sounding balloon flights are foreseen from mid-2019 to late 2021. The flights of the larger zero pressure balloons, each carrying around 150 kg of payload, are planned from Esrange (northern Sweden) and Timmins (Ontario, Canada). The French base in Aire sur l'Adour will be used for launches of the smaller sounding balloons with 3 kg payload. Launches will be operated by the Swedish company SSC and the French space agency CNES in collaboration with the Canadian Space Agency CSA. The HEMERA project will also cover travel and accommodation costs during the balloon campaigns for up to three team members from the selected teams.

The experiments to be flown on HEMERA balloons must be funded by the users, e.g. institutes or universities, national or other means, outside the HEMERA budget.

Users interested in using the HEMERA balloon infrastructure are now invited to submit their experiment ideas within this **Call for Ideas**. The inputs received will be used to assess user needs and to define the following Call for Proposals that is planned to be issued in July 2018, for experiment selection.

The HEMERA **Call for Ideas** is open to all scientists and users from the European Union member states, countries associated to Horizon 2020 and Canada. The deadline of the submission is April 27, 2018, 17.00 Central European Time. The responses should be submitted to hemera@snsb.se as a pdf file by e-mail using the **template for the Call for Ideas.** The proposers should be affiliated at a university/institute or company in the EU, associated country to Horizon 2020 or Canada.

Please note, that this **Call for Ideas** will not lead to a selection of experiments; its purpose is to define subsequent Calls for Proposals. The first Call for Proposals is planned in July 2018 with a deadline in mid-October 2018 and experiment selection in January 2019. Participation in the Call for Ideas is not mandatory for later participation in Calls for Proposals, but it should be seen as a good opportunity to provide input which will allow better definition of the scope and content of the HEMERA project and upcoming Calls for Proposals.

For further details about balloon flights foreseen in the HEMERA project, please read the subsequent chapters and Annex 1 describing typical HEMERA flights and balloon characteristics. Final choice of balloons, time frame and sites for the campaigns etc. will be done based on the outcome of the HEMERA calls, within the available budget of the project.

Your response to this **Call for Ideas** is much welcomed and will help the HEMERA consortium to define the upcoming Call for Proposals and subsequent balloon campaigns. Do not hesitate to submit your idea even if it is outside the scope of the “typical balloons” described below. All responses will be carefully analyzed by the HEMERA project team and used as an important input for definition of the Calls for Proposals and planning of future activities.

Typical Zero Pressure Balloons from Esrange (Sweden) and Timmins (Canada)

Zero pressure balloon (ZPB) is a common balloon type, usually filled with helium gas and geometry of an inverted droplet of water. The balloon has an opening at the very bottom to exhaust excess gas which takes place at the ceiling altitude when the gas expands and the balloon is completely filled. At this point, the ascent stops, and the balloon will fly at a constant altitude. At sunset, the balloon will begin to naturally descend, due to the gas cooling and shrinking. The altitude of the balloon can be controlled by opening of a valve to exhaust gas (descent) and by dropping ballast (maintain altitude or ascent). The balloons considered for the HEMERA project will allow performing scientific measurements during a float at constant altitude for up to 48 hours and to have a slow descent until 15 km to allow atmospheric sounding.

The HEMERA zero pressure balloons will be able to carry several experiments with a total mass of around 150 kg to the altitude of ca 35 km. One of the HEMERA objectives is to address a wider user community, therefore the ambition is to fly up to five experiments in one gondola to allow more teams to participate. The envisaged mass of a single experiment is up to 30 kg but larger experiments will also be considered on a case by case basis (e.g. if some experiments are small, others can be bigger, larger mass can also be flown at lower flight altitudes). An on-board communication service is offered for instrument telemetry and remote-control. The gondolas with the experiments descent with a parachute and are then recovered.

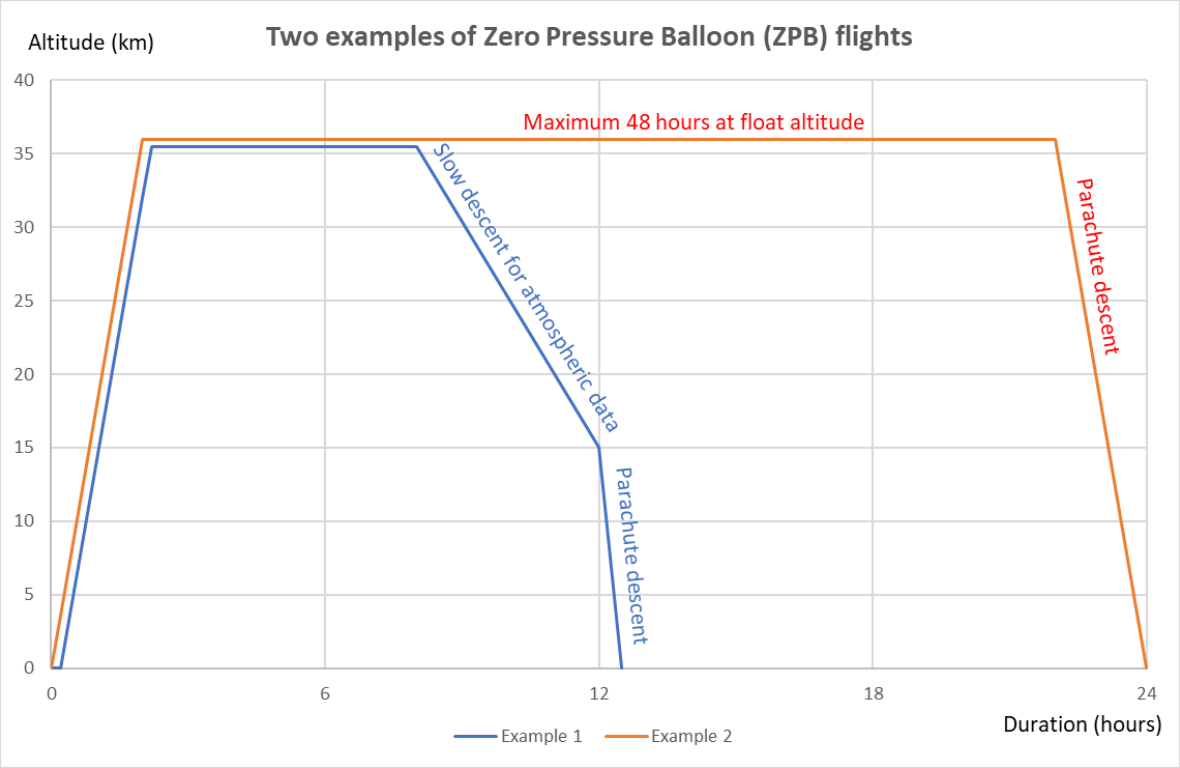

Fig. 1. Examples of zero pressure balloon (ZPB) flight altitude and duration.

Sounding Balloons from Aire sur l'Adour (France)

Sounding balloons (SB) are small expandable balloons, usually made of latex. The volume of these balloons expands during its ascent until the pressure is too high and the balloon bursts which also means termination of the flight. The ascent speed, of around 5 m/s, allows to reach altitudes of 30-35 km in 1.5 to 1.75 hours. After the balloon disintegration, the payload descents with a parachute, with a speed of 6 m/s. The experiments are recovered and can be reused. The mass of the scientific payload is up to 3 kg. During the balloon flight and the parachute descent, wind and atmospheric pressure, temperature and humidity are recorded and transmitted in real time via a weather radiosonde. Experimental data must be recorded on-board, to be collected after the payload recovery. Typical characteristics of a flight is given in the Annex 1 below.

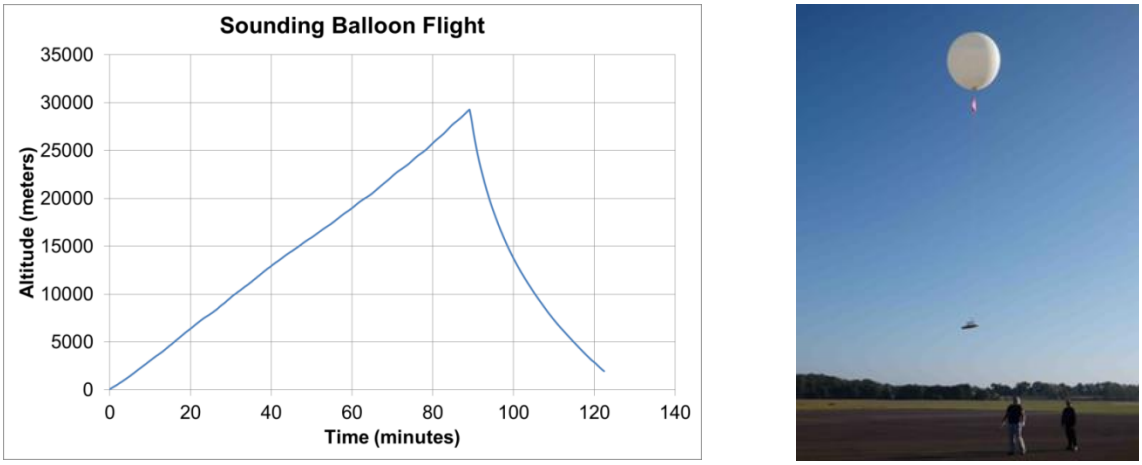

Fig. 2. Typical flight altitude and duration of a sounding balloon.

Potential future HEMERA Balloons

These types of balloons may be considered for later phases of the HEMERA project depending on the user needs, technical and budgetary constraints. Users interested in these balloons are welcome to submit their ideas in response of this call for Ideas. The input received will be used for future planning purposes and definition of possible next phase of HEMERA.

Boundary Layer Balloons

Boundary Layer Balloon (BLB) is a super pressure spherical balloon with a diameter of 2.5 meters for studies of the low terrestrial boundary layer over the ocean. The flight altitude can vary, depending on the meteorological conditions encountered from a few hundred meters to a maximum altitude of 3 km. Within standard BLB setup, the scientific data (e.g. wind and atmospheric pressure, temperature and humidity) are transmitted via the satellite Iridium telecommunication system. The instrument mass is usually up to 1 kg. The maximum flight duration is 30 days, but the flight can also be terminated earlier. Usually, there is no recovery of the balloon and instrument. The launch site of BLB has still to be defined.

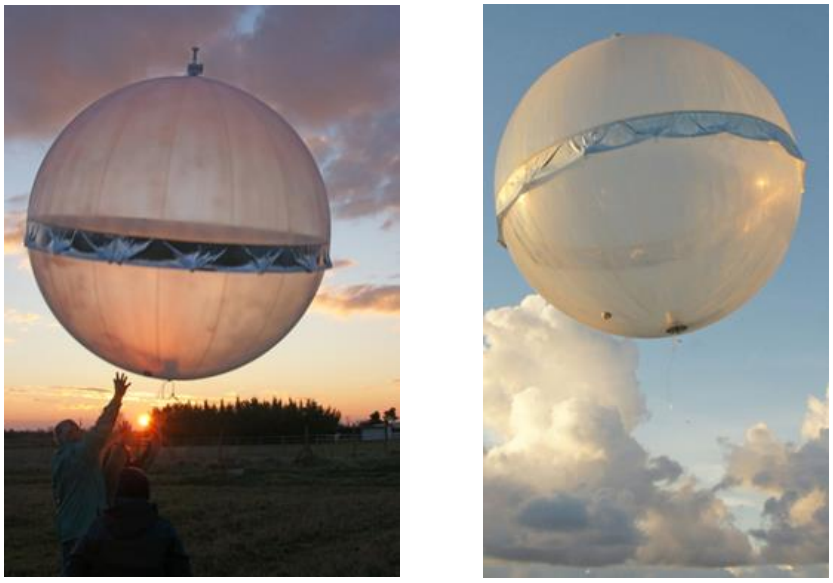

Fig. 3. Boundary layer balloons at launch.

Super Pressure Balloons

A Super Pressure Balloon (SPB) is a spherical pressurized spherical balloon with a diameter 8.5-13 m. The typical flight altitude is 18-20 km, depending on balloon size and total mass. A mass of the gondola is typically 20 kg, which includes the instruments and on-board services systems. The gondola is usually provided by the user/science team. The maximum flight duration is 90 days, but the flight could be stopped before flying outside the authorized latitude band. Usually, there is no recovery of the balloon and payload. These balloons are not considered within this phase of HEMERA.

Fig. 4. Super pressure balloons.

Contacts persons for the Call for Ideas

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Annex 1

Typical characteristics of **Zero Pressure Balloons** and **Sounding Balloons** foreseen in the HEMERA project

Parameter	**Zero Pressure Balloons**	**Sounding Balloons**
Launch site	Timmins, Canada and Esrange, Sweden	Aire sur l'Adour, France
Launch seasons	June-August from Timmins All seasons from Esrange	All seasons
HEMERA flights	6 flights during 2019-2021	Several flights, depending on user needs (max 20 flights)
Balloon volume	150 000 m^3	up to 5 m^3
Total experiment mass in one gondola	Up to 150 kg	Up to 3 kg
Flight altitudes at float	15-38 km	35-38 km
Flight duration (excluding ascent and decent)	3 to 48 hours depending on launch site and season	3 hours
Ascent speed	5 m/s	5 m/s
Descent speed	1-5 m/s	Under parachute only, 5 m/s
Speed at landing	5-7 m/s (landing with parachute, with shock absorbents on the gondola)	Around 5 m/s (landing with parachute)
Indicative mass of a single experiment	Up to 30 kg, including power source (larger experiments can also be considered on a case-by case basis)	Up to 3 kg, including power source
Indicative volume of each experiment	Depends on the choice of gondola and size of other experiments. Largest currently available gondola is 2.45 x 1.85 x 2.20 meters. Please consider that one gondola will carry up to 5 experiments and supporting equipment.	Indicative max dimensions should be calculated based on the area density, i.e. mass of the payload vs. smallest area of the payload. The area density should not exceed 13 g/cm^2.
Experiment data storage	On board storage, and/or transmission by means of communication link	On board only
Speed of the communication link	Up- and downlink up to 2Mbit/s	N/A
Power source for the experiment	Can be provided by the operator or user; the mass of the power source is usually 10-20 % of the experiment	Provided by users
Other services	GPS location, azimuth control, real time flight trajectory, on board cameras.	GPS, pressure, temperature and humidity.