Mem. S.A.It. Vol. 90, 132

Memorie della

HEMERA: new science opportunities using tropospheric and stratospheric balloons

G. Mantovani on behalf of the HEMERA team⋆

Istituto Nazionale di Astrofisica – Istituto di Astrofisica e Planetologia Spaziali, Via del Fosso del Cavaliere 100, 00133 Roma, Italy, e-mail: giulia.mantovani@inaf.it

Abstract. HEMERA is a new research infrastructure funded by the Horizon 2020 framework Programme of the European Union under the grant N° 730970. It will make existing balloon facilities of Centre National d'Etudes Spatiales (CNES) and Swedish Space Corporation (SSC) available to all scientific teams in the European Union and associated states. This work gives an overview of the project and the available opportunities for cost free tropospheric and stratospheric balloon flights that HEMERA can offer you.

Key words. Infrastructure, balloon Science, stratospheric balloon, tropospheric balloon, aeronomy, astrophysics

1. Introduction

HEMERA is a new Research Infrastructure funded by the Horizon 2020 Research and Innovation Programme of the European Union (grant number 730970). It integrates a large starting community in the field of tropospheric and stratospheric balloon-borne research, to make existing balloon facilities available to all scientific teams in the European Union, Canada and associated countries. The complementary of the HEMERA members capabilities in the field of balloon systems and operations will offer an easy and enhanced service to the scientific community. A wide range of scientific and technical themes are addressed (Masi S. et al., 2008), such as astronomy, atmospheric physics and chemistry, climate research, fundamental physics, biology, space research and technology.

This programme aims at provide a transnational access to balloon flights for all the users; enlarge and strengthen the network of the community working in balloon science; join the research to improve balloon technology and scientific instrumentation. Finally, HEMERA aims at develop strong synergies with the European Union programme COPERNICUS, be complementary to the European Space Agency programmes and establish links with other European Commission (EC) infrastructures (e.g. ACTRIS, IAGOS). To do so, HEMERA provides the possibility to fly small to medium payloads at no cost on Centre National d'Etudes Spatiales (CNES)

⋆ Istituto Nazionale di Astrofisica (INAF), Centre National d'Etudes Spatiales (CNES), Swedish National Space Board (SNSB), Agenzia Spaziale Italiana (ASI), Deutsches Zentrum fur Luft- und Raumfahrt e.V. (DLR), Canadian Space Agency (CSA), Swedish Space Corporation (SSC), Andoya Space Center (ASC), Airstar, Centre National de la Recherche Scientifique (CNRS), Karlsruhe Institut fur Technologie (KIT), Heidelberg University in Germany (UHEI), Cranfield University (CU).

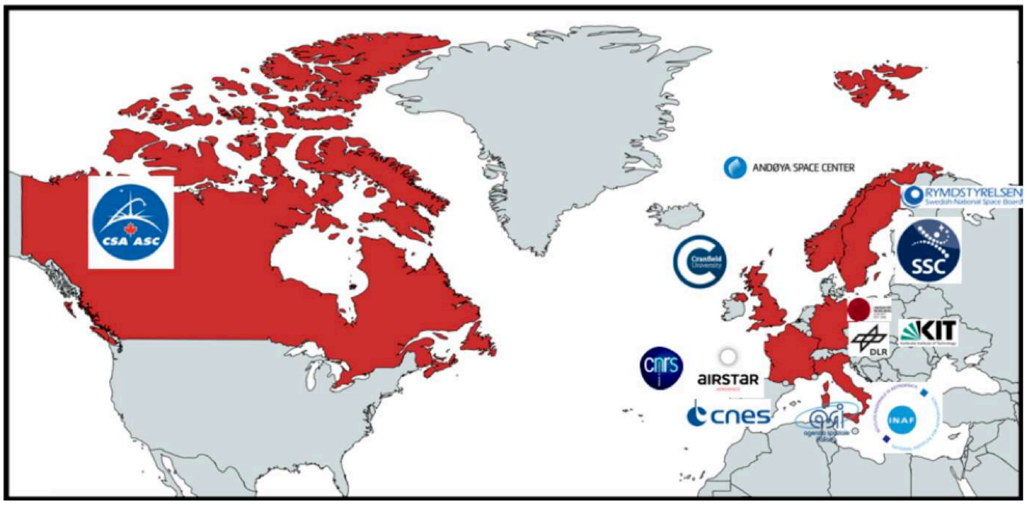

Fig. 1. Locations of the HEMERA partners, encompassing space agencies, companies providing the facilities and balloons and scientific bodies, such as research centres and universities.

or Swedish Space Corporation (SSC) gondolas under Zero Pressure Balloons (ZPB) and Sounding Balloons (SB) (see Section 3). The cost for the development and construction of the payloads is not included. Moreover, it will provide a virtual access to the data: those data acquired during those flights will be collected and mad publicly accessible on a dedicated we portal on www.hemera-h2020.eu.

2. Partners

The HEMERA project sets up a large consortium dealing with balloon-borne research, that encompasses 13 Partners from seven countries:

– **Space agencies:** Centre National d'Etudes Spatiales (CNES) in France; Swedish National Space Board (SNSB) in Sweden; Agenzia Spaziale Italiana (ASI) in Italy; Deutsches Zentrum fur Luft- und Raumfahrt e.V. (DLR) in Germany; Canadian Space Agency (CSA) in Canada.
– **Companies operating these balloons and providing the hardware:** Swedish Space Corporation (SSC) in Sweden; Andoya Space Center (ASC) in Norway; Airstar in France, which provides balloon envelopes.
– **Scientists from the atmospheric sciences, astronomy and astrophysics communities:** Centre National de la Recherche Scientifique (CNRS) in France; Karlsruhe Institut fur Technologie (KIT) in Germany; Istituto Nazionale di Astrofisica (INAF) in Italy; Heidelberg University in Germany (UHEI); Cranfield University (CU) in the UK.

These partners are mostly European and from Canada. Figure 1 shows the location of the institutes, companies and space agencies.

3. HEMERA Balloons

Within the HEMERA programme, two different types of balloons will be accessible by the users who wants to fly their payloads: Sounding Balloon (SB) and Zero Pressure Balloon (ZPB). Those tropospheric and stratospheric balloon types allows users to collect data related to several science fields, starting from Earth observations. In fact atmospheric science can be achieved regarding stratospheric chemistry and dynamics. Moreover, astronomy and astrophysics contributes can be achieved in different fields, such as solar

Fig. 2. Photo of a Sounding Balloon as an example of the one used within the HEMERA programme.

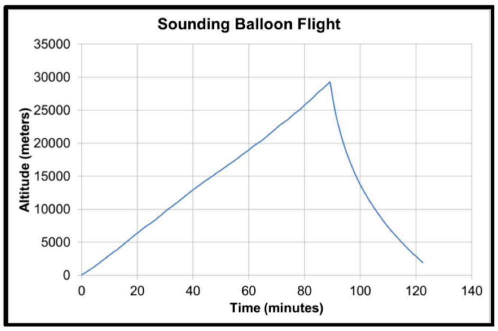

Fig. 3. The plot shows the altitude in km of the Sounding Balloon used within the HEMERA programme as a function of the flight time in hours.

physics and cosmic ray physics, infrared and microwave measurements and gamma ray astronomy.

Hereafter a brief description of the SB and ZPB balloons characteristics.

3.1. Sounding Balloons

Sounding Balloons are the smallest type of balloon users can access within the HEMERA programme. They allow small payloads with weights up to 3 kg. The maximum altitude these balloons can reach is 30 km in the atmosphere with flight durations up to ∼ 2 hours. Balloons ascents are slower compared to the ZPB ones and the payloads are not always recovered. Figure 2 shows a picture of the SB as example, while Figure 3 shows the altitude in km of the SB as a function of the time flight in hours.

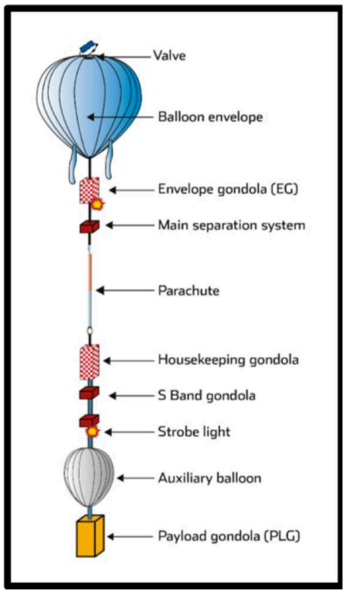

Fig. 4. Scheme of a Zero Pressure Balloon used within the HEMERA programme.

3.2. Zero Pressure Balloons

Zero Pressure Balloons are bigger balloon which allow payloads with a weight up to 150 kg. The maximum altitude these balloons can reach is 40 km with a flight time of ∼ 24 hours. The ascent of ZPB is quite rapid and in this case the payload can be always recovered thanks to the presence of a parachute between the balloon and the gondola. Figure 4 shows the scheme of the ZPB used within the HEMERA programme, while Figure 5 presents the altitude as a function of the flight time for ZPB.

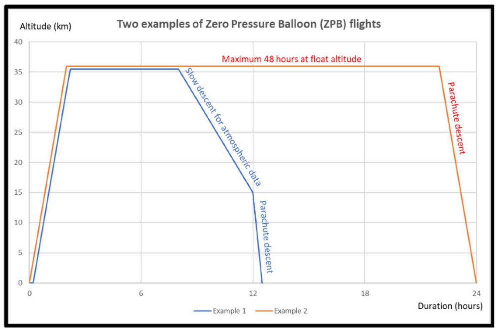

Fig. 5. The plot shows the altitude in km of the Zero Pressure Balloon used within the HEMERA programme as a function of the flight time in hours.

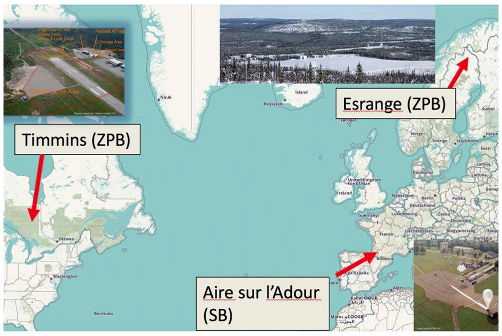

Fig. 6. Locations of the launch sites used within the HEMERA programme.

4. HEMERA launching sites

HEMERA allows users to launch their instruments on the balloons from three different sites: Esrange (Sweden), Timmins (Ontario, Canada) and Aire Sur l'Adour (France). Figure 6 presents the locations of these launch sites. HEMERA partners are considering a new launch site in Trapani-Milo (Italy), in order to perform medium latitude flights. The duration of those flights will be of ~ 24 hours and the direction will be toward Spain during summer and toward Turkey in winter.

- **Esrange:** this is the space operations center for SSC and it has been conducting balloon flights since 1974. The launch facility offers flights in air space with low air traffic density and over sparsely populated areas.
- **Timmins:** it was selected in March 2012 as the Canadian ZPB launch site because of its favourable latitude, wind and weather conditions, low population density in areas surrounding the city and optimal on-site infrastructure.
- **Aire sur l'Adour:** Flights from Aire sur l'Adour have been conducted since early 1960s. This site, located in southwestern France, is the main launch base of CNES and is also the home base for the CNES balloon operations team.

5. HEMERA flight plans

HEMERA will provide a large number of balloon flights to be conducted with ZPB and SB balloons:

- **6 flights** with ZPBs for a payload up to 150 kg. Three flights will be performed by SSC from Esrange and three performed by CNES.
- **20 flights** with SBs for a payload up to 3 kg performed by CNES from Aire sur l'Adour.

The gondolas carrying the instruments will be provided by CNES and SSC. More than one instrument will fly on one single gondola. All the instruments together with the gondolas will be recovered. The flight level will range from 15 up to 38 km depending on the total weight of the payload and gondola.

6. Calls for proposals

A Call For Ideas (CFI) was open in spring 2018 in order to assess the user needs and to support the definition of the following Call For Proposals (CFP) issued in July 2018, which aimed at selecting the experiments. The CFI was open to all the scientists and users from the European Union member states, from countries associated to the Horizon 2020 programme and from Canada. The response to the CFI was outstanding, 70 proposals were received from 17 different countries. The selection of the instruments from the Call For Proposals is finished and the next balloon flights will be organized to be performed during summer 2019 and January 2020.

A second Call For Proposals will be issued in September 2019 with deadline for application in December 2019. Those instruments selected within the second CFP will be performed between the end of 2020 and beginning of 2021.

7. HEMERA events

Within the HEMERA programme two events planned, the HEMERA Summer School and the HEMERA Workshop. The Summer School is organized in Heidelberg from 9^{th} to 13^{th} of September 2019. It is open to advanced master students, PhD students and young scientists interested/involved in balloon research, technicians and engineers from the participating agencies and industries. Major themes of the summer school will cover the following:

– The history, early and modern balloon science and industrial opportunities, recent advances and discoveries.
– The atmospheric environment.
– The general logistics of balloon types, flight control, limitations of the ballooning environment, launching techniques, regulations.
– Specific scientific and industrial ballooning operations of the agencies.
– More detail on modern scientific results from ballooning and the instruments involved.
– Future work, opportunities and measurements.

A dedicated HEMERA workshop will be organized in Rome in autumn 2020. The programme together with the first balloon flights results will be presented. Further information about the workshop will be included the HEMERA website www.hemera-h2020.eu.

8. Conclusions

HEMERA is a new Research Infrastructure funded within the Horizon 2020 programme by the European Union. It aims at integrate a large starting community in the field of tropospheric and stratospheric balloon-borne research, in order to make existing balloon facilities available to all scientific teams in the European Union, Canada and associated countries. It offers tropospheric and stratospheric balloon flights at no cost for small to medium payloads. To apply for those flights Call For Proposals are issued every year.

Acknowledgements. G.M. acknowledge support from Istituto di Astrofisica e Planetologia Spaziali (IAPS/INAF) via EU grant N. 730970.

References

Masi, S., et al. 2008, MmSAI, 79, 3