”My Earth” Astrophysics and Planets - a serious game to build low carbon scenarios in the astronomy academic community

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▶ **To cite this version:**

Fabien Malbet, Alexandre Santerne, Julien Milli, Nicolas Champollion, Laurent Lamy, et al.. ”My Earth” Astrophysics and Planets - a serious game to build low carbon scenarios in the astronomy academic community. SF2A 2024 - Journées 2024 de la Société Française d’Astronomie & d’Astrophysique, M. Bethermin; K. Baillié; N. Lagarde; J. Malzac; R.-M. Ouazzani; J. Richard; O. Venot; A. Siebert, Jun 2024, Marseille, France. hal-04733241v2

HAL Id: hal-04733241
https://hal.science/hal-04733241v2

Submitted on 14 Oct 2024

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SF2A 2024
M. Béthermin, K. Baillié, N. Lagarde, J. Malzac, R.-M. Ouazzani, J. Richard, O. Venot, A. Siebert (eds)

"MY EARTH" ASTROPHYSICS AND PLANETS - A SERIOUS GAME TO BUILD LOW-CARBON SCENARIOS IN THE ASTRONOMY ACADEMIC COMMUNITY

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Abstract. This report summarizes what has happened in the mini-workshops entitled "*My Earth in 180 minutes*" organized during the lunch break at the SF2A 2024 conference in Marseille. The project showcased an innovative serious game designed to raise awareness of greenhouse gas (GHG) emissions in astronomical research laboratories. Participants, organized into teams, simulate strategies to reduce their carbon footprints by 50%, focusing on key astronomical activities such as space instrumentation, data analysis, and laboratory work. The sessions highlight the challenges of achieving significant emissions reductions without disrupting core research activities, such as telescope observations. While the serious game facilitates important discussions on sustainable practices, the results point to the need for broader engagement, adaptation to different cultural contexts, and institutional support. The project highlights the importance of integrating climate action into the academic environment and suggests potential future directions for expanding its impact.

Keywords: Low-carbon, Research, Serious game, Case study, Raising awareness, Scientists, Astronomy, Astrophysics

1 Introduction

During the French Week of Astrophysics (SF2A) held in Marseille from June 4 to June 7, 2024, seven mini-workshops were organized during the lunch break following the methodology *My Earth in 180 Minutes* created and developed by several researchers in Grenoble (Gratiot et al. 2023, 2024). There are several versions in various scientific domains. The serious game version used at this conference is the one that was adapted by Malbet et al. (2022) for *Astrophysics and Planets* laboratory teams.

This project emerged in the context of the global climate crisis and the urgent need to reduce greenhouse gas (GHG) emissions in research laboratories, particularly in the field of astronomy(Knödlseder et al. 2022; Knödlseder 2024). The *My Earth in 180 Minutes* serious game is part of a series of initiatives aimed at raising awareness in the scientific community about the urgency of changing professional practices. This report summarises the objectives, the process and the results of this initiative, which were presented and experienced during the SF2A 2024 conference.

2 Objectives and motivation

The main objectives of this game-based transition support system are (1) to raise awareness among astronomy researchers about the environmental impact of their professional practices; (2) to stimulate the development

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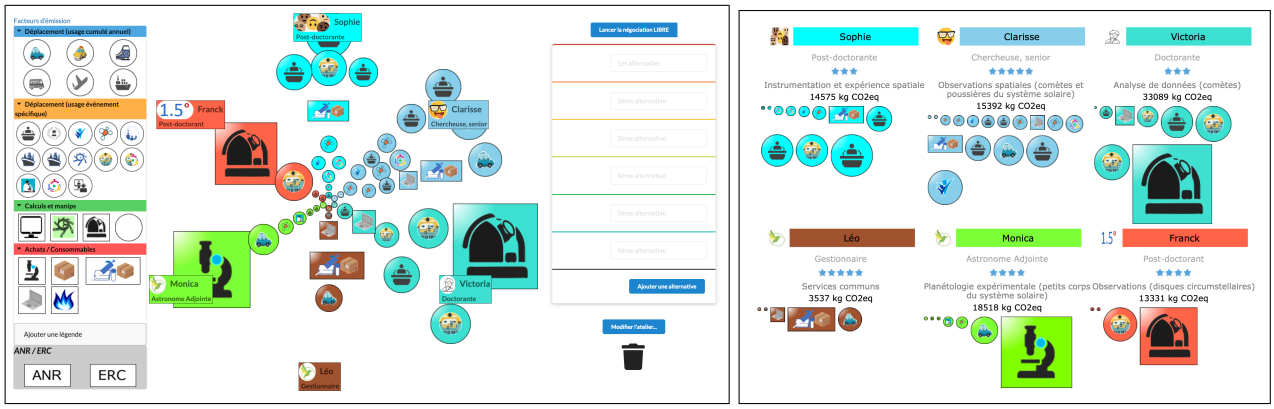

Fig. 1. Left panel : "*Astrophysics and planets*" game board. Right panel : "*Astrophysics and planets*" characters.

Fig. 2. Pictures of three mini-workshops AST-01, AST-02 and AST-06 among the seven that were organized.

of emission reduction trajectories within research labs; and (3) to test innovative strategies through a serious game, enabling participants to simulate the effects of specific actions on their CO2 emissions.

The project initiators highlight that monitoring emissions, while essential, is not sufficient to deeply change behavior. By immersing participants with their pairs in simulations where they must adopt roles and strategies different from their usual practices, the serious game aims at provoking deeper reflection and commitment.

3 The serious game "My Earth in 180 Minutes"

The serious game provides a simulation framework in which participants, working in scientific teams, must develop strategies to reduce their GHG emissions by negociating while maintaining the efficiency and productivity of their research. Participants are invited to project themselves into the skin of a fictional character with specific statuts, gender, carreer, psychological profile. The scenario is built around three main astronomical activities : space instrumentation, laboratory work, data observation and simulation. One should remember that the average carbon emission per astronomer has recently been estimated at about 37 tons CO2eq (Knödlseder et al. 2022).

A concrete example of the simulation was shared during the session in Marseille. Each participant or team embodies a specific role, such as a PhD student, a postdoctoral researcher, an astronomer, or an administrator, with associated initial emissions (Fig. 1). For instance, a third-year PhD student is responsible for 33.1 tons CO2eq, while a senior scientist generates around 15.4 tons CO2eq.

The sessions of this game-based transition support system include negotiation phases where participants aim at achieving a 50% emissions reduction. Various actions are possible: reducing professional travels, extending equipment lifespan, prioritizing the use of archived data over new observations, or pooling long-distance travels. These actions are not specific, and playing a role allows creativity, imagination, and even encourages it, so as to widen the field of possibilities.

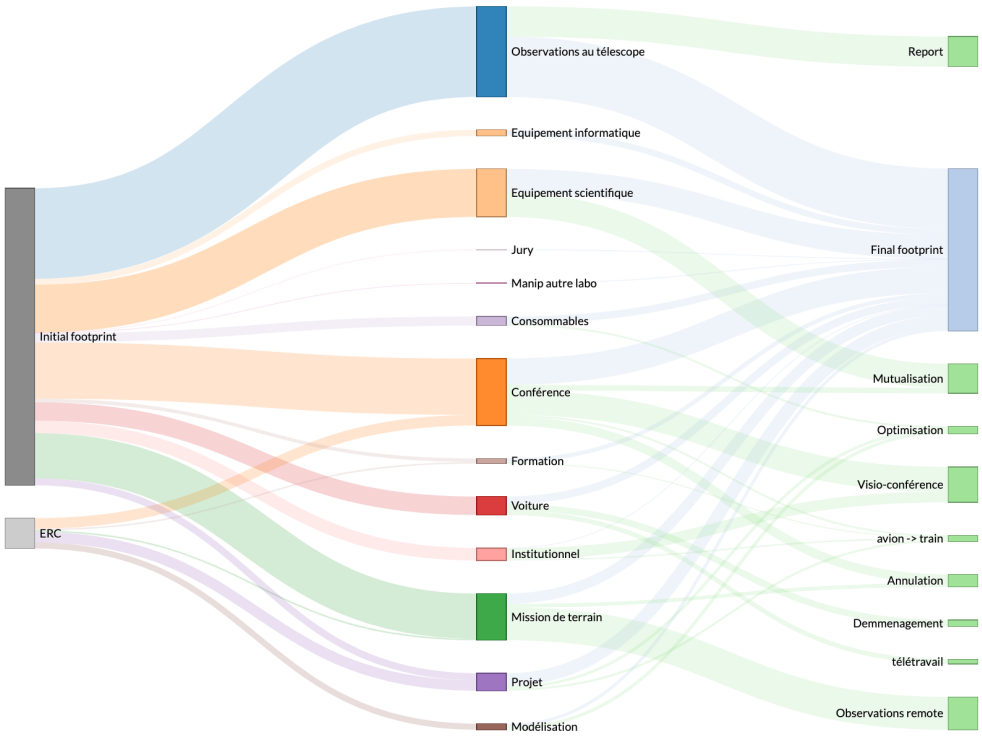

Fig. 3. Decarbonization trajectory of the AST-06 group.

4 Results from the SF2A mini-workshops

During the SF2A session, seven teams for a total number of 45 participants (Fig. 2) took part in the mini-workshops. The most effective suggestions for reducing emissions included (Fig. 3):

- Systematically replacing flights with train travels for missions under 2000 km.
- Promoting virtual meetings to avoid unnecessary travels.
- Using archived data instead of organizing new carbon-intensive observations.
- Extending the lifespan of scientific equipments.
- Pooling long-distance travel for multiple purposes.

However, one of the main challenges highlighted was that achieving a 50% reduction in emissions is extremely difficult without impacting core research activities, such as telescope observations, which are often deemed essential and difficult to cancel (Fig. 4).

5 Perspectives and limitations

The results (Fig. 4) obtained during the SF2A session were generally positive, although several limitations were identified. For instance, some important emission-related topics were not fully addressed like the role of reseearch infrastructure, and the audience was already largely aware of the environmental issues, which could bias the results.

Nevertheless, the project benefits from strong institutional support in France, with partnerships from organizations such as CNRS, IRD, INRAE, and Météo-France. Since 2021, more than 2000 participants have taken part in over 300 workshops across France. To date, 25 virtual teams are proposed and cover many scientific domains.

There are plans to expand the present serious game on a larger scale, by testing the method on a broader, less familiar audience to assess its real impact on environmental awareness, by adapting the serious game to other scientific fields and cultural contexts, such as Vietnam and the United States, by collaborating with specialists in cognitive, social, and environmental sciences to refine and enhance the tool's impact.

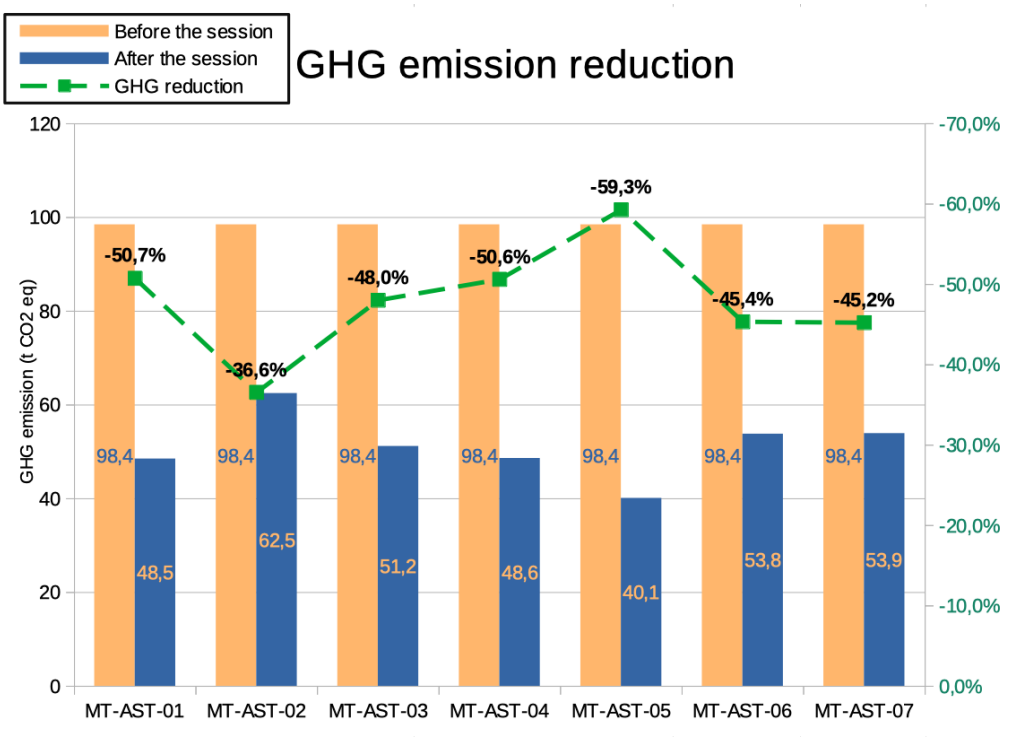

Fig. 4. Summary of the trajectories of the various groups, which achieved emissions reductions ranging from 37% to 59%.

6 Conclusion

The "*My Earth in 180 Minutes*" serious game offers an innovative approach to encourage low carbon activities in astronomy research labs. It allows participants to model the impact of various strategies on GHG emissions while raising awareness of the environmental consequences of professional practices. Expanding this tool to other fields and cultures promises new perspectives for further integrating ecological transition into academic environments. In addition, this serious game could be used as a programming tool to forecast emissions for the coming years and that it canalso be well adapted to work on social justice.

For more information, visit the project's official website: `https://materre.osug.fr`.

We would like to warmly thank the participants to the seven mini-workshops, namely :

- A. Berdeu, A. Jardin-Blicq, O. Venot, N. Brucy, Y. Bernard, L. d'Hendecourt, C. Bergez
- R. Lenoble, V. Hill, A. Marchaudon, M. Motte, M. Tanious, R. Lenoble, V. Chevalier, R. Peralta
- V. Durepaire, D. Barret, S. Lescaudron, L. Michel-Dansac, I. Boisse, A. Schneeberger
- M. Zannese, G. Chaverot, R.-M. Ouazzani, C. Dubois, F. Antoine, J.-F. Gonzalez, I. Vaughlin
- P. Huet, L. Cros, B. Carry, A. Borderies, A. Niemiec, M. Bethermin
- C. Gry, J.-P. Berger, P. Larue, S. Brau Nogue, R. Lallemand, L. Tasca
- M. Mondelin, S. Bontemps, M. Van der Swaelmen, A. Guseva, A. Astoul, P.-A. Desrotou

We would like to gratefully acknowledge the support of the CNRS, IRD, UGA, AMU, OSUG and LAM. We would also like to thank the support of the scientific organising committee and the local organising committee of the Journées Françaises de la SF2A, which enabled us to share this tool with our community.

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