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THE FRENCH AEROSPACE LAB

POST-DOCTORATE PROPOSAL

Title : Air traffic impact on climate and optimization

Reference : **PDOC-DTIS-2021**

(to be recalled in all correspondence)

Start of contract : December 2021 or January 2022	**Application deadline :**

Duration : 18 months - Net yearly salary: about 25 k€ (medical insurance included)

Keywords

Climate impact, Air Traffic, Optimization

Presentation of the post-doctoral project, context and objective

Due to the Green House Gazes (GHG) emissions from aircraft, air traffic contributes to the anthropic Radiative Forcing, responsible for climate change. Even if the aviation CO_2 emissions only represent 2.4% of the global anthropogenic emissions, this contribution could increase due to the aircraft traffic growth, about 4.1% per year before the COVID-19 crisis. Moreover, aviation non-CO_2 effects (including NOx or other GHG emissions, contrails and contrails-cirrus) are non-negligible as they represent 2/3 of the Radiative Forcing according to Lee et al., 2021 of the total aviation impact.

In the context of decarbonization of all the industrial sectors, aviation should address this issue through new types of engines or airplanes, but also thanks to new flight operations. For example, Matthes et al. (2021) estimate a 30% gain on Radiative Forcing by changing cruise altitude.

In this context, this post-doctorate proposal first consists in the simulations of aircraft trajectories and pollutants emissions (including contrails formation). Secondly, the trajectories will be optimized according to their impact on climate: air traffic simulation, minimization of contrails formation and evaluation of benefit/costs on other pollutants emissions. Trade-off studies on environmental benefits will be conducted (e.g. CO_2 and/or NOx emissions vs contrails formation).

The work plan is the following :

- Elaboration of air traffic scenarios and aircraft trajectories; calculation of aircraft and air traffic emissions: CO2, NOx, Sox, VOC, soot, water vapor (using the ATM LAB, an ONERA's simulator)
- Determination of the airspace control zones where contrails formation can be expected for a given scenario and a given atmosphere state.
- Optimization and recalculation of the trajectories minimizing the climate impact according to a climate metric (defined besides).

This work will be done in close collaboration with CERFACS (climate team) who will use the output of this work in order to assess the climate impact of these scenarios with the climate model ARPEGE-Climat.

Bibliography :

Lee, D. S., D. W. Fahey, A. Skowron, M. R. Allen, U. Burkhardt, Q. Chen, S. J. Doherty, et al. « The Contribution of Global Aviation to Anthropogenic Climate Forcing for 2000 to 2018 ». Atmospheric Environment 244 (2021): 117834. https://doi.org/10.1016/j.atmosenv.2020.117834.

Matthes, S.; Lim, L.; Burkhardt, U.; Dahlmann, K.; Dietmüller, S.; Grewe, V.; Haslerud, A.S.; Hendricks, J.; Owen, B.; Pitari, G.; et al. Mitigation of Non-CO2 Aviation's Climate impact by Changing Cruise Altitudes. Aerospace, 2021, 8, 36. https://doi.org/10.3390/aerospace8020036

Profile and skills required

The candidate should have a PhD degree in a subject of relevance for conducting the project such as air traffic management or applied mathematics and/or Atmospheric and Climate Sciences.

The successful applicant should have the capability to work independently as well as in collaboration with colleagues and students at ONERA. Good knowledge in both written as well as spoken English is a necessity in order to publish in international peer-reviewed journal or conference.

External collaborations

The post-doc will work in close collaboration with climate researcher from CERFACS and CNRM/Météo France.

Host laboratory at ONERA

Department : DTIS - Information Processing and Systems Department

Location (ONERA centre) : Toulouse

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