

## 2020 Master-level position at CERFACS and ISAE-SUPAERO

### Impact of global warming on air transportation: take-off distance and payload

#### Context and objective

Air transportation contributes to global warming both directly through greenhouse gas emissions and indirectly through contrails and cirrus, as shown in Fig. 1 [1]. However, global warming also impacts the ability of aircraft to operate safely and efficiently (modification of low and high altitude winds, increase of turbulence, lower air density, etc.). Dozens of flights are already canceled each year due to ground “over temperature”. To better understand how global warming will affect air transportation, a research program (ICCA - Impact of Global Warming on Aircraft), led by CERFACS, METEO-FRANCE, ENAC, AIRBUS and ISAE-SUPAERO has started in 2019. In the framework of this research program, the main objective of the training position is to study the impact of global warming on the take-off distance of a medium-range aircraft and its consequences on payload. The method will rely on the use of an uncertainty quantification method applied to climate and aircraft models [2]. Typically, climatic data, engine thrust and maximum lift coefficients will be considered as uncertain parameters. A first part of the work will be to characterize the sources of uncertainties (like the statistical distribution of uncertain variables that can be dependents or independents). Then a stochastic analysis will be led using a set of numerical simulations of growing complexity considering different climatic scenarios. Finally, the last part of the work will consider a global sensitivity analysis using the library OpenTURNS ([www.openturns.org](http://www.openturns.org)) developed at CERFACS.

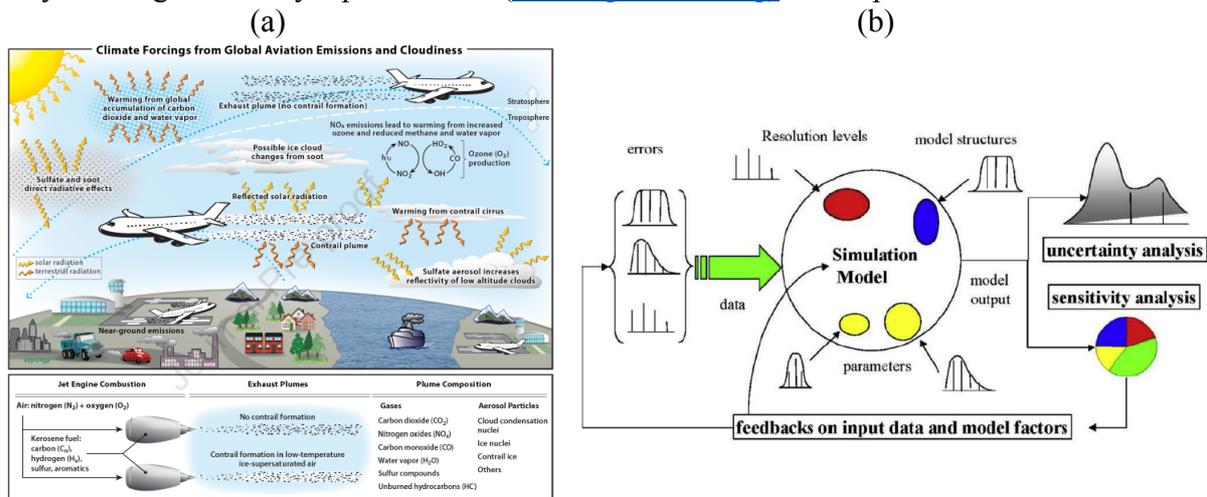


Fig. 1 (a) Radiative forcing from air transportation [1] and (b) uncertainty analysis [2]

#### Application and profile

Ideally, you have a background in fluid mechanics and/or applied mathematics (probability and statistics) and good programming skills (Python). A good knowledge of aircraft design methods and numerical simulation are important assets, as well as good communication skills.

Please send your application before December, 15<sup>th</sup> 2020. to [Sophie.Ricci@cerfacs.fr](mailto:Sophie.Ricci@cerfacs.fr), [Nicolas.Gourdain@isae-supaeo.fr](mailto:Nicolas.Gourdain@isae-supaeo.fr), [Jerome.Fontane@isae-supaeo.fr](mailto:Jerome.Fontane@isae-supaeo.fr).

[1] D.S. Lee et al. “The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018”. In: Atmospheric Environment (2020), p. 117834

[2] A. Saltelli et al. “Why so many published sensitivity analyses are false: A systematic review of sensitivity analysis practices”. In: Environmental Modelling and Software (2019).