Overview of French aerosol research activities for the future Atmosphere Observing System mission

Juan Cuesta[a,*], Oleg Dubovik[b], Cyrille Flamant[c], Laaziz El Amraoui[d], Joel Ferreira De Brito[e], Marc Mallet[d], Michaël Sicard[f], Solène Turquety[c], Claudia Di Biagio[a], Paola Formenti[a], Sergey Khaykin[c], Valérie Gros[g], Anton Lopatin[h], Vincent Noël[i], Jean-Eudes Petit[g], Fazzal Qayyum[a] and Abou Bakr Merdji[a]

[a]*LISA/IPSL, UMR7583 CNRS, Université Paris Est Créteil, Université de Paris Cité, 61 Av Gral de Gaulle 94010, Créteil, France*
[b]*LOA, UMR8518 CNRS, Université de Lille, 59655 Villeneuve d'Ascq Cedex*
[c]*LATMOS/IPSL, UMR8190 CNRS, Sorbonne Université, UVSQ, 4 Place de Jussieu, 75005 Paris*
[d]*CNRM, UMR 3589 CNRS, Météo France, 42,avenue Gaspard Coriolis 31057 Toulouse, France*
[e]*CERI EE, IMT Nord Europe, Institut Mines-Télécom, Université Lille, 59000 Lille, France*
[f]*LACy, UMR8105 CNRS, Université de la Réunion, 15 Cassin, Saint-Denis 97744, La Réunion, France*
[g]*LSCE, UMR 8212 CNRS, CEA, UVSQ, UPS, Orme des Merisiers, Bat 714, 91190 Saint-Aubin, France*
EMail: valerie.gros@lsce.ipsl.fr; jean-eudes.petit@lsce.ipsl.fr
[h]*GRASP-SAS, 3 avenue Louis Neel, 59260 Lezennes,France*
[i]*LAERO, UMR 5560 CNRS, Université Toulouse III, IRD, 14 avenue Édouard Belin, 31400 Toulouse,France*

[*]*Presenting author (cuesta@lisa.ipsl.fr)*

Aerosols and clouds play a major role in the Earth Climate systems, while the quantification and clear understanding of their variabilities, interactions and feedbacks remain a great challenge. In particular, aerosols strongly impact the energy budget by direct modification of solar and infrared radiation, alteration of cloud properties and their formation processes as well as the thermodynamic properties of the atmosphere. Aerosols are also the most harmful air pollutant, being responsible of several millions of premature deaths worldwide each year. Even though diverse observation and modelling approaches of aerosols exist, numerous unknowns remain concerning the chemical and physical mechanisms that affect them, their vertical redistribution in the atmosphere, the quantification of their environmental impacts and their interactions with clouds and convective processes.

In order to tackle these major environmental issues at global scale, a new space mission called Atmosphere Observing System (AOS) has been conceived as an international cooperation between NASA from USA, CNES from France, JAXA from Japan, CSA from Canada and ASI from Italy. This mission is built as a constellation of several satellites following two orbits, a polar orbit with global coverage in the continuity of the A-Train constellation and an inclined designed to document the diurnal variation of aerosol cloud in the Tropics and mid-latitudes. These satellites will carry new generation active and passive instruments for sounding aerosols, clouds, convection, and precipitation, including multiwavelength lidars and one in tandem with a multi-angular polarimeter. Multiple international collaborative actions currently aim the preparation of the AOS mission, whose launching period is planned for 2028-2030.

In the current presentation, we will provide an overview of French aerosol research activities for preparing the scientific exploitation of AOS. They gather relevant contributions from 8 French scientific laboratories: LISA, LOA, LATMOS, CNRM, LAERO, LACy, CERI EE and LSCE and a French industrial partner: GRASP-SAS. These efforts are threefold: (i) the development of

innovative French aerosol satellite products based on AOS observations, (ii) suborbital measurements for feeding both the aerosol products and conceiving a synergetic exploitation with AOS and (iii) synergism with chemistry-transport models. The AOS aerosol observations will provide a new quantification of the vertical profile of aerosol concentration simultaneously for different particle types and chemical species. This information will be derived from lidar only and the synergism of lidar and polarimeter measurements using a so-called GRASP retrieval approach[1]. Additional products will aim the quantification of cloud condensation nuclei for studying aerosols/cloud interactions. The suborbital contribution will characterize aerosol optical, microphysical, and chemical properties from airborne, ground-based from several French sites and laboratory instrumentation. While documenting aerosols properties for different aerosol types and species, they provide a scientific framework for studying complex interactions such as the impact of aerosols on convective activity in specific regions. This is the case of the BACCOPA French field campaign aiming the studying of the impact of biomass burning aerosols emitted from Central Africa in the regional convective activity. Finally, synergetic approaches with chemistry transport-models aim the development of data assimilation methods of AOS measurements and the use of these last ones for evaluating their numerical simulations.

References

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