

## Offre de Stage IPSL 2020

(soutenu par le programme EUR IPSL-Climate Graduate School)

Titre du sujet de stage : **Impact of climate and agriculture on mineral dust emissions in the Sahel.**

Description du sujet (1 page maximum) :

The Sahel is a semi-arid region characterized by low annual precipitation, often combined with long periods of drought during the year, leading to a sparse vegetation, which annual density varies from year to year. This explains why the Sahel is particularly vulnerable to wind erosion. The intensity of wind erosion and of the associated mineral dust emissions, has fluctuated significantly during the last century, with a maximum occurrence of dry haze recorded during the drought periods of the 70's and 80's. The vegetated surfaces in the Sahel have usually been dedicated to pastoral livestock, but are increasingly used for agricultural purposes. In West Africa, due to the increasing population cultivated surfaces have doubled from 1970 to 2000. Field measurements performed in Niger have shown that wind erosion is more intense on cultivated fields than on pastured land and fallows. Wind erosion is mainly due to the strong surface winds associated with the convective activity at the beginning of the wet season. At this period of the year, cultivated surfaces are almost bare or sparsely vegetated, and thus is not efficiently protected from the erosive action of wind.

Wind erosion and mineral dust emissions are driven by meteorological parameters (wind speed and precipitation) but also strongly influenced by land use. In the frame of the ANR research project CAVIARS (Climate, Agriculture and Vegetation : Impacts on Aeolian EROsion in the Sahel, 2013-2018), a modelling approach has been developed to estimate the impact of natural and cultivated vegetation on wind erosion in the Sahel. Over cultivated surface, the SARRA-H agronomic model allows to simulate the seasonal dynamics of millet, the main cultivated species in the region. Additional parametrization are used to represent the degradation of the dry vegetation and litter, including agricultural practices such as the collection of dry vegetation for other uses. The characteristics of the simulated vegetation (height, cover rate) are converted into parameters used by the wind erosion model developed in the LISA to simulate the erosion fluxes and the mineral dust emissions at the regional scale.

The objective of this work is to simulate the evolution of the cultivated vegetation and its impact on dust emissions over periods of the recent past (1960-2010), characterized by different land-use and contrasted climatic conditions, such as the Sahelian droughts and the recent re-greening period. The temporal and geographical pattern of the simulated vegetation will be compared to satellite indexes of green and brown vegetation. A specific attention will be paid to the capability of the model to simulate the start of the green vegetation growing phase in coincidence with the time-period where the highest surface winds are observed in the Sahel and the degradation of the dry vegetation that prevents wind erosion in the dry season. The final objective is to evaluate the impact of land use on wind erosion and dust emissions and to quantify the relative weight of climate and land-use changes in the evolution of wind erosion in the Sahel since 1960.

Résumé en anglais (5 lignes) : The objective of this work is to investigate, by a modelling approach the evolution of the cultivated vegetation and its impact on mineral dust emissions over periods of the recent past (1960-

2010), characterized by different land-use and contrasted climatic conditions. The final objective is to evaluate the relative weight of climate and land-use changes in the evolution of wind erosion in the Sahel since 1960.

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Laboratoire concerné : Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA), 61 Avenue de Général de Gaulle, 94010 Créteil Cedex.

Equipe de recherche concernée (si pertinent) : Groupe « Modélisation » ; Thème « Cycle de l'aérosol Désertique ».

Niveau du stage (Licence, M1, M2, internship) : M2

Licence ou Master(s) où sera proposé le sujet : MOCIS ; WAPE ; Fundamentals of Remote Sensing ;

Thème scientifique de l'IPSL concerné : BIOTECA (Biogéochimie Terrestre, Ecosystèmes et Agriculture)

Durée du stage : 4 à 6 mois

Période : 01/03/2020 → 30/06/2020 ou 31/08/2020

Est-il prévu une thèse dans le prolongement du stage ? OUI