

# Below cloud scavenging on nine types of pollen by different rain conditions

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Nowadays, air quality is one of the main concerns of human health, often compromised by several pollutants, as bioaerosols (like pollen, fungal spore, bacteria), related to human diseases such as influenza, lungs diseases or allergies (Oduber et al., 2019). One of the main sinks of aerosols is the washing by rain. Thus, the study of Below Cloud Scavenging (BCS) under different rain intensities or rain accumulated is crucial. Therefore, the main aim of this study is to analyze the evolution of nine types of pollen during rain events with different rain conditions.

Between January 2015 and December 2018 in León (Spain) a campaign for sampling rain and bioaerosols has been carried out. The instruments used were: i) a Laser Precipitation Monitor of Thies Clima to register rain intensity on a 1-minute basis; ii) a volumetric *Hirst* type spore-trap to estimate the hourly pollen concentration between 10 and 100  $\mu\text{m}$ ; iii) a Davis weather station to register the basic meteorological parameters. The Below Cloud Scavenging has been analyzed through the scavenging efficiency ( $\Delta C\%$ ) for nine types of pollen: *Betula*, *Castanea*, Cupressaceae, Oleaceae, *Pinus*, *Plantago*, Poaceae, *Quercus* and Urticaceae. The  $\Delta C\%$  was estimated using Eq. 1 to evaluate the change in pollen concentration (so, a positive value is considered effective scavenging) between the times  $t1$  and  $t2$ :

Eq. 1

Only events with:

- i) complete rain and bioaerosol data;
- ii) hourly accumulated precipitation higher than 0.1 mm;
- iii) temperature and wind speed variations below  $\pm 3$  °C and  $\pm 2$  m s<sup>-1</sup>, respectively, between 2 h before and after rain;
- iv) the global amount of pollen concentration higher than 1 grain m<sup>-3</sup> before rain are considered.

The selected events were classified by rain intensity: low (5 mm.h<sup>-1</sup>).

Along sampling campaign, 122 events were registered and analyzed. The rain events presented a mean duration of 214 minutes, a mean rain accumulated of 3.58 mm and a mean rainfall intensity of 0.87 mm.h<sup>-1</sup>. Globally, a 71 % of the total events presented effective scavenging, with a mean  $\Delta C\%$  value of  $24 \pm 18$  %. By rain intensity groups, the medium and high rain intensities caused the highest scavenging (69.7 and 69.2 %, respectively) on pollen concentration, mainly on *Castanea* and Cupressaceae types. The low rain intensity group presented an effective scavenging of 40.9 %.

In brief, the rain characteristics affect the effective scavenging of pollen and, furthermore, this washing effect depends on the type of pollen. This kind of studies constitutes a valuable tool for the pollen forecast after a shower. Future studies will focus on the study of scavenging effect caused by different raindrop sizes on different types of pollen.

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Oduber et al. (2019) Links between recent trends in airborne pollen concentration, meteorological parameters and air pollutants. *Agric. For. Meteorol.*, 264, 16–26.

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