PARTICLE PLUME DEPLETION ABOVE A HOMOGENEOUS RURAL COVER BY DRY DEPOSITION: IN SITU QUANTIFICATION BY GAS/PARTICLE DOUBLE TRACING METHOD

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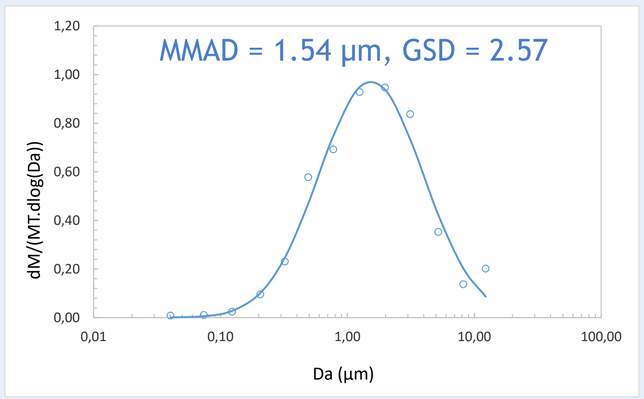
INTRODUCTION

- Atmospheric plume dispersion → models generally only consider diffusion and transport processes in the calculation of atmospheric concentrations, neglecting deposition phenomena → Particle plume depletion is not quantified for environmental and population impact studies
- The only experimental work quantifying the depletion of an atmospheric particle plume is that of Doran and Horst (1985) at Hanford (USA), over semi-arid cover (desert grasses and sagebrush)
- To address the particle plume depletion above a homogeneous rural cover by dry deposition, an original method has been developed based on a dual gas/particle tracing

$$D(p) = 1 - \frac{ATC_{Part}(p)}{ATC_{Gas}(p)}$$

- $D(p)$: particle plume depletion at point p
- ATC (s.m^{-3}): Atmospheric Transfer Coefficient at point p (concentration C (g.m^{-3}) to emission flow rate q (g.s^{-1}) ratio)

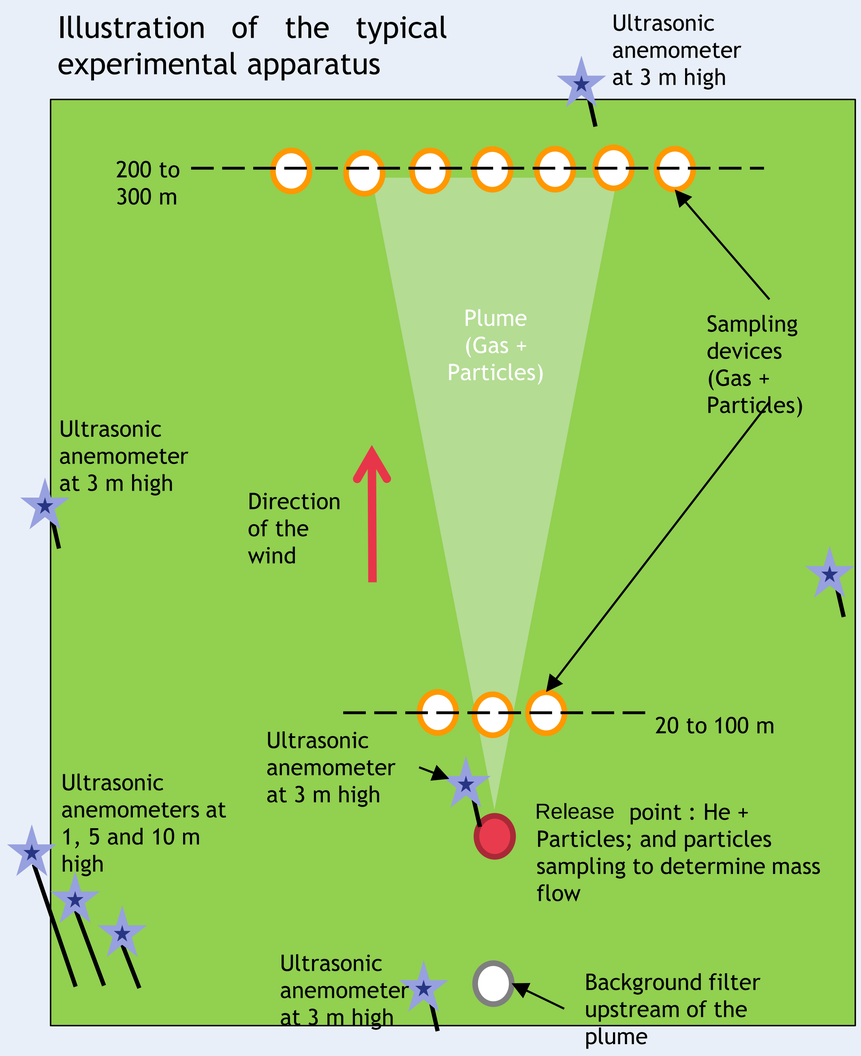
METHOD



Fluorescein/NaCl (40%/60% in mass) particles distribution during experiment 13 (generator: PALAS AGK 2000)

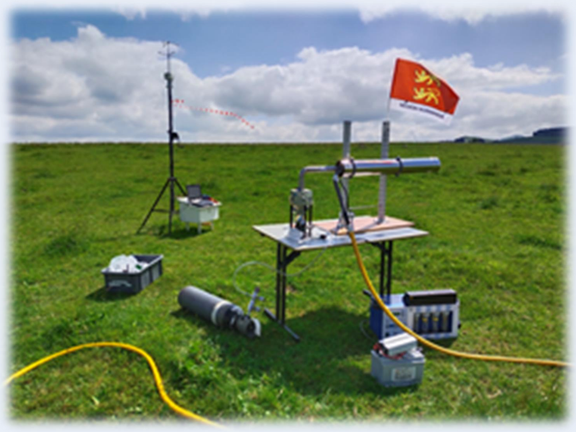
Caracterization of micrometeorlogical conditions: ultrasonic anemometers and meteorological station

Illustration of the typical experimental apparatus



Site: INRAE les Percières
(Laqueuille, France; 45.64433°N; 2.73495°E)

Sampling point (deported at 1m high):
- Particle sampling (SDEC AM3000) on QMA filter
- Gas sampling (developed by IRSN/LRC) in Tedlar bag



Release point at 1,25m high:
- Inert traceable gas (Helium, yellow hose)
- Traceable particles (PALAS AGK 2000)
- Mixing duct

SUMMARY OF EXPERIMENTS

- 14 experiments realized between June 21th and July 2nd 2021
- Wet meteorological conditions for the season
  → Some experiments realized between rainy episodes
  → Others sites could be more indicate to study depletion under dry conditions
- Depletion quantified for unstable and neutral atmospheric conditions (A, B, C and D Pasquill stability class), principally for neutral (D) to slightly unstable (C) conditions
- Only 32% of the data available for depletion calculation
- 31% of rejected data due to $ATC_{Particles} > ATC_{Gas}$
  → Particles size distribution evolution by growing due to hygroscopicity or deposition influencing results ?
  → Need of better characterization of particles plume (size distribution, concentration for each size range) to understand $ATC_{Particles}$ deviations
- 21% of rejected data due to gas samplers dysfunction → Reliability of gas samplers must be improve (stability of the sampling flow principally)

CONCLUSIONS AND PERSPECTIVES

- The method is relevant to study plume depletion, but wet atmospheric conditions were encountered during the campaign
- Material (gas samplers) must be made reliable to limit the loss of data
- Method will be improved with particles plume characterization to understand particles and gas ATC deviations
- Particles composition can be replaced by less hygroscopic compounds

MEMBRE DE ETSON

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