

Influence of sea breeze dynamics on aerosols physicochemical properties and toxicity in an industrialized city

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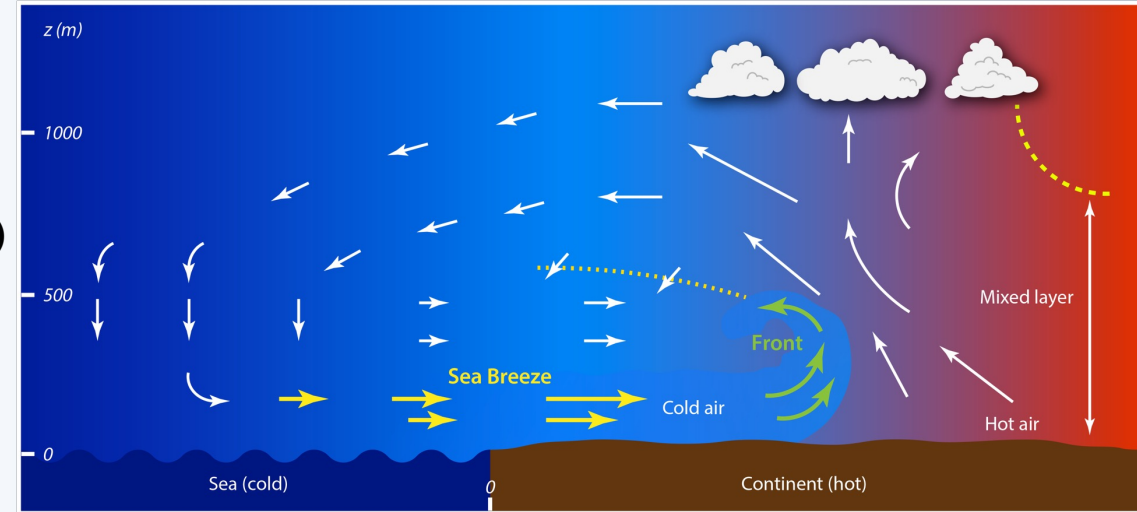
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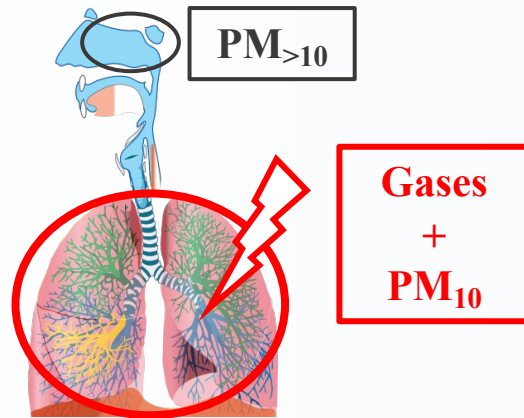
7 Laboratoire d'Océanologie et de Géosciences (LOG), CNRS, Université de Lille 1, Université du Littoral Côte d'Opale (ULCO), France

Introduction

- Sea breeze
 - Mesoscale meteorological phenomenon (coastal locations)
 - Thermal contrast between the sea and the land
 - Cold and wet flow from the sea to the land
- Sea breeze Effects
 - Modify the structure of Atmospheric Boundary Layer (ABL)
 - Influence the air quality
 - Human health



Idealized sea breeze circulation (Lyons, 1975 and Ogawa et al., 1986)



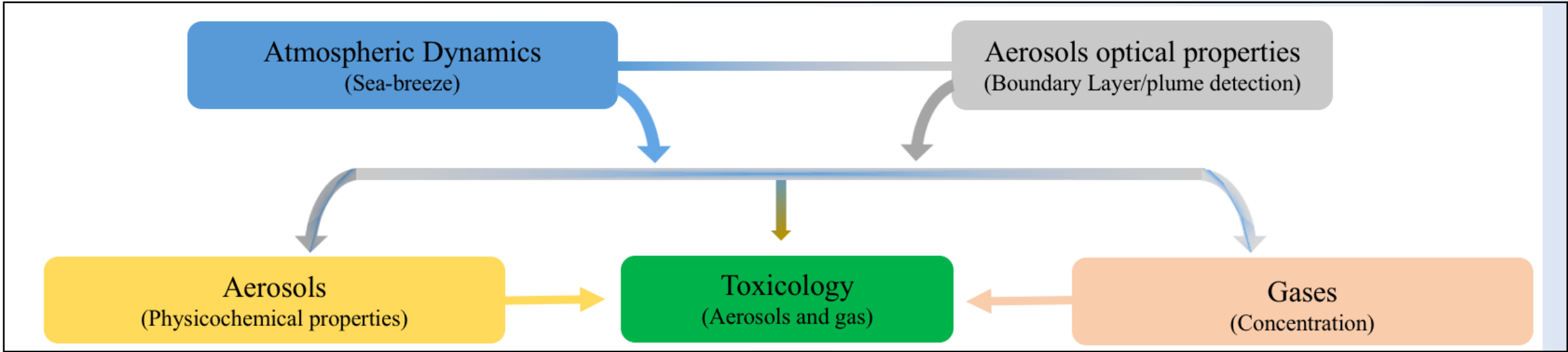
Motivations and objectives

- The EMMA project (Expérience Multi-échelle Mobile Atmosphérique):
 - French collaborative scientific project
 - Investigate atmospheric dynamics, air pollutants and their toxicities in an industrialized city

- The challenge of this project is to better understand the consequences of pollutant dispersion during sea-breeze events in order to answer the following question :
 - What is the impact of sea breeze dynamics on aerosols properties and lung toxicity that can lead to the development of respiratory diseases?

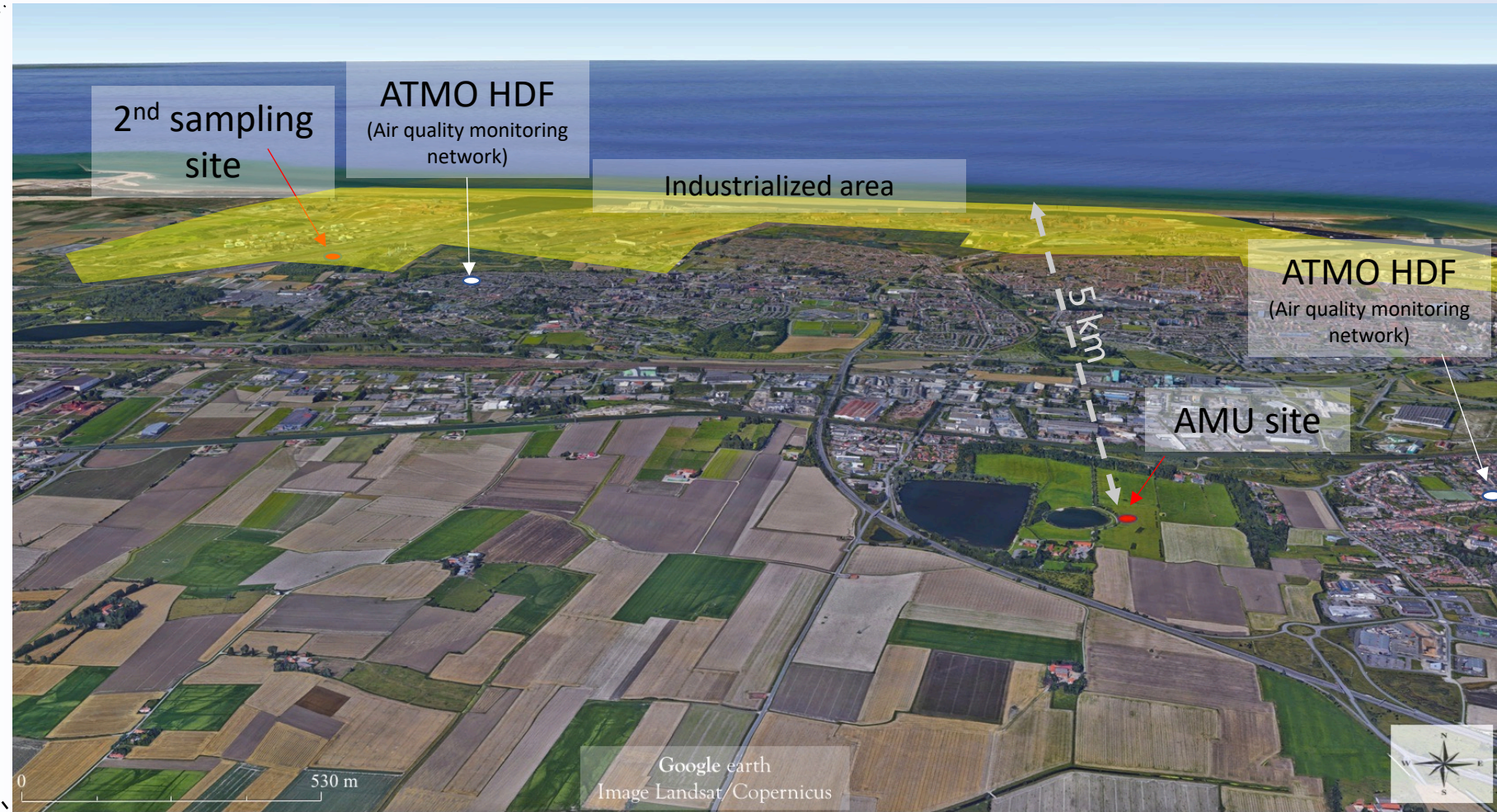
Methodology

This project is based on a multidisciplinary approach and on the development of an Atmospheric Mobile Unit (AMU):

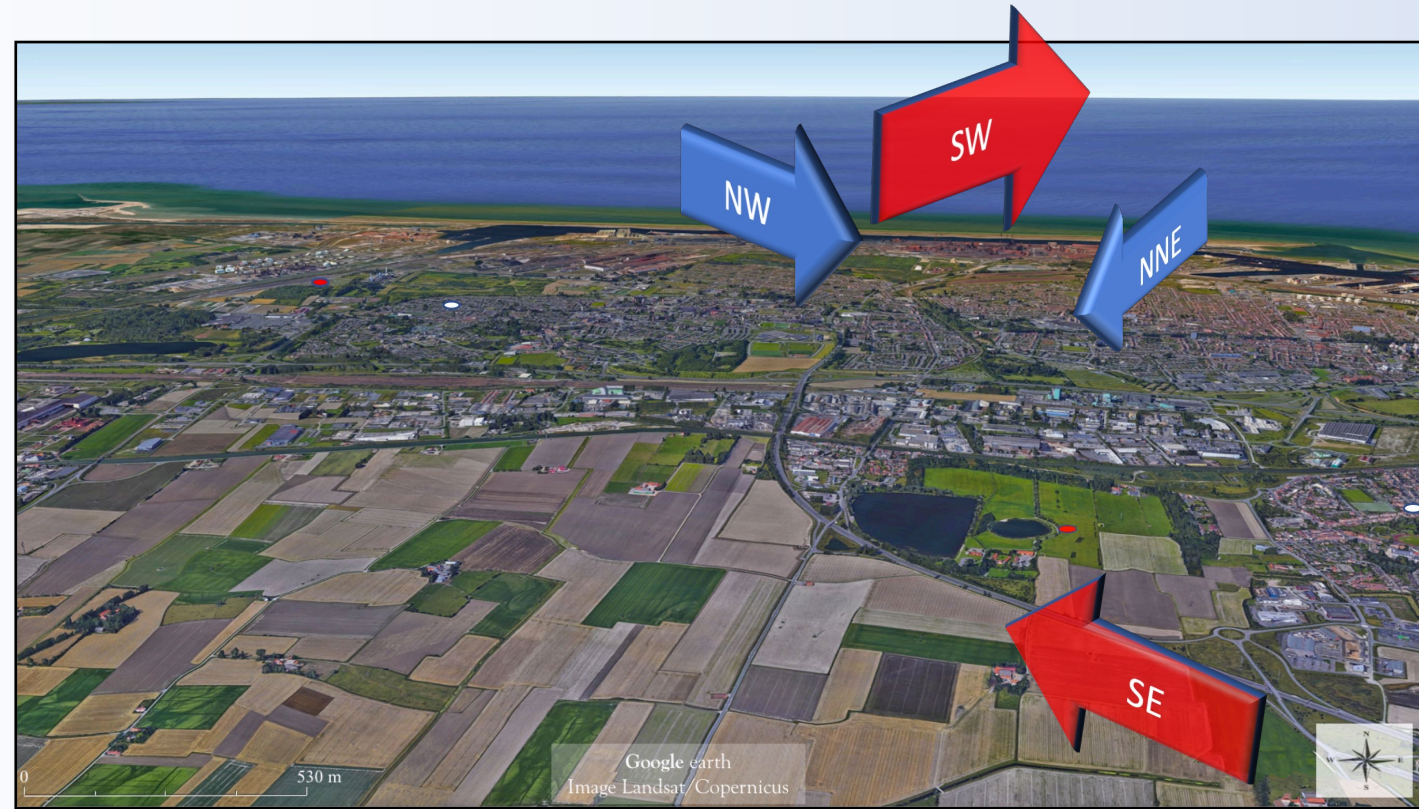
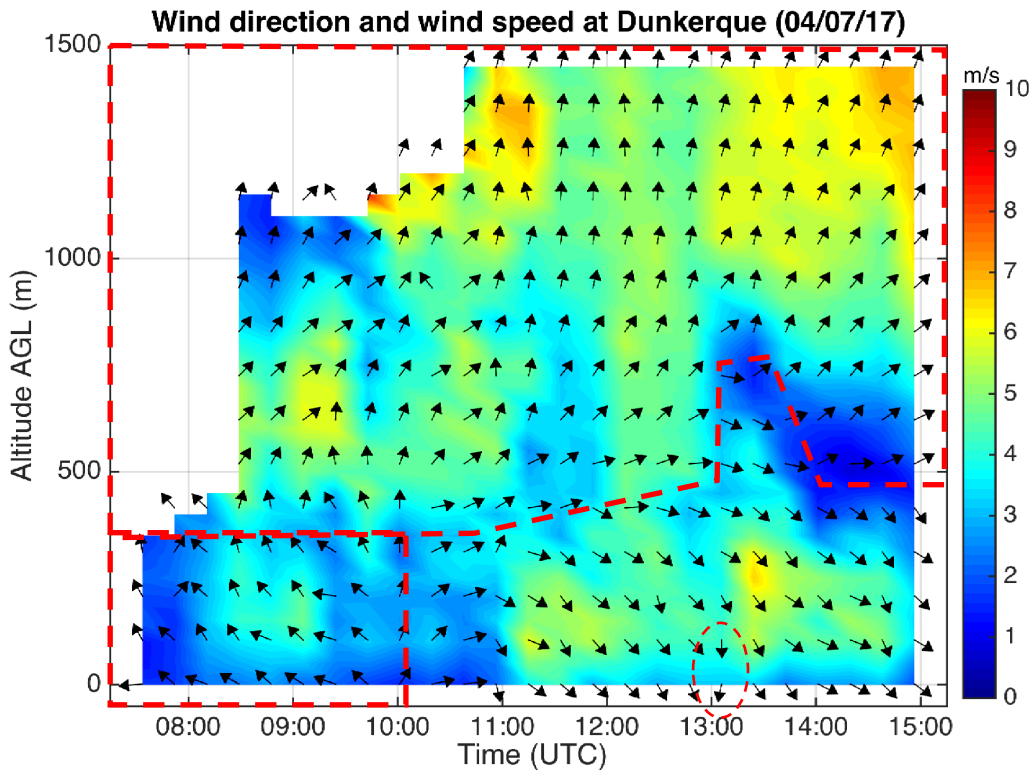


Methodology

Summer 2017



Case study of sea-breeze event : 04/07/2017

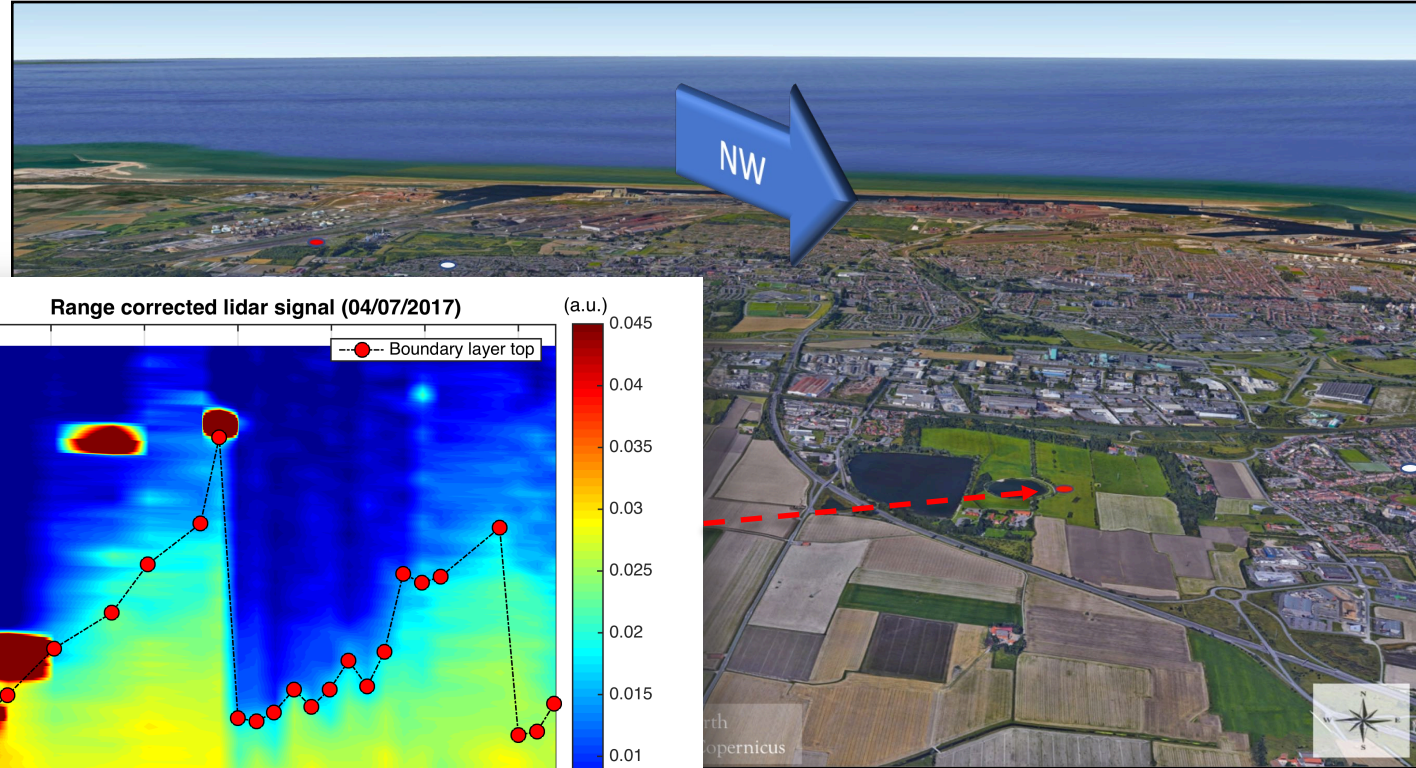
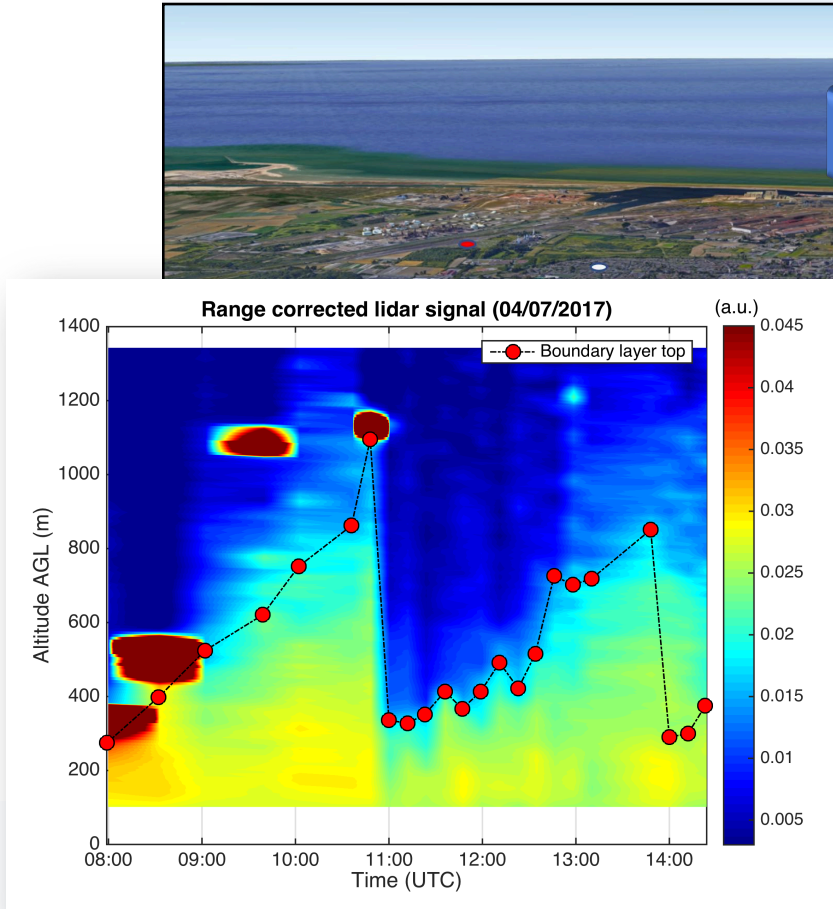
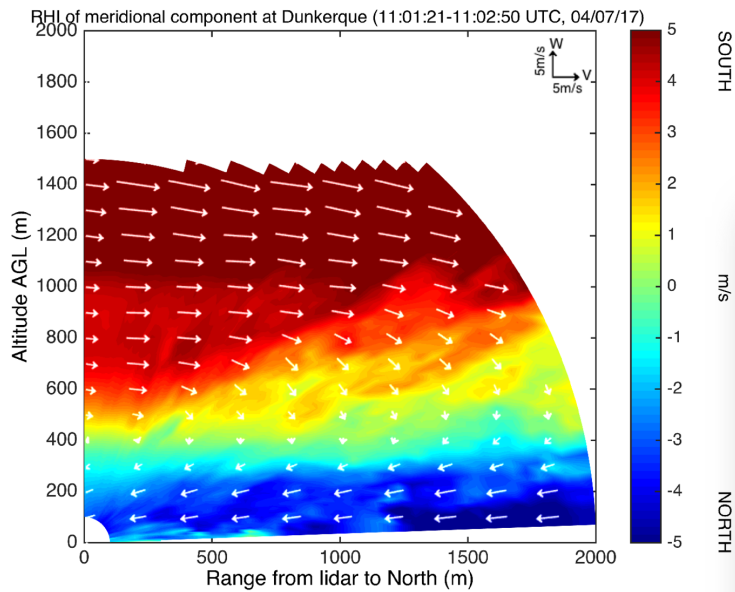


Case study of sea-breeze event : 04/07/2017

Atmospheric Dynamics (Sea-breeze)



Aerosols optical properties
(Boundary Layer/plume detection)



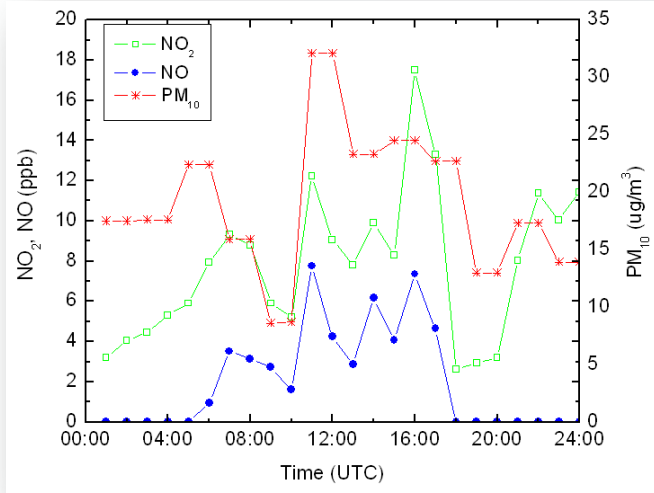
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Atmospheric Dynamics
(Sea-breeze)

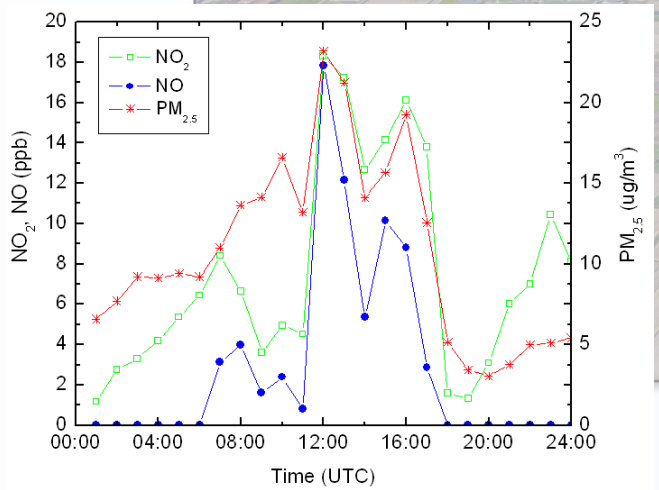
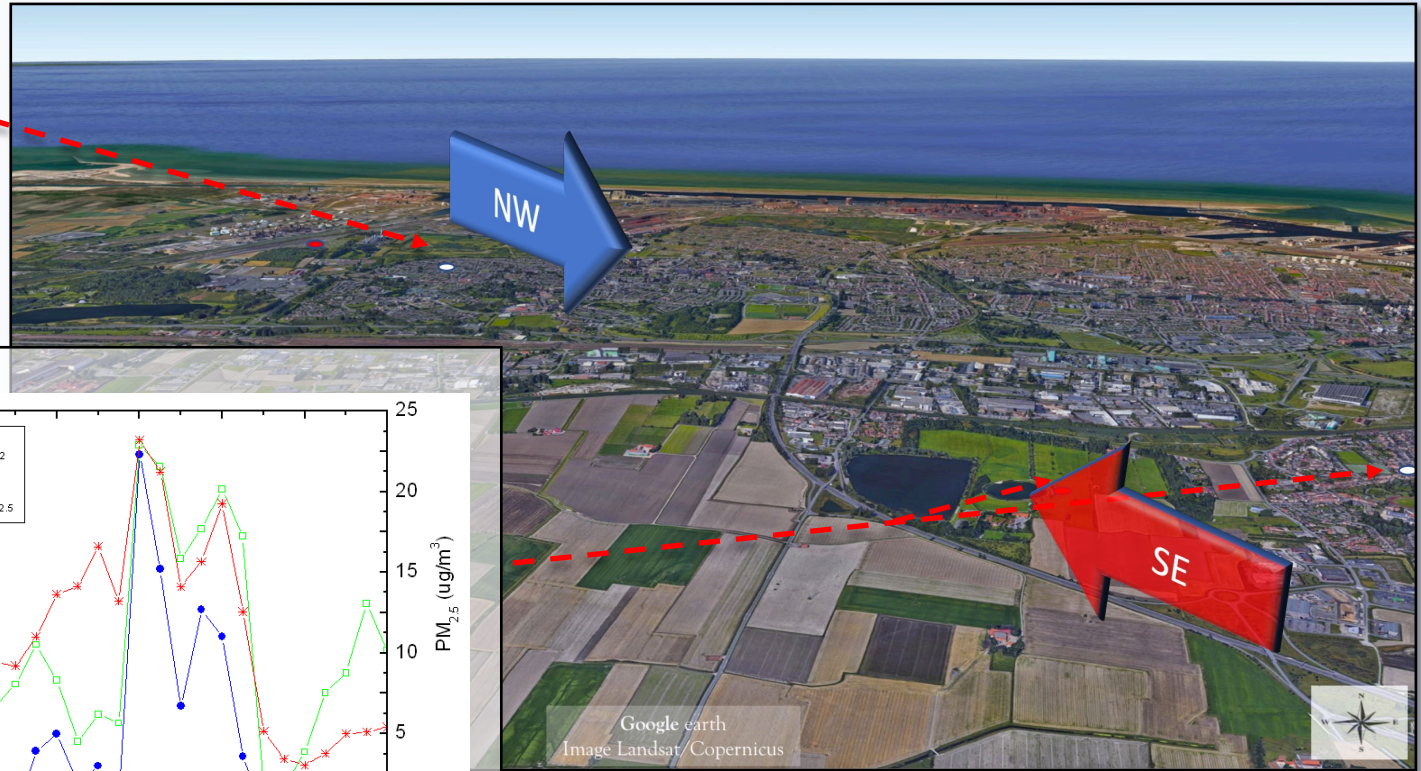
Gases
(Concentration)



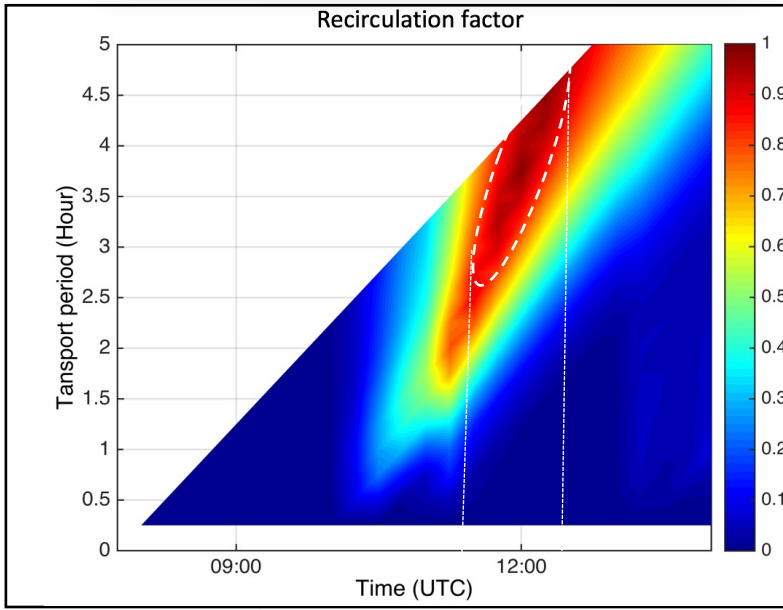
Aerosols
(Physicochemical properties)



Source: Atmo Hauts-de-France

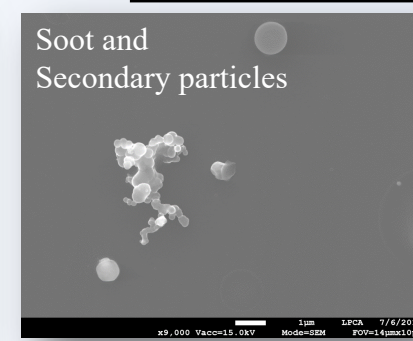
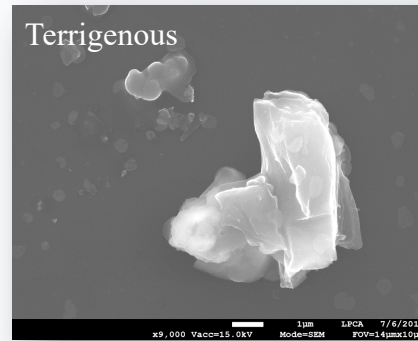
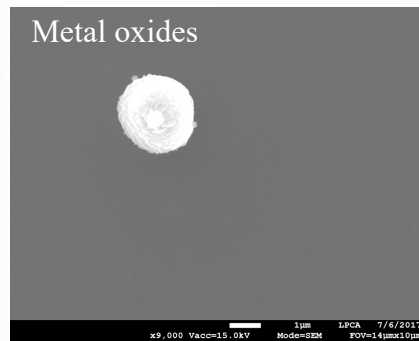
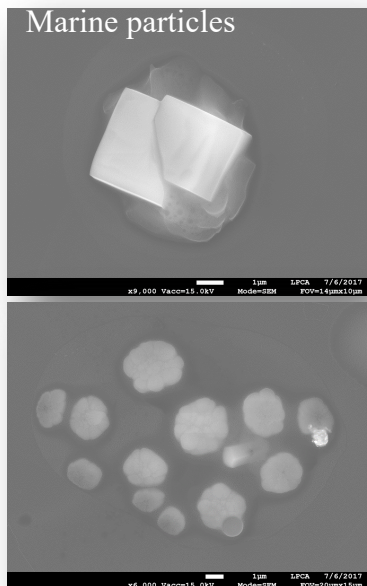
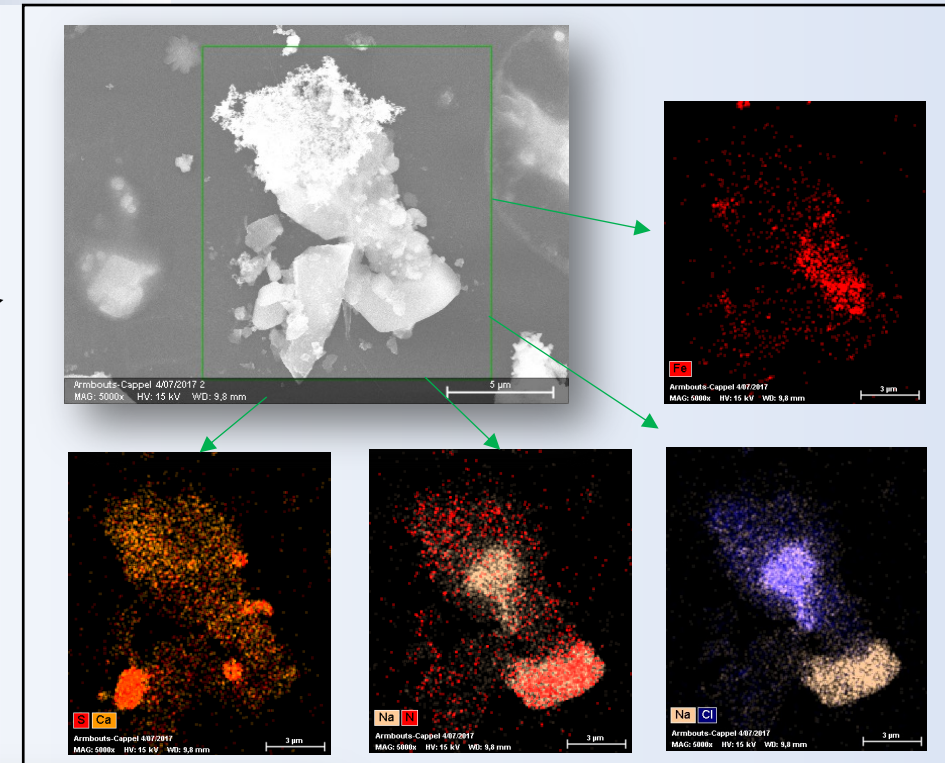
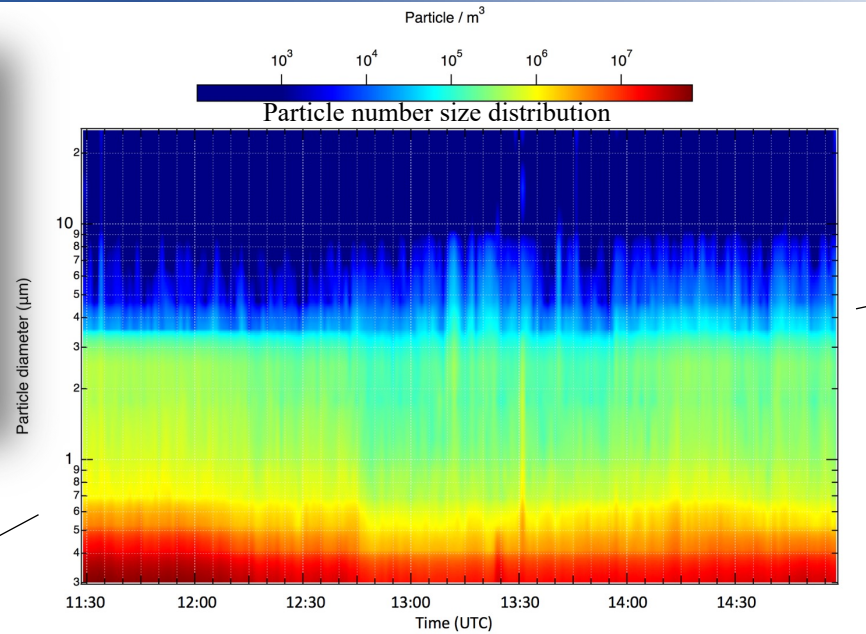
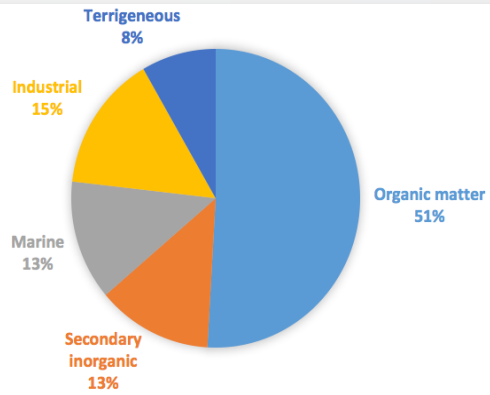


Source: Atmo Hauts-de-France



Case study of sea-breeze event : 04/07/2017

Aerosols (Physicochemical properties)



SEM/EDX

Case study of sea-breeze event : 04/07/2017

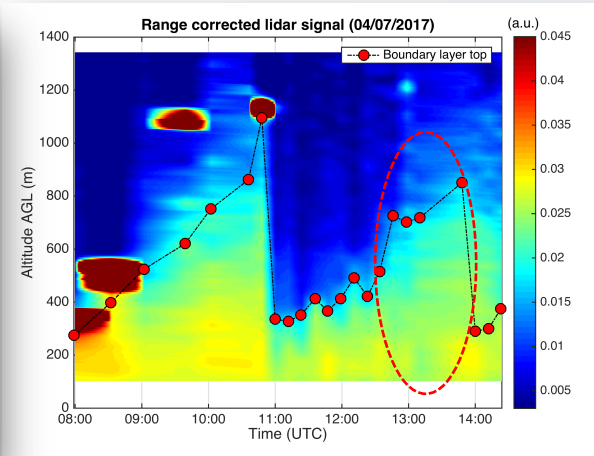
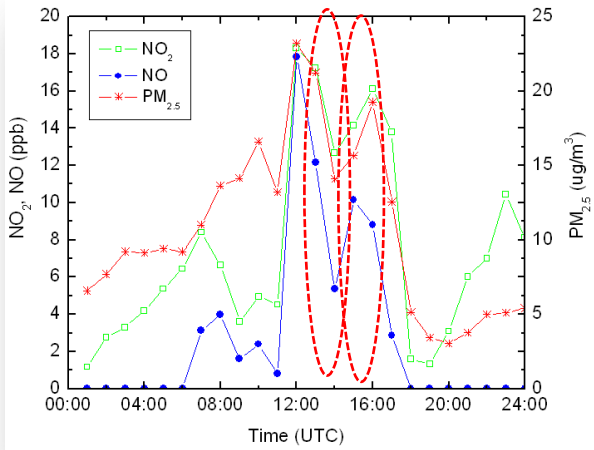
Aerosols
(Physicochemical properties)

Gases
(Concentration)

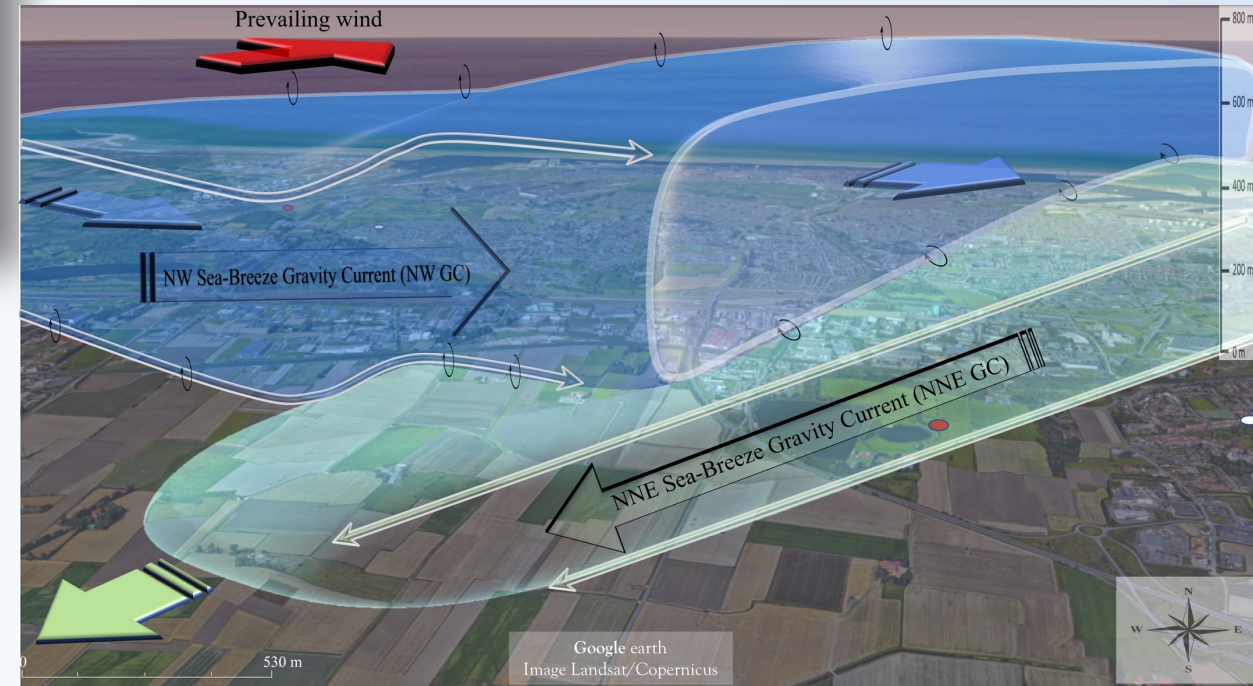
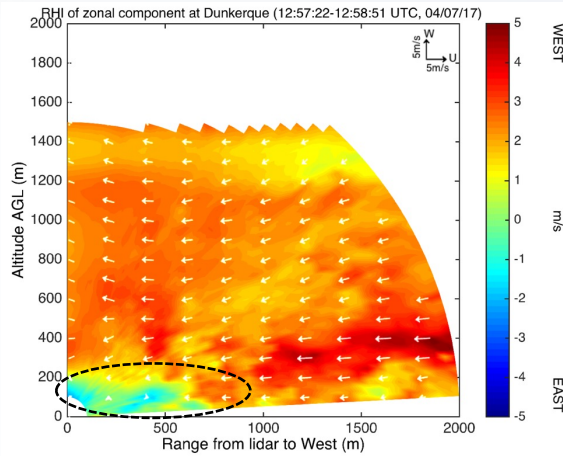
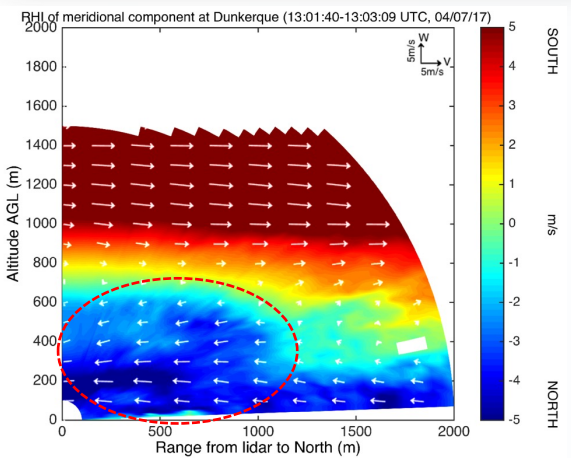


Atmospheric Dynamics
(Sea-breeze)

Aerosols optical properties
(Boundary Layer/plume detection)



Source: Atmo Hauts-de-France



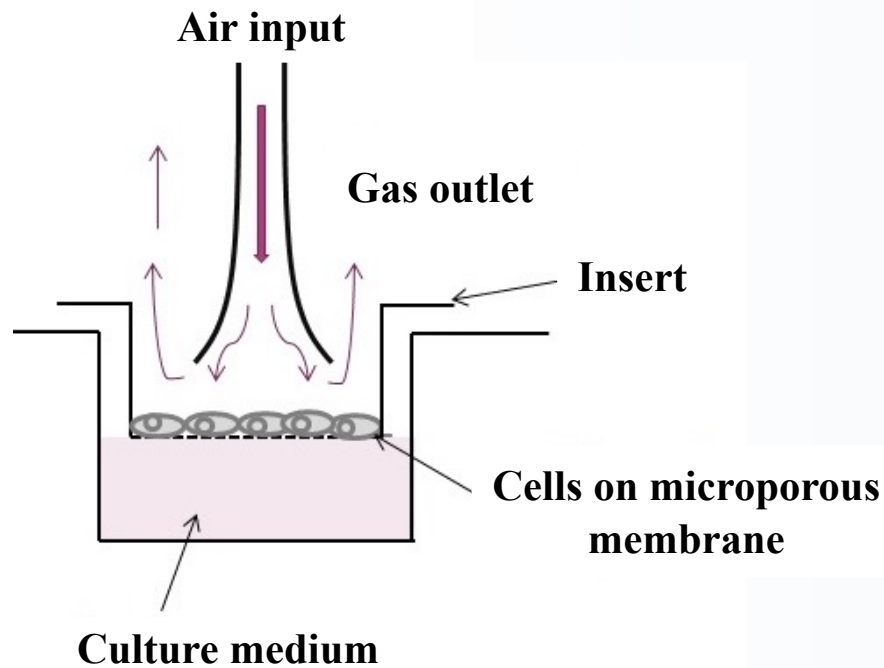
Case study of sea-breeze event : 4 July 2017

Toxicology
(Aerosols and gases)

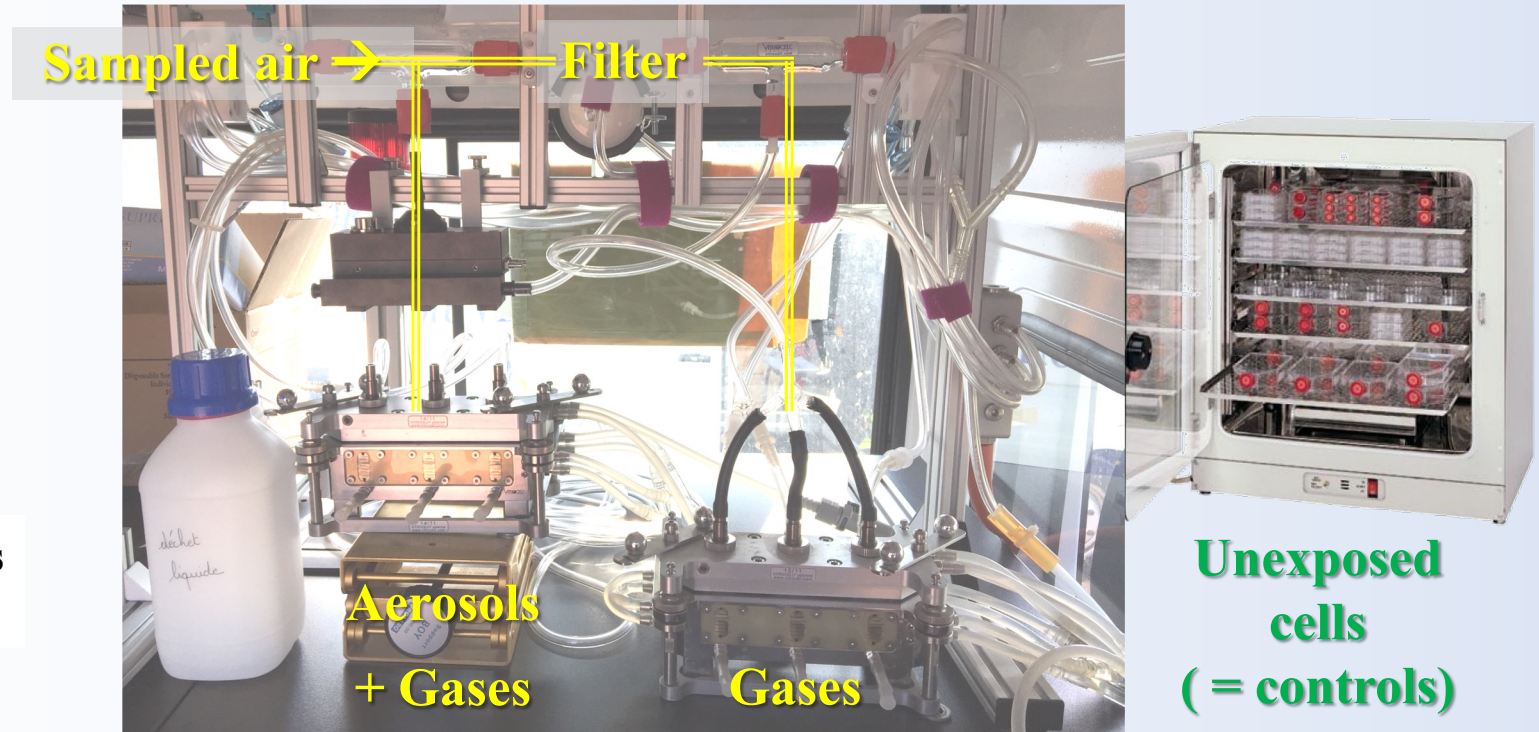


Conditions of Exposure:

- Cells: Human lung cells (bronchi)
- Time: 2 hours (before or during the sea breeze)
- Air-Liquid Interface exposure: Vitrocell®

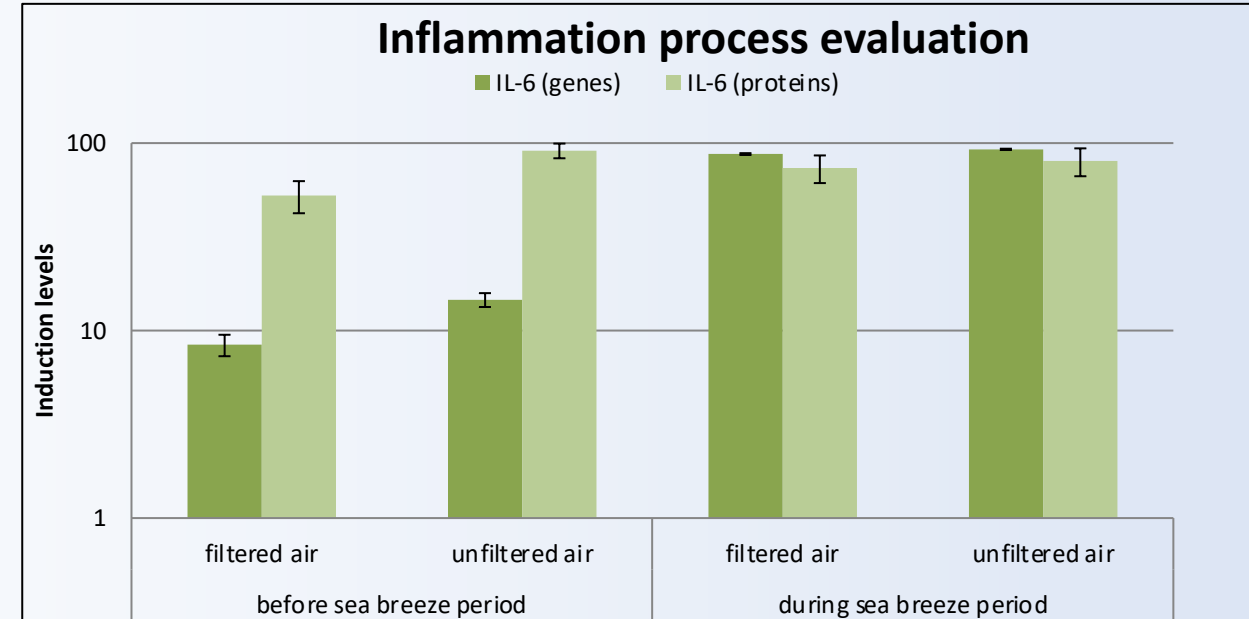
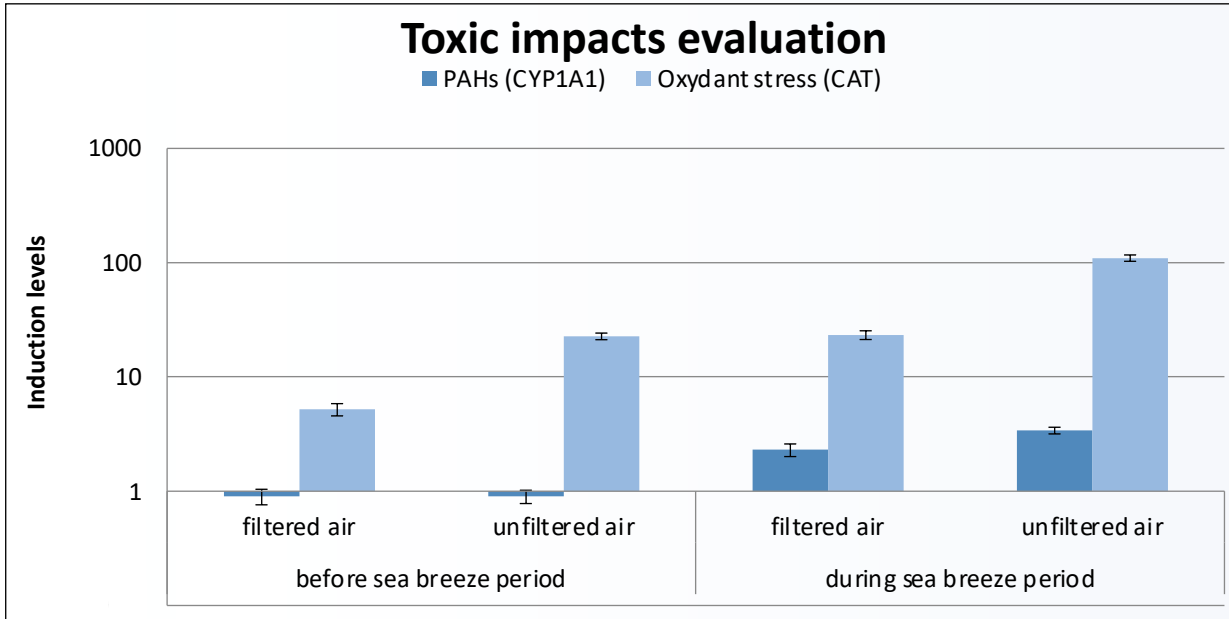


Vitrocell Air-Liquid Interface system



Case study of sea-breeze event : 4 July 2017

Response inducing the expression of several genes:



- Toxic impacts evaluation: Relative gene expression in the cells exposed, in comparison with the unexposed cells:
 - increase of induction levels for CYP1A1 and CAT genes for cells exposed during the sea breeze compared to those exposed before.
 - Cells exposed to unfiltered air exhibit oxidative stress (CAT genes) more important than those exposed to filtered air.
- Inflammation process evaluation: Production of inflammation mediators (gene and protein expression)
 - Increase in the induction levels for all exposures
 - Level of induction of the IL-6 gene is higher in exposed cells during the sea-breeze period

Conclusion

- First results of the EMMA project (case study of sea-breeze event)
- Multidisciplinary approach and on the development of an Atmospheric Mobile Unit (AMU)
- Structure of the sea breeze and the atmospheric boundary layer (SBF ,GC, TIBL)
- Influence of the atmospheric dynamics on the temporal variability of pollutant concentrations (high recirculation conditions and sea-breeze double structure)
- Increase of the oxidative stress and inflammation processes in exposed lung cells during the sea-breeze period

Thank you

