

Our goal this year

This year, we wanted to check the relevance of the college evacuation plan in terms of the weather and wind direction. This resulted in the study of air masses and the influence of building architecture and the environment.

From this first goal, firstly, we wanted to study the influence of obstacles on air masses when they are displaced by the wind or, when an object, like a plane, pass through a cloud (same effects).



Turbulence caused by the passage of a plane in a cloud

Some definitions of departure

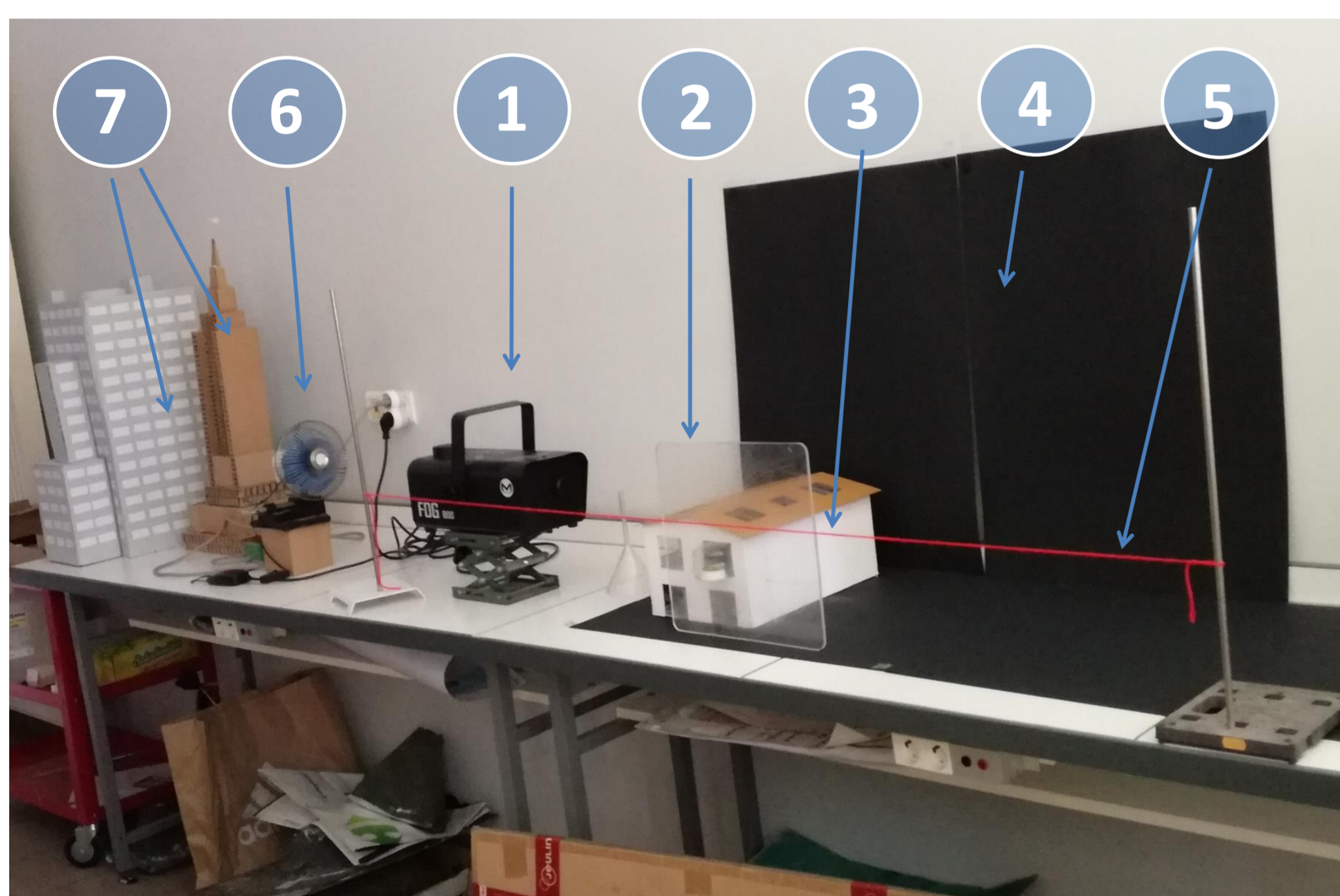
In the atmosphere we can find two objects :

Air mass : An air mass in meteorology is an area of the atmosphere where the conditions of temperature, pressure and humidity mainly, are homogeneous. An air mass is therefore defined as a stable zone in the sense of the measured physical parameters inside it.

The wind : Wind is the movement within an atmosphere, a mass of gas on the surface of a planet, of a part of this gas. Wind is the movement within an atmosphere, a mass of gas on the surface of a planet, of a part of this gas. Winds are generally caused by unevenly distributed global warming from solar radiation, and by the rotation of the planet.

Experimental apparatus

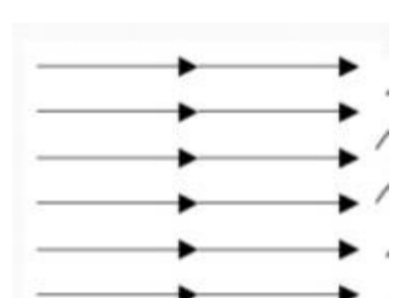
The air is usually transparent. In order to materialize it, we commissioned a smoke machine. We built several models of buildings and mountains that allowed us to highlight the movements of the air masses when they encountered these obstacles.



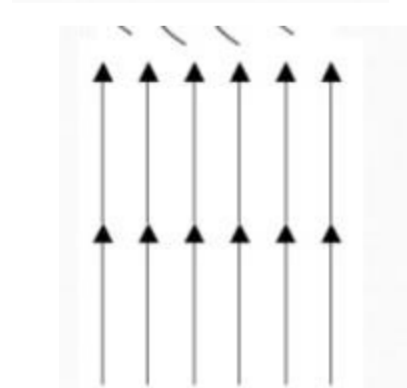
General view of the experimental device

- 1 – Smoke box
- 2 – Glass control
- 3 – Model
- 4 – Black screen
- 5 – Reference line
- 6 – Fan
- 7 – Different models of buildings

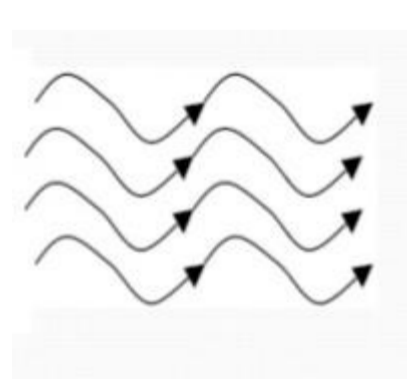
Observed phenomena and new definitions



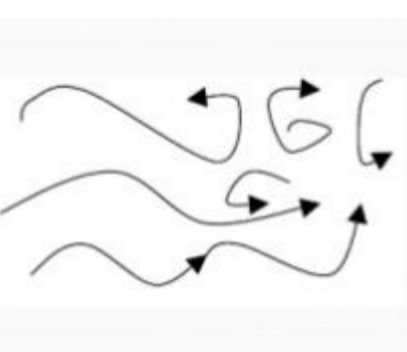
1 - Ecoulement laminaire : un écoulement est dit laminaire lorsqu'il est régulier : l'air qui circule sans rencontrer d'obstacle ou une source de chaleur.



2- Courant de convection : les courants de convections sont des mouvements de la masse d'air verticaux. Ils sont dus à des sources de chaleur qui détendent la masse d'air qui moins dense s'élève en altitude.



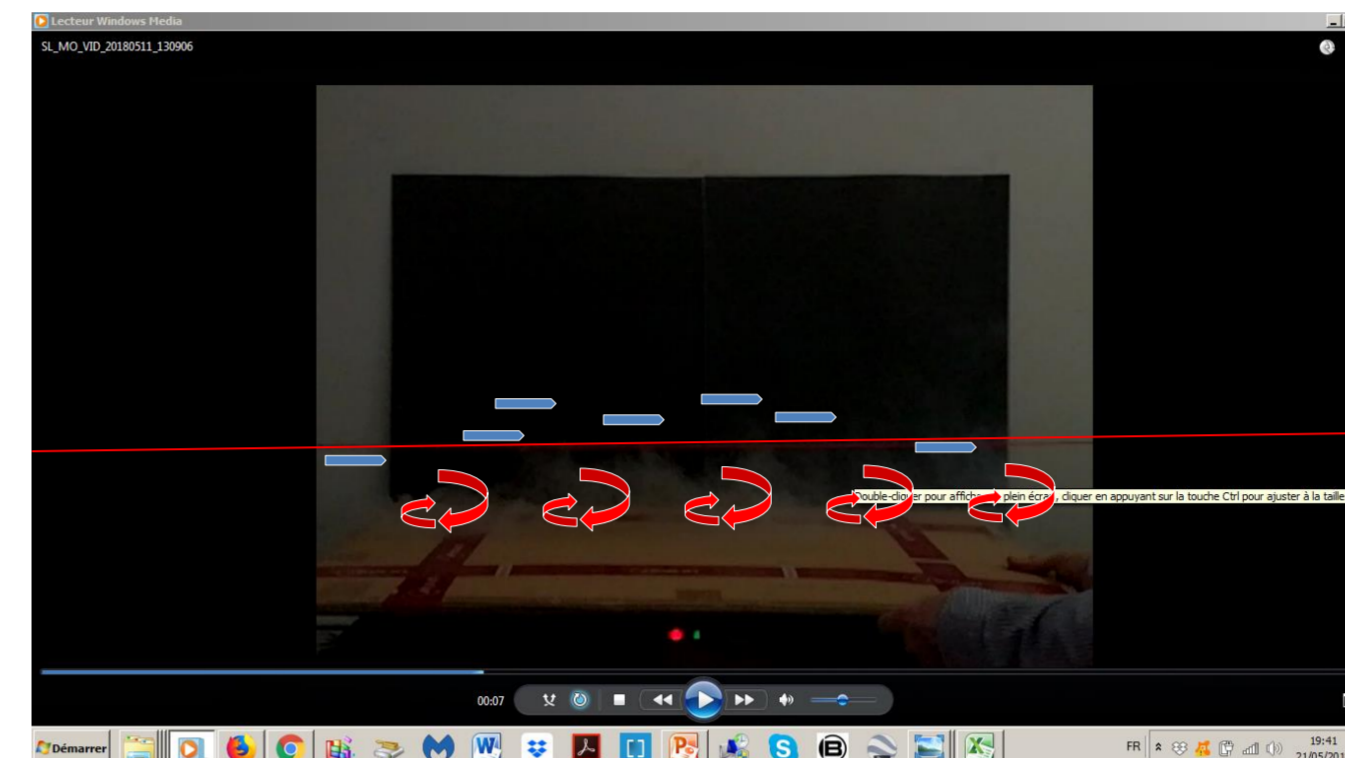
3 - Formation de turbulences : une turbulence est une zone d'écoulement où les particules de la masse d'air se déplacent de manière désordonnée. Ce désordre est causé par une source de chaleur ou différents obstacles : nature du sol, reliefs naturels comme les montagnes et les constructions comme les bâtiments.



4 - Formation de tourbillons : les tourbillons sont des masses d'air qui se déplacent en tournoyant de façon désordonnées. Ce déplacement est dû à une dépression qui se produit en général après un obstacle de grande taille.

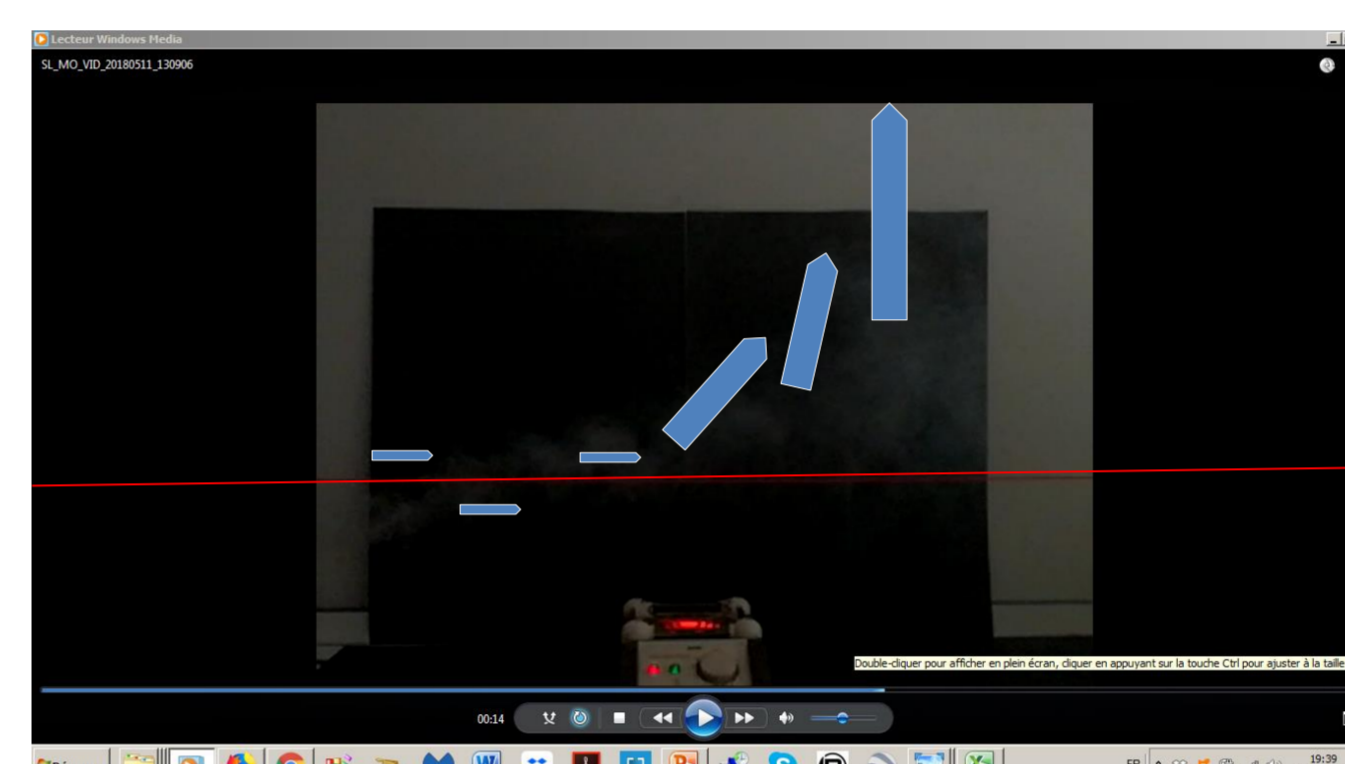
Analyze of the pictures from the observation films

The different movements of the air mass are symbolized by the color of the arrow: blue: laminar, yellow: turbulent; red: swirls.



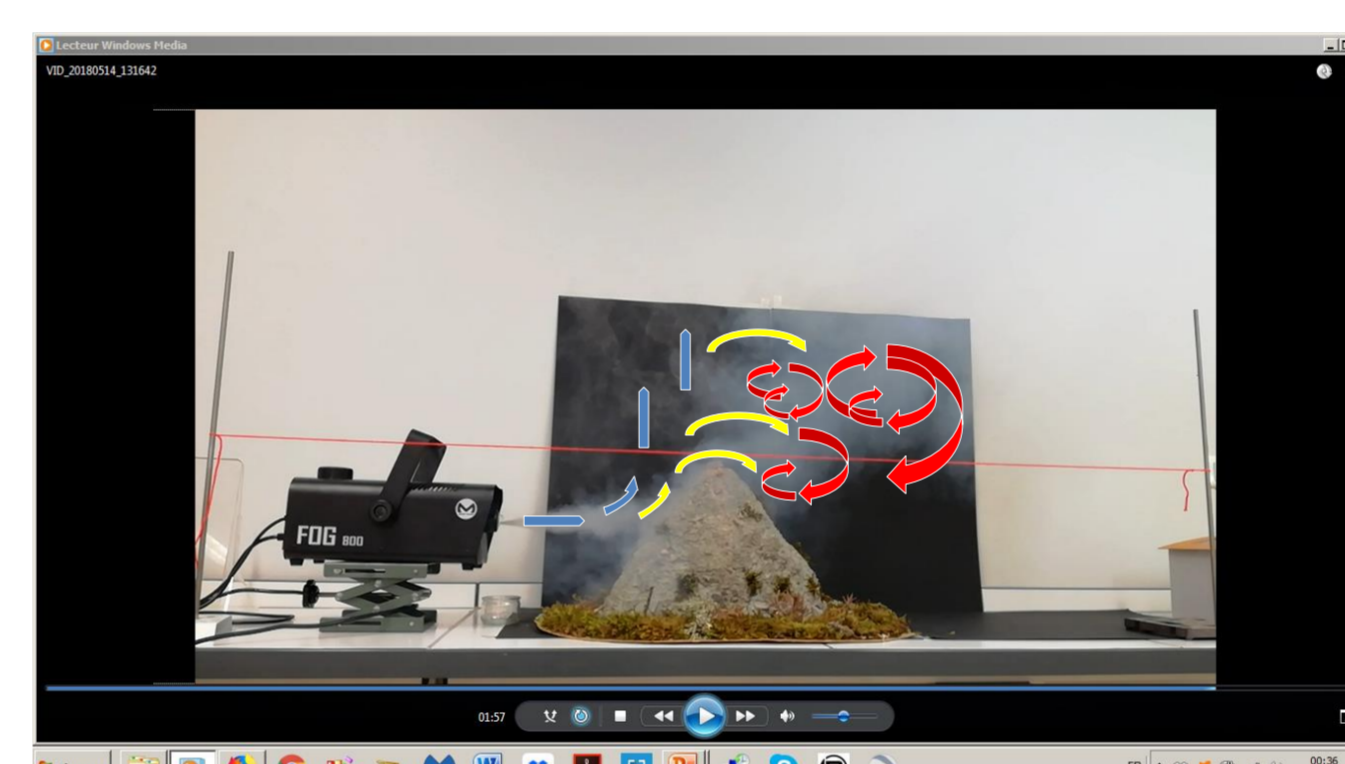
Laminar flow: above the reference red line the air mass displacement are laminar.

Below the red line is the nature of the soil (grass, bitumen, bushes, etc.) that will determine the formation of small turbulence.



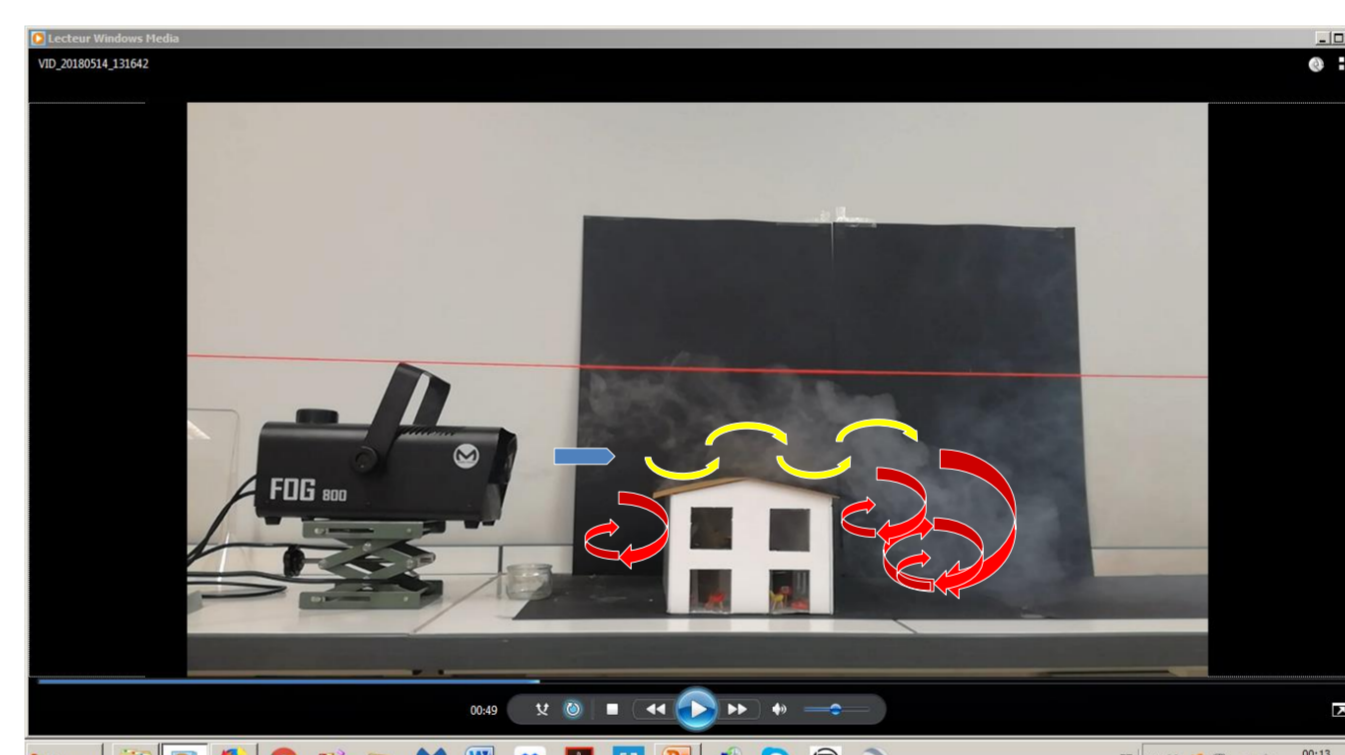
Evidence of a convection current through the passage of the air mass above a heat source. The heat air goes-up over the plate and rises behind depending the wind speed.

Birds and gliders use these streams as lifts to keep themselves in the air.



When the mass of air meets a natural relief, the mass of air rises on the face downwind, it becomes turbulent passing the top and produces vortices on the other side. As with convection currents, birds and gliders use these lifts called dynamic flying.

They avoid the swirl zone created by a depression more or less strong depending the wind speed.



When a mass of air meets a building, there is turbulence on the leeward side because of the overhang of the roof. Turbulence occurs at the top of the building and swirls occur behind the building in the depression zone.

The installation of a chimney is determined by the prevailing wind and the inclination of the roof.

Next steps

After those kind of observations, we want organize new experiences for be able to observe the different kind of pressure.

Internet reference

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