Design Project – SIE 2023

Investigating the History of Dioxins Pollution in Lausanne

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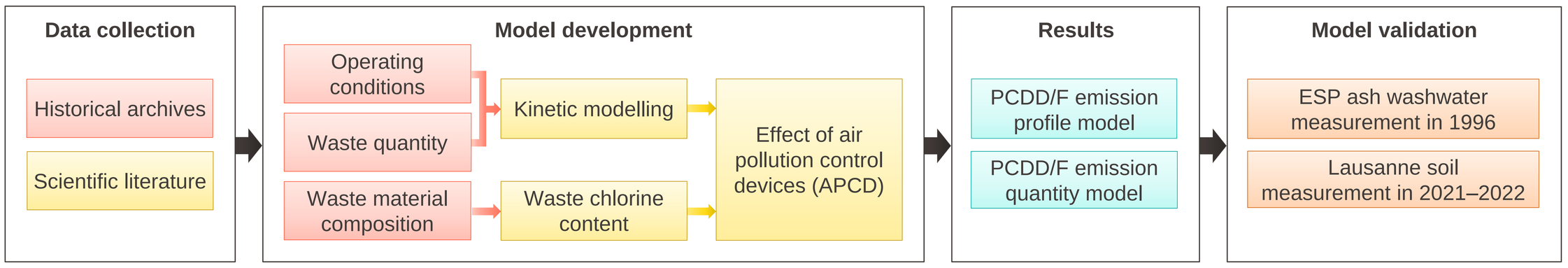
Context

- High concentrations of polychlorinated dibenzo-*p*-dioxins and furans (PCDD/Fs) were measured in Lausanne soil between 2020 and 2022
- The possible source of pollution is the former municipal solid waste incinerator (MSWI) of Lausanne located in Vallon

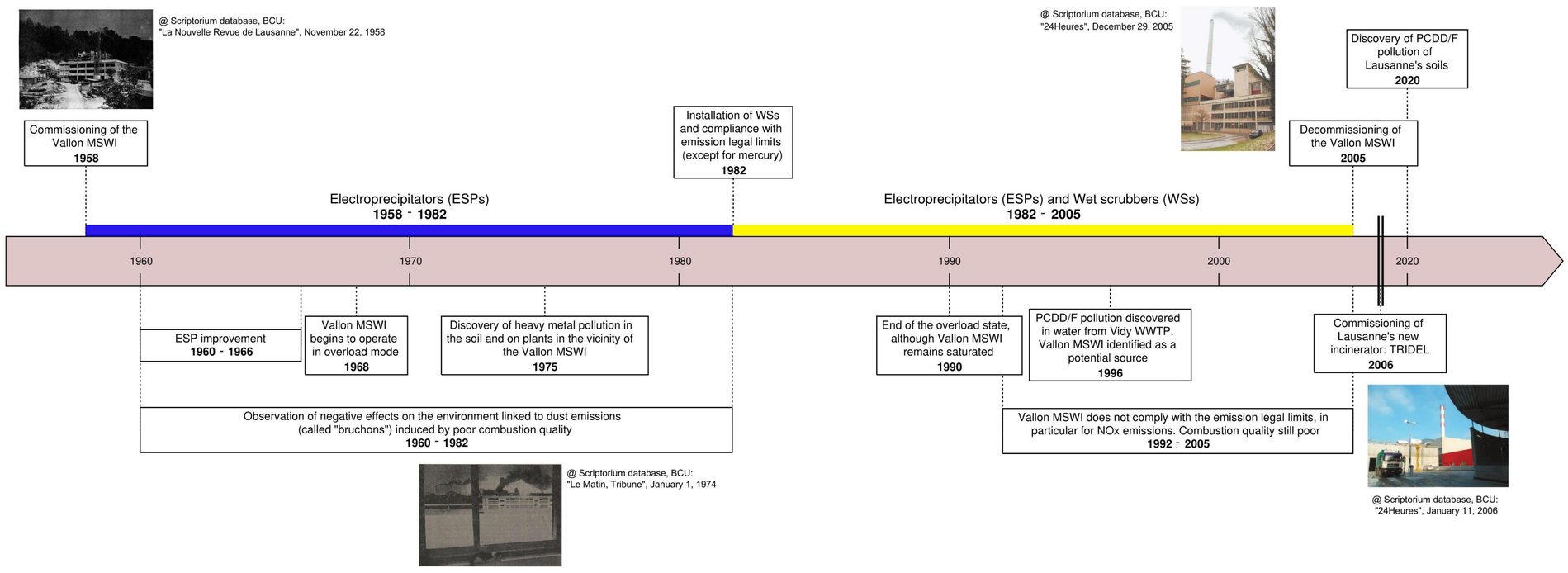
Objective

- Reconstruct the temporal evolution of PCDD/F stack emission levels and congener profiles at the Vallon MSWI
- Identify the contribution of Vallon MSWI to the soil PCDD/F pollution in Lausanne

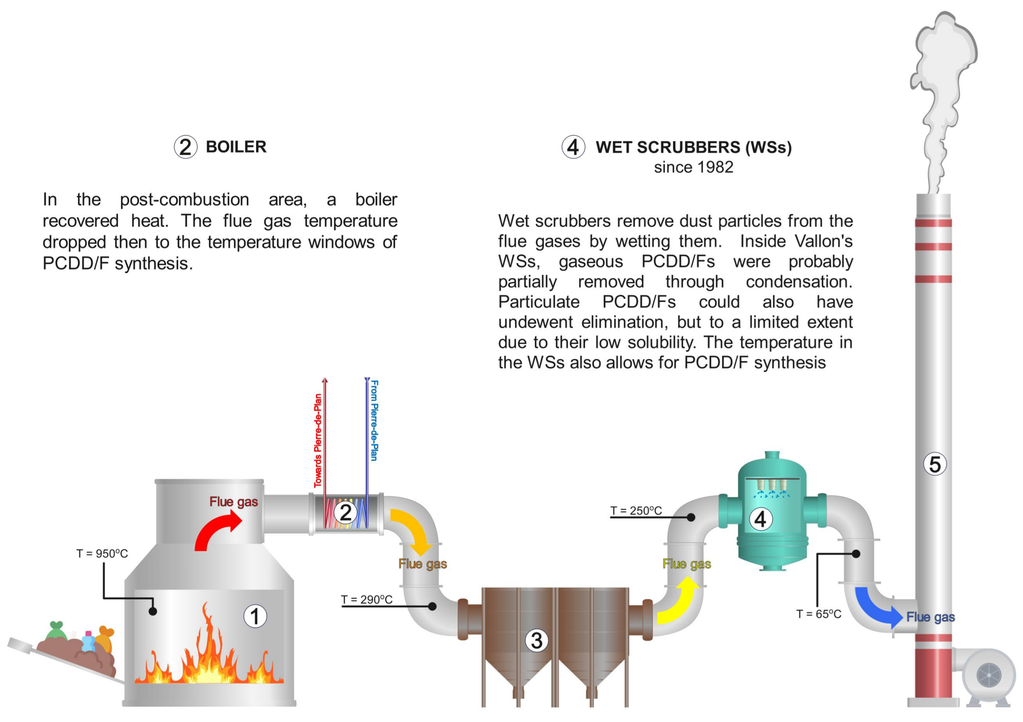
Methodology



History of Vallon MSWI



Technical process of Vallon MSWI



① FURNACES "Von Roll"

The Vallon MSWI had two "Von Roll" furnaces that operated from October 6, 1958 to December 29, 2005.

② BOILER

In the post-combustion area, a boiler recovered heat. The flue gas temperature dropped then to the temperature windows of PCDD/F synthesis.

③ ELECTROPRECIPITATORS (ESPs) since the beginning (1958)

Electroprecipitators aim to remove particles from the flue gases. Inside Vallon's ESPs, particulate PCDD/Fs were probably slightly removed, while many PCDD/Fs were produced due to the favorable temperature.

④ WET SCRUBBERS (WSs) since 1982

Wet scrubbers remove dust particles from the flue gases by wetting them. Inside Vallon's WSs, gaseous PCDD/Fs were probably partially removed through condensation. Particulate PCDD/Fs could also have undewent elimination, but to a limited extent due to their low solubility. The temperature in the WSs also allows for PCDD/F synthesis

⑤ EXHAUST STACK

The flue gases were finally released into the atmosphere from a 80m high stack.

Model output and validation

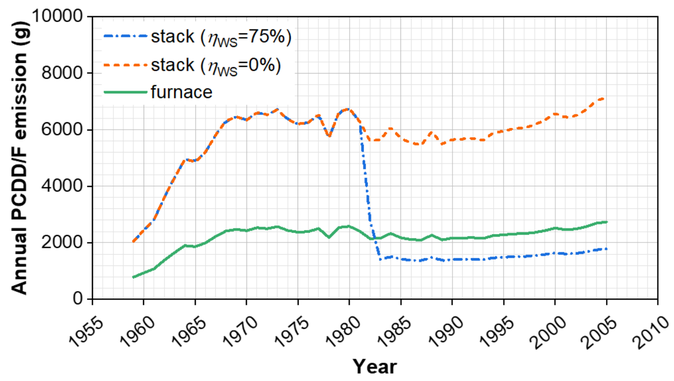


Fig 1. Estimated annual furnace production and stack emission of PCDD/Fs at Vallon MSWI over 1958–2005, with two cases of WS removal efficiency (η_{WS})

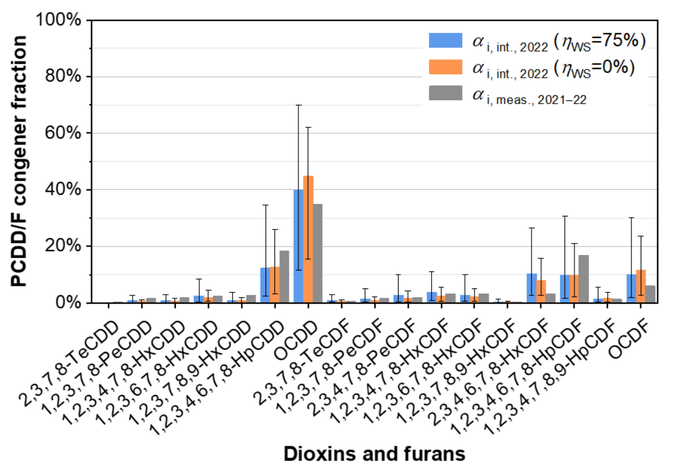


Fig 2. Soil PCDD/F profile derived from measurements in 2021–2022 ($\alpha_{i, meas., 2021–22}$) and modelled for 2022 ($\alpha_{i, int., 2022}$). Error bars correspond to the 2.5% and 97.5% quantiles from 1,000,000 simulations with random sampling on the half-life of PCDD/F congeners

Conclusion

- Vallon MSWI is confirmed to be the primary source of soil PCDD/F pollution in Lausanne by the model
- Measured PCDD/F congener fractions in soil fall within the range of simulated values
- Measured PCDD/F quantity (370 gTEQ) is on similar magnitude with the modelled range (845–1420 gTEQ)
- This model can aid in further analysis of historical human exposure