From Paris to London, post accidental dispersion modelling of a single point source release: The Lubrizol case study

Harmo 16, 8-11 september 2014, Varna, Bulgaria,
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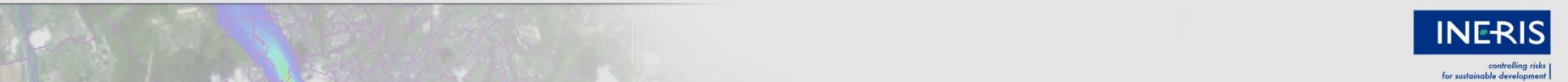
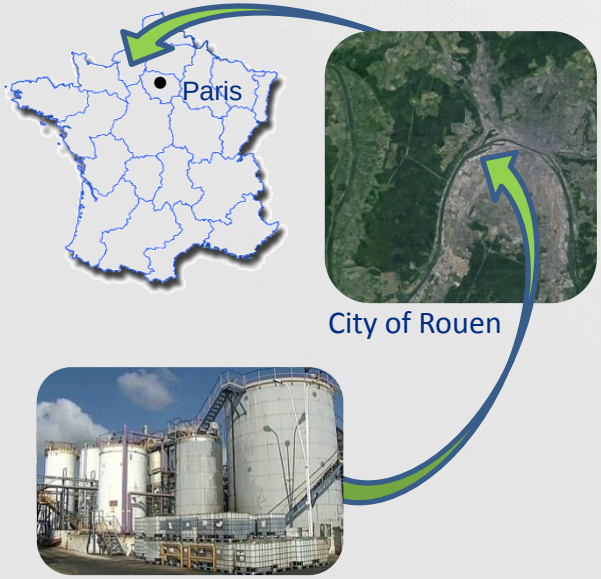


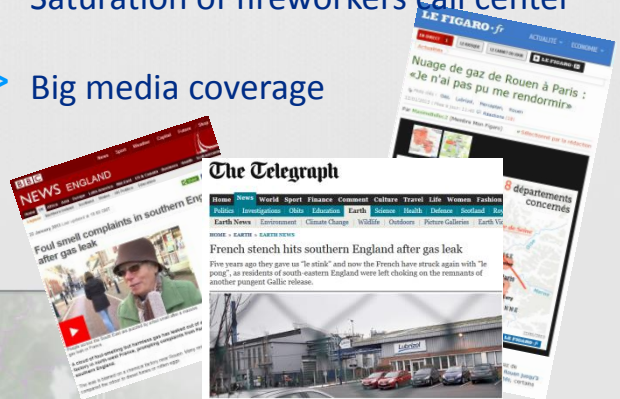
What happened ?

Where ?



What ?

- Uncontrolled reaction resulting in sulfur compounds release (mercaptan)
- Odour of gaz smelt from Paris to London: Lots of complaints recorded by Air Normand and anti poison center.
- Saturation of fireworkers call center
- Big media coverage



When ?

- Major release starts on **21st of january at 8am** and ended on the **22nd of january at 10pm**
- **Long period of neutralization** of the reaction inside the cuve.
- Deplhine Batho French minister on environment announced the **end of operations on 6th of february**

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Authorities involved and requests

> **AUTHORITIES**

From regional authorities to French ministry of environment.

> **EMERGENCY RESPONSE**

CASU (emergency response unit from INERIS) called on monday 21th by both regional and national authorities for:

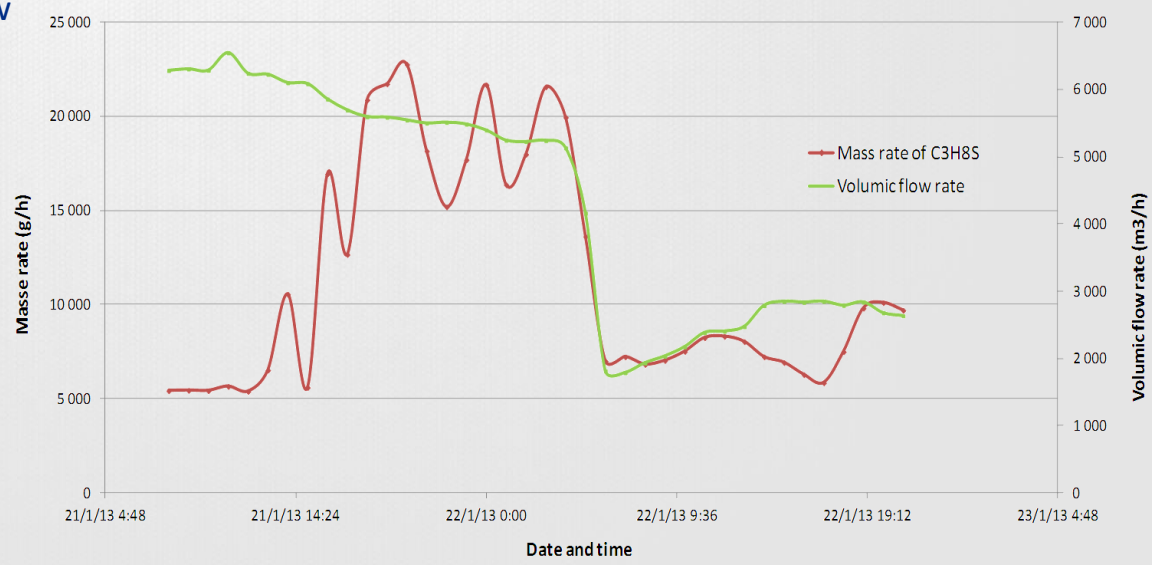
- Rapid diagnose of chimicals compound involved in the reaction and their toxicity.
- Measurements in the environment and at the source.

> **POST ACCIDENTAL RESPONSE**

- Reconstruction of the source term during the first 48 hours of the event
- Reconstruction of the evolution of the plume at two different scales (large scale and local scale)
- Comparison modelling results with the complaints recorded by both anti poison center and Air Normand.
- **Check that population has not been exposed to toxical concentration.**

SOURCE TERM RECONSTRUCTION

- **Tracer**: Isopropyl mercaptant **C3H8S** was chosen for simulations (highly fragrant nature et low toxicity)
- **Total amount of Isopropyl mercaptant** release was 431 kg and this mass was distributed according to Lubrizol and Apave measurements at emission.
- **Volumic flow rate (m3/s)**: from Lubrizol fan and Apave measurements
- **Other dynamic parameters**
  Stack height: 13m, diameter: 0.5m, Temperature: 30°C



Modelling set up

Large scale

- Domain FRANCE

- **CHIMERE model** at 2.5km resolution
- Land use : GLCF (1km)

Local scale

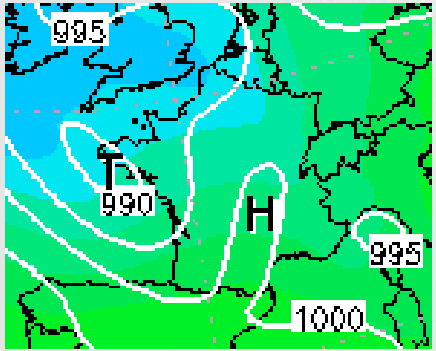
- 20km*20km around Rouen

- **MSS model** at 75m resolution
- Land use : Corine land cover (100m)

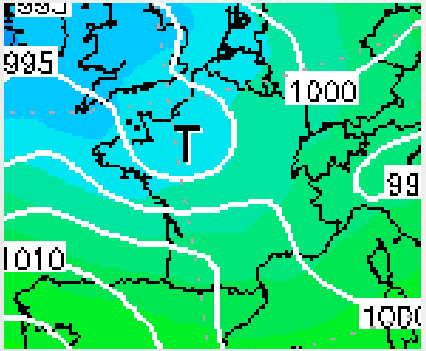
Assumptions for local scale modelling:

- Due to resolution, turbulence induced by specific building is badly represented.
- Topography from IGN (25m) : presence of hills around the Seine.

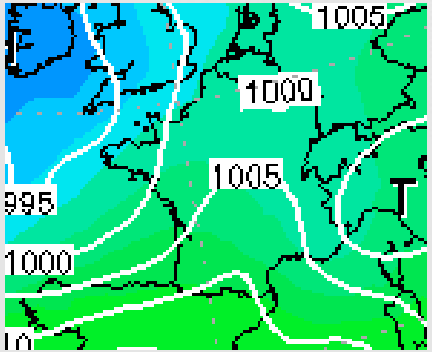
Meteorological overview



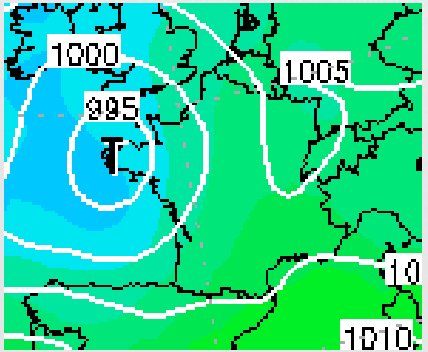
21st 00Z



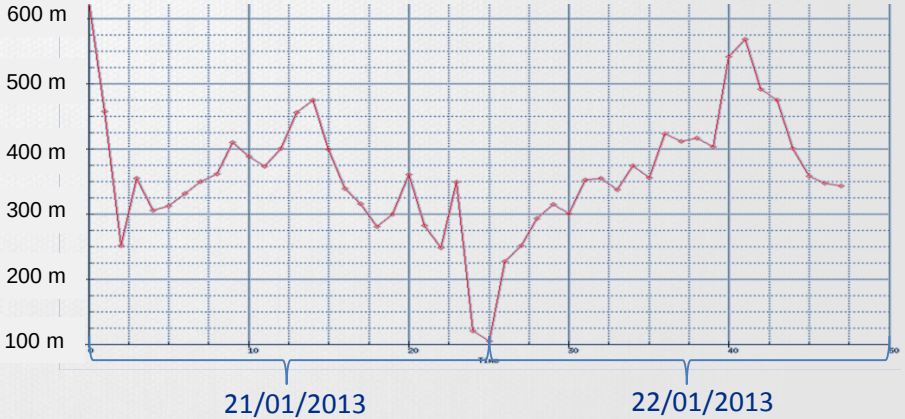
21st 12Z



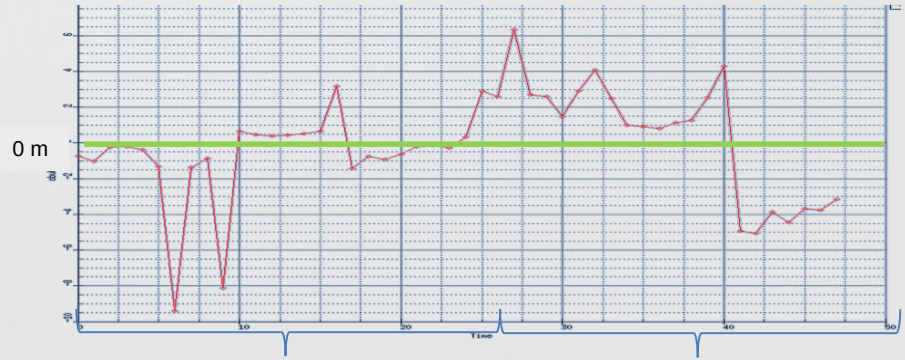
22nd 00Z



22nd 12Z



Boundary layer height



Monin -Obukhov length

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Meteorological Forcing

Large scale (CHIMERE)

- CHIMERE model was forced by the **Meteo France AROME** model **forecast 00Z** for each day

  AROME is at 2.5 km resolution (same as CHIMERE for this domain)

- AROME model is forced by the Meteo France **ARPEGE model** (Global).

Local scale (MSS)

- **Meteo France AROME** are also used.
  - 1 vertical profile for (u, v, w, T) in the center of the domain.
  -9 vertical profiles for (u, v, w, T)

  Then Micro SWIFT preprocessor was run.

- **Simple hybrid reconstruction**

  -Wind direction taken **from the station** as an input for SWIFT reconstruction
  -Wind velocity on the vertical profile is adapted **from AROME** gradient.

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SPATIAL AND TEMPORAL EVOLUTION OF THE COMPLAINTS

Numerous complaints collected :

> 238 complaints recorded by **Air Normand**

> 51 complaints from **anti poison center** and french Institute for public health surveillance.

For each complaint :

> **Time of the nuisance**

> **Exact address of the nuisance**

Results : Confrontation of dispersion modelling results to registered complaints

Three animations are presented:

- 1) results from the **large scale simulation : CHIMERE model forced by AROME.**

Then **the local scale results : Two simulation were carried out**:

- 2) **MSS forced by AROME**
- 3) **MSS forced by hybrid reconstruction**.

For the lowest concentration contour of isopropyl mercaptan, we choose a threshold of 6x10-3 ppb, which is the lowest odor thresholds known for this compound.

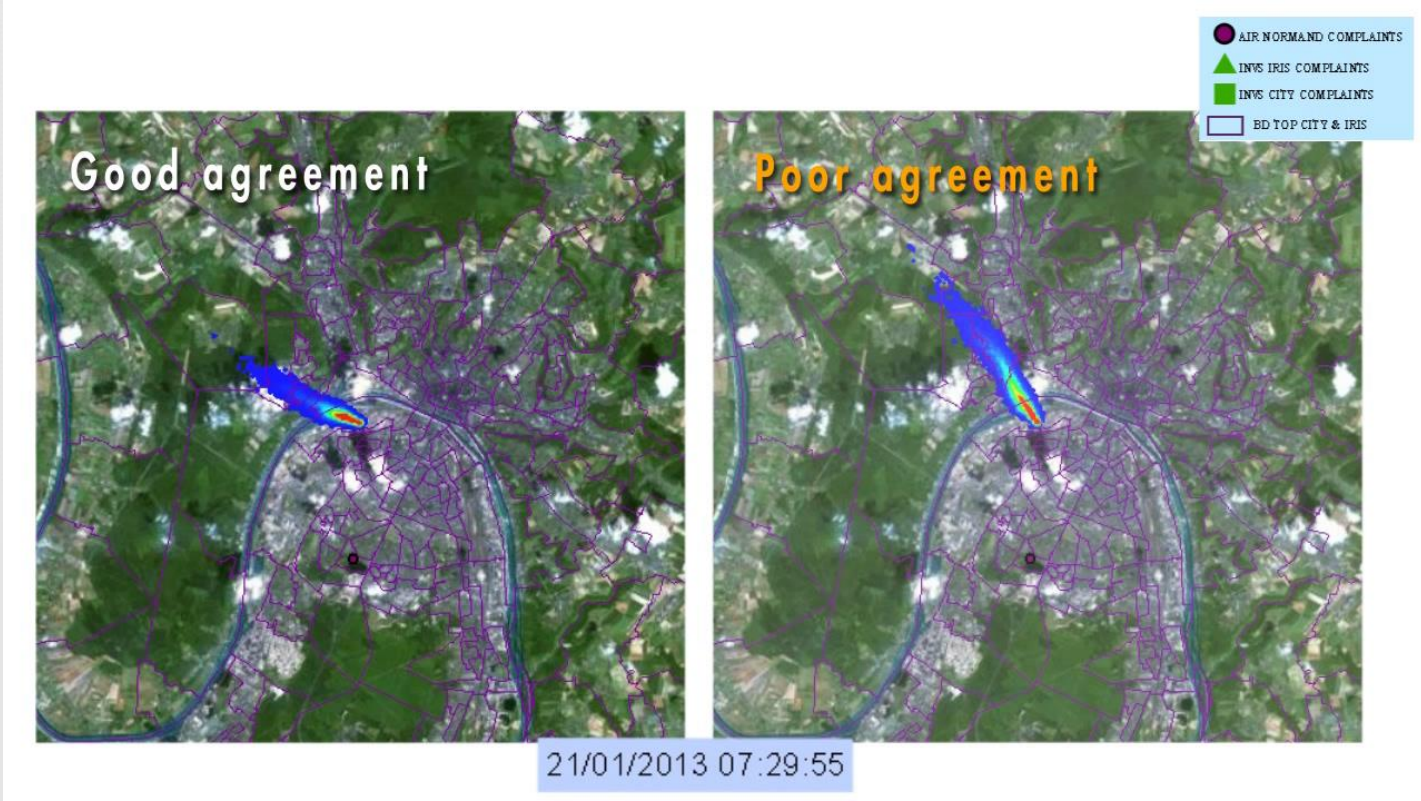
Large scale results

1) CHIMERE forced by AROME

Local scale results

2) MSS forced by AROME

Comparison between the two met input data set



2) MSS forced by AROME

3) MSS forced by hybrid reconstruction

Main results and conclusion

- **On large scale modelling**, simulations are in **good agreement with the complaints** apparition

- **On local scale modelling**, simulations are in good agreement for the first day OR for the night but we did'nt succeed in having good agreement for both period.

- **On exposition**

  Hourly maximum concentration modelled is **1.2 ppm at 100 meters from the release**. This has to be compared with the value of 20ppm for 8 hours exposition for methylmercaptan which is much more toxic (Anti Poison Center).

- **On met input data**

  What is relevant for the large scale simulation to get good agreement with the complaints **is not necessary relevant for the local scale modelling !**

Conclusion and perspectives

- This study gives answers to the initial questions of the authorities

- But this raises more questions for us:
  - whate are the appropriate met data to use? (forecast, analyse, reanalyse ?)
  - where can I find this appropriate data?

  This case study gives the opportunity to investigate with Meteo France the best meterological data set available in case of emergency or post accidental study .

  As a consequencie AROME forecast is now available 4 times a day and not only once for emergency and post accidental purposes. This should improve the quality of the simulation at local scale.

- Reinvestigate this case study by testing the sensitivy with different AROME input data set.

THANK YOU

for your attention !