

An integrated tool to FORECAST and REDUCE refinery contribution on SO₂ pollution peaks

Application on Donges refinery

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Agenda

- ▶ How to avoid SO₂ peak ?
- ▶ A specific and operational modeling platform to avoid pollution peaks
- ▶ Donges refinery results

SO₂ : Air quality Regulation aspect

► Emission limitation :

- Quota for the refinery (ex: 30 tons SO₂ per day)
- Maximum concentration (ex : 1800 mg/m³ SO₂) at stack exhaust

► Air quality : European legislation -> French decree 2002-213 -

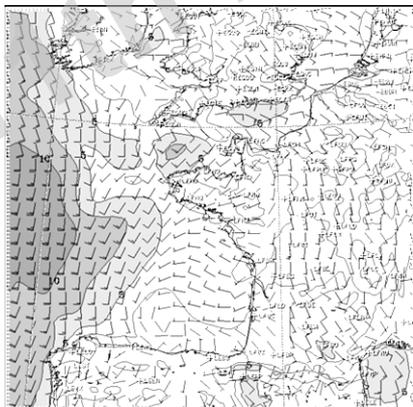
15/02/2002 : SO₂ regulatory levels :

- Annual average concentration : 50 µg/m³ SO₂
- SO₂ peaks :
 - Information level 300 µg/m³ during one hour
 - Alert level 500 µg/m³ during three hours

The unsustainable situation

- 2004 : The Donges refinery, under Local authority (DRIRE) pressure, needs to reduce SO₂ impact, too many peaks above Information level

	1999	2000	2001	2002	2003	2004
Seuil de recommandation et d'information (300 µg/m ³ en moyenne horaire)	40	23	19	36	39	20
Seuil d'alerte (500 µg/m ³ en moyenne sur 3 heures consécutives)	1	0	1	0	2	1



How to avoid SO₂ peak ?

► Constant action :

- Quota reduction, non realistic according to economic aspect
- New De-Sox units, increase stack heightYES but in 2009

↳ **Not sure to be efficient to solve all peaks :**

For many plants, the annual average impact is already significantly lower than regulation limit. Nevertheless, in some critical meteorological conditions, pollution peaks may occur.

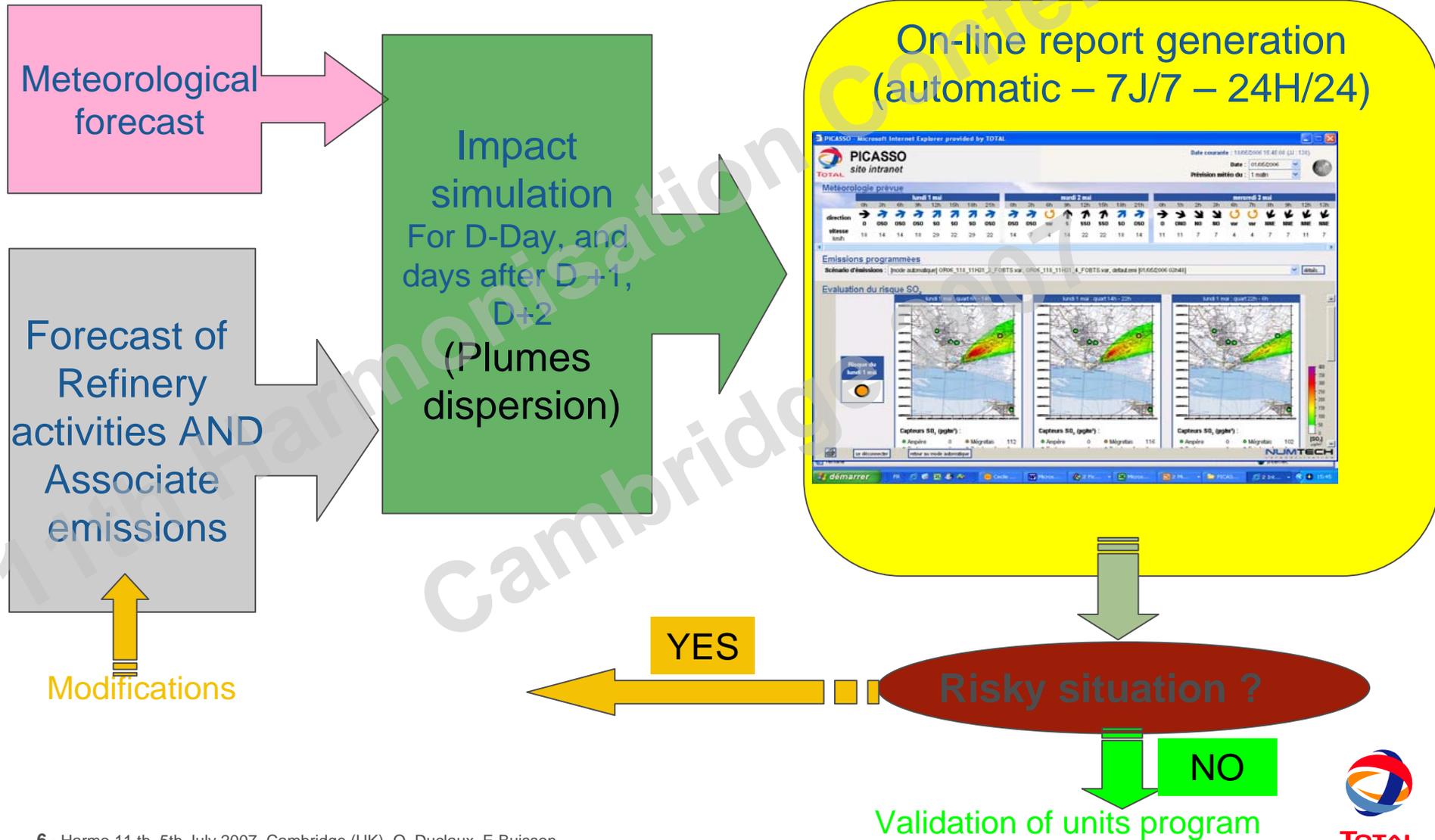
► Temporary and specific emission reduction :

- Identification of local critical meteorological conditions
- Choice of the best emission reduction strategy **at the good time**

► Total Research center (CReS) answer :

- J-1 and J-2 forecast of SO₂ impact taking into account refinery operations and meteorology

Principles of the forecast system

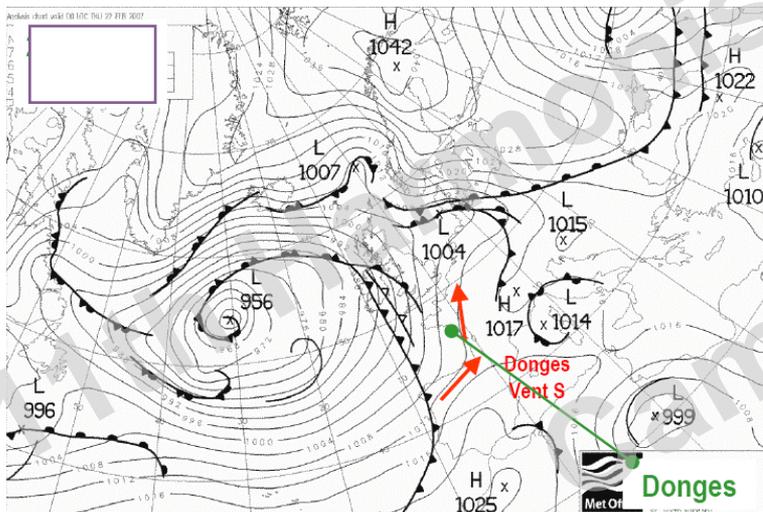


The 3 Keys stages : meteo forecast / dispersion / refinery implication

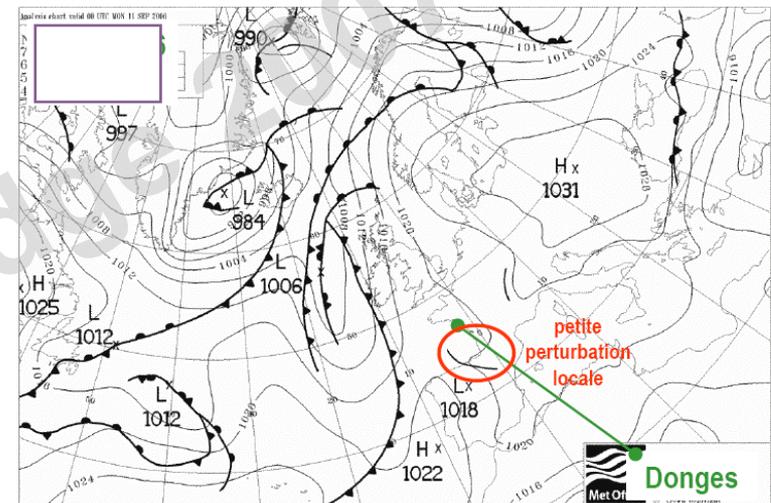
- Understanding of Specific Meteorological situation

- Peak on Donges city :

Arrival of oceanic depression



Anticyclonic situation



- Is it possible to forecast these Specific Meteorological situation evolution ?

The 3 Keys stages :

meteo forecast / dispersion / refinery implication

➔ **Nested simulation grids**

➔ **Automatic meteorological Simulation (provided 24h/24).**

➔ **Detailed and complete information.**

The 3 Keys stages :

meteo forecast / dispersion / refinery implication

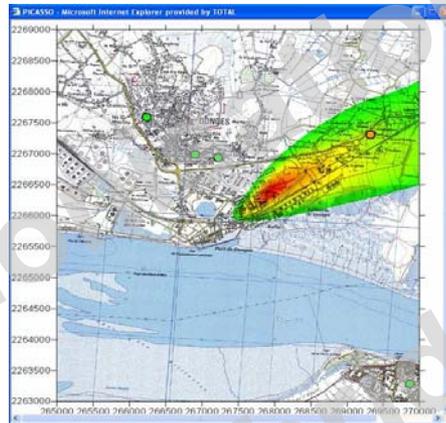
- Comparative tests of different models and configurations (MM5, RAMS) during winter 2004 :
 - Performance assessment of daily forecast during 3 months :
 - Comparison with measurements (direction and wind speed, temperature, ...)
 - Statistics on more than 60 000 data : choose RAMS

	Wind Direction	Wind Speed	Temperature
<i>Tolerance</i>	20°	1m/s	1°C
MM5-conf1	66 %	69 %	82%
MM5-conf2	45 %	67 %	77 %
RAMS	59 %	67 %	56 %
<i>Tolerance</i>	30°	2m/s	2°C
MM5-conf1	72 %	94 %	87 %
MM5-conf2	58 %	83 %	88 %
RAMS	76 %	89 %	75 %
<i>Tolerance</i>	40°	3m/s	3°C
MM5-conf1	77 %	99 %	96 %
MM5-conf2	70 %	95 %	91 %
RAMS	81 %	95%	98 %

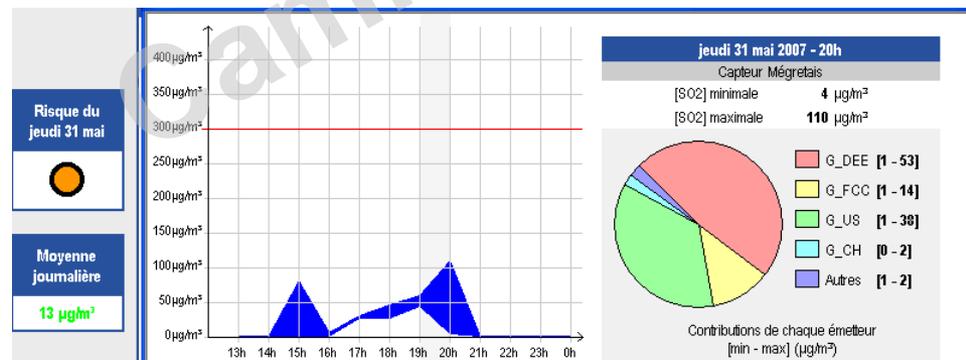


The 3 Keys stages : meteo forecast / **dispersion** / refinery implication

- Use of a dispersion model well-adapted to local configuration
 - ADMS3 : Gaussian model, flat area
 - Max. concentration forecast during the next day

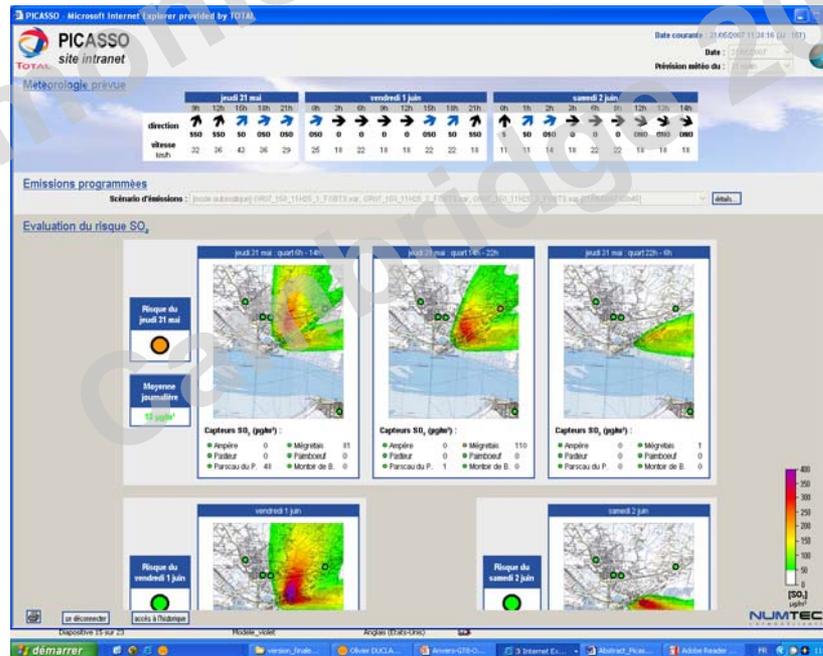


Contribution of each emitter and time series



The 3 Keys stages : meteo forecast / dispersion / refinery implication

- ▶ Meetings with all sectors (Energy, Planning office, Operation, HSE) to define the internal process actions and decision scheme
- ▶ Emission forecast coupled with internal planning tool
- ▶ Shared information – report available on intranet



On-line report on SO₂ peaks risk

PICASSO - Microsoft Internet Explorer provided by TOTAL

PICASSO
site intranet

Date courante : 18/05/2006 15:45:08 (JJ : 138)

Date : 01/05/2006

Prévision météo du : 1 matin

Météorologie prévue

	lundi 1 mai								mardi 2 mai								mercredi 3 mai									
	0h	3h	6h	9h	12h	15h	18h	21h	0h	3h	6h	9h	12h	15h	18h	21h	0h	1h	2h	3h	6h	7h	8h	9h	12h	13h
direction	→	↗	↗	↗	↗	↗	↗	↗	↗	↗	↻	↑	↑	↑	↗	↗	→	↗	↘	↘	↻	↻	↘	↘	↘	↘
vitesse km/h	18	14	14	18	29	32	29	22	14	7	4	14	22	22	18	14	11	11	7	7	4	4	7	7	11	7

Emissions programmées

Scénario d'émissions : [mode automatique] OR06_118_11H31_3_FOBTS.var, OR06_118_11H31_4_FOBTS.var, default.emi [01/05/2006 03h48]

Evaluation du risque SO₂

Risque du lundi 1 mai

lundi 1 mai : quart 6h - 14h

Capteurs SO₂ (µg/m³) :

- Ampère 0
- Mégretais 112

lundi 1 mai : quart 14h - 22h

Capteurs SO₂ (µg/m³) :

- Ampère 0
- Mégretais 116

lundi 1 mai : quart 22h - 6h

Capteurs SO₂ (µg/m³) :

- Ampère 0
- Mégretais 102

[SO₂] µg/m³

se déconnecter retour au mode automatique

NUMTECH L'ATMOSPHERE

On-line report on SO₂ peaks risk

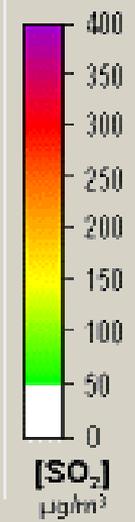
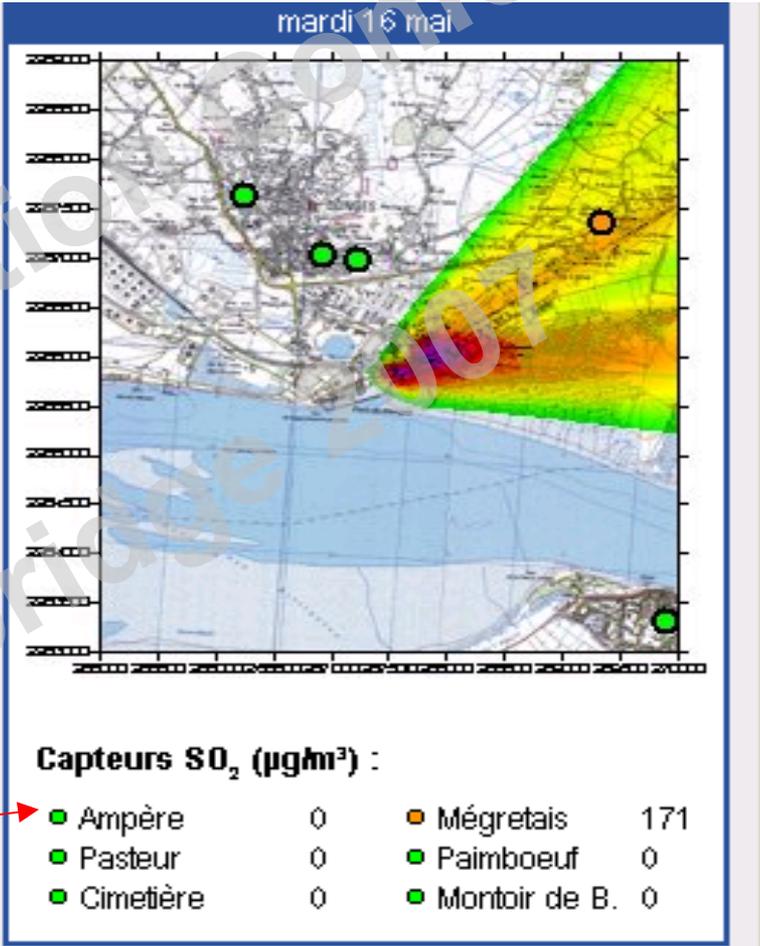
Description of one figure

Risk for one day

Risque du mardi 16 mai

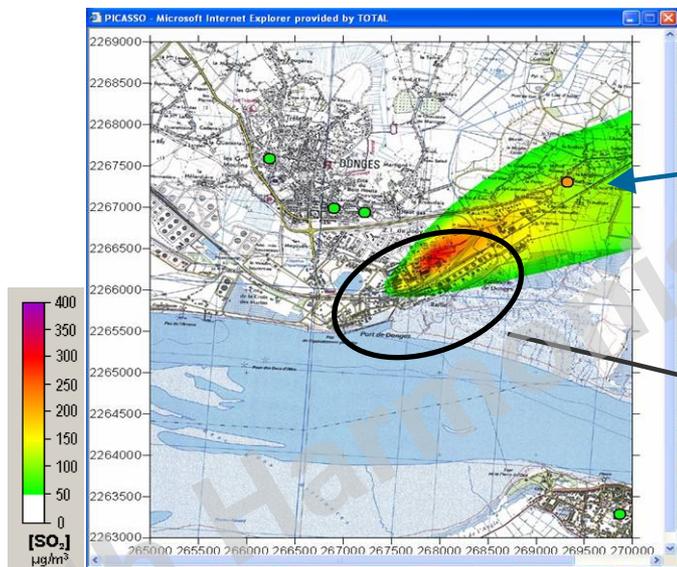


- 0 -100 µg/m³ : Green
- 100 - 200 µg/m³ : Orange
- > 200 µg/m³ : Red

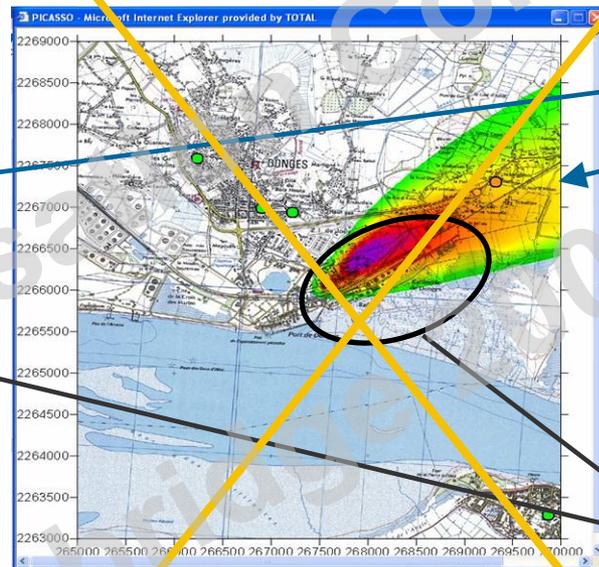


On-line report on SO₂ peaks risk

Example : Decision-making : 1st May, choose between 2 configurations



Configuration 1



Configuration 2

Prévisions :

Config 1 : [50:90]

Config 2 : [150:180]

Site boundary

- Decision thanks to prevision : Configuration 1 chosen
- Validation : Measurement = 66µg/m³.

Modeling tool performances for forecast

- ▶ After 18 months of on-line installation :

- **Well predicted peaks :** 80%
- **No-predicted peaks:** 8%
- **Peaks predicted with errors :** 12%
(error of time scaling or on peak intensity)

- ▶ Satisfactory of site management

tool performances in “real life”

Basse-Loire - Pollution au dioxyde de soufre
Nombre de journées de dépassement des seuils d'information et d'alerte

	1999	2000	2001	2002	2003	2004	2005	2006	2007 (au 18/5)
Seuil de recommandation et d'information (300 µg/m ³ en moyennes horaires)	40	23	19	36	39	20	17	14	9
Seuil d'alerte (500 µg/m ³ en moyenne sur 3 heures consécutives)	1	0	1	0	2	1	0	0	0

Feasibility research study

System operational in the refinery

Increase of peaks, due to meteorological conditions very unfavourable
(warm winter) (more than 10 peaks avoided)