



Nowcasting in Swansea

Air Quality driving congestion control or
A weather driven Public Health intervention

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Health evidence on air quality

- Even stronger – see latest COMEAP report especially for $PM_{2.5}$
- Mortality, cardio-pulmonary, lung cancer
- Causal link for mix with $PM_{2.5}$
- SO_2 NO_2 O_3 still important



Health evidence

- Loss of > 8 months life expectancy
- Underestimate – add morbidity
- US study on teenage lung development
- Is there an O₃ threshold?
- Metals & nanoparticles
- Hong Kong study SO₂ effect



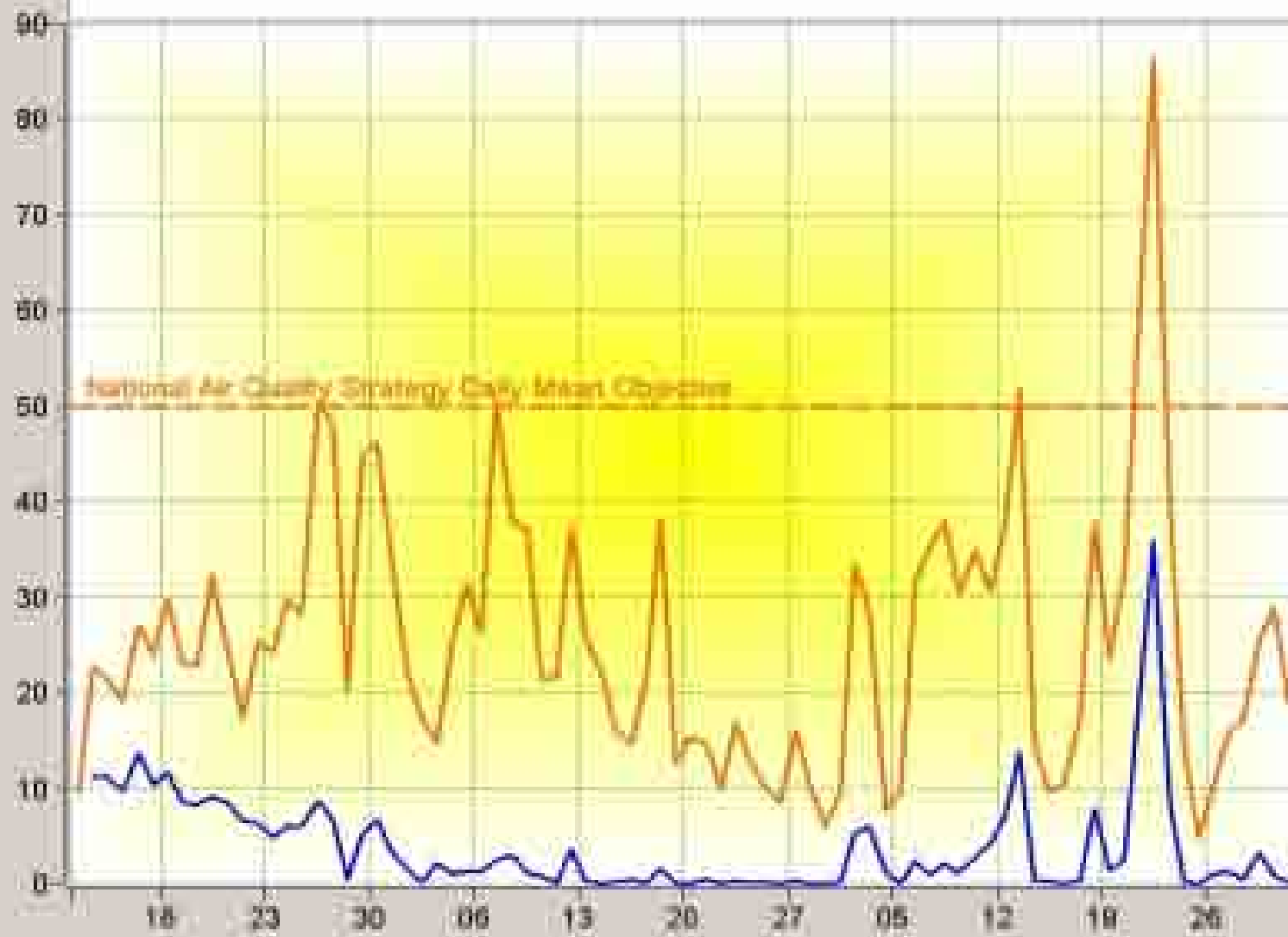
PM10 - Nursing Home (24 Hour Means) 10/01/2000 - 31/03/2000

ug/m³

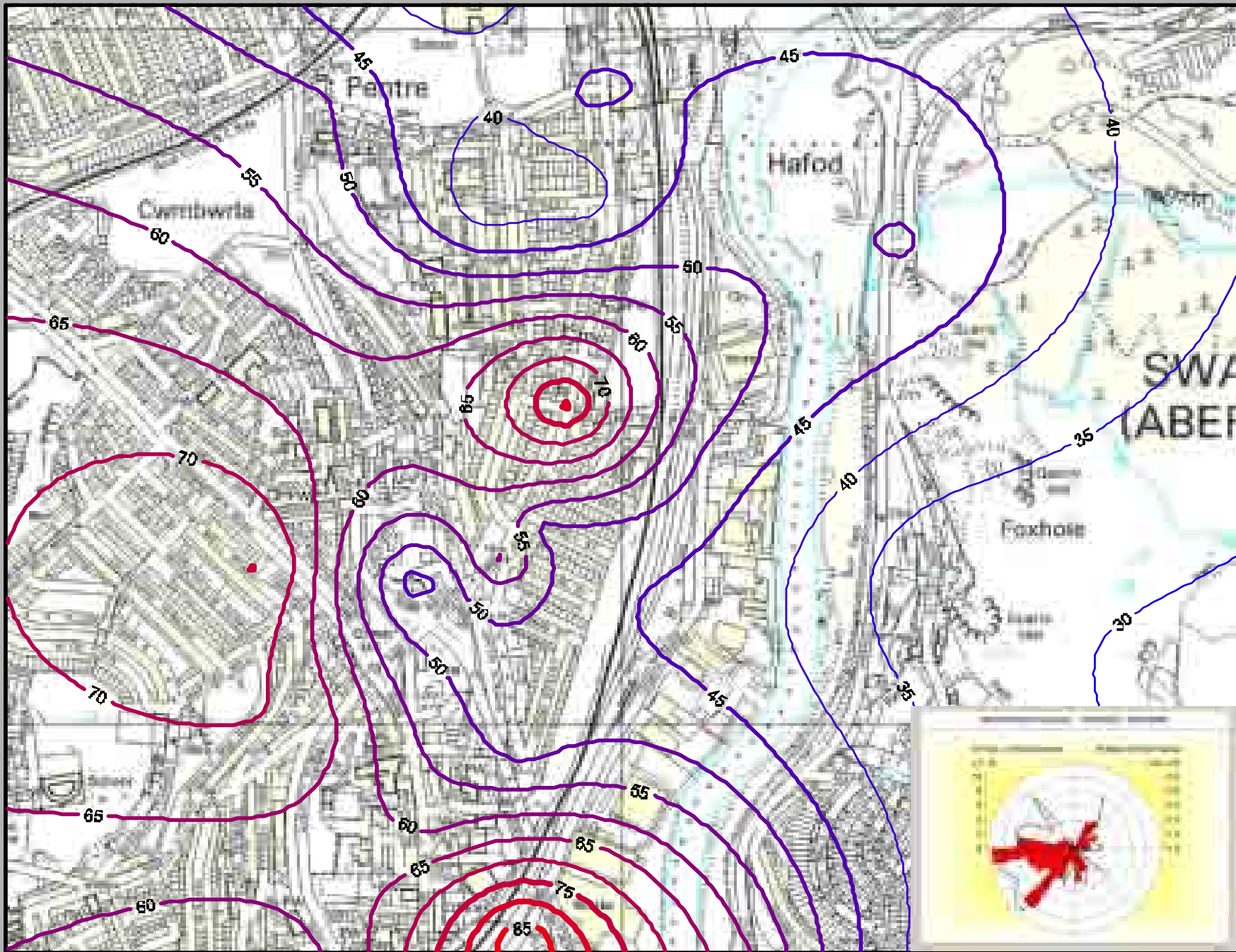
ug/m³

PM10 Garden Nursing Home

PM10 Internal Nursing Home



Pollution Control Division
Nitrogen Dioxide Survey April 2001 - March 2002
Hafod Area 13th - 20th February 2002 Week 46 - Isopleths given as ug/m³



Base Map Reproduced from the Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationary Office
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City & County of Swansea LA 09018L.

Isopleths given as ug/m³



Swansea AURN Roadside



- New AURN Monitoring Station
- 2 FDMS units (1 PM10 and 1 PM2.5)
- NO_x, SO₂, CO, O₃
- Feeds into UK and Welsh AQ forum website
- More on local sites but check with LA





What happens to the data?



- Stations are polled every hour
- Data collected via Opsis Software
- Stored on server
- Can be viewed in Reporter package to perform Stats
- On screen for up-to-date display
- Uploaded to the Web



Congested narrow streets

Nowcasting in Swansea



Neath Road, Hafod - on the valley floor



A "state of the art project" combining:

- ✓ Traffic monitoring
- ✓ Air quality monitoring
- ✓ Weather monitoring
- ✓ Emission mapping
- ✓ Internet & GPRS
- ✓ Variable Message Signs



The Nowcasting principles

We are setting up a combined monitoring and modelling system to diagnose the traffic situation, the weather situation as well as the air quality level in real time.

Using this information and probably extrapolating for the next few hours, we would like to advise the motorists to use alternative routes by informing them via radio, internet and traffic signs.

As a bonus effect we believe that the long term environmental awareness among the population will increase.



The new monitoring system

Nowcasting in Swansea

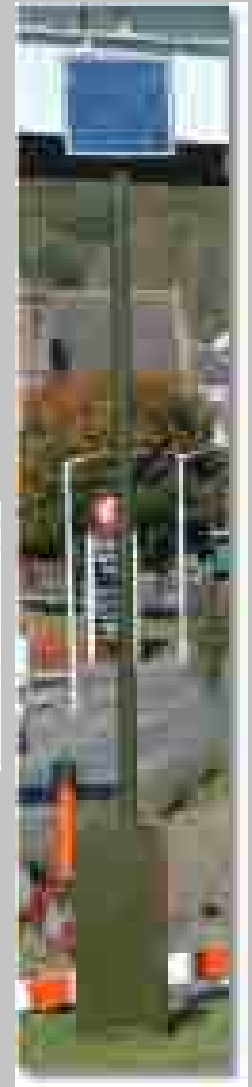
The following monitoring systems
are being installed to support the
Nowcaster concept...



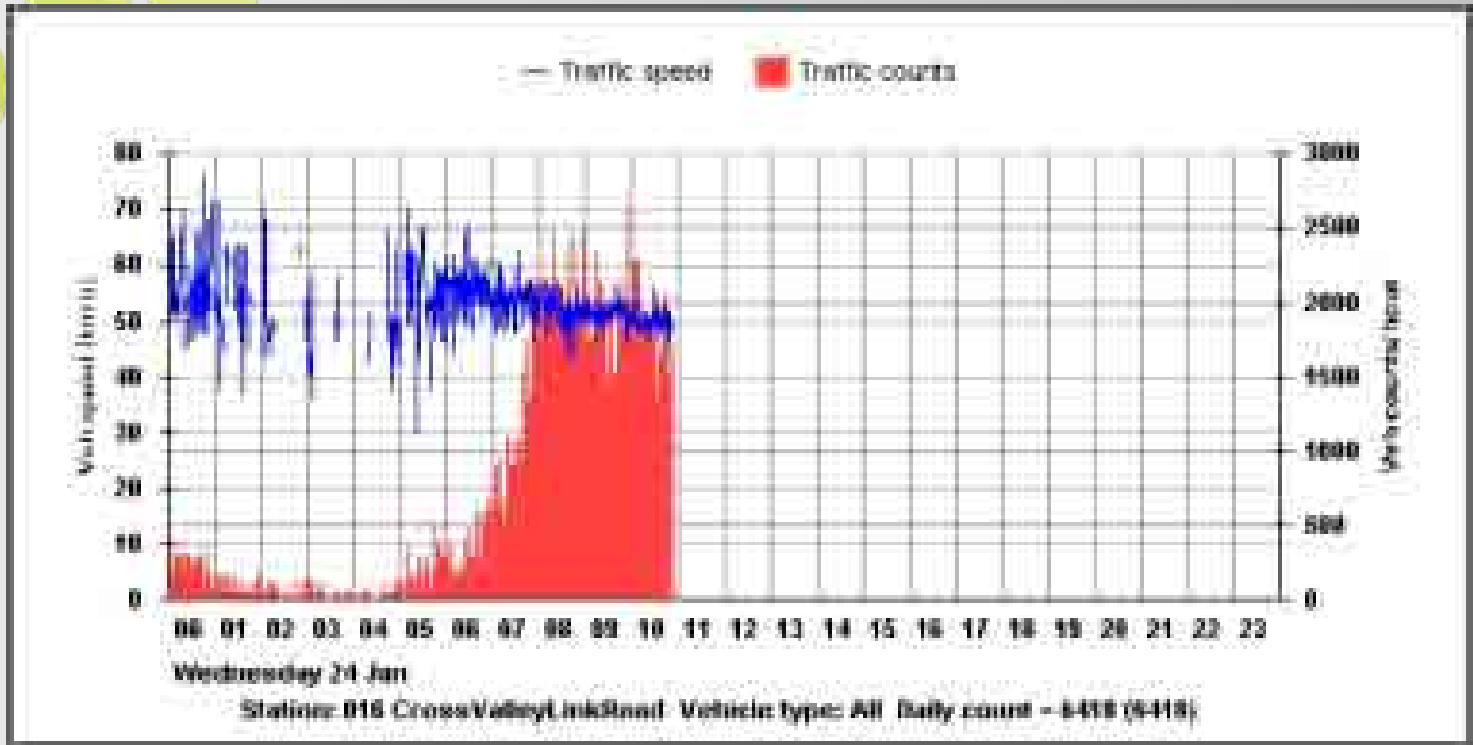
Traffic monitoring

44 traffic counters. Features:

- Monitoring 3-5 lanes at each site
- Individual vehicle identification
- 6 vehicle classes
- Speed detection
- Data transfer every 5 minutes
- Data transfer via GPRS
- No external power required (solar panels + battery)



Traffic monitoring



Traffic data (speed and flow) can be displayed for all stations in near real time (minute resolution every 5 minutes)



Traffic monitoring

10 radar based traffic counters. Features:

- Operated on battery
- Individual vehicle identification
- 3-5 vehicle classes (length based identification)
- Speed detection
- Used for one week campaigns at each site
- Providing infill detail for traffic mapping of smaller roads



Air Quality street monitoring (DOAS)

Nowcasting in Swansea

Measuring:

- NO
- NO₂
- O₃
- Benzene

Resolution: 5 minutes

Data transfer via the Internet (Broadband)

Two roadside DOAS has been installed



Weather monitoring in the street canyon

Detailed monitoring in the street + roof level

Measuring: 3-d winds, temperature and global radiation

Resolution: 1 minute

Data transfer every 5 minutes

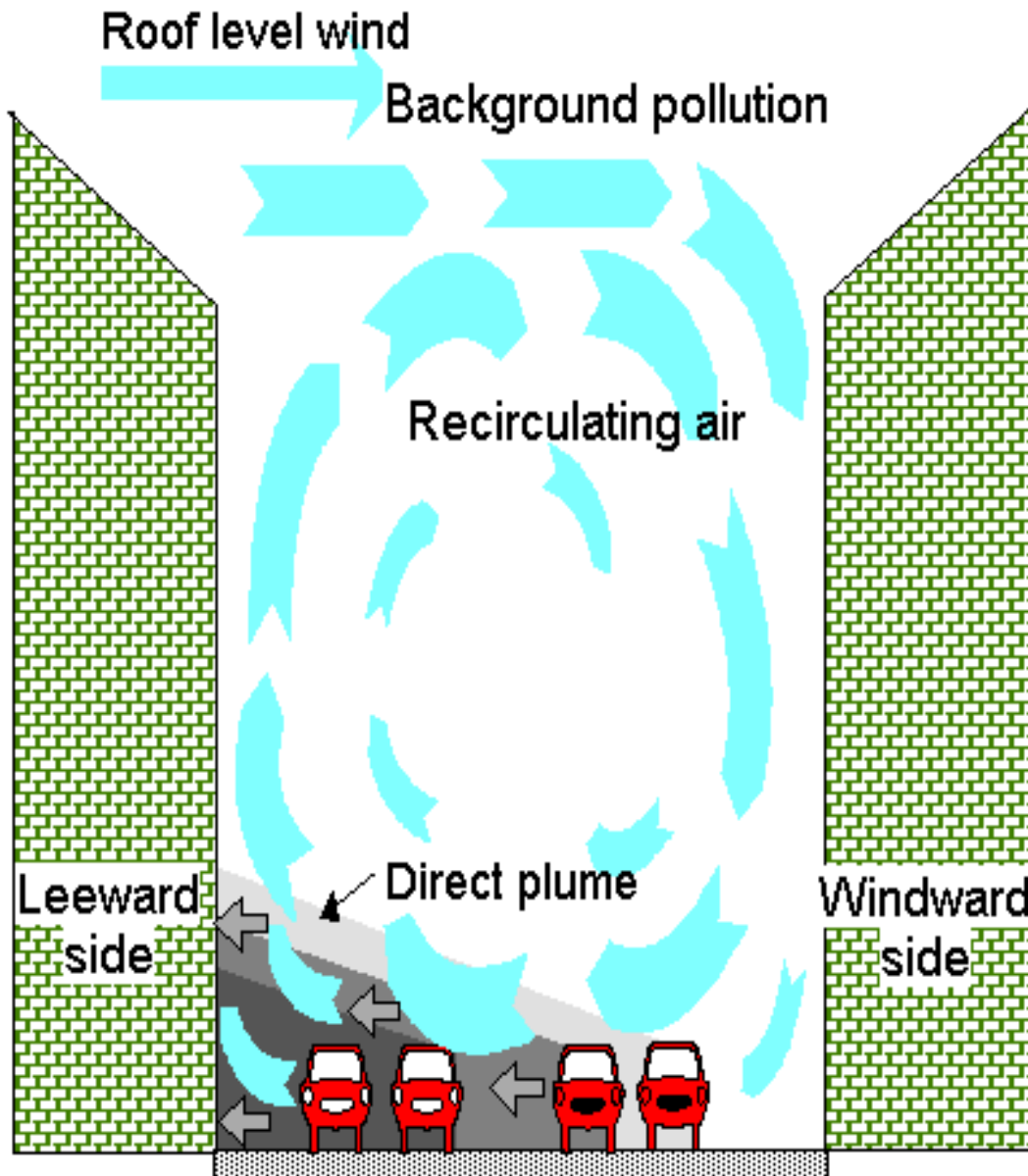


Street monitoring

The special monitoring at the Neath Road, Hafod will be used for:

- A detailed validation of emission/dispersion modelling
- Short time model updates
- Special studies of pollution in a street canyon
- Special studies of the wind/turbulence in a street canyon
- Testing new data transfer technique

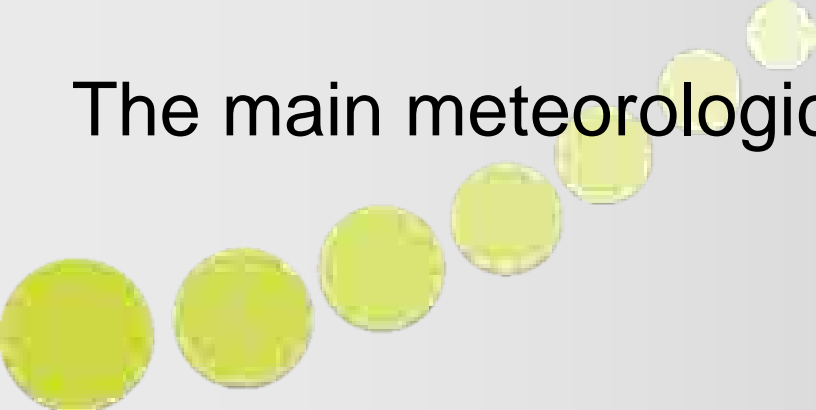




Resolution of 1 minute aids the definition of the vertices and mixing capacity of the street.

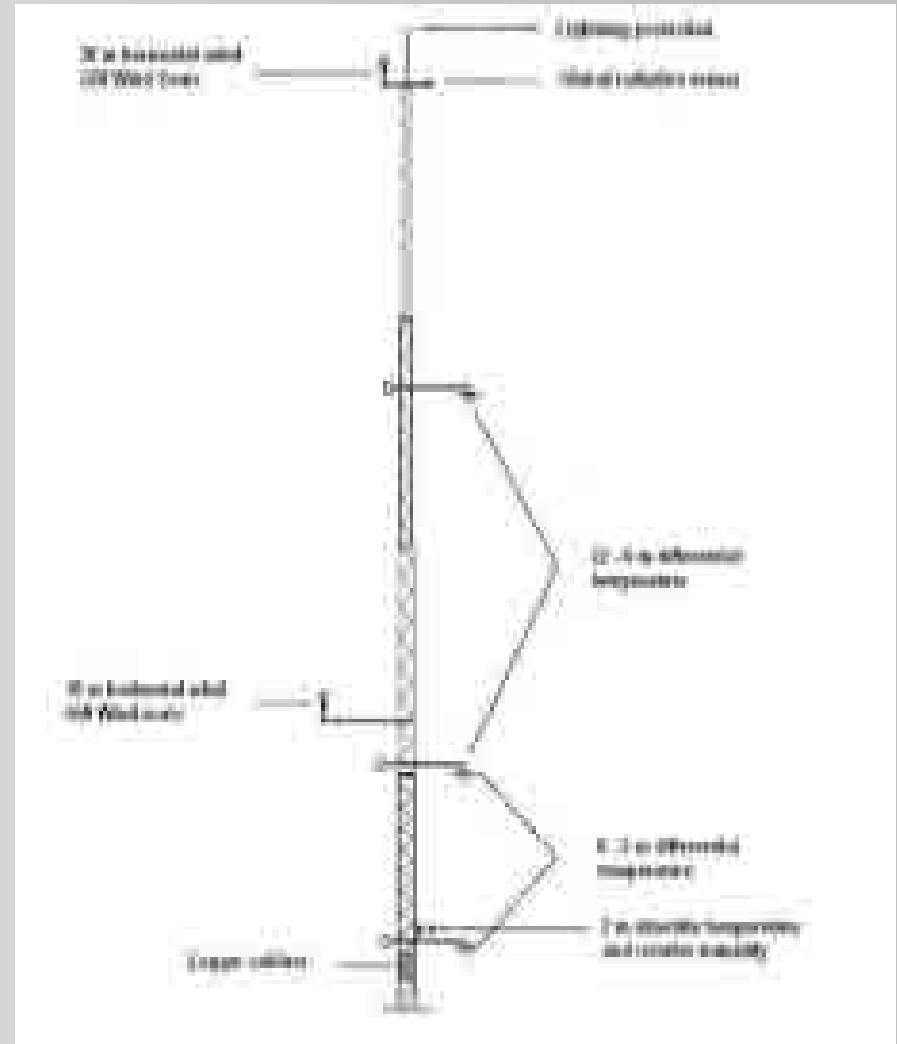
Helps to determine and evaluate the atmospheric chemistry responsible for the formation of NO_2 and ozone within the street.

The main meteorological mast



Weather mast 30 m

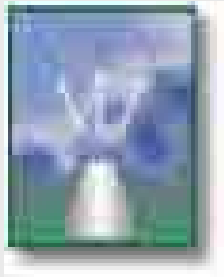
Measuring temperature and wind profiles in the lowest atmospheric layer in the valley



A vertical remote wind sounder

A SODAR has been installed to provide:

- Information about wind profiles up to 300m
- Increase the understanding of the complex wind variations due to topography and land/sea effects



Weather forecasts



- Four times a day, hourly weather forecasts (1-72 hours) are received from NERI - Denmark
- The weather forecasts will be used by the Nowcaster
- The weather forecasts are also presented for the general public on the Internet



The weather forecasts include the following parameters:

- Wind speed (10 m, 80 m and 800 m),
- Wind direction (10 m, 80m and 800m),
- Temperature (2 m, 80 m and 800 m),
- Mean sea level pressure,
- Precipitation (convective, stratisform and snow),
- Boundary layer height,
- Friction velocity, surface heat flux,
- Relative humidity,
- Cloud cover (low and high).



Swansea emission inventory

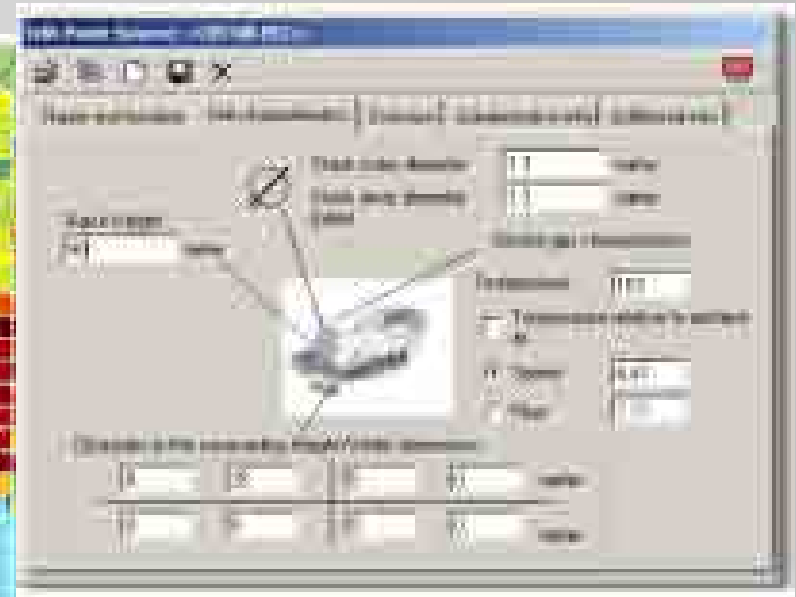
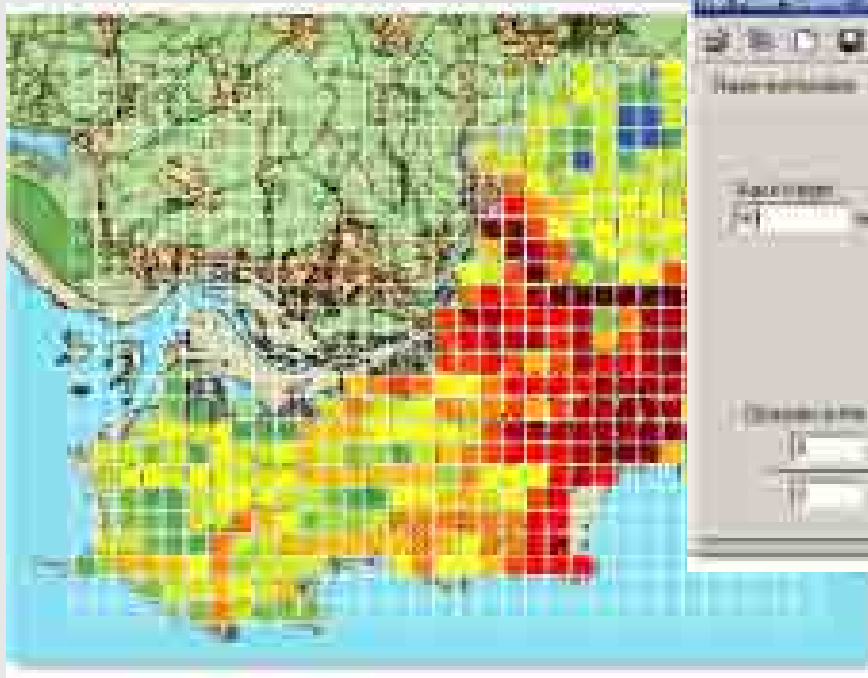
To provide the basic input for the modelling, a detailed dynamic emission database has been compiled including:

- Typical road traffic figures, vehicle composition and diurnal variation for the major roads in the city
- Industrial emissions
- Emissions from domestic heating, agricultural activities, waste disposal, shipping etc



Swansea emission inventory

- Industrial sources included as point sources (stacks) and grid sources
- All other non-traffic activities included as grid sources



- Map the important traffic links
- Add site descriptions for each traffic link (building height, road width etc)
- Introduce emission factors
- Set up initial traffic flows
- Set up daily flow profiles



The base modelling...

The basic emission database includes the bulk features of all emissions and can be used for dispersion modelling



The Nowcaster system

The Nowcaster system will:

- Utilise the basic emission database and update the traffic figures in near real time
- Use the monitoring data to improve the modelling
- Use the weather forecast in order to extrapolate conditions for the next few hours to come



The Swansea Nowcaster system

Nowcasting in Swansea

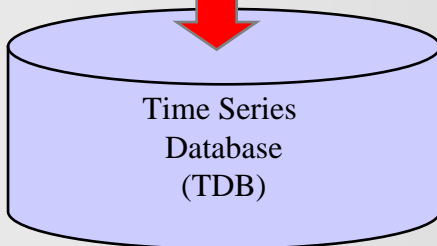
Air Quality (5 min)

Traffic (5 min)

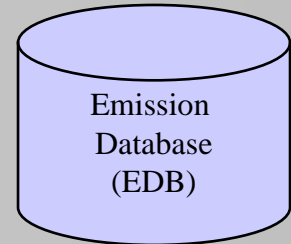
Weather (5 min)

Weather forecast (6 hours)

Data collection from monitoring stations and a weather forecast provider



Read the expected traffic volumes on all traffic links in the EDB and update the figures based on the sample of the most recent monitored traffic data

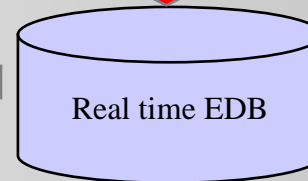


Compute emission for all traffic links using emission factors from the EDB

Air Quality observations

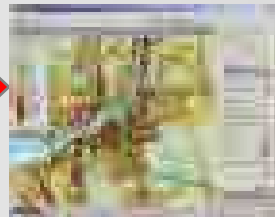
Weather observations
Weather forecast

The EnviMan Nested Grid and Street Pollution Model



Real time emissions

The adaptive modelling filter



Message generator



OPSIS



The users....



EnviMan System (2 computers located in a DMZ)

Internet

Local radio stations or direct to public

City Council:
Env. & Health

Highways dept.

Public Health / clinicians



- Forecasting ahead allows for some of the traffic to be redirected away from “failing” areas.
- Planned to incorporate information on parking spaces in the city centre as well as the park and ride sites at Landore, Port Tennant and Fforestfach.
- This information should allow the motorist to make an informed decision regarding their final destination.
- Nowcaster forecast can expand to match the areas where new GPRS ATC’s are established and where PM10 or 2.5 failures are likely.
- Can trigger health response via targeted e mail



Other information?

congestion/slow moving traffic ahead etc. as the system is able to detect the average speed of the traffic flow on any road link from the vehicle by vehicle GPRS speed data.

Information regarding weather conditions i.e. ice on road / roadwork's ahead / scheduled roadwork's next week/information can all be sent.

Climate change benefits - Structural - technical - political - media



Dissemination of data via the Internet

All monitoring data is uploaded every hour to our web pages at <http://www.swansea.airqualitydata.com>



The charting default presentation is via the index banded system – note the different colours within the chart and the explanation below the chart. The chart can be saved / printed or downloaded

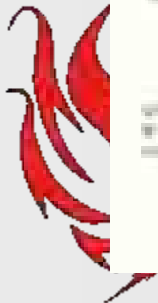
Swansea University
Air Quality Data

Legend

- Green: Good
- Yellow: Fair
- Orange: Satisfactory
- Red: Poor

Search and Filter options:

- Location: [Input field]
- Start Date: [Input field]
- End Date: [Input field]
- Filter: [Dropdown menu]
- Buttons: [Search], [Clear], [Print], [Download]



Updates via email of either charts or data can be sent on a user defined frequency for any parameter/monitoring station of choice

Nowcasting in Swansea

The screenshot shows a web application interface with a yellow navigation bar at the top. The main content area is titled "Email updates" and contains several sections of text, each with a red header:

- Daily updates:** A section describing daily data updates.
- Weekly updates:** A section describing weekly data updates.
- Monthly updates:** A section describing monthly data updates.
- Real-time updates:** A section describing real-time data updates.

At the bottom left, there is a small form titled "Your email address:" with a text input field and a "Submit" button. On the right side, there is a sidebar with a "Settings" section containing various options and a "Save" button.

The system has also been developed to allow automatic email alerts to be sent when a pollutant(s) of choice reach a user predefined level. Helpful for medical health professionals (ie PM₁₀ episodes ?) and the public who are known to be pre-disposed to suffer effects from elevated levels.

Email alerts

Find out how to receive an email alert when a pollutant level reaches a predefined level.

Receive an email alert when a pollutant level reaches a predefined level.

Receive an alert

Enter an email address to receive an alert when a pollutant level reaches a predefined level.

Enter email address:

Send

Select a pollution series

Select a pollution series to receive an alert when a pollutant level reaches a predefined level.

Pollutant	Location	Time
PM10	Swansea Bay	07:00 - 08:00
PM10	Swansea Bay	08:00 - 09:00
PM10	Swansea Bay	09:00 - 10:00
PM10	Swansea Bay	10:00 - 11:00
PM10	Swansea Bay	11:00 - 12:00
PM10	Swansea Bay	12:00 - 13:00
PM10	Swansea Bay	13:00 - 14:00
PM10	Swansea Bay	14:00 - 15:00
PM10	Swansea Bay	15:00 - 16:00
PM10	Swansea Bay	16:00 - 17:00
PM10	Swansea Bay	17:00 - 18:00
PM10	Swansea Bay	18:00 - 19:00
PM10	Swansea Bay	19:00 - 20:00
PM10	Swansea Bay	20:00 - 21:00
PM10	Swansea Bay	21:00 - 22:00
PM10	Swansea Bay	22:00 - 23:00
PM10	Swansea Bay	23:00 - 00:00

