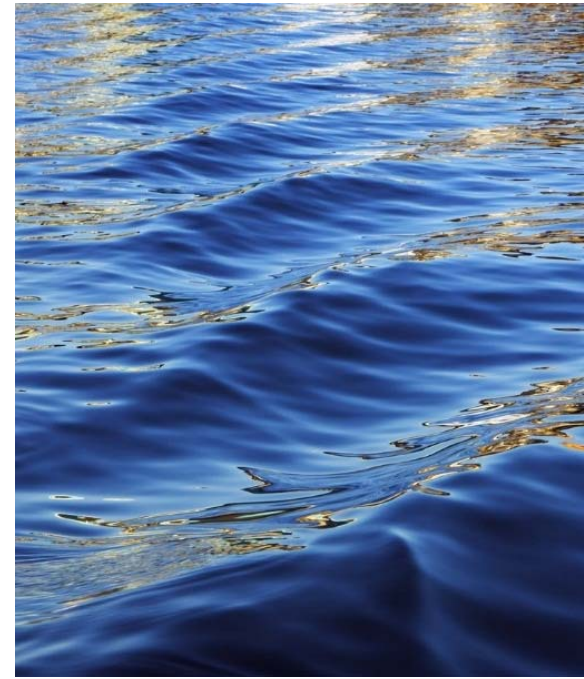




Case Study

Continuous Monitoring System at Metro Vancouver



Scentroid Divisions and Activities

Research Center



- Expert support to env. consultants
- Inter-laboratory Testing (ISO 17025)
- Association of Odour Professionals
- Research on new odour assessment methods
- Help with new policy development
- Development of new standards

Odour Academy



- Odour Expert Training
- Operator Training
- Certification
- Public Awareness
- Online Training
- Dedicated Training
- International Odour Management Conferences (OMCTS 2017 in LA on NOV1-3)

Products



- Field instruments
- Laboratory instruments
- Sampling equipment
- Monitoring equipment
- Real-time modeling software

Lulu Island



- 26 billion litres/yr.
- Primary treatment
- Serves about 600,00 residents of MV

Anaerobic digestion process.

Iona Island

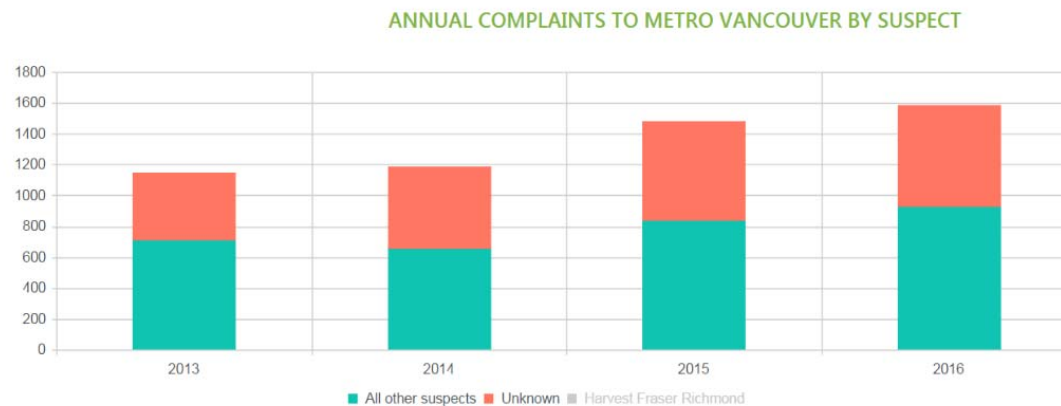


- 207 billion litres/yr.
- Primary treatment
- Serves about 600,00 residents of MV

Anaerobic digestion process

The problem:

- Odour complaints received by Metro Vancouver have been steadily increasing. Some complaints are originated from the WWTP but most are from waste disposal and composting.



While most of the impact has been in the City of Richmond, complaints have been received from as far as downtown Vancouver. A similar map for 2016 is available under "Related Links".

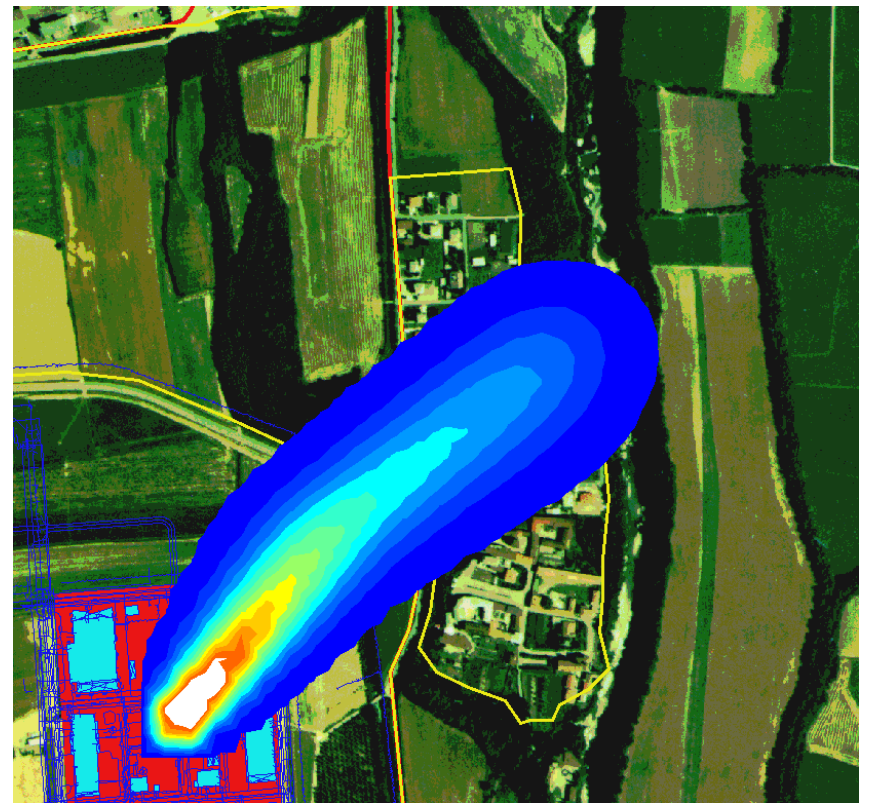
Previous Odour Monitoring Program

- Since 2012 MV has been conducting an odour monitoring campaign.
- The objective:
 - Validate complaint
 - Determine source of odour
 - Determine process variability leading to reduction in odour
 - Evaluate odour mitigation technologies in use.



Previous Odour Monitoring Program

- Campaign consists of:
 - Routine odour patrol of all sources (direct olfactometry)
 - Fence line monitoring when complaints are received
 - Offline dispersion modeling with new source data and metrological conditions at time of complaint.
 - Manual assessment of modeling data including complaint validation.



Need for Real-time Monitoring System

- Disadvantages of the manual campaign:
 - Delay between odour patrol and time of complaint
 - Daily data instead of hourly or minute by minute readings
 - Emission data is updated weekly
 - Extremely time consuming and costly.
 - Requires on-call staff 24/7
- MV decided to implement a new automated real-time monitoring system.



Common Pollutants of Interest in WWTP

Wastewater treatment air pollutants

- Main objective is to know odour concentration.
- Complete monitoring of all gases in an STP is impossible due to the low detection thresholds.
- Monitoring of odours will require finding reliable tracers that can correlated to the total odour concentration.

Inorganic and organic gases

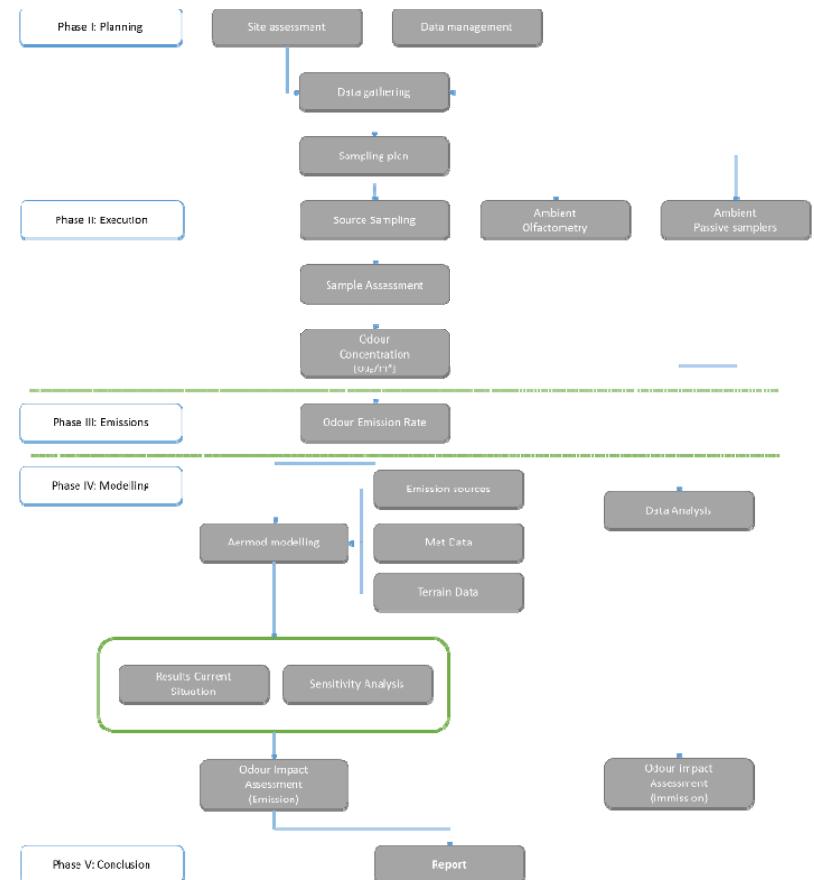
Compound Name	Formula	Human detection threshold (ppmv)	Odour Descriptor
Odororous nitrogen compounds			
Ammonia	NH ₃	17.000	Pungent, irritating
Metyl Amine	CH ₃ NH ₂	4.700	Putrid, Fishy
Ethyl Amine	C ₂ H ₅ SH	0.27	Ammonia-like
Dimethyl Amine	(CH ₃) ₂ NH	0.34	Putrid, fishy
Skatole	C ₉ H ₉ N	0.001	Fecal, nauseating
Odororous sulphur compounds			
Allyl mercaptan	CH ₂ =CH-CH ₂ -SH	0.0001	Disagreeable, garlic
Amyl mercaptan	CH ₃ -(CH ₂) ₃ -CH ₂ -SH	0.0003	Unpleasant, putrid
Benzyl mercaptan	C ₆ H ₅ CH ₂ -SH	0.0002	Unpleasant, strong
Crotyl Mercaptan	CH ₃ -CH=CH-CH ₂ -SH	0.00003	Skunk-like
Dimethyl Sulphide	(CH ₃) ₂ S	0.001	Decayed cabbage
Ethyl mercaptan	C ₂ H ₅ SH	0.0003	Decayed cabbage
Hydrogen Sulphide	H ₂ S	0.0005	Rotten Eggs
Phenyl mercaptan	C ₆ H ₅ SH	0.0003	Putrid, garlic
Propyl mercaptan	C ₃ H ₇ SH	0.0005	Unpleasant
Aldehydes and Ketones			
Acetaldehyde	CH ₃ CHO	0.067	Pungent, fruity
Formaldehyde	HCOH	0.370	Acrid, suffocating
Isobutyraldehyde	(CH ₃) ₂ CHCHO	0.0046	Rancid, sweaty
Acetone	CH ₃ COCH ₃		

Step 1

Design of Odour Monitoring System

➤ Complete odour assessment at the plant by:

- ✓ Odour patrol
- ✓ Chemical identification
- ✓ Source sampling VDI3880:2011
- ✓ Odour assessment EN13725:2003
- ✓ Aermol modelling
- ✓ Determine ideal location for monitoring stations.



Odour Patrol

- Operating conditions
- Field odour measurements- *ASTM- E679-91*
- Direct olfactometry- *EN13725:2003*
- Sampling Strategy - *ISO 10780:1994*
- Chemical Screening using TR8+



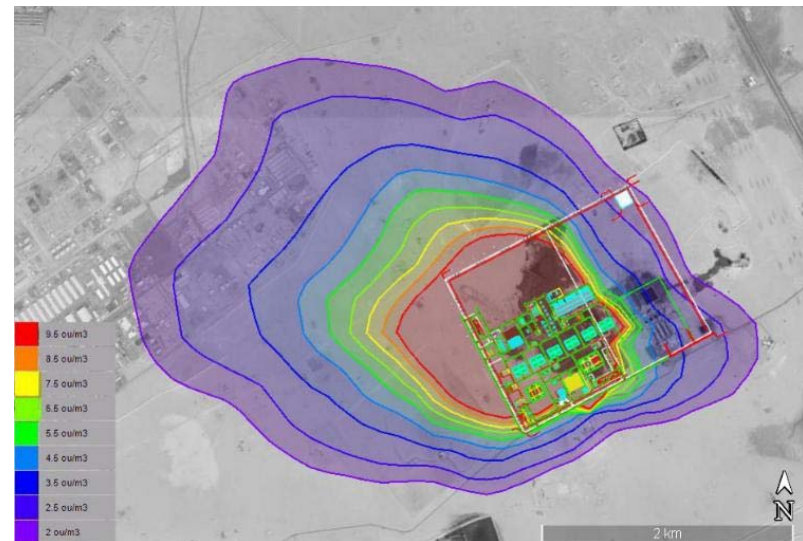
Odour Assessment

- All sampled bags were analyzed in accordance to EN-13725:2003
 - Panel of 6 assessors
 - N-butanol screened 20-80 ppb
 - Force Choice Method
 - Odour concentration in ou_E/m^3



Dispersion modeling

- US-EPA AERMOD
- Input Required
 - Sources of emission
 - Characteristics
 - Emission rates
 - Buildings
 - Sensitive receptors
 - Met data
 - Terrain data
- Through Modeling:
 - Determine the ideal sensor locations
 - Develop the initial conditions of the live model
 - Determine the extend of the odour impact



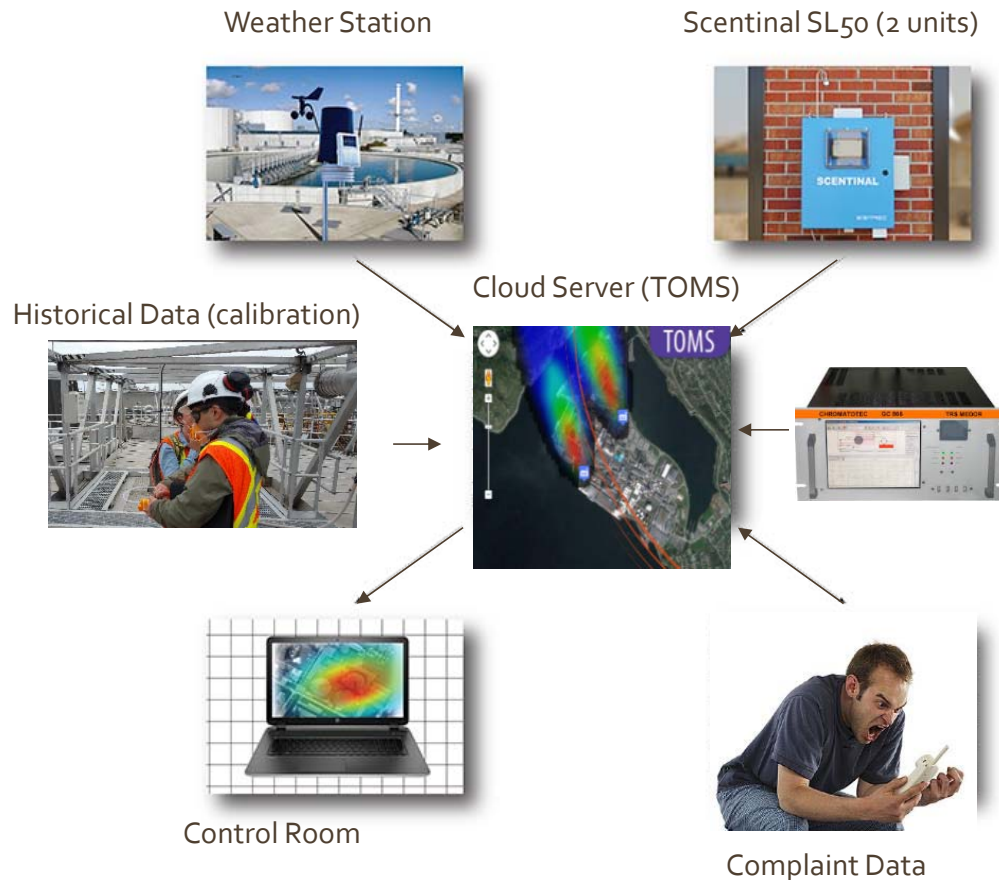
Location of monitoring stations

Locations were selected to

- maximize coverage based on met data
- Be between plant and sensitive receptors
- Directly measure major sources.



The complete Odour Management System



Inputs

- Local Meteorological Data (weather Station)
- SL-50 Scentinal (2 units)
- TRS medor
- Complaints
- Maintenance Log book

Output

- ✓ Iso-concentration plots (Gases and Odour)
- ✓ Concentration forecast
- ✓ Complaint validation
- ✓ Warning to residents

TRS Medor

TRS Medor is high resolution GC Sulfur analyzer. It can detect the following compounds:

- H₂S
- SO₂
- MM
- EM
- DMS
- DMDS
- DES
- IPM
- TBM
- NPM
- 2BM
- IBM
- NBM
- THT

Data is collected via MODBUS and sent through GPRS to Scentroid Cloud server every 20 min.

TRS Medor

Built-In
calibration gas

Sampling Pump



Nitrogen
Generator

Scential

Scential is a compact air and odour monitoring station.

Sensors are selected based on application. For MV project the following Sensors were installed:

- H₂S (electro chemical sensor - 1 ppb resolution)
- VOD (photoionization detector – 1 ppb resolution)
- Methane (non-dispersive Infrared Detector – 1 ppm resolution)
- Ammonia (Metal Oxide Sensor – 1 ppm resolution)

Scential Is equipped with:

- Sampling pump
- Sensor units
- decontamination unit (Internal ozone generator)
- Zero air generator (automated zero offset calibration)
- Internal Server (onboard data storage and setting modification)
- GPRS modem (connection to cloud server)
- GPS Monitor
- AC/Heater



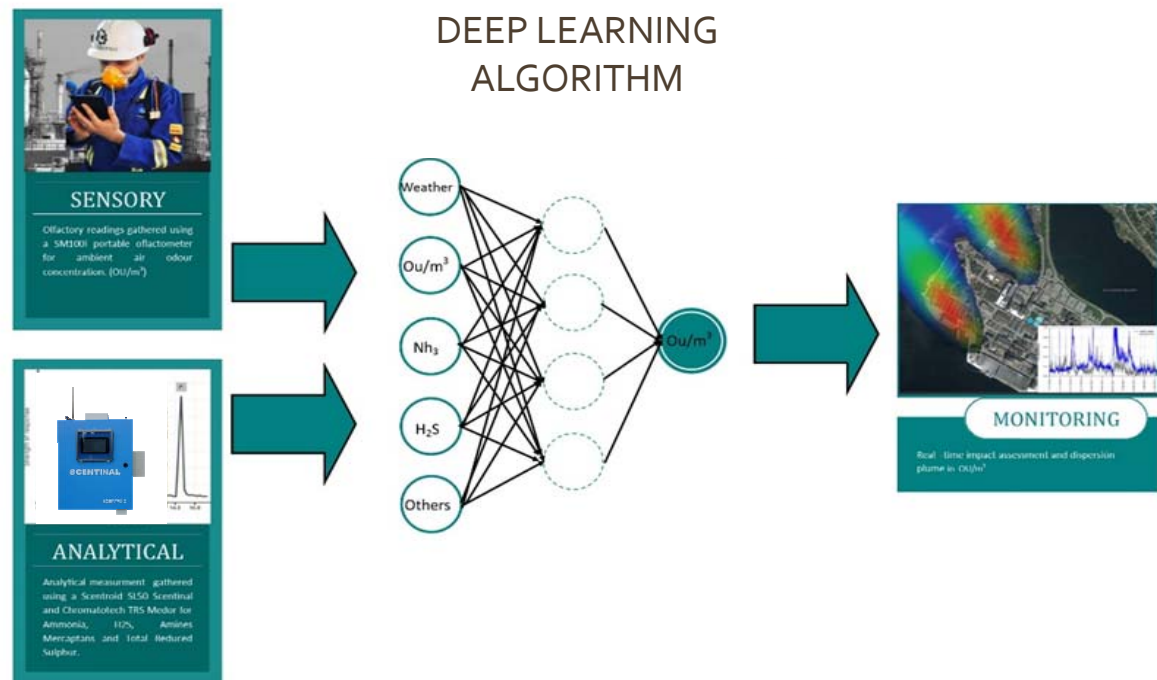
Odour Calculation

Working Principle

- Use of deep learning algorithm to calculate OU/m^3
- Learning Algorithm designed and trained individually for each application
- Periodic update of training is performed to reflect changes in plant process.

Input

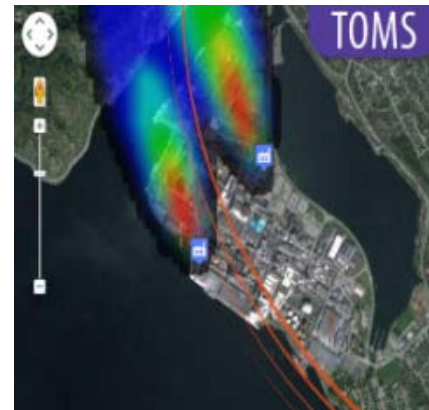
- Local Meteorological Data (wind direction, speed, temperature)
- Sensory measurements (30 samples minimum)
- Analytical Measurements (from SL50 and TRS Medor)



Continuous Odour Monitoring System

The Complete system consists of:

1. GC/wet cell for detection of sulphur compounds and mercaptans in ppt and ppb level (H_2S , MM, DMDS, etc)
2. Scentinal for H_2S , Methane, Ammonia, VOC, and Aldehydes.
3. cloud server for data storage and retrieval
4. Deep Learning Algorithm used to combine data with SM100 readings and convert pollutant measurements to Odour Concentration
5. Total Odour Management Software to provide live dispersion modeling and emission rate estimation



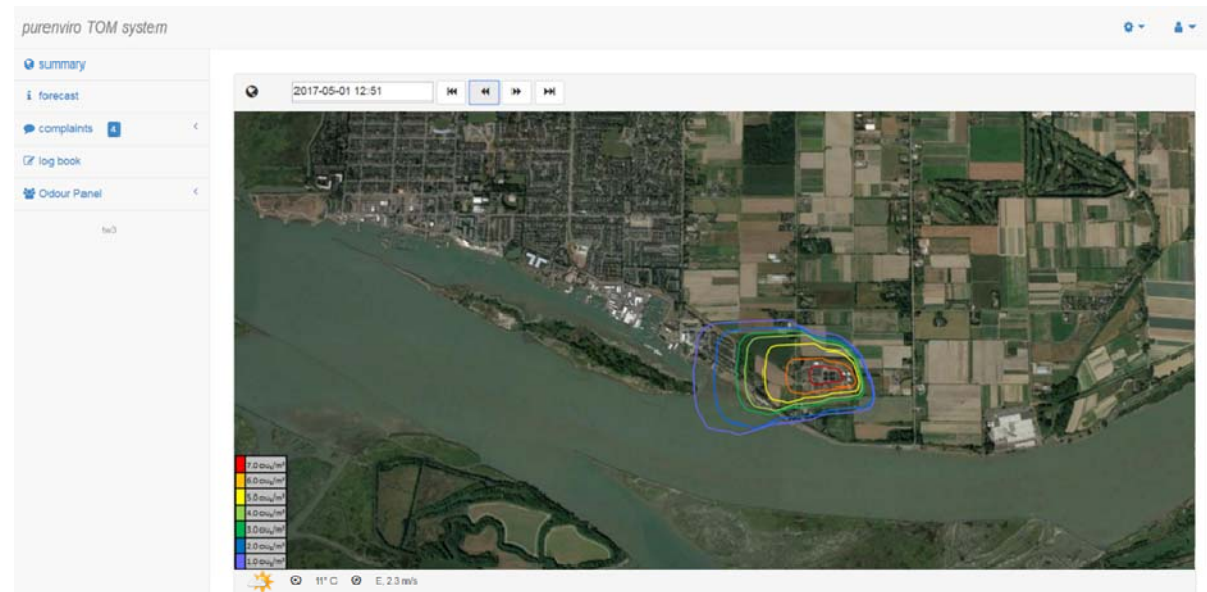
Total Odour Management System Monitoring

Inputs:

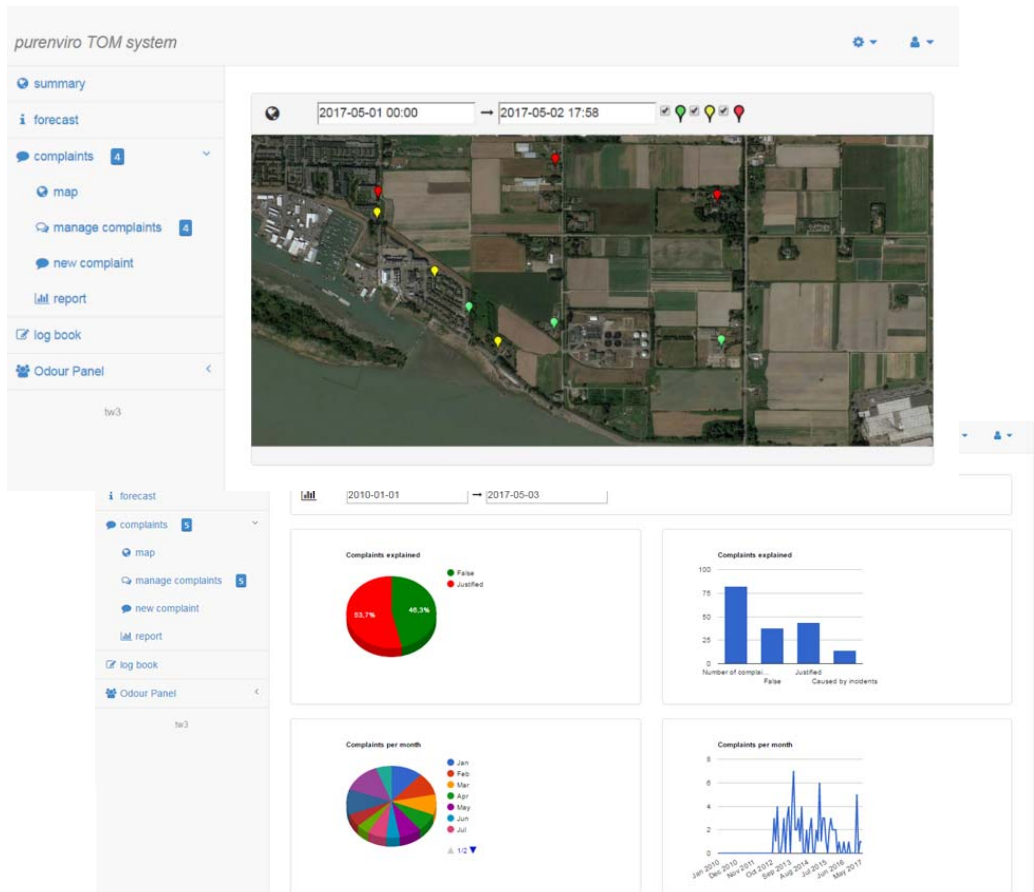
- Real time local weather data
- Local real time emissions
- Calculated odour emissions

Working Principle

- Based on USEPA AERMOD
- Iterative back-calculations and fuzzy logic algorithm to update emission rate from each source.
- Complaint management – record, validate, find source.
- Predictive model to determine possible impact of odour causing activities.



Total Odour Management System Complaint Management



TOMS Complaint management

- ✓ Allows plant operator track all open and closed complaints and label it accordingly
- ✓ Allows plant operator to track back complaints generated by community and trigger action plans. (Log Book)
- ✓ Graphic interface allows to understand complaints generated by the plant, other sources and those under investigation.
- ✓ Creates statistics for reporting proposes.

Total Odour Management System Forecast

purenviro TOM system

summary
forecast
complaints 4
log book
Odour Panel

forecast

10

Day	Time	Weather	Temp	Wind dir	Complaint risk
Tuesday May 2	afternoon		16	NE	
Tuesday May 2	evening		15	NE	
Wednesday May 3	night		6	NNW	
Wednesday May 3	morning		4	NW	
Wednesday May 3	afternoon		13	NE	
Wednesday May 3	evening		14	NE	
Thursday May 4	night		6	NE	
Thursday May 4	morning		6	NE	
Thursday May 4	afternoon		11	NE	
Thursday May 4	evening		13	NE	

TOMS Forecast

- ✓ Allows plant operator to perform preventive maintenance.
- ✓ Trigger plans for odour favorable conditions (i.e. low wind velocity, poor dispersion)
- ✓ Prevent upset conditions from plant emissions management



Any Question?

Thank you