

ENVIRONMENTAL MONITORING SYSTEMS (EMS) B.V.



Continuous air monitoring / air control in greenhouses

SERCOM Integration Sercom climate computer

(Have a scoop: Hortifair 2012)



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with

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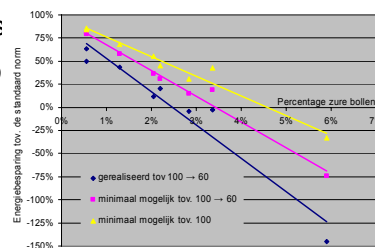
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History EMS - Sercom

- Sercom / EMS 2007 start marketing tulip-bulb market
- Tulip bulb storage: Ethene is 'the' control parameter more then traditional RH and temperature
- Proven concept: Now up to 400 storages are enabled with ethene monitoring
- 2010 expanded with postharves
- 2012 expanded for the greenho control



Figuur 1: Verband tussen energiebesparing en zuur percentage



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Effects of NOx / Ethene

- Damage (visible)
- Nothing is going on (No problems)
- There is something going on, but what? It is not visible. -> estimate 80% – 90% horticultural companies are in this situation



(Translated in unexpected production losses / decrease quality) (€)

- Why measure these compounds?
 - Most existing gases (after CO₂ and H₂O) in flue gas, are these harmful gases / components for plants (Allowed gases are already measured. Why are the non-allowed gases not monitored ???)
 - Most of research is performed to find relation between damage on crop and harmful flue gas. (Much knowledge available.)



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Effect of NOx / Ethene (Theory)

NOx

- Visible harm
- Growth – reduction in biomass, reproduction
- Physiological – stomatal conductance, photosynthesis
- Biochemical – enzymatic chlorophyll content

Ethene

- Necrosis of leaf tissue
- Aging, abortion of flower / fruit
- Epinasty, chlorosis, growth reduction

Cited from: Presentation gasresearch "Grenzen voor luchtkwaliteit 2011".



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Ethene from natural and industrial processes:

- Crop (Only C₂H₄, normal very little emission)
- Outside air / Sources from outside / roads
- Pulsfog systems
- CHP power engines / boilers / flue gas cleaners
- Chimneys
- Acetylene fertilizing (Only C₂H₄)
- manure / composting
- Peripherals around CHP / boilers / flue gas cleaners like valves and gaskets
- Lead blowers / tractors / lawn mowers (all burning engines)
- All others...



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Application of the Greenhouse Gas Analyser (GA) in horticulture

Greenhouse GA measures on critical level

Not allowed part of fluegas:

- C₂H₄ (Etheen op ppb niveau)
- NO
- NO₂ → Samen NO_x (ppb)
- CO (ppb)

Allowed part of fluegas:

- CO₂ (ppm)



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Comparison

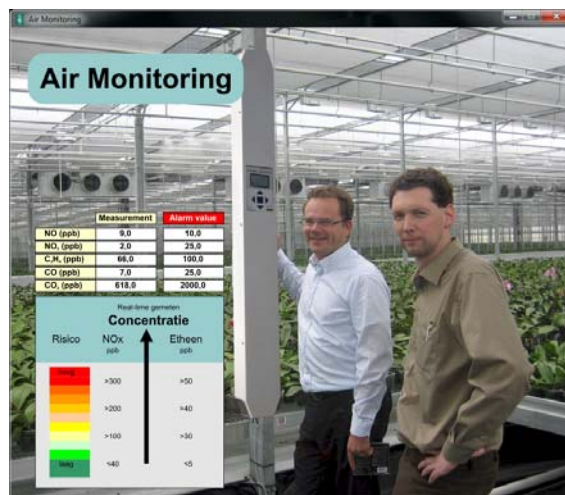
- ❑ CodiNox monitors: **Equipment**
NOx on +/- 20 ppm level (20.000 ppb)
Ethene on 50 – 450 ppb
- ❑ Greenhouse GA monitors: **Crop**
NOx on 0 – 200 ppb level
Ethene on 0 – 50 ppb level



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Solution: SercoVision Continuous air monitoring



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Application Greenhouse GA

Greenhouse GA in greenhouse and IO box and climate computer, modem to internet / office, EMS control, connection with steering windows and source, connection internet with service.

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HortiFair

CropEye

Risk = Time X Concentration

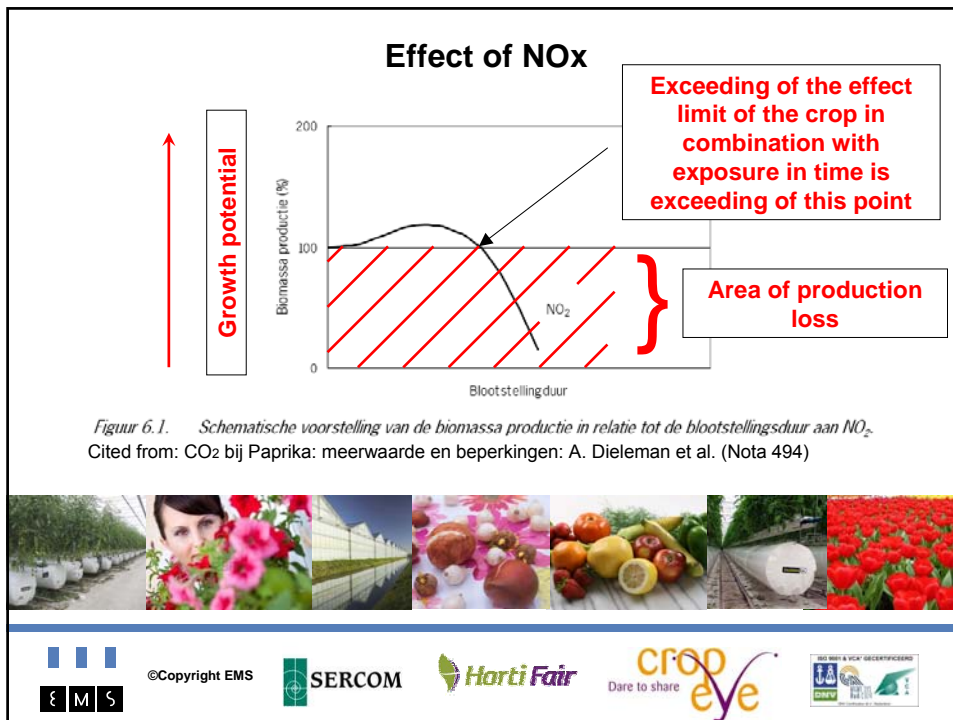
- ❑ Higher risk if:
 - ❑ Concentration CO₂ (thus C₂H₄ and NO_x become higher
 - ❑ Time of exposure of C₂H₄ and NO_x are longer
- ❑ Risk strongly increase if:
 - ❑ The crop is more lightened (thus CO₂ fertilization more used)
 - ❑ The crop is higher loaded
 - ❑ Less ventilated or not ventilated
 - ❑ Technical devices are not periodical maintained
 - ❑ No continuous measurement / guarded / controlled

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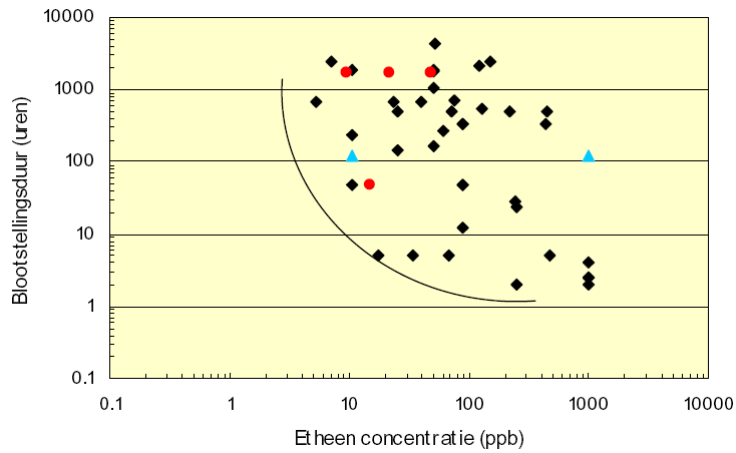
HortiFair

CropEye



- ### Examples of effects:
- Ethene on phalaenopsis 40 ppb in 7 days (Flower abortion / knob abortion, (Also at lower concentrations)
 - Ethene on pepper effect biomass reduction: 9.5 ppb continuous, total knob-abortion
 - NO general: 40 ppb in 8 hours
 - NO on tomatoes: 125 ug/m³ in 2 hours (95 ppb)
 - NO on tomatoes: grow aspects: 15 ug/m³ in 2.5 – 3 month (11 ppb) *Lycopersicon esculentum*: reduction in plant mass.
- Cited from: © WHO Regional Office for Europe, Copenhagen, Denmark, 2000 "Effects of nitrogen containing air pollutants: critical levels" & "Grenzen voor luchtkwaliteit" & "Effecten van stikstofoxiden en etheen op paprika".
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Effect of Ethene: From begassingsonderzoek WUR GVL 2011



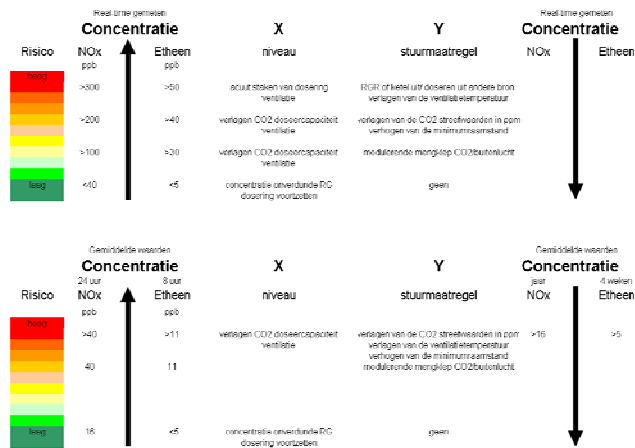
Cited from: Presentation gasresearch "Grenzen voor luchtkwaliteit 2011".



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In numbers: concentration vs. time



DLV Plant BV / EMS B.V. 2011

Disclaimer: De grenswaarden kunnen variëren per gewas, ras, teeltomstandigheid en tijd van het jaar.



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Effect of Ethene: From “begassingsonderzoek WUR GVL 2011”



Controlled 0 ppb
atmosphere



15 ppb ethene
atmosphere

Cited from: Presentation gasresearch “Grenzen voor luchtkwaliteit 2011”.



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NO_x / C₂H₄ measurement -> CO₂ control by:

Dependence of NO_x / C₂H₄ concentration:

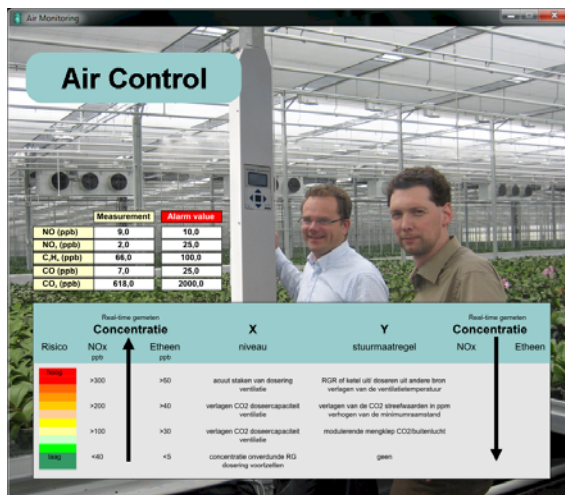
- Lower CO₂ setpoint: (Horticulture pays for CO₂, plant does not took up every CO₂, harmful components in flue gas)
-> **Project Green Formula**
- Control windows -> **Project Green Formula**
- Mixture / switch CO₂ source (fe. clean CO₂) -> Only possible for Ocap or fluid CO₂
- No CO₂ dosing (fe. Last cold winter, bad alternative)



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Solution: SercoVision - Continues air monitoring / air control
 (Connection is possible on all type / brand of climatecomputers)



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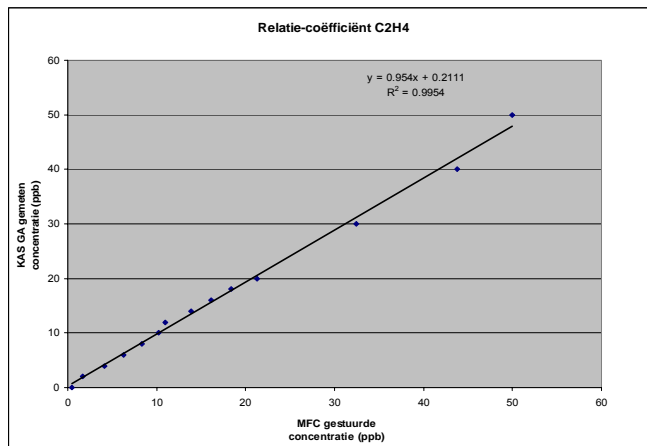
Calibrations: An example

Gas-sensor	Gas	Calibration -date	Calibration-concentrati on	Control-concentration	Calibration method
NO	Nitric Oxide	03-06-12	1030 ppb	See figure 1	2 points calibration, multipoint check
NO ₂	Nitrogen Dioxide	10-06-12	3100 ppb	See figure 2	2 points calibration, multipoint check
C ₂ H ₄	Ethene	03-06-12	1040 ppb	See figure 3	2 points calibration, multipoint check
CO	Carbon Monoxide	04-06-12	1150 ppb	1171 ppb (fig. 4)	2 points calibration, multipoint check
CO ₂	Carbon Dioxide	04-06-12	1800 ppm	1810 ppm (fig. 5)	2 points calibration, multipoint check



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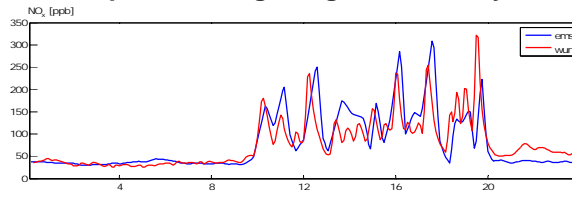
Alternative systems:



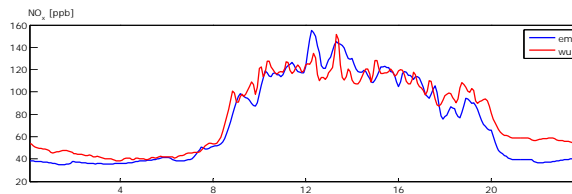
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Tested / comparison Wageningen University / EMS NOx:



NOx verloop op 24 juni 2012, gemeten door EMS en WUR. Bron Prominent



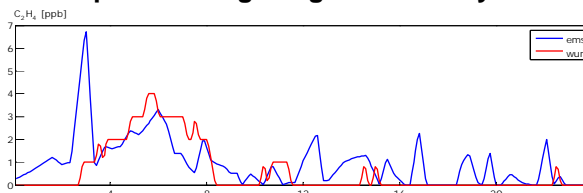
Cyclic NOx pattern from 12 up to 30 June 2012, measured by EMS and WUR. Source: Prominent



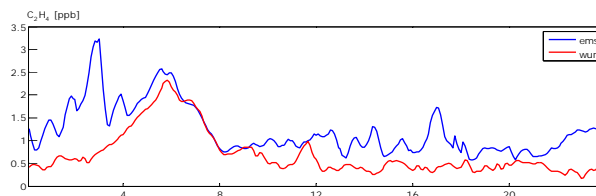
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Tested / comparison Wageningen University / EMS ethene:



Etheen verloop op 24 juni 2012, gemeten door EMS en WUR. Bron Prominent



Cyclic ethene pattern from 12 up to 30 June 2012, measured by EMS and WUR. Source: Prominent



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Future: (Just in progress)

- ❑ Expand the control of climate computers: For example: proportional adding liquid CO₂ or OCAP CO₂ with proportional control of windows
- ❑ Optimisation and near-time analysis of the control translated to Euro's € € €.
- ❑ Analysis and representation of growing potential or reduction potential caused by air quality by near-time analysis
- ❑ Alternative applications / dosing ethene as biocide.



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Summary: Application Greenhouse GA

- ❑ NO_x create reduction biomass -> cost €
- ❑ Reduction of biomass translates indirect photosynthesis -> €
- ❑ Harmful flue gas NO_x and ethene from CO₂ dosing creates unwanted effects to the crop -> €
- ❑ Too much NO_x causes wide-open windows, wide windows causes more energy losses -> €
- ❑ NO_x / ethene monitoring is preventive damage monitoring (Instead of using an assurance company) -> €
- ❑ The amount of concentration from the source (CHP, boiler, liquid CO₂) can influence the decision of which source to use -> delivers knowledge and €
- ❑ Measurement on crop level instead of device level -> knowledge



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**ENVIRONMENTAL MONITORING
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Thanks for your attention

Discussion time

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