

# European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

## WGs and MC Meeting at ISTANBUL, 3-5 December 2014

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year 3: 1 July 2014 - 30 June 2015 (*Ongoing Action*)

## EYE SYMPTOMS FROM REACTIVE INDOOR AIR CHEMISTRY?

**Peder Wolkoff**

Function in the Action (**OFFICAIR, EPHECT**)

NRCWE / Denmark



NATIONAL RESEARCH CENTRE  
FOR THE WORKING ENVIRONMENT

 **cost**  
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



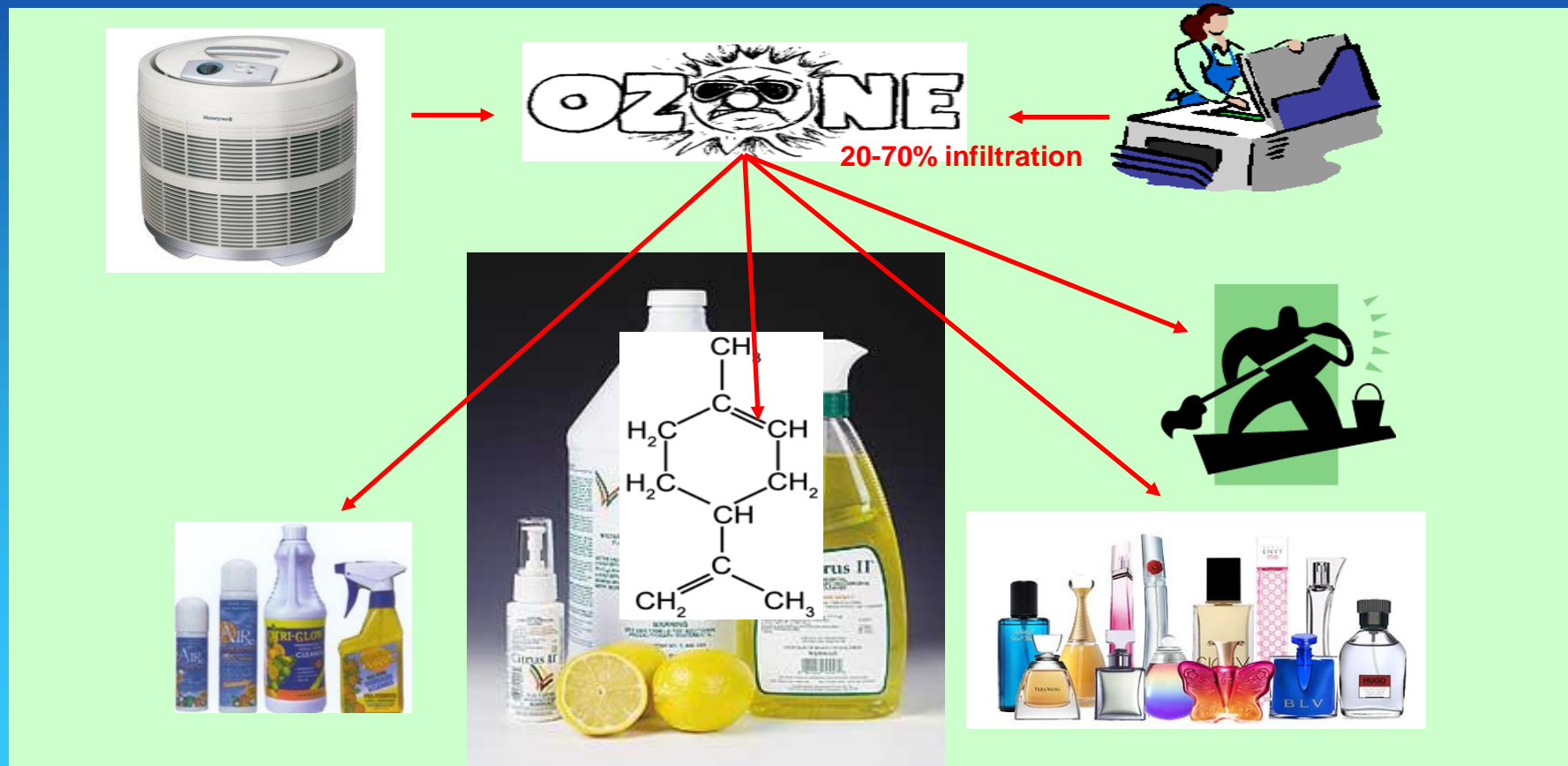
# Scientific context and objectives in the Action



- Eye irritation symptoms have high prevalence in offices (among top-two)
- Common indoor air pollutants (VOCs) are **too** low to be causative – except “possibly” formaldehyde

*Wolkoff, Int J Hygiene and Environ Health 216 (2013) 371-394.*

# "Reactive chemistry hypothesis" Are ozone-initiated terpenoid reactions a harmful cocktail indoors?



Carslaw et al. *Atmos Environ* 43 (2009) 3808-3809.



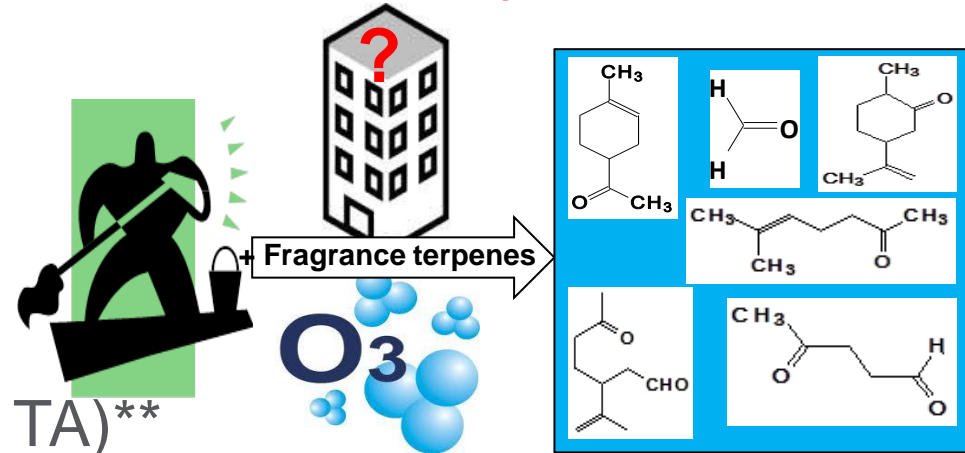
# Current research activities

- Chemical characterization and assessment of respiratory effects imposed by **reactive** indoor air (fragrance) chemistry
- Chemical characterization and toxicological effects from use of (nano) spray products and ozone-initiated chemistry
- Dynamics of semi-volatile organic compounds in indoor air and in dust
- Toxicology of formaldehyde
- Health assessment of indoor air pollutants (IAQ), in general

# Replacement of cleaning agent for smooth floors in 4 offices and 1 reference office (carpet) – **OFFICAIR WP4 intervention study**

## Measurements:

- Fragrance VOCs\* (Tenax TA)
- Ozone reaction products (Tenax TA)\*\*
- Formaldehyde (DNPH)
- Ozone (spectroscopy)
- Recovery study of fragrances and oxidation products at low and high ozone (on Tenax TA)
- 2 hour sampling: morning, noon and afternoon



\*)  $\alpha$ -pinene, geraniol, dihydromyrcenol, linalool,  $\alpha$ -terpineol

\*\*) 4-AMCH, IPOH, 6-MHO, 4-OPA, dihydrocarvone

# Oxidation products ozone+limonene

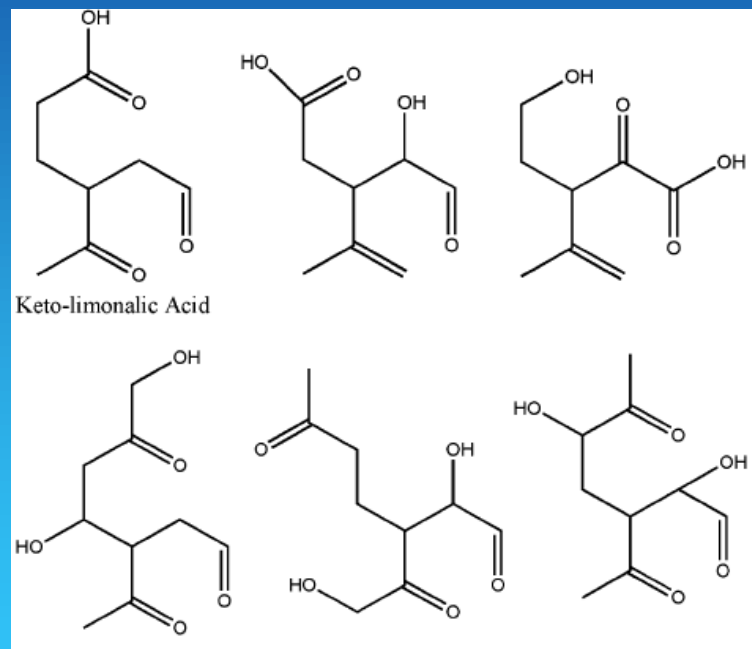
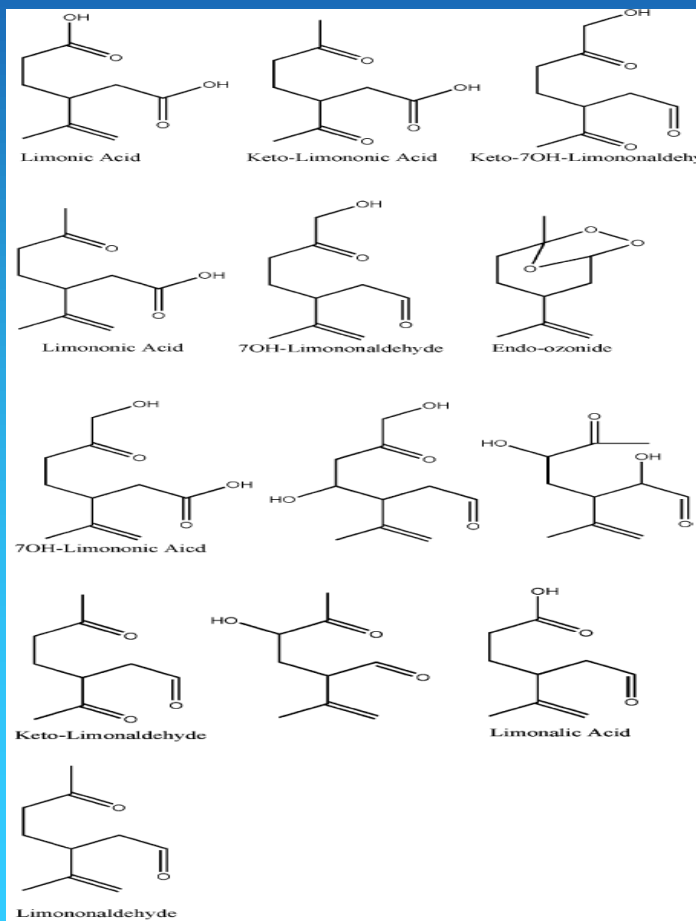
PAPER

www.rsc.org/pccp | Physical Chemistry Chemical Physics

## High-resolution mass spectrometric analysis of secondary organic aerosol produced by ozonation of limonene†

*Phys. Chem. Chem. Phys.*, 2008, 10, 1009–1022

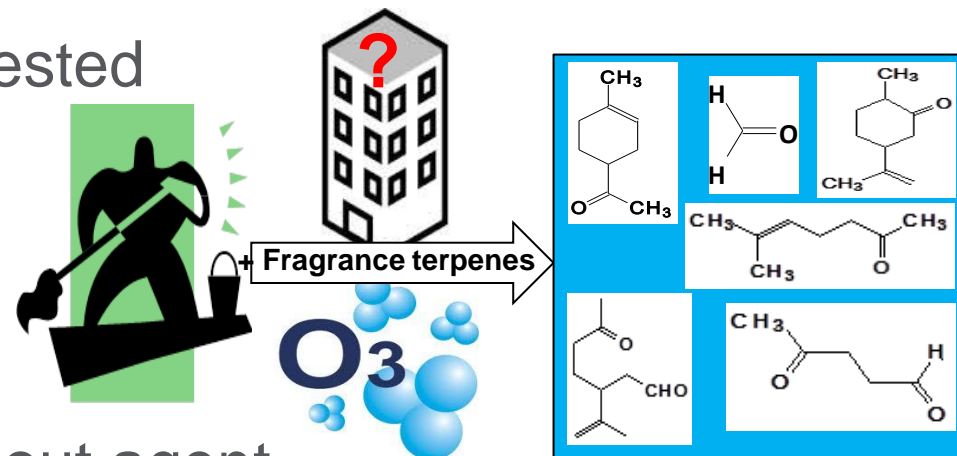
Maggie L. Walser,<sup>a</sup> Yury Desyaterik,<sup>b</sup> Julia Laskin,<sup>c</sup> Alexander Laskin<sup>b</sup> and Sergey A. Nizkorodov<sup>\*a</sup>



Gas-phase and particle-phase products (ultrafines)

# Replacement of cleaning agent for smooth floors

- Regular cleaning agents emission tested
- New low emitting agent selected



- Reference office deep cleaning without agent
- Offices measured before and 4 weeks after the replacement of cleaning agent or deep cleaning in reference office

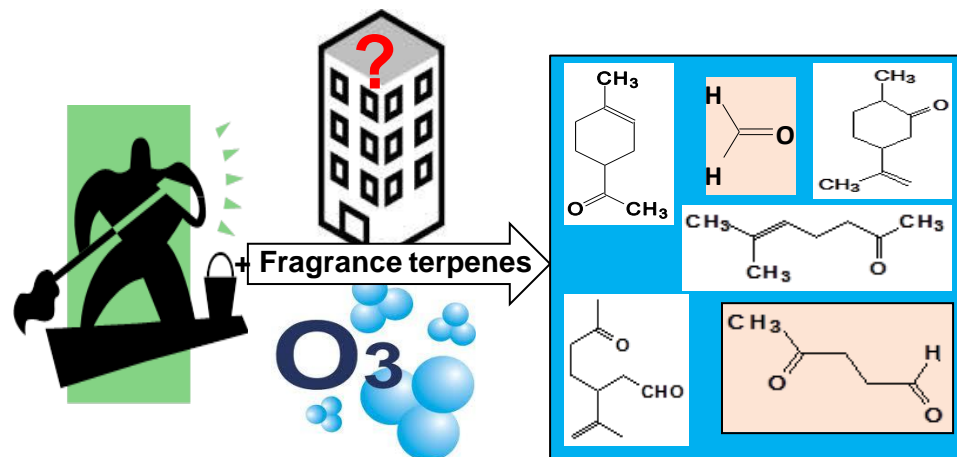
# Replacement of cleaning agent for smooth floors

## Key results

- Regular cleaning agents: limonene and linalool
- New cleaning agent: low in limonene

## After replacement

- Reduction in limonene
- Reduction in formaldehyde
- 4-OPA was reduced
- Deep cleaning reduced 4-OPA
- Many sources of terpenes
- Many sources of 4-OPA





# Replacement of cleaning agent for smooth floors

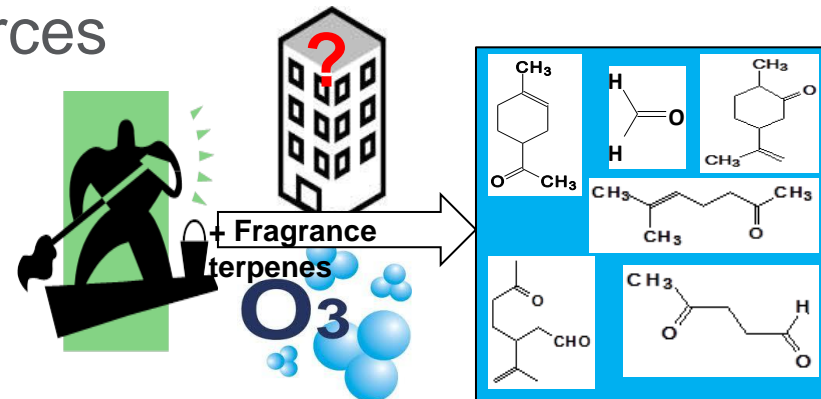
## Key results (acute health effects)

- Health index (max concentrations) for sensory irritation = 0.25
- Health index (max concentrations) for airflow limitation = 0.21
- Pollutant concentrations unlikely causative

## Consequences

- Possible to reduce terpene concentrations by replacement
- 4-OPA (airflow limitation) has many sources

$$\text{Health quotient}_i = \frac{C_i}{\text{Health value}_i}$$
$$\text{Health index} = \sum \text{Health quotients}$$



# Suggested **R&I Needs** for future research

- Toxicological investigations of ozone-initiated chemistries
- Larger field campaigns in offices (interventions)
- Better monitoring methods of critical oxidation products, e.g.
  - 4-OPA
- Sensitive sensors for:
  - Formaldehyde
  - Ozone
  - 4-OPA (partly proxy for human debris (dirt))
  - OH radical
  - (Fungicides)