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

COST Action TD1105

INTERNATIONAL WG1-WG4 MEETING on

New Sensing Technologies and Methods for Air-Pollution Monitoring

European Environment Agency - EEA

Copenhagen, Denmark, 3 - 4 October 2013

Invited Presentation

Action Start date: 01/07/2012 - Action End date: 30/06/2016 - Year 2: 2013-2014

Assessing Human Exposure to Air Pollution in Health Assessment Studies in Europe

Aarhus University

Ole Hertel

Function in the Action: (WG leader)

Aarhus University / Denmark

COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

Measurements from routine monitoring programmes often used in dose-response studies: six cities study etc.

Particulate matter responsible for most of the negative health effects

Since the 1990ties focus on short-term but also long-term effects

Personal exposure monitoring:
APHEA, APHEA-2, EXPOLIS etc

Simple proxies like distance to road:
Brunekref et al.

Modelling based on US studies in many European assessments:
Künzli et al., etc

Danish EVA system:
Applies most recent dose-response

Long term effects according to Hoek et al. (2013)

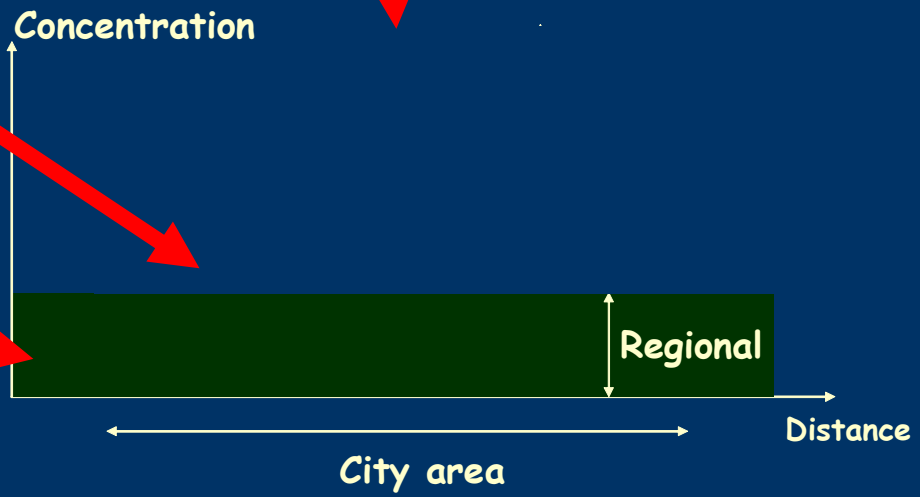
Health effects	PM_{10} per 10 $\mu g/m^3$	$PM_{2,5}$ per 10 $\mu g/m^3$	EC/BC per 1 $\mu g/m^3$	NO_2 per 10 $\mu g/m^3$
Total deaths	3,5 % (0,4 % - 6,6%)	6,2 % (4,1% - 8,4%)	6,1 % (4,9 % - 7,3 %)	5,5 % (3,1 % - 8 %)
Cardiovascular deaths	2 % to 8 % ($PM_{10-2,5}$)	15 % (4 % - 27 %)	4 % to 11 %	-2 % to 36 %
Respiratory deaths	4% to 67%	2,9% (-6% - 13%)	11 %	3 % to 197 %

Danish approach in AIRPOLIFE similar to the one applied in cancer assessment within ESCAPE:

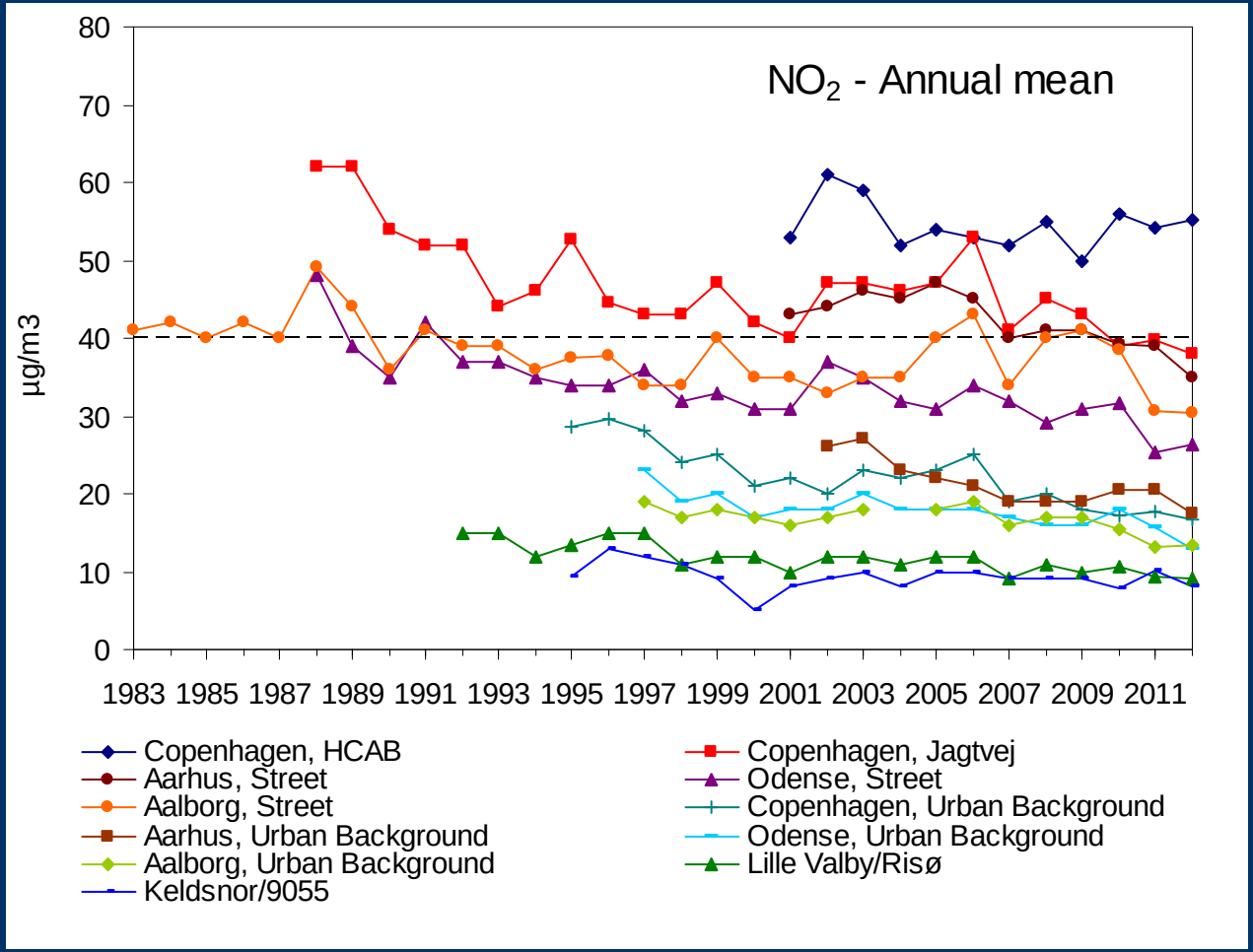
Mix of measurements and model calculations in dose-response determination

Measurements generally used in assessment of short-term effects – dose-response

Model calculations used in long-term effects – dose-response – AirPOLIFE and EGEA-2, ECRHS-I & II


Concentration
Regional
Distance
City area

Trends in nitrogen dioxide in Danish cities



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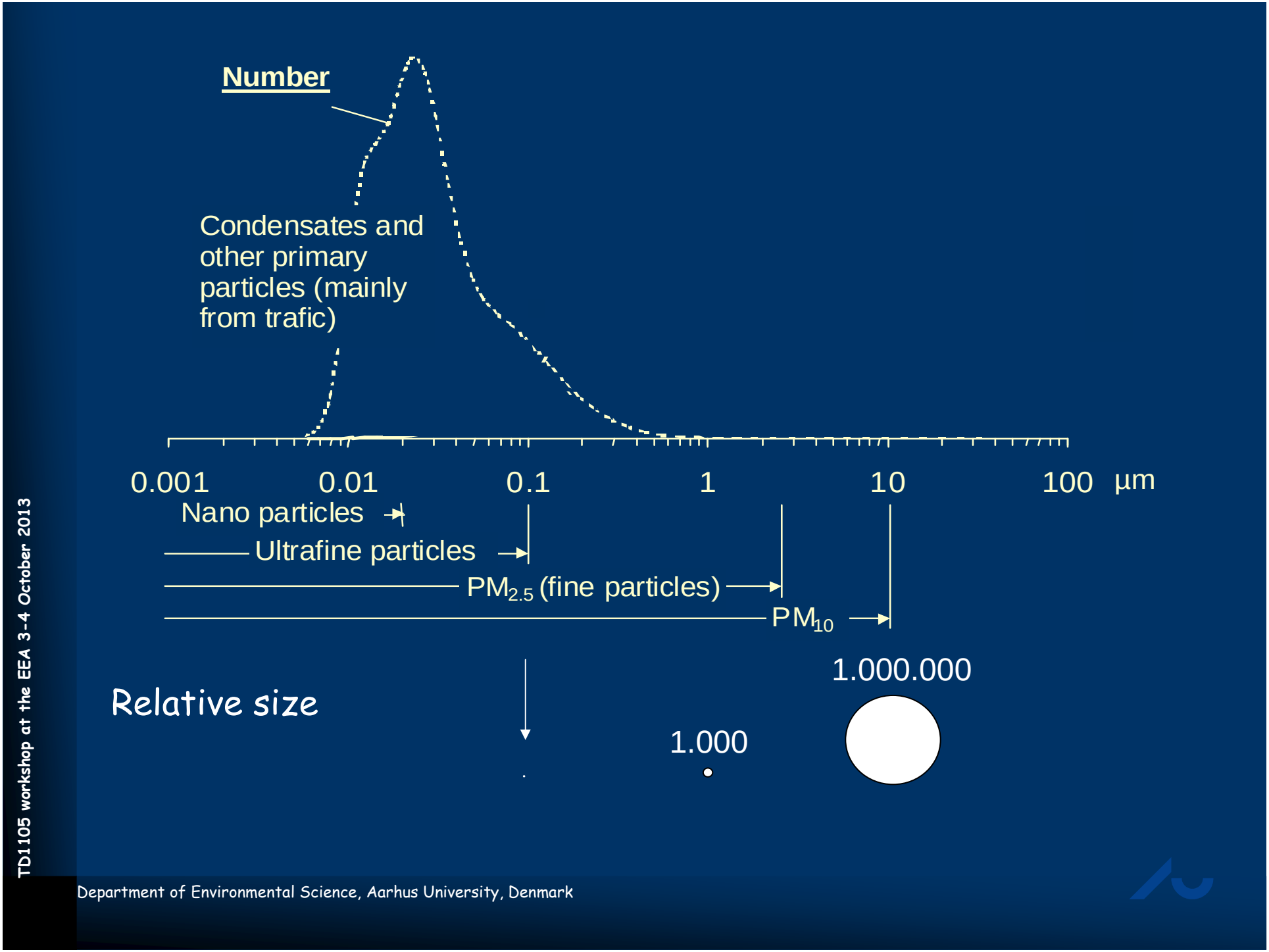

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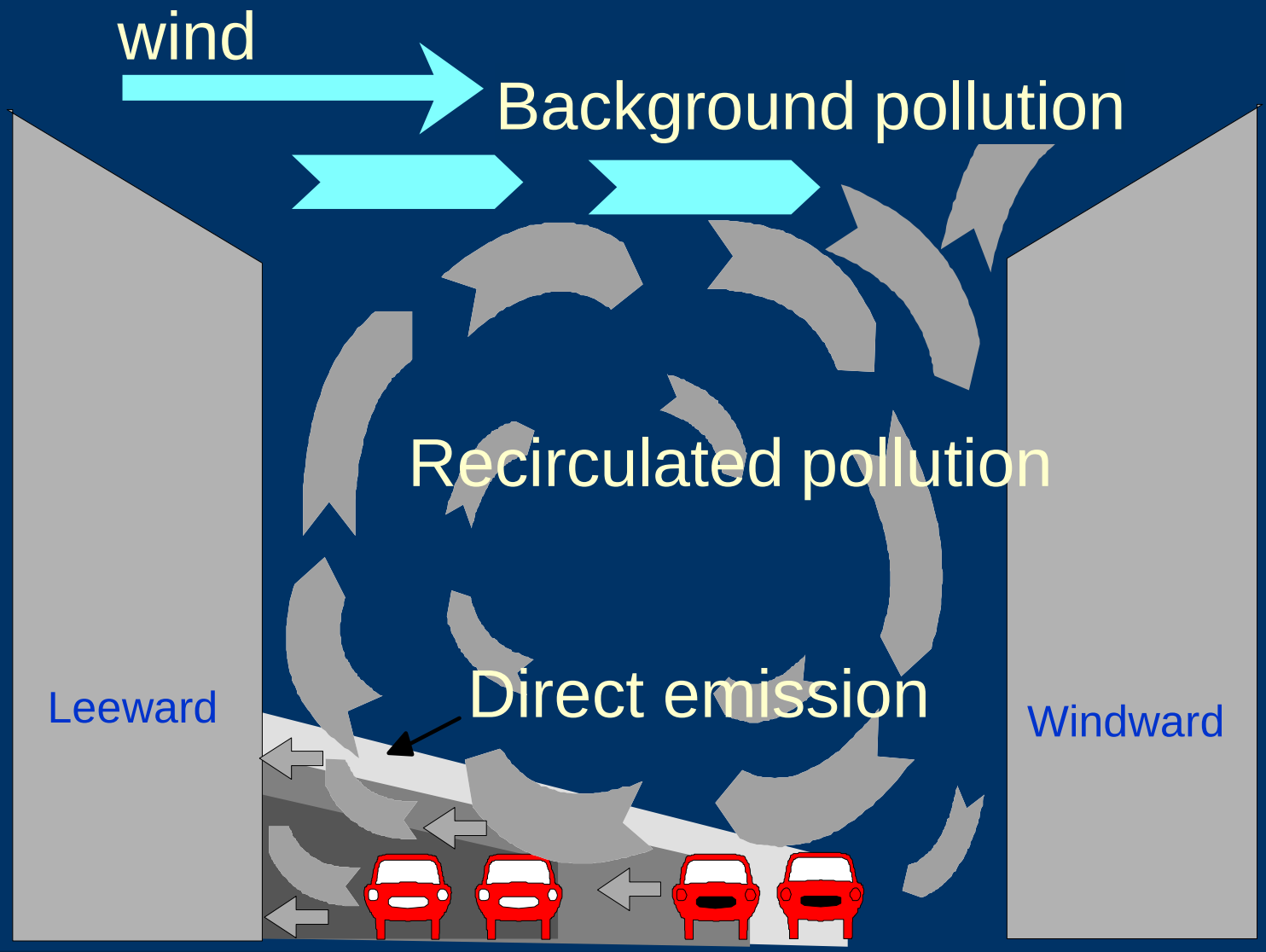
The Operational Street Pollution Model (OSPM)



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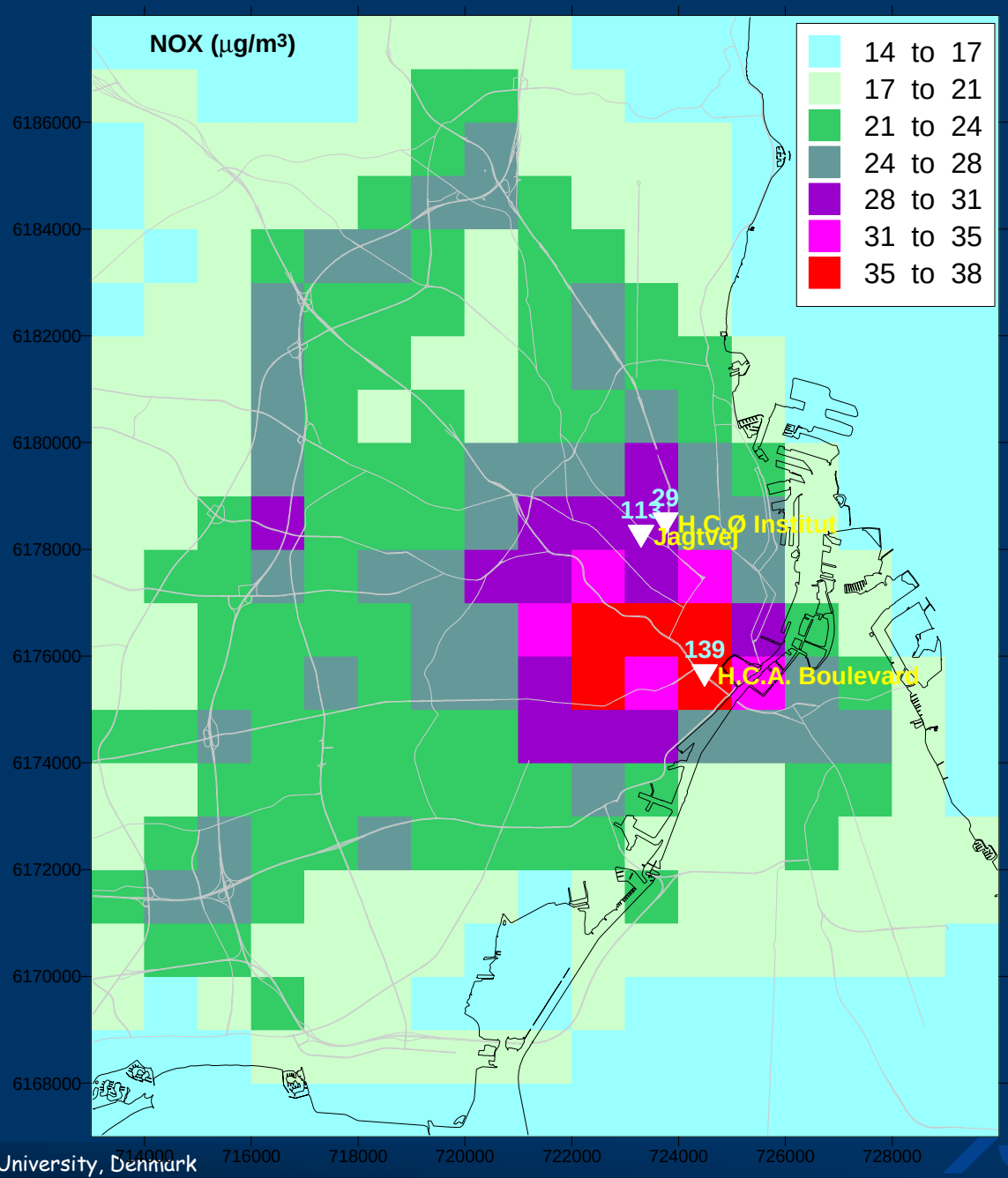
Urban Air Pollution computed with the Urban Background model (UBM)



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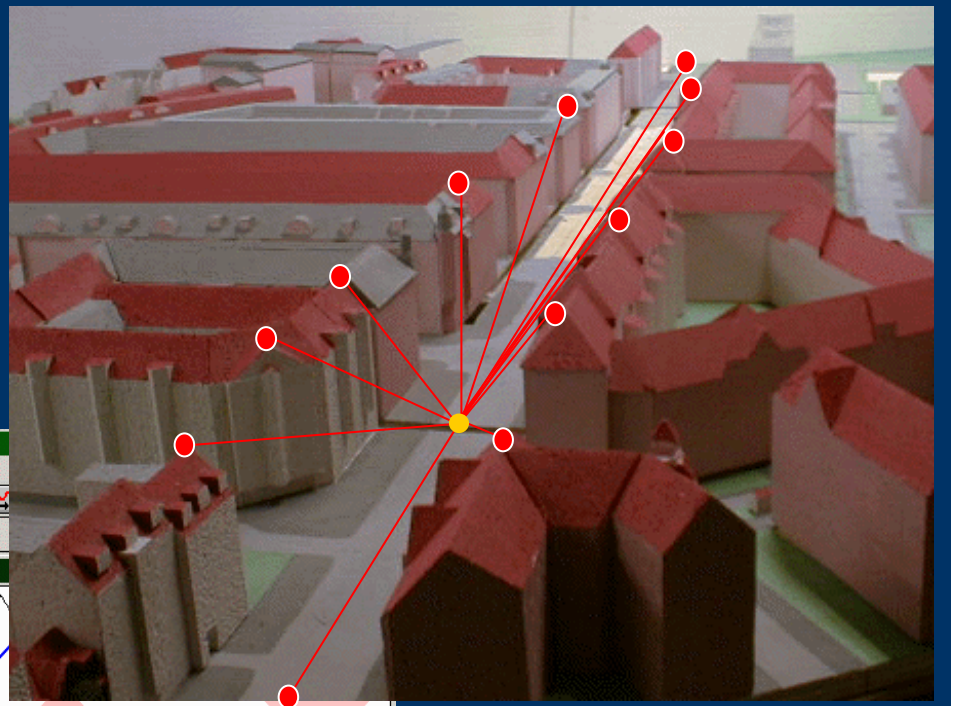
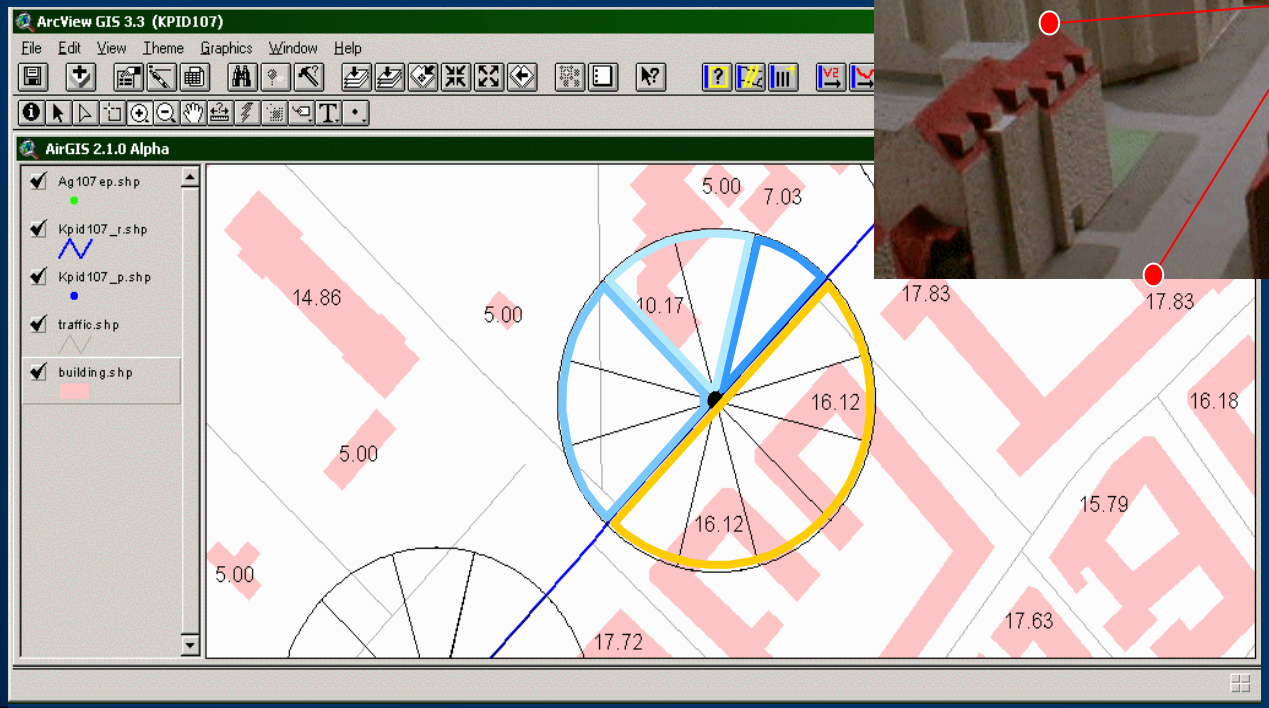
AirGIS automatic generation street configuration

Performed calculations for the entire nutrition, cancer, health cohort of 50.000 people & 200.000 addresses





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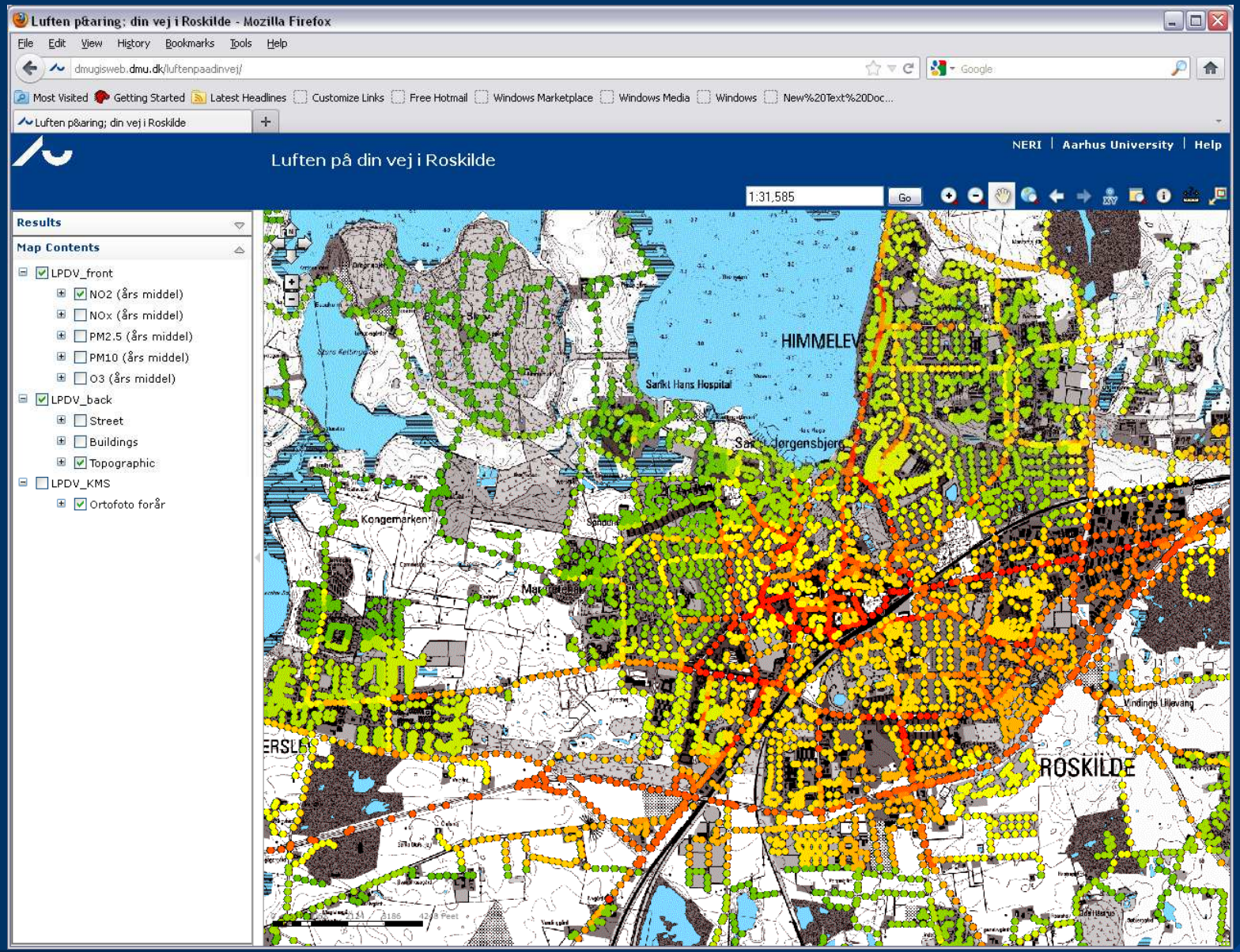
Mapping address level exposure in Danish city



Short-term effects Danish studies

Health endpoint	PM_{10}	$PM_{2.5}$	Particle #	NO_2 / NO_x	CO
Interquartile range, IQR	(7)# 13-14 µg/m^3	5 µg/m^3	3800-3900	6-7/9 pbb	120 ppb
Cardiovascular death, lag 0-5 days	3%			0 to 1%	0 til 1%
Deaths of stroke	0%			0 to 2%	-2 til 2%
Deaths of respiratory disease all ages, summer & winter, 0-5 d lag	-3 to 1%			-2%	-5%
Cardiovascular hospital admission >65 years old lag 0-3 d, or all ages summer & winter 0-5 d lag	3%* 2%	3%*	0%	0 to 2% 2 % & 3%	1 to 2% 1%
Myocardial infarction summer & winter, 0-5 d lag	0 & 4%			2 % & 4%	2 & 7%
Cardiac arrest outside hospital, 3-4 d lag	5%* (IQR 7)	4%*	3%	2 to 3%	2 to 4%
Mild ischemic (clot) stroke, 0-4 d lag	8%		21%*	11%	10%
Respiratory admission >65 years old, 0-4 d lag, and for all ages summer & winter 0-5 d lag	4 to 6%* 4%	0%	4%	4 to 6% 0% & 4%	2 to 4% 1 & 3%
Asthma hospital admission 0-18 years old, 0-4/5 d lag	2 to 8% *	9 to 15%*	6-7%	4 to 13%*	0 to 10%
Wheezing among susceptible 0-1 year old & 0-3 year old, lag 2-4 d	21% & 4%		92% & -15%	45%/30% 19%/14%	33% & 7%

Long term effects Danish studies

	NO_2 per 10 µg/m³	NO_x
Mortality		
Total	8 % (CI: 1 - 14 %)	
Cardiovascular illness	16 % (CI: 3 - 31 %)	
Ischemic	8 % (CI: -11 - 30 %)	
Stroke	9 % (CI: -17 - 42 %)	
Incidents/hospital admission		
Cardiovascular illness		
Stroke, all	5 % (CI: -1 - 11 %) per 43 % increase in NO_2	
Stroke, fatal	22 % (CI: 0 - 50 %) per 43 % increase in NO_2	
Airways disease		
COPD	8 % (CI: 2 - 14 %) per 6 µg/m³	5 % (CI: 1 - 10 %) per 12 µg/m³
Asthma (elderly)	12 % (CI: 4 - 22 %) per 6 µg/m³	
Lung cancer		9 % (CI: -21-51 %) & 37% (CI: 6-76 %) per 100 µg/m³

Long term effects Hoek et al. (2013)

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Recent health assessments indicate that carbon black and possibly also organic carbon may be better indicators of health effects compared with $PM_{2.5}/PM_{10}$

(Jannsen et al. 2012)
(Rohr & Wyzga, 2012)

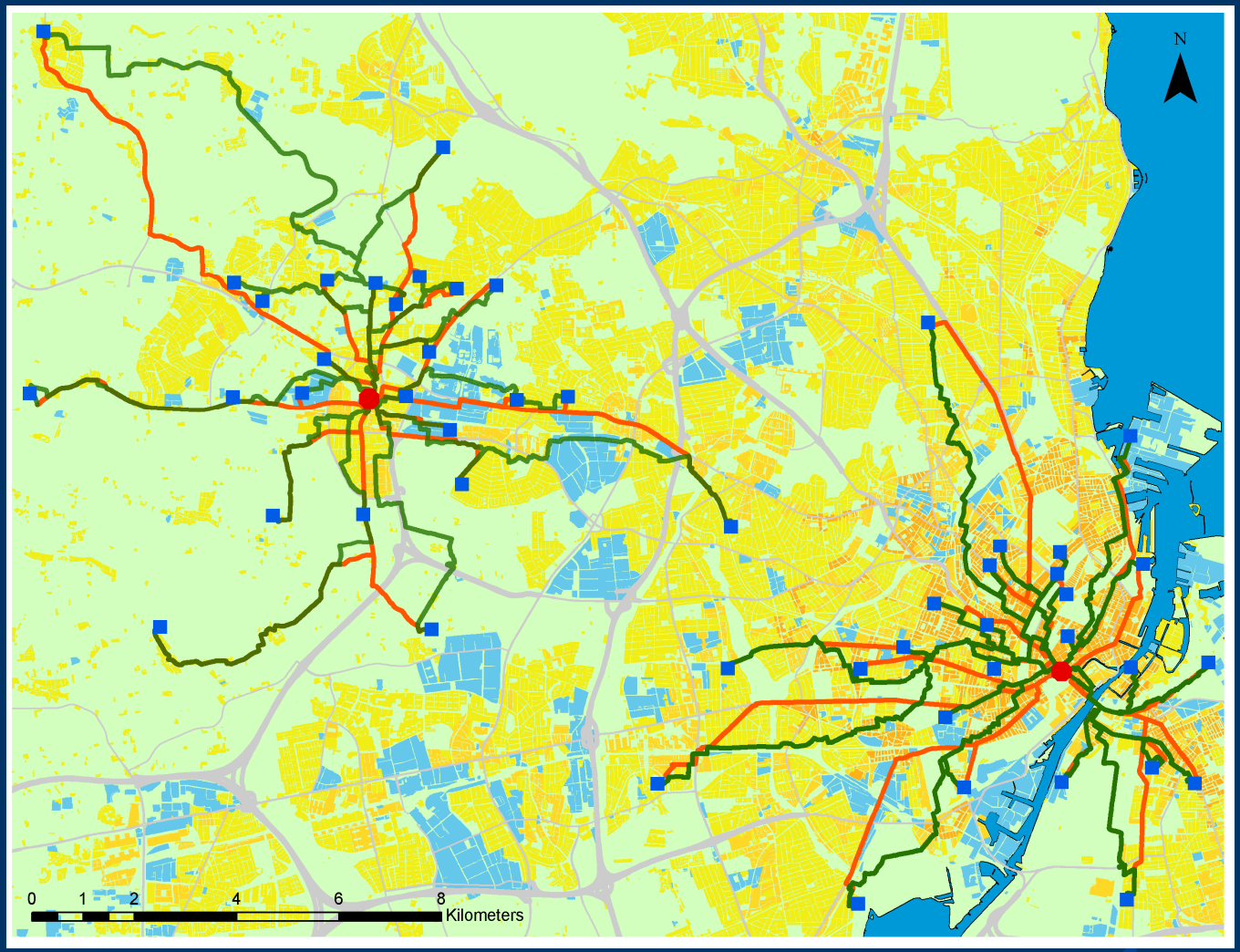
(WHO, 2012)

Also emphasised in Presentation by Bart Elen yesterday

Application of AirGIS/OSPM for exposure study

Exposure bicycling home & work

shortest & cleanest



Legend

- Workplace
- Homes
- Green routes
- Direct routes
- Highway
- Expressway
- Major Road
- Land
- Ocean

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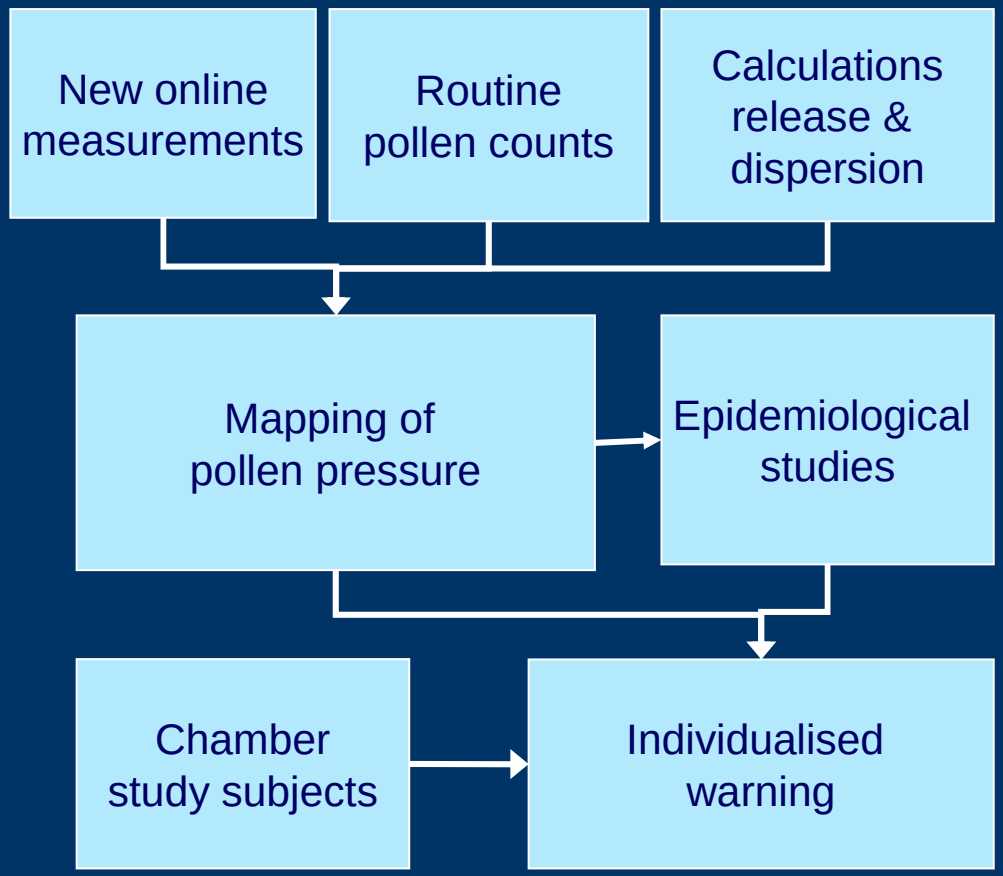
Pollen research centre: map local pollen pressure, dose-response, personal prognoses.

Climate change: new plants, highere CO_2 (polinering), more precipitation and higher temperature



Searching supplementary funding

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Priorities and roadmap

- What do we want to provide on the long term – in relation to routine monitoring and public information?
- Micro-sensors should not substitute but supplement routine monitoring devices
- Future routine networks may look very different from todays and include low cost sensors!?
- The green route through the city or access to information about pollutant load at address might be future goals

Priorities and roadmap

- Still many unknowns in respect to health effects – e.g. what in PM is causing negative health effects – constituents, ultrafine?
- Airborne allergens may also be an issue of interest – >20% suffer from hay fever but monitoring still based on 1950/1960 technology
- Assessment of health effects of emissions from agricultural sources (fungal spore, animal material, ammonia)
- Assessment of health effects from wood stoves – 600.000 wood stove devices in DK (biggest single source of PM in DK)