FFI Forsvarets forskningsinstitutt
Norwegian Defence Research Establishment

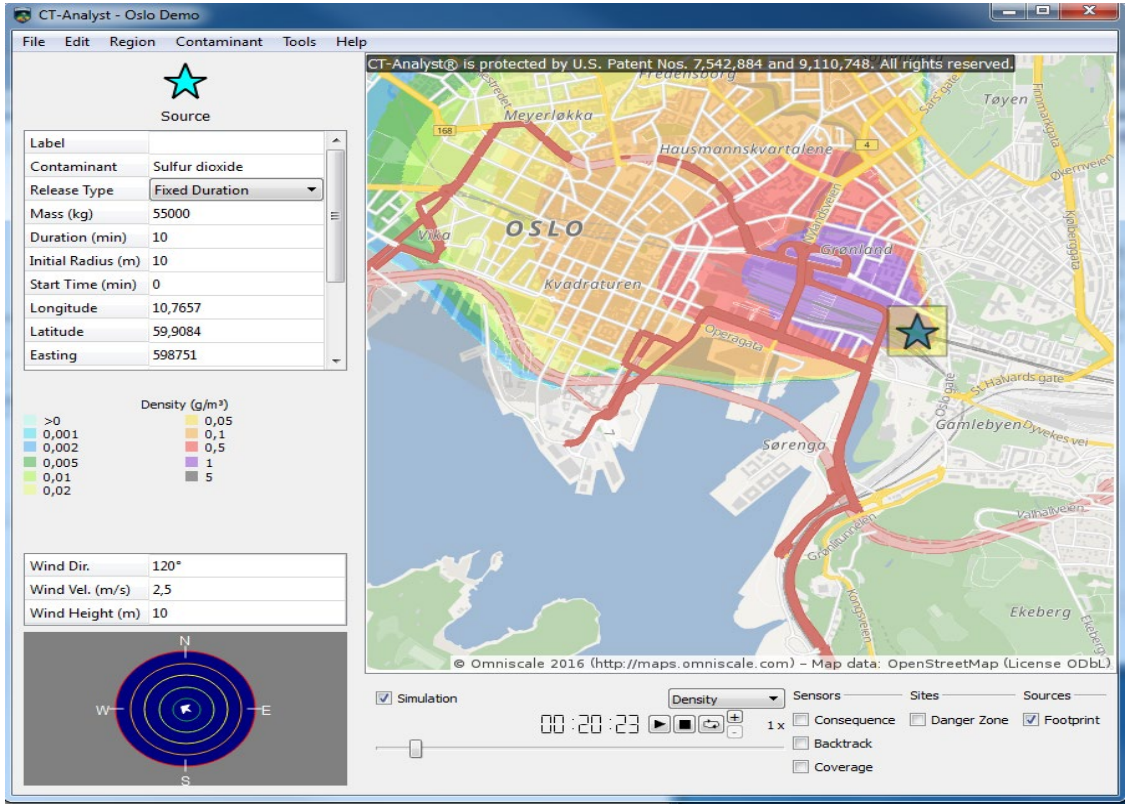
# Operational simulation of airborne gas dispersion in Oslo

Hannibal Fossum

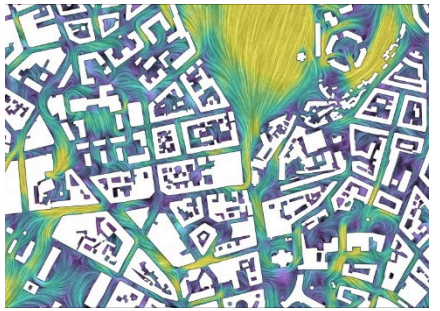
08.02.2022
ADMLC webinar

# Overview

Background




# CT-Analyst® Oslo



Methodology

FFI Forsvarets forskningsinstitutt
Norwegian Defence Research Establishment

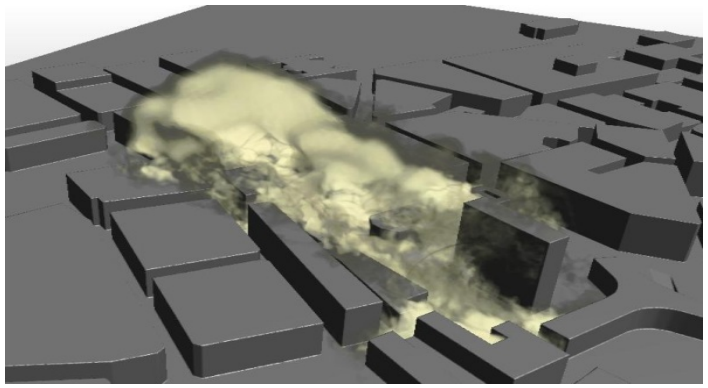
# Background

Dispersion modeling

# Why dispersion modeling?

1. Planning/exercise

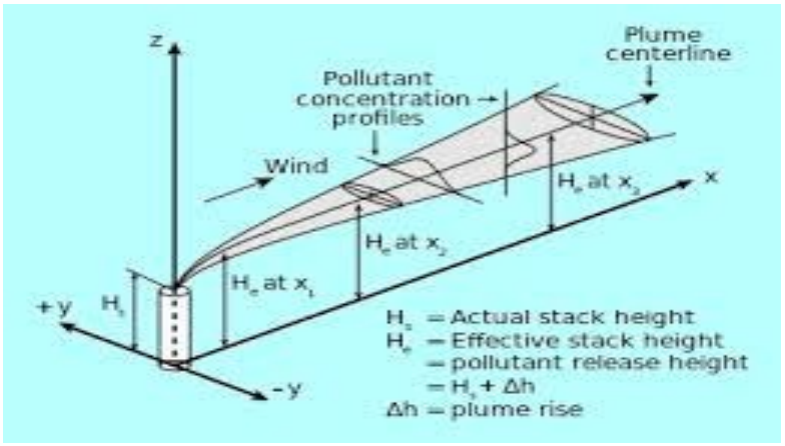
2. Crisis management



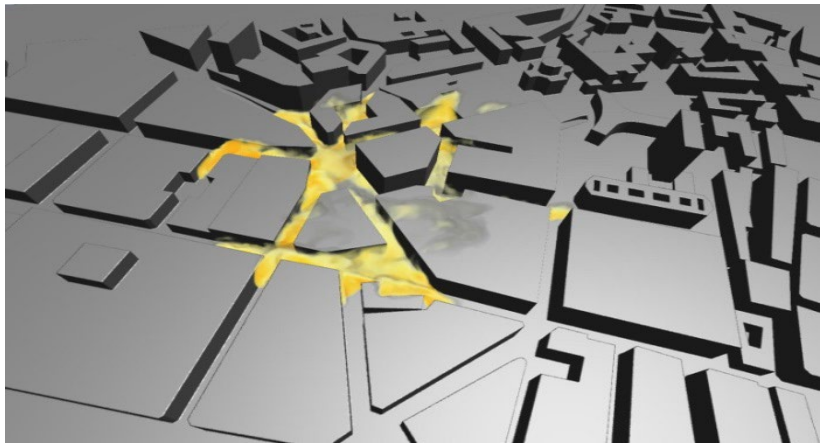
3. Investigation

# Different classes of dispersion models

“Geometric”
(Angular or circular areas)




“Simple model”
(Gaussian/puffs)



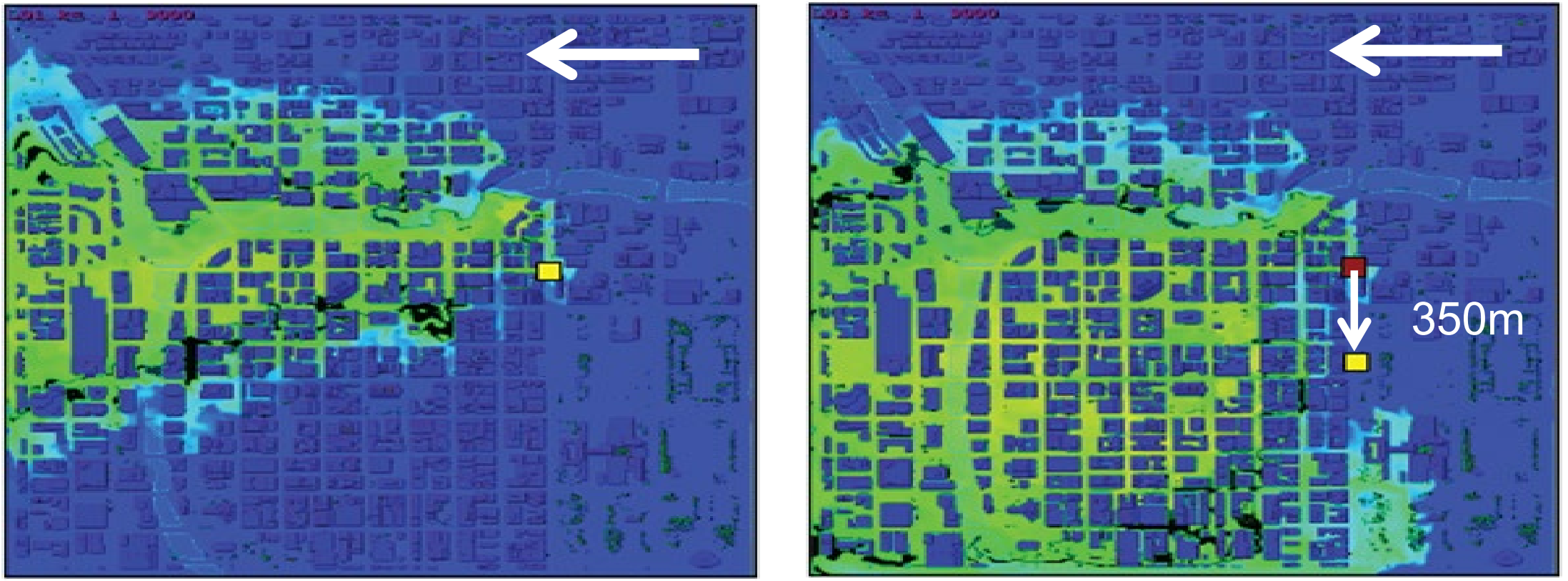
“Sophisticated model”
(CFD)

*Increasing complexity*

*accuracy*

*computational cost*

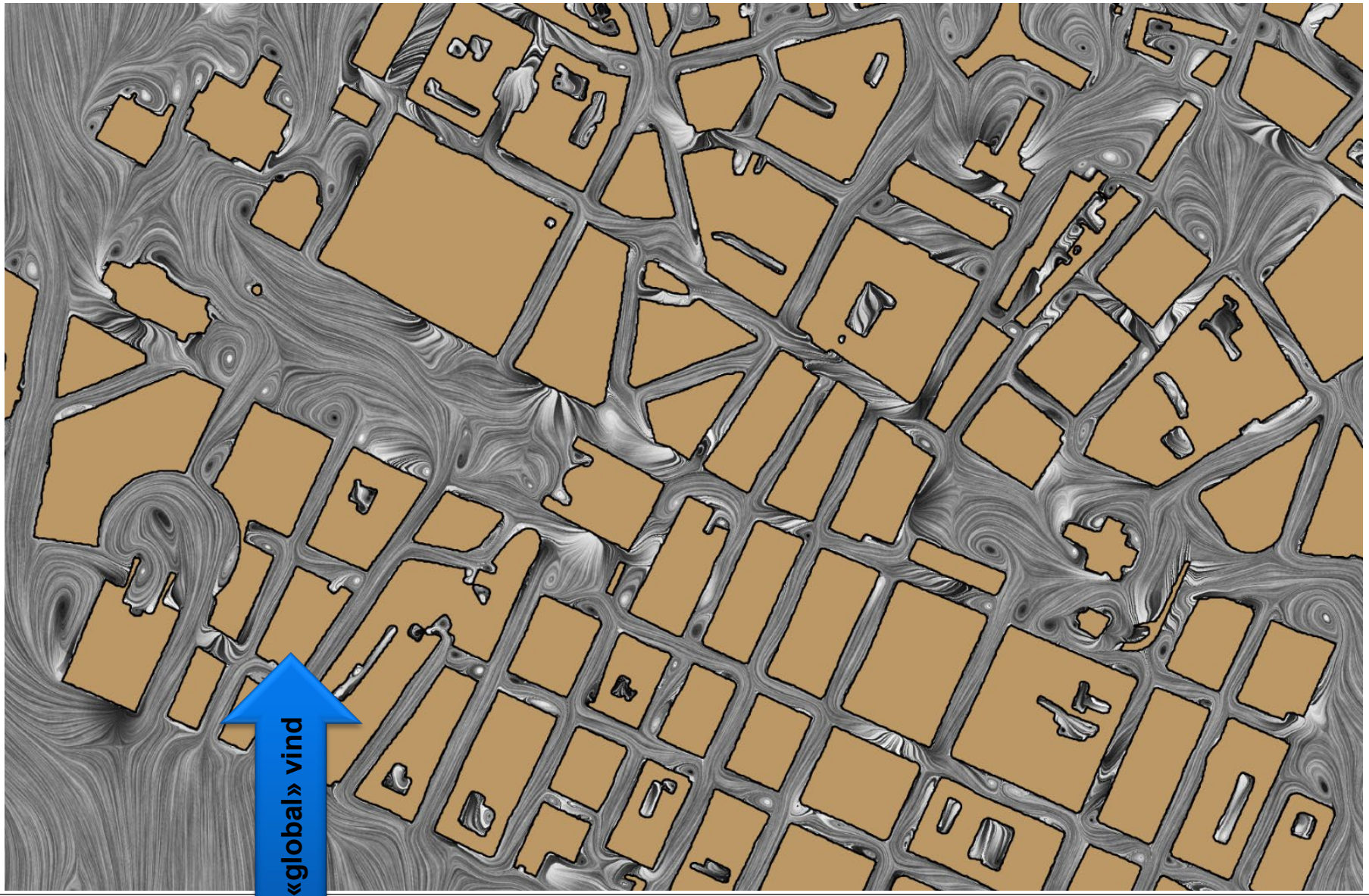
# Sophisticated models required for urban areas



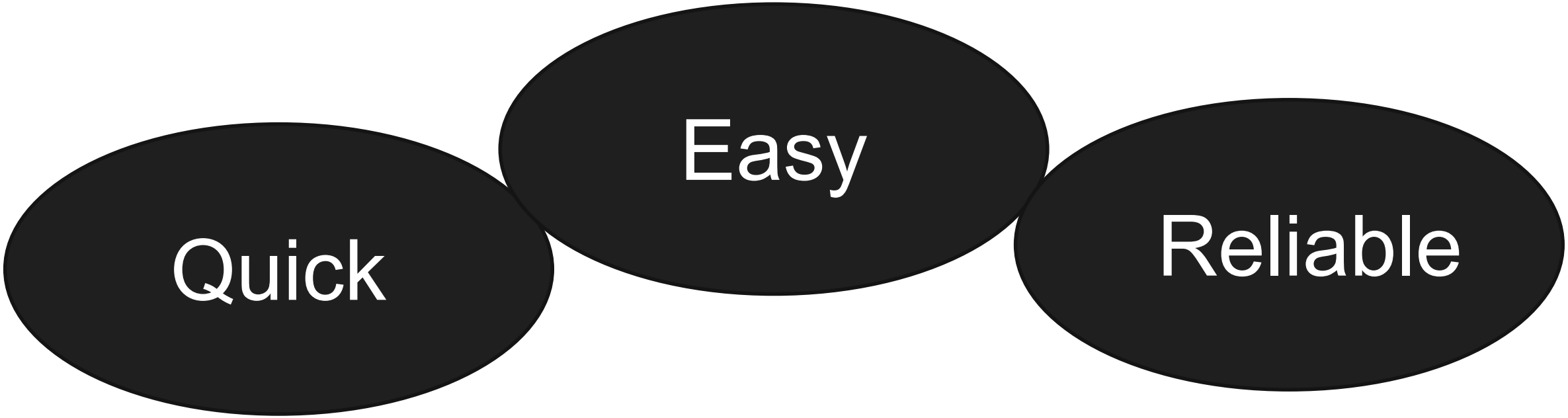

Dispersion from two locations in downtown Chicago.

Similar conclusions in the recommendations from COST Action ES1006: **Best Practice Guidelines**

# Street-level wind is not straight-forward…




## We want dispersion models that are…



FFI Forsvarets forskningsinstitutt
Norwegian Defence Research Establishment

# CT-Analyst® Oslo

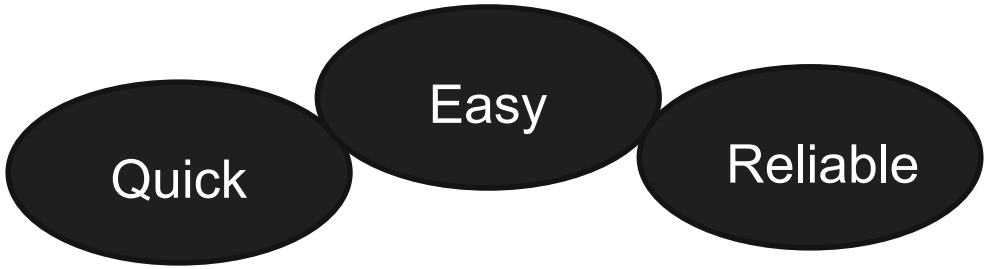
An operational CFD-based dispersion tool

# New operational dispersion tool for Oslo

- *Make sophisticated models quick and easy to use!*


Collaboration: FFI, U.S.Naval Research Laboratory (NRL), Oslo Fire Dept.

- Build a dispersion tool which covers at least 100 $km^2$ of Oslo, based on LES simulations covering «all» wind directions.
- Improve software capabilities.




Similar tool is already in use elsewhere;

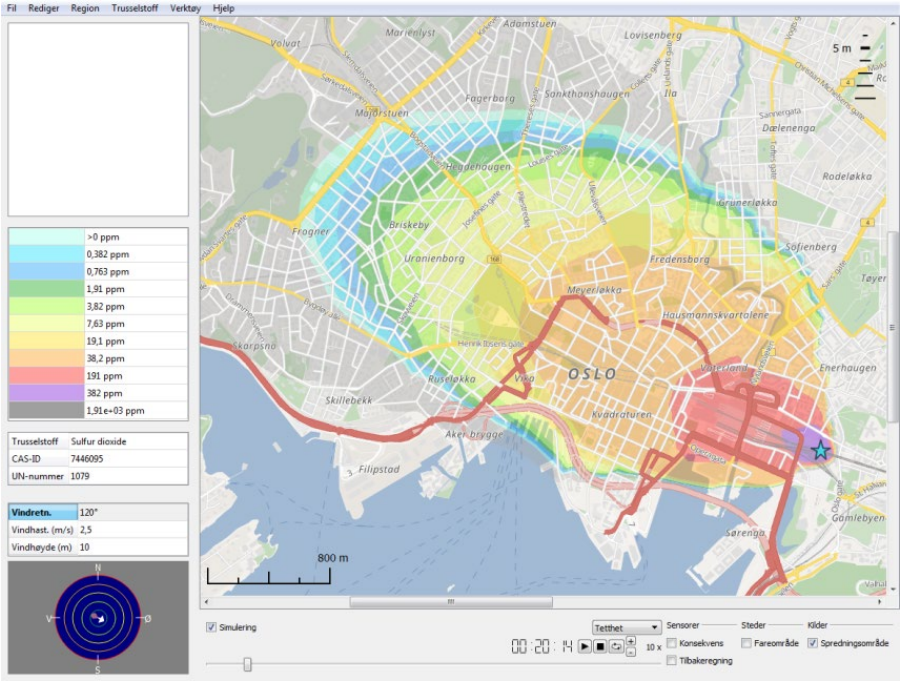
- Hamburg,
- Chicago,
- Washington DC, …

# New operational dispersion tool for Oslo

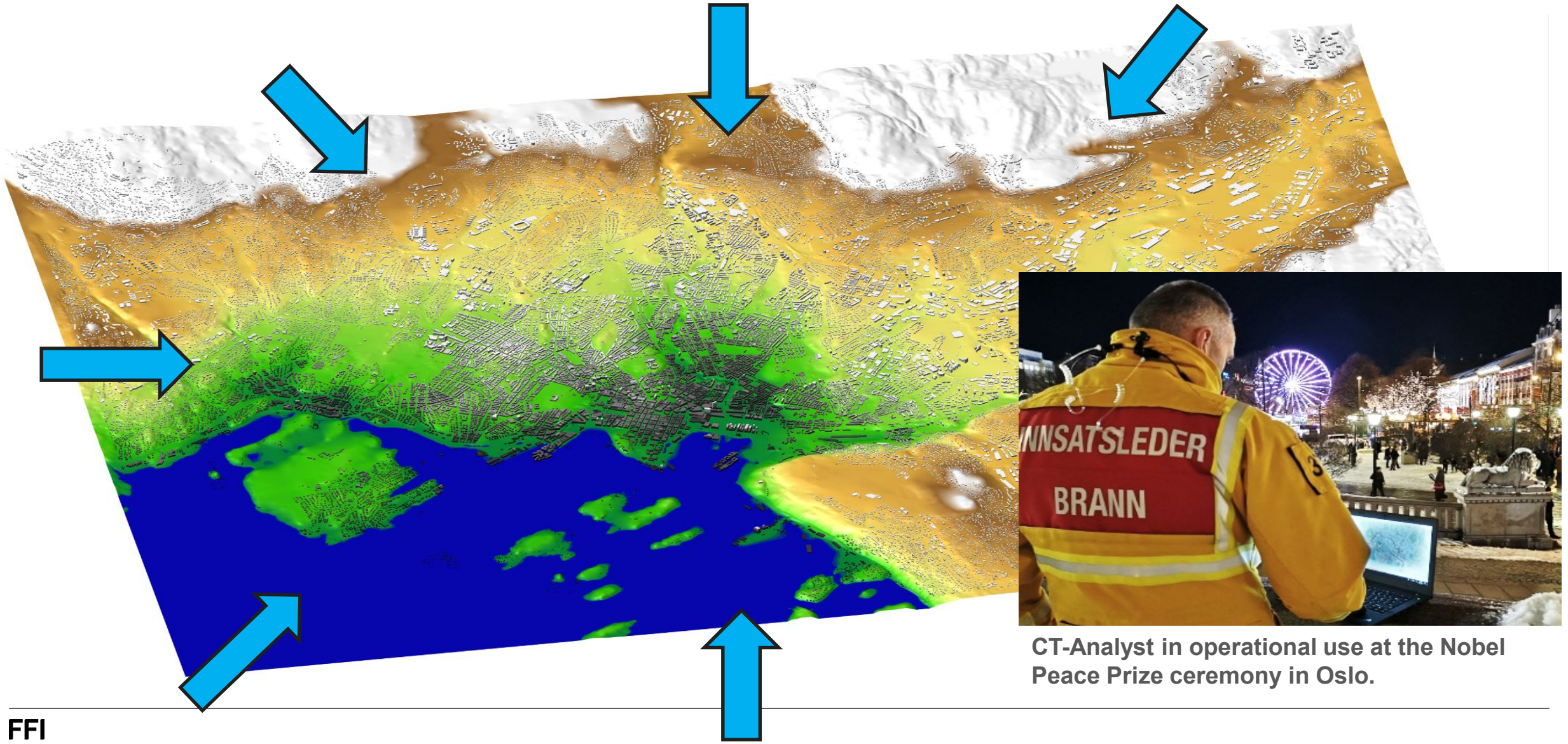
➢ *Make sophisticated models quick and easy to use!*

- Street-level wind is **precomputed**
  → the software is **fast**!

- Advanced «under the hood», but simple to use:
  - Place release source in the map.
  - Specify wind conditions.
  - View the results immediately!



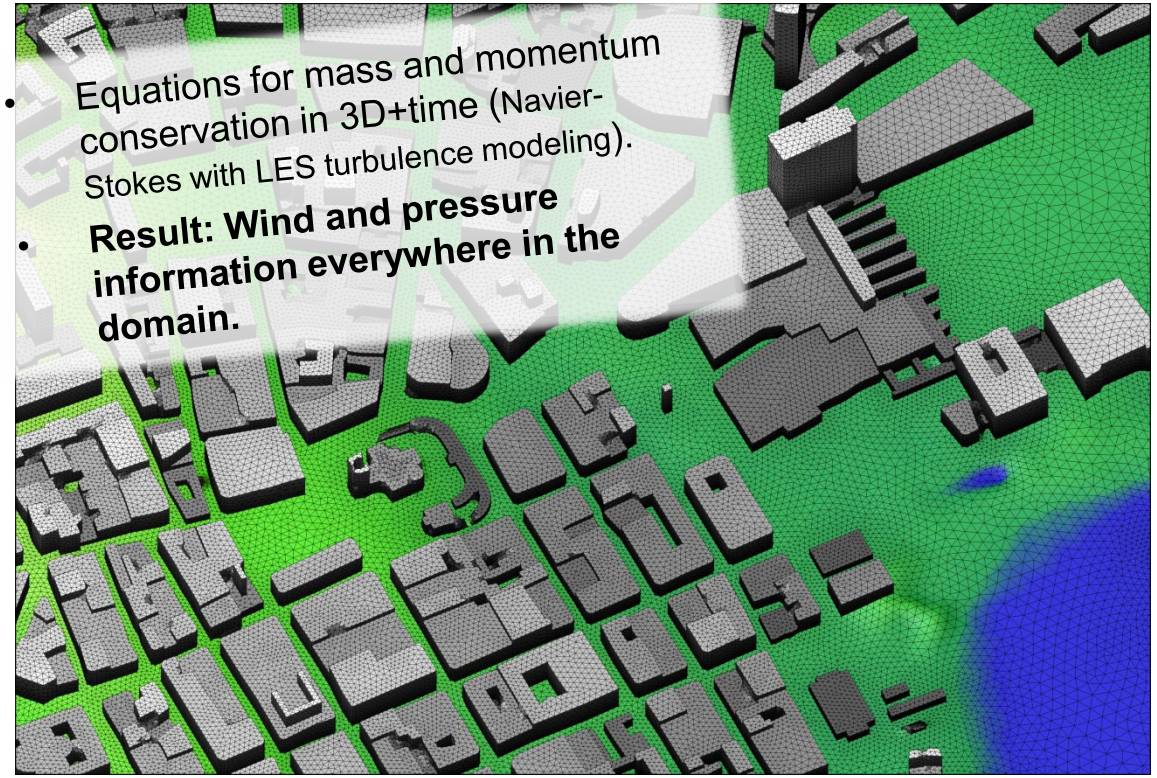

# Pilot version of CT-Analyst Oslo complete and in use






CT-Analyst in operational use at the Nobel Peace Prize ceremony in Oslo.

# Methodology




Map data

Geometry (3D)

**18 wind directions**

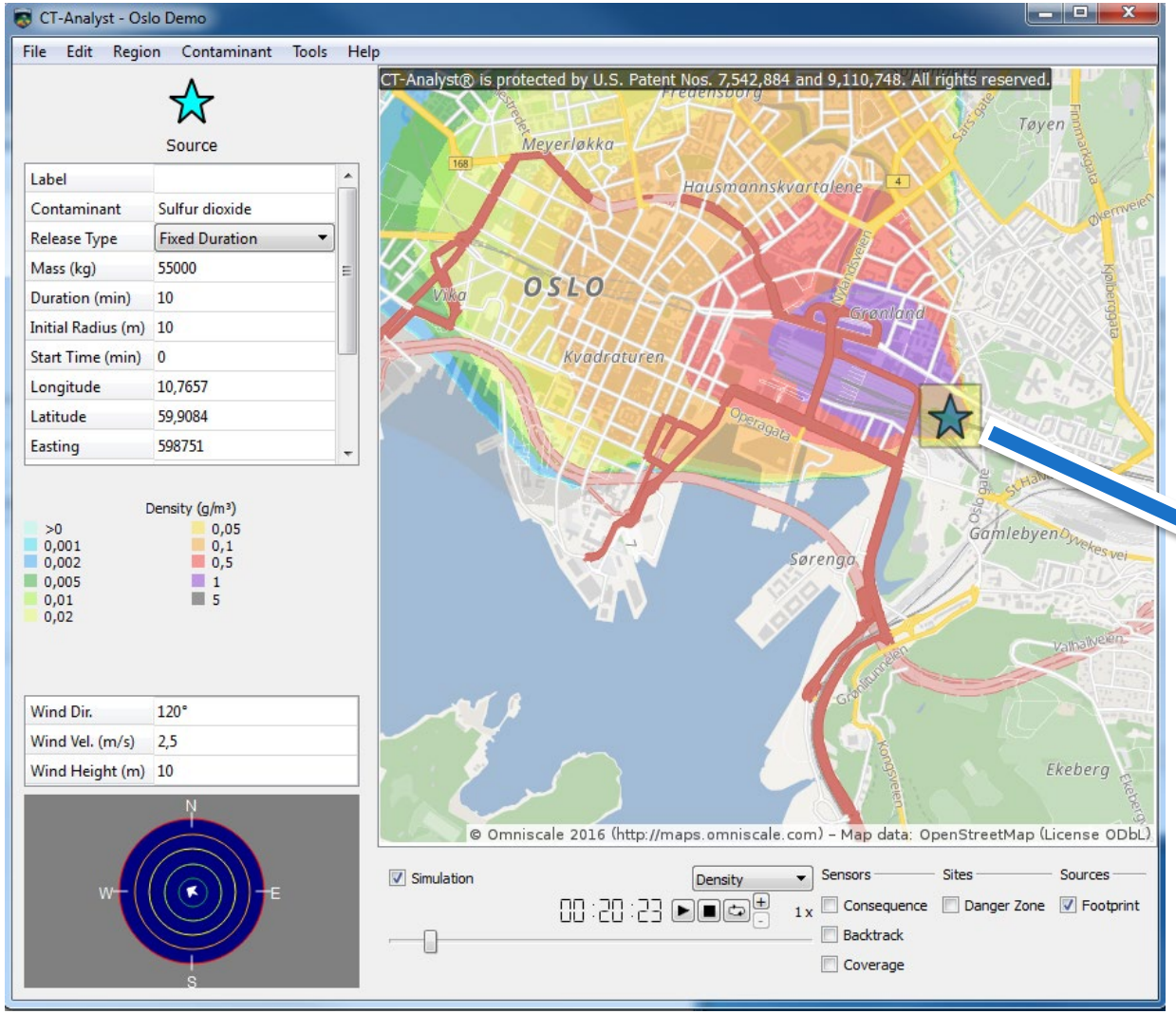
Computational mesh

Modeling
(*wind, forestry, water…*)

Result

Dispersion tool:
**CT-Analyst**

# CT-Analyst Oslo - example




**Interactive dispersion tool:**
Instantaneous effect of changes in wind or source location.

**Data extraction:**
Data can be exported as kml files.

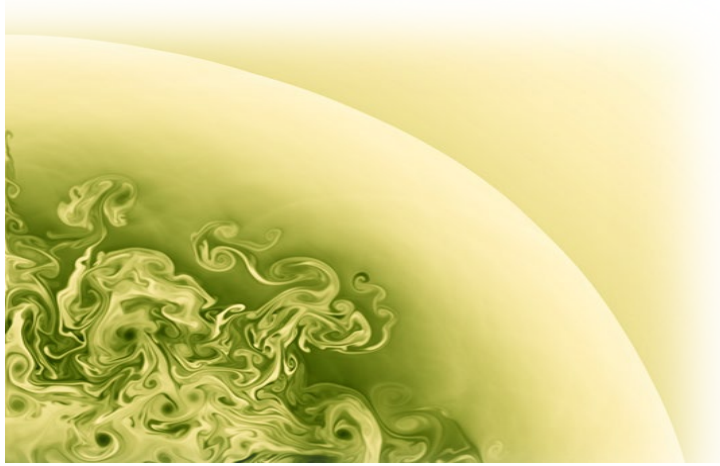
**Example:**

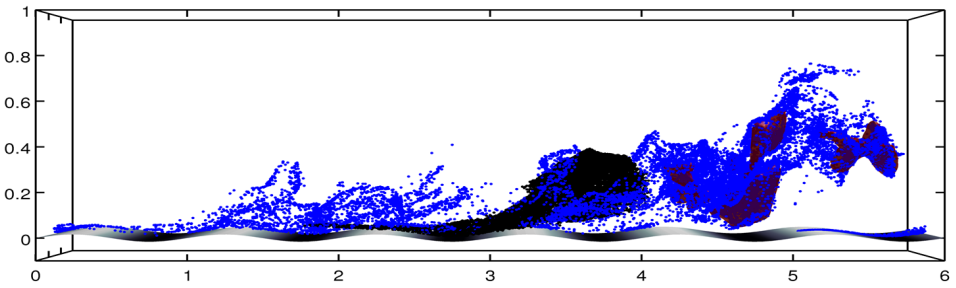
- Pressurized container
- 55 tons of $SO_2$ into the air

# Possible future development

- More advanced release sources
  - Moving? Lines/areas? Evaporation? Predefined sources?
- Dense/light gas
  - Smoke from large fires?
- More complex meteorolog
  - **Tempospatial variation**
  - Inversion due to temperature
  - Fetch weather automatically from web server
- Vegetation, forestry; *requires empirical data!*
- Sea and «heat island» effects..?

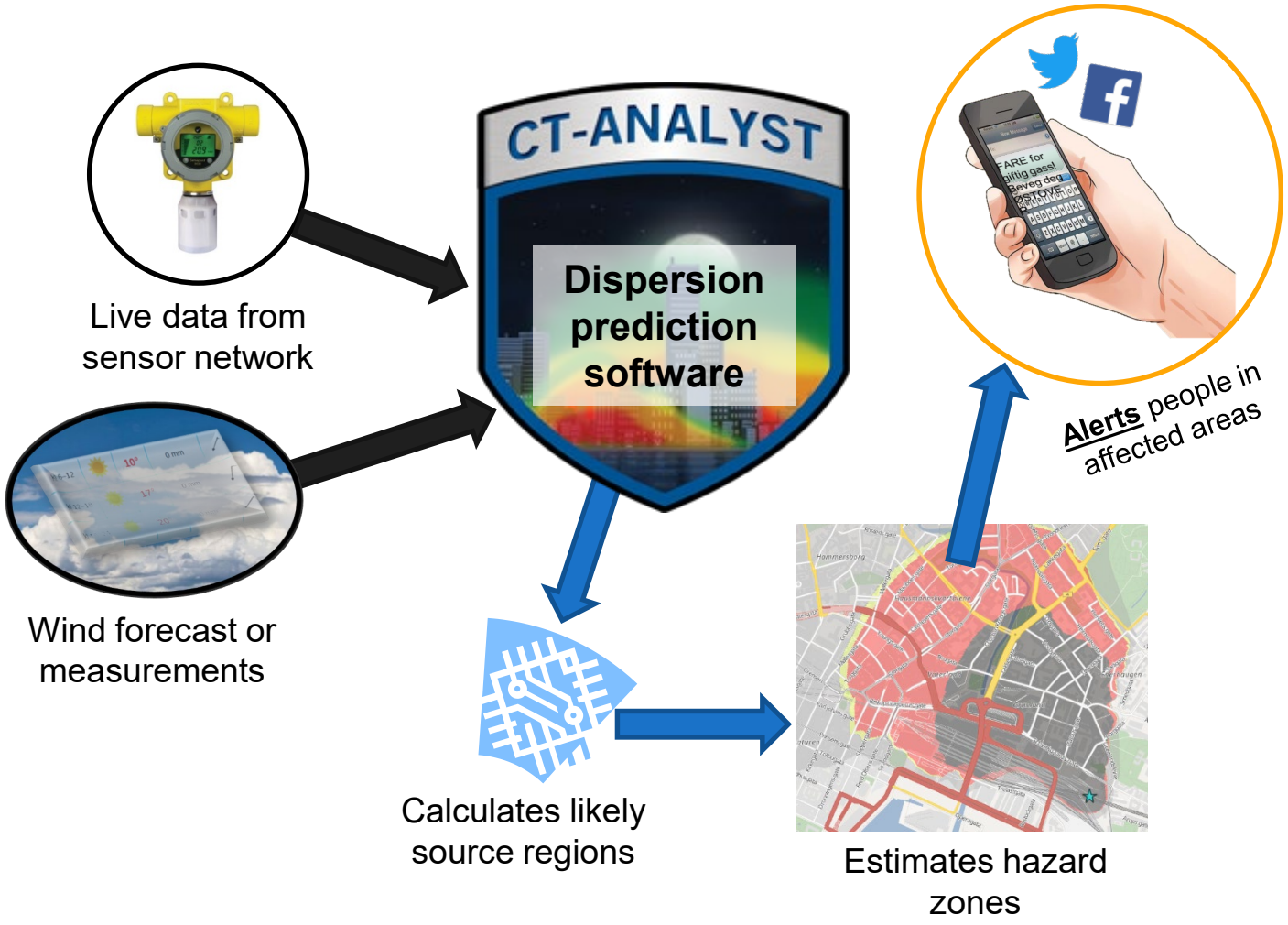
***However:***
***The tool must remain easy to use!***





# Other possible features

- Can be connected to live sensor networks.
- Can be connected to weather forecasting or measurement systems.
- Can be connected to alert systems (e.g. via location-based cell phone messages).
- Back-end can be integrated into other front-end software (e.g. GIS software).
  - C++ API



FFI Forsvarets forskningsinstitutt
Norwegian Defence Research Establishment

# Demonstration of CT-Analyst