FAIRMODE TECHNICAL MEETING 2020
CT4 MICRO-SCALE AQ MODELLING SESSION

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01/10/2020

universidade de aveiro
1973 . 2019

universidade de aveiro
cesam
centro de estudos do ambiente e do mar

universidade de aveiro
dao departamento de ambiente e ordenamento
1978. 2018
a inovar o ambiente

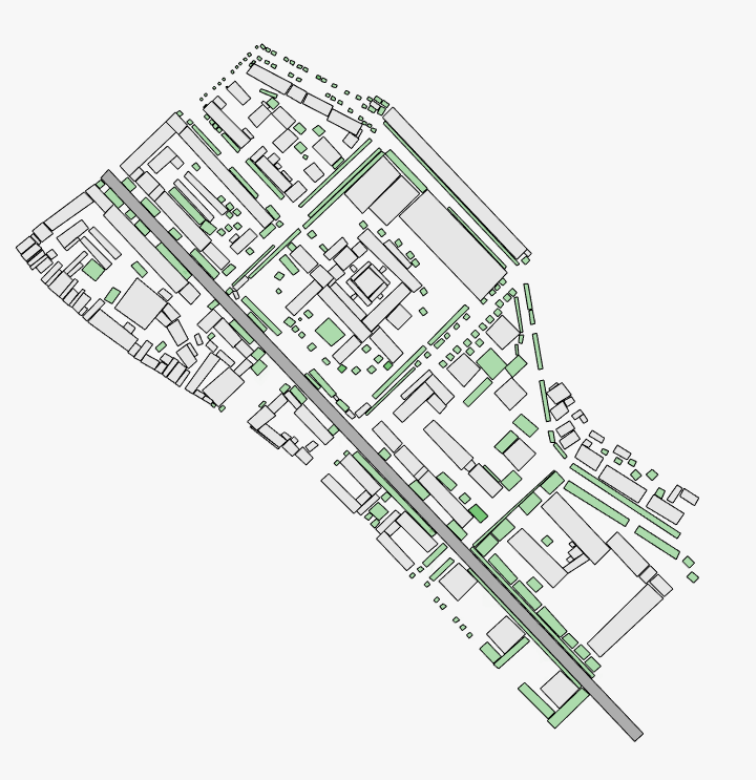
Short description of the model

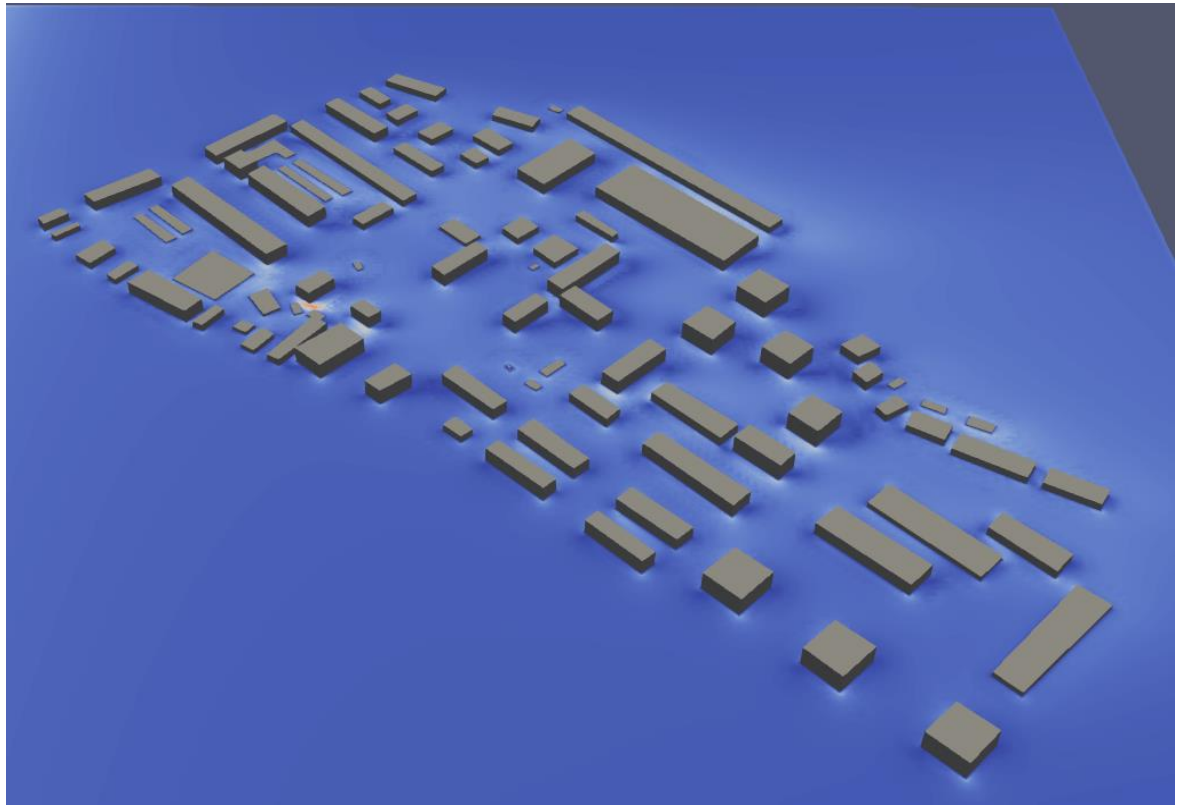
- CFD / RANS, LES, other/ steady, unsteady / chemistry (yes or no) / etc.

VADIS	OpenFOAM
RANS	RANS & LES
Steady	Steady unsteady
No chemistry	Chemistry
Regular and structured mesh	Unstructured mesh
Turbulence closure scheme k-ε standard	Several options

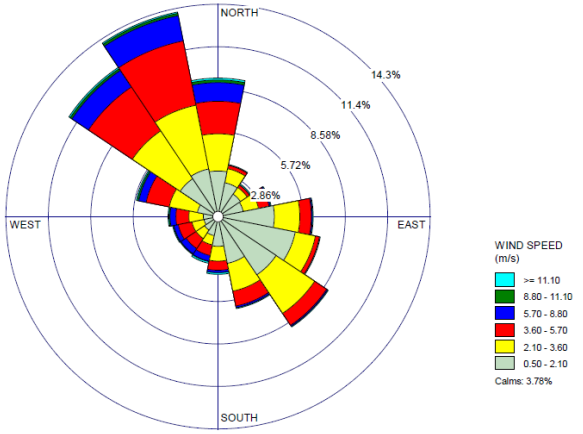
Model set-up

- **Modelling domain (size and type), spatial resolution**
  - **Size: ~ 1 km x 1 km, spatial resolution: ~ 1 m x 1 m**





Model set-up



- Modelling domain (size and type), spatial resolution
- Input data: emissions, meteorology, boundary conditions
  - Meteorological data: statistical analysis to determine the set of simulations
  - Wind rose for 2010 – 2019 obtained from meteorological tower measurements at 10 m height
  - Emission sectors: road traffic and residential
  - Traffic counting data and residential emissions per building blocks
  - NO_2, PM10 and PM2.5
- Main modelling assumptions (neutral stability simulations or stability dependent simulations, neglecting NOx chemistry or not, other important assumptions made)
- Steady or unsteady simulations? If unsteady, how long are the simulations?

Set of simulations needed to retrieve annual statics

- Criteria for defining unique simulations: meteorological conditions (wind direction and speed, stability classes, others), emission patterns (related to time of day, day of week, etc.), other…?
  - Minimum of 5 years: 2010 – 2019
  - Minimum of 8 wind directions and 75% above the main wind irection in the whole year
  - 3 sets: the full year, summer winds, and non-summer winds
  - Emission patterns: typical days

- How many simulations are recommended?
  - A set of representative simulations of the meteorological conditions;
  - A set of representative simulations of the emissions data
  - To build pollutant concentrations of a full year in an hourly basis

Procedure for retrieving annual indicators

- General description and main assumptions.
  - Approach 1: 4 typical days (week and weekend days from winter and summer)
    - Build the entire year in an hourly basis based on weighting factors from a set of measurements (e.g. air quality stations)
  - Approach 2: Loop up table method
    - Representative meteorological data (from wind comfort assessment studies)
    - Emission rates: typical days or emission ranges
- Variables used in the procedure for selecting and combining simulations (meteorological variables, emissions, etc..). Where do they come from (measurements, mesoscale models)?

Total of 11 simulations
Frequencies of 77%

Wind direction	Frequency occurrence	Wind speed
NNW	14.1%	U_0=3.7 m.s^{-1}
NW	11.7%	U_0=3.5 m.s^{-1}
N	9%	U_0=3.6 m.s^{-1}
SE	8.7%	U_0=2.3 m.s^{-1}
ESE	6.5%	U_0=1.3 m.s^{-1}
SSE	6.3%	U_0=2.1 m.s^{-1}
E	6.1%	U_0=2.1 m.s^{-1}
WNW	5.7%	U_0=3.7 m.s^{-1}
S	3.2%	U_0=1.9 m.s^{-1}
ENE	3.1%	U_0=3.0 m.s^{-1}
NNE	2.9%	U_0=1.9 m.s^{-1}

Procedure for retrieving annual indicators

- Description of the process used to combine simulations:
  - Weighting factor of a simulation in the combination of simulations to retrieve annual statistics
  - Formula used for combining and retrieving annual statistics
  - Approach 1: 4 typical
    - Build the entire year in an hourly basis based on weighting factors from a set of measurements (e.g. air quality stations)
  - Approach 2: Loop up table method
    - Interpolation method: nearest neighbor, linear, cubic, …