Traffic @ SISTA

Sven Maerivoet

http://smaerivo.dyns.cx
http://phdsven.dyns.cx

Katholieke Universiteit Leuven
Department of Electrical Engineering
ESAT-SCD (SISTA)

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Short overview

- **Microscopic traffic flow models**
  - *Traffic Cellular Automata +*
  - *CATSIM*

- **Analysis of traffic measurements**

- **Project** – *"Sustainability Effects of TMS"*

  Earlier: Federale **D**iensten voor **W**etenschappelijke, **T**echnische en **C**ulturele aangelegenheden (DWTC)

  Now: Federal Science Policy

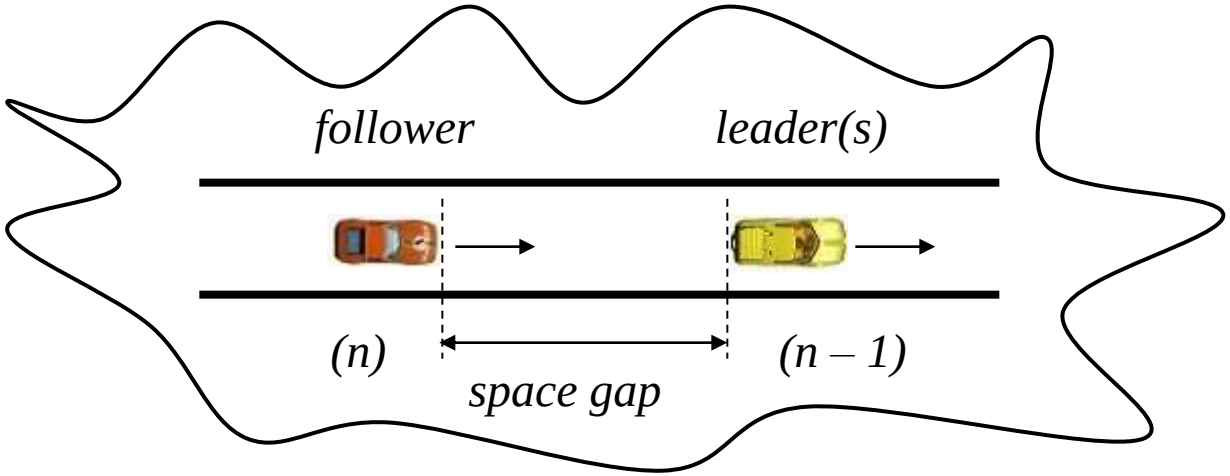
Microscopic traffic flow models

Models of traffic flows

- Macro-/mesoscopic models
  - Based on partial differential equations.
  - *Fluid dynamical* models consider a traffic flow as a **compressible fluid** (i.e., *continuum* models); macroscopic.
  - *Gas kinetic* models consider a traffic flow as a **many-particle system**; mesoscopic.
- Microscopic models
  - Consider each vehicle **separately**.
  - (Too) many parameters and **computationally** intensive.

Microscopic traffic flow models

- Bottom up approach: model vehicle dynamics.
- **Car-following** and **lane-changing** submodels.

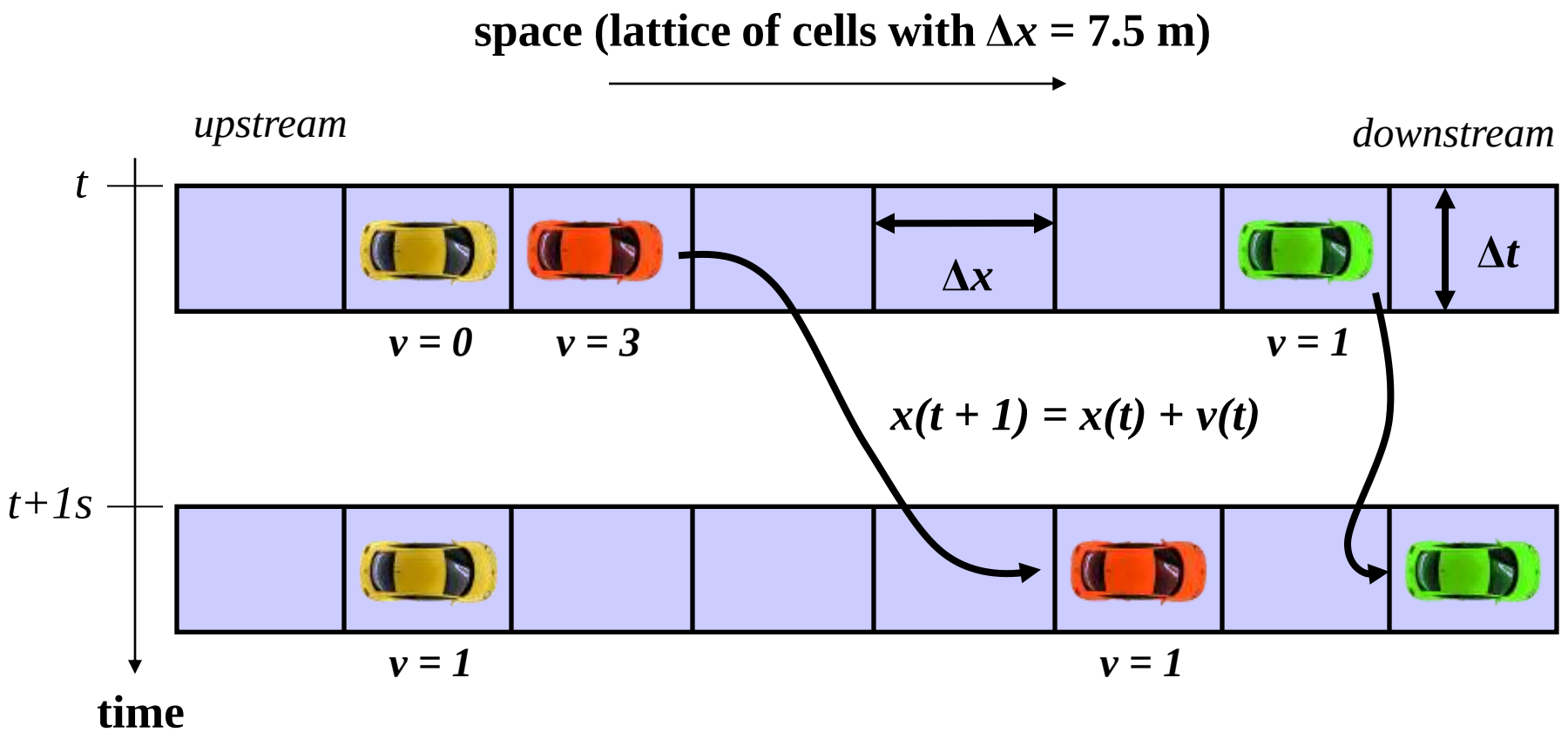


$a_n(t + \tau) \sim f(t, \Theta)$

reaction time

space-/time gap, agression, (relative) speeds, …

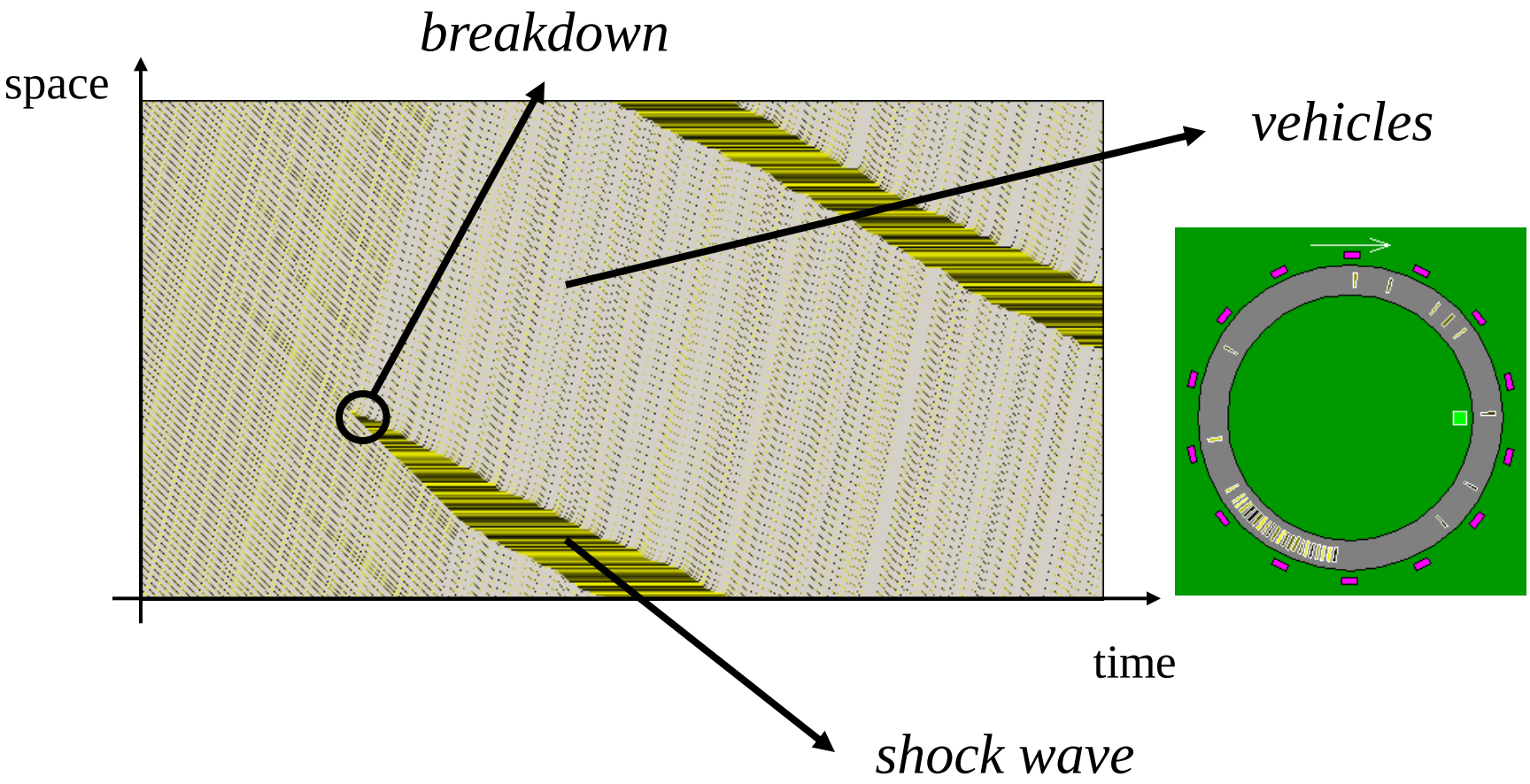
Traffic Cellular Automata +



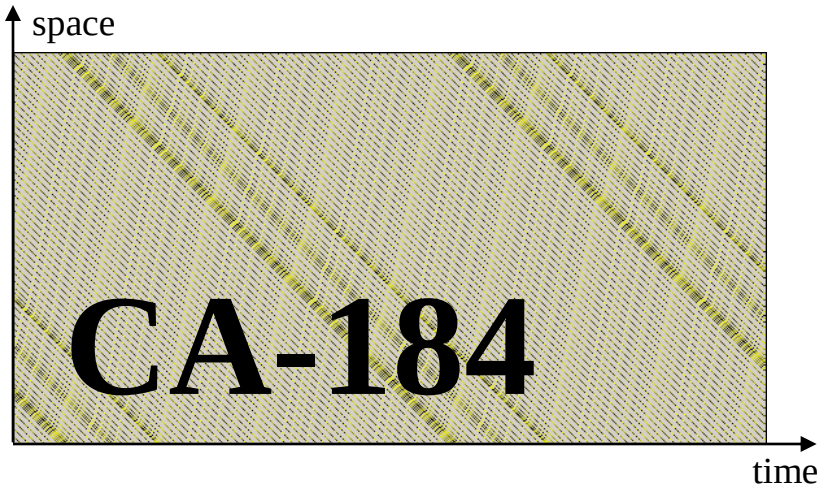
Car-following submodel = collection of local rules

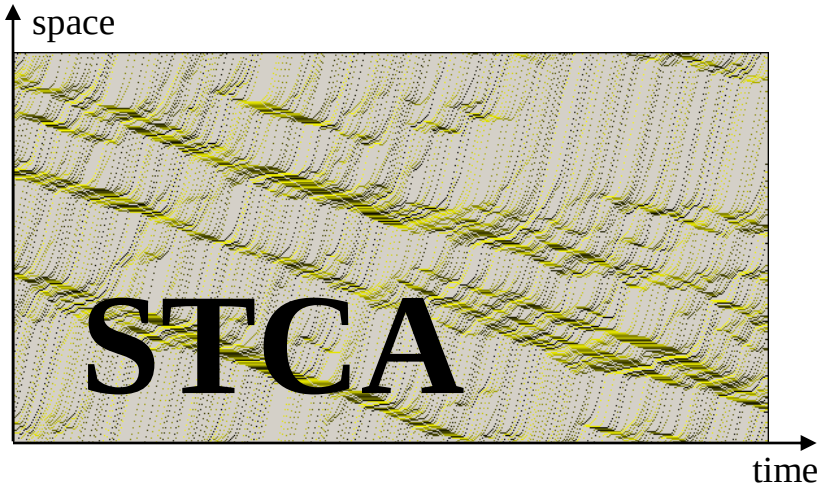
Example: VDR-TCA (Barlović)

- Consider a unidirectional, circular road with one lane:

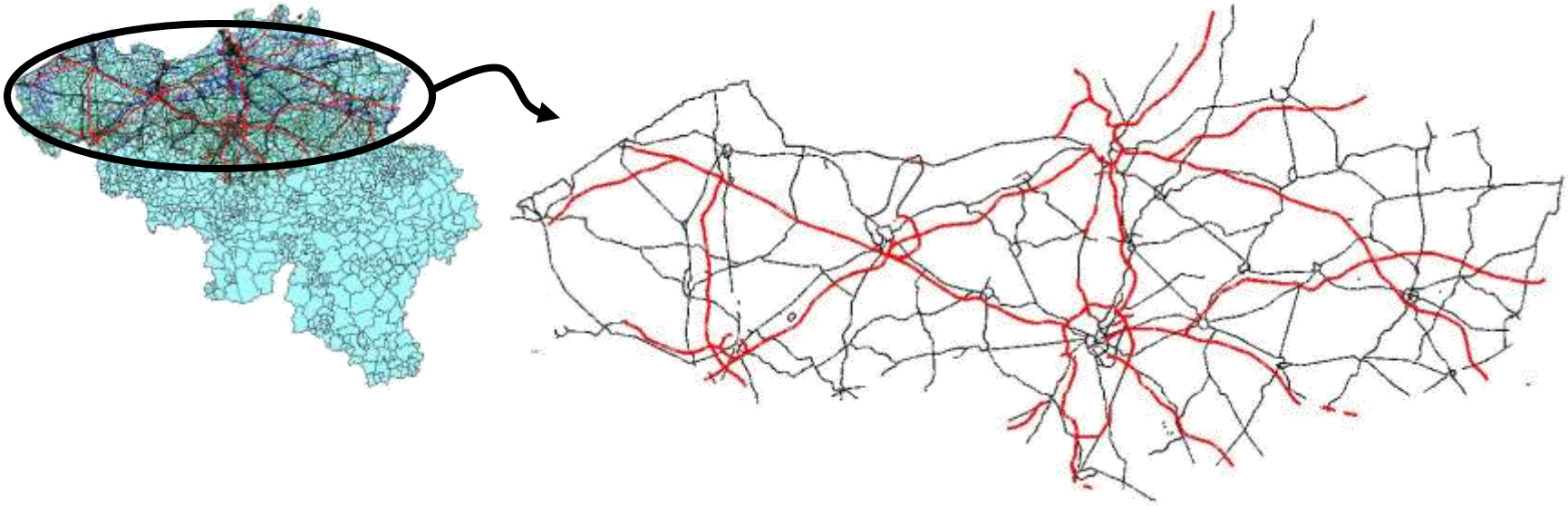


Other TCA models





Simulation of a large scale network



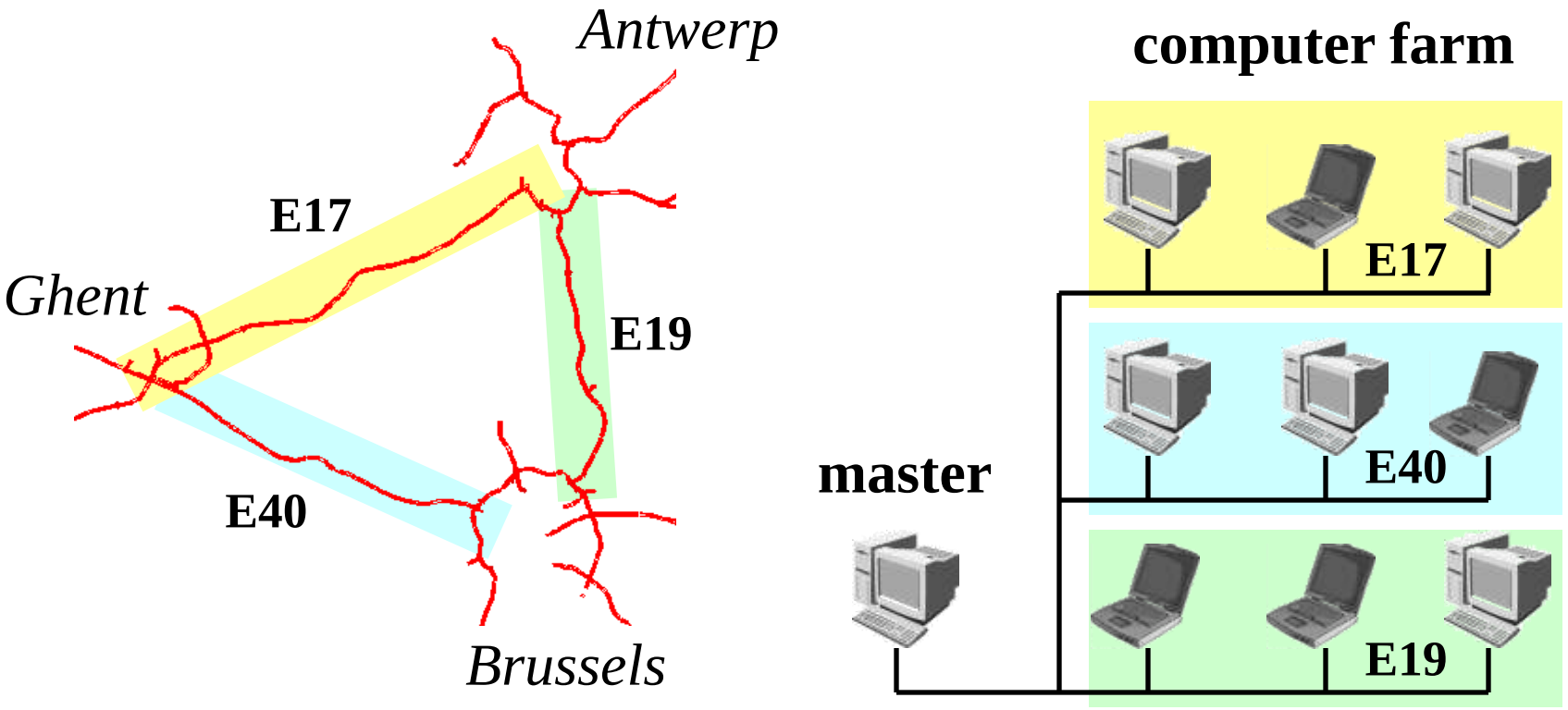
- Flanders has approximately 1350 km of highways:

  ≈ **540,000 cells** (7.5 m/cell; 3 lanes/direction)

- Goal: reasonably *detailed* and *very fast* simulation.

CATSIM

- Distribute the highways over several computing units:

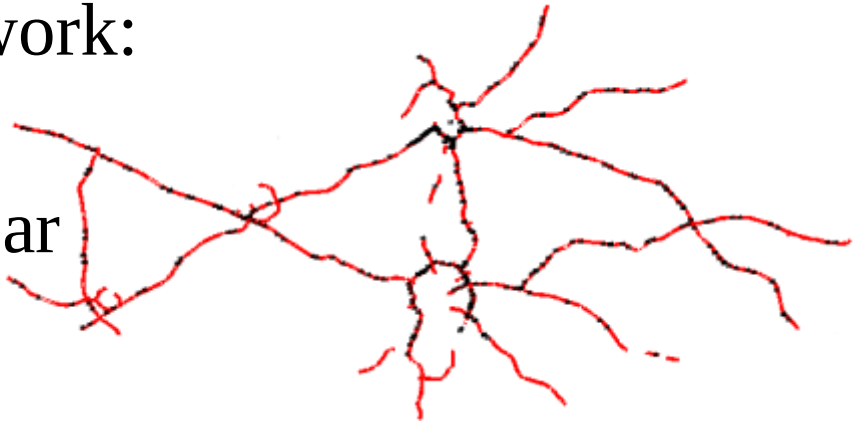


parallellisation through distributed computing (*Java*)

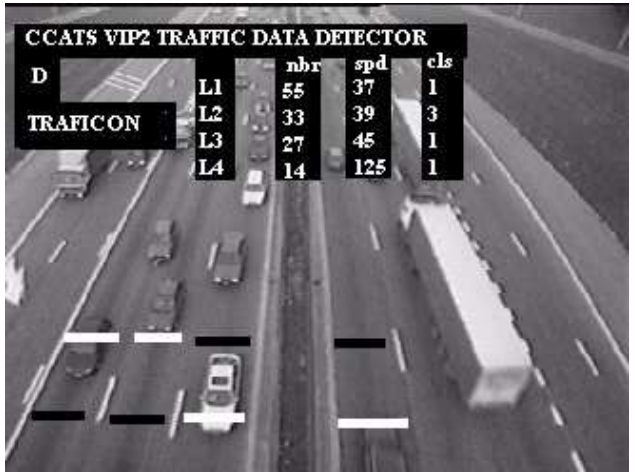
Analysis of traffic measurements

Analysis of traffic measurements

- Flemish highway road network:
  - ± **1655** sensors
  - ≈ 10^6 measurements/year
  - ≈ 3.24 GB

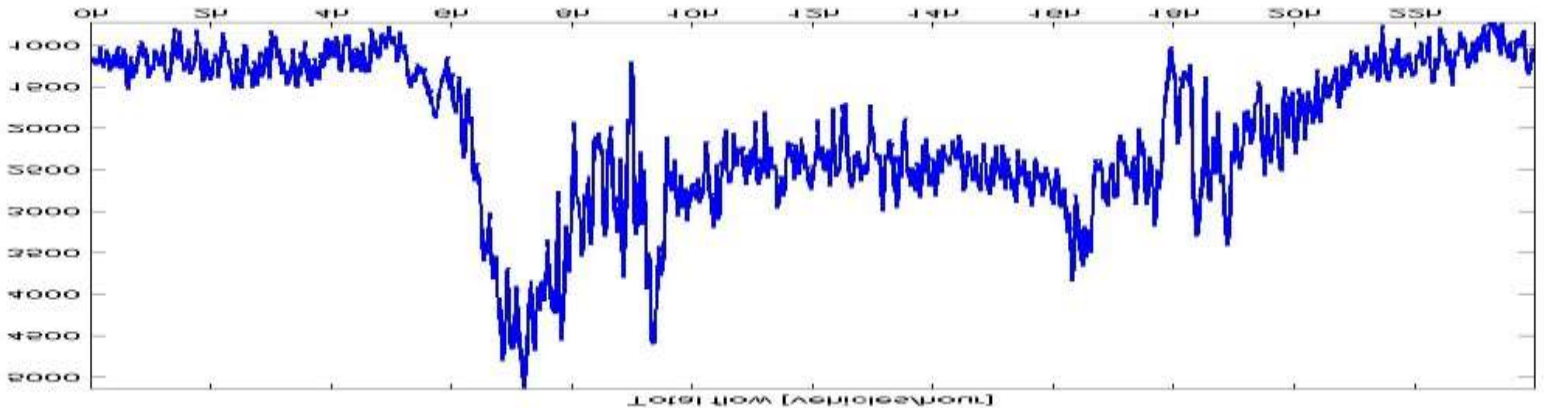


- Single loop detectors / Cameras (*Traficon*)

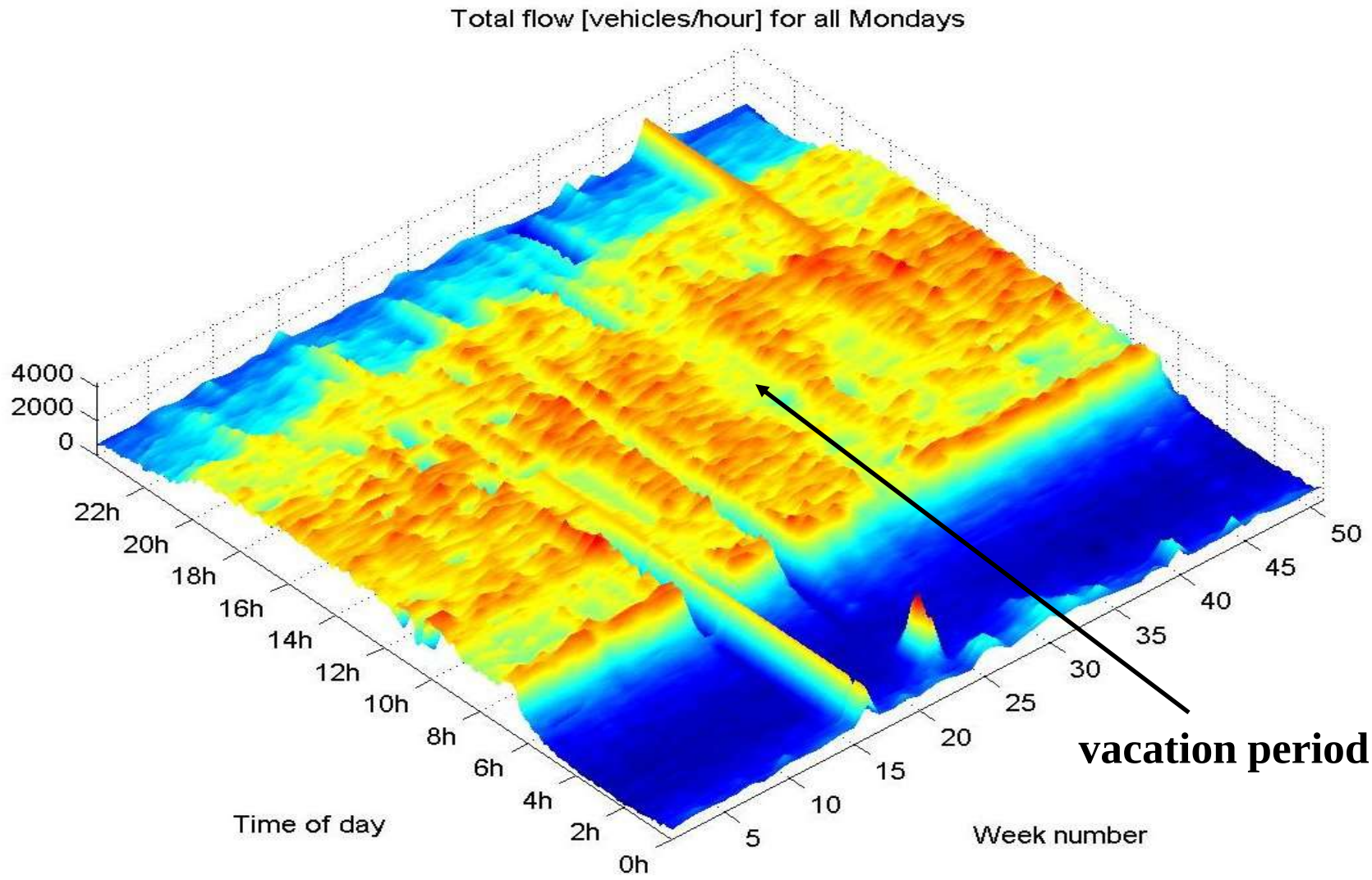


What is being measured ?

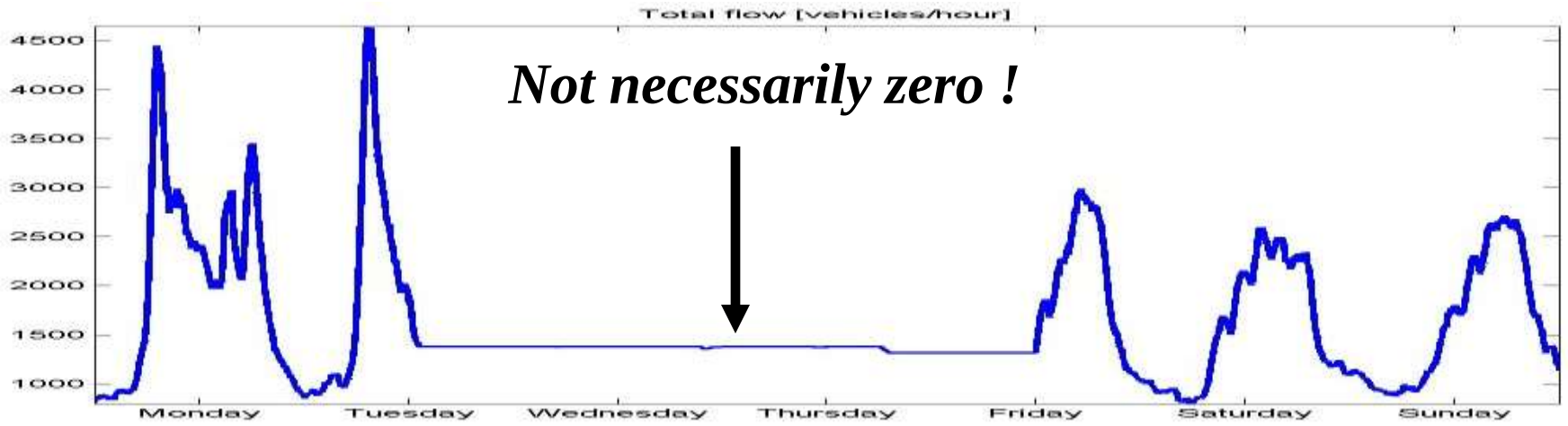
- After each minute, the following quantities are aggregated:
  - Number of cars
  - Number of trucks
  - Occupancy
  - Average speed



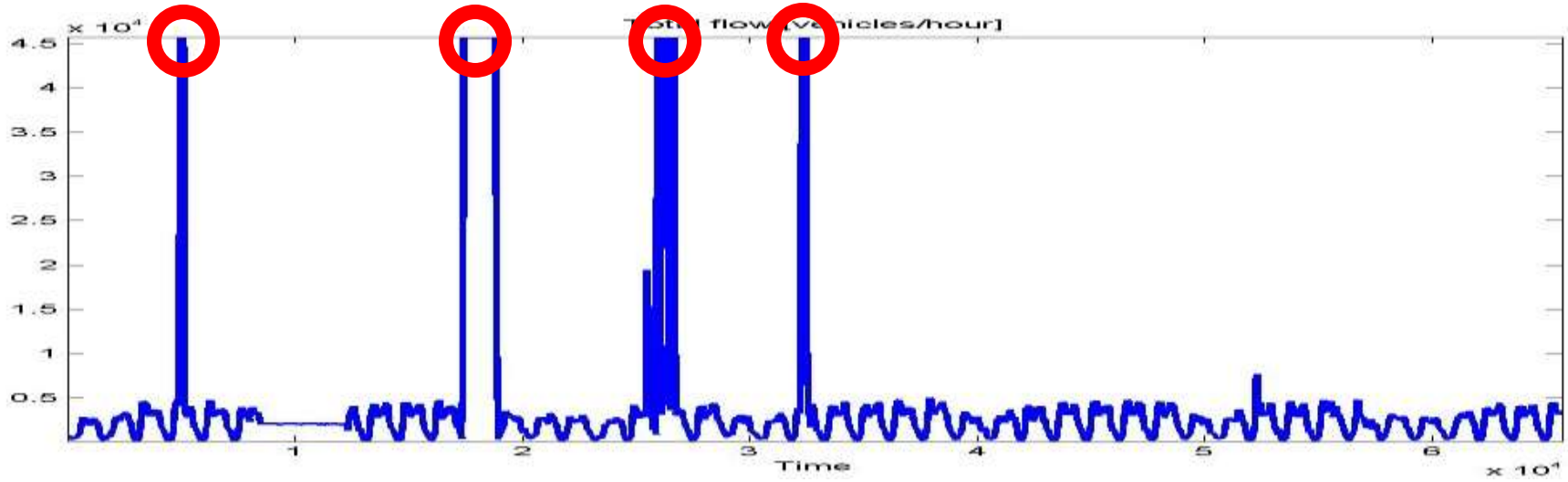
Remember all those ‘mondays’ in 2001 ?



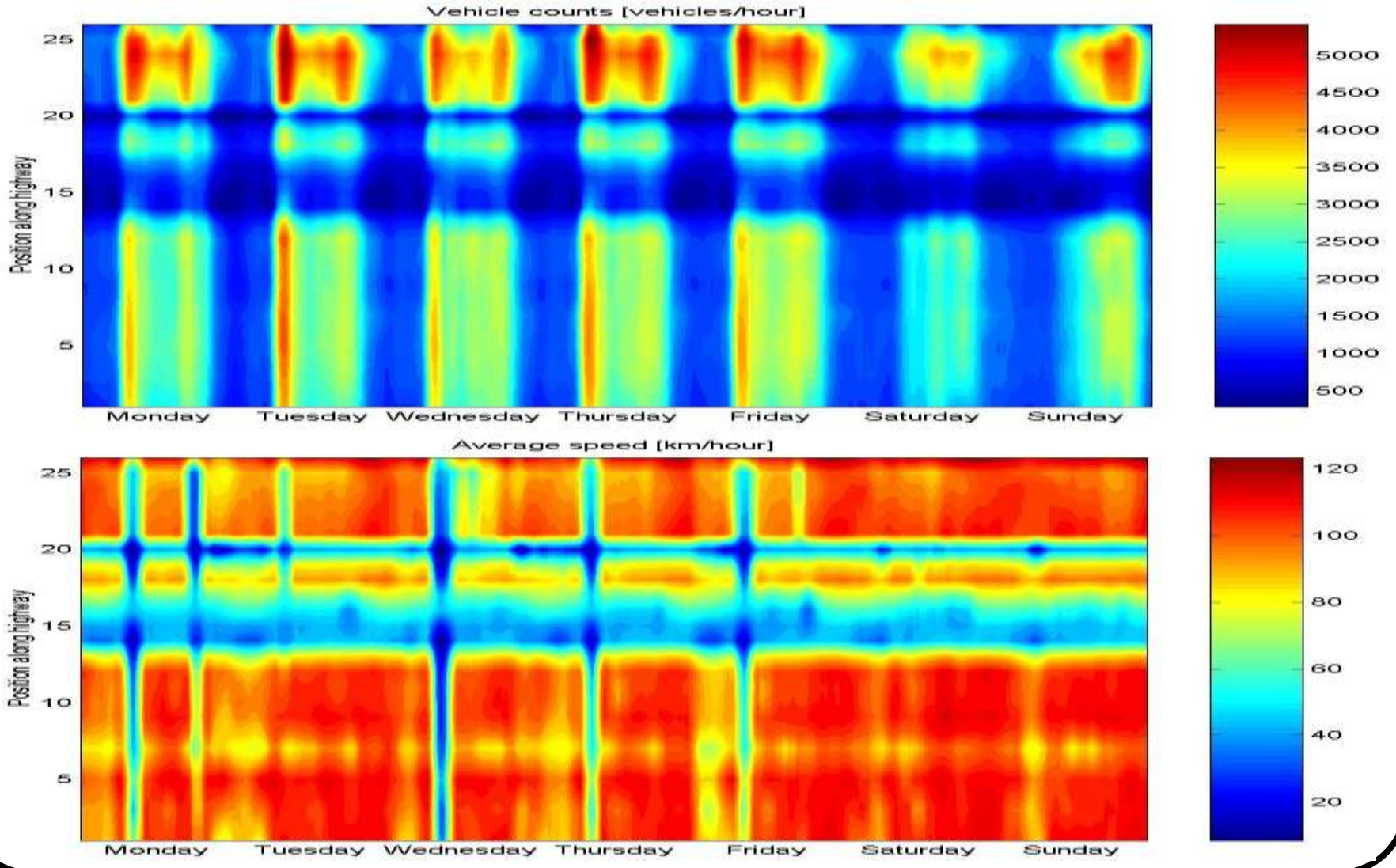
Quality problems…



Not necessarily zero !



Time-space correlations *(one week)*



"Sustainability Effects of Traffic Management Systems"

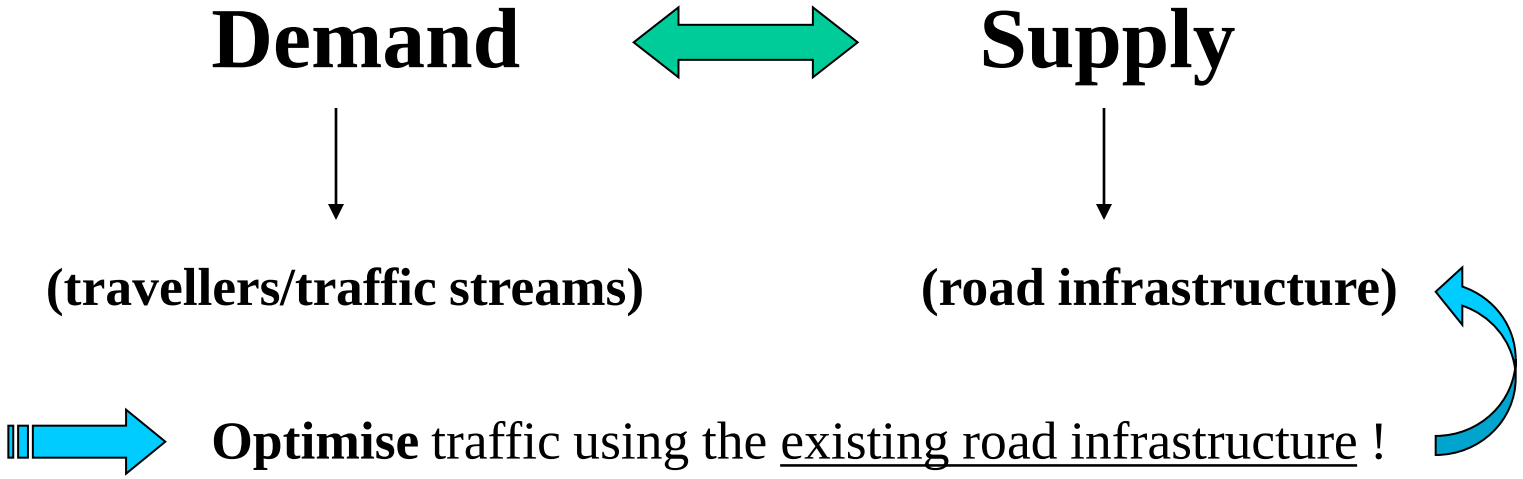
DWTC-CP/40 (2002-2004)

http://dwtc-cp40.dyns.cx

- Katholieke Universiteit Leuven
  - Department of Electrical Engineering
    - **SCD (SISTA)** – B. De Moor
  - Department of Civil Engineering
    - **Traffic and Infrastructure** – B. Immers
  - Centre for Economic Studies
    - **Energy, Transport, and Environment** – S. Proost
- Université Catholique de Louvain
  - Centre for Systems Engineering and Applied Mathematics
    - **CESAME** – G. Campion / G. Bastin
- Universiteit Gent
  - Electrical Energy, Systems, and Automation
    - **SYSTeMS** – R. Boel

Sustainability Effects of TMS

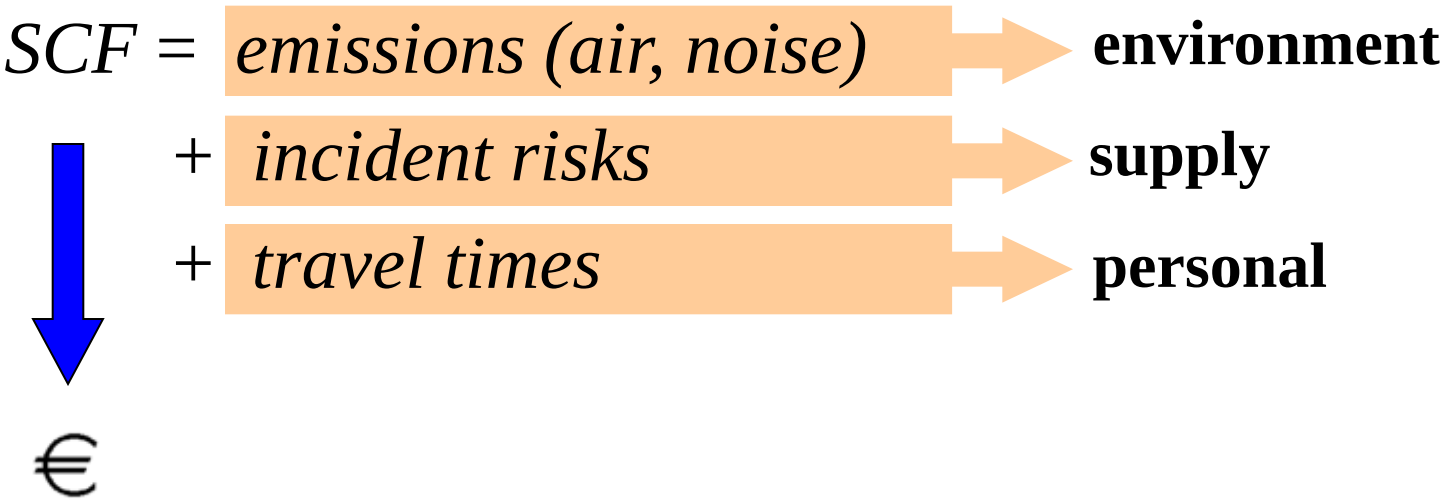
- *"Traffic is dynamic in nature"*



- Methods for optimisation ? → **adaptive control strategies**
  (e.g., model predictive control)
- Optimisation criterion ? → **sustainable cost function**

A sustainable cost function (SCF)

- Characterise the concept of *'sustainability'*, e.g.,



- **Important:** the SCF involves a *trade-off* !

environment friendly ⟷ capacity throughput