CARBO TRAF

EUROPEAN FP7 PROJECT

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

CARBOTRAF

Preliminary results and lessons learned from the CARBOTRAF project

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INTEGREEN workshop, Bolzano, June 24, 2014

SEVENTH FRAMEWORK PROGRAMME

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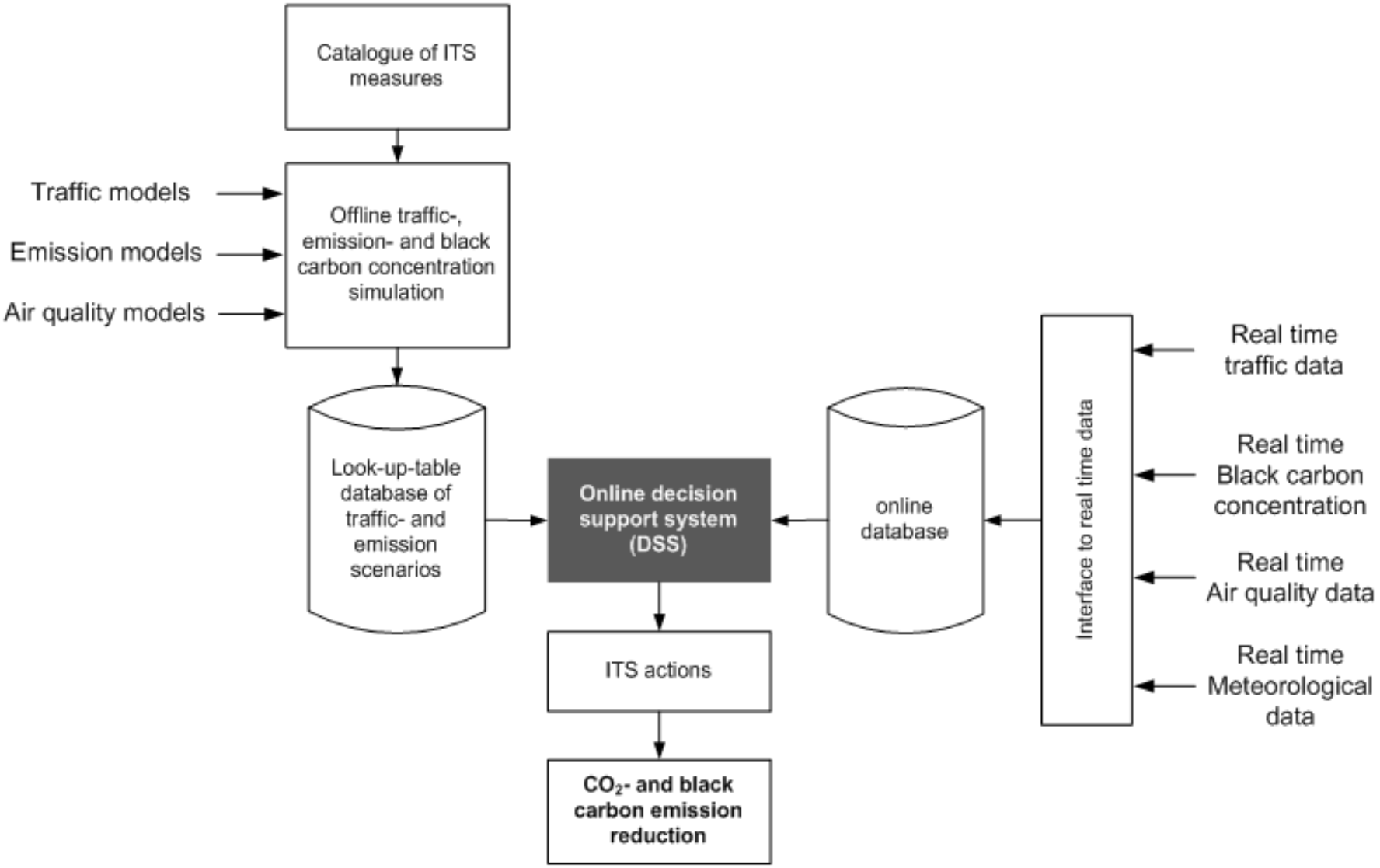
- Introduction and project concept for emission reduction
- Traffic and air quality simulation results for Graz
- Black carbon measurement results Graz
- Lessons learned so far

Project Idea and Innovation

- Idea
  - CO_2 and black carbon (BC) emission reduction by smart traffic management
  - Pilot operation in Graz and Glasgow
- Innovation
  - Linking of CO_2 - aspects and ITS measures (main focus not on reduction of congestion but rather "CO_2-reduced" traffic)
  - Black carbon is the second most important greenhouse factor and is also dealt with in the project
  - ITS aspect: Not only traffic development prediction but also decision support for ITS counter measures
- Goals
  - → Development of methods and tools to reduce emission of CO_2 und BC by e.g. re-routing traffic
  - → Evaluation of the concept in two pilot installations/test operations

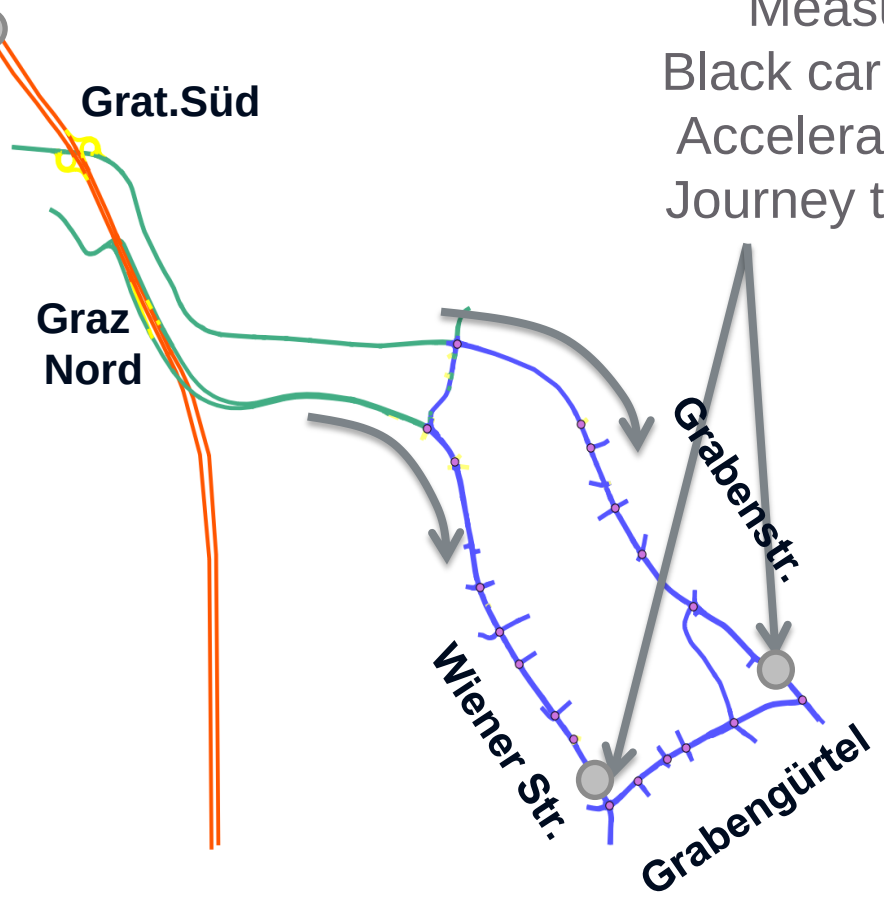
Decision Support System (DSS)

- step 1: real time monitoring of traffic situation
  Traffic monitors (existing devices and additionally installed by the project) **measure speed, volume and composition of vehicles and detect emission relevant traffic states (e.g. stop/start situation). Air quality is also monitored.**
- step 2: prediction of traffic situation 30-60 mins. into the future
- step 3: computing **CO_2 & BC emissions and corridor journey times (current and prediction) from traffic**
- step 4: an improved traffic scenario is selected that is able to satisfy the traffic demand at reduced total CO_2 & BC emissions (and improves further defined key performance indicators)
- step 5: ITS **action proposals** are displayed to the traffic centre operator who finally deceides on their implemetation („human in the loop“)



VMS at A9

Measure:
Black carbon
Acceleration
Journey time



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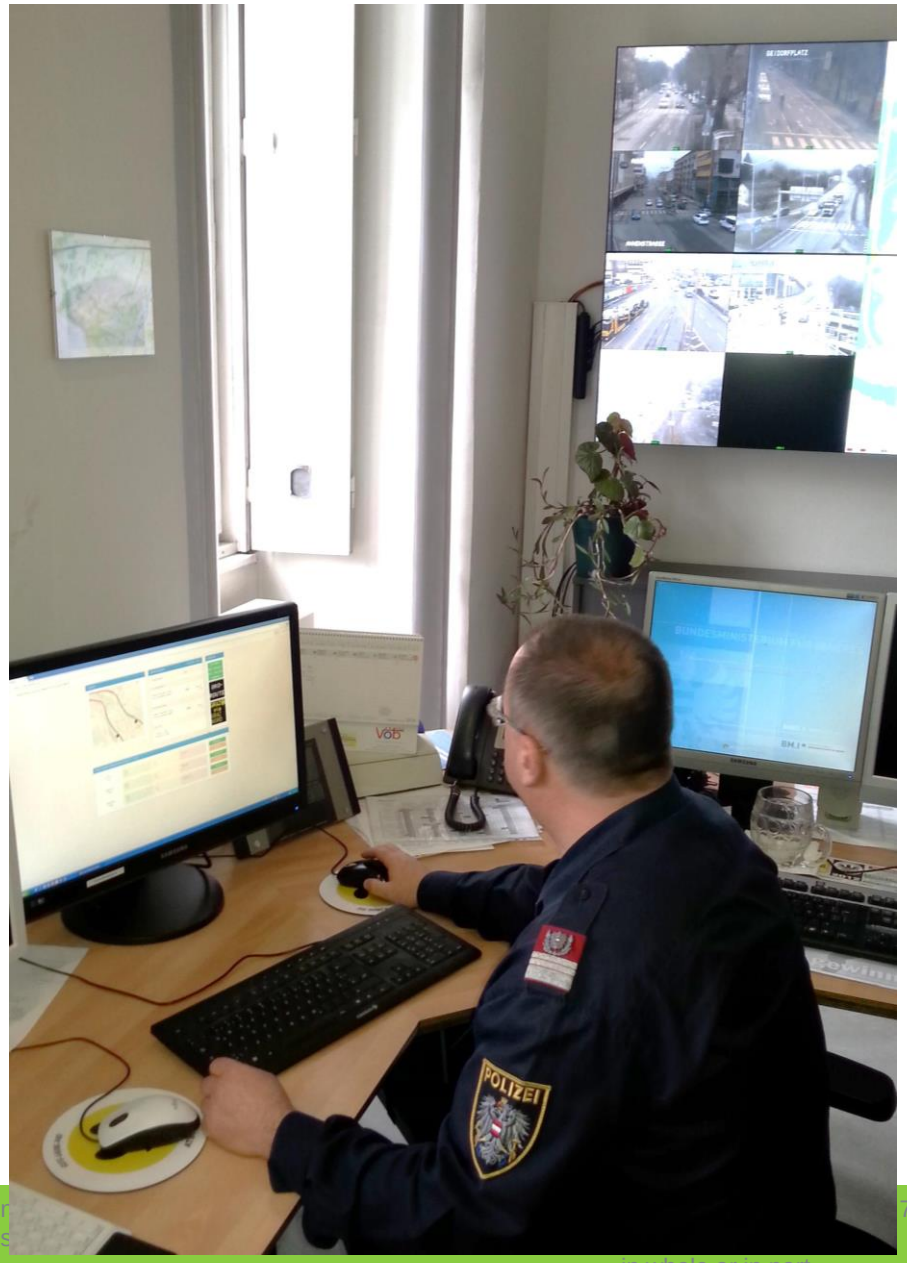
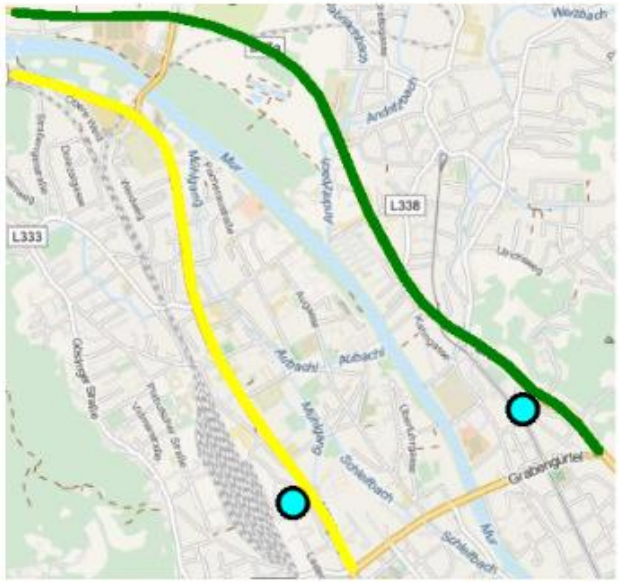
User Interface for Operators

- ITS action proposals
  - Traffic light programs
  - Rerouting messages on VMS
- Predictions on
  - Emissions of CO2 and black carbon
  - Journey time
- Operators can accept or reject proposals



CARBOTRAF Operator WebUi (90:aee268ec0d1c) Graz Log out "graz"

Lagebild



Aktuelle Situation (09:33 @ 12.06.14)

Ampelprogramm		Normal
Ost (Grabenstraße)		
Relative Reisezeit (+/- min.)	-1	09:25 @ 12.06.14
Russkonzentration (µg/m³)	5.8	09:15 @ 12.06.14
West (Wienerstraße)		
Relative Reisezeit (+/- min.)	+3	09:20 @ 12.06.14
Russkonzentration (µg/m³)	4.0	09:25 @ 12.06.14
Emissionen bei Normalprogram		
Gesamt CO_2 (kg/h)	----	---
Gesamt Russ (µg/h)	----	---

Infotafel A9

Ausschalten
Empf. Graz Nord
Empf. Gratk. Süd
Regelbetrieb

Vorgeschlagene Maßnahmen (08:36 @ 18.06.14)

StG.30:S2, StG.32:S2, Empf. Graz Nord	Russ -4.0 %	CO_2 -1.0 %	Reisezeit +0 min	Akzeptieren	Ablehnen
StG.30:S2, StG.32:S5, Empf. Graz Nord	Russ -3.0 %	CO_2 -0.8 %	Reisezeit +0 min	Akzeptieren	Ablehnen
StG.30:S2, StG.32:S2	Russ -5.0 %	CO_2 -1.0 %	Reisezeit +0 min	Akzeptieren	Ablehnen

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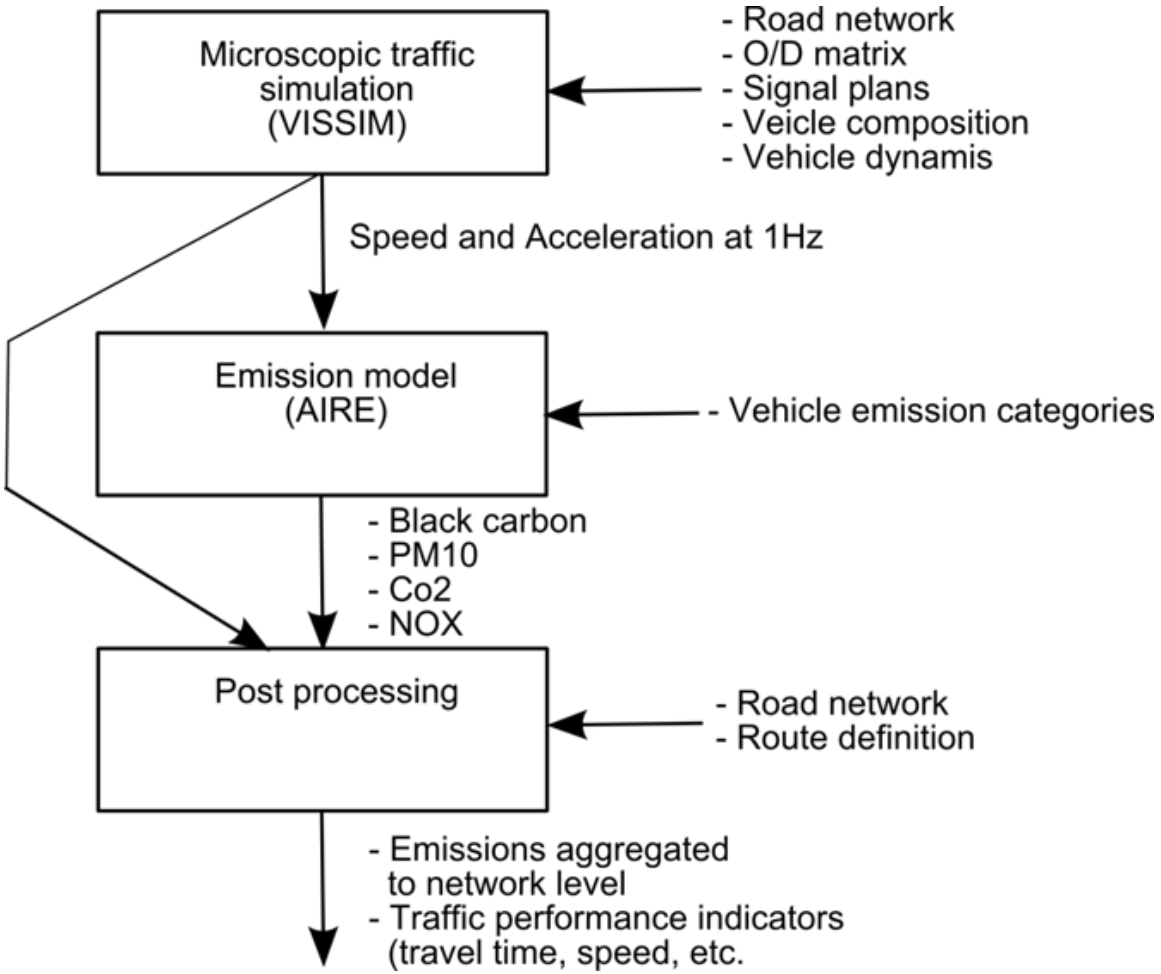
Results Traffic and Emission Simulation

Traffic Micro Simulation with VISSIM

- Calibration of the model using FCD
  - Speed
  - Acceleration
- 39 Traffic scenarios have been simulated, combinations of
  - Traffic light control programs
  - VMS route advices
  - 3 different compliance rates for route advices
- 3 hours per simulation, morning peak
- In total about 800 simulation runs with different “random seeds” to increase data variation
- Based on the results the predictions of the decision support system will be computed

Combined traffic/emission simulation

- In total several millions of datasets of simulated traffic/emission situations
  - Traffic Flow
  - Speed
  - Journey Time
  - Emissions
- Per network link



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Results indicate potential for moderate emission reduction

			Graz: BC percentage respective base scenario		
Traffic light Program	VMS	Compliance	(6-7)	(6:30-7:30)	(7-8)
W2E2	do nothing	/	100%	100%	100%
W2E2	Go East	5	99%	101%	99%
W2E2	Go East	10	99%	98%	97%
W2E2	Go East	15	98%	98%	96%
W2E2	Go West	5	99%	100%	99%
W2E2	Go West	10	99%	100%	101%
W2E2	Go West	15	99%	101%	101%
W2E5	Go West	5	99%	99%	96%
W2E5	Go West	10	100%	99%	97%
W2E5	Go West	15	99%	100%	98%
W5E2	Go East	5	100%	100%	99%
W5E2	Go East	10	100%	99%	98%
W5E2	Go East	15	100%	98%	97%

Note: During peak traffic (~ 1 hour)

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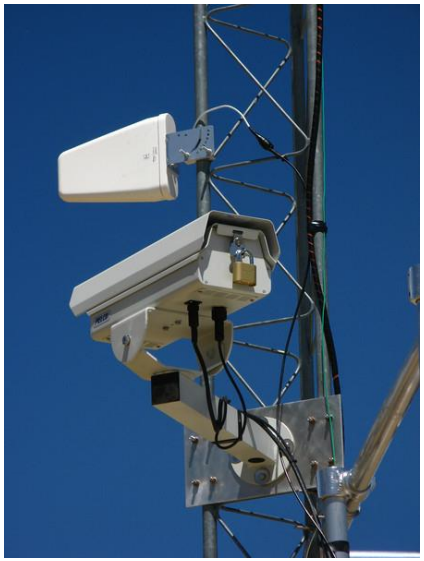
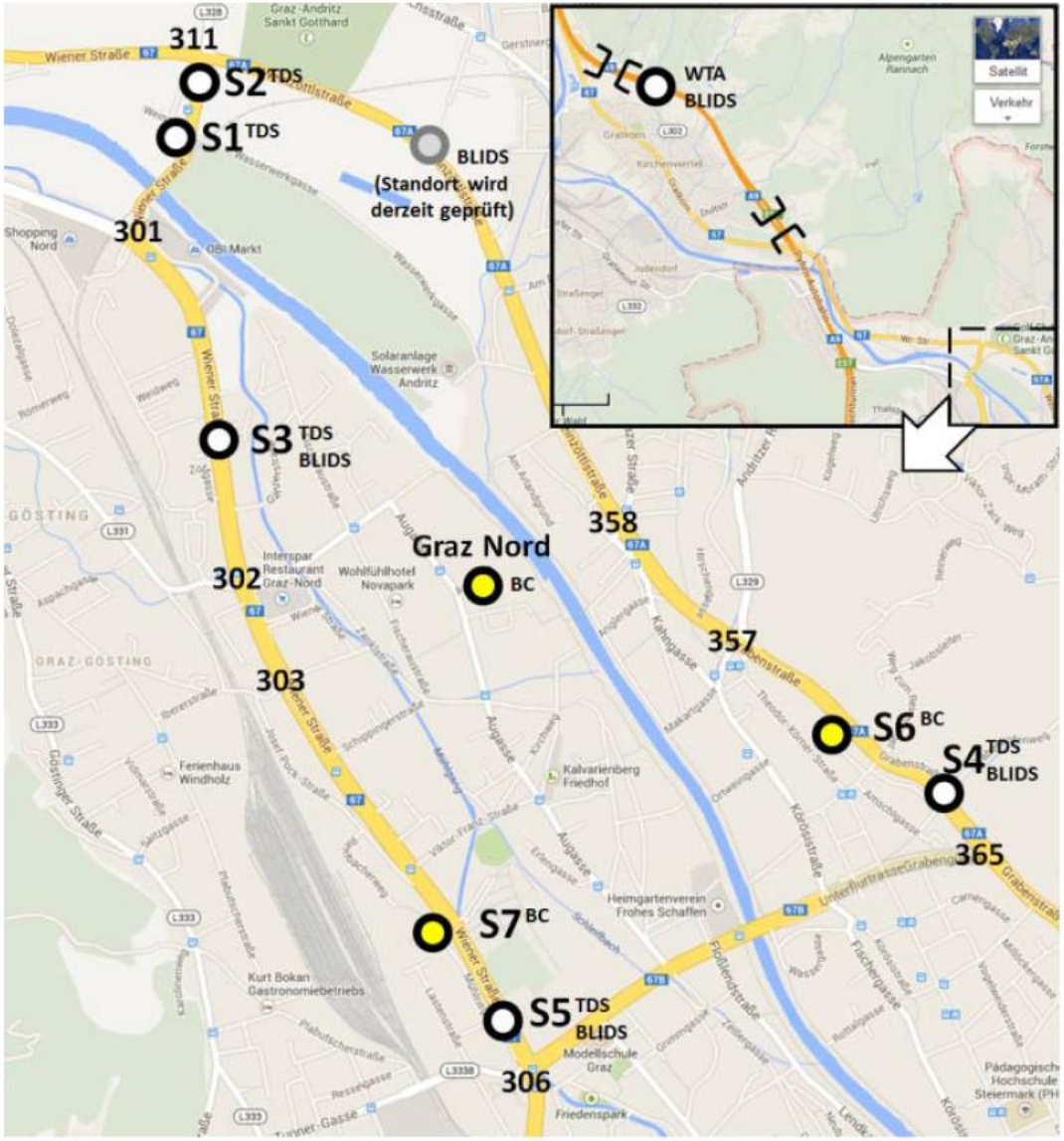
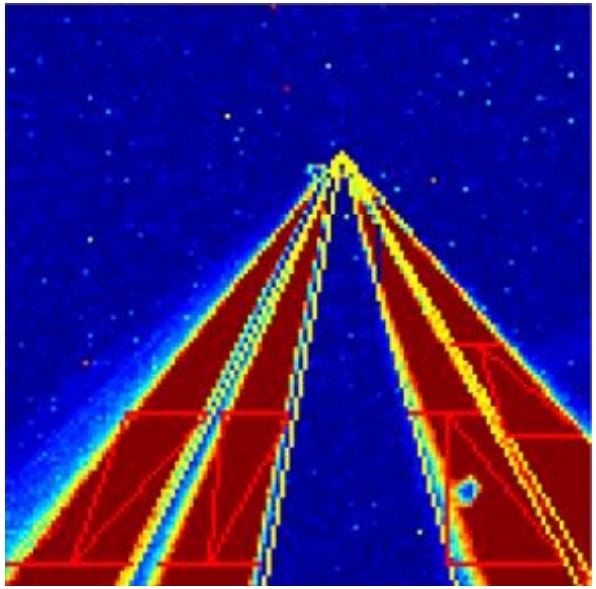
Results Measurements







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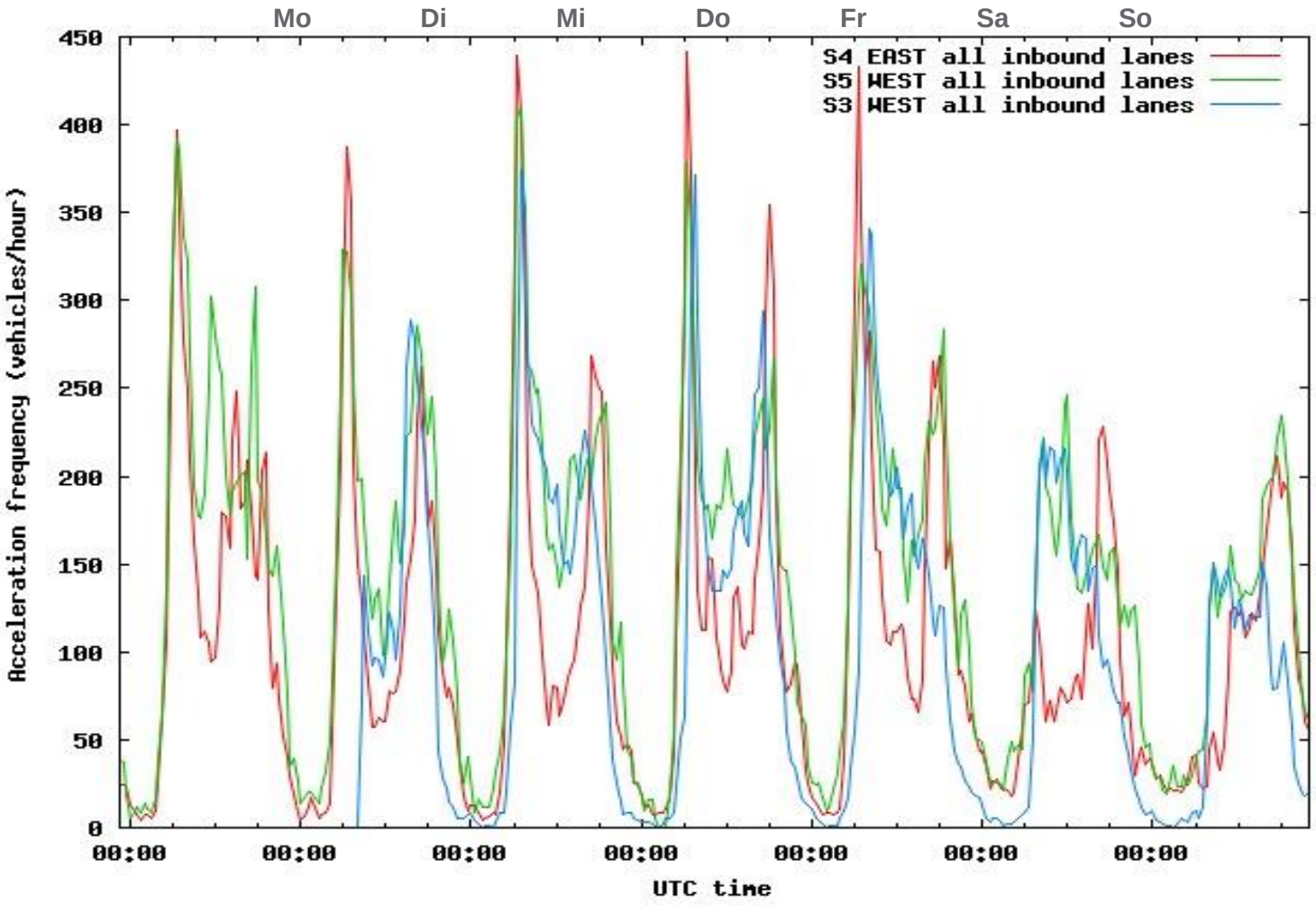
Direct measurement of stop and go



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Investigating a “black carbon equivalent” for traffic

- Accelerating cars have a higher tailpipe emission than “free flowing” vehicles

First Approach :

$$Q_{"BC"} = Q_{total\text{-}vehicles} + 6 * Q_{accelerating\text{-}vehicles}$$

(can be even more complex including weight factors for HGV etc...)

- Local (road-side) black carbon concentrations need to be reduced by “background” values to “isolate” traffic related component

$$C_{BC} = C_{road} - C_{background}$$

And of course wind speed is of interest at the same time ... !

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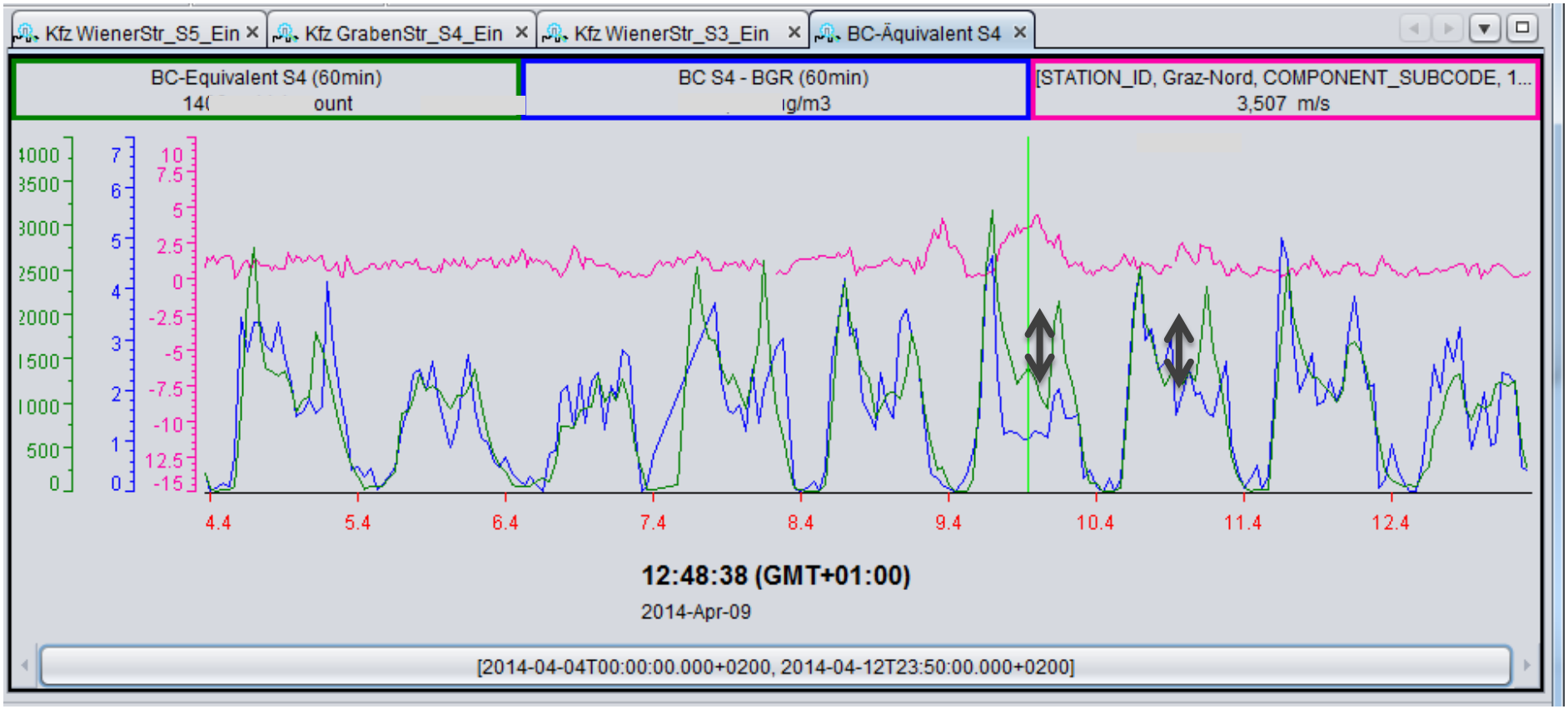
Strong similarity of BC and Stop/go “equivalent”

But depending on meteo-conditions. During episodes of stronger wind, the correlation drops!



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Lessons learned so far

- Data availability
- Potential for emission reduction
- Complexity of the simualtion approach
- Stop/go cycles can be measured routinely on the road
- VMS design and selection of displayed message
- Importance of stakeholder process

Project Supporters

STADT GRAZ STRASSENAMT

ASFINAG

Das Land Steiermark

Project partners and their roles in the project

- **AIT Austrian Institute of Technology GmbH**
  coordination, air quality monitoring Graz, traffic monitoring technology provider
- requirements analysis, traffic simulation and ITS actions selection
- **IBM Österreichische Büromaschinengesellschaft mbH with IBM Research Irland (as "third party")**
  Decision Support System (situation prediction and ITS actions proposal)
- **EBE Solutions GmbH, Austria**
  User Interface for traffic centres, installation of equiptment in Graz, hosting
- **Imperial College London, UK**
  traffic simulation, emission models
- **VITO, Belgium**
  Emission models, planning of pilot installations, evaluation of results
- **Air Monitors Ltd., UK**
  installation of equiptment in Glasgow, air quality monitoring Glasgow
- **European Tech. Serv., Belgium**
  Dissemination and exploitation of project results

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Project Facts

- EC collaborative research project in the 7th framework program:
  - submitted January 2011
  - project started Sept. 1st 2011
  - Project end Feb. 2015 (prolonged by 6 months)

- Project Coordination: AIT Austrian Institute of Technology GmbH

- Project Partners: 8 organzations from 4 different countries (Austria, Belgium, UK, Ireland)

- Budget: € 4,4 Mio. (€ 3,0 Mill. EC funding)

www.carbotraf.eu

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A Decision Support System for Reducing CO_2 and Black Carbon Emissions by Adaptive Traffic Management

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