INFRAS/FVT/MKConsulting – Philipp Wuethrich

Handbook Emission Factors for Road Transport 道路交通排放手册 Localizing HBEFA for China 中国本地化

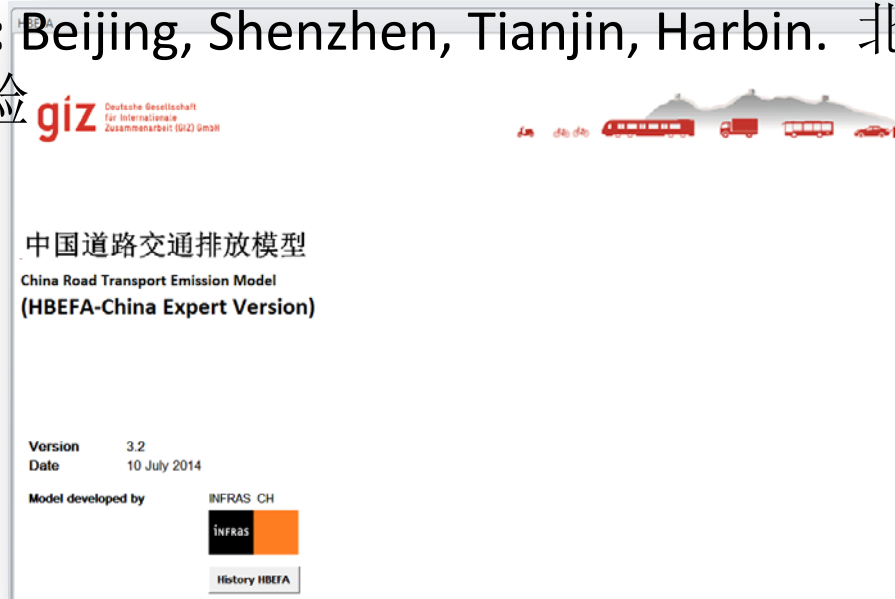Beijing Landmark Hotel, March 3 2016

Agenda目录

1. Key elements for localising HBEFA for China本地化的 关键因素
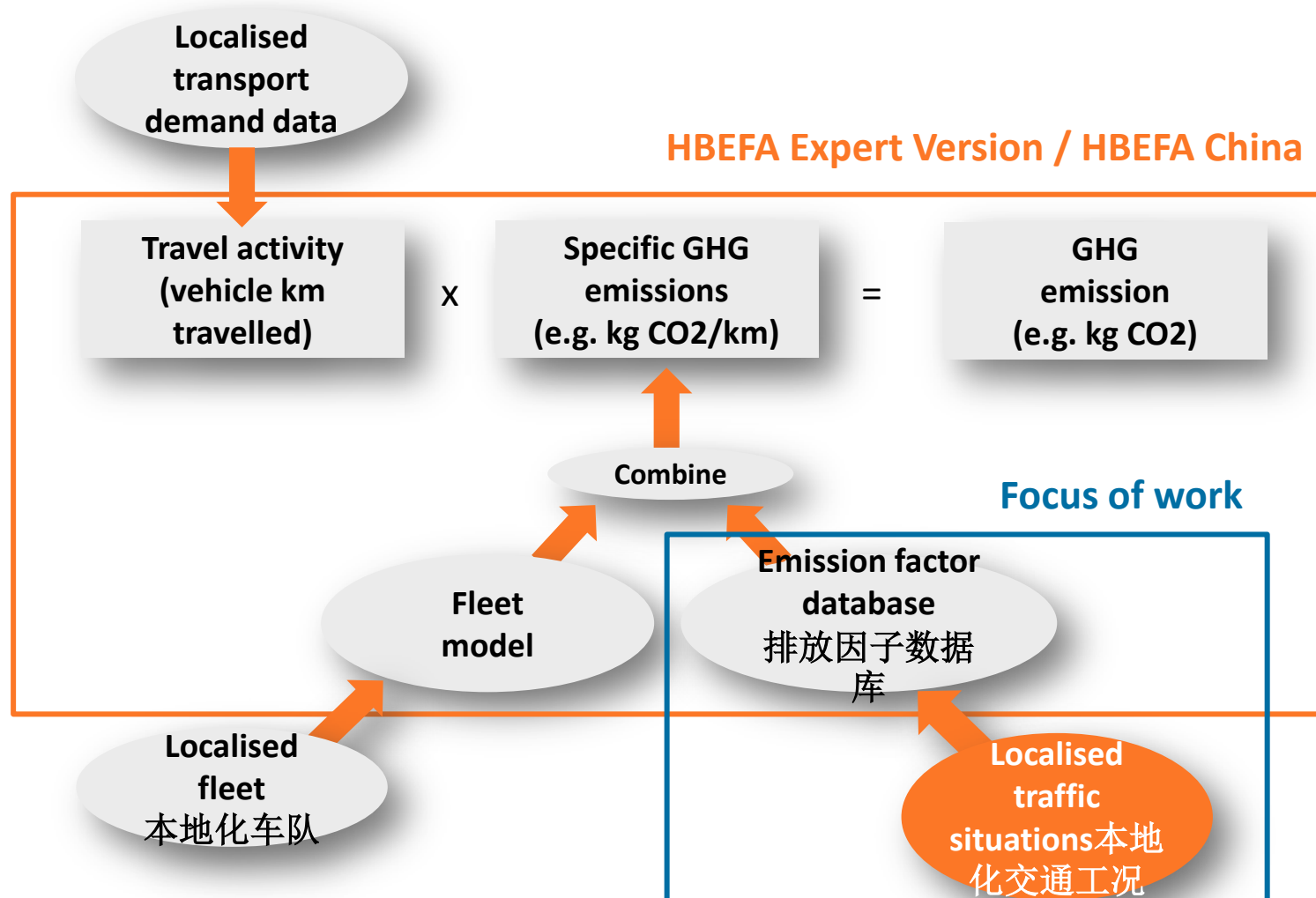2. Software tool CRTEM/HBEFA China
3. Conclusions
4. Further steps

China Road Transport Emission Model (CRTEM) HBEFA China Expert Version 中国道路交通排放模型(CRTEM)

- Developed on the basis of **HBEFA Europe** (Version 3.2), started in 2012, funded by GIZ. 2012年基于欧洲HBEFA3.2版本开发，GIZ赞助
- Focuses on **greenhouse gas emissions** (but air pollutants included)关注温室气体排放
- Focuses on **passenger cars** (but other vehicle categories included)关注轻型客车排放
- **Pilot cities:** Beijing, Shenzhen, Tianjin, Harbin. 北京、深圳、天津、哈尔滨实验

中国道路交通排放模型
China Road Transport Emission Model
(HBEFA-China Expert Version)

Version 3.2
Date 10 July 2014

Model developed by   INFRAS CH

Localizing traffic situations for China
交通工况中国本地化

Localised transport demand data

HBEFA Expert Version / HBEFA China

Travel activity (vehicle km travelled)

X

Specific GHG emissions (e.g. kg CO2/km)

=

GHG emission (e.g. kg CO2)

Combine

Focus of work

Fleet model

Emission factor database 排放因子数据库

Localised fleet 本地化车队

Localised traffic situations本地化交通工况

Are the HBEFA emission factors transferable to Chines cities? HBEFA的排放因子能适用于其他国家么？

**HBEFA emission factors
for Europe 欧洲**

**Emission factors for
Chinese cities 中国城市**

**Vehicle
fleet 车队**

**Comparable
(with adaptions)
适用✓**

**Traffic situations
交通工况**

**Must be
investigated!
需要调研**

Adaption of traffic situation scheme:
by road types and congestion levels (LOS) 交通工况分类：根据道路类型和拥堵程度

Separation of traffic situations for Chinese cities by:

- **Road types**: Freeway/Expressway, Major arterial, Minor arterial, Branch 高速/主干道/次干道/之路
- **Level of Service (LOS)**服务水平 based on congestion levels: Free flow, Saturated traffic, Heavy traffic, Stop and go, Heavy stop and go (defined by speed bins)基于拥堵等级

Level of service	LOS 1: Free flow	LOS 2: Heavy traffic	LOS 3: Saturated traffic	LOS 4: Stop and go	LOS 5: Heavy stop and go
Congestion level	Unimpeded	Basically Unimpeded	Mild congestion	Moderate congestion	Severe congestion
Unit	*km/h*	*km/h*	*km/h*	*km/h*	*km/h*
Highway/Expressway	>55	40-55	30-40	20-30	≤20
Major arterial	>40	30-40	20-30	15-20	≤15
Minor arterial	>35	25-35	15-25	10-15	≤10
Branch	>35	25-35	15-25	10-15	≤10

Development of GHG emissions factors based on typical traffic situations for Chinese cities
中国城市基于典型工况的GHG排放因子发展

Collection of GPS data收集GPS数据

- Collection of GPS data to record driving cycles by taxis出租车GPS数据记录工况
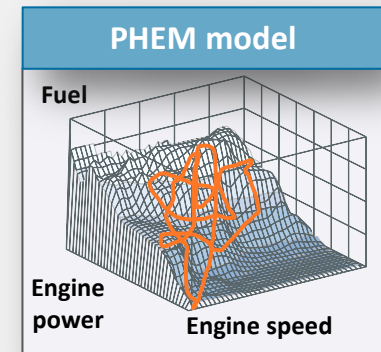- data collection in Beijing and Shenzhen: around 2,000 hours of GPS data 北京及深圳2000多小时数据

Analyses of GPS data分析:

- Assignment to road types (map matching) 地图匹配道路类型
- Identification of typical driving cycles ⇨ traffic situations 典型工况识别
- Comparison with traffic situations included in HBEFA对比
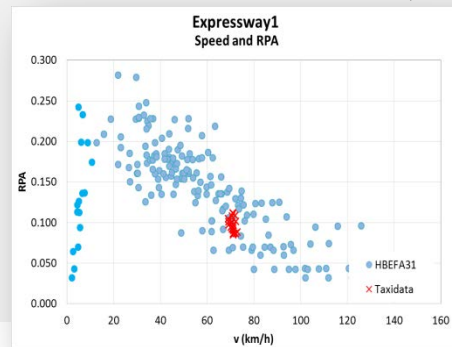
Calculation of new emission factors 计算新的排放因子
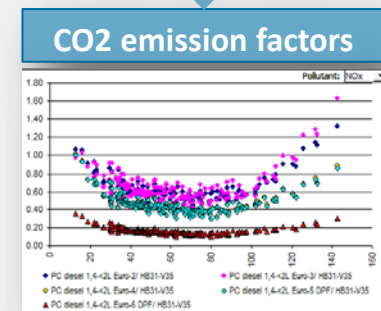
Example: Expressways – Free flow: Selected top 20 cycles based on average speed, RPA and stop share 高速路自由流：基于平均速度、RPA和停车比率的前20条道路

Expressway: Free flow (LOS1)
Speed and RPA

○ cycles from Beijing and Shenzhen
● TOP 20 cycles

Identification of TOP 20 cycles by using the method of least squares considering average speed, RPA and percentage of stop time 使用最小平方法选取道路

RPA

Average speed [km/h]
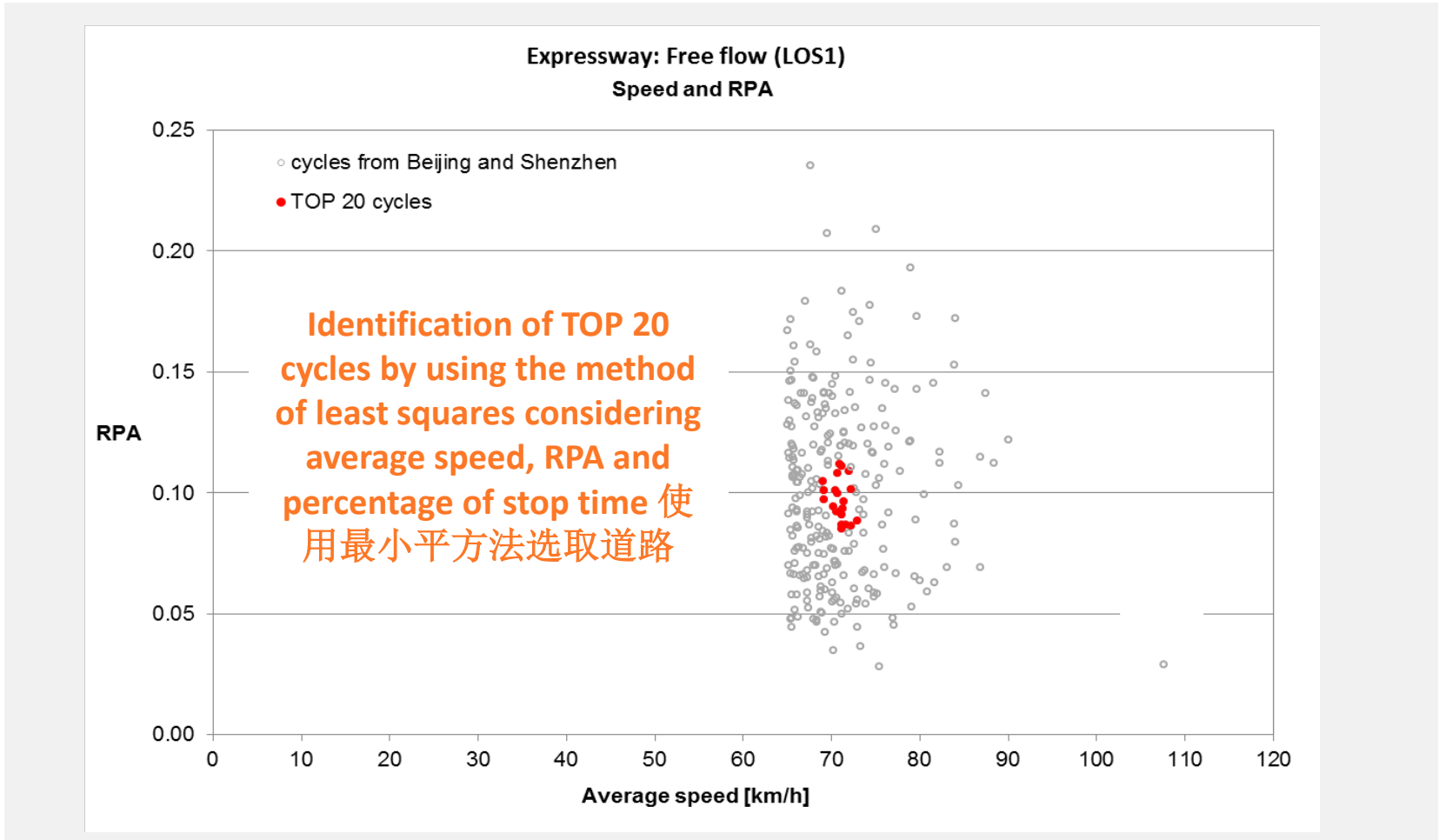
Expressways – Free flow: Identification of typical cycles for Chinese cities
高速路自由流：中国城市典型工况
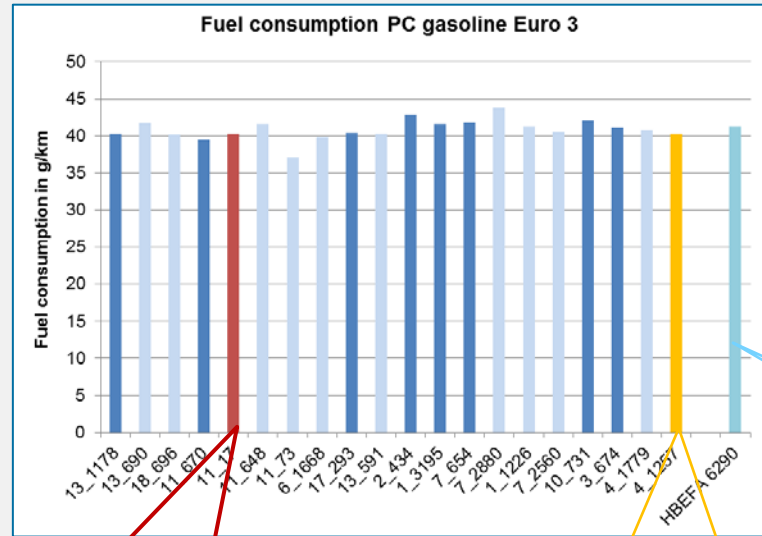
Legend:

- Untypical driving cycle非典型工况
- Typical driving cycle (pre-selection)典型工况
- **Selected driving cycle 选定工况**
- Second best fitting driving cycle 次优工况
- HBEFA driving cycle HBEFA使用工况
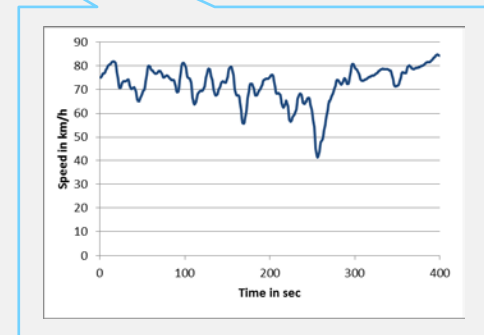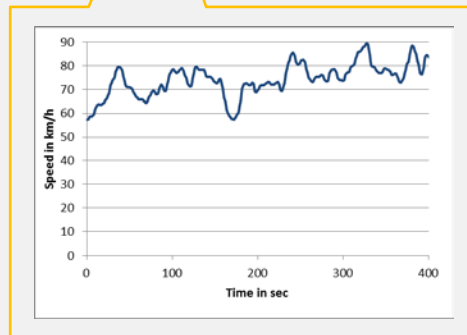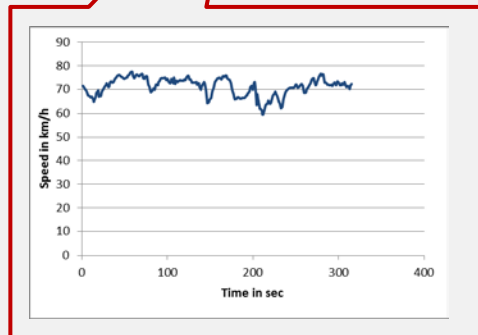
Selection of Chinese specific traffic situations by road type and level of service (1)
由道路类型和服务水平确定中国典型交通工况

Expressway/Highway高速路

Key parameters关键参数:

	Average speed	RPA	% stop time
	km/h	m/s3	%
LOS 1	71.2	0.09	0%
LOS 2	57.3	0.11	0%
LOS 3	42.3	0.13	1%
LOS 4	25.8	0.17	7%
LOS 5	12.0	0.17	26%

LOS 1: Free flow 自由流
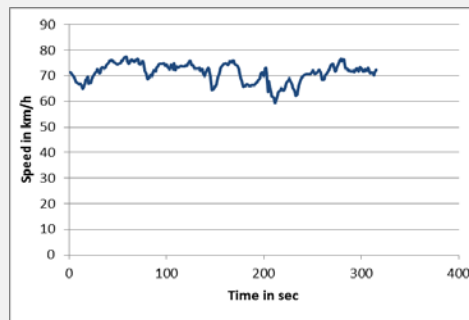
LOS 2: Heavy 较拥堵
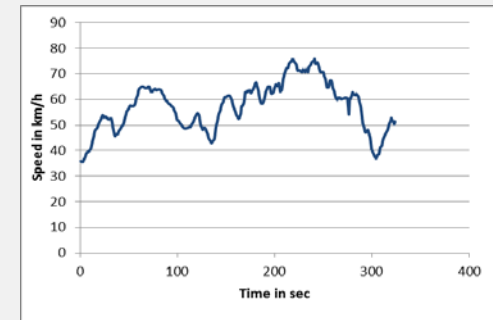
LOS 3: Saturated 饱和
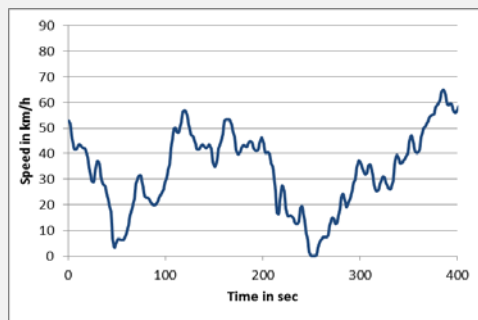
LOS 4: Stop+go 1 堵塞1
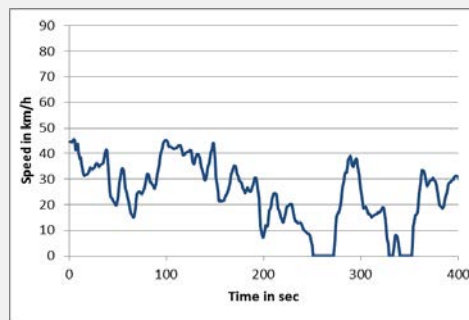
LOS 5: Stop+go 2 堵塞2
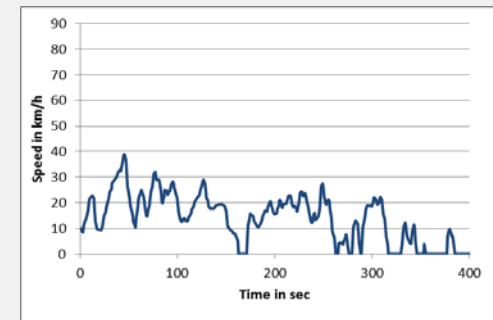
Result: CO$_2$ emissions of standardized gasoline-fueled passenger car (2002, 1.4-2.0 l) for China
结果：中国小型汽油车(2002,1.4-2.0L) CO$_2$排放

CO$_2$ emissions for a standardized passenger car (2002, 1.4-2.0 l)

CO$_2$ emission factors can be used for other Chinese cities
CO$_2$排放因子可用于中国其他城市
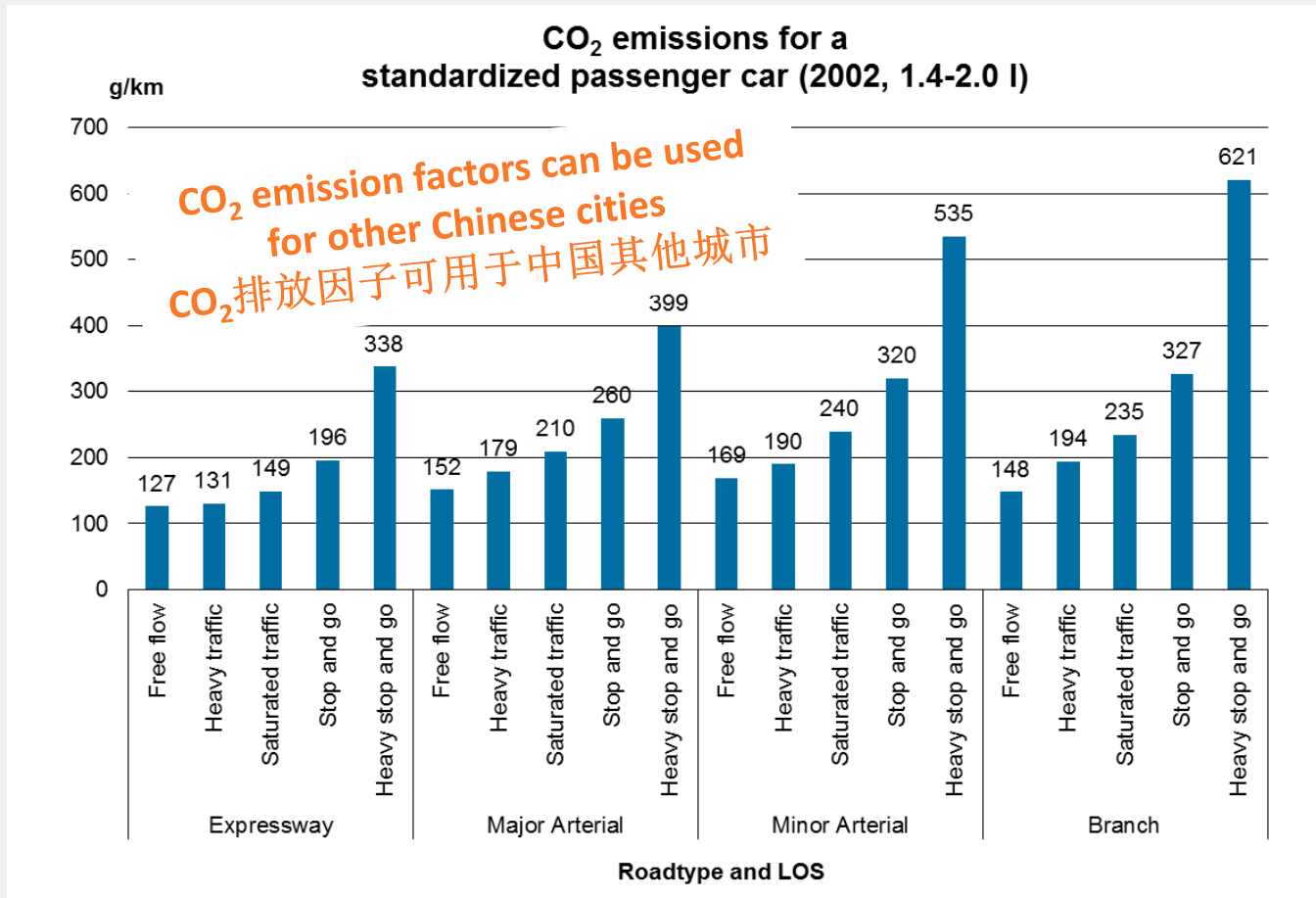
CO$_2$ emissions of standardized gasoline fueled cars: Chinese and HBEFA traffic situations
中国和HBEFA的交通工况下CO$_2$排放因子
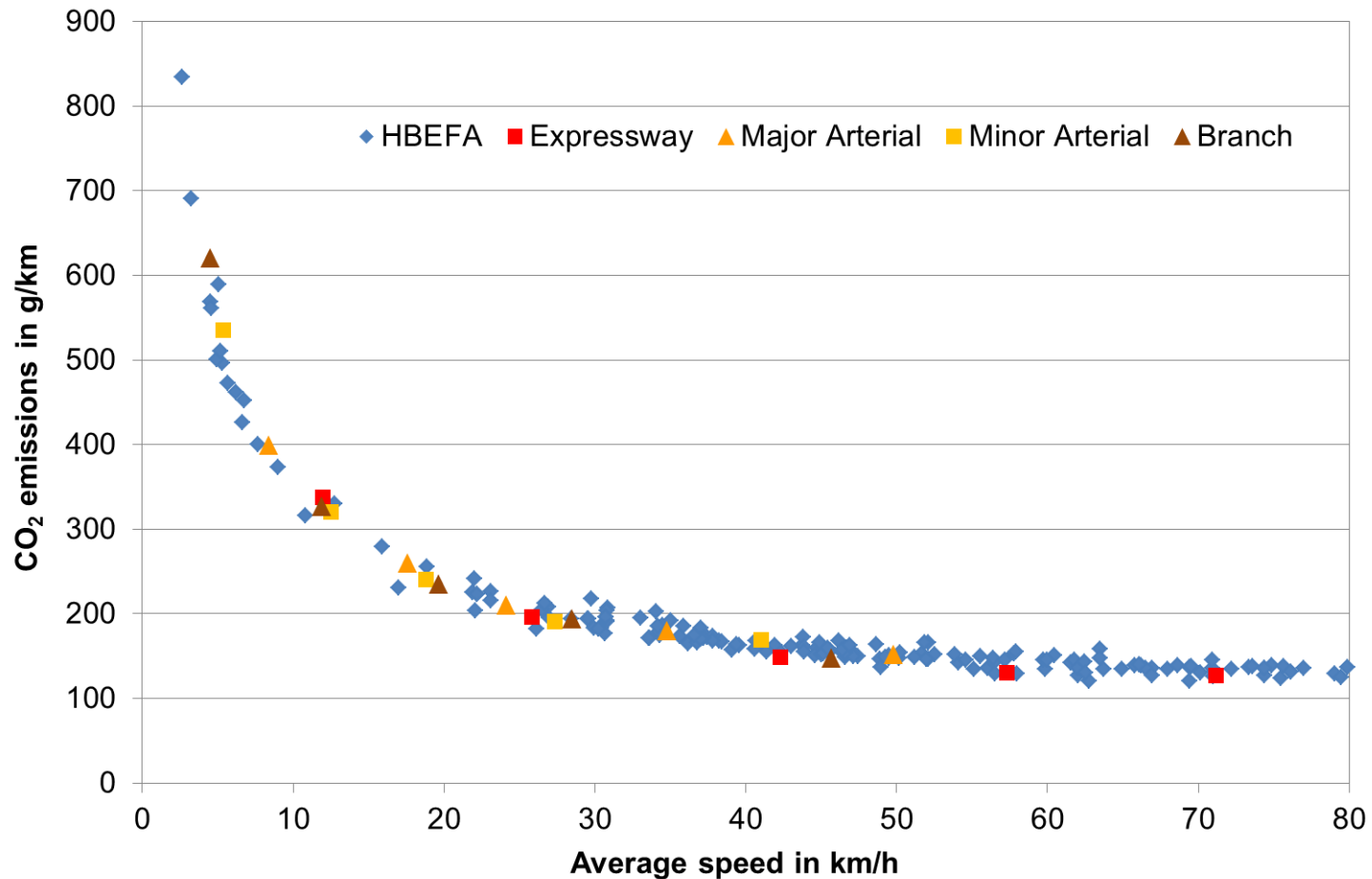
Application: CO$_2$ emission (and air pollutants) calculation tool in Shenzhen应用 深圳CO$_2$ (及空气污染物)排放计算工具

Agenda

1. Key elements for localising HBEFA for China
2. Software tool CRTEM/HBEFA China CRTEM/HBEFA中国软件工具
3. Conclusions总结
4. Further steps

Modules of HBEFA "Expert Version" (EV)
"专家 版本(EV)"模块

Data base tool provides user interface to access the modules of HBEFA China/CRTEM
HBEFA China/CRTEM用户界面

Basic definitions
基本定义

Fleet model
车队模型

Emission factor database
排放因子数据库

Traffic activity data
交通活动水平

Emission model
排放模型
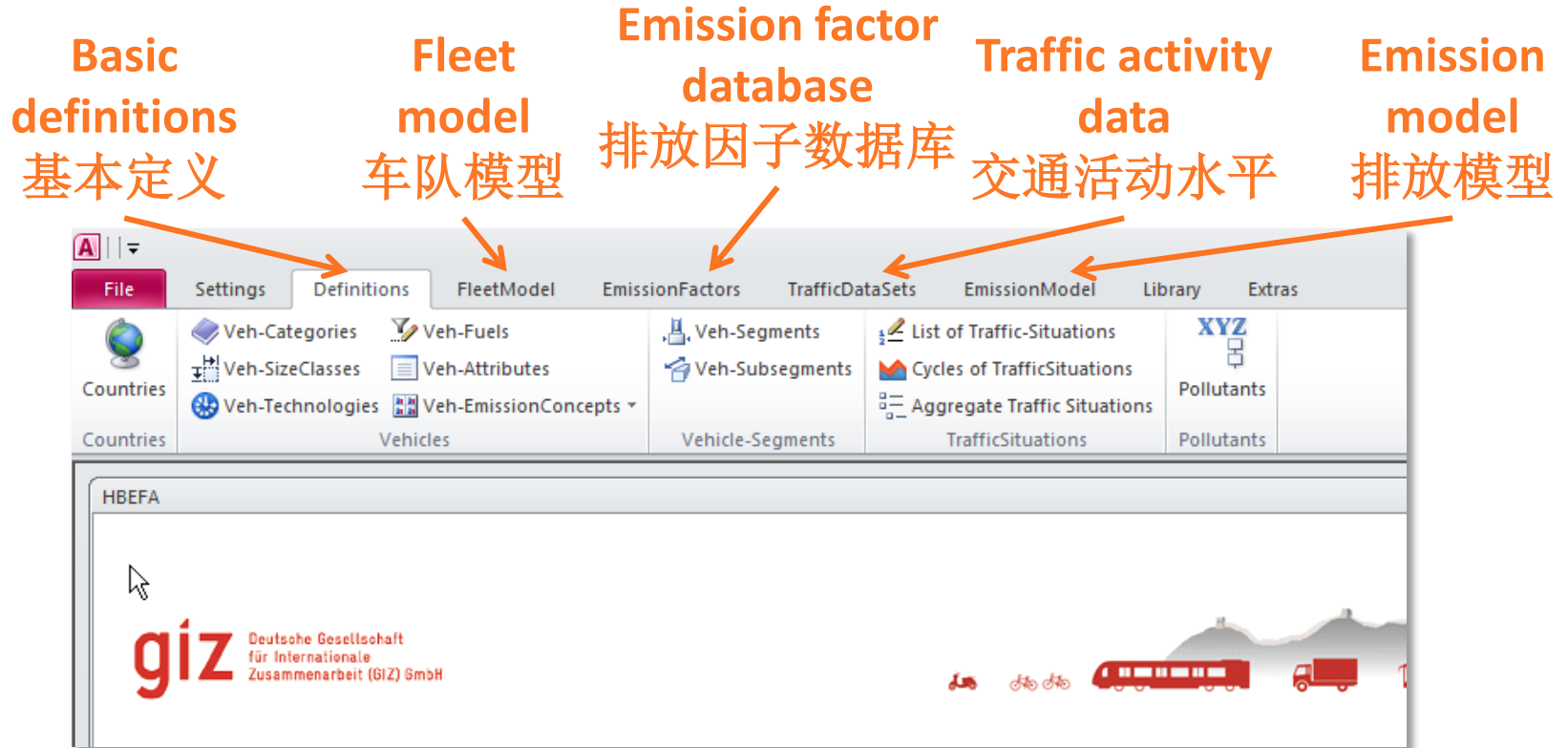
Forms with graphic representation of input data
输入数据表格与图示

Interface for automatic import of traffic activity data from TDM
TDM交通活动水平数据自动输入界面
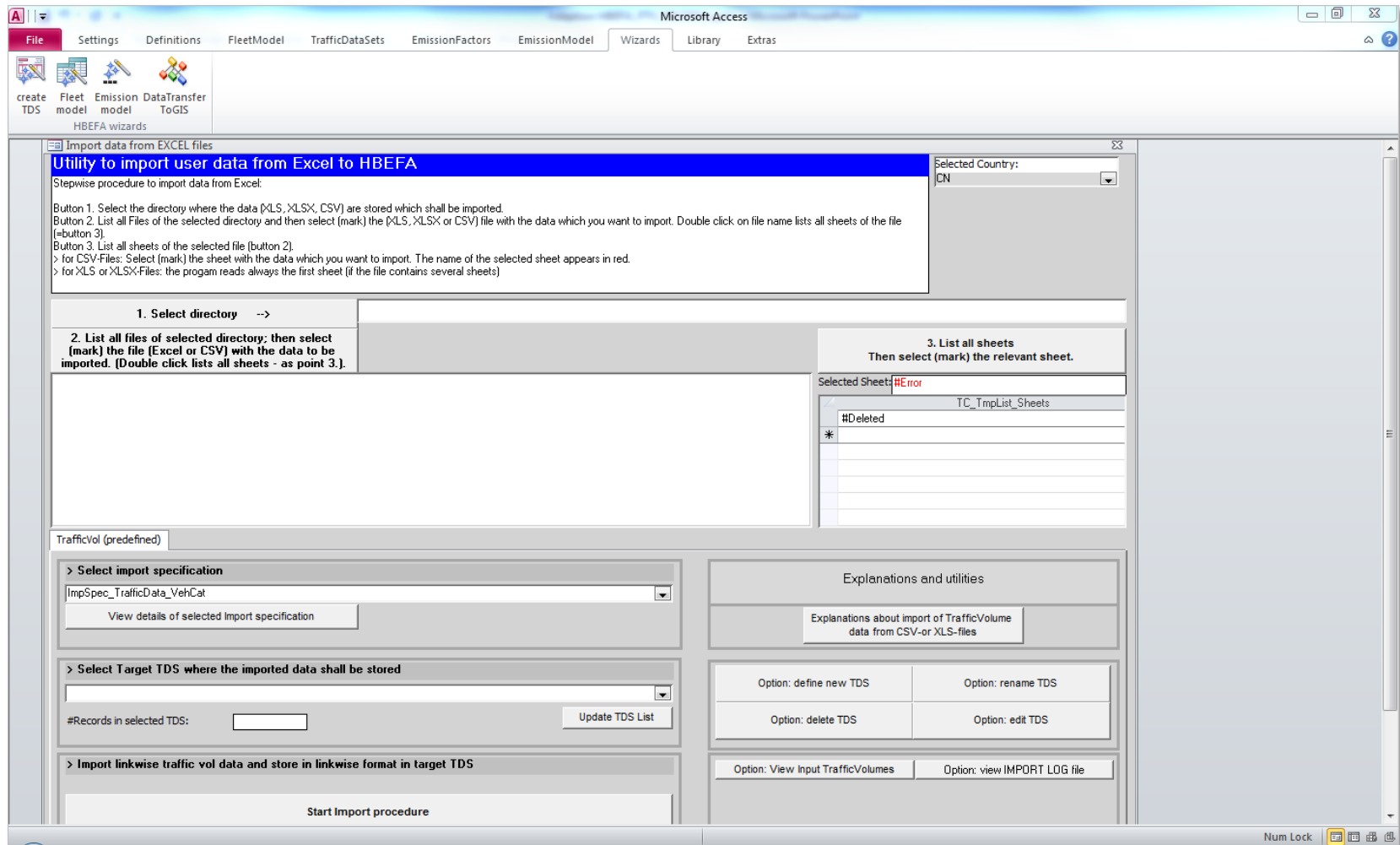
Step-by-step configuration of emission calculation 排放计算的逐步架构

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Localizing HBEFA for China: Conclusions

- **HBEFA emission factors** are based on the European situation but **are localized to Chinese cities for GHG emission quantification** of road transport. HBEFA排放因子基于欧洲工况，但对中国城市交通GHG排放量进行了本地化

- **The traffic situation approach** used for HBEFA **allows a general use of the emission factors** – in different Chinese cities. HBEFA的交通工况方法使得其排放因子可以被普遍应用

- Only **if additional traffic situations are identified new GHG emission factors have to be calculated** ⇨ this has to be done only once, afterwards the emission factors can be used for all cities 仅当有新的道路工况被定义时，才需要计算新的GHG排放因子

- Emission factors for **air pollutants** are more complex ⇨ since air pollutants depends on fuel quality, vehicle technology and maintenance of the vehicles **European emission factors can only used after a review based on locally measured data (→ see further steps)** 空气污染物的排放因子比较复杂，因此欧洲排放因子需要基于本地化测试数据进行检验后才能使用。

Agenda

1. Key elements for localising HBEFA for China
2. Software tool CRTEM/HBEFA China
3. Conclusions
4. Further steps 后续计划

Further steps for localizing HBEFA China (1)
未来计划

Current GIZ-Project (2015-2018) ensures further development of HBEFA China GIZ 2015-2018项目确保了HBEFA China的长远发展

逐秒GPS驾驶
数据采集

数据地图关联

本地驾驶工况

中国典型车辆测试

PHEM模型验证

| On road driving data collection, GPS recording second by second |
| Driving data pre-process, map matching |
| Develop local driving cycles/traffic situations |

| Real measurement of typical vehicles in China |
| Validate the PHEM Model to China Context |

"European" Version of PHEM 欧洲PHEM模型

Using PHEM Model to generate new emission factors

Emission Factors Database in China

Validation of PHEM for China (CO2 and air pollutants) 中国PHEM模型检验
→ see Presentation of M. Rexeis
M. Rexeis将进行展示

Further steps for localizing HBEFA China (2)

- **Traffic situations for non-PC-vehicle categories非客车类别的交通工况:** Typical driving cycles for **busses and trucks.** Are included in present version (based on analogies to PC) but need further refinement by evidence from Chinese cities: 公交车和货车的典型工况在本版本是基于小型客车典型工况开发的，需要中国城市实际道路数据修正

121路 主干路专用道，畅通
Route 121 arterial lane unblocked

324路 主干路道路条件较好，畅通
Route 324 arterial lane unblocked
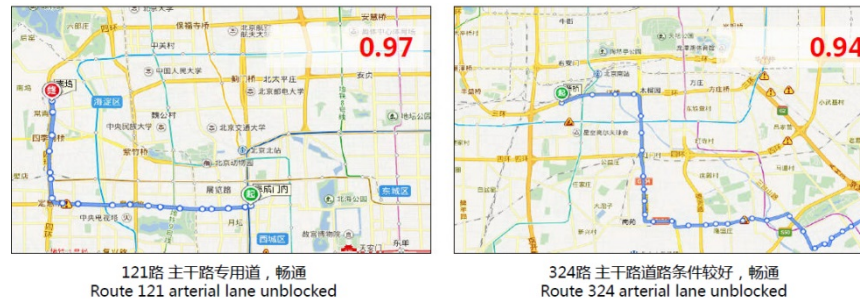
Source: College of Metropolitan Transportation Beijing University of Technology

- **Fuel types燃料类型:** Evaluate existing fuel types (petrol, diesel, CNG, LPG) and add **new types** (LNG, etc.). Update of assumptions for electric vehicles (Plug-in-Hybrids PHEV, battery-electric BEV)增加新型燃料。更新电动车数据预测

- **Plus其他:** Training, documentation and communication培训，文档编制和交流

Thank you for your attention 感谢

Philipp Wuethrich

Head of Transport and
Environment Division

INFRAS
Sennweg 2
CH-3012 Bern
Switzerland
Tel +41 31 370 19 11
philipp.wuethrich@infras.ch