Workshop on Road Traffic Modelling and the European Environmental Noise Directive

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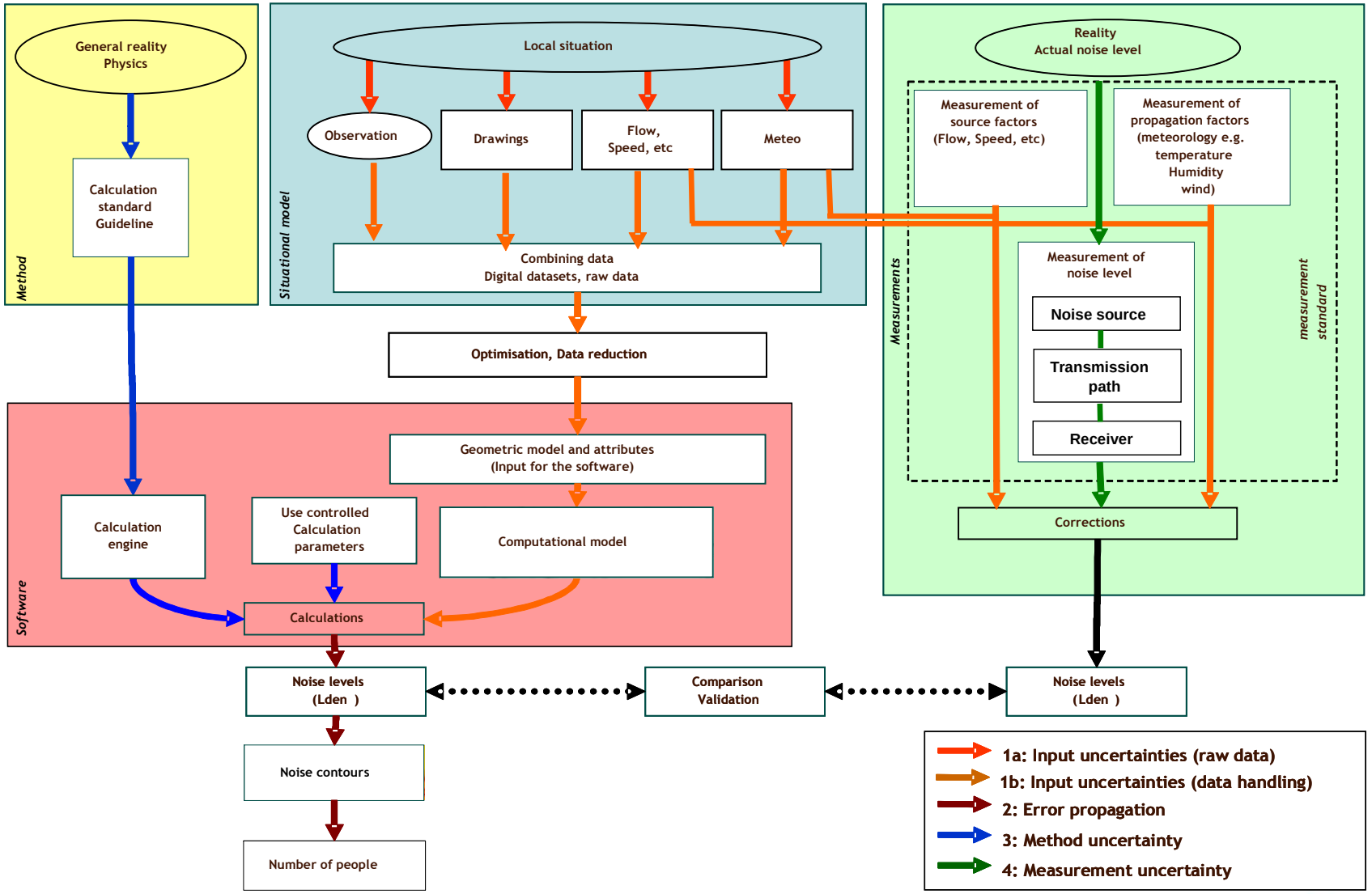
Interrelationship between different types of uncertainty



Non-geometric input parameter guideline

- General guideline for the accuracy of input parameters required for different decibel errors in the calculated results.

- Ranking the sensitivity of the decibel error in the calculated result to the uncertainty contained in the input parameter

Rank of important	Percentage of heavy vehicle (%HV > 30)	Percentage of heavy vehicle (%HV < 30)
1st	Heavy vehicle velocity (HV)	Light vehicle velocity (LV)
2nd	Heavy vehicle flow (Hq)	Light vehicle flow (Lq)
3rd	Light vehicle velocity (LV)	Heavy vehicle velocity (HV)
4th	Light vehicle flow (Lq)	Heavy vehicle flow (Hq)
5th	Road gradient	Road gradient
6th	Road surface	Road surface

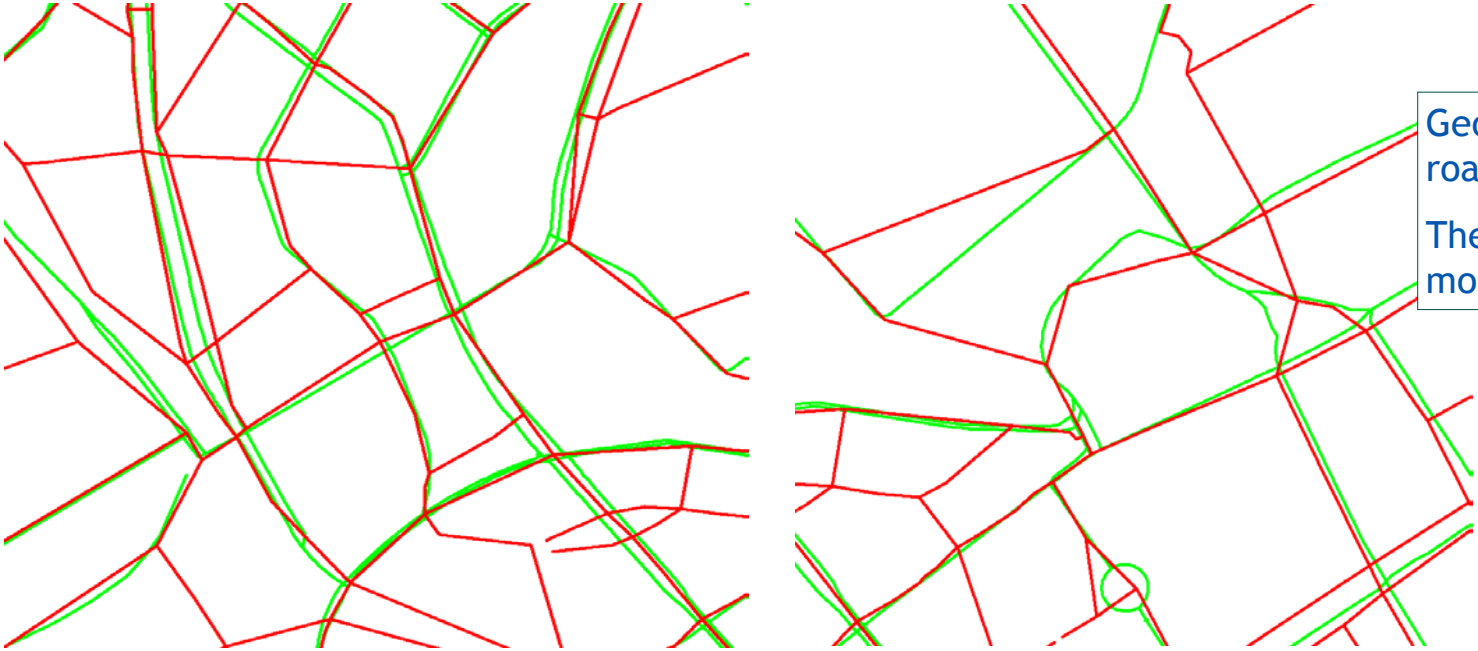
Input parameter guideline (I)

	Traffic Flow	Group A 0.5-1dB(A)	Group B 0.5-1dB(A)	Group C 1-3dB(A)	Group D 3-5dB(A)	Group E >5dB(A)
Heavy Vehicle Flow (Hq)	Continuous Fluid	20%<	20-40%	40-90%	90-160%	>160%
	Non differentiated Pulsed					
	Pulsed Accelerated					
	Pulsed Decelerated					
Heavy Vehicle Velocity (HV)	Continuous	10%<	10-20%	20-70%	70-130%	>130%
	Non differentiated Pulsed					
	Pulsed Accelerated					
	Pulsed Decelerated	5%<	5-10%	10-30%	30-50%	>70%
Light Vehicle Flow (Lq)	Continuous	20%<	20-45%	45-100%	100-200%	>200%
	Non differentiated Pulsed					
	Pulsed Accelerated					
	Pulsed Decelerated					
Light Vehicle Velocity (LV)	Continuous	10%<	10-20%	20-65%	65-120%	>120%
	Non differentiated Pulsed					
	Pulsed Accelerated					
	Pulsed Decelerated	5%<	5-10%	10-40%	40-95%	>95%

Input parameter guideline (II)

	Factor	Group A 0.5-1dB(A)	Group B 0.5-1dB(A)	Group C 1-3dB(A)	Group D 3-5dB(A)	Group E >5dB(A)
Source	Gradient Type (flat= >+2% - <-2%)	No error, sections <50m	No error, sections <100m	No info (up or down), sections <200m	No info (up or down)	No info (up or down)
	Traffic Flow Type	No error	Within 1 class	Within 1 class (continuous)	No info (continuous)	No info (continuous)
	Surface Type	No error, sections <50m	No error, use classes	1 class away	2 classes away	No info (dense asphalt)
	Road centreline (Vertical)	<0.5m	>0.5m - <1.0m	>1.0m - <2.0m	>2.0m - <5.0m	>5.0m
	Road centreline (Horizontal)	<1.5m	>1.5m - <4.0m	>4.0m - <8.0m	>8.0m - <15m	>15m

Link to traffic flow model

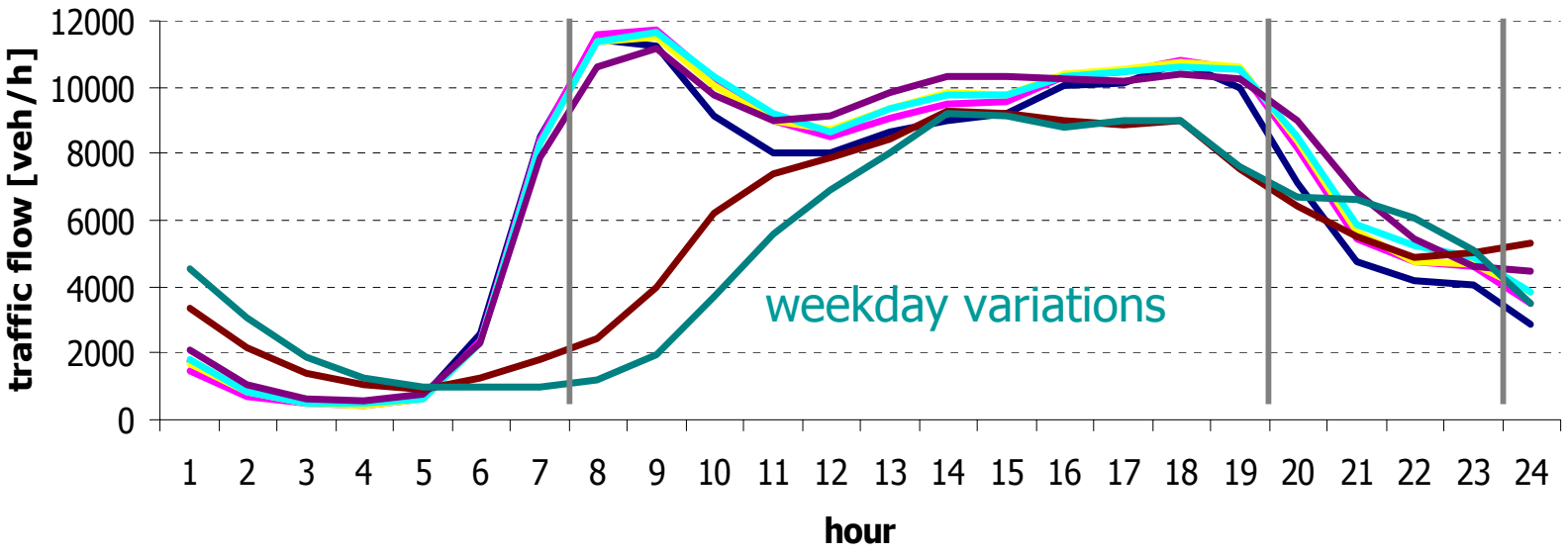


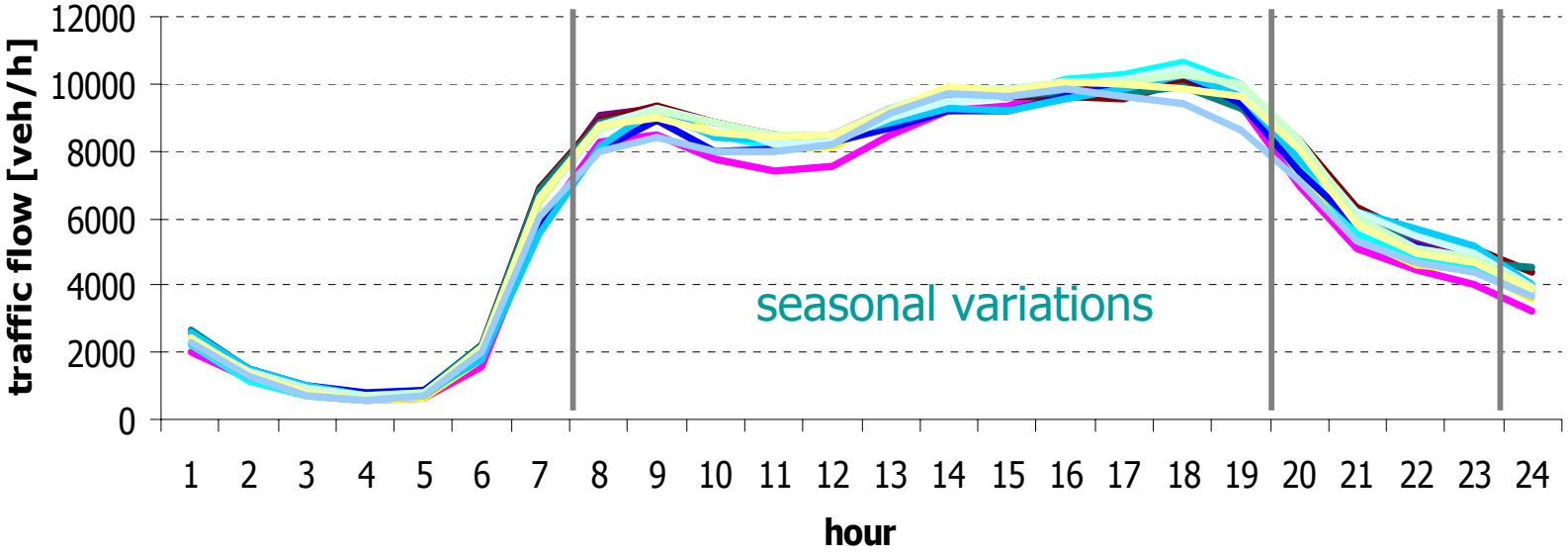
Geographic correct road axes in green

The traffic flow model in red

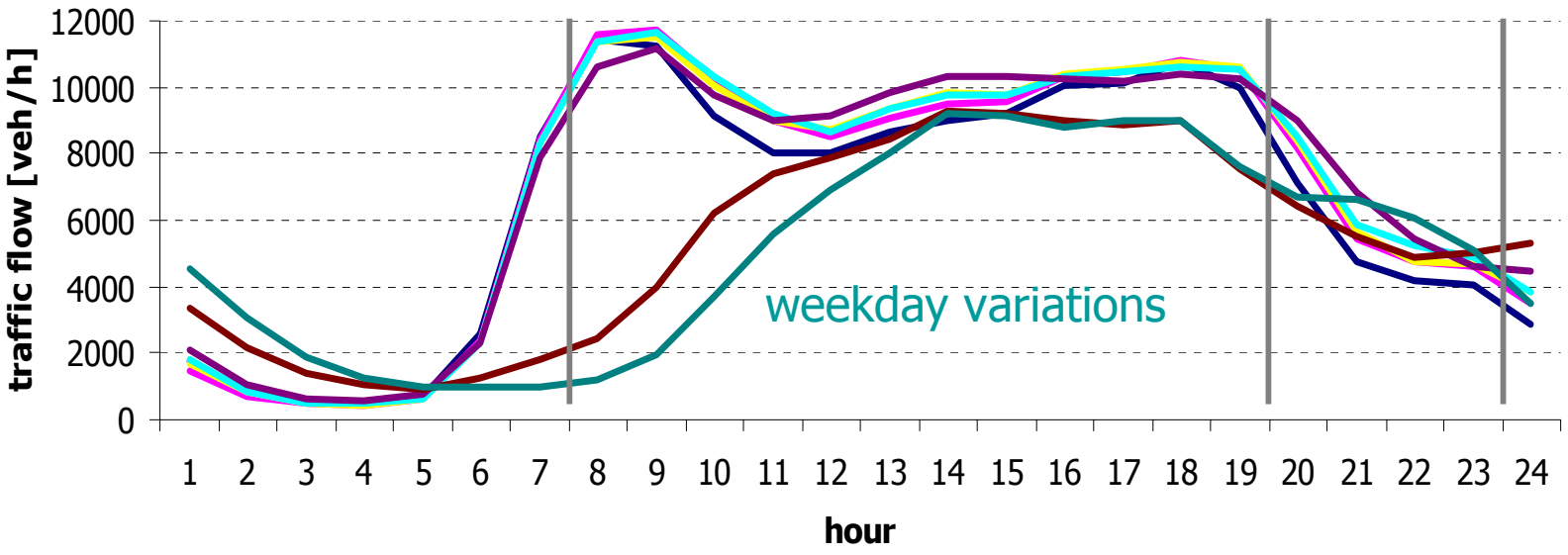
- Road axes are mapped to the traffic model
- Problems:
  - One road axis has two data lines in the traffic model
  - Two road axes have one data line in the traffic model
  - Geometry do not map exactly

Uncertainty in factoring Traffic Flow





Uncertainty in factoring Traffic Flow



The actual sunrise and sunset time leads to significant difference between daytime and nighttime propagation.

- up to 10 dB for the short time equivalent noise level.
- up to 3.5 dB for the L_{DEN}.

Accuracy of the flow model

- all traffic – most passenger cars
- No trucks
- Only rush hours
- Standard correction for the average daytime and nighttime hour
- Driving speed

Toolkit 17: Road surface type

Available information		applicable tool
Acoustical road surface parameters are known by measurement	yes / no	no further action
Acoustical measurements of the road surfaces	yes / no	Tool 17.1
Surface type for road segment based on physical properties	yes / no	Tool 17.2
Road surface type based on visual inspection	yes / no	Tool 17.3
Road surface type based on road type	yes / no	Tool 17.4
No road surface data known	yes	Tool 17.5

Tool 17.1: Acoustical measurements of the road surfaces

Method	complexity	accuracy	cost
CPX measurement			
Perform a Close Proximity Measurement (CPX) to determine the acoustical road surface parameters. The main advantage of a CPX measurement is the fact that variations in the quality along the road can be measured. Also the aging effect of the pavement can be taken into account. (ISO/CD 11819-2)		< 0.5 dB	
SPB measurement			
Perform a statistical pass-by measurement (SPB) to determine the acoustical road surface parameters. The correction of the measured road surface is assumed to be representative for the complete road. (or for the complete road network where this road category is present. (ISO 11819-1)		< 0.5 dB	

Tool 17.2: Surface type for road segment based on physical properties

Method	complexity	accuracy	cost
Categorisation on physical parameters			
This categorisation is based on the chipping size, porosity and type of pavement (asphalt, concrete or cobblestones/ pavement stones) The road corrections are assigned to every road segment according to the following table[1]:		1 dB	

Uneven pavement stones	PS uneven	4.8	
Even pavement stones	PS even	3.1	
Cement concrete, transversely brushed	CCB tr		
Cement concrete, longitudinally brushed	CCB lo		
Exposed aggregate	EA		
Burlap treated cement concrete	CC burlap	1.1	
Surface Dressing 0/11	SD		
Grip-surface	GR		
Hot rolled asphalt	HRA		
Gussasphalt	GA		
Asphalt concrete 0/16	AC 0/16		
Asphalt concrete 0/11	AC 0/11	0.0	
Drainage asphalt more than 5 years old	DA 0/11 g5		
Stone mastic asphalt 0/11	SMA 0/11		
Drainage asphalt 0/16, 3-5 years old	DA 0/16 3-5		
Drainage asphalt 0/11, 3-5 years old	DA 0/11 3-5		
Drainage asphalt 0/8, 3-5 years old	DA 0/8 3-5		
Drainage asphalt 0/16, less than 3 years old	DA 0/16 k3	-2.7	(-1.7)
Drainage asphalt 0/11, less than 3 years old	DA 0/11 k3		
Drainage asphalt 0/8, less than 3 years old	DA 0/8 k3		
Twin layer drainage asphalt, more than 5 years old	DA twin g5		
Twin layer drainage asphalt, 3-5 years old	DA twin 3-5		
Twin layer Drainage asphalt, less than 3 years old	DA twin k3	-3.5	(-2.5)
Porous Thin Layers 0/8	Thin 0/8		
Porous Thin Layers 0/6	Thin 0/6		

Remark: for 50km/h roads with drainage or low noise asphalt -1.7 and -2.5 dB

Tool 17.3: Road surface type based on visual inspection

Method	complexity	accuracy	cost
Apply for every road noise reductions based on visual inspection in asphalt/concrete/porous or cobblestones.		1 dB	

Uneven pavement stones	PS uneven	4.8	
Even pavement stones	PS even	3.1	
Cement concrete / Rough asphalt	Con / Ror	1.1	
Smooth asphalt (reference)	Ref	0.0	
Drainage asphalt < 5 years	DA	-2.7	(-1.7)
Low noise porous asphalt	LN P	-3.5	(-2.5)

Remark: for 50km/h roads with drainage or low noise asphalt -1.7 and -2.5 dB

Tool 17.4: Road surface type based on road type

Method	complexity	accuracy	cost
Divide all roads into different categories and apply for every road type the default pavement most likely for this kind of road. Depending of the region or Member State the following classification can be used:		2 dB	

Type of road	Default pavement
dead-end roads	stones
service roads	stones
collecting roads	asphalt
small main roads	asphalt
main roads	asphalt
major main roads	concrete/porous/asphalt
trunk roads	concrete/porous/asphalt
motorways	concrete/porous/asphalt

This is an example. Every region or Member State can make this classification.

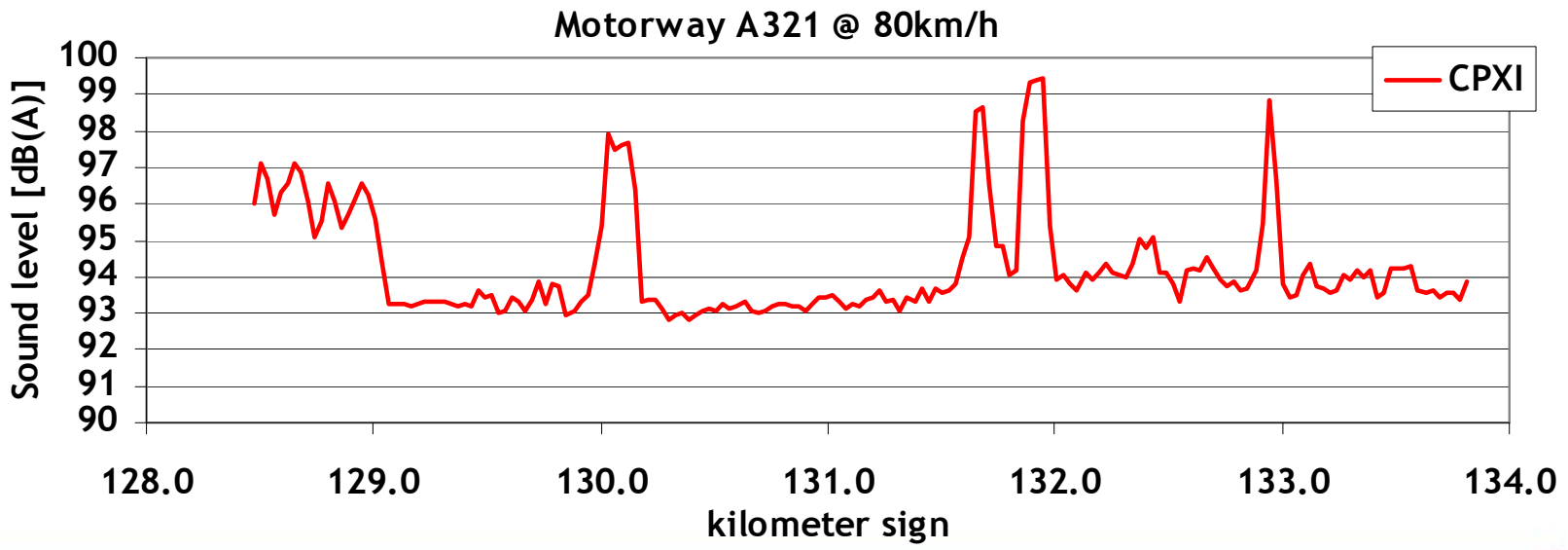
Use Tool 17.2 or Tool 17.3.

Tool 17.5: No road surface data known

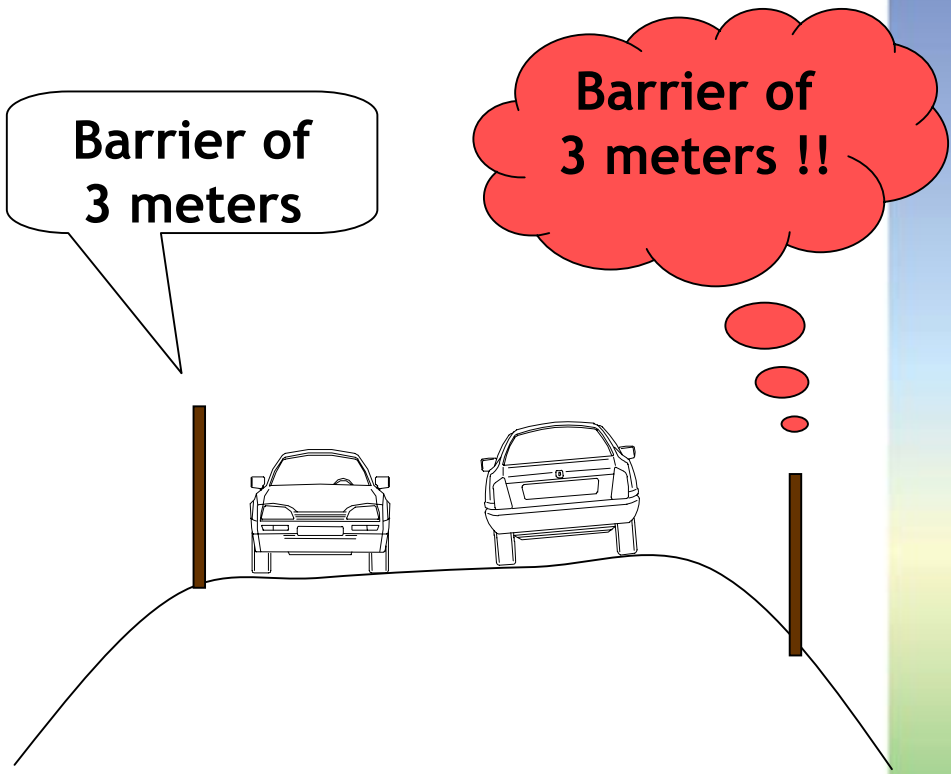
Method	complexity	accuracy	cost
Use dense asphalt for every road, correction is 0 dB.		3 dB	

Road surface

- Information on type of surface
- Variation in homogeneity of a road surface
- Age, time after construction
- Manhole cover, rim's, ramp's ect



Height of noise barriers



Height of noise barriers

Conclusions

- Special care with the geometry for roads when these do not map exactly
- Take care on the factoring of the flow for weekday variations
- Accuracy of the flow model
  - Based on rush hours
  - Driving speed
- Information on type of surface and the variation in homogeneity of a road surface
- Information on noise barrier height and other characteristics
  - Knowledge on acoustics