



Evaluation of FMI's New Forecast Model of Surface Friction

- Preliminary results/discussion...

Pertti Nurmi

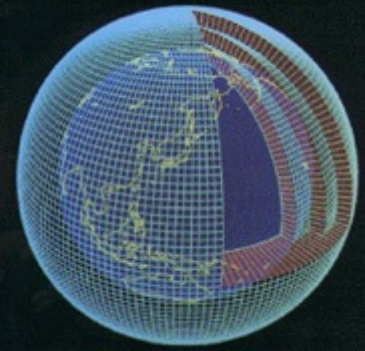
Marjo Hippi, Ilkka Juga

- **Research funded by EU_FP7_ROADIDEA project**
 - **WP3: Method and model development** ⇔ *Friction model*
 - **WP6: Pilot services** ⇔ *Testing the methods in practice*
 - **WP8: Validation and evaluation !**
 - **WP9: Dissemination** ⇔ *"spread the message"*
- **Follow-up to SIRWEC_ROADIDEA paper by Hippo et al. ⇔ ID-15**
- **Closely associated with :**
 - **EU_COST Action TU0702** ⇔ **ID-45 (SIRWEC, Thu 5.2.10, 17:15)**
 - **EUREKA/Celtic Project WiSafeCar**

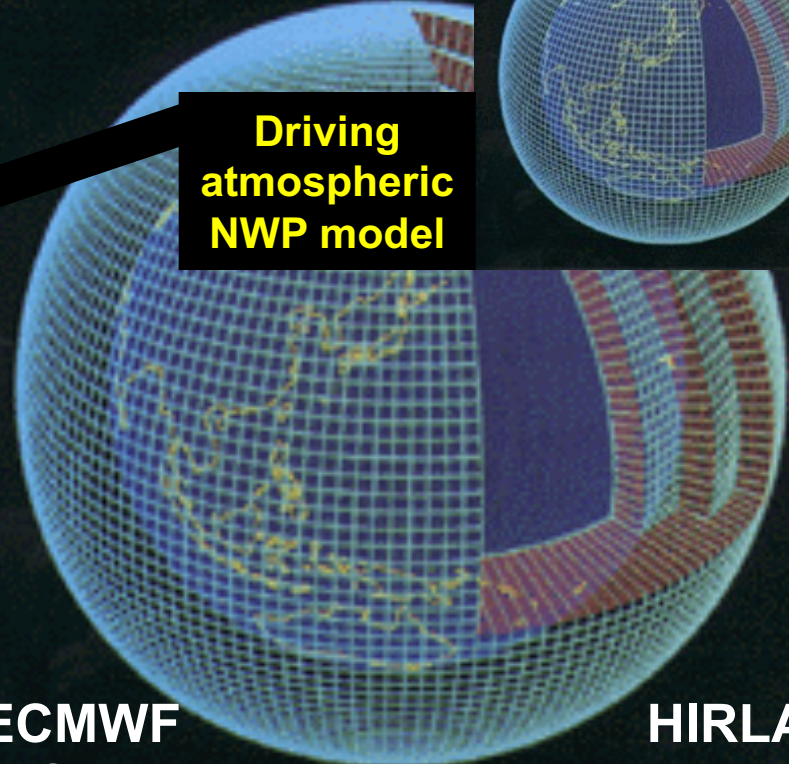


Road Weather Model

Driving atmosphere

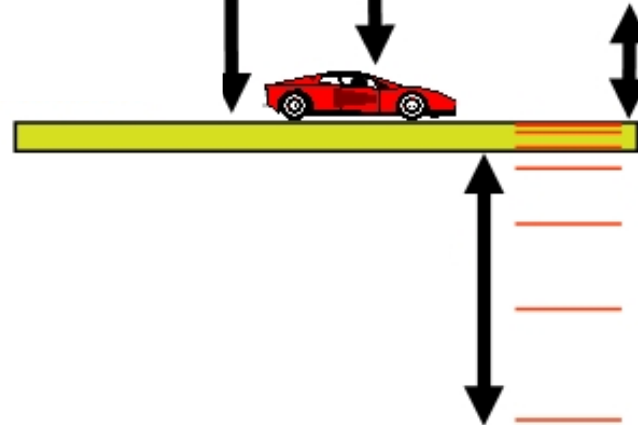


Driving atmospheric NWP model

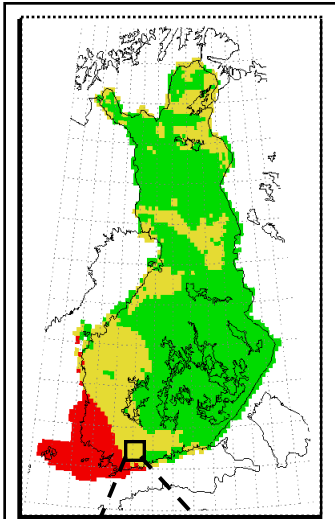


Road Weather

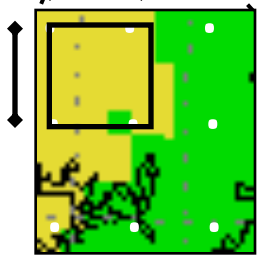
ECMWF Global HIRLAM Regional



Model resolution






10 km



Road Weather Model

Output :









Temperature

- road temperature 
- air temperature 
- air dew point 



Road index

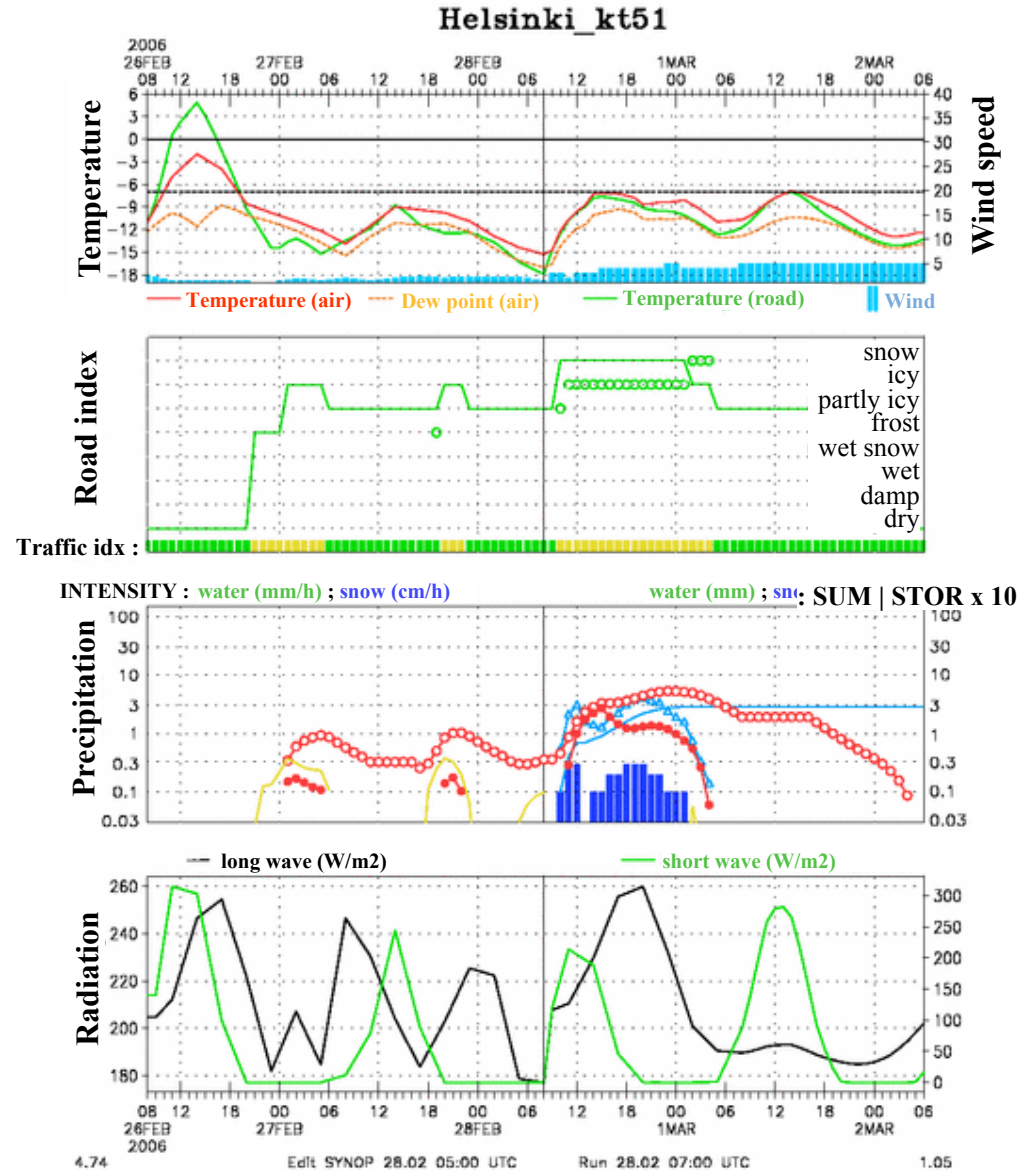
- primary 
- secondary 

Precipitation and storages

- water prec. mm/h () , mm ()
- water storage ()
- snow prec. mm/h () , mm ()
- snow storage ()
- ice storages ( ; )

Incoming radiation

- long wave 
- short wave 



for Friction :

... based on friction as observed by the DSC111 sensor

... utilizing road weather model output as predictor variables for the regression equations:

$$\text{Ice / snow} \Rightarrow F_1 = a_1 * f(\text{IS}) + b_1 * T_{rs} + c_1 \quad (\text{i})$$

$$\text{Water} \Rightarrow F_2 = a_2 * f(\text{W}) + c_2 \quad (\text{ii})$$

$$\text{Dry surf} \Rightarrow F_3 = 0.82 \quad (\text{iii})$$

where

a_i	b_i	c_i	= regression parameters
T_{rs}			= road surface temperature
IS			= thickness of ice/snow [in mm]
W			= water content [in mm]

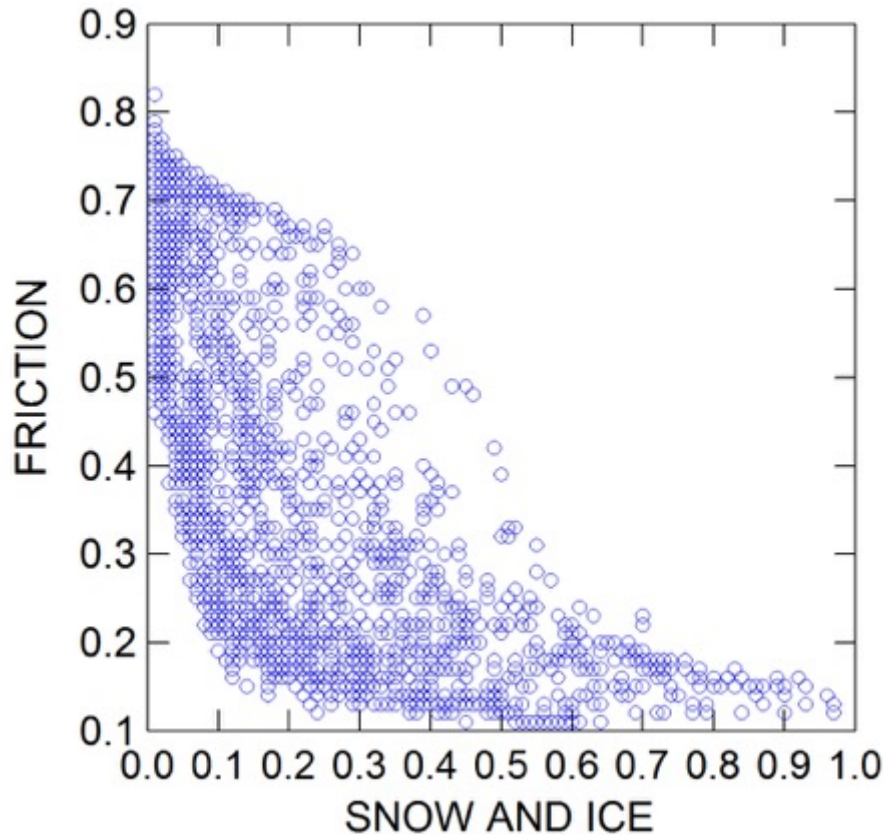


for Friction :

$$F_1 = a_1 * f(IS) + b_1 * T_{rs} + c_1$$

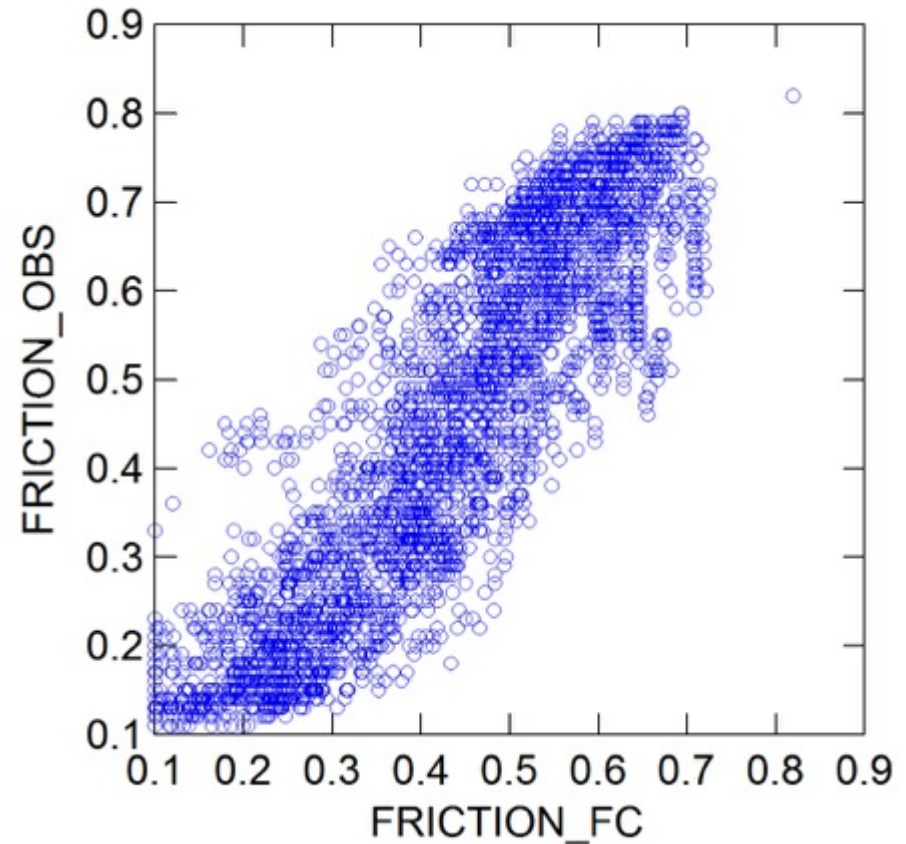
Station: Anjala

Relationship, winter 2007-08



Station: Anjala

Independent data, winter 2008-09

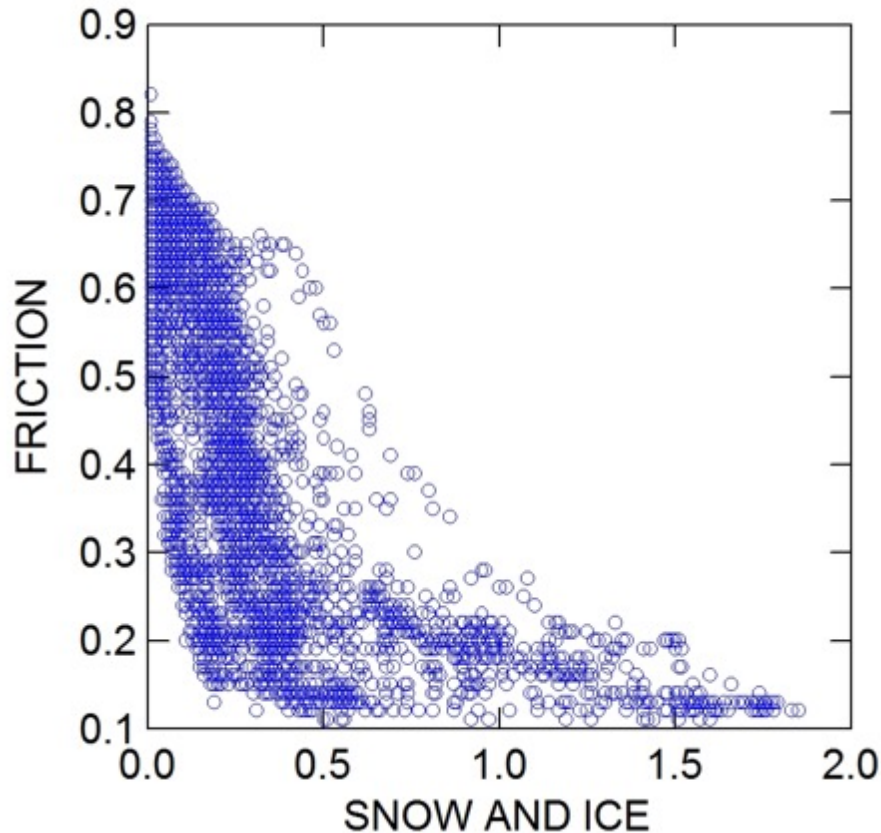


for Friction :

$$F_1 = a_1 * f(IS) + b_1 * T_{rs} + c_1$$

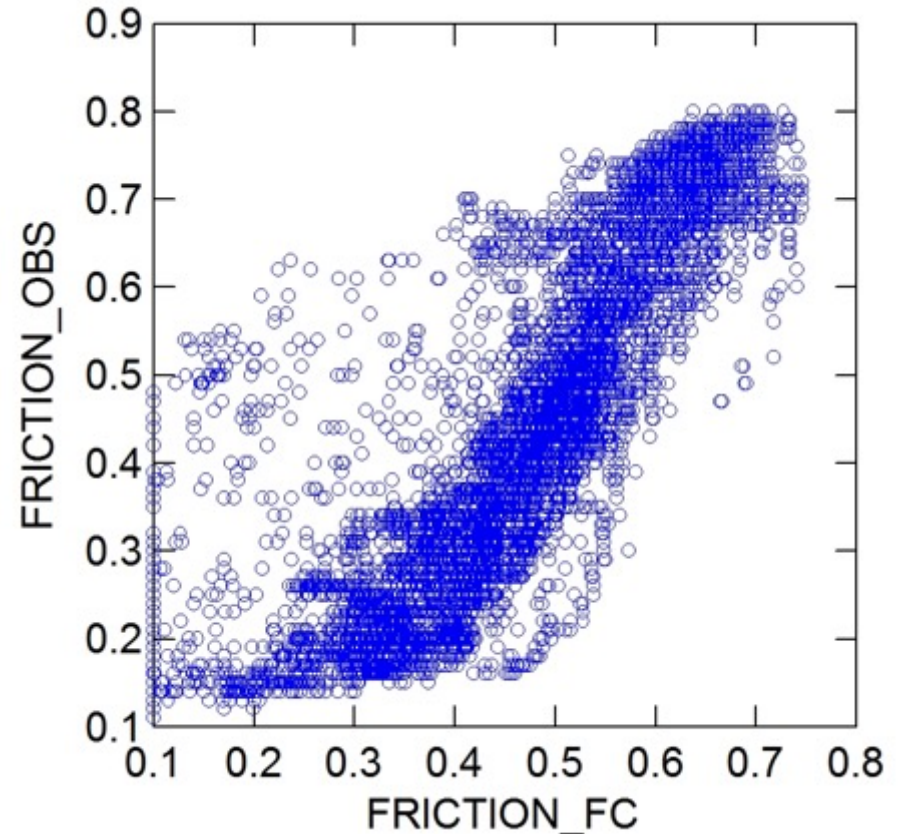
Station: Utti

Relationship, winter 2007-08



Station: Utti

Independent data, winter 2008-09



Classification :

	0.15			0.30		
Friction	0.00 – 0.14	0.15 – 0.19	0.20 – 0.24	0.25 – 0.29	0.30 – 0.44	0.45 – 1.00
Description of the road surface	Wet ice	Icy	Packed snow	Rough ice/ packed snow	Clear and wet	Clear and dry
Slipperiness classification	Very slippery	Slippery	Fair winter condition	Good winter condition	Good road condition	Good road condition
Road weather index	Very bad road weather		Bad road weather		Normal road weather	

Source: Finnish Road Administration



Validation

Trad. Scores

$$PC = (a+d)/n$$

$$POD = H = a/(a+c)$$

$$FAR = b/(a+b)$$

$$F = b/(b+d)$$

$$KSS = POD - F$$

$$TS = a/(a+b+c)$$

$$ETS = (a - a_r)/(a+b+c - a_r)$$

$$\text{where } a_r = (a+b)(a+c)/n$$

$$HSS = 2(ad - bc) / \{ (a+c)(c+d) + (a+b)(b+d) \}$$

Event forecast	Event observed		Marginal total
	Yes	No	
Yes	a	b	a + b
No	c	d	c + d
Marginal total	a + c	b + d	a + b + c + d = n

$$EDS' = \frac{\log F - \log H}{\log F + \log H}$$

(ref. D. Stephenson, C. Ferro)

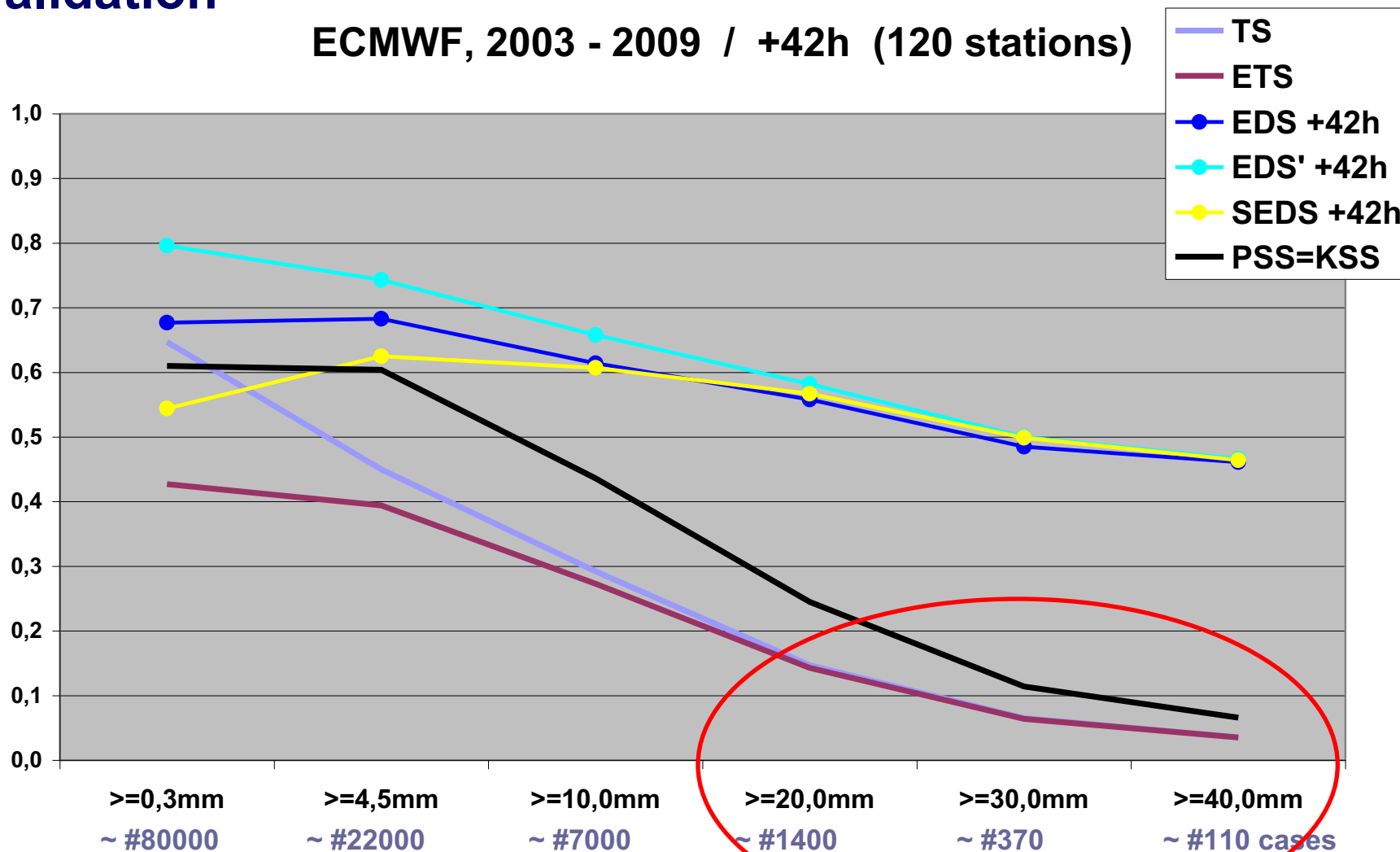
$$SEDS = \frac{\log [(a+b)/n] + \log [(a+c)/n]}{\log (a/n)} - 1$$

(ref. Hogan et al.)



Validation

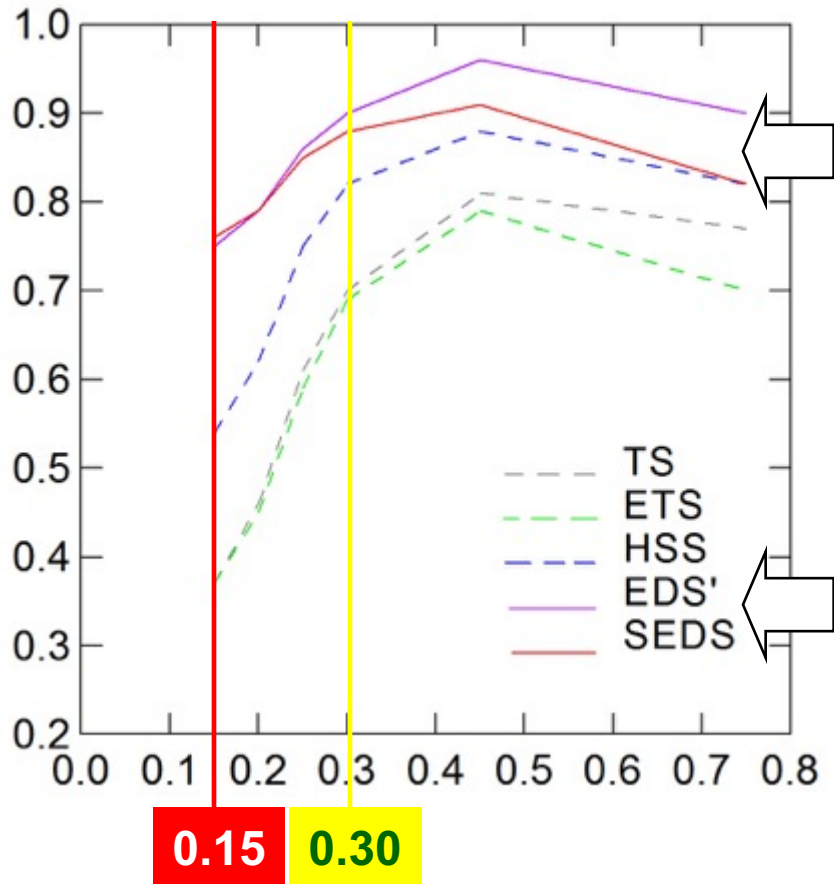
ECMWF, 2003 - 2009 / +42h (120 stations)



Validation

Friction forecasts

Station: Anjala



0.15

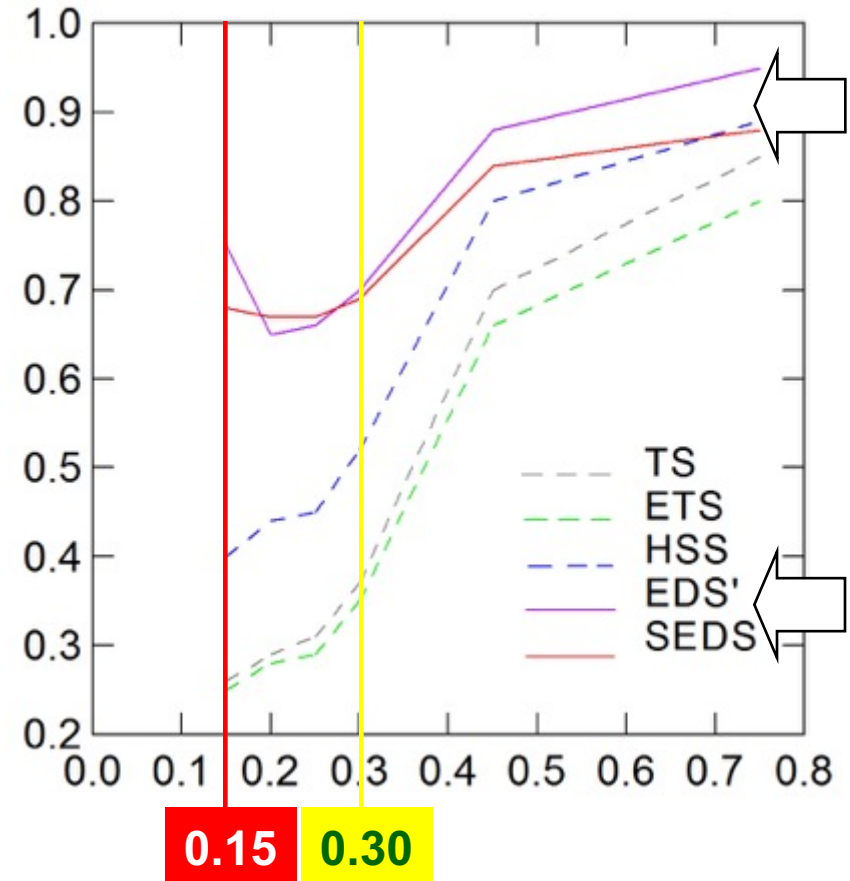
0.30



Validation

Friction forecasts

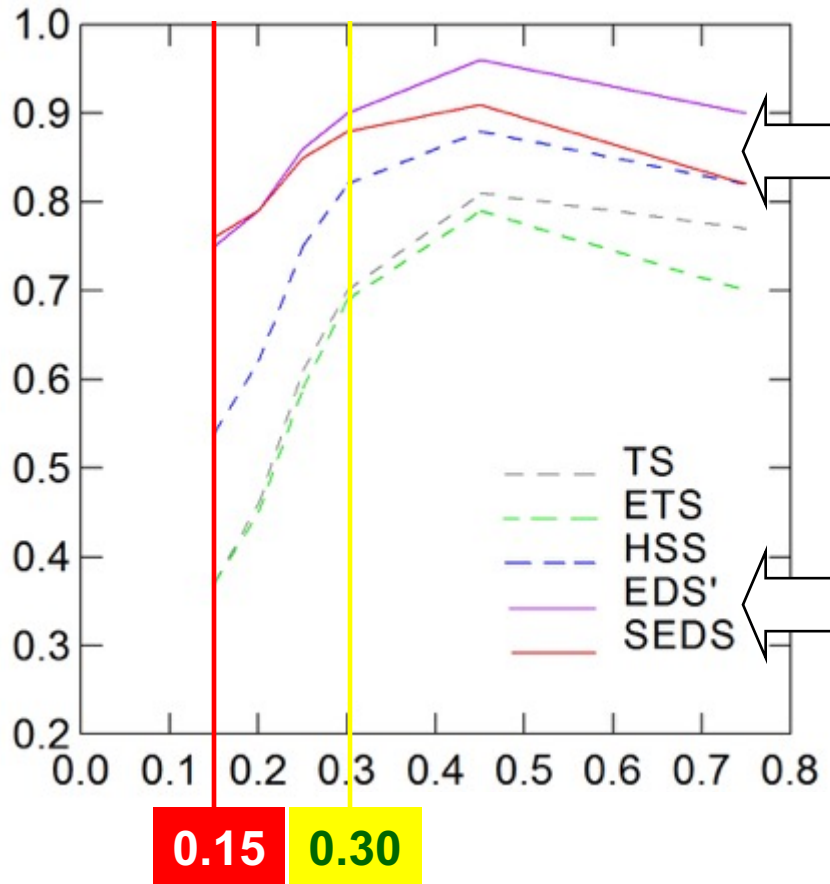
Station: Utti



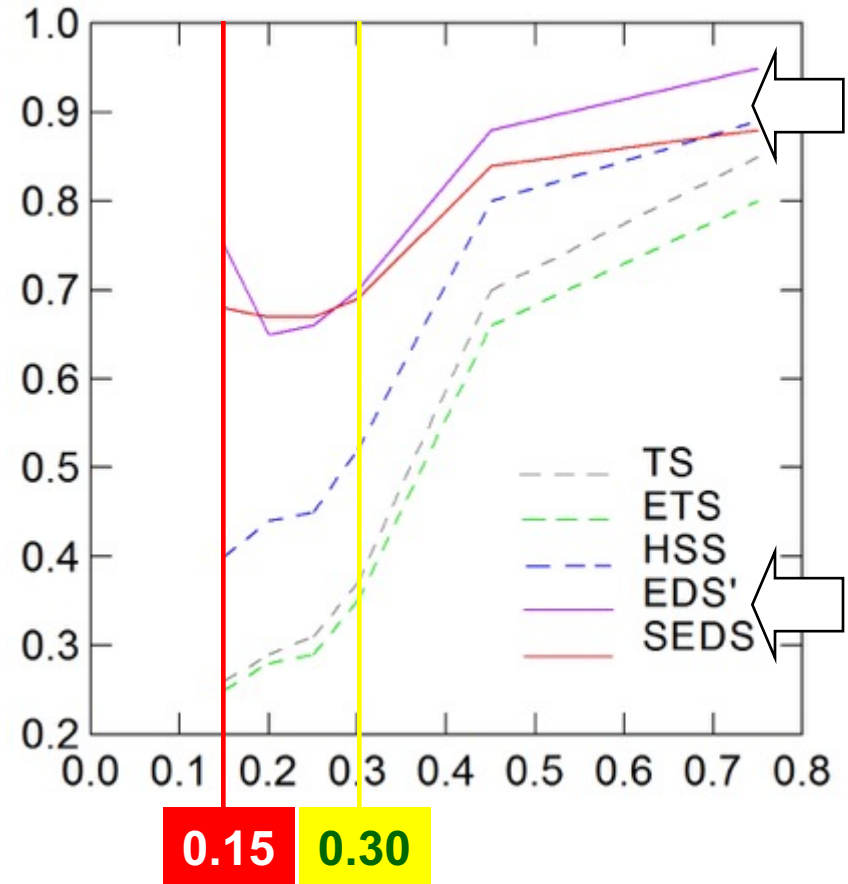
Validation

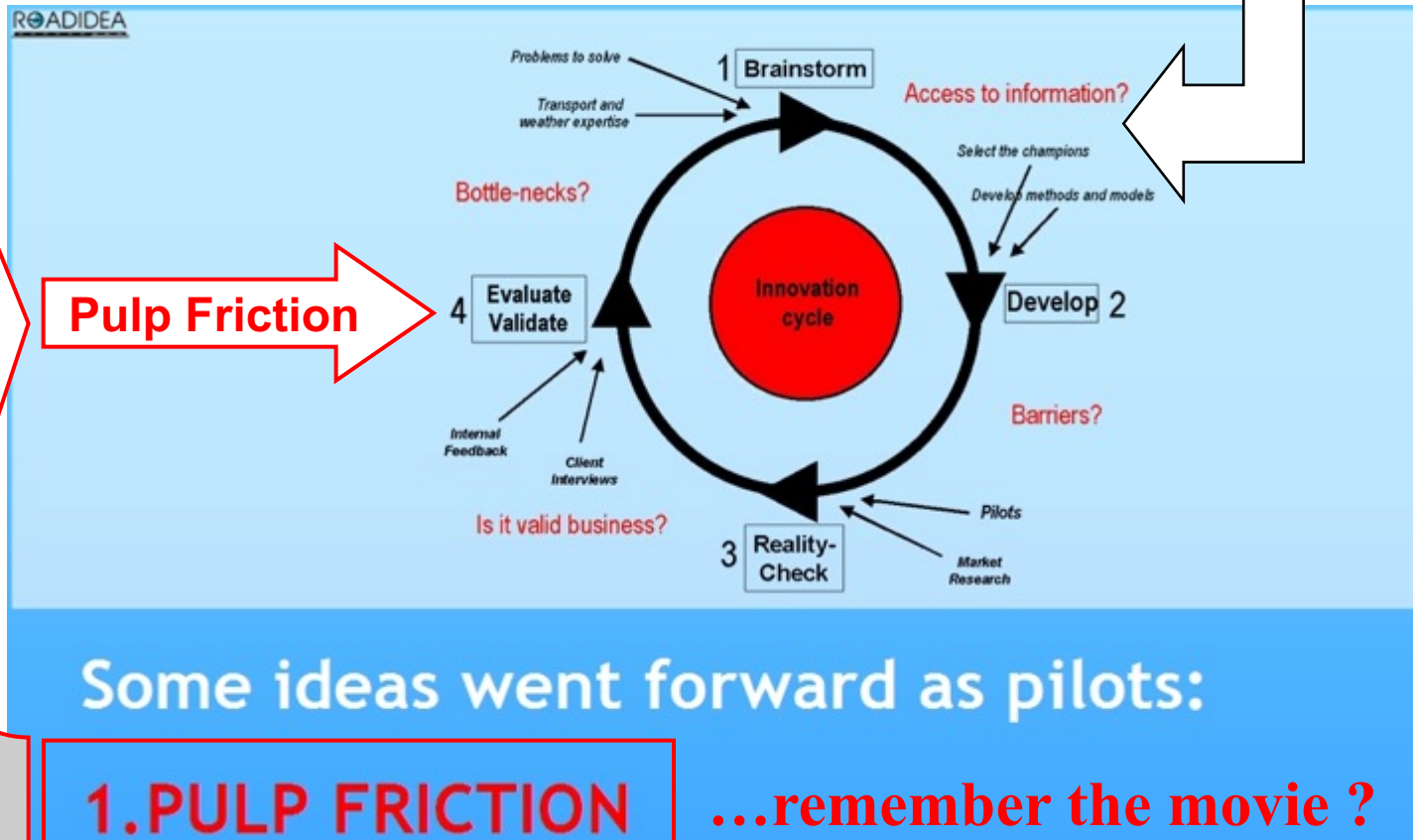
Friction forecasts

Station: Anjala



Station: Utti





<http://pilot.roadidea.eu/mobilefriction/Default.aspx>

position lat 60.169880° lon 24.938408°
accuracy 140000 m

name kt51_Vaskisalmi_Opt

distance 4.8 km

Time 13:00:00 12:00:00 11:00:00
+02:00 +02:00 +02:00

Air °C -9.4 -9 -8.4

Road °C -10.5 -9.9 -7.6

Friction 0.82 0.82 0.82

Surface dry dry dry

Condition normal normal normal



position lat 60.169880° lon 24.938408°
accuracy 140000 m

street Simonkatu

city 00100 Helsinki

county Uusimaa

region Southern Finland

country Finland

name kt51_Vaskisalmi_Opt

distance 4.8 km

Time 13:00:00 12:00:00 11:00:00
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Air °C -9.4 -9 -8.4

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Friction 0.82 0.82 0.82

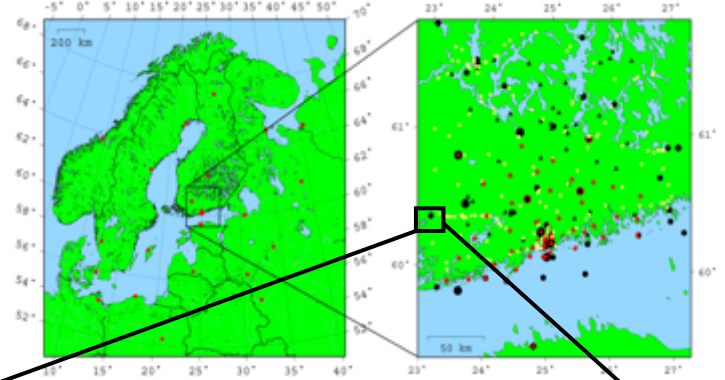
Surface dry dry dry

Condition normal normal normal



... within the Celtic /WiSafeCar Project

- ✓ Wireless traffic service platform
- ✓ Wireless data transfer
- ✓ Hybrid networking
- ✓ Mobile application validation
- ✓ Vehicle vs. mobile data
- ✓ Service updating
 - Friction forecasts
 - Road weather
 - Incident warnings





Further information :

- ✓ <http://www.roadidea.eu>
- ✓ <http://wisafecar.gforge.uni.lu/>
- ✓ <http://tu0702.inrets.fr/>

Thank You for
Your Attention !