

ROADEX

Implementing Accessibility

Tyre Pressure Control

ROADEX IV final seminar
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Outline of the presentation

- Basic idea of CTIS/TPCS
- Historical development
- Effect of TPC on wheel/road contact
- Principle of operation to reduce tyre wear
- Effect of TPC on road stresses
- Effect of TPC on traction/mobility
- Effect of TPC on driver's health (by Johan Granlund tomorrow)
- TPC installation statistics in some of the ROADEx countries

Basic idea of CTIS/TPCS

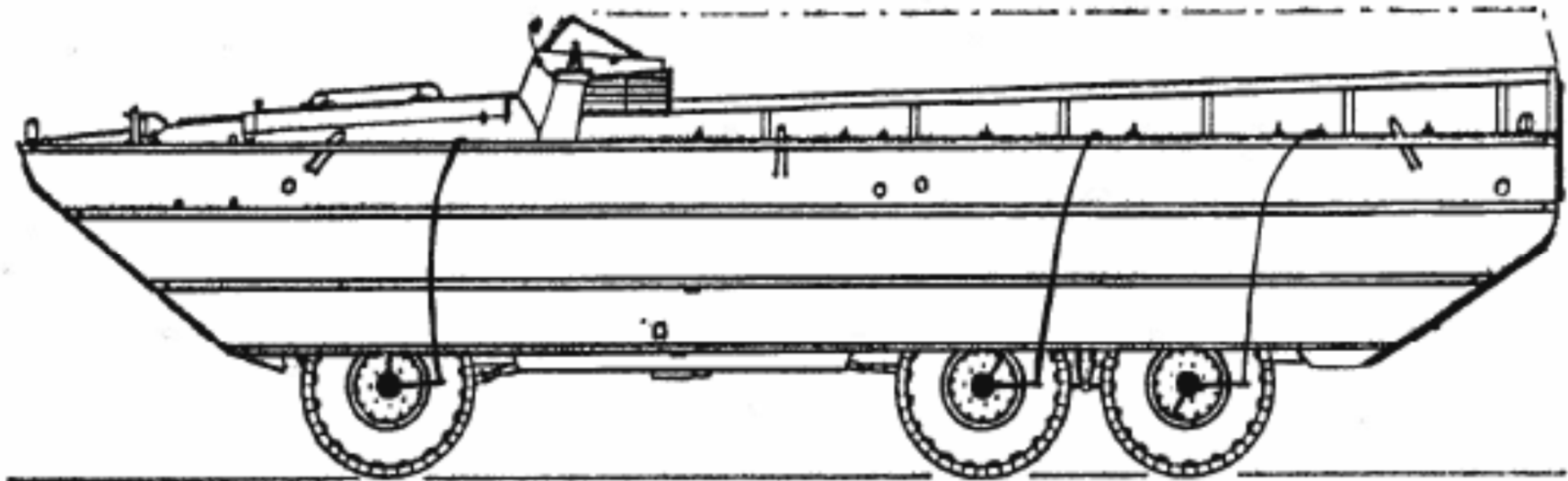
CTIS = Central Tyre Inflation System

TPCS = Tyre Pressure Control System



Historical development

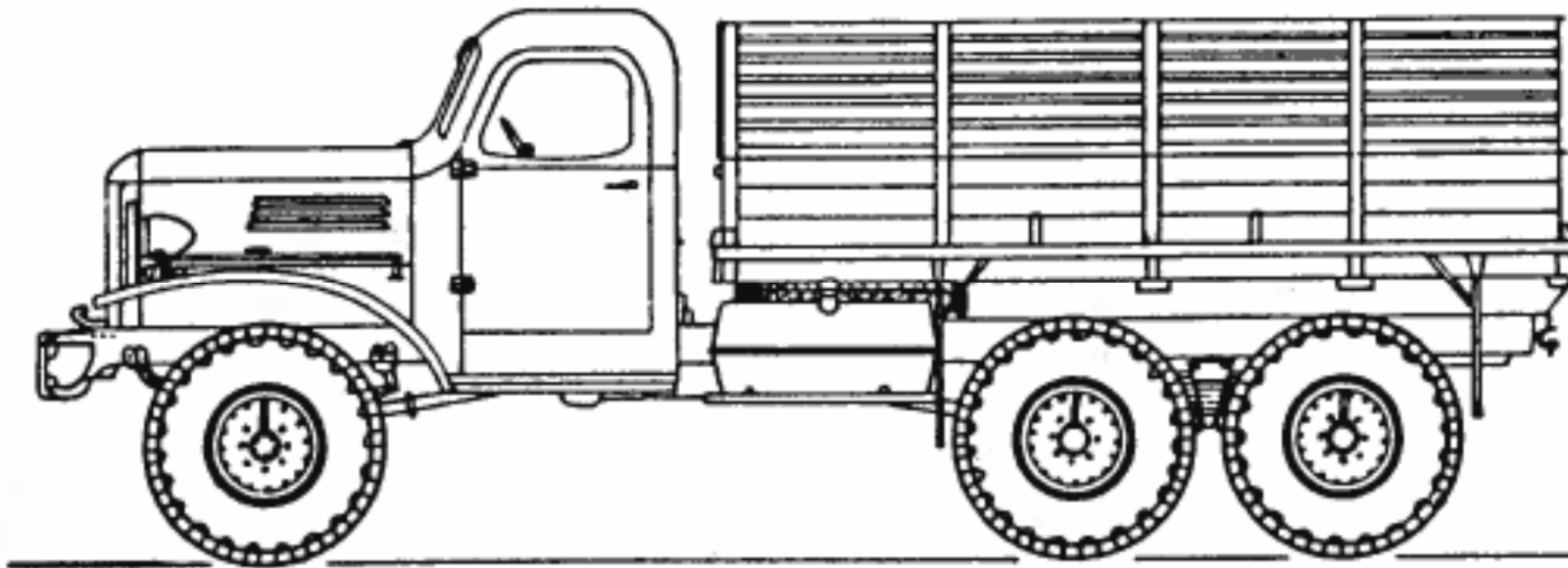
- 1942 US amphibious landing craft



DUKW-385 (6 × 6) 2500 kg amphibious vehicle with external airlines for tyre pressure regulation system

Historical development

- 1944 - 1960 widespread development and use in military applications by Soviet Union
- 1960 - 1970 also in many civil applications

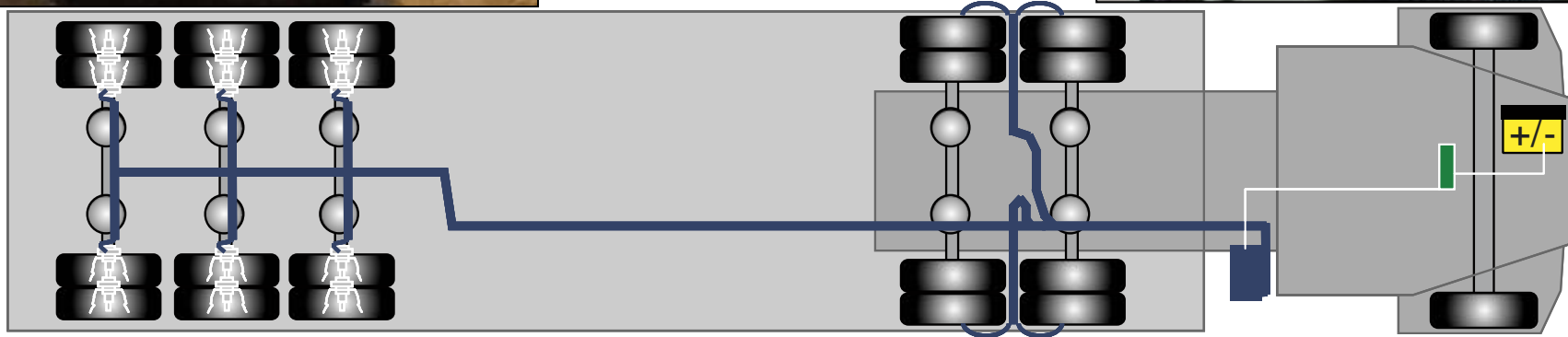


Material borrowed from Allan Bradley, FPInnovations FERIC, Canada

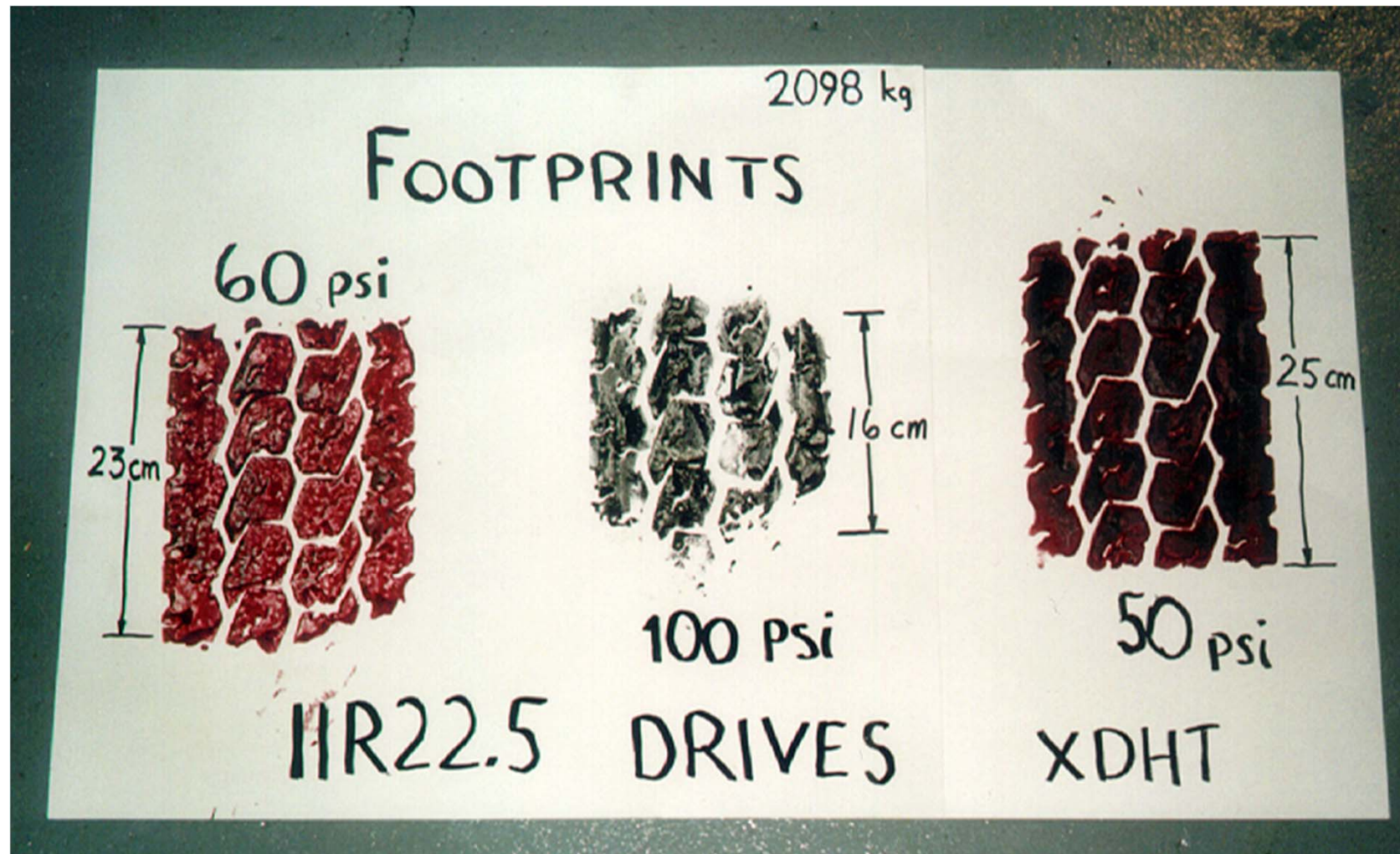
Historical development

- Widespread adoption by US and western European militaries in 1990s;
- By 1990, 30+ types of CTI used around world
- In 1982, USFS began CTI research program; applied to various forestry vehicles
- In 1993, first two TPCS for commercial trucks

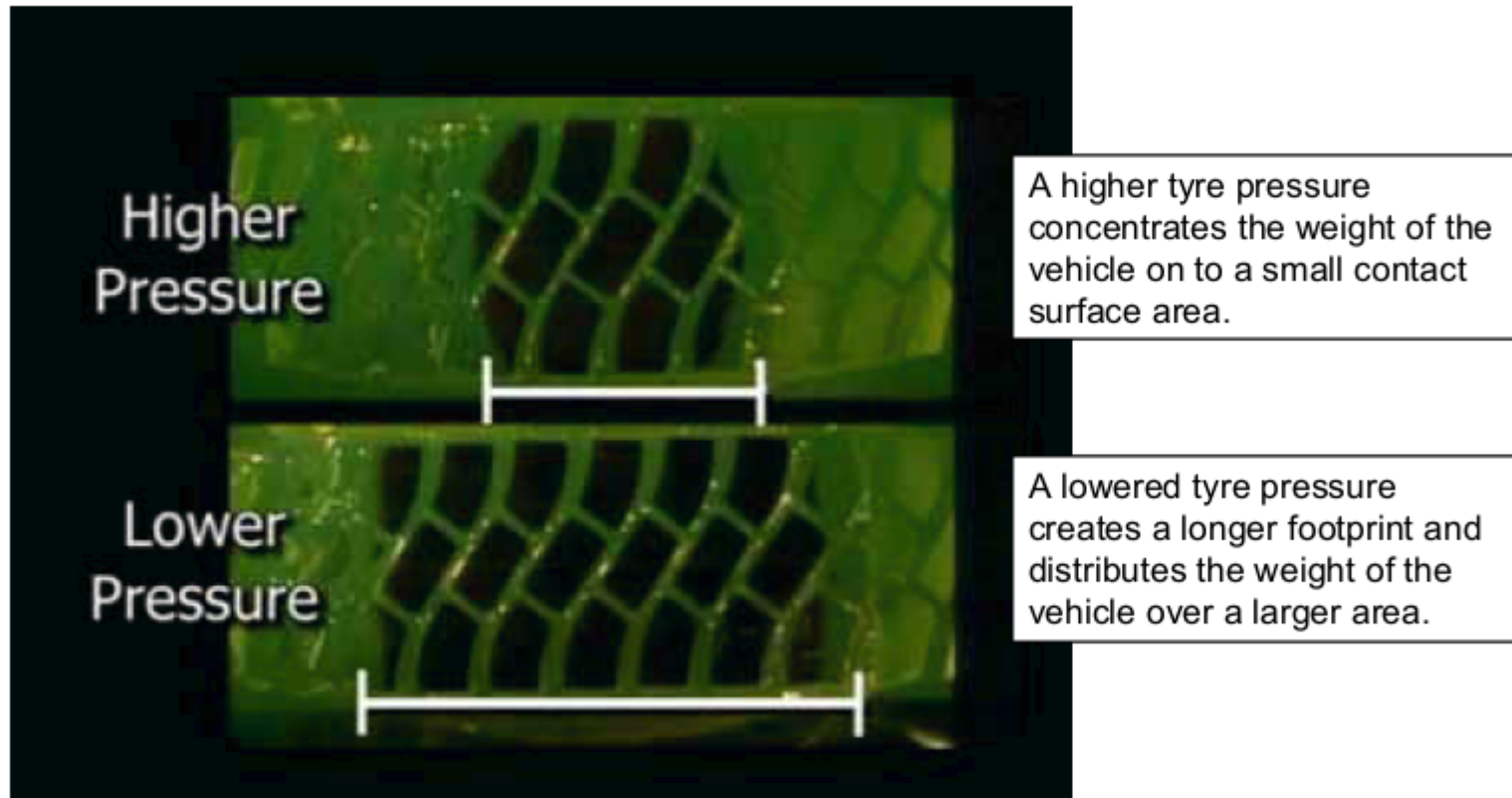
TPCS components



Effect of TPC on wheel/road contact



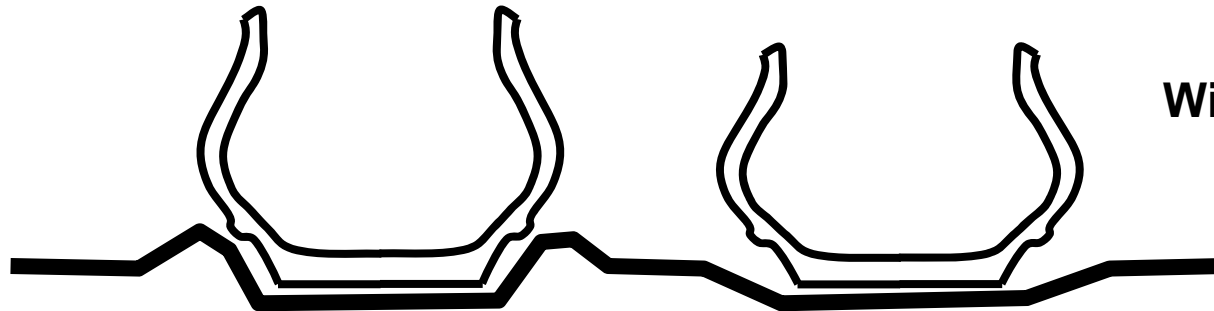
Effect of TPC on wheel/road contact



Munro, R. & MacCulloch, F. (2008) Tyre Pressure Control on Timber Haulage Vehicles, ROAD EX III report

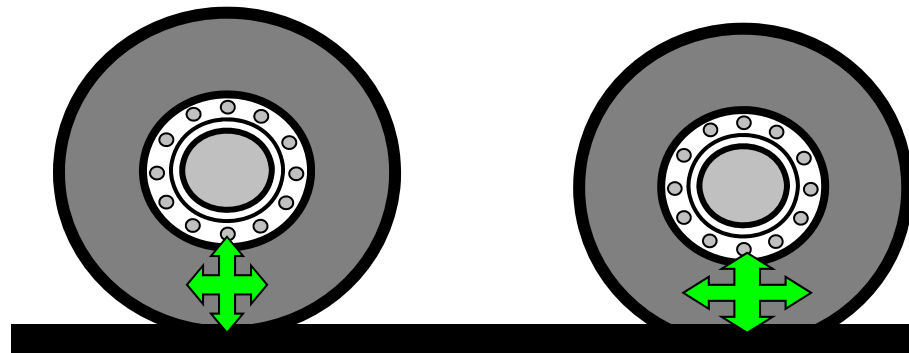
Effect of TPC on wheel/road contact

Rut shape



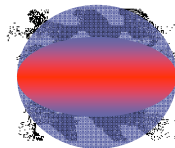
**Wider, shallower
rut**

**Stiffness and
spring rate**

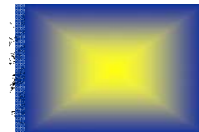


**Less impact
energy**

**Contact
area**

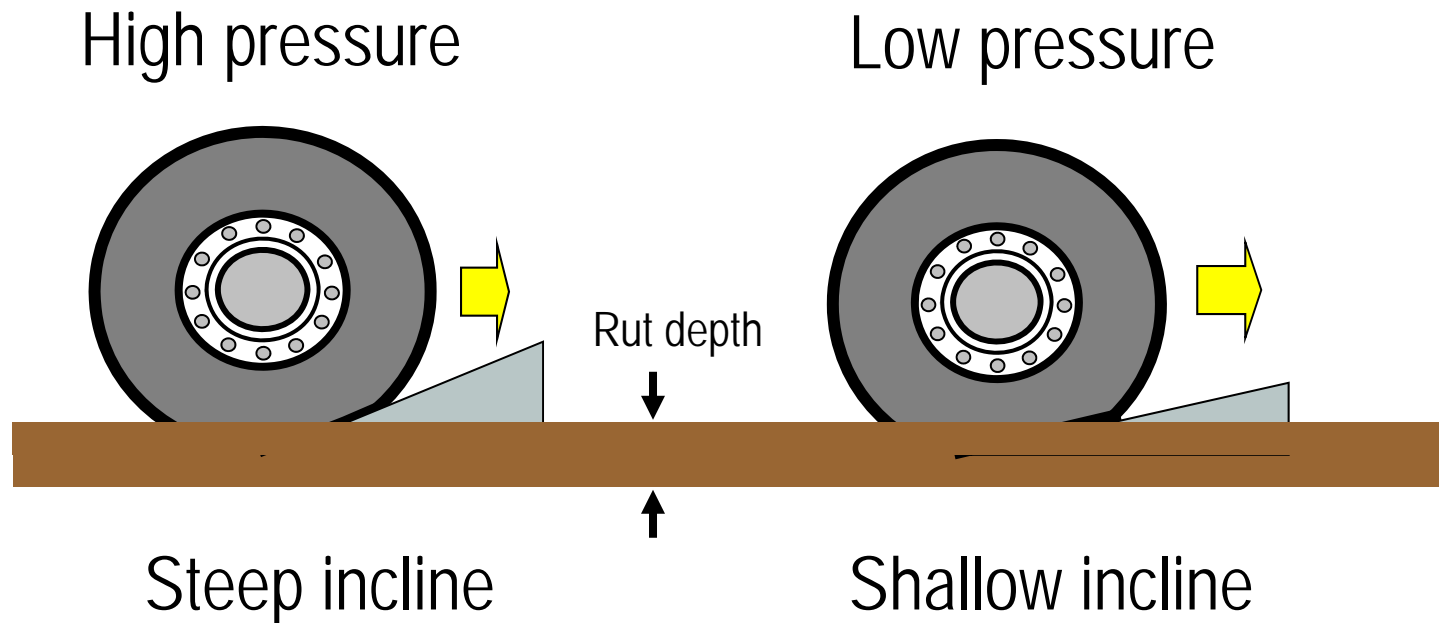


**Contact stress
distribution**



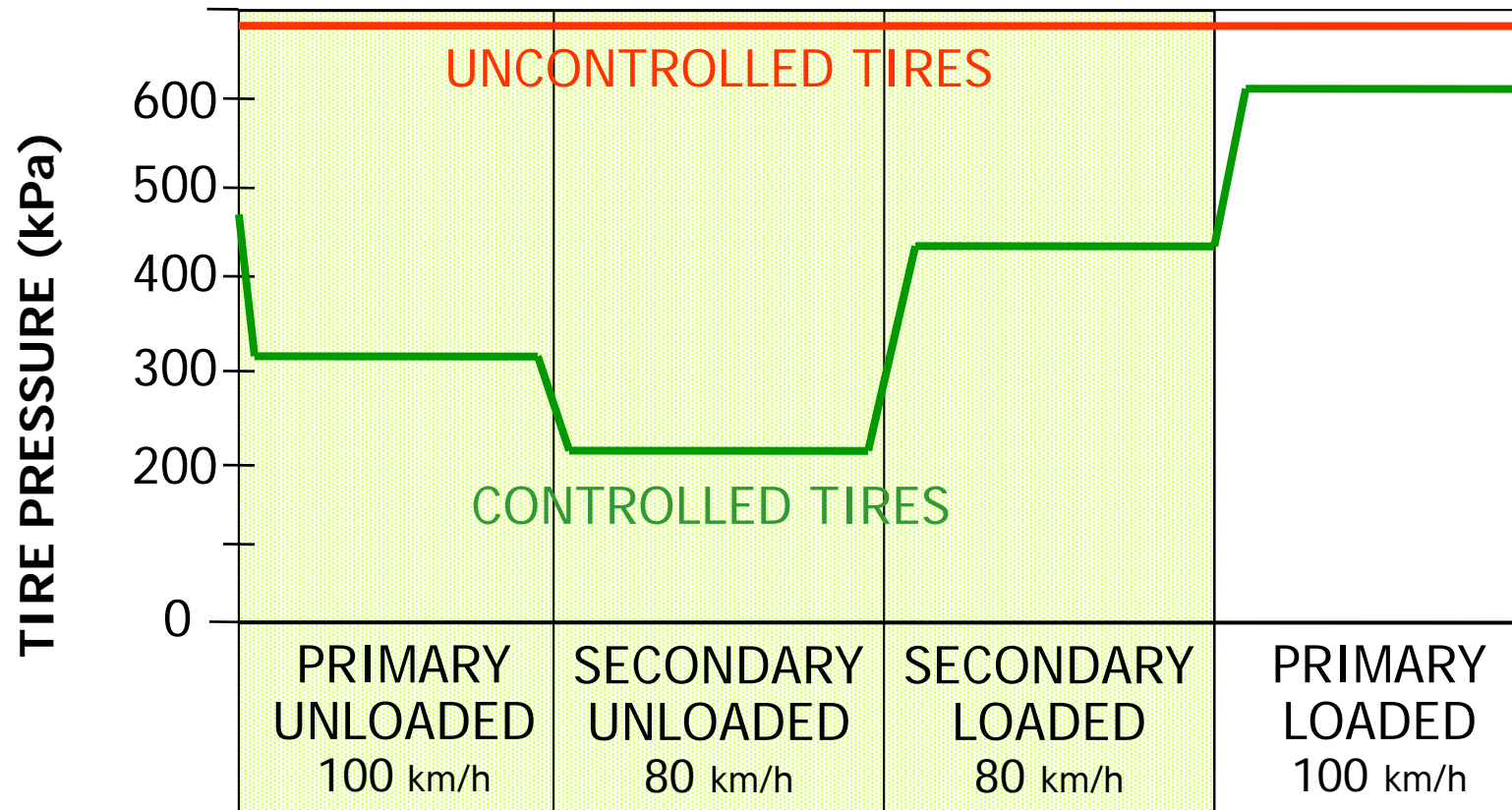
**Lighter
footprint, more
tread**

Effect of TPC on wheel/road contact



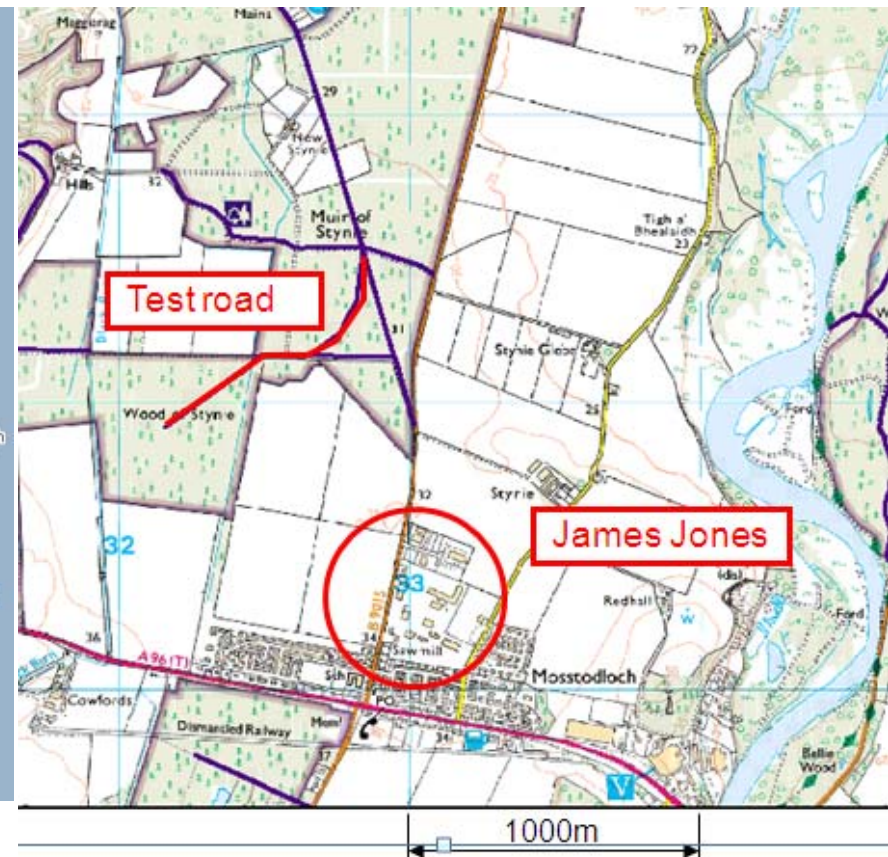
Less motion resistance in the direction on driving → **better mobility of the vehicle**

Principle in the use of TPCS



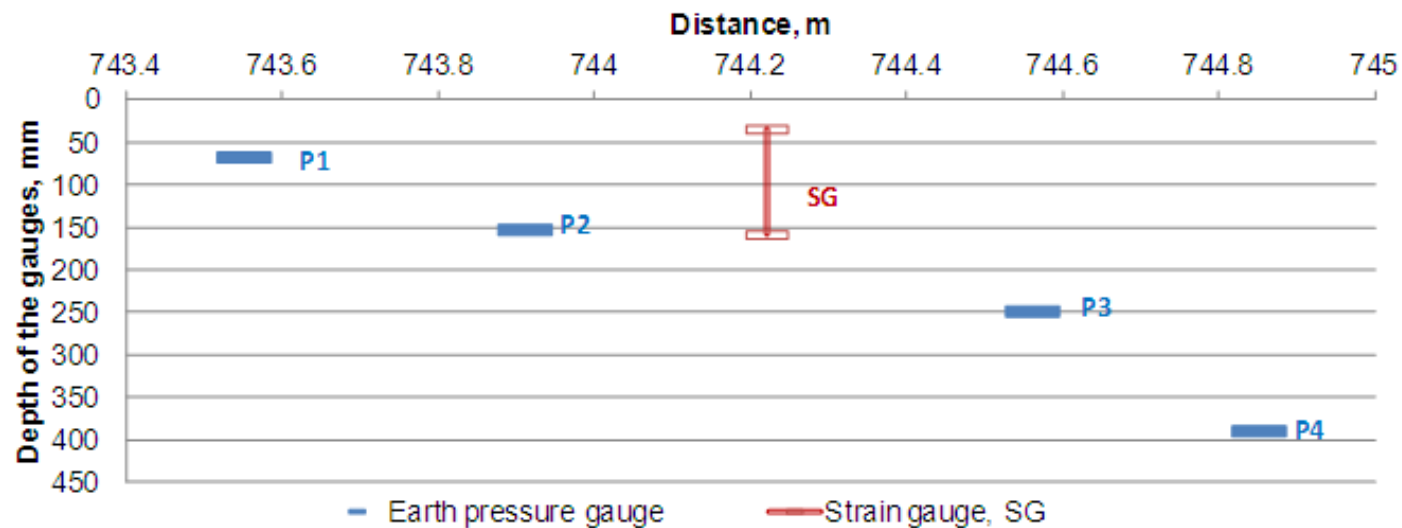
Uncontrolled tires are over-inflated for 75% of the trip
 → less tyre wear with the use of TPC

Effect of TPC on road stresses – Field trial at Stynnie Woods, Scotland

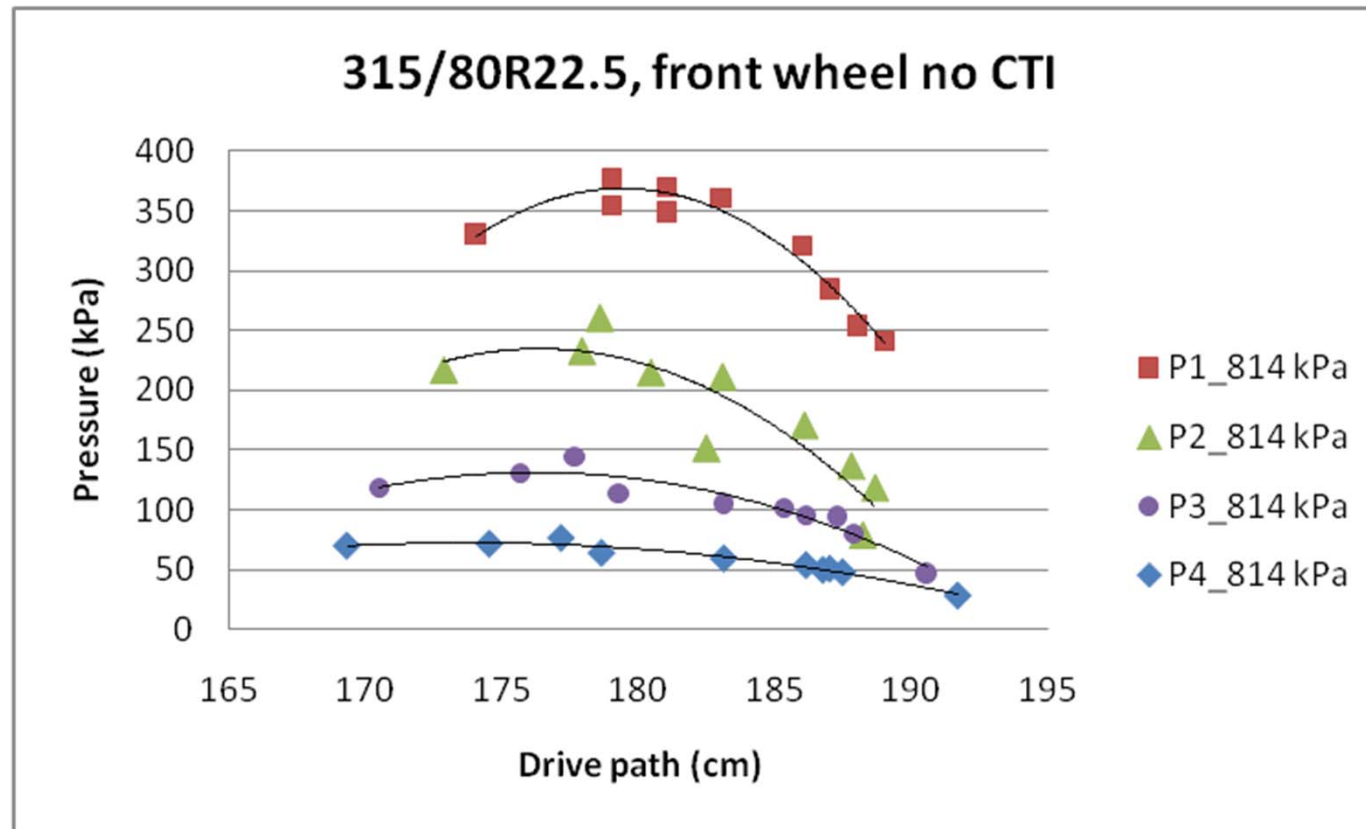




Installation of the earth pressure gauges

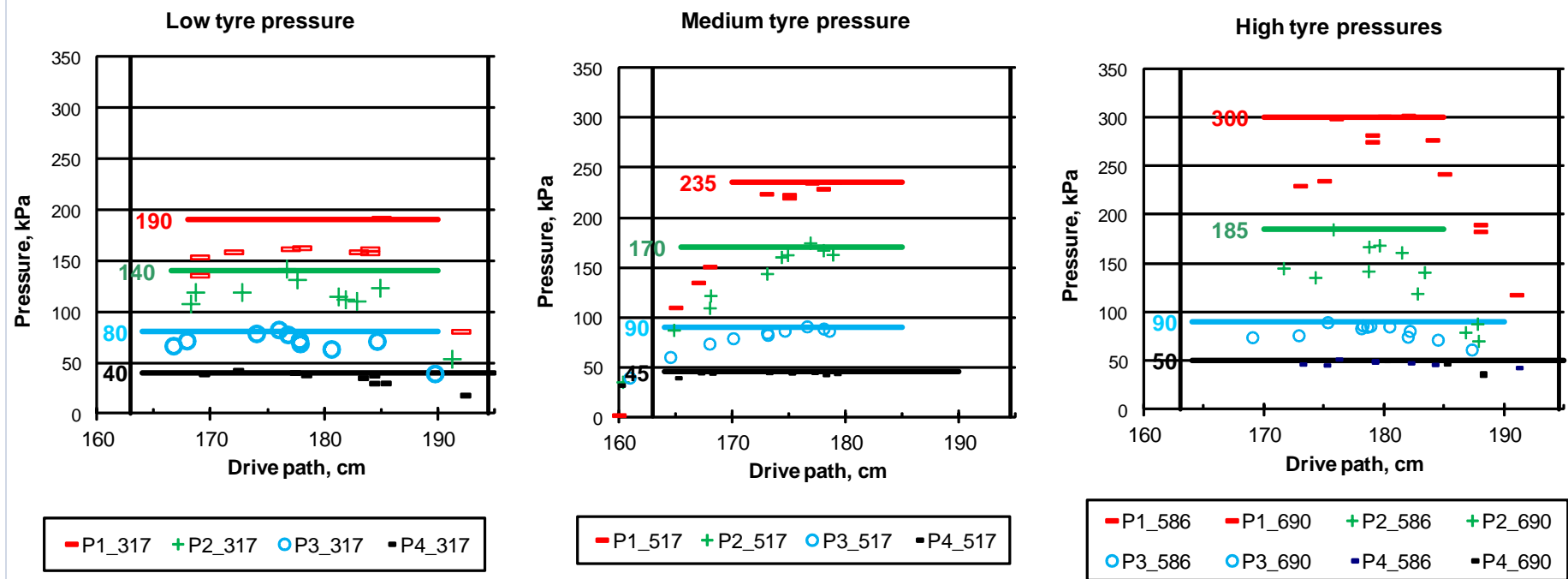


Pressure distribution at full tyre pressure under the front wheel

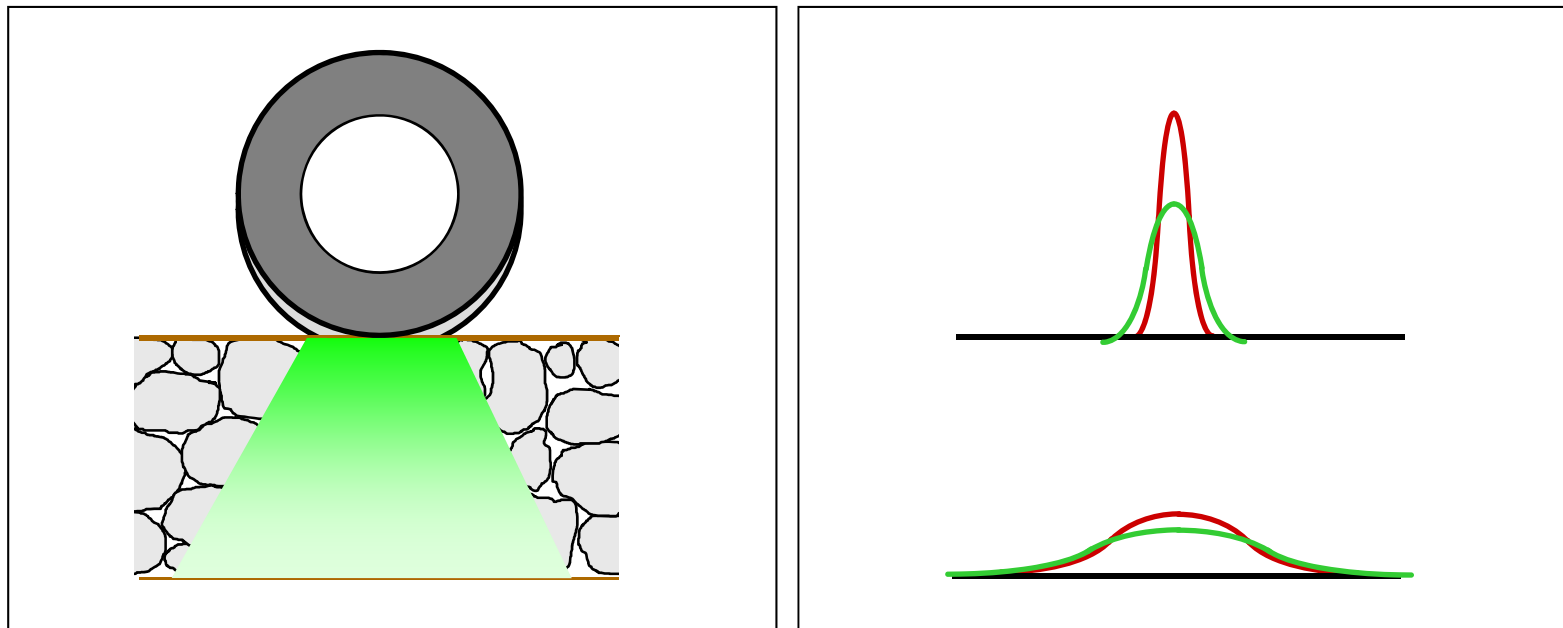


Pressure distribution as a function of depth as expected.

Effect of tyre inflation pressure on road stresses

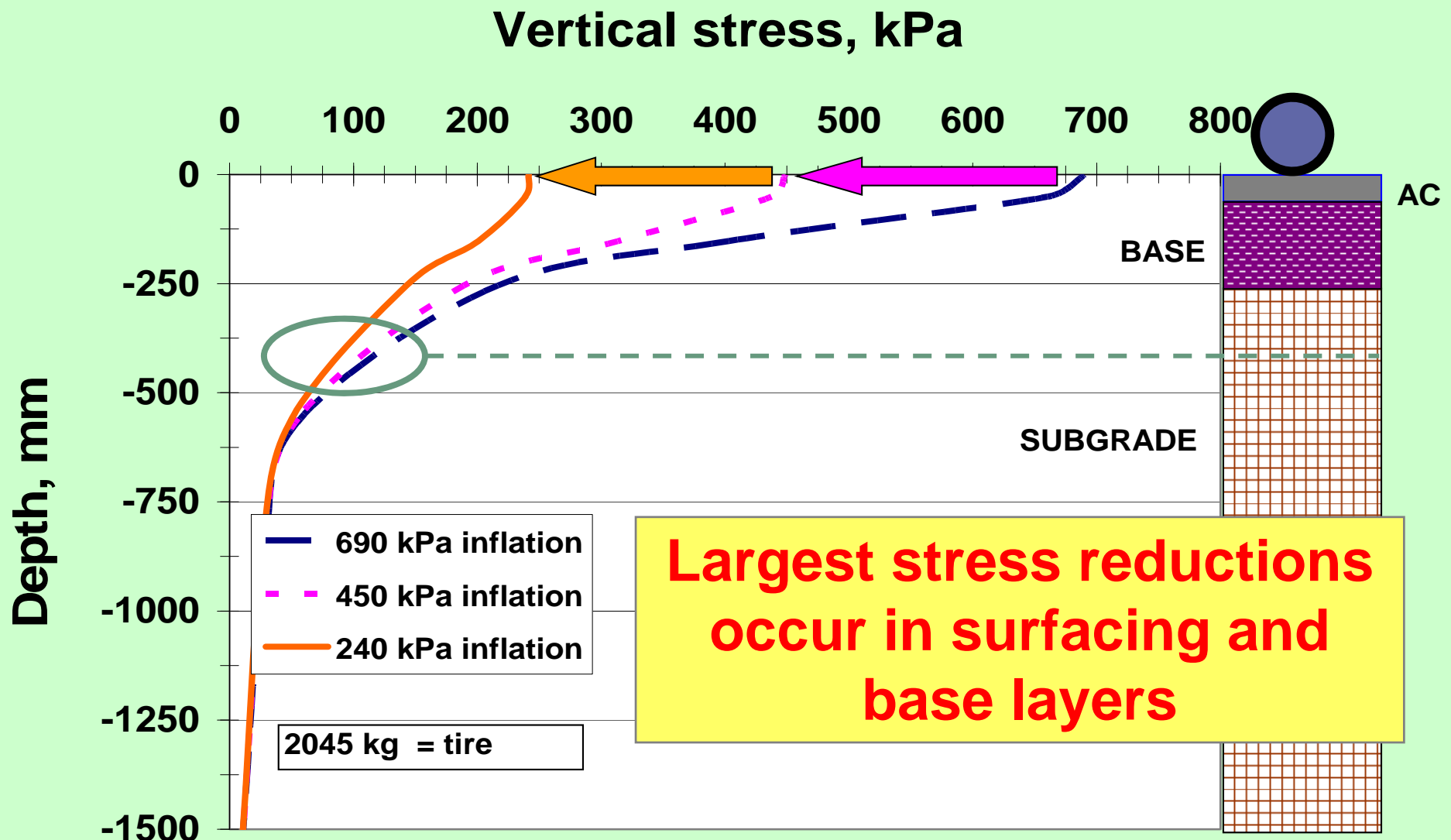


Effect of TPC on road stresses



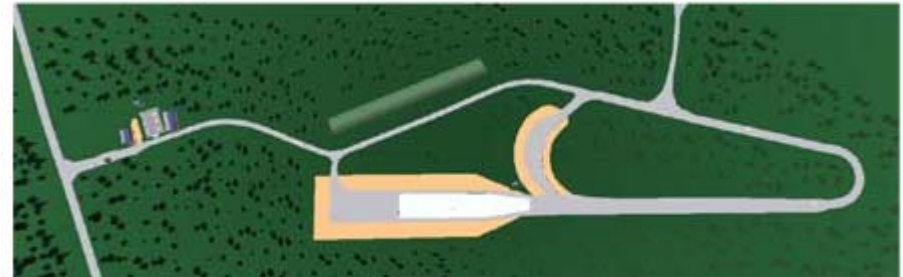
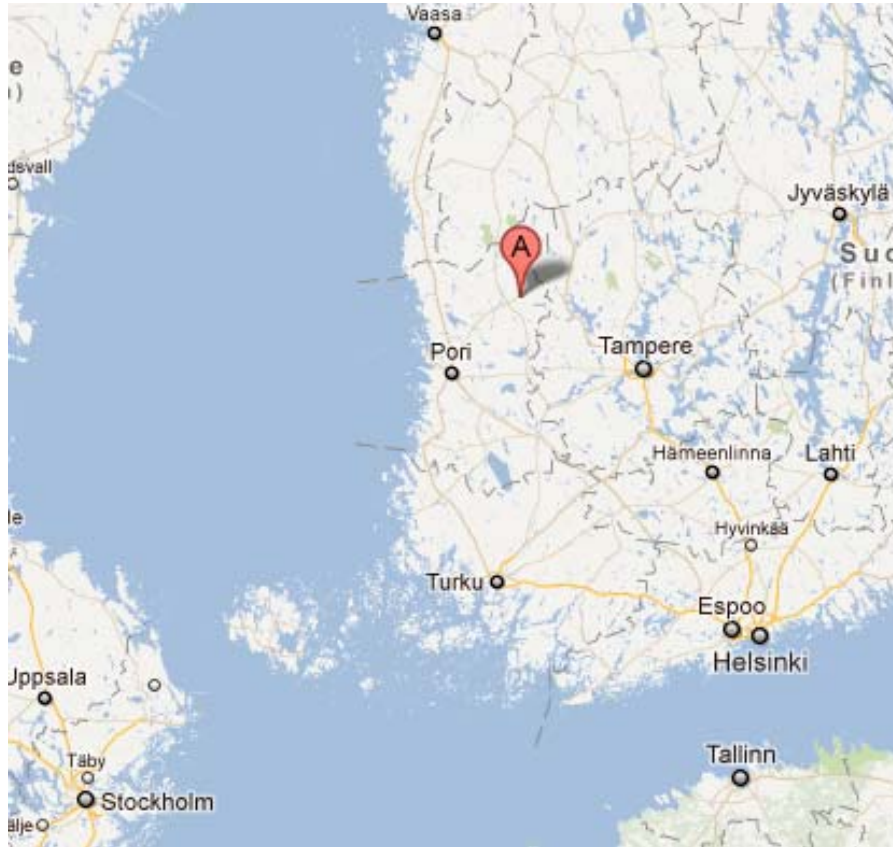
Stresses are reduced near to the road surface but much less deeper in the subgrade → **TPC helps on Mode 1 rutting, but not on Mode 2**

Calculated effect of lowered tyre pressure



Material borrowed from Allan Bradley, FPInnovations FERIC, Canada

Effect of TPC on traction /mobility - Filed trial at Niinisalo, Finland



Effect of TPC on traction/mobility

Field trial at Niinisalo, October 2011



Effect of TPC on traction/mobility

Field trial at Niinisalo, October 2011



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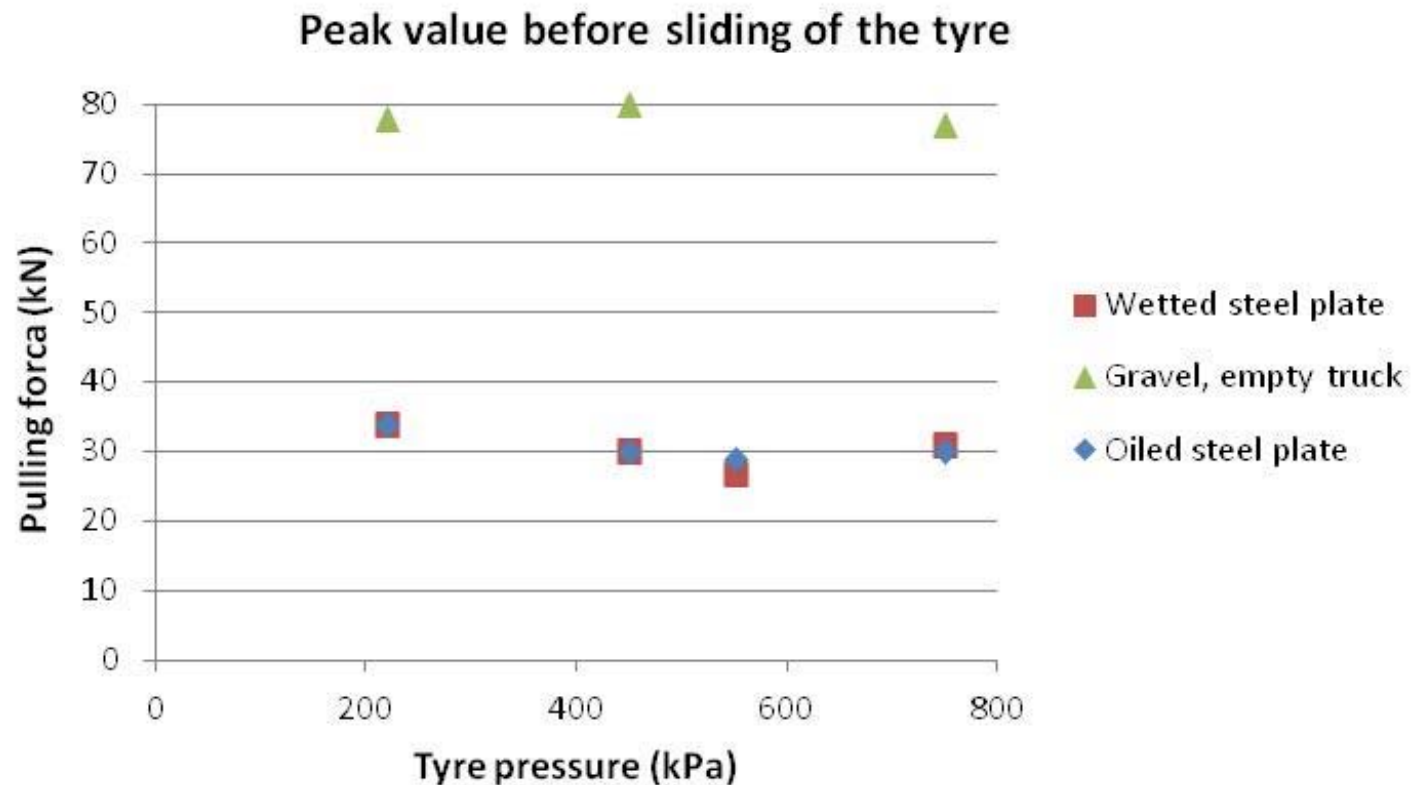
Effect of TPC on traction/mobility

Field trial at Niinisalo, October 2011



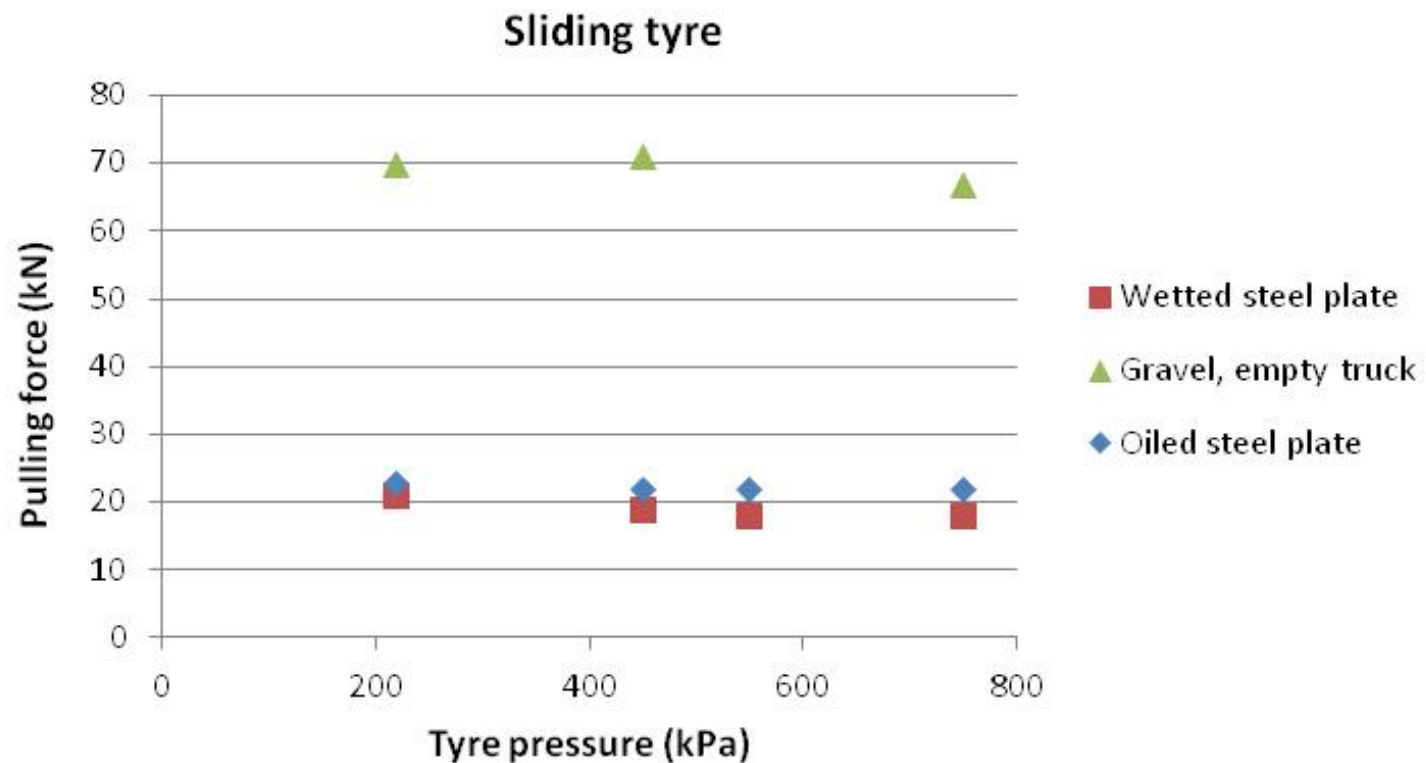
Effect of TPC on traction/mobility

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Field trial at Niinisalo, October 2011



Effect of TPC on traction/mobility

Results obtained on loose / soft surface

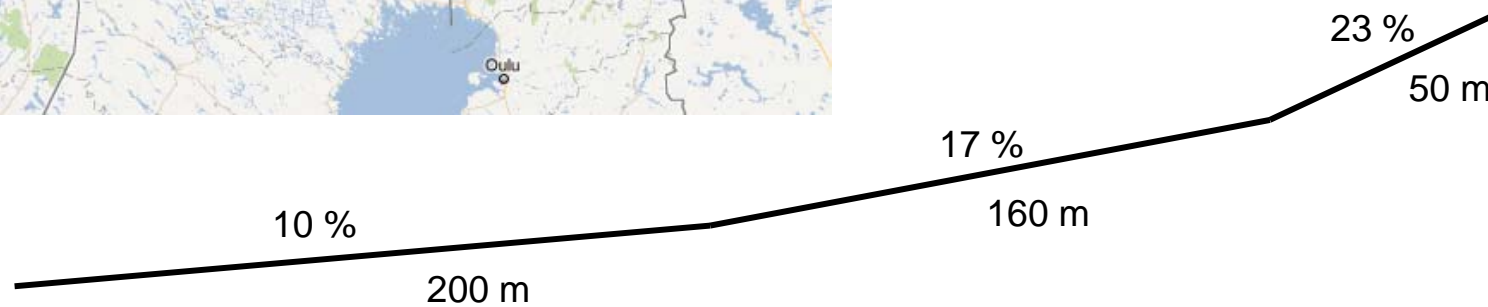
Road surface	Highway inflation (kPa)	TPCS tire pressure (psi)	Measured tractive increase
Loose gravel*	610	210	42%
Sugar sand	690	450	34%
Wet clay	690	450	17%

** Less or no tractive hop at reduced tire pressure*

Effect of TPC on traction /mobility - Wintertime field trial at Ivalo, Finland



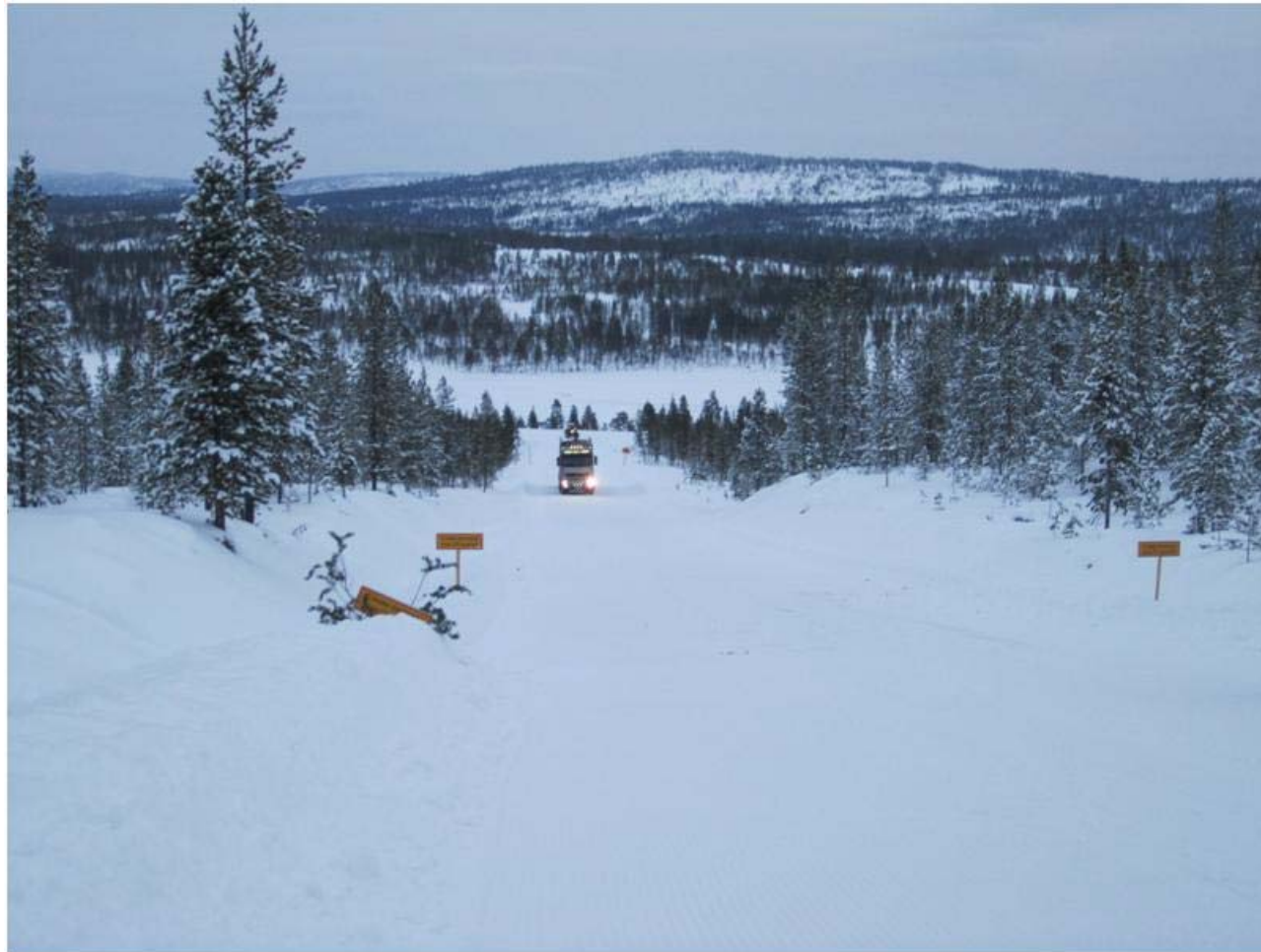
Uphill profile at the Nokian Tyres test site:



Effect of TPC on traction /mobility - Wintertime filed trial at Ivalo, Finland



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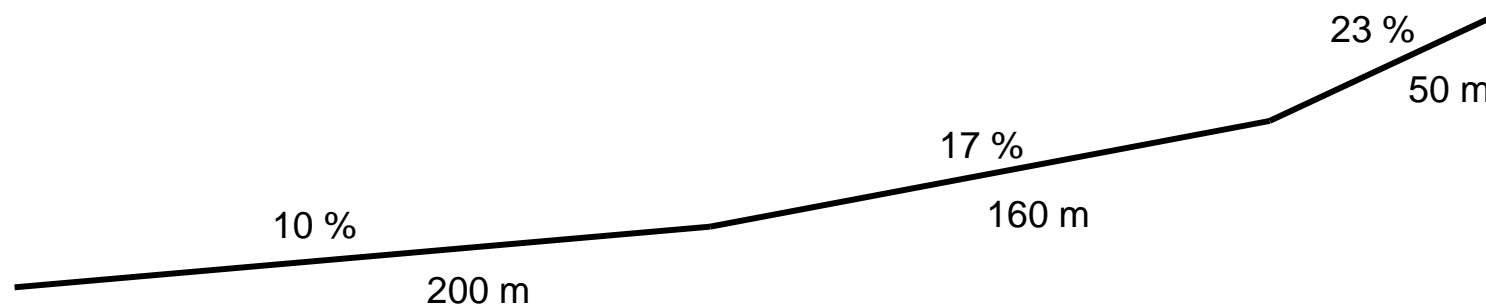
Effect of TPC on traction /mobility - Wintertime field trial at Ivalo, Finland



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Tyre inflation pressures (kPa)	Climbing distance (m)
Full pressure in all tyres	370
'Medium' / 350 kPa in driving wheels	380
Low / 220 kPa in driving wheels	379 - 380

Effect of TPC on traction /mobility - Wintertime field trial at Ivalo, Finland



TPC installation statistics in some of the ROADEX countries

Country	Year of the first TPCS installation	Approximate number of installations today
United Kingdom	2006	About 100
Sweden	2003	> 130
Finland	2009	>10

Questions ?

