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Northern Periphery Programme 2007–2013

Innovatively investing in Europe's Northern Periphery for a sustainable and prosperous future

European Union
European Regional Development Fund

Tyre Pressure Control

ROADEX IV final seminar
Rovaniemi, 25 April 2012

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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

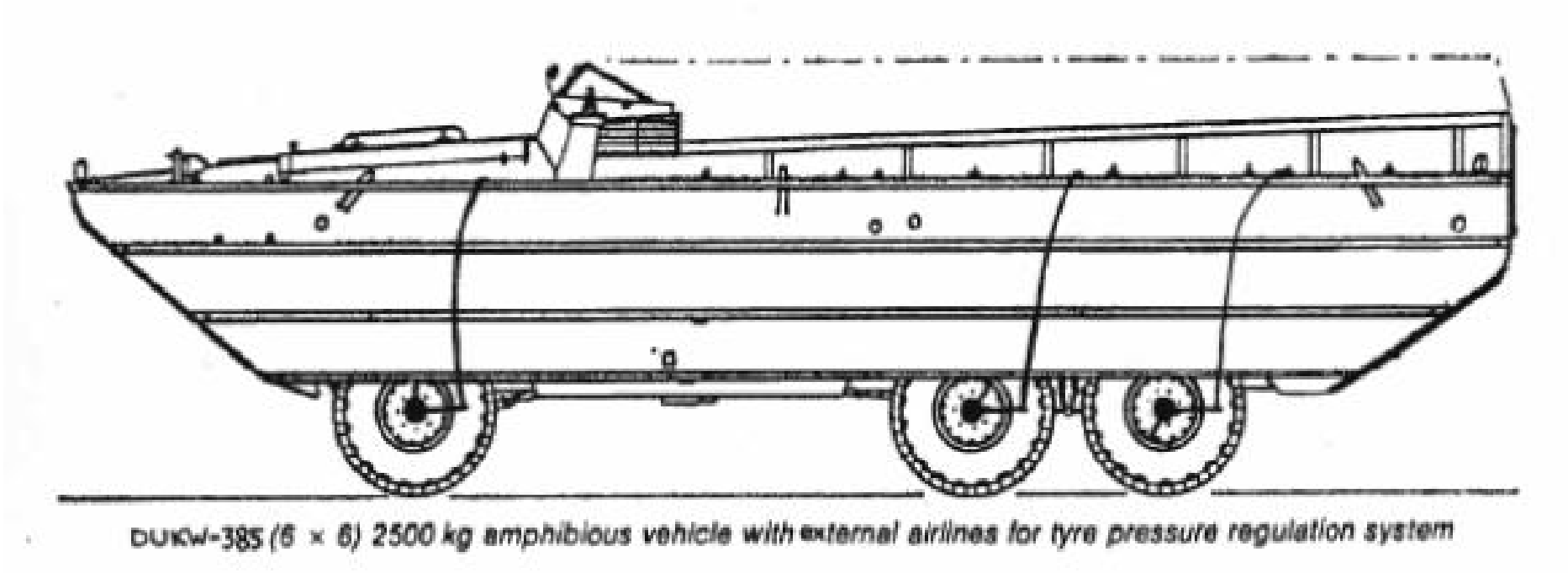
Basic idea of CTIS/TPCS

CTIS = Central Tyre Inflation System

TPCS = Tyre Pressure Control System

Historical development

- 1942 US amphibious landing craft

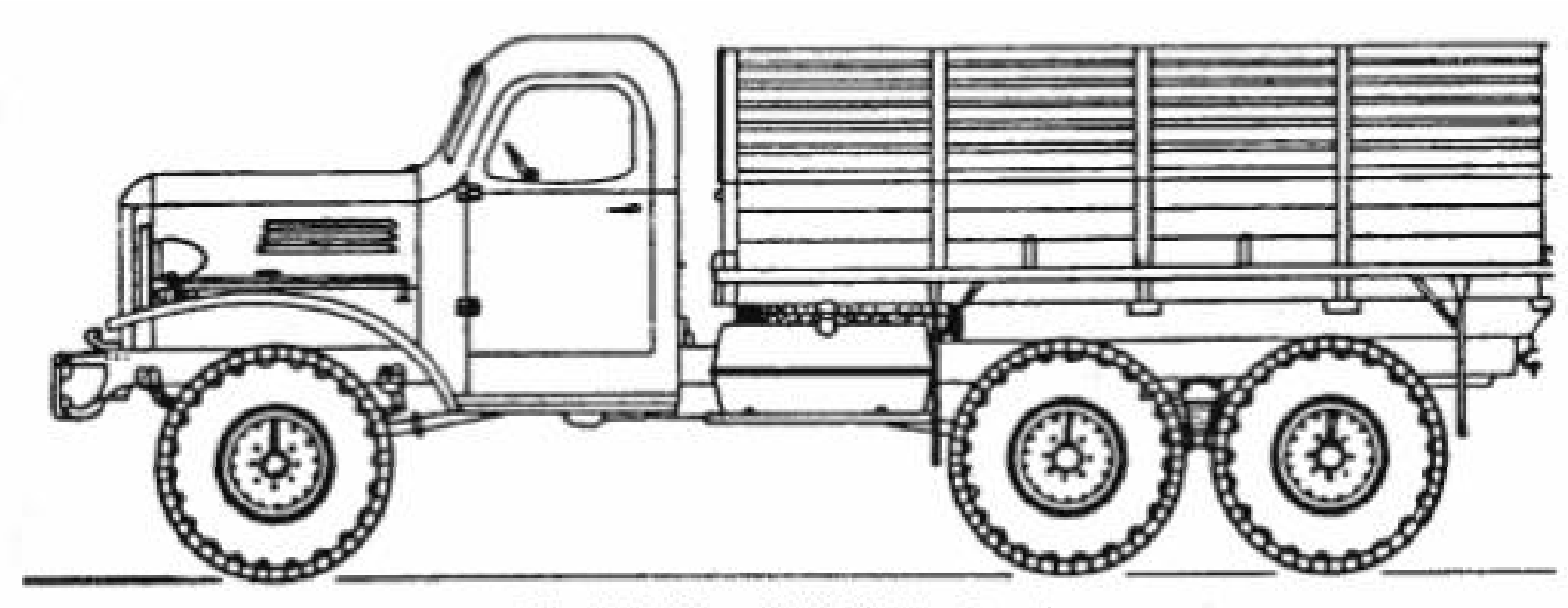


DUKW-385 (6 × 6) 2500 kg amphibious vehicle with external airlines for tyre pressure regulation system

Material borrowed from Allan Bradley, FPInnovations FERIC, Canada

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

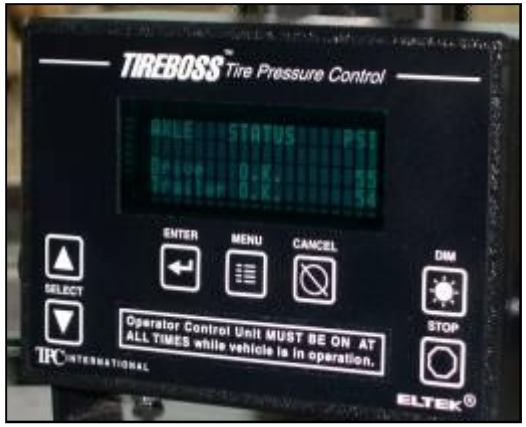
Historical development

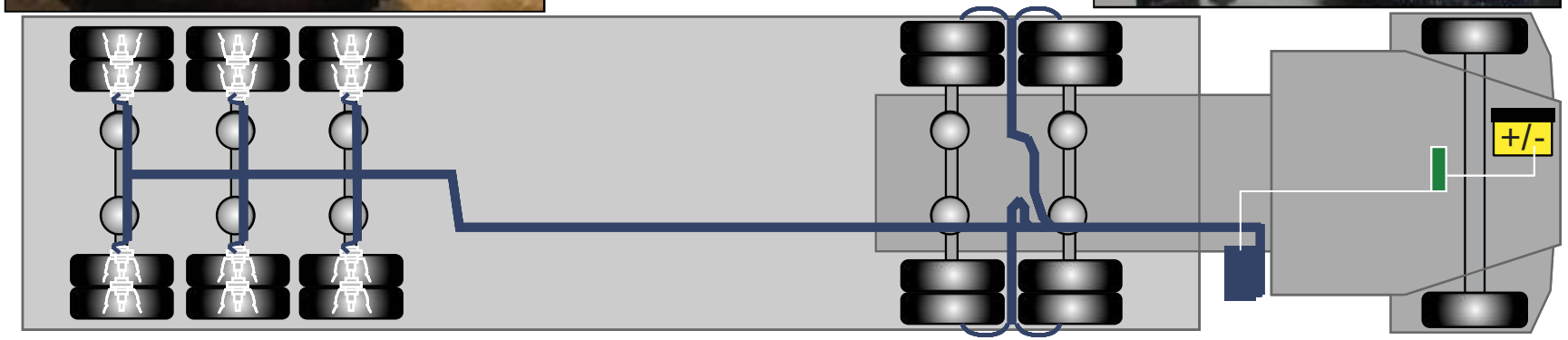
- Widespread adoption by US and western European militaries in 1990s;
- By 1990, 30+ types of CTI used around world

- In 1982, USFS began CTI research program; applied to various forestry vehicles
- In 1993, first two TPCS for commercial trucks

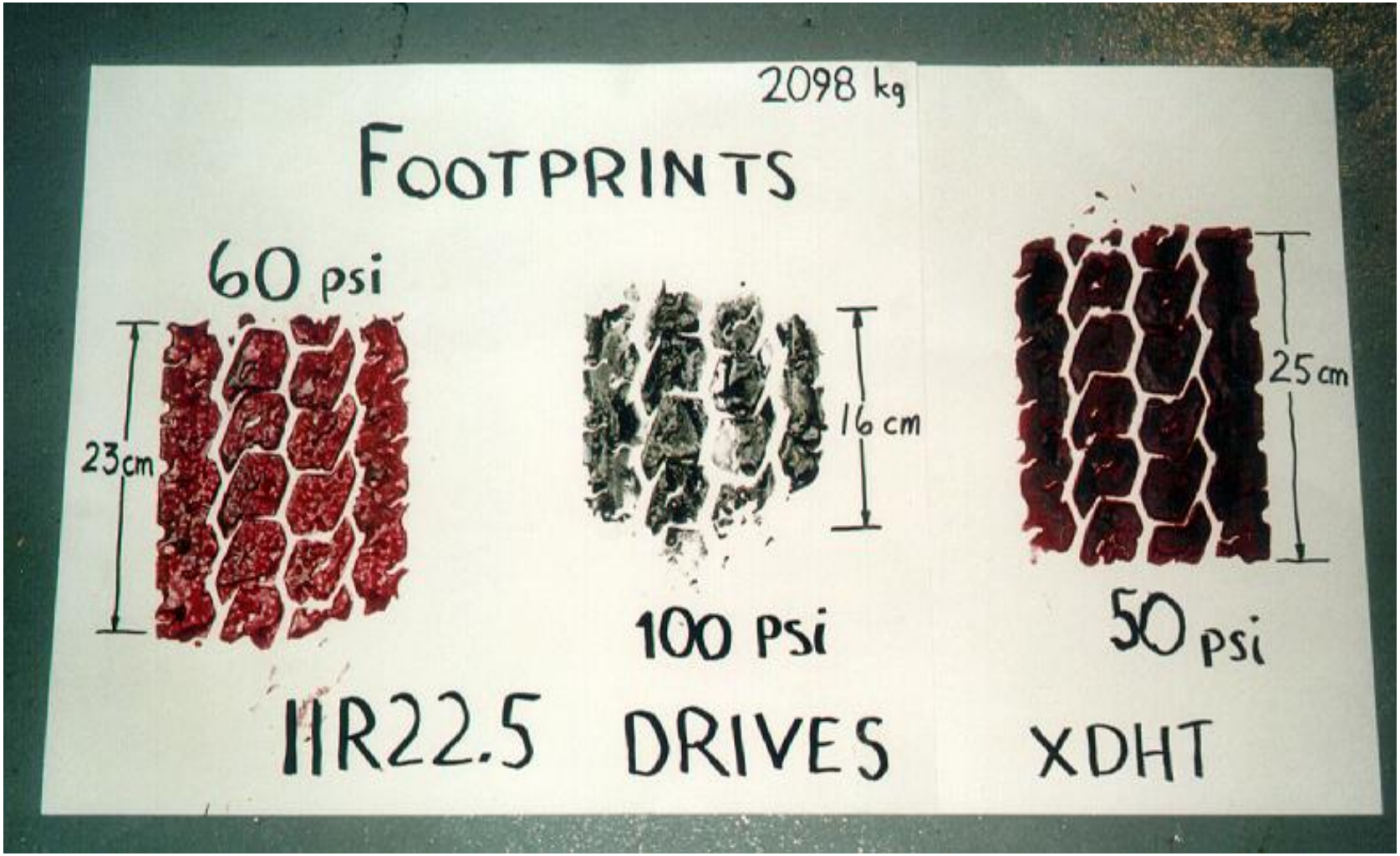
Material borrowed from Allan Bradley, FPInnovations FERIC, Canada

TPCS components



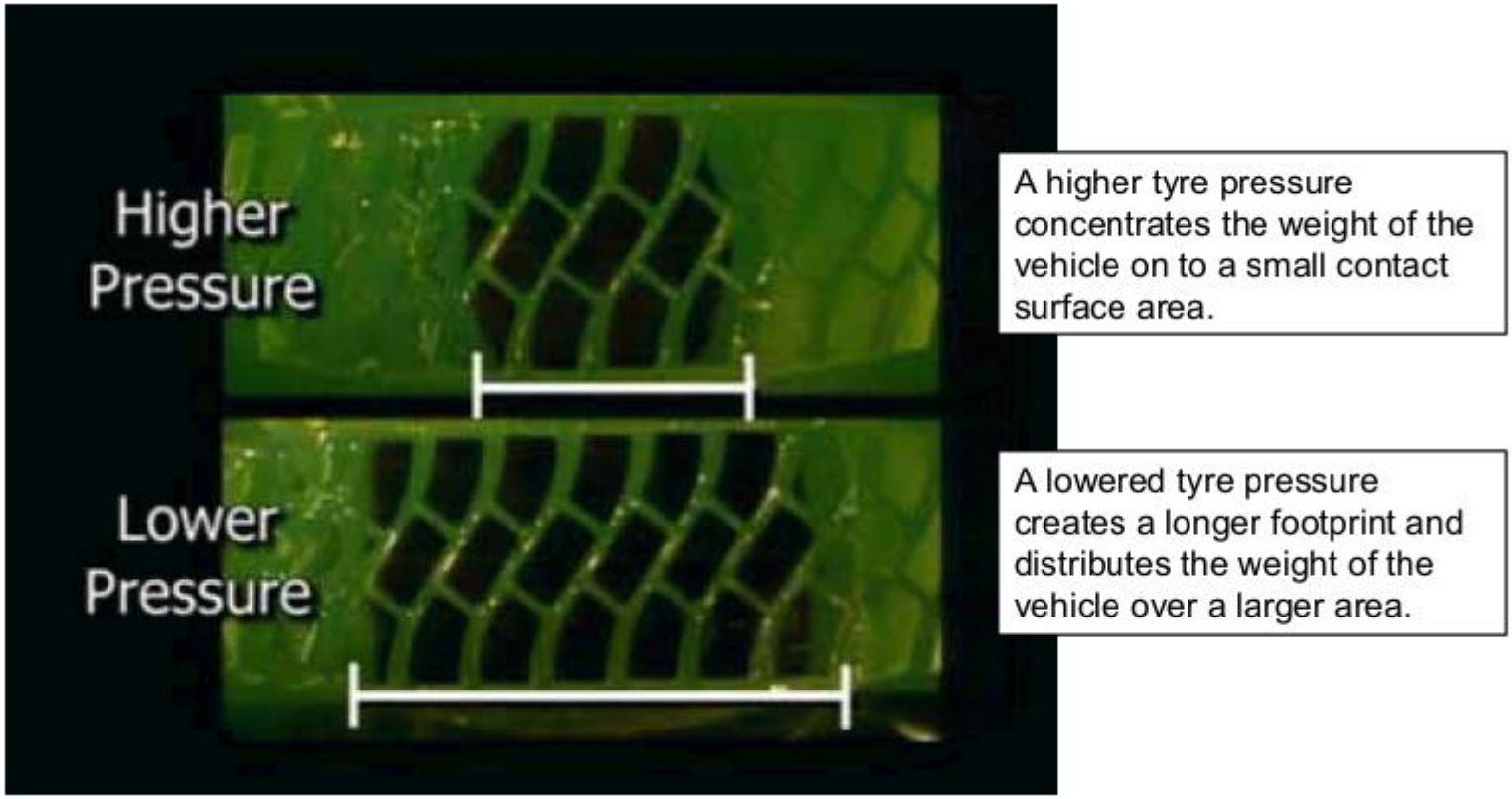


Effect of TPC on wheel/road contact



Material borrowed from Allan Bradley, FPInnovations FERIC, Canada

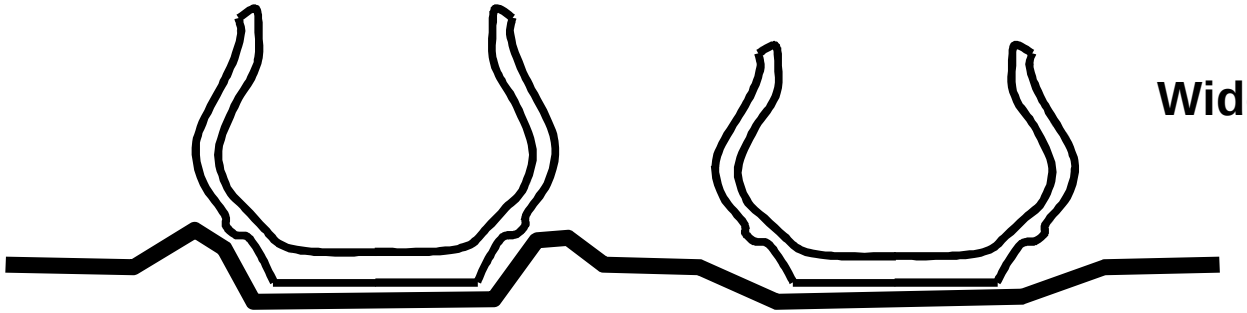
Effect of TPC on wheel/road contact



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

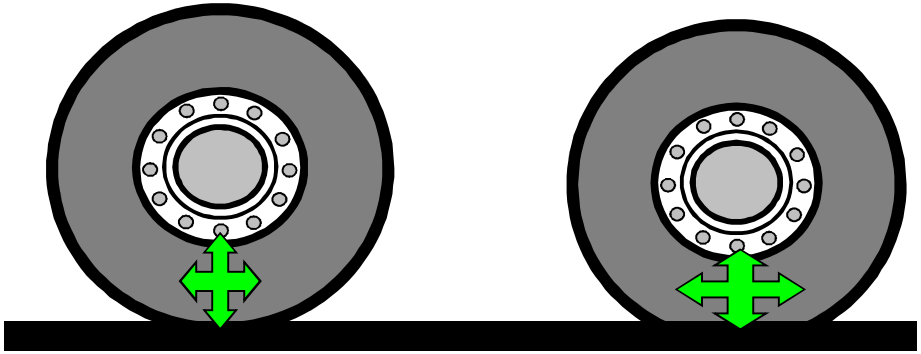
Effect of TPC on wheel/road contact

Rut shape



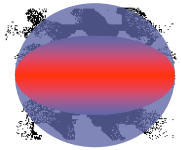
Wider, shallower rut

Stiffness and spring rate

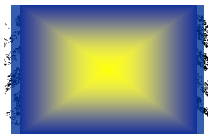


Less impact energy

Contact area



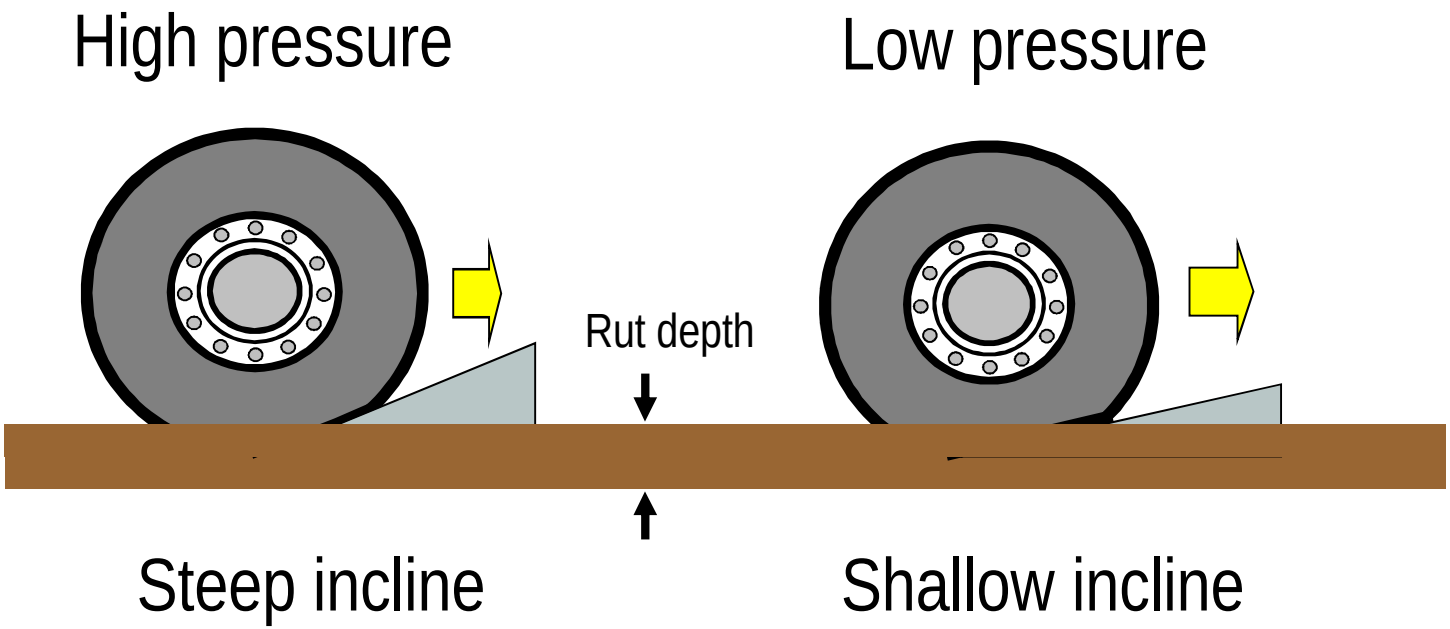
Contact stress distribution



Lighter footprint, more tread

Material borrowed from Allan Bradley, FPInnovations FERIC, Canada

Effect of TPC on wheel/road contact



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

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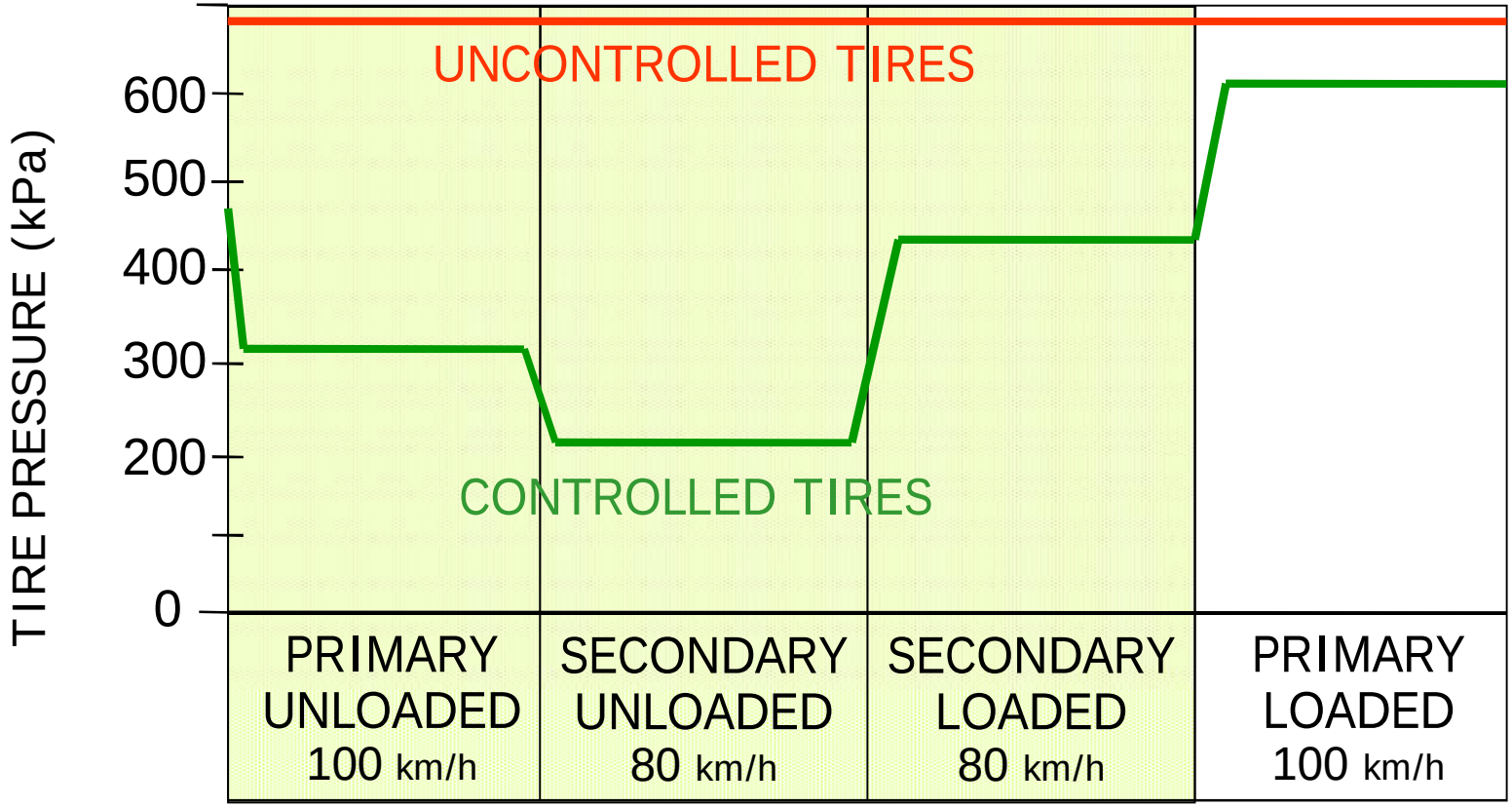
Principle in the use of TPCS

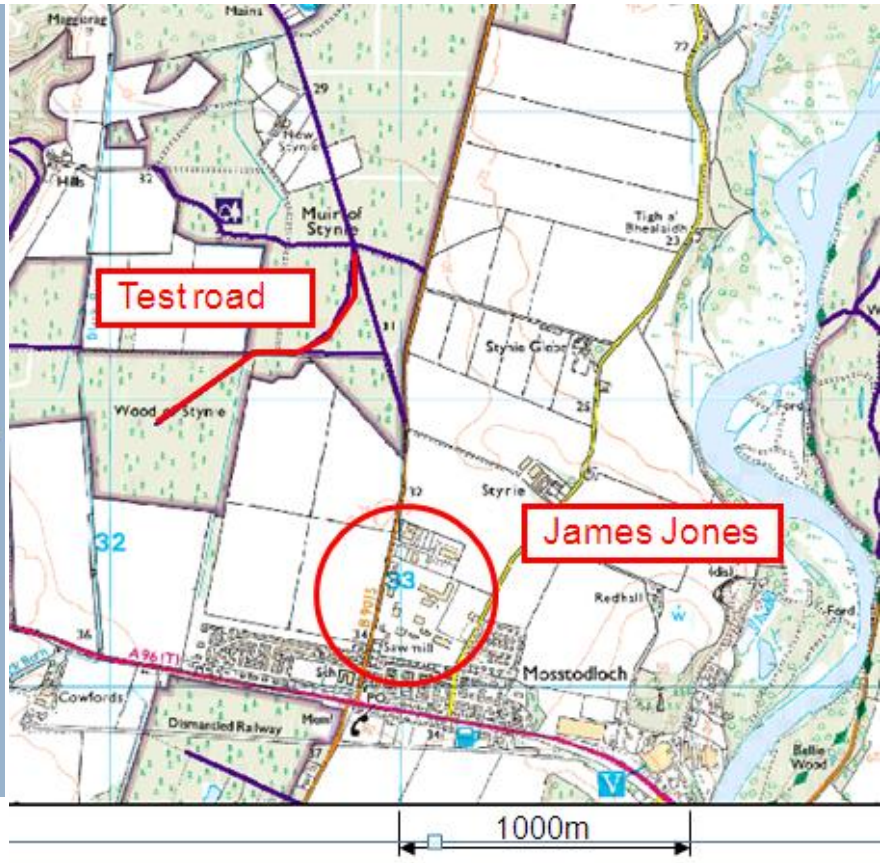


Uncontrolled tires are over-inflated for 75% of the trip

→ less tyre wear with the use of TPC

Material borrowed from Allan Bradley, FPInnovations FERIC, Canada

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



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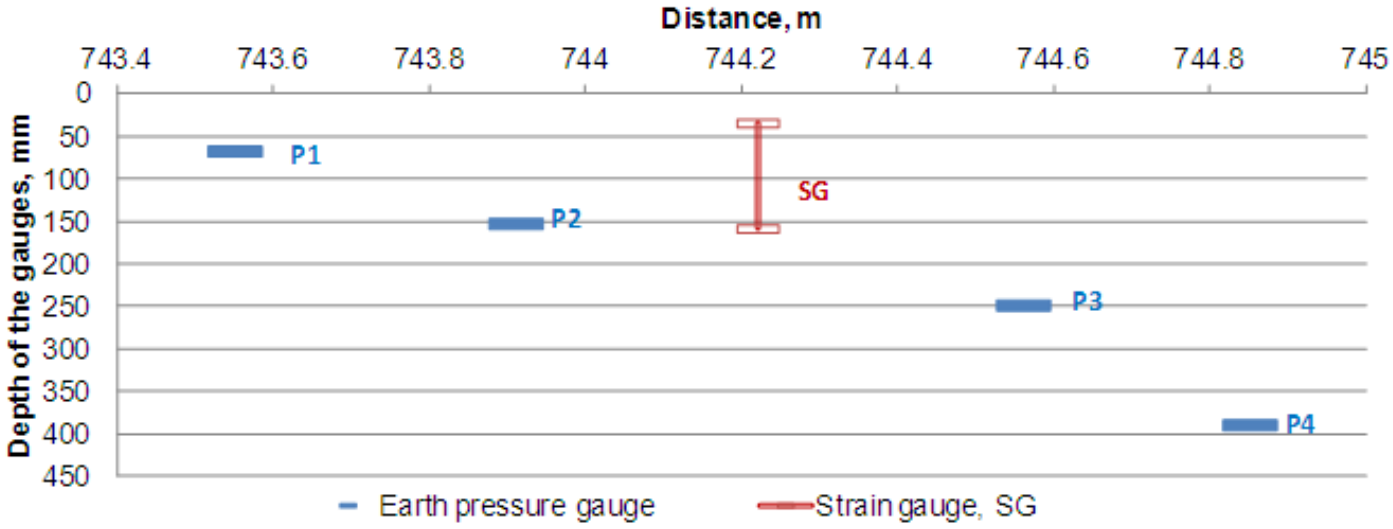
Installation of the earth pressure gauges



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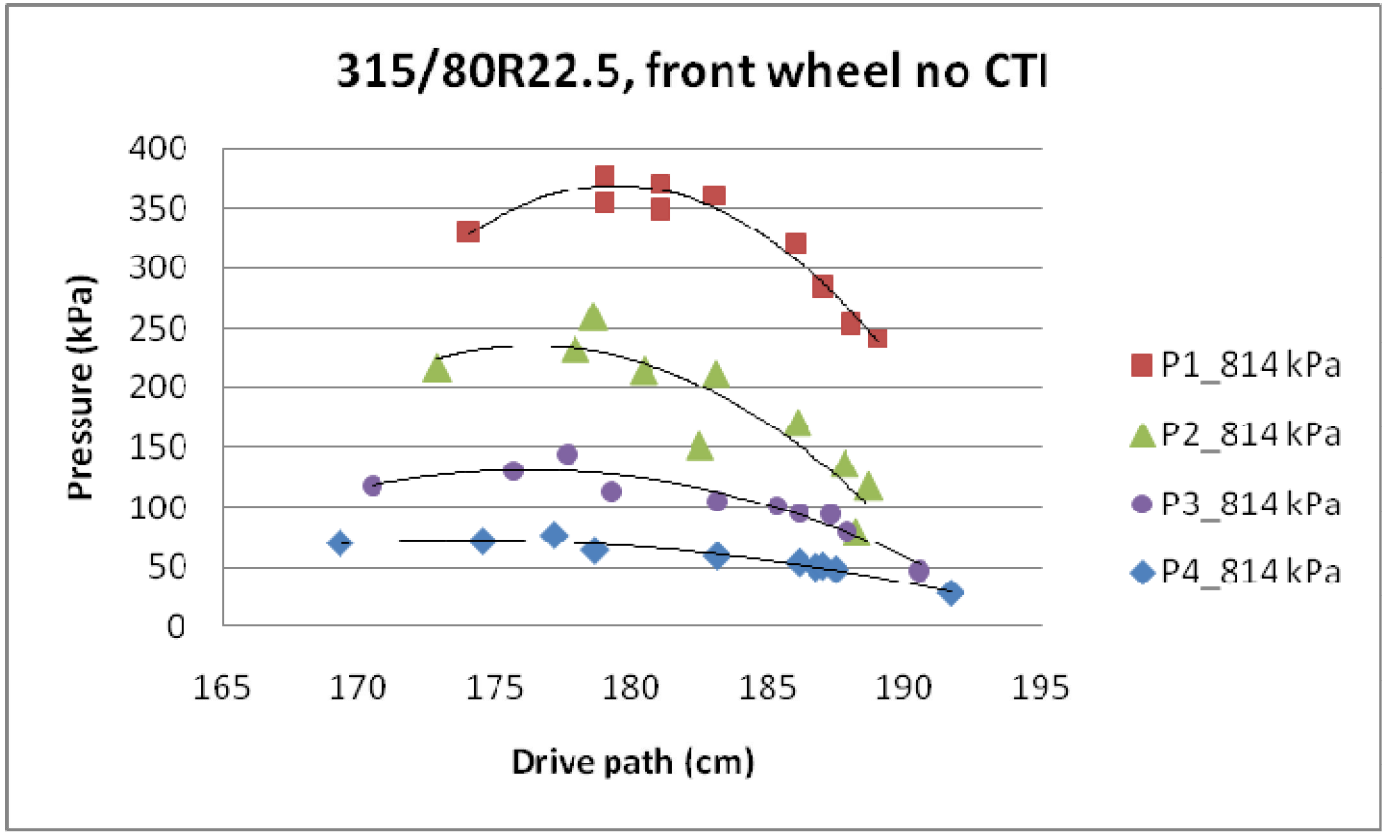
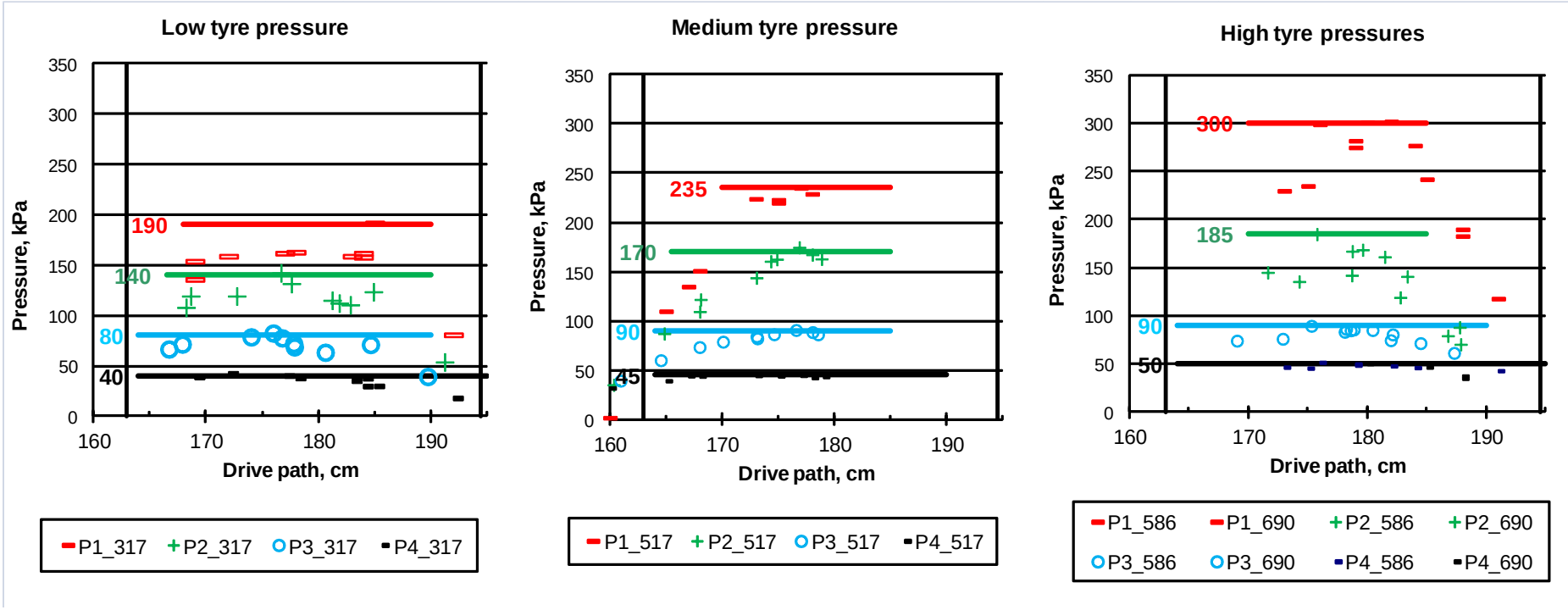
Pressure distribution at full tyre pressure under the front wheel



Pressure distribution as a function of depth as expected.

Effect of tyre inflation pressure on road stresses



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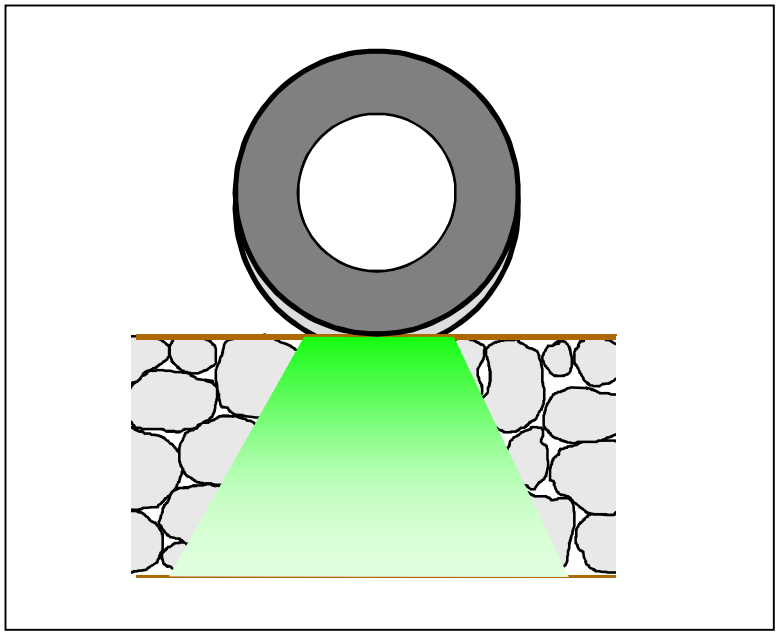
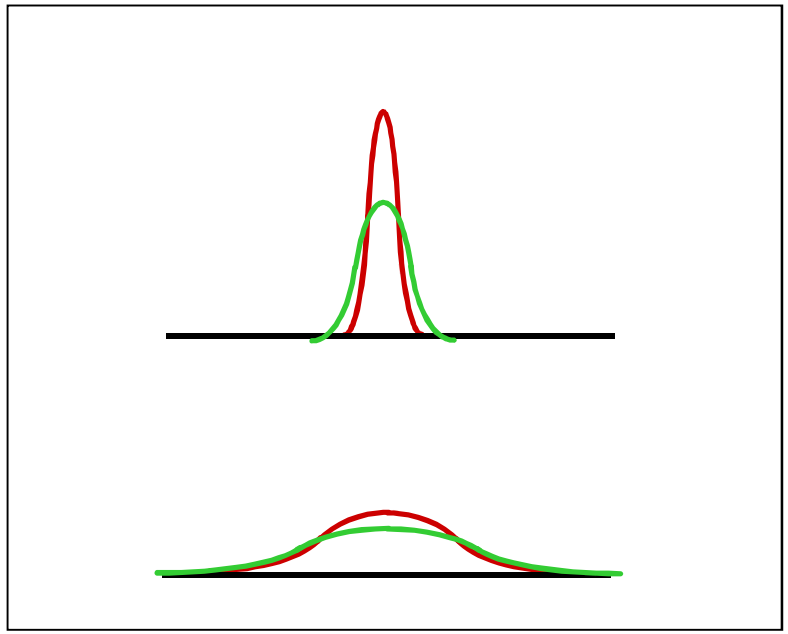
Effect of TPC on road stresses





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

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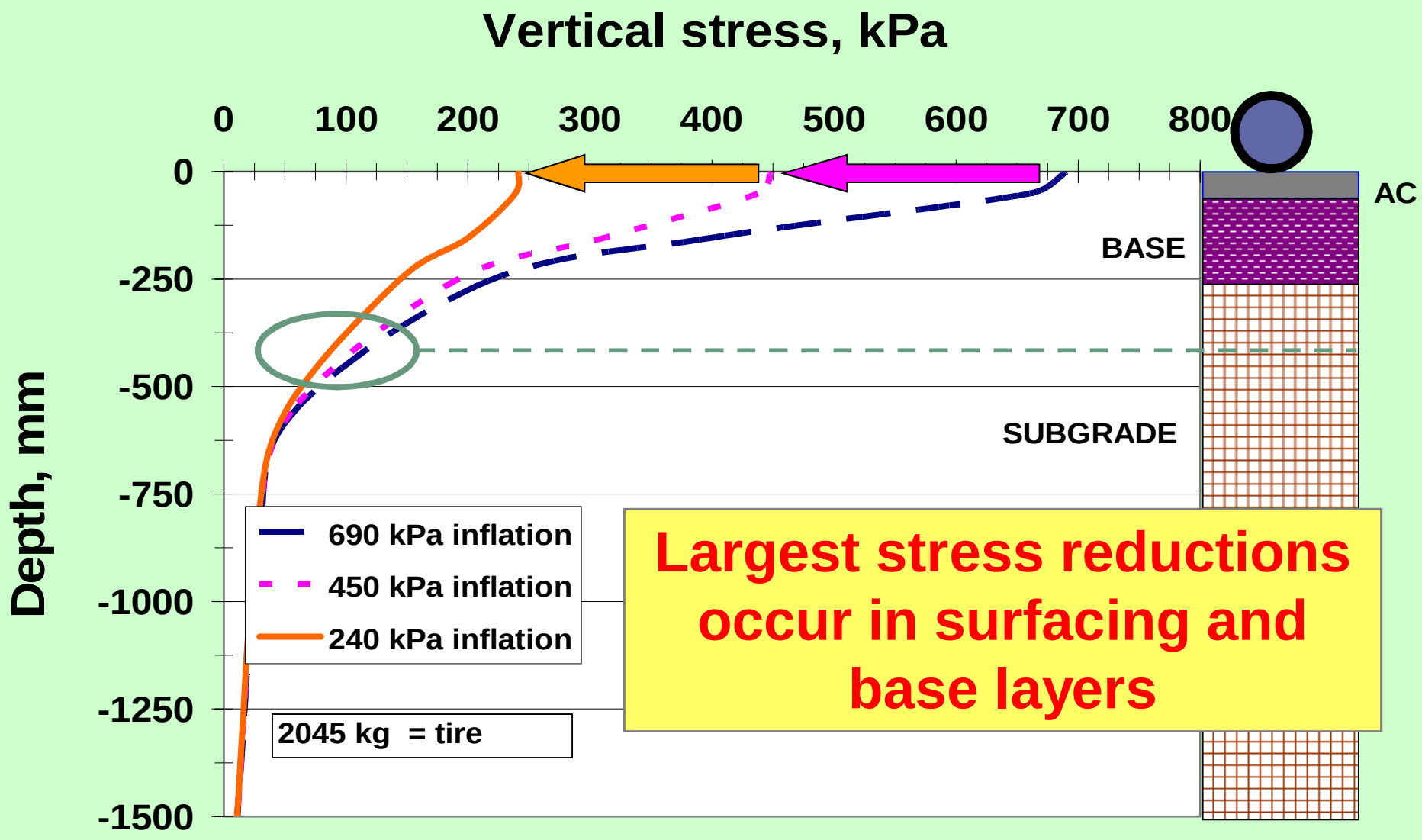
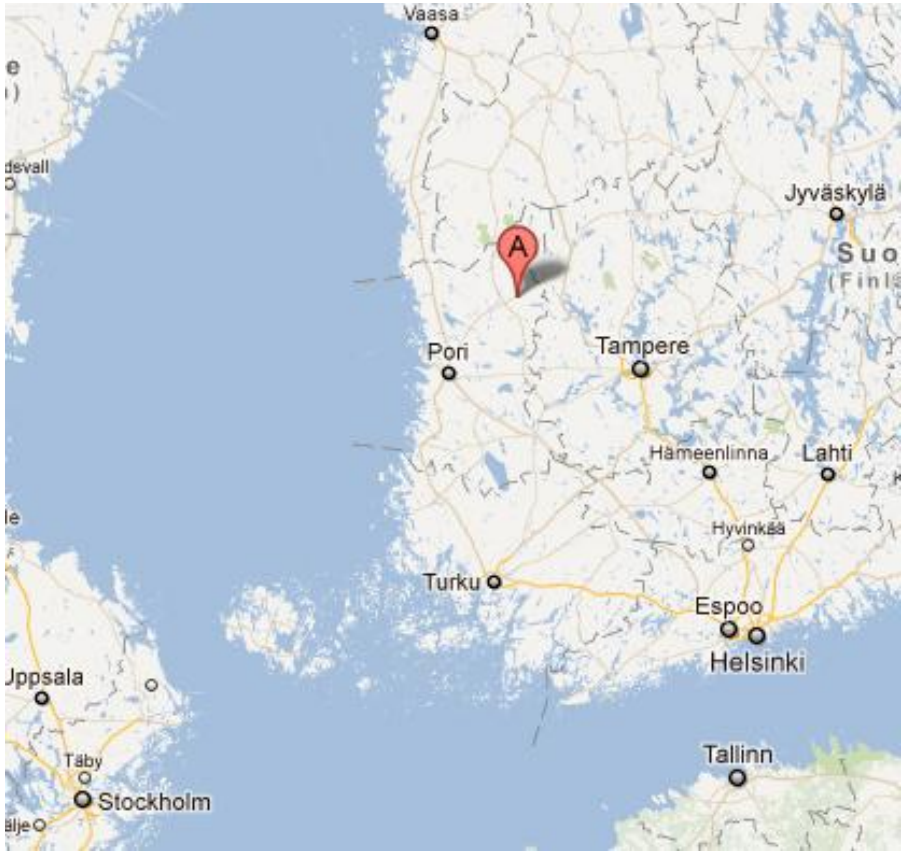
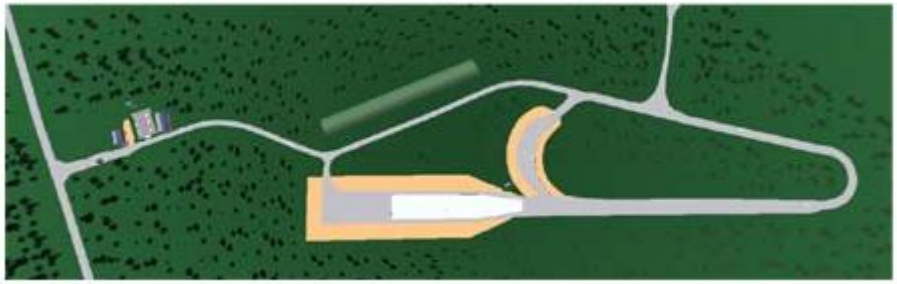
Calculated effect of lowered tyre pressure



Material borrowed from Allan Bradley, FPInnovations FERIC, Canada

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





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Effect of TPC on traction/mobility
Field trial at Niinisalo, October 2011

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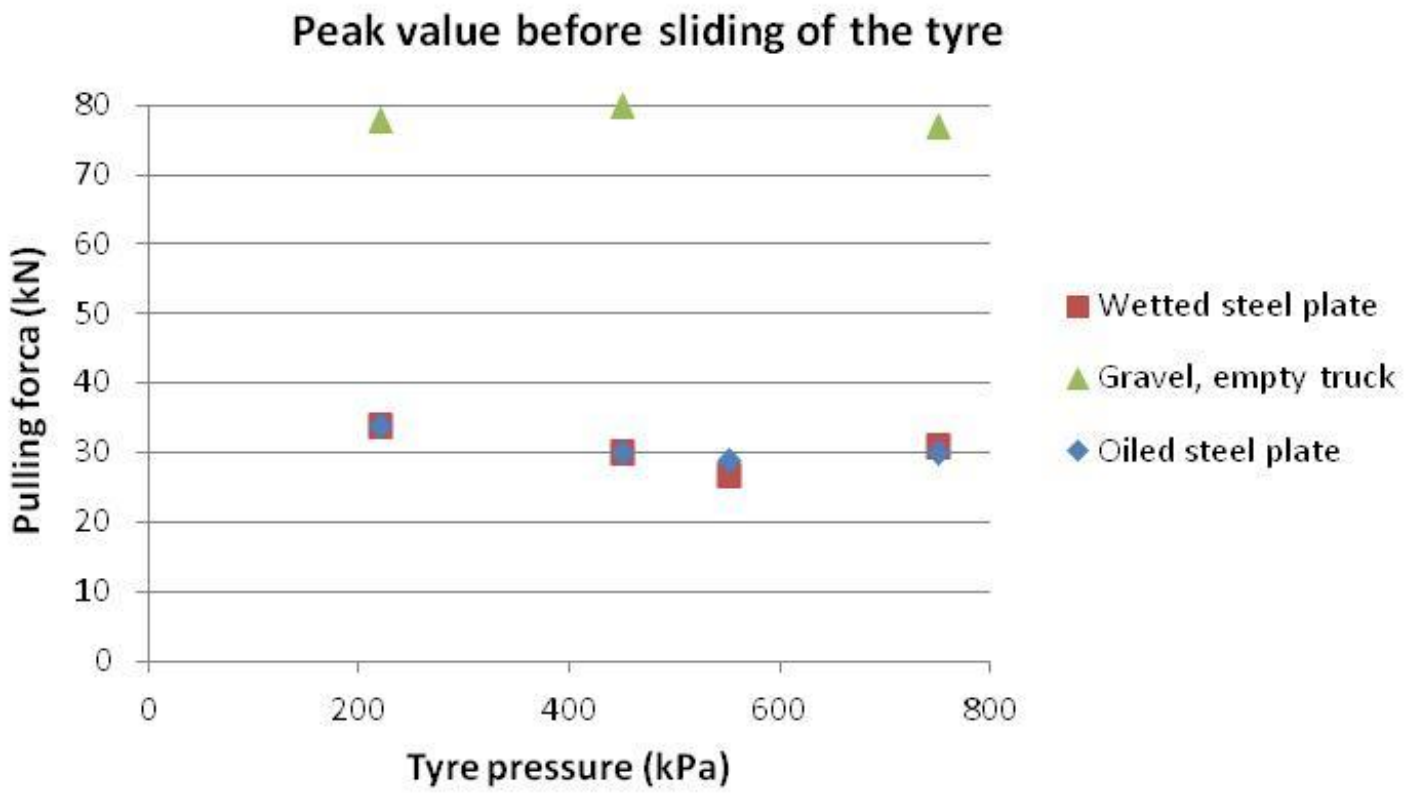

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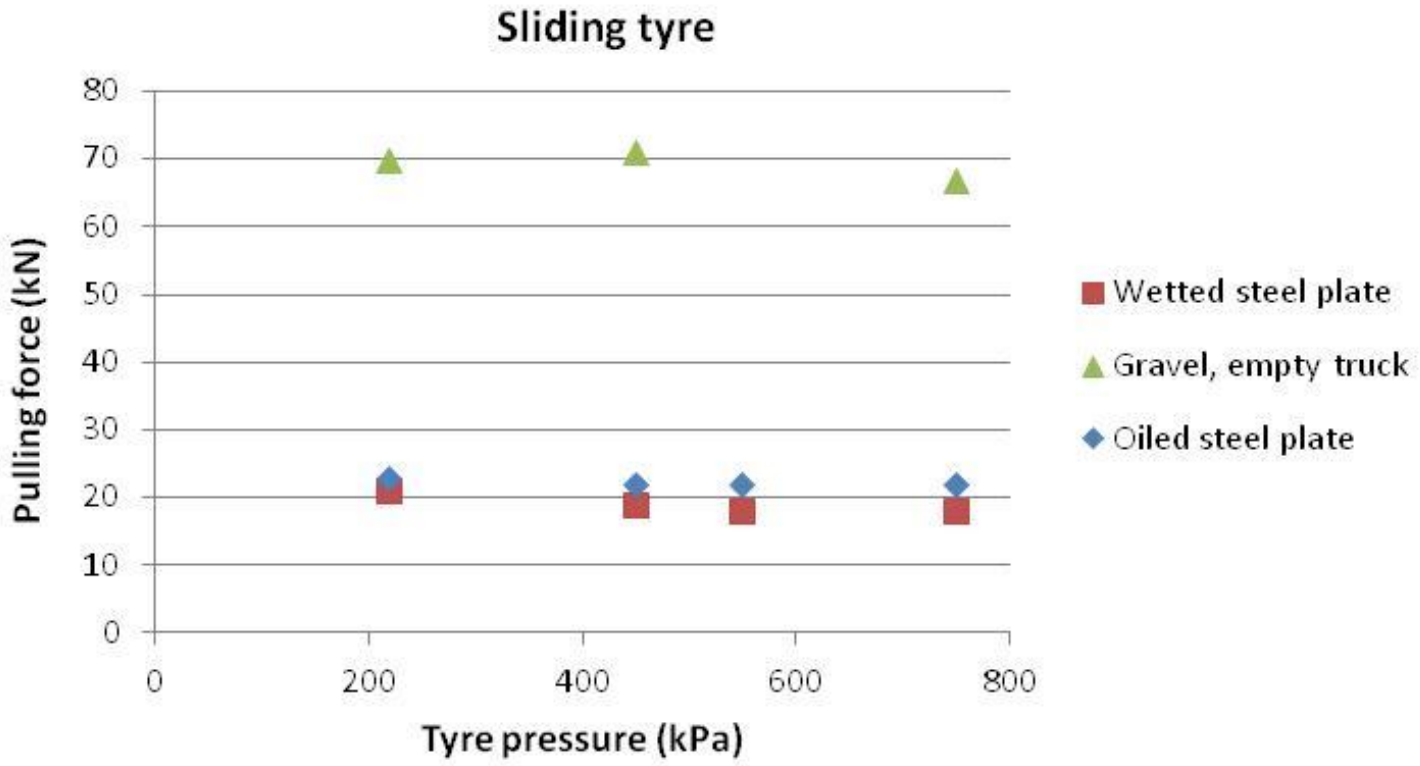
Effect of TPC on traction/mobility Field trial at Niinisalo, October 2011



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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*

Material borrowed from Allan Bradley, FPInnovations FERIC, Canada

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

Uphill profile at the Nokian Tyres test site:

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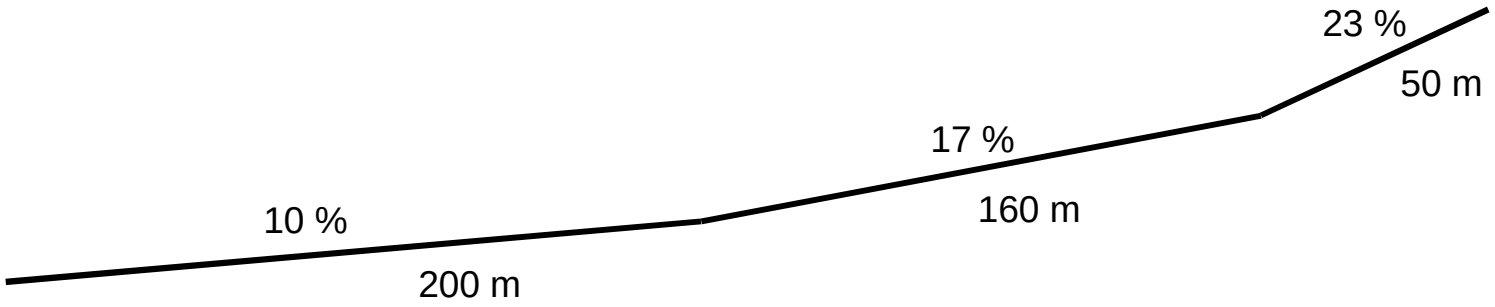

Tyre inflation pressures (kPa)	Climbing distanace (m)
Full pressure in all tyres	370
'Medium' /350 kPa in driving wheels	380
Low / 220 kPa in driving wheels	379 - 380

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

A heap of show in front of the trailer wheels in the low pressure drive.

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 ?


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