TYROSAFE

WP4: Environmental effects and impact of climate change

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Session 2: Overview

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Work Package 4 – Overview

- Environment effects and climate change
  - Environmental implications of optimising skid resistance
    - Establish the importance of the various factors involved
    - Establish current state of knowledge
  - Identify areas for future research on environmental effects
  - Consider potential impact of climate change

Work Package 4 – Overview

- Started in June 2009; runs for 12 months
  - Using information from the other WPs
  - Literature searches
  - Contributions from relevant experts

WP4 - Deliverables

- D12 *(due February 2010)*

  Report on future research areas for environmental effects

- D16 *(due May 2010)*

  Report on possible impact of climate change on road surfaces and tyres

Work Package 4 – Overview

- Two main strands:
  - The influence that the provision of harmonised/optimised skid resistance could have on the environment
  - The effect of climate change on skid resistance

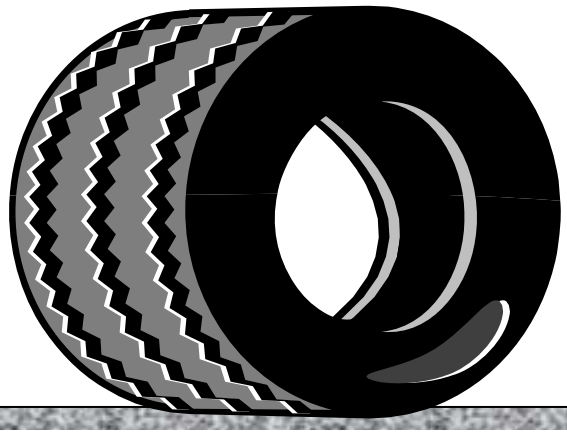
Scope of the review- Strand 1

Environmental conditions

Tyre characteristics

Future socio-economic developments

Vehicle characteristics



Driving behaviour

Pavement characteristics

Road geometry and topology

Tyre / surface interaction

Skid resistance
Rolling resistance
Noise emissions
Particulates

Scope of the review- Strand 2

Climate Change Impacts

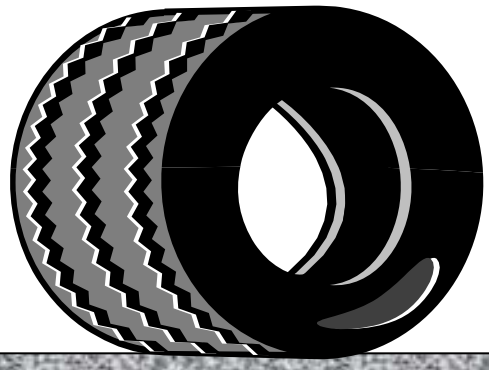
Direct impacts - changes in climate variables

Indirect impacts – mitigation and adaptation actions

Tyre characteristics

Vehicle characteristics

Driving behaviour



Pavement characteristics

Measurement

Winter service

Tyre / surface interaction

Skid resistance
Rolling resistance
Noise emissions
Particulates

Strand 1: Environmental impacts (1)

Skid resistance policies and tyres/pavement design can influence environmental impacts:

Tyre/surface noise → Vehicle noise emissions

Rolling resistance → GHG and local air quality

Tyre and road we → PM_{10}, water and soil pollution

Strand 1: Environmental impacts (1)

De-icers → Vegetation damage and water pollution

Retexturing → Particulates

Measurement → Water use

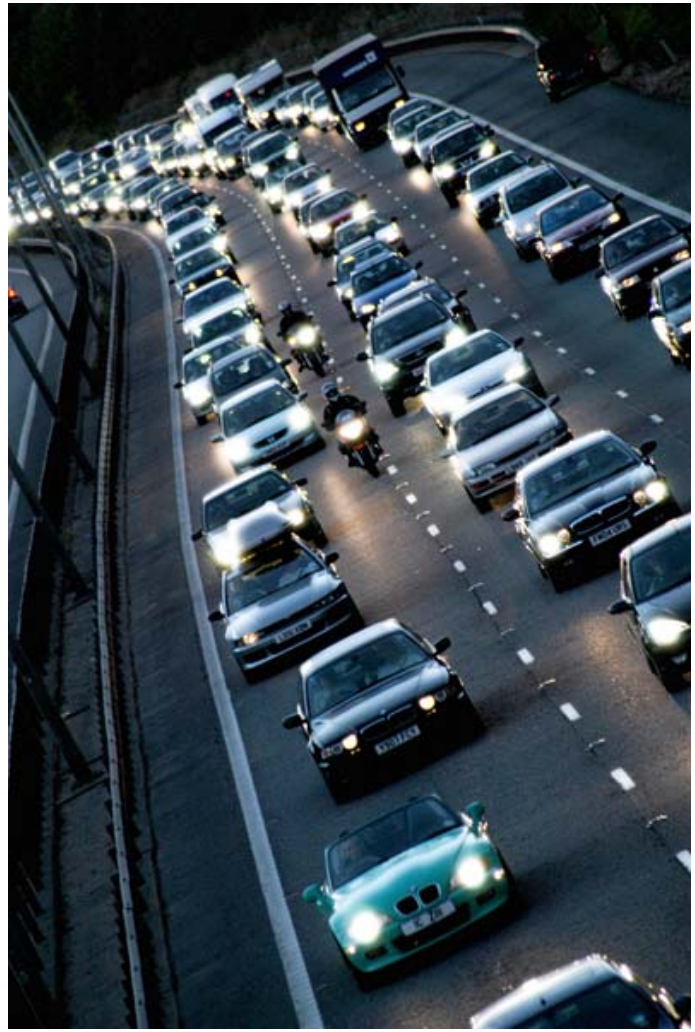
Environmental impacts (2)

- Life Cycle Analysis
  - Need to consider the whole life cycle of a process when determining environmental effects

Life Cycle Analysis

ROAD SURFACINGS

- Raw materials
- Transportation
- Production of mix
- Laying of the asphalt
- Use
- Maintenance



Life Cycle Analysis

TYRES

- Raw materials – rubber, steel, textiles, water, energy
- Manufacturing process – VOCs, PAHs, smell, noise, waste
- Transportation – GHG, NO_X, HCs, PM_{10}
- Use – fuel consumption and particulates
- Disposal – recycle, retreading, energy recovery

Effect of harmonisation/optimisation

- May increase skid resistance requirements in some countries
  - Increased use of polish resistant aggregates
    - Effects of quarrying and production
    - Emissions from transportation
    - Increased tyre wear ➔ particle emissions
    - Increased rolling resistance ➔ fuel consumption and GHG and other exhaust emissions
    - Reduced maintenance?
  - Increased texture depth
    - Increase in noise

Effect of harmonisation/optimisation

- Must balance need for safety (i.e. appropriate levels of skid resistance) with desire for low noise and rolling resistance
- Changes to road or tyre properties to maximise one parameter may have adverse effects on the others (TYROSAFE WP3)
- Similarly, changes to reduce one environmental effect may have consequences elsewhere

WP4 – Strand 2: Climate change

- The effect of climate change on skid resistance
  - Likely scenarios for temperature, rainfall patterns, etc
  - How skidding risk may change
  - How to address changes – material specifications
    - Texture depth
    - Drainage
  - Impact on harmonised/optimised skid resistance
    - Including measurement techniques/survey strategies
    - Will surface characteristics change over time.
      - In different ways?
      - Or on different timescales?

Strand 2: Climate Change

Temperature

- Increase in average annual temperature
- Largest increases in winter in northern Europe and in the summer in the south
- Increase in maximum summer temperatures (heatwaves)

Strand 2: Climate Change

Precipitation

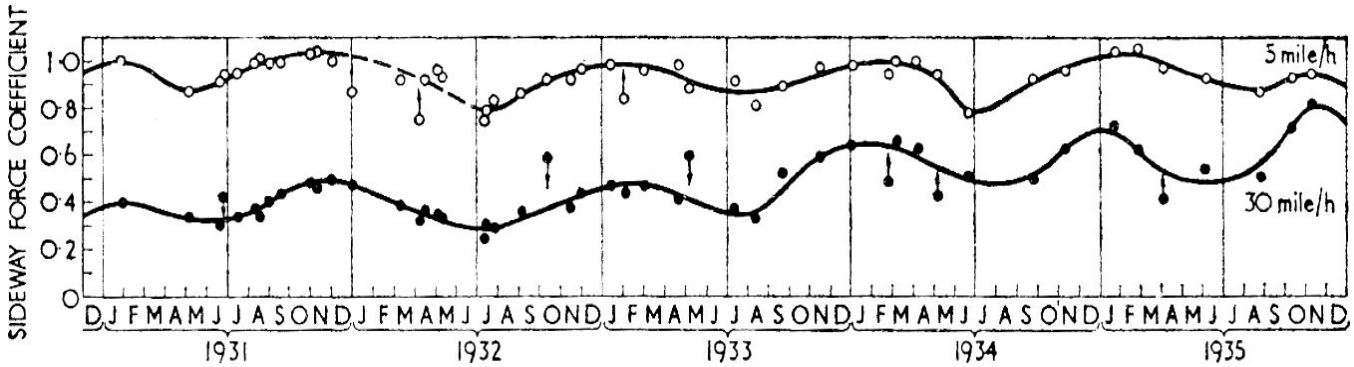
- Annual precipitation very likely to increase in northern Europe and decrease in the Mediterranean area
- In central Europe, precipitation is likely to increase in winter but decrease in summer
- Summer precipitation is likely to decrease in southern and central Europe
- Pattern of precipitation very likely to change with periods of intense rainfall (flash flooding) and periods of drought

Strand 2: Climate Change

Direct impacts of climate change

- Skid resistance identified as affected by climate change
  - High temperatures – fatting up, embedment
  - Drier summers – increased polishing

- Observations
  - Case studies
  - News reports
- UK HA study on changes in seasonal variation



Direct impacts of climate change

- Studies on temperature effects, e.g.
  - Skid resistance decreases with temperature (0.003/°C)
  - Noise decreases with temperature (-0.1dB(A) /°C dense, -0.06dB(A)/°C porous)
  - Rolling resistance decreases with temperature (1% per °C)
- Studies on wet surfaces, e.g.
  - Skid resistance decreases significantly in the wet
  - Tyre noise increases in the wet (0-15dB(A))
  - Wet surface increases rolling resistance (10% at 60km/h)
- Use studies like these to predict possible future effects

Indirect impacts of climate change

- Mitigation and adaptation actions and policies
  - Changes to vehicles – fuel, weight and technology
  - Changes to pavements – materials and mix, design, SUDS and hard shoulder running
  - Changes to tyres – composition and design, Tweel? Orange peel?
  - Changes to driver behaviour – user charging, modal shift and congestion

Identification of research areas

- Review has shown that much is already known about:
  - Environmental effects associated with road/tyre interaction
  - Potential impact of climate change on roads and tyres
- However knowledge gaps do exist that require further investigation…….

Identification of research areas

Theme 1

- Understanding the use of local aggregates
- Impact of changes to tyre composition and/or design
- Impact of changes to road materials and/or design
- Water use during skid resistance measurement
- Particulates from different tyres and road surfaces

Identification of research areas

Theme 2

- The effect of wet roads on rolling resistance
- Noise generation in the wet
- Build up of road dust in dry periods
- Changes due to electric vehicles
- Changes in the seasonal variation of skid resistance

Summary

- Factors identified in WP3 also change the environmental impact
- Theme 1- Environmental impacts resulting from tyre/surface interaction
  - Noise emissions
  - GHG emissions and air quality (rolling resistance)
  - Particulates (air, water (WFD), soil)
  - Need to consider actions take to improve SR
  - Need to consider LCA, e.g. source of aggregates

Summary

- Theme 2- Climate change impacts
  - Tyre and pavement properties change with temperature
  - Tyre/road interaction changes when wet
  - Seasonal changes
  - Changes to tyre materials and design
  - Changes to pavement materials and design
  - Changes to vehicles
  - Changes to user behaviour

Thank you!