Airport Pavement Working Group Meeting

Atlantic City, April 15-16-17, 2013

DGAC/STAC Research Update 2013

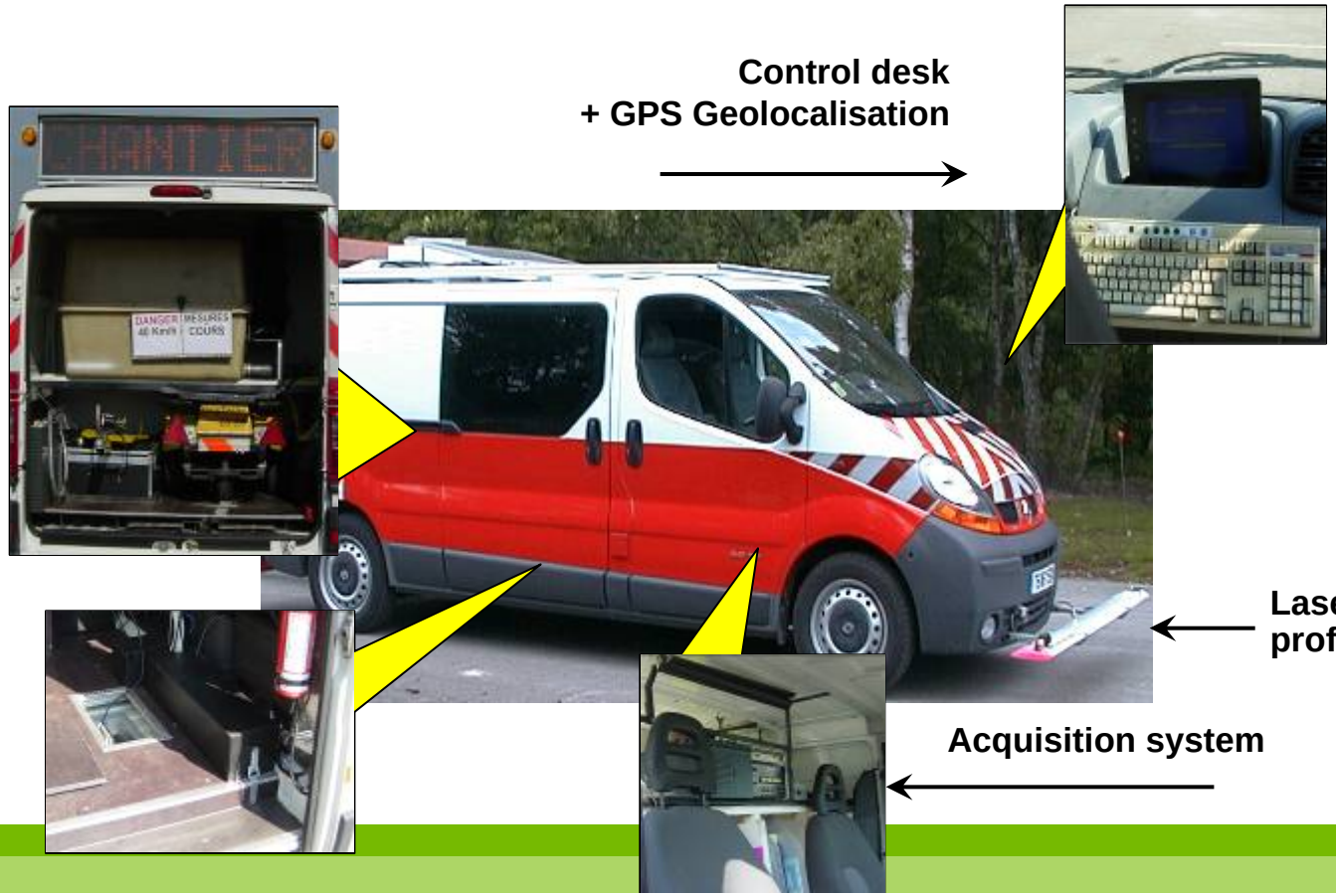
Modeling of Water Depth on Runway

Serge LE CUNFF

Service technique de l'aviation civile

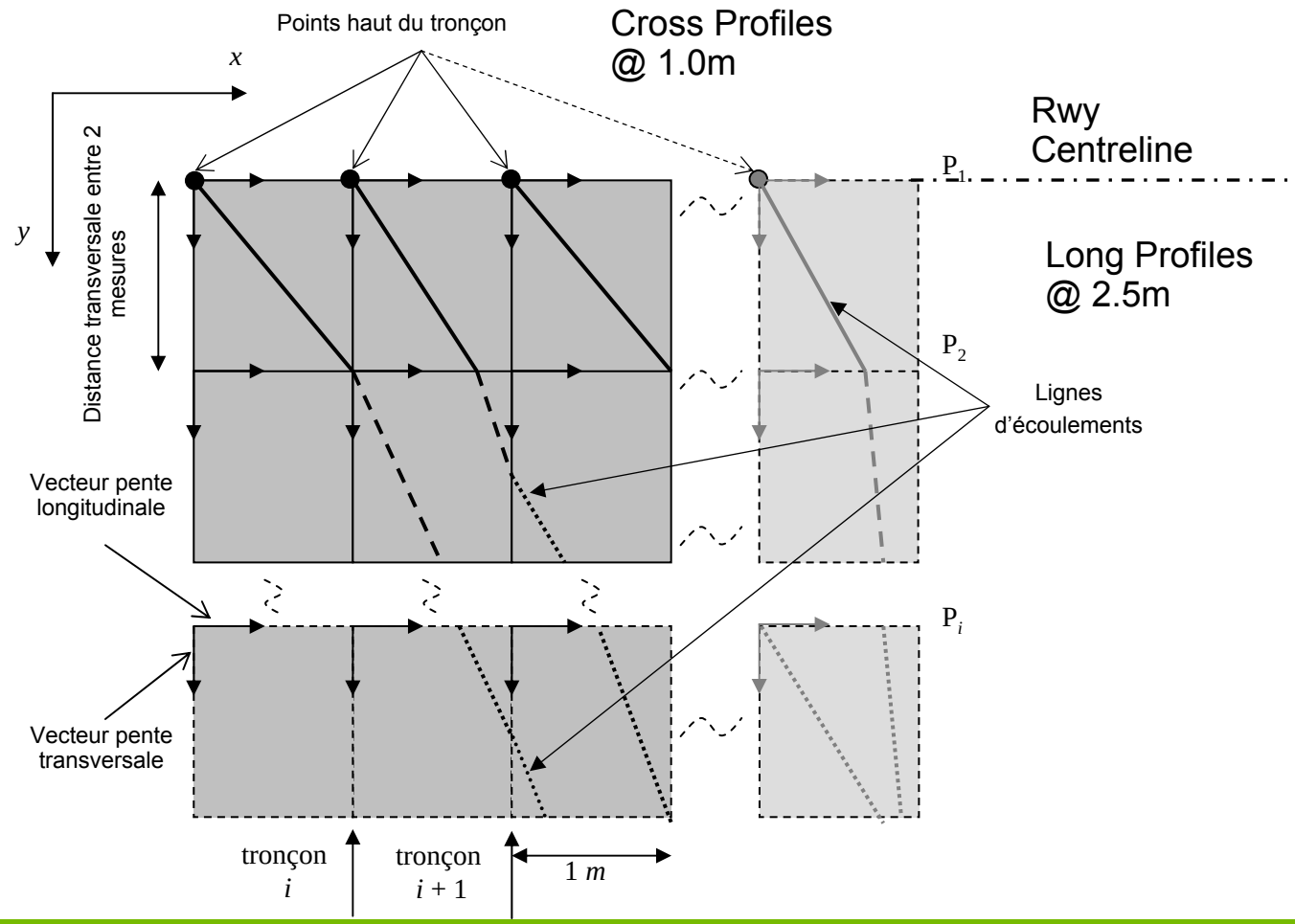
Modeling of water depth on runway

- Measurement of runway characteristics (Slopes, roughness, macro-texture, micro-friction)



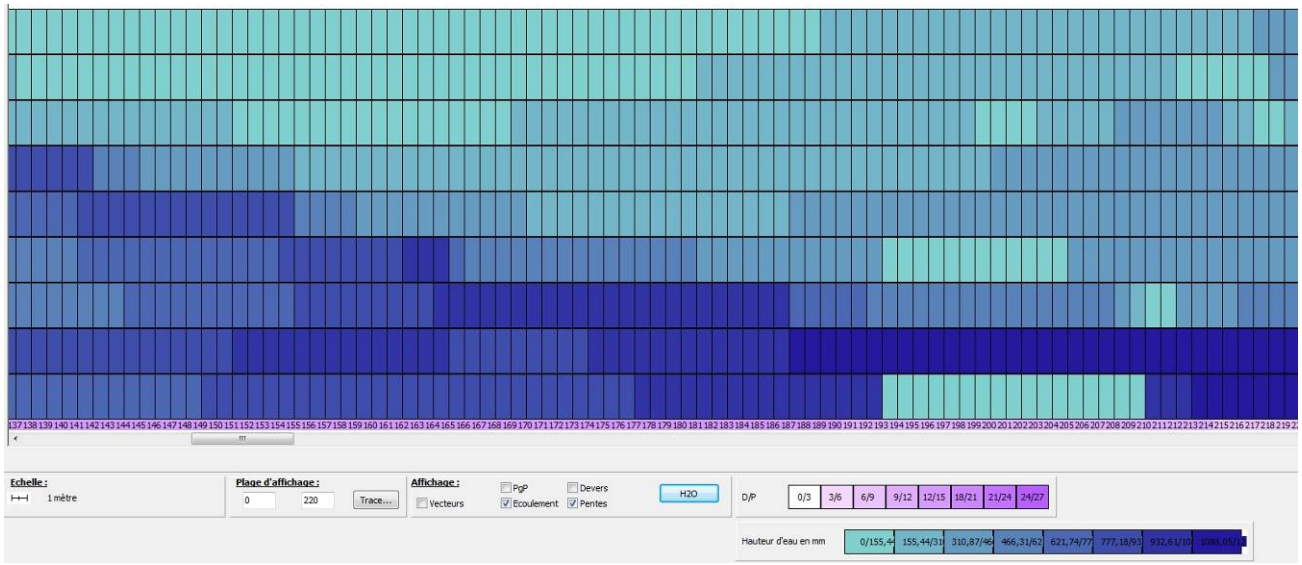
Modeling of water depth on runway

- DTM and modeling of water flow



Modeling of water depth on runway

- Modeling of water depth



- Site Validation

  (Vaisala sensors)

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Friction Measurement Variability Study

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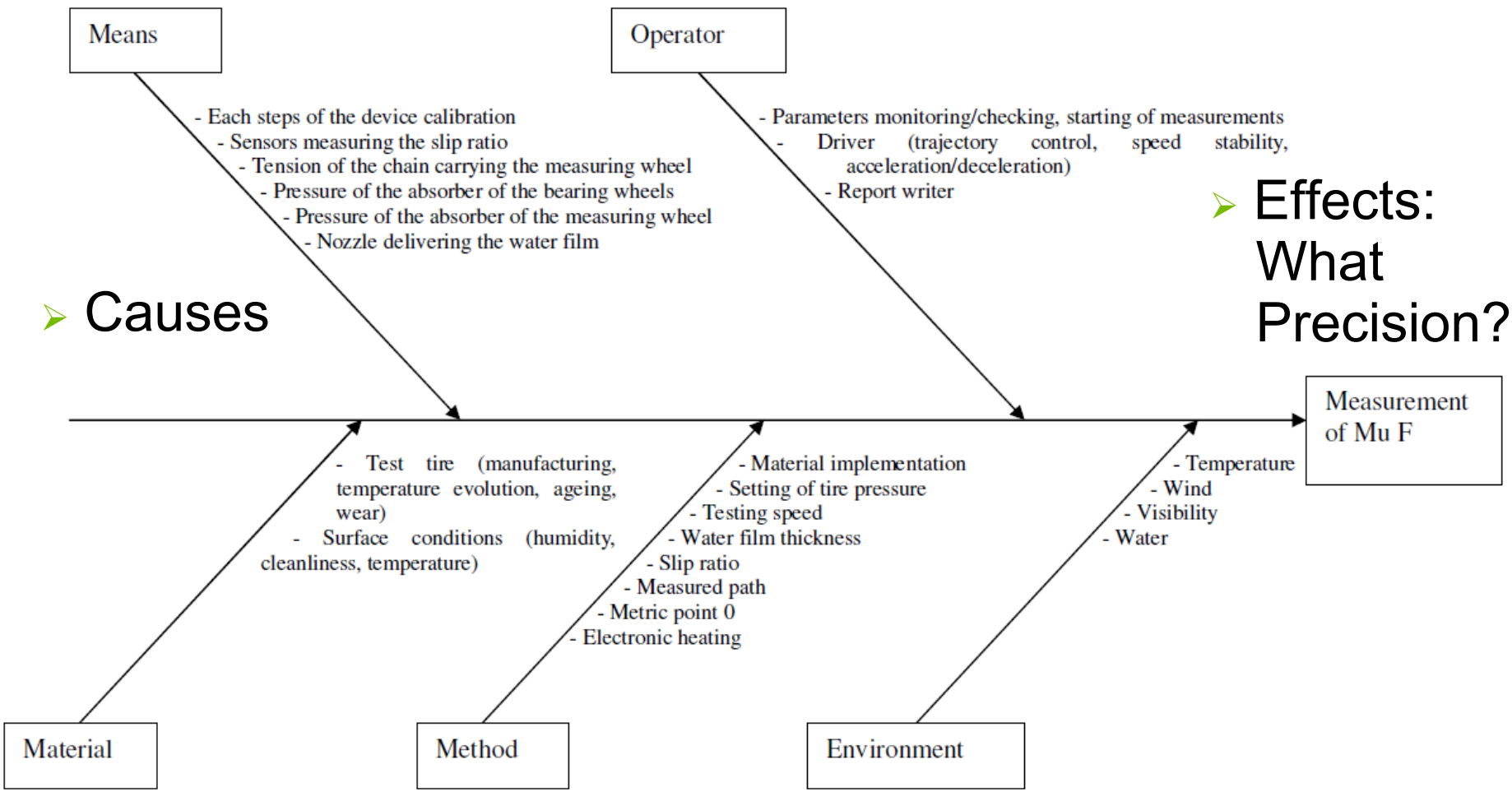
Variability Study

- Reliability of friction measurements with CFMEs?



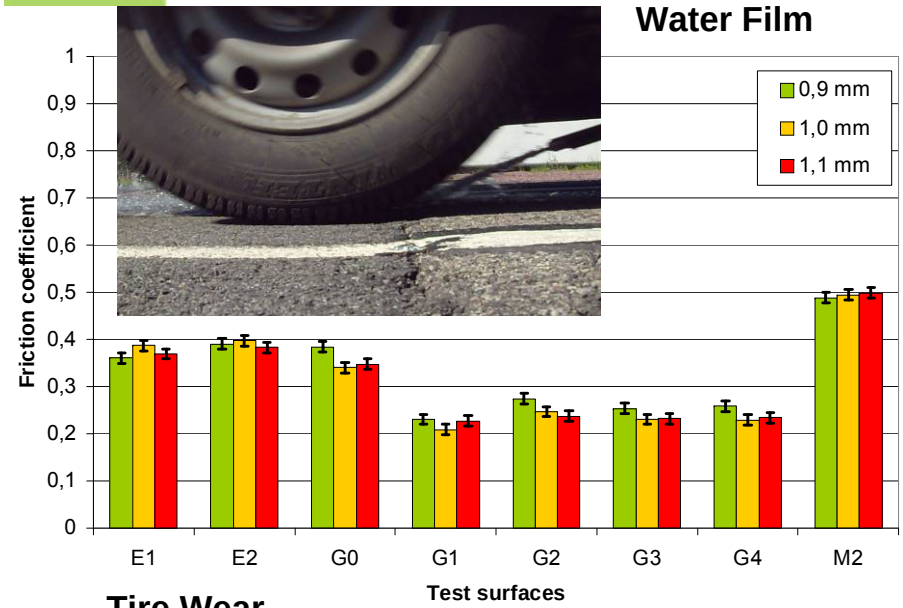
- Causes

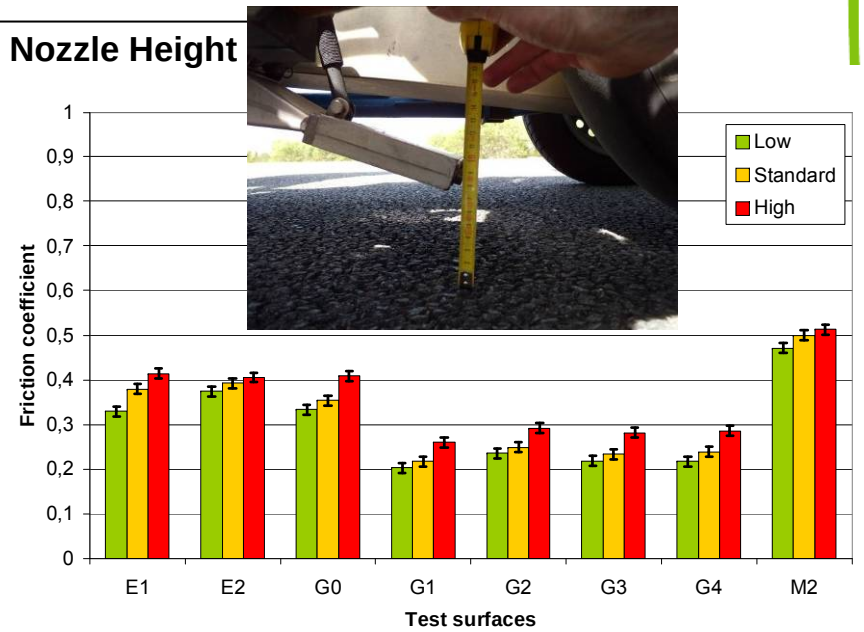
- Effects: What Precision?

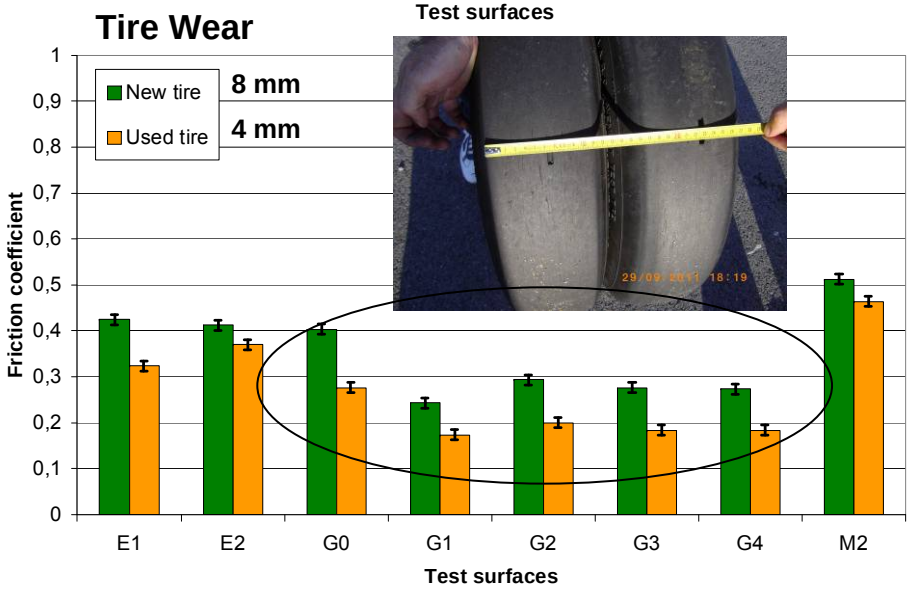
Variability study

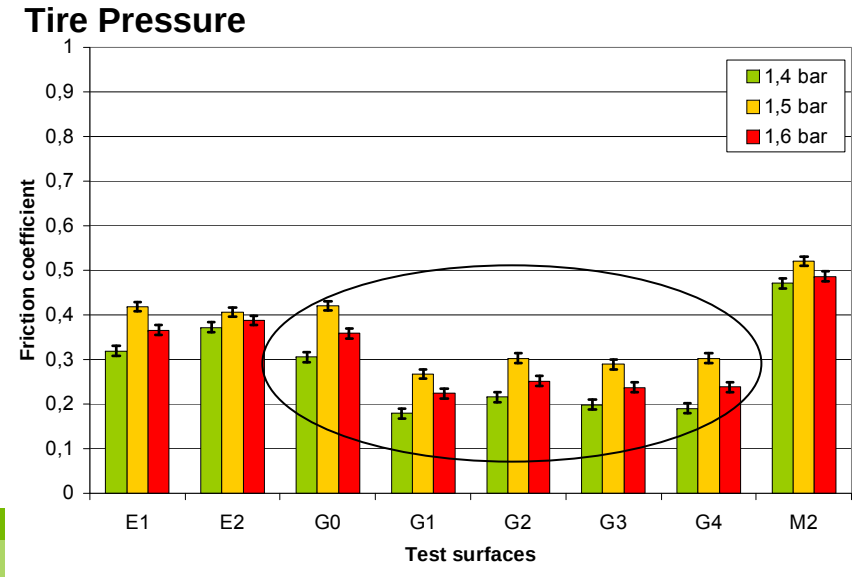
- Application of international standards
  - Evaluation of measurement data — Guide to the expression of uncertainty in measurement (JCGM 100:2008)
- 7 main parameters
  - Calibration
  - Tire (wear, pressure)
  - Nozzle height
  - Water depth
  - Speed
  - Slip rate
  - Horizontality of sensors
- Experimental work

Variability study



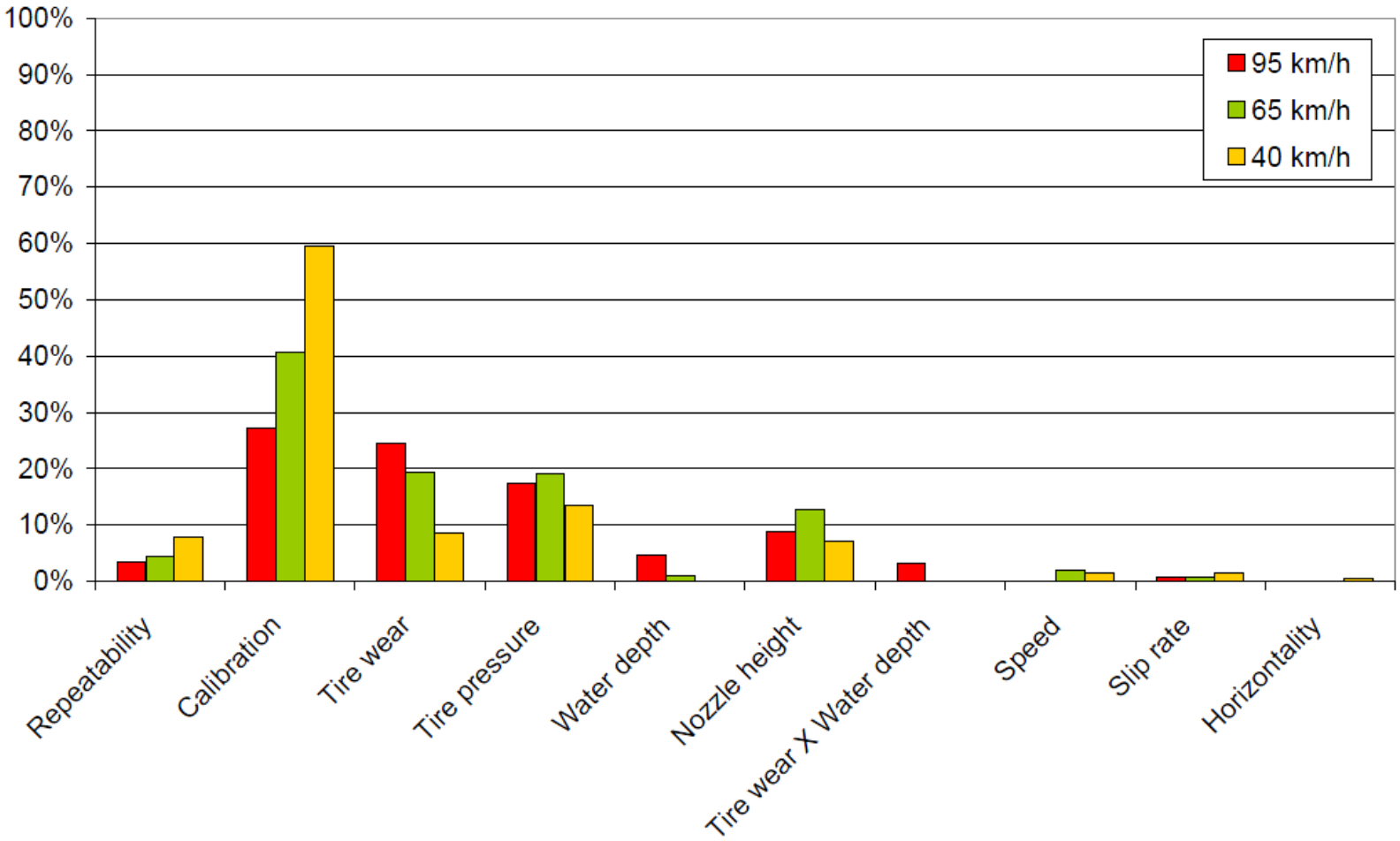






Variability study

- Aims: - Identify, quantify and reduce uncertainties
  - Be more confident in friction results



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Friction Measurement: from Device to Aircraft

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Friction Measurement: from Device to Aircraft

Device friction coefficient

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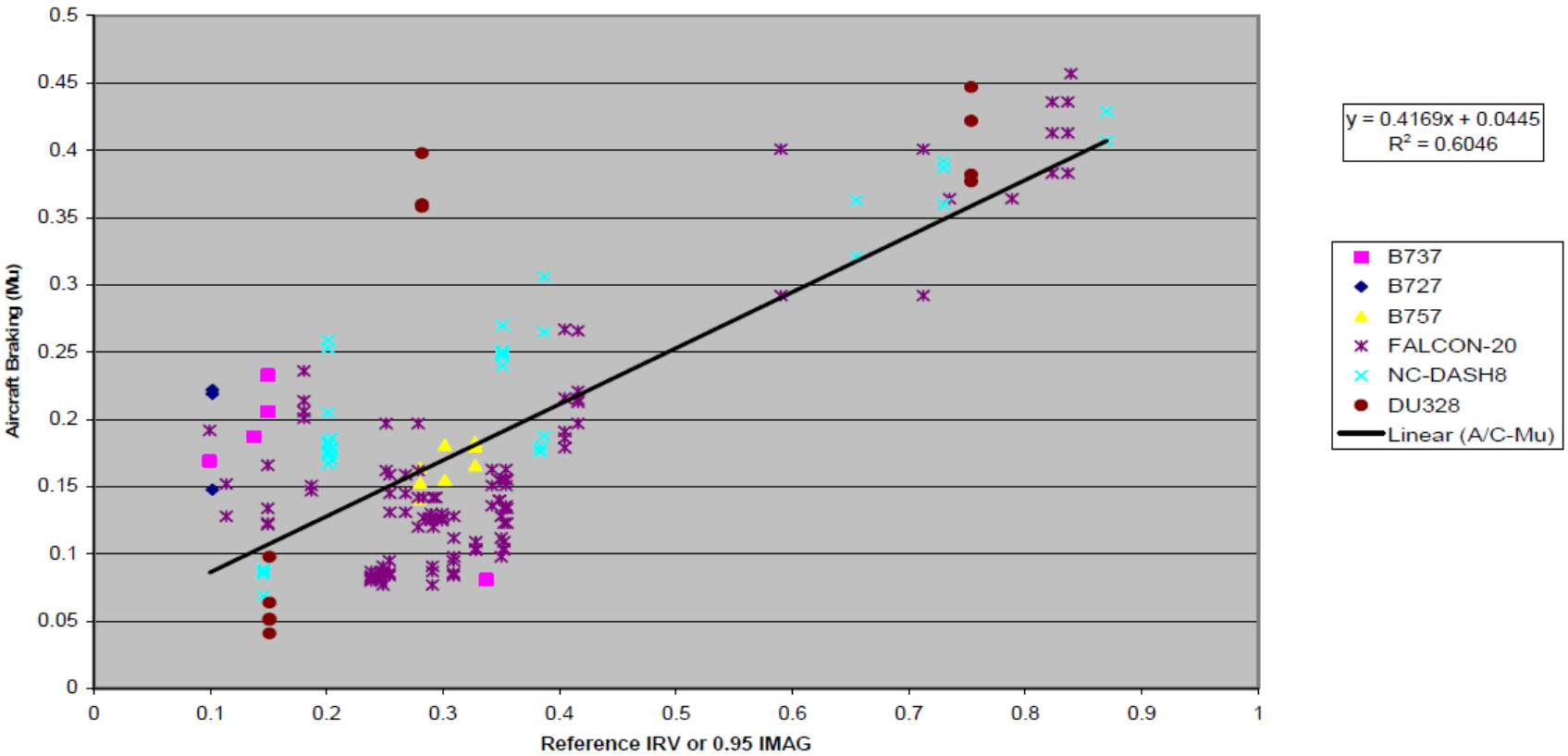
Aircraft friction coefficient

Friction Measurement: from Device to Aircraft

- Joint Winter Program
  Linear correlation between aicraft and devices



Friction Measurement: from Device to Aircraft

- Use of a model to consider non-linear effects
- ESDU International plc.. *Development of a Comprehensive Method for Modelling Performance of Aircraft Tyres Rolling or Braking on Dry and Precipitation-Contaminated Runways.*
  - Aircraft braking modeling
  - Simple analytical relation
  - 8 parameters related to the vehicle, to the surface, to the contaminant
  - Rolling resistance, drag, braking
  - 3 situations
    - Wet runways
    - Ice-covered runways
    - Snow-covered runways

Connecting with the TALPA matrix

Airport Runway Condition Assessment				Pilot Reports (PIREPs) Provided To ATC And Flight Dispatch
Assessment Criteria		Downgrade Assessment Criteria		
Code	Runway Condition Description	Mu (μ) [1]	Deceleration And Directional Control Observation	PIREP
6	• Dry		-	Dry
5	*1/8" or less depth of:* • Wet (Damp or Water 1/8" or less) • Water (Includes Wet or Damp) • Slush • Dry Snow • Wet Snow	40 or Higher	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal.	Good
4	• Frost *-15°C and Colder outside air temperature:* • Compacted Snow	39	Brake deceleration and controllability is between Good and Medium.	Good to Medium
3	• Wet ("Slippery when wet" runway) • Dry Snow or Wet Snow (Any Depth) over Compacted Snow *Greater than 1/8" depth of:* • Dry Snow • Wet Snow *Warmer than -15°C outside air temperature:* • Compacted Snow	to	Braking deceleration is noticeably reduced for the wheel braking effort applied. Directional control may be noticeably reduced.	Medium
2	*Greater than 1/8" depth of:* • Water • Slush	30	Brake deceleration and controllability is between Medium and Poor. Potential for hydroplaning exists.	Medium to Poor
1	• Ice [2]	29 to 21	Braking deceleration is significantly reduced for the wheel braking effort applied. Directional control may be significantly reduced.	Poor
0	• Wet Ice [2] • Water on top of Compacted Snow [2] • Dry Snow or Wet Snow over Ice [2]	20 or Lower	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain.	Nil

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Study on Decelerometer for Runway Operations Friction Measurement

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Use of Decelerometer by Aerodrome Operators

- ICAO : few recommandations
- DGAC/STAC Information Notice « Caracterisation caractérisation of runway surface condition in adverse meteorological situations »
- Transport Canada : intercomparisons since 2000 to evaluate key factors influencing measurements

Need for guidance to improve reliability and precision

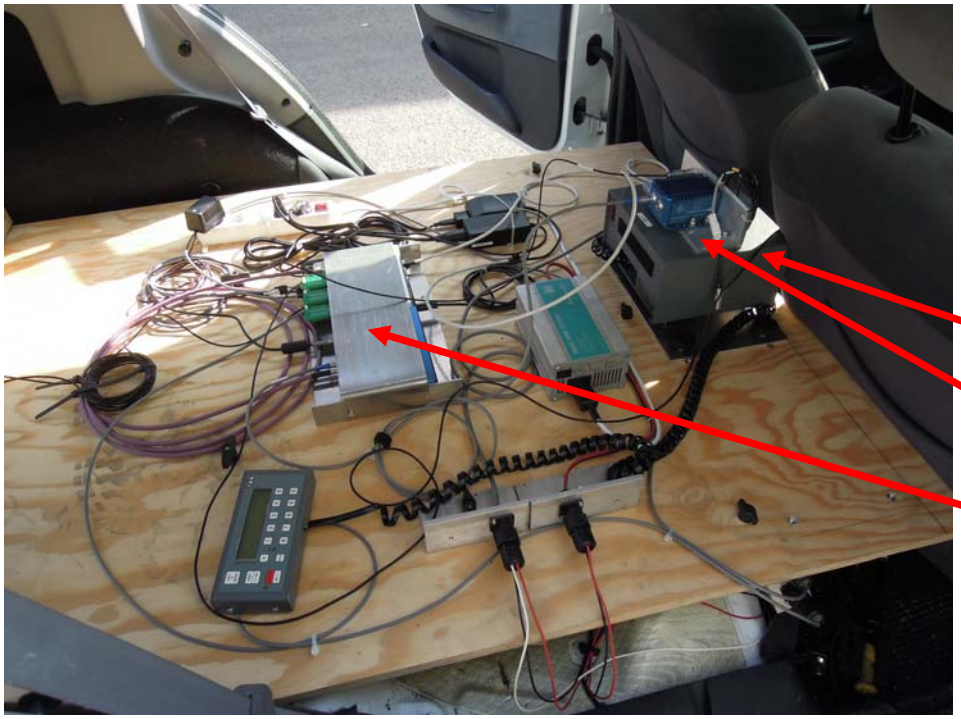
DGAC/STAC Information Notice

Recommendations :

- Only on runways under solid and homogeneous contamination
- Trials speed : 40 km/h
- Vehicle minimum weight : 1000 kg
- Rigid suspension
- ABS deactivated
- Ordinary road tires
- Offset from Rwy Centreline : between 3 and 7 m
- Measurements interval : 200 et 300 meters
- Minimum 3 measurements by 1/3 of Rwy

STAC experiment (2012-2013)

- State of the art (october 2012)
- On site tests (april 2013)
- Report (march 2014)



Decelerometer

Accelerometers

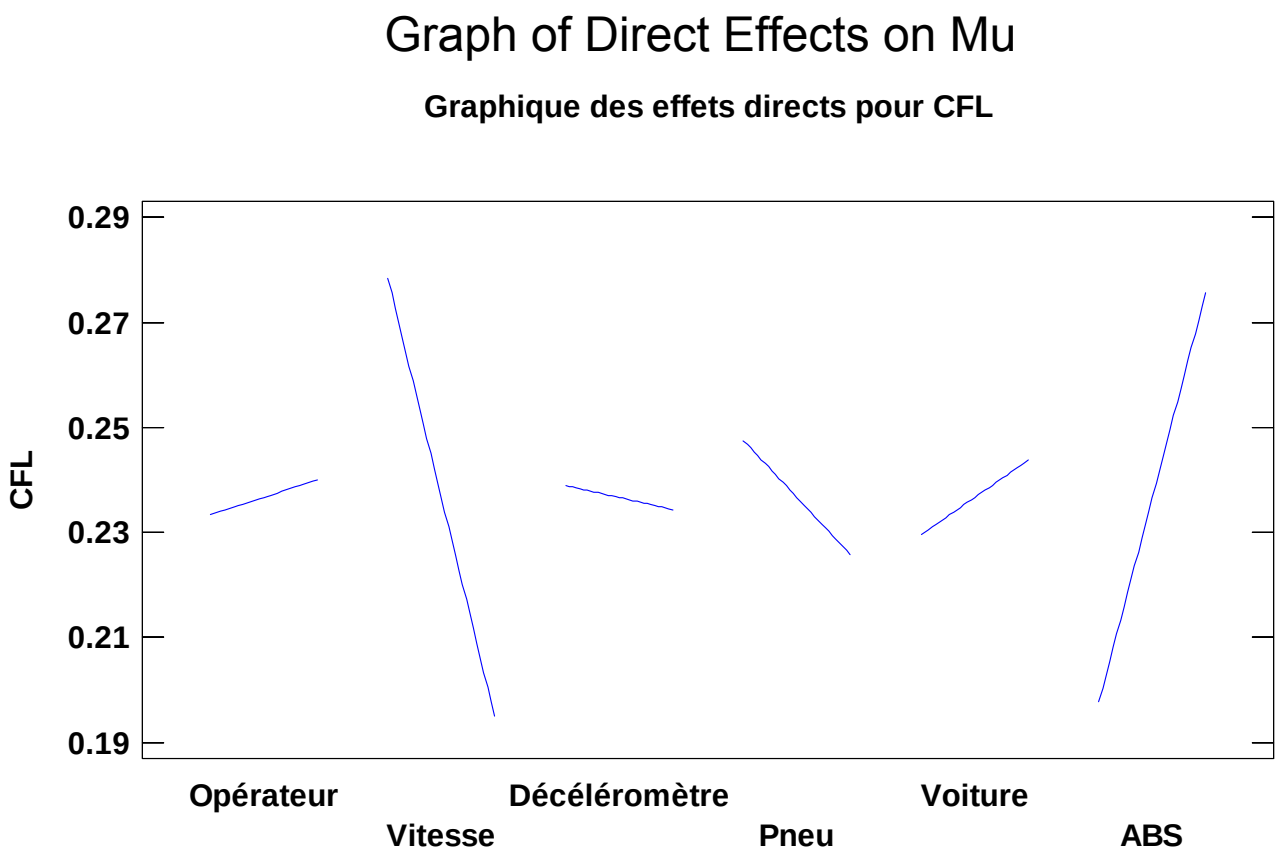
Data acquisition unit and GPS

STAC experiment (2012-2013)

Preliminary tests

- Wet resin pavement
- 3 instrumented vehicles (1 utility car, 2 passenger cars)
- Preliminary tests (32 scenarii => 32x3= 96 runs)
  - 2 target speeds : 30 et 40 km/h
  - 2 positions of decelerometer : center and right side
  - 2 operators
  - ABS on and off
  - 2 tire pressures : standard and -15%

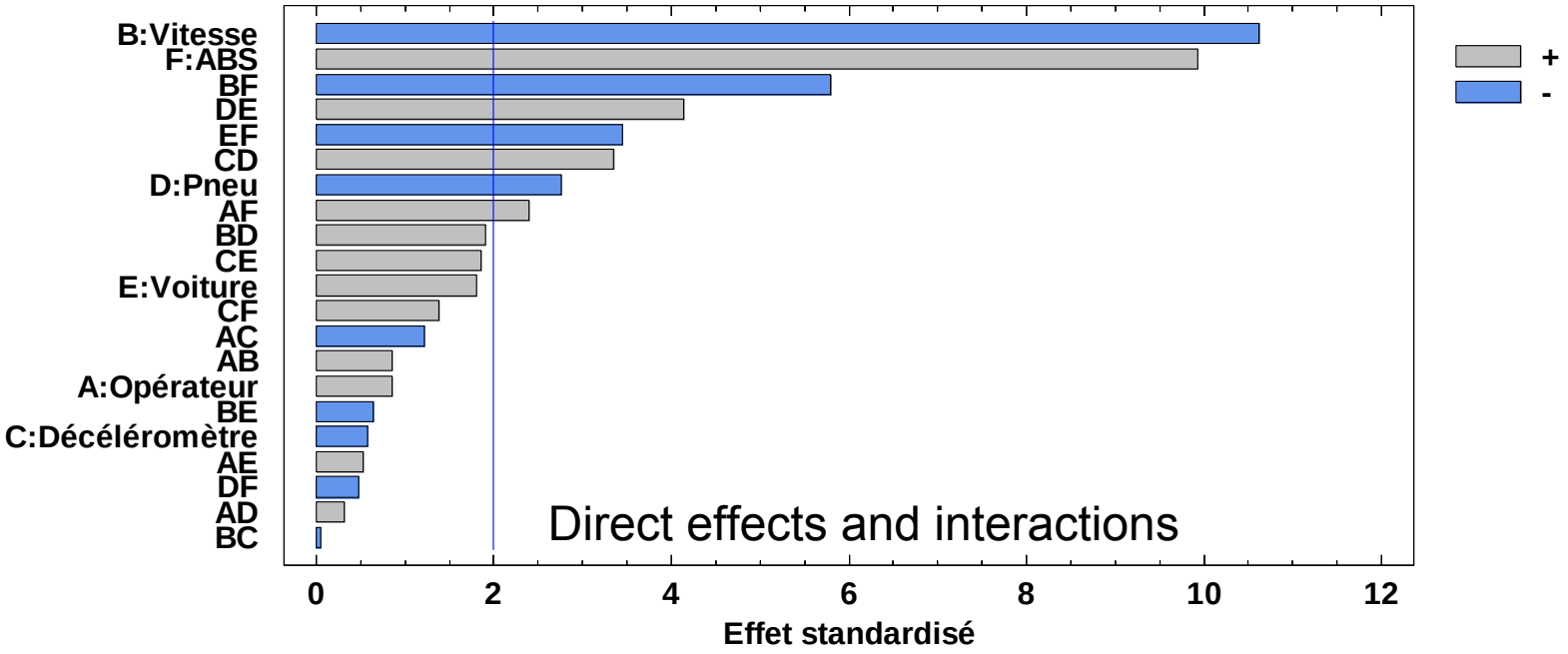
First results : factorial analysis



First results : factorial analysis

Standardised Pareto Graph for Mu

Graphique de Pareto standardisé pour CFL



Average Mu Coefficient : 2.4

Thank you for you attention

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