

Accuracy Analysis of WIM Systems for the Cold Environment Test



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Introduction - Objectives



- Test from June 1997 to December 1999 (11 test periods) = CET I + CET II.
- Test is part of COST 323 and WAVE project.
- Objectives:
 - To test efficient operations of existing and future WIM systems in cold and northern climates under harsh environmental conditions,
 - To analyse the system accuracy in compliance with European Specifications (COST 323, 1997).

Description of the Test Site



- Test site:
 - 2 traffic lanes, bituminous pavement.
 - Class II (COST 323 European Specifications).
 - Slight road deterioration after each winter season.

- Traffic on test site:
 - 350 heavy lorries per day in each direction.
 - Lorry speed limit is 80 km/h.
 - Heavy vehicles often travel with their outside tyres partially or totally on the wide hard shoulder (impact on percentage of identified vehicles and calibration of some systems).

Description of Tested WIM Systems



- Prototype or marketed systems.
 - Datainstrument: *2 piezo-ceramic nude cables, Datarec 410 (with automatic self-calibration procedure),*
 - PAT: *2 bending plates, DAW 100,*
 - Kistler + Golden River: *2 piezo-quartz bars, Marksmann 660,*
 - Oy Omni Weight Control: *(prototype) instrumented composite structure.*
- Manufacturers not permitted to modify system in any way during test, except for prototypes.
- After CET I: manufacturers permitted to modify electronics, sensors and/or calibration systems. (Only PAT modified calibration procedure).

Test Schedule



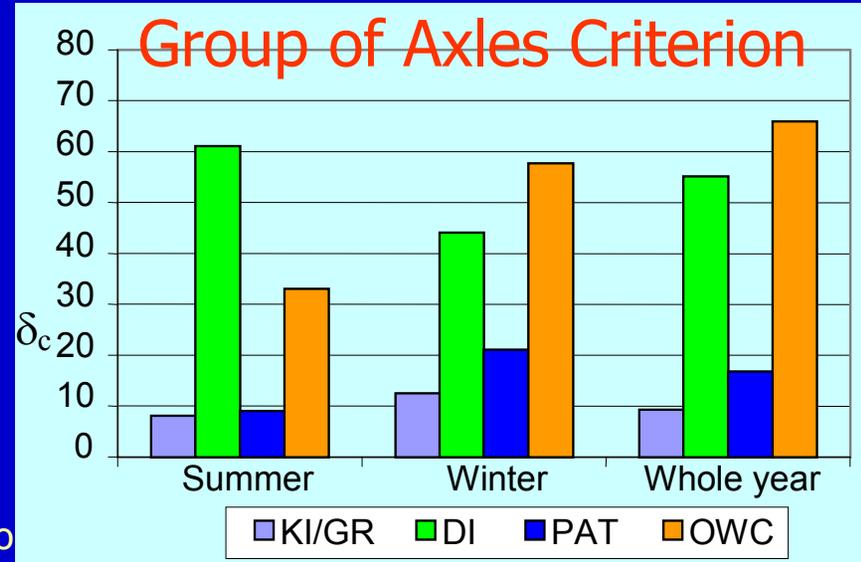
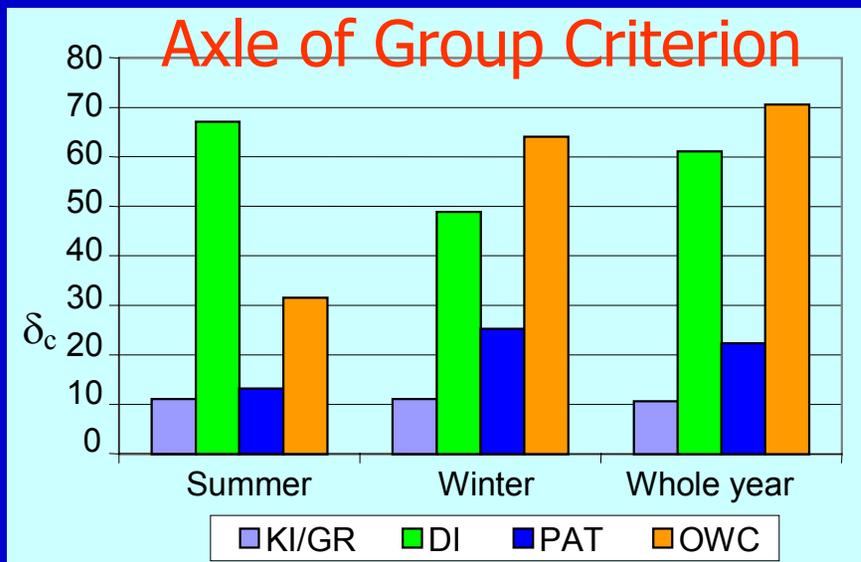
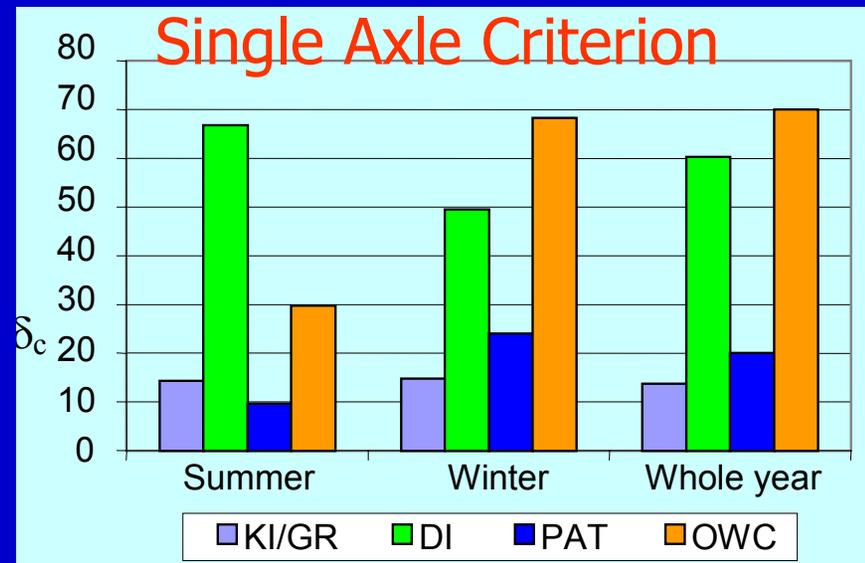
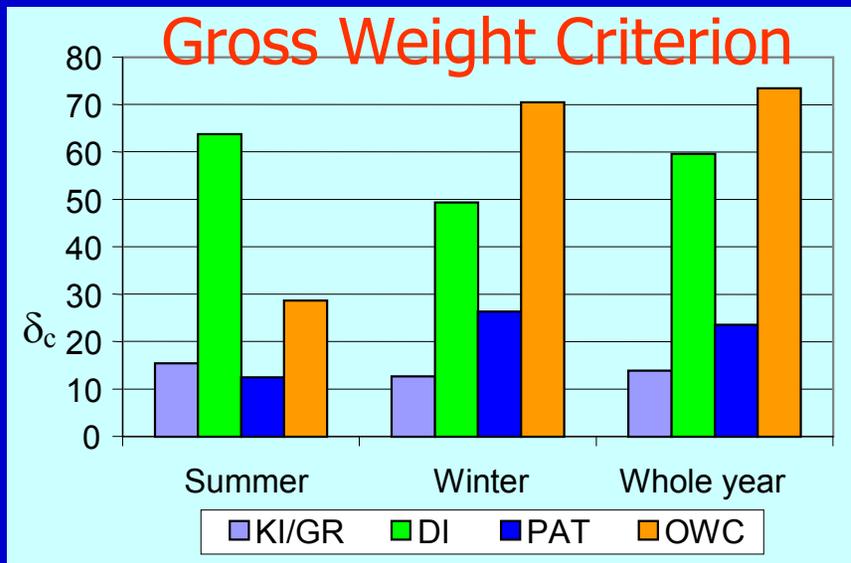
- At each major seasonal change:
 - CET I: June 97 (installation and calibration of the systems), first frost (December 97), coldest period (January 98), beginning of the spring thaw (March 98), spring (April 98), summer (June 98).
 - CET II: October 98, November 98, March 99, April 99 & December 99.
- During each test period:
 - At least one test vehicle with various loads & speeds
 - Some vehicles from traffic were post-weighed statically.

Data Analysis Procedure



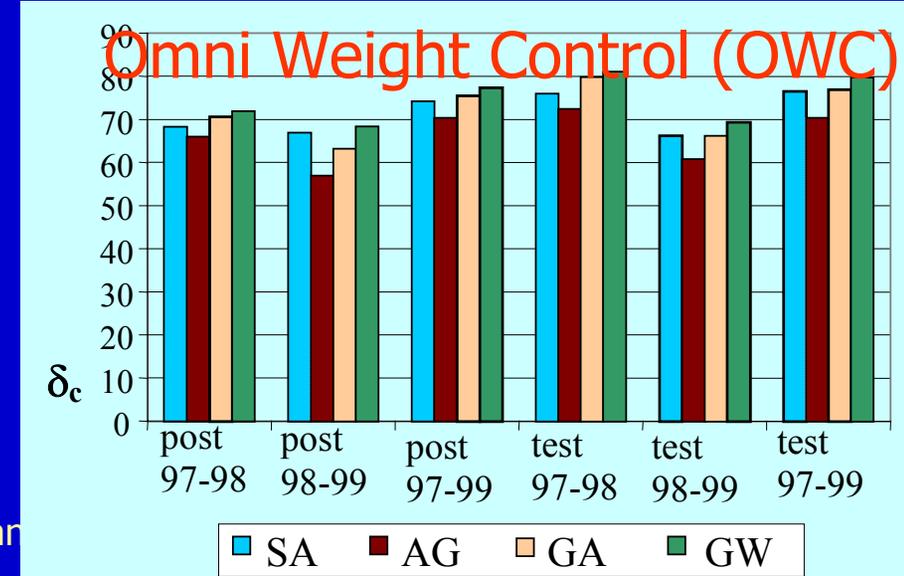
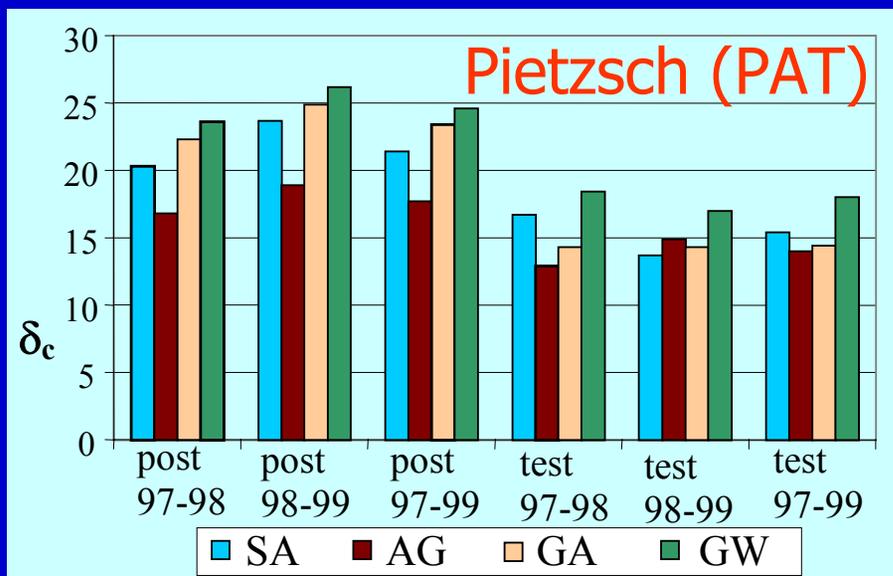
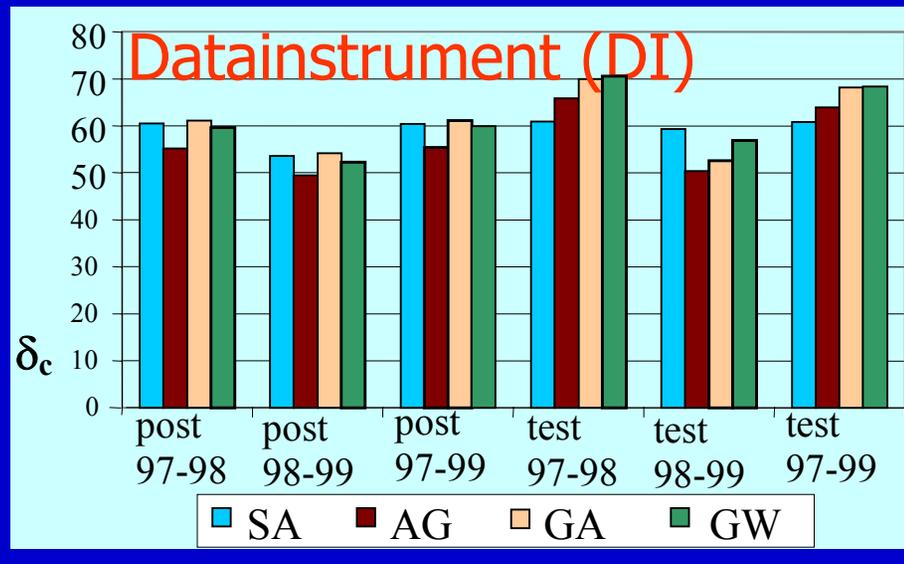
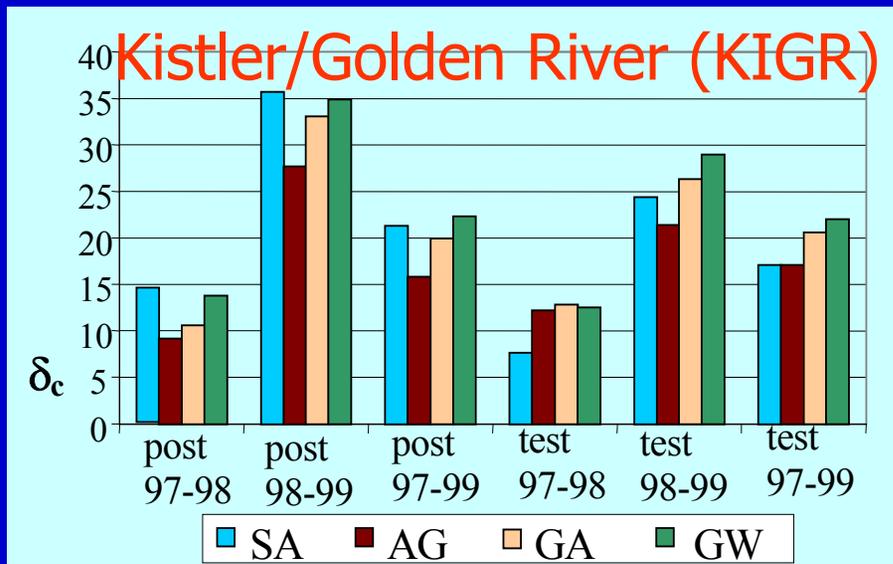
- Based on COST 323 European Specifications.
 - Post-weighed vehicles: full reproducibility conditions (R2) & environmental repeatability conditions (I) for each period.
 - Test vehicle population: extended repeatability (r2) or limited reproducibility conditions (R1) & environmental repeatability conditions (I) for each period separately.
- Three steps of the data analysis:
 - Identification of selected vehicles in each data file. (elimination of vehicle with error code).
 - Checking static values if 2 \neq available static systems.
 - Accuracy determination.

Results of the First Year – CET I



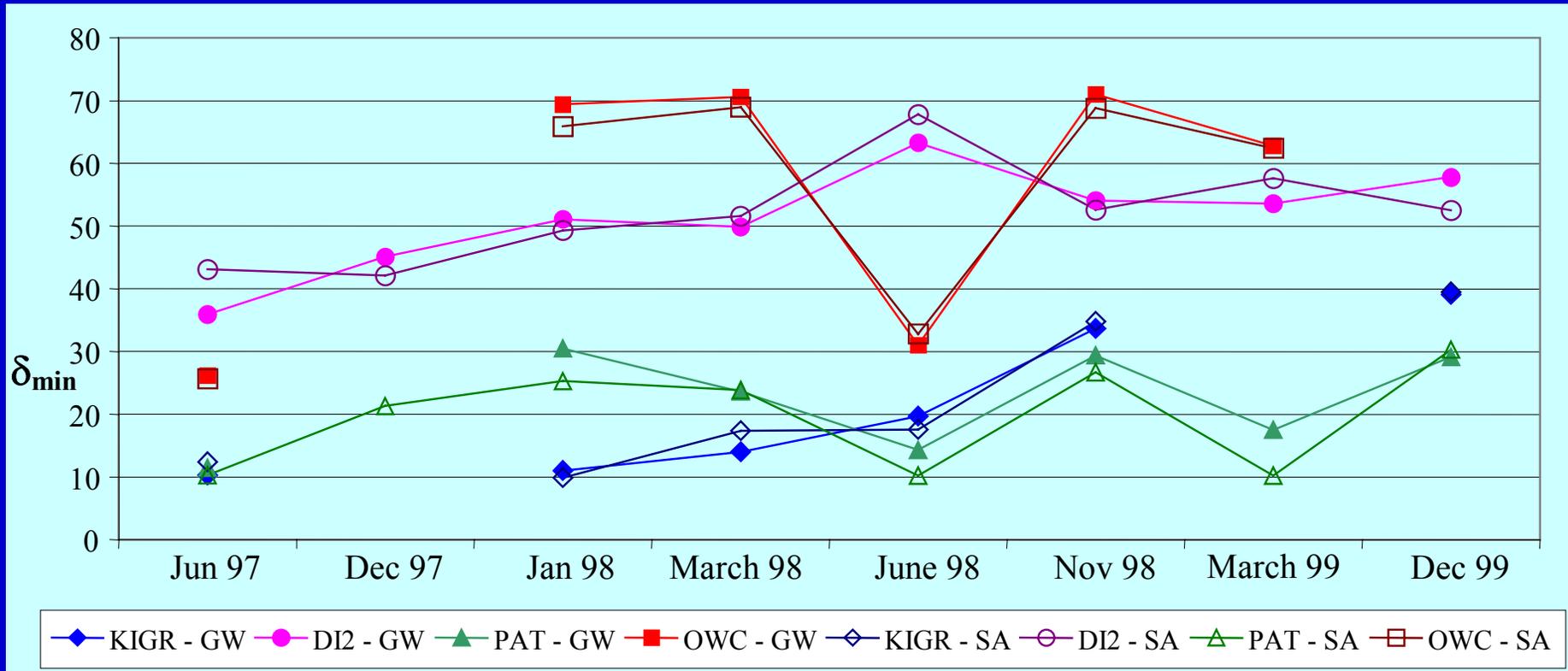
Results of the Second Year – CET II

Full environmental reproducibility conditions (II)



Results of the Second Year – CET II

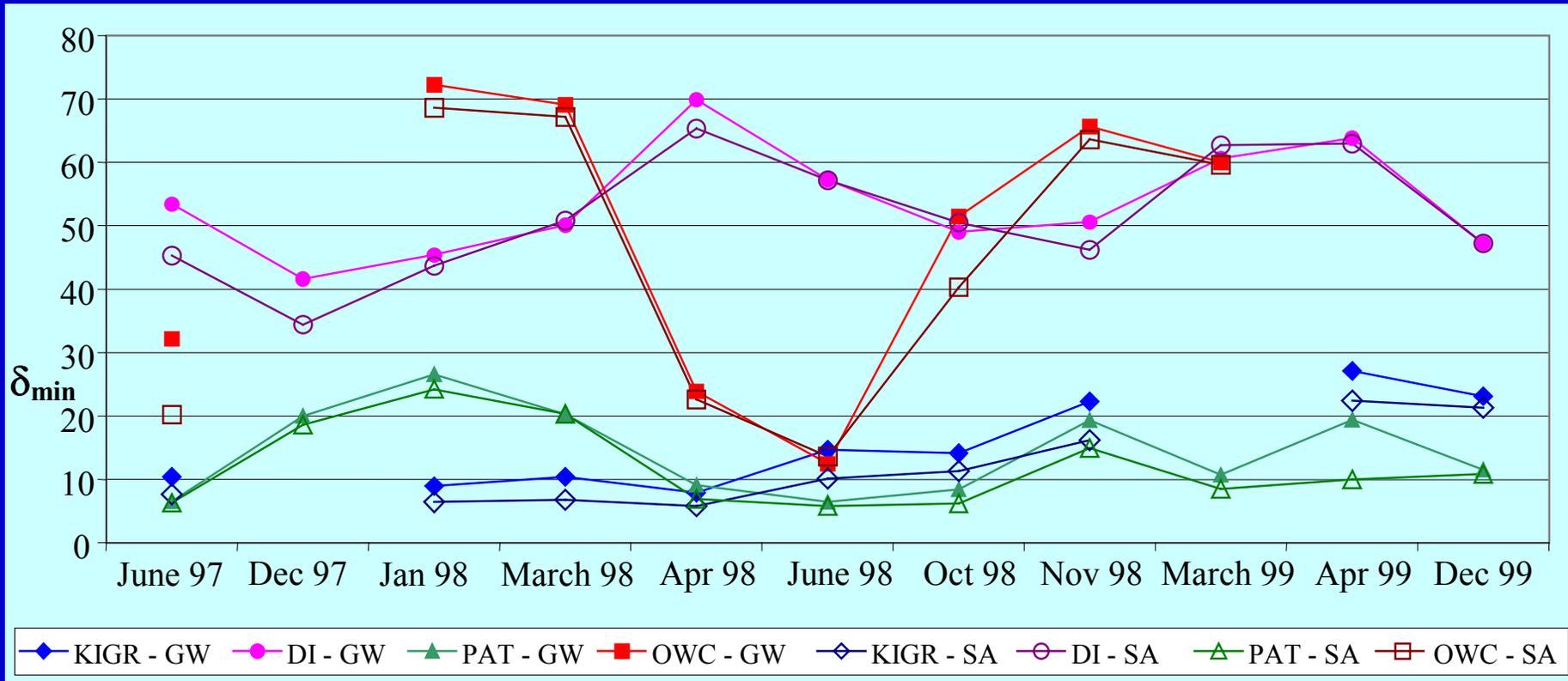
■ Environmental repeatability conditions (I)



Post-Weighed Vehicle Population

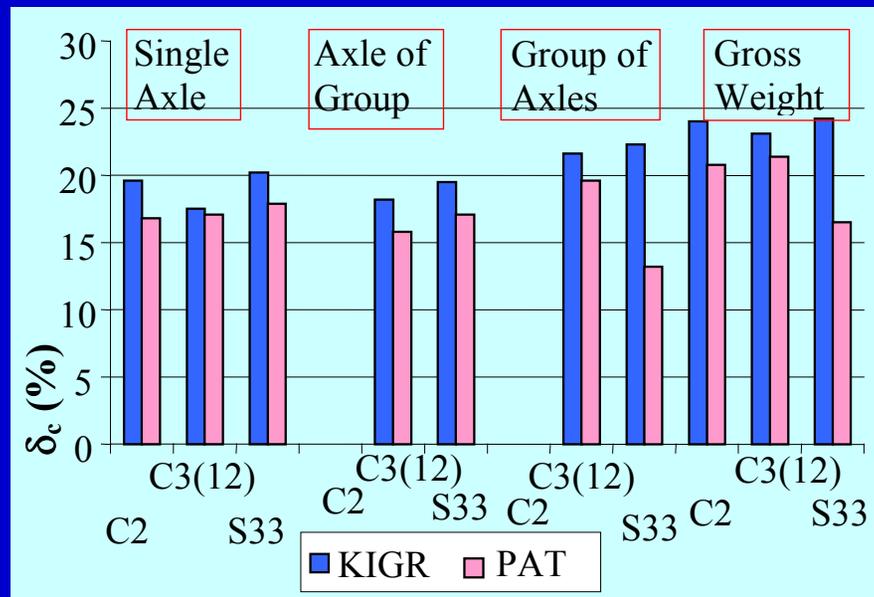
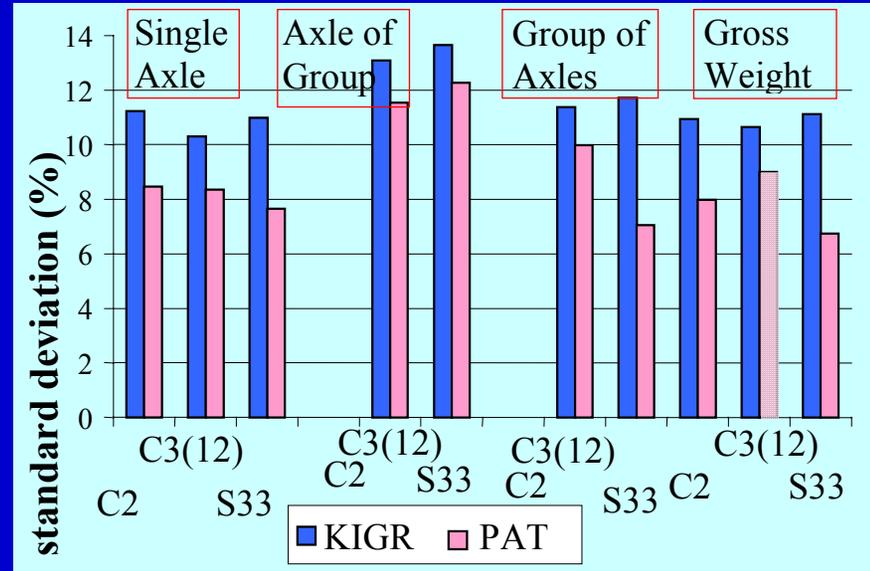
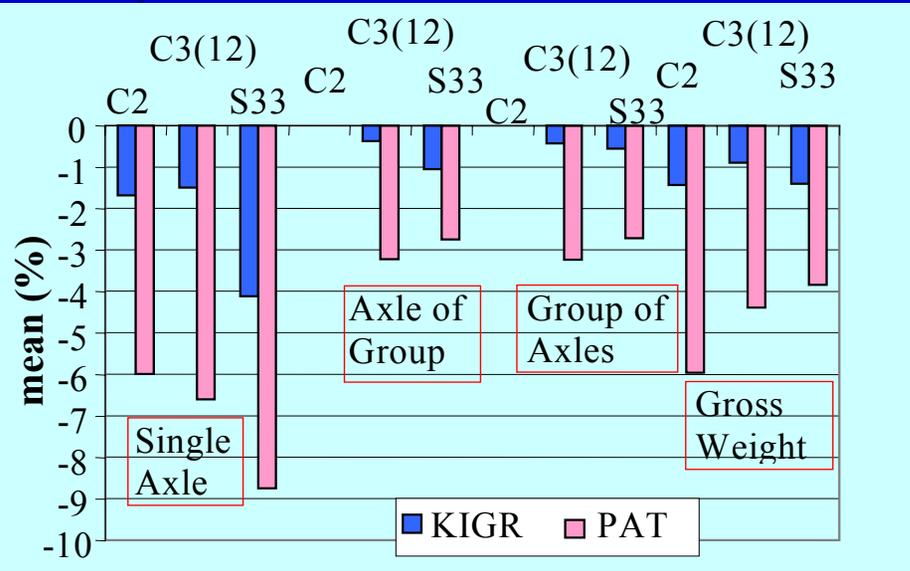
Results of the Second Year – CET II

■ Environmental repeatability conditions (I)



Test Vehicle Population

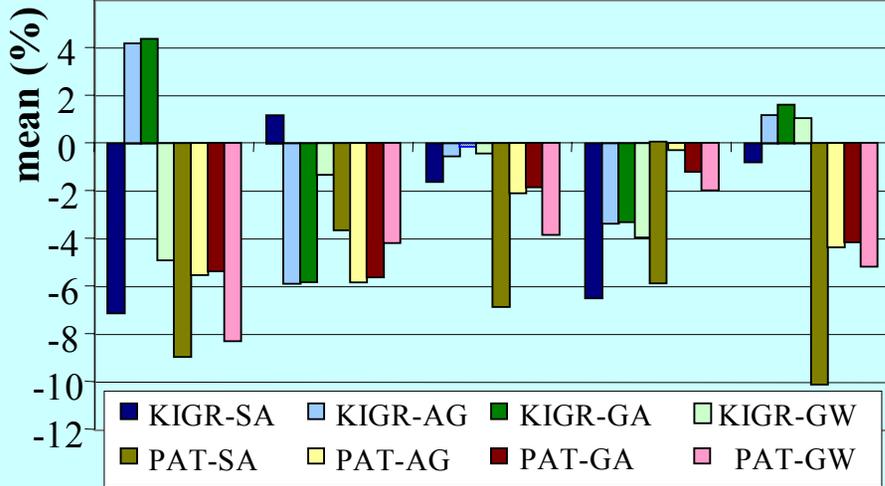
Analysis per Type of Axles



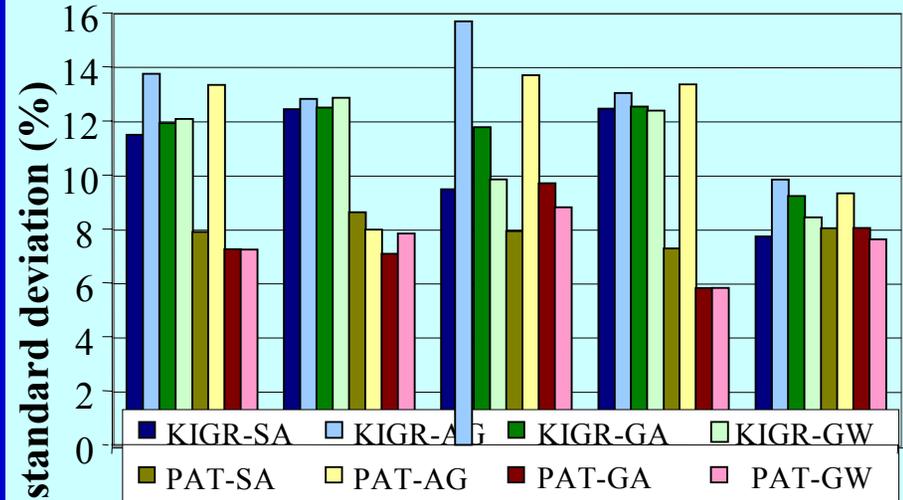
Analysis per Axle Load



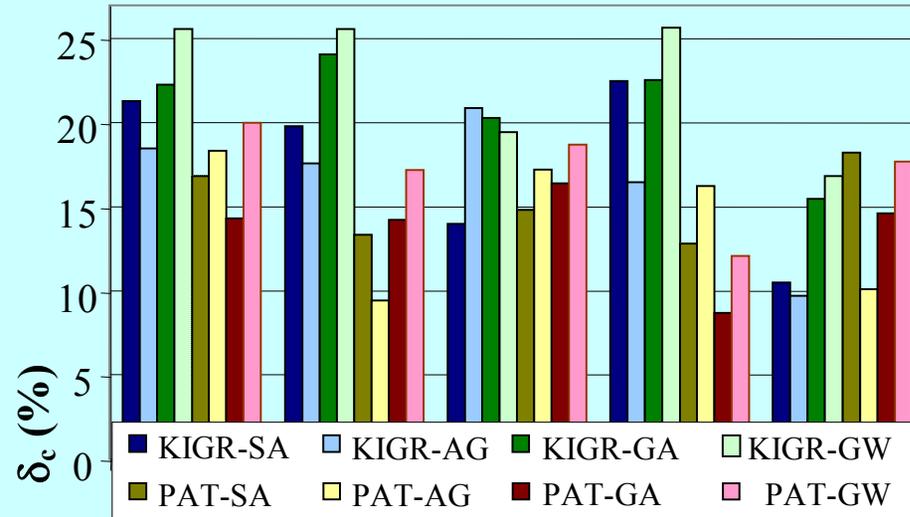
Very Light Light Half Heavy Very Heavy



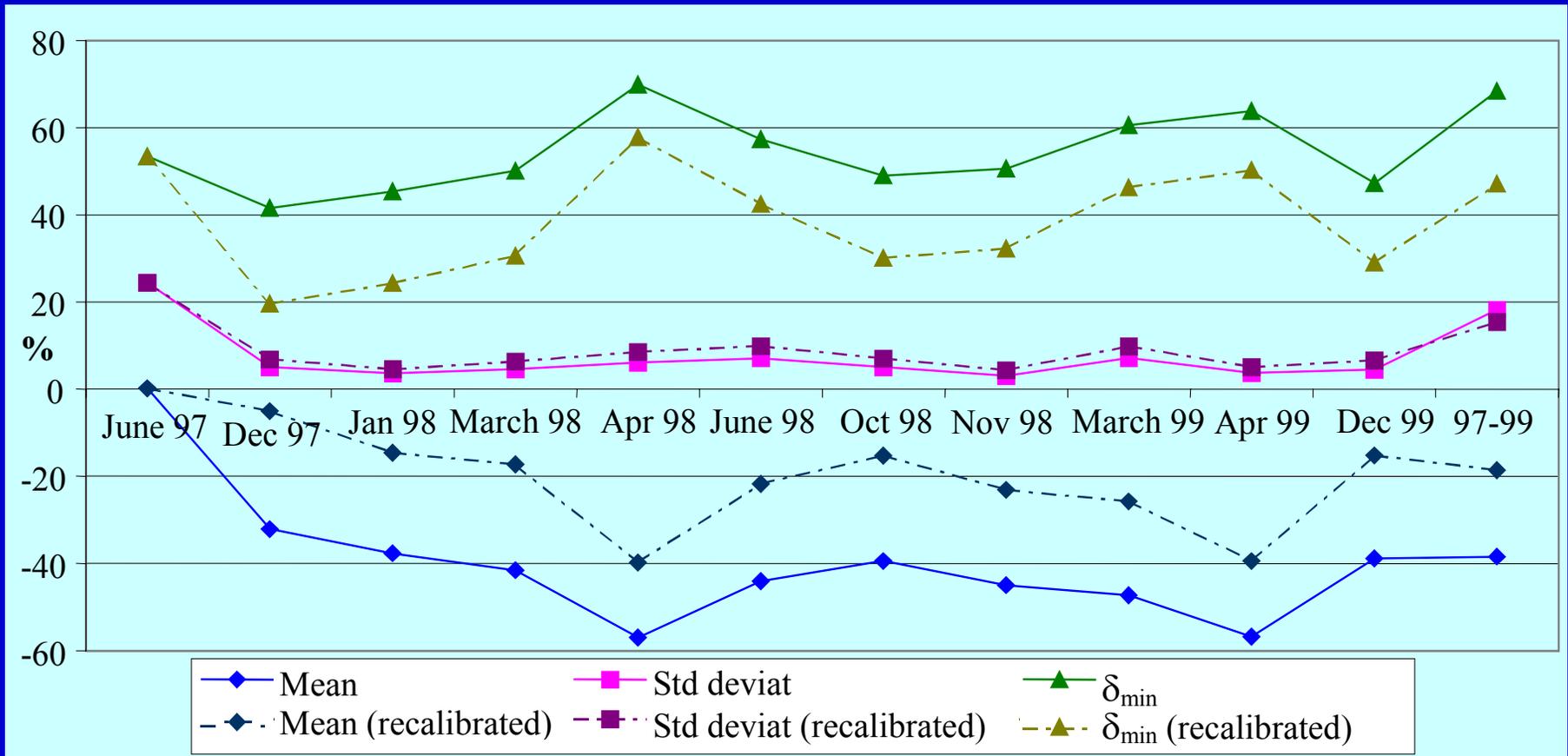
Very Light Light Half Heavy Very Heavy



Very Light Light Half Heavy Very Heavy



Impact of the calibration problem on the accuracy of Datainstrument



Gross Weight Criterion

Conclusions - I



- Each system recovered accuracy after 1st winter but lost it after 2nd winter, except for Pietzsch (improved by new calibration procedure).
- Omni Weight Control (prototype):
 - Accuracy improved during summer after software modifications,
 - Number of vehicles correctly identified was low,
 - Accuracy class for the entire year: E(80) (conditions R2, III).
- Datainstrument:
 - Automatic self-calibration system without temperature compensation,
 - Bias higher than 25 % (due to Swedish driving habits),
 - Accuracy class for the entire year: E(60) (conditions R2, III).

Conclusions - II



■ Pietzsch:

- With error code to identify vehicles driving partially outside traffic lane,
- Poor results during 1st winter (lack of temperature compensation ?),
- Accuracy class for the entire year: D(25) (conditions R2, III).

■ Kistler/Golden River (prototype combination):

- Consistent results during 1st year,
- Accuracy dropped during 2nd year (lack of re-calibration ?),
- Over the entire year (= CET I + CET II), (conditions R2, III), accuracy class: D(25).