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Introduction of Single Step genomic evaluations in German Holsteins

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Single Step GE in German Holsteins

Introduced officially in April 2025

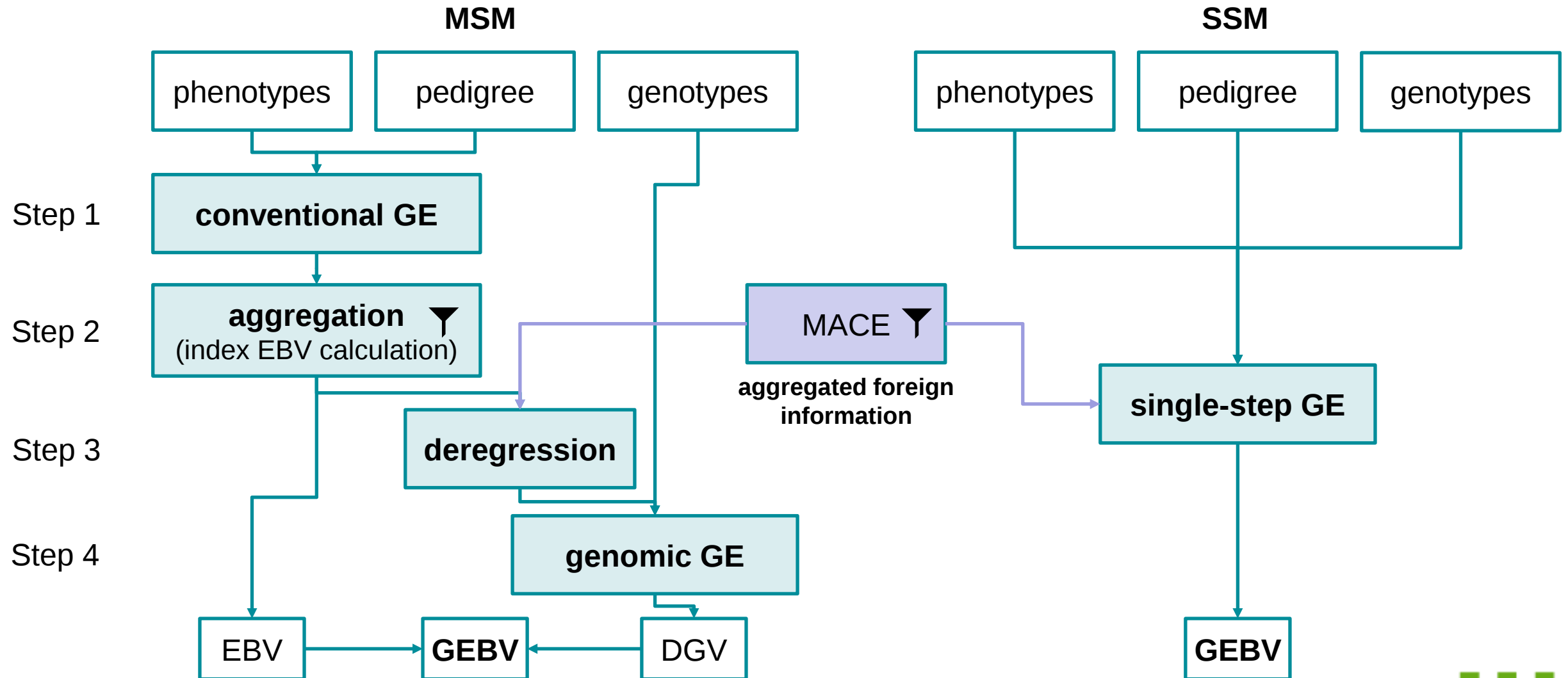
- Holsteins (black-and-white & red-and-white)
 - all traits
 - Single-Step SNP-BLUP, including MACE information
-
- building on decades of multi-step GE development
 - full model definitions (fixed & random effects) from previous conventional GE
 - all data as used in previous conventional GE

Building on decades of GE development

- models with SSM stem from previous conventional models in MSM
 - trait definitions
 - fixed effects (but additionally: regression on inbreeding coefficients)
 - genetic effects
 - genetic parameters
 - index EBV calculation

- all data is used with SSM as previously used with conventional GE in MSM
 - left-sided data truncation 01.01.2000
 - sire and dam's sire must be known
 - sire and dam's sire must belong to breeds consistent with the animal's breed
 - further trait-dependent plausibility checks

Multi-step model (MSM) vs Single Step model (SSM)

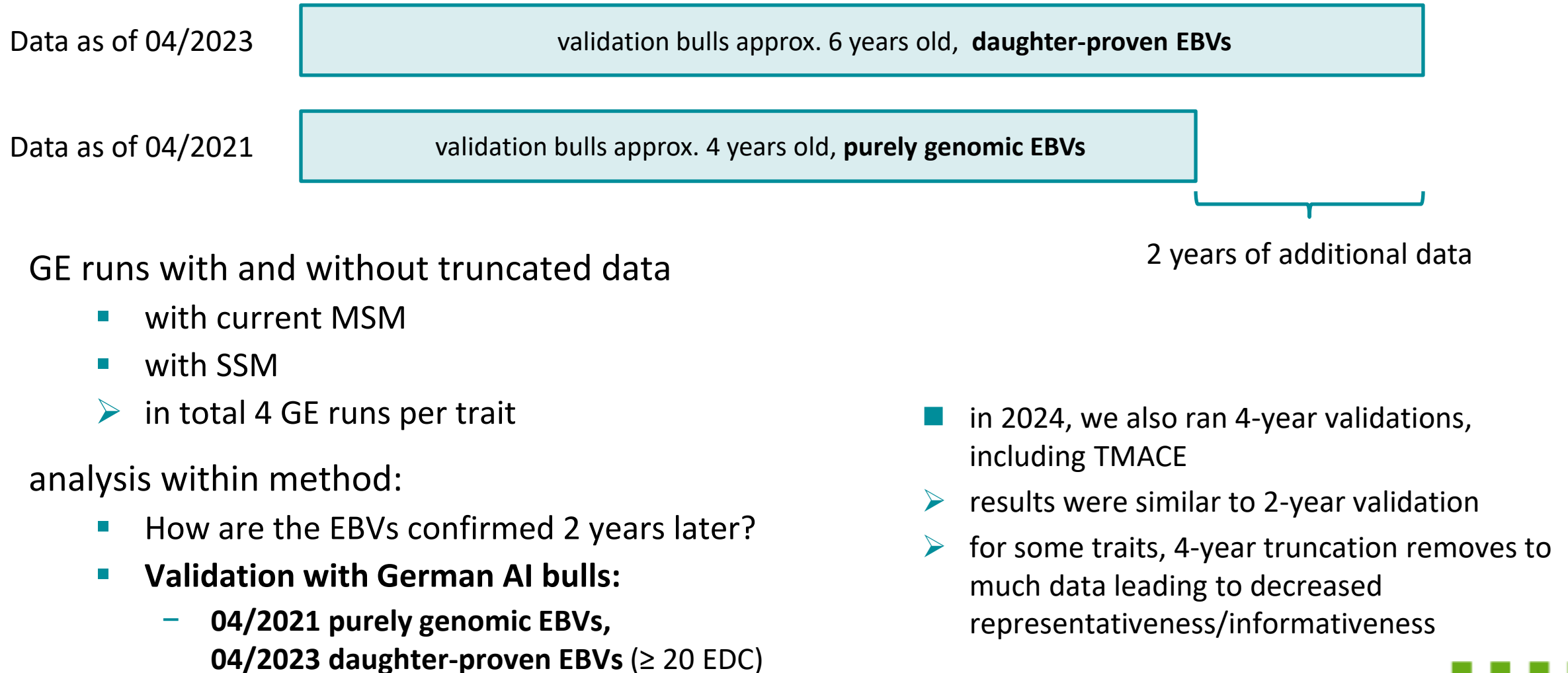


Minor adjustments

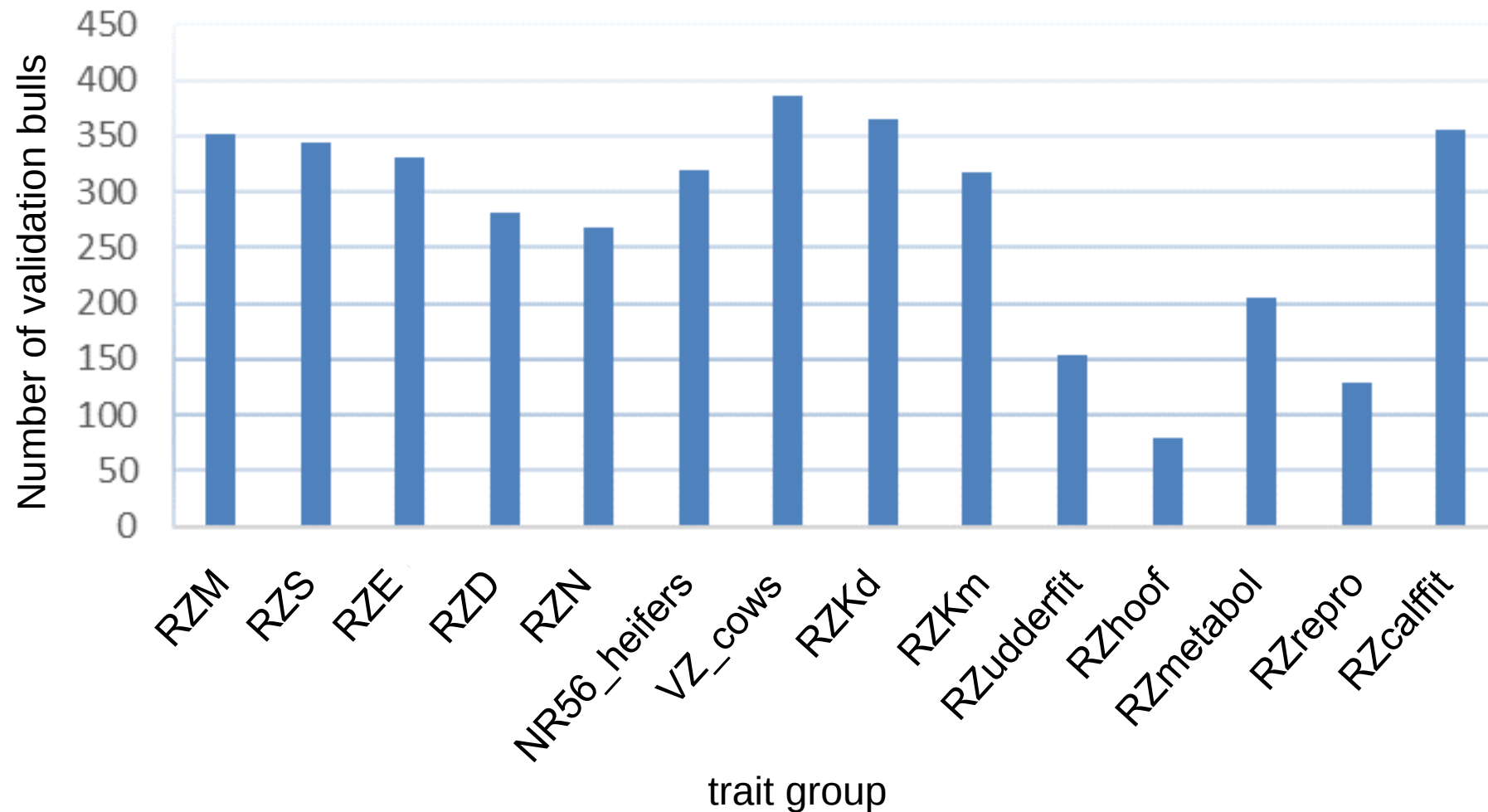
	MSM	SSM	comment
reference population for genomic evaluation	- cows with phenotypes - bulls with ≥ 10 herds - MACE bulls born in 1986 or later - further restrictions depending on the trait	all animals with - own performance - offspring performance - genotypes (born 2005 or later) - MACE EBVs if born 1995 or later	
consideration of inbreeding	depending on trait, usually via relationship matrix	for all traits via: - relationship matrix - fixed regression on inbreeding coefficient	low impact on EBVs; EG Golden Standard
reliabilities	from trait-dependent constant genomic reliability & conventional reliability	- same principle as multi-step - new calculation of the genomic EDC (effective daughter-contributions) - new method for calibration of the genomic reliability	according to Interbull recommendation
genetic std of RZM (production index)		recalibration of RZM's standard deviation	post-processing: std of RZM slightly reduced



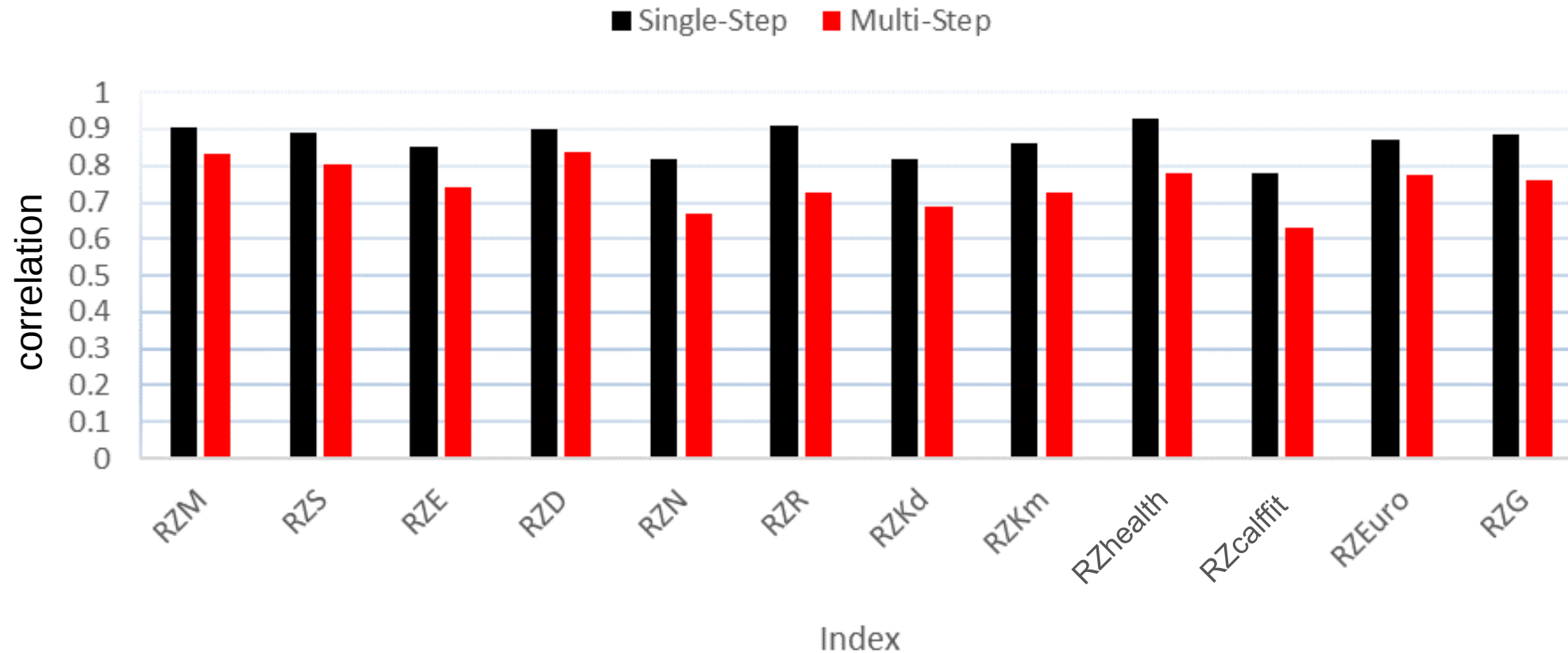
Validation



Number of validation bulls



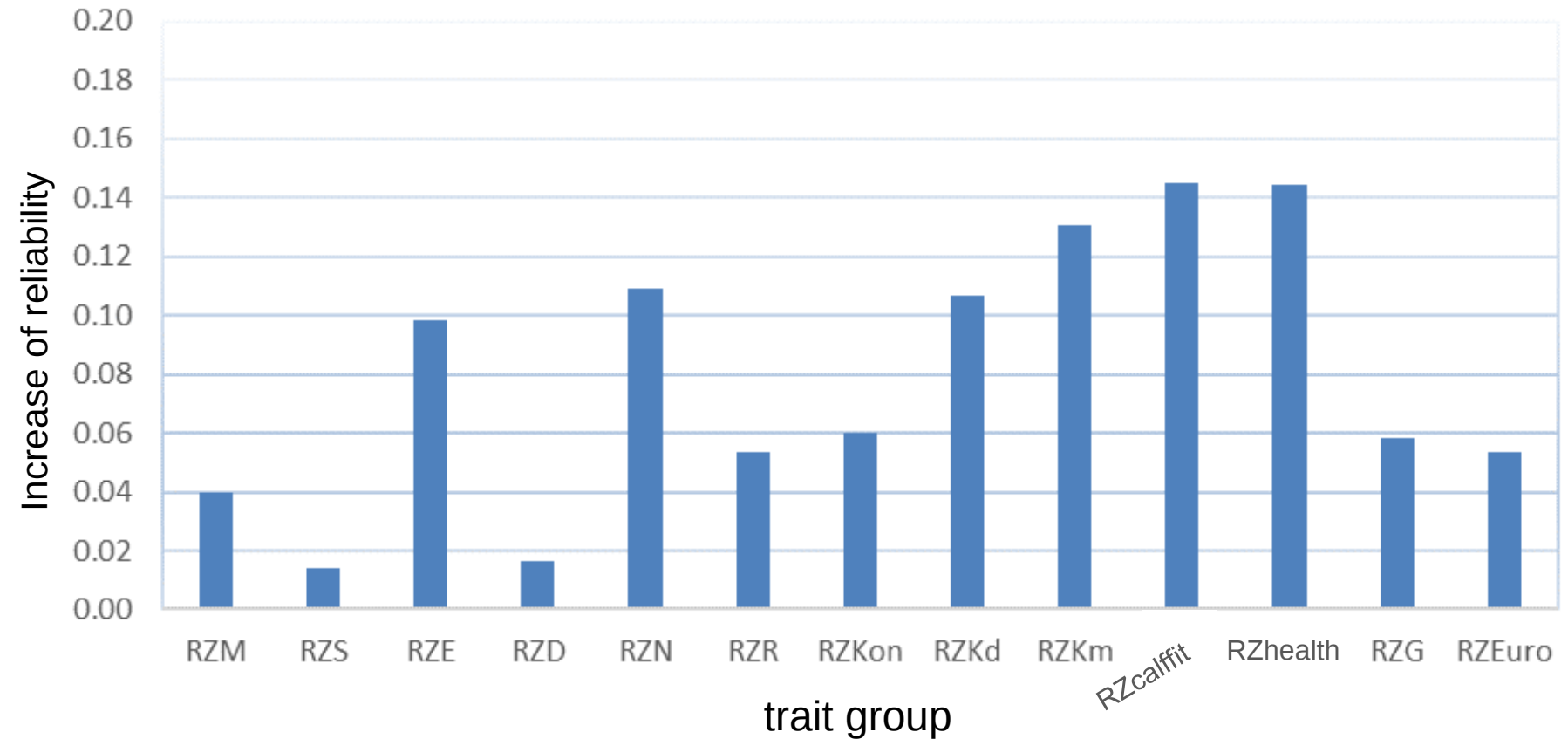
GEBV correlations 04/2021 vs 04/2023



- SSM GEBVs of young bulls predict later daughter-proven GEBVs better than Multi-Step
- improved stability of GEBVs

Reliability gains

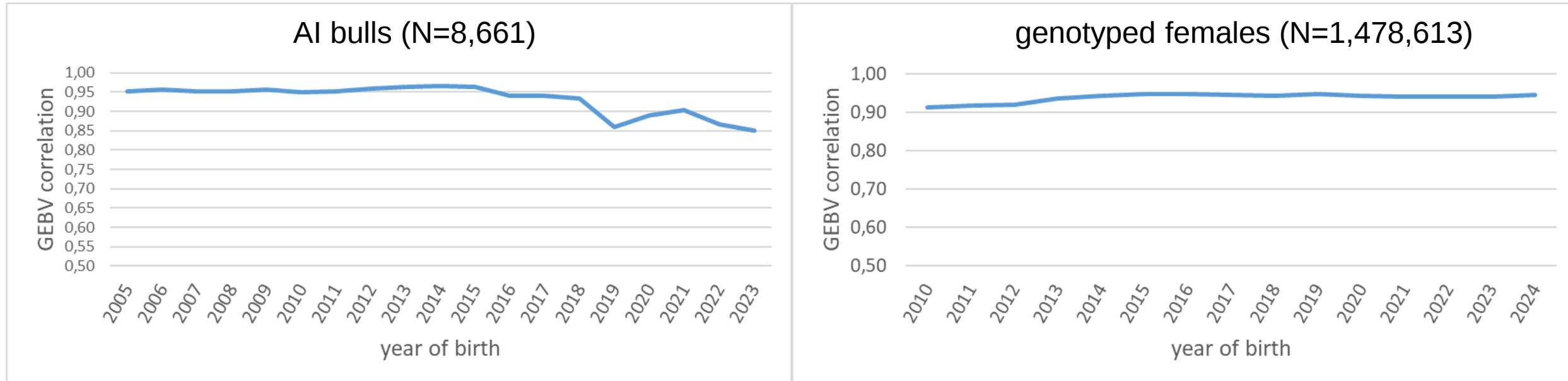
- reliabilities of GEBVs as of 04/2023
- 258 German Holstein AI bulls born 2021



- improved reliabilities in all traits with SSM
- functional traits, especially health traits improve most

Correlations SSM vs MSM (Holstein b&w)

Total Merit Index: RZG



- results as of December 2024
- correlation of ca. 0.95 for daughter-proven bulls
- correlation going down to ca. 0.85 for purely genomic bulls

Alignment with the industry

- we made clear from the beginning that introduction of single step
 - **will be a major improvement over MSM**
 - requires huge effort
 - will affect ranking of animals heavily

- we provided test results from Sept 2024 on
 - main evaluations
 - weekly evaluations

- we had multiple feedback rounds with breeding organisations

- we used the feedback for further improvements
 - see also the presentation from Zengting Liu on calf fitness (Session III, 15:45)

- **strong support from the industry along the way**



Conclusions



- Single Step evaluations are a major improvement
 - increased reliabilities for all traits
 - better prediction of daughter-proven GEBVs from purely genomic GEBVs
- introduction of Single Step was a one-time major change
 - but increased stability over GE runs for all traits
- strong support from the industry during the entire process

Thank you!