

Integrating foreign information into single-step evaluations in US Holsteins

Ignacy Misztal, Daniel Lourenco, Shogo Tsuruta, Matias Bermann

University of Georgia

Alberto Cesarani, University of Sassari, Sardinia

Andres Legarra, Ezekiel Nicolazzi, Rodrigo Mota, CDCB

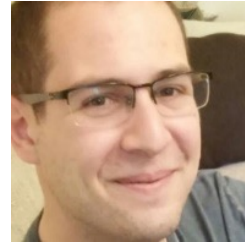
Paul VanRaden, USDA

Ignacio Aguilar, INIA, Uruguay



Steps at UGA for ssGLUP implementation in US dairy

- Single breed evaluation
- Multiple breed evaluation
- Evaluation of crossbreeds

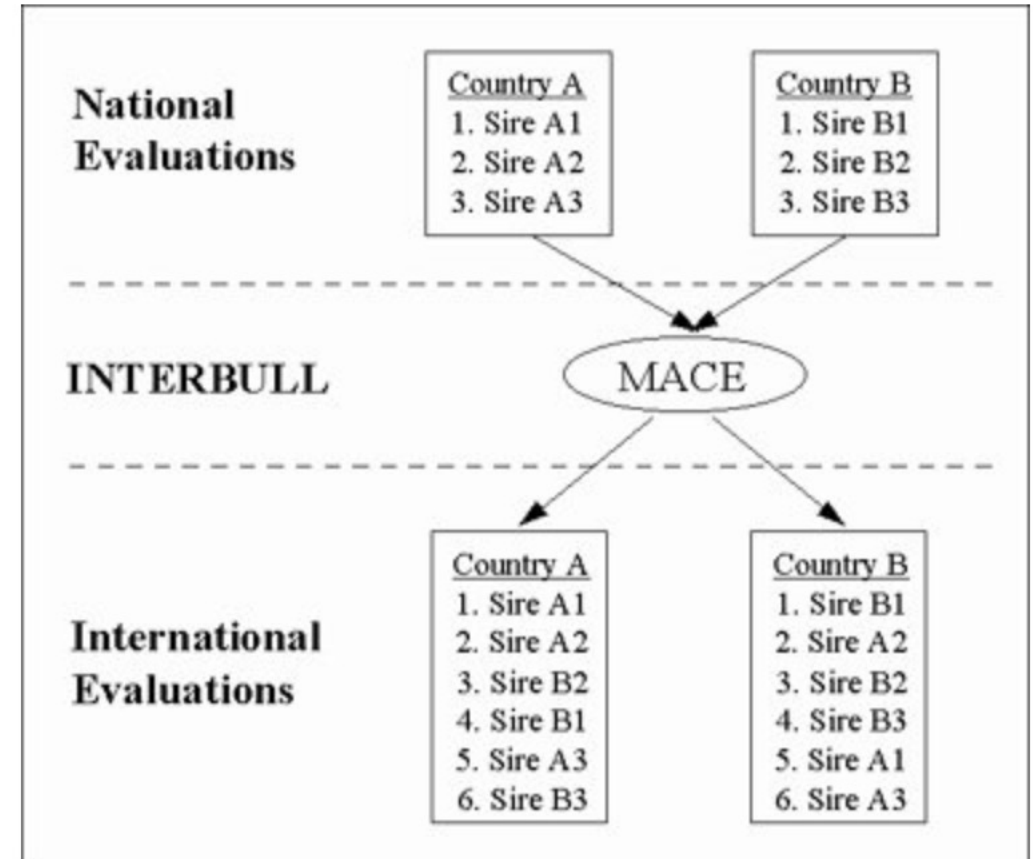


Alberto
Cesarani

- **Inclusion of external information from Interbull**

International evaluations

- International bull comparisons
- Interbull and MACE
 - Input - pseudo-observations for bulls from member countries
 - MACE – Larry Schaeffer
 - Output - PTA on each country scale

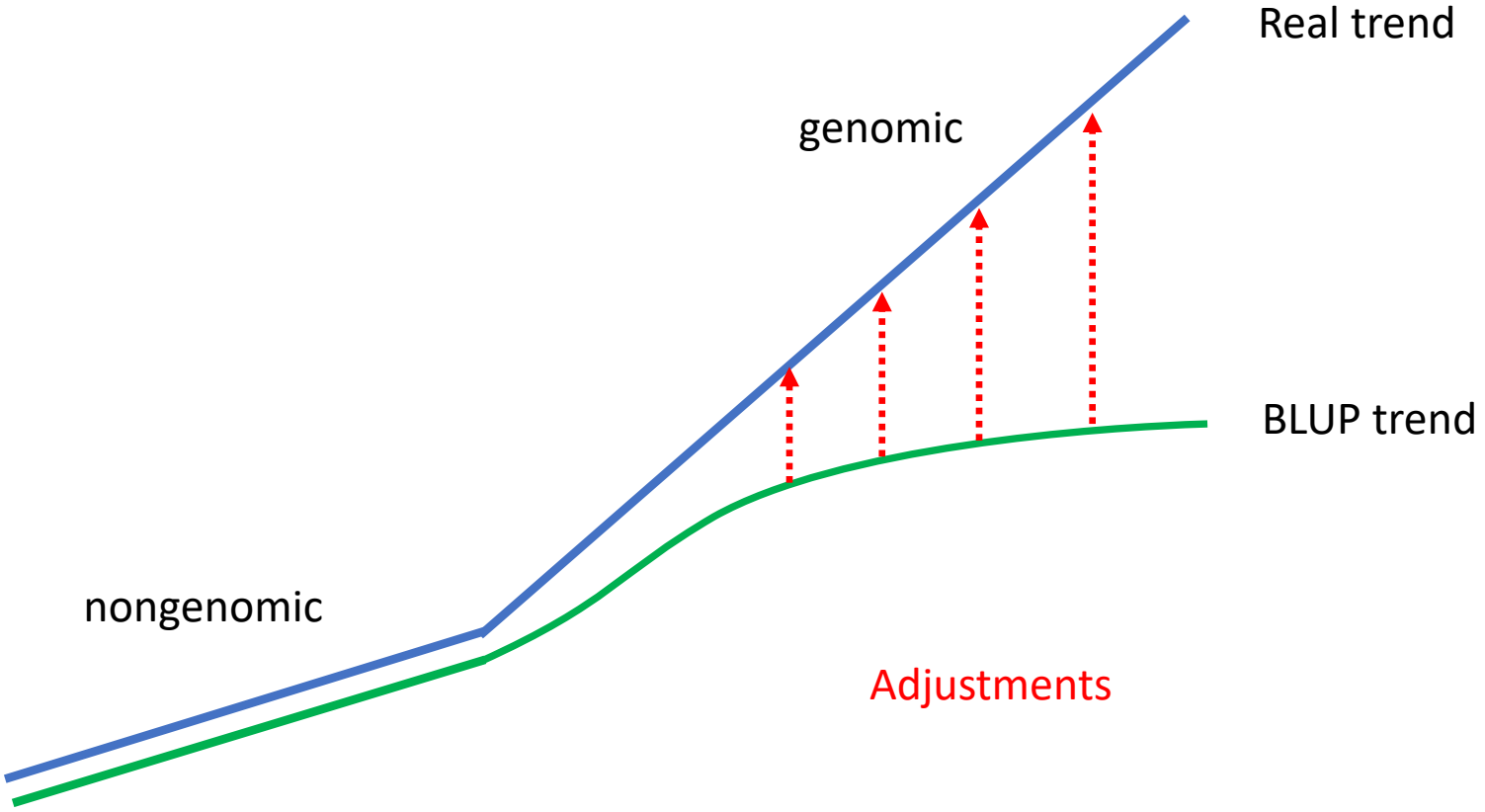


Changes under genomics

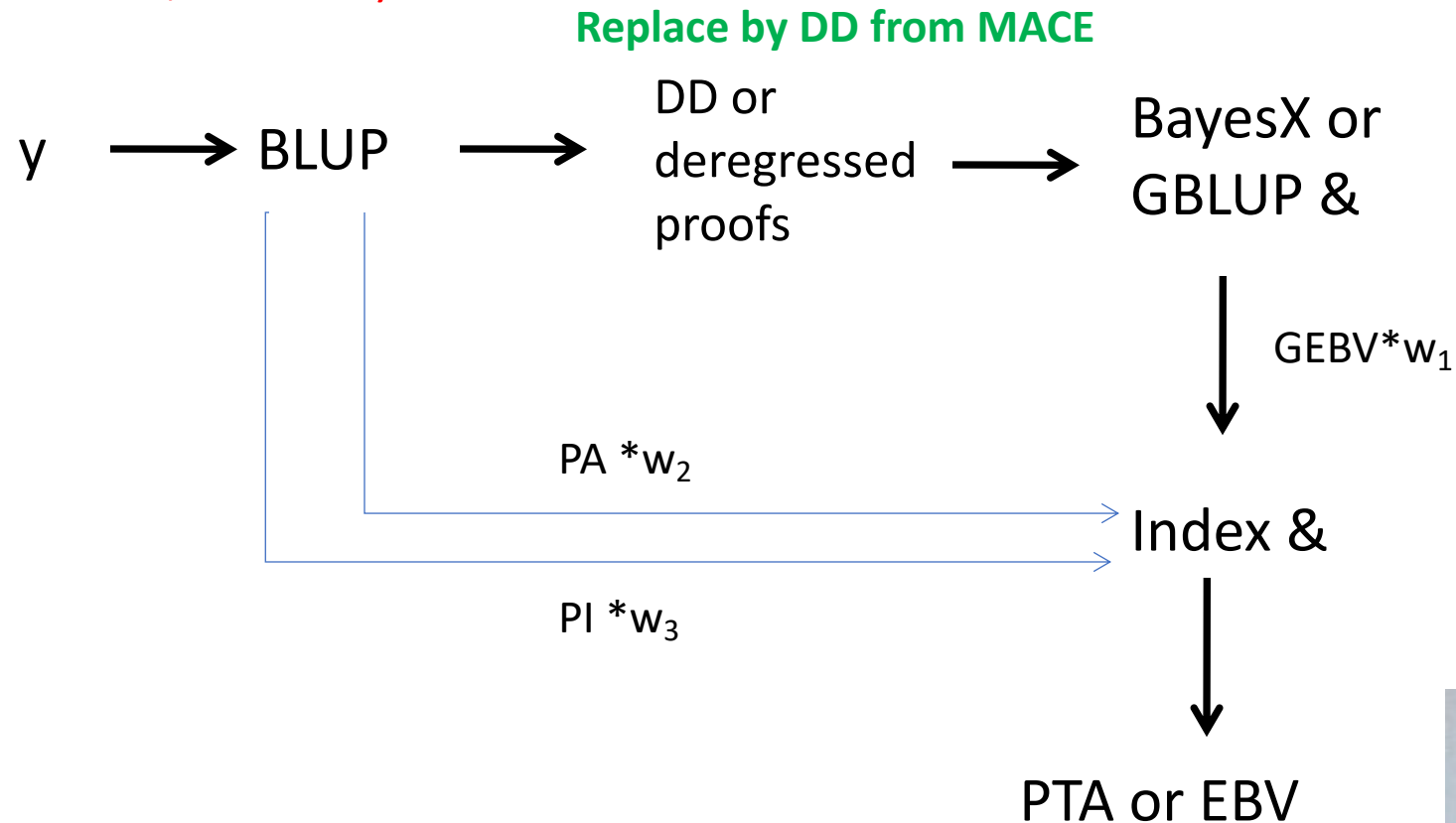
- Young bulls the new focus - proven bulls less relevant
- Preselection bias in pseudo-observations from BLUP
- Across country evaluations – use country specific SNP effects

- Some use for MACE results
 - Better evaluations of foreign proven sires
 - Better reference population if genotypes available
 - Small countries
 - Low heritability or scarcely recorded traits

Trends and pre-selection bias



Multistep genomic evaluation in dairy (VanRaden, 2008)



HO bulls squared correlations* (R²)

	Foreign			USA		
	Domestic		TMACE	Domestic		TMACE
Milk	88	+1	89	78	0	78
Fat	88		90	82		82
Protein	86		88	80		80
Fat%	92		93	90		90
Pro%	92		93	86		87
NM\$	89		89	82		81
PL	68	+15	77	59	+8	67
SCS	83		87	77		81
INT	72		77	71		70
CC1	52		62	47		51
HCO	73		79	68		71

*Predict August 2021 official GEBVs

External information in ssGBLUP

- Extract part of PTA that excludes own data
- Methods:
 - Bayesian priors
 - Pseudo-observations
- Consider type of Interbull data: average of 3 parities
- Some references
 - Quaas, 2004; Legarra et al., 2007; Pribyl et al., 2013; Tsuruta et al., 2017; Boerner et al., 2022,...

Separating foreign data

Inputs from USA and Interbull:

PTA

DE - daughter equivalents

Output:

PTA that excludes USA data

$$PTA_{NUSA,i} = \frac{(D_{NUSA,i} + \alpha)PTA_{IB,i} - (D_{USA,i} + \alpha)PTA_{USA,i}}{D_{NUSA,i} + \alpha}$$

External info as observations

Deregressed proof: $drp = g + a + e^*$

Repeatability model: $y = hys + a + pe + hs + e$

Pseudo observations: $y_{drp} = hys_e + a + 0 + 0 + e^*$

DRP observation with weight: $weight = \text{var}(e^*) / \text{var}(e)$

One hys_e for modeling base change

Multiple hys_e by year of birth to account for preselection

Bayesian prior for external information

$$u_E | y_E \sim \text{MVN}(\mu + \widehat{u}_E, D)$$

E – external info

D – function of accuracy, may be diagonal

μ – base difference

$$\begin{bmatrix} X'X & X'Z & 0 \\ Z'X & Z'Z + \alpha H^* & \alpha H^* Q \\ & Q' \alpha H^* & \alpha Q' H^* Q \end{bmatrix} \begin{bmatrix} \widehat{b} \\ \widehat{u} \\ \widehat{\mu} \end{bmatrix} = \begin{bmatrix} X'y \\ Z'y + H^* \widehat{u}_E \\ Q' H^* \widehat{u}_E \end{bmatrix}$$

Quaas, 2004

Legarra et al, 2008

Tsuruta et al., 2016

$$H^* = H^{-1} + \begin{bmatrix} 0 & 0 & 0 \\ 0 & D^{-1} - A_{EE}^{-1} & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

Implemented in BLUP90MBE

Used for many beef breeds

Comments

- Test implementation for test day model (Aguilar, 2023)
- Focus on obtaining DRP from ssGBLUP
 - E.g., Masuda et al. (2021)
- International evaluation and SNP prediction – Do genomic predictions for major traits converge?

Conclusions

- External info can be incorporated in ssGBLUP
- Use as pseudo observations simpler than as priors
- Largest gains for
 - Small populations – de-facto reversed SNP prediction
 - Low heritability traits
 - Sparsely recorded traits

UGA AB&G team

