

Predicting Facial Microbial Distribution

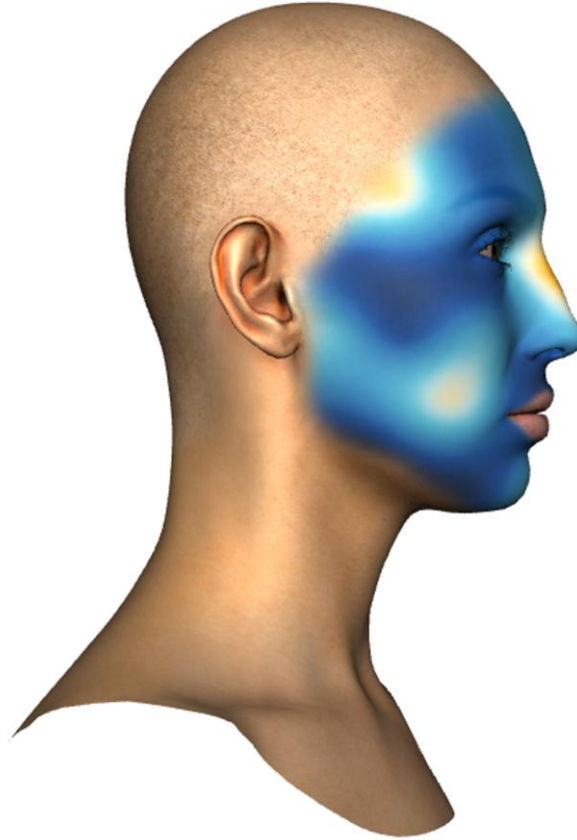
A Machine Learning Approach

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C. acnes Facial Map

**Measured
Distribution**

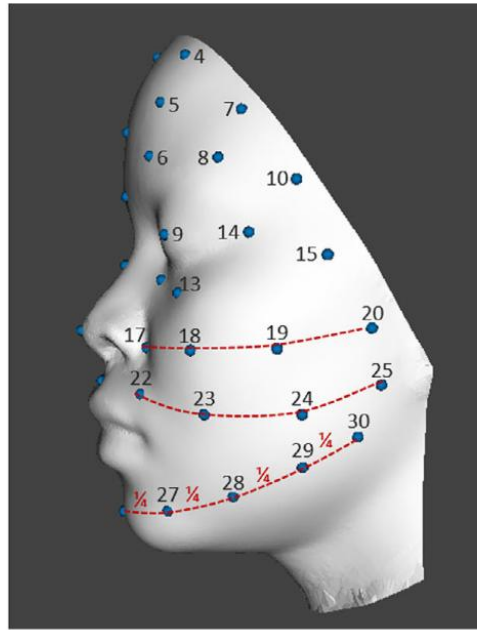
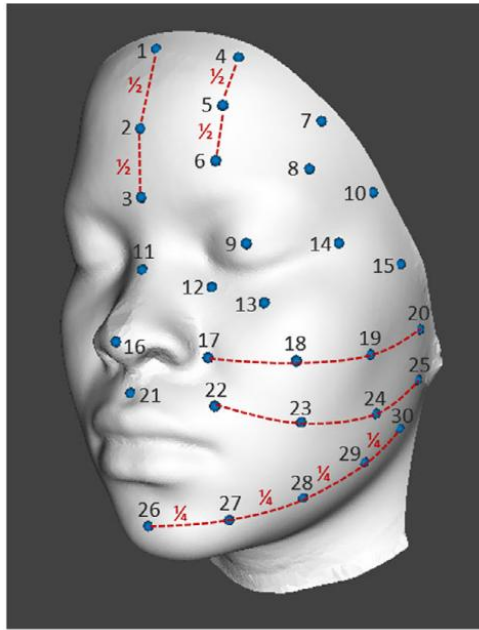
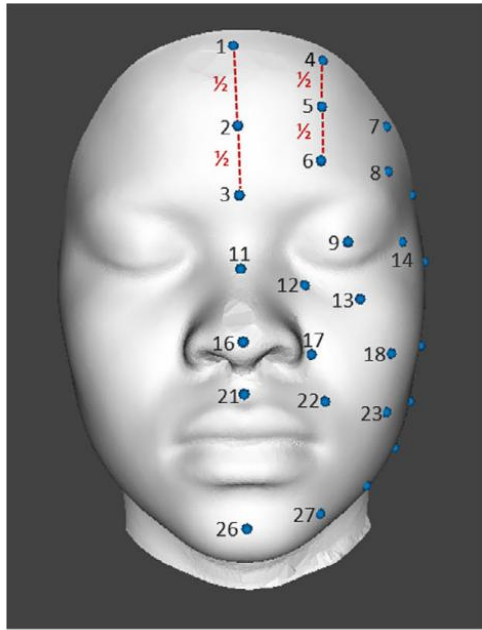


**Predicted
Distribution**

Can we reconstruct full facial microbiome distributions from a minimal number of sampling sites?

Fewer sites = less sampling and overall lower costs

Facial Maps – High resolution 3D models



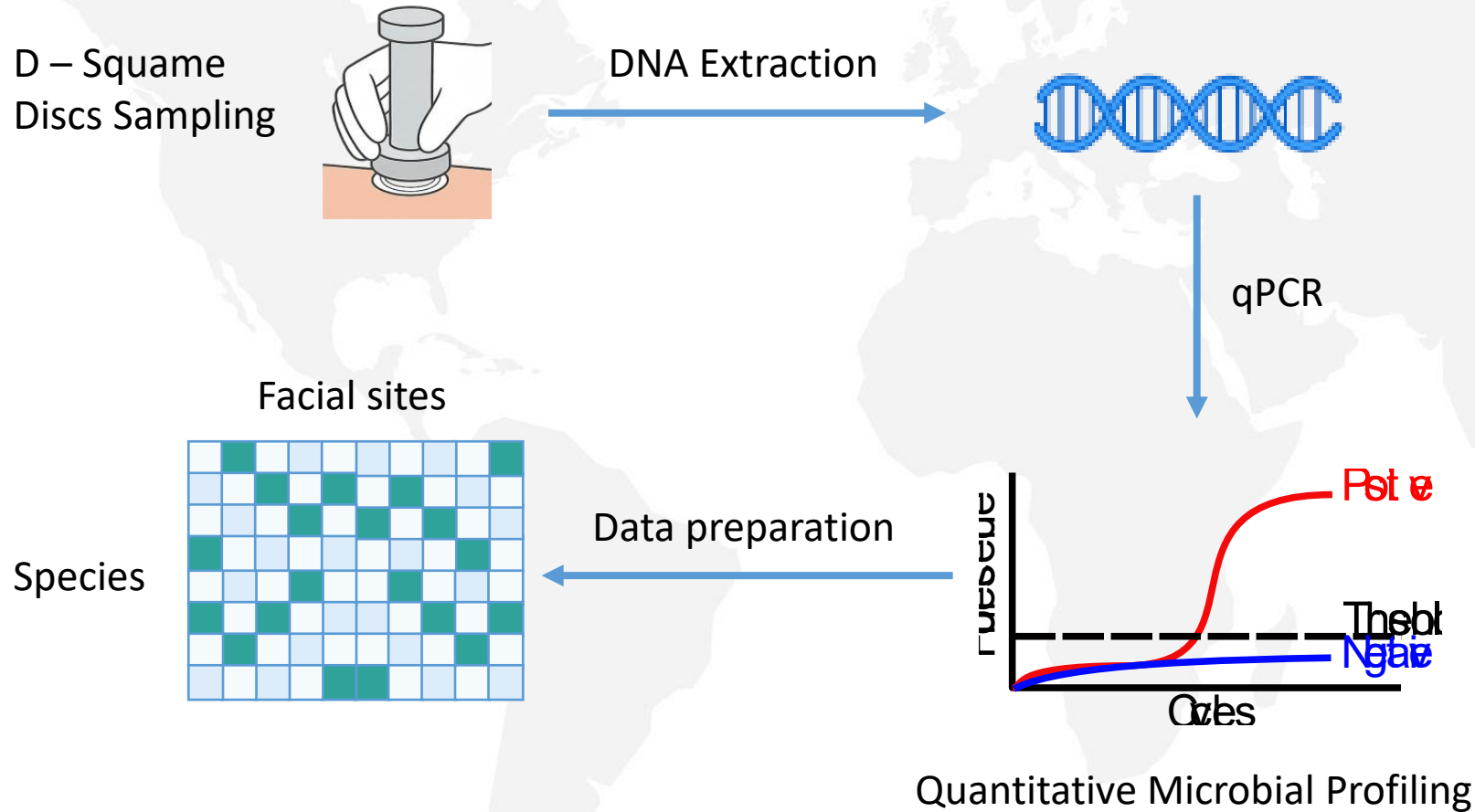
Existing applications:

- Skin surface pH
- TransEpidermal Water Loss (TEWL)
- Skin hydration

Showcased at tradeshow and conferences.

Interpolation with thin-plate splines.

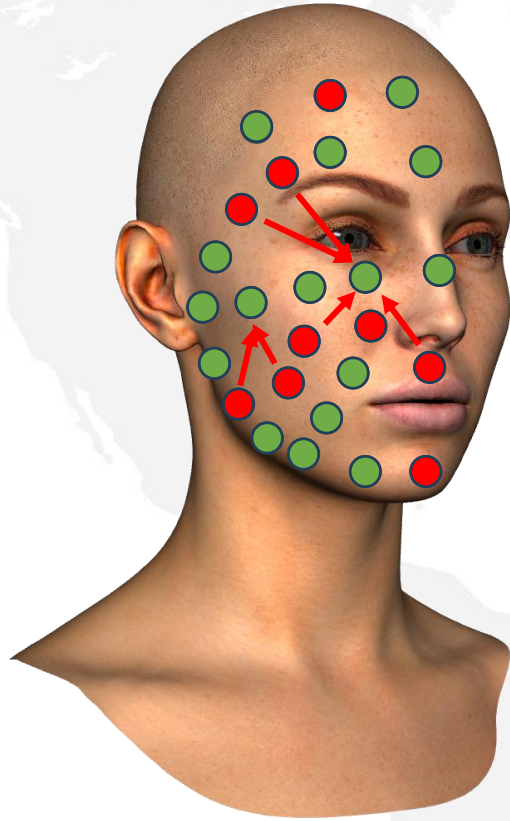
Study design



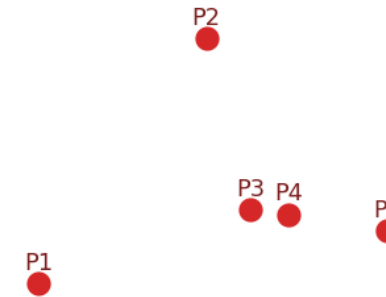
Details:

- 5 Healthy participants
- 21 Facial sites
- 55 Species and genera

Machine Learning approaches

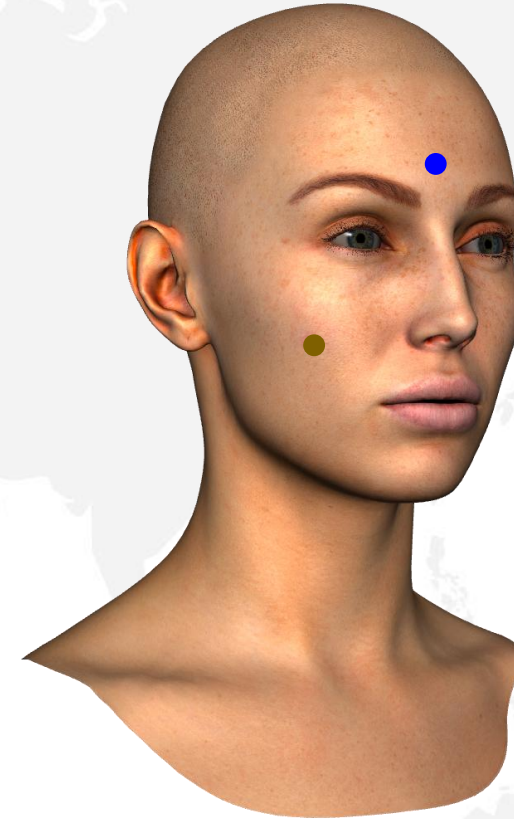
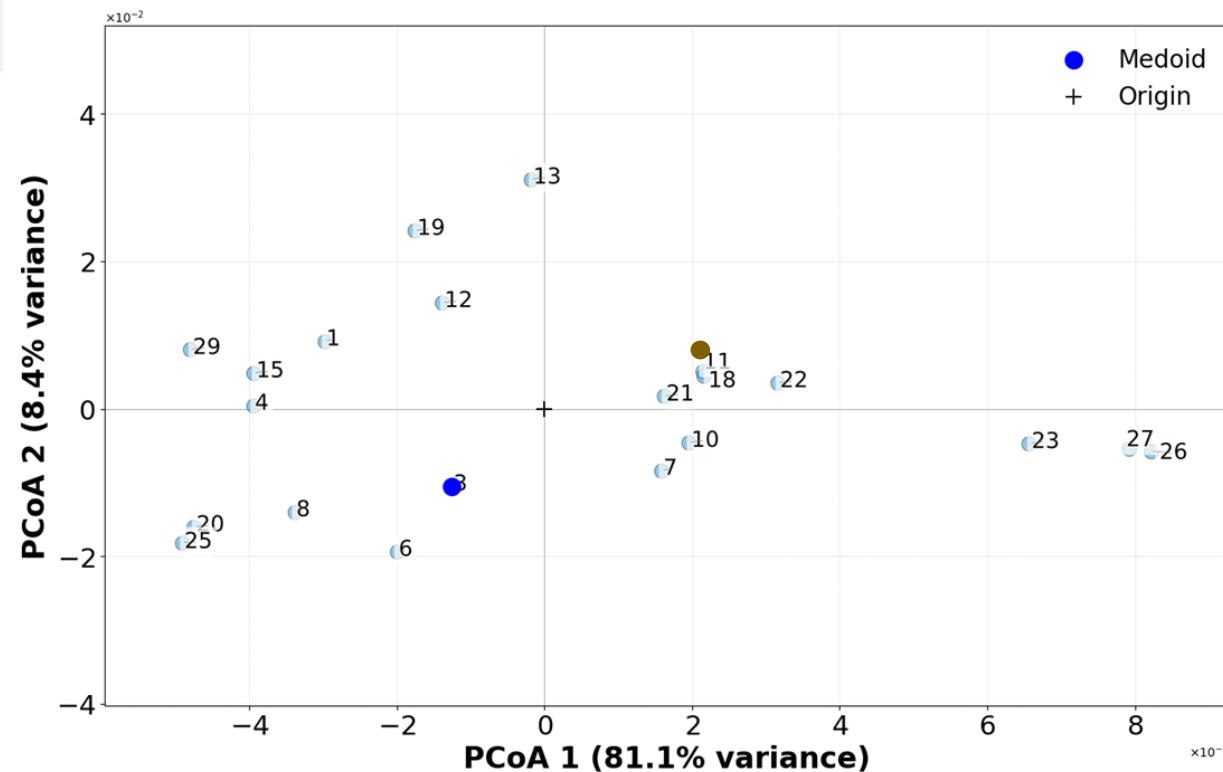


Anchor points in 3D space



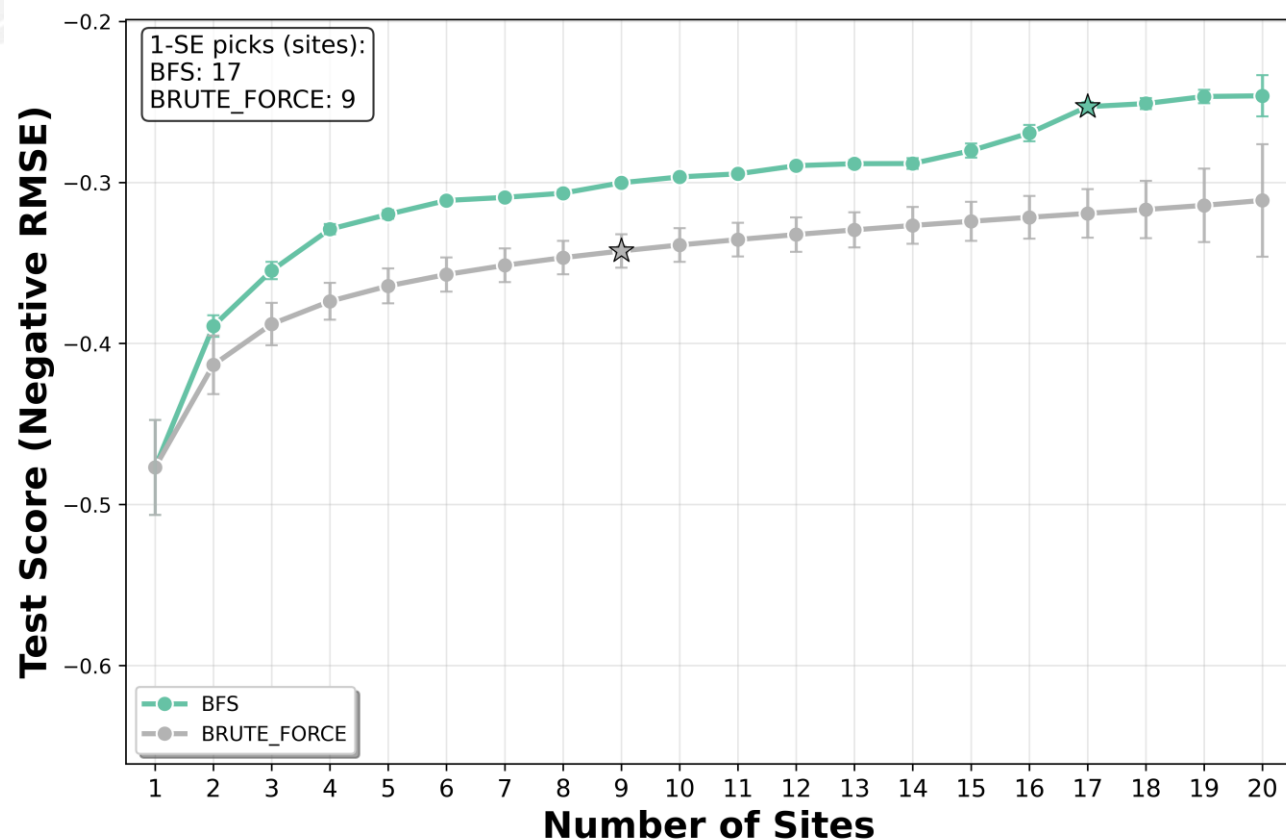
Select minimum number of sites to generate facial map

Most “representative” site



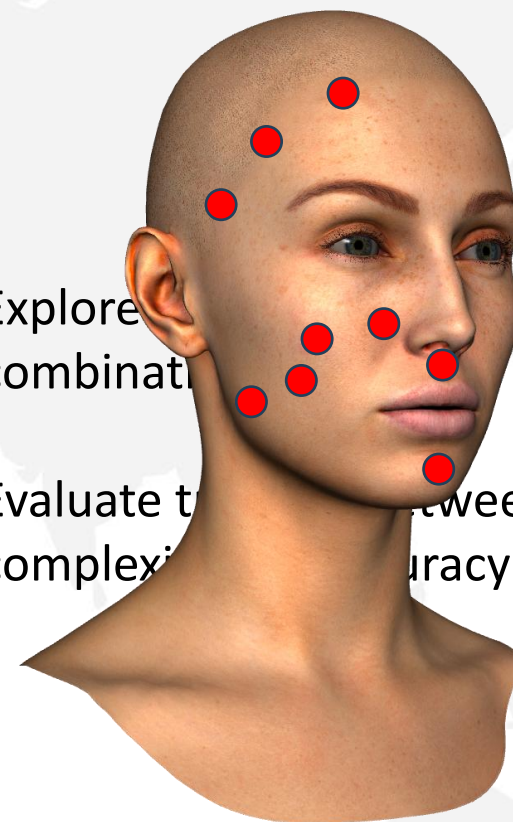
- Forehead, but others found cheek.
- Most works, this one included, are small in cohort and sample size.

Evaluating millions of possible solutions



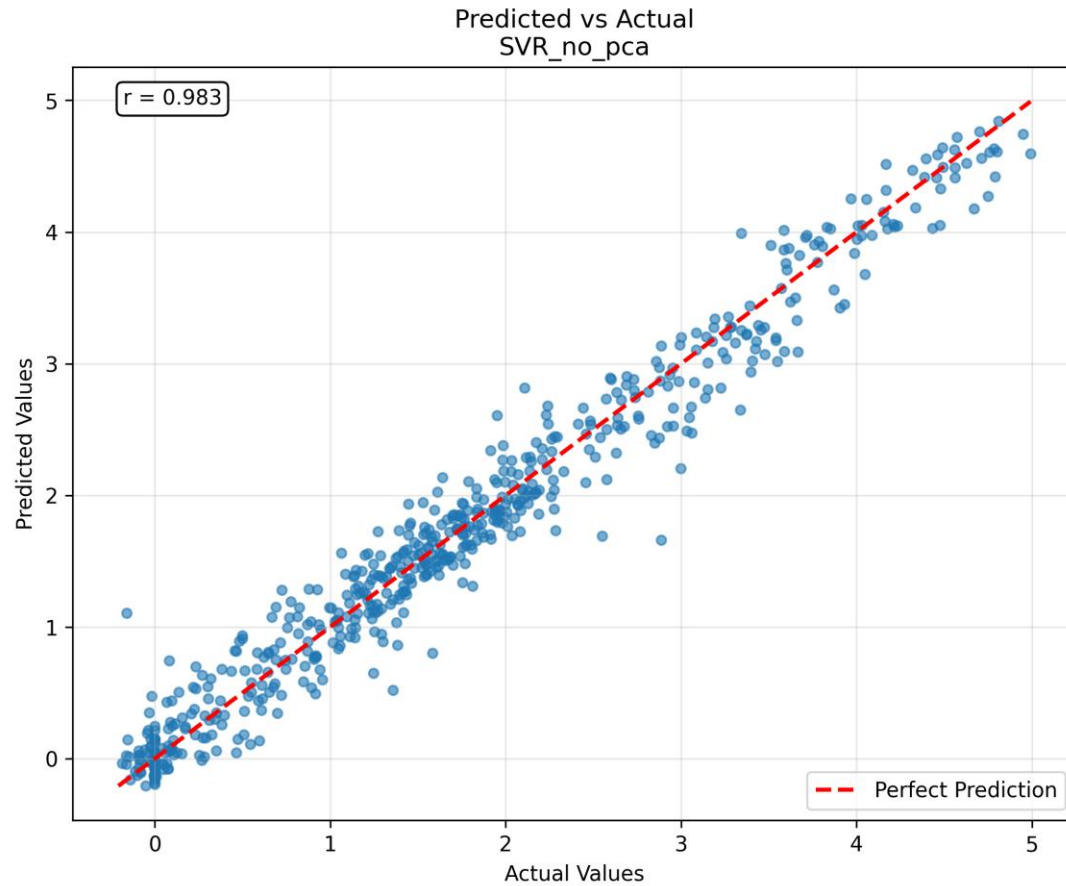
1 Standard Error selection heuristic

- Explore combinations of sites
- Evaluate trade-off between complexity and accuracy

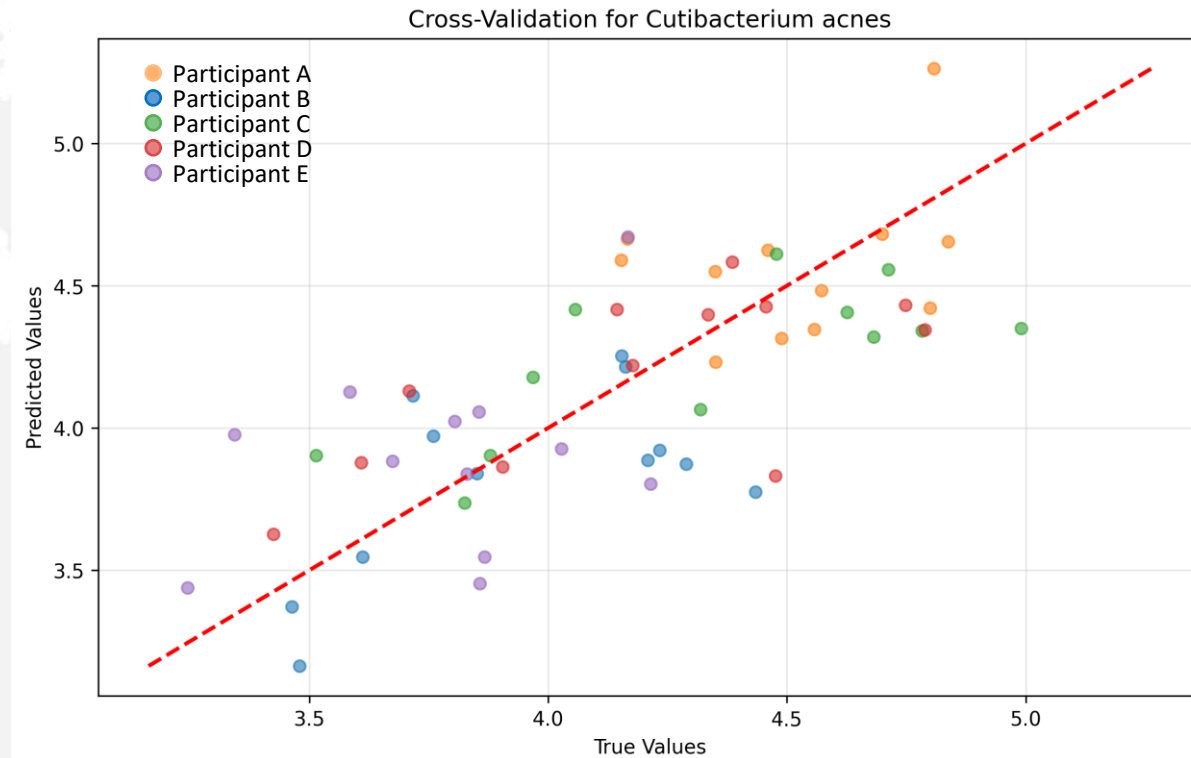


How “good” is the model?

Fit and Data inspection

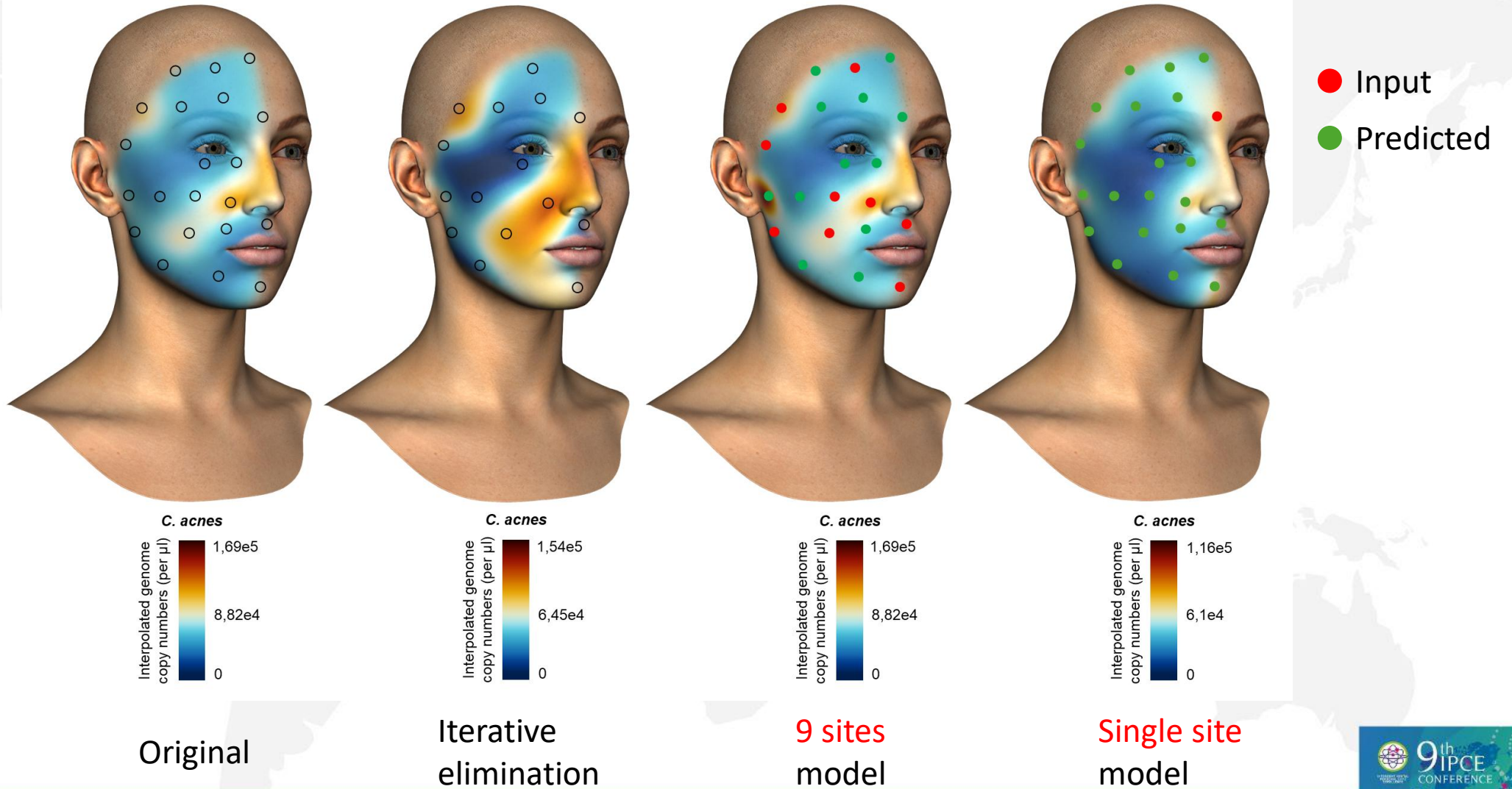


Evaluation



Good fit, but still strong subject bias as shown in the individual bacterium example

Is it useful?



Conclusions

Machine learning allows reconstruction of spatial distributions of microbes with ca. 60 % less sampling (9 sites model)

Future potential applications:

- Detecting and mapping facial skin dysbiosis in a cost-efficient way.
- Microbiome – based facial skin age clock
- Solutions to support a healthy skin microbiome

Acknowledgements

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Dr. M. Pagac	Idea and study execution
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Dr. R. Campiche	Support and funding

ANH (Austria)

S. Raurich	Microbiome analysis expert
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Bio-Me

Dr. A. Finzel	q-PCR analysis
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Related works:

- **Patent application pending / filing:** CAMPICHE, Remo Hadrian, Martin Patrick PAGAC, Alexander Schlifke-Poschalko, and Martin Stalder. Method and system for providing a plurality of localized values representative of quantities of at least one facial microbiome taxa. WO2025224015A1, filed April 17, 2025, and issued October 30, 2025.
- **JID Letter:** Stalder, Martin, Sergi Raurich, Ana Finzel, et al. "3-Dimensional Facial Skin Microbiome Mapping: An Integrated Technology for Continuous Visualization of Absolute Microbial Densities." *Journal of Investigative Dermatology* (2026).

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