

Introduction

- Maddieson (1984) with some reference to secondary articulations in about 317 languages
- No address of secondary articulations in other studies (e.g., Gordon, 2016)
- Research aim: Quantitative typological overview of **labialization**, **palatalization**, **pharyngealization**, and **velarization** using a large dataset

Methods

- Datasets: **PHOIBLE** (Moran & McCloy, 2019) & **GLOTTOLOG** (Hammarström et al., 2022)
- Data basis: *One randomly sampled phoneme inventory for each Glottocode in PHOIBLE* (= 2,177 phoneme inventories)
- *Python v3.10* (Van Rossum & Drake, 2009), *Cartopy v0.20.2* (Met Office, 2015), *PyMC3 v3.11.2* (Salvatier et al., 2016), *Bambi v0.7.1* (Capretto et al., 2020)
- Phonemes were grouped into *Place* according to the major category of their transcription; *Manner* groupings were done partly according to Hayes (2009); *Voicing* according to the feature [\pm periodicGlottalSource] (ambiguous values, e.g., "+,-", "-,+ " were ignored)

Geographical distribution

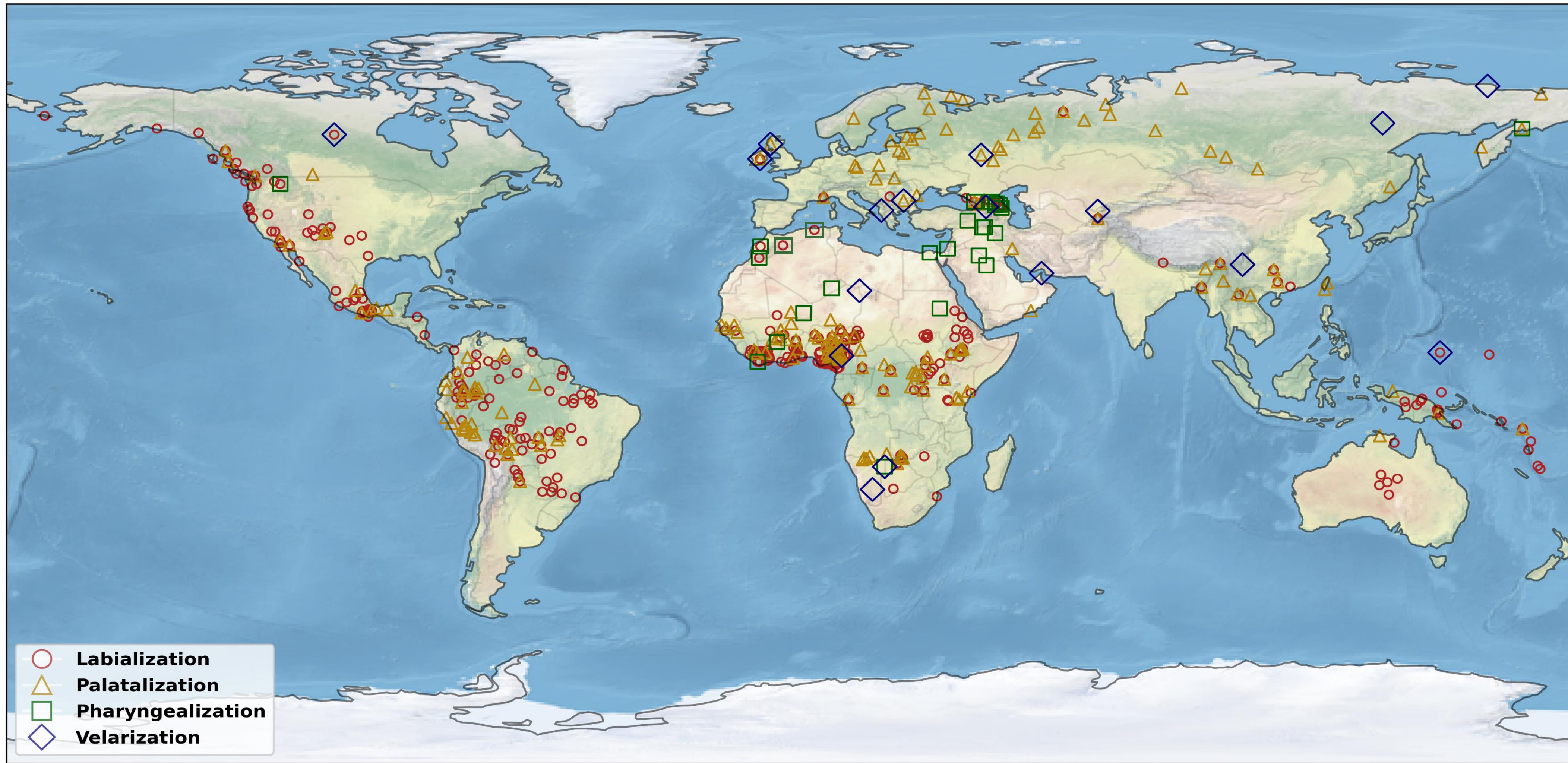


Figure 1. Geographical distribution of secondary articulations.



Overview

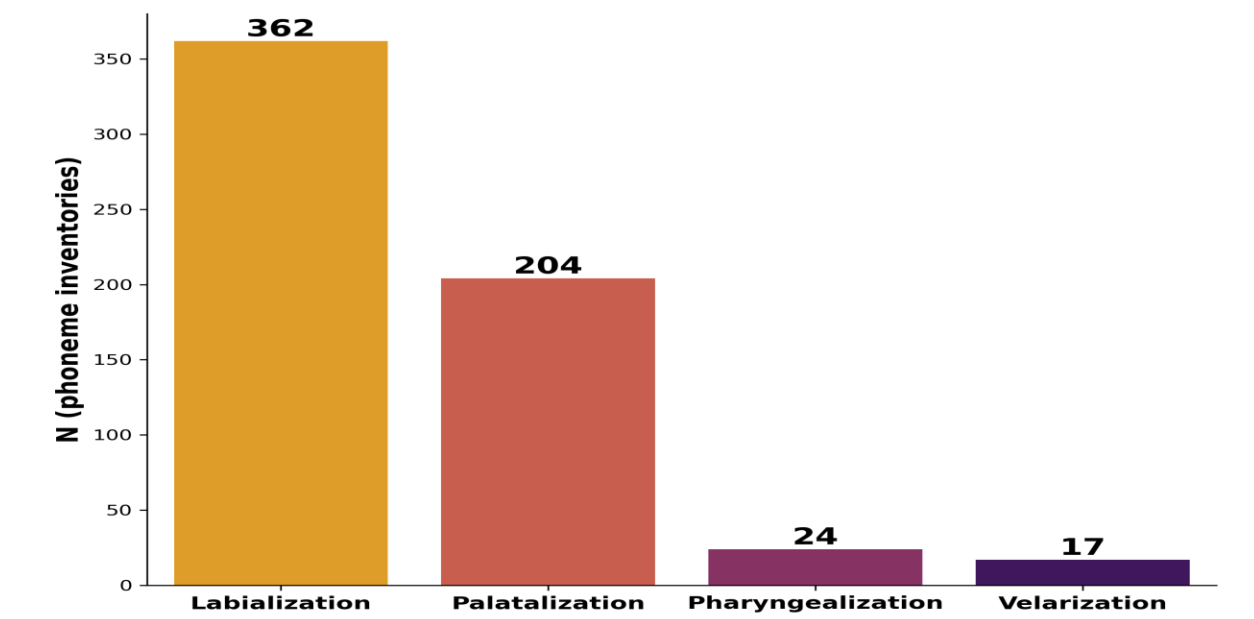


Figure 2. Number of phoneme inventories by secondary articulation.

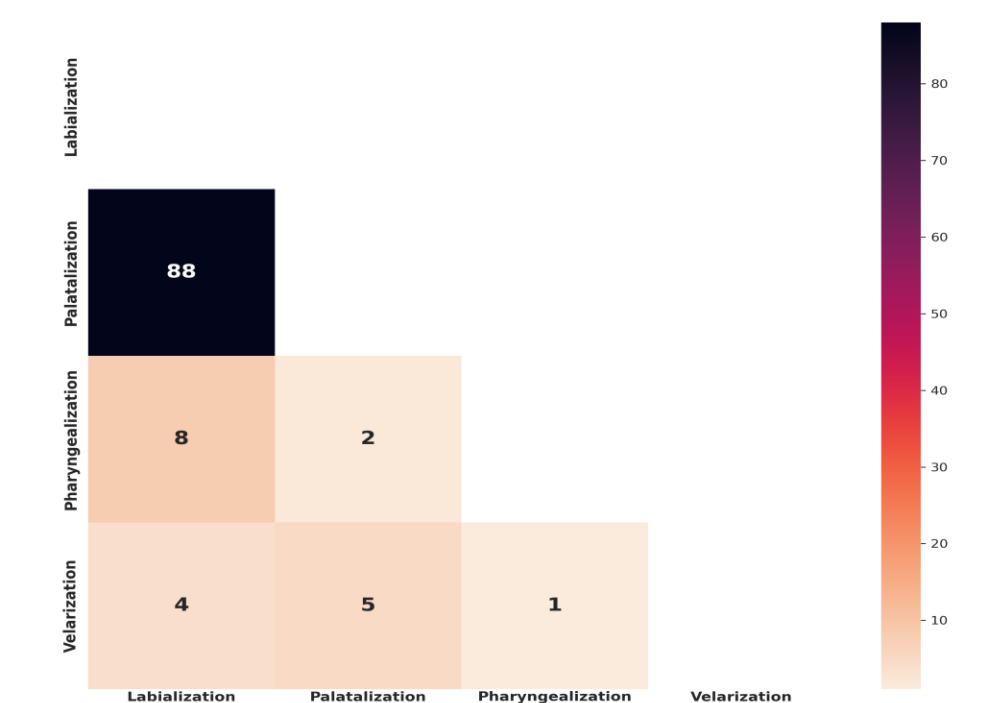


Figure 3. Heatmap of the number of phoneme inventories with two secondary articulations.

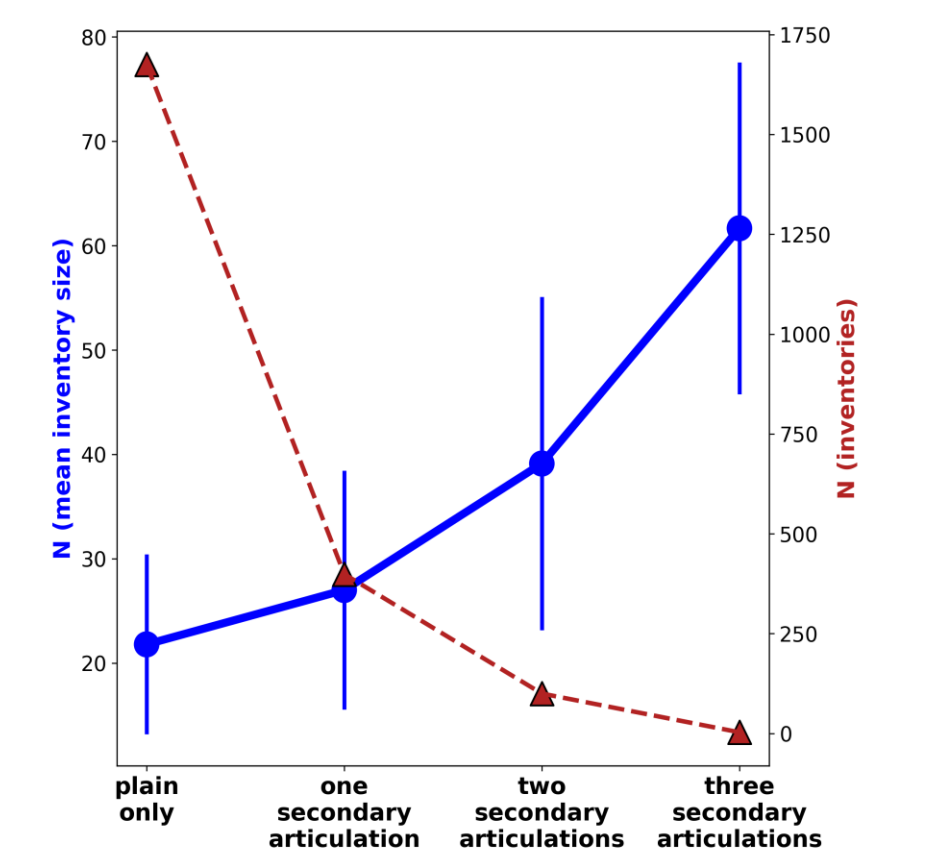


Figure 4. Mean consonant inventory size (blue) and number of inventories (red) by number of secondary articulations.

Place

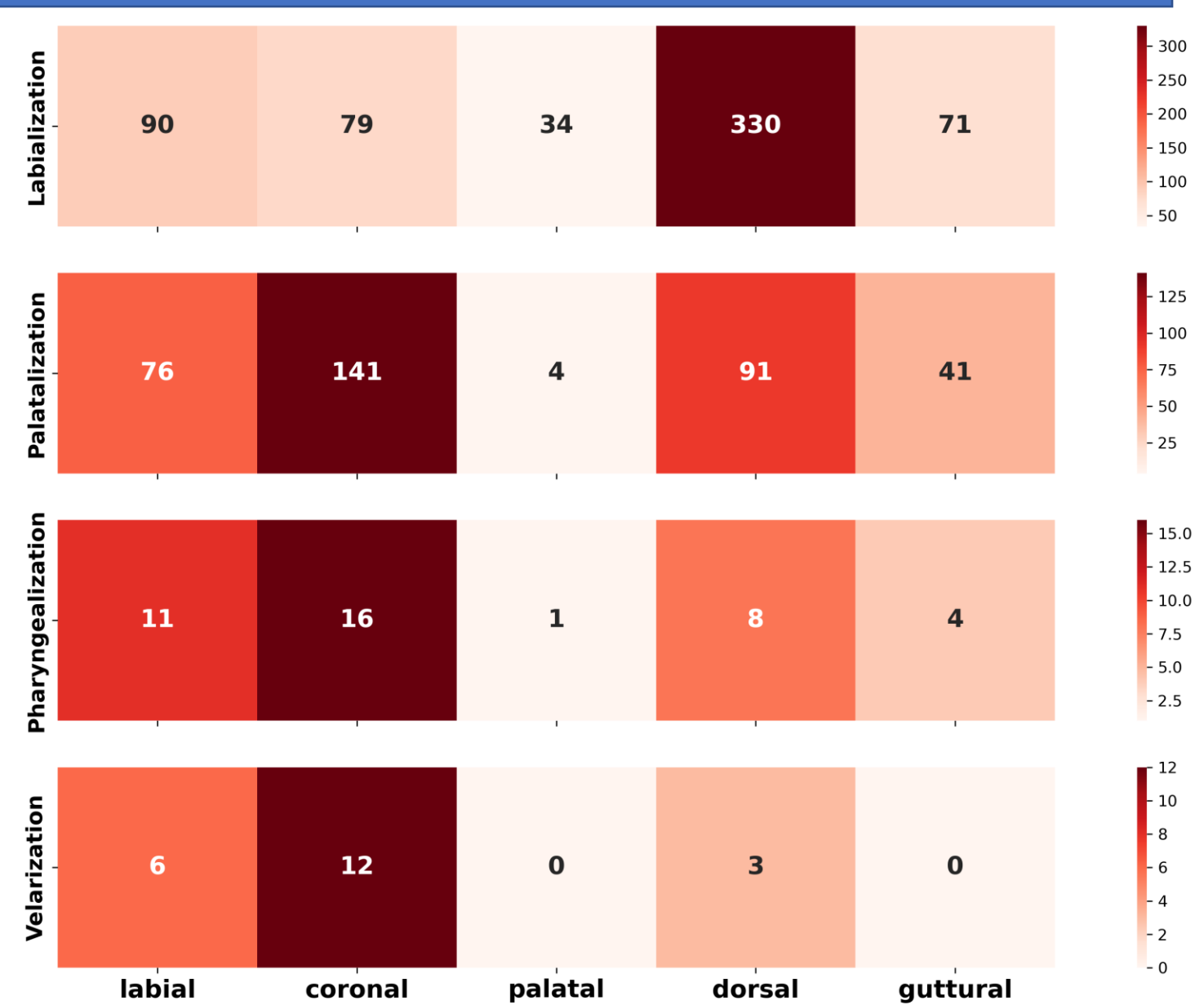


Figure 5. Number of phoneme inventories by secondary articulation and place.

Manner

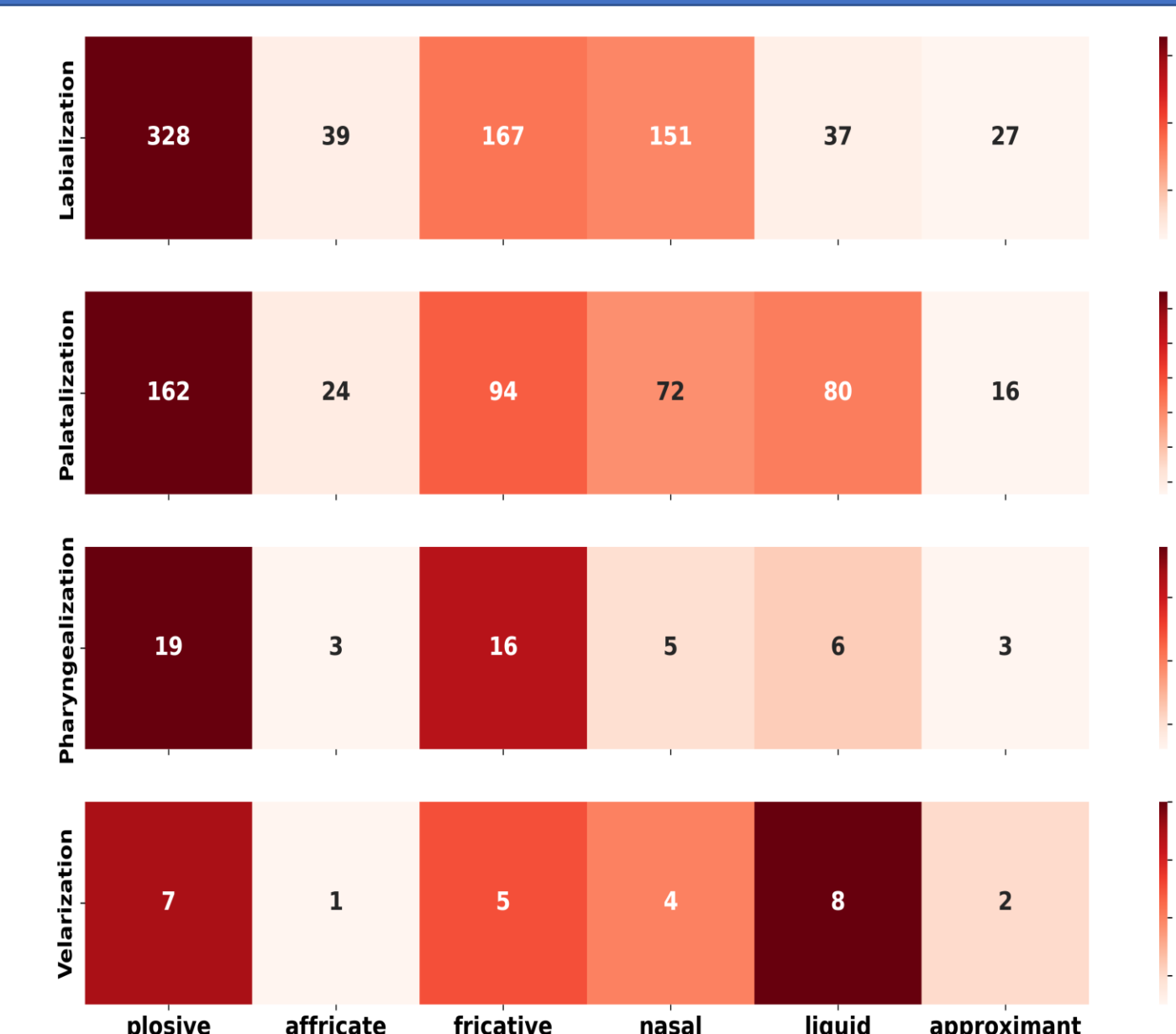


Figure 6. Number of phoneme inventories by secondary articulation and manner.

Voicing

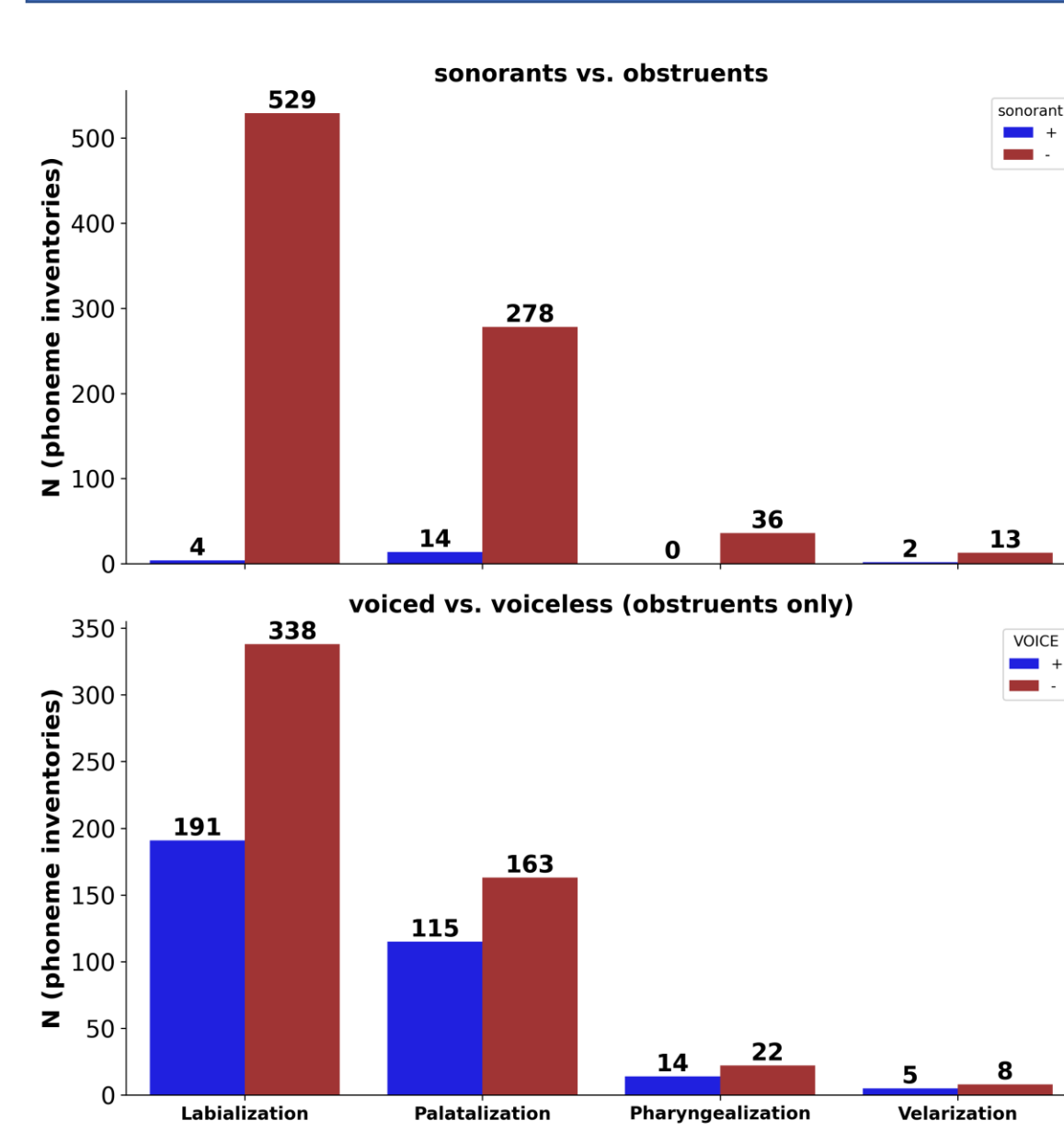


Figure 7. Number of phoneme inventories by secondary articulation and sonorant/obstruent (top) and voicing distinction (bottom).

General observations

- ~ 23% (502/2,177) of the phoneme inventories have at least one secondary articulation
- Order by frequency: **labialization** > **palatalization** > **pharyngealization** > **velarization** (Fig. 2)
- If a phoneme inventory has two secondary articulations, labialization and palatalization pattern most often together (Fig. 3)
- If a phoneme inventory has simultaneous secondary articulations (e.g., /m^{wy}/ in Satawalese), labialization is always one of them:
 - Labialization + Palatalization (N=5)
 - Labialization + Pharyngealization (N=3)
 - Labialization + Velarization (N=2)

Feature-based principles

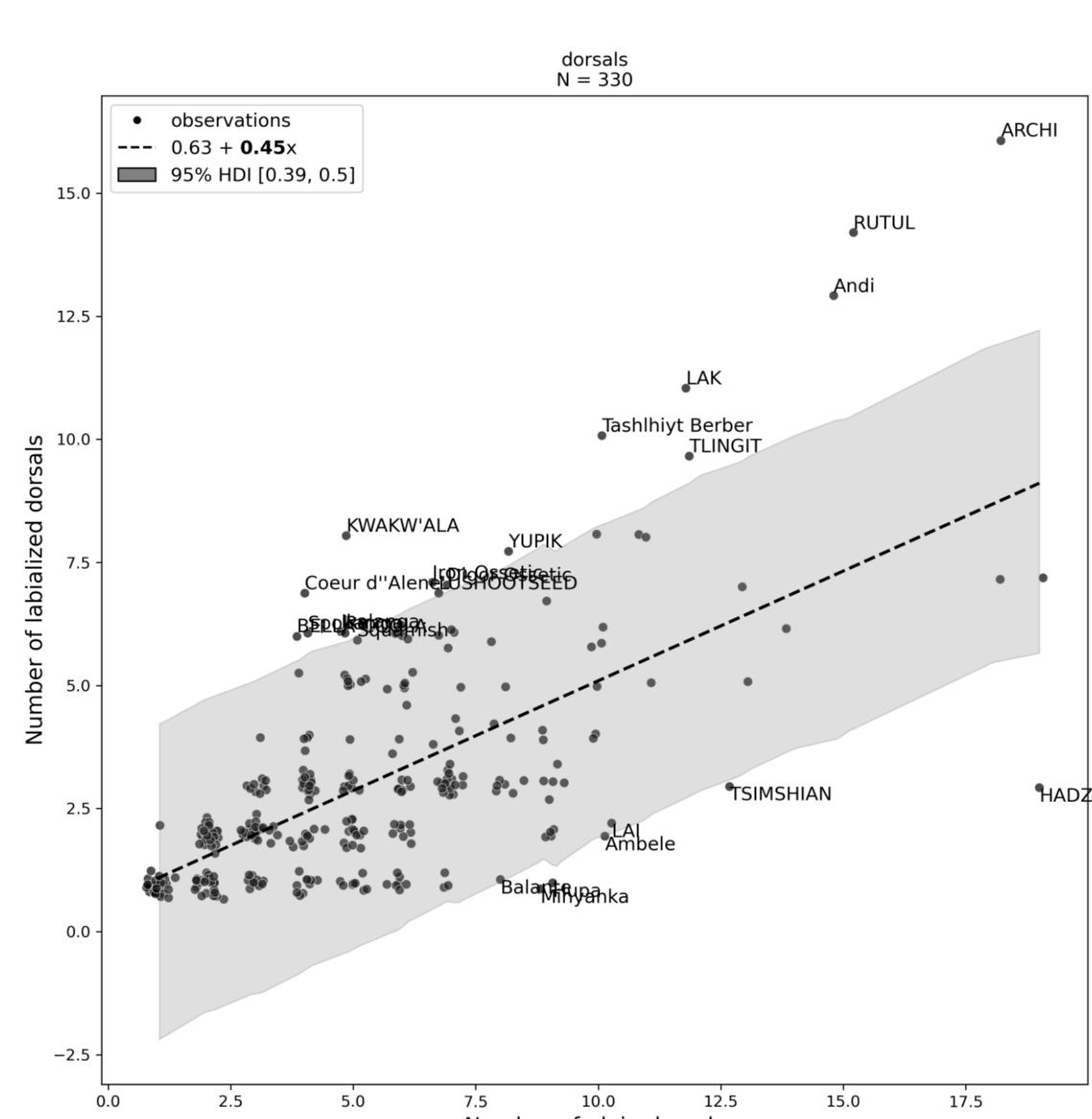
- **PLACE**: Set of consonants with a secondary articulation is inferior to the set of their plain counterparts (Fig. 8)
- **MANNER**: Secondary articulation most likely in plosives, most unlikely in affricates and approximants (Fig. 6); Most phoneme inventories have labialized and palatalized stops; pharyngealization occurs in plosives and fricatives (almost) alike
- **VOICING**: The overwhelming majority of the phoneme inventories has secondary articulations on obstruents. More languages have secondary articulations on voiceless obstruents than on voiced obstruents (Fig. 7)

When Feature-Economy counteracts Markedness:

- Labialization in Tashlhiyt, Rutul, Archi, etc. (Fig. 8)
- See also the case of pharyngealization in Tashlhiyt with its sixteen pharyngealized consonants.

Marked Feature Avoidance (Clements 2009):

- Negative correlation: segments with secondary articulation occur in fewer inventories (Fig. 4)
- Positive correlation: marked segments occur in larger inventories: phoneme inventories with 3 sec art (≈ 62) > phoneme inventories with 2 sec art (≈ 39) > languages with 1 sec art (≈ 27) > phoneme inventories with 0 sec art (≈ 22)



For detailed analyses see:



Figure 8. Scatterplot and regression estimates of the number of labialized dorsals by plain dorsals (with added jitter) with 95% HDI. Phoneme inventories falling outside the 95% HDI are marked with their language name.

References

Capretto, T., Piho, C., Kumar, R., Westfall, J., Yarkoni, T., & Martin, O. A. (2020). Bambi: A simple interface for fitting bayesian linear models in python. Retrieved May 2, 2022, from bambinos.github.io/bambi/ | Gordon, M. K. (2016). Phonological typology. Oxford University Press. | Hammarström, H., Forkel, R., Haspelmath, M., & Bank, S. (2022). Glottolog 4.5. Leipzig: Max Planck Institute for Evolutionary Anthropology. Retrieved May 16, 2022, from www.glottolog.org | Hayes, B. (2009). Introductory Phonology. Wiley-Blackwell. | Maddieson, I. (1984). Patterns of sounds. Cambridge University Press. | Met Office. (2015). Cartopy: A cartographic python library with a matplotlib interface. http://scitools.org.uk/cartopy | Moran, S., & McCloy, D. (2019). PHOIBLE 2.0. Retrieved May 16, 2022, from https://github.com/phoible/dev | Salvatier, J., Wiecki, T. V., & Fonnesbeck, C. (2016). Probabilistic programming in python using pymc3. PeerJ Computer Science, 2, 1–24. https://doi.org/10.7717/peerj-cs.55 | Van Rossum, G., & Drake, F. L. (2009). Python 3 reference manual. CreateSpace.