

Analyzing Source Sampling to Reduce Error in ECG Forward Simulations

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Introduction

- ECG imaging (ECGI) is a promising technology for diagnosing and treating arrhythmias.
- ECGI requires well validated forward simulations to compute the cardiac activity [1]
- ECG forward simulations still have significant error [2]
- A possible origin of error is under-sampling of the atria
- We will analyze the effect of ignoring these cardiac source by testing various

Methods

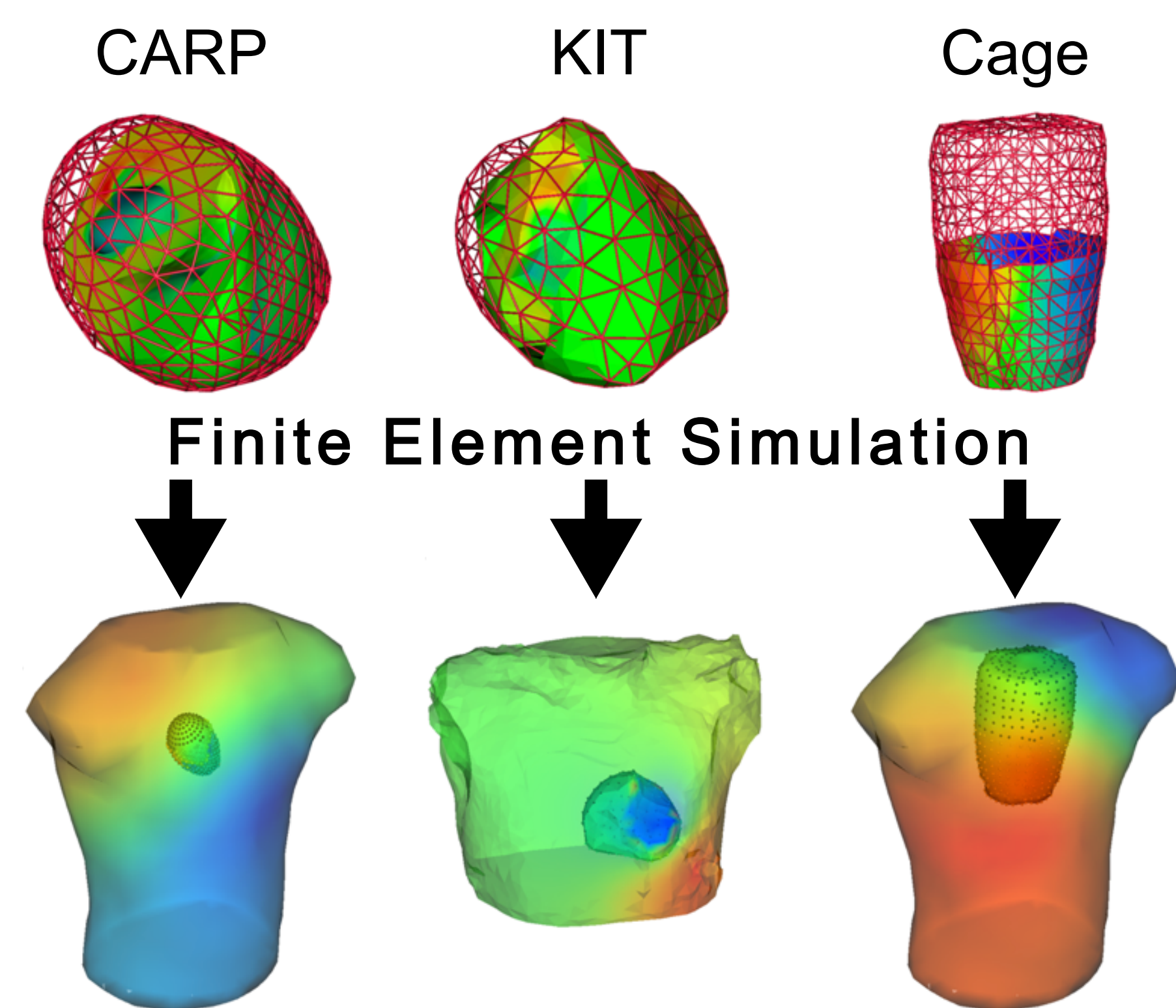


Figure 3. Three ground truth data used to test sampling in the ECG forward simulation.

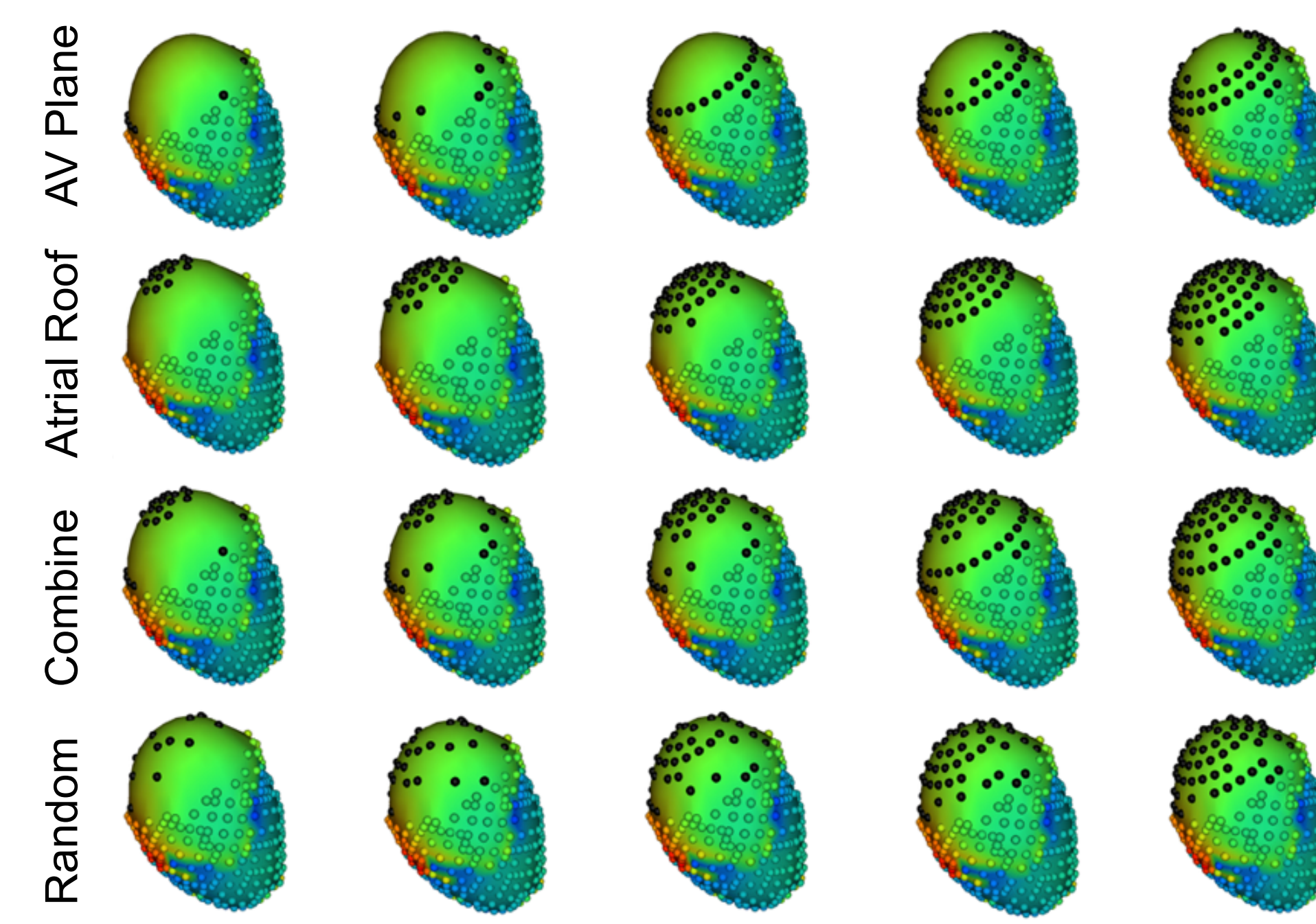


Figure 4. Four sampling strategies used to evaluate effect of the atrial sampling on the forward simulation.

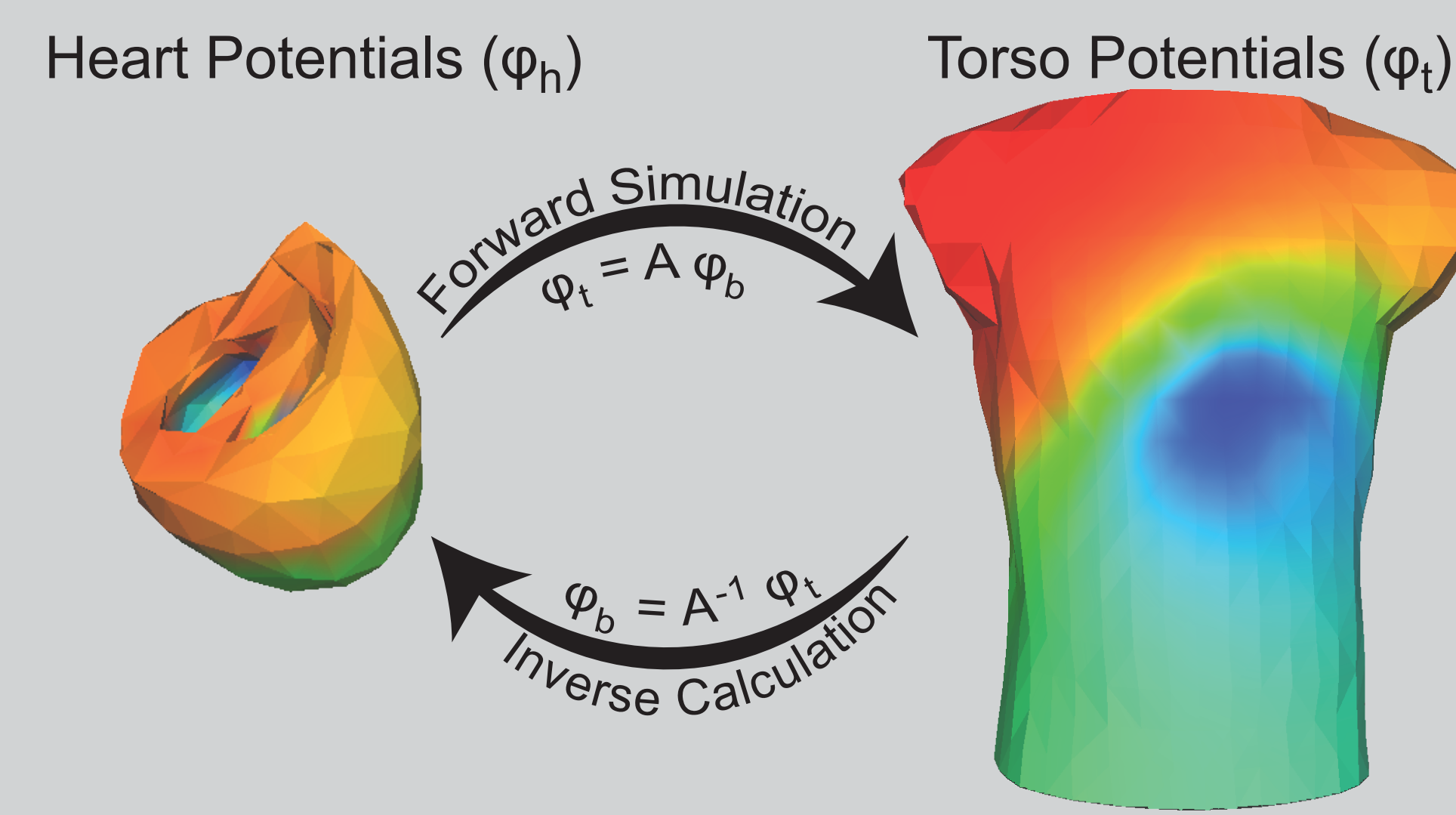


Figure 1. Forward and Inverse pipeline in electrocardiography.

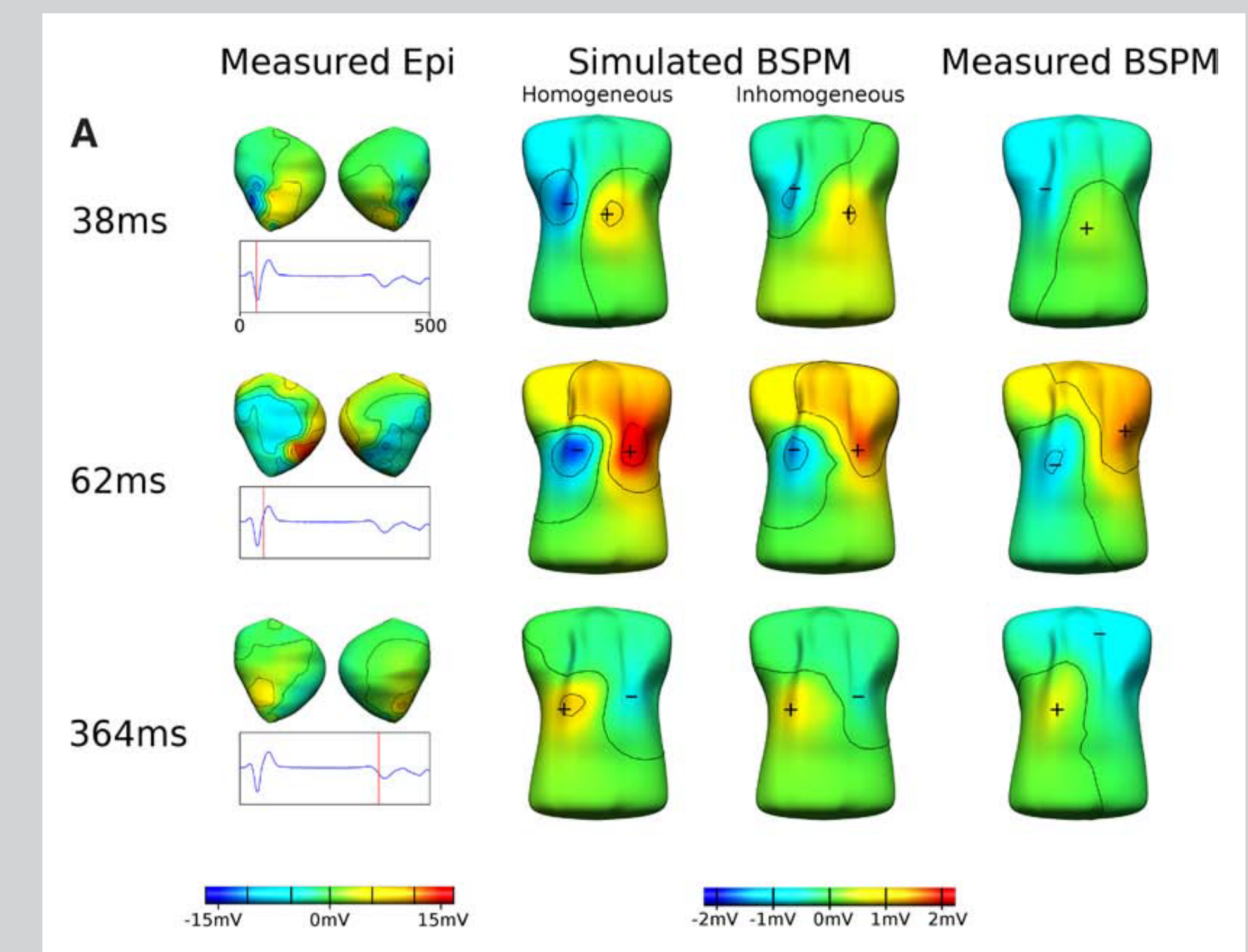


Figure 2. Differences in forward simulation as reported in Bear, et al. [2].

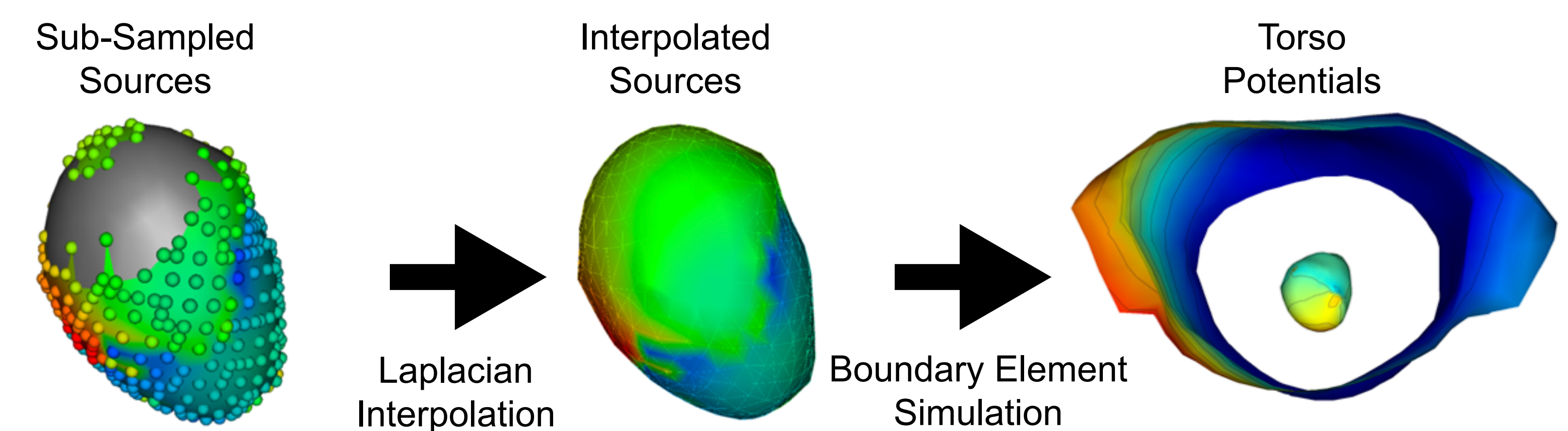


Figure 5. Forward simulation pipeline with sub-sampled cardiac sources.

Results

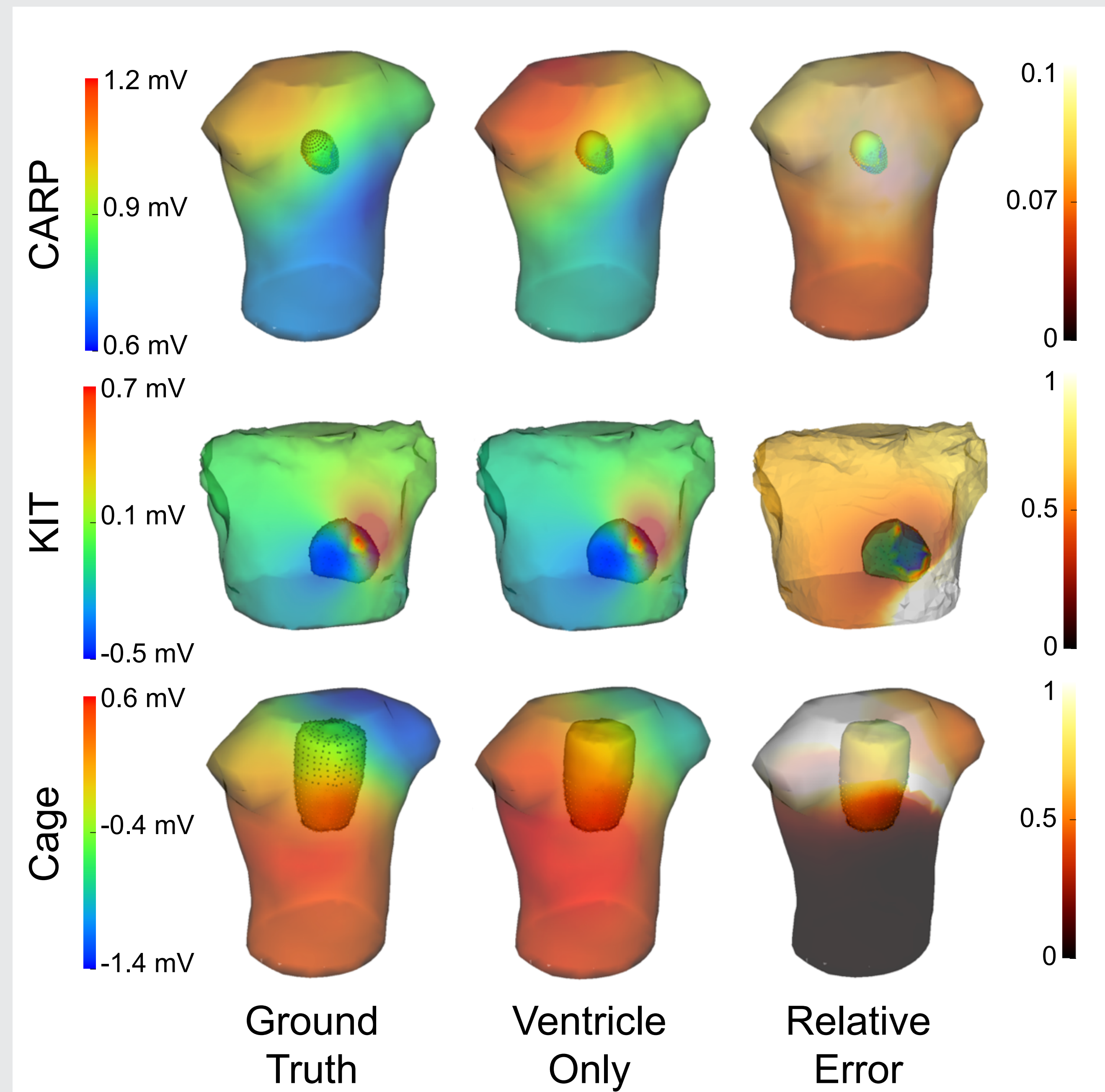


Figure 6. Potential map changes when atrial sampling is ignored.

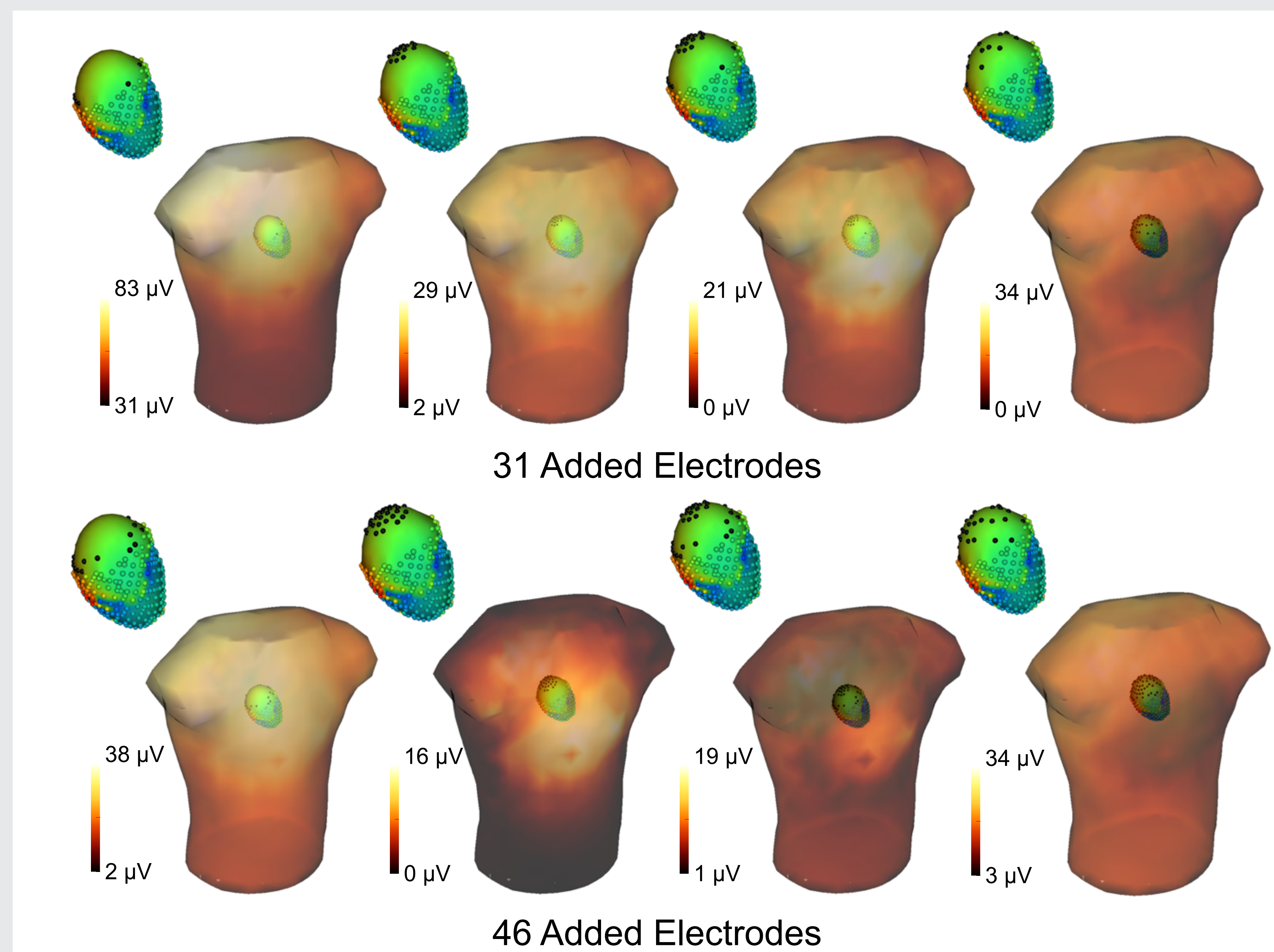


Figure 7. Effect of various sampling strategies as electrodes are added to the atrial region.

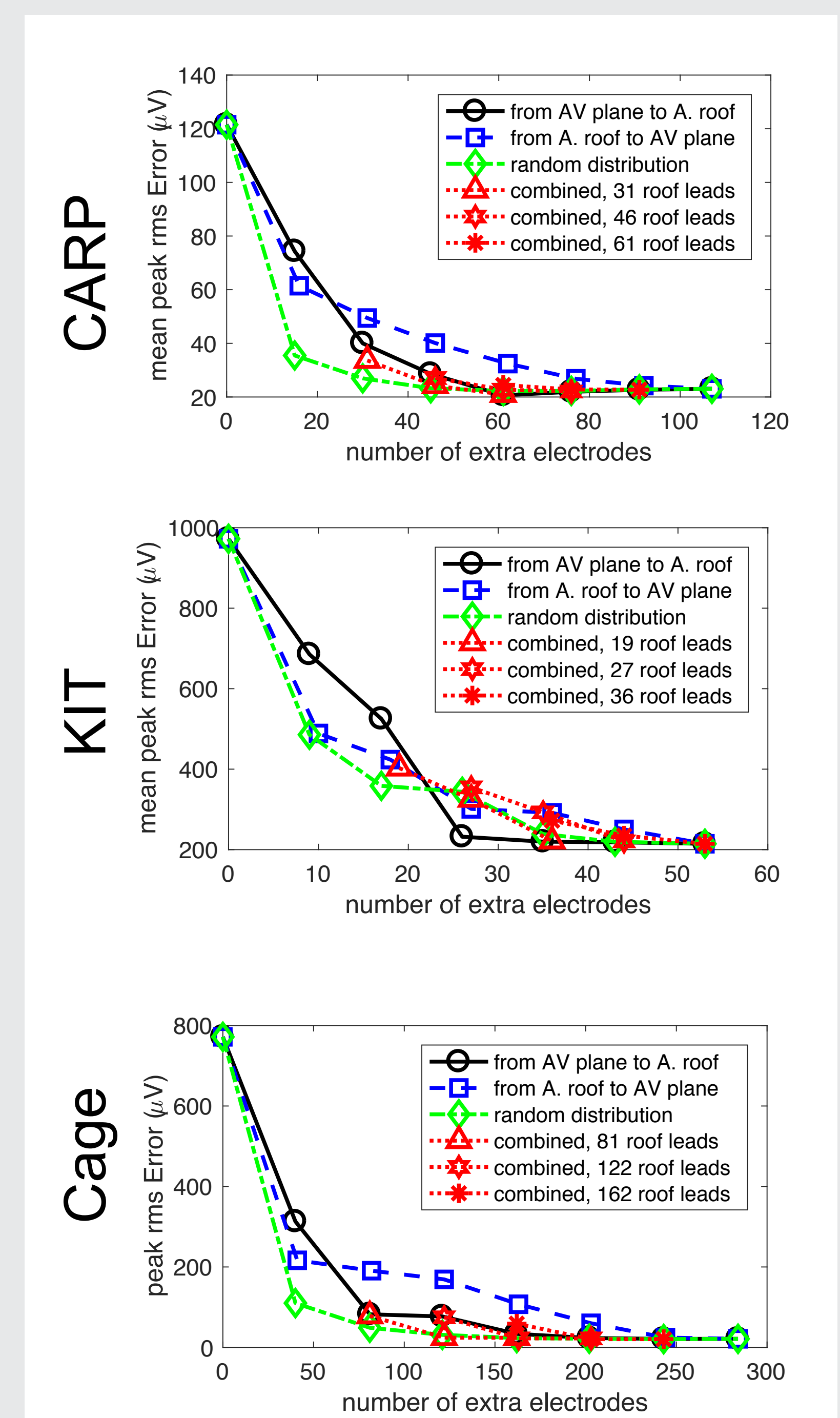


Figure 6. Peak RMS error as sampling is increased in the atrial region.

Conclusions

- Atrial sampling is needed to accurately compute ECG forward simulations
- Incrementally increasing the sampling on the atria will incrementally reduce the error in the ECG forward simulation
- A distributed or combined sampling approach may reduce error with few recording locations
- Future validation studies should include sampling of the atrial region

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