Atrial fibrillation (AF) is the most common serious cardiac arrhythmia encountered in clinical practice, affecting over 3 million Americans. While technological advances have permitted treatment of this condition with electrophysiology study and catheter ablation (CA), outcomes have remained poor. A major limitation is the heterogeneity of the disease – **effective ablation sites for one patient may not translate to a different patient, since each patient has unique features of electrical excitability, atrial size, and anatomy.** If the features of excitability and geometry are known for a given patient, a computer simulation can predict the sites of AF initiation, perpetuation, and potentially elimination with CA. We propose to generate patient-specific computational models of single cell and whole heart electrical activity, constrained wholly on data recorded during catheter ablation procedures. These data will be used to produce in silico electrophysiology studies, whose results can be compared to in vivo data. This precision medicine approach to catheter ablation holds promise to improve outcomes of management of atrial fibrillation.