Defining SCEC5 Priorities

Palm Springs, California

7-10 September 2014

SCEC

an **NSF+USGS** center

SCEC5 Theme Sessions

1. How do we deal with known unknowns and unknown unknowns?
   - Reducing epistemic uncertainty and characterizing aleatory variability - Biasi
2. What properties of the Earth and the faults within it are important for understanding system behavior?
   - Simulators - Lapusta/Dunham
   - Beyond elasticity - Fialko/Johnson/Hirth/Olsen
3. How can the hazard from simulated earthquakes effectively reduce risk in the real world?
   - Ground motion simulations - Olsen/Graves
   - Infrastructure system risk - Baker
4. What aspects of earthquake behavior are predictable?
   - Science of operational earthquake forecasting - Field
   - "Atectonic" seismicity - Brodsky/Sandwell
5. Here it comes! What just happened? How can SCEC better prepare to respond to future earthquakes?
   - Earthquake early warning research - Cochran
   - Earthquake response - Oskin
6. How can we communicate more effectively what we know and what we don't?
   - Risk communication and new technologies – Benthien

Ingredients for a good SCEC5 proposal

- **Visionary overarching theme**
  - **SCEC4: "Tracking Earthquake Cascades"**
- **Strong summary of SCEC successes in research and CEO**
  - **SCEC4: articulation in terms of 4 SCEC3 priority objectives**
- **Science plan focused on first-order scientific problems**
  - **SCEC4: 6 fundamental science questions**
- **Interdisciplinary research initiatives**
  - **SCEC4: CVMs, SFSAs**
- **Effective organizational plan**
  - **SCEC4: TAGs, EE Implementation Interface, special projects**
- **CEO plan that builds on SCEC successes**
  - **SCEC4: *ShakeOut*, ECA, EPIcenters, *Roots* series, intern programs**
- **Management plan**
  - **SCEC4: diversity plan, IT/data management plan**
- **Metrics and milestones**
  - **SCEC4: added during negotiation of cooperative agreements**

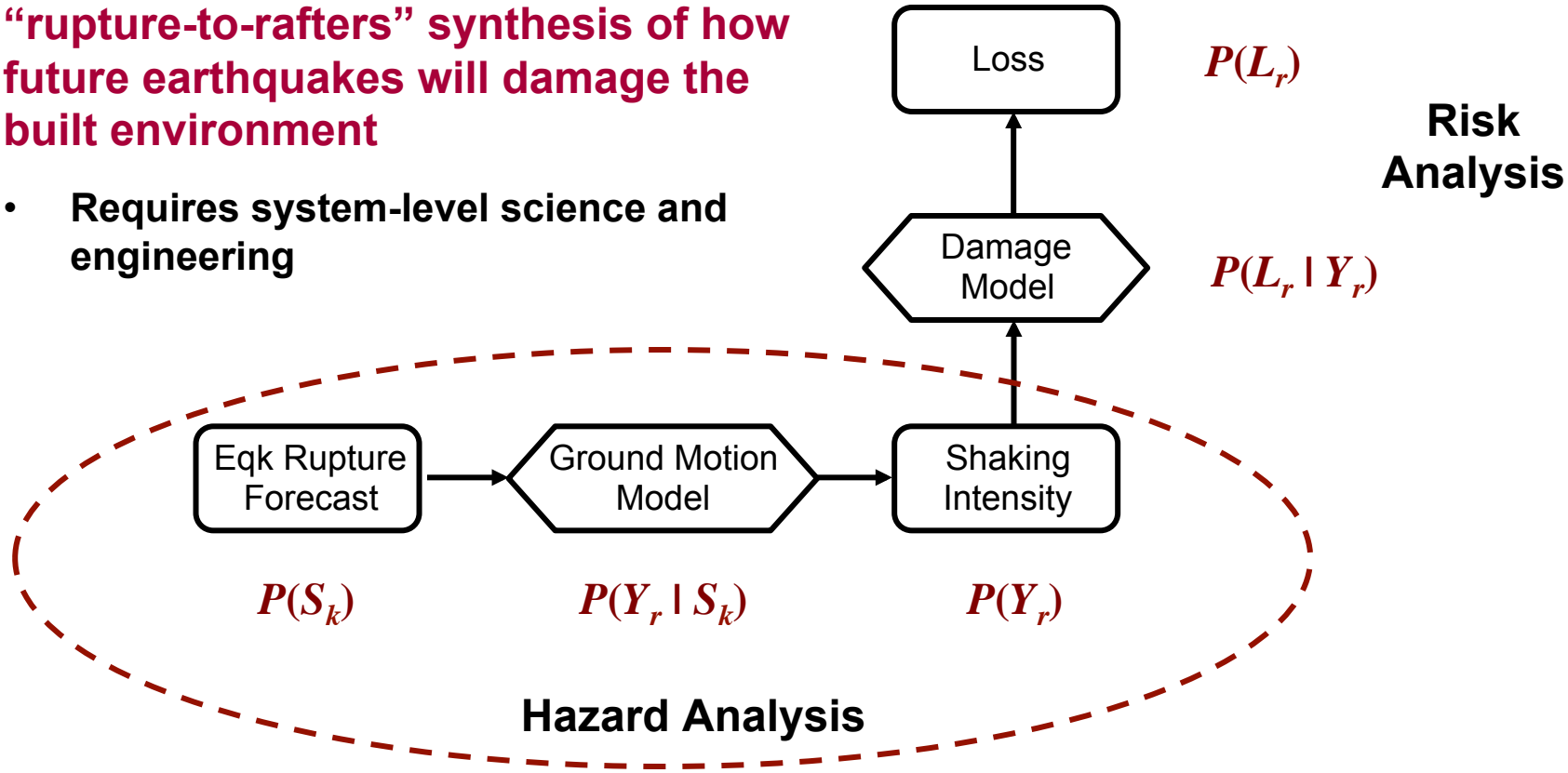
Components of the SCEC5 Proposal

- **Introduction (6 pp)**
  - SCEC and its Community
  - Framework of earthquake system science
  - Intellectual merit
  - Broader impacts
- **Research Accomplishments (20 pp)**
  - Science accomplishments
    - Six fundamental problems & SCEC4 initiatives
  - CEO accomplishments
- **SCEC5 Project Plan (30 pp)**
  - SCEC5 vision
  - Science plan
  - CEO plan
  - Diversity plan
  - IT plan
- **Management Plan (4 pp)**
  - Earthquake response plan

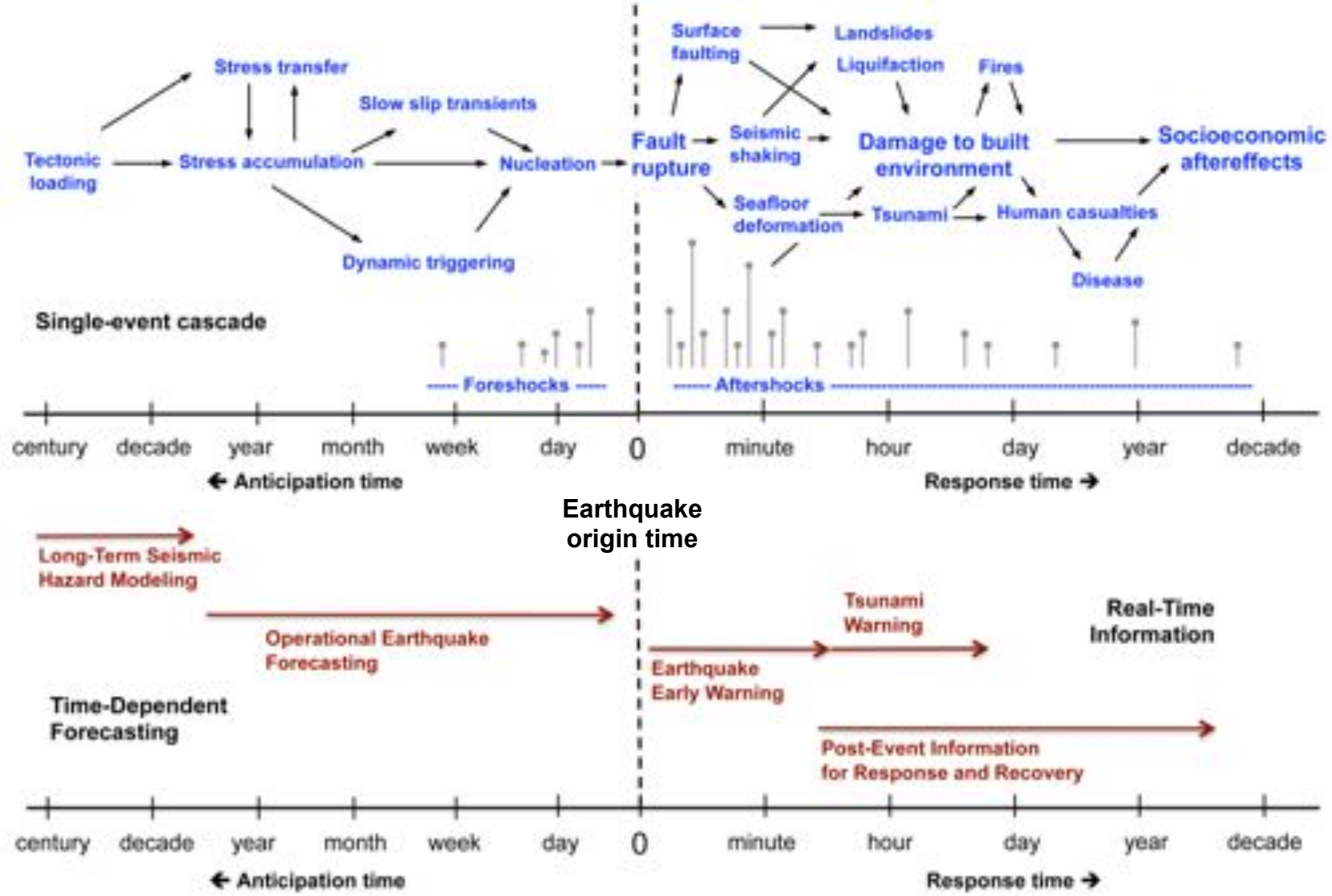
Earthquake System Science

Earthquake system science seeks a "rupture-to-rafters" synthesis of how future earthquakes will damage the built environment

- **Requires system-level science and engineering**



SCEC4 Theme: Tracking Earthquake Cascades



Sustained Development of SCEC Community Models

- **System-level models of the SCEC natural laboratory sufficient for provisioning explanatory models**
  - **Community Velocity Model (CVM)**
  - **Community Fault Model (CFM)**

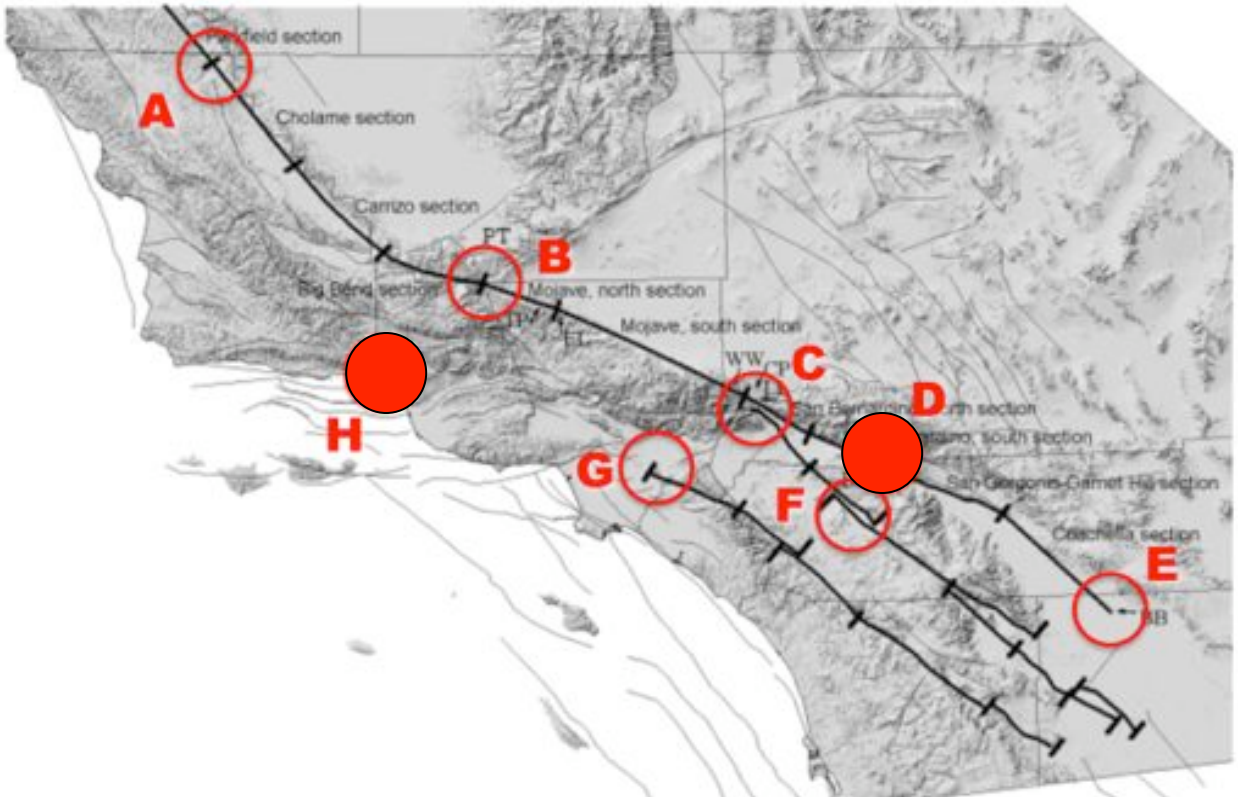
  } **Unified Structural Representation (USR)**

  - **Community Geodetic Model (CGM)**
  - **Community Stress Model (CSM)**

  } **SCEC4 initiatives**
- **All of these models will be further developed in SCEC5**
- **What should be the SCEC5 modeling initiatives?**
  - **Community Rheology Model (CRM)?**
- **Should the concept of a SCEC community model be extended to earthquake simulation codes?**

Special Fault Study Areas

- **SFSAs are a major SCEC4 initiative**
  - **Are they worthwhile foci of SCEC research to be continued in SCEC5?**
- **In SCEC4, there are two SFSAs: San Gorgonio 7 Ventura**
  - **How many in SCEC5? Which ones?**



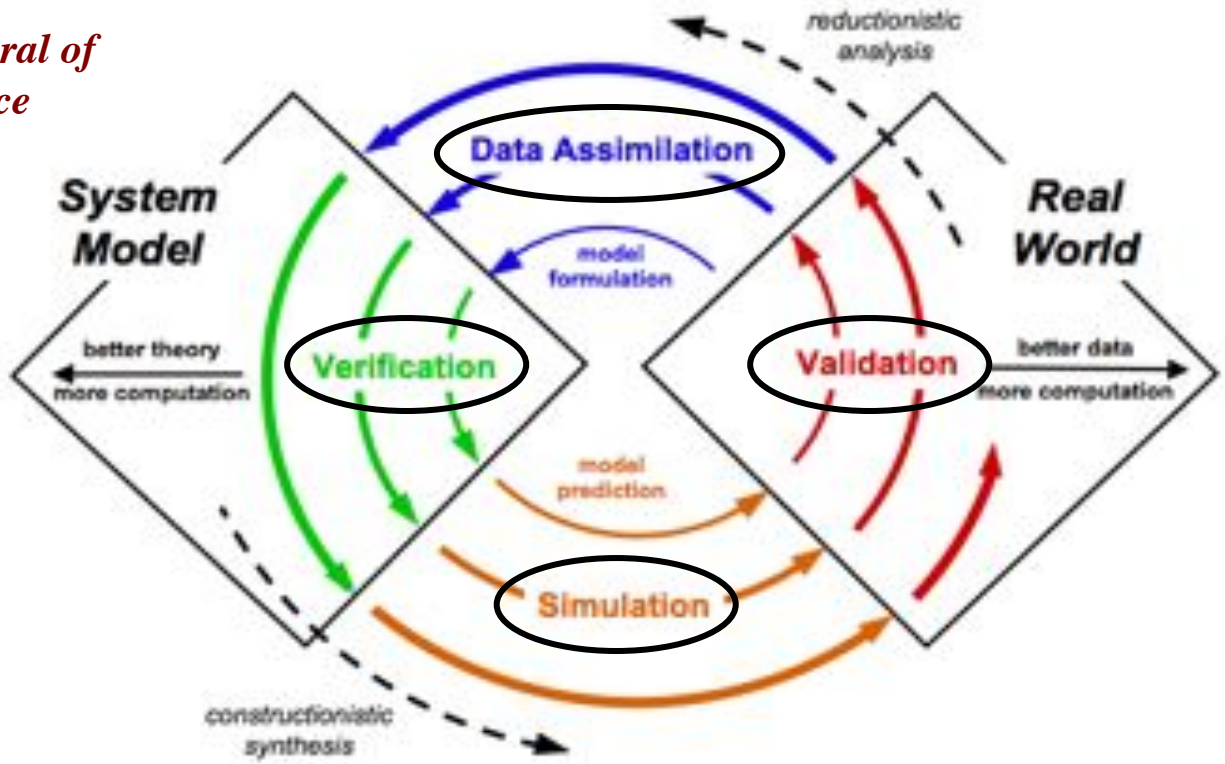
Nonlinear Dynamics of Seismic Wave Excitation and Propagation

- **Two nonlinear domains, near-fault and near-surface, separated (in most cases) by a linear domain**
- **Major challenges:**
  - **New parameters to describe the dynamics (cohesion, prestress, fluid saturation, etc.)**
  - **Verification of HPC simulation codes**
  - **Can't use seismic reciprocity to compute the large ensembles of simulations needed for PSHA (CyberShake)**
  - **How to validate?**
- **End-to-end simulations ("ruptures-to-rafters") become more important**
  - **Nonlinear hazard-risk interface**
  - **Convergence of geoscience and engineering methodologies; e.g., through engineering-oriented validation**

Inference Spiral

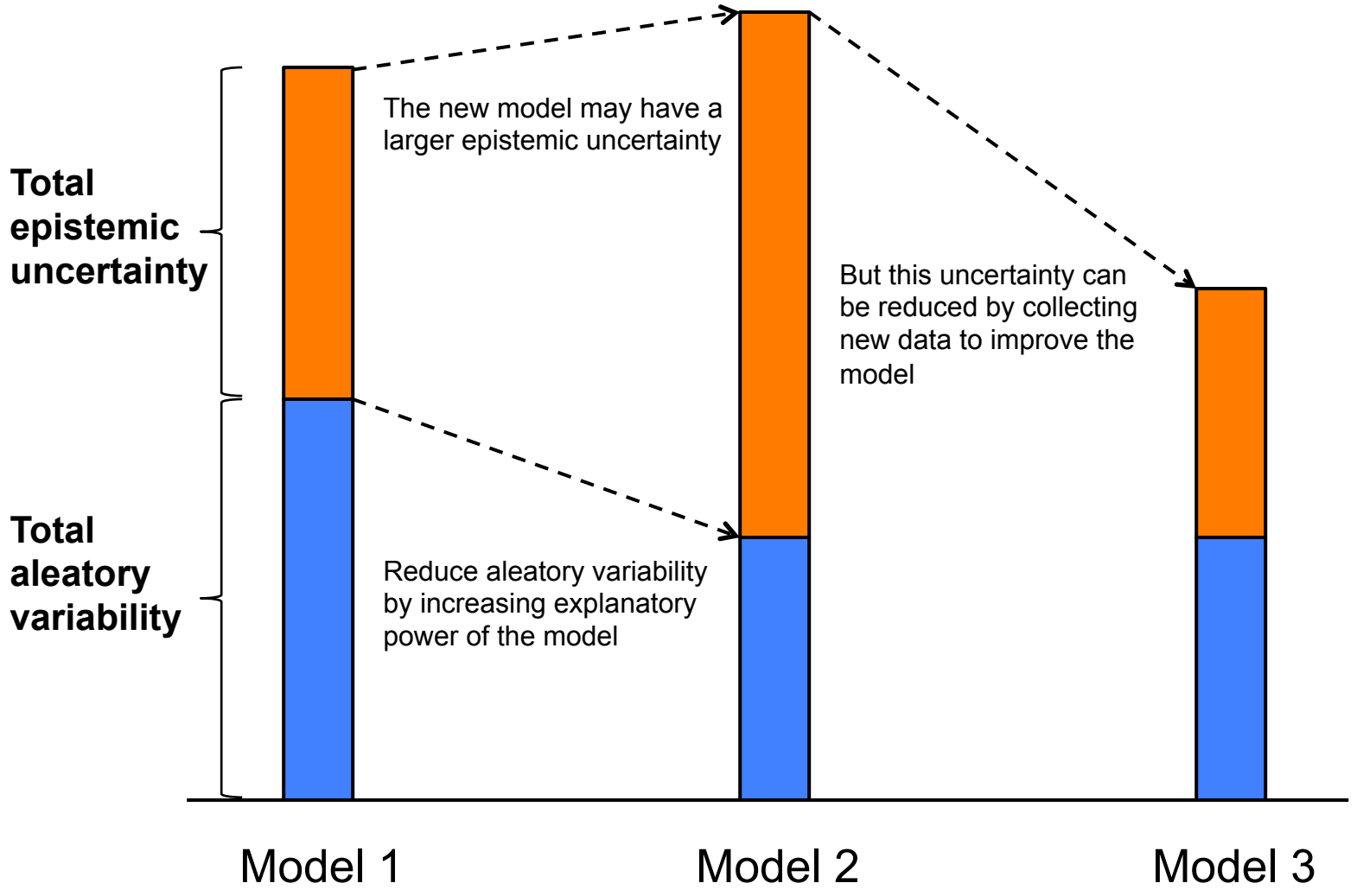
- **Earthquake system science requires an iterative, computationally intense process of model formulation and verification, simulation-based predictions, validation against observations, and data assimilation to improve the model**

Inference Spiral of System Science

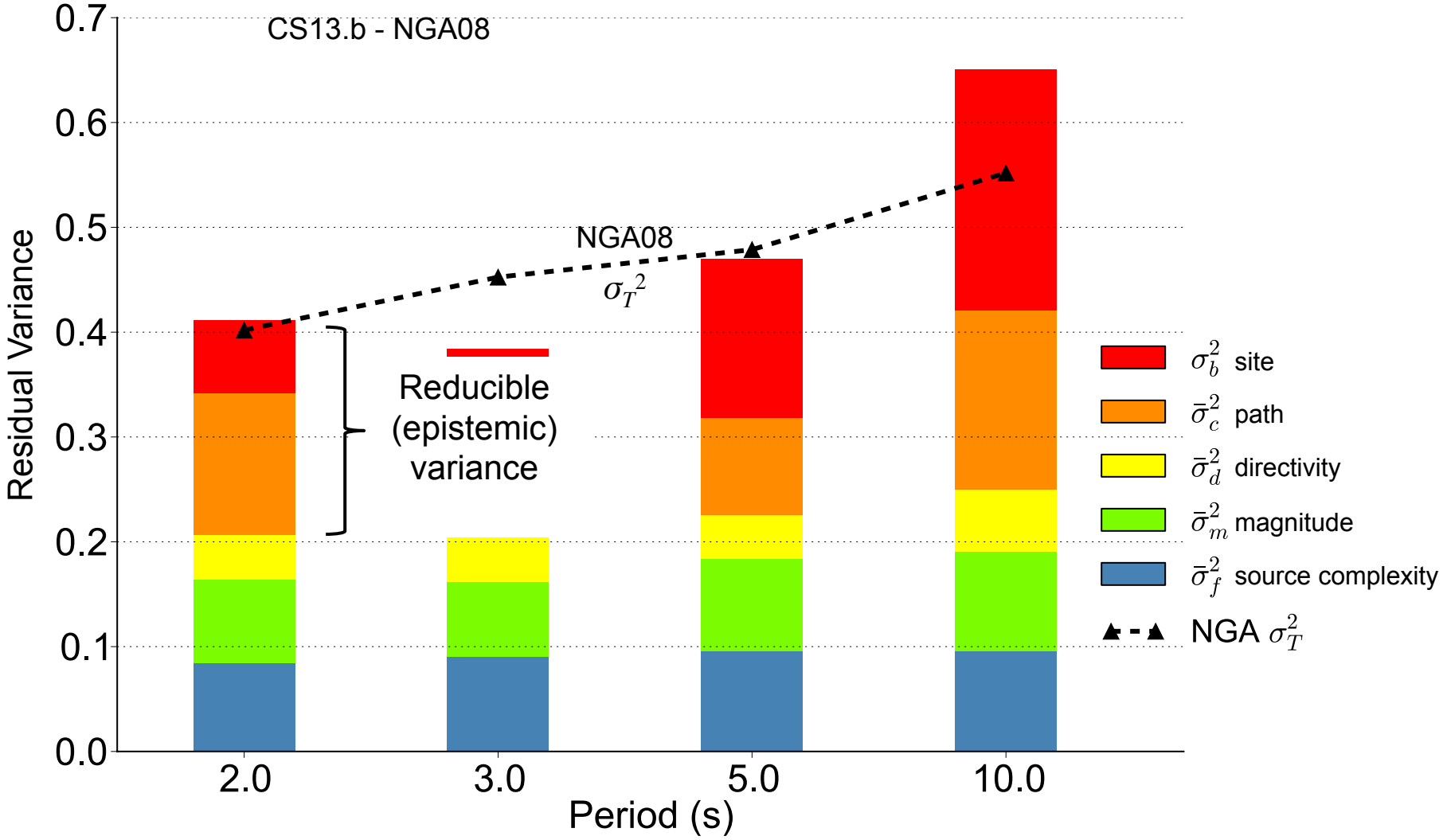


- **This intrinsic structure of earthquake system science is reflected in the SCEC4 TAGs.**

Reduction of Aleatory Variability



ABF Variance Analysis



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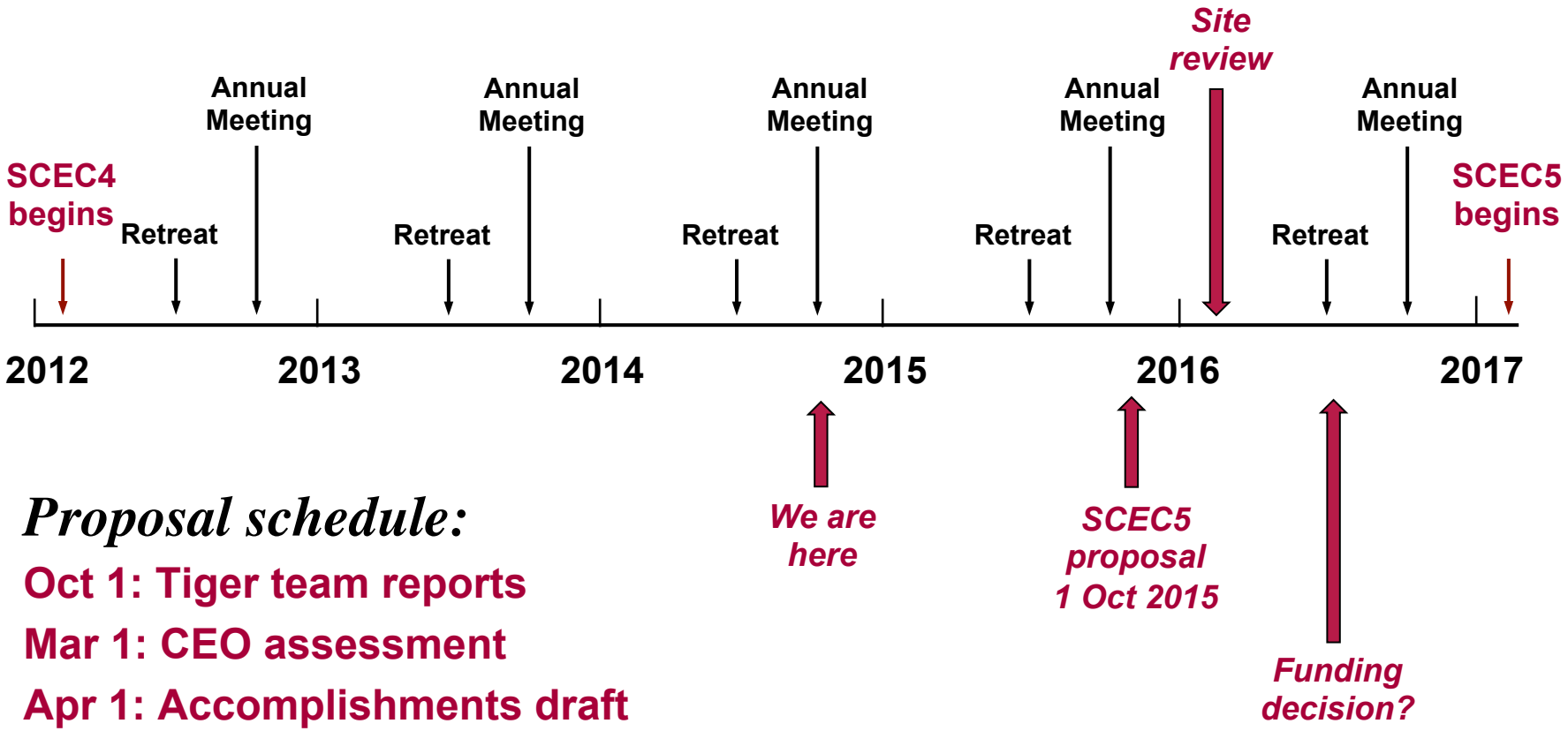
What's Missing?

SCEC Timeline



Proposal schedule:

- Oct 1: Tiger team reports
- Mar 1: CEO assessment
- Apr 1: Accomplishments draft
- Jun 1: Science plan draft
- Aug 1: Proposal complete

End