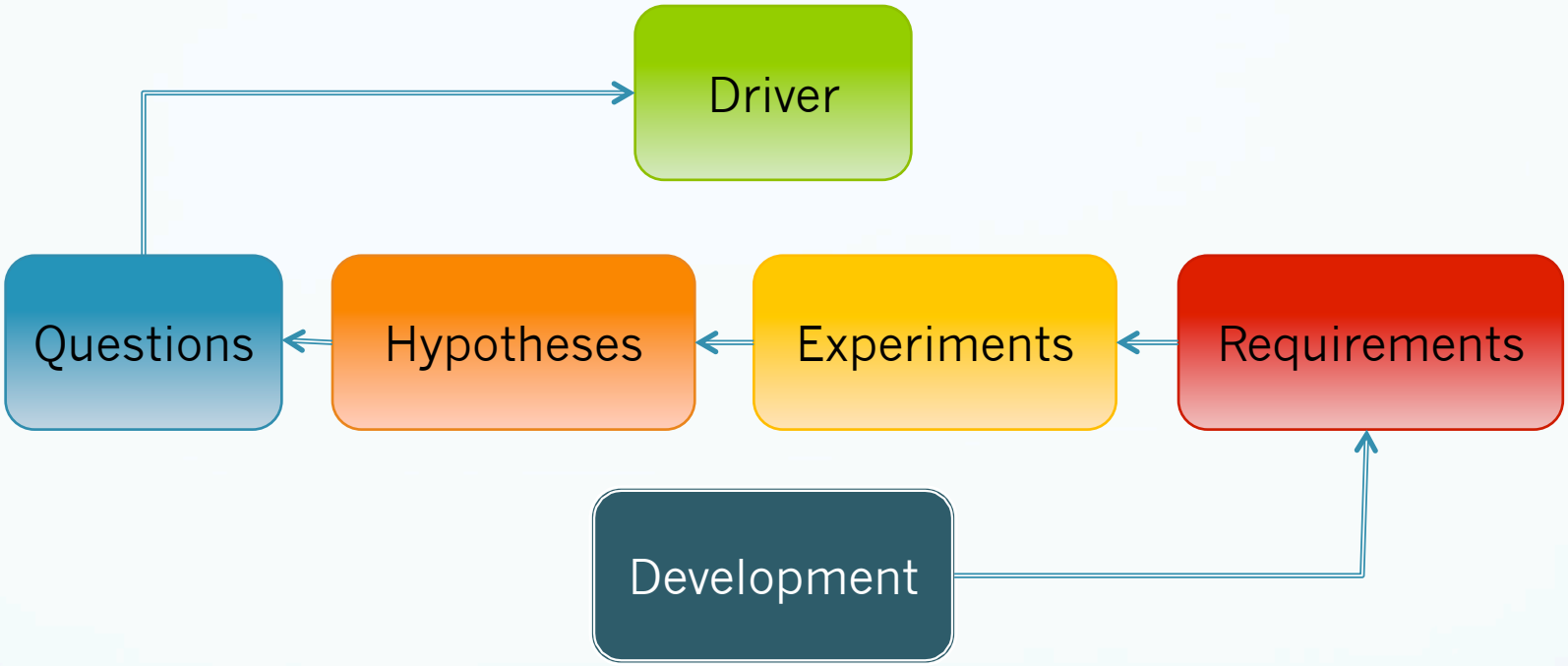
Scientific and Computational Drivers

10 June, 2013

Science Drivers as Guides for Model Development

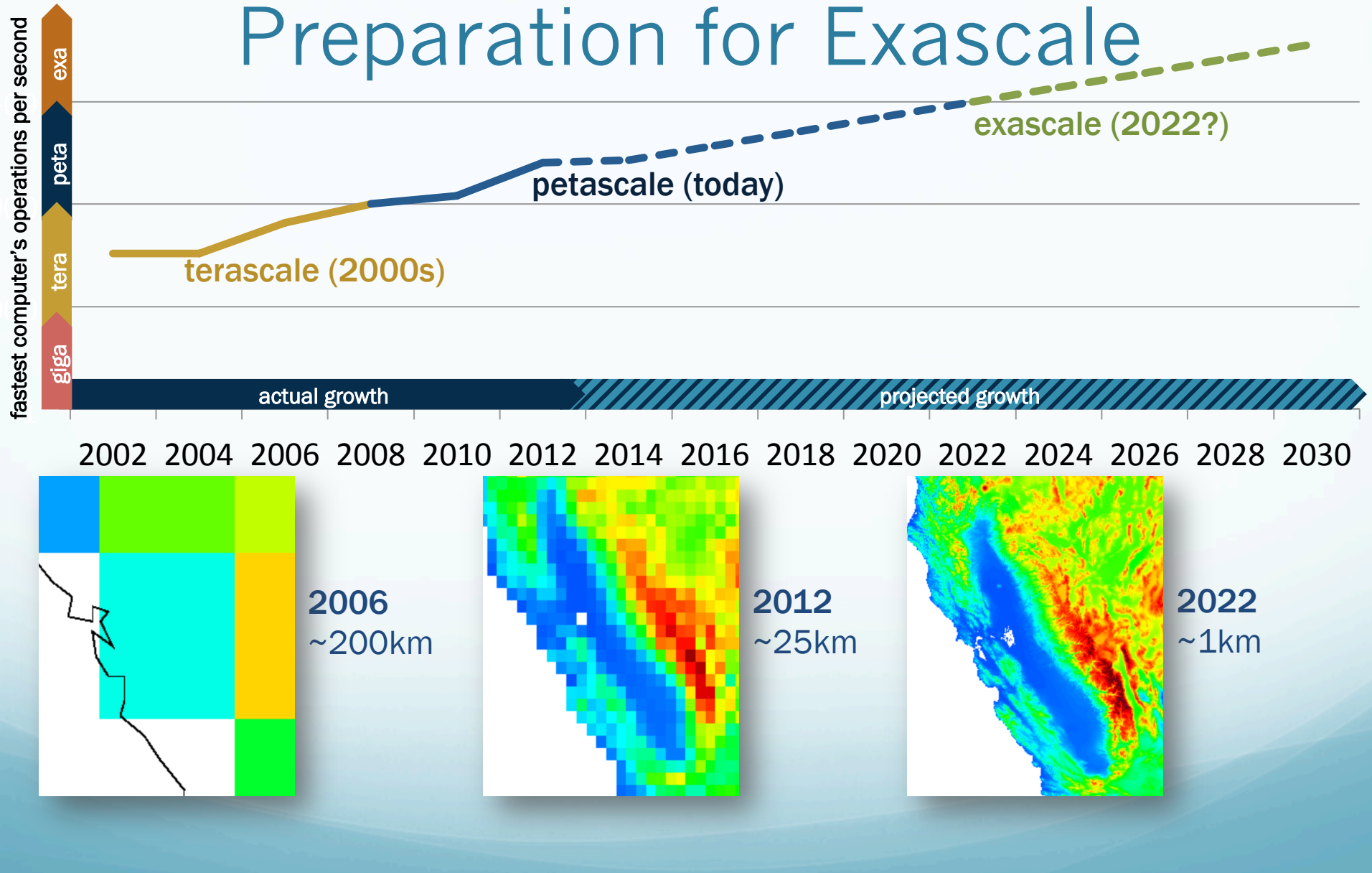


- How do the hydrological cycle, and water resources, interact with the climate system on local to global scales?
- How do biogeochemical cycles interact with global climate change?
- How do rapid changes in cryospheric systems interact with the climate system?
- How do short-term variations in natural and anthropogenic forcings interact with natural variability and contribute to regional and global environmental change?

Science Drivers ➔questions ➔hypotheses

- *Driver:* **How do short-term variations in natural and anthropogenic forcings interact with natural variability and the rates of global environmental change?**
- *Question:* **What are the relative contributions of human perturbations through changes in greenhouse gases, aerosols, land use/land cover, human water systems, and urbanization to climate extremes in the past?**
  - What are the signatures of human perturbations on climate extremes? Are they distinguishable from each other and from the noise?
- *Falsifiable Hypotheses:* **Human perturbations have contributed to detectable changes in climate extremes such as floods, droughts, heat waves in the past.**
  - Global warming has increased land-atmosphere coupling strength, leading to more extreme heat waves and droughts in hot spots of land-atmosphere feedbacks .

Computational Driver: Preparation for Exascale



Computational Challenges

- Reasonable time to solution for experiments supporting DOE's climate-science mission.
- Performance portability to rapidly evolving petascale to exascale architectures.
- Attainment of greater accuracy, portability, and scalability using advanced SciDAC math methods.
- New multiscale methods for ocean/atmosphere/ice dynamics required for science experiments.
- New methods to address model complexity and extensibility with proven testing capability.