Current climate modeling **practice places a high priority on** the development and use of a few dozen state-of-the-art climate models, many of which are housed at national modeling centers. **Recently, however, a number of scientists have proposed** substantial changes to the practice of climate modeling (see, e.g., Held 2005; Hurrell et al. 2009; Palmer 2012; Curry 2013). In fact, some even say that a “revolution” in climate modeling is needed (Shukla et al. 2009).

**The leading proposals for** change **can be described as** the unified **approach**, the hierarchy **approach, and** the pluralist **approach**. The unified approach would pool international resources to develop and deploy a small number of climate models that have spatial and temporal resolutions that are much higher than those of current models and that are constructed within a seamless prediction framework; these efforts are intended to meet "societal demand" for d2009, and Palmer 2012). **The** hierarchy **approach would have** climate scientists devote more attention to the development and systematic study of hierarchies of models that relate to one another in known ways, in order to facilitate understanding of the climate system (Held 2005, 2014). The pluralist approach would have climate scientists increase the diversity of modeling efforts, by systematically increasing the structural variation of state of- the-art, physics-based models and perhaps also by developing more data-driven and semi-empirical models.

**Up to now, there has been no** comparative discussion of these different proposals.

**We offer such a** discussion. **After briefly reviewing the current state of** climate modeling **and some of the limitations that motivate** calls for changes in practice (Section 2), **we outline** the different proposals in turn, identifying some challenges and questions that remain for each. **Section 3 focuses on** the unified approach, calling attention to uncertainty about when – and even whether – it would deliver much more accurate climate change projections. **Section 4 focuses on** the hierarchy approach, highlighting the potential limitations of its reductive strategy as well as the challenge of identifying hierarchies of lasting value. **Section 5 considers** the pluralist approach, noting uncertainty about what systematic exploration of model structures might involve as well as worries about the predictive reliability of empirical models, but suggesting that differences between empirical models and other climate models should not be exaggerated. **In discussing** each proposal, **we distinguish between aspects that are** primarily practical, e.g., institutional and organizational aspects, **and those that are** primarily scientific.

**Finally, in Section 6, we discuss** the reasonably expected gains and costs of the three different approaches and offer some closing reflections. **We argue that** the policy-based argument for accelerating the development of very high resolution models is not entirely persuasive. **We also suggest that** piecemeal pursuit of the hierarchy approach and increased attention to empirical modeling approaches **can be expected to benefit** climate science without requiring much increase in resources. **Finally, we note that** substantial resources might be freed by bringing the number of complex climate models into line with the effective number of models of this kind.