Intensified extreme precipitation and corresponding floods are the most relevant consequences of climate change over the northeastern US (NEUS). To evaluate the impacts of climate change or certain climate perturbations on future extreme weather events which are dynamically similar to historic analogs, the pseudo-global warming (PGW) method has been frequently employed; however, this method lacks precise definition and guidelines, thus limiting its application. More specifically, three key questions related to the application of the PGW method remain unanswered: At what spatial scale should climate perturbations be applied? Among the different meteorological variables available, which ones should be perturbed? And will PGW projections vary significantly when different perturbations are applied? To address these questions, we examine the sensitivity and robustness of conclusions drawn from the PGW method over the NEUS by conducting multiple PGW experiments with varied perturbation spatial scales and choice of perturbed meteorological variables. The results show that the projections of precipitation and other essential variables at the regional mean scale are consistent across the PGW simulations, with a relative difference of much less than 10%; however, different perturbation modifications can cause significant displacements of the storm events being simulated. Several previously assumed advantages of modifying only the temperature at regional mean scale, such as the preservation of geostrophic balance, do not appear to hold. Also, for these experiments, we find the regional mean perturbation produces a positive precipitation bias because it ignores the land-ocean warming contrast, which is a robust regional response to global warming. Overall, PGW experiments with perturbations from temperature or the combination of temperature and wind at the gridpoint scale are both recommended, depending on the research questions. The first approach can isolate the spatially-dependent thermodynamic impact, and the latter incorporates both the thermodynamic and dynamic impacts.