There are long-standing concerns that the vulnerability of nuclear forces to counterforce attack and missile defense operations could increase the risk of nuclear escalation. Nuclear-armed states have sought to minimize this vulnerability by securing their arsenals against a preemptive attack. However, a spate of technological developments in recent decades—such as enhancements in missile guidance leading to improved accuracy and the proliferation of remote-sensing technologies – have spurred a debate about whether nuclear arsenals will remain survivable in the face of technological change. There is little consensus on the likely outcome of this competition.

One group holds that the technologies of counterforce have been rapidly advancing and will continue to so that only the largest and most sophisticated arsenals will remain survivable. Proponents of this position argue that the competition between counterforce and survivability is inherently biased in favor of counterforce – missiles will become more accurate and remote-sensing systems will become more sensitive, inexorably making survivability more difficult to achieve. The second group does not see the competition as inherently biased in favor of the offensive, and that, with sensible investments, even small arsenals can continue to be kept survivable. Partially as a result of these different understandings, the two groups offer very different policy prescriptions on whether the United States should seek a damage limitation capability *vis-à-vis* its adversaries.

The debate surrounding the ability of remote-sensing systems to track mobile missiles, in particular, has some significant flaws. Space-based radar has rightly been identified as probably the key potential surveillance technology. However, the capabilities of both existing and potential future remote-sensing technologies—such as whether the information gathered by two different sensors is complementary or redundant—are poorly understood in the security studies literature. Moreover, there are widespread misunderstandings about what information is required to track a mobile system. For example, the effect of regular coverage gaps of tens of minutes have been downplayed in the literature but would repeatedly provide mobile systems the opportunity to move tens of kilometers undetected. The result is that survivability pessimists have overestimated the ability of plausible remote sensing systems to track mobile missiles and have underestimated the potential decisiveness of countermeasures (while the optimists have failed to identify these weaknesses with the pessimists' arguments).

Drawing on my background in physics, I will produce a technically supported and policy-informed analysis that contributes five crucial insights:

1. A clear, qualitative model of what information is needed to track a mobile missile, and how remote-sensing modalities can generate that information.
2. An evaluation of the ability of existing remote-sensing capabilities to track both small and large numbers of mobile missiles to identify potential gaps in current capabilities.
3. An analysis of the conditions under which emerging technologies—space-based radar, in particular—could be used to track mobile missiles.
4. A discussion of the conditions under which countermeasures could be decisive in defeating tracking.
5. A discussion of the implications of points 1-4 for contemporary policy debates.

This work would provide a framework for analyzing any set of remote-sensing technologies and argues strongly in favor of the restraint-oriented camp. In addition to contributing to the academic debate through a journal article, I will also highlight my findings and recommendations to decisionmakers and their advisors within the U.S. government.