



Hudson Institute

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Questions about the Geopolitics of Climate Engineering

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Author's Note

The U.S. intelligence community and other federal agencies have commissioned the National Academies of Science (NAS) to study climate engineering. The term 'climate engineering' (CE) refers to a family of concepts that might be used to curtail global warming. In 2013, the NAS assembled an expert panel to study the subject. The panel plans to issue a report in the fall of 2014.

The panel's work may well suggest further research into the governance of CE. However, such reports can sometimes end up merely summarizing themes and assumptions that are common in the existing scholarly literature. In this case, that literature, while containing many worthwhile insights, has also often assumed that (1) the world's major states will, at some point, largely subordinate the normal rivalries of world politics to concerns about halting climate change, and (2) international legal rules and norms represent an effective check, indeed, the only effective check, on the potential use of CE. The following essay, which was submitted to the panel on January 21, 2014, is meant to probe the validity of these two assumptions. It proposes as well an alternative research agenda that would be more closely aligned with the premises of the realist school of international relations.

Questions about the Geopolitics of Climate Engineering

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In theory, some version of solar radiation management (SRM) could lessen the increase in global mean temperature that will otherwise result from rising concentrations of greenhouse gas (GHG) in the atmosphere. SRM is a family of technology concepts that might enhance and manage some of the physical processes that reflect sunlight back into space; for example, researchers have envisioned adding to the layer of sulfuric acid that is already present in the lower stratosphere (Lane and Bickel 2013). This effect, at fairly modest cost, might be used to avoid some of the rise in global temperatures that would otherwise occur. If so, it could diminish the harm now expected to result from climate change; the total cost of adapting to climate change would fall as would the present value of an optimal GHG control regime.

However, even if SRM tamped down the rise in global mean temperature, it would entail risks of its own. SRM use might, for instance, lead to changes in some regional climates, and, in principle, these changes could produce net costs. As a result, no one as yet proposes to deploy SRM without much more research and extended tests.

Nonetheless, some observers fear that governments may be tempted to resort to a reckless deployment of SRM. To suppress that supposed temptation, they propose various sorts of international compacts or norms to rein in SRM use. This essay poses a number of questions about the realism of both the threat of rash SRM use and the purported remedy of international law.

Why is there growing interest in SRM?

The last twenty years of largely futile effort on GHG control confirms that the path to abatement will be long and torturous. Abatement policies would impose high costs on states with GHG-intensive economies; yet, most of these states stand to reap only modest benefits from abatement; conversely, few of the states with the most to gain from limiting GHG output have much power to bring it about (Buys, et al. 2007). Moreover, within key states, major power blocs oppose GHG controls (Lane and Montgomery 2013). A global GHG control accord would, therefore, require that some states shoulder the costs of compelling or inducing otherwise recalcitrant governments to abate emissions. No state has so far made the attempt.

Even though the present value of the expected net harm from climate change will rise over time, the impact on the prospects for GHG control is likely to be muted. In most of the world's states, leaders win power by promising to deliver private goods to small elites (Bueno de Mesquita, et al. 2005). Where 'selectorates' are much broader, collective action problems limit the selectors' diligence. The latter often back candidates based on feelings about events in the recent past rather than on expected future outcomes (Achen and Bartels 2002). Neither of these two modes

of selecting governments is apt to incent power seekers to supply a very long-term global public good like a stable climate.

At some point, the need may arise for a faster acting response to climate change; if so, the governance of SRM will become a serious issue.

Why is there fear of ill-considered SRM use?

Concerns about rash use of SRM are grounded in part on the concept's economics and in part on the role of power in world affairs. The prospective costs of developing and deploying an SRM system may turn out to be only a small fraction of the total savings from avoided harm from climate change. Therefore, a state might still secure net gains from SRM even if it bore all of the deployment costs while capturing only those savings from less warming that occurred on its own soil. All else being equal, the larger a state is, and the more exposed to harm from climate change it is, the more likely it would be to realize net gains from SRM.

Also, SRM could, in theory, produce gains for some states but losses for others. Global politics is a 'self-help world,' which is to say that, without a third party able to settle conflicts and to enforce rules, states have no choice but to rely on their own resources. In such a system, when interests clash, power will greatly influence outcomes.

The states that govern the largest economies and strongest armed forces remain by far the most potent actors on the world stage (Krasner 2009). Experts debate about which criteria best define the class of great powers. For purposes of discussing SRM policy, suffice it to say that at least three states are plainly great powers—the United States, China, and Russia. At present, Japan, India, Britain, Brazil, Germany, and France might be thought of as second tier powers.

What really matters in world politics is relative power, and relative power varies from one issue to the next (Gilpin 1975). Power also varies with states' objectives (Gruber 2000). Namely, states sometimes possess go-it-alone power. That is, they can act alone, or with a few partners, to change the status quo. At other times, they command hold-up power; they can block other states from taking some action. Where a state has neither go-it-alone nor hold-up power, but wishes to affect other states' actions, it must attempt to exercise coercive power.

Any of the great powers or second tier states, and perhaps even a few lesser states, could, as a technical matter, someday deploy an SRM system. In effect, a number of states would have go-it-alone power over SRM deployment. In contrast, no states have hold-up power over it.

Logically, then, one state striving to halt another's SRM deployment would have no recourse other than coercion. But attempting to coerce a major power can be very expensive, and it often fails (Gruber 2000). Thus, if ill-advised SRM deployment does pose a problem, it is likely to prove most troubling if one of the great powers is the proponent.

How might domestic politics constrain great power deployment of SRM?

Despite the putative temptation to go it alone on SRM, no government has taken even initial steps to do so. In the first place, none of the three great powers has made climate change anything like a first tier issue. Then too, for now at least, the uncertainties that surround SRM's capabilities render it a marginal aspect of this already secondary issue.

Of course, nothing guarantees that SRM's future salience might not increase. After all, to a small degree, it already has. Even should that trend continue, though, non-trivial political barriers will remain. In effect, for different domestic political reasons, neither the United States nor Russia is likely to want to deploy an SRM system. In contrast, China, were it to become more concerned about climate change, would face no obvious domestic constraint.

In the United States, the ideological scene is hostile to SRM. The greens are passionately committed to GHG control, and they adhere to the precautionary principle, which inclines them against SRM. Meanwhile, the political right tends to dispute the findings of mainstream climate science. It also distrusts expansion of the public sector, and SRM would be, in effect, a global-scale public works program. Amplifying the effects of this clash of worldviews, the U.S. political system is rife with veto points; the result is pervasive policy gridlock. Therefore, barring proof of severe imminent harm from climate change, U.S. policy seems to be tilted against pursuing an SRM option (Lane and Bickel 2013).

The political constellation differs in China, but so far the result is much the same. Beijing does not appear to now have an SRM research plan (Edney and Symons 2013). Clearly, though, the PRC's pollution levels testify to green ideology's political impotence there. Indeed, in general, popular grass roots groups are a minor factor in the PRC's policy process (Fewsmith 2013). Thus, while Beijing is fully aware that climate change poses a threat, it also has plans to use large-scale public works to adapt to it (CENTRA Technology, Inc., and Scitor Corporation June 2009). The PRC lacks the dense lattice of formal veto points that is such a pronounced feature of U.S. government. By inference, from the standpoint of domestic politics, were Beijing to become more concerned about climate change, it would be much freer to exercise an SRM option than Washington is.

Russia is the least likely of the great powers to support SRM deployment. Currently, Moscow prefers a warmer climate to a colder one (CENTRA Technology, Inc.; Scitor Corporation September 2009). However, the oil and gas industry has a large impact on Russian policy. The industry faces trade-offs between the costs from melting permafrost and the gains from receding Arctic sea ice. Should its assessment of warming's net effects change; so the Kremlin's. Again, institutional veto points do not appear to greatly hobble Russia's policy elite's freedom of action.

In sum, the internal constellation of forces differs markedly among the three great powers. At present, none of the three is pursuing an SRM capability. In any case, Washington's institutions and clashing worldviews constrain it in ways that have no close analogues in the other two capitals.

What foreign policy factors would constrain great power use of SRM?

Domestic politics, of course, is not the sole constraint on the use of SRM. Absent clear proof of an imminent climate crisis, an attempt to deploy SRM would meet resistance from abroad. At least four motives would impel objections.

First, as noted above with the case of Russia, some countries simply prefer a warmer to a colder climate. Beijing certainly would need to consider Moscow's response to SRM deployment. While Russia may be a declining power, it still holds potential leverage over the PRC's future energy supply (Mirski 2013). To a lesser degree, the United States would need to pay some heed to Canadian sentiments—although Canada's stance on warming seems ambivalent.

Second, many states would oppose a great power's deployment of SRM on balance of power grounds. Even if all states expected to capture net economic gains from an SRM system, the states that controlled the supply of SRM would be able to withhold, increase, or change the incidence of those benefits. That ability would confer power and prestige on whatever state or states had it. States are apt to fear the great power that is located nearest to them. Hence, the PRC's increasingly assertive stance around the Western Pacific and Indian Ocean littorals is already stoking much anxiety, both among its neighbors and, for different reasons, in the United States (Luttwak 2012). All of these states would be likely read a PRC bid for control of SRM as reinforcing Beijing's growing power. Brazil might have a similar response to a U.S. move toward SRM.

Third, many states strongly support sweeping concepts of sovereignty. These notions would collide with any workable system of SRM governance. For many states, these sovereignty claims buttress resistance to liberal integrationist efforts that threaten non-liberal governments' holds on power. For this reason, many states have sought to limit cross-border radio and TV signals; they have even tried to restrict satellite imaging (Krasner 1991). In the same vein, the PRC asserts a right to control access to the internet. Beijing and Moscow both champion this expansive view of sovereignty; indeed, the former has made it a mainstay of its global diplomacy and uses it as a lure for Third World support (Odgaard 2013).

Fourth, green ideology opposes SRM. Most greens in EU countries, Germany is one, are likely to be deeply hostile to the concept. This ideology might also become a factor in countries such as Australia and Japan. As noted above, the greens' worldview may influence U.S. policy as well. Perhaps reassuring scientific findings about SRM's side effects would temper these fears. But experiments, by their nature, cannot definitively prove the negative that SRM will cause no harm. And some greens have adopted views that condemn human impacts on nature on grounds that are rooted more in morality than in science (Nelson 2010). In such cases, new research findings may gain little purchase.

The prospect of opposition also implies that no single state would be likely to wield sole control over SRM. A state wishing to deploy SRM would have to expect that opponents might use sanctions against it. Having a strong bloc of allies could help to defeat sanctions or, better still, to

deter their use. But if a state needs allies, those allies have bargaining leverage. The likelihood of conflict over SRM, therefore, would tend to diffuse power over how the system was managed; thus, the fear of an SRM “Lone Ranger” is at odds with the logic of power politics.

That being said, the logic of inclusion is also subject to limits. As the number of states with a voice in SRM management rises, preferences within the coalition would become more diverse; the benefits to any one state would fall. And the number of states needing to be consulted would climb, raising the transaction costs of managing the system. For this reasons, other global regimes use weighted voting and other devices to limit the number of states with effective voices in regime management (Drezner 2007). These same forces would be likely to shape an SRM regime.

How might SRM play out amidst the evolving U.S. / PRC relationship?

Current trends in world politics imply that the U.S. / PRC relationship would be central to the way in which a possible future SRM deployment might evolve. As by far the two strongest states in the system, these powers, while cooperating on some fronts, compete on many others. Current trends in this relationship imply that (1) either state’s move to go it alone on SRM deployment would spark strenuous opposition from the other, but (2) U.S. / PRC cooperation on some form of joint SRM deployment is also likely to be difficult.

As the PRC becomes stronger relative to the United States, the two states’ relations are likely to grow more contentious. This pattern has often prevailed in the past, and it is all the more likely if the rising power seeks to revise the rules of global governance (Lemke 2004). Both Beijing and Washington have noted these risks, and they have vowed to avoid them, but the logic of structural change may be hard to suppress. As states gain in power, the more equal power distribution is likely to lead to mistakes about relative strength, a common factor in past conflicts (Jervis 1976). The more equal power distribution also blurs the states’ relative status in the international system, another source of past conflicts. In theory, timely concessions to the rising power can defuse conflict; in practice, concessions can call forth new demands rather than leading to settlement (Wohlforth 2009).

Intense economic rivalry, and the practice of strategic trade policies, increase states’ sensitivity to disproportionate gains by rival powers, and this relative-gains sensitivity tends to disrupt cooperation (Powell 1991). To be sure, it is also true that the defense dominance of nuclear weapons lessens relative-gains sensitivity (Lieberman 1996). Even so, recent maritime incidents in the Western Pacific and the South China Sea appear to herald growing tensions. Chinese popular resentment of both the United States and Japan is pervasive and it can be virulent (Shirk 2007).

Changes in both U.S. and PRC military postures reflect these rising stresses. Beijing’s growing access denial capabilities in the Western Pacific and its increasing presence in the Indian Ocean may lessen the U.S. Navy’s ability to deter threats to Taiwan. Conversely, the motives behind the

U.S. “pivot” into the Western Pacific and Indian Ocean are not hard to fathom; Beijing is correct to perceive the U.S. stance as implicitly involving an element of containment (Friedberg 2011).

As to the effects on SRM, given these trends, either power’s attempt to go it alone on SRM would risk triggering a spiral of sanctions and counter-sanctions. True, such measures could be costly to both states. However, in such a case, the substance of the issue would become entangled with the two powers’ autonomy and relative status. This is precisely the kind of conflict that has, in the past, often led to costly conflicts (Wohlforth 2009). Skillful statecraft would foresee this outcome and perhaps head it off before costs escalate, but, historically, those circuit breakers have sometimes failed to trip in time (Jervis 1976).

Alternatively, the two powers might at some point seek to pursue SRM use on a cooperative basis. This approach would be very consistent with the current U.S. strategy for managing the PRC’s rise. Through several presidencies, U.S. policy has striven to integrate Beijing into the system of liberal global governance. However, the more that the relationship becomes charged with rivalry and relative gains sensitivity, the more difficult cooperation will be.

Moreover, the PRC has often shown scant inclination to shoulder the burdens of supplying public goods like GHG control or global trade liberalization (Bergsten, et al. 2008). Given the costs of global leadership, this reluctance makes sense (Schweller and Pu 2011). Emergent powers are often hesitant about becoming global system managers. Between the world wars, the United States rebuffed a global leadership role. Even in the immediate postwar years, it accepted it only under duress from the looming Soviet threat. Russia before the Congress of Vienna (Schroeder 1994), or even the Republic of Rome 230-170 BCE, displayed the same kind of reticence (Eckstein 2012). The pattern persists because emergent powers are often struggling to master social stresses at home, and the exercise of global leadership is a costly (and often vexing) task (Schweller 2011).

In sum, if as seems probable, U.S. / PRC dealings become more tense and fraught with rivalry, they are likely to cast a shadow over the prospects for SRM use. In such a scenario, the likelihood of strenuous peer power objection could deter go-it-alone deployment by either state. Yet the tensions between the powers plus the incentives to shirk the costs of supplying global public goods could also render cooperation problematic.

Is a lesser state likely to seek to deploy SRM?

Thus, the emerging pattern of great power politics does not seem to favor SRM deployment. Still less, is it likely that a small state would attempt to deploy an SRM system of more than regional significance.

Two factors work against such a move. First, all else being equal, the smaller a state is, the smaller will be its share of the global benefits of SRM; therefore, the greater will be the likelihood that deployment costs would exceed the benefits. Second, and perhaps more importantly, a great power could easily quash a lesser state’s bid to launch an SRM system.

Small states are vulnerable to economic sanctions. And, where power differences are very great, armed force remains the ultima ratio. By inference, a lesser state can deploy SRM only at great power sufferance.

Somewhat more plausibly, a lesser state might consider an SRM system that was designed to have strictly regional impacts. A lesser Arctic state, for instance, might in theory be willing to incur costs in order to slow that region's rapid warming. Yet, even in that case, both of the Arctic great powers would hold a veto power should they choose to exercise it. The People's Republic of China is also interested in exploiting the opportunities offered by an ice-free Arctic (Pedrozo 2013). Therefore, it too, might inject itself into plans for an Arctic SRM scheme.

Other regional SRM plans might draw less resistance. Thus, climate scientist Michael MacCracken has suggested that Australia might use SRM to lessen its trend toward chronic drought. Such an effort would differ from one that impinged directly on a great power's economic or strategic interests. The powers might, though, still be concerned based on the implied precedent.

To what degree will “global legalism” govern SRM use?

As with many other important issues, the normal workings of global power politics will determine the future use of SRM. This prospect troubles many “global legalists.” Global legalism is a doctrine widely held among U.S. academicians and environmentalists (Posner 2009). It has dominated much of the U.S. and EU thinking about climate policy.

Global legalism posits that (1) international law effectively constrains states' actions. (2) Trends in world politics will, over time, tighten this constraint. (3) The United States has a moral duty to incur costs in order to enhance global welfare or to conform to the varied deontological principles favored by many global legalists.

Global legalists have tended to assume—contrary to the analysis presented above—that the absence of a global legal constraint on SRM meant that it was nearly certain to be deployed. In response, they have proposed both formal and informal global rules and norms that are intended to constrain SRM's use. While no one denies that international law is sometimes helpful, it is far from clear that it always is, and SRM deployment may be a potential case in point.

First, as noted above, the premise that states are likely to plunge recklessly into SRM deployment ignores both internal and external checks on the behavior of even the most powerful states in the system. Domestic politics appear to impede a U.S. or Russian move toward SRM. And in all three cases, international factors would raise costs and lower benefits.

Second, if a great power were resolved to deploy SRM, a prior global rule or norm might not be much of a deterrent. Where global agreements and norms are not self-enforcing, they will be effective only if some states are (1) willing to bear the costs of enforcing them and (2) have the power to do so. In effect, rules are effective only if states can solve the collective action and power political problems that the rule was meant to solve in the first place. Realistically, states

like China, Russia, India, Brazil, and Japan will make such efforts only when doing so serves their own interests (Posner 2009). While, the modern state system is less fiercely Hobbesian than that of the ancient Mediterranean, Thucydides maxim retains much truth, “all men have their rights conceded to them in proportion to the power at their disposal.”

Finally, the costs and risks of global rules and norms should be weighed against their benefits. Some global legalists, for instance, wish to grant each and every state legal veto power over SRM deployment (Kraemer 2010). Such schemes, though, would amount to effectively granting the likes of Robert Mugabe a veto over global SRM deployment. Handing SRM as a hostage to the world’s kleptocrats hardly seems like wise climate policy. And the experience with foreign aid has shown the transfer payments to governments of this type further weaken their incentives to supply public goods to their tax payers (Easterly 2006). This outcome clashes equally with U.S. national interests and global humanitarian goals.

Policy inferences and further questions

In theory, states might either deploy SRM too hastily, or they might incur needless harm from climate change through being too reticent to deploy it. The less likely it is that climate change will trigger a bright-line crisis, the greater the risk that SRM deployment will be too hesitant rather than too hasty. To date, almost all of the discussion of SRM governance has assumed a kind of highly simplified economic determinism that posits that the former kind of risk is dominant. The above analysis suggests that domestic institutions, ideology, and global power rivalries work to counter a hasty or unilateral move to deploy SRM. Compared to these factors, the efficacy of global rules and norms is open to question, and, should they prove to be effective, it is not obvious that their net effect would be benign.

Of course, futures other than the one based on a U.S. / PRC power shift are also possible. Without structural reform, the PRC’s economic growth may stall. Or Russian preferences over climate might change. Institutional reform might unleash a sustained growth surge in India, or Brazil, or Russia producing a different distribution of global power. Such changes might well have major impacts on U.S. preferences over a future development of SRM.

The United States needs to gain a clearer understanding of how options for SRM governance will affect its interests. This understanding should consider both the risks of too little restraint on SRM and those of shirking and too much reticence. It should as well take careful account of the way in which alternative geopolitical futures might affect judgments about SRM. This research should inform policy toward legal rules and norms meant to govern SRM deployment.

Works Cited

- Achen, Christopher H., and Larry M. Bartels. "Blind Retrospection: Electoral Responses to Drought, Flu, and Shark Attacks." *Annual Meeting of the American Political Science Association*. Boston: American Political Science Association, 2002.
- Bergsten, C. Fred, Charles Freeman, Nicholas R. Lardy, and Derek J. and Mitchell. *China's Rise: Challenges and Opportunities*. Washington, DC: Peterson Institute for International Economics,, 2008.
- Bueno de Mesquita, Bruce, Alistair Smith, Randaolf M. Silvenson, and James D. Murrow. *The Logic of Political Survival*. Cambridge: MIT Press, 2005.
- Buyts, Piet, Uwe Deichmann, Craig Meisner, Thao Ton That, and David Wheeler. *Country Stakes in Climate Change Negotiations: Two Dimensions of Vulnerability*. Policy research working paper, Washington: The World Bank, 2007.
- CENTRA Technology, Inc., and Scitor Corporation. *China: The Impact of Climate Change to 2030. Geopolitical Implications*. A commissioned research report, Washington: National Intelligence Council, June 2009.
- CENTRA Technology, Inc.; Scitor Corporation. *Russia the Impact of Climate Change to 2030: Geopolitical Implications*. Conference Report, Washington: National Intelligence Council, September 2009.
- Drezner, Daniel W. *All Politics is Global: Explaining International Regulatory Regimes*. Princeton: Princeton University Press, 2007.
- Easterly, William. *The White Man's Burden: Why the West's Efforts to Aid the Rest Have Done So Much Ill and So Little Good*. New York: Penguin Books, 2006.
- Eckstein, Arthur M. *Rome Enters the Greek East: From Anarchy to Hierarchy in the Hellenistic Mediterranean 230-170 BC*. Malden: John Wiley & Sons, 2012.
- Edney, Kingsley, and Jonathan Symons. "China and the Blunt Temptations of Geoengineering: the Role of Solar Radiation Management in China's Strategic Response to Climate Change." *The Pacific Review*, 2013: 1-26.
- Fewsmith, Joseph. *The Logic and Limits of Political Reform in China*. New York: Cambridge University Press, 2013.
- Friedberg, Aaron. *A Contest for Supremacy: China, America, and the Struggle for Mastery in Asia*. New York: W.W. Norton & Compant Inc., 2011.
- Gilpin, Robert. *U.S. Power and the Multinational Corporation: The Political Economy of Foreign Direct Investment*. New York: Basic Books, 1975.
- Gruber, Lloyd. *Ruling the World: Power Politics and the Rise of Supranational Institutions*. Princeton: Princeton University Press, 2000.
- Jervis, Robert. *Perception and Misperception in International Politics*. Princeton: Princeton University Press, 1976.

- Kraemer, R. Andreas. "Schöner Leben im Labor? Geo-Engineering und das Recht, die Welt zu verändern." *Internationale Politik*, 2010: 70-75.
- Krasner, Stephen D. "Global Communications and National Power: Life on the Pareto Frontier." *World Politics* (Routledge), 1991: 336-366.
- Krasner, Stephen D. "Sovereignty and Its Discontents." In *Power, the State, and Sovereignty: Essays on International Relations*, by Stephen D. (ed.) Krasner, 179-210. New York: Routledge, 2009.
- Lane, Lee, and J. Eric Bickel. *Solar Radiation Management: An Evolving Climate Policy Option*. Policy Report, Washington: The American Enterprise Institute, 2013.
- Lane, Lee, and W. David Montgomery. "An Institutional Critique of New Climate Scenarios." *Climatic Change*, 2013.
- Lemke, Douglas. "Great Powers in the Post-Cold War World: A Power Transition Perspective." In *Balance of Power: Theory and Practice in the 21st Century*, by T.V. Paul, James L. Wirtz and Michael (eds.) Fortmann, 52-75. Stanford: Stanford University Press, 2004.
- Lieberman, Peter. "Trading with the Enemy: Security and Relative Economic Gains." *International Security*, 1996: 147-175.
- Luttwak, Edward N. *The Rise of China vs. the Logic of Strategy*. Cambridge: The Belknap Press of Harvard University Press, 2012.
- Mirski, Sean. "Stranglehold: The Context, Conduct and Consequences of an American Naval Blockade of China." *Journal of Strategic Studies*, 2013: 385-421.
- Nelson, Robert H. *The New Holy Wars: Economic Religion vs. Environmental Religion in Contemporary America*. University Park: The Pennsylvania State University Press, 2010.
- Odgaard, Liselotte. "Between Integration and Coexistence: US-Chinese Strategies of International Order." *Strategic Studies Quarterly*, 2013: 15-39.
- Pedrozo, Raul. "Arctic Climate Change and U.S. Accession to the United Nations Convention on the Law of the Sea." *International Law Studies* (U.S. Naval War College), 2013: 757-775.
- Posner, Eric A. *the Perils of Global Legalism*. Chicago: The University of Chicago Press, 2009.
- Powell, Robert. "Absolute and Relative Gains in International Relations Theory." *American Political Science Review*, 1991: 1303-1320.
- Schroeder, Paul, W. *The Transformation of European Politics: 1763-1848*. New York: Oxford University Press, 1994.
- Schweller, Randall. "Emerging Powers in an Age of Disorder." *Global Governance*, 2011: 285-297.
- Schweller, Randall, and Xiaoyu Pu. "After Unipolarity: China's Visions of International Order in an Era of U.S. Decline." *International Security*, 2011: 41-72.
- Shirk, Susan L. *China: Fragile Superpower*. New York: Oxford University Press, 2007.
- Wohlforth, William. "Unipolarity, Status, Competition, and Great Power War." *World Politics*, 2009: 28-57.

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Mr. Lane has testified before the U.S. House of Representatives Committee on Science and Technology and has frequently been an invited expert at policy conferences. He received his B.A. degree with honors from the University of Wisconsin, where he also completed two years of post-graduate work in European history.