

The multifaceted nature of global climate change negotiations

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Abstract International climate change negotiations primarily occur during annual Conferences of the Parties (COPs) to the United Nations Framework Convention on Climate Change and currently involve virtually every country in the world. What effect does such a large and heterogeneous group of states have on the complexity of climate change negotiations? Would a smaller, more homogenous, assortment of countries produce a more efficient negotiation space? To begin to answer these questions, I apply Latent Dirichlet Allocation to a corpus of High-level climate change conference speeches, covering the formal statements made by country-representatives at the 16th-to-19th COPs. This exercise yields a very large and coherent set of latent topics and many, but not all, of these topics correspond to the negotiating positions presumed by extant research. Analysis of the resultant topics reveals that the dominant dimensions of climate change negotiation favor developing country concerns over cooperation, though reducing negotiations to a smaller core group of countries may lessen this disparity. Together these findings indicate that unsupervised topic models can substantially expand our understandings of climate change negotiations, and international cooperation more generally.

Keywords Climate change · International cooperation · UNFCCC

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International climate change negotiations primarily occur during annual sessions to the United Nations Framework Convention on Climate Change's (UNFCCC) Conference of the Parties (COPs) and currently involve virtually every country in the world. What effect does such a large and heterogeneous group of states have on climate change negotiations? Exactly how many negotiation dimensions arise? Given the heterogeneous mix of preferences, which of these dimensions are most prominent and which become watered down? Would a smaller group of countries significantly reduce the dimensions by which countries negotiate over climate change? The present paper attempts to answer these questions by quantitatively analyzing national governments' High-level statements at several recent UNFCCC COPs.¹

With respect to the questions posed above, it is widely argued that the UNFCCC's recent struggles in negotiating and implementing a global (post-Kyoto) climate change treaty have arisen because these negotiations have become too complex; not because countries are merely too far apart (Victor 2006, 2011; Stavins 2010; Schüssler 2014). Negotiation complexity, often characterized as an excessive dimensionality in the number of issues that countries have been tasked with negotiating over, has generally arisen within the UNFCCC for two interrelated reasons. First, the anticipated costs and benefits of addressing climate change are highly asymmetric across countries (Bernauer 2013, 424), meaning that countries' treaty preferences will be extremely heterogeneous as well. Second, the UNFCCC's institutional design—specifically its one-member-one-vote rule and near global membership—guarantees that this manifold assortment of global preferences must be addressed in order for member-countries to reach consensus on a global climate treaty. As the number and diversity of issues to be negotiated over increases, states' abilities to find an acceptable and effective global solution to the climate change problem have accordingly become exceedingly difficult, and contentious (Victor 2011, 209-210).

The logic outlined immediately above is very compelling, and has gained wide recognition within academic,² media,³ and policy circles.⁴ Yet, with a few notable exceptions (Weiler 2012; Genovese 2014), we have little sense of just how complex UNFCCC negotiations have become, or of the true distribution of countries' *initial* UNFCCC negotiating positions.⁵ That is, while recent research has made progress in

¹ Annual UNFCCC COPs last approximately two weeks and encompass organizational matters, working groups and reports, adoptions of proposals, national communications, and High-level segments, among other agendas. While the majority of these tasks are performed by a country's broader representatives to the UNFCCC, the High-level segment encompasses a shortened session during a COP's two-week negotiating period at which time each country's formal environmental minister or head-of-state travels to the COP host site to deliver a national statement, as well as to provide negotiation guidance more generally.

² See, e.g., Victor (2006, 2011), Stavins (2010) and Schüssler et al. (2014).

³ See, e.g., McDonald (2009), Sasman (2010) and The Financial Express (2013).

⁴ See, e.g., Soliz (2011), Widerberg and Stenson (2013) and Schunz (2009).

⁵ As argued below, the unstructured and unprompted nature of UNFCCC High-level segment speeches—in contrast to other forms of UNFCCC participation such as national communications—allows me to identify these initial positions and concerns towards climate change cooperation. By 'initial,' I specifically mean the positions countries hold towards climate change prior to their being forced to tailor their opinions and demands to a more limited set of pre-defined, core climate change issue areas. I also refer to initial positions as 'pre-agreement' positions, and use 'negotiation' and 'bargaining' interchangeably, throughout the text.

determining countries' ultimate climate change stances via UNFCCC position texts and issue-specific country statements, such approaches only identify countries' climate change positions under scenarios where at least some acceptance of core, or technical, climate change issues has been achieved. This is problematic as it ignores the broader set of tangential⁶ issues and concerns that countries initially bring to the negotiating table. Not every government has an overriding political stake in, or concern for, climate change cooperation and the fact that, for example, at least 37 governments—listed in the supplementary files⁷—dedicated significant portions of their (16th-to-19th) COP High-level Segment national statements to calls for Taiwan's recognition and participation in the UNFCCC suggests that politics can crowd out environmental concerns for even the most climate-vulnerable countries. Ignoring initial, and tangential, negotiating demands such as these limits our abilities to understand climate change politics, as these lurking issues lie at the very heart of contemporary gridlock in international climate change cooperation.

Hence, gaining a better empirical understanding of pre-agreement UNFCCC issue complexity, and its distribution across states, is critical to our understandings of international (environmental) cooperation. In these respects, it is argued below that measuring the full number and scope of UNFCCC pre-agreement topics, and their divergence from core climate change concerns, will help us to better answer questions as to whether the UNFCCC's near-global membership has indeed led to a negotiation-forum marked by excessive dimensionality, and hence also whether a "club" based approach⁸ to international climate change negotiation, as is often advocated (e.g., Stavins 2010; Keohane and Victor 2011, 17), would be a realistic solution to the current UNFCCC stalemate. Furthermore, if a club based forum is indeed identified as ideal, then a comprehensive understanding of countries' UNFCCC pre-agreement positions could also potentially allow researchers and policymakers to identify the optimal subgroup(s) of countries—that, for example, maximize legitimacy while minimizing complexity—for such a club. Finally, developing an accurate measure of the full dimensionality of recent UNFCCC climate change negotiations would likewise improve scholars' abilities to test theories of, or more generally identify, the national and subnational determinants of countries' initial UNFCCC bargaining positions.

Accordingly, the first objective of this paper is to empirically determine the extent to which countries' High-level Segment statements at several recent UNFCCC COPs correspond in topics and dimensions to the complexity and topic-space claimed by scholars of the UNFCCC negotiation process. I then assess whether this dimensionality, if present, can be reduced by limiting negotiations to smaller clubs, as has been suggested by researchers and policymakers. To achieve these objectives I use

⁶By 'tangential,' I mean any concerns or demands that countries bring to UNFCCC negotiations that fall outside of the core issue-areas of UNFCCC climate change cooperation (defined below).

⁷Available on the Review of International Organization's webpage.

⁸Clubs are institutions or forums that (initially) involve only a small number of core states in the tasks of agenda setting, rule-making, and international cooperation (Keohane and Nye 2001). Their more limited size helps to facilitate international cooperation through an ease of monitoring and an increased ability of members to withhold benefits and thus deter free riding (Keohane and Victor 2011, 16).

latent Dirichlet allocation (LDA) models to determine the most common latent topics found within a novel collection of country-level speeches made during the 16th-to-19th UNFCCC COPs. I first informally assess the uncovered topics and categories and evaluate the extent to which these relate to primary climate change cooperation issues rather than secondary ones. I then examine the dominant topics found within several subgroups of my country-level climate speeches so as to assess whether limiting negotiations to smaller clubs offers the advantage of reduced (but representative) issue-dimensionality. I conclude by discussing several potential implications and extensions.

1 Theoretical motivation

The international community's collective efforts to address global climate change are primarily conducted under the auspices of the UNFCCC during annual meetings of the UNFCCC's COP. Recent years have seen the UNFCCC become truly *global* in this respect. At present, the UNFCCC boasts 195 member countries (plus the European Union) and several additional observer states—thereby encompassing all UN member states and even a number of non-UN members (UNFCCC 2014). Furthermore, the Convention's consensus-based structure by and large provides each of these members with a comparable voice in the negotiation process. The resultant need for a *global consensus* within the UNFCCC has become especially apparent since COP 15 in Copenhagen (2009) wherein the UNFCCC's member states began to increasingly focus their efforts on negotiating a comprehensive, and binding, climate change agreement to succeed the Kyoto Protocol. Though some progress on this front has been achieved in recent meetings, it is widely believed that it has been far too limited, and too slow, to be claimed a significant achievement in addressing global warming (Widerberg and Stenson 2013; Bernauer 2013, 423).

Partially due to the international community's slow progress in creating and implementing a future global climate treaty, and in part because of past failures in global climate cooperation,⁹ many have characterized the current UNFCCC negotiation framework as flawed and ineffective in achieving a robust solution to the climate change problem. Depledge (2006, 1) notes in this regard that “the global climate change regime—centered on the 1992 [UNFCCC] and the 1997 Kyoto Protocol—has not only got ‘stuck,’ but is digging itself into ever deeper ‘holes’ of rancorous relationships, stagnating issues and stifled debates, and thus rendering itself unable to serve as a tool or arena for learning.” Others have similarly characterized the contemporary state of UNFCCC-based climate change cooperation as being one of gridlock (Victor 2011; Keohane and Victor 2011, 10), deadlock (Heyward 2007, 531), or stalemate (Soroos 2001; Sharma 2010). In these respects, a consensus seems to be emerging that the current UNFCCC institutional framework is not a suitable venue

⁹See, e.g., discussions of Kyoto's slow ratification process and unfulfilled promises among key states (Buchner and Dall'Olio 2005; Crowley 2007), as well as assertions of Kyoto's failures in gaining either U.S. ratification or binding commitments from developing states—especially China and India (Victor 2006, 91).

for the negotiation of a global treaty that would enable countries to mitigate carbon emissions in a manner conducive to avoiding major climate change consequences.

The most common answer as to *why* the UNFCCC negotiating framework has proven incapable of achieving this lofty goals is one of “issue complexity,” rather than “issue indivisibility” or “issue salience.” That is, most contend that the severe gridlock in recent UNFCCC negotiations has arisen because the relatively large number of member countries now in the UNFCCC has dramatically increased the number, and complexity, of issues being brought to the initial negotiating table, rather than arguing that this gridlock has arisen because negotiating parties are merely too far apart on these dimensions, or any subset thereof.¹⁰ Victor (2011) argues here that, for the UNFCCC, the “sheer length and complexity of the diplomatic agenda made it impossible for countries to focus on practical actions that would make a difference” (2011, xxvii), later elaborating that as the number of negotiating parties has expanded, “each new country brings a new wariness and special demands; tailoring the agreement to meet those needs becomes more complicated. And each tailoring affects the needs and interests of other members, which adds to the complication and gridlock” (2011, 52). Stavins (2010), Schüssler et al. (2014), and Depledge (2006) each echo these concerns, with the latter observing that “the negotiating agenda has expanded over time to encompass an ever wider spectrum of issues—land use, land-use change and forestry (LULUCF), adaptation, technology transfer, methodologies, market mechanisms, international aviation, linkages with other regimes, and more” (2006, 8). In essence, the UNFCCC’s near global membership has led to an increasingly complex and heterogeneous negotiating space, where bargains over climate change are inhibited by the need to find simultaneous solutions to a host of secondary, and tangential, concerns that fall outside of the fundamental and mean objectives to global climate change cooperation.¹¹

The literature offers a number of explanations as to why these problems have arisen. The above claims reflect the complementary (cooperation) challenges of excessive issue scope and member size that are often highlighted by international institutional design scholars (e.g., Koremenos et al. 2001, as well as concerns regarding the effects of climate change asymmetries on collective action problems in global environmental cooperation (Ward et al. 2001; Bernauer 2013, 424). In this vein, even the staunchest advocates of issue-expansion and issue-linkage within international bargaining caution against going too far, wherein requirements to find joint resolutions over sets of divisive and less contentious issues may render agreements impossible (Sebenius 1983, 300). Others have similarly demonstrated that issue-linkage, and hence issue-expansion, can likewise impede international cooperation under related circumstances, such as in contexts where states are predominately concerned with international competitiveness (Urpelainen 2013). The UNFCCC’s

¹⁰Put another way, my claim is that the number of issue dimensions, unconditional on their distance or salience, is widely argued to be the overriding contributor to current climate change gridlock.

¹¹I give examples of several asserted fundamental (“core”) and secondary issues further below. Note that secondary issues, while arguably non-fundamental to climate change cooperation, are still extremely important to this endeavor for reasons of issue linkage, leverage, and value differentiation (Sebenius 1983).

broader institutional design, including the one-member-one-vote rule, further contributes to the above dynamics, as these design features provide even the smallest or poorest of countries equal voice to that of major powers and major carbon emitters in climate negotiations (Heyward 2007; Depledge 2006, 10). Here, extant research suggests that the UNFCCC's design, and its unanimity features, have had an especially notable, and positive, effect on the empowerment of small island nations, many of whom stand the most to lose from climate change (Ashe et al. 1999; Betzold 2010). Qualitative evidence confirms these assertions, reporting for instance that small island states have recently been able to shift the UNFCCC conference agenda away from purely environmental issues and more towards broader security and prosperity concerns (Jaschik 2014, 286). Yet, the very same UNFCCC design features that provide small island states with a much needed voice in the negotiation process also spell trouble for negotiation when extended to all other UNFCCC members (as the UNFCCC affords). Indeed, the sheer *number* of secondary issues that have emerged due to these design features—and the increased inter-linkages across these secondary issues—appear to have become the overriding concern among those studying UNFCCC negotiations (Victor 2006; Depledge 2006; Victor 2011; Widerberg and Stenson 2013; Schüssler et al. 2014).¹²

However, researchers have provided very little detail on exactly what these secondary UNFCCC issues are, or their full scope. Here, policymakers and academics seem to have come to a relative consensus over what the core, shared issues of contemporary climate change negotiation are—i.e., adaptation, finance, mitigation, and technology¹³—but exhibit little consensus, and provide scant detail, on the full nature of the secondary issues that have arguably precluded global climate change cooperation. Put differently, while all nations may not necessarily agree on the *relative salience* of adaptation, finance, mitigation, and technology to international climate change cooperation, most researchers and policymakers identify and accept these “central” issues as fundamental to any ultimate climate change agreement. On the other hand, the presence of a large number of more disparate, latent climate change concerns—that never make it into published country positions or signed agreements¹⁴—is widely observed by those studying the UNFCCC (e.g., Carlarne 2010; Fisher 2011; Victor 2011; Depledge 2006, 8), yet no comprehensive or definitive list of these peripheral (pre-bargain) concerns has been identified. Hence, assertions over the number of, and extent that, secondary issues actually impede climate change cooperation at recent UNFCCC COPs remain untested hypotheses, as does the question of whether these secondary issues are sufficiently important so as to complicate climate change negotiation even after countries'

¹²Although it remains an untested assumption as to whether the (potentially) large issue number and high issue complexity of contemporary UNFCCC negotiations are the *causes* of gridlock. That is, complexity could instead be more of a symptom than a cause of contemporary levels of UNFCCC gridlock.

¹³Indeed, these are the four core components identified under the “Focus” section of the UNFCCC website <https://unfccc.int/2860.php>. Though some—such as Victor (2011)—have implied that even this set of issues may be too expansive for successful global climate change cooperation (especially adaptation).

¹⁴Such as broader land-use demands or the Taiwan concerns mentioned above.

bargaining positions have been reduced down to each UNFCCC member's main interest(s). I therefore test the following hypothesis and corollary below:

- Hypothesis 1: Countries' pre-agreement stances towards UNFCCC climate change negotiations will exhibit a range of issues that is notably larger than the four core climate change issue-dimensions identified above.
- Corollary 1: Any secondary issues that are observed within country-level UNFCCC speeches will continue to contribute to pre-agreement complexity even after each country's negotiating positions have been reduced to a dominant negotiating position.

A related argument that is often made with respect to the UNFCCC's negotiation gridlock pertains to a potential solution to the excess dimensionality problem described above. Specifically, scholars frequently claim that the complexity and diversity of UNFCCC climate change negotiations, and the stalemates that accordingly arise, could be avoided by reducing the number of states negotiating over climate change to either smaller groups (Heyward 2007, 531) or more limited "clubs" of essential members (Stavins 2010; Victor 2011; Keohane and Victor 2011, 17). In essence, the private decision-making that clubs allow for is argued to enable club-members to achieve deep cooperation—as opposed to thin or unambitious agreements—by freeing members from the need to reach consensus among large groups of countries with highly divergent interests (Keohane and Victor 2011, 16). Victor accordingly argues for a club based approach to global climate change cooperation in noting that, "[b]y focusing initially on the countries that matter most, the number of voices will be fewer and it will be easier to craft complicated deals" (2011, 264). This logic follows conventional bargaining theory, as it has long been argued that smaller, as opposed to larger, groups help actors solve coordination and commitment problems (Buchanan and Tullock 1962; Olson 1968; Oye 1986). Here, the cooperation benefits associated with limited membership follow directly from Olson's arguments with respect to actors' relative ease of self-monitoring and self-regulating in smaller groups, which have in turn been shown to extend to international environmental agreements specifically (Weiss and Jacobson 1998, 521). Increasing group size in a cooperative setting not only has the opposite effects, but also often expands the heterogeneity of actors' preferences,¹⁵ which given the consensus-based design of the UNFCCC, further undermines cooperation by exacerbating collective action problems (Bernauer 2013, 424) and restricting potential solutions to only those that are acceptable to the least common denominator (Ward et al. 2001, 438).

On the other hand, limiting group size also has its drawbacks. For many international issue-areas, the free riding of non-member states on any resultant goods can undermine the value of a group-based arrangement, and can deter major powers from participating in such clubs altogether (Kahler 1992). For the climate change problem specifically, a core implication of the climate's "global commons" nature is that international agreements in this arena must achieve full global participation in order

¹⁵ And undermines countries' abilities to identify a common interest (Oye 1986, 19).

to achieve effectiveness (Ecchia and Mariotti 1998, 574). Without such participation, concerns over free-riding, trade leakage, and the shifting of carbon-intensive industries to “pollution havens” in nonparticipating countries could potentially preclude successful global cooperation among even the most environmentally motivated states (cf Finus 2008; Wagner 2001, 397-398). Moreover, restricting international cooperation to smaller groups additionally runs the risk of excluding important voices from the negotiation process, leading to an under-representation of some (developing country) interests and skewing the benefits of international institutions and agreements towards the interests of more powerful states (Posner and Sykes 2014). By shrinking the issue-space in this manner, such restrictions can also reduce potential zones of agreement by eliminating opportunities for joint gains and side payments between negotiating states (Sebenius 1983). Hence, while limiting the number of UNFCCC parties to a select club may make for an easier negotiating space, it also could potentially distort the topics under negotiation to the point where they no longer encompass the issues necessary for effective global climate change cooperation.

These drawbacks notwithstanding, many have drawn upon the aforementioned club-based rationales to argue that smaller groupings of countries would be better able to negotiate and implement an effective international climate change agreement (Stavins 2010; Victor 2011; Keohane and Victor 2011). Yet there is again little consensus on what an ideal group of essential members would look like, although perhaps Victor again comes closest in stating that his “hunch is that it is about a dozen—the top ten emitters from burning fossil fuels, plus Brazil and Indonesia (two of the top emitters of CO₂ from changes in land use). At numbers greater than a dozen negotiating complexity will overwhelm the advantages of additional leverage” (2006, 95). As support for this contention, Victor also stresses that “leverage over the problem—measured by emissions—saturates quickly as numbers rise. The top six emitters (counting the EU as a single emitter) account for 64 % of world emissions of CO₂ from burning fossil fuels; the top dozen are responsible for about 74 %. Gaining another ten percent of emissions requires adding another 10 countries” (2006, 95). Stavins (2010) similarly calls for limiting climate change cooperation to a small grouping of the world’s major emitters while discussing the potential replacement of the UNFCCC with the 17-member Major Economies Forum on Energy and Climate. In both cases, the implicit claim being made is that reducing the set of negotiating parties to a subset of countries with more comparable emissions levels will cut down on the aforementioned challenges of preference heterogeneity while still ensuring a negotiating space that encompasses the core issues needed to successfully address global warming. However, given the club-based tradeoffs highlighted above, it is unclear whether any resultant issue space would continue to encompass these fundamental climate change concerns—especially if one believes developing countries’ interests in adaptation, finance, mitigation, and technology to fall within this set of core issues.¹⁶ Hence, a second hypothesis can accordingly be derived and tested below:

¹⁶As many do (e.g., Najam 2005; Parks and Timmons Roberts 2006).

- Hypothesis 2: Clubs can significantly reduce the UNFCCC's pre-agreement issue-dimensionality while still encompassing core, and developing country, climate concerns.

Before proceeding to my empirical tests, several additional points bear mentioning. First, note that even if the empirical record is found to correspond to the claims made in Hypothesis 2, this does not imply that more successful global climate change cooperation will follow from a club approach. Indeed, there are clear tradeoffs to be had in limiting climate change negotiations to a select few, both with respect to the adverse effects of carbon leakage (Kuik and Hofkes 2010, 1741) and to an undermining of the perceived legitimacy of any resultant treaty (Najam 2005; Parks and Timmons Roberts 2006, 351). While it is often suggested that club-based climate treaties can be later expanded to accommodate additional member countries (Victor 2011), ignoring developing country participation with respect to global warming during the treaty design stage—including their input over sustainable development and adaptation—may simply shift the current global climate change negotiation stalemate to the treaty expansion stage. Likewise, note that the identification of a large number of issues within UNFCCC negotiations (Hypothesis 1) does not necessarily imply that there is positional conflict over these issues. That is, the impact of any identified negotiation space upon relative issue salience (and actual cooperation) remains unverified under the ensuing research design. Thus, in exploring the number and nature of UNFCCC issue-dimensions, rather than their consequences, the tests presented below are only a first step in fully understanding the relationships between countries' initial UNFCCC positions and successful climate change cooperation, and I discuss several potential extensions in the conclusion.

2 Method

Latent Dirichlet Allocation (LDA) is an unsupervised topic model used for finding sets of words that characterize latent dimensions of texts. In the usual LDA application to document classification, each document is assumed to be a mixture of multiple, overlapping latent topics, each with a characteristic set of words (Bagozzi and Schrodt 2013). LDA then estimates these topics via a three-level hierarchical Bayesian model that treats each document as containing a finite mixture of underlying topics, where the topics themselves are specified as an infinite mixture over a corresponding latent set of topic probabilities (Blei et al. 2003, 993). In this manner, document classification is performed by associating a document's words with the topics most likely to have generated the observed distribution of words in the document, and the intention of LDA is to then determine those latent topics from patterns in the data (Bagozzi and Schrodt 2013).

The latent topics that are uncovered by LDA are beneficial for at least three purposes. First, to the extent that the words associated with a given topic suggest a plausible construct, they are useful in determining the most prevalent latent issues found within a set of documents (Bagozzi and Schrodt 2013). For example, Bagozzi and Schrodt (2013) use LDA to identify the most common topical categories for a corpus of politically relevant international news-wire reports. The

authors demonstrate that LDA uncovers a very plausible set of latent “news” topics, which in some cases correspond closely to existing political event data coding categories (e.g., “Diplomacy,” “Protest,” or “Missile Attacks”), but in others reveal systematic topics that have gone relatively unnoticed within extant event data ontologies (e.g., “Elections,” “Smuggling,” or “Hostages”). They go on to suggest that LDA holds promise as a flexible engine for the coding of political events data both within and between countries. Likewise, Rice (2012) uses LDA to uncover and compare the latent dimensions of U.S. Supreme Court opinions to existing judicial policy coding schemes, while related (non-LDA based) probabilistic topic models have recently been used by political scientists to identify the underlying dimensions to U.S. Senate floor speeches and Senate press releases (Quinn et al. 2010; Grimmer 2010). As mentioned above, what often sets LDA apart from these other approaches is its assumption that each document of interest contains a mixture of underlying topics, rather than a single topic—a premise that fits nicely with the multifaceted nature of the individual climate speeches analyzed below.

Second, researchers can also use LDA to determine not only the content but also the topical density, or number of latent topics, found within a given set of documents. For instance, LDA-derived measures of topical density have been employed as a means of identifying the readability level of documents within the arena of educational development (Qumsiyeh and Ng 2011) as well as a criteria for assessing the representativeness of a document sample with respect to the broader themes found within a document collection (Baille et al. 2009). In these regards, the most common metric used in determining the number of underlying topics identified by LDA across a set of documents is the perplexity measure, which is defined for a given test set S_{test} of M documents (d) containing words N as

$$\text{perplexity}(S_{test}) = \exp\left(-\frac{\sum_{d=1}^M \log p(\mathbf{w}_d)}{\sum_{d=1}^M N_d}\right) \quad (1)$$

where $p(\mathbf{w}_d)$ corresponds to each document’s marginal probability, and a lower perplexity score indicates better generalization performance (Liénoú et al. 2010, 30). Less frequently, the marginal likelihood for one’s LDA model, which is monotonically increasing in one’s perplexity statistic, is used as an auxiliary measure of model fit and choice of topic number (e.g., Grün and Hornik 2011, 28) as are a number of more advanced model selection and validation techniques that seek to guard against the potential drawbacks of maximizing model fit over substantive interpretation (e.g., Roberts et al. [Forthcoming](#)). Finally, one’s LDA-identified topics can be used with other statistical approaches such as (logistic) regression or support vector machines in order to classify new documents (Bagozzi and Schrodtt 2013), or to assess the extent to which one’s uncovered topics vary according to a document’s external traits. Social science applications in this vein are illustrated in, for example, Gerrish and Blei (2011) and Roberts et al. ([Forthcoming](#)).

The importance of uncovering the latent dimensions to countries’ climate change positions (and the High-level statements on this topic) is due to issues of measurement. Scholars cannot comprehensively ask governments what their true stances are towards global warming, and towards climate change cooperation specifically. This

is a major limitation to theory testing, as social science theories in this arena often pertain directly to national political actors' positions on the climate issue, and variation therein. In response, researchers have recently developed a number of indices to approximate latent country positions towards climate change such as the Climate Change Performance Index (Burck and Bals 2011) and the Climate Change Cooperation Index (Bernauer and Böhmelt 2013). Yet, given their focus on emissions outcomes, these measures are better suited as indicators of an economy or society's aggregate contributions to climate change than as direct representations of national governments' foreign policy intentions on these issues.¹⁷ Similarly, the negotiation-position measures that have been derived by Weiler (2012) and Genovesi (2014) from submitted UNFCCC documents and survey questions also cannot fully identify countries' *pre-agreement* positions towards UNFCCC cooperation, as these documents and survey questions reflect countries' technical responses to specific climate change prompts or issues, thereby precluding countries' the opportunity to express whether they value more tangential concerns over central climate change policy-issues. Thus, the measures listed above, while insightful, are at best the "tip of the iceberg" when it comes to governments' latent positions towards climate change, and fail to capture the full diversity of interests that countries hold at the initial bargaining and negotiating stage of climate change cooperation, which is precisely the juncture at which international climate cooperation appears to have stalled.

Examining governments' more wide-ranging High-level climate speeches allows for a more direct means of assessing political leaders' initial stances on this issue, and on international environmental negotiation more generally. As elaborated upon below, the unprompted, unconstrained nature of these UNFCCC High-level segment speeches provides a unique window into the positions that countries may hold towards climate change prior to any narrowing of their concerns or demands to a pre-defined set of official document prompts or questions. It is for this reason that I argue that the UNFCCC's High-level segment speeches correspond to countries' initial (that is, pre-agreement) climate change positions, including any tangential concerns that may exist therein. With respect to the audience(s) for these speeches, it is worth noting that the UNFCCC's High-level segment speeches are given by (nationally accountable) ministers or heads-of-state at each COP, often to much fanfare, and are widely covered by domestic journalists and news-outlets. Thus, domestic audiences are a key component to countries' High-level speeches and the fact that countries often, but not always, favor delivery of these speeches in their national languages¹⁸ would seem to support this point. At the same time, because these speeches are presented at international conventions, with climate change negotiations ongoing, and with other countries' representatives, journalists, and non-governmental organizations in attendance, the international community likely represents another core audience for each speech. Yet, while these latter audiences may compel countries

¹⁷Moreover, to the extent that the above indices do capture political behavior, the focus is largely on yes/no questions of major treaty ratification and compliance.

¹⁸When their national languages correspond to Russian, Spanish, French, Arabic or English.

to engage in some “cheap talk” within their High-level climate speeches, these tendencies are likely offset by the aforementioned domestic audiences, as well as by the importance of the UNFCCC venue within the overall climate change negotiation process. Regarding the latter, there is a reason why (i) the vast majority of countries send their heads-of-state or top environment ministers to deliver these High-level speeches, rather than lesser bureaucrats, and (ii) virtually every member-country issues a speech in the High-level segment even though it is not compulsory. Most countries’ opportunities to influence climate change negotiation are highly limited. With the UNFCCC COP only taking place once a year, and being the primary forum for the negotiation of future global climate change agreements, this is often governments’ best (and only) opportunity to influence the international climate change policymaking process, and the tumultuous nature of recent COP meetings suggests that countries do take these negotiations very seriously. Recent analyses confirm these assertions, in noting that country-level factors far outweigh international strategic dynamics in determining country-level UNFCCC negotiating positions (Bailer and Weiler 2014).

3 Data

This sample used for this study corresponds to the statements given by countries’ High-level UNFCCC political representatives¹⁹ during the High-level Segments to the UNFCCC’s four most recent COPs: COP 16 (2010), COP 17 (2011), COP 18 (2012), and COP 19 (2013). As mentioned previously, COP High-level segments are shortened sessions during each COP’s two-week negotiating period at which time each country’s formal environmental minister or head-of-state travels to the COP host site to deliver a national statement and to provide negotiation guidance more generally. As such, these official High-level Segments offer every UNFCCC member-country an opportunity to outline their current and future desires for climate change cooperation and each speech typically touches upon several distinct climate change topics and concerns. A qualitative reading of a random sample of 50 speeches suggests that the speeches themselves were fairly unstructured, with very little content dedicated to introductions and conclusions. High-level speech texts were not available for pre-2010 UNFCCC COPs, which accordingly restricted the sample frame to the four COPs mentioned above. While unfortunate, limiting the sample frame in this manner nevertheless offers the advantages of (i) allowing the discourse of negotiations to be relatively comparable across the COPs analyzed and (ii) ensuring that the findings discussed below will be especially pertinent to policymakers and related actors, as the focus of negotiations during the 2010–2013 sample period was primarily on negotiation of a future climate change treaty, rather than on the formation of Kyoto or past compliance therein. PDF or PDF Image files of the High-level speeches for COPs 16–19 were obtained directly from the

¹⁹These are generally heads-of-state, environment ministers, heads of similar ministries such as agriculture, forestry or natural resources, or ambassadors to a given COP host-country.

UNFCCC's website,²⁰ and were converted to machine readable text using Optical Character Recognition (OCR) software specifically designed for the handling of texts from various languages. The vast majority of speech texts were available in English, with a minority in Spanish or French, and a very small minority in Arabic or Russian.

This approach yielded a total of 554 individual speeches (documents) for analysis. In line with High-level segment time requirements, the duration of each speech was fairly short, with an average length of 644 words, a standard deviation of 225 words, and a maximum number of words per speech of 1,668 for my speech-document sample. While all UNFCCC member countries had the opportunity to speak during each of the four High-level Segments under analysis, some speeches were missing for various countries depending on the COP, though the missingness was not severe and appeared to be at random. Indeed, at least some of this missingness appears to have been due to some country speeches not being uploaded to the UNFCCC website, and pair-wise comparisons of a binary missingness indicator for my 2010-2011 speeches to (one year lagged) country-level measures of (log) GDP per capita, democracy, (log) CO₂ emissions per capita, and year suggest that missingness was not significantly related to a majority of these traits.²¹ Accordingly, the speech-documents for COPs 16-19 were pooled together to form a single corpus in the analysis below, which has the advantage of ensuring that nearly every country in the world contributes at least one climate speech and at most four speeches to my analysis. An extended analysis of the dominant topics identified for these speeches (see the supplementary files) reveals that there were no significant year-to-year shifts in identified topics, which suggests that my pooling of COP speeches likely has minimal costs for my analyses. Having converted these statements to machine readable text, the next step was to preprocess these texts for LDA-estimation. The first task in this regard was to standardize the speeches via machine-translation of the entire corpus to English. Given the "bag of words" framework of LDA, little information is lost based on this approximate translation approach, and this is especially the case here given that non-English speeches represented a minority of all speeches in the corpus.

For each speech, I then processed its text to remove all proper nouns,²² punctuation, numbers, and stopwords. The removal of the latter three character-sets is standard preprocessing for LDA analysis (Rice 2012; Bagozzi and Schrodt 2013; Roberts et al. *Forthcoming*), whereas proper noun removal is a more recent preprocessing step that has proven to be extremely useful for LDA's estimation and identification of coherent topics within international political texts (Bagozzi and Schrodt 2013). Finally, as is also commonplace in probabilistic topic modeling, all remaining words were converted to lower case, stemmed, and re-structured into a document-term-corpus before analysis.

²⁰<https://unfccc.int/2860.php>, various pages.

²¹The exception being democracy, which was negatively and significantly related to missigness, although its substantive effect was not inordinate in size. See the supplementary files for this analysis.

²²The methods used for this task may miss some (extremely obscure or misspelled) proper nouns. Examinations of my topics' top word-stems suggests that this did not significantly affect the analysis.

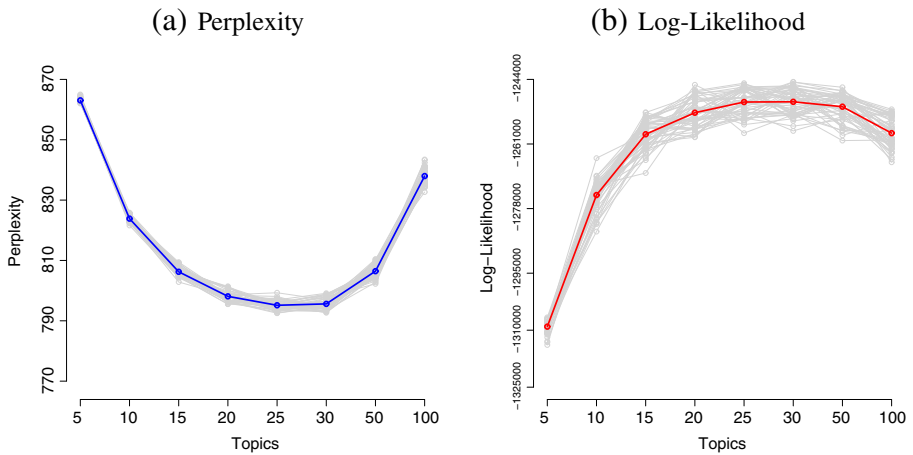


Fig. 1 Model selection

4 Results

I estimated a series of LDA models for my resultant document-term-corpus using Gibbs sampling and first sought to determine the optimal number of topics to assign for these models. Measures of both model perplexity and marginal likelihood were used to determine the ideal number of common topics underlying my collection of 554 climate speeches. Specifically, I estimated LDA models for my entire corpus with the number of topics, k , set to $k = \{5, 10, 15, 20, 25, 30, 50, 100\}$,²³ and calculated each model's corresponding posterior log-likelihoods²⁴ and perplexity measures at each k . This process was then repeated 50 times using different initializations to ensure that my conclusions were not being driven by specific starting parameters. The resultant perplexity and log-likelihood values are plotted in Fig. 1a–b for every initial set of starting parameters (grey) and each measure's respective mean values across all initializations (blue or red). Figure 1a–b suggest in this case that an optimal number of topics for my corpus rests somewhere in the $k = 25$ to $k = 30$ range, since this general range yields the lowest and highest values for my perplexity and log-likelihood measures, respectively. In order to provide the most conservative test of my hypotheses, as well as to guard against potential overfitting, a total of 25 topics were chosen for the primary LDA model discussed below, and it is to this model that I now turn.

In finding that a 25 topic LDA model yields a substantially better model fit for my climate speech corpus than does an LDA model with far fewer topics, I have uncovered an initial degree of evidence in support for Hypothesis 1. Specifically, a topical density of 25 implies that a relatively large number of latent topics underlie

²³I evaluate topics up to $k = 100$ given the topic numbers identified and explored in past applications of unsupervised topic models to political texts (e.g., Quinn et al. 2010; Gerrish and Blei 2011; Rice 2012).

²⁴For the entire corpus, conditional on topic assignments; referred to hereafter as simply “log-likelihoods.”

contemporary international climate change negotiations, which is in line with recent contentions that the *global* nature of the UNFCCC's more recent COPs has significantly increased negotiation complexity beyond the 3–4 essential components to climate change cooperation itself, as well as with more recent analyses of countries' national reports to the UNFCCC concerning domestic climate change and UNFCCC compliance activities (Genovese 2014). Regarding the latter point, my 25 identified topics are comparable in number to the topics (of 22 and 23) that Genovese (2014) identifies for two earlier periods of UNFCCC negotiation while using different text analysis approaches and documents. But are my identified topics substantively meaningful? To begin to answer this question, I present the top 10 word-stems associated with each of the 25 topics estimated by my primary LDA model in Tables 1 and 2 below, and report top 20 word-stems in the supplemental information appendix. The column labels were assigned by the author to give a general sense of how one would characterize each cluster of words.

Turning to these tables, one can first note that the 25 topics identified by LDA generally appear to correspond to meaningful negotiation issues. However, the correspondence between the latent topics and the core, most widely accepted, dimensions of global climate change cooperation—as defined by the UNFCCC²⁵ or related research (Weiler 2012; Bailer and Weiler 2014)²⁶—is mixed. Regarding instances of high correspondence, two topics (“GHG” and “Mitigate”) appear to be directly related to issues of greenhouse gases (GHG) and *mitigation*; whereas the “Ocean,” “Terrestrial,” and “Weather,” topics clearly correspond to the varying concerns held by subsets of countries with respect to the consequences of climate change and hence *adaptation*. The “Finance” topic shares commonalities with both the UNFCCC's core *finance* issue-area and Weiler's (2012) market mechanisms (mitigation) policy area. A separate “Cooperation” dimension appears to encompass countries' broader efforts to find an international solution to climate change. Several other categories—such as “Energy” and “Economic”—may also correspond to the UNFCCC's *technology* component, though these appear to relate mostly to “green economy” and renewable energy concerns of advanced industrialized democracies, rather than to technology transfers for developing countries. Finally, the “Development” topic appears to capture developing countries' concerns across a host of issues, including *finance*, *adaptation*, and *technology*; perhaps underscoring the divergent perspectives held on these issues among developed and developing countries.

At least as interesting, however, are the large number of topics which appear to have wide and distinctive coverage but do *not* correspond to the UNFCCC's major categories of climate change cooperation. Rather, these additional topics appear to relate to more narrow or tangential global climate change concerns that, while still critically important to (some) countries, can nevertheless be seen as secondary (in

²⁵I.e., adaptation, finance, mitigation, and technology.

²⁶E.g., Bailer and Weiler (2014) identify six “crucial” UNFCCC negotiation issues, which they suggest can be summarized by two main factors relating to mitigation and reduction targets. Weiler (2012) identifies eight core policy issues, including two related to reduction targets, two related to adaptation, two related to mitigation, one related to market mechanisms (e.g., finance), and one related to measurement/reporting.

Table 1 Top words (Topics 1-16)

Hope	Ocean	Terrestrial	Uncertainty	Warming	Negotiation	Mitigate	Agriculture
can	island	glacier	scenario	atmosph	confer	cut	coastal
world	small	mountain	converg	dioxid	negat	follow	list
time	state	melt	worst	carbon	peac	per	person
much	polit	biodivers	cross	sea	state	capita	spirit
point	lie	water	clariti	vast	success	ton	next
today	sea	ecosystem	resolv	ice	deal	ghg	plant
just	ocean	lake	case	concentr	especi	struggl	eros
now	member	fragil	content	gender	gentlemen	exceed	farm
hope	rise	glacial	nevertheless	glacier	good	mind	led
planet	greater	deep	sum	potenti	desir	plant	observ
Strategies	Introductions	Conflict	Finance	Immediacy	Openings	Catastrophe	GHG
intend	gentlemen	power	outcom	entir	peopl	death	gas
famili	ladi	speci	financ	word	impact	tri	greenhous
communic	behalf	war	balanc	empti	behalf	typhoon	first
extent	planet	bank	ensur	spent	address	may	reduct
wrong	welcom	capit	second	tomorrow	warm	hit	amend
constant	fight	histor	deliv	undoubt	hospit	cope	new
law	warm	impos	enhanc	dare	call	magnitud	transit
ordinari	wish	life	key	hour	deleg	light	agreement
perhap	congratul	absenc	must	interpret	statement	sympathi	period
postpon	excel	control	operation	mr	leadership	era	fulfil

Table 2 Top Words (Topics 17-25)

Forest	Gesture	Development	Pollution	Energy	Humankind	Cooperation	Weather	Environment
forest	pass	countri	pollut	energi	human	will	drought	environ
manag	evid	develop	oil	renew	life	global	flood	protect
deforest	ten	chang	compens	effici	environment	must	increas	environment
area	condol	climat	summit	sourc	generat	new	sever	occup
conserv	found	adapt	net	power	social	agreement	loss	territori
protect	man	support	billion	electr	societi	need	event	degrad
sinc	topic	thank	segment	fuel	educ	year	agricultur	illeg
use	victim	effort	avoid	invest	involv	part	extrem	occupi
hectar	aphid	effect	idea	solar	model	toward	vulner	destruct
land	elder	respons	propos	gas	product	start	water	land

shared global importance) to the core climate change issues mentioned above.²⁷ For instance “Forest,” and “Agriculture” clearly correspond to the forestry and land-use issues highlighted by Depledge (2006, 8), whereas “Pollution” and “Environmental” each seem to capture instances where countries are seeking to address their broader or tangential environmental concerns within the UNFCCC forum. Likewise, the “Conflict” topic—with top word-stems of “war,” “bank,” and “power”—seems to primarily relate to more expansive concerns over war and economic crisis. Hence these particular latent topics, along with a number of those highlighted above (e.g., “Ocean,” “Terrestrial,” “Energy,” and “Economic”), chiefly encompass climate change concerns that, though important, are likely not held by a majority of countries within the UNFCCC negotiating forum. In this respect, the appearance of these topics offers some additional support for Hypothesis 1, which posited that the UNFCCC’s diverse and inclusive nature would induce climate change negotiations to encompass an issue-space that extends well beyond the core climate change issue-dimensions emphasized by the UNFCCC and others.

In addition, several of the latent topics found in Tables 1 and 2 appear to relate to the practice of negotiation itself—for example, “Openings,”²⁸ “Introductions,”²⁹ and “Strategies”³⁰—or to countries’ efforts to frame the global warming threat. Regarding the latter, these latent topics correspond—with varying degrees of ambiguity—to leaders’ attempts to frame climate change (cooperation) via expressions of “Hope,” “Uncertainty,”³¹ “Immediacy,” and “Catastrophe.” Hence, as a whole, the broad array of relatively coherent topics uncovered by LDA for the four most recent UNFCCC COPs suggests that climate change negotiations do indeed take on a diverse number of distinct positions and issues. These findings accordingly offer support not only for Hypothesis 1, but also for the more general use of probabilistic topic models in the study of international negotiations. In this respect the topics identified not only appear diverse, but are also highly plausible, given the breadth of issues that are often referenced as important to global climate change cooperation (e.g., Najam 2005; Depledge 2006; Victor 2011), and the bargaining issues identified by related content analysis approaches (Weiler 2012; Genovese 2014).

Before turning to Hypothesis 2, recall that a key corollary to Hypothesis 1 posited that the high dimensionality of any uncovered set of latent climate change negotiation dimensions would remain even after reducing countries’ negotiating topics down to

²⁷Especially if one uses the UNFCCC’s own stated agenda (<https://unfccc.int/2860.php>) and past scholarship (Depledge 2006; Victor 2011) as a point of reference.

²⁸Which, in contrast to the more formal “Introduction,” category, appears to correspond to countries’ overview remarks concerning their specific climate change goals, and to more general attempts to signal a country’s willingness to participate in climate change cooperation.

²⁹My speeches dedicated an average of 3% of their content to “Introductions.”

³⁰Along with “GHG” topic discussed above, this topic appears to correspond to a number of the more technical topics identified by Genovese (2014), as well as to the measurement, reporting and verification topic identified by Weiler (2012). In these regards, note that the issue-areas identified in the studies mentioned above likely appear more technical than those identified here because the former studies focused specifically on policy, while the present paper is more generally focused on climate change negotiating positions.

³¹Genovese (2014) identifies a similar topic in her analysis of National Reports and decision level texts.

their most “dominant” bargaining positions. This corollary is crucial, as while the 25 topics identified by LDA will by definition have a degree of systematic support across my speech corpus, this does not imply that each of these 25 topics represents an actual bargaining dimension that (i) deeply matters to (some subset of) countries and (ii) hence contributes to the actual dimensionality of initial climate change *negotiation*—as opposed to simply being a latent dimension of climate change speech-making. Indeed, the multiple issue-framing topics discussed earlier likely correspond more to the climate change rhetoric and posturing espoused by countries during the negotiation process, rather than to the actual issue-demands that countries are committed to seeing through. Hence, I next seek to better identify the primary bargaining space for my COPs of interest by determining the *dominant* underlying topic for each and every speech-document. I do so by identifying the topic whose associated words represent the highest proportion of all words found within a given speech-document, which I then assign as the dominant topic for that document, and repeat this process for each speech. In this manner, I am assuming that the latent topic that a country devotes the majority of its speech to will be the bargaining topic that is most valued by that country within international climate change negotiations. This exercise leaves me with a single latent topic-assignment for each of my 554 climate speeches, which I represent via a frequency distribution—again using my assigned topic labels—in Fig. 2.

Figure 2 provides strong support for the corollary to Hypothesis 1: even after reducing the 25 topic LDA model’s resultant topic-space down to the most dominant topic for each climate speech, a large and diverse number of latent topics continues to dominate the UNFCCC’s overall climate change negotiation process. Specifically, I find that 15 topics remain after applying the dimension reduction exercise described above, with the five most frequent topics, in order from highest to lowest, being “Development,” “Cooperation,” “Hope,” “Openings,” and “Finance.” Unsurprisingly, a majority of these top five topics correspond to the core climate change cooperation issues described earlier. It is also interesting to note here that the “Development” topic appears to be by far the most prevalent dominant topic of all, perhaps suggesting that developing country concerns have come to dominate the current UNFCCC climate change negotiation space. Looking beyond the five most frequent dominant topics in Fig. 2, the remaining dominant topics by and large correspond to disparate, but substantive, climate change concerns, rather than to any of the issue-framing categories, which suggests that the dimension reduction approach employed here is performing as expected. Thus, even after reducing UNFCCC negotiating stances to the single most dominant topic discussed by each country, the LDA-derived negotiating space continues to include a large number of central *and* disparate climate concerns, further demonstrating that the UNFCCC’s climate change negotiations are typically expansive and complex.

Hypothesis 2 posited that the UNFCCC’s expansive climate change issue-dimensionality could be significantly reduced by limiting climate change negotiations to a smaller club of core negotiating states, while still maintaining the global representativeness of core negotiating topics. Because the subset of countries that such a club would encompass is often ambiguously defined in the literature, my tests of Hypothesis 2 will assess multiple potential club groupings, and will err on the side of over-inclusion of countries in these clubs so as to provide “hard tests” of

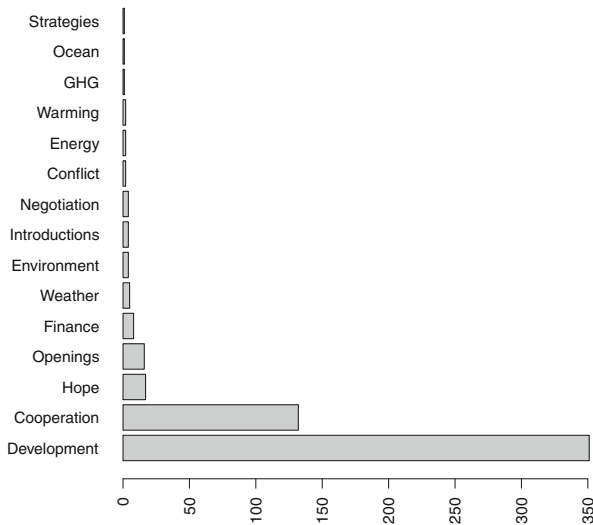


Fig. 2 Frequency of latent topics

this hypothesis. Perhaps the closest that an expert comes to defining an ideal core club of states for future climate change negotiation is Victor (2011), who argues that the optimal number of countries for this club “is about a dozen — the top ten emitters from burning fossil fuels, plus Brazil and Indonesia” (2011, 213-214) and then goes on to mention that for this club, “enthusiastic nations from the industrialized world along with a few of the most rapidly growing reluctant nations — notably Brazil, China, India, Indonesia, and South Africa—are essential” (2011, 264-265). Hence for my first potential club grouping, which I term the “Primary Emitters” club, I attempt to synthesize the above points by including the following 12 countries: Australia, Brazil, Canada, China, Germany, France, India, Indonesia, South Africa, Japan, United Kingdom, and the U.S.³²

I chose to leave out the European Union (EU)—and any additional individual EU countries—from the above grouping so as to maintain a threshold of approximately a dozen countries, and because (i) while the EU is itself now a member to the UNFCCC, each individual EU country continues to offer its own perspectives within the UNFCCC’s High-level COP Segments and climate negotiation process and (ii) Victor appears to imply that restricting club participation among EU members to only France, the United Kingdom, and Germany may be ideal for future climate change negotiations. Indeed, with respect to negotiations over future climate change research and development (R&D), Victor notes that “[b]etter than having the

³²Definitions of “top emitters” vary depending on how and when emissions are calculated. I rely primarily on the figures and countries outlined in Victor (2011) for consistency, and leave Russia out of this club because it was not explicitly mentioned among Victor’s suggested club members (though the other BRIC nations were) and he elsewhere seems to implicate Russia as a direct contributor to the problematic dimensionality of the current negotiations (Victor 2011, 2006, 91). I do include Russia within my larger club grouping.

EU join the table would be to have the top three innovators within the EU—Germany, France, and the United Kingdom (13 percent of world R&D) rather than the less reliable EU voice” (2011, 158). Nevertheless, past research also at times implies that the other EU members should be included as a single entity or group within any resultant club,³³ along with a number of other major emitters such as Korea, Russia, and Mexico.³⁴ In order to ensure that my original selection of club member countries was not too narrow, I therefore define a second club assortment—referred to hereafter as the “Expanded Emitters” club—by also adding the following countries to the “Primary Emitters” club presented above: Russia, Korea, Mexico, and all remaining EU member countries.

To assess whether limiting the number of climate change negotiating parties to these two smaller, more select clubs actually reduces the total number of dimensions to climate change negotiation, I return to the dominant dimension graph reported in Fig. 2. Recall that the topic distribution in this figure corresponded to my assignment of a single latent topic for each speech. To reevaluate the dimensionality of climate negotiations under the smaller clubs listed above, I thus reduce my speech-corpus down to match the specific set of countries in each club, and then re-plot the distribution of my previously assigned dominant topics for each club. These club-based dominant topic distributions are presented in Fig. 3. Turning first to the “Primary Emitters” club’s topic distribution (Fig. 3), the evidence strongly suggests that limiting climate change negotiation to a club of “Primary Emitters” can substantially reduce bargaining dimensionality. Specifically, Fig. 3 suggests that the UNFCCC’s dominate climate change negotiation topics, which originally spanned 15 different topical categories, can be reduced to an assortment of only four dominant topic categories by limiting a treaty’s negotiating parties to the aforementioned “Primary Emitters.” Similarly, limiting UNFCCC membership to the larger grouping of “Expanded Emitters” (Fig. 3) again substantially contracts the dimensionality of topics, from 15 to seven. Interestingly, and perhaps underscoring the utility of clubs for climate cooperation, the *most* dominant topic within the latter club—measured by frequency—now appears as “Cooperation” as opposed to “Development,” although “Development” remains as a dominant topic dimension for each subgroup. Thus, and in confirmation of Hypothesis 2, restricting climate change negotiations to small or medium sized clubs can both shift the focus of negotiations towards international *cooperation*, and, notably reduce the overall dimensionality of these negotiations.

But are these dimensionality reductions statistically significant? This is a concern, as even a random draw of topics from Fig. 2 could yield a subset of only 3 topics given the relatively high frequency of Fig. 2’s “Development” and “Cooperation” topics and the relatively low frequency of other 12 topics in this figure. To evaluate this concern, I apply a generalized Fisher’s Exact Test to the probabilities associated with drawing each of the two samples reported in Fig. 3a and b (without

³³See Victor (2006, 95) and Victor (2011, 213).

³⁴These are the additional UNFCCC member states listed in Figure 1.1 of Victor (2011, 10). Together these states should arguably be included within any club of ‘top ten carbon emitters’ provided that the EU is treated as a single entity—as it is in Figure 1.1.

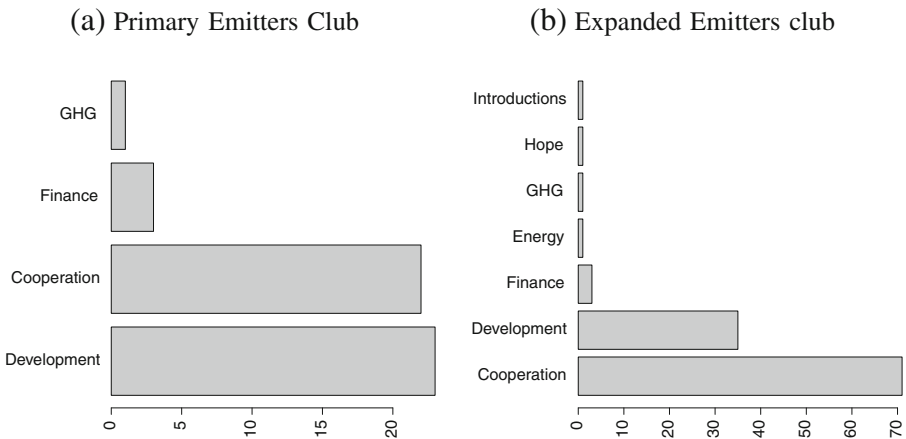


Fig. 3 Frequency of dominant latent topics among potential clubs

replacement) from the topic density reported in Fig. 2. In this respect, I am asking whether the number and distribution of topics that I obtain in each club grouping is significantly distinct from the speech topics that one would obtain by randomly selecting two groupings of country-speeches of comparable number to those recovered for my “primary emitters” and “expanded emitters” clubs, respectively. Based upon these tests, the simulated p -values associated with randomly drawing (without replacement) the topic-combinations reported in Fig. 3a and b are significant at the $p < .10$ and $p < .01$ levels, respectively. Hence, the topic assortments reported for these two potential clubs are highly unlikely to have arisen due to chance. The topic distributions in Fig. 3 thereby support the contention that limiting international climate change negotiations to a core club could significantly reduce the dimensionality of these negotiations (Hypothesis 2), while, interestingly, suggesting that doing so can still address developing country interests—albeit while placing more weight on “Cooperation,” relative to “Development” concerns.

5 Conclusion

Using an unsupervised topic modeling technique alongside a text corpus of High-level country-speeches from the four most recent UNFCCC COPs, this paper evaluates whether contemporary climate change negotiations can be characterized as topically complex. It then assesses whether limiting UNFCCC membership to a select group of states (efficiently) reduces the topical complexity of climate change negotiation. To do so, I first analyze the number and character of the latent topics underlying these UNFCCC country-level climate speeches. I next determine whether this identified topic space remains after country-speeches are re-coded based upon their single most prevalent topic. Finally, I test whether the UNFCCC’s latent negotiation dimensionality can be reduced by limiting the

UNFCCC's negotiating parties to a smaller subset of "critical" countries—which is a frequently proposed solution to the current levels of gridlock in global climate change negotiations.

In support of my expectations, I find that UNFCCC climate change negotiations are indeed highly complex with respect to the number of topics under initial negotiation. Specifically, model fit statistics suggest that approximately 25 latent topics underlie the four most recent COPs. Moreover, while one subset of identified topics appears to closely correspond to the international community's central concerns over climate change cooperation, many additional issues uncovered can be more accurately characterized as secondary issues—such as deforestation, agriculture, or general pollution—that are unlikely to be accepted as *necessary* components to a successful global climate change agreement by *most* states. These findings support existing claims that the global nature of the UNFCCC's negotiating forum has led to a proliferation of secondary issues which have in turn largely crowded out the primary dimensions of climate change negotiation. Analysis of the most prevalent topics associated with each speech also suggests that these secondary demands remain even after countries' bargaining positions are reduced down to their most dominant dimensions. Finally, I find strong evidence to suggest that the club based approach suggested by Victor (2006, 2011), Keohane and Victor (2011, 17), and Stavins (2010), among others, largely eliminates secondary demands from the international climate change negotiation space while simultaneously reorienting negotiation towards countries' more general concerns for international cooperation. Hence it does indeed appear that a club based approach would offer a more feasible international negotiation forum for addressing climate change than does the UNFCCC's current design—though it remains an open question as to whether such a forum could ultimately achieve an effective global climate treaty, especially one that simultaneously avoids many of the negative externalities mentioned earlier.

This paper also contributes more broadly to the study of international cooperation by illustrating the applicability of LDA and related probabilistic topic modeling approaches to the quantitative study of international negotiation speeches and texts. With respect to political science applications, automated text analysis techniques of this sort have been primarily implemented by scholars of American and comparative politics (e.g., Quinn et al. 2010; Grimmer 2010; Rice 2012; Roberts et al. [Forthcoming](#)), and remain relatively under-utilized within the arena of international relations.³⁵ Nonetheless, an enormous amount of text has recently been made available on the web for various international negotiations and agreements. Systematically coding texts for international climate change negotiations or other areas of international cooperation is highly challenging with respect to both time and measurement. The approach presented here provides researchers with a solution to these challenges: LDA can be applied to corpora of relevant negotiation speeches and agreement texts—*when the full set of negotiation topics is unknown a priori*—to

³⁵Exceptions include Boockmann and Thurner (2006), Stewart and Zhukov (2009) and Genovese (2014).

identify and code the most relevant features of these documents, as well as their variation across time and space. Coded documents could then be used in an analysis similar to that presented above, or as actual variables in more traditional statistical models.

The findings for issue dimensionality discussed above could also be used as a point of reference in evaluating the contributions made by non-state actors to the UNFCCC's climate change negotiations. While the focus of this paper has been on *countries'* positions towards UNFCCC climate change negotiations, non-state actors such as non-governmental organizations (NGOs) are playing an increasingly important and sizable role in the UNFCCC climate change negotiation process (Bernauer 2013, 437). Do the contributions made by these non-state actors further increase the dimensionality of UNFCCC climate change negotiations, or does their participation instead simply reinforce the topics identified above? If the latter, do non-state actors shift the balance of issue-support away from or towards secondary climate change concerns? Answering these questions would help us to better understand the impact of these actors on international (environmental) cooperation while also providing a better sense of the complexity of UNFCCC negotiations. To this end, a small but notable subset of NGOs do indeed speak during the UNFCCC's High-level COP Segment, and thus one possible extension would be to add these speeches to the corpus analyzed earlier so as to see how the above conclusions change once these additional actors' speeches are included. Similarly, the present paper's issue dimensionality findings could also be employed as a starting point for a more thorough analysis of the hierarchical linkages between countries' core climate objectives and lower-level means. Gaining a better understanding not only of the scope of UNFCCC negotiation issues, but also of how these topics correlate with and relate to one another, would be useful in furthering our understandings of the role(s) that these issues ultimately play in positional conflict and global climate change cooperation.

A third extension relates to questions of how country-level factors—such as political institutions or national contributions to carbon emissions—affect the attention paid by individual countries to different negotiation topics within the UNFCCC setting. My LDA analysis suggested that countries' High-level COP statements were typically composed of an uneven mixture of topical concerns, ranging from mitigation and adaptation to more secondary issues such as agriculture and pollution. In this respect, LDA and related approaches enable one to not only identify the number, and characteristics, of the commonly shared latent topics across the climate speeches examined here, but also allow one to determine the specific topical composition of each country's UNFCCC speeches. At present I have only employed the latter information in examining the dominant dimensions assigned to each speech, without particular reference to country-level factors. However, variation in topic attention could be examined more directly as a function of country level covariates with the aid of a number of recently developed LDA-extensions, perhaps most notably the Structural Topic Model (Roberts et al. [Forthcoming](#)). Using the topics uncovered above to evaluate how national characteristics shape countries' actual bargaining positions vis-à-vis climate change is thus an anticipated 'next step' in this research agenda.

References

- Ashe, J.W., Van Lierop, R., Cherian, A. (1999). The role of the alliance of small island states (AOSIS) in the negotiation of the United Nations framework convention on climate change (UNFCCC). *Politics*, 23(3), 209–220.
- Bagozzi, B.E., & Schrodt, P.A. (2013). The Dimensionality of Political News Reports. Presented at the International Studies Association Meeting, San Francisco.
- Bailer, S., & Weiler, F. (2014). A political economy of positions in climate change negotiations: economic, structural, domestic, and strategic explanations. *Review of International Organizations*.
- Baille, M., Carman, M.J., Crestani, F. (2009). A topic-based measure of resource description quality for distributed information retrieval. *Advances in Informational Retrieval*.
- Bernauer, T. (2013). Climate change politics. *Annual Review of Political Science*, 16, 421–448.
- Bernauer, T., & Böhmelt, T. (2013). National climate policies in international comparison: the climate change cooperation index. *Environmental Science & Policy*, 25, 196–206.
- Betzold, C. (2010). National climate policies in international comparison: the climate change cooperation index. *Politics*, 30(3), 131–148.
- Blei, D.M., Ng, A., Jordan, M. (2003). Latent dirichlet allocation. *Journal of Machine Learning Research*, 3, 993–1022.
- Boockmann, B., & Thurner, P.W. (2006). Flexibility provisions in multilateral environmental treaties. *International Environmental Agreements*, 6, 113–135.
- Buchanan, J.M., & Tullock, G. (1962). *The calculus of consent: logical foundations of constitutional democracy*. Ann Arbor, MI: University of Michigan Press.
- Buchner, B., & Dall’Olio, S. (2005). Russia and the kyoto protocol: the long road to ratification. *Transition Studies Review*, 12(2), 349–382.
- Burck, J., & Bals, C. (2011). The Climate Change Performance Index: Background and Methodology. Germanwatch and CAN Europe, Berlin/Brussels.
- Carlarne, C.P. (2010). Artic dreams and geoengineering wishes: the collateral damage of climate change. *Columbia Journal of Transnational Law*, 49, 602–668.
- Crowley, K. (2007). Is Australia faking it? The kyoto protocol and the greenhouse gas policy challenge. *Global Environmental Politics*, 7(4), 118–139.
- Depledge, J. (2006). The opposite of learning: ossification in the climate change regime. *Global Environmental Politics*, 6(1), 1–22.
- Ecchia, G., & Mariotti, M. (1998). Coalition formation in international environmental agreements and the role of institutions. *European Economic Review*, 42(3-5), 573–582.
- Finus, M. (2008). Game theoretic research on the design of international environmental agreements: insights, critical remarks, and future challenges. *International Review of Environmental and Resource Economics*, 2, 29–67.
- Fisher, P.B. (2011). Shifting global climate governance: creating long-term goals through UNFCCC article 2. *PORTAL Journal of Multidisciplinary International Studies*, 8(3).
- Genovese, F. (2014). States’ interests at international climate change negotiations: new measures of bargaining positions. *Environmental Politics*, 23(4), 610–631.
- Gerrish, S.M., & Blei, D.M. (2011). Predicting legislative roll calls from text. In *Proceedings of the 28th International Conference on Machine Learning*.
- Grimmer, J. (2010). A Bayesian hierarchical topic model for political texts: measuring expressed agendas in senate press releases. *Political Analysis*, 18(1), 1–35.
- Grün, B., & Hornik, K. (2011). Topicmodels: an R package for fitting topic models. *Journal of Statistical Software*, 40(13), 1–30.
- Heyward, M. (2007). Equity and international climate change negotiations: a matter of perspective. *Climate Policy*, 7, 518–534.
- Jaschik, K. (2014). Small states and international politics: climate change, the Maldives and Tuvalu. *International Politics*, 51(2), 272–293.
- Kahler, M. (1992). Multilateralism with small and large numbers. *International Organization*, 46(3), 681–708.
- Keohane, R.O., & Victor, D.G. (2011). The regime complex for climate change. *Perspectives on Politics*, 9(1), 7–23.
- Keohane, R.O., & Nye, J.S. (2001). The club model of multilateral cooperation and problems of democratic legitimacy. In R. Porter, P. Suavé, A. Subramanian, A.B. Zampetti (Eds.), *Efficiency*,

- equity, legitimacy: the multilateral trading system at the millennium*. Washington D.C.: Brookings Institution.
- Koremenos, B., Lipson, C., Snidal, D. (2001). The Rational Design of International Institutions. *International Organization*, 55(4), 761–799.
- Kuik, O., & Hofkes, M. (2010). Border adjustment for european emissions trading: competitiveness and carbon leakage. *Energy Policy*, 38(4), 1741–1748.
- Liénoù, M., Maître, H., Datcu, M. (2010). Semantic annotation of satellite images using latent dirichlet allocation. *IEEE Geoscience and Remote Sensing Letters*, 7(1), 28–32.
- McDonald, F. (2009). New world order set agenda in climate talks. The Irish Times.
- Najam, A. (2005). Developing countries and global environmental governance: from contestation to participation. *International Environmental Agreements*, 5, 303–321.
- Olson, M. (1968). *The logic of collective action*. New York: Shoken Books.
- Oye, K. (1986). Explaining cooperation under anarchy. In K. Oye (Ed.), *Cooperation Under Anarchy*. Princeton: Princeton University Press.
- Parks, B.C., & Timmons Roberts, J. (2006). Globalization, vulnerability to climate change, and perceived injustice. *Society & Natural Resources: An International Journal*, 19, 337–355.
- Posner, E., & Sykes, A.O. (2014). Voting rules in international organizations. *Coase-Sandor Working Paper Series in Law and Economics*, 673, 1–29.
- Quinn, K.M., Monroe, B.L., Colaresi, M., Crespin, M.H., Radev, D.R. (2010). How to analyze political attention with minimal assumptions and costs. *American Journal of Political Science*, 54(1), 209–228.
- Qumsiyeh, R., & Ng, Y.-K. (2011). ReadAid: a robust and fully-automated readability assessment tool. In *23rd IEEE International Conference on Tools with Artificial Intelligence*.
- Rice, D. (2012). Measuring the issue content of supreme court opinions through probabilistic topic models. Paper Presented at the 2012 Midwest Political Science Association Conference, Chicago. April 12-15, 2012.
- Roberts, M.E., Steward, B.M., Tingley, D., Lucas, C., Leder-Luis, J., Gadarian, S., Albertson, B., Rand, D.G. (Forthcoming). Structural topic models for open ended responses. *American Journal of Political Science*.
- Sasman, C. (2010). Is International Litigation Possible to Fight Climate Change? New Era (Windhoek).
- Schunz, S. (2009). After Bonn-2: as the clock is ticking, high-level political intervention will be critical. FACET Commentary No. 16 —July 2009.
- Schüssler, E., Rüling, C.-C., Wittneben, B.B.F. (2014). On melting summits: the limitations of field-configuring events as catalysts of change in transnational climate policy. *Academy of Management Journal*, 57(1), 140–171.
- Sebenius, J.K. (1983). Negotiation arithmetic: adding and subtracting issues and parties. *International Organization*, 37(2), 281–316.
- Sharma, S. (2010). Copenhagen: a missed opportunity. RSIS Commentaries 13/2010.
- Soliz, C. (2011). Complexity and the state of the UNFCCC talks. CWIS: Center for World Indigenous Studies.
- Soroos, M.S. (2001). Global environmental politics and the futility of the kyoto process. *Global Environmental Politics*, 1(2), 1–9.
- Stavins, R.N. (2010). Options for the Institutional Venue for International Climate Negotiations. Issue Brief 2010-3, Cambridge, Mass.: Harvard Project on International Climate Agreements, May 2010.
- Stewart, B.M., & Zhukov, Y.M. (2009). Use of force and civil-military relations in russia: an automated content analysis. *Small Wars & Insurgencies*, 20(2), 319–314.
- The Financial Express (2013). Climate change: what will warsaw 2013 cast on Paris 2015. The Financial Express (Bangladesh).
- UNFCCC (2014). Status of ratification of the convention. United Nations Framework Convention on Climate Change. http://unfccc.int/essential/background/convention/status_of_ratification/items/2631.php.
- Urpelainen, J. (2013). Issue linkage in clean technology cooperation: for better or worse? *Clean Technologies and Environmental Policy*, 15(1), 147–155.
- Victor, D.G. (2006). Toward effective international cooperation on climate change: numbers, interests and institutions. *Global Environmental Politics*, 6(3), 90–103.
- Victor, D.G. (2011). *Global Warming Gridlock: Creating More Effective Strategies for Protecting the Planet*. Cambridge, UK: Cambridge University Press.

- Wagner, U.J. (2001). The design of stable international environmental agreements: economic theory and political economy. *Journal of Economic Surveys*, *15*(3), 377–411.
- Ward, H., Grundig, F., Zorick, E.R. (2001). Marching at the pace of the slowest: a model of international climate change negotiations. *Political Studies*, *49*, 438–461.
- Weiler, F. (2012). Determinants of bargaining success in the climate change negotiations. *Climate Policy*, *12*(5), 552–574.
- Weiss, E.B., & Jacobson, H.K. (1998). Assessing the record and designing strategies to engage countries. In E.B. Weiss, & H.K. Jacobson (Eds.), *Engaging countries: strengthening compliance with international environmental accords*. Massachusetts: Massachusetts Institute of Technology.
- Widerberg, O., & Stenson, D.E. (2013). Climate clubs and the UNFCCC. *FORES Study*, *3*, 1–52.