Appendix 1. Interpretation of control variable and structural parameter estimates from exponential random graph models

All analyses were conducted using the "statnet" suite of packages (Handcock et al. 2008) in R version 3.3 (R Core Team 2016). In the description and interpretation of each parameter below, specific statnet terms are identified as they appear in the model formula. Estimation followed a burn-in of 50,000 proposals; the sample size and interval were both set to 6,000.

The parameter COLLABORATIVE CLOSURE (modeled using the statnet term "edgecov") is a generic variant of the substructures depicted in panels C and D of Figure 1; it does not account for the levels at which actors and forums operate. In the full model, which includes XL-UP VIA COLLABORATIVE CLOSURE and XL-DOWN VIA COLLABORATIVE CLOSURE, this parameter captures the propensity of within-level actor-forum linkages that feature collaborative closure, while in the baseline model, the parameter indicates the likelihood of within- or cross-level forum participation conditional on collaborative closure. In both models, the parameter is positive and significant, indicating that collaborative closure increases the likelihood forum participation (in the baseline model) as well as the likelihood of participation in forums at actors' own levels of operation (in the full model).

The INFLUENTIAL PARTICIPANTS ("edgecov") is similar to COLLABORATIVE CLOSURE in that it is a generic variant of the substructures depicted in panels E and F of Figure 1; it does not account for the levels at which actors and forums operate. The parameter estimate indicates that joint participation of influential actors does not significantly increase the likelihood of within-level actor-forum linkages.

The parameter ACTOR STAFF SIZE ("b1factor") is binary and takes the value of "large" for actors with more than 25 staff members (the median staff size for our data), and "small" otherwise. We included the parameter to help control for the effect of actor capacity on forum participation. The parameter is not significant, indicating that actors with more than 25 staff members are not significantly more likely to participate in a given forum compared with actors with 25 or fewer staff members.

The parameter ACTOR COLLABORATIVE ACTIVITY ("b1cov") accounts for out-degree centrality in actors' collaborative relationships with one another. The survey prompted respondents to identify these relationships through the question: "Please list the organizations your organization has collaborated with in the context of climate change adaptation in the past year." Using these data, we constructed a network of actor-actor collaborative relationships. This parameter was not significant. However, the ACTOR COLLABORATIVE POPULARITY ("b1cov") parameter, which measures in-degree centrality, was positive and significant, indicating that actors nominated as collaborators by a larger number of other actors tend to participate in more policy forums.

FORUM LEVEL ("b2factor") accounts for the popularity of forums that operate at levels lower than the regional level, compared to forums operating at the regional level or at higher levels. This parameter did not have a significant effect. Because the cross-level parameters (XL-UP and XL-DOWN) are binary and measure linkages between two levels, it is not possible to include a corresponding "actor level" parameter without eliminating the FORUM LEVEL parameter (i.e., there would be no reference category).

The EDGES ("edges") parameter provides a reference measure of the likelihood that a given actor participates in a given forum. This parameter is commonly described as analogous to the intercept term in a logit model.

The final two terms account for more complex network structures. Specifically, the GW (ACTOR) DEGREE ("gwb1degree") and GW (FORUM) DEGREE ("gwb2degree") parameters measure the degree distribution of both modes (i.e., actors and forums) of the network. In network terminology, "degree" is the sum of ties on each actor/forum node. In our context, an actor of degree 3 participates in 3 forums. A forum of degree 10 has 10 actors that participate in it. For each of the two modes in the network, the corresponding parameter indicates the extent to which each tie decreases the likelihood of an additional tie, and the strength of this effect itself decreases geometrically according to a decay parameter θ_s. For example, the negative GW (FORUM) DEGREE parameter estimate indicates that actors tend to participate in forums that have relatively many other participants, rather than few. The GW (ACTOR) DEGREE parameter is positive, but not significant. The decay parameter θ_s, which controls the geometric weighting of the degree count statistic, was set at 2.5 for both GW (FORUM) DEGREE and GW (ACTOR) DEGREE to optimize model fit (Figure A2.1).

References:

Handcock, M. S., D. R. Hunter, C. T. Butts, S. M. Goodreau, and M. Morris. 2008. statnet: Software Tools for the Representation, Visualization, Analysis and Simulation of Network Data. *Journal of statistical software* 24(1):1548–7660.
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