Exclusive Apart, Inclusive as a System: Polycentricity in Climate City Networks

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Abstract

It is often thought that local governments in the Global South have less influence over climate city networks than those from the Global North. We question this by examining how different climate city networks relate and function as interconnected, yet independent, decision-making centers. We explore the extent to which this polycentric system overcomes the assumed exclusivity and inequality of these networks. We analyze twenty-two climate city networks using qualitative comparative analysis to classify the networks with a majority of members from either the Global North or the Global South based on conditions related to their context, diversity of members, and degree of homogeneity. We find that climate city networks overcome North–South dependencies through targeted support reflecting the local needs and conditions of city members. This diversity of tailored alternatives for cities provides equality and inclusivity at the polycentric system level, despite showing inequality and exclusivity at the network level.

The 2015 Paris Agreement strengthened the importance of subnational climate action and set new ambitions for the role of *climate city networks*, that is, formalized networks of subnational governments with climate change as their focus (Chu 2018; Hale 2016). Climate city networks fulfill a range of roles in enabling their members to develop and share information, build capacity for designing and implementing policies and projects, and monitor and certify a range of climate-related targets (Busch et al. 2018; Lee and Jung 2018). Cities also use these networks to bypass their national governments to engage in the global climate policy regime (Acuto and Leffel 2020; Acuto and Rayner 2016). Following wider trends in climate policy, city networks have expanded from networks focusing mainly in North America and Europe in the 1990s to global networks from the 2000s onward (Bulkeley et al. 2014; Castán Broto 2017).

The literature on climate city networks has largely focused on the role of affluent or large city members (labeled as "leaders"), with the expectation that knowledge and experience generated through these networks and members are

* The authors thank the Dutch Research Council (Nederlandse Organisatie voor Wetenschappelijk Onderzoek, NWO) for financial support (Vidi grant 016165322).

Global Environmental Politics 22:3, 2022, https://doi.org/10.1162/glep_a_00657

transferred to less affluent, smaller member and nonmember cities (or "followers") (Bulkeley 2005; Kern and Mol 2013; Wurzel et al. 2019a). This literature also highlights inequalities between network members in terms of who learns from whom (Lee and van de Meene 2012), who holds power over decision-making (Bouteligier 2013), and the geographic distribution of membership (Bansard et al. 2017). The outcome of this inequality is that some members have a stronger voice within the network and, as a result, are able to capture greater benefits at the expense of other members or could even fully exclude (prospective) members from participating in the network. A common observation is that the greater the participation and leadership from cities in the Global North is, the less influence cities in the Global South have over the performance of these networks, which in turn replicates dependencies inherent to the Global North–South divide (Bouteligier 2013; Chu 2018; Davidson et al. 2019; Hale 2016).

Questions are nevertheless increasingly asked about the form, function, and impact of city networks and the differences between them. This work has observed that city networks are heterogeneous in terms of geographical scope, themes, structure, activities, number and type of members, and governance structure (Acuto and Rayner 2016; Haupt and Coppola 2019). However, whether this diversity among climate city networks reproduces exclusive and inequitable membership and support remains unclear (Chu 2018). Is it possible, for instance, that networks of smaller cities and/or cities exclusively in the Global South provide more inclusive and equitable support for improving the implementation of urban climate plans? Are these networks less relevant for larger cities with adequate internal capacity? And is it possible that instead of creating or replicating patterns of exclusivity and inequality, the growing heterogeneity of city networks affords opportunities for engagement in the climate regime? To examine these questions, we conceptualize the heterogeneity of climate city networks as a polycentric system and explore the extent to which this polycentric system overcomes the assumed exclusivity and inequality of these networks.

Polycentricity refers to the interconnectivity between multiple independent decision-making centers that self-organize around a set of common services through cooperation, competition, conflict, and conflict resolution (Ostrom 2010; Ostrom et al. 1961). In a polycentric system, the interests of diverse actors operating in decentralized but interlinked sites of decision-making are assumed to enable more durable system-level changes than centralized decision-making and control (Ostrom 2010; Ostrom et al. 1961). Climate city networks are often envisaged as a polycentric system, given that they collectively involve cities in the global climate regime and promote urban climate action (Jordan et al. 2018; Thiel and Moser 2019). In this article, we go one step further by applying the concept of polycentricity to explore the heterogeneity of city networks. In doing so, we explore whether dispersed rather than hierarchical political authority in and between climate networks makes North–South dependencies less

relevant (Dorsch and Flachsland 2017; Jordan et al. 2018) or whether greater exposure to global networks makes them more vulnerable to power imbalances that in fact reify North–South dependencies (Chu 2018; Hale 2016). In summary, this article asks two questions: How is the polycentric system of climate city networks organized? How inclusive is it?

Our results indicate that, contrary to much of the existing literature, a heterogeneous polycentric system of climate city networks affords alternative opportunities for cities to engage with the climate regime in a way that is tailored to their particular demands for climate action solutions. Despite the inequalities at the level of individual networks, we find that the system of climate city networks as a whole is more inclusive than previously recognized. We also find a variety of pathways for cooperation in the climate regime for cities to choose from, some of which reflect "traditional" dependencies, while others bypass these dependencies and provide tailored support for climate action.

To reach this conclusion, we analyzed twenty-two climate city networks using qualitative comparative analysis (QCA) to group networks comprising mainly members from the Global North and networks comprising mainly members from the Global South according to conditions related to their context, diversity of members, and degree of homogeneity. This provides us with a typology of the alternative "pathways" through which member cities can engage with the climate regime through city networks. We elaborate on these conditions in the following section before outlining how the QCA was performed. We then present these pathways and characterize key dimensions of a polycentric system of climate city networks and reflect on the opportunities this system presents for the participation of cities in the global climate regime.

Understanding City Network Diversity

The global climate regime is shifting from a monocentric to a polycentric governance system in two ways (Jordan et al. 2018). First, steering and coordination have moved from top-down systems based on intergovernmental agreements to bottom-up systems based on both country and sectoral initiatives. Second, climate mitigation has shifted from a dependence on intergovernmental measures to centering around multiple measures adopted through networks of international, transnational, national, subnational public, and private actors—including networks of cities (van der Heijden 2018).

Central to a polycentric system is self-organization, with independent actors establishing norms and rules governing their internal behavior and patterns of interaction (Jordan et al. 2018). But while city networks can be seen as independent decision centers (Haupt et al. 2020), it is less clear whether (and if so, how) multiple city networks with differentiated membership self-organize to accommodate cities with different climate goals and needs for reaching these goals. Do different networks, for instance, set explicit goals, rules, or norms for cities in the Global North and the Global South (Dorsch and Flachsland

2017)? Do they communicate these goals, rules, and norms in a way that enables them to collectively work in different yet coherent ways (Carlisle and Gruby 2019; Stephan et al. 2019)? And if there is coherence, do their internal behavior and collective patterns of interaction lead to more inclusive and equitable climate action? Providing empirically based clarity to such questions enables a clearer understanding of whether a polycentric system of climate city networks provides cities with sufficient alternatives for developing their capacity for engaging in the global climate regime.

If climate city networks were to create or replicate inequalities and dependencies considered inherent to the North–South divide, then we would expect to find one or both of the following patterns in real-world settings (building on Bansard et al. 2017): first, separate memberships made up of predominantly Global North or Global South cities *and* substantial differences in how the networks enable their members to engage with the climate regime—that is, high levels of empowerment in networks with predominantly Global North memberships and low levels in those with predominantly Global South memberships—and second, networks with mixed Global North/South memberships but structured in a way that enables member cities from the Global North to capture more benefits than member cities from the Global South.

With these expectations as our starting point for exploring dependencies in the polycentric system of climate city networks, we focus on networks with members predominantly from the Global North or from the Global South as our outcome of interest (see "QCA Methodology" for details). This allows us to identify three sets of paired conditions assessing the heterogeneity of city networks, the inclusion of cities from the Global North and South in different networks, and how these different city networks enable cities to engage with the climate regime.

Our first paired set of conditions assesses the heterogeneity of climate city networks. First, we determine that a city network exhibits a *multitiered structure* (MT) if it presents subnetworks based on thematic or geographical factors. In this way, networks cover a broader geographical space while allowing for concrete subcoalitions (Acuto and Rayner 2016). Having thematic or geographical subnetworks offers its members alternatives to engage with the network, effectively allowing a city network to target different niches. We then determine whether the *initiator* (IN) of these networks is cities or noncity organizations, such as multilateral organizations, nongovernmental organizations, philanthropy organizations, and for-profit organizations (Gordon 2018). The initiator brings its own goals for and perspectives on climate action, which are reflected in the network's initial agenda, activities, and membership. As climate city networks constitute bottom-up efforts to promote urban climate action, determining who initiated these networks reflects the degree of input and influence cities have over a network vis-à-vis "outsider" organizations that bring their agendas and resources (Acuto et al. 2017; Acuto and Rayner 2016; Davidson et al. 2019; Gordon 2018; Gordon and Acuto 2015).

We assess the inclusion of climate city networks using a further paired set of conditions. First, we determine whether the *origin of most members* (OM) in a climate network is the Global North or South. We use the location of a city in a country in the Global North or South to reflect an assumed dependency, capacity, and resources (Bansard et al. 2017), as well as an assumed difference in how these cities frame and act upon climate change. Underlying this geography is a further assumption that perceptions of climate change and its potential solutions held by the majority of city members influence a city network's agenda and activities (Thiel and Moser 2019). Second, we then assess the *member diversity* (MD) of these networks by determining whether climate city networks have either open membership for cities willing to join the network or a targeted membership where the city network selects its members. We assume that more open membership can provide many cities access to a diversity of resources, while a targeted membership can provide more tailored support for members (Haupt et al. 2020; Keiner and Kim 2007; Smith 2011).

Our final pair of conditions determines how city networks connect with the global climate regime. We first determine whether a city network works within *overarching rules* (OR). Polycentric systems are embedded within hierarchical government levels (Dorsch and Flachsland 2017; Stehle et al. 2020); climate city networks are embedded between the overall climate regime and local governments. The presence or absence of these overarching rules directly influences the evolution of a polycentric system in terms of autonomous decision-making of its members and their self-organization (Thiel and Moser 2019). These overarching rules include climate ambitions, goals, regulations, and standards within the climate action framework. Climate city networks might work within a well-defined set of obligatory rules, such as within a national jurisdiction or the European Union (EU) framework. Alternatively, they may operate across multiple jurisdictions where they work with less defined or voluntary rules to which city networks adhere. The better defined the rules are, the more concretely a climate city network can link its members to the climate regime. Second, reflecting the networked linkages between actors across sectors inherent to polycentric governance (Wurzel et al. 2019b), we assess climate city networks' horizontal links by noting if they have *permanent strategic partnerships* (PS). These connections to noncity organizations develop into more complex structures intersecting local governments and the climate regime (Davidson et al. 2019). We assume that permanent partnerships allow the networks to offer more resources to their members but also tie the network with the climate perspective of their partners (Acuto et al. 2017; Chu 2018). Conversely, we also assume that not having permanent partnerships limits the resources available in the network, opening the way for cities with higher capacities to be in a better position than the rest to implement climate action (Haupt et al. 2020; Kern and Mol 2013).

QCA Methodology

We apply our six conditions to a crisp-set QCA (csQCA) of twenty-two climate city networks with memberships made up predominantly from either the Global North or the Global South. QCA is a method based on set theory and Boolean algebra that locates observations within the potential combinations of conditions used (Schneider and Wagemann 2012). Through a systematic process of logic simplification, patterns linking the sets of conditions to the outcome are identified. These patterns are sets of conditions related to the outcome within the data set analyzed. *Crisp-set* denotes that each condition is well defined, meaning that it is clear for each observation whether it is part of a condition. The fundamentals and background of QCA are well explained and documented in a series of textbooks and applications (Ragin 2008; Ragin and Rihoux 2009; Schneider and Wagemann 2012; van der Heijden 2017). The following discussion describes the key steps taken in the data analysis and the results found. For a detailed explanation of the QCA methodology used, see the Supplementary Materials.

Data Analysis and Results

We identified a starting sample of sixty-four climate city networks based on a search of existing studies (Acuto and Ghojeh 2019; Bansard et al. 2017; Castán Broto 2017; Lee and Jung 2018; Lusk and Gunkel 2018), conferences, and online materials (see Supplementary Materials for details). Information on the sample of climate city networks was then extracted from their websites and public reports for each condition. For each climate city network, the conditions were coded as 1 or 0 based on specific thresholds summarized in Table 1. This coding uses numerical symbols but remains qualitative because each condition represents a complex characteristic of the network. These numerical descriptors are not a quantification of the (often) qualitative data. Instead, each condition is a qualitative set of which a given observation might or not be part.

Of the initial sixty-four networks identified, forty-two were discarded because of incomplete data, because of inactivity, or because promoting urban climate action was not one of their goals (see Supplementary Material for details). We were able to find valid and complete data for our csQCA for the remaining set of twenty-two networks (Table 2). From this set, we found that 82 percent of them (n = 18) have members mostly from either the Global North or the Global South. This was defined by having over 70 percent of their membership from either origin. There is sufficient diversity in each of the conditions in the sample (Table 2), indicating that the sample is broad enough to represent a variety of types of climate city networks for csQCA to draw conclusions (Schneider and Wagemann 2012). We note that QCA typically results in moderatum generalizations (rather than empirical generalizations), that is, systematically derived propositions (often about broad processes rather than broad

Table 1
Coding Rules for QCA Conditions

	Present (1)	*Absent (0)*
Outcome		
Network with most members from Global North or South (NM)	More than 70% of the members come from Global North or South	Fewer than 70% of the members come from Global North or South
Conditions		
Multitiered structure (MT)	Network has thematic or geographic subnetworks	Network doesn't have subnetworks in its structure
Initiator (IN)	Network initiated by noncity organizations	Network initiated by cities
Origin of most members (OM)	Most members from Global North	Most members from Global South
Membership diversity (MD)	Little or no selection criteria for new members	New members have to comply with selection criteria
Overarching rules (OR)	Network works within one country or the EU (well-defined rules)	Network is global or works across jurisdictions beyond the EU (not well-defined rules)
Permanent strategic partnerships (PS)	Network has permanent strategic partnerships with noncity organizations	No permanent strategic partnerships with noncity organizations

populations) that are testable and might be refined, confirmed, or refuted through future evidence (Payne and Williams 2005; Ragin 2014).

Following QCA methodology, we have first carried out an analysis of necessary conditions. This analysis does not indicate that any of the conditions is necessary for (i.e., can individually produce) the outcome of interest. We then undertook an analysis of sufficient conditions using the Quine–McCluskey algorithm (Ragin 2018) with fsQCA software support (Version 3.0; Ragin and Davey 2016) (details in the Supplementary Materials). This analysis shows whether and how conditions interact (conjunctural causation) and whether there are one or more types of interacting conditions related to this specific performance outcome (equifinality) (Ragin and Rihoux 2009, chapter 5, box 8.1; Schneider and Wagemann 2012, chapter 11). In doing so, we identified which configurations of conditions are present once the outcome condition has been identified. This allowed us to identify a typology of the city networks with memberships mostly from the Global North and South. Each type is then described in terms of the six conditions used.

Table 2
Data Matrix from Twenty-Two Climate City Networks Included in the Study

Climate City Network	*Website*	*NM*	*MT*	*IN*	*OM*	*MD*	*OR*	*PS*
Red Chilena de Municipios ante el Cambio Climático (REDMUNICC)	redmunicc.cl	1	0	1	0	1	1	1
Red Argentina de Municipios contra el Cambio Climático (RAMCC)	ramcc.net	1	0	0	0	1	1	0
MobiliseYourCity Partnership	mobiliseyourcity.net	1	0	1	0	1	0	1
South African Local Government Association (SALGA)	salga.org.za	1	1	1	0	0	1	0
The Climate Registry (TCR)	theclimateregistry.org	1	0	0	1	1	1	1
The Regional Network of Local Authorities for the Management of Human Settlements (CityNet)	citynet-ap.org	1	1	0	0	1	0	1
Cities Clean Air Partnership (CCAP)	cleanairasia.org/cities-clean-air-partnership	1	1	1	0	1	0	1
World Association of the Major Metropolises (Metropolis)	metropolis.org	1	1	0	0	1	0	0
Federation of Canadian Municipalities (FCM)	fcm.ca	1	1	0	1	1	1	0
R20–Regions of Climate Action	regions20.org	1	1	1	0	1	0	1
Under2Coalition	under2coalition.org	0	0	0	0	1	0	1
Global Covenant of Mayors for Climate and Energy	globalcovenantofmayors.org	1	1	1	1	1	0	1
Carbon Neutral Cities Alliance (CNCA)	carbonneutralcities.org	1	0	0	1	0	0	0
Climate Mayors (also known as Mayors National Climate Action Agenda or MNCAA)	climatemayors.org	1	0	0	1	1	1	0

ICLEI–Local Governments for Sustainability	iclei.org	0	1	0	0	1	0	0
Climate Alliance of European Cities with Indigenous Rainforest Peoples	climatealliance.org	1	1	1	1	1	1	1
100 Resilient Cities–Pioneered by the Rockefeller Foundation (100RC)	100resilientcities.org	0	0	1	0	0	0	1
Union of the Baltic Cities (UBC)	ubc.net	1	1	0	1	1	1	0
Energy Cities/Energie-Cités	energy-cities.eu	1	0	0	1	1	1	1
EUROCITIES	eurocities.eu	1	1	0	1	1	1	1
Network of Regional Governments for Sustainable Development (NRG4SD)	nrg4sd.org	1	1	0	0	1	0	1
C40 Cities Climate Leadership Group	c40.org	0	1	0	0	0	0	0
Percentage of items coded 1		*82*	*59*	*36*	*59*	*41*	*82*	*45*

Table 3
Complex Solution

Path	*Formula*	*Raw Coverage*	*Unique Coverage*	*Consistency*	*Climate City Networks in This Path*
1	in*OM*MD *OR	0.333	0.278	1.00	TCR, FCM, ClimateMayors, UBC, EnergyCities, EUROCITIES
2	MT*IN*OM*MD*PS	0.111	0.056	1.00	GlobalCovenantofMayors, ClimateAlliance
3	mt*in*OM*md*or*ps	0.056	0.056	1.00	CNCA
4	mt*in*MD*OR*ps	0.111	0.056	1.00	RAMCC, ClimateMayors
5	MT*IN*MD*or*PS	0.167	0.111	1.00	CCAP, R20, GlobalCovenantofMayors
6	MT*IN*om*md *OR*ps	0.056	0.056	1.00	SALGA
7	mt*IN*om*MD*PS	0.111	0.111	1.00	REDMUNICC, MobiliseYourCity
8	MT*in*om*MD *or	0.167	0.167	0.75	CityNet, Metropolis, ICLEI(Global), NRG4SD

Model: NM = f(MT, IN, PS, MD, OM, OR). Algorithm: Quine–McCluskey. Frequency cutoff: 1; consistency cutoff: 0.5. Solution coverage: 1; solution consistency: 0.95.

The result from the analysis is the complex solution presented in Table 3. We have decided to stay with the complex solution because the existing literature does not give us enough confidence about the causal direction of each condition to identify intermediate or parsimonious solutions (Schneider and Wagemann 2012).

Each path identified represents a configuration of conditions. A condition in lowercase script indicates that it is absent, while uppercase script indicates that it is present in the causal configuration. When a condition is not included, it means that the path is indifferent to this condition, so city networks in this path may or may not have the conditions and still share the rest of the characteristics of the path. The high solution coverage (1.00) indicates that the solution strongly relates to the outcome observed (Ragin 2008; see Schneider and Wagemann 2012, section 5.3). The solution consistency is high as well (0.95), indicating the high empirical importance of the solution in reaching the outcome.

Table 3 shows eight pathways representing types of climate city networks with members mostly from the Global North or South in our data set. The configuration of conditions in each path characterizes each of these types, making this an evidence-based typology of climate city networks with members mostly from the Global North or South (Fiss 2011). The coverage (raw and unique) of each path indicates how much of our data were covered by each configuration of conditions (see Supplementary Material for a detailed explanation of each path).

Interpretation of Results

Our results show that two conditions—overarching rules and origin of most members—appeared in eight pathways in different combinations. Given their prominence, we use these conditions as two axes with varying degrees of influence over the eight pathways based on whether the conditions are absent, present, or indifferent (Figure 1). For OR, this translated into three categories corresponding to whether rules were well defined, had no effect (i.e., were indifferent), or were not well defined. For OM, this translated into three categories corresponding to whether most members were from the Global North, membership origin had no effect, or most members were from the Global South. We use the intersection of these two conditions to represent different types of climate city network works and the characteristics of their members.

A climate city network pathway that was indifferent to overarching rules and the origin of their members would be located in the center of the two axes in Figure 1. We find that none of the pathways are positioned at this intersection, meaning there is no climate city network in our sample that offers the same opportunities to all kinds of cities in all contexts. This is a consequential finding because it indicates that climate city networks are highly differentiated on at least one of two conditions: their operation within national/supranational

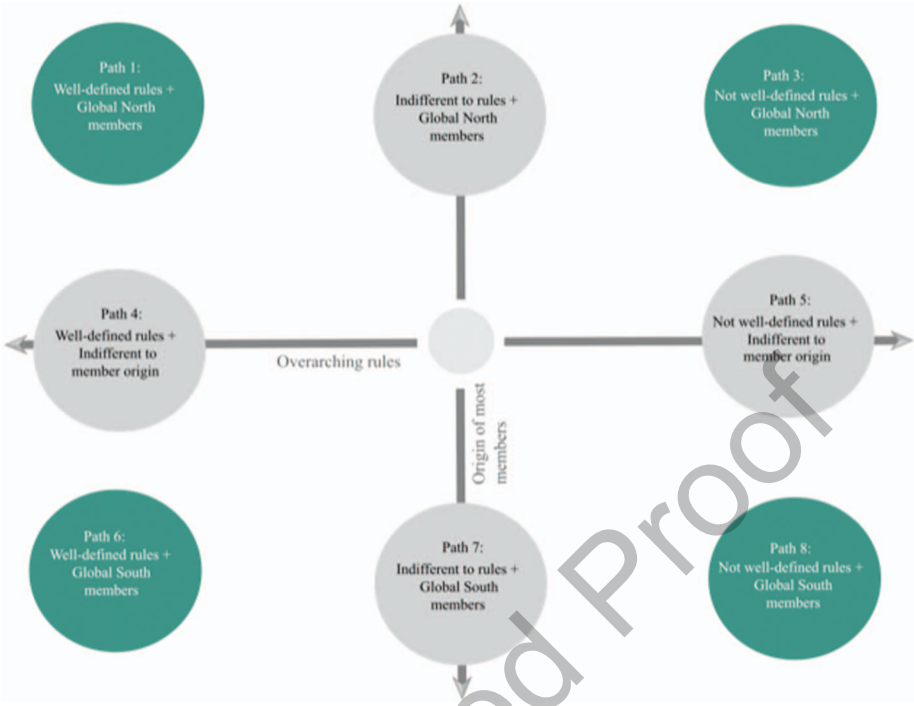

Figure 1
Distribution of the QCA Pathways According to Overarching Rules and Origin of Most Members

Each condition can take three values in a configuration: present, indifferent, or absent. This diagram maps the eight pathways found according to conditions OR and OM. The eight pathways are distributed in all but the central position in this diagram, meaning that no type of climate city network was found to be indifferent to both OR and OM.

jurisdictions or across multiple jurisdictions and/or the needs and resources of their members to engage in climate action. It indicates that while individual climate city networks may be unequal and/or exclusive (Bansard et al. 2017; Bouteligier 2013; Lee and van de Meene 2012), multiple networks operating as a polycentric system may enable inclusive and tailored support for climate action.

The differentiation of city networks is first explained by the presence or absence of overarching rules representing a well-defined climate action framework. City networks operating within a well-defined set of climate rules at an either national or supranational level (e.g., the EU or a national government) tend to focus on either lobbying to change these rules on behalf of their members or supporting their members to comply with the rules (paths 1, 4, and 6 in Figure 1). For example, the South African Local Government Association

(SALGA[1]) highlights in the 2019–2020 annual report that it participated in amendment bills for the municipal systems and structures acts, lobbied for local government concerns, and advised municipalities on the implications of amendments to the municipal systems act (SALGA 2020).

In contrast, global and regional city networks working across multiple jurisdictions (outside the EU) are, by definition, not embedded within a well-defined set of rules (paths 3, 5, and 8 in Figure 1). These networks instead defer to either voluntary standards, such as the Carbon Neutral Cities Alliance (CNCA[2]), requiring a community-wide carbon neutrality goal across electricity, thermal, transportation, and waste sectors for their members, or global goals, such a CityNet,[3] promoting the Sustainable Development Goals (SDGs) in its Urban SDG Knowledge Platform.[4] The activities of these networks are focused on improving the capacity of their members in broad thematic areas, such as carbon neutrality and urban sustainability. In doing so, their support is not aimed at a specific lobby or policy issue but instead adopts a generalist approach to improve the capacity of their members to implement climate action that members themselves have to adapt to their specific contexts.

The differentiation of city networks is also explained by whether the members represented by these networks come mostly from countries in the Global North or South. We find that networks with most of their members from the Global North tend to address climate change proactively by setting higher standards or promoting opportunities to prepare for the impacts of climate change (paths 1, 2, and 3 in Figure 1). For instance, the Sustainable Cities Commission of the Union of the Baltic Cities (UBC) presented in October 2021 its next UBC Sustainability Action Programme covering the period 2022–2030.[5] The perspective of climate change in these networks is more anticipatory, helping cities to prepare to take advantage of the coming opportunities and avoid their risks.

In contrast, networks with members mostly from the Global South tend to support their members to build the capacity for climate action through international cooperation in light of the diversity of local challenges they face with limited resources (paths 6, 7, and 8 in Figure 1). For example, MobiliseYourCity Partnership[6] offers access to knowledge and finance to plan for sustainable mobility through tested tools and methodologies emphasizing ready-to-implement solutions for cities. Equally, Metropolis offers a "learning station"[7] providing training resources in different urban topics and SDGs to strengthen the capacities for metropolitan governance. In these networks, climate change is a current crisis requiring cities to implement solutions in a context of limited capacities and concurrent challenges.

1. https://www.salga.org.za/, last accessed January 24, 2022.
2. https://carbonneutralcities.org/, last accessed January 24, 2022.
3. https://citynet-ap.org/, last accessed January 24, 2022.
4. https://www.urbansdgplatform.org/, last accessed January 24, 2022.
5. https://www.ubc.net/commissions/sustainable-cities, last accessed January 24, 2022.
6. https://www.mobiliseyourcity.net/, last accessed January 24, 2022.
7. https://www.metropolis.org/learning-station, last accessed January 24, 2022.

Looking at the combined effect of both conditions gives a better picture of the dynamics in the climate city networks. The city networks populating the four corners of Figure 1 are affected by the condition of overarching rules and by the origin of their members.

City networks operating under well-defined rules and with members predominantly from the Global North (path 1, top left of Figure 1) tend to proactively lobby governments on behalf of their members. These networks are founded by cities, have open membership within a clearly defined geographical scope, and emphasize a high degree of self-determination in defining the form and function of their climate actions. In contrast, city networks operating under less well-defined rules (i.e., across multiple jurisdictions) and with members predominantly from the Global North (path 3, top right of Figure 1) focus on members that voluntarily self-impose a high standard to address climate change. Because of these high standards, these networks have strict selection criteria for new members and explicitly aim to facilitate the visibility of their members' climate actions.

On the other side, city networks operating under well-defined rules and with members predominantly from the Global South (path 6, bottom left of Figure 1) tend to develop lower-cost compliance strategies for complying with national requirements or formulate programs to enable joint climate action. This set of networks stands apart from those with members from the Global South operating under less well-defined rules (path 8, bottom right of Figure 1). Without well-established sets of rules to guide climate action and with members with limited resources, these networks tend to be developed by cities to increase capacity through knowledge and resource sharing. They also tend to have a small number of advanced cities gaining prestige by providing knowledge and/or resources to the rest of the members, conforming to leader–follower patterns (following Fenton and Busch 2016).

Finally, we identify city networks representing what we term *bridging networks*. These networks, located at the center of each axis of Figure 1 (paths 2, 4, 5, and 7), demonstrate indifference to either the presence of overarching rules or the origin of their members. By being affected by one of the conditions, but indifferent to the other, they connect their member cities across the condition to which they are indifferent. This might be relevant, for instance, for cities looking to share experiences and resources between cities in the Global North and South or to identify strategies working in contexts both with and without well-defined overarching rules.

We find that bridging networks that are indifferent to the origin of their members (paths 4 and 5) offer the same opportunities to cities from the Global North and South and allow them to connect with each other. Where rules are well defined (path 4), these networks are more likely to be established by cities coalescing around a clear challenge related to climate action regardless of where their members are located. Where rules are not well defined (path 5), these networks tend to be established by noncity organizations attracting cities by

providing a strategy and resources for climate action—again, regardless of where their members are located.

Conversely, we find that bridging networks that are indifferent to the presence or absence of overarching rules (paths 2 and 7) tend to offer common opportunities for cities regardless of the climate action framework available to their members. Where members come from the Global North (path 2), these networks tend to expand their cooperation with members in the Global South. However, it remains unclear whether these networks promote climate action values, knowledge, and strategies that are suitable for cities in the Global South. Where members come from the Global South (path 7), these networks are established by noncity organizations bringing knowledge and resources and promoting a narrower agenda that is significant to their members regardless of their rules context.

Discussion

Our results support existing claims in the literature that climate city networks are exclusive, unequal, and homogenous—confirming both of our preceding hypotheses. Yet, our results also expand this literature by demonstrating the complementarity of multiple climate networks as a global polycentric system. This complementarity reframes the perceived negative consequences of exclusivity, inequality, and homogeneity at the individual network level by opening up global benefits from differentiated polycentric systems of climate city networks.

The eight possible pathways we identify describe a polycentric system of climate city networks that has evolved in response to either one (and in many cases both) of two conditions. The first of these is the clarity and strength of rules structuring climate action. The second is their members' conceptualization of climate change and its potential solutions. This differentiation, as such, represents a response by city networks to overcome the multiple challenges faced by a highly diverse set of cities across the Global North and South. Following Thiel and Moser (2019), we argue that this differentiation represents a form of self-organization that can enable a more inclusive, and ultimately more effective, city-level climate action (see also Dorsch and Flachsland 2017). This observation holds at least four consequences for a polycentric understanding of how an internally differentiated system of city networks can enhance global climate action.

First, we find that the differentiation of climate city networks is driven by more than just the capacities and resources available to member cities. In line with Thiel and Moser (2019), the two conditions of member origin and overarching rules indicate that the polycentric city network system is driven by perceptions on climate change and how to act upon it, on one side, and the framework of climate policies where cities are located, on the other. Seen as such, climate city networks do more than transfer knowledge and resources from advanced cities to less advanced ones. They instead target their support

to the wider needs and opportunities of their members. Doing so enables this polycentric system of climate city networks to overcome North–South dependencies inherent to many global climate action initiatives through targeted support that reflects the local needs and conditions of city members.

Second, all climate city networks promote urban climate action by providing knowledge, implementation support, recognition, or lobbying capacity. However, the type of support that climate city networks offer to their members is conditioned by the degree to which rules governing climate differ across jurisdictions. The diversity of climate city networks therefore appears to reflect adaptation to different jurisdictional contexts, with networks working within well-defined rules more likely to either lobby on behalf of their members or directly support compliance. For example, Eurocities (n.d.) believes that "cities must be included directly in the European decision making and should be direct receipt of European funds." In contrast, networks working in regions without well-defined rules are more likely to set their own principles, goals, and rules for guiding climate action. We see this in the Covenant of Mayors for Climate and Energy (n.d.), which claims that its members "share a long-term vision of supporting voluntary action to combat climate change." These climate city networks offer less guidance on how to translate these principles, goals, and rules into action. City networks do not as such only fulfill different roles and functions (Busch et al. 2018; Lee and Jung 2018); they adapt their roles and functions to respond to the climate action frameworks they encounter. Similarly, climate city networks target their services in response to the perceptions and current climate action capabilities of their members. This again highlights the differentiated support that already exists across the global system of climate networks.

Third, the tailored support provided by heterogeneous city climate networks enables the polycentric system of climate city networks to be far more inclusive than previously thought. The diverse ways in which city networks engage cities in the Global North and South respond to the demands of different cities facing different challenges related to climate change. Recognizing this diversity challenges the idea that networks are established by "pioneers for pioneers" (Kern and Bulkeley 2009) and that these networks are mechanisms for transferring knowledge and resources from leader to follower cities (Bulkeley 2005; Kern and Mol 2013; Wurzel et al. 2019a). We claim that network heterogeneity enables tailored solutions that can match the diverse needs of cities and potentially improve the efficiency of the climate regime as a whole (Dorsch and Flachsland 2017). In this way, climate city networks do not drive inequality but instead provide support to members that can enable more equal and inclusive engagement in responding to climate regime goals. This support ranges from offering practical guidance for developing local climate change plans (e.g., REDMUNICC) to mobilizing climate action with the goal of meeting global carbon neutrality goals (e.g., CNCA). This tailored approach can also enable cities to set targets that align with their own needs and capacities. For cities in

the Global North, this might mean setting ambitions for climate action that goes beyond, for example, the Paris Agreement. For cities in the Global South, it can mean setting "intermediate" goals that, while not at the same level of ambition as the Paris Agreement in the immediate term, afford these cities the possibility to engage in climate action in line with the global climate regime over the long term.

Finally, we identify "bridging networks" that provide a means to participate in the climate regime independently of the experiences members have of climate change or the degree to which climate actions are defined and implemented. In doing so, these networks appear to offer similar opportunities between cities with different capacities for dealing with climate change. While we did not find evidence of these climate city networks providing access to the climate regime in the same way for all cities in all contexts, we do find that they offer a clear strategy for promoting climate action for their members that transcends the differences in either origin or climate jurisdictions. It may still be the case that cities from the Global North and South within these networks adopt different roles due to power imbalances that render them less competitive and/or effective (Chu 2018). Such power imbalances are consistent with follower–leader patterns that result in less advanced or small cities not being able to reap as many benefits of the climate city networks as advanced cities (Kern and Bulkeley 2009; Kern and Mol 2013) and may even advance the interests of private actors or more advanced cities (Chu 2018; Davidson et al. 2019). Climate city networks in such situations should be careful that the differences in capacity and resources between their members do not enable some cities to benefit by limiting the potential of others. Having said that, if well managed, these networks still appear to offer productive avenues for cooperation between cities beyond the Global North–South divide.

Conclusions

The global polycentric system of climate city networks identified in this article is not isolated from dependencies inherent to the Global North–South divide. But within their shared goal of supporting members in their own climate action ambitions, we demonstrate that city networks collectively provide differentiated forms of support that can enhance climate action in line with the contexts and capacities of their members. In this way, the polycentric system of climate city networks provides a balanced set of opportunities for cities in a broad variety of (climate change) contexts.

Our results highlight the need for academics, policy makers, and practitioners to look beyond the capacity and resources (or lack thereof) of cities to implement climate action. City networks already appear to overcome this narrow view by differentiating themselves based on how cities conceptualize the problem of climate change and act upon it, and across different climate policy jurisdictions. Recognizing these conditions opens up new ways to

understand the role of city networks as a global polycentric system and the effects of this polycentric system for effectively furthering the role of cities in global climate action.

More importantly, perhaps, we find that the heterogeneity of climate city networks provides equality and inclusivity at the (polycentric) system level, despite showing inequality and exclusivity at the individual (network) level. The diversity of climate city networks, we have demonstrated, indicates that there are multiple approaches for enabling cooperation between cities. As climate city networks adapt to fill the niches of different contexts and origins of their members, they develop new ways to promote North–North, North–South, South–South, and perhaps even South–North cooperation. The polycentric system created by this collective provides alternatives tailored to the diversity of cities around the world. In this way, the inequalities within individual city networks become a strength at the system level as they offer a diversity of alternatives for cities to choose from. This finding holds relevance beyond climate city networks, as it shows the emergence of system-level characteristics in networked polycentric systems.

Our results call for further research in at least three directions. First, the effectiveness of climate city networks that provide differentiated support to their members, either as individual networks or as a system, remains unclear. Further research is therefore needed on how participation in city networks translates into actions on the ground, considering that a city might participate in different city networks with different objectives. Second, it remains unclear how different city networks adjust to each other's goals, roles, and memberships through collaboration, competition, or any other means. Finally, further research is needed to understand the diversity of internal dynamics in each of the network types we have identified—especially in the case of bridging networks where diverse sets of members coexist. Together these new areas of research can further inspire the examination of the differentiated role of networked actors within global polycentric governance systems.

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