DEFINING THE DECISION-MAKING / ACCOUNTABILITY SPATIAL INCONGRUENCE PROBLEM

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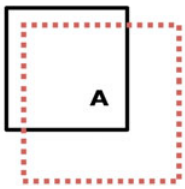
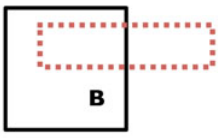
When scholars engage decision makers around fundamental, complex questions in interdisciplinary settings, they may face a significant but oft overlooked inferential challenge related to the spatial dimension or scale of their phenomenon of interest: namely, how the spatial unit and scale at which decision makers are held accountable for their decisions may actually be incongruent with that of the underlying data, jurisdiction, or even impact of those decisions. We define this particularly unique analytical challenge as the Decision-Making/Accountability, Spatial Incongruence Problem (DASIP), building upon and extending two well-defined problems that are widely known among applied spatial scientists: the Modifiable Areal Unit Problem, MAUP (Gehlke & Biehl 1934; Openshaw 1983), and the Uncertain Geographic Context Problem, UGCoP (Kwan 2012). Carefully articulating this problem answers the call for greater explicit scholarly attention to the relationship between scale and decision making, especially in light of increasing demand for multidisciplinary research to generate scientific findings that support decision making.

To begin to articulate the meaning and implications of DASIP, we first consider the well-known MAUP (Gehlke & Biehl 1934; Openshaw 1983). This problem refers to a statistical bias in which results derived from spatial analysis are influenced by both the means in which point-based data is aggregated into areal units, and the size and shape of the districts into which that data is grouped. Despite nearly a century of scholarship exploring this problem, few generic and practical solutions exist to overcome or counteract this selection bias. The definition of this problem lies squarely with the agency of the researcher, as the focus is on the action of delimitation of the study. The second perplexing methodological issue is covered by the UGCoP, which refers to a separate but related problem whereby analytical results about the effects of area-based attributes on individual behaviors or outcomes may be affected by the "spatial uncertainty in the actual areas that exert contextual influences on the individuals being studied and the temporal uncertainty in the timing and duration in which individuals experienced these contextual influences" (Kwan 2012, 959). Likewise, since much about context of individual spatial behavior can never be completely known, there are few methodological fixes yet identified. The definition of this problem shifts focus to the agency of the subject to explore behavior of those being studied as it relates to the analysis.

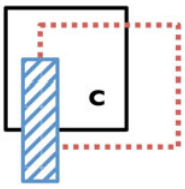
Like the MAUP and the UGCoP, DASIP derives from analytical challenges of researchers determining an appropriate spatial unit of analysis relative to the data, as well as incorporating spatial behavior characteristics from contextually disperse influences. DASIP is, however, a unique problem that recognizes the special nature of particular types of spatial behaviors that go beyond routine individual decision making. Instead, DASIP draws particular attention to the agency of special actors and sets of actors (such as elected officials, public administrators, stakeholders, CEOs) who are responsible for engaging in some decision-making process that potentially shapes or informs outcomes that in turn can affect others in important ways. Such dynamic interactions affect the public, and the impact is felt in a spatial unit, with a particular scale, such as a jurisdiction. DASIP recognizes the problem of the spatial scale of data generation which influences policy decisions being incongruent with the scale and spatial unit of decision-making jurisdictions. Policy decisions may be affected by behavior discourses and outcomes in different spatial areas or scales, and the spatial scale and area for which decision makers are held accountable may be different again from data, decisions or impact. It may not even be congruent with the jurisdiction that authorizes this actor.



Representation of MAUP: geographic analysis of data from the thick black box can differ radically from analysis with boundaries depicted by the dashed-line (red) box, both ostensibly describing area "A".



Representation of UGCoP: geographic analysis of population area B using the thick black boundaries cannot fully account without uncertainty for all spatial behaviors of inhabitants who move across boundaries into areas depicted by the dashed-line (red) box, a source of contextual influences on area B.



Representation of DASIP: decisionmaker(s) with jurisdiction C depicted with thick black boundaries make decisions that impact locations in the dashed-line (red) bounded area, which can be incongruent with their jurisdiction. Furthermore, decisionmakers with jurisdiction C can be held accountable by only some constituents within the black box and can be made to answer to actors external to their jurisdiction, depicted by the shaded (blue) box.

The implications of the MAUP for decision making is that there exists a risk for conclusions to be drawn prematurely, and hence often the spatial evidence available to justify or deny the decision using the areal unit that fits the conclusion, such as what happens in cases of gerrymandering. The implications of the UGCoP for decision making include that conclusions might be drawn about a given population that does not take into account all of the key behaviors that this population engages in, and which may affect or be affected by that decision. One

important implication for decision making related to the necessity of articulating DASIP, is that there is a risk for conclusions to be drawn about a given population that do not include information about all of the individuals who may be affected by that decision, or that some decisions inaccurately account for other individuals for whom the decision is not being made. It also implies that conclusions risk missing key insights if the anticipated consequences to decision makers being held accountable for their decisions are not taken into the picture, particularly when accountability does not coincide with the footprint of the expected impact of said decisions. While this may not be a challenge relevant to all scientists working to understand spatial influences and scale, to those seeking to link science with policy, this additional dimension can be significant and warrants particular consideration.

Like Leitner, Sheppard and Sziarto (2008), the definition of DASIP argues for paying attention to the real, materiality of space and scale when working in the intersection between science and decision making, but further seeks to articulate the role of the "engaged" knowledge producer of science (Latour 2004; Brown & Duguid 2000). Established terms of "scale mismatch" or "problem of fit" from the field of ecology are useful, as they point to the need to characterize links between scientific results and decision making in a spatial context (Cumming et al. 2006) and to understand the idea of scale itself as dynamic (Borgstrom et al. 2006). Ahlborg and Nightingale (2012) propose an approach using "triangulation for divergence," as a way to reveal where data sets do not match. To remedy some of the shortcomings of spatial mismatch, Cumming introduces the idea of the property of reflexivity, referring mainly to decision makers receiving feedback from their constituencies (2013). But the literature as yet has paid little to no attention to the need to reflect upon the role of the researcher to define such scales in the first place, which is an important consideration that DASIP may shed light upon.

These challenges not only have a spatial scalar dimension, but a temporal one as well. In order to base decisions on future conditions, key actors must not only understand perceived risk, but also grasp the connections that cross geopolitical domains and that overlap with incongruous physical or sociopolitical boundaries, offered at a time scale appropriate for decision making and governance. What action is implemented now will impact and be affected by a later phenomenon. Ensuring that the DASIP is seen as a spatiotemporal problem implies that researchers also pay explicit attention to the timing of the decision cycle where decision makers are held accountable, which is a spatial process in its own right.

Finally, it is important to note that the definition of DASIP is intended to describe a methodological rather than a theoretical problem. Thus, there is a need to innovate methodologically around decision making as a particular category of spatial behavior, and perhaps policy making as a specific instance of spatiotemporal, scaled decision making. Indeed, DASIP recognizes the spatiality of collective, accountable decision-making behaviors as distinct from independent, individual choices. Doing so may in turn lead to new, insightful approaches to the spatiotemporal characteristics and scale of important complex issues researchers approach. The article above utilizes three case studies that begin to illustrate ways this may play out in practice, drawn from research in climate science in Arizona (Vanos et al. 2016), water resources in Kansas (Solís 2005), environmental justice in Texas (Forbis & Kear 2011), and urban food security (Battersby & Watson 2019). Future research is needed that involves interdisciplinary teams of scientists engaged reflexively in practice with decision makers to explore methodological solutions and experiments that first identify, then overcome or mitigate the methodological challenges related to spatial dimensions and scale in decision making. Such collaboration may help further illuminate underlying principles related to spatial incongruences across the landscape of decisions and public accountability for those decisions.

Ahlborg, H., and A. J. Nightingale. 2012. Mismatch between Scales of Knowledge in Nepalese Forestry: Epistemology, Power, and Policy Implications. *Ecology and Society* 17 (4), Article 16.

Battersby, J. and V. Watson. 2019. The planned 'city-region' in the New Urban Agenda: an appropriate framing for urban food security? *Town Planning Review* 90(5):497-518.

Borgström, S. T., T. Elmqvist, P. Angelstam, and C. Alfsen-Norodom. 2006. Scale Mismatches in Management of Urban Landscapes. *Ecology and Society* 11 (2), Article 16.

Brown, J. S., and P. Duguid. 2000. *The Social Life of Information.* Boston, Mass.: Harvard Business School Press.

Cumming, G. S. 2013. Scale Mismatches and Reflexive Law. *Ecology and Society* 18 (1), Article 15.

Cumming, G. S., D. H. Cumming, and C. L. Redman. 2006. Scale Mismatches in Social- Ecological Systems: Causes, Consequences, and Solutions. *Ecology and Society* 11 (1), Article 14.

Forbis, Jr., R. E. and A. Kear. 2011. Fracking Across the USA: Disparate Political Responses to Unconventional Energy Development. Western Political Science Association 2011 Annual Meeting Paper.

Gehlke, C. E., and K. Biehl. 1934. Certain Effects of Grouping Upon the Size of the Correlation Coefficient in Census Tract Material. *Journal of the American Statistical Association* 29 (185A): 169--170.

Leitner, H., E. Sheppard, and K. M. Sziarto. 2008. The Spatialities of Contentious Politics. *Transactions of the Institute of British Geographers* 33 (2): 157--172.

Kwan, M. P. 2012. The Uncertain Geographic Context Problem. *Annals of the AAG* 102 (5): 958--968.

Latour, B. 2004. *Politics of Nature: How to Bring the Sciences into Democracy*. Translated by C. Porter. Cambridge, Mass.: Harvard University Press.

Openshaw, S. 1984. The Modifiable Areal Unit Problem. *Geo Abstracts.* Norwich, U.K.: University of East Anglia.

Solís, P. 2005. Water as rural heritage: reworking modernity through resource conflict in Edwards County, Kansas. *Journal of Rural Studies* 21 (1): 55--66.

Vanos, J. K., A. Middel, G. McKercher, E. R. Kuras, and B. L. Ruddell. 2016. Hot playgrounds and children's health: a multiscale analysis of surface temperatures in Arizona, USA. *Landscape and Urban Planning* 146: 29–42.