Actor-Network Theory as a Theory of Space

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Actor-network theory (ANT), sociology of translation, sociology of associations, and material semiotics are some of the terms used in the 1980s and 1990s by a group of scholars in the field science and technology studies (STS) to describe a singular, constantly evolving approach to the study of knowledge production and technology development characterized by its strong appreciation of two types of indeterminacy concerning the nature of the social.

The first type involves the indeterminacy of actors. ANT scholars argue that no assumptions could be made with regard to what should be considered an actor, for this is precisely what is at stake in the social: what, who, and how can make a difference in the trajectories of technoscientific objects. What is regarded as an actor is thus the result of both: processes of translation, by which certain entities become associated with others forming larger or smaller actor-networks, and trials of force, that is, conflicts and controversies in which the capacity of such actor-networks to make a difference is tested. In this understanding of the social, the difference between humans and nonhumans is irrelevant. Actor-networks are hybrids.

The second type of indeterminacy concerns the contexts of action. Here, ANT theorists again refuse to make any generalizations concerning the contexts in which action might happen, regardless of whether they are imagined as institutional, structural, or even spatial contexts. Indeed, analytical distinctions between the context and content of a practice, between the depth and surface of a discourse, or between global or local scales of action are understood as pre-emptive empirical analysis. ANT theorists are interested in the continuities between such distinctions, and thus avoid descriptions that assume that there is a qualitative or ontological difference between them. Instead the aim is to show how actor-networks create their own contexts, discourses, times, and, yes, spaces. Actor-networks are worlds.

The invitation to discuss the methodological contributions of actor-network theory to spatial research can be extremely productive for various reasons. Firstly, it allows us to engage with key analytical premises of actor-network theory from an uncommon standpoint: namely, spatial theory. Indeed, ANT might be easily associated with various turns in the social sciences and humanities, such as the practice turn or the ontological turn. The so-called "spatial turn" has hardly played an explicit role in the development of ANT,

and yet ANT has much to say about how to study space and various spatial formations – contributions that go beyond the mobilization of a specific spatial figuration, the network, to rethink the social. Secondly, it allows us to challenge the common understanding of ANT as a new theory of the social. Bruno Latour's remark that ANT is not a theory is often cited to argue that ANT, if anything, should be understood as a methodology committed to following actors as they fluidly move across nature and culture, technology and society, the big and the small. This is certainly accurate, yet what Latour was after was something different: "ANT," he argued, "is not a theory of the social, it is a theory of a space in which the social has become a certain type of circulation" (Latour 1999, 22). We take this definition as a cue to reconstruct ANT's contributions to the study of space.

We have divided this article into three main sections. In each of these sections we outline the broad and diverse field of ANT and, as the French philosopher Michel Serres would say, "betray" it in at least two ways. Firstly, we focus on very punctual contributions and interpret them as representatives of different moments in the history of ANT.[1] Secondly, we translate their content into a methodological contribution to the study of space. We start with "early ANT" as captured by Michel Callon's (1986) statement of methodological principles for a sociology of translation and reframe this as a critique of the most influential approach to the critical study of space, that is, Henri Lefebvre's (1991) theory of the production of space. Next, we engage with what has come to be known as "post-ANT" (Gad and Jensen 2010) or rather "after-ANT" (Law 1999) and discuss John Law and Annemarie Mol's (2001) topological approach to studying the circulations of technoscientific objects. We conclude with "near-ANT" (Farías et al. 2019), explorations of the Anthropocene, as put forward by Bruno Latour's most recent collaborations aimed at a re-mapping of the terrestrial (Arènes et al. 2018).

1 Early ANT: Toward a critique of the social production of space

When speaking of ANT and its broader reception in the world of social theory, it all comes down to one figure, the actor as a network of humans and non-humans, and especially one underlying concept: the network. Does this refer to globalization and digital infrastructures? Does this imply imagining a world of heterarchical relations? And what about hierarchies? Boundaries? Exclusion? What is often misunderstood in such discussions is that "network" does not describe the context or space within which actors would act. Rather, network is used to describe the practical work by means of which actors shape the webs in which they exist. A network describes both a (spatial) object and a (spatial) practice, and it reflects the concomitance of the two (Callon 1986; Law 1992). A second important point is that actor-networks are the result of material-semiotic processes of translation (Callon 1986; Law 2008). Early ANT takes the form of a sociology of translation that studies the "negotiations, intrigues, calculations, acts of persuasion and violence, thanks

1 Although we focus on the work of a few authors, it must be stressed that ANT was a collective effort even before it was known as such. It involved Madeleine Akrich, Michel Callon, Antoine Hennion, Bruno Latour, John Law, Anne-Marie Mol, Arie Rip and Helen Verran, to name but a few of its most prominent early representatives.

to which an actor or force takes, or causes to be conferred on itself, authority to speak or act on behalf of another actor or force" (Latour and Callon 1981: 279). We can now qualify the previous definition: Actor-networks as object-spaces are made of physical and social, material and semiotic relations between humans and nonhumans. This understanding of actor-networks as more-than-spatial figures invites us to imagine ANT as part of the broader "spatial turn" in the social sciences and humanities.[2]

The "spatial turn" has laid the ground for a more praxeological exploration of society, paying attention to the hybrid ecologies of elements that shape action, as well as the modes in which spaces are socially produced. At the very core of this development, we encounter Henri Lefebvre's theory of the social organization of space and his radical rejection of a container model that imagines space as a system of physical and absolute coordinates. Space, Lefebvre argues at the beginning of his book *The Urban Revolution* (2003), is a social product. In his acclaimed book The *Production of Space*, Lefebvre (1992) develops insights into a fully fledged theory of the historical and analytical dialectics between three components or moments in the production of space:

- *Representations of space* shape the dominant space of society—a space conceived by experts and ordered by means of technoscientific knowledge for the circulation of capital
- *Spaces of representations* refer to space as experienced by inhabitants and users through public or collective symbols and imaginaries—these are the lived spaces of everyday life
- *Spatial practices* entail the non-representational spatial perceptions and competences of people and embrace both conceived and lived space

These moments, he proposes, are to be understood as opposing each other, but dialectically connected. The dual tension delineated between the conceived and the lived, as well as between the representational and non-representational, has been extremely influential in socio-spatial research (see De Certeau 1984, Low 2016, Zukin 1996). Many scholars are indeed concerned with the conflicts and contradictions between different modes of doing space, paying attention to how a professionally conceived and produced space alienates everyday experiences and imaginaries, while at the same time never losing hope in the subversive capacity of everyday tactical improvisations and logics.

In order to understand ANT's methodological contribution to the study of space, it seems crucial to begin by underscoring how it differs from a dialectical approach as proposed by Lefebvre and widely adopted in socio-spatial research to date. We would like to highlight three key methodological principles of ANT (agnosticism, generalized sym-

2 This may also explain the great interest that ANT arouses in disciplines concerned with the design of social spaces, especially in architecture and planning. According to Guggenheim (2019: 68), "the difference between science and design is that in the latter, the agency attributed to designers and the terms 'fabrication' and 'construction' used to describe their work fit perfectly with their self-descriptions […] There are therefore no critical effects that the descriptions of ANT could have on architecture".

metry, and free association—see Callon 1984) and explore their critical implications for Lefebvre's trialectics of space.

The principle of "agnosticism" is not only directed toward what is considered self-evident in specific fields of practice. What ANT proposes is expanding agnosticism to include the sociological categories used to analyze the construction of truths, evidences, or values. Especially when it comes to the role played by actors, we need to let go of the sociological definition of action as human competence for intentional activity. Seen from this perspective, Lefebvre's framework, while agnostic in terms of what we commonly understand as space, appears shaped by unquestioned assumptions concerning the social as composed by groups of individuals divided by class, occupation, and gender, as well as institutions, such as the state. His conceptualization of the city as an *oeuvre* (Lefebvre 1996) produced by historical subjects, while at the same time producing the material conditions for their existence, duly expresses Lefebvre's attachment to conventional sociological categories. Early ANT invites us to go beyond the understanding of space as the construction of social actors.

The principle of "generalized symmetry" is often misunderstood as suggesting that all entities and forces forming actor-networks are equally powerful, as though the social were a heterarchical space without inequality, asymmetry, and difference. Such misunderstandings forget that ANT was first conceived as a sociology of power that takes Foucault's relational understanding of power very seriously. Generalized symmetry implies that our analytical frameworks and conceptual languages should not make an *apriori* differentiation between types of actors or action. Human and nonhuman, expert and lay, powerful and weak, global and local, institutional and individual actors—all such analytically distinct categorizations should be avoided and treated as empirical questions. From this perspective, Lefebvre's trialectics of space would ultimately preempt the study of space, reducing empirical research to the task of finding already prefigured tensions between lived, conceived, and perceived spaces.

The third methodological principle of early ANT is what Callon calls "free association." The social, and for that matter space, is made of hybrid relations, where anything can be connected with anything else, hence the description of ANT as a "sociology of associations" (Latour 2005). The crucial consequence of this principle is that the social is, so to speak, unfinished, that is, always expanding and shrinking, combining new entities while separating others. Accordingly, the key methodological principle is to follow the actors as they go about hybridizing the social. This understanding is, of course, diametrically opposed to the dialectical method, which conceives of the social as shaped by logical contradictions. Instead of approaching the production of space by means of abstract (and universal) tensions between different modalities, ANT's methodological challenge is to chart the multiplicity of means and forms in which spaces come into being and/or beings come into space.

2 After-ANT: A topological turn in the study of technoscientific objects

Early ANT had an important implication for the study of space (and time), which are to be thought as "consequences of the ways in which bodies relate to each other" (Latour

1997). Or more drastically: "We never encounter time and space, but rather a multiplicity of interactions with actants that have their own timing, spacing, goals, means, and ends" (ibid: 182). Whereas early ANT developed a highly differentiated vocabulary to describe such interactions, the network metaphor came to dominate its imagination of space.

In the 1990s, friendly fire suggested that the figure of the network was anything but neutral. Instead, it implied a very specific imaginary of the social: one that puts emphasis on control, univocity, and coherence (Star 1999). Accordingly, one of the most prominent issues in what has come to be called post-ANT or after-ANT is an exploration of the empirical varieties of object-spaces in actor-networks (Mol and Law 1994, Murdoch 1998). Latour and Hermant's (1998) book *Paris Invisible City* offers a good example of this. On the one hand, it introduces the concept of urban *oligoptica* to characterize the small offices at the center of large technical networks in which knowledge of urban ecologies and infrastructures is produced and used to coordinate their functioning, maintenance, and repair. Oligoptica are centers of coordination in network spaces, places in which only a very small portion or aspect of the city can be seen, albeit in great detail. One the other hand, the authors explore and theorize about other spatial figures: urban space as a "juxtaposition" of objects and regimes of intelligence formatting urban inhabitants in different ways and urban space as a "plasma", as the virtual, unknown space that none of the urban networks and oligoptica cover and that is the source of potential associations.

More generally, after-ANT participates in a broader turn to topology in social theory, thus joining the ranks of authors such as Martina Löw (2016 [2001]), who pointed out early on that despite a broad consensus about space as something embodied, flexible, and relational, most authors do not accurately describe how space results from relational arrangements of objects (understood as both things and persons). After-ANT is thus in good company moving from a sociology of translation to a topology of multiplicity (see Mol 2010). Indeed, whereas early ANT was mainly concerned with how an actor engages others to generate a network that speaks with one voice, after-ANT was mainly concerned with the multiplicity of translations, voices, and versions of objects and networks. Multiplicity is well summarized by the slogan that things are "less than many but more than one" (Mol 2001). Multiplicity does not simply suggest the existence of a plurality of objects, or the existence of many objects. Rather, it is an ontological claim about the multiple identities of every object, or its capacity to adopt different forms simultaneously. Yet multiplicity is not primarily an argument about time but an argument about space. Objects, John Law would then argue, "are always enacted in a multi-topological manner, and are dependent for their constancy on the intersection of different spaces" (Law 2002: 98).

After-ANT's topology of multiplicity thus conceptualizes four interrelated research questions. The first is the problem of homeomorphism or, to put it differently, of deformation without transformation. Topology, Law (1999) describes, is the study of the abstract set of relationships that define the form of an object. From a topological perspective, objects might be physically deformed—that is, bent or stretched—yet they still hold their form. In such abstract terms, there is no difference between a cube and a sphere or between a donut and a needle, as each pair might be deformed into one another without transforming their topological structure. The early ANT concept of network, Law argues, is aimed precisely at mapping such topological continuities of technoscientific objects.

A good example of this is Sophie Houdart's (2015) analysis of the architectural studio as a multi-local practice intended to facilitate the smooth circulation of models, ideas, and people between the architectural studio and the building site. Similarly, Monika Kurath and Julio Paulos (2019) have studied the ways in which planning becomes an issue of public interest, moving from the secluded spaces of bureaucracy to new sites of participation. In both accounts, we see how architecture and planning work involve the deformation, but not transformation, of highly heterogeneous inscriptions of urban things: A building is transformed into a survey which is then drawn by hand in the shape of a diagram or fabricated as a model, which is subsequently transformed into a rendering, etc.

The second question that arises is whether there are other modes of producing homeomorphic object-spaces. Two contributions seem particularly propitious. First, de Laet and Mol (2000) speak of "fluid objects" to describe objects whose ability to operate in a certain way remains stable despite the exchangeability, subtle mutability, and local adaptability of its parts. The case presented by de Laet and Mol is a technical object, a water-pump, that holds itself together as an object not despite but actually because of its local adaptation and the slight change of shape and scope of the sociotechnical networks that constitute it. Law and Singleton (2005) speak of "fire objects" in reference to objects that radically change their shape and even their name as they are constantly coping with discontinuous realities that cannot be made present simultaneously. A good example of a fire object-space is provided by Tironi (2010) in his study of the eventful urban topology of an alternative music scene. Rather than having a fixed topography of locations, the scene regularly crystallizes at different locations in different forms. Tironi speaks of a *gelleable space*, in which "what counts as a 'project' or as a 'band' is the performative effect of a momentary association that has 'gelled' into a unitary agent" (44). So, rather than proposing abstract concepts for describing topological relationships, ANT invites us to open up the list of topological formations that allow objects to maintain their identity while being radically deformed. While the trilogy of network, fluid, fire object-spaces has been mostly received as a typological classification, the research agenda set up by after-ANT is to continue adding topological formations.

The third question refers to the multi-topological nature of objects. Using the example of renovation in processes of urban renewal and gentrification, Guggenheim and Söderström (2010) argue that buildings exist in different spaces: Euclidean space, where the building form is physically homeomorphic and defined by stable or changing uses, and network space, where it is historically or conceptuality related to the adaptability and flexibility of classifications concerning its type. Guggenheim and Söderström argue that the instability of buildings as types is a result of their dual existence as a topography that becomes the object of reuse and a typology that is adaptable and flexible. After-ANT's commitment to multiplicity, we see here, is about understanding how objects become more robust or unstable. It is tempting to contrast this multi-topological approach with Lefebvre's trialectics of space. But in contrast to multiplicity, Lefebvre's frame implies a zero-sum articulation of different types of space: the more "conceived space," the less "lived space," and vice versa.

Finally, and perhaps the most unexpected turn of the argument, a multi-topological approach allows after-ANT not to simply reject Euclidean space but to incorporate

it into its analysis as a crucial topological formation: "The old unspoken hierarchical ANT view—that network-objects and network-spatiality underpin Euclidean-objects and spatiality—is misleading" (Law, 2002: 97). John Law's suggestion is fascinating as it involves adopting a symmetric perspective on the relationship between Euclidean and other topologies. Using the example of tourist maps, Farías (2011) argues that instead of accusing such maps of propagating confusion, "Imagine that—the real world confused with the white expanse of a piece of paper!" (Latour, 2009: 142), we should underscore how tourist maps decompress and expand destination space. By visualizing the destination as a *res extensa*, tourist maps counteract the possibility of a synecdoche of the tourist destination and render physical movement into a necessary condition to cover the material extensions making up destination space. Rather than overcoming Euclidean conceptions of space, the analytical challenge is to equate Euclidean space to other types of spaces.

3 Near-ANT: Speculative cartography for the study of critical zones

John Law's observation that a relational turn should not mean leaving physical space untheorized resonates in important ways with Bruno Latour's most recent work on redressing our understanding of the Anthropocene and the terrestrial through the notion of the *critical zone*. In geoscience, the critical zone refers to the thin layer of the earth's surface where life, human and non-human, has come to physically and chemically modify the cycles of matter. Critical zones are therefore locations on the envelope of the earth where geological, biophysical, and techno-social processes intermingle and which "under stress […] may break down entirely or shift to another state" (Latour 2014: 4). Latour's own term for the critical zone is that of a *metamorphic zone*, a space where heterogeneous entities come together and undergo fundamental morphogenetic transformations, exchanging properties and changing their form and identity.

The critical zone, to be clear, is not a topological but rather a metamorphic space. It is a space of life and death, and it involves the radical transformation, not the smooth deformation, of life forms. Rather than an after-ANT or post-ANT project aimed at fixing the shortcomings of early-ANT, Latour's work with critical zones can be regarded as a "near-ANT" project, one that is obviously inspired and very close to ANT but not primarily committed to the development of ANT (Farías et al. 2019). Something bigger and more urgent seems to be at stake: namely, the question of whether and how we can live together. Learning to live in the Anthropocene or, as Latour would put it, "facing Gaia" requires radically changing our understanding and perception of our planetary condition, making visible the interconnections and ecological transformations occurring in the critical zones of the earth (Latour 2017).

In recent years, Latour has embarked on just such an intellectual project in close collaboration with geoscientists, designers, and visual artists. His objective is to develop a new visual language, a post-cartographic mode of representation, to stage the earth as what it is: not a planetary system that can be viewed from above with a global perspective but rather a terrestrial rhizome that needs to be represented from the inside, taking into account the interconnections of life on the earth (see Aït-Touati 2012). One of the

key challenges, Alexandra Arènes, Bruno Latour, and Jérôme Gaillardet (2018) argue, is how to give depth and volume to the thin layer occupied by critical zones. The common visual representation of critical zones, they explain, follows the conventions of a "block diagram," meaning a cross section of the earth's surface with the atmosphere on top, the critical zone in the middle, and various geological layers on the bottom.

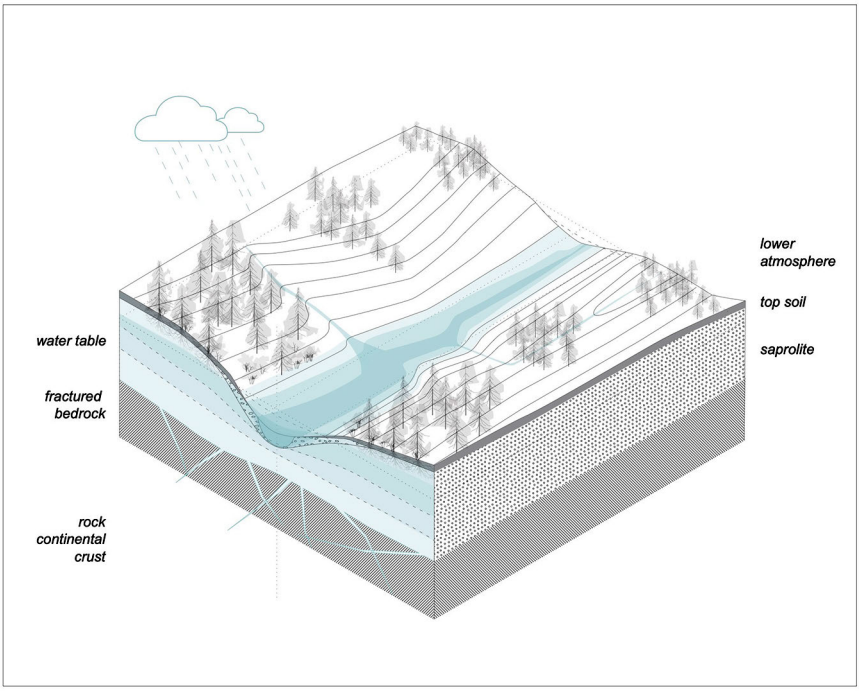

Fig. 1: Block diagram of a critical zone by Arènes, Latour, und Gaillardet

One of the problems with these representations is that they are incapable of displaying the complex ecological processes and metabolic dynamics that shape life in the critical zone. Block diagrams represent critical zones as local ecologies, thus missing how their dynamics result from complex distributions of the microscopic and the planetary, quick reactions and geological time, the local and the global.

In order to develop an alternative visual representation of critical zones, Latour and his colleagues rely on what is called anamorphosis in projective geometry: that is, a deformation of the scales and relations between the elements of a space without transformation. The first anamorphic operation consists of flattening the cross section of the critical zone to produce a two-dimensional circular representation of the geological layers that come together at a specific point in space. A critical zone is not represented as a local region of the planet (like the cross section) but as a series of concentric circles with the continental crust in the center and the atmosphere on the borders. The second anamorphic operation involves simply reversing the order of the layers so that the atmosphere

is at the center and the mantle on the borders of the plane. The third operation entails adding a third dimension to represent the sun as a source of energy for biochemical processes.

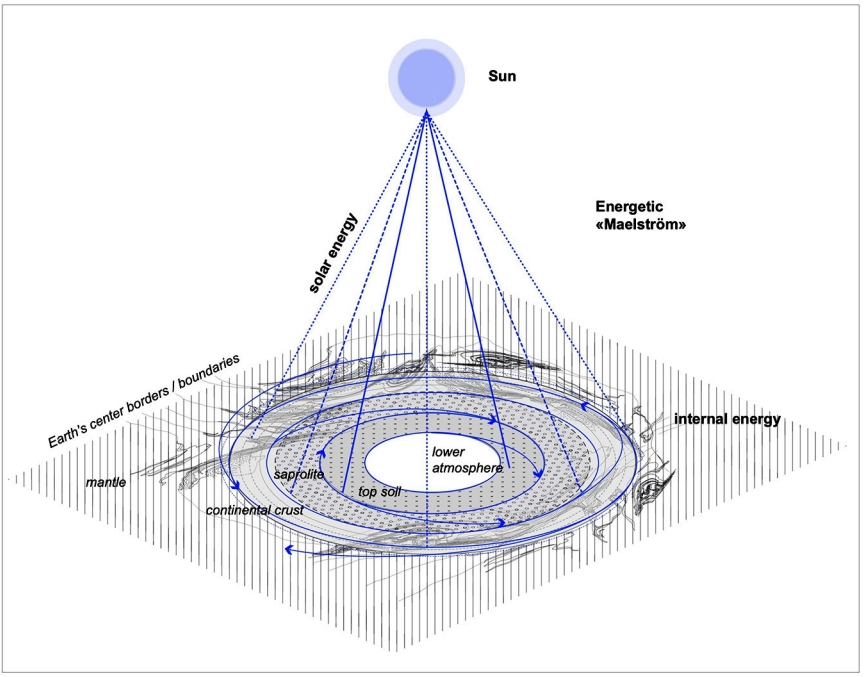

Fig. 2: Anamorphic view of a critical zone by Arènes, Latour, und Gaillardet

The result is surprising. In the center of the map is the lower atmosphere and the top soil: the critical zones in which life unfolds. The biochemical processes, feedback processes, and other dynamic relations between inhabitants of the critical zone can be represented in this space and related to both the sun and the earth mantle as two major sources of energy: tectonic and solar energy. The distributions of local and global, microscopic and planetary processes can be traced both by moving from the soil to the atmosphere and from the soil to the mantle. A system of spiral arrows is also proposed to represent the processes cutting across layers with different intensities and velocities. Latour and his colleagues exemplify this notation system with a map of the carbon biogeochemical cycle.

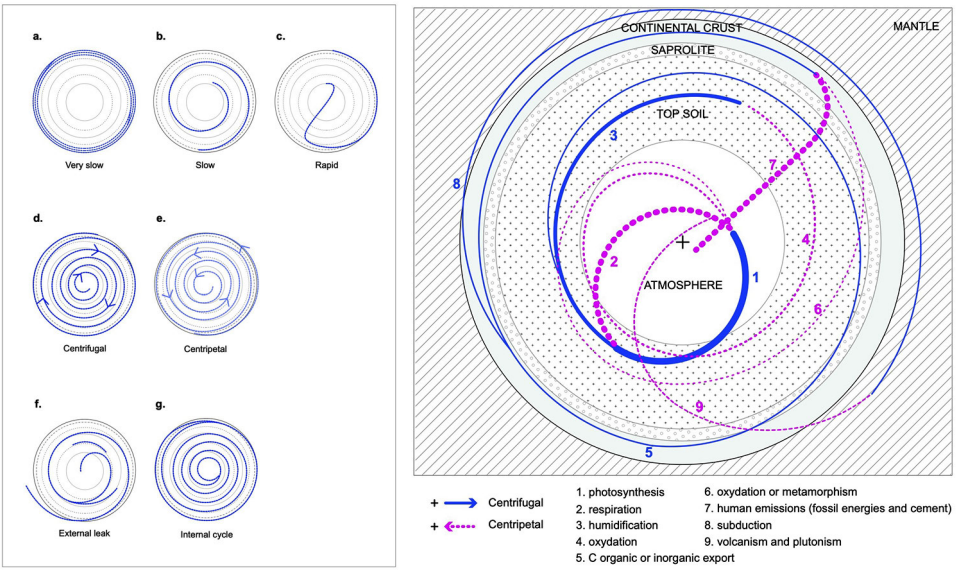

Fig. 3: Notational system for dynamic processes in a critical zone by Arènes, Latour, und Gaillardet

Have we finally arrived at ANT's ultimate contribution to the study of space? The answer is, of course, a resounding no. The value of these cartographic experiments, we believe, is less a possibility for establishing a new set of visual conventions to represent the terrestrial and more an invitation to experiment with anamorphic and topological representation of spaces, center-staging the multiple and complex interactions between different kind of actors, humans and nonhumans. ANT is indeed nothing but a theory of the spaces through which the social, understood as a more-than-human issue, circulates.

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