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A situated proposal for a grounded approach to socio-hydrology☆

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ABSTRACT

Socio-hydrology, a range of attempts to better account for 'the social' in hydrological processes, has made significant progress during the Panta Rhei scientific decade of the International Association of Hydrological Sciences. Yet, where socio-hydrological studies continue prioritizing hydrological dynamics in explanations and solutions, critical social science studies continue to remain reluctant to engage in helping solve water problems, especially when this involves quantification. This Special Issue gathers contributions that share the ambition to enhance methodological symmetry between hydrological and social science forms of knowledge-making. Realizing this ambition hinges on (1) revisiting hydrology's epistemological preference for detachment, distance and replicability, replacing it with more modest forms of situated engagement that explicitly (*re-)connect* socio-hydrological knowledge-making to (always specific and political) places, waters, experiences, people, concerns and actions, and (2) inviting critical social science to leave the comfort of moral high grounds to become engaged in the design and development of practical solutions. This *grounding* of socio-hydrology takes the form of situated engagement and makes resulting knowledge both more accurate and more actionable, better linking proposed solutions to the transformations towards sustainability and justice that are so urgently needed.

1. Introduction

It is now well recognized that hydrological and societal dynamics depend on and influence each other. Different scholars have suggested ways to theoretically understand and methodologically grapple with such interactions between water and people (Gober and Wheater, 2014; Linton and Budds, 2014; Jepson et al., 2017; Wada et al., 2017; Massuel et al., 2018), resulting in a range of proposals to combine hydrological with social sciences. These proposals diverge, roughly depending on the disciplinary identification and associated onto-epistemological commitments and methodological preferences of the scholars involved. Hence, efforts of those with a background in hydrology range from inserting social and economic variables into existing quantitative statistical approaches or the models classically used (Blair and Buytaert, 2016, Roobavannan et al., 2018, Khalifa et al., 2020); borrowing methods coming from social sciences like "interviews, focus groups and surveys" (Ross and Chang, 2020) to capture 'the social' dimensions of water; to experimenting with forms of stakeholder participation in different stages of hydrological knowledge-making (Carr et al., 2012). In general, socio-hydrologists favour quantification and prediction, relying on modelling tools to produce sophisticated simulations, interpretations or explanations of complex water-society dynamics that can serve as a basis for policy advice or the design of future interventions. Safeguarding the longer-term sustainability of water-based or water-dependent ecosystems is a prominent concern that animates their research efforts, but socio-hydrologists may also be motivated by other objectives, such as flood protection (di Baldassarre et al., 2013). Most socio-hydrological studies remain rather "hydrocentred" with social-political-economic dynamics being treated as the contexts against which hydrological dynamics play out or human dimensions being reduced to those that are relatively easy to insert in existing hydrological models (Massuel et al., 2018).

Those with a critical social science background interested in water instead often do the reverse: they use hydrological dynamics as the background against which socio-political processes and relations play out (Wesselink et al., 2017). Many of them set out to demonstrate how water distributions and dynamics are (also) shaped by socio-political or economic dynamics. Hence, there are studies that show how

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hydrological dynamics are co-produced by often uneven processes of capitalist development that reinforce existing hierarchies and perpetuate deeply ingrained colonial legacies (Linton, 2010). Making use of in-depth description, and qualitative sociological, geographical or historical methods, one important aim of the resulting analyses is to open up accepted water policies, technologies and infrastructural interventions for critical questioning. Studies for instance shed critical doubt on the effectiveness, accuracy and legitimacy of formal water authorities, expertise and decision-making processes; question how supposedly universal models, theoretical frames or preferred categorisations foreground some concerns at the expense of others; or show how the use of technical indicators and measurements depoliticizes water governance. In this way, these studies successfully demonstrate how 'natural' waters or 'technical' interventions are always also social and political. Yet, social scientists have invested less effort in studying how 'the social' is co-shaped by water, in spite of Bakker's (2003) famous conclusion that water's physical characteristics are important to help explain why it is inherently resistant to commodification. Repeated pleas for more attention to how the material properties of water shape social relations (see Zimmerer and Bassett, 2003; Walker, 2005; Whatmore, 2006; Braun, 2008; Rusca et al., 2025; Bakker, 2012) have, as yet, not resulted in many social scientists seriously engaging with the numbers, models and methods that hydrologists use to trace, map, explain and predict the behaviour of water. Although there are some promising recent exceptions (see Alba et al, 2025; Molle, 2024; Rusca and Di Baldassarre, 2019), critical social scientists in general seem to shy away from quantification. This makes the conceptual and methodological tools of critical social scientists as ill equipped to account for hydrological dynamics as those of hydrologists are for grappling with socio-political and economic dynamics. In addition, social scientists tend to be more hesitant than hydrologists to engage in practical problem-solving or policy advice, preferring to instead limit their engagement to dissent, critique or protest (Srinivasan, 2019).

Reviews of attempts to combine hydrological with social scholarship highlight how epistemological, ontological, methodological and axiological differences between hydrology and (critical) social sciences make interdisciplinary collaboration seem almost impossible (Wesselink et al., 2017). A few recent articles nevertheless suggest that, in actual practices of collaboration, differences need not be as unsurmountable as they seem in theory. Rusca and Di Baldassarre (2019) for instance find that although hydrologists and social scientists use different ontologies of water, this does not make it impossible for them to fruitfully work together. Krueger and Alba (2022) identify hydrological modellers' dealings with uncertainty as an interesting basis for collaboration with interpretative social scientists, even when not resulting in integration or commensuration. This article likewise starts from optimism about the possibility of rapprochement between hydrologists and critical social scientists. Our optimism is partly inspired by the advances made in the field of socio-hydrology. That these are not always or easily acknowledged by social scientists is one important motivation behind this Special Issue. Our optimism also stems from accounts of real-life collaborations, with different researchers from different disciplines working together to jointly diagnose and solve water problems as manifested and experienced in a given singular location (see Collard et al., 2024; Massuel et al., 2018; Riaux and Massuel, 2014).

We draw on such accounts to make a plea for expanding and enriching socio-hydrological or hydrosocial forms of knowledge-making with an approach that we call "grounded socio-hydrology". Rather than the single best way forward, it is one proposal among possible others. It is importantly inspired by Donna Haraway's term 'situatedness', which she uses to re-define scientific objectivity. It is a term that might be more familiar to social scientists than to hydrologists and other natural scientists. It expresses that knowledge is contingent on the circumstances of its production, including the positionality of the researchers. The implication is that all knowledges are partial, and that other partial knowledges are possible. The notion of situatedness informs our plea for grounding, by which we mean mean physically working together in a same location, and is motivated by shared concern about the future of the specific water(s) in that location. We see it as a form of knowledge-making that is explicitly connected to and anchored in place-based experiences of people, aimed at helping solve their water-related problems. It is modest and actionable, yet does not let go of the ambition to formulate broader principles or lessons for acting on and relating to water.

Awareness about how 'development-as-usual' threatens sustainability and justice has triggered the alertness and sensitivity of socio-hydrologists to the deeply intertwined nature of hydrological and societal dynamics, also sparking reflections about how water-related interventions either perpetuate or can potentially transform extractive or exploitative societal processes. The realization that understanding and solving water problems hinges on questioning existing societal orders or the paradigm of economic growth is prompting some socio-hydrologists to more explicitly explore combining hydrological assessment and prediction with serious societal-political engagement or even activism. These explorations require giving up dreams of detachment and positivist objectivity and have perhaps never been fully convincing given the proximity that has long existed between the science of hydrology, engineering and decision making. A growing number of social scientists in turn aspire to move beyond critique and have started engaging with quantitative tools of description and prediction more seriously to support the development and implementation of practical solutions. This requires not just a willingness to leave the relative comfort of moral high grounds or teleological ideals but also, often, to "pair-down" the messiness that social scientists have long aimed at unravelling – which can be a significant source of discomfort for them.

Our proposal for a "grounded socio-hydrology" builds on current debates in the field to, on the one hand, push socio-hydrological knowledge-making beyond mere incorporation of 'the social' and, on the other hand, stimulate hydrosocial knowledge-making going beyond critique. It is, in other words, a proposal to help realize desires to (re-) connect, engage in and contribute to critical and potentially transformational forms of problem-solving in water. We are self-appointed and rather adulterated representatives of the two groups referred to above, critical social scientists (Margreet Zwarteveen, Jean-Philippe Venot, Marcel Kuper), hydrologists (Andrew Ogilvie), and a complex system modeller at the interface (Olivier Barreteau). We have interacted and engaged in joint conversations about our different ways of making sense of water problems during more or less formal meetings, many of which happened at the interdisciplinary Joint Research Unit "Water Management, Actors, Territories" (UMR G-EAU) in Montpellier, and in the wake of the Grounded Socio-hydrology session we convened at IAHS General Assembly in 2022. Inspired by these conversations, and by the social-science oriented concept of "situatedness", we use this introduction to the Special Issue to suggest that explicitly (re-)connecting socio-hydrological knowledge-making to (always specific) places, waters, experiences, people, concerns and actions is a productive and relatively easy way to combine social sciences with hydrology (or vice versa), making the resulting knowledges more effective and actionable. We maintain that cultivating situated engagement, with researchers from different disciplines becoming part of and explicitly involved in the water problems they are jointly studying and aspire to help solve, is one promising approach to advance socio-hydrology.

Grounding entails two main steps: *contextualizing* and *anchoring*. In the section that follows, we explain each of these, and discuss their philosophical and theoretical roots. We then go on to explain that for *grounding* to happen, both hydrologists and social scientists may need to make some changes to their preferred ways of doing and justifying their research. We end this introductory paper with a short discussion of different approaches and tools for grounding and situated engagement, based on the different contributions to this Special Issue.

2. Contextualizing and anchoring

Contextualizing refers to a series of steps to make knowledge as suitable as possible for a particular context. Theoretically, it builds on the insistence of pragmatism that all knowledge is based on experience, stemming from actions that are located in contexts (Dewey, 1916). Haraway's plea for acknowledging that all – including scientific – forms of knowledge-making are informed by always specific attachments is a powerful feminist articulation of this pragmatist proposal. According to Haraway, the conventional definition of scientific objectivity as seeing from a position of no-where (the god-eye view) is a dangerous power move, which is why she makes a plea to instead define scientific objectivity as seeing from a limited location and a situated position (Haraway, 1988). Without letting go of representational accuracy (or: while holding on to a form of realism), Haraway's proposal implies replacing the ideal of one holistic and universal account of the world, with the cherishing of many partial versions of it. While each of these versions may be true, they are not necessarily easy to reconcile or combine. Contextualizing positively resonates with pleas to 'provincialize' or 'decolonize' knowledge (for water, see for instance Furlong and Kooy, 2017; Khandekar et al., 2023), which are terms that articulate similar pleas for letting go of ideals of universality and generalization in favour of explicitly acknowledging that all knowledges come from distinct places and are based on always specific experiences: they are located and locatable. Deciding which or whose version of a hydrosocial reality to use for diagnosing a water problem or describing socio-hydrological dynamics, therefore, entails making choices. How to best do and organize this choice-making, and how to nurture the required reflexivity, is as much a practical and political question as it is a scientific or epistemic one.[1]

Contextualizing, then, consists of conscious attempts to 'put socio-hydrological research (back) in its context'. As Stuart Lane put it: "hydrological knowledge (…) cannot be understood if it is divorced from the networks within which it is produced, that is, an assemblage of elements that are *material* (e.g. conservation of fluid mass, flood defences), *technical* (e.g. state of knowledge, computational power), *regulatory* (e.g. defined modelling procedures) and *human* (e.g. ability to improvise, perception)" (Lane, 2014: 942). Pande and Sivapalan likewise observe that "scientific knowledge, like any other type of knowledge, is contingent on the specific cultural, political, economic, and technological circumstances within which it is produced, and in turn feeds back to the circumstances" (Pande and Sivapalan, 2017). A first step in contextualizing entails a critical tracing of the legacy of particular ways of simplifying, generalizing, discretizing or making abstractions, both to identify what and whose experiences inform them or which purposes they serve, and to unravel how they have become encoded or hard-wired into methods, tools or models to measure, account for or describe hydrosocial dynamics and realities. Linton's critical discussion of the hydrologic cycle is one possible example of such an exercise. He traces the evolution of the concept of the hydrologic cycle as it is currently used to regions with temperate hydrological conditions (Northwestern Europe and Northeastern America) where mean annual precipitation is relatively even. "By representing water as a constant, cyclical flow, the hydrologic cycle establishes a norm that is at odds with the hydrologic reality in much of the world, misrepresenting the hydrological experience of vast numbers of people" (Linton, 2008: 639). He concludes that "the temperate bias of the modern hydrologic cycle helped sustain – until very recently – what might be described as hydrological Orientalism: the (mis)apprehension and portrayal of deserts, arid lands, and tropical regions as respectively barren, poor, uncivilized, lawless, and violent places (and peoples) that requires the intervention of hydrological engineering to be civilized" (Linton, 2008: 640). The point is that water is different when theorized from a South Asian monsoon perspective than when theorized from a Western United States perspective. Similarly, as Choukrani and co-authors show in their article in this SI, what a wetland is depends on the positioning and identifications of the researcher: it can be a wasteland to be drained and reclaimed; a hotspot of biodiversity to be preserved or restored; a buffer zone; or a place where people live and make a living (Choukrani et al., 2023, this SI). This first step of contextualizing, then, entails cultivating active awareness of where the simplifications that guide or inform abstractions, conceptualizations or generalizations (ontological definitions, models, theories) come from. It serves to put them into relief, and comes with an invitation to compare them with other possible ways of making sense of and measuring the hydrosocial dynamics of a particular place to appreciate and discuss the merits and disadvantages of each of them (see Agrawal et al., 2024, this SI).

A second step in contextualizing logically follows from this first step. It consists of making tools or models that come from one place appropriate for another particular water context or group of actors – be they water managers, concerned citizens, irrigators, turtles, fish or indeed the river, lake or aquifer itself. An existing method or a tested modelling approach can never be simply transposed to a new situation; it needs to be translated, with the act of translation potentially modifying the precise meaning and functioning of the method or approach. To say this differently: to become 'true' or 'effective' for a new context, the tools, methods, models or theories need to become aligned to new networks (of facts, artefacts, people and meanings). How 'good' a model, concept or theory is, is never a given and only partly related to its intrinsic qualities. Making it work – which itself may mean something else in every specific situation – requires active efforts from those involved, including work of creating interest in and mobilizing support for the particular way of diagnosing, making sense of or solving a water problem that it embodies.

This step hinges on appreciating that different actors may need different types of analyses and different knowledges, because they have different interests and goals: different things matter to them. In the example of Choukrani et al. referred to above this is very clear: the preferred definition of a wetland is closely linked to what researchers consider to be the main concern(s) and what their favoured future is. Contextualization therefore requires some initial familiarization with, and discussion about, what the goals of the knowledge-making project and of those involved in it are (Choukrani et al., 2023, this SI). As Riaux et al. show in their contribution to this SI, this question does not stop at clarifying ontological definitions (in their case of groundwater dynamics), but may extend to how to best present the outcomes of the analysis. They ask themselves: "Did we want to wave the red flag of overexploitation and thus position ourselves as a kind of whistle-blower? Or did we want to temper the alarmist discourse of administrations and scientists and highlight other (hidden) critical water problems, including the increased cost of pumping, social exclusion, and the failure of water authorities?" (Riaux et al., 2023, this SI).

These two steps of contextualizing presuppose the explicit and always political positioning of the researcher(s) in the relations – with humans and others – in and through which their knowledge-making happens. In this sense, contextualization also is an invitation to explicitly nurture and account for the resulting attachments, something researchers can do by showing their identifications, affiliations and concerns. Who are their clients or funders, whom do they hope to support or assist, what are they worried about, what would they like to (help) change and whom are they, or want to be, accountable to? More fundamentally, it also means that researchers engage in a conscious process of clarifying and discussing their own role in the changes or transformations they hope to bring about (see Chambers et al., 2021; Scoones, et al., 2020; Temper et al., 2019), moving beyond overly simplistic 'telling truth to power' or policy advice narratives.

Anchoring, the second move of grounding socio-hydrology, has to do with cultivating the openness and patience to recognize and navigate the

[1] See Klein et al. (2024) for an elaborate discussion of how to translate Haraway's ideas to environmental modelling.

specificities of the socio-hydrological system or hydrosocial territory under study. Anchoring resonates with the methodology that qualitative social scientists call Grounded Theory, which is an inductive methodology in which concepts or ideas emerge from the empirical data, rather than the other way around – i.e. empirical data being used to either confirm or refute hypotheses (see Glaser and Strauss, 1967; Yancey Martin and Turner, 1986; Strauss and Corbin, 1994). Doing this importantly hinges on literally 'being there', spending time in the field, with those concerned. It is based on the belief that embodied physical interactions between people (including researchers) and other-than-human entities in their hydrosocial environment provide a (the most?) fertile starting point for actionable knowledge-making. After all, each particular hydrosocial or socio-hydrological space, territory or system is unique: it is characterized and co-determined by a distinct plurality of possible interdependencies that generate their own interactions and feedback loops between human and other-than-human agents as well as between physical entities among each other (e.g. water courses, technologies…) (Beven, 2002). Interdependencies include the connection(s) of the researcher(s) to the area and its inhabitants, as their measurements, interpretations or predictions will inevitably change existing dynamics: i.e. their research interferes (Mol, 2002; Law, 2002) or, perhaps, intra-acts (Barad, 2007) with studied realities. Staying with specificities and the multiple, unique and often messy interactions that they generate, or so we posit, will provide the 'thick' explanations of the co-emergence of hydrological and social dynamics that are needed for effectively informing actions and policies.

It is never possible to trace and apprehend all interdependencies; any attempt to know a hydrosocial or socio-hydrological reality is partial. This also means that there are always more and other possibilities to represent, or indeed interfere with, them. Anchoring therefore implies explicitly making choices about which interdependencies between water and society to open up for investigation, based on a careful and always political assessment of their meaning and origin (what they carry, enable), and which ones to ignore (at least temporarily). If unfairness is the concern, for instance, it makes sense to foreground and thematize those interdependencies which, when propagated, provoke further injustices (Valentine, 2008). The realization that there is more than one possibility of knowing a water situation also makes it necessary to develop ways of dealing with plurality and difference. Where trying to reach a pragmatic consensus or a form of integration is the oft-preferred approach to doing this, there may be situations where it is better to either respectfully 'agree to disagree' – what Mouffe (1999) calls agonistic contestation – or engage instead in other, more experimental, ways of learning to connect and interject-with and –against others (Van Dooren, 2014; Agrawal et al., 2024, this SI). Anchoring also means understanding the possible dynamics of change: all interdependencies are privileged pathways to propagate changes, or they might be obstacles to them. Making theories of change explicit encourages scholars involved in transformation processes to assess the possibilities to move forward as well as the potential unintended consequences and associated risks of maladaptation (Atteridge and Remling, 2018).

In short, rather than focusing on the interfaces and interdependencies between entire (aggregate) 'social' and 'hydrological' systems, *anchoring* is a call for a finer-grained analysis of interdependencies, to identify the interactions they enable and the consequences of their combinations in ways that are meaningful to the people experiencing, or responsible for managing, them on a day-to-day basis. Contextualizing and anchoring always imply choices: choices about definitions, concepts, parameters and methods; choices about which actors (including other-than-human ones) to align with; and choices about which interdependencies to engage with and foreground. Making these choices is itself often an only partly conscious process that is, moreover, never fully in the hands of researchers. Yet, the fact that choices are and will be made, each creating different possible versions of the realities under study, underscores the importance of cultivating reflexivity (see Riaux et al., 2023 this SI for a possible way of doing this): the ability to critically examine, discuss and negotiate why and how choices come about; the willingness to scrutinize and justify what values they are based on (see Imani et al., 2025 this SI for an example of this); and the patience to explore what their effects are for understanding and changing complex hydrosocial dynamics.

3. Grounding as re-connecting to, and helping solve, problems in the field

Socio-hydrology has structured itself around a shared ambition: to provide practical and actionable knowledge to help solve water problems. Our proposal for a grounded socio-hydrology is that this can be done through situated engagement. Theories of situated cognition (that nicely resonate with Haraways' proposal of situated knowledge) epistemologically inform this. These posit that knowledge-making – also when done by scientists – is not a disembodied activity, something that happens outside of the 'real' world. Instead, it happens in the mutual accommodation – the interactions – between knowledge-makers and the environment (Suchman, 1987). To know "is to be capable of participating with the requisite competence in the complex web of relationships among people, material artifacts and activities" (Gherardi, 2008: 16). It follows that knowing is always a practical accomplishment, an activity of inquiry that happens in a continuous back and forth between experience and concepts. By focusing on how people can solve practical problems, this conceptualisation of knowledge-making comes with proposals to judge the validity, or truth, of a model, concept or theoretical frame not just by its representational accuracy – how well it represents a reality –, but also by its real-world effects: what does it (help) do and for whom?

For those originally trained in hydrology, situating knowledge-making means (re-)learning to cherish the importance of physical proximity to whatever is the object of study. For those originally trained in (critical) social sciences, it means moving beyond critique to become concerned about what and whose problems their knowledge helps solve. One way of doing this is by becoming more engaged in the design and perhaps implementation of practical solutions. We discuss these trajectories that some socio-hydrologists already follow, in more detail below.

A return to the field. Until the mid-20th century, hydrology was largely catering to the emerging needs of river engineering, water supply and urban drainage (Rosbjerg and Rodda, 2019), with hydrological measurements and observations often directly serving the purposes of managing, exploiting, regulating or controlling water. For a long time, the discipline was strongly based on observations, examinations and measurements of hydrological processes and phenomena that required the presence of researchers in the field. This proximity of hydrologists to the objects of their research made it relatively straightforward to confront their measurements and predictions with ground observations, while it undoubtedly also helped them to stay 'grounded' in other ways (Massuel et al., 2018). Over the last decades, however, the amount of field work in hydrology has "withered away" (Burt and Mcdonnell, 2015). Insufficient public funding led to the deterioration of observation networks (The Ad Hoc Group et al., 2001; Kundzewicz 1997), while enthusiasm about the possibilities of remote sensing made the need for field observations seem ever less important (McCabe et al., 2017). From an empirical operational discipline, hydrology has gradually become a science that discretizes processes to model them. The models used have become more sophisticated: where earlier models used Newtonian mechanics at a scale where these can be considered homogeneous (Sivapalan, 2018), newer models use more dynamic Darwinian ideas of co-evolution to deal with the heterogeneity of small-scale processes and dynamics over time (Sivapalan, 2018; Bierkens et al., 2015). The effect of the reduced reliance on direct measurements and observations, however, is that the purpose of field data collection has changed from discovery to model parameterization (Burt and McDonnell, 2015) and ground truthing. Many hydrologists can now analyse and model catchment processes from their computer, without ever having physically

observed the waters they study or met the people directly experiencing the consequences of hydrological dynamics.

This gradual physical distancing may have fuelled and strengthened epistemological beliefs in the possibility and desirability of detachment and transcendence as qualifiers of good hydrological science. This is partly reflected in the preference of many scientific journals for broader scale studies, prioritizing replicability as a marker of scientific excellence while sidelining detailed, locally-focussed investigations (McCurley and Jawitz, 2017). In any case, the increased physical distance to research sites has allowed the continued cherishing of, the not always explicitly adhered to, belief that hydrologists have unmediated access to the water realities they study. This is, as many have pointed out, a belief that is dangerous (see Linton, 2010; Zwarteveen, 2023; Agrawal et al., 2024, this SI). Grounding socio-hydrology importantly means *re-establishing* the embodied – and affective – connections and engagements between researchers and the waters and people they investigate. Rather than detachment, the ability to consciously cherish connections then becomes the qualifier of good science. It makes researchers more directly accountable to their results, as it increases possibilities to compare measurements and predictions to ground observations and to the experiences of those living in the areas studied. Engaging and connecting also means becoming part of the messy politics and power relations that always surround water or that water is part of, making it even more important for researchers to consciously allow for or perhaps even design possibilities to be challenged. Hydrologists can learn from critical social scientists about how to do this. Rather than pretending that it is possible to disappear from the knowledge process, it starts with explicitly appreciating that the arts of building relations of trust and becoming familiar with a particular terrain are an intrinsic part of their expertise; something that they can learn to cultivate.

Solving problems. Much of the engagement of critical social scientists with water and with hydrology, in particular of those associating with the field of political ecology, has been concerned with exposing how water distributions and dynamics are caused by or the outcome of often uneven processes of capitalist development that reinforce intersecting socio-economic hierarchies – based on class, caste, gender, ethnicity etc. – and perpetuate deeply ingrained colonial legacies. Making use of in-depth description, and qualitative sociological, geographical or historical methods, one important aim of the resulting analyses is to open up accepted water policies, technologies and infrastructural interventions for critical questioning. Such research is useful in that it sheds light and questions the monopoly of hydrologists to speak for water, as well as the often-claimed objectivity of hydrological analyses (or the positivism of water sciences more generally, see also Wesselink et al., 2017). Analyses have for instance demonstrated the partial and contested nature of supposedly neutral hydrological data (Bakker, 2000; Baviskar, 2007; Budds, 2009; Mehta, 2007; Zwarteveen et al., 2018), or revealed how hydrological concepts and studies stem from particular worldviews and are mobilized in line with vested interests (Boelens, 2013; Boelens and Vos, 2015; Linton and Budds, 2014; Zwarteveen and Boelens, 2014; Budds and Zwarteveen, 2020). Critical social science analyses have also helped trace how hydrosocial dynamics can, at least partly, be explained by entrepreneurial forms of profit-making that are supported by distinctly neoliberal forms of governmentality (Ahlers, 2010; Bakker, 2003; Vos and Boelens, 2018; Swyngedouw, 1999). By documenting and exposing how water is both the contested topic of and an important ingredient in enduring forms of discrimination and marginalization, these critical social science accounts provide important arguments in support of change or transformation. Yet, and as some scholars have recently pointed out, exposing the causes of injustices is itself not enough to undo them. In fact, while revealing the structural dimensions of processes of depletion and spoliation is useful for sparking resistance and protest against those responsible for causing it, they are less helpful for helping solve the immediate problems of water scarcity, insecurity or lack of safety that such processes cause.

Grounding socio-hydrology is a plea to push critical social scientists to go beyond merely exposing how water is political and thick with power and culture. It invites them to mobilize their insights to pro-actively help design and implement practical solutions to water problems – and they can learn something from the practical hands-on problem-solving mentality of hydrologists. Both the rapidly growing scholarship on transformations to sustainability as well as post-structuralist and post-humanist feminisms can provide inspiration here (see Gibson-Graham, 2006; Von Redecker, 2020; Leach et al., 2021; Leonardelli et al., 2023). With proposals for reparative theorizing (or theories of repair), this scholarship suggests that transformations always necessarily start with practical and pragmatic projects of caring for, repairing or recovering things and relations. Projects that do not form part of new 'grand narratives', Big Structures or are in opposition to them, but that consist of smaller attempts to do things differently, constituting what Von Redecker (2020) calls an 'interstitial revolution'. They propose treating such smaller attempts to do things differently as never-finite forms of experimentation (Mayaux et al., 2022). The contribution of Gramaglia and co-authors in this Special Issue is a possible example of this: they treat practical de-paving efforts – efforts to make city surfaces more permeable to water – in the city of Montpellier as potentially transformative in that becoming involved in them can improve citizen's awareness of climate change and increase their willingness to do something about it, individually or collectively (Gramaglia et al., 2024, this SI).

4. How to ground? Reflections based on the contributions to this special issue

The articles submitted to this Special Issue represent a wide array of possible approaches to ground socio-hydrological knowledge-making. For the purpose of presenting and discussing them we group them in three, overlapping, categories. The first category focuses on making *tools* – e.g., models, games –, suitable for helping understand, explore and solve water problems of specific people in a specific place, either by improving the granularity of representation of interdependencies or by including local or social-science sources of information in them. The second category focuses on bringing different *sources of knowledge and forms of knowledge-making* together for an in-depth diagnosis of problems as experienced in a specific location, often showing how these can complement each other to provide a more comprehensive understanding than would have been possible if relying on just one discipline or source of knowledge. The third category focuses on designing procedures or protocols for improving the *process* of knowledge-making as a way to better contextualize and anchor it in the concerns of those who directly experience water problems, or of those with formal responsibilities for solving them. Below we refer to these three categories to introduce the various contributions to this Special Issue, also showing how some authors creatively combine them.

Grounding socio-hydrological knowledge-making entails dealing with broad sets of data that are related to often very different dimensions of socio-hydrological dynamics. Models and statistical analyses constitute a classical category of tools to represent and explore socio-hydrological dynamics, often through simulation. To meaningfully contextualize these models, a number of contributions to this SI propose ways to improve their ability to account for contextual specificities. Hence, Singh and Dhanya (2024, this SI) use unsupervised clustering associated with Local Indicators of Spatial Autocorrelation analysis and further spatial regression techniques to produce a fine-grained understanding of hazards and flood impact pathways in India, one that incorporates socio-demographic variables. Timewise, statistical analysis can also be useful to identify actual changes. Hence, Song and colleagues (2024, this SI) propose Principal Component Analysis and Differenced Synthetic Control to assess how two major institutional reforms – the 1987 Water Allocation Scheme and the 1998 Unified Basin Regulation – have affected and transformed the socio-economic systems in the Yellow River Basin. Their study shows how the use of these advanced modelling

tools can be useful to understand whether and how institutions fit with the scale and dynamics of hydro-social processes, which is useful for improving their design. In a study in Fort McMurray in Canada, Ghoreishi et al. (2024, this SI) combine agent-based modelling with hydraulic modelling to better understand how adaptive behaviours of human actors interact with and change the risk of ice-jam flood risks. By looking at possible trajectories of ice-jam flood risk for different scenarios – artificial breakage, status quo and dynamic adaptation – the analysis allows exploring the effectiveness of different risk mitigation strategies. An important novelty of the proposed Dynamic Ice-jam Flood Risk Assessment framework is that it allows modelling the interactions between government-level and individual level adaptations, for instance revealing how government-led artificial break-up activities can cause a regime shift in ice-jam flood risk.

Causal Loop Diagrams, as part of a qualitative System Dynamic Modelling Approach, can be useful for the identification of interactions among variables involved in socio-hydrological dynamics, thereby providing a useful way to integrate different knowledges. Giordano and co-authors, as well as Coletta and co-authors, use these tools to produce a granular understanding of the complex dynamics at stake in river basins, in a proposal to make nexus-analyses more actionable. A carefully crafted process of stakeholder engagement is an important part of their proposal, consisting of participatory workshops (Coletta et al., 2024, this SI) and graph analysis tools to facilitate collaboration between scientists and stakeholders and jointly map the complex web of connections across policy sectors (Giordano et al., 2025, this SI). This process of co-creation is important not just in improving the relevance and accuracy of the resulting analysis, but also in mobilizing interest in and support for the identified transformations. Sousa et al. (2025, this SI) also experiment with how scientists can collaborate with those experiencing water problems as part of efforts to improve the actionability of socio-hydrological knowledge. In their case, in the Brazilian Cerrado, they hope to involve farmers – the main stakeholders in their study – in decisions about the implementation of environmental flow objectives. They propose a two-way coupling of a data-driven agent--based modelling with a calibrated hydrological model (ABM-WEAP) to assess whether collective water grants can be an effective tool to manage water-related conflicts. An important finding of their study is that the sharing of water withdrawal data provides a fruitful starting point for engaging in a collective process of deliberation about water sharing. It can also, or so the authors suggest, help improve cooperation among water users Sousa et al., 2025 this SI).

For Gwapedza et al. (2014, this SI) bringing together very different water actors to jointly discuss and agree on a water management plan was not a more or less accidental by-product of grounding their socio-hydrological modelling process in the Koue Bokkeveld in the Western Cape Province (South Africa), but one of its explicit aims. Their action-research project intended to experiment with participatory dynamics to support the sustainable sharing of waters. By combining models with workshops with those interested in and concerned about the catchment, with the project hoping to spark a process of renewing and improving water governance. The research team selected those models that help visualise and demonstrate the interconnectedness between different uses and users within the catchment, showing how these affect river flows and what the consequences are for possible futures. Hence, they combined the Adaptive Planning Process and the Actor, Resources, Dynamic and Interaction approaches with more classical hydrological modelling tools to build a collective understanding that could serve as the basis for negotiating a water management strategy. The lessons learned include the importance of tailoring stakeholder engagement frameworks to the location; closely monitoring the engagement process through stakeholder feedback; and organizing explicit reflections on the process for continued improvement to occur (Gwapedza et al., 2024, this SI). A different and perhaps more playful way of engaging users and decision-makers is through games. Camelo Cid et al. (2024, this SI) discuss 'Drought in play', a serious game designed to involve different actors in drought management planning, initially in Ceara, Brazil. The boardgame uses role plays in which users can assume different roles, thereby increasing mutual understanding. It also uses simulated water use scenarios that allow users to visualise the collective impact of their water decisions on water availability, thereby enhancing social learning on drought concepts and its mitigation. The authors conclude that the game improved the effectiveness of drought management plans.

In the second category of articles, there are a number of contributions that, instead of trying to improve models and the process of modelling, combine a range of methods – such as spatial mapping techniques, different hydrological and chemical measurements, archival data and data obtained through surveys, ethnographic methods or interviews – to obtain an in-depth understanding of water-society dynamics in a specific location. Kuhn et al. (2024, this SI) show the merits of a detailed, interdisciplinary (combining hydrological and technical data with the analysis of politics and discourses) and relational understanding of long-distance water transfers to bring much-needed nuance to broad-based generalizations of such transfers as always and everywhere leading to negative externalities and lock-ins. Their contextualization of a particular long-distance water transfer – the Elbaue-Ostharz water transfer system (FEO) in Central Germany – shows that it is a contested process that emerges, declines and re-manifests differently through time and space, depending among others on prevailing policies (i.e. the influence of the commercialization of water supply) and on what different actors expect to gain or lose from it. Grounding large-scale hydraulic infrastructures, or so they argue, therefore helps articulating a more sophisticated analysis of their effects and impacts, one that is also useful in expanding possibilities of politically engaging with them beyond resistance or accommodation (Kuhn et al., 2024, this SI). Seigerman and colleagues combine ethnography and archival research with several embedded ways of inquiring and observing rainfall and reservoir levels to produce a situated explanation of the institutional and infrastructural responses to a succession of hydroclimatic extremes in Ceará, a semi-arid area in North-Eastern Brazil. They show that droughts are much more engrained in the region's identity and collective memory than floods, with institutions and infrastructures being also much better able to deal and live with drought than with flood episodes. As a result, or so they conclude, climate adaptation in Ceará prioritizes droughts and drought impacts over floods. Where droughts signal emergency and distress, feelings about floods are more mixed and paradoxical even when the damages caused by heavy rainfall events can be and have been considerable. Infrastructural and institutional solutions developed to deal with droughts might exacerbate those damages, which is why the article ends with a plea for policies to consider the intertwining dynamics of drought, extreme rainfall, and flooding (Seigerman et al., 2024, this SI).

Bhuyan and Deka (2024, this SI) through extensive interviews and field surveys, explore temporal shifts in water use patterns and their influence on regional waterscapes in the Brahmaputra floodplain. They show how the growing reliance on groundwater for household and agricultural water needs has gradually reduced the care for surface water resources. The resulting negligence of water-covered areas and ecosystem preservation measures is endangering the aquatic flora and fauna that depend on wetlands. The article ends with the question of how to re-create and re-nurture people's relations with and attachments to surface water bodies, as doing this is a precondition for restoring wetlands and biodiversity (Bhuyan and Deka, 2024, this SI). A somewhat similar question about how to change people's perceptions and behaviours animates the contribution of Gramaglia et al. (2024, this SI). Their article demonstrates the importance of qualitative social science methods not just to complement more quantitative technical or natural science data to produce a more comprehensive and fine-grained understanding, but also to generate a different type of knowledge: knowledge about how to incite people to change their habits and perceptions and become interested in collectively transforming their living environments. The analysis starts with the critical diagnosis that paving

– mainly with concrete and bitumen – in cities (here in Montpellier) not just aggravates flooding and degrades the quality of surface water but also contributes to the creation of heat islands and hinders biodiversity. It is not difficult, therefore, to make a case for the greening of cities. Yet, through interviews and focus groups discussions with a range of urban inhabitants and decisionmakers, the analysis shows that improving runoff management techniques and permeability requires more than scientific arguments. It also requires social and political support, and efforts to increase awareness of and interest in the issues at stake. Creating a broad-based alliance of supporters for de-paving, or so the article concludes, can only happen through collective learning experiences that can be fostered through carefully crafted participatory knowledge-making experiments (Gramaglia et al., 2024, this SI).

The exercise of Imani et al. (2025, this SI) provides yet another example of how different knowledges can be combined: through interviews, they invited Iranian water policy makers to make their conceptions of justice more explicit. Limiting their attention to distributive justice, they show that there is no agreement about what justice means or should mean. Many interviewees nevertheless stayed close to a distinctly libertarian conception of distributive justice. Their plea for boosting water productivity by allowing its trade on free markets, something that requires private water titles, resonates with and resembles what seems to be a global neo-liberal consensus. The authors end their article with a reflection about the desirability of this libertarian water doctrine for Iran. Their doubts partly stem from the well-documented difficulties to create water markets in other countries, many of which stem from the fact that water flows cannot be easily monitored or accounted for. Yet, they also have reservations about the libertarian water justice concept (and the free-market doctrine that it forms part of) because it does not fit with the prevailing legal, cultural and political conditions in Iran. It for instance risks going against the need for Iran to achieve national food security, while it also clashes with deep-felt cultural and religious norms to treat water as a human right. Rather than simply adopting a global policy discourse, the authors therefore conclude with a plea for a more grounded treatment and discussion of water justice, one that is anchored in what water users already believe in and do, and that suits the particular political, economic and cultural conditions of Iran (Imani et al., 2025, this SI). Just as justice, also peace is a somewhat unfamiliar theme for socio-hydrological studies. Döring and co-authors use their article for staging a dialogue between the literature on water sharing, international norms on water and domestic water disputes on the one hand and socio-hydrology on the other to explore how insights from peace (and conflict) studies, especially environmental peacebuilding, can be woven into socio-hydrology. After all, or so is their argument, the sustainable management of water is crucial for building and maintaining peace, which is why there is a potentially important role for socio-hydrology in peace-building. They show that this requires creating more explicit space for discussing issues of politics and power, something that speaks to a rapprochement between political ecology and socio-hydrology, but may also require embracing ethnographic methods (Döring et al., 2024, this SI). Yet another way to combine knowledges entails choosing a specific object, assumed as being instrumental in the evolution of the hydrosocial territory considered. Mitroi and colleagues (2025, this SI) show how water infrastructures, which have been central in drought management in North Eastern (Nordeste) Brazil from the early 1900s onwards, incorporate moralities and norms about who can legitimately receive more water. Their historical approach shows that despite the much-touted change of paradigm in the Nordeste – from fighting *against* towards living *with* drought – the development of water infrastructure, aimed at increasing water supplies, remains at the heart of public drought policies. While the diversity of water infrastructure has undoubtedly played an important role in attenuating the effects of drought for the inhabitants of the Nordeste, it has also encouraged ever-increasing water supplies to cities, industries and irrigation schemes, and legitimized economic development. Indeed, Mitroi and colleagues show how the massive construction of reservoirs, has shaped an ontology of water as hydric resources, stored and controlled through dominant technical ways of knowing and imagining water. The authors conclude that the important role of infrastructures in water-society relations, between water control and social appropriation, calls for a deeper and interdisciplinary field analysis to understand their specific role (Mitroi et al., 2025, this SI).

The third category of articles, those that foreground the *process* of grounding socio-hydrology, all somehow emphasize the merits of treating socio-hydrological knowledge-making as experimental and open-ended; a process of joint learning that potentially transforms all involved. Hence Saidani et al. (2024, this SI) document how, in a study of aquifer management in the oasis of Beni Isguen in Algeria's Sahara, the dialogue with communal water stewards enriched and improved their research. These interactions were based on mutual respect, trust and a joint desire to learn from each other, with the researchers acknowledging the profound and active knowledge of communal water stewards, who in turn hoped to learn from the researchers' methods to trace and measure water flows. The starting point of the study was the presence of water in the superficial aquifer used for irrigation. This was puzzling because the aquifer is fed by flash floods, and no flash floods had occurred since 2011. The researchers designed a hydrogeological and isotopic study to determine the origin of this water. Discussions with the communal water stewards and the wider community, through individual exchanges and during participatory workshops, and the use of archival data, made it possible to cross-check the sporadic hydrological data available. Through these interactions, the researchers found out that the phreatic aquifer is not just fed by occasional floods, but also with water that is pumped up for domestic uses. The article's in-depth account of the process of joint socio-hydrological knowledge-making describes it as a process of weaving together different forms of knowledge, a process during which expertise and authority are re-defined and re-distributed. The authors therefore conclude that while this weaving of different forms of knowing is a good way to ground socio-hydrology, it requires letting go of entrenched ideas about the superiority of science over local or experiential expertise (Saidani et al, 2024, this SI).

The analysis of Saidani et al. (2024, this SI) provides another set of insightful reflections about some of the difficulties of co-creation, and the combining of local insights and knowledges with scientific knowledges and methods. For instance, how to make the often-complex results of modelling and mapping exercises understandable for non-scientists and meaningful for informing policies? Are there trade-offs between scientific rigor and inclusivity? Riaux and colleagues, in their article, approach grounding as a conscious and reflexive process of re-establishing the relationship between hydrology and society. The paper describes a planned, interdisciplinary, process of understanding groundwater dynamics in Tunisia that took place from 2016 to 2020. They conclude that for hydrologists and water researchers more in general to re-connect and re-engage with society, they first of all need learn to more explicitly and clearly articulate and discuss their values with each other and with those societal actors they collaborate with. Secondly, they need to firmly connect their knowledge-making to the specific societal goals they want to help achieve, thereby positioning hydrology in society rather than outside it. A third dimension of grounding that they identify has to do with the importance of crafting cautious ways to interact with and reach societal collaborators. And finally, the fourth pillar of their approach to grounding deals with improving the dialogue between computational hydrology tasks, field-based measurements and associated societal interactions. Rather than outlining straightforward guidelines or procedures for each of these dimensions, the article makes a plea for staying with the discomforts that each of them may cause. These, or so the authors argue, provide useful ingredients to question routinized preferred ways of thinking and doing, thereby bringing to light the unthought, the inconsistencies and the contradictions in them. These provide a fertile breeding ground for reflexivity, pushing researchers to re-think why they do what they do

and how they do it (Riaux et al., 2023, this SI).

Agrawal and collaborators also explicitly focus on the process of grounding socio-hydrological knowledge-making. Their article describes a concerted attempt to develop a more in-depth, fine-grained and accurate understanding of groundwater dynamics in the Kaveri delta than what is available on the basis of existing sources. The most important reason for engaging in this attempt was the ambition to make research results useful for improving the management of groundwater. The process took more than 4 years, during which those involved discovered that *grounding* entails changing existing research protocols and methods. Their attempt to understand what is happening to groundwater in the Kaveri delta consisted of combining different sources of knowledge to make hydrological sense of groundwater: a numerical model, a government computation, and observed well data. As there were ambiguities and inconsistencies between these knowledges, the team decided to generate a fourth source of information by engaging in a participatory data collection programme. In addition to yielding additional evidence, this also helped situate or indeed ground the other sources of groundwater knowledge by allowing to trace the actors (engineers, farmers, activists, modelers) producing it, creating an empathetic understanding of how each of them makes sense of water flows in the delta. Different understandings and different ways of measuring water were also present within the team, which is why it was crucial to dedicate time in learning to understand and appreciate the logics, methods, definitions and languages of the other team members. This required slowing down, being open to, and actively engaging with, one another. During team meetings, conversations ranged from aquifer dynamics to celebrating a water goddess, and from inter-state distributive politics to fluid common property institutions. The authors conclude that learning to have conversations across and beyond disciplines is an important pillar of methods to ground socio-hydrology. A second important pillar of the grounding method, according to them, consists of active efforts to understand how those directly experiencing (ground) water dynamics make sense of it: for example, the farmers who see their wells running dry, the engineers responsible for managing canals, or the activists involved in improving groundwater re-charge through the restoration of rundown tanks (Agrawal et al., 2024, this SI).

The contributions of Riaux et al. and Agrawal et al. explicitly discuss how different knowers sometimes produce very different understandings of socio-hydrological dynamics. Such differences arise from disciplinary preferences, but may also stem from how knowers are related to a particular situation: with whom do they identify, what do they care about, whom do they report to and to whom are they accountable? Learning to deal with such differences is an important part of grounding, something that – as Agrawal et al. argue – may entail respectfully agreeing to disagree (Agrawal et al., 2024, this SI). In the contribution of Choukrani and co-authors, differences between differently situated knowers about what a wetland is form the heart of the analysis. They convincingly show how these differences are more than different ways of perceiving and representing a hydrosocial reality: different definitions and knowledges form part of and become connected to assemblages of peoples and waters, co-shaping infrastructural and institutional interventions that transform what wetlands are and become. Knowledges, therefore, do not just represent realities but also help bring them into being: they are worldmaking. In the Gharb plain, where the authors conducted the study, profound and long-lasting disagreements about what wetlands should be play out in how different people define, know and make sense of them. In showing this, the authors underscore how grounding always also means a political engagement: it entails making choices about which hydrosocial reality is the preferred one. The question of who makes or should make these choices, or of how to best organize this choice-making, thereby becomes part of what socio-hydrological or hydrosocial researchers should be concerned about. Many contributors to this SI agree that doing this is difficult to fix in clear procedures, protocols or guidelines, also because waters often escape such controlling efforts. Processes of grounding are most effective when part of open-ended processes of experimentation that hinge on establishing relations of trust among all those involved, importantly including those directly experiencing (the effects of) changing waters (Choukrani et al., 2023, this SI).

5. Conclusion

The papers in this Special Issue all provide elements or examples of ways to *ground* socio-hydrology; pushing it beyond traditional "systems modeling and decision support" (Xu et al., 2018) towards "more serious attempts to capture multiple levels of social systems and to combine methods […] to develop a multifaceted understanding of human–water systems" and achieve methodological and disciplinary cross-fertilization for theory development" (Yu et al. 2022). *Grounding* consists of two movements: contextualizing and anchoring that together help recognize, acknowledge and deal with the place and temporal specificity of knowledge(s) produced. *Grounding* can be considered a two-sided plea: first for hydrologists to reconnect with field hydrology, which itself has to be reinvented after a long period of hydrologists distancing themselves from the field, and second for critical social water scholars to go beyond mere critique and engage towards modest problem-solving and trajectories of transformation. *Grounding* is a form of situated engagement, which entails an explicit appreciation of the existence of diverse ways of knowing sociohydrological dynamics.

Our proposal draws on concepts that may be more familiar to social than natural scientists, but that are of interest to both we think. Grounding is theoretically inspired by pragmatism and feminist studies that reject understandings of knowledge production as detached from contexts and values to instead treat knowing as relation- and indeed community-making: relations and communities between people, methods, geographies, things and waters. Engaging in practices of relation-making happens across differences – whether disciplinary, cultural, or epistemological. It is a process of forming bonds in which identities and roles of researchers, participants, disciplines and even research problems are not predetermined or fixed but emerge from the research process. In this sense, grounded socio-hydrology resonates with what Isabelle Stengers calls earthly sciences, which she distinguishes from royal sciences. Where royal sciences are about literally or figuratively extracting things from their environments to understand them as distinct units, earthly sciences are "attached to the ground of memories and experiences that allow all people, including scientists, to let themselves be touched – not converted but inflected, influenced, modified – by what others deem to be important" (Stengers, 2020, p. 235). Grounding socio-hydrology, in other words, is a plea and a proposal for an approach to socio-hydrology that is less concerned with producing universally applicable models and truths, to instead engage in more modest and situated forms of knowledge-making that are fine-tuned to help solve problems as experienced by those living in a specific socio-hydrological space.

How to perform this pragmatist move towards a deeper and finer understanding of human-water interactions? Through its set of diverse papers, this SI proposes a range of possible tools, methods and ways to fine-tune socio-hydrological knowledge-making to specific situations, problems and actors. Many of the papers showcase grounded socio-hydrology as a journey involving successive opportunities to engage with people, other-than-humans, infrastructures and mineral worlds. As already done by some socio-hydrologists, several contributions to this SI highlight that actively involving users and decision-makers in data collection, interpretation and analysis is itself a potentially fruitful way of identifying pathways to solutions. It for instance helps in detecting the best leverage points for change or improve cooperation among water users while also contributing to the mobilization of support for implementing solutions (Giordano et al., 2025, this SI; Sousa et al., 2025, this SI). Anchoring the research in the concerns of those directly implicated in or affected by water problems also usefully opens the door for reflexively engaging in processes of dialogue and co-construction

(Jeanjean et al., 2023), methods socio-hydrologists increasingly use in their research. This, in turn, improves the usefulness of produced knowledges in supporting social groups to navigate their own destiny.

A review of the contributions to this SI allows discerning three important aspects of proposals to *ground* the study of human-water interactions: downscaling interdependencies; joint engagement in a place; and acknowledging power relations in relation to knowledge. By downscaling the analysis of interdependencies within social-hydrological systems, the focus of studies shifts to human-water interactions as they take place, considering local social and physical specificities to understand the dynamics conveyed by interdependencies. As doing this entails choices, *grounded* knowledges are always partial. This also mean that more than one way of knowing and understanding a problem or situation is possible. The need to remain open to stakeholders' contributions and feedbacks in the construction of knowledge, moreover, implies that *grounding* always happens in an open-ended, experimental process of joint learning in which all involved – humans and others – may change. Researchers need to nurture the reflexivity needed to navigate this process, as well as the ability to engage in joint negotiation and decision making about possible solutions and futures.

The process of *grounding* socio-hydrological knowledge making importantly rests on researchers and other knowers working together in a same field site and studying the same objects– a reservoir or a well for instance – or similar phenomena – such as the depletion of an aquifer. Spending time together – often several years – to make sense of water situations, diagnose problems or propose solutions, and fine-tune respective methods is crucial for the creation of attachments and building the trust needed to build support for problems diagnoses and create the willingness and enthusiasm to engage in solutions or become part of collective processes of transformation. Doing this is never innocent or politically neutral, which is why *grounding* involves explicitly acknowledging and navigating the power and authority relations that characterize any water problem. Differences of power and competing interests will inevitably also manifest in different ways of knowing and making sense of a particular situation, with existing hierarchies between experts and forms of expertise co-shaping whose and what knowledges are most appreciated. Cultivating critical sensitivity to such hierarchies is therefore important, as part of learning to become respectful of all knowledges whatever their discipline, status or experience with water. Unavoidable frictions between knowledges are nevertheless unavoidable, which is why learning to organize always political processes of constructive dialogue becomes itself something that socio-hydrologists need to explicitly engage in.

CRediT authorship contribution statement

Margreet Zwarteveen: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Olivier Barreteau:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Andrew Ogilvie:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Marcel Kuper:** Writing – review & editing, Methodology, Formal analysis, Conceptualization. **Jean-Philippe Venot:** Writing – review & editing, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No specific hydrological data nor code was used.

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