

## Responses to Reviewer 1

### **Response to General comment 1:**

As kindly suggested by reviewer 1, re-structuring the document and better clarification of the scientific ambition and contribution of this research at the beginning of the manuscript, will help separating the confirmation of best practices, and highlight new insights arising from this process. We have also included a new figure showing how these 5 steps are distributed in the process. In this way we also better highlight the contribution we want to make by reflecting on our own case.

To address the scientific gap, we will better explain how usually, hydrological modeling is focused on situations in which there is time and disposition for a long engagement between academia and participants, and how in this article we reflect and critically confront good practices in a conflictive situation, in order to contribute to the participatory modeling conversation. Precisely our contribution is aiming at pointing out dilemmas and limitations that result from engaging into a hydrological modeling consultancy in an aligid moment for the community. To address this comment, we have mentioned this in the Introduction, page 3: *“Best practices for participatory hydrological modeling include: Having a clear problem that all recognize and embrace; selecting an appropriate, simple, and flexible modeling tool for the question complexity, funding, and time; engaging different types of local knowledges from a diverse group of participants as early, as frequent, and as long (all stages of the process) as possible; in a neutral, transparent (in its uncertainties) and scientifically sound process that recognizes local historical disagreements; and incorporates facilitation and negotiation (Voinov and Gaddis, 2008; Voinov and Bousquet, 2010; Basco-Carrera et al., 2017). These participatory hydrological modeling recommendations are usually focused on situations in which there is time and disposition for a long engagement between academia and participants. However, as we experienced in our case, the context in which these tools are applied can deeply vary, impacting the success of these best practices and frustrating these complex science-society efforts.”*

As reviewer 1 commented, the five step-guideline may sound similar to other best practice literature for modeling in general. Although we recognize that existing literature on participatory modeling is fundamental to make several of our points, in this revised version we will better show in what points existing good practice literature does not reflect on the impact that context have in these initiatives. Although we have built from those good practice's recommendations, we also incorporated recommendations from environmental conflict literature as our context was not one for a peaceful process. In this article we reflect and critically

discuss those good practices in a conflictive situation in order to contribute to the participatory modeling conversation. Precisely our contribution is aiming at pointing out dilemmas and limitations that result from engaging into a hydrological modeling consultancy in an aligid moment for the community. What should be the role of modelers and what considerations they should have when in that situation is what this manuscript is about. In a revised version we will strengthen the context description and the key learnings from this specific process in the light of the participatory modeling literature. Also, to respond to the need to incorporate details about limitations, details of what we consider successful and unsuccessful about this experience will be reflected in the discussion.

In this version, we will also include in the Results an explanation of what happened with its application after the model was finished (2019). As we explain in the results, *“The process and model results were key to support conversations and strategies evaluation during the first year of the Collaborative meetings (2018-2019). However, other political changes and economic interests affected the internal dynamics of this collaborative group that had a short span of funding (2 years). As the model results did not necessarily validate all opinions and expectations, its usefulness was impacted by these changes. Currently, the Aculeo WEAP model is part of a new project set to estimate the ecosystem services of native forest and to analyze the exacerbated impact of climate change in the water balance due to both: changes in native forest dynamics and the basin hydrological response.”*

### **Specific comments**

**Lines 166 – 183: if the details of the model are published elsewhere, there is no need to repeat them in this paper, which focuses more on the participatory modelling experience to support science policy dialogues.**

Response Specific comment 1: We have reduced this section to the minimum referring to the published paper. However, we have remained some explanations so the process it is not completely unknown for the readers.

**Section 3.2: It is not fully clear if this should not be part of the Results, if the paper seeks to focus on the experiences with contributing to the science-policy dialogue. The iterative modelling and its steps and choices, including the listing and selection of action/strategies, then are part of the experience/result. The result is not only the model output, but also the process of dialogue about modelling questions and boundaries and elements between scientists and stakeholders.**

Response Specific comment 2: Indeed, it is difficult to structure an article that both wants to discuss the process and outcomes as part of the research results. We wanted to show the original way it was conducted in the methods, but the reflection on the dilemmas and limitations, in the results sections. In this version we have moved aspects of section 3.2. that are more related with the experience/result, to the Results (section 4), and general explanations to the Methods section 3. Section 3 now follows the 5-steps guidelines, including limitations within each step.

**Figure 2 is nice, as illustration of the types of questions and debates the model helps to address. What is not yet there (and not yet in the paper) is the final step of how the model then was used / received by the stakeholders and used to inform their policy dialogue - and if it helped them reach a decision, or not (yet).**

Response Specific comment 3: In this version, we will also include in the Results an explanation of what happened with its application after the model was finished (2019). As we explain in the results, "The process and model results were key to support conversations and strategies evaluation during the first year of the Collaborative meetings (2018-2019). However, other political changes and economic interests affected the internal dynamics of this collaborative group during the time there was funding (2 years). Furthermore, and as the model results did not necessarily validate all opinions and expectations, its value was impacted by the lobby of economic interests pushing for particular strategies. Currently, the Aculeo WEAP model is part of a new Governmental funded project set to estimate the ecosystem services of native forest and to analyze the exacerbated impact of climate change in the water balance due to both: changes in native forest dynamics and the basin hydrological response. In this project, stakeholders will play a smaller role identifying ecosystem services."

**Lines 241 - 242: How was this list of water management strategies arrived at with stakeholders? Was any used made of specific techniques that can support such an exercise with stakeholders? Or was it based on an open discussion, using whatever came up there?**

Response Specific comment 4: As we now better explain, "a list of eight water management strategies (e.g. water use by the agricultural sector), as well as four institutional support ideas management strategies were collected from the AVGC debates and extreme positions presented by the different stakeholders during those open discussions in which we were participants". That condensed list was then used for an individual interview with stakeholders from 9 groups, in order to better understand their opinions and level of acceptability of each one in an

individual and confidential conversation than the open debates. This is explained in the following sentence: “A refined list of those 12 strategies mentioned and others that are being applied in other basins were presented to 25 individuals from nine stakeholders groups participating in the AVGC process (Table 1) to elicit their interest or concerns about the strategies.”

**Section 4, end: See above. Could you add a final sub-section with the role that model results played in the stakeholder discussions?**

Response Specific comment 5: In a revised version, the role that model played in the stakeholder discussion has been included in section 4.5, step 5, communicating and discussing results. Along with that information, in this section we will further discuss one of the most complex aspects of the participatory modeling: **communication scientific information to the public.**

**Line 378 states: “when underlying conflicts may demand a more collaborative process.” – but with underlying conflicts, a collaborative process may also be more difficult? For instance, how to get all stakeholders at the table? Maybe acknowledge/reflect on this as well.**

Response Specific comment 6: Indeed, both situations are correct. The sentence now reads “From this experience, we have insights for science society initiatives involving hydrological modeling under limited information, and when underlying conflicts may demand a more cautious, but still, participatory process, to help uncover crucial elements for the modeling process success”. The paragraphs that followed have been reduced and rewritten to the key messages we want to convey to the reader.

**Lines 379 – 391: The heading: “Addressing the right question” does not seem to cover the text that follows. The text is more about the information that can be obtained from local users, but does not visibly cover the questions that are/were addressed in the participatory modelling process.**

Response Specific comment 7: The whole section has been rewritten to the key messages we want to convey to the reader: 1) Conflictive situations require facilitated participation, 2) Accepting manageable uncertainties, 3) Approaching positions have a limit, and 4) No neutral role for the hydrological model. For this purpose, we have deleted information that was not essential and kept key insights related with limitations in this type of processes.

**Line 393: It seemed surprising that Hirschmoller et al and Webler et al. would argue against making model uncertainties transparent. In the article by Hirschmoller et al I couldn't find such a finding or statement easily. Rather, I found more claims in the opposite direction, such as: "scientific uncertainty should be explicitly dealt with in the models and in the dialogue and should be processed in such a way that participants can grapple the horns of the issue." (p.67). Please check and clarify.**

Response Specific comment 8: Reviewer is correct that the way it was written was incorrectly pointing at these authors alleging for hiding uncertainties; but the purpose was to point out they discussed this subject in similar contexts. However, the whole section has been rewritten to the key messages we want to convey to the reader. For this purpose, we have deleted information that was not essential and kept key insights related with limitations in this type of processes.

**Lines 411-413: Most of the insights have appropriate references, this insight on the limits of dialogue is not referenced but is also known from prior research, especially work on the advocacy coalition framework, which also has applications in the water sector. See e.g. Weible, C. M., Pattison, A., & Sabatier, P. A. (2010). Harnessing expert-based information for learning and the sustainable management of complex socio-ecological systems. *environmental science & policy*, 13(6), 522-534. doi:10.1016/j.envsci.2010.05.005 .**

Response Specific comment 9: We thank the reference suggestion of the reviewer. This is a key point we want to transmit. Weible et al., (2010) and other references will be used to better clarify the message in the point "Approaching positions have a limit".

**Lines 437-438: How do your five steps relate to the contents and guidelines of the papers cited here and above? And what do you add, or confirm?**

Response Specific comment 10: As the reviewer suggested, the way the results will be presented helps to better discern our findings from literature review. Precisely what we want to transmit in the article is a critical review of good practices in a conflictive situation where not everything worked. We hope with this to contribute to the participatory modeling conversation.

**Line 498: Hydrological models as boundary objects is mentioned in the Introduction and again here in the Conclusion, but not in the Results section.**

**It is an important concept, with its own literature, so if you want to include it in Introduction and conclusions, please also develop it as part of the Results. Otherwise, give it less prominence in Intro and Conclusions.**

Response Specific comment 11: Although we believe linking process of modeling to achieving the co-creation of boundary objects is an important discussion, we do not have enough information for the results. Therefore, we have removed all sections mentioning this concept.

### **Technical corrections**

**Table 1: “disturbing superficial and underground water”. Is this referring to surface water or to shallow ground water? Please correct/ clarify.**

Technical correction 1: In a revised version, the sentence now reads: “distributing surface and groundwater to over 400 riverine families.”

**Line 255: Table 2 is referred to in Section 3 here, but is only shown and explained in Section 4. Please make sure to keep Table and text aligned and in the same section. If needed here, then also report Table 2 in this section. Also see above – maybe this is not the Method, but part of the Results?**

Technical correction 2: In the revised version, table 2 and its accompanying description it is only mentioned in section Results. All previous mentions have been removed.

**Line 424: Vogel et al. (2007) is quoted here, but this publication is not included in the reference list.**

Technical correction 3: The reference has been included in the bibliography: Vogel, C., Moser, S., Kasperson, R. Dabelgo, G. 2007. Linking vulnerability, adaptation, and resilience science to practice: Pathways, players, and partnerships. *Global Environmental Change* 17: 349-363.

**Line 471: Goleman (1989) is referenced here, but not included in the reference list.**

Technical correction 4: The reference has been included in the bibliography: Goleman, D. J.: What is negative about positive illusions? When benefits for the individual harm the collective. *J. Soc. Clin. Psychol.*, 8(2), 190-197, doi: 10.1521/jscp.1989.8.2.190, 1989.

## Responses to reviewer 2

### General Comments

Response to general comment Reviewer 2: As suggested by the reviewer, in a revised manuscript we will better clarify the scientific ambition and contribution of this article by framing the results using the 5-steps recommendations previously on the discussion section. We have also included in the introduction a succinct description of best-practices recommendations for participatory modeling. As we better clarify in the introduction: and mentioning the point about the main characteristic of this research that contributes to the participatory modeling and transdisciplinary science conversation. With these changes, page 3: *“Best practices for participatory hydrological modeling include: Having a clear problem that all recognize and embrace; selecting an appropriate, simple, and flexible modeling tool for the question complexity, funding, and time; engaging different types of local knowledge from a diverse group of participants as early, as frequent, and as long (all stages of the process) as possible; in a neutral, transparent (in its uncertainties) and scientifically sound process that recognizes local historical disagreements; and incorporates facilitation and negotiation (Voinov and Gaddis, 2008; Voinov and Bousquet, 2010; Basco-Carrera et al., 2017). These participatory hydrological modeling recommendations are usually focused on situations in which there is time and disposition for a long engagement between academia and participants. However, as we experienced in our case, the context in which these tools are applied can deeply vary, impacting the success of these best practices and frustrating these complex science-society efforts”*. Following, in a next paragraph we mention: *“In this article we will explore these participatory modeling best practices recommendations in a case study that was 1) not originally intended as participatory, 2) in a community experiencing conflict over an environmental catastrophe and 3) during other governmentally-lead attempts at finding collaborative solutions”*

### Specific Comments

**Line 80: In the statement “The hydrological modeling study collided and strongly collaborated with a participatory process called [...]” What does it mean to collide and to collaborate? Can a study collide or collaborate with a participatory process?**

Response to specific comment 1. Indeed. As we will better explain, although these two processes were designed to be implemented in separately, giving the level of conflict and large number of uncertainties, we saw an opportunity actively participate in the AVGC process and move towards a more transdisciplinary hydrological modeling. In a new version we use the word “coincided in time”, and later in section 3.2 we further explain: “As it was explained earlier, a Voluntary Agreement for Watershed Management process initiated at the same time as the hydrological modeling exploring the potential causes and possible solutions to restore the Aculeo Lake<sup>1</sup>. Authors of this paper were in charge of the hydrological study, but at the same time, guest participants of the AVGC discussion acting as potential academia partners for the resulting agreement. As this study was conducted independently, but simultaneously with the AVGC process, there was a synergy that resulted in increased participation in the hydrological modeling, and consideration of the model in the discussions about the lake rehabilitation measures.”

**Line 95. In the statement: “Therefore, the importance of this study to shows how to use this tool to work towards effective collaboration and mutual learning, while disseminate their usefulness for transdisciplinarity in hydrological and water resources management.” To what tool is it specifically referring to? Is there an innovation in the design of a new tool to water resources management that is being proposed?**

Response to specific comment 2: Reviewer is right that the sentence was not clear. The new paragraph reads: “This is important in Chile, as the combination of surface and underground hydrological WEAP modeling described in this article is being implemented in National watershed management to develop the first set of 101 Strategic Planning at the Watershed Level throughout Chile. Therefore, this study also contributes to show how a WEAP modelling process can also be used for collaboration and mutual learning in water resources management.”

### **Technical Corrections**

**Line 55: The following statement is not clear “Both the process and the result are connected, as the a legitimate result is part of a credible and salient science collaboration in decision making (Cash and Clark, 2001)”**

Technical correction 1: The reviewer is right that the clarity and the location of the sentence was not correct. In a new version we have changed the paragraph location and rewritten the sentence that now reads: “Both the decision context and decision

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<sup>1</sup> FIC-R 2017 BIP 40002646-0 “Caracterización del consumo hídrico y del sistema hidrogeológico en la cuenca de Aculeo, determinación de posibles soluciones y campaña de educación ambiental”.



result are connected, as a legitimate scientific product, should an outcome of a credible and salient science collaboration process (Cash and Clark, 2001). In the case of hydrological modelling, there are best practices recommendations on the level of involvement of participants in the design and testing of hydrological models (Voinov and Gaddis, 2008), that prove how process has a key role in the sense of co-authorship over the product and results of this collaboration (Basco-Carrera et al., 2017)..."

**Line 95: Correct spelling "[...] the importance of this study to shows how to use this tool to work towards effective collaboration and mutual learning [...]"**

Technical correction 2: The sentence has been rephrased to "Therefore, this study also contributes to show how a WEAP modelling process can also be used for collaboration and mutual learning in water resources management."

**Line 145 : Correct spelling "[...] we saw an opportunity actively participate in the AVGC process and move towards a [...]"**

Technical correction 3: The sentence has been rephrased to "we saw an opportunity to actively participate in the AVGC process and advance towards a more transdisciplinary hydrological modeling."

**Line 205: Correct spelling "[...] On one hand, these instances were used by the modelers (this article authors) to identify additionally questions that were pressing and causing suspicion and conflict."**

Technical correction 4: The sentence that is now in a different location, has been changed to: "These instances were used to identify additionally questions that were pressing and causing suspicion and conflict among participants, such as belief that water diversions upstream was not only illegal, but also causing the lake desiccation."