

EGUSPHERE-2024-2695. Responses to Referee Comments

This document includes responses (in blue) to comments from referee 1 (in black).

RC1

Overall Review

The authors have improved the clarity of presentation by addressing the reviewers' comments in mostly suitable ways. However, a few things still need improvement. Line numbers refer to the track change document. A major source of confusion throughout the manuscript remains: the terminology for the different types of water use is not explained clearly enough, and sometimes, the terms are still used incorrectly.

1. I suggest providing, in the introduction, the exact definition of consumptive use (the amount of water evapotranspired during use), non-consumptive use, and water abstractions/withdrawals, the sum of consumptive and non-consumptive use. "Water use" and "water demand" are only loosely defined and difficult to quantify, and should only be used in this loose or overall meaning. And please provide the definition of the latter two terms, too, as most readers might not be familiar with the exact meaning of these terms.

We agreed and have added the following text to the revised introduction:

"Water use estimates typically rely on national inventories, which are often incomplete, unavailable, or even non-existent. As a result, these datasets can carry large uncertainties in some regions, as noted by Wada and Bierkens (2014) for South America. Depending on usage characteristics within a basin, water use can be classified as consumptive, when the water is extracted and not returned to the system (e.g., due to increased evapotranspiration in agriculture or other activities), or as non-consumptive, when the withdrawn water is returned after use and thus does not significantly affect the basin's overall water balance (e.g., hydroelectric power generation)."

2. L317. Revise the newly introduced sentence as you describe later that water abstractions are taken into account, and, from the values in Table S3, I deduce that also livestock water use is rather abstractions than consumptive use. In Table S3, correctly identify which values refer to consumptive use and which to abstraction (Drinking water and livestock). Do not use the term consumption rates, but specify as abstractions or consumptive use.

As we explained in the previous revision and clarified further in the revised text, our water uses estimates are considered consumptive for most secondary sectors (manufacturing industries, mining, and livestock), following the criteria and methods of DGA (2017). In the case of drinking water, we provide a global estimate (i.e., total abstractions), while for LULUCF and energy, we account for both consumptive and non-consumptive uses.

We have added an additional column to Table S3 to clarify the nature of water use.

3. Clarify that the often-used WSI value for water stress of 0.4 refers to water abstractions, not consumptive use.

We modified the following paragraph in the revised Sect. 2.6, L373:

"The WSI, here defined as a water demand-to-availability ratio (Falkenmark and Lundqvist, 1998), depends on how both components are quantified, potentially leading to different outcomes (Liu et al., 2017a). Most previous studies using this index rely on water use estimates based on gross demand (as a proxy for total withdrawals, e.g., Vörösmarty et al., 2000; Oki and Kanae, 2006; Kuzma et al.,

2023), while others consider net demand (equivalent to consumptive use, e.g., Wada et al., 2011), or assess both measures (e.g., Munia et al., 2016). Using total withdrawals in basins with large return flows—such as in Chile, where many watersheds are modified for hydroelectric power generation—results in very high WSI values that do not necessarily reflect actual water stress. For this reason, and to preserve a water balance rationale, only consumptive uses are considered in the WSI calculation in this study."

4. In the new Table B1, FAO values may be wrongly listed as consumptive uses, as, in my understanding, FAO only provides withdrawals for the sectors domestic, industrial, and irrigation.

Yes, FAO-AQUASTAT variable names explicitly indicate that the estimates correspond to withdrawals. Accordingly, we will move them to the withdrawal row in Table B1, while maintaining drinking water as an exception, as it is considered alongside consumptive use from other sectors.

5. While it is now explained that domestic water use refers to abstractions and not consumptive use, the reasons for including abstractions and not consumptive use in the case of domestic water use, I would contend that the given arguments (no reuse possibility due to coastal discharge and laws against reuse) are also true for manufacturing and mining use.

Please refer to our response to comment #2.

State more clearly early in the manuscript that LULUCF also includes the evaporation from artificial reservoirs, and that "energy" water use refers to the cooling of thermal power plants (if correct).

This is already explained in Section 2.5 and highlighted in Section 4. To clarify further, we have modified the following paragraph in Section 2.5 (line 333):

"A third simulation was performed in the same way as ET_{FULL} but without irrigation (ET_{NI}), allowing the estimation of the ET change component driven by rainfed agriculture and forestry (the 'green' water use), as well as by modifications in water bodies—~~including hydroelectric reservoirs~~. We note that the latter includes all types of artificial reservoirs, so consumptive water use due to evaporation losses from hydroelectric reservoirs is included within LULUCF, rather than under the energy sector."

The energy sector does not refer exclusively to thermal power plants (despite the fact that consumptive use in this sector is dominated by thermoelectric facilities, as shown in Fig. 4), but includes all types of energy production, including hydroelectric (the non-consumptive component), thermal, and non-conventional renewable energy (NCRE) sources. The less intuitive choice is that evaporation losses from reservoirs are accounted for within the LULUCF sector (which is also true), because these water bodies are explicitly represented in our land cover maps.

It would be interesting to know which fraction artificial reservoirs contribute to human water use or LULUCF use in Chile; could this be distinguished, e.g., in Fig. 4b?

This would indeed be an interesting analysis for some regions with large reservoirs, and could be estimated using our methodology. However, it would require a specific simulation—one that isolates land cover changes associated only with artificial water bodies—which falls outside the scope of the present study.

Explain, at the latest in section 2.5 but better in the introduction, why you include, in total water use (line 516, Fig. 4a), only the non-consumptive uses of hydro-electricity and irrigation, but not of cooling of thermal power plants, manufacturing and mining, which also should have "major return flows" (line 317 ff).

Please refer to our response to comment #2. In our view, this work represents a substantial effort to estimate dynamic water use across Chile. As with other similar datasets, further refinements could be made to incorporate more detail. However, non-consumptive water use from the additional sectors mentioned (e.g., thermal power plant cooling, manufacturing, and mining) likely accounts for less than 1% of total water use. Neither we account for non-consumptive use from other sectors—such as aquaculture—as their contribution is not expected to significantly affect water stress in Chile.

L549: Also discuss the large discrepancies between the F. Chile (2018) and your estimates for irrigation consumptive and non-consumptive uses, which indicate large uncertainties of irrigation water use efficiencies. Explain whether and why the estimates of your study are more realistic than the values of F. Chile.

The differences in the estimates may arise from a range of factors, including the climate data, land cover data, and crop coefficients used in both studies. The scope of this work does not include a thorough comparative analysis and the attribution of causes for these differences, but rather presents them in broad terms to illustrate the uncertainty, as kindly suggested by a referee in the previous stage.

Unlike the other available studies presented in Table B1, the estimates from our study provide historical data over time, using a consistent methodology in terms of climate, soil moisture, and land cover changes. This represents a comparative advantage and helps fill a critical information gap in Chile.

Check links. For example, links to COCHILCO references do not work anymore.

Thank you. These web addresses have changed since the initial stage of the study. We have now updated the links accordingly.

Check for typos: The revisions introduced new typos, e.g., in lines 15 and 58. In Line 309, the reference to Table B1 seems incorrect.

Typo in L15 corrected. We have not found a typo in L58. Reference to table corrected. Thanks.