This study addresses the critical issue of water scarcity in the Yellow River Basin, presenting a novel and comprehensive assessment framework for analyzing water shortage. By utilizing a combination of models and statistical data, it explores the spatiotemporal changes in this severely water-deficient river basin over a span of nearly sixty years and provides insightful predictions for the future. The research question, which is a unique and crucial aspect in the field, is clearly defined, the thought process is clear, and the logical chain is complete, resulting in scientifically valuable information and conclusions. The figures are also well-designed. However, before formal publication, I have some suggestions for consideration by the authors:

Response: Thank you for your positive comments and valuable suggestions to improve the quality of our manuscript. We will make extensive modifications to our manuscript and data to make our results convincing. The detailed point-by-point responses are listed below.

R1C1: The abstract and the primary texts are too extended; it's recommended that they be simplified and the main contributions highlighted.

Response: Thank you for this suggestion. We will simplify the abstract and main body text to highlight the main findings in the revised version. For example, we will reduce the general implications of the results and some descriptions about future water use. Additionally, we will place certain figures, such as the driving factors of changes in irrigation, in the Supporting Information.

R1C2: In lines L103-L105, explicitly addressing the deficiencies in previous studies would be beneficial. For instance, what specific challenges do global water stress assessments face? This requires further clarification. Additionally, the decision not to consider upstream inflow and consumption, while not a significant issue in my view, should be explained or referenced to strengthen the paper's argument.

Response: Revised as follows:

Recently, considering quality requirements, a comprehensive series of assessments of nationwide water scarcity at multiple temporal and geographic scales has been performed in China (Ma et al., 2020a). This has markedly advanced our understanding of current water scarcity conditions. **However, upstream inflows or water consumption were usually not taken into account in most of these assessments. The neglection of upstream water availability means that downstream water stress will be overestimated (Munia et al., 2020; Sun et al., 2021).** Previous work in China showed that the difference in population affected by severe water stress was 60% with and without consideration of upstream water resources, which is even larger in northern water-limited areas (Liu et al., 20119). **Incorporating upstream flows and water consumption offers a more reasonable assessment of water stress in the real world.** Some studies have made significant progress in understanding water stress in the YRB by considering upstream components, reservoir operations, or water transfer projects (Albers et al., 2021; Omer et al., 2020; Xie et al., 2020; Sun et al., 2021). **Yet, they often covered short periods (less than 20 years), thus precluding a comprehensive documentation of the temporal dynamics of water stress.**

References:

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Liu, X., Tang, Q., Liu, W., Veldkamp, T. I. E., Boulange, J., Liu, J., Wada, Y., Huang, Z., and Yang, H.: A spatially explicit assessment of growing water stress in China from the past to the future, Earth's Future, 7, 1027-1043, https://doi.org/10.1029/2019EF001181, 2019.

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R1C3: In line L122 regarding environmental flow requirements, there has been extensive discussion of this flow rate of Yellow River from different perspectives, leading to varied estimates; you need to elaborate on how you evaluated these considerations here.

Response: Yes, we agree with you. As you stated, there are indeed many methods to calculate environmental flow requirements (EFR), such as the Tennant method (Tennant, 1976), the Smakhtin method (Smakhtin et al., 2004), the presumptive standard method (Richter et al., 2012), and the variable monthly flow (VMF) method (Pastor et al., 2014). Liu et al. (2021) reported that the impacts of different EFRs on water stress assessment are substantial in many regions but comparatively minor in areas with intensive human water use, such as Northern China and India. Pastor et al. (2014) compared and tested different calculation methods for the estimation of EFR. **They showed that the VMF method was most compatible with actual environmental water requirements,** distinguishing between low-flow (60% of a water resource allocated to EFR) and high-flow conditions (30%). **Given its performance in the seasonal assessment of water availability (Veldkamp et al., 2017), we therefore adopted this EFR method in our study.** We acknowledge that our results will depend on the chosen method to determine EFR and thus water availability. **However, finding an appropriate EFR method that determines water stress is out of the scope of this study. In the revised version, we will add the reasons why we selected the VMF method and the specific algorithm.**

References:

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Richter, B. D., Davis, M. M., Apse, C., and Konrad, C.: A presumptive standard for environmental flow protection, River Res. Appl., 28, 1312-1321, https://doi.org/10.1002/rra.1511, 2012.

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R1C4: In Figure 2 and the introduction of the study area - clarify how you distinguish between upstream and downstream regions. Or rather, readers expect an understanding of how upstream usage creates pressure on downstream resources within your study area description.

Response: The sub-basin delineation is based on the Digital Elevation Model (DEM) using the SWAT model. Additionally, we used the "Burn in" tool in the SWAT model to ensure that the generated sub-basin reaches align with known stream locations. We will add the spatial distributions of river systems and sub-basins in the Supporting Information.

R1C5: On the Yellow River, policy-making & unified dispatching already dominate human water use. In your proposed analysis framework emphasizing coordination with upstream, does such coordination significantly impact the basin system?

Response: Yes, you are right. In the Yellow River basin, policy-making and unified dispatching are critical in managing human water use. These measures ensure a coordinated approach to water allocation and use, which is essential given the river's limited and highly variable water resources. In this study, we found that upstream flows were responsible for changes in net water availability in 36%–40% of the sub-basins. In these regions, effective coordination with upstream areas can reduce the frequency and severity of water scarcity and ensure a more reliable water supply for various users. Such coordination can greatly influence the basin system by enhancing water availability, alleviating stress, and bolstering overall resilience to climate change.

R1C6: We understand that Zhou's data only went up until 2013. Still, the authors need to find ways to explain that the lack of data from the recent decade will not lead to outdated trends affecting analysis or causing bias in conclusion.

Response: As you have noted, we agree that the lack of data from the recent decade is a potential limitation of the study. In the revised version, we will try our best to collect recent data on human water withdrawals (post-2014) and meteorological data to rerun the model and conduct a similar analysis to the current study. Additionally, to accurately assess the impacts of irrigation efficiency improvements on alleviating future water stress, newly published water management policies will also be incorporated. We expect that these efforts will make the manuscript more reliable. Please also refer to our response to Reviewer 2's comments (Comments 6 and 7).

R1C7: During the discussion, it is necessary to include a comparative analysis with previous calculations using other water shortage indicators. This will highlight how the contributions of this assessment can compensate for the shortcomings of previous ones.

Response: We sincerely appreciate the valuable comments. In the current manuscript, we have already compared our findings with other similar studies in the Yellow River basin regarding water stress hotspots regions, future water demand, and drivers of changes in water stress (please see Section 4.1). **As you suggested, we will include more case studies in this basin to further strengthen our contributions.**