We wish to thank C. Scott for his constructive comments and suggestions on our paper. Our responses to the comments are presented below and we propose to make changes to the manuscript based on most of the specific comments provided (in bold)

General comments

This is an ambitious paper that seeks to integrate biophysical and human impacts on hydrological processes in the Peruvian Amazon and link these to a two-part (quantity and quality) definition of water security. It does so through application of WaterWorld, a tool that has been developed it seems largely by co-author Mulligan. The challenges identified and addressed by the paper are real, and in general terms, the methods used allow for successful development of the model runs. The manuscript makes some clear contributions to the field of modeling in data-poor environments. However, I find there are some conceptual and methodological challenges in using the model for water security assessments. The water balance and supply-demand analyses appear not to account for groundwater.

Response: groundwater is a store and in the long term the level of groundwater is controlled by the water balance. Where human water extraction is greater than recharge through the water balance, groundwater reserves are diminished. Like dams, groundwater is thus a temporary buffer against insecurity but cannot resolve insecurity in the long term. Long term insecurity (including in groundwater can be well understood from variation in the water balance). We are careful to indicate this in the description of the water security metric and will ensure that text is clearer. Moreover, little use is made of groundwater in the area (McClain et al., 2001). This is probably the result of limited access to equipment and resources to drill for it.

And the analyses of water-quality threats to water security are based on assumptions that are not verifiable (e.g., area of extractive concessions that are actually exploited, differences in downstream water-quality impacts that result from mining compared to land conversion for agriculture, etc.).

Response: The purpose of the paper is to compare the impacts of multiple possible drivers of change to see which may be more significant than others, rather than to develop predictions, we produce a set of qualitative scenarios. We will compare the exploited areas chosen here against those in heavily mined areas in the Andes/Amazon.

This limitation in itself might be remedied with a sensitivity analysis,
e.g., varying concession exploitation percentages, instead of the arbitrary definition of HF > 50%.

Response: We will show the raw human footprint numbers in addition to the population with HF>50%. Also see comment on sensitivity analysis in response to review of W. Buytaert.

However, 1) the local-scale (point discharge) to medium-scale (subcatchment accumulation) processes of water-quality impacts of land disturbance, and 2) differences in impact caused by various land uses raise questions about the validity and utility for decision-making of the water quality component.

Response: a user can set different impacts for different land uses (the intensity parameter of the model) but we have chosen not to do this. What is important at these spatial scales is the area covered by the land use in question in relation to rainfall, not the intensity of the pollution over that area since areas of coverage can vary much more than intensities of pollution and we are focusing on the long term continuous human footprint, not high intensity, low frequency pollution events.

Finally, given that exploration of scenarios, their implications, adaptive actions, etc. Is at least part of the authors' stated objectives (in the abstract and conclusions), I am struck by the apparent lack of any engagement with users, decision-makers, or other stakeholders. My sense is that this may be a stated intent for future work; however, if this is the case, then a process by which users engage with the model and its outputs should be outlined.

Response: that is not the purpose of this paper. Other papers will explore these dimensions. The purpose of this paper is to explore the relationships between multiple drivers using the model, not user interactions with the model. This will be reflected more clearly in the stated objectives.

In sum, my evaluation is that this manuscript should be reconsidered after major revisions.

Specific comments
Last parts of Introduction read too closely to the Abstract.
This will be reworded

569/25 – the following is not clear: "10 deg square tiles at 1 km2 resolution or 1 deg square tiles at 1 ha resolution". This refers to the maximum grid size; simply state WaterWorld accepts a YxY grid.
Sentence will be changed

573/8-10 – trend in temperature is per year? Increase of 2 degC over what time period?
573/19 – per year?
For the period 2000-2050, this will be added.

574/5-9 – not clear: "modelled wind driven precipitation, actual evapotranspiration and its cumulation downstream as runoff" – you are modeling ET land-atmosphere flux, cloud formation, and subsequent precipitation?
No, modelled precipitation refers to measured precipitation corrected for wind driven effects. Sentence will be altered for more clarity.

Additionally: "output generated by the wash soil erosion model and snowfall and melt water production" – I assume the output of the erosion model is sediment transport
Yes, that is correct
but is this also runoff to be combined with melt water?
The snow and ice model is a separate module and does contribute meltwater to runoff

574/15 – clarify how you separate irrigated from rainfed agricultural ET – blue from green water if you will – because your water security definition appears to be based on blue water. Alternately if you combine them, the green water is likely to very substantially dominate the water balance (sufficiency-based water security definition) in volume terms.
Our water security analysis incorporates both "colours" of water since we calculate actual ET based on the vegetation cover which reflects both rainfed ET and irrigated ET where it occurs.

574/23 – there have been water security assessments that consider groundwater
As far as we know these are not available for this region and at this scale, especially for scenario analysis

575 - The human footprint assessment of water quality (percentage of runoff generated on land upstream that has some human activity) is a very crude indicator, understandable

given the lack of information available. However, the point-source impacts of mines, oil/gas development, and urban wastewater (is any of it treated, even for urban centers?) indicates that this is a major methodological limitation of WaterWorld.
This point is unclear. How do point-source impacts indicate a methodological limitation?

I have no ability whatsoever to comment on the assumption of 10% mining conversion and 1% oil/gas conversion of concessioned area to actual exploitation. This raises further questions about the water quality component of the analyses.
No, these are indicative scenarios only aiming to represent the extreme scenarios. However, we may still be on the conservative side with these percentages. For instance, in 2009 around 10% of oil and gas concessions in the Peruvian Amazon were being exploited (Finer and Martinez, 2010)

577/13-14 – should be denoted SRES A2a scenario; warming by 2100 is relative to 2000.
Correct

577/19-20 – mean *annual* increases of 61mmyr-1 and 180mmyr-1 are impossible;
you mean 21st Century projected increases of X and Y in annual precip
These changes are not per year but over the whole 50 year period. Sentence will be changed.

578/6-10 – "nearly 45%" ... "nearly doubling" - which one do you mean? Sustained 5%/yr population growth for 60 years (1990-2050) would increase population by over 18 times; for 40 years (2010-2050) by over 7 times. Obviously sustained 7%/yr growth would increase numbers far more. Have you looked at other projections? I don't know Peru well, but many countries in the LAC region have populations that are projected to plateau within a few decades from now.

These are indicative and extreme scenarios for the purpose of comparison with other drivers. There would be little point in using population projections that had little impact. We will review the population projections relative to recent growth rates in the region to provide an indicator of their magnitude relative to recent change.

578/20 – what water storage and transfer currently exist? Your comments on 582/23 don't clarify which sub-basins are slated for infrastructure development, compared to those you are projecting will face water deficits.
This will be added

From a policy perspective, are you indicating that water storage and transfer should be expanded, or that lack of infrastructure will limit growth (or per capita water demand, ie, through different livelihood futures)?

581/5 – I assume you mean changes in the *intra-annual/seasonal* distribution of precip?
Correct, this will be added

581/14-17 – what is important is how well individual GCMs within the ensemble reproduce the climatology. Additionally, I don't know how well CIAT's downscaling accounts for Andean topography (I think this is the point you're trying to make by citing Wouter Buytaert).

Single GCM data is available within the model. However given the large uncertainty in climate projections for this region the ensemble mean is considered to be the best predictor. This discussion will be expanded on.

581/27 – not clear "brown and grey water" (mining and wastewater?)

Brown is sewage and grey is wastewater (e.g. from irrigation or industrial process/domestic use)

582/20 – 583/2 – this paragraph needs to be rewritten to better capture what I believe you are trying to say, i.e., that dams provide storage until filled with sediment; that construction of dams, road, power lines, etc. disturbs the land and generates erosion (HF impacts). "major infrastructural threats" = threats of major infrastructure?
Correct
What is it about "managed flow regulation and changes in sediment loads" (or is it sedimentation from a previous sentence?) that "could have serious implications for water quantity and water quality"?
Paragraph will be altered for clarity.

583/7 – you have made some major assumptions along the way to claim "the model includes all necessary data". And I'm not clear what "interactively" in the final sentence of the paragraph actually refers to, interactive modeling with users?

This refers to user interaction with the model. Sentence will be altered for clarity.

What would be particularly interesting here would be to actually have "non-technical users" look at WorldWater or review/discuss your outputs. I assume this hasn't been done or at least not yet in a planned fashion.

This has been done on many occasions (e.g. through workshops in Peru, Colombia, Bolivia and Ecuador). However, this is not the focus of this paper or the special issue.

You may find it useful to look at the large and expanding literature on science-policy dialogues, the use of (modeling-supported) Scenario Planning to identify critical uncertainties, etc.

Technical corrections
None – this is written very clearly.

References:

Finer, M., Orta-Martínez, M., 2010. A second hydrocarbon boom threatens the Peruvian Amazon: trends, projections, and policy implications. Environmental Research Letters, 5.

McClain, M.E., Aparicio, L.M. Llerena, C.A. 2001. Water use and protection in rural communities of the Peruvian Amazon basin. Water International (26) 3