

Reviewer comments to the manuscript HESS-2015-90 “Groundwater-dependent ecosystems: recent insights, new techniques and an ecosystem-scale threshold response” by Eamus et al.

GENERAL COMMENTS

In this paper, Eamus et al. review the last advances accounted for providing a better understanding of Groundwater Dependent Ecosystems. The review rests over three main pillars: (1) Identification of GDEs; (2) Quantification of their water requirements, and (3) Definition of response functions to water table changes. Authors refer to a relevant number of recent studies that cover a wide range of techniques based on remote sensing, hydrodynamics, and ecophysiological and dendroecological measurements. Among all these techniques, a more emphasis has been given to satellite-based or remote sensing techniques developed recently to answer the two first pillars described above.

In general, it is a good and well-written paper which addresses a relevant scientific issue within the scope of HESS. Several items refereed inside the manuscript seem to be “out of the blue” (e.g. section 5 regarding the GRACE mission). In this regard, more space could be saved in an attempt to simplify the text or, if it is preferred, to go in deep in other interesting sections, e.g.: a) adapt the text in sections 3.2.3 and 4 to the different methods implicitly suggested in table 3; b) improve the conclusions maybe suggesting a a potential roadmap of activities or items that should be addressed in the next future, and how water management boards or agencies should address this topic.

Does the paper present novel concepts, ideas, tools, or data?

Because its nature, this paper review concepts and methods previously published in scientific literature. Most of the references are appropriate and relatively new. However, the list lacks of other key references that should be recognized here.

Are the scientific methods and assumptions valid and clearly outlined?

Paper structure is improvable. A new structure is suggested to get the concordance required between the objectives depicted in Introduction and the rest of sections.

Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

Some figures and tables should be better credited. Please, put more attention to this item.

Does the title clearly reflect the contents of the paper?

Yes, but could be shortened. Maybe “Groundwater-dependent ecosystems: Recent insights and, satellite and field-based studies”

Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

Several changes are suggested in the following notes.

MAJOR COMMENTS

Structure article

In order to make easier the comprehension of the topics covered within the manuscript, several changes in the structure are suggested (sections should be in concordance with the three pillars depicted at the end of the Introduction). For example,

1. Introduction
2. Identifying GDEs
 - 2.1. Indirect methods
 - 2.2. Direct methods
 - 2.2.1. Satellite-based approaches
 - 2.2.2. Water table depth fluctuations
 - 2.2.3. Isotopic analyses
3. Quantifying water requirements of GDEs
 - 3.1. Satellite-based approaches (now section 4 and 4.2.)
 - 3.1.1. Scaling issues (now section 4.1.)
 - 3.2. Hydrological modelling
 - 3.2.1. Conceptual water balance approaches (now 6.1)
 - 3.2.2. Physically-based water balance approaches (now 6.3)
 - 3.3. Field-based measurements
 - 3.3.1. Daily fluctuations of water table (now section 6.2.)
 - 3.3.2. Isotopic techniques (now 6.4.)
4. Functional responses of GDEs to changes in water table depths
 - 4.1. Evidences from dendrochronology and plant growth traits (now section 8)
 - 4.2. Two case studies in semiarid regions (now section 7)
 - 4.2.1. The Gnangara Mound (SW Australia)
 - 4.2.2. Riparian forests in southwestern USA
 - 4.3. Integrating multiple-scale responses (now section 9)
5. Concluding remarks

In this review, section 5 focusing on GRACE measurements (and all the references inside) must be eliminated because the spatial and time resolutions of the outputs provided by this mission are not appropriate at all to infer data useful for improving our knowledge on GDEs.

In the following, major items organized according the sections suggested in this review are highlighted

Introduction

First paragraph is suggested to be reduced. Please go directly to the focus of the paper, i.e. GDEs, trying to highlight what has been done until now in order to identify them and understand their functioning. Regarding this there are similar review essays reported in scientific literature focusing on GDEs (e.g. (Barron et al., 2014; Naumburg et al., 2005; Orellana et al., 2012)). Within this framework, authors are encouraged to highlight the reasons why a new revision is required.

Regarding the potential drivers that are threatening the health and good ecological status of GDEs, authors may refer other excellent reviews recently written (see e.g. (Danielopol et al., 2003; Kløve et al., 2011a, 2011b))

The simplified classification scheme with 3 classes described in section 2 is suggested to be moved to Introduction. Authors could delete the description of the detailed classification scheme without affecting the quality of the paper (a reference to a previous work would be sufficient for the purposes of this paper)

Table 1 does not provide useful and relevant information to the topic discussed here. It is suggested to be deleted

Identifying GDEs

Indirect methods

Two interesting applications are described by Brown et al. (2011) and Howard and Merrifield (2010).

Direct Methods – Satellite-based approaches (now section 3.2.3)

Mapping GDEs based on the “green island method” or the concept of “spatial anomaly of vegetation” has been also tested by Contreras et al. (2011) in remote regions of central Argentina. Contreras et al.’s use positive anomalies of a vegetation index (VI) as surrogates of groundwater (or lateral inflow) reliance. Anomalies are spatially computed from the observed VI and a local rainfall-based expected value resulting from a regional Mean Annual Precipitation-VI function previously calibrated for a set of reference (non-disturbed) sites. In Contreras et al. (2013) the usefulness of the spatial vegetation anomaly is complemented with other seasonal phenometrics or greenness traits in order to get more accurate information on groundwater reliance patterns.

Direct Methods – Stable isotope analysis (now section 3.2.2)

Here, key references are Jobbagy et al. (2011) and Aranibar et al (2014) who use water stable and C/N isotopes to explore the reliance and dynamics of Prosopis woodlands in the Monte desert.

Quantifying groundwater consumption rates

O’Grady et al. spreadsheet tool (now section 6.1)

- For the “groundwater risk model”, it is stated that “*groundwater uptake by vegetation is assumed to occur when ET exceeds rainfall*”. Authors should question this assumption or justify better its validity. This could be assumed at the annual scale, but not at the monthly scale in which soil moisture storage may play an important role in providing water to vegetation. If this statement is not right (probably I am missing something), please explain briefly the reasons.

Sub-daily fluctuation in groundwater depth

- “White method” refers to White (1932). Please cite it. Figure 4 is not self-explanatory and is difficult to understand from who is not familiar with the method. Please improve the figure and its caption to avoid jumping to the text.

Ecological responses to groundwater table changes

Page 4715, L12-15. It is suggested that the water table depth threshold is around 9-10. However the abrupt breakpoint suggested may range between 6-10 m (no measurements exist in between).

Tables

Table 3. A lot of references inside have been not cited in the “References” section. Include studies of Contreras et al. (2011, 2013) as a “Green island method”.

MINOR COMMENTS:

- Page 4682, Line 23. Where says “Identifying the location of GDEs is the vital first step to managing them”, change by “Identifying the location of GDEs is the first requisite step to manage them”.
- P4685, L9-10. Where says “Remote sensing (RS) provides rapid and spatially extensive techniques to assess [...]”, change by “Remote sensing (RS) provides a robust and spatially-explicit mean to assess [...]”
- P4685, L11. Delete “This is now discussed” (vague sentence)
- P4686, L28 – P4687, L1-2. The relationship found by Jin et al. (2011) is not surprising at all. The two-side effect of groundwater table depth in vegetation productivity has been described widely, also in forests (Bogino and Jobbágy, 2011) and crops (Nosetto et al., 2009). Shallow groundwaters (<2 m) usually promote negative effects on growth vegetation because waterlogging or root anoxia, or salinization as Jin et al. described in his paper
- P4687, L8&9&10. “EVI” instead of “eVI”
- P4687, L24. Maybe “alternative” instead of “alternate”?
- P4688, L10. At the end of the sentence, change “drought” by “droughts” or “drought periods”
- P4689, L14. “Scaling-up” instead of “Moving”
- P4697, L22. “Fig. 3” instead “Fig. 2”. From here, all the references in the text to figures are wrong. Please check them.
- P4698, L10-11. “Local” instead of “existing”? Another key reference regarding the hydrological equilibrium hypothesis is given by Nemani and Running (1989).
- P4698, L13. Explicit which means foliar[N]
- P4700, L6. “The White method tends to over-estimate ET”. Do you mean ETg instead of ET?
- P4700, L9. “because” instead of “although”?
- P4701, L26. “HYDRUS” instead of “HYRDUS”
- P4703, L12-15. Regarding this, interesting studies have been recently published by Guevara et al. (2009)and Giordano et al. (2011)

Section 7. Is it necessary to introduce each case study describing a “problem”. I think these sentences do not add relevant information, so I suggest to delete them in both sub-sections.

P4706, L27. “Gnangara” instead of “Gnangarra”

P4708, L7. Maybe “reliance” better than “dependency”

Section 8. Maybe rename as “Effects of groundwater on growth and dendrochronological traits”

- Regarding dendroecological approaches, Giantomasi et al. (2012) provide a very interesting study in the Prosopis woodlands of the Monte desert.

P4714, L11. “observed” instead of “resultant”
P4714, L12. “Refer to...”. Move this last sentence as part of the figure caption.
P4716, L6. “Main means for” instead of “principle means of”.
P4716, L8 “methodologies which include the use...” instead of “methodologies, including use...”
P4716, L10. Delete “putatively” (not relevant)
P4716, L11. “the location of GDEs but also... features of their functional behaviour” instead of “the location but also... features of the functional behaviour of GDEs”
P4716, L12-16. This sentence is too long. Please make shorter or rephrase.
P4716, L17. “providing data on” instead of “pertaining to both”

Fig. 7 (caption). “Eamus (2006b)” instead of “Eamus (2006)”

Figure 8 (caption). “Table 5” instead of “Table four”

“References” Section

P4720L31. First author is “Doody” instead of “Doodym”

Is it possible make shorter the reference of Kattge et al. (2011)?

References used in this review

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