

Interactive comment on “Contrasting roles of interception and transpiration in the hydrological cycle – Part 2: Moisture recycling” by R. J. van der Ent et al.

R. J. van der Ent et al.

r.j.vanderent@tudelft.nl

Received and published: 9 May 2014

We thank all the referees for their careful reading of the manuscript and the constructive comments provided. We will answer all of the comments in separate responses. In this response, however, we would like to focus on the use of the term evaporation or evapotranspiration to express total evaporation. The main concern of referee #1 is the consistent use of terminology. We appreciate this comment as we also feel that is it a very important part for the readability of our paper. Specifically this referee suggests the use of the term evapotranspiration (ET) and to split that into evaporation (E) and transpiration (T). A similar remark was made by referee #3, while and referee Helge

C133

Goessling has no problems with this part of the terminology. Although we acknowledge that the terminology as such is (unfortunately) indeed being used by many people we consider the term evapotranspiration in itself redundant and confusing. We consider it more logical and elegant to split evaporation (E) into several components, of which transpiration (E_t) is one. In this reply we try to clarify why we think so and hope to convince the referees (and hopefully many others) that we should get rid of the term evapotranspiration.

Before we continue with our arguments we think it is important to have some historical context. The term evapotranspiration is a much newer term than the term evaporation. The term evaporation has existed for centuries, but the term evapotranspiration dates back only to the end of the 19th century. Unfortunately, it is not easy to pinpoint the exact inventor. Evapotranspiration became a common word in scientific literature only much later (Table 1). In the 1950s evapotranspiration appears to have had its definite breakthrough, and despite a small dip in 1980s evapotranspiration has been gaining terrain on evaporation ever since. In the early days it was only used in the context of vegetated lands and not over bare soil and water bodies. Unfortunately some people have started to use the term evapotranspiration even over the ocean.

Presumably the word evapotranspiration came into use with good intentions. Namely, to stress the difficulty of quantifying which part of the evaporation had passed through the vascular system of a plant. The sad thing about the word evapotranspiration is that it also highlights our inability to make the distinction between the productive and non-productive components of evaporation (Savenije, 2004). However, as this paper (van der Ent et al., 2014) and the companion paper (Wang-Erlandsson et al., 2014) also stress, these play a very different role in the hydrological cycle and should be considered separately.

Despite the somewhat alarming trend in the last column of Table 1, we think it would be good to realise that many giants in this field were perfectly fine with evaporation and felt no need to use evapotranspiration. When we, for example, look at the

C134

reference list of Monteith (1981), we find an impressive list of people in the evaporation camp: e.g., I. S. Bowen, J. L. Monteith, H. L. Penman, C. H. B. Priestley, R. J. Taylor, A. J. Rutter, W. J. Shuttleworth and C. W. Thornthwaite. Many standard works also simply use evaporation to express total evaporation (e.g., Maidment, 1993; Brutsaert, 2005; Gash and Shuttleworth, 2007), as do many reanalyses products, such as NCEP's CSFR (<http://rda.ucar.edu/datasets/ds093.2/>) and ECMWF's ERA-Interim (http://apps.ecmwf.int/datasets/data/interim_full_daily/). Moreover, although not specifically mentioned in the manuscript preparation guidelines of *Earth System Dynamics*, multi-letter variables such as ET are considered bad practice in many scientific journals (e.g., *Hydrology and Earth System Sciences* http://www.hydrology-and-earth-system-sciences.net/submission/manuscript_preparation.html).

Table 1. The use of evaporation and evapotranspiration in titles of scientific literature according to Google Scholar (16 April 2014).

Decade	# Evaporation	# Evapotranspiration	# ET-fraction (%)
1901-1910	98	0	0
1911-1920	173	2	1
1921-1930	208	2	1
1931-1940	404	1	0
1941-1950	416	10	2
1951-1960	1300	219	14
1961-1970	3970	630	14
1971-1980	5190	1170	18
1981-1990	6340	1800	22
1991-2000	8760	2100	19
2001-2010	12600	4750	27
2011-2014	5150	2250	30

C135

Our most important argument is, however, that evapotranspiration, from a language point of view, is imprecise and a bit awkward. Transpiration is generally understood to be the passage of water through a living body (e.g., plants), which is given off to the atmosphere as water vapour by evaporation (through the plants stomata). Thus, the process of transpiration fits perfectly into the overarching term evaporation. Therefore, the term evaporation is suitable to describe to sum of all evaporative fluxes, including that of evaporation from plant stomata (i.e., transpiration). However, the term evapotranspiration sounds rather silly over bare soil and water surfaces as the “transpi” plays absolutely no role there. Moreover, “evaporation” is perfectly understood by almost any layman, but the word “evapotranspiration” is jargon, which we think should be avoided unless absolutely necessary. Evaporation can be made into the normal verb “to evaporate”, but from evapotranspiration we get “to evapotranspire” (or is it “to evapotranspirate”?) making a non-existing verb. In conclusion, we think that “evaporation” must be considered the proper term to describe the overarching process of water going from the liquid to the vapour state and “evapotranspiration” should be deleted from our vocabulary.

References

- Brutsaert, W. H.: *Hydrology: An Introduction*, Cambridge University Press., New York, 605 pp., 2005.
- Gash, J. H. C., and Shuttleworth, W. J.: *Evaporation, Benchmark Papers in Hydrology, 2*, edited by: McDonnell, J. J., IAHS Press, Wallingford, 521 pp., 2007.
- Maidment, D. R.: *Handbook of Hydrology*, McGraw-Hill, New York, 1424 pp., 1993.
- Monteith, J. L.: *Evaporation and surface temperature*, Q. J. Roy. Meteorol. Soc., 107, 1-27, doi:10.1002/qj.49710745102. 1981.

C136

Savenije, H. H. G.: The importance of interception and why we should delete the term evapotranspiration from our vocabulary, *Hydrol. Process.*, 18, 1507-1511, doi:10.1002/hyp.5563. 2004.

Van der Ent, R. J., Wang-Erlandsson, L., Keys, P. W., and Savenije, H. H. G.: Contrasting roles of interception and transpiration in the hydrological cycle - Part 2: Moisture recycling, *Earth System Dynamics Discussions*, 5, 281-326, doi:10.5194/esdd-5-281-2014. 2014.

Wang-Erlandsson, L., van der Ent, R. J., Gordon, L., and Savenije, H. H. G.: Contrasting roles of interception and transpiration in the hydrological cycle - Part 1: Simple Terrestrial Evaporation to Atmosphere Model, *Earth System Dynamics Discussions*, 5, 203-279, doi:10.5194/esdd-5-203-2014. 2014.

Interactive comment on *Earth Syst. Dynam. Discuss.*, 5, 281, 2014.