Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2017-153-RC1, 2017
© Author(s) 2017. This work is distributed under
the Creative Commons Attribution 4.0 License.

Geoscientific Model Development Discussions

Interactive comment on "On the Predictability of Land Surface Fluxes from Meteorological Variables" *by* Ned Haughton et al.

Anonymous Referee #1

Received and published: 24 August 2017

The manuscript by Haughton et al. evaluates the use of weather data as a baseline for model intercomparison. I found the idea interesting and compelling. I have however concerns regarding the presentation, manly: - the introduction is too focused on the PLUMBER and model intercopmarison. You should cite recent (and less recent) work using weather data, such as Noihan and Mahfouf 1993, who were the first to realize that weather data can be sued to estimate surface variables and fluxes. More recently Salvucci and gentine 2013, Rigden et al. 2015, 2016 and Gentine et al. 2016 have shown the potential of using weather data to estimate surface fluxes. In addition Nearing has shown that such data is not correclty used by land surface models. I would thus reframe the introduction (and conclusion) so that it is broader (see also my annotated comments). - The results should be discussed in much more detail. I find

Printer-friendly version

Discussion paper

the discussion too fast and superficial in a few instances. Please adjust as your results are really interesting and would benefit the community. Don't take this as a negative but rather as a way to improve the message so that your paper will be more easily read, by a broader community than land-surface modelers. My specific comments are attached in the pdf.

Please also note the supplement to this comment:
https://www.geosci-model-dev-discuss.net/gmd-2017-153/gmd-2017-153-RC1-supplement.pdf

---

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2017-153, 2017.

Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2017-153
Manuscript under review for journal Geosci. Model Dev.
Discussion started: 12 July 2017
© Author(s) 2017. CC BY 4.0 License.

Geoscientific Model Development Discussions
Open Access
EGU

On the Predictability of Land Surface Fluxes from Meteorological Variables

Ned Haughton[1], Gab Abramowitz[1], and Andy J. Pitman[1]

[1]Climate Change Research Centre, UNSW Australia

Correspondence to: Ned Haughton (ned@nedhaughton.com)

Abstract. Previous research has shown that Land Surface Models (LSMs) are performing poorly when compared with relatively simple empirical models over a wide range of metrics and environments. Atmospheric driving data appears to provide information about land surface fluxes that LSMs are not fully utilising. Here, we further quantify the information available in the meteorological forcing data that is used by LSMs for predicting land surface fluxes, by interrogating Fluxnet data, and extending the benchmarking methodology used in previous experiments. We show that substantial performance improvement is possible for empirical models using meteorological data alone, thus setting lower bounds on a priori expectations on LSM performance. The process also identifies key meteorological variables that provide predictive power. We provide an ensemble of empirical benchmarks that are simple to reproduce, and provide a range of behaviours and predictive performance, acting as a baseline benchmark set for future studies. We re-analyse previously published LSM simulations, and show that there is more diversity between LSMs than previously indicated, although it remains unclear why LSMs are broadly performing so much worse than simple empirical models.

1 Introduction

Land Surface Models (LSMs) represent the land surface within climate models, which underlie most projections of future climate, and inform a range of impacts, adaptation and policy decisions. Recently, Best et al. (2015) (PLUMBER hereafter) conducted a multi-model benchmarking experiment, comparing a broad set of current LSMs to a handful of simple empirical models, at multiple sites, and for multiple fluxes. PLUMBER showed that current LSMs are not performing well relative to simple empirical models trained out-of-sample: an instantaneous simple linear regression on incoming shortwave was able to out-perform all LSMs for sensible heat prediction, and a three variable cluster-plus-regression model was able to out-perform all LSMs for all fluxes. A follow-up study (Haughton et al., 2016) ruled out a number of potential methodological and data-based causes for this result, and it remains unclear why LSMs are unable to out-perform simple empirical models.

Many of the processes involved in LSMs demonstrate non-linear interactions with other processes. It is also rarely (if ever) possible to capture enough observationally-based information about a single process, in isolation from other processes, to define clear physical relationships from empirical data for the wide range of circumstances in which we expect a climate model to perform. This problem is an example of *confirmation holism*, discussed in-depth in a broader climate modelling context in Lenhard and Winsberg (2010). On top of this uncertainty about how the system operates in a general sense, there are often

1

Fig. 1.

Printer-friendly version

Discussion paper