

Interactive comment on “Using digital image processing to characterize the Campbell–Stokes sunshine recorder and to derive high-temporal resolution direct solar irradiance” by A. Sanchez-Romero et al.

Anonymous Referee #2

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General comments

The authors present a semi-automatic method of processing CS recorder cards using an image scanner, describe a method of inferring direct solar insolation information from the scanned images and then compare those data with a reference pyrheliometer. The work is generally well written and the author's arguments are well presented. However, the sections describing the image capture method is for the most part not original and has already be described elsewhere. The scientific value of this work is in

C3007

the analysis of, and comparison between, sunshine data from co-located instruments of differing types and a pyrheliometer. The testing of a "transfer function" for obtaining values of direct solar insolation from CS recorder data is of particular value.

Specific comments

Throughout the manuscript the authors describe their method being semi-automatic despite it needing considerable manual intervention (feature location). This manual component means that the method would not be practical for the extraction of long time series that they propose in the conclusions. The image capture and processing described is a subset of that already published in Wood and Harrison (2011), and Horseman et al. (2013). The manuscript would benefit from the authors reworking section 3 to simply reference this previous work and state where their method differs i.e. the manual location of key features and omission of the rectification step. They could then expand the description of their solar insolation data extraction "thresholding" which is new. Including a figure showing the Im1 and Im2 stages and their combination would aid clarity. Similarly the conclusions should be refocused on the thresholding method, data analysis and comparisons.

The abbreviation DSI (direct solar insolation) throughout the manuscript values obtained from pyrheliometer measurement, derived from CSSR burnwidth and indirectly from CSSR sunshine duration - this can be confusing. The authors should take care to clearly indicate the origin of the DSI each time it is used, maybe using a suitable suffix.

p9542 l8 The method used by Jaenicke and Helmes also needed cloud cover data. It would be useful to mention this here. l20 see p9543:l24-27

l21 mentioning a high temporal resolution of 1h is not consistent with the resolution of 1min mentioned elsewhere - this needs clarification

p9543 l4-5 as CSSRs are affected by environmental conditions it would be useful to very briefly describe the climate of the location

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l6-11 the WMO recommend that the horizon for sunshine detectors be clear above 3 degrees above horizontal which is not true for the site used. The authors state that this is not a problem, it would be useful to explain why.

l24-27 The time period of 2 years (January 2012 to January 2014) is mentioned, but only 239 cards were analysed. It would be useful to state why only ~33% of the available cards were used e.g. lack of any discernible burn or cards were too damaged etc. This kind of information is important for building complete time series.

p9545

l7-24 this is the core of the thresholding process and would benefit from expansion, perhaps a step-by-step explanation referencing a figure

p9546

l7 the cards are described as symmetric, but Fig 2 suggests they do have a little asymmetry. Do the authors mean that the markings are symmetric about the midday marker even if the card edges are not?

l15 explain why the geometry of the Thies Clima cards is difficult

p9548

l1-5 non-solar environmental effects will also affect the SD series from CSSRs

l15 the term "SDpyr method" needs explanation here

l27 see P9549:l1

p9549

l1 it is not clear if the "latter values" means both 55W/m² and 110W/m² or just 110W/m². The correspondence between SDI and the CSSR threshold here and on p9548 needs further explanation. Have the authors considered whether the apparent difference in sensitivity between the CSSR instruments is influenced by the different

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"time to distance across the card" scaling mentioned at p9547:l9

p9550

l2-7 Was the installation and alignment of the instruments checked? The differences between instruments could also be due to simple manufacturing variation.

l7-12 It would be better to mention revised thresholds in the section regarding further work

p9551

l3 could the lag between the CSSR and DSI simply due to the inherent lag in getting the card up to charring temperature, which is also influenced by moisture and temperature.

l21-24 the meaning of this sentence is unclear, please reword

p9553

l1- The logistic curve fitting shown in Fig 6 has clear "tails". Could the authors expand upon the physical reasons for these i.e. the saturation at the upper end most likely due to their threshold method not weighting burn-through, and the sensitivity of the onset of burn to environmental factors like moisture and temperature.

l27-29 would this still be true if "burn through" could be correctly accounted for?

p9555

l10-14 this is confusing and should be reworded

l17-24 this repeats the conclusions of Helmes, Jaenicke, Kasten, Horseman etc. and doesn't relate to the detail of the manuscript - it should be removed or reworded

l25-29 it would be fairer to say that work validates the idea of constructing a long time series of DSI data from CSSR proposed by previous authors

p9556

C3010

l1-5 these useful references could be moved to the introduction (around p9540:l10) and given as motivation for examining the CSSR record.

p9569-70

Fig 6 and 7 The geometry of the cards is different for the winter, equinoctial, and summer periods, as is the environmental conditions the instruments experience. It would be useful to differentiate between results from each period, perhaps by colour-coding the points or even providing separate plots for each period. This may offer insights into the reasons for the 'tails' of the fitted functions. Although the latter option may require too much additional work for incorporation in this manuscript.

p9565

Caption, identify each model of instrument and cards shown in the image

Technical corrections

p9538

l5 remove ". Contrarily, " and run sentences together with ", but"

l7 remove semi-automatic and follow method with "of analysis is used,"

l14 re "unbiased" it is difficult to see how all bias can be removed, better to say improve estimation

l15 preface results with "experimental"

p9539

l13 replace "involve" with "are"

l14 replace "plate" with "frame"

l15 replace "metallic spherical" with "metal frame"

l17-20 mention that different designs of card are used

C3011

l23 replace "During" with "Over"

l25 remove "methods"

p9540

l1 replace "in" with "during"

l8 the meaning of "filling" is not clear in this context, do the authors mean "recording"

l29 remove "by"

p9540

l1 remove "Concretely,"

l7 insert "apparently" before "lasting"

l28 replace "of" with "to the"

p9542

l13 insert "analysis" after "new"

p9543

l1 replace "Burnt" with "Exposed"

p9544

l7 explain the abbreviation TST

p9547

l20-25 I don't think this paragraph is needed.

p9548

l9 either "after the 1960s" or "after 1960"

l19 replace "accounted" with "counted"

C3012

l26 insert "by" before "searching"
p9549
l11 remove the 's' from "advices"
p9550
l15 remove "both"
l23 replace "null" with "nil"
p9551
l17 insert "with" before "respect"
l21 replace "among" with "between"
l26 remove "their"
l27 remove "basically"
l28 remove "basically"
p9552
l3 replace "us to propose a certain" with "a"
l5 remove "too"
p9553
l6 replace "proven" with "shown"
l12 replace "of" with "about"
l13 remove "on"
l14 insert "as to" before "whether"
p9554

C3013

l6-7 reword "threshold in DSI" to "DSI threshold"
l8 remove "several"
l9 remove the 's' from "advices"
p9558
l30 page reference missing
p9559
l23 the pages for this reference are 327-331
p9560
l23 "Abridged Final Report of the Third Season"

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 9537, 2014.

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