

Review ESSS-2017-130 diurnal land-atmosphere fluxes

Link to the BACI server at BGC-Jena works well but registration step remains an unwelcome and un-necessary barrier! As I understand, ESSD advocates open 'one-click' access! Why did the ESSD publishers and editors allow these particular impediments? I want to provide an anonymous review but to see the data I must supply name and email. The system sends notice to data owner (lead author in this case), who now knows my name and email address. How does that qualify as anonymous? BACI will get more data usage and better data tracking (through Thomson-Reuters doi-based data usage tracker) if they open this up.

Interesting approach to develop a subdaily product then merge it back up to a monthly average. I definitely resonate with the file size savings: gigabytes for the former and megabytes for the latter. The ftp site has a good organization and relatively easy navigation. But see file veracity concerns below.

Overall all thorough well-organised and well-written paper describing a very useful data set. Potentially an excellent product for ESSD.

Technical issues

Page 1 line 8: technically diurnal = daytime, nocturnal = nighttime, diel = 24 hour cycle of day plus night. Here the authors - in common with many other researchers - use 'diurnal' when in fact they mean 'diel'? They use the climatological term 'diurnal cycle' to indicate a pattern that repeats daily (e.g. light-driven carbon fixation in GPP) but NEE - which includes 24 hour respiration - should properly carry the label 'diel' cycle? These authors could and should make a more precise distinction between 'diel' and 'diurnal'. Ecologists - who might represent one of the audiences for this data set - generally use the term 'diel'. Occasionally the authors use the phrase 'diurnal courses' (e.g. page 1, line 15). This reviewer does not understand that phrase, nor will readers. Suggest 'diurnal' for light-driven processes (e.g. GPP) but 'diel cycles' or 'diel patterns' for all other 24-hour cycles. Or the authors should define their use of 'diurnal' near the top of the manuscript and then follow that usage carefully throughout. Authors can substitute diel for diurnal without changing the ADC acronym.

Page 1 line 17: 'plain' half-hourly flux products. Use of the word 'plain' here implies ordinary or simple. Not an accurate reflection of your work! Perhaps 'full' or 'more extensive'?

Page 1 line 24: 'underlying observations'? Confusing. Observations underlay the eddy covariance measurements? Or the eddy covariance measurements underlay land-atmosphere interactions? Better to write 'the underlying measurements are local'

Page 2 line 2: proofed or proved?

Page 2 line 7: 'model is being applied'. Instead, 'model is applied' or 'models are applied'.

Page 2 line 9: replace 'making' with 'initial' - 'do not require initial assumptions on functional relationships'

Page 2 line 11: 'first' what? First machine learning paper? First upscaling paper? First in a series of Jung et al. 2009 papers but the reference list only shows one Jung et al. for 2009. Need clarity here!

Page 2 line 24: 'this paper' Which paper? Tramontana et al. 2016? This (current) ESSD paper? Vague language allows confusion here.

Page 2 line 30: NCEP wants their full name and location specified, at least the first time you use their acronym.

Page 3 line 2: rises or raises?

Page 3 line 4: In addition to what? Do you mean 'never the less'?

Page 3 line 5: a diel rather than diurnal cycle?

Page 3 line 11: heat 'waves'? You mean heat extremes or temperature extremes? Heat waves typically have multiple day duration?

Page 3 line 22: good explanation and justification of focus on GPP

Page 3 line 23: delete this first sentence, you don't need it.

Page 3 line 29: freely available after registration and certification. Your definition of 'freely available' does not match either ESSD or organisation (e.g. WDS, RDA) standards and expectations?

Page 4 line 1: here you clearly mean diel, not diurnal

Page 4 line 4: only achieved temporally by eddy covariance instruments and only extended spatially by deployment of those instruments on globally-distributed towers.

Page 4 line 7: 'By now, the flux towers have produced valid data for sufficient time to ... but temporal representativeness remains highly uneven'. Chu et al. 2017 indicates some risk or challenge to using flux tower data to resolve full diel cycle? Does the use of data from 222 towers somehow obviate or smooth over the factors identified by Chu et al?

Page 4 line 10: each tower has - thanks to FLUXNET standards - instrumentation and data outputs similar enough to allow each site to serve as a valid local node in a system-wide machine learning exercise? The machine learning training is not local, it requires or assumes multiple comparable sites widely distributed?

Page 4 line 13: the authors should help us understand the frequency and impact of these gaps? 20% (my best guess) due to instrument failures, power failures, data recording failures? Can the authors assure us of random gaps over the diel operation periods or do the gaps have diurnal or nocturnal dominance? If the authors want to assure on this point, e.g. that they can 'safely' ignore gaps, we need a more information.

Page 4 line 14: Table 2 of Tramontana gets cited in this ESSD paper six times, starting here. Table 2 has only a few lines and exists in a sister (Copernicus) open access journal, so why not save the reader a few moments by simply reproducing the Table and its caption here? Several of the same co-authors, permission should occur easily? You could actually save some explanatory text here before appropriately referring the reader to more details in specific sections of Tramontana (e.g. as you do in line 22).

Page 4 line 31: Here we get definition of the CRU and NCEP acronyms (even through you already used NCEP above). But CRU at Univ East Anglia UK and NCEP at Asheville or Silver Spring in USA will want their affiliations and locations listed and promoted somewhere at least once?

Page 5, section 3.1 Randomized decision tree: very good description and clear figure. No external references? We assume this section therefore comes entirely from initiative and experience of authors? Reference to other work, e.g. Breiman, appears at the start of Section 3.2, implying that these authors know at least some other uses and exploration of decision tree research and literature. We can assume the authors have saved us a lot of effort with these short clear discussions sans references?

Page 7 lines 11, 12: Here the authors must tell us - or must already have told us - how they use the term 'diurnal cycles'. Do they mean light-driven daily cycles or full 24-hour diel cycles?

Page 8 line 10: I question the use of the word 'accurate' here. Averages of repeated measurements under stable environmental conditions can improve accuracy. Averages of measurements taken over - by definition - non-stationary environmental conditions do not,

without additional thorough statistical treatment, qualify as more accurate? Mean wind and wind gust - both highly dependent on sensor averaging times - offer a good example? One could say more useful or less noisy, smoother - perhaps better suited for climatological averaging - but not necessarily more accurate without better definition of accuracy requirements? We almost never read about instrument accuracy or instrument noise on daily time scales?

Page 8 line 12: daily temporal resolution? Do the authors mean once per 24 hour time period? Two overpasses? Eight-day repeat ground tracks? I think you mean not more frequent than once per 24 period?

Figures 3 and 4 clearly show a diurnal (light-driven) cycle of GPP nested within a full 24-hour diel cycle. The authors could and should use figures like these to explain their intentions and use of terms diurnal, diurnal cycle, diurnal course, diurnal pattern. Introduction of the more accurate term diel would greatly help resolve this confusion.

In Figure 4, the vertical columns of different colors in the upper panel, derived from specific half-hour training periods in Figure 3, now go through a generalized (uniform across all 48 time periods) RDF. So the output of that RDF, the so-called second option, visualized by the downward arrows in the lower panel, should in fact apply uniformly to all 48 time periods, not to specific time periods as indicated by the dashed arrows? E.g. the RDF outcome or output in Figure 4 should look different to the outcome shown in Figure 3?

Page 9 line 16: the use of 1st diff of Rpot to distinguish rising (morning) or falling (afternoon) seems like a clever benefit of the overall Rpot approach. Did this group discover or initiate that technique? For nocturnal periods, Rpot = zero for many consecutive hours so 1st diff Rpot also zero. Here we have the basis for a definitive distinction of diurnal and nocturnal, which varies substantially with latitude and season, and which summed together give a full diel cycle. Make use of this relatively simple indicator to define diurnal vs diel?

Page 10 lines 7 to 9. Here the authors contend that, in the absence of half-hour global gridded meteorological data, the high-temporal resolution of the tower-based flux and attendant micrometeorological data can prove useful in a validation of the upscaled products. But the earlier statement about ignoring temporal gaps impinges here? If those gaps amount to 20% with a distinct diel pattern - this we don't know but presumably the authors do - then use of the flux data as a validation tool introduces additional uncertainty. Again, we don't know the quantitative impact but, thanks to the authors, we do know that temporal gaps exist. If 2%, not a problem? If 20%, the authors need to at least assure us about random (in time) occurrence? At this point we need an answer to our earlier question: should we safely ignore those gaps or not?

Page 12 Figure 5: We need definition of the location acronyms / codes used to designate individual flux tower sites on the X axis? Otherwise the reader needs to scroll through the long list of Appendix A to find 6 specific sites? CA-Man Manitoba Black Spruce DE-Hai Hainich Germany FR-Pue Puechabon IT-Cpz Italy Castelporziano US-Goo Mississippi Goodwin Creek US-Var California Vaira Ranch. If you do it for Figure 5 you would not need to do it again for Figure 8.

Because the authors use the phrase modeling efficiency in this section and across many of the sections that follow, we need a little more information about Nash-Sutcliffe? Somehow related to predictive skill (also called predictive performance), with values approaching 1 preferred? Derived from river forecasts but evidently much used for forecast evaluation in the NWP community? Statistically based or pattern based? Small amount of explanation would buttress the subsequent analysis sections.

Section 5 - very valuable. Good analysis, good figures. The identification of seasonal drought as a distinct limitation and complication seems like a very important outcome. I also like the leave-one-month-out approach, clever. Again, at the initiative of this group or did they learn that idea from some other example? They should take credit or give credit! In Figures 7, 9, 10, 11, this reviewer sees a distinct diurnal pattern of GPP nested within (and artificially centred in these plots) a repeatable 24-hour diel cycle. Presumably if we looked at NEE we would observe a different pattern, with a weaker light-synchronized distribution, extending across more or all of the full diel cycle. And just because diurnal GPP flattens or disappears in March and October (at these

exclusively northern hemisphere example sites), measurable diel patterns of soil microphysics and heterotrophy and of plant biochemistry will not have disappeared?

Data check

Using ncd4 library in R I opened one of the ADC (average diel cycle) files, extracted a month and hour time slice and plotted it (below). As specified in the netCDF file, scale = 1 and offset = 0, e.g. no scaling or offset.

This 4D file: GPP_halfhourly_monthlyADC.upscalingProduct_v1.array4D.720.360.2010.nc; with this float variable: GPP_halfhourly_monthlyADC (average diurnal/diel cycle?); at Hour = 20 (roughly 1200 local over North America or, if 20th position in the array rather than 20 UTC, 1000 local over Europe?); and Month = 6 (June).

Apologies for the weak plot. I do not claim expertise in R but I use it semi-regularly for data processing and to open and check ESSD data files of various formats. In the plot below, I have obviously preserved correct X (lon) and Y (lat). I would not have expected negative GPP values? Please can the authors check to assure that this result represents an ingest or plotting error by me and not an error in the data files. Negative values suggest that we might have an NEE rather than GPP file? If we do have a file type or data type error, the authors then need to check and verify the full set of files?

