Interactive comment on "Remote sensing-based estimation of gross primary production in a subalpine grassland" *by* M. Rossini et al.

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This is a good and solid paper that should be published. Some of the sub-sections under Results will benefit from rewriting (examples provided below). The Discussion could be compressed somewhat. Some references are missing (Cheng et al., 2010, 2011; Middleton et al. 2011âĂŤreview chapter). The following suggestions are given to assist the reader in understanding the paper. Tables: Table 1. Why are MTCI wavelengths reported to more than 2 decimal places? Please add a column (or 2) to this table for band descriptions (band center and width, mean ± FWHM; SNR if known) and whether index is computed from MODIS or MERIS band information in this paper. Table 2. this information could be moved to text in the Methods sections. I suggest the authors replace this table with a more important one that provides the

annual means for environmental conditions a tower values. Provide annual mean and a measure of variance (e.g., SD), with units used for reporting. Columns should include these headings: Year, PAR (μmol m-2 s-1), T (oC), Precip (mm), SWC (mm3 mm-3), LAImax (m2 m-2), LAImean (m2 m-2), Chlmax (μg g-1), Chlmean (μg g-1), GPPdaily EC (gC m-2 y-1), LUEmid-day (μmol CO2 μmol-1 photon), LUEg (g C MJ-1)

Table 3. Correctly identify what these variables in heading are. LAI = LAIg? Fg = FIPARg? Add units. Put sample size on next row. The second most successful variable should also be highlighted (with italics?) because all have a very close second (1: PRI667, 1. PRI645, 3. PRI667, and 4. PRI555). Table 4. Put Title at beginning of legend: Mid-day Statistical Summary. Put horizontal lines to separate model sections. Highlight the 3rd row from bottom since it, too, is really no different from the one already highlighted (row 4, M4). Then, draw a box around the "most successful of all models for this analysis (row 4, M4)âĂŤmake it stand out.

Table 5. Put Title at beginning of legend: Daily Statistical Summary. Put horizontal lines to separate model sections. Highlight the 3rd row from bottom for M4–since it, too, is really no different from the one already highlighted (row 4, M4). Then, draw a box around the "most successful of all models for this analysis (row 4, M2)âĂŤmake it stand out.

Table 6. Put Title at beginning of legend: Resampled Mid-day Statistical Summary. [Variables are mis-named here!] Put horizontal lines to separate model sections. Highlight the 3rd row from bottom since it, too, is really no different from the one already highlighted (row 4, M4). Then, draw a box around the "most successful of all models for this analysis (row 4, M4)âĂŤmake it stand out.

Table 7. Put Title at beginning of legend: Resampled Daily Statistical Summary. Put horizontal lines to separate model sections. Highlight the 4rth row from top for M4–since it, too, is really no different from the one already highlighted (3rd row from bottom,

M4). Then, draw a box around the "most successful of all models for this analysis (row 4, M2)âĂŤmake it stand out.

Figures:

Figure 1. OK. But, could you add the months below DOY on X axis, since you describe months in text, but reader will have to guess. (Prefer different order, see comment for next figure.)

Figure 2. OK, but could you add months on X axis (see fig. 1 comment above)? Prefere rewrite of figure caption.Seasonal variation of 2009 (filled circles, solid line) and 2010 (open circles, dotted line) for: (a) leaf area index, LAI (m2 m-2, mean $\pm$ SD, n=12); (b) leaf chlorophyll content, Chl (ïA∎g g-1, mean $\pm$ SD, n=12); (c) mid-day IPAR, IPARm (ïA∎mol m-2 s-1); and (d) mid-day green IPAR, (IPARg)m (ïA∎mol m-2 s-1). SD = standard deviation.

Figure 3. Use "filled circles" and "open circles", and add months to X axis. Suggest that you add vertical lines in each plot at the maximum value, which will clearly guide the reader to see the difference in the phenology related to two PRIgreen (551, 555) indices vs. the 4 other indices. I would also put ovals around the points that show clear annual differences ($\sim$ DOY 220-240 in panels b,d,g). It is worth noting that NDVI does not discriminate any annual differences, whereas the others do.

Figure 4. Add months to X axis. Add vertical lines at Max or Min values (GPP, DOY $\sim$190; LUE, DOY $\sim$225.) Seasonal variation of mid-day carbon variables in 2009 (filled circles) and 2010 (open circles: (a) gross primary productivity, GPP (ïA∎mol CO2 m-2 s-1); and (b) green LUE, (LUEg)m (ïA∎mol CO2 ïA∎mol-1 photon).

Figure 5. OK. ButâĂŤadd the two other bands used in other indices (858 and 460 nm), and link to Table 1. Add more ticks on both axes.

Figure 6. Label the two columnsâĂŤ2009 and 2010. Label rows by model. What is the black curve in (a) and (b)? Add this to caption. Add months to X axis. Redo the

caption, as per the suggestions given for previous figure captions.

Figure 7. Are these annual values? If so, add "Annual " GPP to Y axis. Annual GPP accumulated from daily GPP (g C m-2 y-1). Model results using Models 2, 3, and 4 produced results similar to those obtained from tower measurements ($\pm$??) in both 2009 and 2010. Resampled data from all 5 Models underestimated tower values in 2009, but overestimated tower values in 2010âĂŤexcept for MOD17.

Other Comments: 1] Use consistent variable names throughout (e.g., fg =fIPARg?) 2] P. 1716 (l2) should reference Joiner et al. (2010). 3] Use "nadir", not "nadiral". 4] Give units for LUEg on p. 1719. 5] Don't keep defining variables over and over (e.g., PAR). 6] What is IFOV of spectrometer at 3.5 m above surface (p. 1720)? 7] Give general form of equation IV. (p. 1722) (i.e., GPP = ε * fAPAR * PAR). 8] Give units for εmax on p. 1723 (g C MJ-1?). 9] p. 1725 (l 28) "...started to decrease earlier and showed year to year variability." 10] Redo Section 3.3. 11] p. 1726 (l 25) "...tracked GPPm quite well (delete next phrase)(Fig. 4a)." 12] p. 1727 (l 5) "...were instead correlated..." 13] p. 1728 (l 7) "..different VI contributions...(no plural for VI). Section 3.5.1. Measure time series. This is a mess! Please rewrite!!!

14] p. 1729 (l 19) "...both GPPm (Tab. 6) and GPPdaily (Tab. 7)..." (l 20) As before, ln(PAR) ... than linear PAR...improvement (delete section here) was higher for GPPm estimation. [l 23] "...in estimating resampled GPPm..." (l 24-26) Parenthses needed. "model 1 (estimating... MTCI) and model 4 (estimating...PRI555). However, Model 2 , driven...ln(PAR), (delete section here) performed better for GPPd estimation."

15] p. 1730 (l 6) "...described the seasonal dynamics..." (l 13) "...seasons (Tabs. 5 vs. 7)." (l 14) "...each model class. On days for..." (l 27) EC, GPPd, [delete] especially at..."

16] p. 1731 (l 9-12). Rewrite sentence. (l 19-20) ???? (l 21-22) "...well, MODIS bands 1 and 13, ..."

17] p.1732 (l 17-20) (delete section). "MTCI was the best predictor for both GPPm and GPPd, confirming the better performances of MTCI, with respect to EVI, in estimating GPP in grassland . . ."

18] p. 1733 (l 6-7) Edit this. "This higher efficiency at lower PAR can. . .light scattered within the canopy. . . . . .Furthermore,. . .lower PAR. . ." (l 19) Add comma. ". . .ecosystem, APARg. . ."

19] p. 1734 (l 9) ". . .inevitably provide. . ." (l 15) ". . .better understanding of the. . ." (l 23-24) "Unfortunately, the computation. . .satellite is currently ONLY feasible from the NASA Earth Exploring One (EO-1) Hyperion sensor, which is near the end of its lifetime with 12 years in orbit (launched Nov. 2000)."

20] p. 1735 (l 12-13) ". . .as an indicator for LAI. . ., the MTCI for leaf. . .PRI552 for LUEG. . ." (l 14) insert MTCI (l 19-21) Add parentheses. ". . .fAPARg (estimated. . .MRCI) and ε (as a function of PRI551);" (l 23) ". . .than those obtained from. . ."

Rewritten section, 3.3 The higher sensitivity of MRCI to chlorophyll content was confirmed by the correlation analysis. Chl was best correlated to MTCI (r=0.91, p<0.001) and two PRI indexes using red reference bands (PRI645, PRI667); the NDVI provided a lower correlation (r=0.80, p<0.01) but EVI (n.s.) was not related to Chl content (Table 3). The best index for association to LUEg was the PRI551 obtained with MODIS B4 (r=0.64, p<0.001); similar results were obtained for PRI555 with MODIS B12. Therefore, LUEg was best correlated to PRI indexes based on green reference bands (551, 555 nm), providing results $\geq$20% better than for those obtained for LUEg using the PRI indexes based on red reference bands (PRI645, B1; PRI645, B13).

Discussion: Please make a statement about the spatial resolution of actual MODIS bands (land vs. ocean bands) ranging from 250 m to >1 km. Give similar information for MERIS. How do the in situ measurements examined in this study scale up to satellite, or is this useful at all?

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