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Interactive comment on “Impacts of UV radiation on plankton community metabolism along the Humboldt Current System” by N. Godoy et al.

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Godoy et al contribute with new insights to an already open question of Solar radiation effect (in their UV and PAR spectrum) on plankton production/ respiration along Humboldt Current by using an onboard incubation procedure and oxygen comparison between borosilicate and quartz bottles of different volumes. The authors main conclusion suggested that “high increased UV levels along HCS from 54.8 S to 23.85 S may have suppressed net community production of the plankton communities, possibly driving plankton communities in the Southwest Pacific towards CO₂ sources”.

My main concern is related to the authors overestimation of negative UV effects which can not be taken as a lineal increase to latitude or even low ozone distributed levels because had not been properly showed with environmental data in this manuscript.

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Besides no comparison of solar radiation effect on metabolic response due to dose or to irradiance was assessed.

Many variations in the criteria for data collection and experimental setting may difficult to follow the conclusions specially only on UVB effect when experimental setting includes also UVA within the treatments.

Finally I am agreed with previous reviewer observations and recommendations of re-submit manuscript with more critical analysis and deep immersion on previous contributions some suggested along the text for further comparisons.

My detailed comments as follows:

In abstract Line 5 p5828 “Research has shown that phytoplankton photosynthesis can be severely inhibited by surface radiation and there are concerns that this will reduce not only algal carbon fixation, but also the carbon supply for higher trophic level.” No previous references for HCS is neither in introduction

In abstract Line 15 p5828 “Experimental evaluation of the effect of UVB radiation on surface waters, those most strongly affected by UVB, showed that UVB radiation suppressed net community production, resulting in a dominance of heterotrophic communities in surface waters, compared to the prevalence of autotrophic communities inferred when materials, excluding UVB radiation, are used for incubation. These results show that UVB radiation, which has increased greatly in the study area, may have suppressed net community production of the plankton communities, possibly driving plankton communities in the Southwest Pacific towards CO2 sources”.

Borosilicate bottles spectrum should be presented in this paper, specially if UVA is partially removed in borosilicate bottles to be compared with former experimental settings in solar radiation effects microbial metabolism developed previously at HCS.

Introduction objective lines 17-20-methods line 25 p5830 “Here we experimentally evaluate underwater UV penetration and absorption and the impact of UV radiation on NCP

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along the Humboldt Current System. We do so on the basis of measurements and experiments conducted by a meridional cruise along the Chilean coast in March 2009 from the Patagonian channels to 23.85° S (Antofagasta, Chile) on board R/V Hesperides”.

Please specify which Patagonian channel had been evaluated because recent contributions refer to solar radiation effects on channel primary production (i.e. Gonzalez et al 2010; Montero et al 2011) and formerly about respiration in low latitudes (i.e. Gonzalez et al 1998).

Introduction lines 23-25 p5830

Häder et al 2007 also highlighted another complex effects like enhancing production under normal solar radiation levels and complex photochemical effects enhanced by UVA i.e free radical formation. I believed that a very poor search on previous studies on respiration autotrophic and heterotrophic responses concerning UV specially for HCS has been made. Kindly check the suggested at the end to improve introduction starting in lines 26 p 5828 p 5829 p5830 and discussion

Methods line 1-10 p5831 Please specify criteria to select only 5m depth as surface water samples especially in Fjord where depending of location freshwater runoff can bring more freshwater and CDOM making more difficult to compare with ocean stations. Please specify how you separated the effect of use 2 methods to collect water samples pumping directly from vessels at the channels as compared with niskin sampling which might bring also more interference with acclimation and metabolic responses. In addition please clarify or include a graphic of the daily temperature variation during on deck experimental incubations vs measured irradiance along experiments due to the fact that experimental Fjord surface temperature and irradiance is not expected to be similar to the Antofagasta surface temperature and surface irradiance.

Methods line 11-24 p5831 solar radiation measurements Please change the word “incidence” for incident solar radiation. Kindly organize data presented at table 1 with the

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sensors used. As PUV 2500 poses a surface reference and downwater irradiance sensor please refer to these measurements to address comparisons also with former works developed along Chile and HCS. Finally please provide specifications of sensor calibrations and the calculation of UV index and if this could be used for comparison purposes. Finally please correct rewrite and include properly reference for Kesler 1986

Methods line 2-16 p5832 light absorption estimates Please include “Seston” into the title “Seston light absorption estimates” include references Agusti and Cruzado, 1992; Lieselotte and Dale, 1997, Bricaud and Strasmki, 1990 which are not in the reference list. Kindly explain criteria to select OD above 0.7 μm as index of seston light absorption estimates without including water absorbance estimates.

Methods line 14-16-25 p5834 metabolism measurement Kindly rewrite paragraph including a detailed explanation of the criteria for measure community respiration at 24H and how as compared with previous respiration measurements (48H) made at HCS. Please specify in a table attenuation coefficients assed by neutral density screens and temperature used for each depth used during each experimental setting and where did you incubated and obtained dark bottles (0

Methods line 4-14 p5835 UV impacts on community metabolism Specify why is not included Fjord stations for UV effects respiration measurements if 5 m stations where the only considered for this analysis. Please include criteria used different volumes shape and materials for incubation please include brand and characteristics of the filters used to exclude UV radiation or include the quartz and bosilicate transparence spectrum comparison

Results Meteorological considerations: Please include data on cloudiness and wind speed from meteorological station referred in methods and data from ozone concentrations which were mentioned in abstract and discussion.

Results line 23-25 p5835 line 1-5 p5836 Please include in figure 2 reference spectrum “a clean-water saturated Whatman GF/F filter as a blank used in order to obtain

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Seston absorption profile”. Standardize and analyze peaks heights of UV protective compounds on figure 2 with proper software (i.e. Origin). The relation with pigments presence is not well established in results or discussion Results line 5-9 p5836 Several inconsistencies are present between text, figure and respiration rates showed in results. Please look carefully especially when the treatments are mentioned Quartz bottles allow total solar radiation to pass trough (in their PAR, UVA, and UVB) and Winkler bottles were partially transparent to UV but is not specified in text. Results line 15-25 p5836 Please referred results to methods section where respiration rates under solar exposure might be compared only at 5 m depth in 8 stations? or should be referred to 3 depths for 5 stations? Authors might paraphrase these lines carefully.

Discussion line 5-7 p5837 “The waters sampled were not particularly transparent to UVB compared to the ultraoligotrophic waters in the South Pacific Gyre, where UVB was reported to penetrate down to 150m (Morel et al., 2007)” please include more studies in the area regarding water penetration along HCS and “Patagonian channels” (i.e. Montecino et al 1995, Beardall et al.,1997; Montecino 2001, Troncoso et al 2003; Lovengreen et al 2005; Huoniven and Gomez 2011).

Regarding climate Lovengreen et al has been demonstrated that High cloudiness could also enhances also to 20Discussion line 11-14 p5837 “Examination of absorption spectra by the plankton communities revealed evidence of the presence of UVB photo-protection pigments showing the peaks of absorption of micosporine-like aminoacids, as observed in plankton at areas exposed to high UVB as reported from the Southern Ocean (Karentz et al., 1991; Helbling et al., 1996; Moisan and Mitchell, 2001; Ingalls et al., 2010)”. I was not able to see clearly the presence of the pigments peak for specific MAAS for seston samples and what about water absorbace? Is the same for Fjord that for open ocean in front of upwelling zones of Concepcion and Antofagasta? in figure 2 please clarify and include references regarding pigments or MAAS detection along HCS which had been already published and used to define biooptical properties (i.e. Montecino et al 2004).

Discussion line 17-19 p5837 “The metabolic rates observed were within average values reported for the ocean (Robinson and Williams, 2005), and indicated that the area sampled was not exceptionally productive at the time of the study”. Please include more specific references regarding productivity extensively published for HCS (i.e. Cuevas et al 2004, Eissler et al 1999,2010; Anabalon et al 2009). Even more plankton metabolism is classical approach but include also heterotrophic respiration coming from bacteria and Archea please include references for heterotrophic metabolism as Molina et al 2010; Hernandez et al 2006, 2007.

Discussion line 19-20 p5837 “All stations occupied had autotrophic plankton communities when incubated in glass, as has been done in the past. However, plankton communities are exposed to UVB in nature, so that assessments of metabolic rates in glass material overlook the effect of in situ UVB levels on metabolic rates. Indeed incubation in glass material removes the incidence of in the water column, whereas the results derived from incubation of the community in quartz better represents the metabolic rates under the light field in situ, which includes significant UVB levels”

Authors need to be more critic regarding the wide variability of their experimental design and be aware of correct the misinterpretation of their results regarding UVB effect due to the fact that Winkler bottles might have also partially UVA transparency. More comments on the effects of vertical mixing, seasonality of air masses with low ozone stratospheric ozone and comparisons with other contributions along Chile and HCS will be needed.

Discussion line 25-27 p5837; line 12-19 p5838 Exposure of surface (5 m) communities to UVB radiation, greatly reduced NCP in all but one community and rendered all, except one of the communities investigated heterotrophic”; “Our results show, therefore, that the penetration of UVB radiation increases towards the Equator along the Humboldt Current System, affects the communities located in the upper layers of the water column. In experimental evaluation of the effect of UVB radiation in surface waters, those most strongly affected by UVB, showed that UVB radiation strongly sup-

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pressed net community production in most communities, resulting in a dominance of heterotrophic communities in surface waters, compared to the prevalence of autotrophic communities inferred when materials excluding UVB radiation are used for the incubation”

There is already known that even under normal levels microbial community can be impaired under solar radiation, Hernandez et al 2007 demonstrated for south central Chile high inhibition under PAR levels for bacterial secondary production specially for surface water as compared with waters coming from AESS.

It is important to point out that previous research has been assessed trying to deval what is the role of plankton respiration Please see recommended references for further details Bacterial metabolism related to the classical respiration

Regarding references many references that cite UV effects on microplankton, phytoplankton bacterioplankton should be taken in to consideration. I suggest the authors kindly check the following references as a start

• http://rchn.biologiachile.cl/pdfs/1998/4/Gonzalez_et_al_1998.pdf <http://www.nrcresearchpress.com/doi/abs/10.1139/f96-320> <http://www.sciencedirect.com/science/issue/5928-2011-999689996-2888776> <http://plankt.oxfordjournals.org/content/21/12/2263.full.pdf> + <http://plankt.oxfordjournals.org/content/21/12/2263.full.html> Anabaln, V., Morales, C.E., Escribano, R., Varas, M.V., 2007. The contribution of nano- and microplanktonic assemblages in the surface layer (0–30m) under different hydrographic conditions in the upwelling area off Concepcion, central Chile. *Progress in Oceanography* 51: 414-444. Cuevas, L.A., Daneri, G., Jacob, B., Montero, P., 2004. Microbial abundance and activity in the seasonal upwelling area off central Chile: a comparison of upwelling and non-upwelling conditions. *Deep-Sea Research II* 51, 2427–2440. • Daneri G, V Dellarossa, RA Quiñones, B Jacob, P Montero O Ulloa. 2000. Primary production and community respiration in the Humboldt Current System off Chile and associated oceanic areas. *Marine Ecology Progress Series* 197: 41-49. • Diaz, S., Camilión, C., Deferrari, G., Fuenzalida,

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H., Armstrong, R., Booth, C., Paladini, A., Cabrera, S., Casiccia, C., Lovengreen, C., Pedroni, J., Rosales, A., Zagarese, H., Vernet, M., 2006. Ozone and UV radiation over Southern South America: climatology and anomalies. *Photochemistry and Photobiology* 82 (4), 834–843. â€” Eissler, Y., Letelier, J., Cuevas, L.A., Morales, C.E., Escribano, R., 2010. The microbial community in the coastal upwelling system off Concepci3n, Chile, 36°S, 2002-2003 period. *Revista de Biolog3a Marina y Oceanograf3a* 45(1), 1-18. â€” Hern3ndez, K.L., Quiñones, R.A., Daneri, G., Helbling, E.W., 2006. Effects of solar radiation on bacterioplankton assemblages from the highly productive system off Central-South Chile. *Marine Ecology Progress Series* 315, 19–31. â€” Hern3ndez, K., Quiñones, R., Daneri, G., Farias, M.E., Helbling, E.W., 2007. Solar UV- solar radiation modulates daily production and DNA damage of marine bacterioplankton from a productive upwelling zone (36°S). *Journal of Experimental Marine Biology and Ecology* 343 (1), 82–95. â€” Iriarte, J.L., Gonz3lez, H.E., Nahuelhual, L., 2010. Patagonian Fjord Ecosystems in Southern Chile as a Highly Vulnerable Region: Problems and Needs. *AMBIO: A Journal of the Human Environment* 39(7), 463-466. â€” doi: 10.1007/s13280-010-0049-9. â€” Lovengreen, C., Fuenzalida, H., Videla, L., 2005. On the spectral dependency of UV radiation enhancements due to clouds in Valdivia, Chile (39.8°S). *Journal of Geophysical Research* 110, D14207. doi:10.1029/2004JD005372. â€” Molina, V., Belmar, L., Ulloa, O., 2010. High diversity of ammonia-oxidizing Archaea in permanent and seasonal oxygen-deficient waters of the eastern South Pacific. *Environmental Microbiology* 12(9), 2450-2465. â€” doi: 10.1111/j.1462-2920.2010.02218.x â€” Montecino, V., Astoreca, R., Alarc3n, G., Retamal, L., Pizarro, G., 2004. Bio-optical characteristics and primary productivity during upwelling and non-upwelling conditions in a highly productive coastal ecosystem off central Chile (36°S). *Deep Sea Research II* 51(20-21), 2413-2426. â€” doi: 10.1016/j.dsr2.2004.08.012â€” Morales, C.E., 2008. Plankton monitoring and analysis in the oceans: capacity building requirements and initiatives in Latin-America. *Revista de Biolog3a Marina y Oceanograf3a* 43(3), 425-440. â€” <http://www.revbiolmar.cl/resumenes/v433/433-425.pdf> â€” Pav3s, H.J.,

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González, H.E., 2008. Carbon fluxes within the pelagic food web in the coastal area off Antofagasta (23°S), Chile: The significance of the microbial versus classical food webs. *Ecological Modelling* 212(3-4), 218-232. doi: 10.1016/j.ecolmodel.2007.10.004

Stuart, V., Ulloa, O., Alarcón, G., Sathyendranath, S., Major, H., Head, E., Platt, T., 2004. Bio-optical characteristics of phytoplankton populations in the upwelling system off the coast of Chile. *Revista Chilena de Historia Natural* 77(1), 87-105. doi: 10.4067/S0716-078X2004000100008

Troncoso, V.A., Daneri, G., Cuevas, L.A., Jacob, B., Montero, P., 2003. Bacterial carbon flow in the Humboldt Current System off Chile. *Marine Ecology Progress Series* 250, 1-12. doi: 10.3354/meps250001

Van Wambeke, F., Obernosterer, I., Moutin, T., Duhamel, S., Ulloa, O., Claustre, H., 2008. Heterotrophic bacterial production in the eastern South Pacific: longitudinal trends and coupling with primary production. *Biogeosciences* 5, 157-169. doi: http://www.biogeosciences.net/5/157/2008/

Finally take into account that 5 references are cited in the text and not are in the reference list kindly check.

Interactive comment on *Biogeosciences Discuss.*, 8, 5827, 2011.

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