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Interactive comment on "Ocean acidification modulates expression of genes and physiological performance of a marine diatom" *by* Y. Li et al.

Anonymous Referee #1

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General Comments: This paper focuses on the effects of changing light and CO2 on diel gene expression of key metabolic genes in the model diatom Phaeodactylum tricornutum. The work is motivated by a desire to better understand the effects of climate change drivers (higher CO2, higher mixed layer irradiances) on diatoms in the ocean. In addition to dramatic diel changes in the expression of many genes, this work documents significant effects of both CO2 and light on the expression of certain genes. Given the amount of work that has been done on climate change effects on diatoms there has been surprisingly little work on gene expression and so this work does fill a gap there. However, gene expression is only relevant if interpreted in the context of the overall physiological response of the diatom to changing environmental variables, and in particular if it helps explain biogeochemically relevant responses such as changes in growth rate, nutrient uptake, etc. Here the gene expression data is interpreted in

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a piecemeal fashion, and while there is an attempt made to connect the response of individual genes to particular physiological responses (e.g. changes in Lhcf3 to NPQ responses) there is no holistic interpretation of the data. Finally the experimental design, which includes rapid, large changes in CO2 and light intensity applied for short duration, is problematic since the research aims to address climate change variables that will develop gradually and persist. The treatments are only applied for several days and so the cells are not likely to have acclimated to the new conditions. Lack of acclimation is clear in the gene expression data.

Specific Comments: 1. P 15813 line 10. Were the outdoor incubators screened or exposed to full sunlight? A shift from 130 umol photons m-2 s-1 to full sunlight is quite severe and certainly more extreme than would be expected under climate change scenarios. 2. P 15818 line 18. Upregulation of nitrite reductase at high CO2 is in contrast to a down regulation of nitrate reductase (gene and activity) at high CO2 in T. pseudonana as found by Shi et al. LO 60 1805-1822. While these are different genes, nitrite reductase is part of the nitrate acquisition pathway and so presumably reflects activity of this pathway. It is interesting to see such different responses between diatom species. 3. P 15818 line 23 – P 15819 line 2. It would be worth exploring the contrast between the previous study, which indicated the combination of high CO2 and high light was detrimental to growth, and the present study further. In particular what were the light levels in the current and previous study and how might that explain the differences in the finds. 4. P 15819 lines 3-12. The authors attribute previous inconsistencies in the connection between CCM downregulation and enhanced growth at high CO2 to differences in growth irradiance among experiments. However, the current data would argue against that as similar effects of CO2 on both the CCM and growth are observed at dramatically different light levels.

Technical corrections: 1. p 15814 line 4. Should read “relative electron transfer rate”.

Interactive comment on Biogeosciences Discuss., 12, 15809, 2015.