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Bio-optical feedbacks in the coupled climate system of the tropical Pacific

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This study investigates the effects of biologically induced radiant heating in the tropical Pacific using a fully coupled ocean-atmosphere model including sea ice and marine biogeochemistry models. After 200 years of simulation, the model appears to have internally adjusted and it is compared with another 200 year physics-only experiment. The presence of biology does not appear to change El Niño-Southern Oscillation variability in a significant manner. However the difference between the biology and the physics-only experiments shows that a thermal and dynamical response involving a feedback with the atmosphere occurs over the whole tropical Pacific. In the east, a biologically induced increase of subsurface temperatures in off-equatorial latitudes enhances the meridional tilting of the mixed layer depth, which accelerates surface westward currents through geostrophic adjustment. In the cold tongue region sea surface temperatures in the biology experiment are slightly lower (about 0.2 ºC) with respect to the physics-only experiment because of increased upwelling. In the western Pacific, the biological heating effect causes instead a slight increase in sea surface temperatures; this in turn is associated to westerly wind stress anomalies and to enhanced precipitation. By means of a heat budget analysis, we observe that dynamical feedbacks in the atmosphere and ocean appear to partly counterbalance the heating effect due to biology.