EUCFe cruise report
19 May 2008
Lance (onboard) and Barber:

I. C-14 On-deck primary productivity (PP)

Primary productivity was measured in support of three aims: 1) to provide measurements in context with the degree of influence from the Equatorial Undercurrent; 2) to provide additional observations in this relatively undersampled region of the central and western equatorial Pacific and 3) to provide ^{14}C uptake rates for normalizing other nutrient uptake and/or growth rates measured during the EUCFe cruise. Samples were collected from Niskin bottles fitted with silicon tubing closing mechanisms (to minimize trace metal contamination) and mounted on a profiling CTD package. Samples were collected at most stations at any time of day from 6 depths from surface to the 0.1% light depth which was generally about 125 m. Samples were inoculated with ^{14}C tracer and incubated for 24 h in on-deck incubators shaded with blue sheet filters and neutral density screening to simulate 6 *in situ* light levels and temperature-controlled with flowing surface seawater. Samples were filtered through Gf/f filters (nominal pore size ~0.7 μm) to give "total" primary productivity and on some occasions through polycarbonate filters (2 and 5 μm pore sizes) to give size-fractioned primary productivity which gives the proportion of primary productivity by 3 operationally defined size classes (picoplankton gff to 2 μm; nanoplankton 2 to 5 μm; and microplankton >5μm). "Total" PP profiles were measured at 27 out of 30 stations. The final 3 coastal stations were not sampled due to time constraints of completing measurement protocols and securing all ^{14}C activity before arriving at port. Optimal PP (P_{OPT}) values are the maximum PP within a given water column profile and often found at or near the surface except in cases where PP may be photoinhibited by high light conditions. P_{OPT} ranged from about 0.14 to 2.0 mmol C m^{-3} d^{-1} and were generally found at the 50% light level. Areal primary productivity (PP_{EU}) is volumetric PP integrated to the 0.1% light level. "Total" PP_{EU} ranged from 5 to 79 (mmol C m^{-2} d^{-1}) (Fig 1a). Size-fractioned PP profiles were measured on 20 of those 27 "total" PP stations. Microplankton, nanoplankton and picoplankton were responsible for approximately 61-92%, below detection-12% and 6-31% (respectively) of PP_{EU} at those stations (Fig 1b and c).

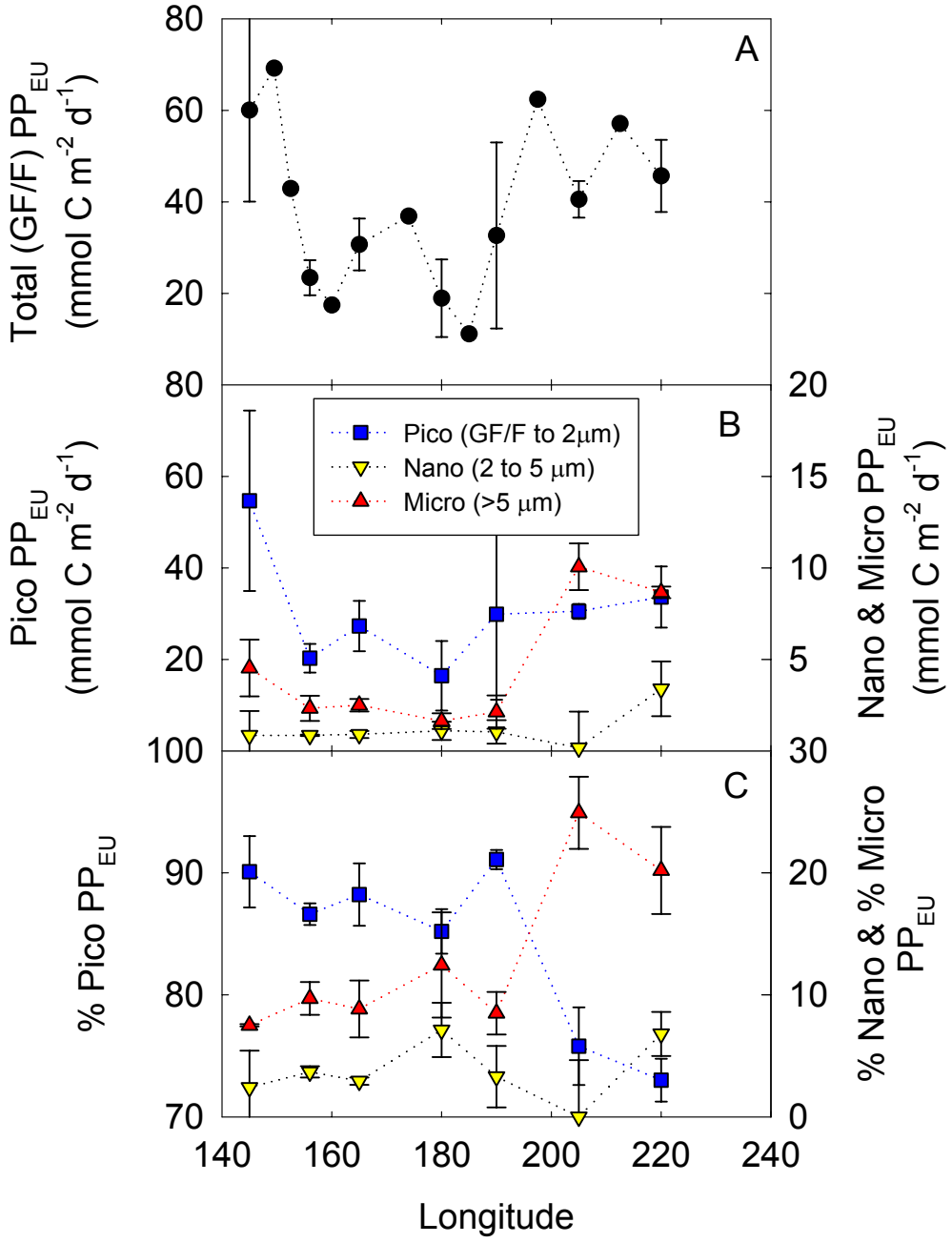
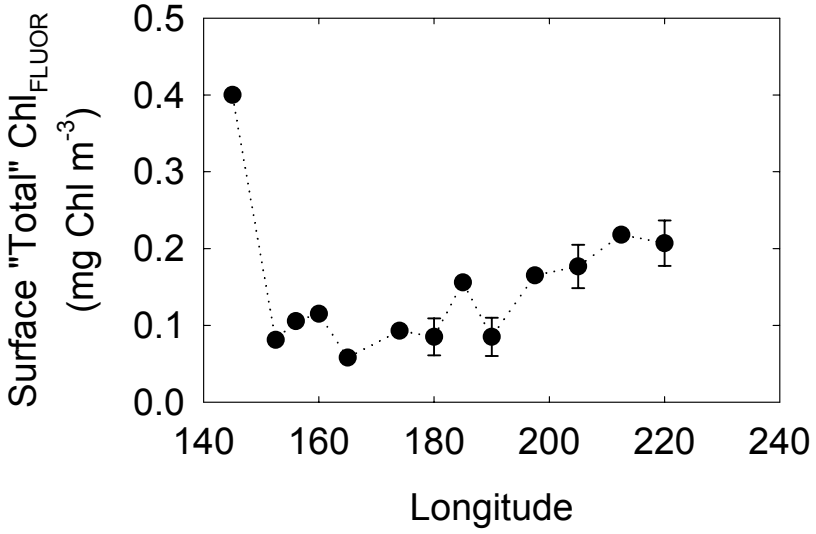


Figure 1: Areal primary production integrated to the 0.1% light depth. Values are means of stations at given longitude. Error bars are standard errors of the means. (A) "Total" PP_{EU}; (B) Size-fractioned PP_{EU}; (C) Percentage of total PP_{EU} contributed by operationally defined pico, nano and microphytoplankton size fractions (see text).

II. Fluorometric Chlorophyll a (Fl-Chl)

Fluorometric chlorophyll was measured to provide concentrations of chlorophyll biomass. Profile samples were collected at most stations often from two casts per station but at least from 6 to 12 depths from surface to ~ 200m. Samples were filtered onto Gf/f filters (nominal pore size ~0.7 μm) and on some occasions through 2 and 5 μm pore-sized polycarbonate filters (both serial fractionation and parallel filtration/subtraction methods were used on various sampling occasions) and extracted in 90% acetone for at least 24 h (but not more than 30h). Near surface Fl-Chl ranged from about 0.05 to 0.2 mg m^{-3} along the equator with a much higher value of 0.4 mg m^{-3} at station 26 (Fig Y).



III. High Pressure Liquid Chromotography pigment analysis (HPLC):

About 50 HPLC pigment samples were collected at 16 stations which were a mix of day and night CTD casts from 3 depths (generally 5, 25 and 75m which approximately corresponded with near surface, 50% light depth and the depth of the deep chlorophyll maximum). Samples were collected from the CTD rosette into 2L amber Nalgene bottles and were filtered onto Gf/f filters and stored in a -70°C freezer for later analysis of suite of phytoplankton pigments. Samples will be analyzed at University of Hawaii by the analytical staff of the Robert Bidigare lab.

IV. Phytoplankton Absorption (A_{ph}):

About 50 A_{ph} samples were collected at 16 stations which were a mix of day and night CTD casts from 3 depths (generally 5, 25 and 75m which approximately corresponded with near surface, 50% light depth and the depth of the deep chlorophyll maximum). Samples were collected from the CTD rosette into 2L amber Nalgene bottles and were filtered onto Gf/f filters and stored in a -70°C freezer for later spectrophotometric analysis. Samples will be analyzed at University of Hawaii, Zackary Johnson lab. These observations will be used in conjunction with HPLC samples for various model relationships and also used with the photosynthesis vs. irradiance experiments described

below in the determination of the quantum yield of photosynthesis, in other words, the number of moles of carbon fixed per mole quanta (light) absorbed.

V. Photosynthesis vs. Irradiance (PE) experiments:

About 50 PE experiments were performed at 16 stations which were a mix of day and night CTD casts from 3 depths (generally 5, 25 and 75m which approximately corresponded with near surface, 50% light depth and the depth of the deep chlorophyll maximum). Samples were collected from the CTD rosette into 20 mL acid-washed plastic scintillation vials, inoculated with ^{14}C tracer, incubated for 2 h in 3 photosynthetrons which contained 12 light chambers each. The 12 light chambers were screened to provide a range of light conditions necessary to observe both the light limited potential ^{14}C uptake rate (α^B) and the light saturated ^{14}C uptake capacity (P^B_{max}). After incubation, the samples were filtered onto Gf/f filters, acidified and analyzed with an onboard liquid scintillation counter similar to methods described for PP analysis above. These observations will be used in conjunction with the A_{ph} samples described above in the determination of the quantum yield of photosynthesis, in other words, the number of moles of carbon fixed per mole quanta (light) absorbed.