To investigate the importance of equatorial and near-equatorial regions, three additional coupled simulations were run for 100 years to determine the shortwave absorption profile. In a second simulation (Blue), chlorophyll-a is coupled to the atmosphere, land and ice components used in the GFDL global coupled climate model [Delworth et al., 2006] in which aerosols and greenhouse gases are held constant, such that the meridional resolution is 3.8 at the equator. The ocean mixed layer is represented with a refined, bulk mixed layer model [Hallberg, 2003]. HMM is run coupled to the atmosphere, land and ice components used in the GFDL global coupled climate model (Delworth et al., 2006).

We use the model for shortwave penetration into the water column proposed by Manizza et al. [2001] which is based on the data of Morel [1988]. The scheme parameterizes shortwave extinction in terms of near-surface chlorophyll-a concentration. It is consistent with the Morel [1988] scheme at the lower limit of its validity. The Manizza scheme has a deeper clear water reference than previous algorithms, resulting in shortwave extinction heating at depths well beyond 100 m. This heating becomes significant when integrated over decades and larger timescales.

Five global simulations are run using the simulation protocol for the 1990 control runs with the GFDL coupled climate model [Delworth et al., 2006] in which aerosols and greenhouse gases are held constant. Initial conditions for all coupled simulations are identical and are based on those described in Delworth et al. [2006]. One simulation (Green) uses the SSWFS monthly composite chlorophyll-a figure 1996-2004 to determine the shortwave absorption profile. In a second simulation (Blue), chlorophyll-a is set to zero to emulate the absorption profile of optically pure water. These experiments were run for 100 years long enough to establish surface biases (Gnanadesikan et al., 2006).

To investigate the importance of equatorial and near equatorial regions, three additional coupled simulations were run with modifications to the GFDL chlorophyll-a monthly mean concentrations. We run one where chlorophyll-a concentrations falling between latitudinal bands 5 S and 5 N in the Pacific are set to zero (Noequ), a second where chlorophyll-a concentrations falling below 0.2 mg/m3 in the Pacific are set to zero (Minus0.2), and a third where concentrations above 0.2 mg/m3 are set to zero (Plus0.2). (Fig. 1b). The wind response to SST anomalies is explored in Figure 7. Shown is the detrended SST (normalized to unit amplitude). While there are subtle differences, the overall character of the ENSO appears the same. The changes in variability do not appear to be a result in a change in SST spatial response.