Title: Effect of light on N₂ fixation and net nitrogen release by Trichodesmium in a field study

Abstract. Dinitrogen fixation (NF) by marine cyanobacteria is a crucial pathway to replenish the oceanic bioavailable nitrogen inventory. Light is the key to modulate NF, however, field studies regarding light response curve (NF-I curve) of NF rate and the effect of light on diazotroph derived nitrogen (DDN) net release are missing that may relatively sparse in the literature hampering an accurate nitrogen model prediction by the models. Uncontaminated ¹⁵N₂-gas A dissolution method was applied using uncontaminated ¹⁵N₂ gas to examine how the light changes may influence the NF intensity and DDN net release in the oligotrophic ocean. Experiments were conducted at stations with diazotrophs dominated by filamentous cyanobacterium Trichodesmium spp. in the Western Pacific and the South China Sea. The light effect of light on carbon fixation (CF) was measured in parallel using the ¹³C labelling tracer method specifically for a station characterized by Trichodesmium bloom. Both NF-I and CF-I curves showed Ik (light saturation coefficient) range of 193 to 315 μE m⁻² s⁻¹ with saturation light saturation at around 400 μE m⁻² s⁻¹. The proportion of DDN net release ranged from ~6% to ~50% revealing suggesting an increasing trend as the light intensity decreased. At the Trichodesmium bloom station, we found CF/NF ratio was light-dependent and the ratio started to increase as light was lower than the carbon compensation point of 200 μE m⁻² s⁻¹. NF pathway was most likely preferentially blocked under low light to conserve energy for photosynthesis, thus, there is a metabolism tradeoff between carbon and nitrogen fixation pathways under light stress. Results showed that short-term (<24h) light change modulates the physiological state, which subsequently determined the C/N metabolism and DDN net release of field by Trichodesmium. Energy Reallocation of energy associated with the variations of field in light intensity would be helpful for model prediction of global biogeochemical cycle of N by models involving Trichodesmium bloom.