Photosynthesis, Earth System Models and the Arctic

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The primary goal of Earth System Models (ESMs) is to improve understanding and projection of future global change. In order to do this they must accurately represent the huge carbon fluxes associated with the terrestrial carbon cycle. Photosynthetic CO_2 uptake is the largest of these fluxes and is well described by the Farquhar, von Caemmerer and Berry (FvCB) model of photosynthesis. Most ESMs use a derivation of the FvCB model to calculate gross primary productivity (GPP). In ESMs, parameters associated with modeling photosynthesis are usually fixed for a given plant functional type (PFT) and in many cases, fixed for all vegetation. Although Arctic GPP is a small flux relative to global GPP, uncertainty is large. Only four ESMs currently have an explicit Arctic PFT and the data used to derive Arctic specific traits in these models relies on small data sets and unjustified assumptions. Focusing on species representing dominant vegetation and key Arctic PFTs growing on the Barrow Environmental Observatory, Barrow, AK we are investigating key model assumptions and parameterization associated with modeling photosynthesis in the Arctic, and also advancing process knowledge in areas that are not yet represented in models.