NAME: Anthony Walker
ORGANIZATION: Oak Ridge National Lab
PROGRAM AFFILIATION: TES
ABSTRACT TITLE: FACE experiment model inter-comparison synthesis.

ABSTRACT: A wealth of data on forest ecosystems have been gathered at free-air CO_2 enrichment (FACE) experiments. The spatial and temporal scales over which these data were collected make the FACE experiments ideally suited for comparison with terrestrial biosphere models (TBMs) and in this study we simulate the Duke and Oak Ridge forest FACE experiments with a suite of 11 TBMs.

Introducing confidence intervals to model-to-observation goodness-of-fit (GOF) metrics demonstrated that only a single model (which was heavily parameterised) was a statistically better predictor of annual net primary production (NPP) under ambient CO_2 than the mean of those observations. However, many more models captured a significant level of the inter-annual variability in NPP and the reason for the poor comparison with the observed mean as a predictor was either due to a positive magnitude bias or a lack of sensitivity to drivers of inter-annual variability (low sensitivity bias).

We advocate a diagnosis of the under-lying causes of differences between the models, followed by assessment of these competing model structural assumptions (hypotheses) in the context of observed/experimental data. Applied to the simulation of leaf area index (LAI) the competing hypotheses represented by the model structural assumptions are classified by their partitioning of leaf carbon (fixed-scaling, pipe-model or optimisation) and leaf growth and litterfall phenology (none, active, multi-phase).

Poor reproduction of the evergreen seasonal LAI cycle demonstrated that fixed-scaling or the pipe-model without active litterfall phenology were inconsistent with the observed data. A major difference between the various modelling methods was the timelag between carbon assimilation and incorporation into leaf growth and the timing of the determination of LAI (instantaneous or a seasonal delay). Observations potentially support the pre-determination of a 'target' LAI although further research needs to be done to understand the underlying determinants of LAI versus the constraints on LAI.