GRENE-TEA Model Intercomparison Project (GTMIP): Stages 1 & 2

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As part of the terrestrial branch of the Japan-funded Arctic Climate Change Research Project (GRENE-TEA), which aims to clarify the role and function of the terrestrial Arctic in the climate system and assess the influence of its changes on a global scale, this model intercomparison project (GTMIP; Miyazaki *et al*. 2015) is designed to (1) enhance communication and understanding between the modelling and field scientists and (2) assess the uncertainty and variations stemming from variability in model implementation/design and in model outputs using climatic and historical conditions in the Arctic terrestrial regions. This project is comprised of Stage 1 (site scale) and Stage 2 (pan-Arctic scale).

The Stage 1 is site simulations driven by statistically fitted data created using the GRENE-TEA site observations for the last 3 decades (Sueyoshi *et al*. 2015). The target metrics for the model evaluation cover key processes in both physics and biogeochemistry, including energy budgets, snow, permafrost, phenology, and carbon budgets. Analyses have been conducted on these metrics (e.g., annual mean latent heat flux, annual maximum snow depth, gross primary production, and net ecosystem production) for inter-model and inter-site differences to delineate the inter-dependence among the key processes and provide cues for improving model performance. Also, the cause or attributes of the differences among models, or between models and observations, will be explored by employing statistical evaluations such as multivariate analyses and time series analyses on the metrics and individual eco-climate variables. This will improve understanding of the interrelation between the incorporated processes in each model. Figure 3 shows an exemplary comparison of a seasonal transition in the snow–permafrost–vegetation subsystem, expressed similarly by box plots. The figure summarizes the average dates for (from bottom to top) the completion of snowmelt, the thawing of the top soil layer, the start and end of greening, the freezing of the top soil layer, and the start of seasonal snow accumulation.

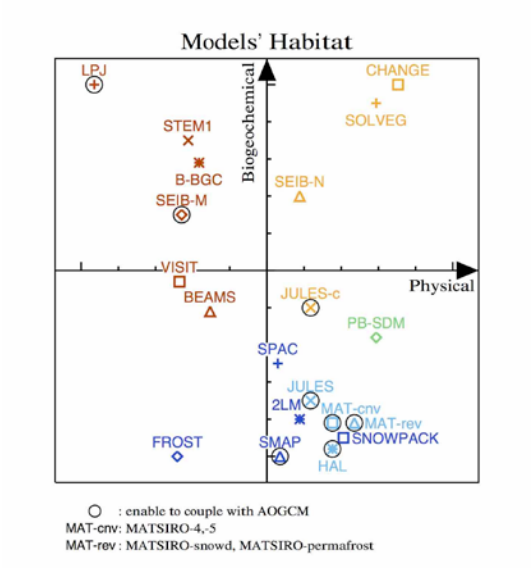

Figure 1. The habitat of models participating in the GTMIP.

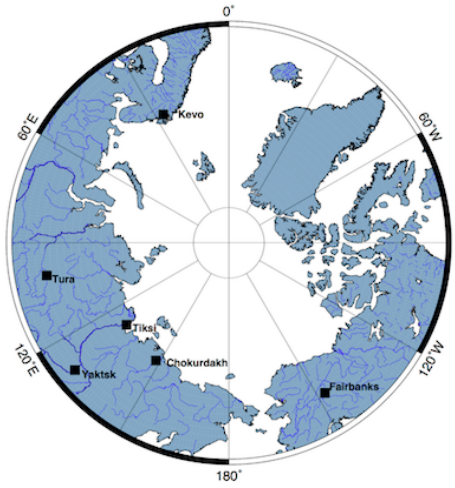

Figure 2. GRENE-TEA observation sites used in the GTMIP Stage 1.

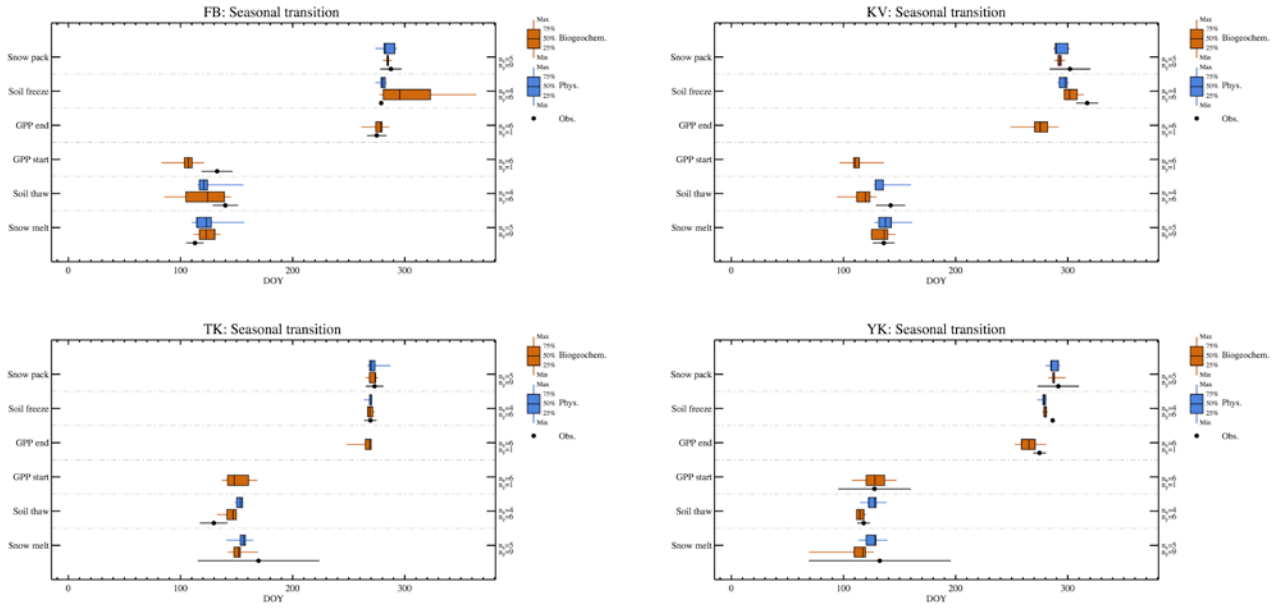

Figure 3. Seasonal transitions in ground temperature, snow, and vegetation growing among models.

The Stage 2 is pan-Arctic simulations from 1850 to 2100, driven by historical (1850-2005) and projected (2006-2100) data, taken from the MIROC-ESM simulation outputs made for CMIP5. This stage targets to evaluate a) temporal and spatial scales of terrestrial response to climate change both in the physical and ecosystem perspective, and b) spatial extent of extendibility of the Stage 1 results.

References

Miyazaki, S. and others, The GRENE-TEA model intercomparison project (GTMIP): overview and experiment protocol for Stage 1, Geoscientific Model Development, *accepted*, 2015.

Sueyoshi, T. and others, The GRENE-TEA Model Intercomparison Project (GTMIP) stage 1 forcing dataset, Earth System Science Data Discussion, *8, 703–736, doi:10.5194/essdd-8-703-2015, 2015*.