

Poster #26

Observed and Modeled Spatial Distribution of Uncertainties in Alaskan Soil Carbon Stocks

Umakant Mishra¹, Julie Jastrow¹, and Roser Matamala¹

¹ Argonne National Laboratory

Contact: Umakant Mishra [umishra@anl.gov]

Uncertainties in the magnitude and distribution of permafrost soil organic carbon (SOC) stocks are primary contributors to uncertainties in predicted permafrost carbon-climate feedbacks. In this study, we generated 95% prediction intervals of Alaskan SOC stocks (to 1 m depth) by using 585 SOC profile observations, secondary environmental information representing soil-forming factors (climate, topography, land cover types, surficial geology), and geospatial modeling. We compared our results with uncertainties (95% confidence intervals) generated from four CMIP5 equilibrium SOC stock estimates. Our results showed non-stationary environmental controls on SOC stocks across Alaska. Among the investigated variables, land cover had the most heterogeneous control on SOC stocks, whereas elevation exhibited the least heterogeneous control. The magnitude of uncertainties varied spatially. Among observations, spatial prediction of SOC stocks was least uncertain in Coastal Rain Forests (31 – 33 kg C m⁻²) and most uncertain in Bering Tundra ecoregions (28 – 33 kg C m⁻²). The strength of environmental controllers doubled between the most and least uncertain ecoregions. Despite severe underestimation in comparison to observations, CMIP5 models showed the highest confidence in Arctic Tundra (2.5 – 14 kg C m⁻²) and lowest confidence in Intermontane Boreal (2.4 – 27 kg C m⁻²) ecoregions. Among the six major ecoregions considered, the smallest discrepancies between observed and modeled uncertainties were in the Alaska Range Transitions and Intermontane Boreal ecoregions. Our findings can inform efforts towards (1) quantifying uncertainties in SOC observations, (2) representing observed spatial heterogeneity of SOC in large scale models, and (3) improving understanding of large scale SOC dynamics.