



## US Forest Service R&D PNW Research Station

**Project Title:** Climate and Carbon in Southeast Alaska: Beyond the Threshold of Change in a Dynamic Landscape

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### Project Description:



The coastal temperate rain forest biome (CTR) extends from the Gulf of Alaska to northern California. Along the coast of Canada and Alaska, northern CTR watersheds receive year-round precipitation, and forest fires do not affect long-term carbon cycles. The Tongass National Forest (Tongass), composed of a mainland fringe and an island archipelago with 11,000 miles of coastline, contains the largest portion of intact northern temperate rain forest in North America. The Tongass is carbon rich, containing 8 percent of all the carbon currently stored in U.S. forests. There are over 2,800 watersheds in the Tongass draining forested soils, waterlogged peatlands, alpine snowfields, and glaciers. Reciprocal interactions between the forest and adjacent marine system are intense, with 90 percent of the Tongass lying within 5 km of saltwater. Therefore, organic carbon and other materials lost from the terrestrial ecosystem are quickly

transferred to freshwater and marine ecosystems with uncertain consequences for those habitats.

Carbon storage and cycling in forest soils and prospects for mitigating the increase in atmospheric carbon dioxide through forest management are of great interest to the Forest Service. The CTR biome has received little attention because of the perception that carbon stocks and fluxes in CTR will remain stable under the predicted warmer and wetter climate regime. However, climate changes have already caused large-scale forest decline and accelerated the recession of most tidewater glaciers. Our research suggests that assumptions of stability are wrong, and a large potential for changes in carbon storage exists. The impacts of changing soil processing rates and hydrology pose an enormous challenge to scientists and managers in a region with little baseline information to inform carbon cycle models.

Recent research indicates that northern CTR watersheds are disproportionately important in regional carbon cycling. Cumulative annual discharge from Tongass watersheds equals or exceeds that of the Yukon River in an area 1/13<sup>th</sup> the size. Dissolved organic carbon (DOC) concentrations are high and the total DOC flux from the Tongass is the highest per unit area of any ecosystem in the world. The volume of carbon moving in this single export vector indicates

that changes in temperature and precipitation could mobilize carbon stored in forest soils and flush large amounts of carbon, nitrogen, and phosphorus from the forest to the adjacent marine ecosystem with potentially large impacts on marine productivity and the regional carbon balance.

**Project Deliverables:** This research will result in estimations of carbon flux values for soils and streams at stand, reach, and regional scales; carbon flux for representative coastal temperate rain-forest watersheds; carbon sequestration magnitude in young-growth forests and response to different thinning regimes throughout the stand development chronosequence; and an increased understanding of the role of pristine and managed ecosystems in the carbon cycle of southeast Alaska.

**Project Outcomes:** The deliverables will result in improved tools for use by managers to estimate existing carbon stocks in terrestrial ecosystems; to support decisions for planning carbon sequestration strategies; to develop preliminary models of ecosystem carbon fluxes; and to improve predictive models of terrestrial and aquatic ecosystem response to changes in precipitation and temperature to assess the impact of climate change.