FORESTS WITHOUT BORDERS:

Large, climate-sensitive soil carbon stocks mapped with pedology-informed machine learning in the North Pacific coastal temperate rainforest

Soil Forming Factors

To create a soil organic carbon map of the north Pacific coastal temperate rainforest we used information from over a thousand soil profiles, along with digital maps of the factors that influence soil formation (Jenny, 1954). At each soil profile, we calculated how much carbon was stored to a depth of 1 m and related those estimates to the maps of soil forming factors.
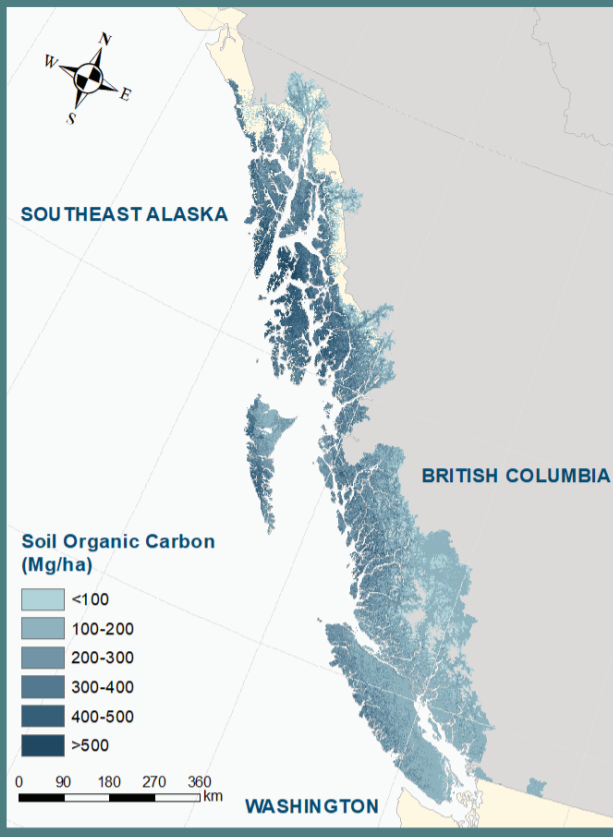
Climate
Relief
Organisms
Time
Parent Material

SOUTHEAST ALASKA

BRITISH COLUMBIA

Soil Organic Carbon (Mg/ha)
<100
100-200
200-300
300-400
400-500
>500

0   90   180   270   360 km

WASHINGTON

Environmental Factors Controlling Carbon Soil Content

With data from a transboundary soil profile dataset, we determined which environmental factors have the greatest influence on soil carbon density. Weighing the relative importance of soil forming factors such as slope, bedrock material, and vegetation, we determined that soil carbon stocks track climate gradients.

The soil profile dataset spans the entire north Pacific coastal rainforest and contains:

1,307 soil profiles
6,976 horizons

Longitude
Elevation
Precipitation
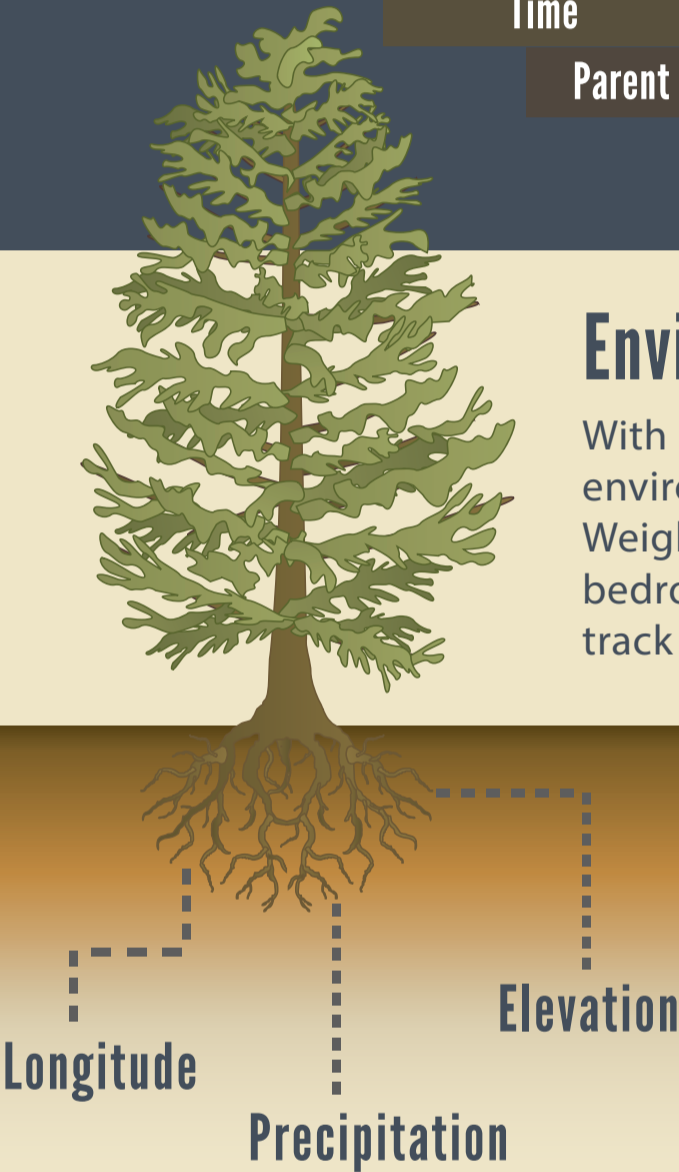
The dominant factors controlling soil carbon concentrations. This indicates that soil carbon stocks are sensitive to changes in climate, particularly precipitation.

The total soil carbon stock of the north Pacific coastal temperate rainforest*:

4.5 Petagrams of Carbon

*north of Washington state

That's equivalent to about half of the total global carbon emmisions released from fossil fuels and industry every year.

More than 2% of the carbon stock in North America is stored in the North Pacific coastal temperate rainforest, a region that makes up just 1% of the land area.

Smooth gradients of soil carbon across the US-Canada border highlight the need for coordinated research and datasets across political boundaries.

NSF

ALASKA COASTAL RAINFOREST CENTER

UNIVERSITY of ALASKA SOUTHEAST

FOREST SERVICE U.S DEPARTMENT OF AGRICULTURE

Hakai
Science on the Coastal Margin

USDA
United States Department of Agriculture

McNicol G, Bulmer C, D'Amore DV, Sanborn P, Saunders S, Giesbrecht I, Gonzalez-Arriola S, Bidlack AL, Butman D, Buma B. Large, climate-sensitive soil carbon stocks mapped with pedology-informed machine learning in the North Pacific coastal temperate rainforest. Environmental Research Letters. In Press.

Jenny, H. 1941. Factors of soil formation. McGraw-Hill, New York, New York, USA.

Tree graphic courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/symbols/)