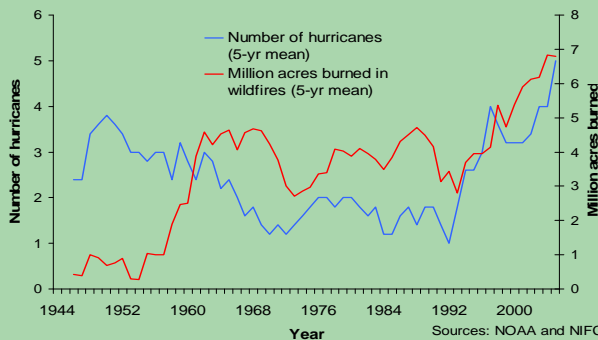


Introduction

The United States is the world's largest single emitter of carbon dioxide (CO₂). Linkages between increasing atmospheric CO₂ and global warming have caused policy makers to consider using increased forest carbon sequestration as a mechanism to partially offset gross carbon emissions. However, natural disturbances such as wildfires and hurricanes can have a major impact on tree growth and mortality, thus increasing forest CO₂ loss to the atmosphere. In this study, we developed a series of equations to convert measured forest volume loss into teragrams (Tg 10¹² g) of carbon (C). We then used historic reports of disturbance-caused timber mortality and damage to calculate gross CO₂ loss across the United States for the past 90 years.

Changes in U.S. Forest Disturbance



Forest Disturbance

Timber damage estimates are reported after disturbances in a variety of sources. We used annual forest fire reports published by the USDA Forest Service and wildland fire statistics reported by NIFC for wildfire volume and acreage estimates. Hurricane damage is more localized, so state forestry agencies typically compile damage assessments. Measurements of forest mortality due to disturbances are most commonly measured in commercial units of board feet, cords or cubic meters.

Focus Area

Historic Disturbance Impacts on Gross Forest Carbon Sequestration Across the U.S.

Converting Forest Volume Loss to Gross C Loss

Equations for calculating the total (i.e., above and below ground) gross carbon loss from estimates of forest damage are presented:

Cubic Meter to Gross Forest Carbon Loss Conversion

$$VCL = (m^3Loss) * (CarbFrac) * (SpecGrav) * (StmRat) * (WatCnt) * (U)$$

Board Foot to Gross Forest Carbon Loss Conversion

$$BCL = (BdftLoss) * (CarbFrac) * (SpecGrav) * (StmRat) * (BdftCft) * (WatCnt) * (U)$$

Cordwood to Gross Forest Carbon Loss Conversion

$$CCL = (CrdLoss) * (CrdVol) * (CarbFrac) * (SpecGrav) * (StmRat) * (WatCnt) * (U)$$

Where:

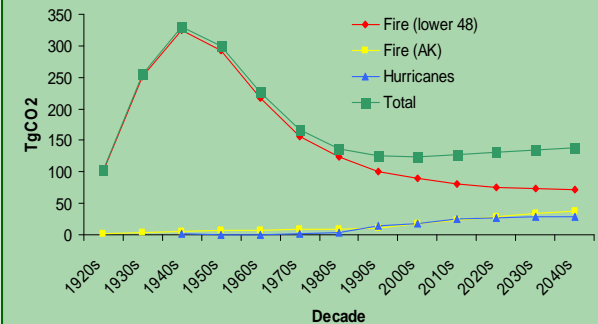
| | |
|--|--|
| <i>m3Loss</i> = reported m3 of timber loss | <i>BdftLoss</i> = reported bdft of timber loss |
| <i>CarbFrac</i> = proportion of wood composed of carbon | <i>BdftCft</i> = conversion of bdft loss to ft3 loss |
| <i>SpecGrav</i> = species specific gravity of reported timber loss | <i>CrdLoss</i> = reported cords of timber loss |
| <i>StmRat</i> = proportion of timber volume loss to total tree volume by forest type | <i>CrdVol</i> = solid volume of wood in a cord (minus air space) |
| <i>WatCnt</i> = proportion of wood w/o residual water content | <i>U</i> = unit conversions |



Forest Decomposition

Disturbances significantly increase gross CO₂ return to the atmosphere from unharvested wood relative to CO₂ loss from processed wood products. To account for CO₂ emission due to wood decomposition, we multiplied the Tg C stored in disturbance-killed timber (from equations) by annual decay rates based on forest type, disturbance type, geographic location, and post-disturbance forest condition (e.g., dead standing or blow down).

Average Annual CO₂ Emitted to Atmosphere Due to Disturbances, Projected to 2050



Climate Change, Disturbances, & C Loss

Current annual CO₂ emission to the atmosphere due to wildfire and hurricanes is 123 Tg CO₂, and is projected to increase by 10% in the next 30 years. Climate change is likely a contributor to the recent increase in natural disturbances and associated gross carbon loss. Elevated wildfires in Alaska could be attributed to a 7° temperature increase over the past 20 years, which has also resulted in melting of permafrost and decomposition of organic soil matter. Some of the increased intensity of hurricanes has also been attributed to global warming, with warming oceans providing hurricanes with more energy. There is also evidence that the US has entered a period of increased hurricane activity that is projected to last 10 to 40 years.