Equations for Predicting Carbon Monoxide Emissions from Amazon Rainforest Fires

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Rainforest emissions benchmark poorly.

FireMIP, % of models whose cell mean is 50% < x < 200% of reference:

0 10 20 30 40 50 60 70 80 90 100



Most fire consequences occur via emissions.

via emissions

via burned area



log response scale

linear response scale

We fitted to 2 Amazon fire CO inventories.



Regressions: one dataset, diverse forms



Accuracy is scored on 3 metrics.

Metric	Meaning
r ²	ability to explain CO differences
ratio of means	overall bias
ratio of explained variance	oversensitivity to predictors

3 uses = 3 equations

Eq. Name:	Linear	Log	LinearPMet
Best use	 Linear-scale emissions Burned area Mixed uses 	- Log-scale emissions	- If meteorology is known
Native time scale	month	month	year

Key predictors: humidity, deforestation rate



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Deforested in prior 5 years Deforested in current year Land allocation = secondary forest Potential vegetation, % dry Land allocation = crop or pasture 100 - relative humidity Current precipitation Rain in prior month Days since wetting rain Rain in typically wettest 3 months





The Linear equation's monthly linear r² = 0.18

- If meteorology is known, use it.
- Monthly linear $r^2 \leq .68$.
- Annual accuracy matters for persistent fire effects.
- Log equation is for specialty studies only.

Accuracies can differ markedly by scale.



New r²s are higher than (some?) FireMIP models







Deforestation rate is a valuable rainforest fire predictor.

Which equation is best varies by use.

Deforestation rate is a powerful predictor.

Prediction accuracy for tropical rainforest fire emissions can be improved (burned area tbd).

Comments and questions

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Correlation of Naus with GFED for non-zero monthly fire CO



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Key predictors = humidity, deforestation rate

* Includes lag & cumulative derivatives

Different problems require different diagnostics. blue = accurate predictions; red = predictions with a problem ratio of explained r2 bias of the mean variances ratio ratio of $r^2 = 0.22$ of mear explained variance = 1.49= 2.01 $r^2 = 0.58$ ratio ratio of of means = 1explained variance = 1

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Even in rainforest, grass is key for burned area.

Predictors in Burned Area Conversion Equations

Burned area r² are rankings similar to emissions r²

r² of Burned Area v. GFED4s

GFED5 with refitted emission conversions ranks similarly.

r² of Burned Area v. GFED5

Sensitivity is steadier for deforestation than for warming or SD(rain).

Experiments, Mean Change in CO

LinearPMet needs more inputs but is more accurate.

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