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Building the Fire Energetics and Emissions Research (FEER) Smoke Emissions Inventory Version 1.0

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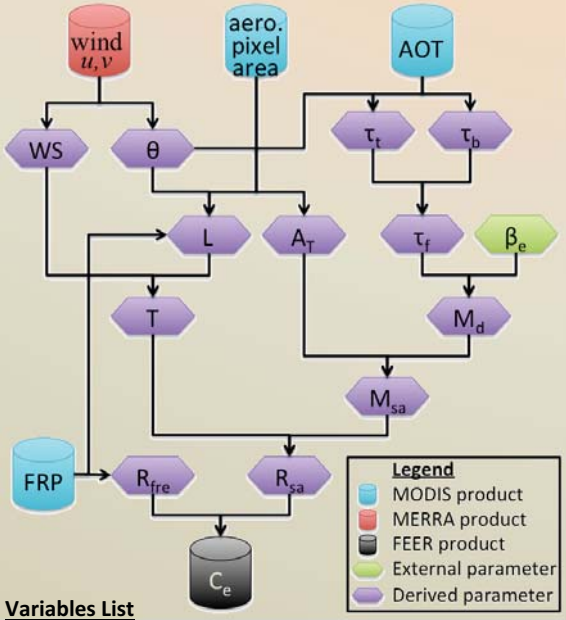
The Fire Energetics and Emissions Research (FEER) group's new coefficient of emission global gridded product at 1×1° resolution that directly relates fire radiative energy (FRE) to smoke aerosol release, **FEERv1.0 Ce**, made its public début in August 2013. Since then, steps have been taken to generate corresponding maps and totals of total particulate matter (PM) emissions using different sources of FRE, and subsequently to simulate the resulting $PM_{2.5}$ in the WRF-Chem3.5 model using emission rates from FEERv1.0 as well as other standard biomass burning emission inventories. An flowchart of the FEER algorithm to calculate Ce is outlined here along with a display of the resulting emissions of total PM globally and also regionally. The modeling results from the WRF-Chem3.5 simulations are also shown.

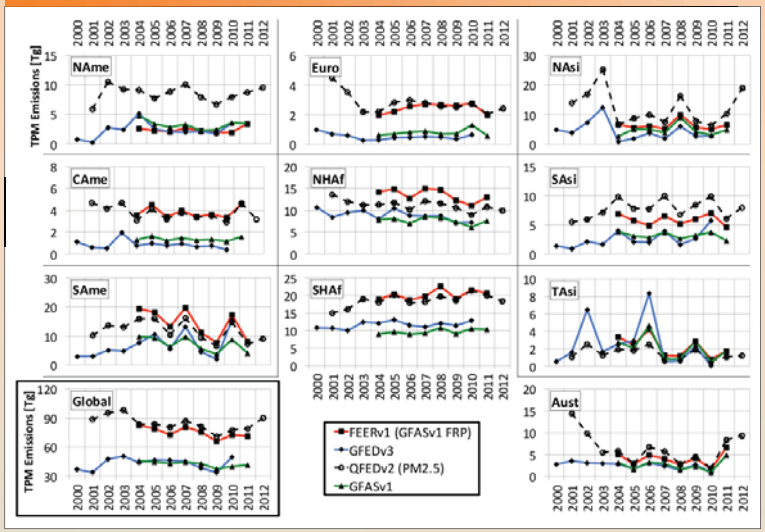
FEERv1.0 Ce Algorithm



Variables List

WS	*m/s*	Wind speed
θ	*deg*	Wind azimuth
L	*km*	Plume length to pixel edge
T	*s*	Plume time to pixel edge
τ_t	–	AOT of downwind pixels
τ_b	–	AOT of background pixels
τ_f	–	AOT of plume
β_e	m^2/g	Mass extinction efficiency
M_d	g/m^2	Smoke-aerosol column mass density
A_T	km^2	Total area of the downwind pixels
M_{sa}	*kg*	Mass of smoke aerosol
R_{sa}	*kg/s*	Rate of smoke aerosol emission
R_{fre}	*MW*	Rate of radiative energy release

Total PM Emissions



Comparisons among FEERv1.0, GFEDv3.1, QFEDv2.4 and GFASv1.0 of total particulate matter (PM) emissions from biomass burning in different regions, delineated according to the GFAS definitions. Note that the FEER emissions were generated using GFAS FRE data. Also notice that the QFED line is of $PM_{2.5}$, not total PM which was not available for version 2.4. $PM_{2.5}$ ranges between 65-100% of TPM according to Andreae and Merlet (2001), depending on ecosystem type. There is a noticeable separation between the bottom-up approaches (GFED and GFAS) and the top-down approaches (FEER and QFED).

References

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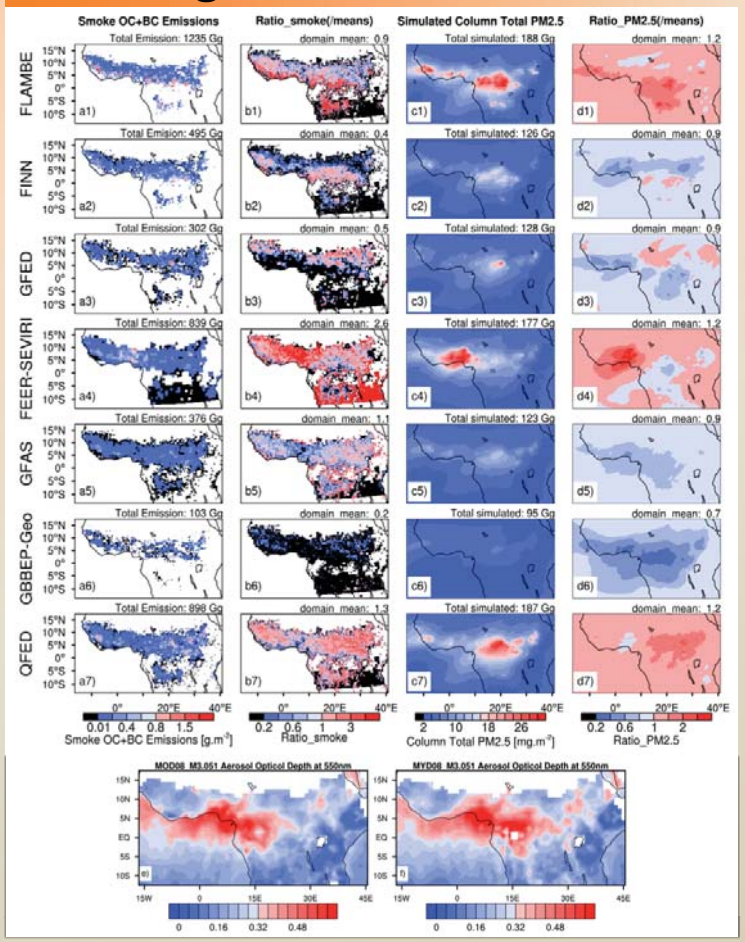
Modeling



Comparisons among FLAMBE, FINNv1.0, GFEDv3.1, FEER-SEVIRIv1.0, GFASv1.0, GBBEP-Geo and QFEDv2.4 for (a1-a7) Monthly total smoke OC+BC emissions (unit: g.m-2) during February 2010. The plot is made at the native resolution for corresponding emission inventory; (b1-b7) the ratio of individual smoke emissions to their means among different inventories (Ratio_smoke); (c1-c7) February mean column total $PM_{2.5}$ (unit: mg.m-2) simulated by WRF-Chem3.5; (d1-d7) the ratio of $PM_{2.5}$ from different emission inventories to their means (Ratio_PM2.5). (e and f) total column aerosol optical depth (AOD) at 550 nm wavelength from MODIS on Terra and Aqua satellites, respectively, as plotted within the NASA Giovanni interactive visualization system (http://disc.sci.gsfc.nasa.gov/giovanni/).

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