
Project Goals

Estimate biomass burning emissions of organic and black carbon particulate matter (OCBC) using the fire radiative power (FRP) released during combustion.

Fire Radiative Energy

Estimating fire emissions using the integrated fire radiative power (FRP), or fire radiative energy (FRE), released during combustion was first developed by Kaufman et al. (1996) and later refined by Wooster et al. (2002, 2005). FRE can be used to estimate the total fuel combusted (Fig. 2) and, given an emission coefficient ($E_f$), the total emissions released (Eq. 1).

\[ E \text{ (tonnes OCBC)} = F R P \times E_f \] (Eq. 1)

OCBC Emission Data

To retrieve organic and black carbon particulate matter emissions from biomass burning a combination of satellite and ground-based observations, along with chemical transport modeling, was used in concert with forward and inverse modeling (Dubovik et al., 2007). This data was used to estimate the emission coefficient using FRP retrievals.

OCBC Emission Coefficient

Emission coefficients ($E_f$, grams OCBC emitted/MJ FRE) were calculated using a power function. Fig. 9 displays the relationship between FRE and the OCBC product was examined for multiple test sites (e.g. Fig. 9). The coefficient (slope) for each site was then plotted against the annual mean FRP within the site (Table 1), yielding the power function (Fig. 10). Plotting the power function-predicted $E_f$ against the observed $E_f$ demonstrates the strength of the function (Fig. 11). Figure 12 shows a map of the calculated emission coefficients.

Results

OCBC emission from biomass burning was calculated using Equation 1.

We calculated 72.6Tg globally for 2001, which is close to the 63Tg reported by Chin et al. (2007), but well above van der Werf et al.’s (2006) estimate of 23Tg.

Comparison of the temporal cycle of emissions between our estimate and the OCBC inversion product were very close (e.g. Fig. 14).

![Figure 13: Total OCBC emissions estimated from fire for 2001.](image)

![Figure 12: Modeled power function calculated using FRP and mean annual FRP.](image)

![Figure 11: Predicted versus Observed emission coefficients.](image)

![Figure 10: Modeled power function based on relationship between mean FRP and $E_f$.](image)

![Figure 9: Analysis of relationship between fire sites (104x10) between FRE (MJ) and OCBC (g).](image)

![Figure 8: FRE (MJ/hour) for 2001.](image)

![Figure 7: 2 parameter vs. Terra data.](image)

![Figure 6: 3 parameter vs. Terra data.](image)

![Figure 5: 3 parameter vs. Terra data.](image)

![Figure 4: Terra & Aqua FRP for 48 months.](image)

![Figure 3: 2 parameter vs. Terra data.](image)

![Figure 2: Biomass contribution rate.](image)

![Figure 1: OCBC.](image)

[Table 1: Synergy of observation and modeling.](image)

| Scenario | Retrieval method | Comparison | Agreement
|----------|-----------------|------------|----------|
| MODIS & SEVIRI | Global aerosol retrievals | MODIS & SEVIRI | Good agreement
| MODIS & AERONET | Global aerosol retrievals | MODIS & SEVIRI | Good agreement
| MODIS & GOCART | Global aerosol retrievals | MODIS & SEVIRI | Good agreement

![Figure 1: Synergy of observation and modeling.](image)

![Figure 2: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 3: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 4: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 5: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 6: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 7: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 8: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 9: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 10: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 11: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 12: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

![Figure 13: Comparison of FRE estimates between MODIS and SEVIRI for Southern Africa.](image)

Literature Cited


