Modeling wildfire emissions from the 2003 and 2007 Santa Ana events

Discussion
Requirements of the model

Relatively high spatial and temporal resolution

**Spatial**
500m (cfr. MODIS)
30m (cfr. Landsat) might be overkill

**Temporal**
at least 6-hourly (cfr. input to regional air pollution model, UCLA)
Bottom-up approach

\[ \text{Emission} = \text{BA} \times \text{FL} \times \text{CC} \times \text{EF} \]

BA = Burned Area
FL = Fuel Load
CC = Combustion Completeness
EF = Emission Factor
Burned area and fire progression

Preferably 6-hourly

Using MODIS active fire product (MOD14, MYD14)
IDW interpolation (cfr. Fernando)

(MCD14L not on Reverb? Fernando?)

In SoCal: 4 acquisitions/day
5-6 AM
9-10 AM
5-6 PM
9-10 PM

Looks nice, but how to validate this?
Burned area and fire progression: Potential validation

- Availability of ‘ground truth’ over a large fire (2011 Wallow fire, AZ)

- Fires in the higher latitudes have more acquisitions
  -> use 4 time clusters for modeling
  -> use left-over time clusters for validation
  -> will give an idea on the quality for regions with only 4 acquisitions such as Socal
Fuel load

CASA

500m MODIS resolution?

Which data input is required and are those readily available?
Combustion completeness

CASA + remote sensing

500m resolution?

First guess CC from CASA
Which data input is required and are those readily available?

Further refined with severity data from remote sensing
Combustion completeness

Example of vegetation mortality derived from spectral unmixing
### Emission factor

From Andreae and Merlet (2001)

<table>
<thead>
<tr>
<th>Species</th>
<th>Stratospheric</th>
<th>Tropical Forest</th>
<th>Rainforest</th>
<th>Biomass Burning</th>
<th>Charcoal Mulch</th>
<th>Charcoal Biomass</th>
<th>Agricultural Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>1.613 ± 0.95</td>
<td>1.560 ± 0.90</td>
<td>1.580 ± 1.31</td>
<td>1.570 ± 0.95</td>
<td>44.0</td>
<td>3611 ± 2.84</td>
<td>1551 ± 1.17</td>
</tr>
<tr>
<td>CH₄</td>
<td>0.31 ± 0.15</td>
<td>0.31 ± 0.12</td>
<td>0.31 ± 0.15</td>
<td>0.31 ± 0.15</td>
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<td>0.31 ± 0.15</td>
<td>0.31 ± 0.15</td>
</tr>
</tbody>
</table>

#### Table 1. Emission Factors for Pyrogenic Species Emitted From Various Types of Biomass Burning

- **CO**: carbon monoxide
- **CH₄**: methane
- **C₄H₈**: ethylbenzene
- **C₅H₁₀**: isopropylbenzene
- **C₆H₁₂**: toluene
- **C₇H₁₄**: n-heptane
- **C₈H₁₈**: o-xylene
- **C₉H₂₀**: p-xylene
- **C₁₀H₂₂**: n-decane
- **C₁₁H₂₄**: n-undecane
- **C₁₂H₂₆**: n-dodecane
- **C₁₃H₃₀**: n-tridecane
- **C₁₄H₃₂**: n-tetradecane
- **C₁₅H₃₄**: n-pentadecane
- **C₁₆H₃₈**: n-hexadecane
- **C₁₇H₃₈**: n-heptadecane
- **C₁₈H₄₀**: n-octadecane
- **C₁₉H₄₀**: n-nonadecane
- **C₂₀H₄₂**: n-eicosane
- **C₂₁H₄₄**: n-icosahexane
- **C₂₂H₄₄**: n-docosane
- **C₂₃H₄₆**: n-tricosane
- **C₂₄H₅₀**: n-tetracosane
- **C₂₅H₅₂**: n-pentacosane
- **C₂₆H₅₄**: n-hexacosane
- **C₂₇H₅₈**: n-heptacosane
- **C₂₈H₆₀**: n-octacosane
- **C₂₉H₆₂**: n-nonacosane
- **C₃₀H₆₄**: n-undecacosane
- **C₃₁H₆₆**: n-tetracosane
- **C₃₂H₆₈**: n-pentacosane
- **C₃₃H₇₀**: n-hexacosane
- **C₃₄H₇₂**: n-heptacosane
- **C₃₅H₇₄**: n-octacosane
- **C₃₆H₇₆**: n-nonacontane
- **C₃₇H₇₈**: n-decanontane
- **C₃₈H₈₀**: n-undecanotane
- **C₃₉H₈₂**: n-hexadecanotane
- **C₄₀H₈₄**: n-hexacosanotane

**Note**: Values are given in units of kg CO₂-eq per kg of biomass burned.
In summary

Fire progression

Wildfire emission model for the 2003 and 2007 SA events (6-hourly, 500m)
Combination of CASA and RS