



*Supplement of*

## **Evaluation of regional isoprene emission factors and modeled fluxes in California**

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## S1. Ecoregion codes (Legend to Figure 1)

### Legend

- Isop flux available
- Isop flux unavailable

ca\_eco\_i4  
CA\_Ecoregion\_level4

LA\_KEY  
13aa Sierra Nevada-Influenced Semiarid Hills and Basins  
13bb Sierra Valley  
13cc Upper Owens Valley  
13dd Mono-Adobe Valleys  
13ee Bishop Volcanic Tableland  
13hh Lahontan and Tonopah Playas  
13ii Tonopah Basin  
13v Tonopah Sagebrush Foothills  
13x Sierra Nevada-Influenced Ranges  
13y Sierra Nevada-Influenced High Elevation Mountains  
13aa Eastern Mojave Basins  
13bb Eastern Mojave Low Ranges and Arid Foothills  
13cc Eastern Mojave Mountain Woodland and Shrubland  
13dd Arid Valleys and Canyonlands  
13ee Mojave Playas  
13ff Amargosa Desert  
13gg Death Valley/Mojave Central Trough  
13hh Mattole Flat/Badwater Basin  
13ii Western Mojave Basin  
13kk Western Mojave Low Ranges and Arid Foothills  
13mm Western Mojave High Elevation Mountains  
13nn Mojave Lava Fields  
13oo Mojave Sand Dunes  
13aa Coastal Lowlands  
11 Northern Franciscan Redwood Forest  
11 King Range/Mattole Basin  
11k Coastal Franciscan Redwood Forest  
11l Fort Bragg/Fort Ross Terraces  
11m Point Reyes/Farallon Islands  
11n Santa Cruz Mountains  
11o San Mateo Coastal Hills  
4d Cascade Subalpine/Alpine  
4e High Southern Cascades Montane Forest  
4f Low Southern Cascades Mixed Conifer Forest  
4g California Cascades Eastside Conifer Forest  
4h Southern Cascades Foothills  
5a Sierran Alpine  
5b Northern Sierra Subalpine Forests  
5c Northern Sierra Upper Montane Forests

5d Northern Sierra Mid-Montane Forests  
5e Northern Sierra Lower Montane Forests  
5f Northeastern Sierra Mixed Conifer-Pine Forests  
5g Central Sierra Mid-Montane Forests  
5h Central Sierra Lower Montane Forests  
5i Eastern Sierra Great Basin Slopes  
5k Eastern Sierra Mojavean Slopes  
5l Southern Sierra Subalpine Forests  
5m Southern Sierra Mid-Montane Forests  
5n Southern Sierra Lower Montane Forest and Woodland  
5o Tehachapi Mountains  
5n Tuscan Flows  
6aa Eastern Hills  
6ab Pleasant Valley/Kettleman Plain  
6ad Temblor Range/Elk Hills  
6ad Grapevine Transition  
6af Tehachapi Foothills  
6af Salinas Valley  
6ag Northern Santa Lucia Range  
6ah Southern Santa Lucia Forest and Woodland  
6ai Northern Santa Lucia Range  
6aj Southern Santa Lucia Range  
6ak Peso Robles Hills and Valleys  
6al Salinas-Cholame Hills  
6am Cuyama Valley  
6an Carrizo Plain  
6ao Caliente Range  
6ap Solomon-Purisima-Santa Ynez Hills  
6aq Santa Maria/Santa Ynez Valleys  
6ar Upper Sacramento River Alluvium  
6b Northern Sierran Foothills  
6b Southern Sierran Foothills  
6d Camanche Terraces  
6d Tehama Terraces  
6f Foothill Ridges and Valleys  
6g North Coast Range Eastern Slopes  
6h Western Valley Foothills/Dunnigan Hills  
6i Clear Lake Hills and Valleys  
6j Mayacamas Mountains  
6l Napa-Sonoma-Lake Volcanic Highlands  
6l Napa-Sonoma-Russian River Valleys  
6m Sonoma-Mendocino Mixed Forest  
6n Bodega Coastal Hills  
6p Bay Flats  
6q Suisun Terraces and Low Hills  
6r East Bay Hills/Western Diablo Range  
6s San Francisco Peninsula  
6u Livermore Hills and Valleys  
6v Upper Santa Clara Valley  
6w Monterey Bay Plains and Terraces  
6x Leeward Hills/Western Diablo Range  
6y Gabbs Range  
6z Diablo Range  
78a Rogue/Illinois/Scott Valleys  
78d Serpentine Siskiyous  
78e Inland Siskiyous  
78g Klamath River Ridges  
78h Border High-Siskiyous  
78i Western Klamath Low Elevation Forests  
78j Western Klamath Montane Forests  
78k Eastern Klamath Low Elevation Forests  
78l Eastern Klamath Montane Forests  
78m Marble/Salmon Mountains-Trinity Alps  
78n Scott Mountains  
78o Klamath Siskalpine  
78p Pit River  
79a Outer North Coast Ranges  
79b High North Coast Ranges  
7a Northern Terraces  
7b North Valley Alluvium  
7c Butte Sink/Sutter and Colusa Basins  
7d Southern Hardpan Terraces  
7e Sacramento/Feather Riverine Alluvium  
7f Sutter Buttes  
7g Yolo Alluvial Fans  
7h Yolo/American Basin  
7j Delta  
7k Lodi Alluvium  
7l Stockton Basin  
7m San Joaquin Basin  
7n Manteca/Merced Alluvium  
7o Westside Alluvial Fans and Terraces  
7p Granite Alluvial Fans and Terraces  
7q Panache and Cantua Fans and Basins  
7r Tulare Basin/Fresno Slough  
7s Kern Terraces  
7t South Valley Alluvium  
7u Antelope Plain  
7v Southern Clayey Basins  
80d Pluvial Lake Basins  
80g High Lava Plains  
80j Semiarid Uplands  
81a Western Sonoran Mountains  
81b Western Sonoran Mountain Woodland and Shrubland  
81c Western Sonoran Basins  
81d Sand Hills/Sand Dunes  
81e Upper Coachella Valley and Hills  
81f Imperial/Lower Coachella Valleys  
81g Lower Colorado/Gila River Valleys  
81h Sonoran Playas  
81i Central Sonoran/Colorado Desert Mountains  
81j Central Sonoran/Colorado Desert Basins  
81k Arizona Upland/Eastern Sonoran Mountains  
85a Santa Barbara Coastal Plain and Terraces  
85b Oxnard Plain and Valleys  
85d Los Angeles Plain  
85f Degan Coastal Terraces  
85g Degan Coastal Hills and Valleys  
85g Degan Western Granitic Foothills  
85g Moreno/Boundary Mountain Chaparral  
85i Northern Channel Islands  
85j Southern Channel Islands  
85k Inland Valleys  
85l Inland Hills  
85m Santa Ana Mountains  
88a Western Transverse Range Lower Montane Shrub and Woodland  
88b Western Transverse Range Montane Forest  
8c Arid Montane Slopes  
8d Southern California Subalpine/Alpine  
8e Southern California Lower Montane Shrub and Woodland  
8f Southern California Montane Conifer Forest  
8g Northern Transverse Range  
8g Klamath/Goose Lake Basins  
9h Fremont Pine/Fir Forest  
9i Southern Cascades Slope  
9j Klamath Juniper Woodland/Devils Garden  
9k Shasta Valley  
9l Pit River Valleys  
9m Warner Mountains  
9n High Elevation Warner Mountains  
9o Like Tableland  
9p Modoc/Lassen Juniper-Shrub Hills and Mountains  
9q Adin/Horsehead Mountains Forest and Woodland  
9r Adin/Dixie Low Hills  
9s Modoc Lava Flows and Buttes  
9t Old Cascades

Figure S1. Legend to Figure 1 describing ecoregion codes.

## S2. MEGAN architecture and main differences between versions

The main differences of MEGAN v.2.1 to MEGAN v.2.04 are:

- 1) v2.04 does not have soil moisture or CO2 response (but these were not used for MEGAN v.2.1 simulations in this study);
- 2) MEGAN v.2.04 uses a different emission factor database and has different light response algorithms (which are nearly the same for isoprene and mostly impact other compounds);
- 3) MEGAN v.2.04 uses different parameters in the canopy environment model.

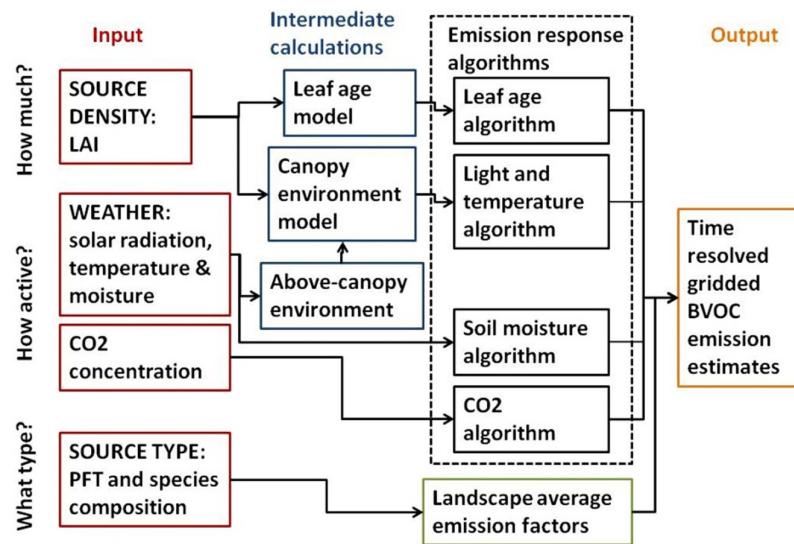
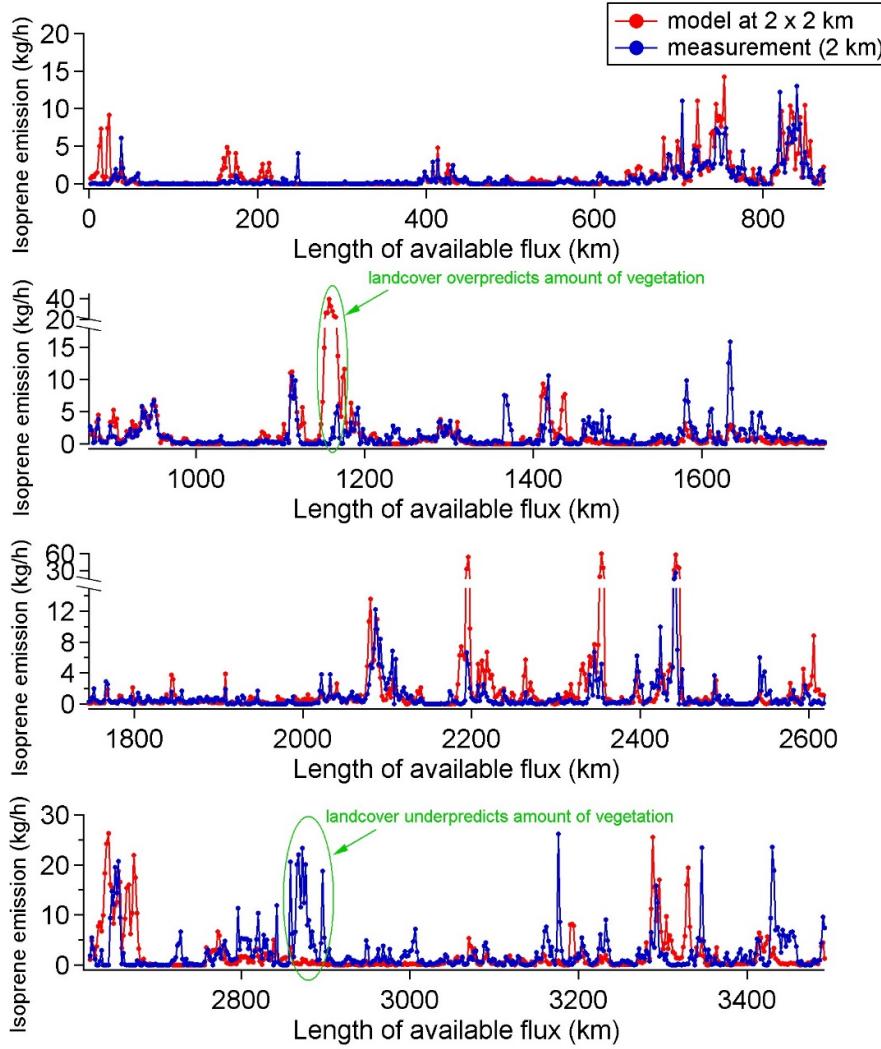


Figure S2. Schematic of MEGAN v.2.1 model components and driving variables (taken from Guenther et al., 2012).

### S3. Timeseries of simulated and observed emissions

In Figure S3, the time series of simulated and measured emissions are shown (plotted along the complete flight tracks).

Local similarities and discrepancies are observed in specific areas along the flight track and are discussed in the manuscript. Although there are different sources of uncertainty, the largest discrepancy occurs if the trees are significantly under or overrepresented, which could be due to fires, new growth, or incomplete landcover.



*Figure S3. Time series for modeled and measured isoprene fluxes using the approximated circular footprint areas (only the data when flux was available are shown) along the full length of the flight tracks during the CABERNET campaign.*

#### S4. The inverse G06 algorithm used in airborne emission factor derivation

In the original G06 algorithm (equation below),  $F_{G06}$  is the unknown, and BER is the known emission factor at standard temperature and PAR conditions. We inverse the equation so the BER is unknown and  $F$  is the airborne-derived surface flux. This BER is referred to as airborne basal emission factor (BEF) or just emission factor which represents the airborne flux inferred for the standard conditions of PAR=1000  $\mu\text{mol m}^{-2} \text{ s}^{-1}$  and temperature = 30 °C.

$$F_{G06} = \text{BER} \cdot b_3 \cdot \exp[b_2 \cdot (P_{24} - P_0)] \cdot (P_{240})^{0.6} \cdot \frac{[b_1 - b_2 \ln(P_{240})] \cdot \text{PAR}}{\sqrt{1 + [b_1 - b_2 \ln(P_{240})]^2} \cdot \text{PAR}^2} \cdot b_5 \cdot \exp[b_6 \cdot (T_{24} - 297)] \cdot \exp[b_6 \cdot (T_{240} - 297)] \cdot \frac{C_{T2} \cdot \exp\left[C_{T1} \cdot \left(\frac{1}{T_{\text{opt}}} - \frac{1}{T}\right) \cdot \frac{1}{0.00831}\right]}{C_{T2} - C_{T1} \cdot \left[1 - \exp\left(C_{T2} \cdot \left(\frac{1}{T_{\text{opt}}} - \frac{1}{T}\right) \cdot \frac{1}{0.00831}\right)\right]}$$

$\underbrace{\phantom{F_{G06} = \text{BER} \cdot b_3 \cdot \exp[b_2 \cdot (P_{24} - P_0)] \cdot (P_{240})^{0.6} \cdot \frac{[b_1 - b_2 \ln(P_{240})] \cdot \text{PAR}}{\sqrt{1 + [b_1 - b_2 \ln(P_{240})]^2} \cdot \text{PAR}^2} \cdot b_5 \cdot \exp[b_6 \cdot (T_{24} - 297)] \cdot \exp[b_6 \cdot (T_{240} - 297)] \cdot \frac{C_{T2} \cdot \exp\left[C_{T1} \cdot \left(\frac{1}{T_{\text{opt}}} - \frac{1}{T}\right) \cdot \frac{1}{0.00831}\right]}_{\gamma_P}}_{\gamma_T} \cdot \left[1 - \exp\left(C_{T2} \cdot \left(\frac{1}{T_{\text{opt}}} - \frac{1}{T}\right) \cdot \frac{1}{0.00831}\right)\right]$

The micrometeorological variables include temperature close to the surface ( $T$ ) and PAR. Previous 24 and 240-hour history of temperature and PAR are accounted for in  $T_{24}$ ,  $P_{24}$ ,  $T_{240}$ ,  $P_{240}$  variables. The parameters of the algorithm were used as default (i.e.  $C_{T1}=95$ ,  $C_{T2}=230$ ,  $T_{\text{opt}}=313$ ,  $P_0=200$ ,  $b_1=0.004$ ,  $b_2 = 0.0005$ ,  $b_3=0.0468$ ,  $b_4=0.6$ ,  $b_5=2.034$ ,  $b_6=0.05$ ).

#### Supplementary references:

Guenther, A. B., Jiang, X., Heald, C. L., Sakulyanontvittaya, T., Duhl, T., Emmons, L. K., and Wang, X.: The Model of Emissions of Gases and Aerosols from Nature version 2.1 (MEGAN2.1): an extended and updated framework for modeling biogenic emissions, Geosci Model Dev, 5, 1471-1492, 10.5194/gmd-5-1471-2012, 2012.