Fire severity and impact on carbon emission estimates from wildfires

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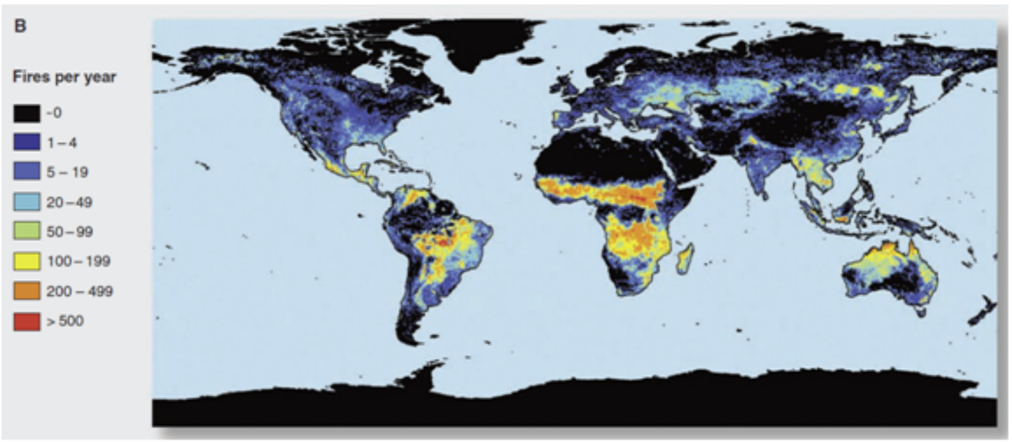
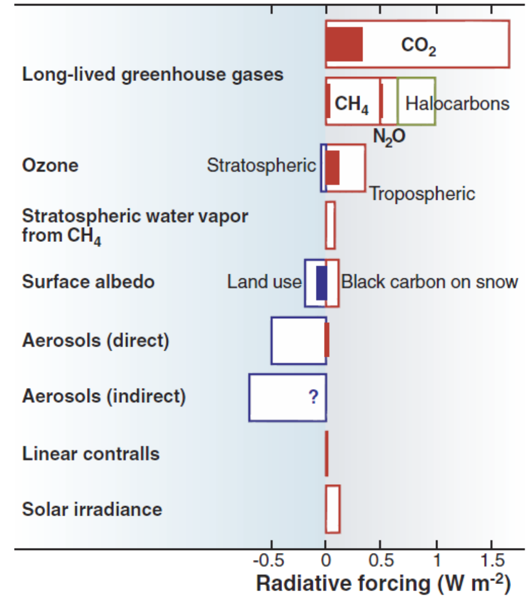
Carbon emissions from wildfires

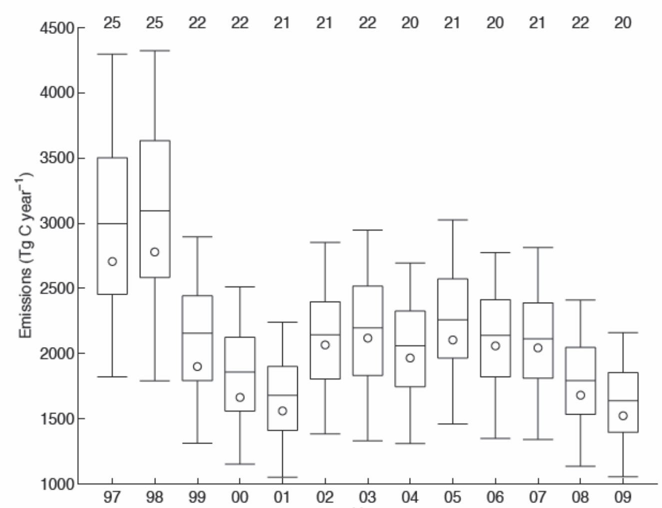




(Bowman et al. 2009)

Carbon emissions from wildfires account for 20-40 % of the total global carbon emissions (van der Werf et al. 2010)

Uncertainties in wildfire emission estimates are large



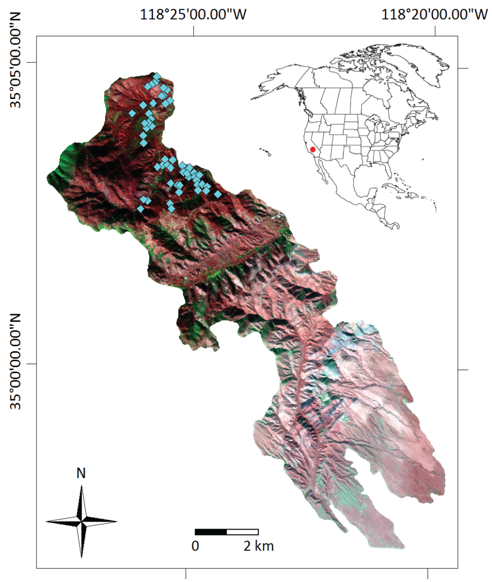
Research aims

Demonstrate:

1) Synergy of VSWIR (0.4-2.5 μm) and TIR (3.5-12.5 μm) data for assessing fire severity (HyspIRI)

2) the impact of including a remotely sensed fire severity product on carbon emission estimates

VSWIR (0.4-2.5 µm) and TIR (3.5-12.5 µm) synergy: data and methods

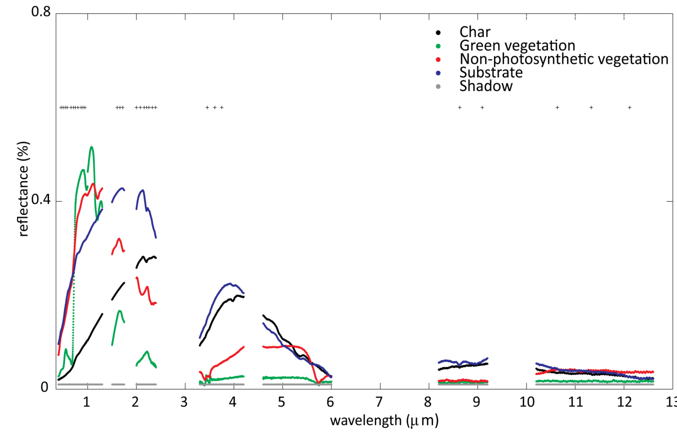


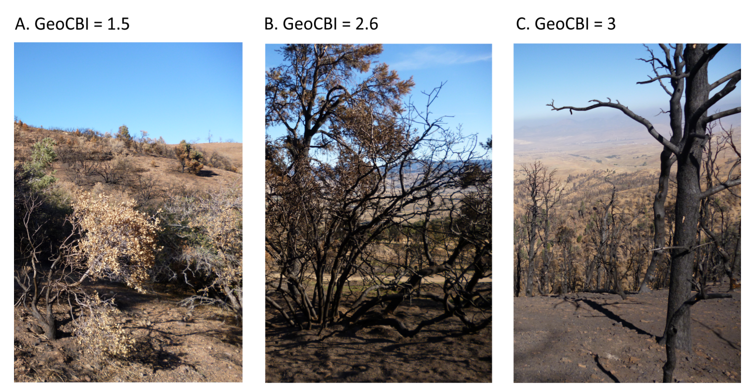
Data

➢ Post-fire airborne MASTER imagery (HyspIRI surrogate)

➢ Spectra library of char, green vegetation (GV), non-photosynthetic vegetation (NPV) and substrate

➢ Geo Composite Burn Index (GeoCBI) plots





Methods

Spectral Mixture Analysis (SMA) applied on:

➢ simulated data

➢ airborne MASTER data (HyspIRI surrogate)

3 different scenarios were run:

1) VSWIR data only

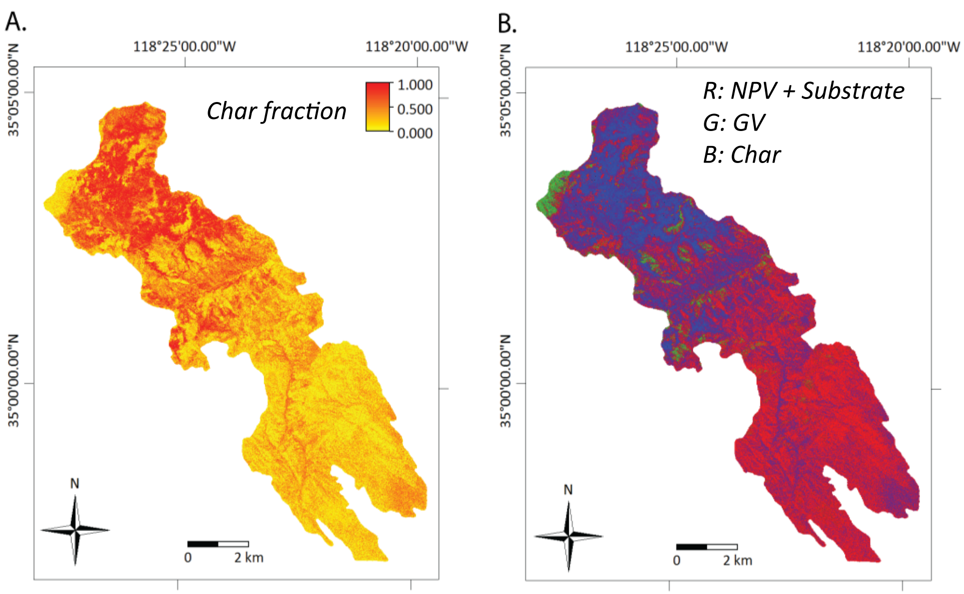
2) TIR data only

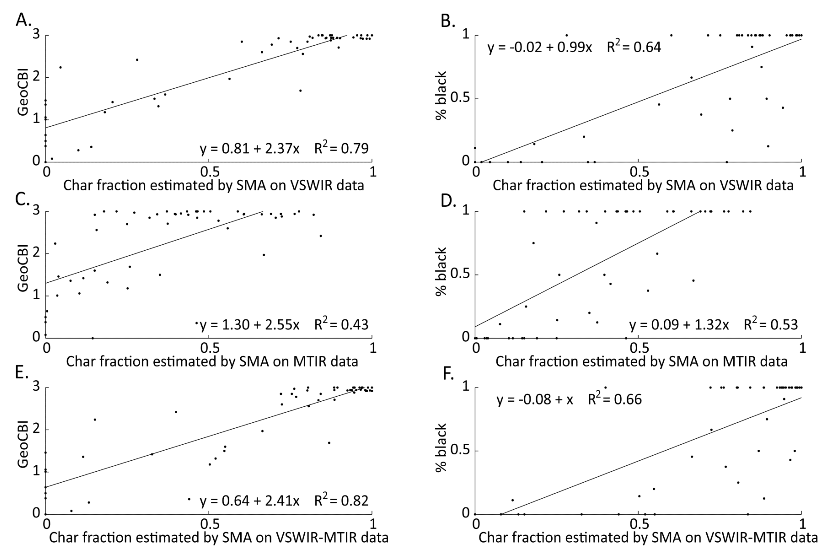
3) VSWIR and TIR synergy (HyspIRI)

VSWIR and TIR synergy: results

- VSWIR outperforms TIR for all ground cover types
- VSWIR-TIR synergy outperforms VSWIR for all ground cover types (HyspIRI)

Spectral region	Char R^2	Char a	Char b	GV R^2	GV a	GV b	NPV R^2	NPV a	NPV b	Substrate R^2	Substrate a	Substrate b
VSWIR	0.88	0.00	0.98	0.91	0.01	0.99	0.83	0.01	0.94	0.87	0.00	1.01
TIR	0.31	0.03	0.86	0.22	0.01	0.92	0.34	0.07	0.80	0.57	0.00	0.94
VSWIR-TIR (HyspIRI)	0.93	0.00	1.01	0.92	0.01	0.98	0.90	0.01	0.97	0.94	0.00	1.02





Fire severity and impact on carbon emission estimates

Retrieval of char, GV, NPV and substrate fractions

$$\textit{Burned fraction} = \frac{\textit{Combusted material}}{\textit{Combustible material}}$$

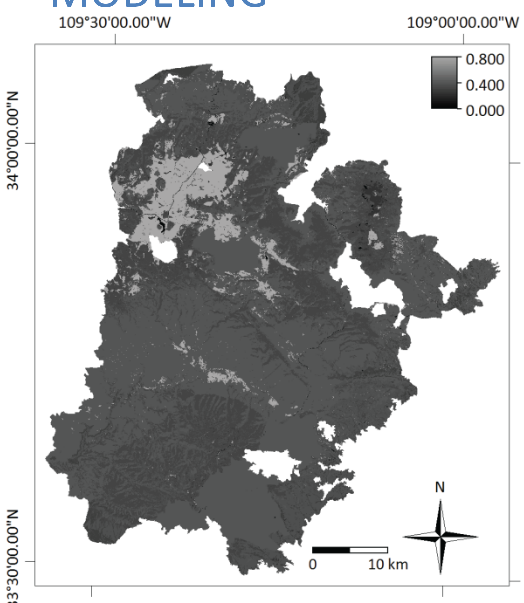
$$\textit{Burned fraction} = \frac{\textit{char}}{\textit{char} + \textit{vegetation}}$$

Emission = Area X Mass X Combustion factor X Emission factor

Combustion factor depends on:

Fuel type
Fuel moisture } Modeling
Fire severity → Remote sensing

MODELING & FIRE SEVERITY → COMBUSTION



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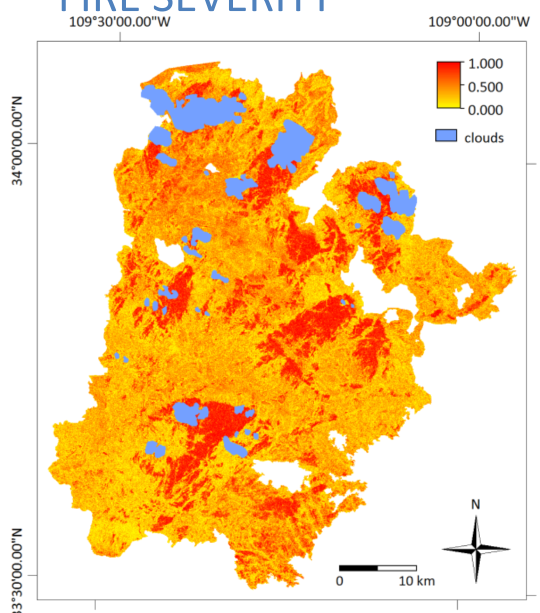

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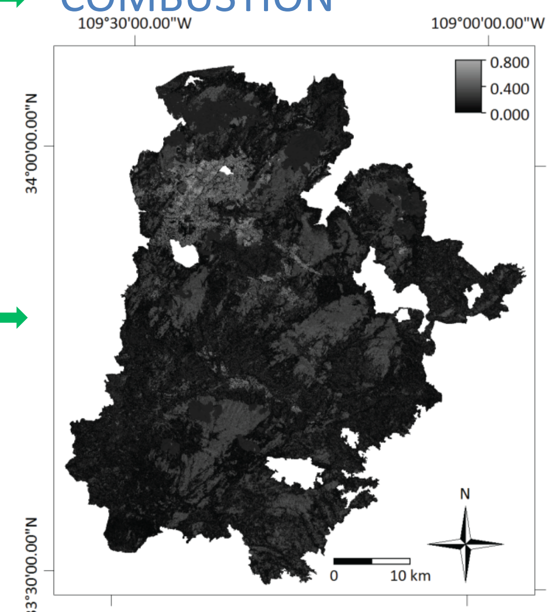
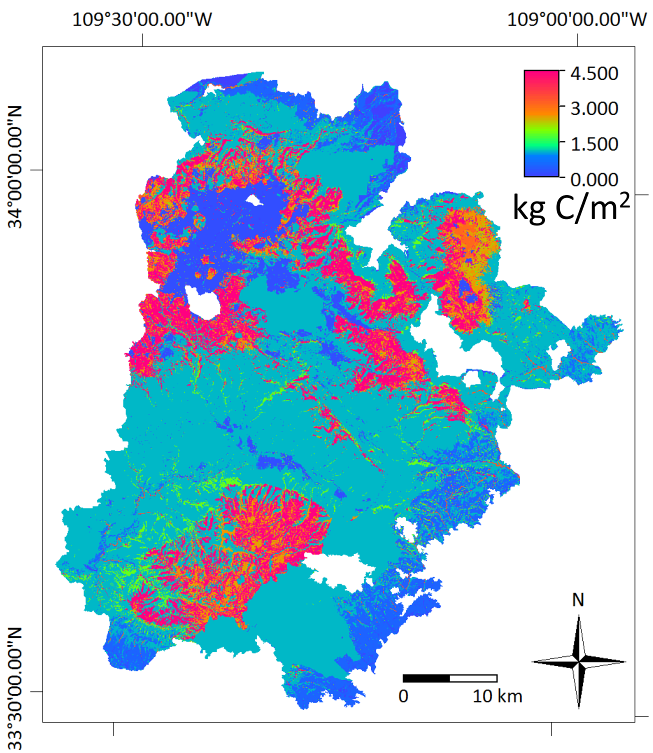
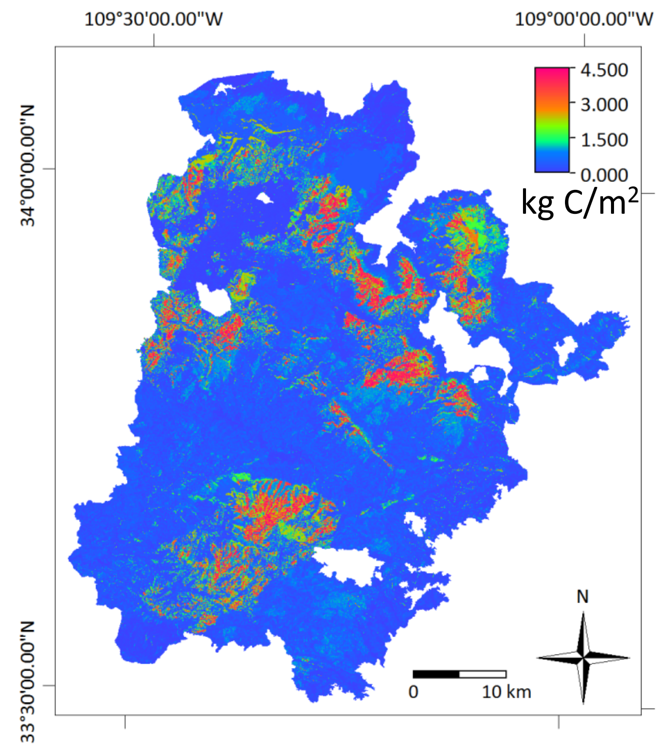


Fire severity and impact on carbon emission estimates

C emission from modeling only



C emission from modeling and remote sensing



Fire	Burned area (ha)	CC estimation methodology	Total C emission (Tg)	Area normalized C emission (kg/m²)	% carbon emitted relative to 'modeling-only' approach
Wallow	218 000	Modeling	3.44	1.57	1
Wallow	218 000	Modeling and remote sensing	1.52	0.70	0.45
Canyon	5900	Modeling	0.12	2.02	1
Canyon	5900	Modeling and remote sensing	0.09	1.47	0.73

Conclusions

1) A synergy of VSWIR and TIR data improves fire severity assessments (HyspIRI)

2) Fire severity data have big potential to refine combustion completeness and carbon emissions estimates

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Synergy of VSWIR (0.4–2.5 μm) and MTIR (3.5–12.5 μm) data for post-fire assessments

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