Effects of COVID-19 on CO_2 emissions globally and in the U.S.

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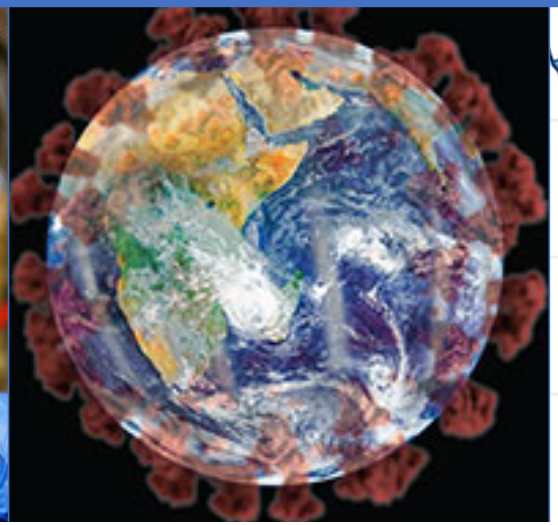
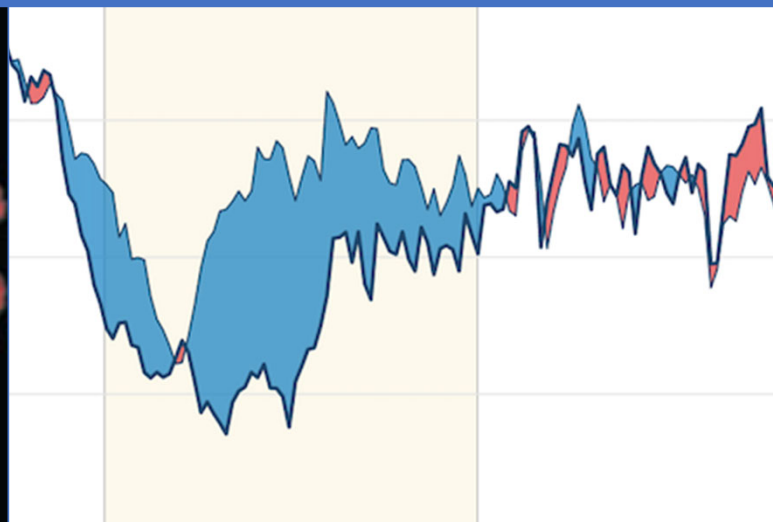
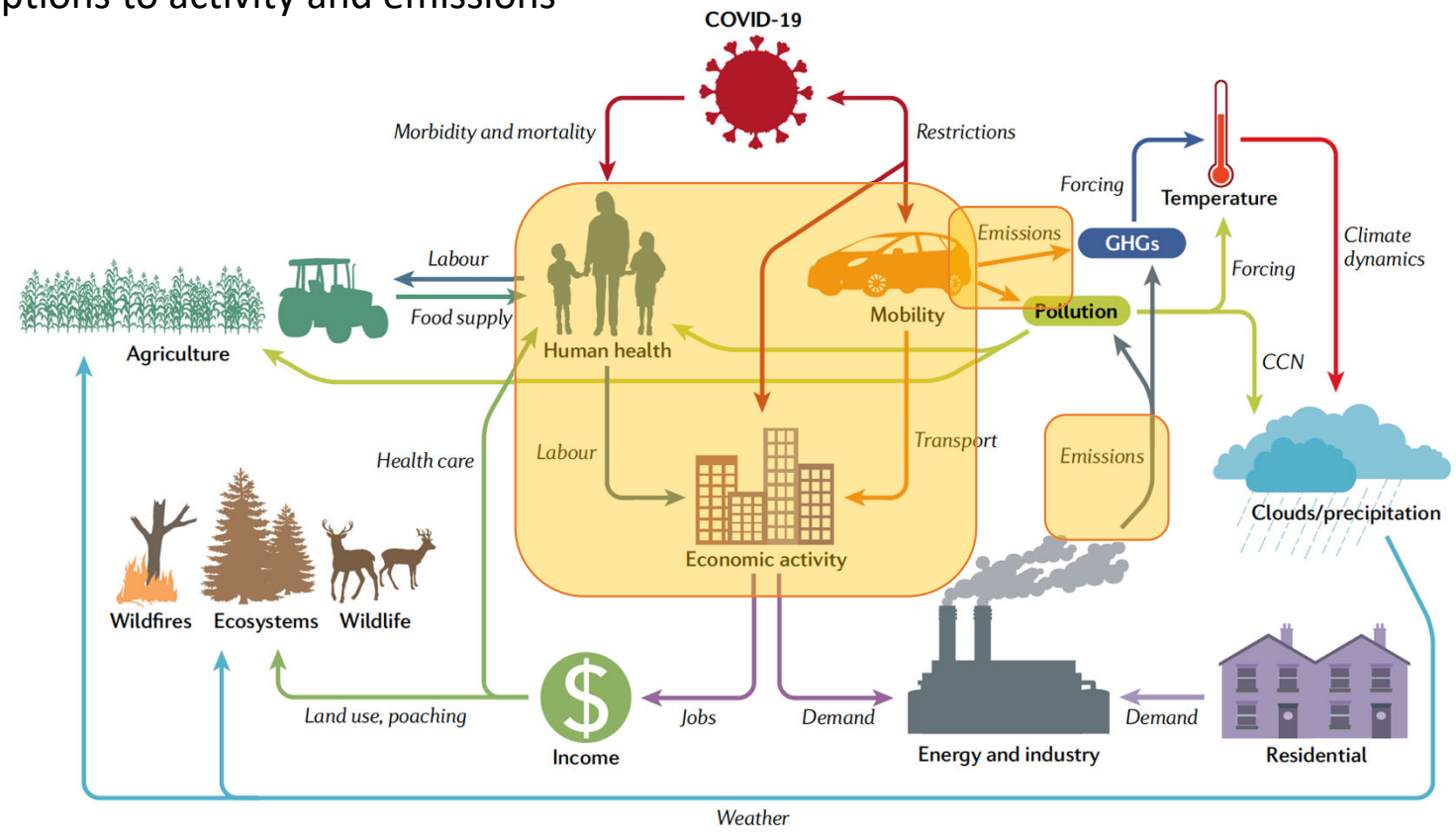
CalPlug Workshop





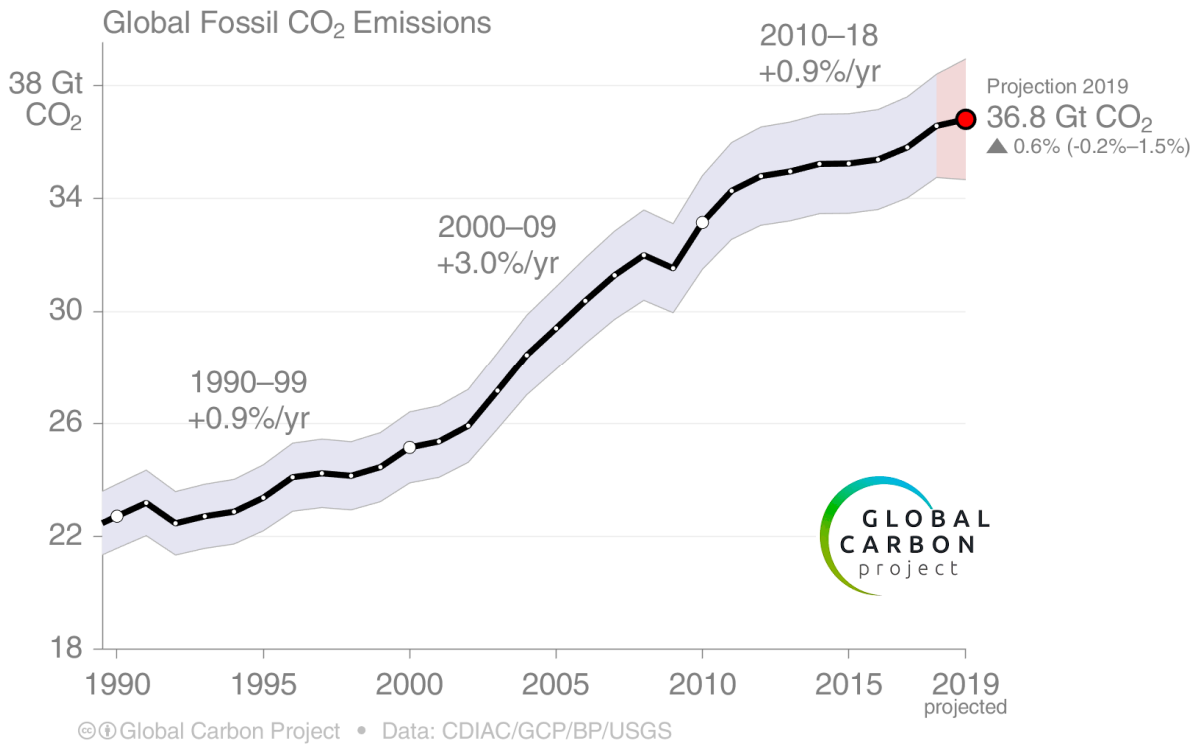
COVID disruptions to activity and emissions



Public health responses that limit mobility reduce transportation emissions and affect energy and industry emissions via changes in economic activity.

Diffenbaugh et al., *Nature Reviews Earth & Environment*, 2020

Fossil fuel CO_2 emissions

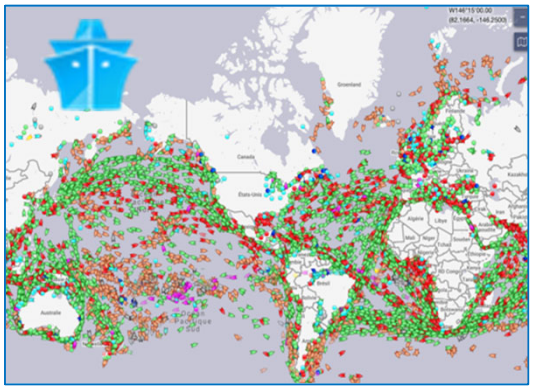


But global (and national) emissions have in recent years been reported *annually*, and even then projected based on partial data and assumptions.

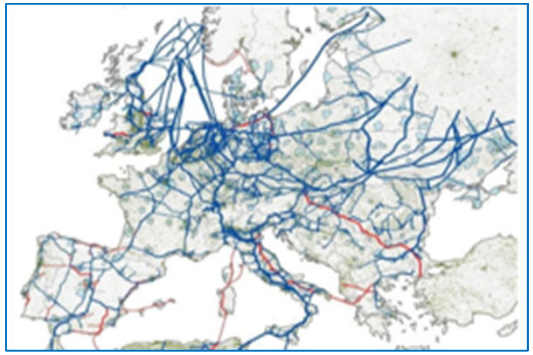
Friedlingstein et al., *ESSD*, December 2019

Hourly or daily activity data related to CO_2 emissions in different sectors

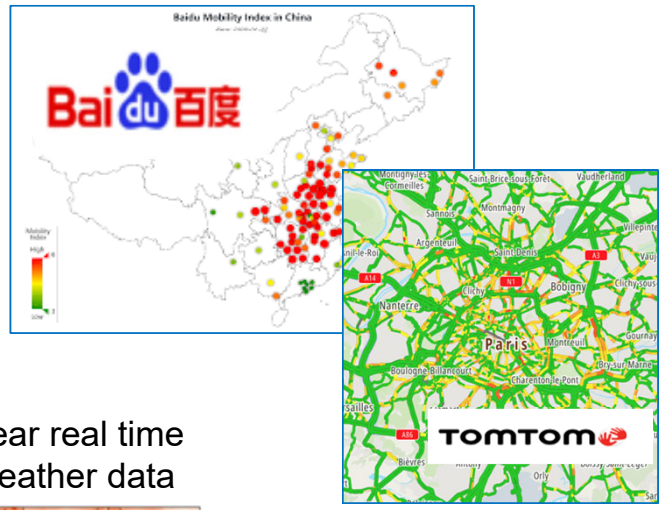
Aircraft and ship tracks



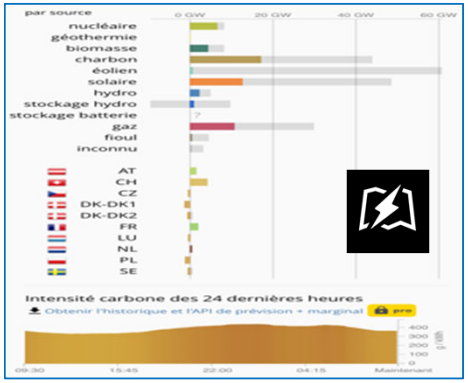
Pipeline delivery of gas to residential & commercial buildings



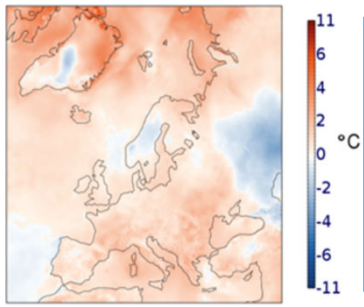
Traffic & mobility data from city to county scale



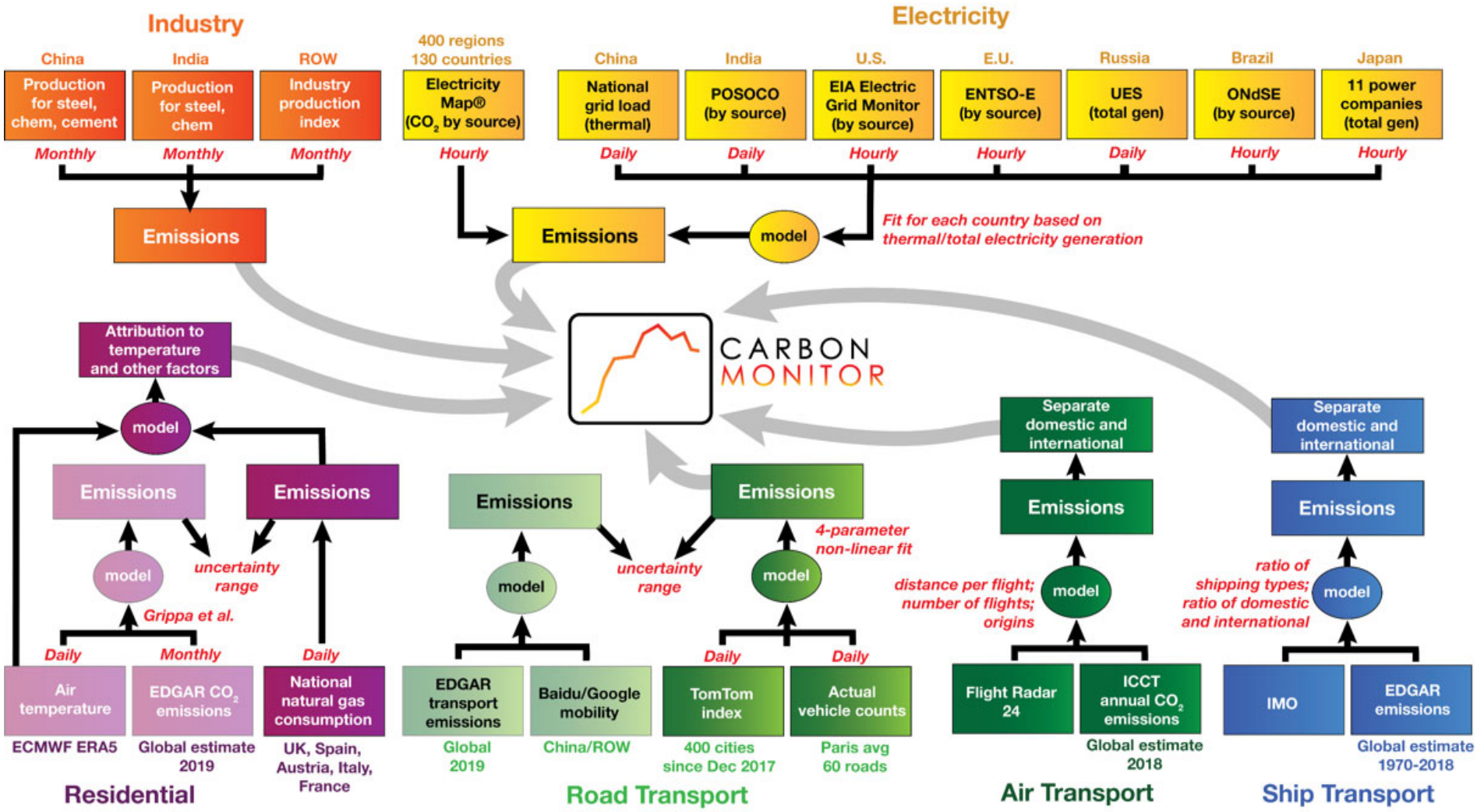
Hourly to daily electricity data
Including fossil & low carbon mix



Near real time weather data

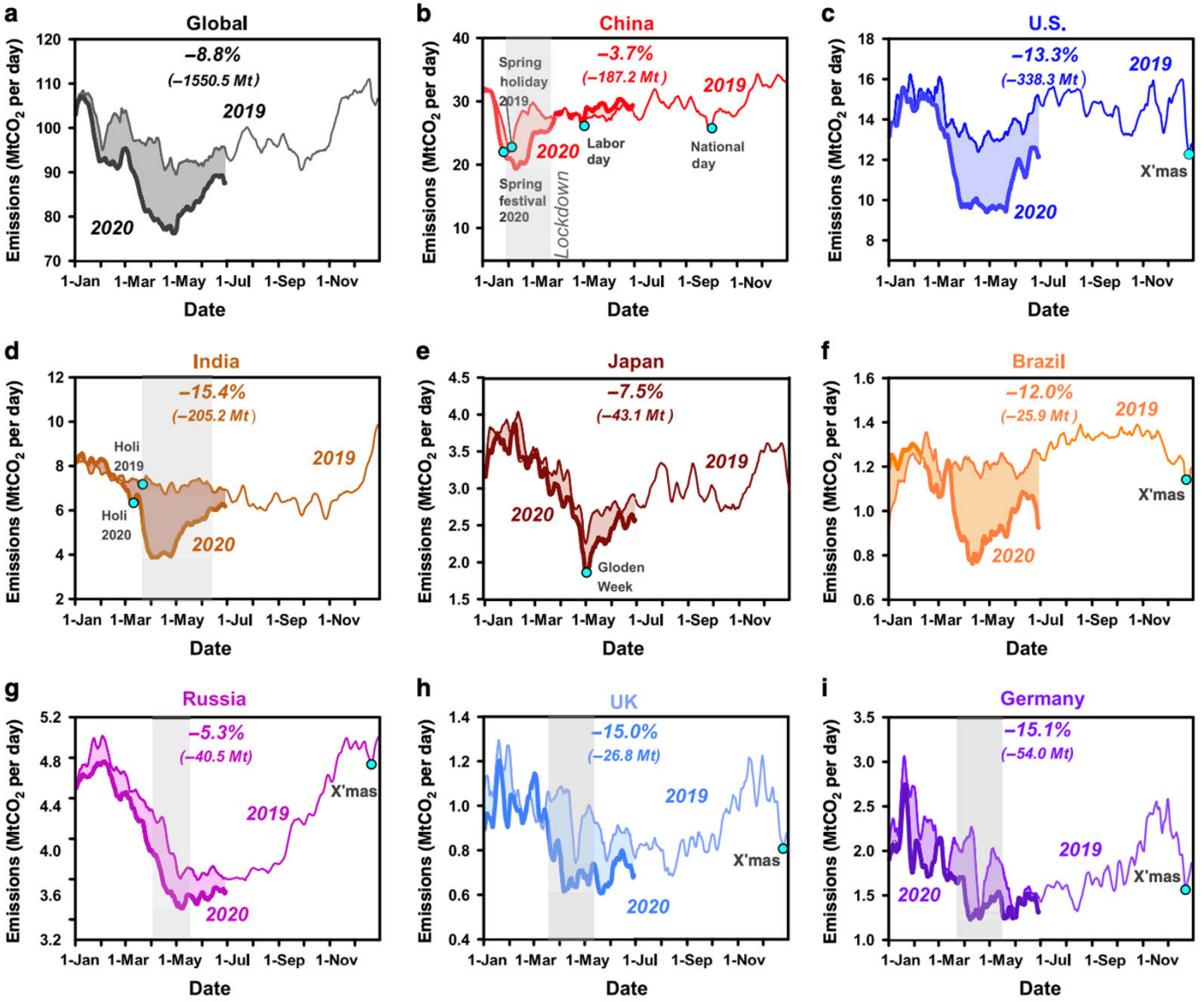


CO_2 emissions operational analysis system for six sub-sectors



Daily emissions estimates show COVID-related reductions

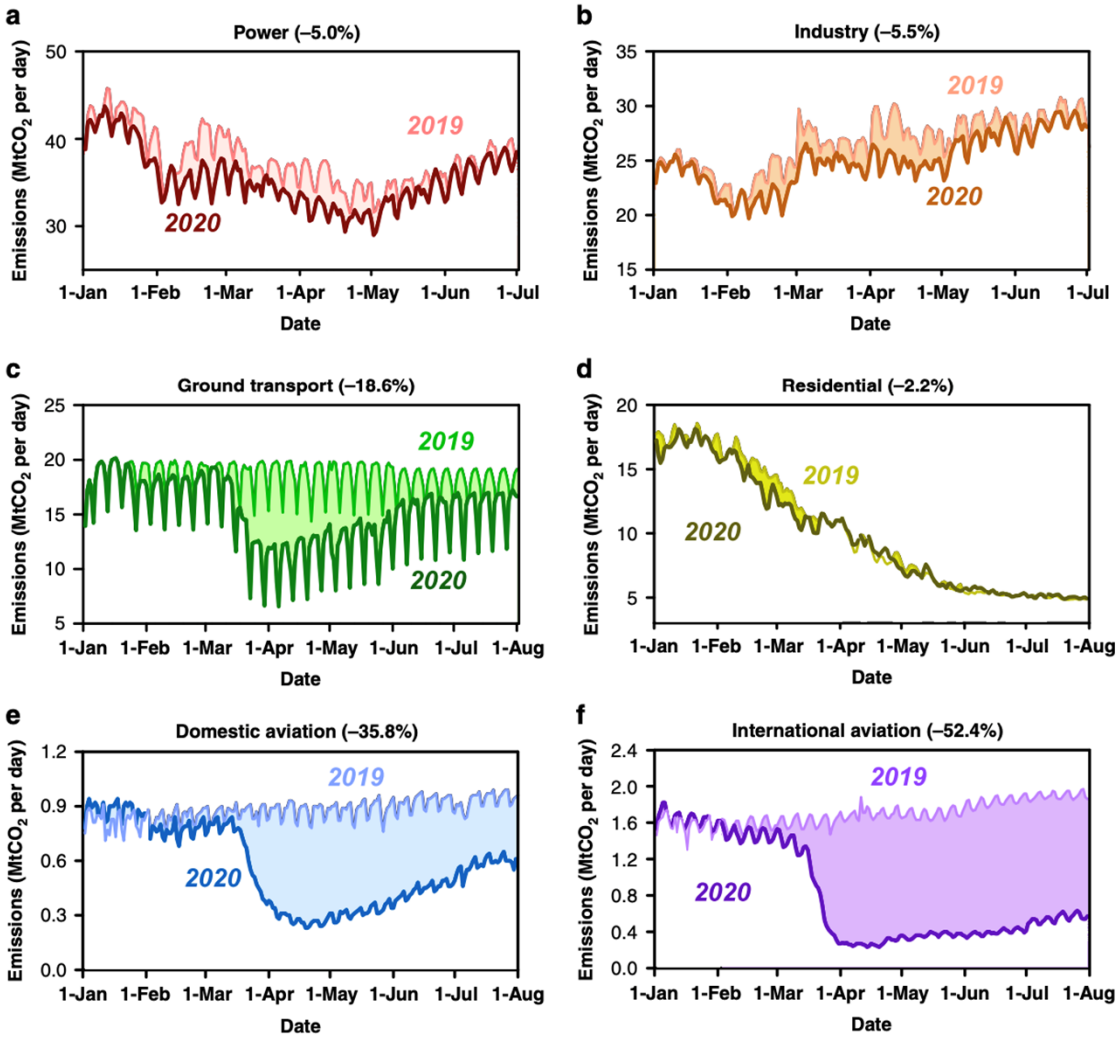
- Daily emission estimates reveal all variations caused by energy price, weather, climate, weekends and holidays and COVID
- Global emissions were down 8.8% January through June
- Return to pre-COVID levels in China and some EU countries



Liu et al., *Nature Communications*, 2020

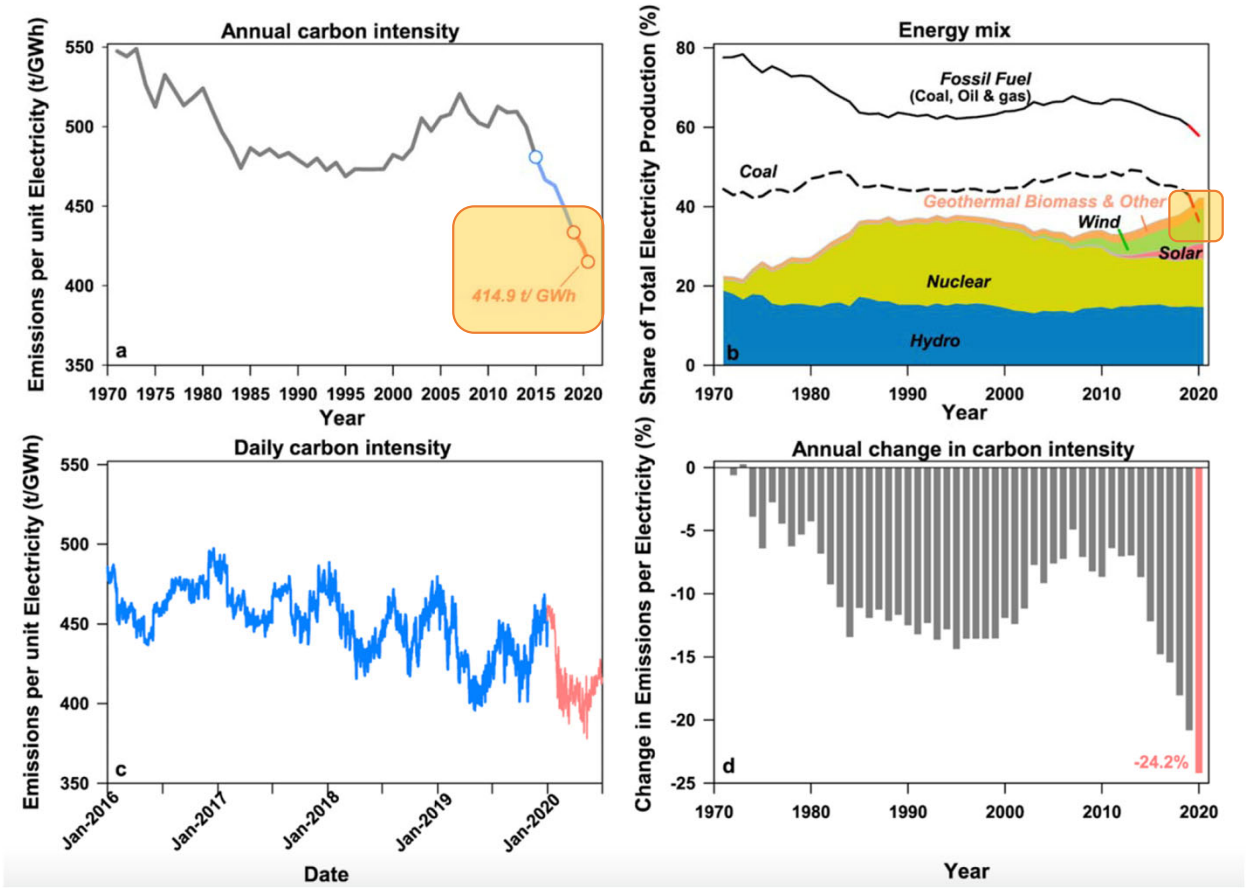
Different sectoral impacts (globally)

Emissions from **ground transportation** and **aviation** have decreased most.



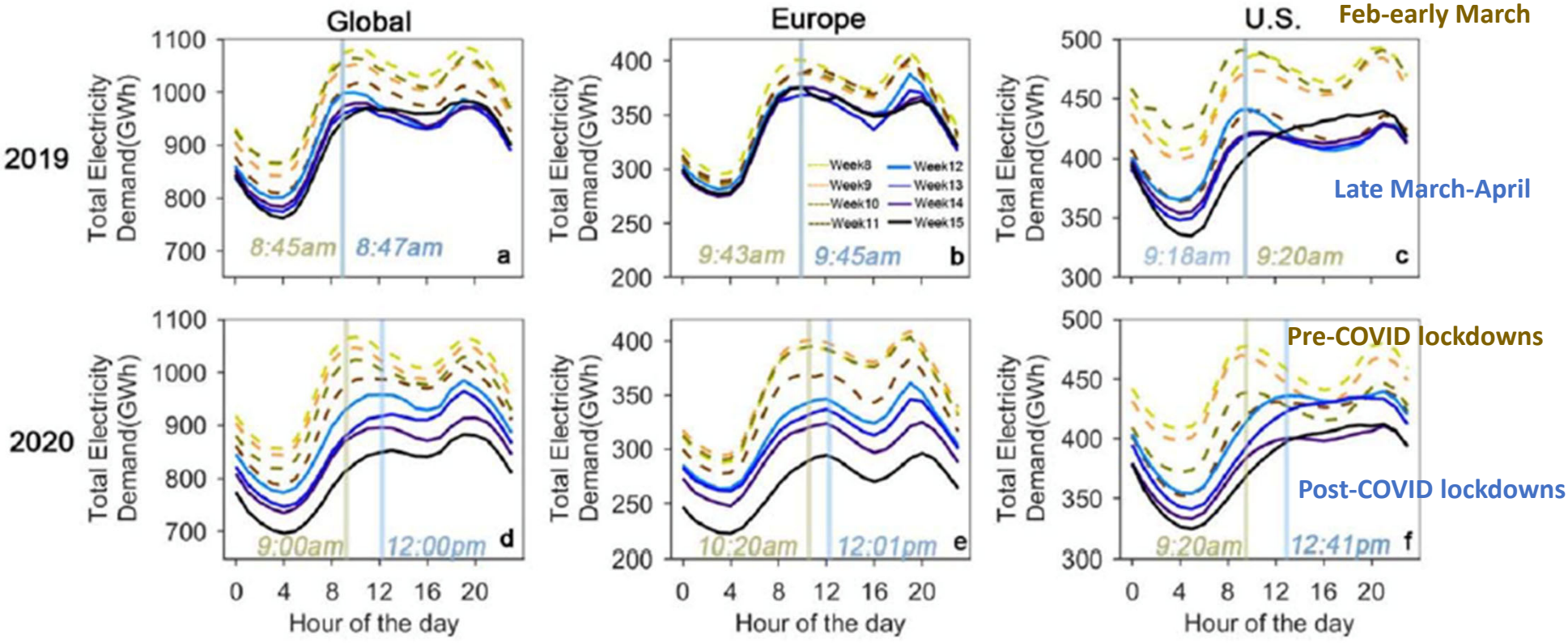
Liu et al., *Nature Communications*, 2020

Also changes in the carbon intensity of the power sector worldwide



Liu et al., *in review*

Changes in timing of demand also favored renewables



Liu et al., *in review*

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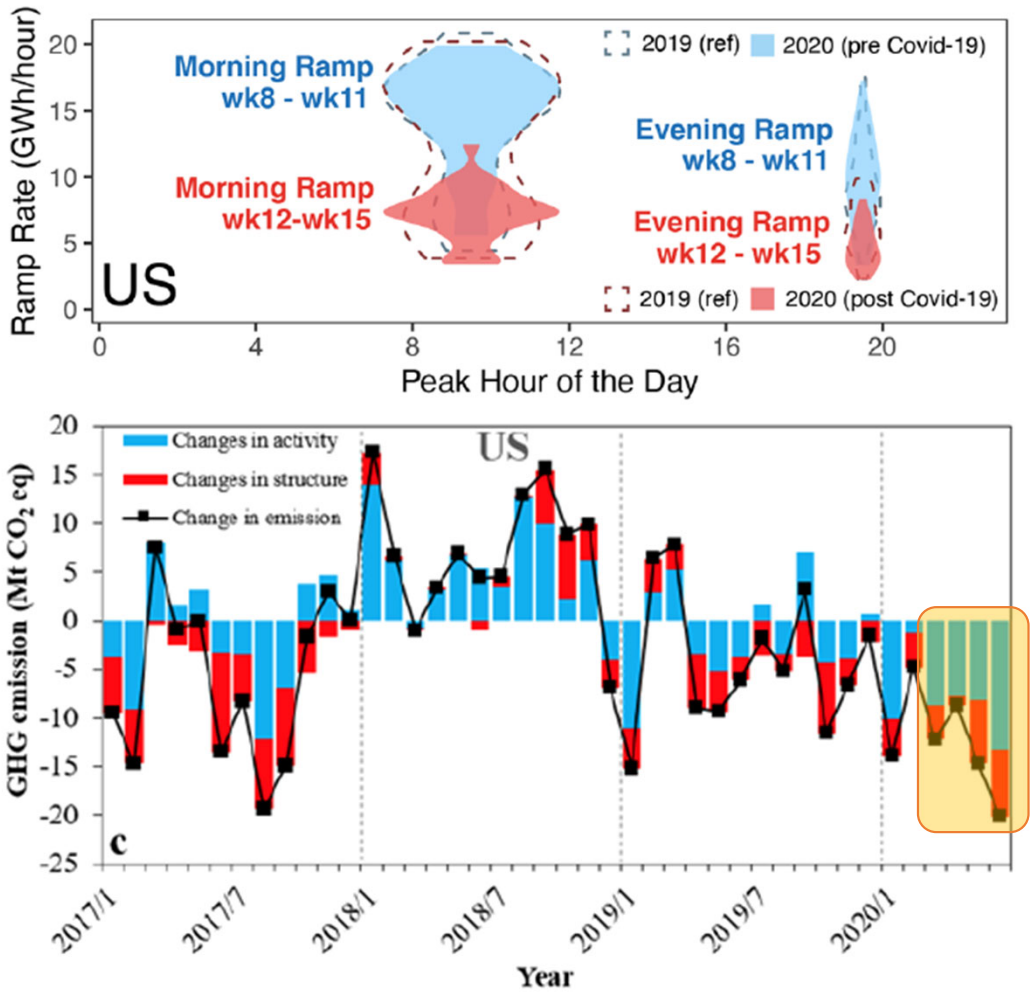
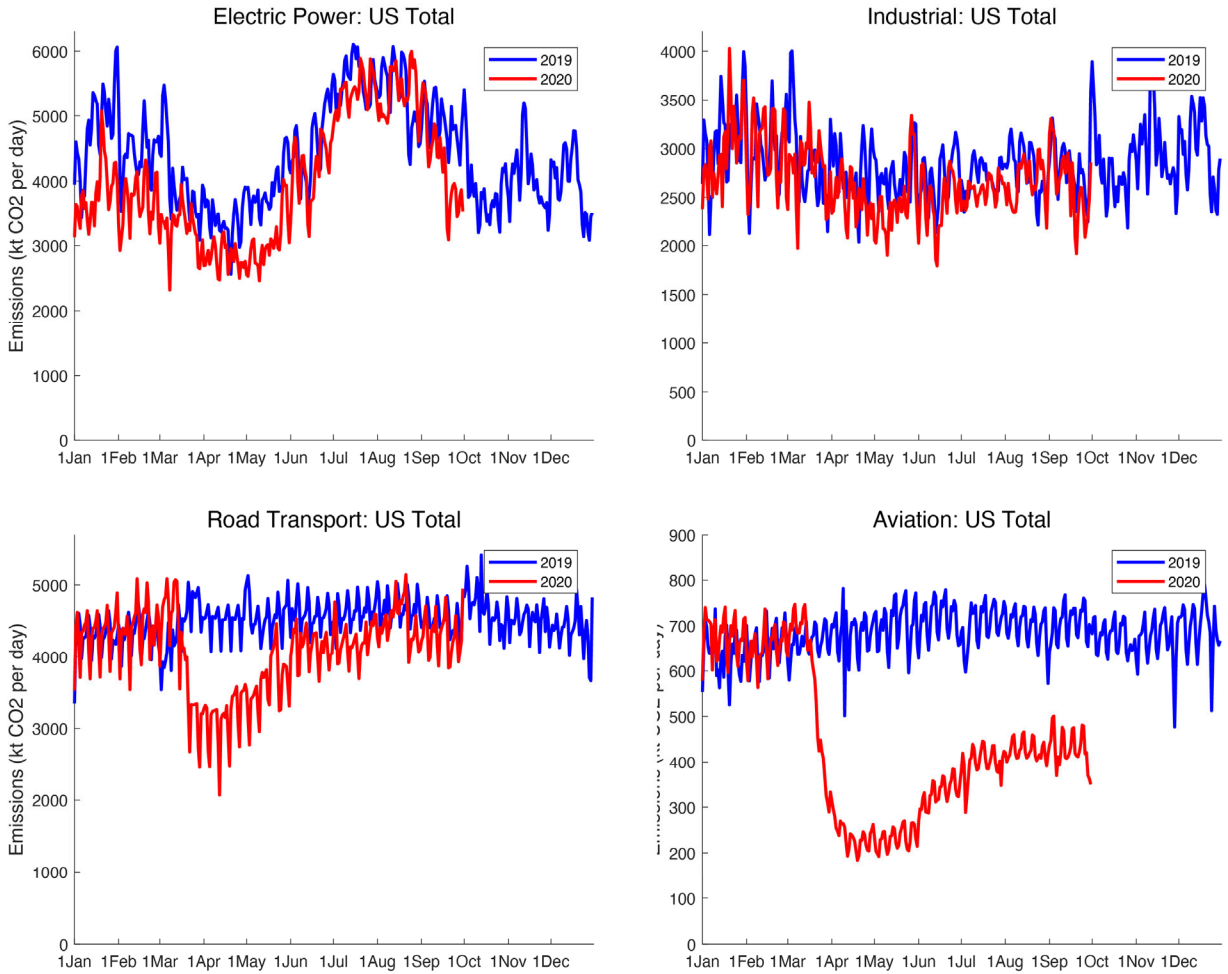


COVID lockdowns

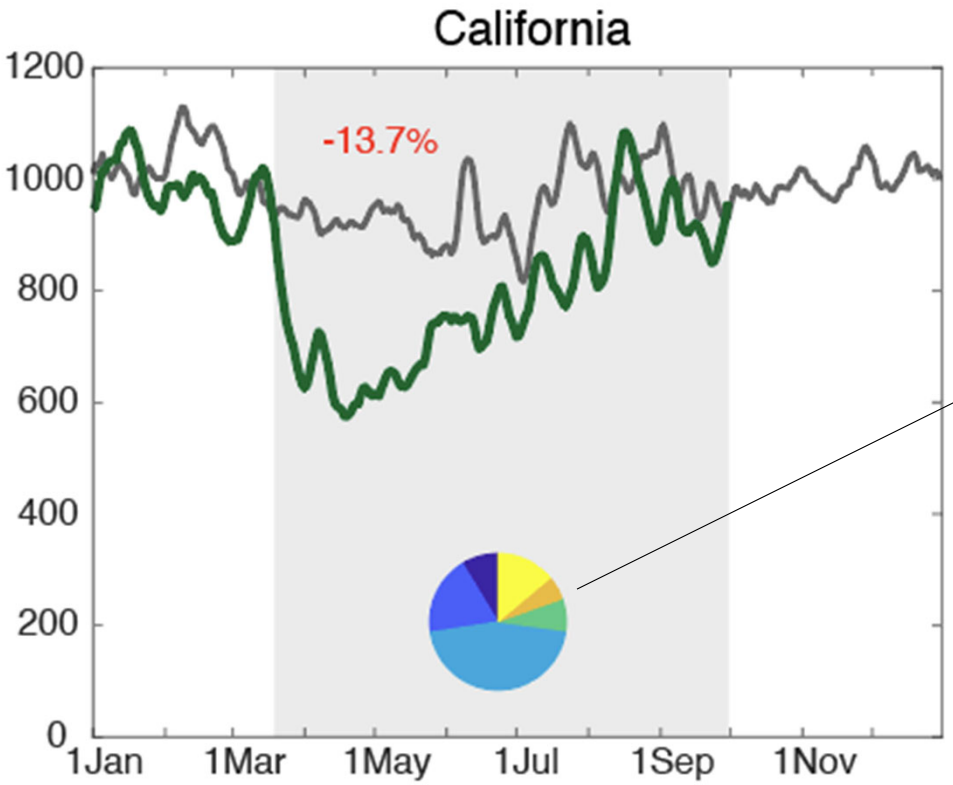
Liu et al., *in review*

Digging into sector-specific differences in U.S. emissions



Hong et al., *in prep*

Now making estimates at the U.S. state-level



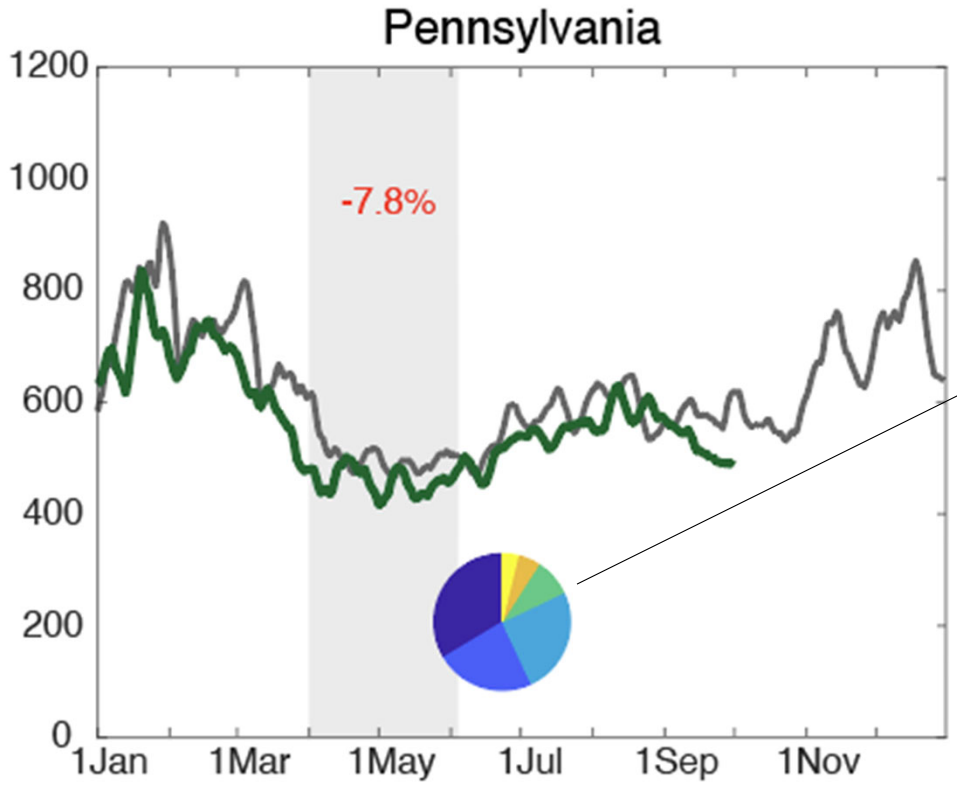
Sectoral breakdown of emissions in 2019:

Power
Industry
Road Transportation
Residential
Commercial
Aviation

Note the large share of emissions from road transport and aviation.

Hong et al., *in prep*

Now making estimates at the U.S. state-level



Sectoral breakdown of emissions in 2019:

Power
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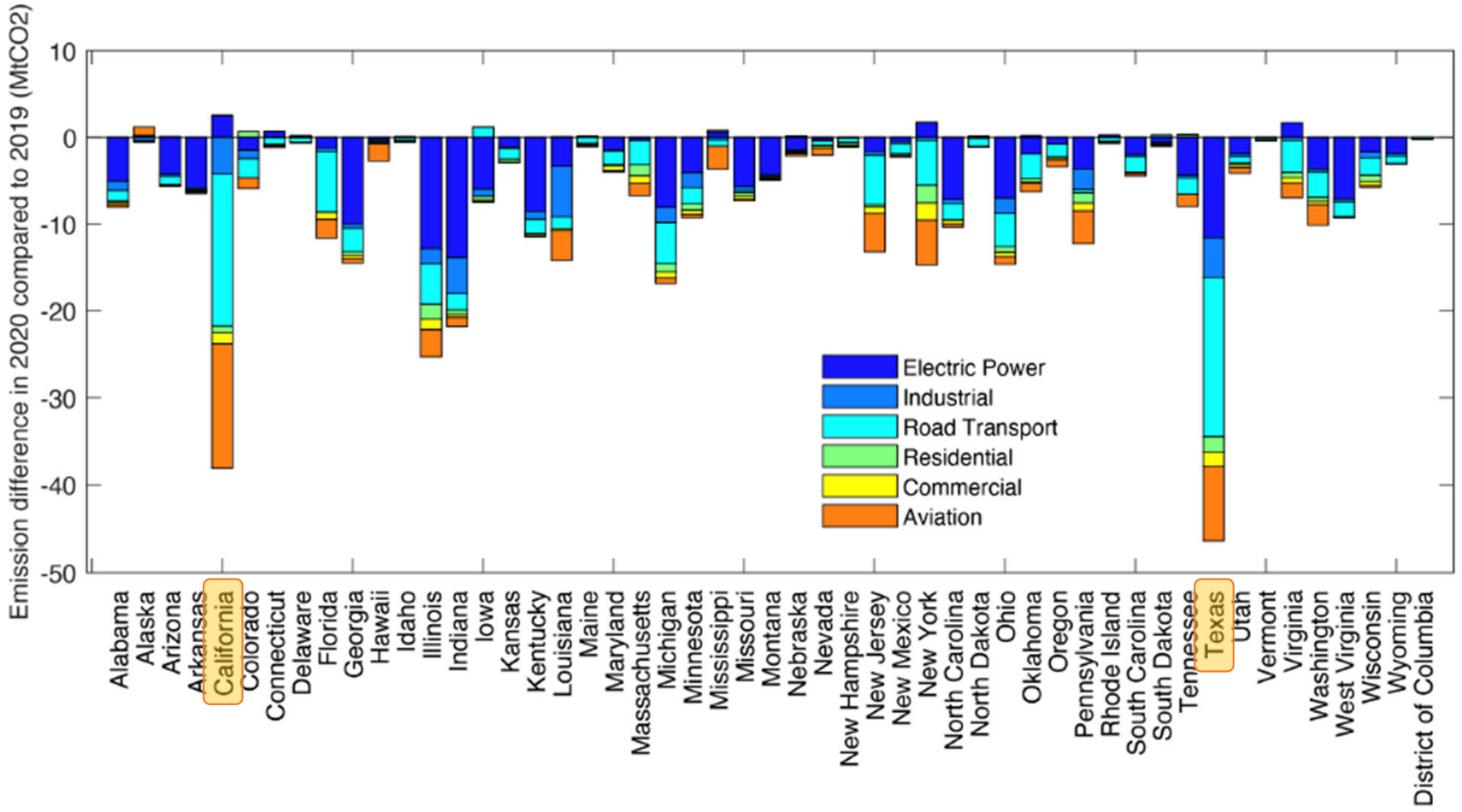
With a lower share of emissions from transport, difference between 2019 and 2020 is less.

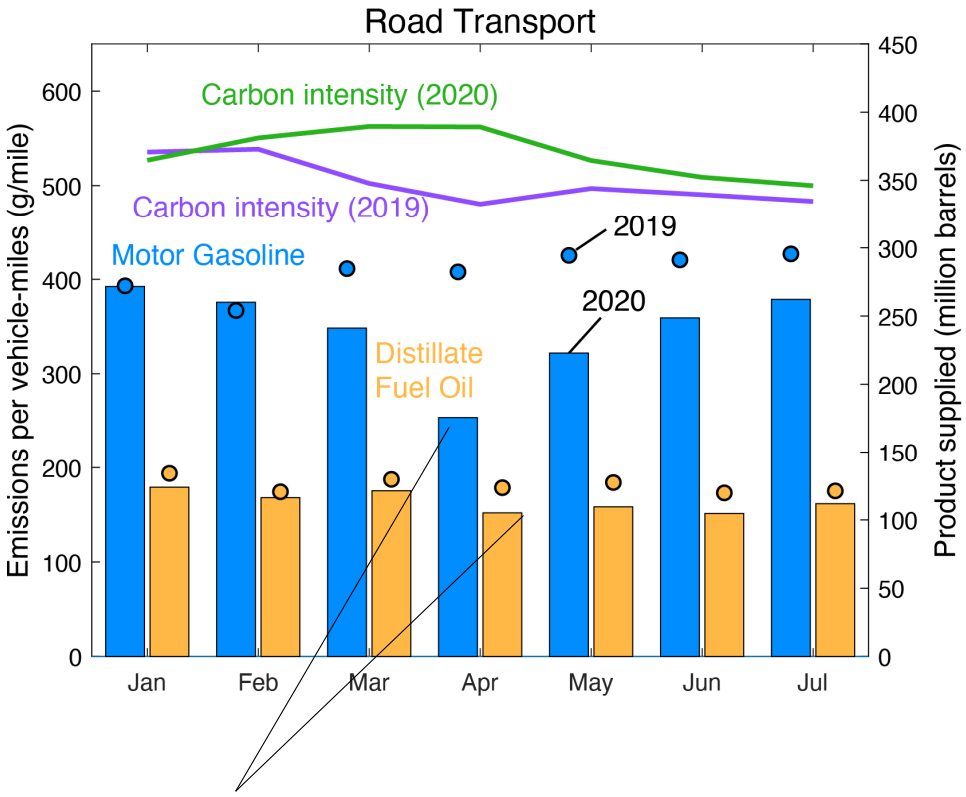
Hong et al., *in prep*

Biggest absolute decreases in largest states

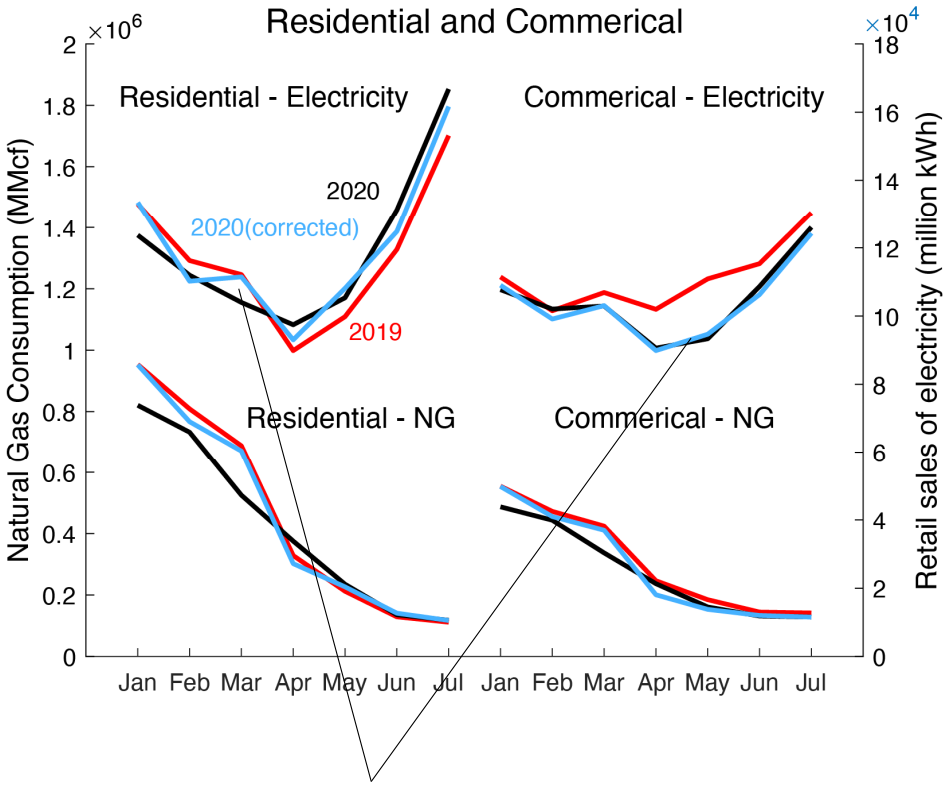


Hong et al., *in prep*

Sector-specific changes



Gasoline sales dipped much more than **diesel** in 2020.

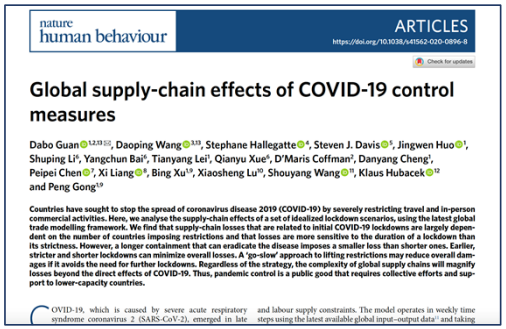


Residential electricity spiked a bit early in 2020, while commercial electricity dipped.

Hong et al., *in prep*

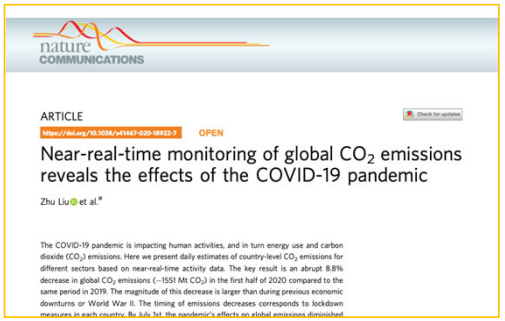
Take-aways

- The pandemic has given us an opportunity to observe how large-scale changes in human activity and mobility affect energy use and CO_2 emissions at planetary scales.
- Although a 9% decrease in global emissions is the largest on record, it's remarkably small considering the disruption in our daily lives. Deep decarbonization requires not only behavioral changes by systemic changes in energy structure.
- Going forward, near-real time estimates of CO_2 emissions at country- and state-level can help monitor the effects of technology and policy changes, enabling more adaptive management.

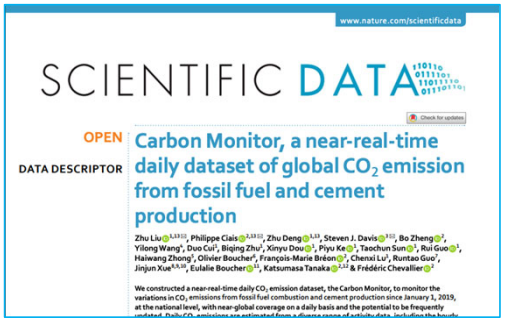


Guan et al., *Nature Human Behavior*, 2020

Diffenbaugh et al., *Nature Reviews Earth & Environment*, 2020



Liu et al., *Nature Communications*, 2020



Liu et al., *Scientific Data*, 2020

Acknowledgements

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Thank you.

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