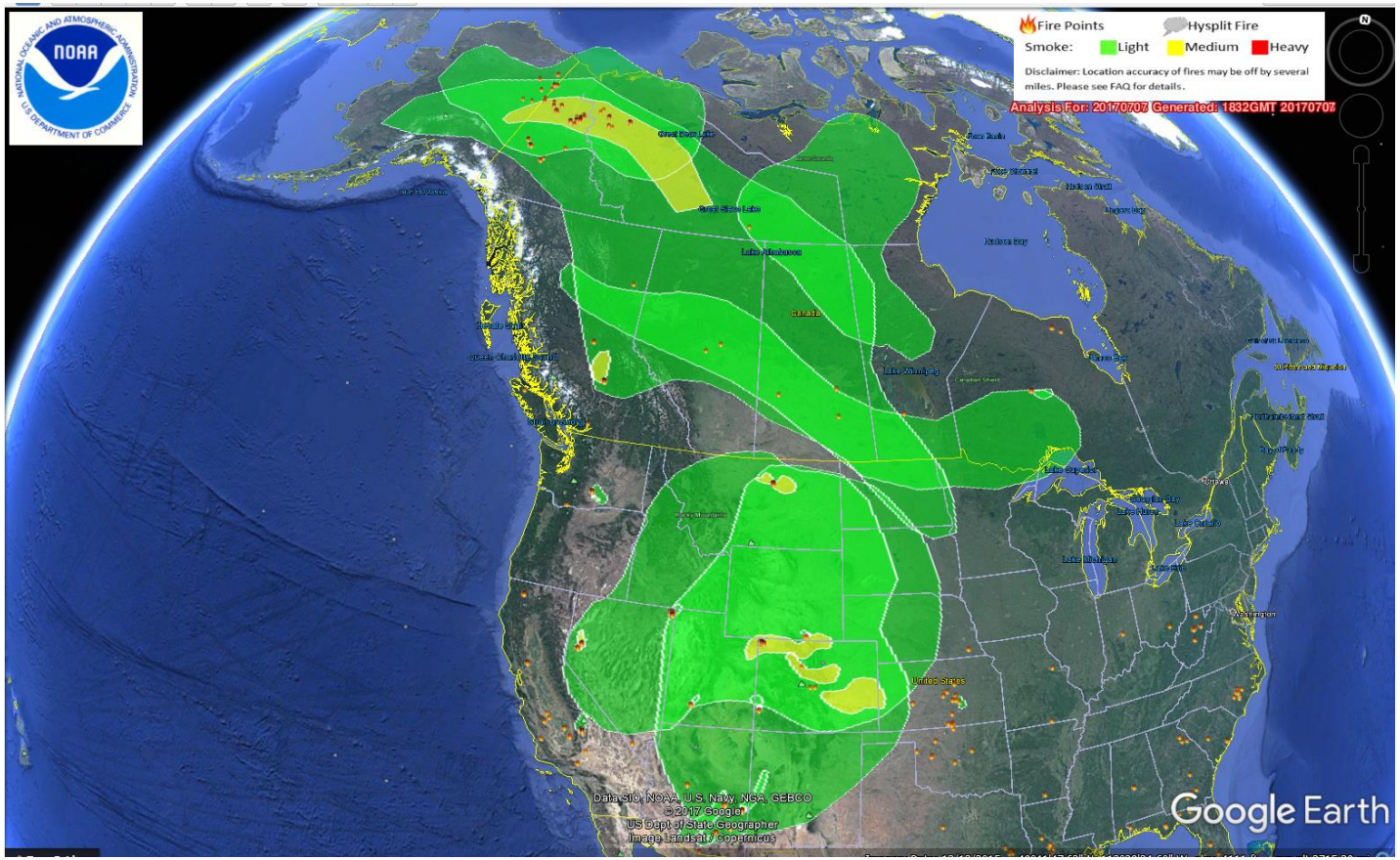
# Fire datasets, emissions, forecasting, land cover

Christine Wiedinmyer

# Overview

- Emissions from Fires
  - Available inventories
  - Creating your own emissions
    - Input datasets
- Fire Forecasting
  - What's available online data
- What else are you looking for?



# Estimating emissions from open burning

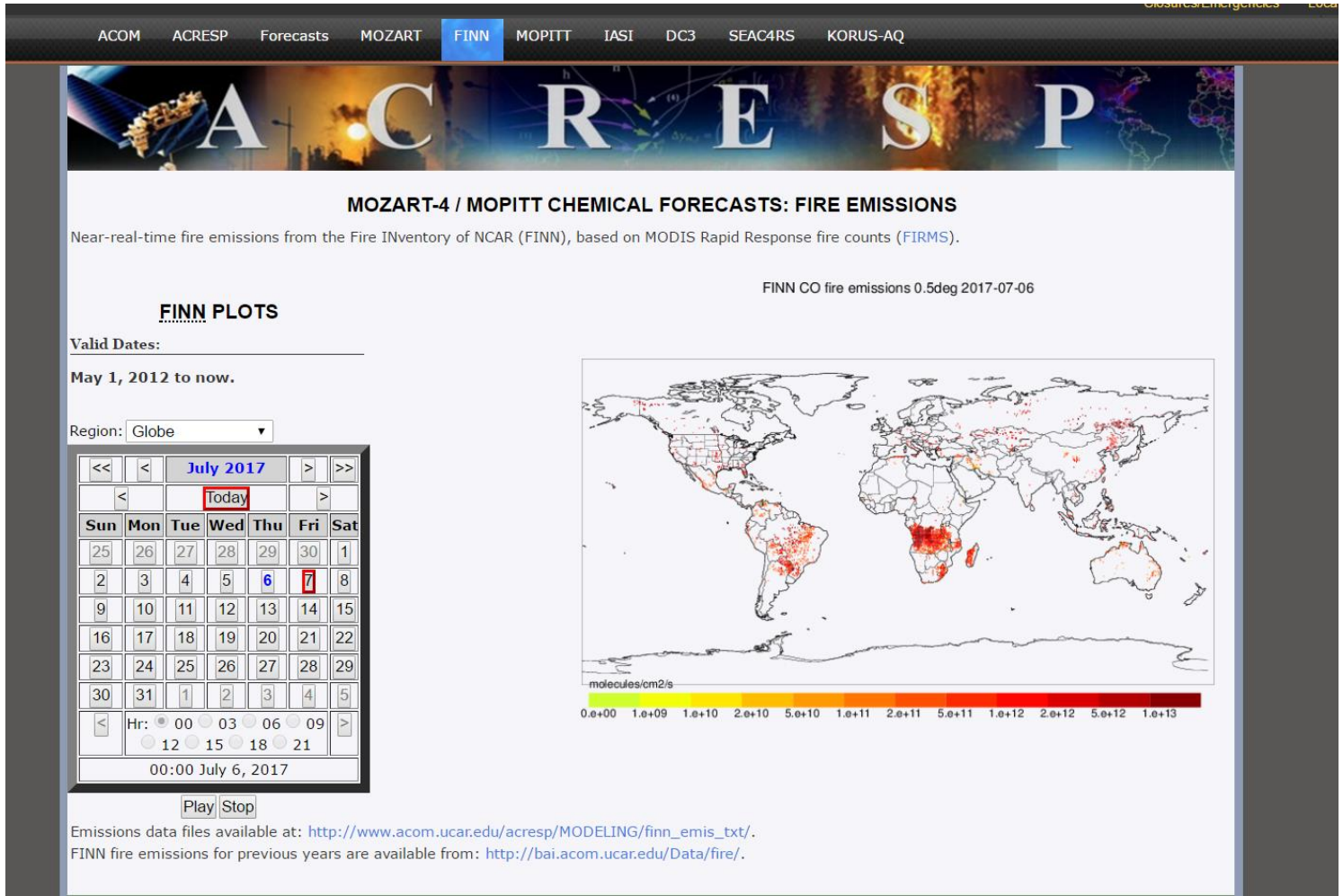
- Fire-Specific Estimates
  - Biscuit Fire (Campbell et al., 2007)
  - Black Saturday Fires Australia (Murphy et al., 2012)

- Regional Models
  - FLAMBE (Reid et al., 2008)
  - North America (Wiedinmyer et al., *AE,* 2006)
  - Himalaya (Vadrevu et al., *AE*, 2011)
  - Western U.S. (Urbanski, *ACP,* 2012)
  - Asia (Song et al., *ERL,* 2010)
  - Western Africa (Liousse et al., 2010)

- Global Models
  - GFED (van der Werf et al., *AC&P,* 2010 and others)
  - FINN (Wiedinmyer et al., *GMD*, 2011)
  - GFAS, (Kaiser et al. *Biogeosciences,* 2012)
  - QFED (Darmenov, A. S., and da Silva, A. 2015. *The Quick Fire Emissions Dataset (QFED): Documentation of versions 2.1, 2.2 and 2.4*. (R. D. Koster, Ed.) (Vol. 38). USA.)

# Where can I find these?

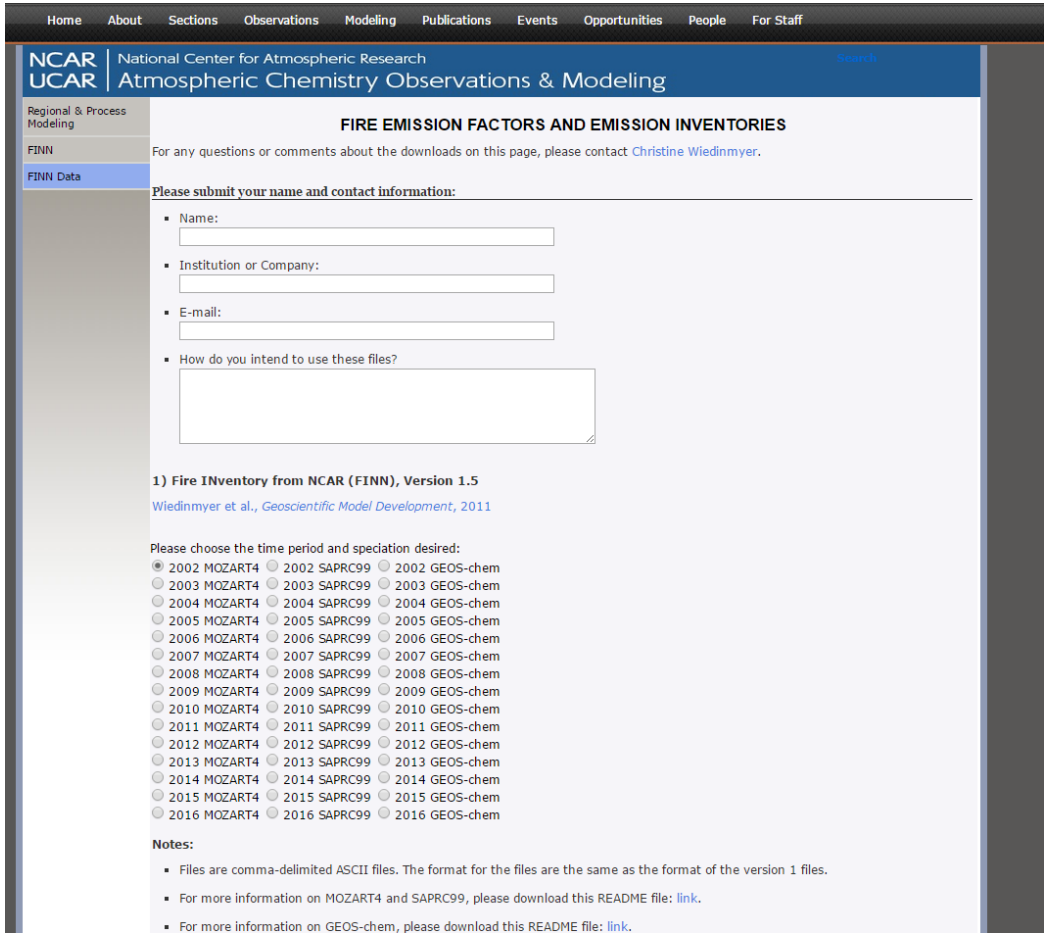
- FINN
  - Forecast emissions (version 1): https://www.acom.ucar.edu/acresp/forecast/fire-emissions.shtml



Stay prior to the current year. Overlapping years are okay

# Where can I find these?

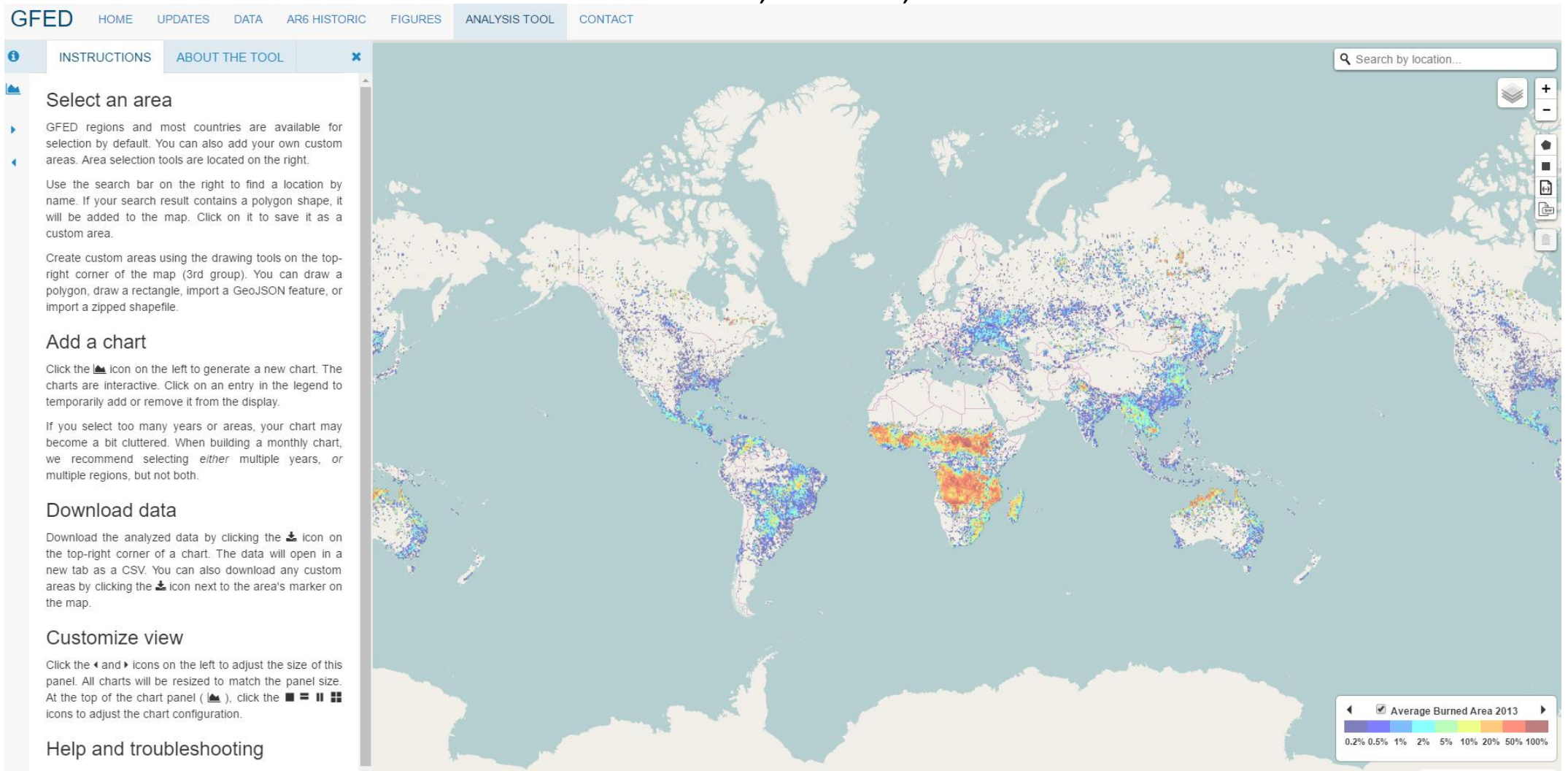
- FINN
  - Forecast emissions (version 1): https://www.acom.ucar.edu/acresp/forecast/fire-emissions.shtml
  - Hindsight emissions (version 1.6): http://bai.acom.ucar.edu/Data/fire/
    - Comma-delimited files
    - Each fire a different entry
    - Developing tool to extract and develop gridded emissions



# Where can I find these?

- GFED
  - http://www.globalfiredata.org/

van der Werf, G. R., Randerson, J. T., Giglio, L., van Leeuwen, T. T., Chen, Y., Rogers, B. M., Mu, M., van Marle, M. J. E., Morton, D. C., Collatz, G. J., Yokelson, R. J., and Kasibhatla, P. S.: Global fire emissions estimates during 1997–2015, Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2016-62, in review, 2017.



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  - 0.1 degree gridded data, 2000- November 2016 available at:
    - ftp://iesa@ftp.nccs.nasa.gov/aerosol/emissions/QFED/v2.4r6/0.1/
    - Monthly files by compound in NetCDF file format

**Index of /aerosol/emissions/QFED/v2.4r6/0.1/Y2016/M11/**

| Name | Size | Date Modified |
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| [parent directory] | | |
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| qfed2.emis_ch2o.005.20161101.nc4 | 819 kB | 11/9/16, 5:00:00 PM |
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| qfed2.emis_so2.005.20161101.nc4 | 819 kB | 11/9/16, 5:00:00 PM |

# Where can I find these?

- GFAS
  - Kaiser et al, *Biogeosciences*, 2012
    - http://www.biogeosciences.net/9/527/2012/bg-9-527-2012.pdf
  - http://atmosphere.copernicus.eu/documentation-fire-emissions

# Estimating emissions

$$Emissions_i = f(A(x,t), B(x,t), E_{f_i})$$

**A(x,t):** Area burned

**B(x,t):** Biomass burned (biomass burned/area)

- type of vegetation (ecology)
- fuel characteristics:
  - amounts of woody biomass, leaf biomass, litter, ...
- fuel condition
  - moisture content

**$E_{fi}$**: Emission factor (mass emission$_i$ /biomass burned)

- fuel characteristics
- fuel condition

# Emission factors for open and domestic biomass burning for use in atmospheric models

S. K. Akagi[1], R. J. Yokelson[1], C. Wiedinmyer[2], M. J. Alvarado[3], J. S. Reid[4], T. Karl[2], J. D. Crounse[5], and P. O. Wennberg[6]

Atmos. Chem. Phys., 11, 4039–4072, 2011
www.atmos-chem-phys.net/11/4039/2011/
doi:10.5194/acp-11-4039-2011

Published 2011
2015 Update at:
http://bai.acom.ucar.edu/Data/fire/

http://bai.acom.ucar.edu/Data/fire/finn-subset.shtml

# Chemistry of Emissions

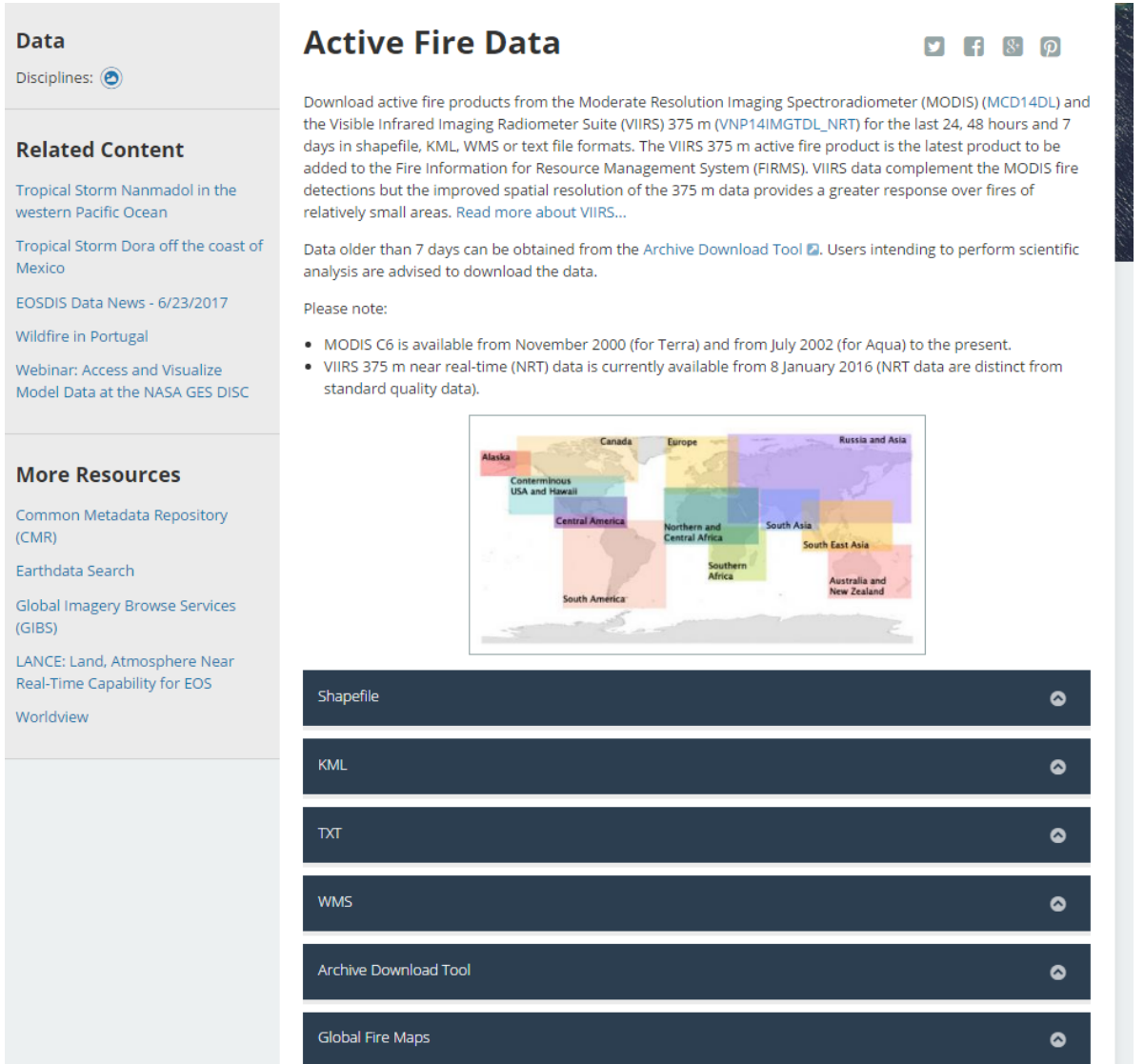
- Applications for models
- How explicit do we need the emissions?

- Temporal changes in emissions
- Controlling variables:
  - Fire conditions (i.e., temperature, flaming/smoldering)
  - Vegetation type, density
  - Vegetation conditions (i.e., drought stressed)

# Fire Locations

- https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms

MODIS and VIIRS fire detections
Current and Archived Data
Text, KML,  or GIS shapefiles

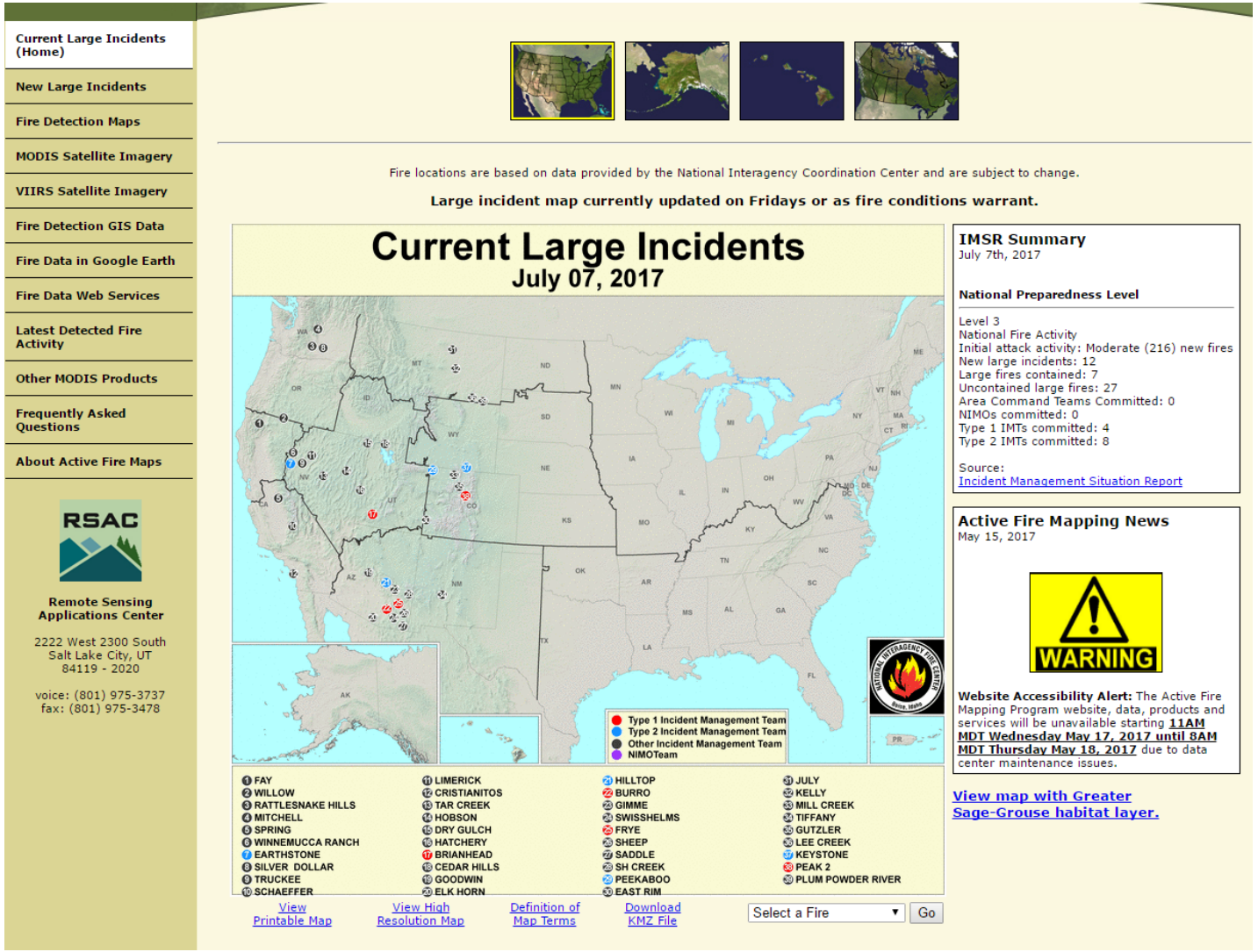


# Fire Locations

- NOAA Hazard Mapping System
  - http://www.ospo.noaa.gov/Products/land/hms.html

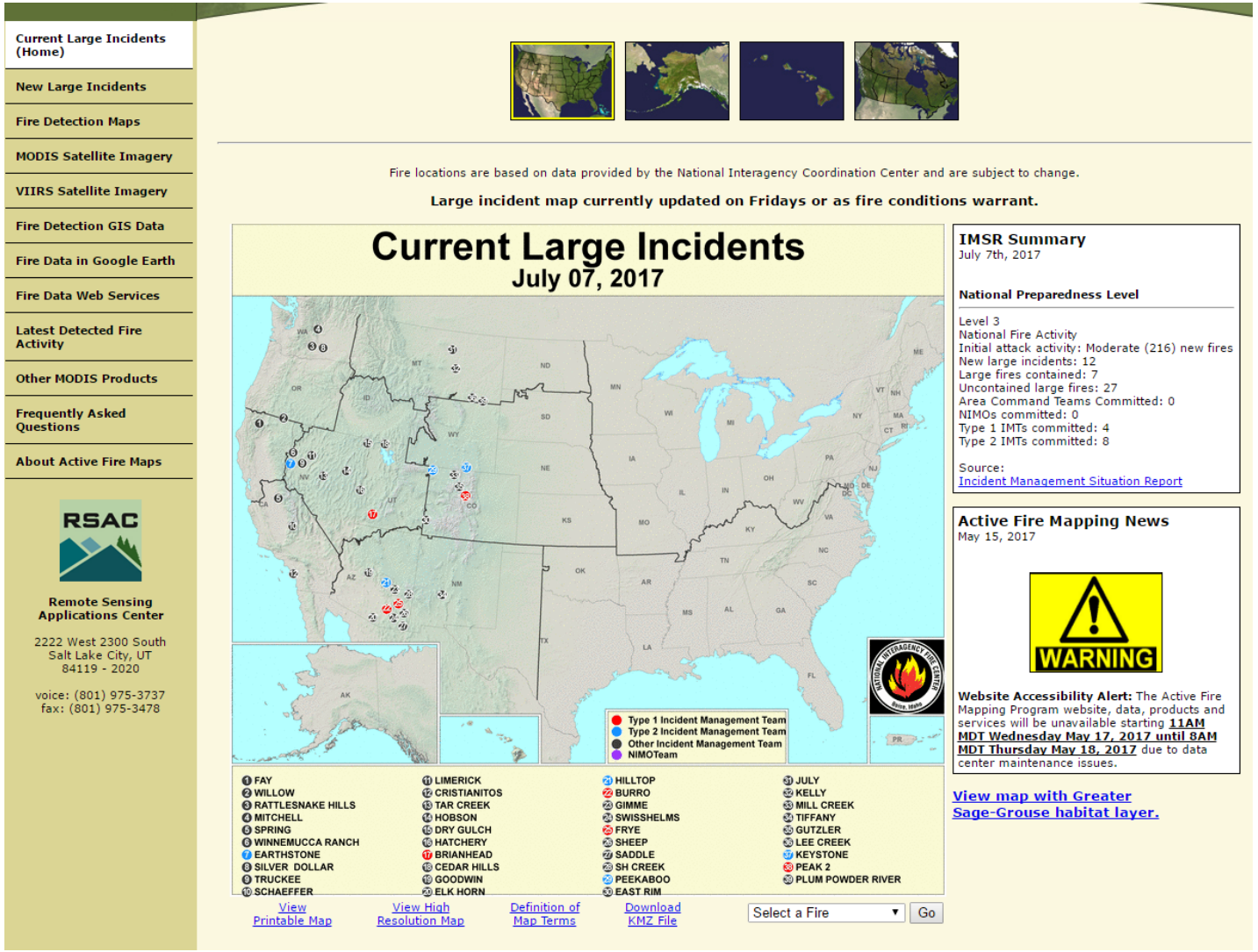
# Fire Locations

- USFS RSAC
  - https://fsapps.nwcg.gov/afm/



# Fire Locations

- USFS RSAC
  - https://fsapps.nwcg.gov/afm/
  - MODIS, VIIRS, AVHRR, GOES



# Other resources about fire locations, etc.

- Wildfire Automated Biomass Burning Algorithm (WFABBA)
  - http://wfabba.ssec.wisc.edu/
  - North and South America
- InciWeb
  - https://inciweb.nwcg.gov/
- NIFC
  - https://www.nifc.gov/
- NICC
  - https://www.predictiveservices.nifc.gov/intelligence/intelligence.htm

# Burned area data

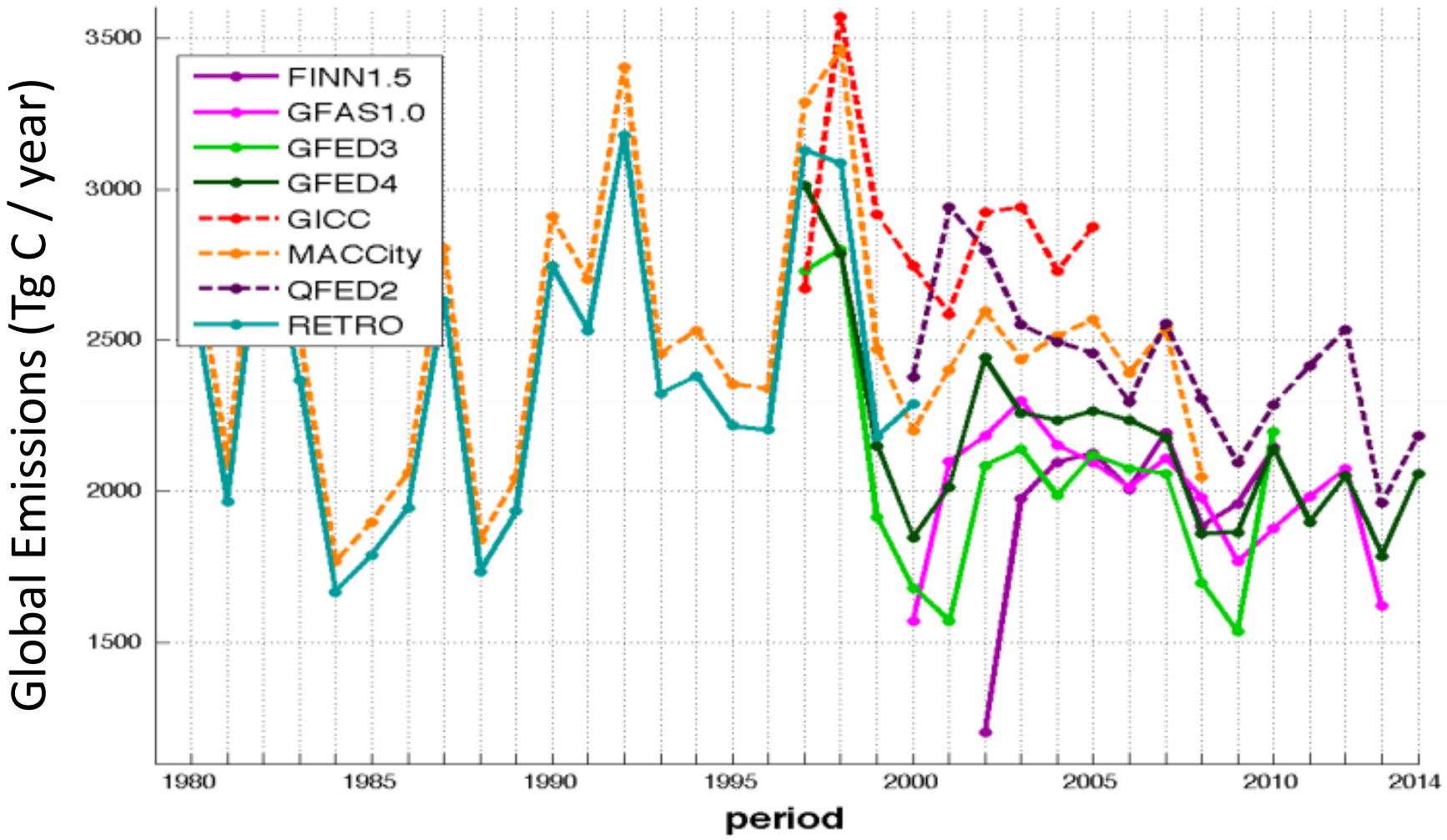
- MODIS Burned Area Products
  - http://modis-fire.umd.edu/pages/BurnedArea.php
- USFS Burned Area Emergency Response (BAER)
  - https://www.fs.fed.us/eng/rsac/baer/
- Monitoring Trends in Burn Severity (MTBS)
  - http://www.mtbs.gov/

# Vegetation

- Global
  - MODIS DatasetsLand Cover Type
    - Vegetation Continuous Fields
  - USGS 30m Land Cover
    - https://landcover.usgs.gov/glc/
    - Tree cover
  - Global Land Cover, http://www.globallandcover.com/GLC30Download/index.aspx
  - ESA 200m Annual Land Cover (1992-2015)
    - https://www.esa-landcover-cci.org/?q=node/175

# Uncertainties in Emission Estimates

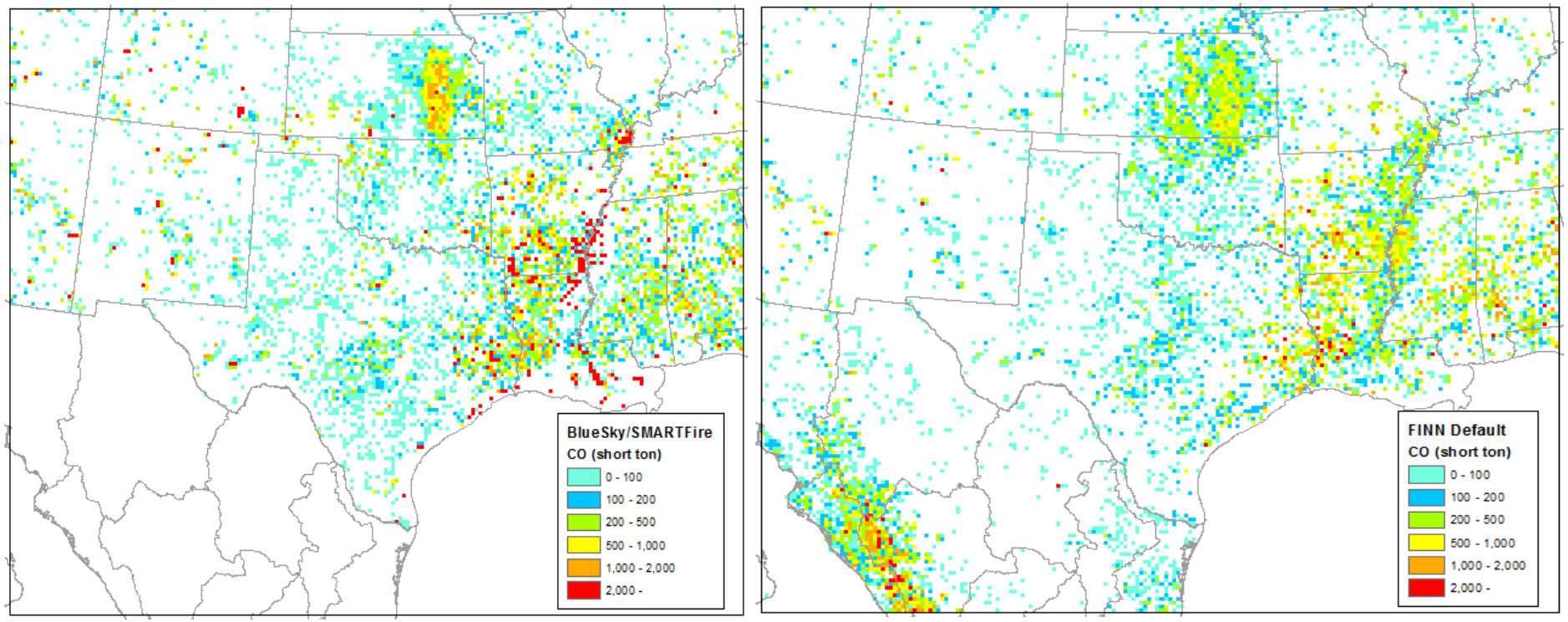
# Uncertainties in the emission models




K. Sindelarova, *in prep*

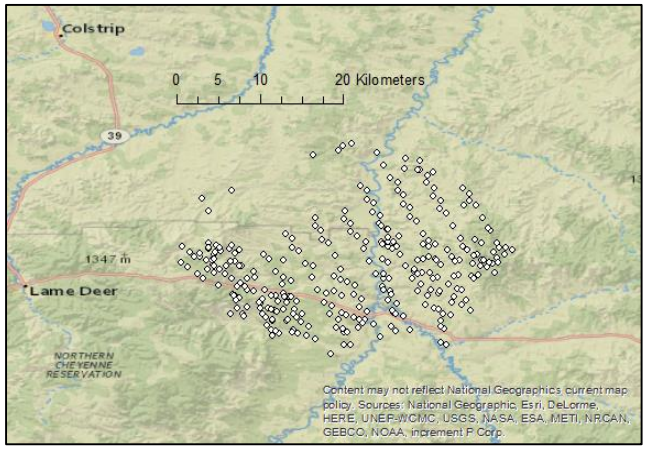
# Uncertainties in the emissions

- Emission Factors
- Fire location/timing
- Fuel loadings
- Fuel Consumption

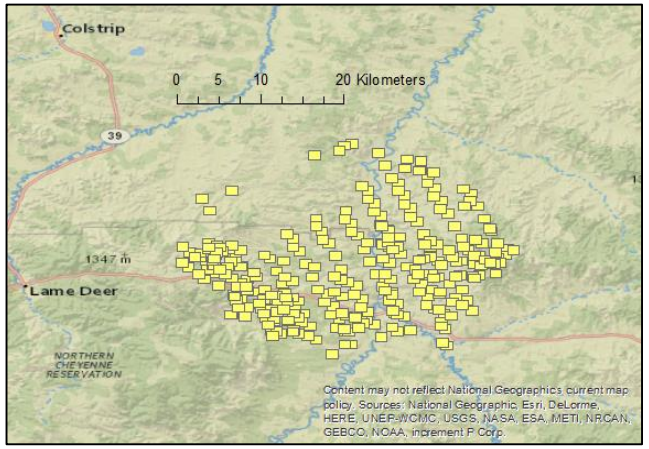



*E. McDonald-Buller, C. Emery, C. Wiedinmyer 2013*

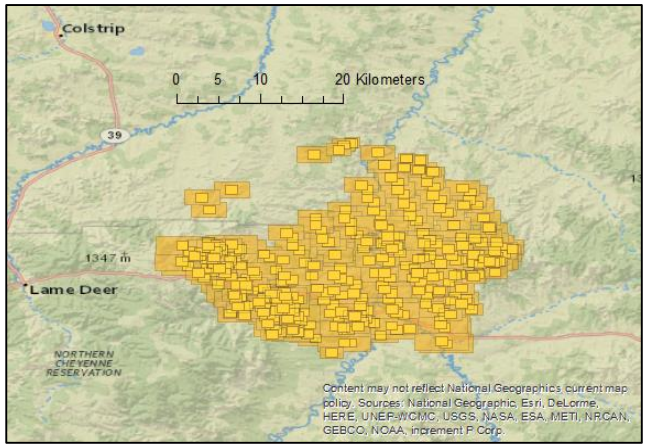
# FINNv2: *Updates in Progress*



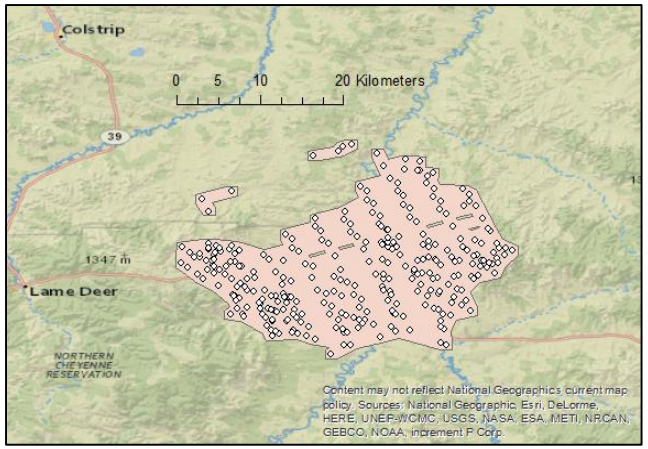

MODIS fire detections




1-km$^2$ area per detection



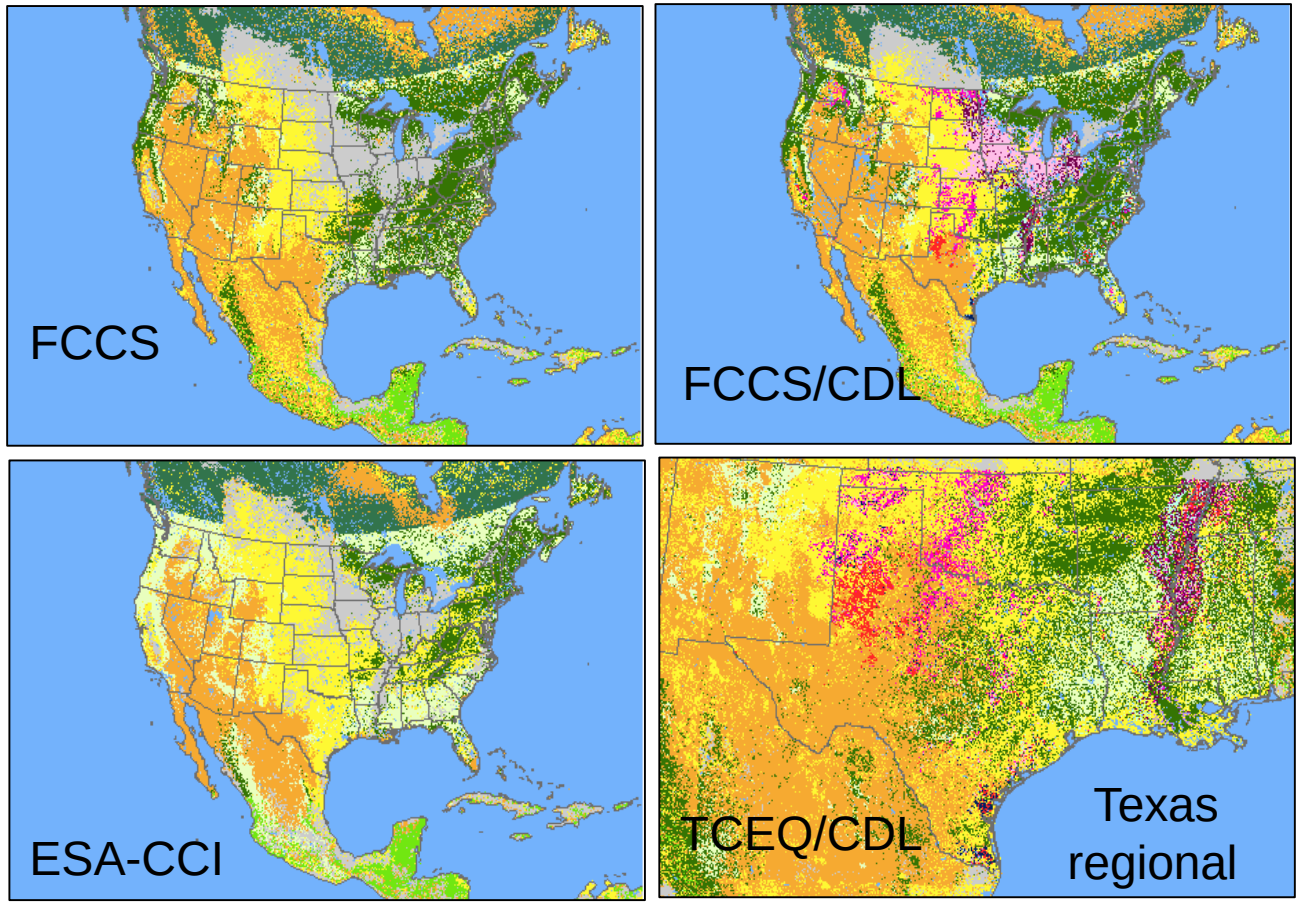

110% of easterly and northerly dimensions of satellite scan and track sizes identifies detection cluster.




Polygon formed from convex hulls of clusters of detections for burned area.

# FINNv2: *Updates in Progress*

## Comparing impacts from land cover inputs




*E. McDonald-Buller, C. Emery, C. Wiedinmyer, Y. Kimura*

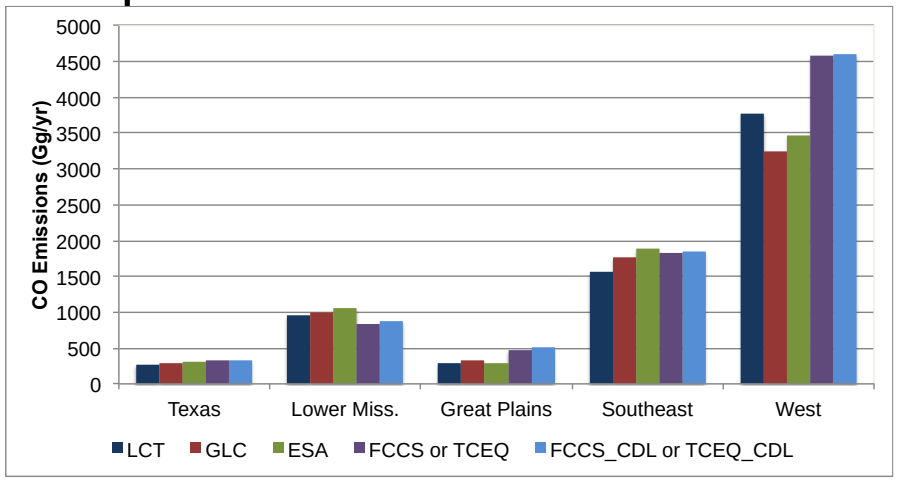
# FINNv2: *Updates in Progress*

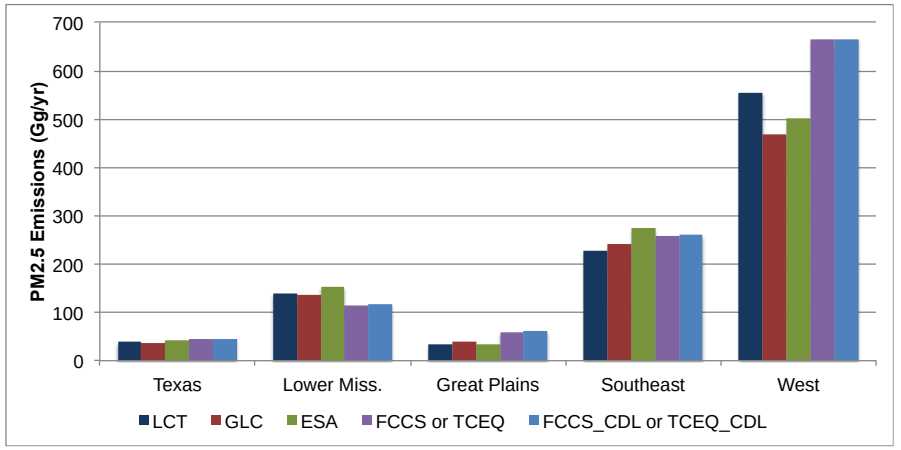
- Comparing impacts from land cover inputs

Annual regional total CO and $PM_{2.5}$ emissions during 2012 from FINN v.2.1.

Land cover influences assignments of emission factors and fuel loadings.

Specification of crops captures seasonal activity but with little effect on total emissions




*TCEQ regional land cover includes only Texas and the Lower Mississippi Valley (Louisiana, Mississippi, Arkansas). FCCS for CONUS and MODIS LCT applied elsewhere.

*E. McDonald-Buller, C. Emery, C. Wiedinmyer, Y. Kimura*

# What's needed for forecasting?

*Depends on…*

- What scales are you looking at?
- Where in the world are you looking?
- What do you want to know?

# Forecasting

- Fuels and Fire Danger in the US
  - https://www.predictiveservices.nifc.gov/fuels_fire-danger/fuels_fire-danger.htm
- NOAA Hazard Mapping System
  - http://www.ospo.noaa.gov/Products/land/hms.html
- Naval Research Laboratory
  - https://www.nrlmry.navy.mil/aerosol/
  - Includes FLAMBE emissions and forecasts
- GEOMAC
  - https://www.geomac.gov/viewer/viewer.shtml