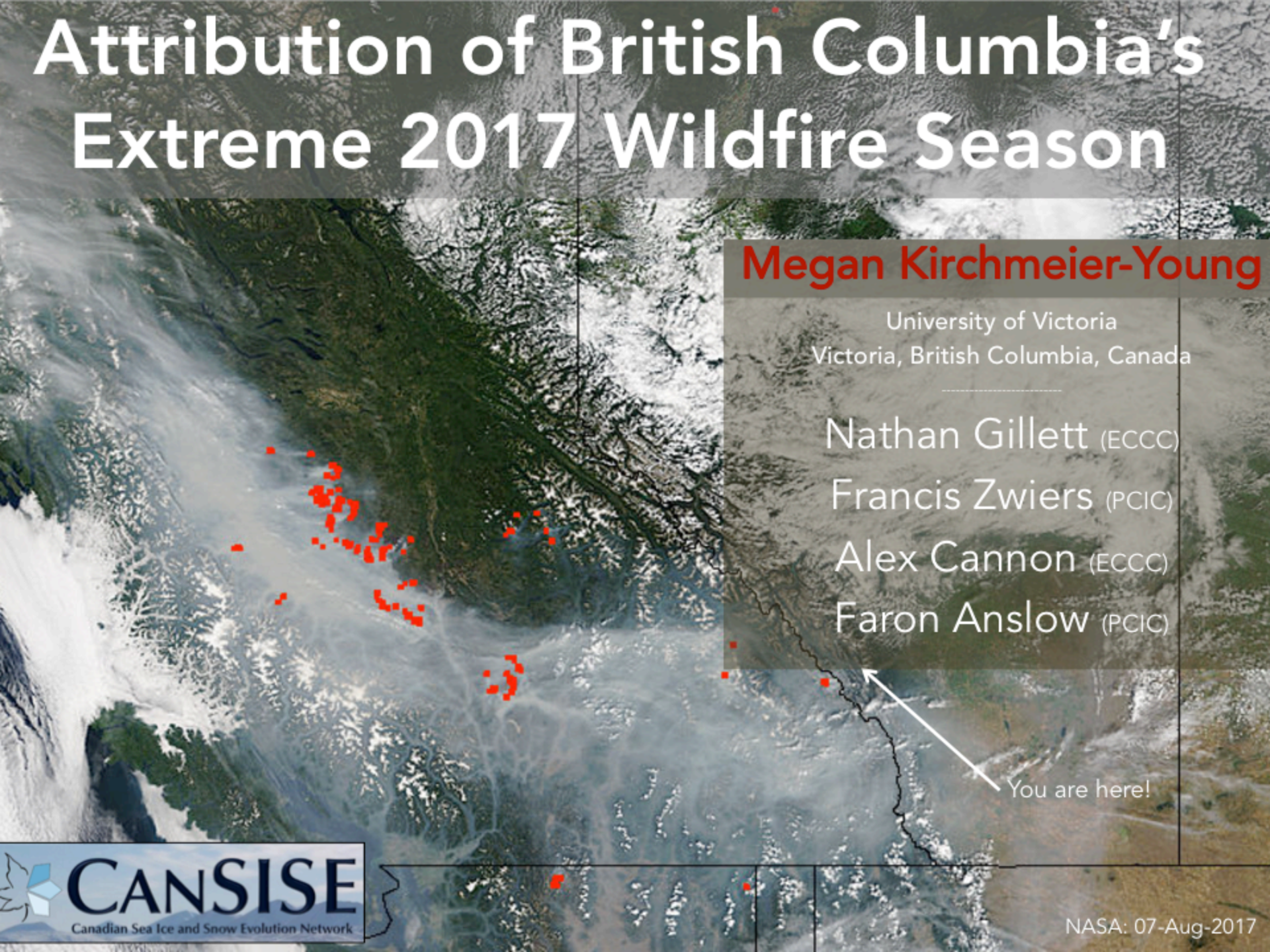
Attribution of British Columbia's Extreme 2017 Wildfire Season



Megan Kirchmeier-Young

University of Victoria
Victoria, British Columbia, Canada

Nathan Gillett (ECCC)

Francis Zwiers (PCIC)

Alex Cannon (ECCC)

Faron Anslow (PCIC)

You are here!

CanSISE
Canadian Sea Ice and Snow Evolution Network

NASA: 07-Aug-2017

2017 British Columbia Wildfires

'Extraordinary' fire situation with over 170 new fires started in B.C.: official

Hundreds of firefighters battling largest wildfire ever recorded in B.C.

19 wildfires have merged to create massive fire burning in the province's Interior

By Mike Laanela, Brady Strachan, CBC News Posted: Aug 22, 2017 8:19 AM PT | Last Updated: Aug 22, 2017 3:47 PM PT

BC Wildfires: New Blaze Forces Evacuation Of 1,100

Evacuees will stay at a church in Kelowna.

08/24/2017 19:43 EDT | **Updated** 08/24/2017 21:32 EDT

2017 British Columbia Wildfires

B.C.'s wildfire season surpasses 1958 record for amount of land burned

B.C. forest fire claims at least 41 more homes

British Columbia wildfires - 14,000 evacuated as fires spread

Several B.C. wildfires merge into single, massive blaze

2017 British Columbia Wildfires

'It's alarming': Wildfire emissions grow to triple B.C.'s annual carbon footprint

Canada wildfires: almost 40,000 evacuated in British Columbia amid state of emergency

B.C. surpasses worst wildfire season on record

As evacuation orders are downgraded and evacuees return home, the situation remains unpredictable

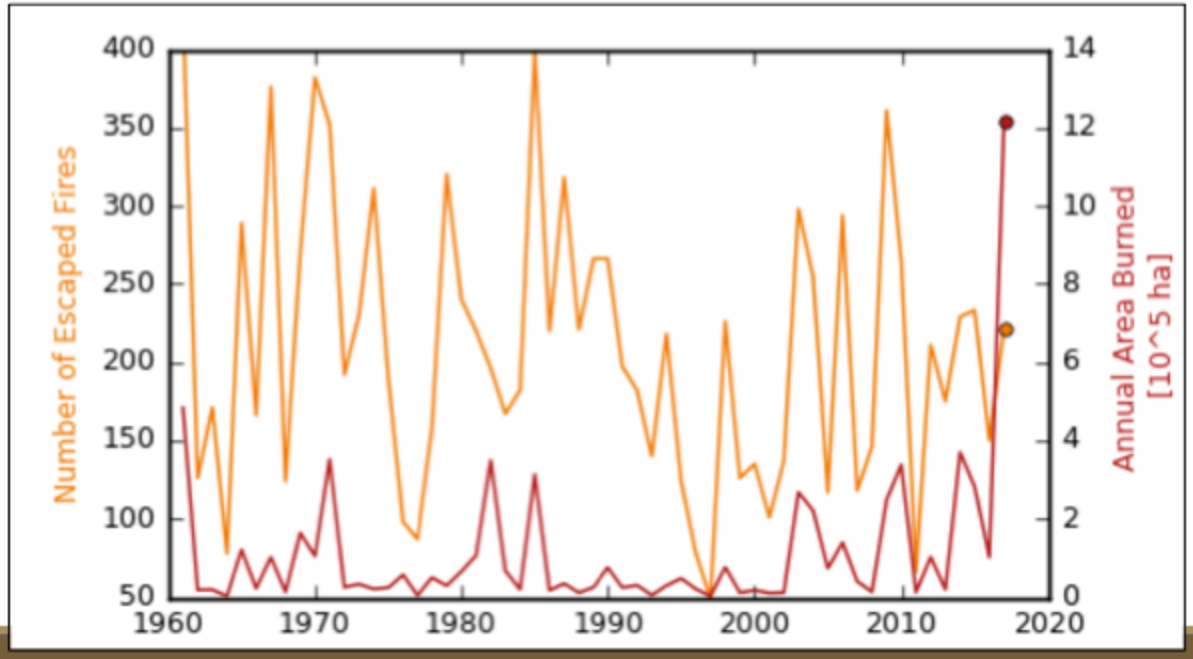
By Michelle Ghoussoub, CBC News Posted: Aug 16, 2017 12:51 PM PT | Last Updated: Sep 21, 2017 10:17 AM PT

2017 British Columbia Wildfires

- 1.2 million ha burned
- Provincial State of Emergency for 70 days

new records!

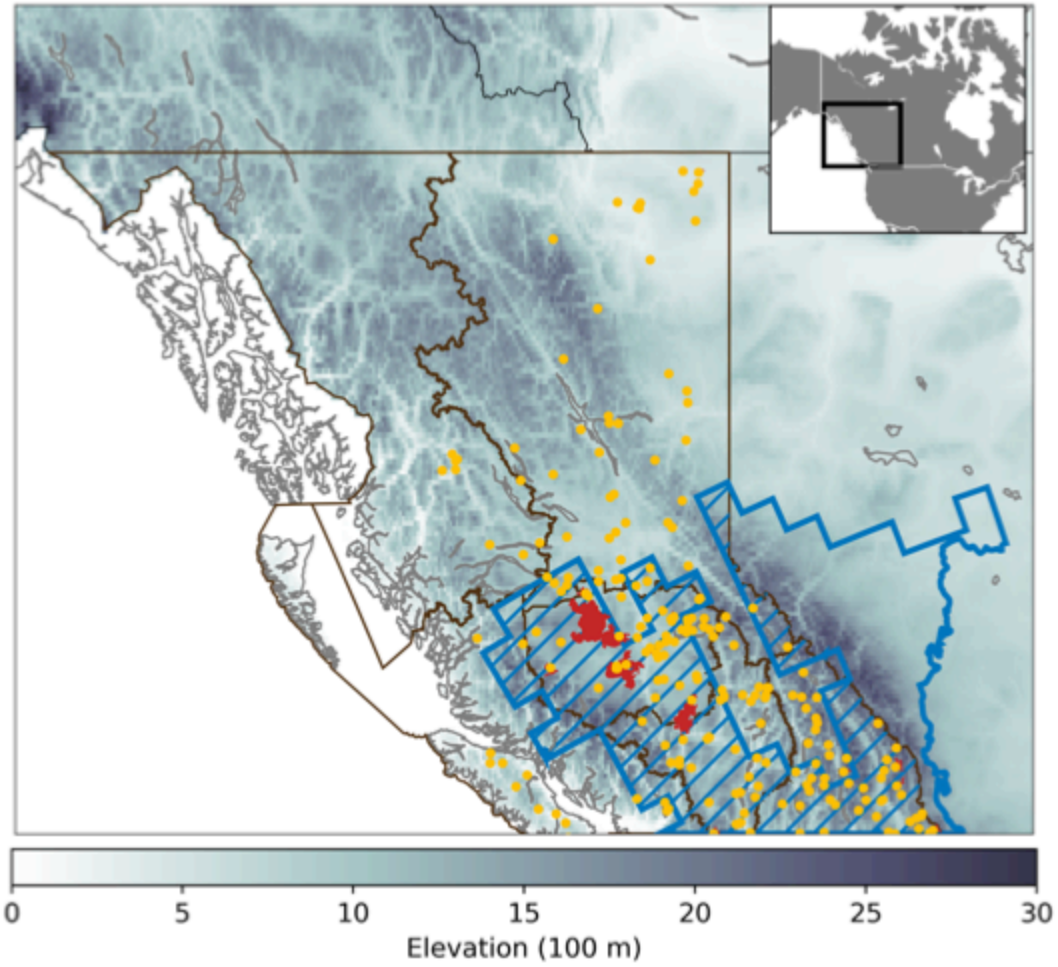
- 65,000 people evacuated
- Over $500 million spent on fire suppression



100 ha = 1 km²

BC Wildfire Service

2017 British Columbia Wildfires



- Locations of escaped fires (> 4 ha)
- ◆ Fire perimeters
- – BC fire management centres
- – Southern Cordillera Homogeneous Fire Regime zone
  - → Focus on this region in BC

Most wildfire activity in July-August in southern BC.

HFR: Boulanger et al. 2014

Has anthropogenic climate change increased the chances of a fire season like 2017 in southern BC?

Has anthropogenic climate change increased the chances for high fire risk or high area burned in southern BC?

Use event attribution framework:

1. Define fire risk or area burned "events"
2. Calculate probability of each event with and without anthropogenic forcings
3. Compare probabilities to determine the anthropogenic impact on event's occurrence

See National Academies report "Attribution of Extreme Weather Events in the Context of Climate Change" (2016)

Has anthropogenic climate change increased the chances for high fire risk or high area burned in southern BC?

Use event attribution framework:

1. Define fire risk or area burned "events"
2. C… and w…
3. C… anthropogenic impact on event's occurrence

Event attribution results can be sensitive to the framing of the attribution question.

See National Academies report "Attribution of Extreme Weather Events in the Context of Climate Change" (2016)

Factors Influencing a Wildfire

- Ignition sources
  - Lightning, humans
- Fuel characteristics
  - Type, amount, moisture
- Weather conditions
  - Hot, dry, windy
- Management decisions

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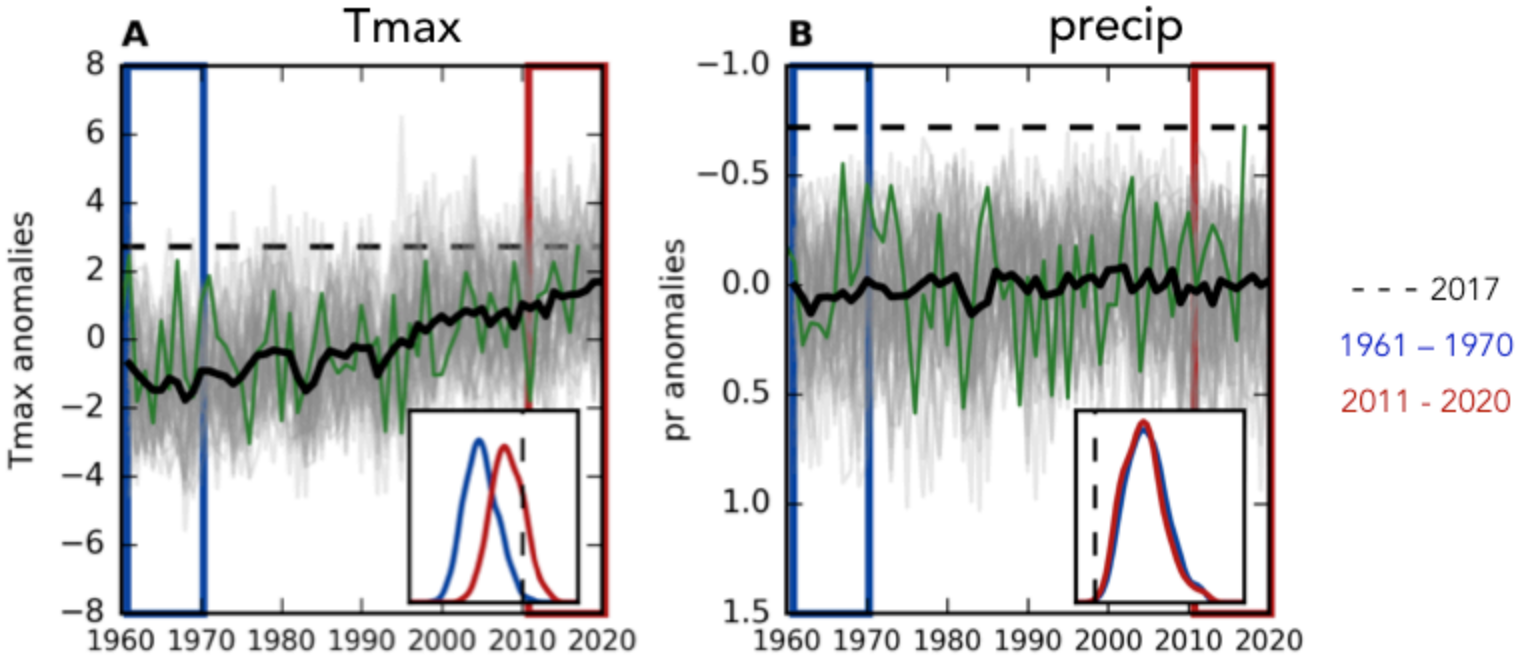
July and August were extremely hot and dry

Event Attribution 1: hot and dry

- **Event attribution question**: How has anthropogenic climate change influenced the occurrence of hot and dry conditions during July-August in southern BC?
- **Metric**: mean July-August anomalies for Tmax and precipitation
- **Event**: mean anomalies are more extreme than observed 2017 values

Event Attribution 1: hot and dry

- July-August extremely hot and dry



Observations

Gridded station product from PCIC

CanRCM4 large ensemble

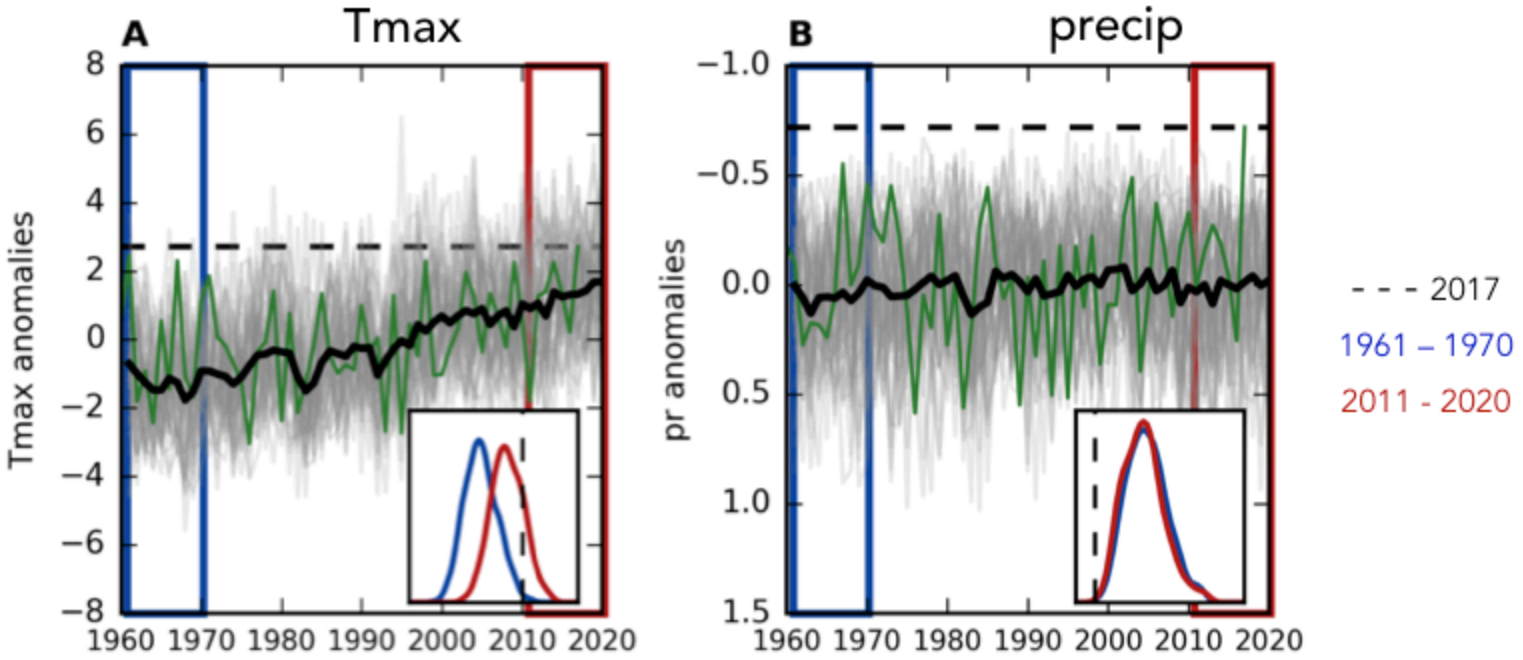
50 realizations, bias corrected

CanRCM4: Scinocca et al. 2016, Bias Correction: Cannon 2017, MERRA2: Gelaro et al. 2017, MSWEP: Beck et al. 2017

Event Attribution 1: hot and dry

- July-A… and dry

Step 1: Define events.



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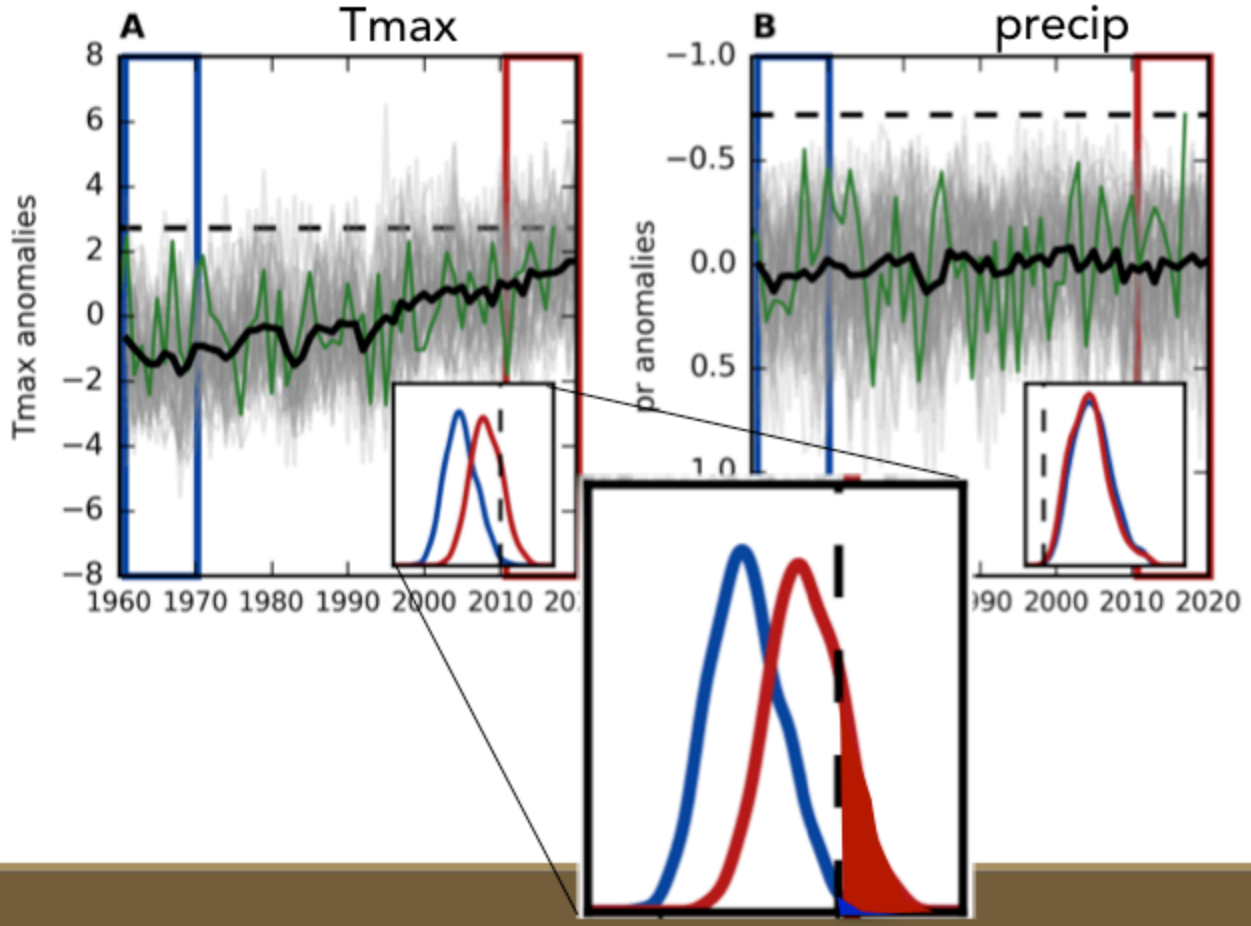
Event Attribution 1: hot and dry

Step 2: Calculate Probabilities.

Integrate PDFs to get probability of event occurrence:

p1 → with realistic anthropogenic forcings

p0 → with reduced anthropogenic forcings



Event Attribution 1: hot and dry

Step 3: Compare Probabilities.

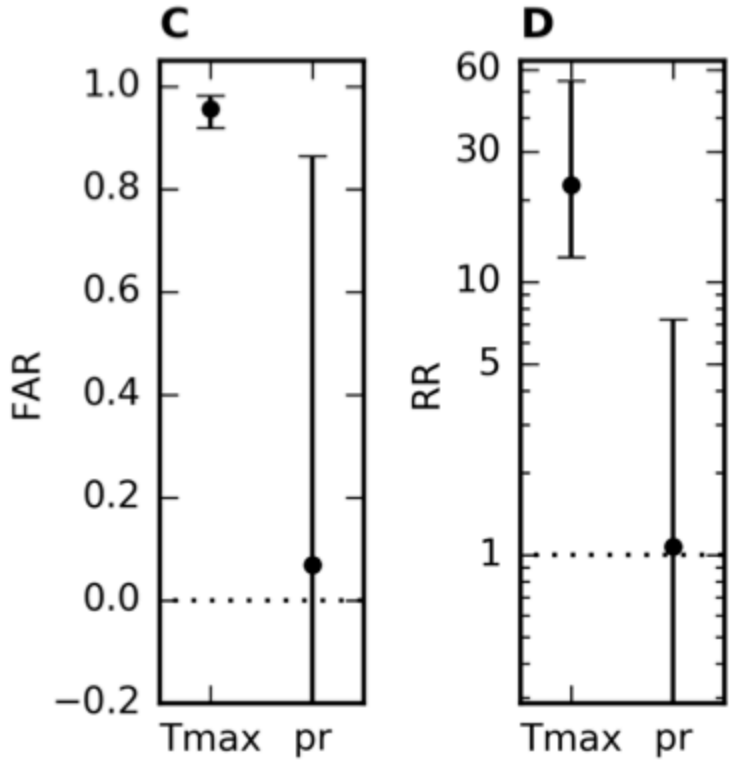
Event attribution metrics:

Fraction of risk attributable to the anthropogenic forcings

$$FAR = 1 - \frac{p_0}{p_1}$$

Risk Ratio: How many times as likely due to anthropogenic forcings

$$RR = \frac{p_1}{p_0}$$



95% of risk for 2017 Tmax anomalies due to anthropogenic factors, but no attribution for precipitation

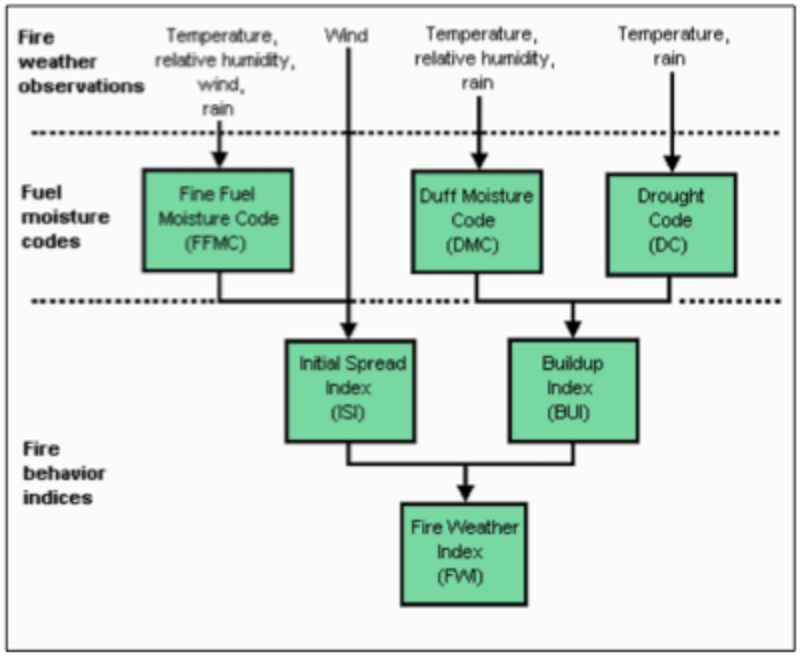
Hot and dry conditions lead to elevated fire risk

Event Attribution 2: CFFDRS

- **Event attribution question**: How has anthropogenic climate change influenced the occurrence of extreme fire risk during July-August in southern BC?
- **Metric**: 95th percentile of daily July-August fire weather/behavior indices
- **Event**: 95th percentile exceeds 2017 value from the MERRA2 reanalysis

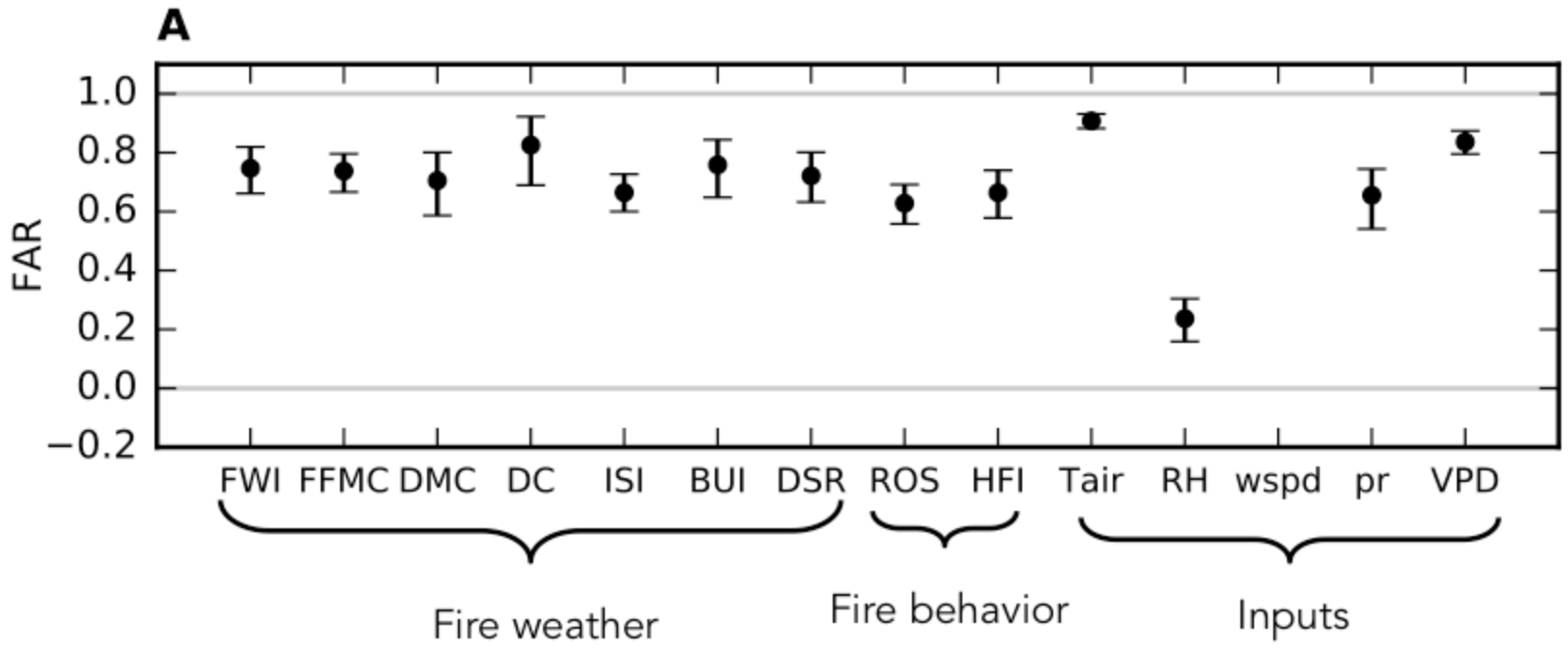
Canadian Forest Fire Danger Rating System (CFFDRS)

- Hot, dry, and windy conditions → increased fire risk
- Two main components:
  - Fire Weather Index System
  - Fire Behavior Prediction System



Event Attribution 2: CFFDRS

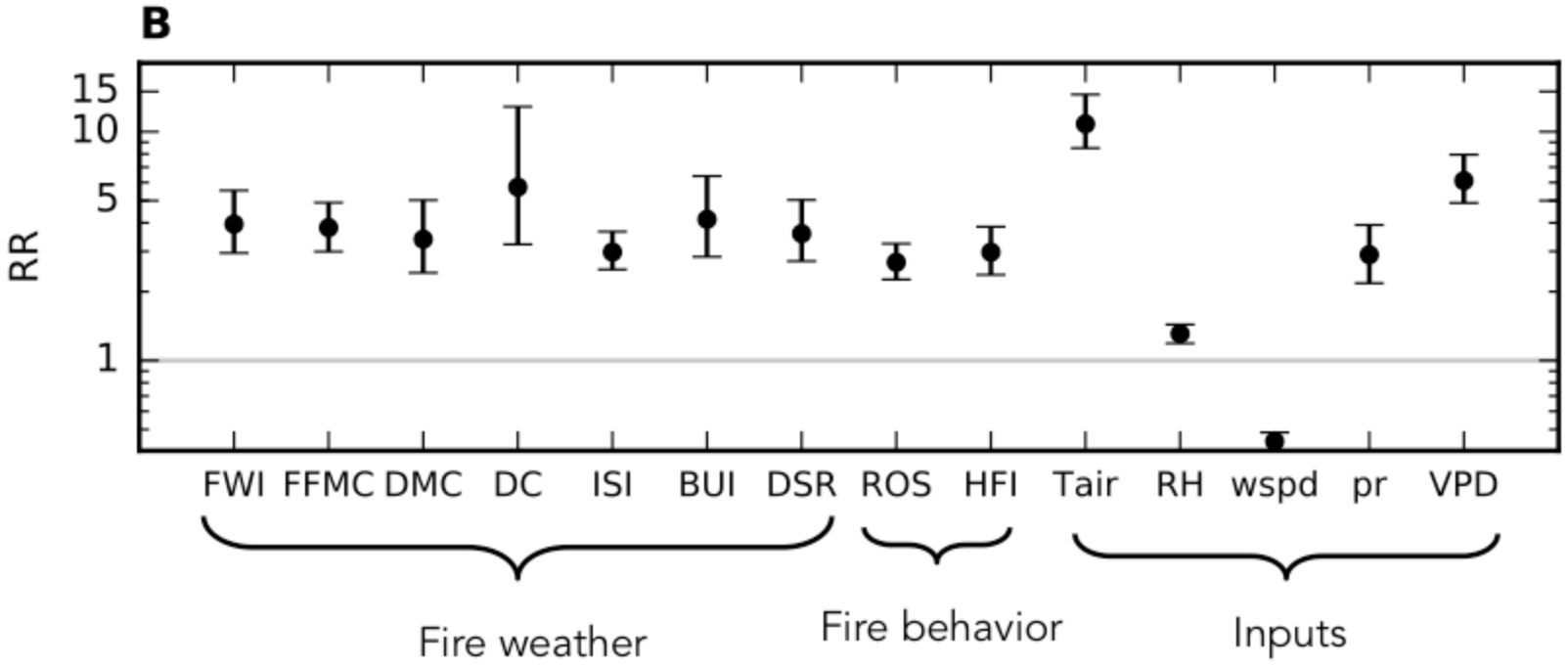
- Fraction of Attributable Risk:



60-90% of the risk of 2017's extreme values of wildfire risk and behavior indices due to anthropogenic factors.

Event Attribution 2: CFFDRS

- Risk Ratio:



Extreme values of wildfire risk and behavior indices (in 2017) 2-4 times more likely due to anthropogenic factors.

Increased fire risk can
lead to increased area burned

Conclusions

- British Columbia set a new record for area burned in 2017, with most fires occurring in July-August
- July and August were hot and dry
  - Tmax anomalies: 95% of risk
  - Precip anomalies: no attribution
- Hot and dry (and windy) leads to elevated fire risk:
  - Extreme values of the CFFDRS indices generally 2-4 times more likely
- Increased fire risk can lead to increased area burned
  - Regression analysis indicates that anthropogenic climate change also increased risk of large burned areas

Megan Kirchmeier-Young mkirch@uvic.ca