Co-producing Actionable Climate Science for Wildland Fire Operations and Policy

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NCAR Wildfire, March 2022, Photo Credit: CBS

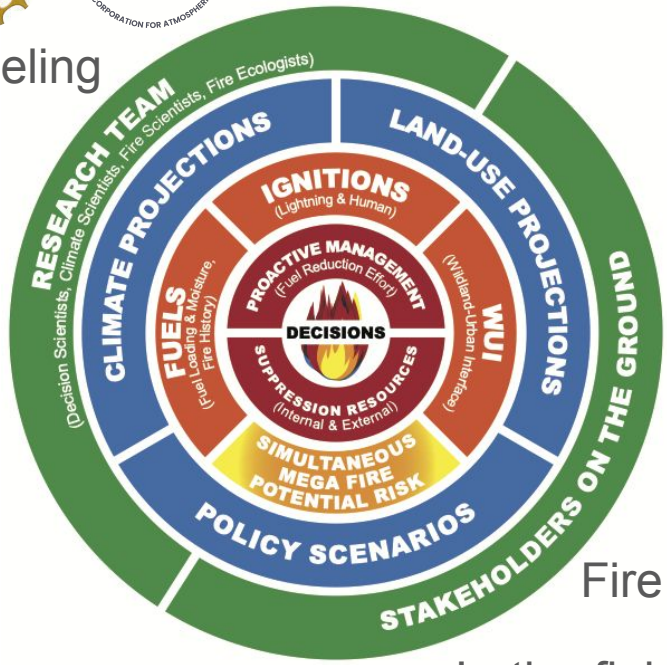
Translate climate simulations to address stakeholder needs

Climate modeling

Public policy

Fire ecology

Fire science

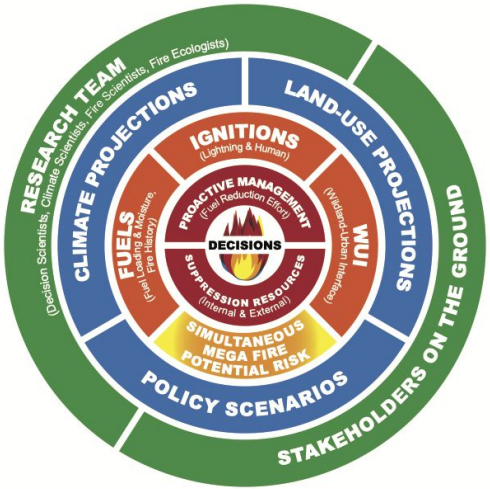


Policymakers

Fire management

In-the-field practitioners

Convergence is hard



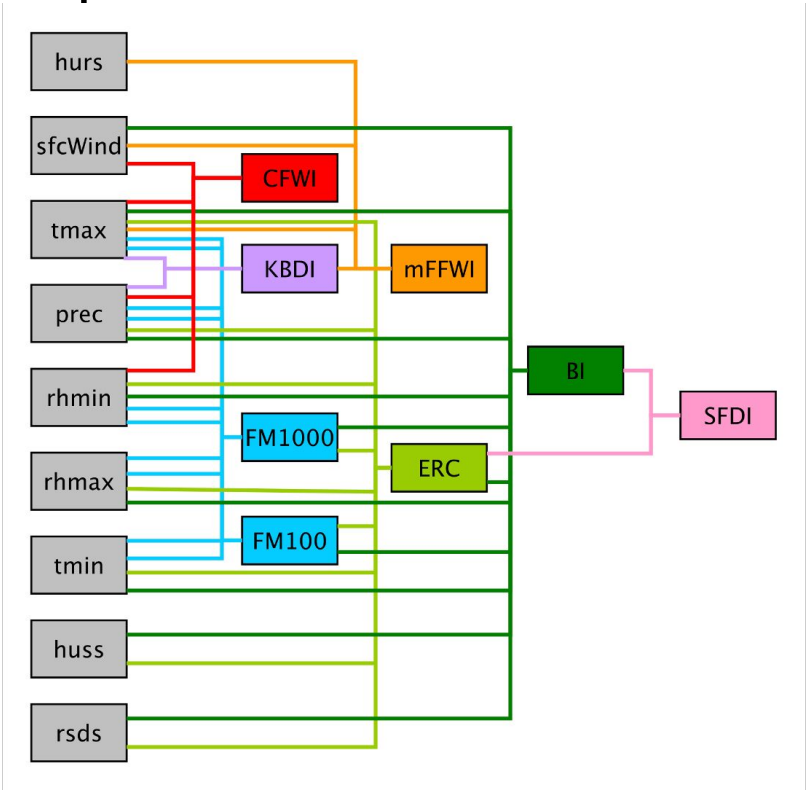
- It takes time and effort to…
  - Develop common language
  - Find areas of focus and complementary areas of expertise
  - Ensure data is understood by all
- Specifically, some of our climate-related questions include:
  - How and where can we try to make climate change more of a focus in fire management?
  - What sort of decisions in fire management move on timescales appropriate for climate change information?
  - How do we communicate our climate data so that it can be used appropriately in applications?

Regional Climate Simulation Ensemble

- NA-CORDEX
- RCP8.5 high emission scenario
- Dynamically downscaled
- Projections run from 1950-2100
- CMIP5-era GCMs

GCM	RCM	Grid spacing
GFDL-ESM2M	RegCM4	¼ degree
GFDL-ESM2M	WRF	¼ degree
HadGEM2-ES	RegCM4	¼ degree
HadGEM2-ES	WRF	¼ degree
MPI-ESM-LR	RegCM4	¼ degree
MPI-ESM-LR	WRF	¼ degree
MPI-ESM-LR	CRCM5-UQAM	¼ degree
MPI-ESM-MR	CRCM5-UQAM	¼ degree
CanESM2	CRCM5-UQAM	¼ degree
CanESM2	CanRCM4	¼ degree
CanESM2	RCA4	½ degree
EC-EARTH	RCA4	½ degree
EC-EARTH	HIRHAM5	½ degree

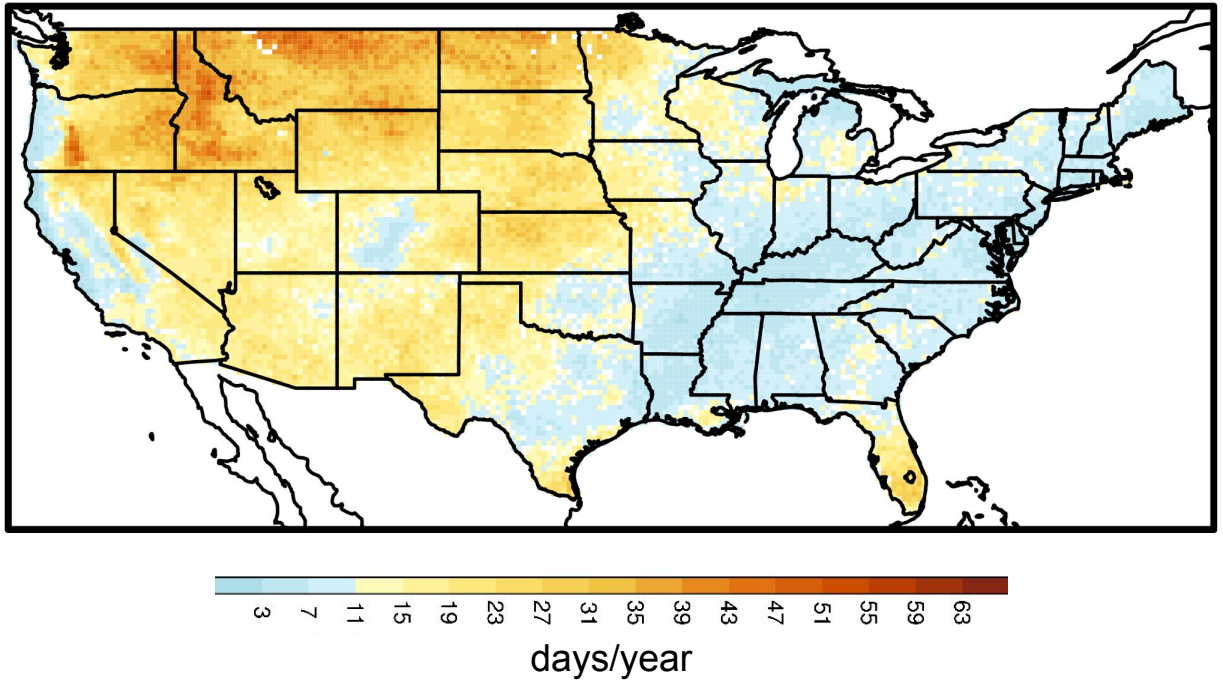
Fire Index Inputs



Communicate simulations spatially:

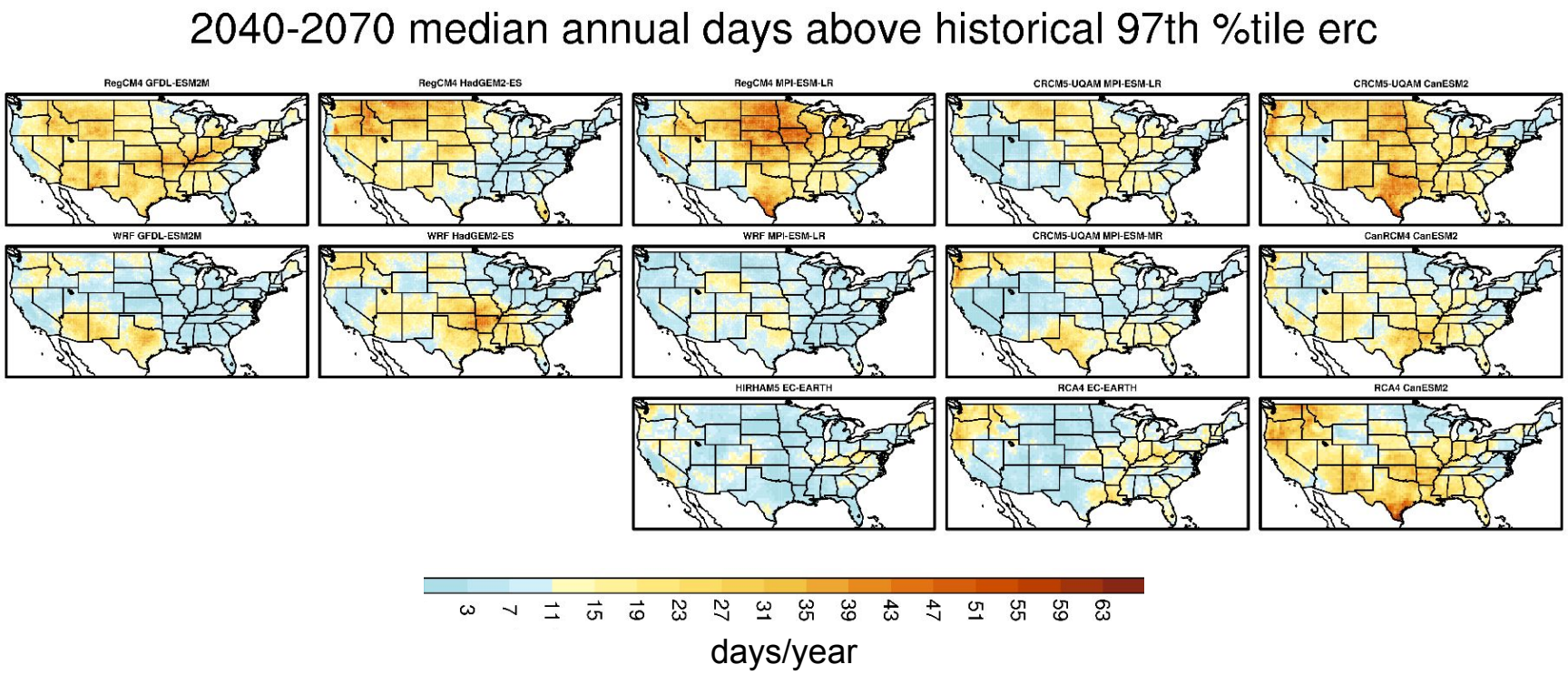
Ensemble maps aimed at regional/national management

Annual count of days above the historical 97th %tile for ERC



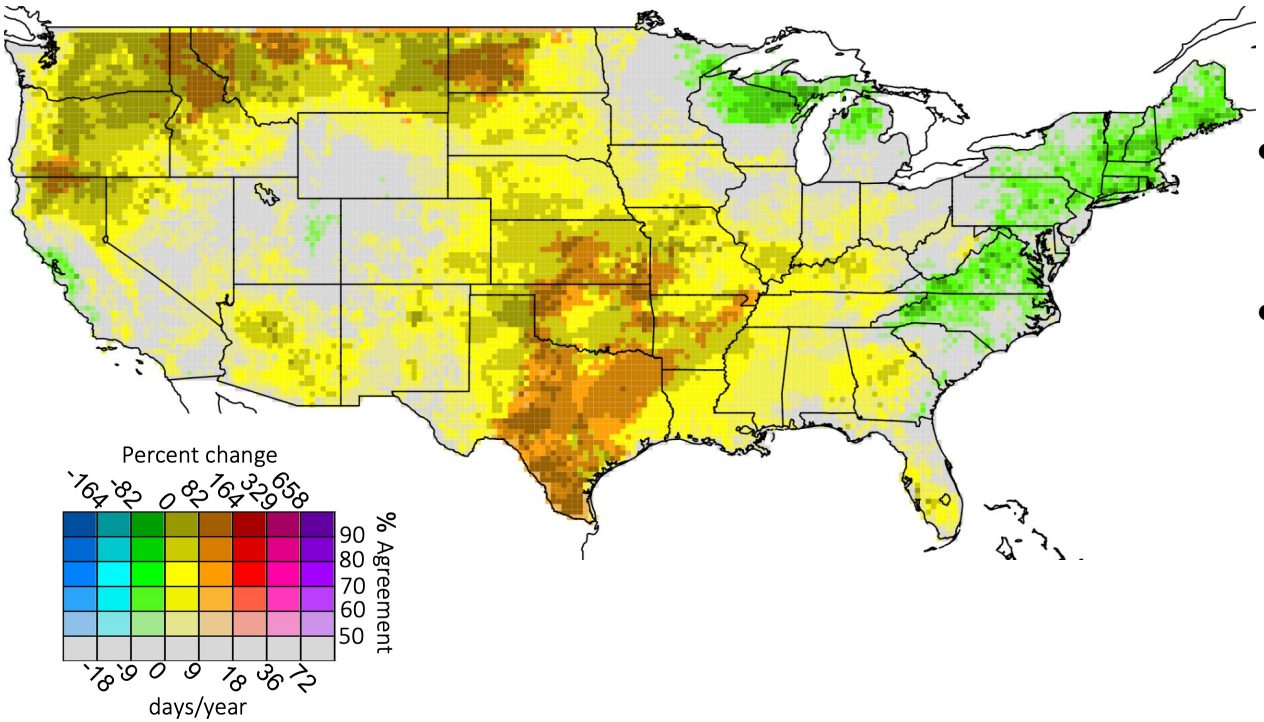
- One simulation: RegCM4 regional climate model driven by HadGEM2-ES global climate model
- Historical period of 1970-2000
- Future period of 2040-2070

Paneled by model



Consolidate and refine

Simulation ensemble agreement for change in the annual average count of days above 97th percentile ERC G



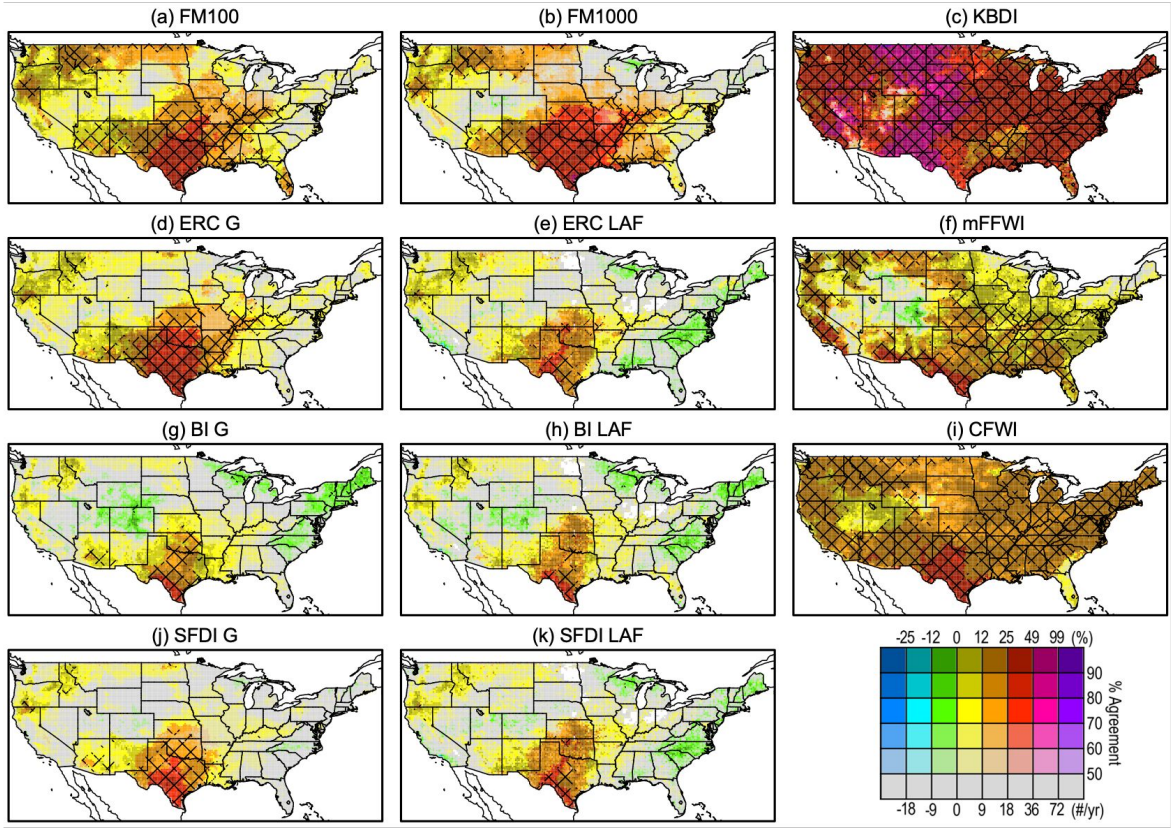
- **Color** denotes the average amount of change in the ensemble
- **Color saturation** denotes level of ensemble agreement
- **Grey** denotes ensemble disagreement on sign of change

Reference period was changed to 1980-2010

Future period presented is now 2030-2060

Ensemble mean maps of change in high fire danger days

80th percentile (2030-2060) - (1980-2010)

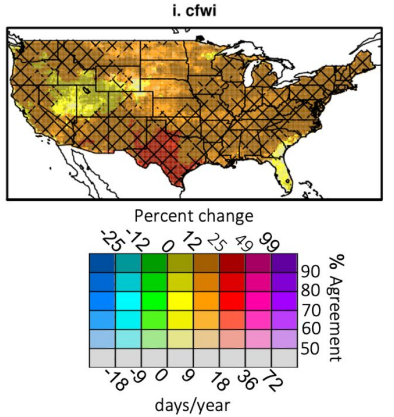


- **Color** denotes the average amount of change in the ensemble
- **Hatching** denotes statistically significant change with 70% ensemble agreement on sign of change
- **Color saturation** denotes level of ensemble agreement
- **Grey** denotes ensemble disagreement on sign of change

The ensemble maps contain stakeholder relevant information

- Stakeholders expressed interest in length of fire season and the frequency of extremes
- Relevant thresholds were used

Midpoint	Fire season definition (Jolly et al 2015)
80th percentile	High fire danger threshold
90th percentile	Very high fire danger threshold
97th percentile	Severe or extreme fire danger threshold



- A count of days above a percentile threshold is easily understandable and relevant for planning for levels of fire danger
- Localized percentile thresholds allows for relatively uniform interpretation across space

A familiar framework:

Pocket cards aimed at local scale fire management

Pocket Cards:

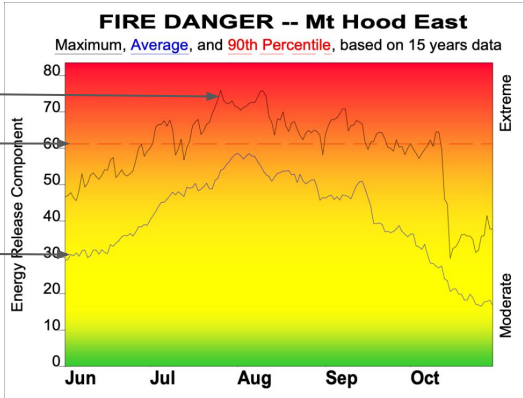
A field tool to contextualize current conditions with climatology through fire indexes

Maximum

90th percentile

Average

Specific years and specific incidents to reference



Fire Danger Area:

- Mt Hood East
- Fire Wx Zone OR 639
- Pollywog & Wamic

* Meets NWCG Wx Station Standards

Fire Danger Interpretation:

EXTREME -- Use extreme caution

High -- Watch for change

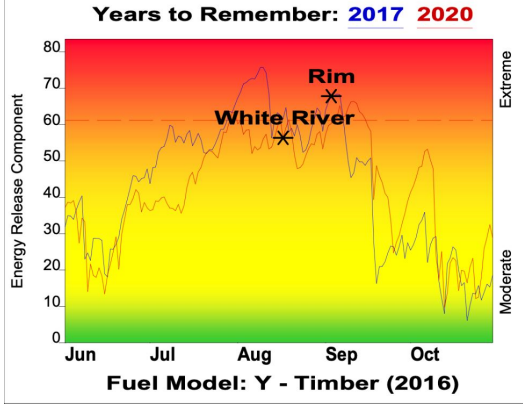
Moderate -- Lower Potential, but always be

Maximum -- Highest Energy Release Component by day for 2006 - 2020

Average -- shows peak fire season over 15 years (2279 observations)

90th Percentile -- 10% of the 2279 days from 2006 - 2020 had an Energy Release Component above 61

Local Thresholds - Watch out: Combinations of any of these factors can greatly increase fire behavior:
20' Wind Speed over 10 mph, **RH** less than 30%,
Temperature over 85, **100-Hour Fuel Moisture** less than 9



Remember what Fire Danger tells you:

- Energy Release Component gives seasonal trends calculated from 2 pm temperature, humidity, daily temperature & rh ranges, and precip duration.
- Wind is NOT part of ERC calculation.
- Watch local conditions and variations across the landscape -- Fuel, Weather, Topography.
- Listen to weather forecasts -- especially WIND.

Past Experience:

-East Wind Events/ Thermal Trough: high temps, low RH with poor recovery, rapid drying of fuels, increase wind and gust speed, and instability

-Haines 5 or 6 can lead to rapid fire spread

-Lichen draped fuels become available near 35% RH, increasing likelihood of canopy fire

-Topographic features that funnel winds

-Down slope winds and downhill fire spread

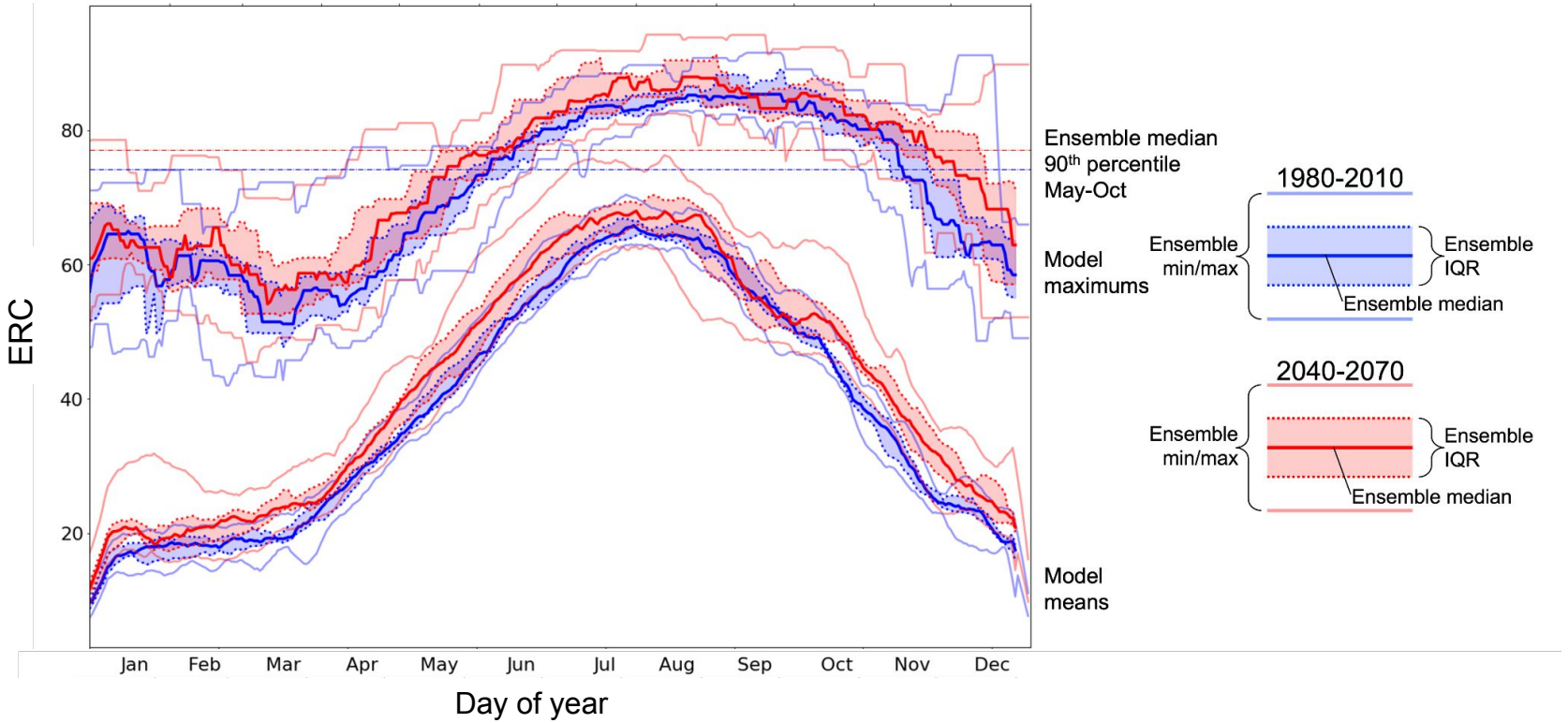
Fire	Date	Acres	Temp	RH %	ERC	100 HR FM %
Rim	9/3/2017	237	95	18	67	8
White River	8/17/2020	17442	92	29	56	9

Responsible Agency: USFS *FF+5.0 build 20191211 06/09/2021-07:16*

Design by NWCG Fire Danger Working Team

Adapt pocket cards to communicate climate simulations

Replace observations with reference period and future period of future projection ensemble



Next Steps

- Tools used in the field are being explored presently with stakeholders
- In the next few years of our project we intend to integrate our projection information (and other data from this project) into these tools as a way of better informing the future of wildland fire management
- Projection of WUI and WUI risk

East Troublesome Fire, October 2020, Photo Credit: Wildfire Today

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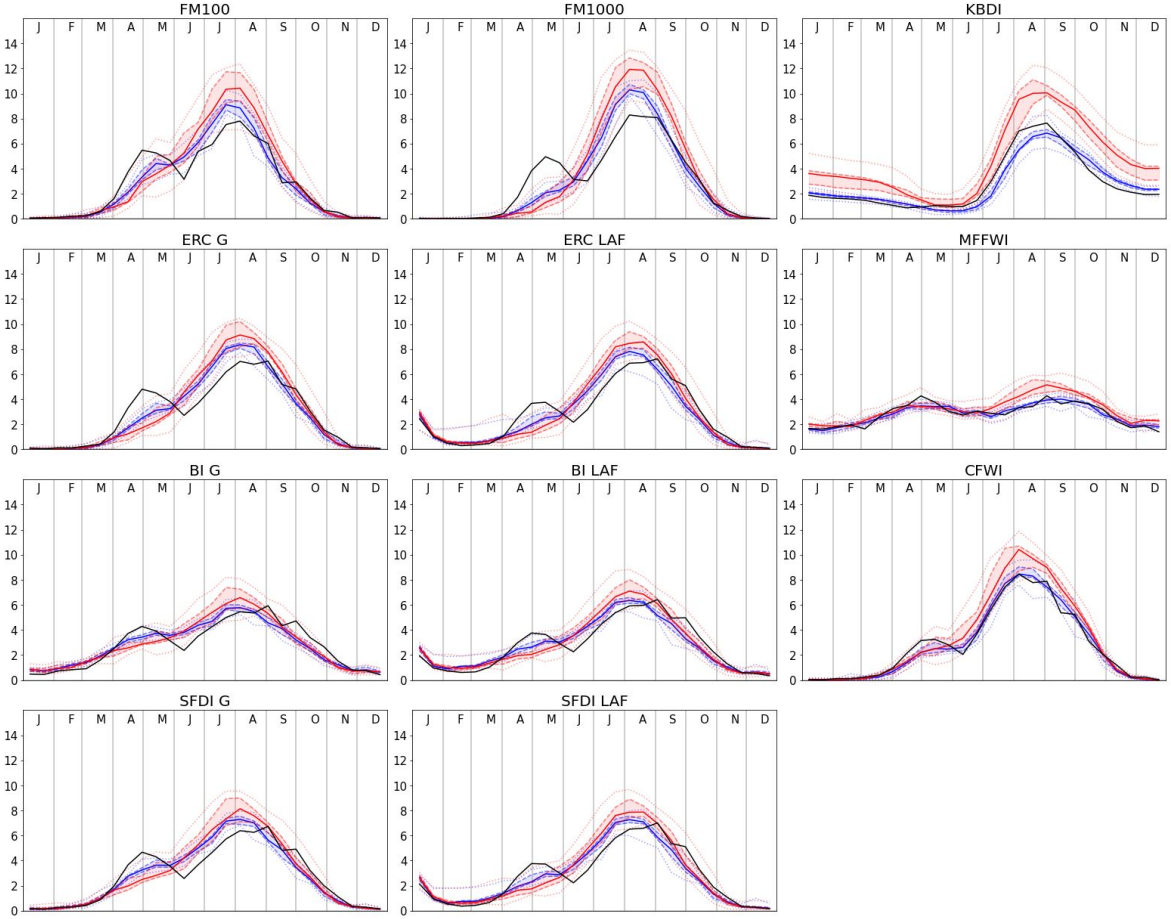
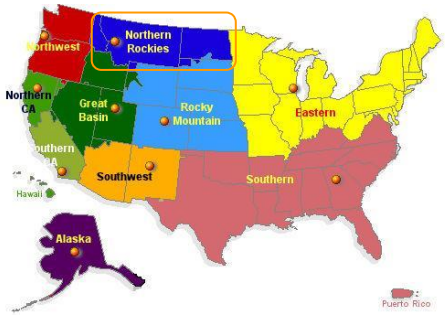
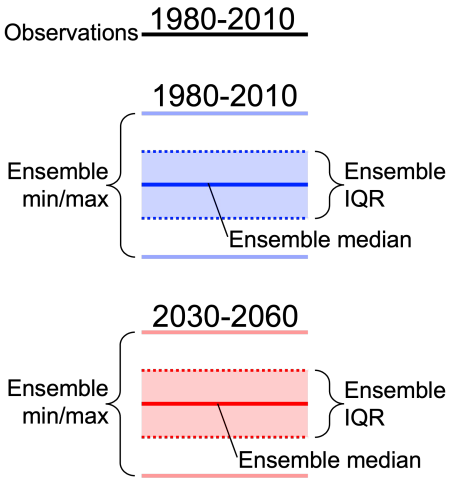
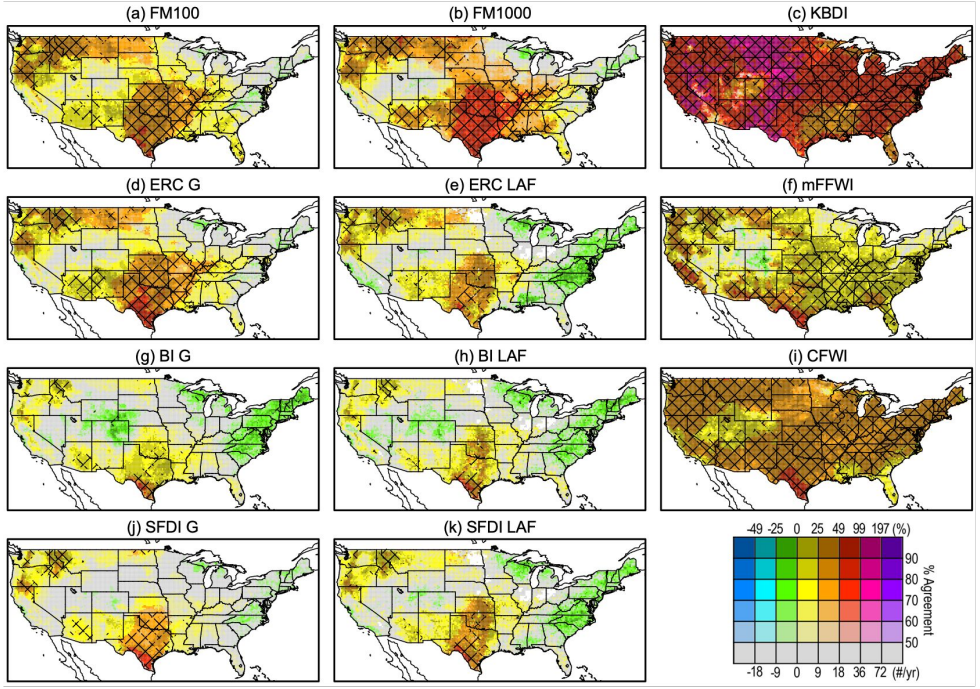
Average two-weekly count of high fire danger days on a GACC level



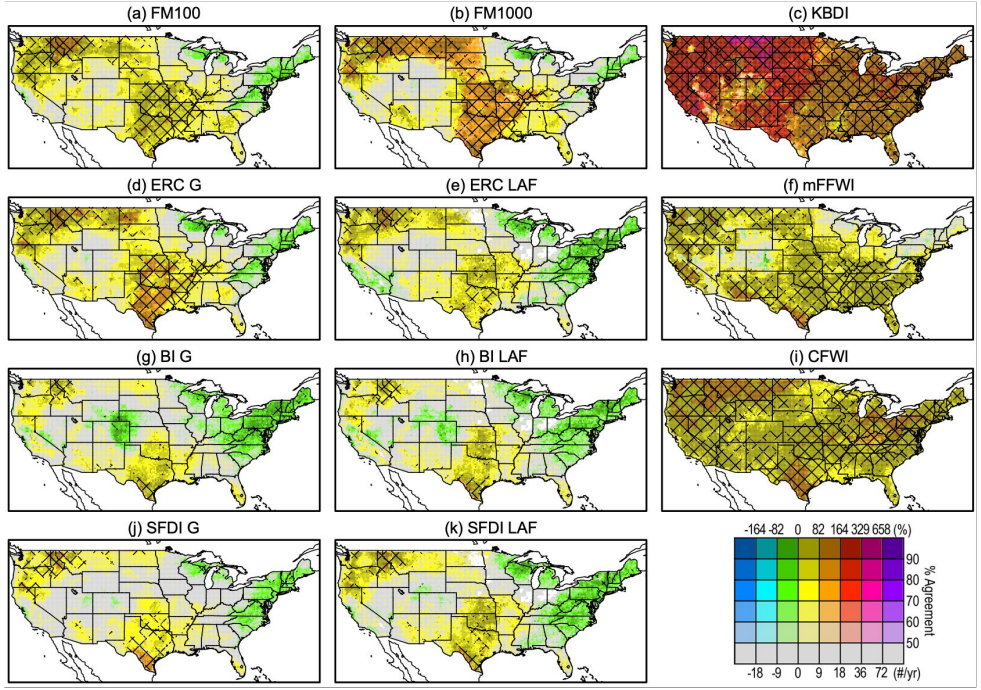




Mean annual change in days exceeding the 90th percentile (2030-2060)-(1980-2010)



Mean annual change in days exceeding the 97th percentile (2030-2060)-(1980-2010)



Mean annual change in days exceeding the 80th percentile (2069-2099)-(1980-2010)