Jan 6 2020 Australian bushfire emissions, Image credit NASA
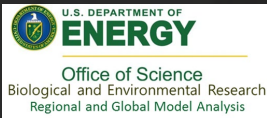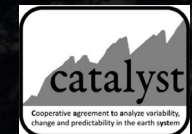
Climate Effects of Recent Wildfires in CESM2
Unexpected Climate Responses: Case #1: CMIP6 forcings Case #2: 2019/20 Australian Wildfires
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catalyst
Cooperative agreement to analyze variability, change and predictability in the earth system

U.S. DEPARTMENT OF
ENERGY
Office of Science
Biological and Environmental Research
Regional and Global Model Analysis

Background

Wildfires have traditionally been viewed as responding to climate rather than driving climate responses.

In recent decades, wildfires have become larger and more intense.

The representations of clouds in climate models has also become more complex, with more complete microphysical interactions with aerosols.

Motivating Question:
What are the climate responses to recent major fires in CESM2 and what does this suggest about how fire is represented in climate predictions and projections?

Case 1: CMIP6 Biomass Emissions
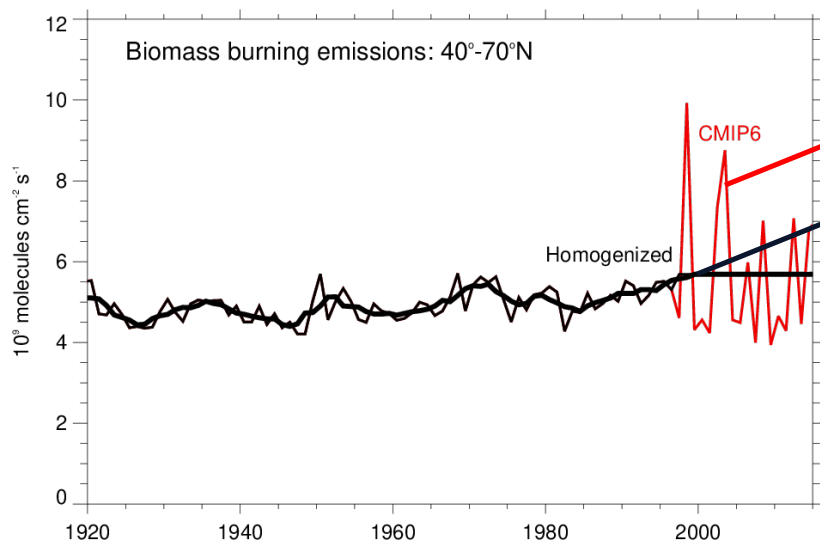
Interannual variability from satellite data was incorporated in CMIP6 forcing datasets during the GFED era (1997-2014).

Using an ensemble of 20 CESM2 simulations forced by homogenized emissions from 1997-2014 compared with 11 CMIP6 members, a significant fraction of the CESM2 vs CESM1 contrast is found to arise solely from prescribed biomass emissions.

For more info, see poster session

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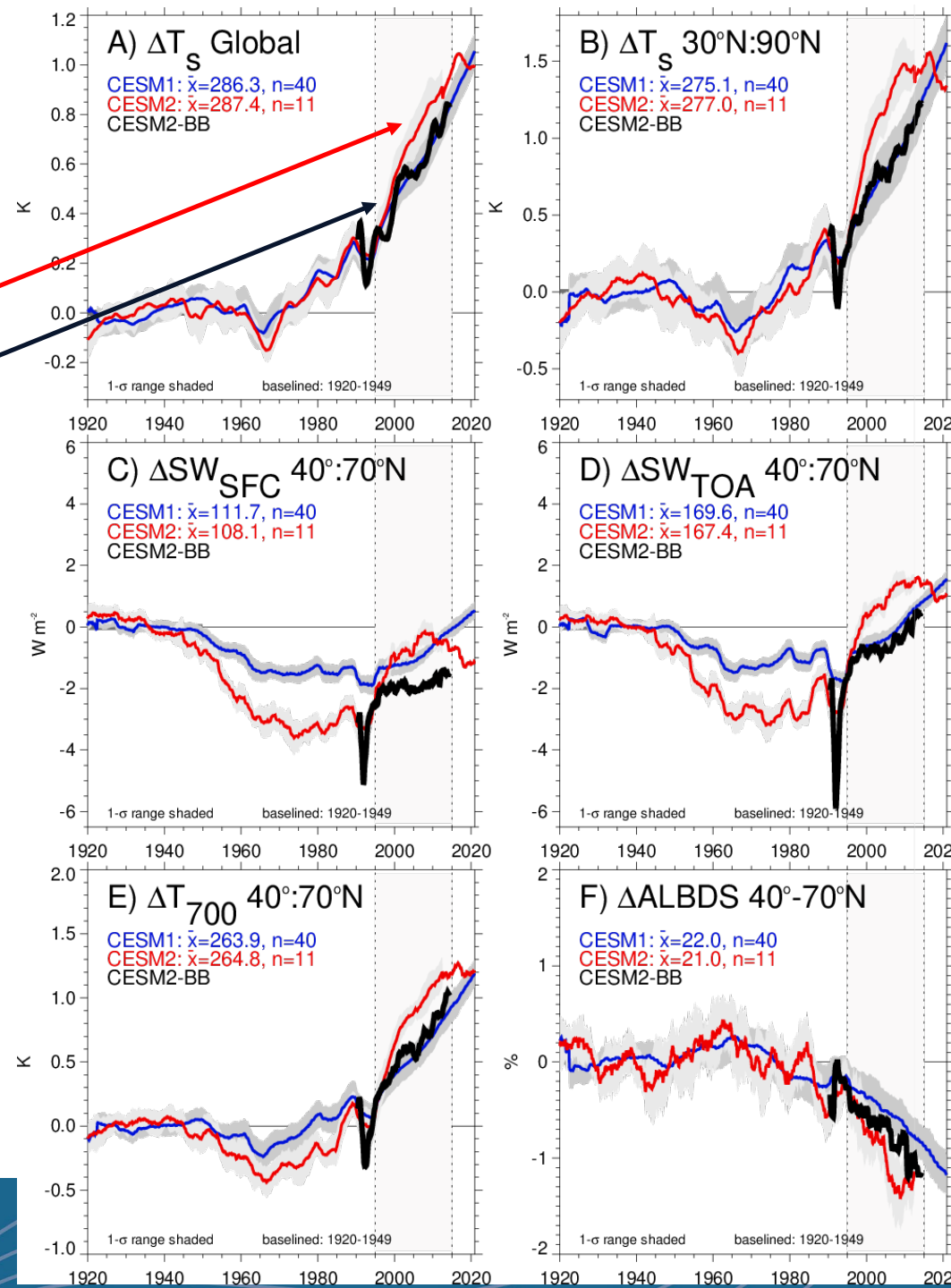
Case 2: The 2019/20 Australian Wildfires

The recent Australian bushfires drove a robust climate response, on par with a major volcanic eruption, and due largely to aerosol interactions with clouds.

Notably the associated interhemispheric radiative imbalance anomaly is greater than at any time during the entire span of the CESM2 LE.
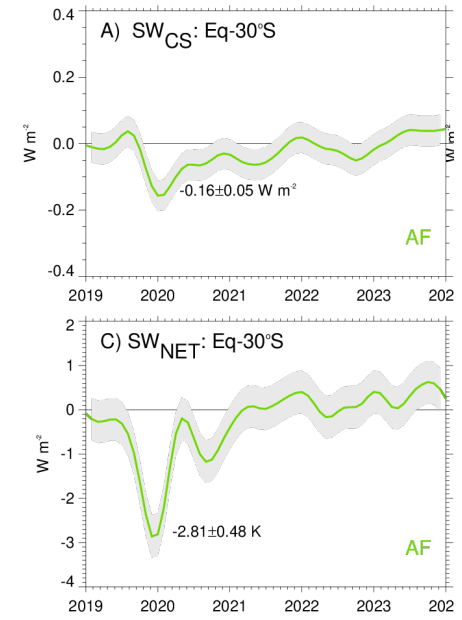
Small clear-sky effects (~0.2 W m⁻²)

Large all-sky effects (>2 W m⁻²)

Cloudy Sky Albedo: Response to Fires (Jan 2020)
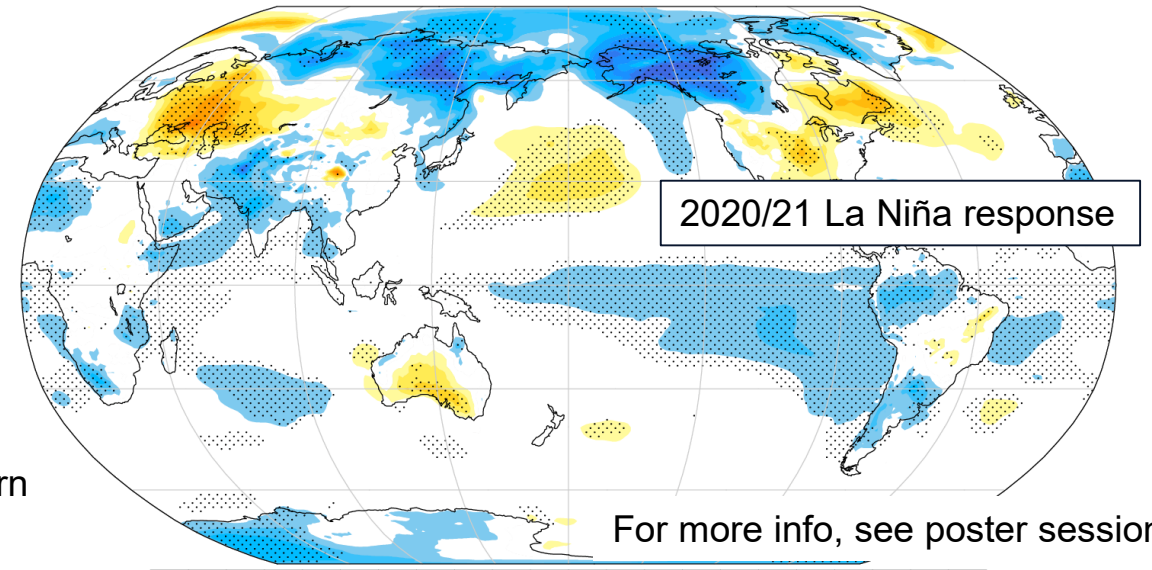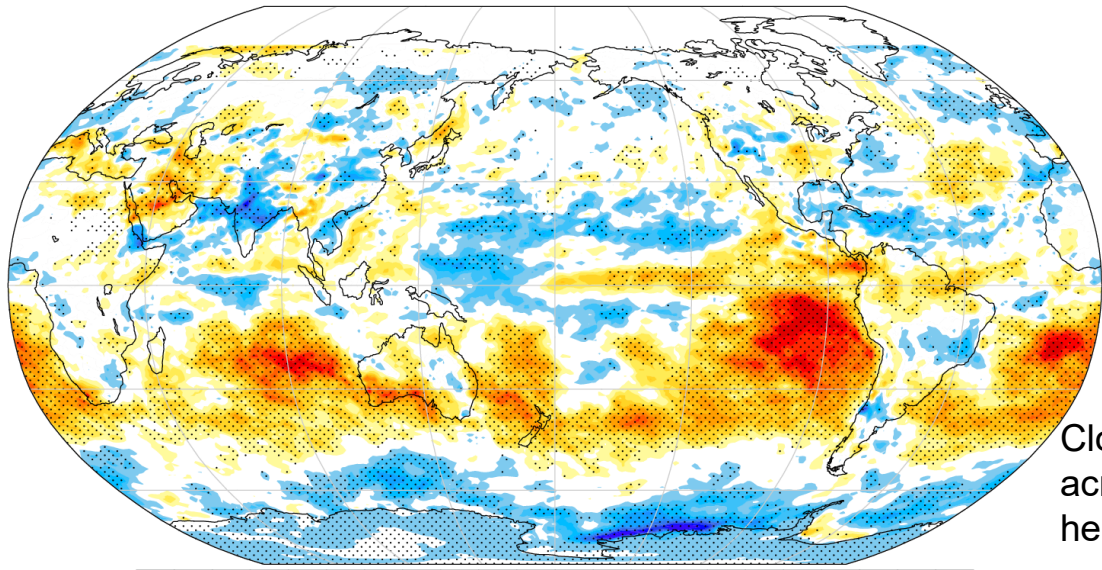
Cloud brightening across the southern hemisphere

2020/21 La Niña response

For more info, see poster session

1) Is it appropriate to view wildfire emissions as a prescribed external forcing when the emissions themselves depend on the climate state?

2) Case 1: Are wildfires an important climate feedback?

3) Case 2: Do wildfires comprise an important source of predictability in the climate system?