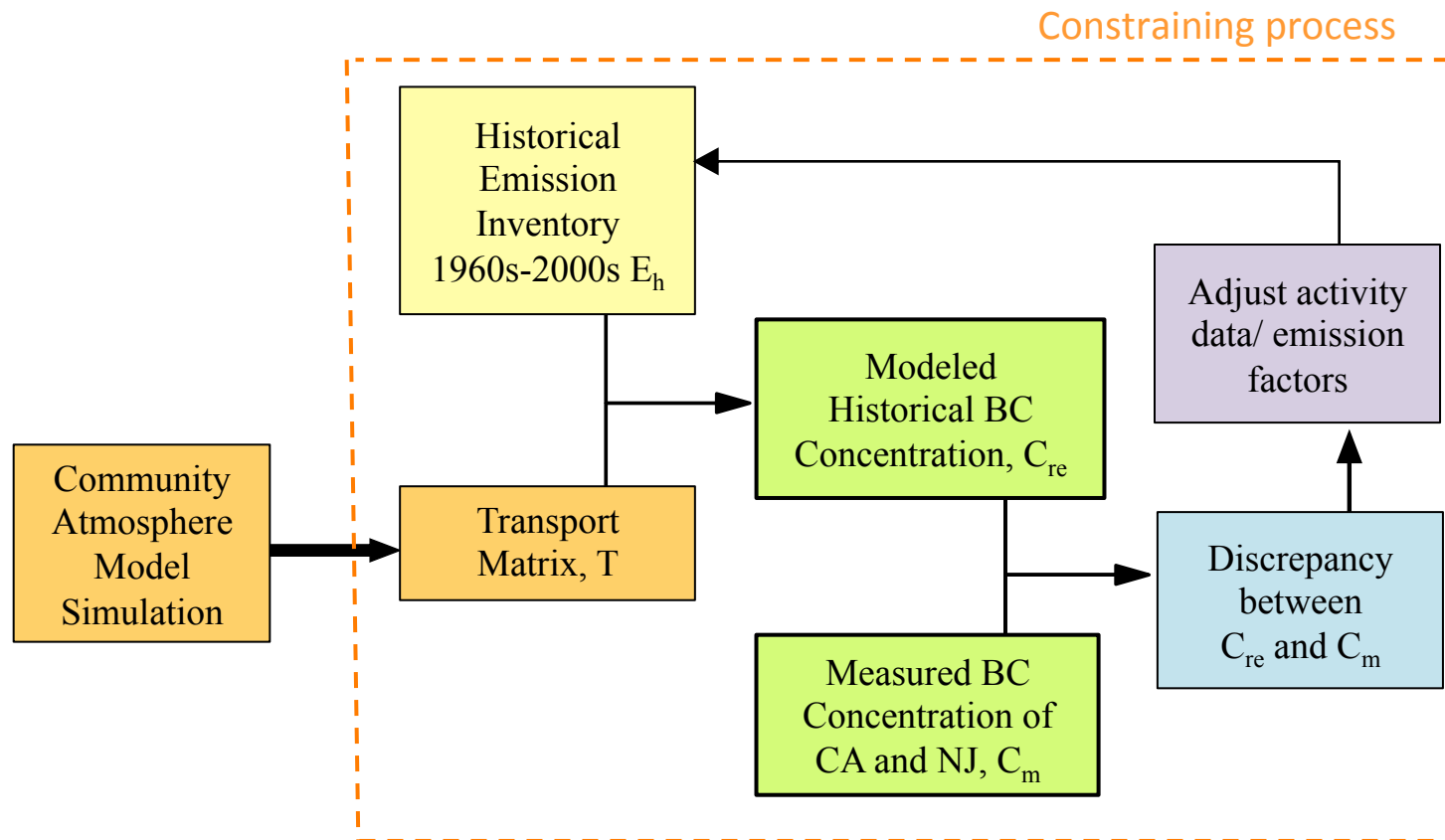


Constraining a Historical Black Carbon Emission Inventory of the United States for 1960-2000

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Based on [Emission](#) from EIA 2010 data and the SPEW trend vehicle fleet model
[Measurement](#) of historical BC trend :

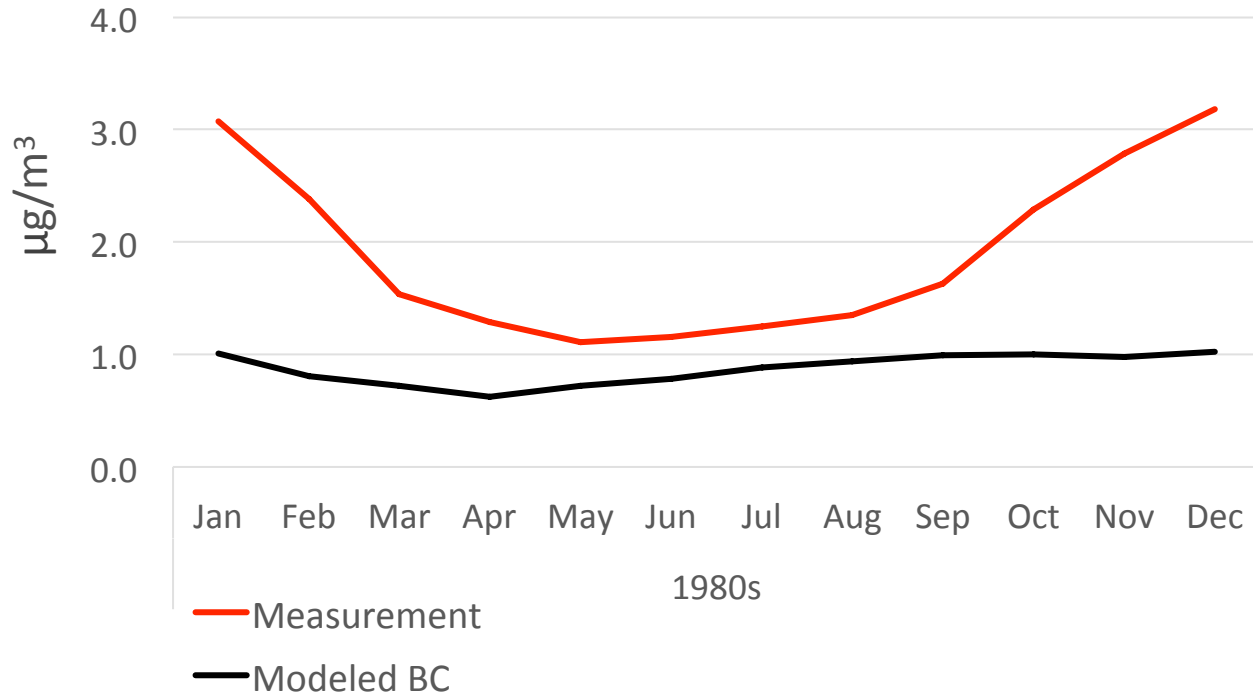
1. Baseline BC emission needs to be much higher in the 1960s and somewhat higher in the 1970s, possibly because emission factors of old vehicles should be higher
2. Inventory captures change in seasonal emission, although emission adjustment needs to be somewhat higher in the 1970s
3. Heating degree days represent seasonality well, with a slight overestimation in the 1960s



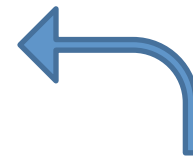
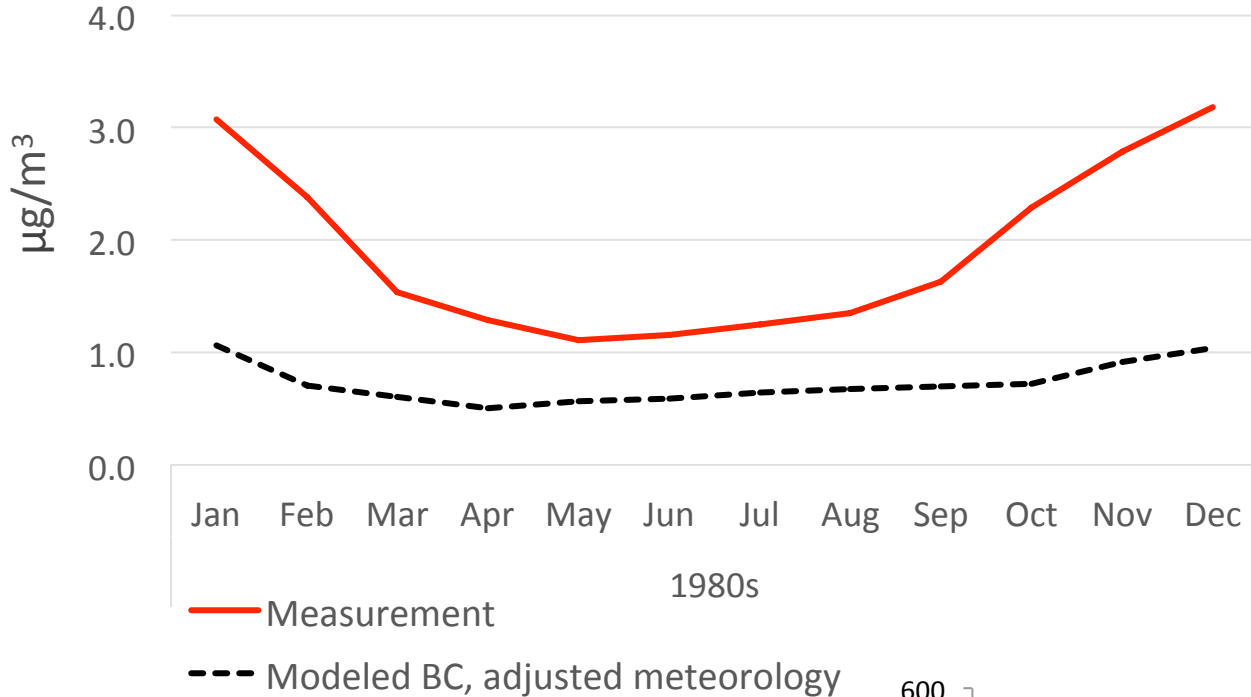
- BC emissions update:
 - ✓ EIA 2010 data with increased wood fuel use and emission
 - ✓ Connected to SPEW trend: more realistic vehicle fleet model
- Historical BC measurements: California and New Jersey

Trend is more instructive than the absolute magnitude since the measurement and the model are in different resolution

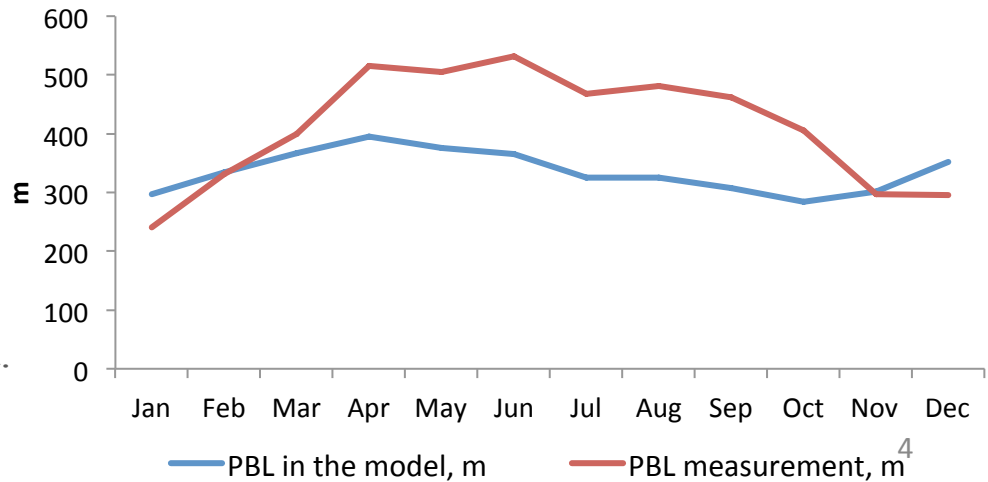
Modeled BC Concentration and Measured BC Concentration of California



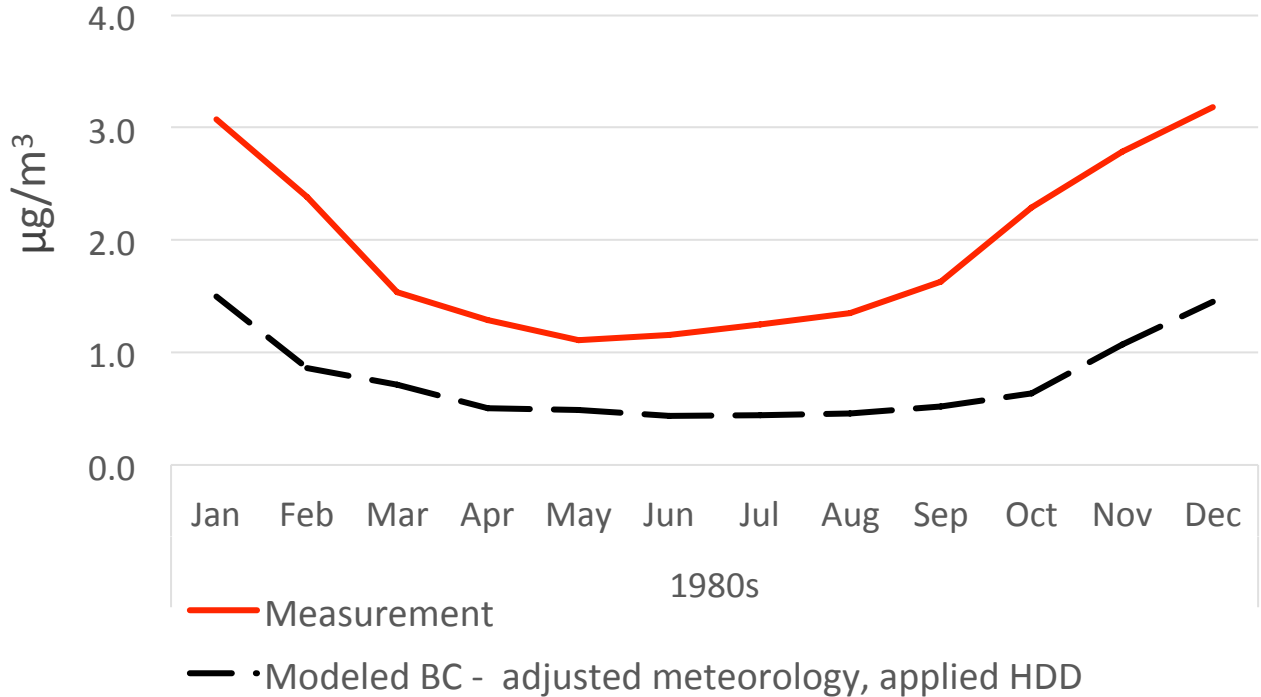
Adjust Modeled BC Concentration to Account for Error in Model Meteorology



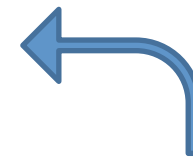
Planetary Boundary Layer for Bay Area.
 Model vs. Measurement
 (Data from MERRA)



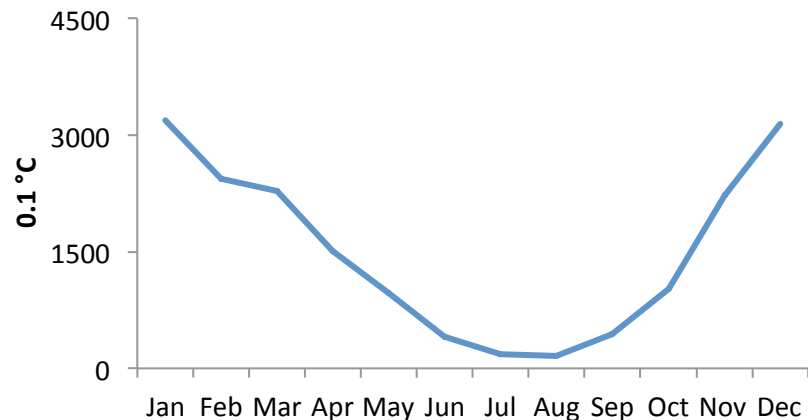
Apply Heating Degree Days to Construct Seasonality of Emission



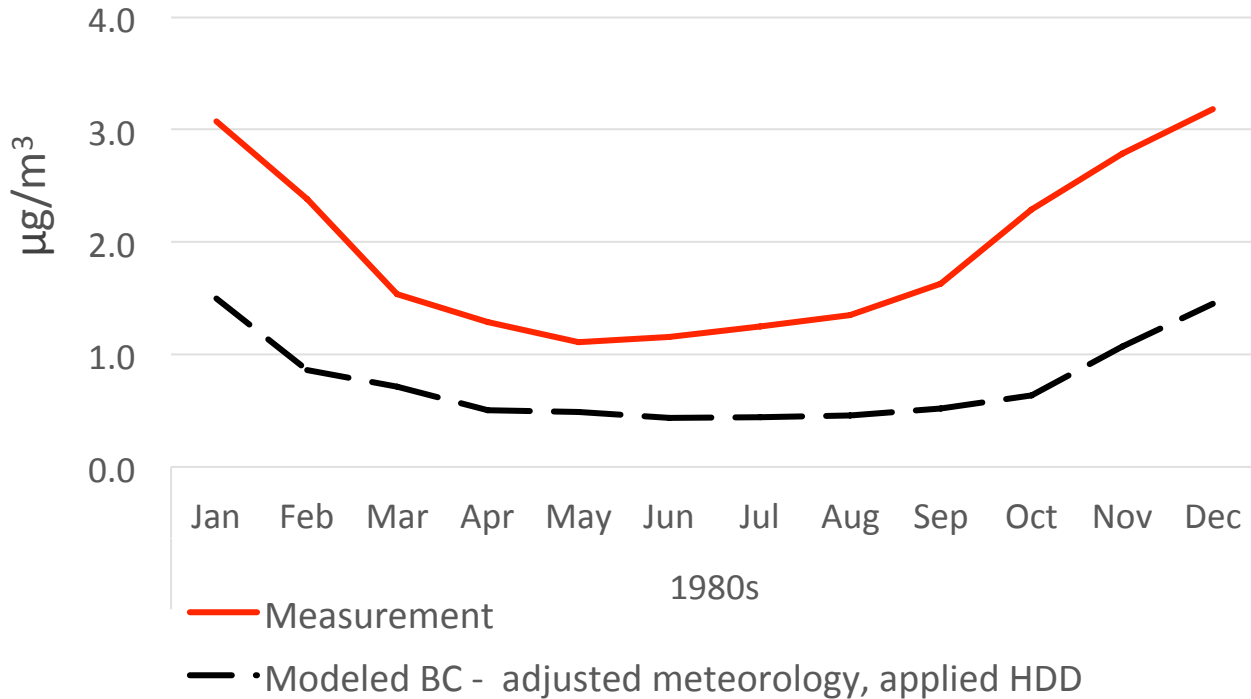
Apply historical seasonal temperature record (heating degree days, HDD) to **residential emissions** to calculate the seasonality



Heating degree days for California, 1980s
(Data from NOAA)



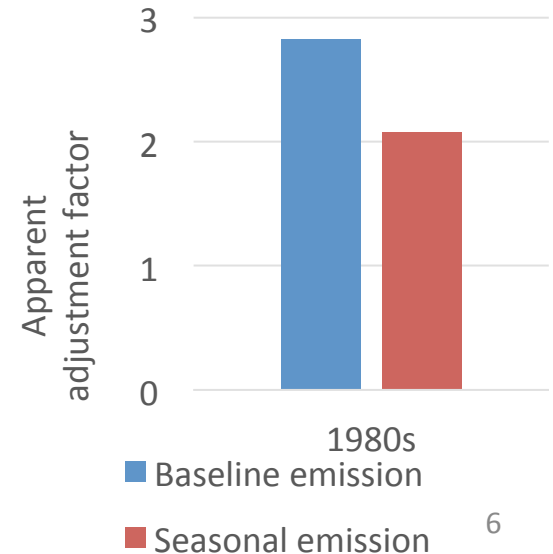
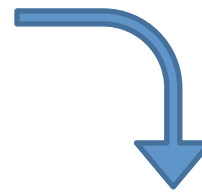
Determine Adjustment if Emissions are the Sole Cause of discrepancy



Assumptions:

Seasonal emission is zero in summer (emission for heating)

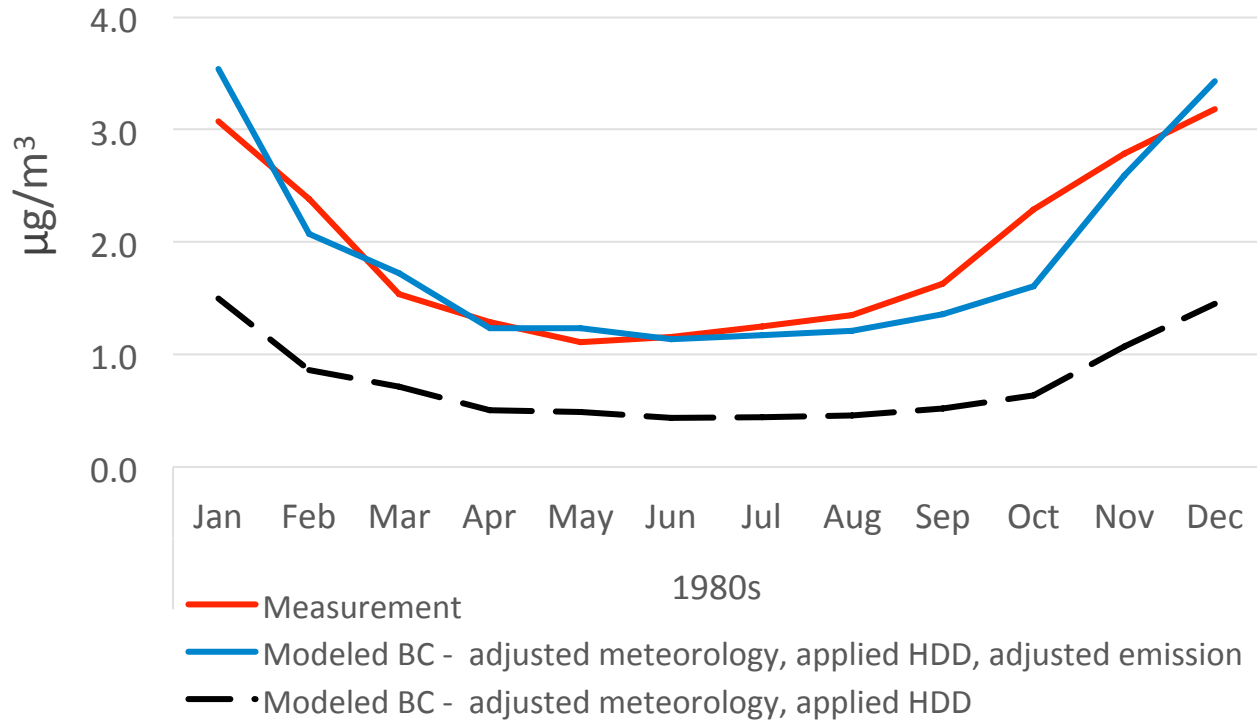
Concentration is proportional to emission.



- Apparent adjustment factors imply improvement of emission inventory
- **Trend** is more instructive than the absolute magnitude

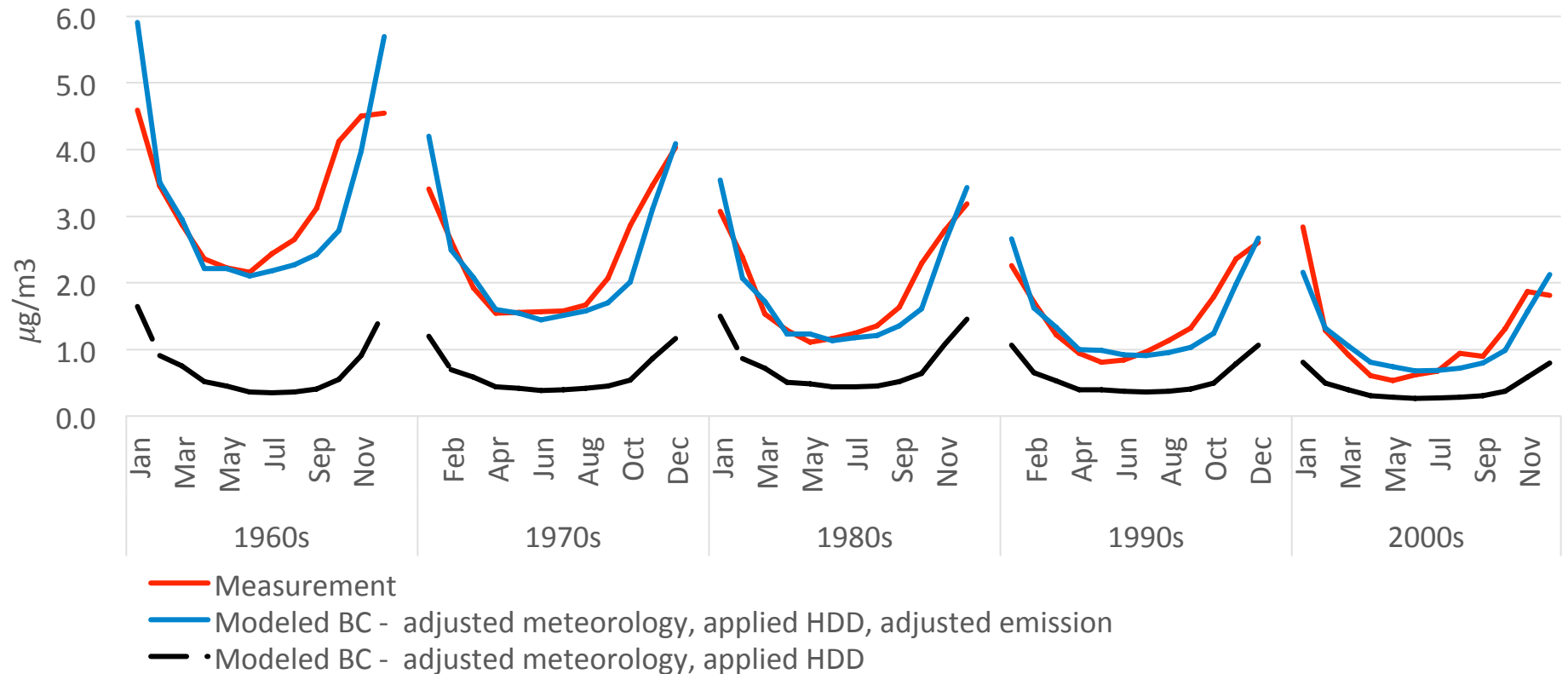
Emission adjustment factor for US BC Emissions in 1980s

Modeled Concentration from Adjusted BC Emissions for 1980s



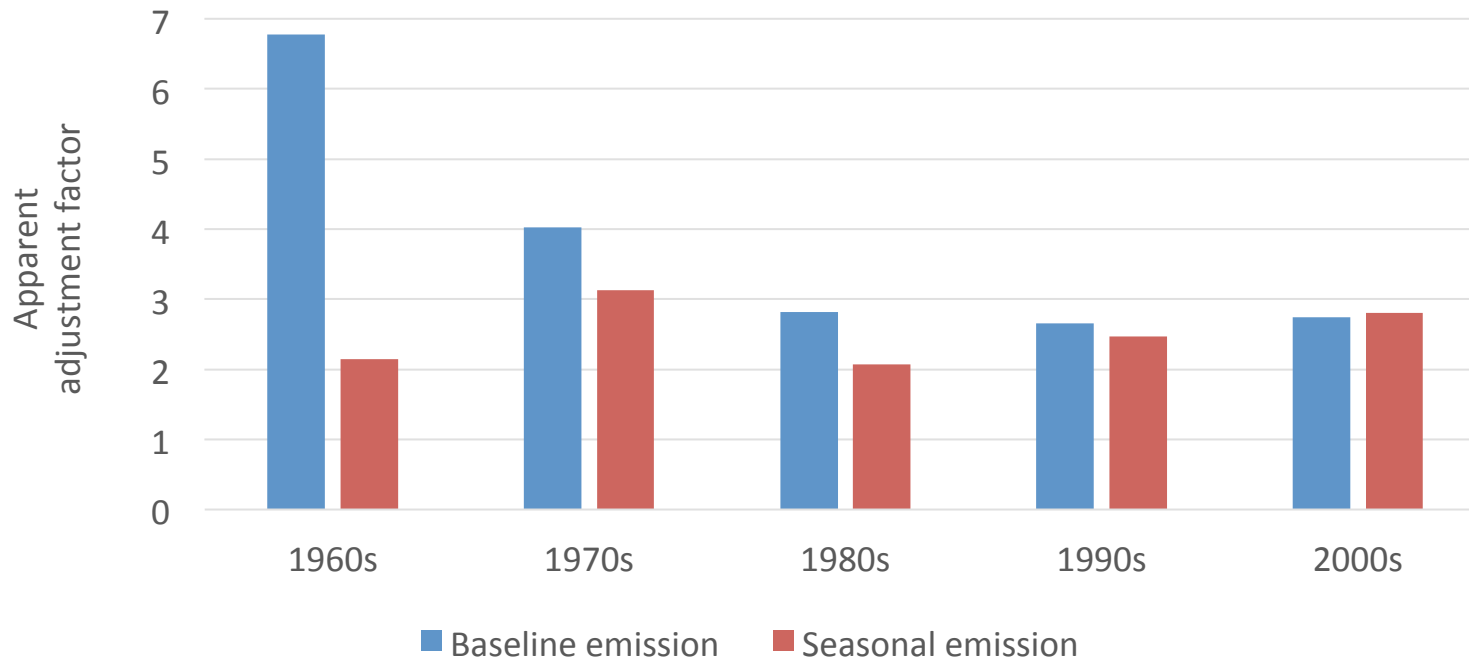
- Heating degree days represent seasonality well

Modeled BC Concentration and Measured BC Concentration of California for 1960s- 2000s



- Heating degree days represent seasonality well, with a slight overestimation in the 1960s

Apparent Adjustment Factor for Baseline Emission and Seasonal Emission for 1960s to 2000s



- A general factor of 2 is observed for all decades due the different resolution between measurement and model.

Based on the **trend**:

- Baseline emission needs to be much higher in the 1960s and somewhat higher in the 1970s, possibly because emission factors of old vehicles should be higher
- Inventory captures change in seasonal emission, although adjustment needs to be somewhat higher in the 1970s