Biases in E3SM

Most of these are based on the E3SM low resolution (1 degree) pre-industrial control run, unless otherwise noted

- Double ITCZ
- Excessive wind stress over southern oceans
- Amazon:
    - Dry bias over central and eastern Amazon, high bias in shortwave radiation; maybe wet bias over western Amazon; (lack of resolution of Andes?)
- Greenland summertime warm bias, due to elevation bias, affects surface mass balance
- Tropical west Pacific: Weak ocean salinity stratification, linked to precip bias, maybe contributes to ENSO bias
- Clouds
    - Insufficient stratocumulus above coastal upwelling regions
    - LW cloud forcing too weak, especially over deep convective regions (also in high-res model)
- Radiation:
    - TOA clear-sky SW biases over land (excessive absorption)
- Precipitation and moisture
    - Diurnal cycle over land (lack of night-time precipitation)
    - Regional biases: too little over TWP; too much over N. Indian Ocean, Central Africa and maritime continents
    - Lack of intense precipitation and too much light precipitation (also with high-resolution version)
    - Dry bias in tropical free troposphere
    - Excessive precipitation over high elevations
- Dynamics and variability
    - Weak tropical convectively-coupled waves (MJO and Kelvin)
    - Weak ENSO variability
- Temperature
    - Warm bias over mid-latitude lands
- Ocean/ice
    - Labrador sea surface temperature and sea ice biases
    - sub-ice shelf melt rates biased high / low as a result of:
        - near- and on-continental shelf water mass property (T, S) and distribution biases
        - regional and global, coupled climate biases affecting broader distribution of S. Ocean properties
        - highly localized (sub-ice shelf boundary layer) process scale model biases
- Land
    - Surface SW biases due to snow pack and/or snow albedo biases over land
    - High-latitude land – overestimation of latent-heat flux, surface net heat flux too low
    - C soil dynamics – inconsistent estimates of C stocks and turnover times with depth
    - Poor coupling between plant hydraulics and leaf C exchanges
    - C4 grasses in Southern Amazon, the Sahel, and southern Congo have too low C4 photosynthesis and NPP; leads to low fire response
    - Tropical CH_4 emissions biased low - maybe due to hydrology and CH_4 BGC biases