

Appendix B :

difference between fully-coupled and atmosphere-only simulations – zonal averages

April 21, 2020

Main observations

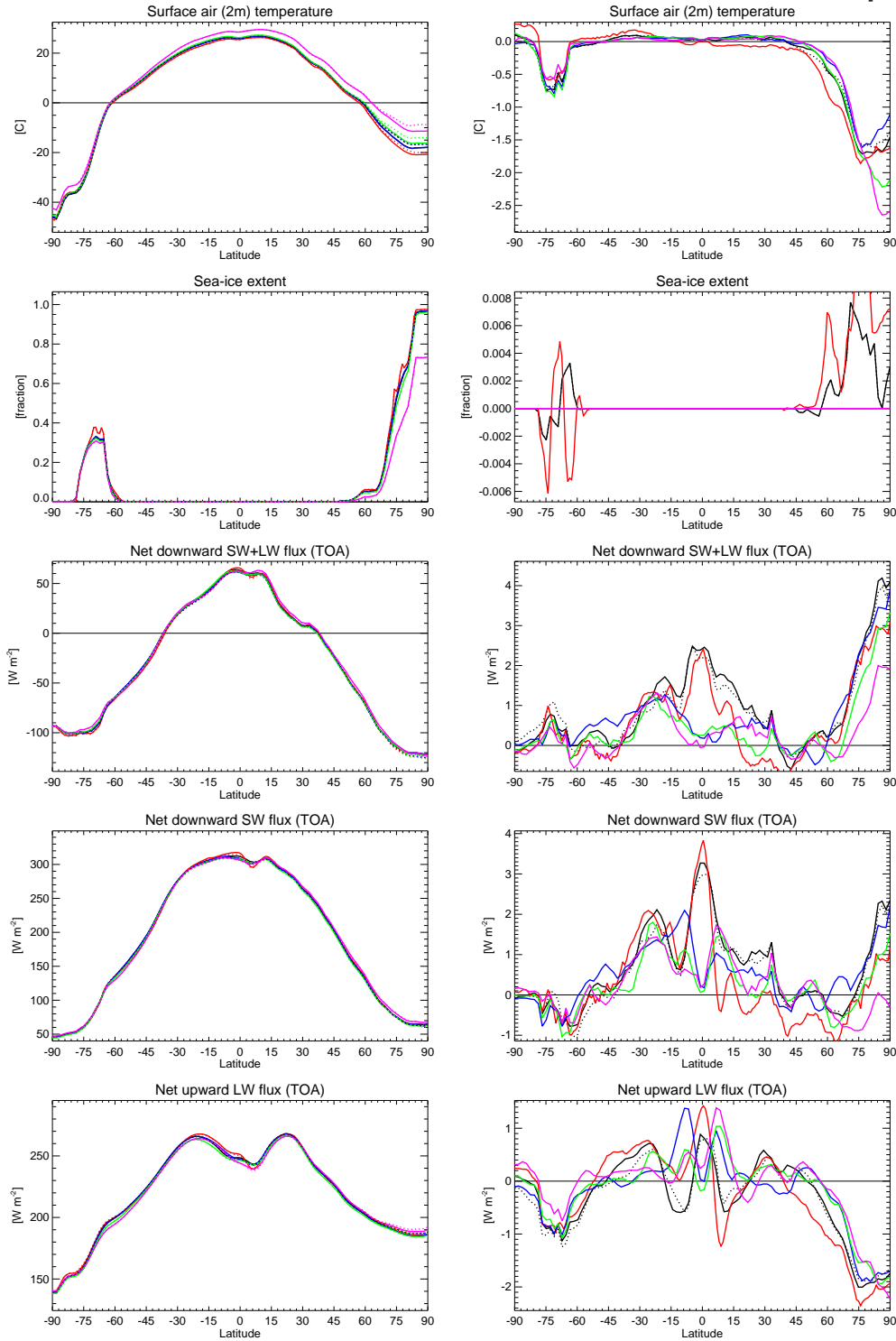
1. Annually averaged, the near-surface (2 m) air temperature is too cold in the region 80°S–65°S by around 0.5 K. Temperatures north of 50°N are also too cold : largest differences are found in the region 75°N–90°N in the range -1 to -2.5 K. This difference seems to be caused by a strong cold bias in local winter (–2 to –6 K north of 70°N in DJF; between -1 and -1.5 K in 65°S–80°S in JJA). In the local summer season, there seems to be a small positive temperature bias at both poles.
2. The sea-ice extent is identical for the combinations histSTT/historical and ssp370SST/ssp370. Small differences (smaller than 1 %) are however found in the combination piClim-control/piControl, both in the 2°x2° and 1°x1° horizontal resolution.
3. The atmosphere-only simulations have netto more incoming radiation than the fully-coupled simulations. The bias is present in the regions 80°S–65°S and north of 60°N, but also at low latitudes.
4. For the TOA imbalance, the piClim-control/piControl (both 2°x2° and 1°x1° horizontal resolution) have considerably stronger positive difference than the other combinations (histSST/historical and ssp370SST/ssp370) at low latitudes.
5. The TOA LW imbalance difference follows the temperature difference at the surface at the high latitudes.
6. The primary organic matter emissions contain also the non-ocean emissions. They increase strongly in the histSST/historical [1985–2014] and ssp370SST/ssp370 combinations at low latitudes.
7. Sea-salt and primary organic matter emissions are considerably lower in the atmosphere-only simulations, especially at mid- and high latitudes (in both hemispheres).
8. In the piClim-control/piControl 1°x1° combination, some fine-scale spatial variability is visible for the difference in primary organic matter emissions. This is probably not caused by the natural marine ocean emissions, but probably related to the slightly different setup of emission files.
9. Discrepancy in DMS emission strength is further reduced when doing an additional Δ DMS change.

Questions

1. Why is there a discrepancy in sea-ice cover for the piClim-control/piControl combinations? The piClim-control land-only simulations are based on a generated climatology, whereas for histSST and ssp370SST the prescribed sea-ice boundary conditions still vary from year to year.
2. What causes the fine-scale difference in primary organic matter emissions in piClim-control/piControl 1°x1° combination? (probably these are the anthropogenic emissions, but it has to be checked)

Absolute

Difference [fSST – coupled]



piControl – piControl [2x2] – historical [1850–1979] – historical [1985–2014] – ssp370 [2071–2100]

Figure 1: Zonal- and annual-averaged near-surface (2 m) air temperature, ice cover fraction, TOA imbalance (net downward), TOA SW imbalance (net downward), and TOA LW imbalance. Left : values for atmosphere-only simulations (solid lines), and fully-coupled simulations (dotted lines). Right : difference between atmosphere-only and fully-coupled simulations. The different setups are : piClim-control/piControl on $2^\circ \times 2^\circ$ (black) and $1^\circ \times 1^\circ$ (red), histSST/historical during 1850–1879 on $2^\circ \times 2^\circ$ (blue), histSSY/historical during 1985–2014 (green), and ssp370/ssps370SST on $2^\circ \times 2^\circ$ (purple).

Absolute

Difference [fSST – coupled]

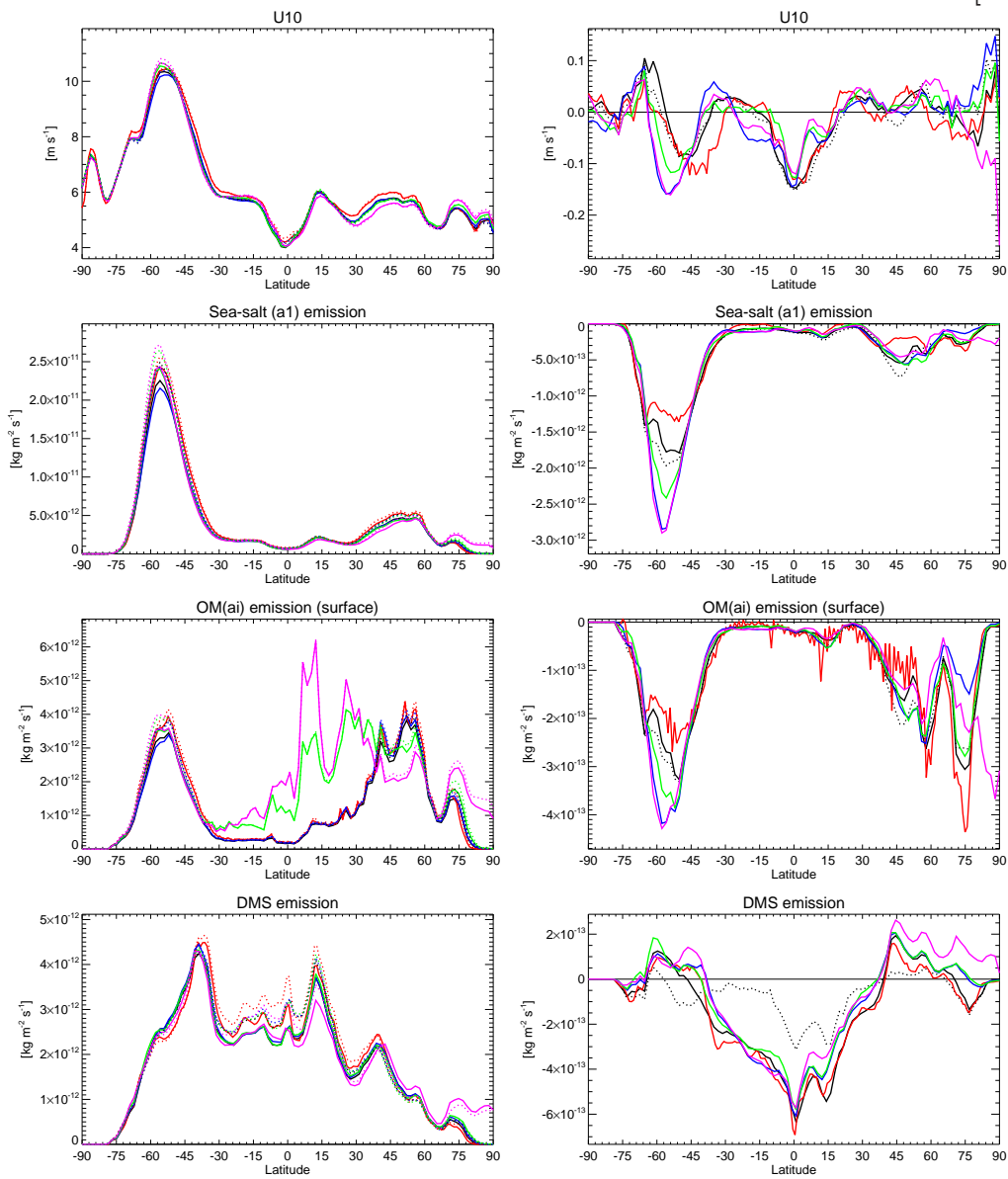


Figure 2: As Fig. ??, but near-surface (10 m) wind speed, and emissions of sea-salt (mode 1), primary organic matter, and DMS.

Absolute

Difference [fSST – coupled]

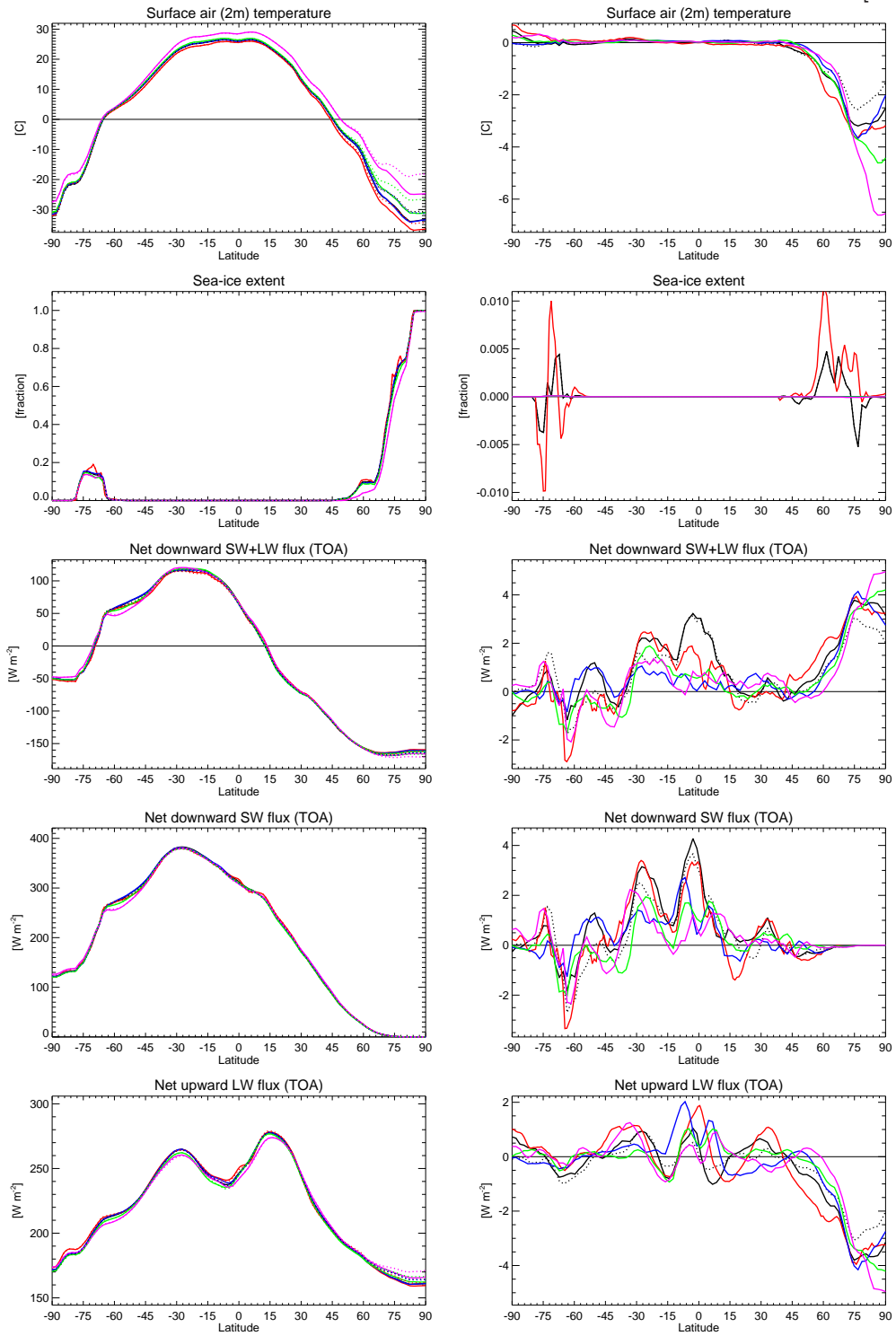


Figure 3: As Fig. ??, but for DJF.

Absolute

Difference [fSST – coupled]

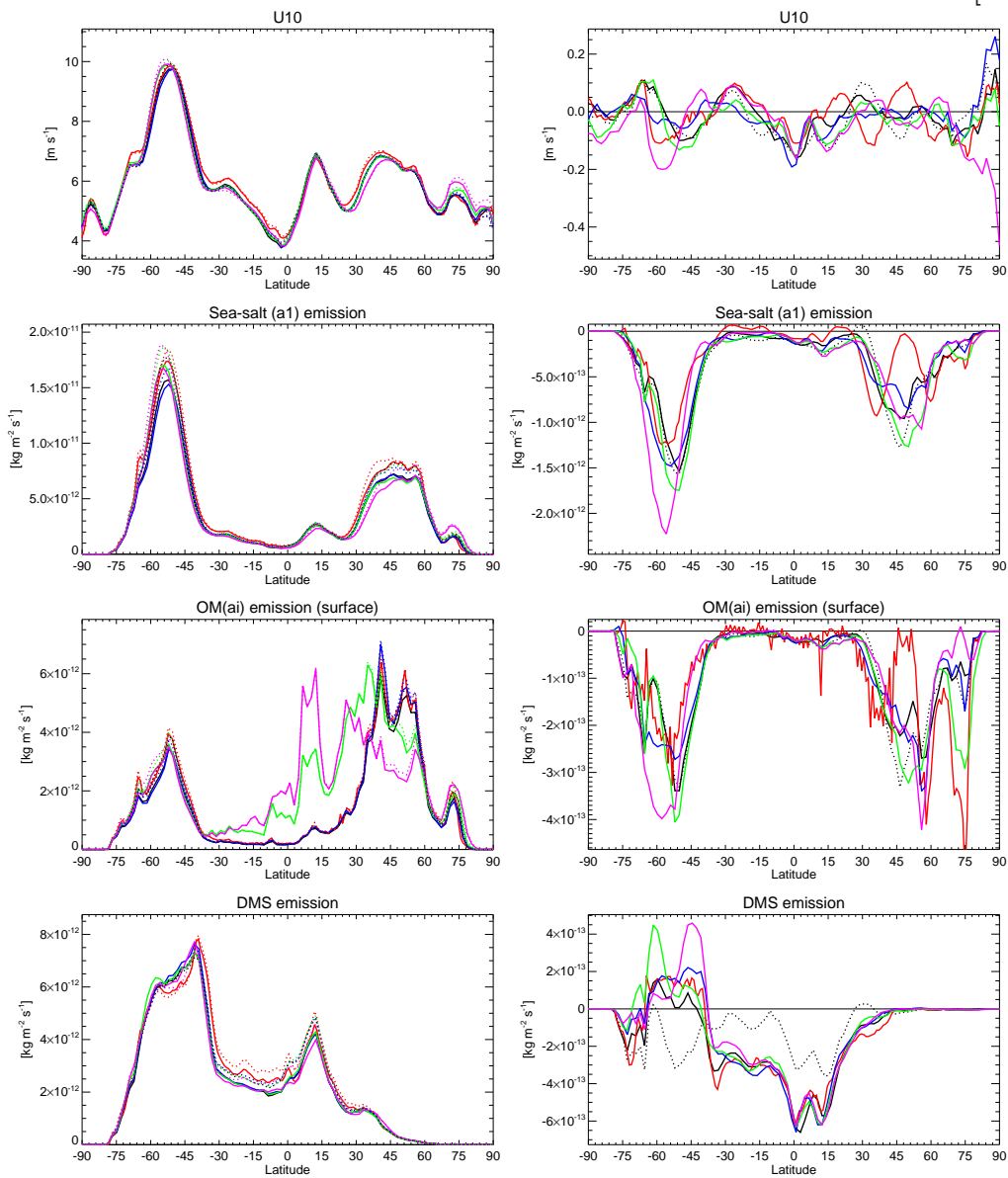
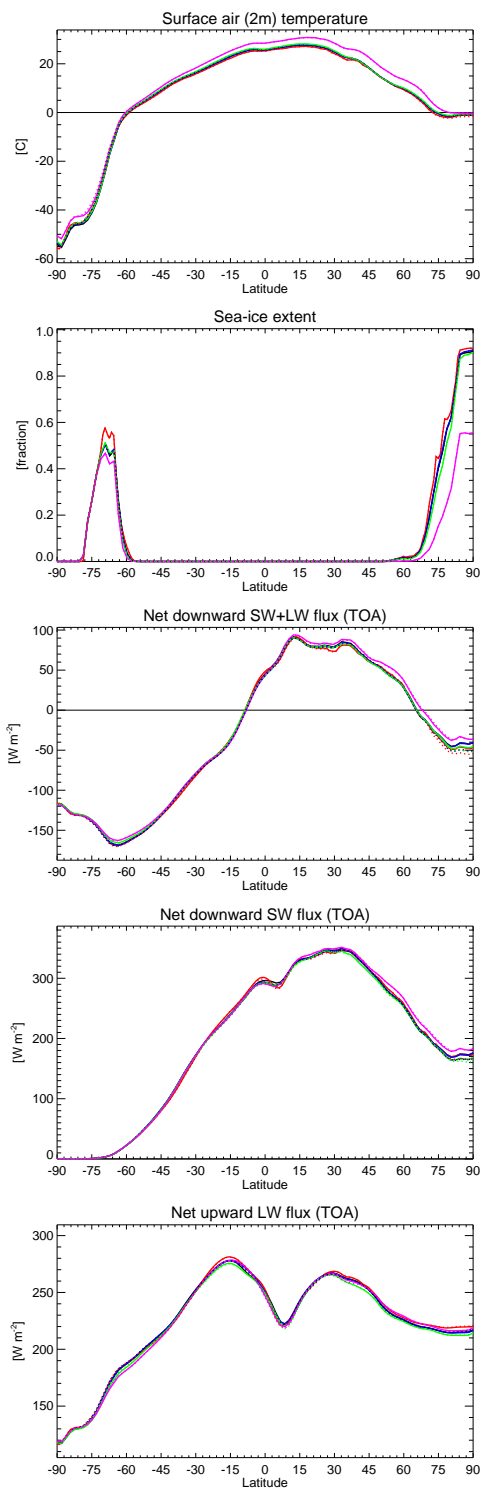


Figure 4: As Fig. ??, but for DJF.

Absolute



Difference [fSST – coupled]

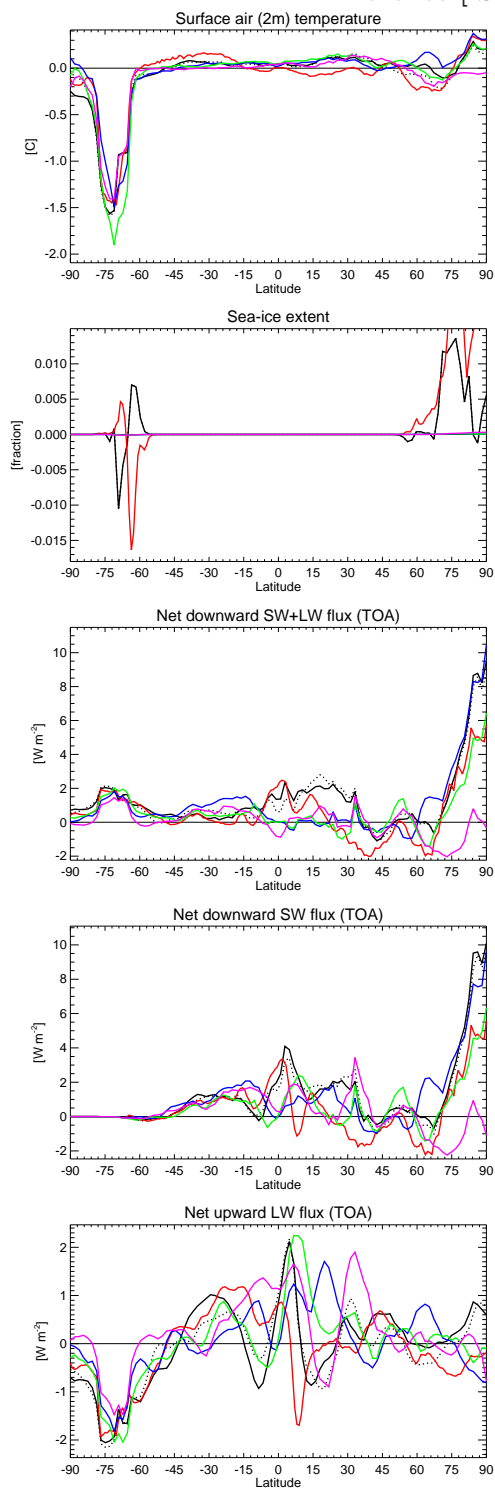


Figure 5: As Fig. ??, but for JJA.

Absolute

Difference [fSST – coupled]

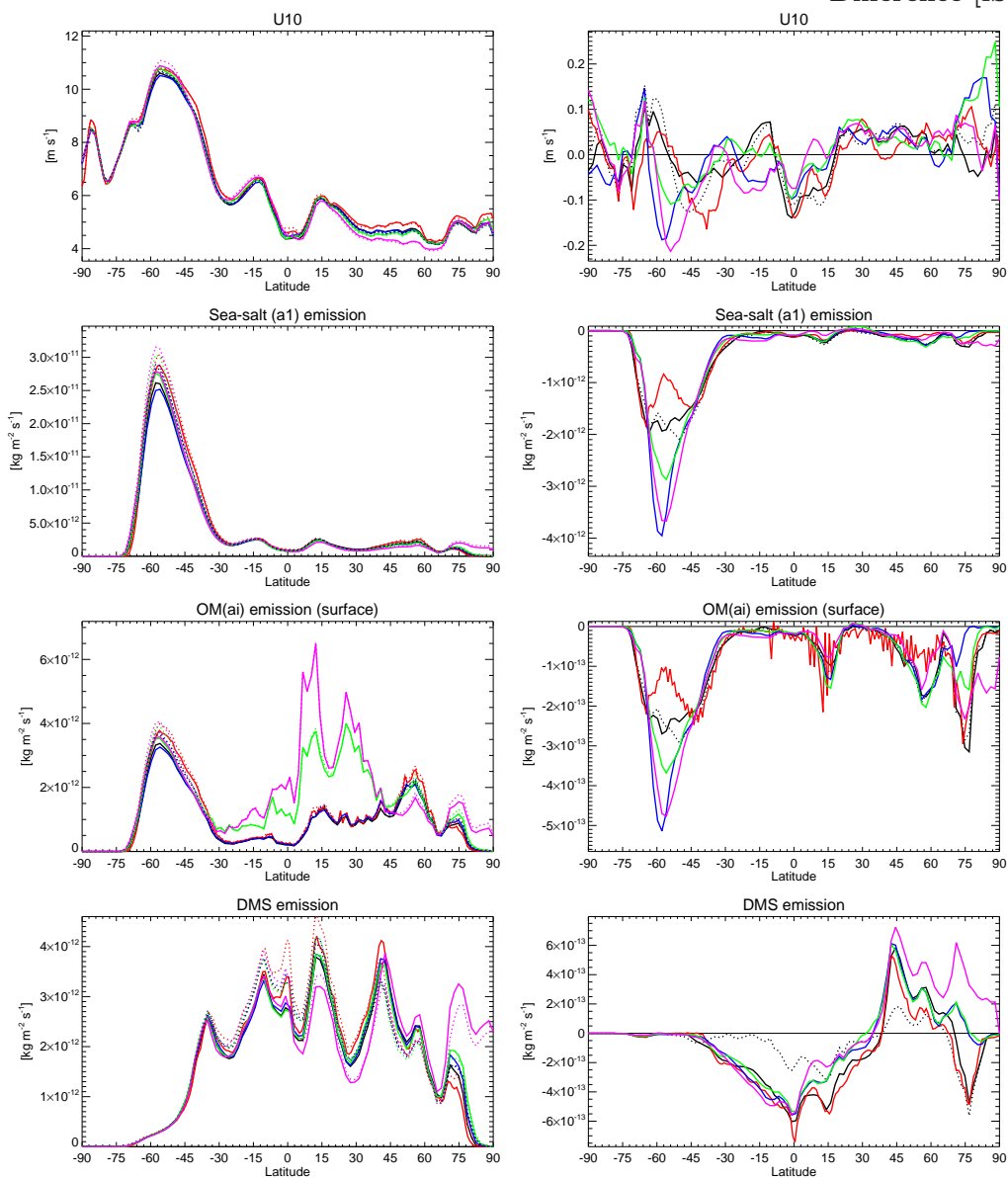


Figure 6: As Fig. ??, but for JJA.