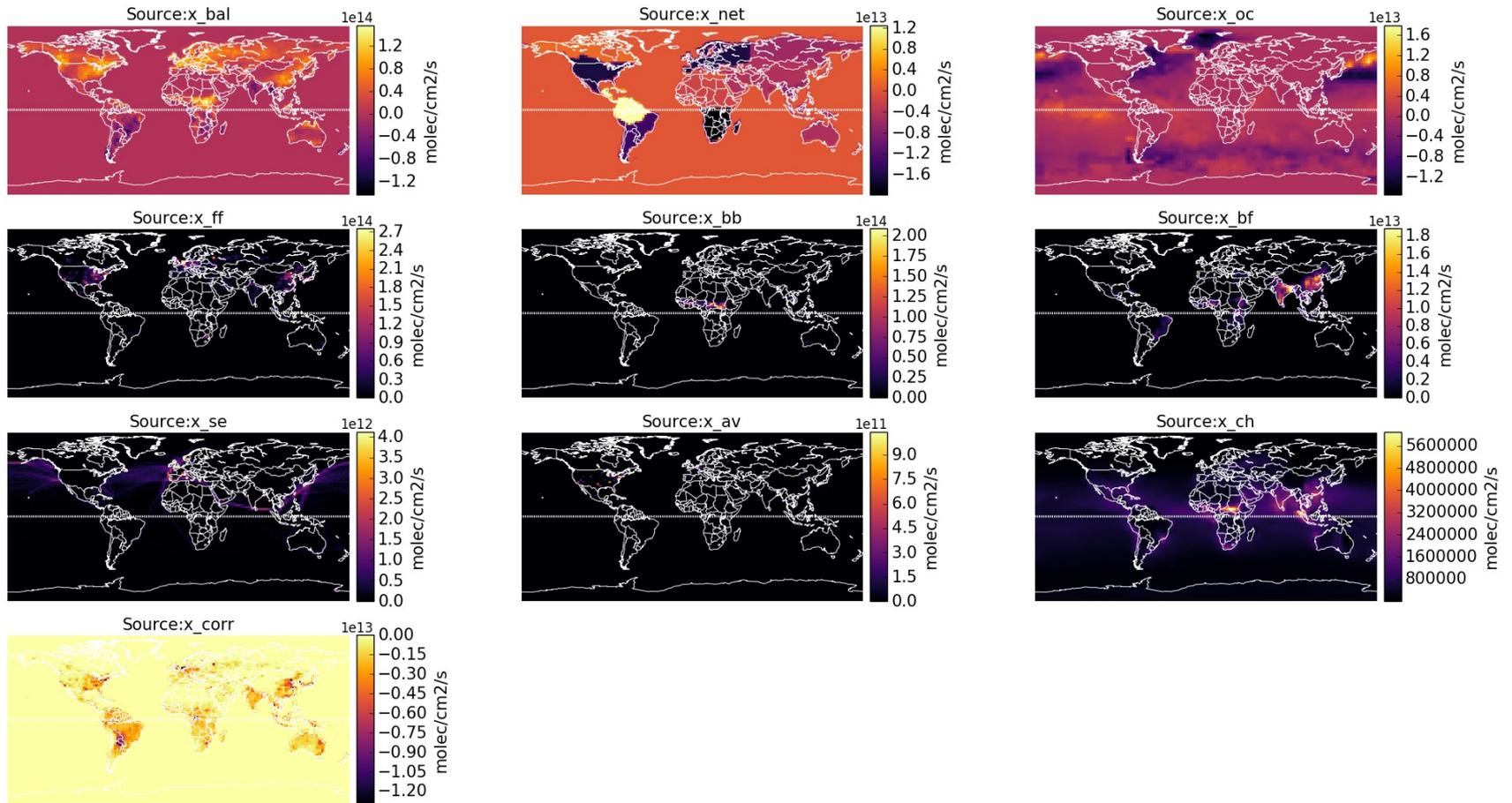


CO2 speciality simulation bug

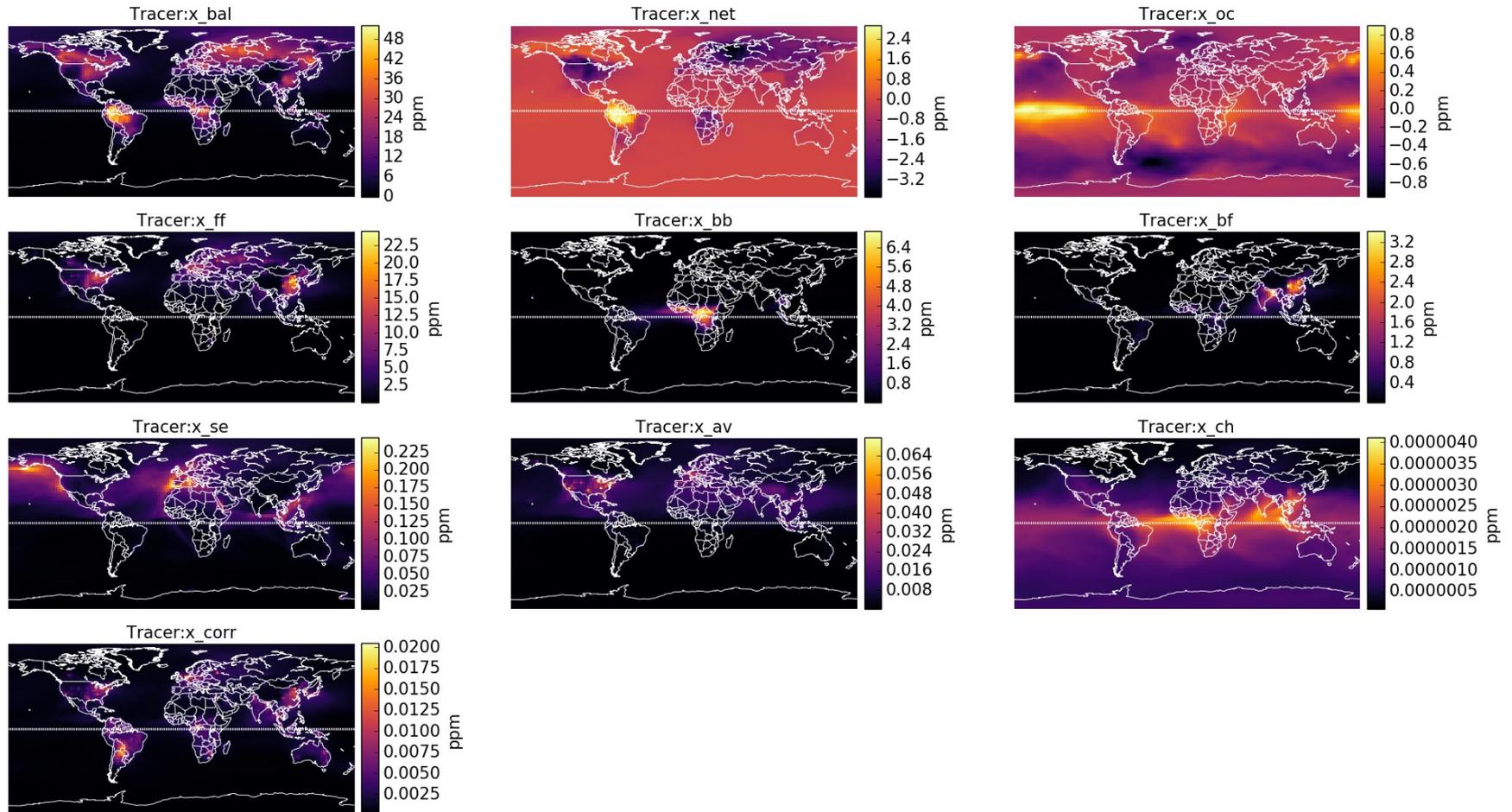
Problem

- The different tracers in the CO₂ simulation weren't reflecting the sources related to the those tracers. It seemed that additional sources were added to all the tracers.

CO2 sources for all the tracers

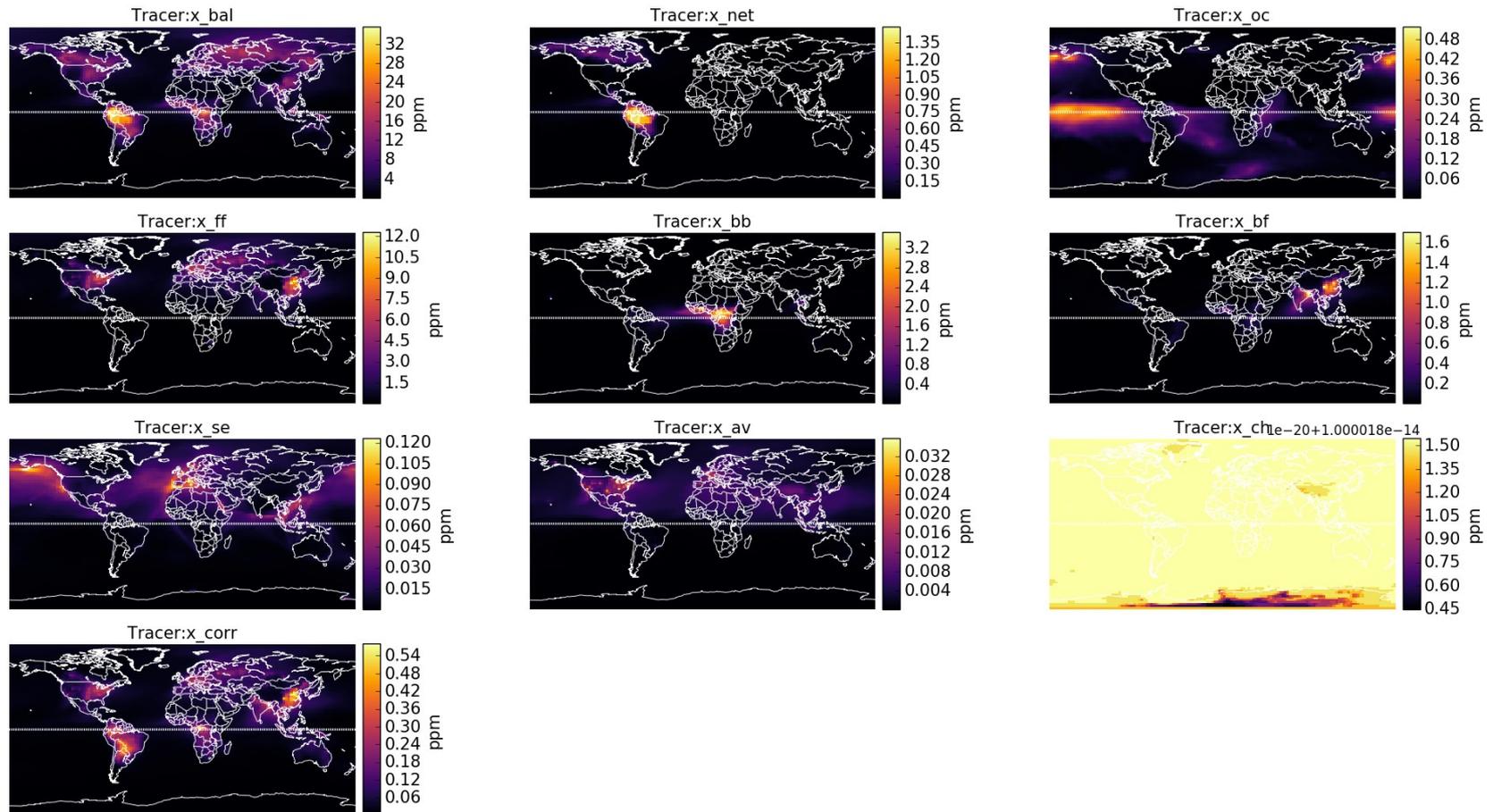


CO2 tracers



The simulation was initialised with a ~ 0 background field for all the tracers (365 ppm for the balanced biosphere, ocean and net terrestrial exchange in order to get negative values which was subtracted from these tracers after the simulation), however it seemed like additional sources were added to the tracers based on for example the balanced biosphere values (whose values are way too high!)

Simulation without sources added to the tracers in the co2_mod.F



In order to investigate this we removed the sources added to the Spc array in co2_mod.F for all the tracers (e.g. line 470 $\text{Spc}(I,J,1,2) = \text{Spc}(I,J,1,2) + E_CO2 \rightarrow \text{Spc}(I,J,1,2) = \text{Spc}(I,J,1,2)$). The results were supposed to show a field filled with MISSING_VV ($1.0e-20_fp$) for all the tracers however, most of them showed a significant amount which meant the simulation was additionally adding sources for all the tracers.

It seemed like it was double-counting the sources

- It was also adding the sources from hco_interface_mod.F90 lines 185-190

```
=====
! GetHcoVal begins here
=====

! Init
FOUND = .FALSE.
IF ( PRESENT(Emis) ) Emis = 0.0_hp
IF ( PRESENT(Dep) ) Dep = 0.0_hp

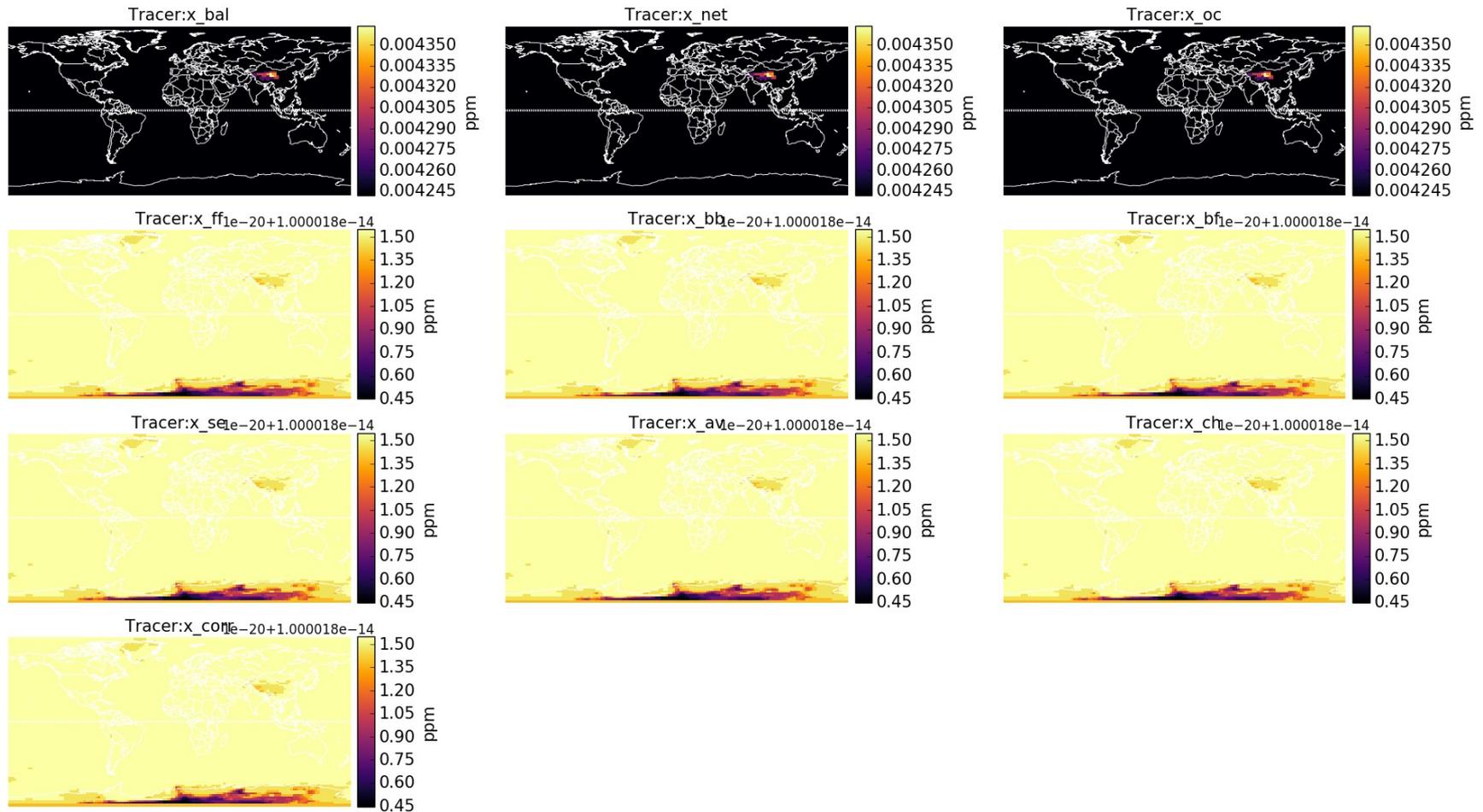
! Define tracer ID to be used.
HcoID = TrcID

! ! HEMCO species ID corresponding to this GEOS-Chem tracer
! IF ( tID > 0 ) HcoID = M2HID(tID)%ID

! If HEMCO species exists, get value from HEMCO state
IF ( HcoID > 0 ) THEN
  IF ( PRESENT(Emis) ) THEN
    IF ( ASSOCIATED(HcoState%Spc(HcoID)%Emis%Val) ) THEN
      Emis = HcoState%Spc(HcoID)%Emis%Val(I,J,L)
      FOUND = .TRUE.
    ENDIF
  ENDIF
  IF ( PRESENT(Dep) ) THEN
    IF ( ASSOCIATED(HcoState%Spc(HcoID)%Depv%Val) ) THEN
      Dep = HcoState%Spc(HcoID)%Depv%Val(I,J)
      FOUND = .TRUE.
    ENDIF
  ENDIF
ENDIF
ENDIF
ENDIF

END SUBROUTINE GetHcoVal
```

After commenting out those lines
the results looked good and the
initial fields were ~ 0



Conclusion

- The CO2 simulation was reading in the emissions from `co2_mod.F` and additionally through `hco_interface_mod.F90`, double-counting them which lead to wrong tracer values.

Future

- Test if this also affects other speciality simulations (e.g. CH₄)