Steady-State 5-day equinox tiegcm runs: Dynamic vs Constant Critical Latitudes

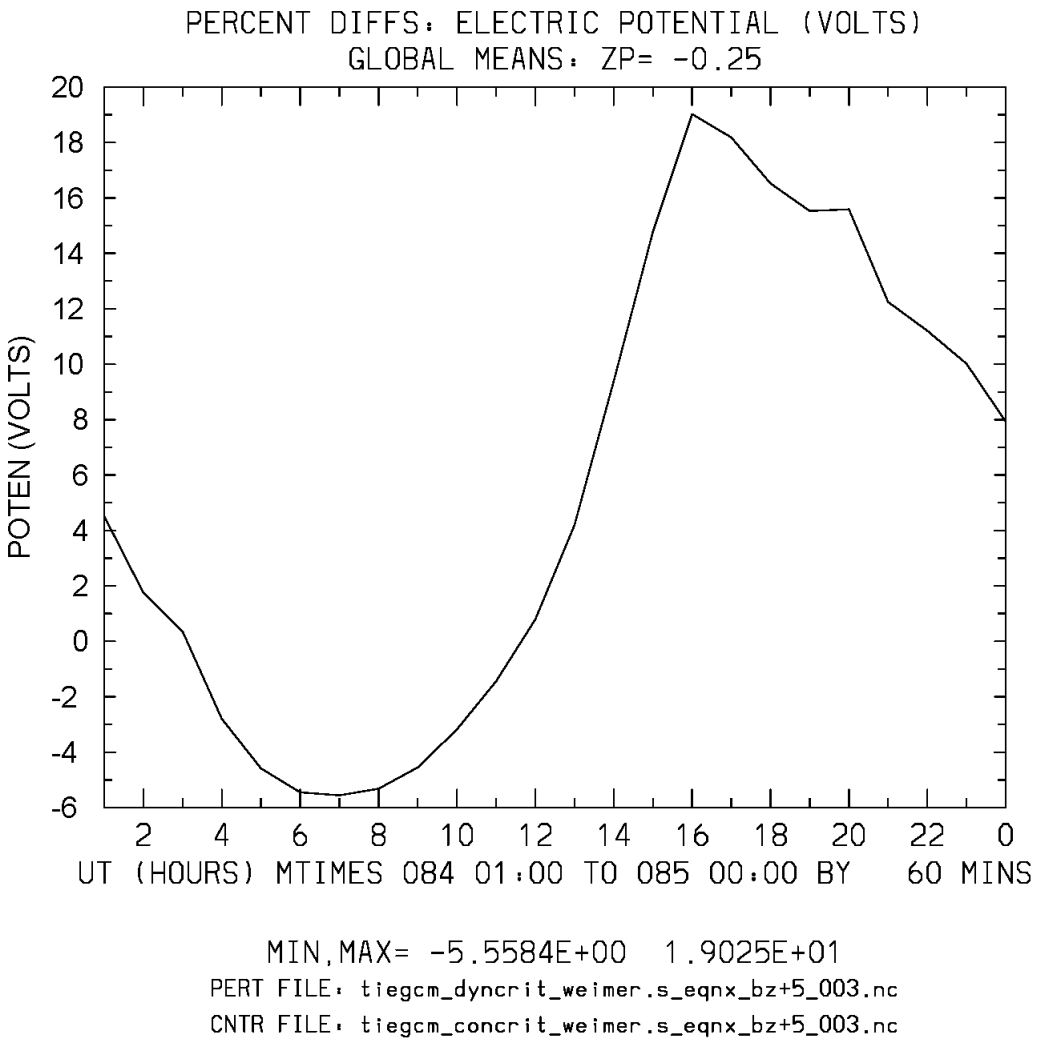
- Concrit Heelis c30p8 -> crit = 15., 30.
- Dyncrit Heelis c30p8 -> crit = 17.25, 32.25

- Concrit Heelis c95p58 -> crit = 15.,30.
- Dyncrit Heelis c95p58 -> crit = 21.12, 36.12

- Concrit Weimer BZ+5 -> crit = 15.,30.
- Dyncrit Weimer BZ+5 -> crit = 17.09, 32.09

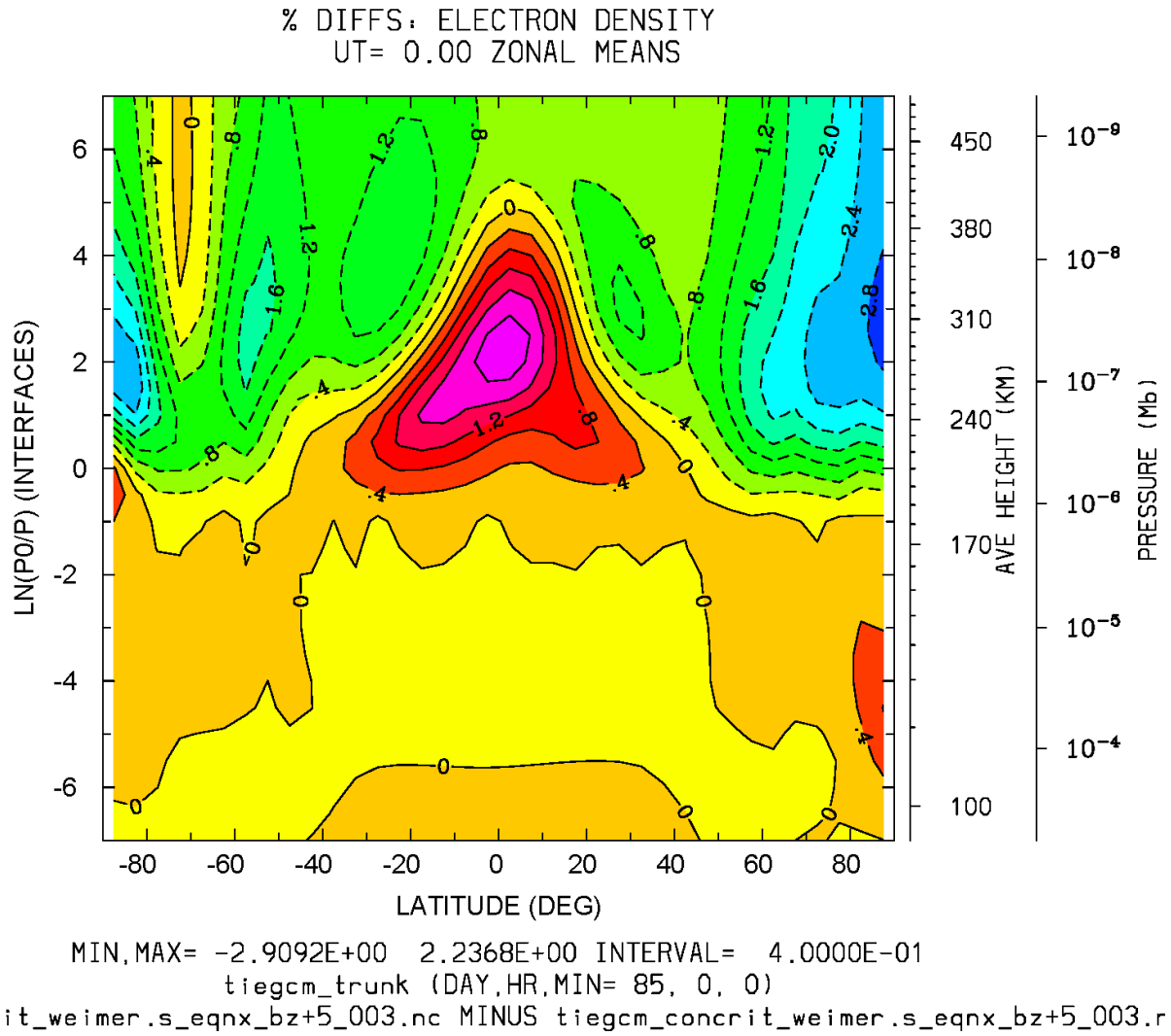
- Concrit Weimer BZ-5 -> crit = 15.,30.
- Dyncrit Weimer BZ-5 -> crit = 20.09, 35.09

Weimer BZ=+5 (%Diffs: dyncrit-concrit)



%Diffs Min,Max = -5.5, 19.0

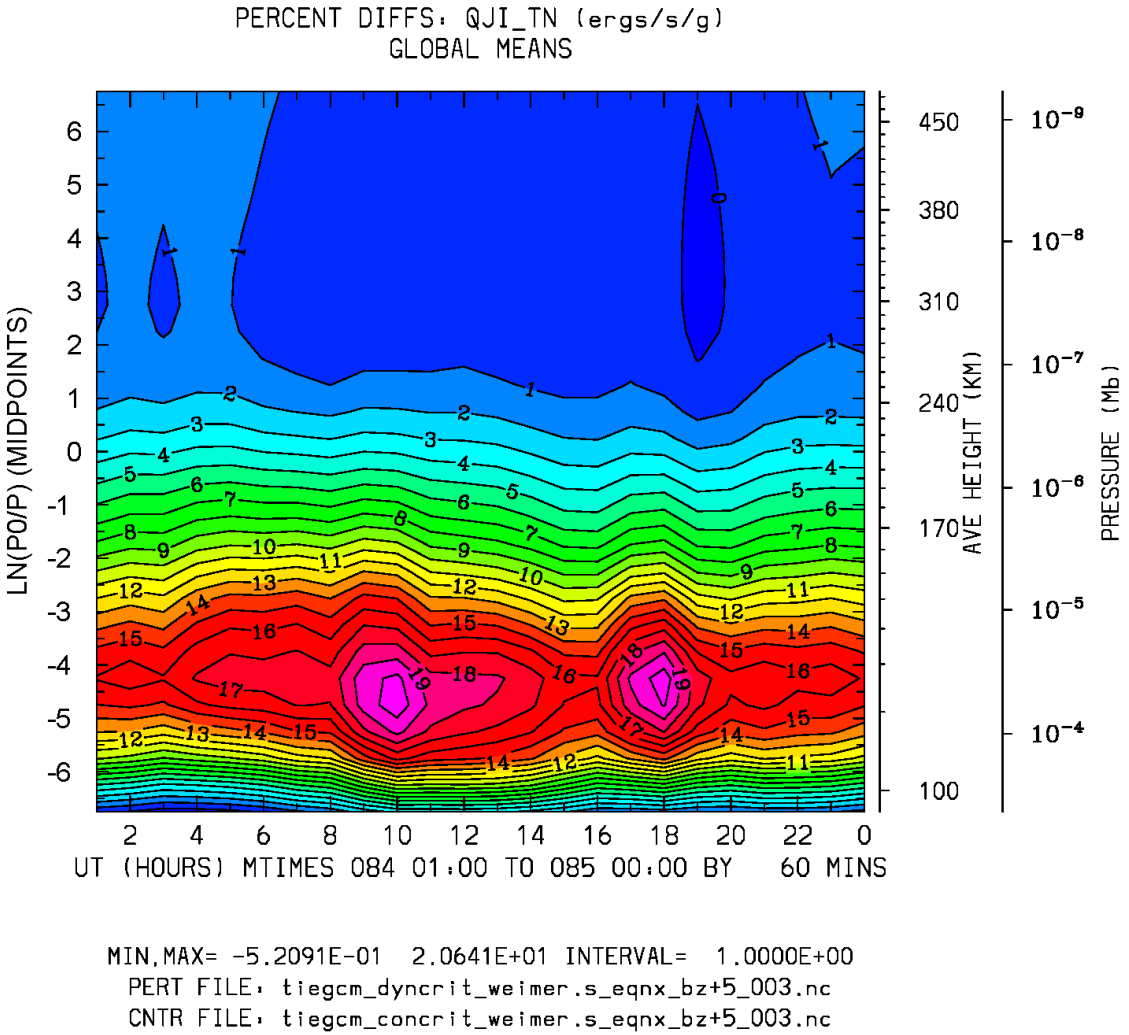
Weimer BZ=+5 (%Diffs: dyncrit-concrit)



%Diffs Min,Max = -2.9, 2.2

Joule Heating (TN)

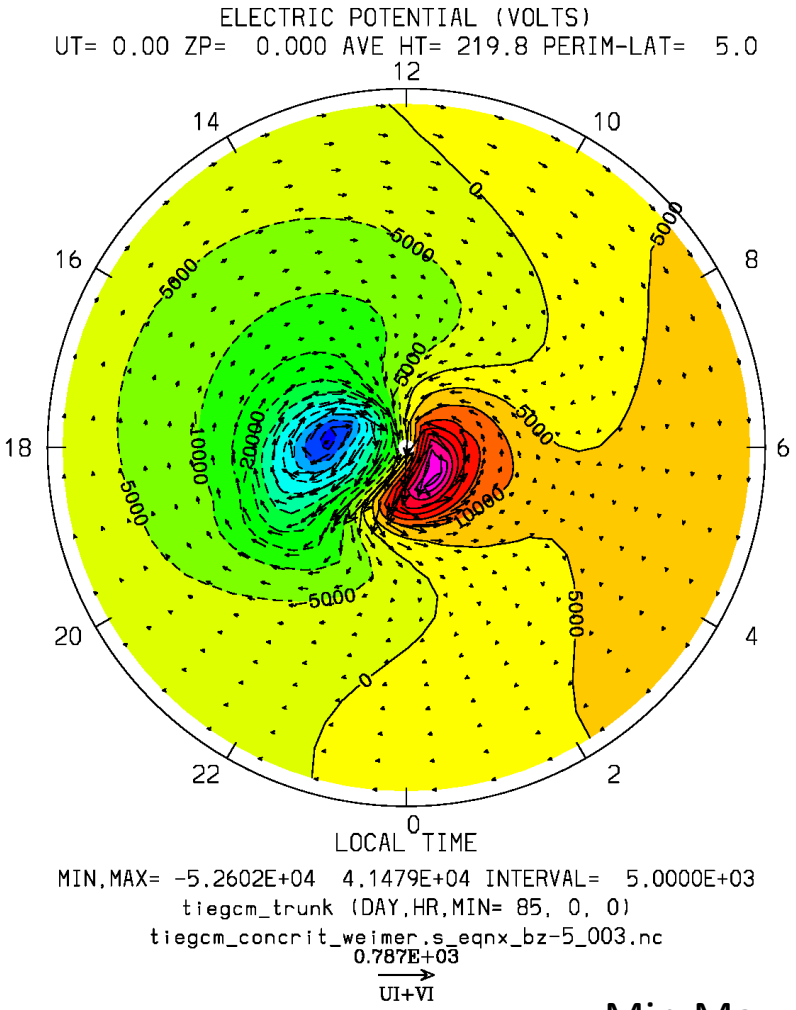
Weimer BZ=+5 (%Diffs: dyncrit-concrit)



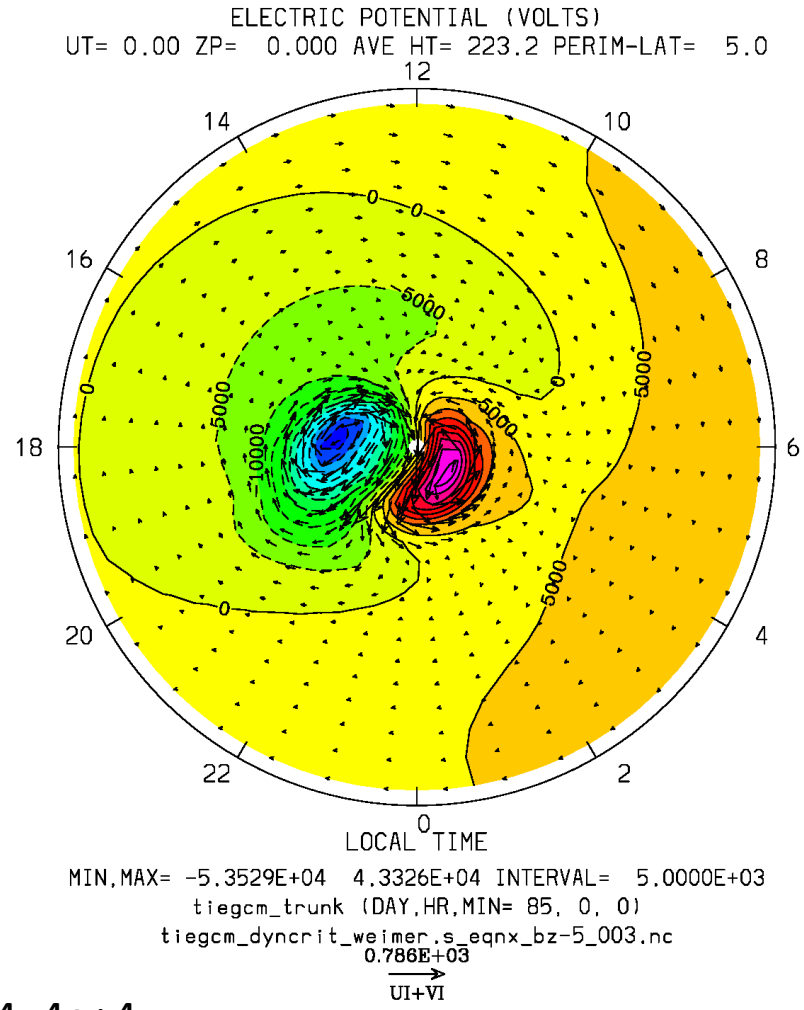
%Diffs Min,Max = -0.5, 20.6

Electric Potential + UI,VI (full fields)

Concrit: Weimer BZ=-5



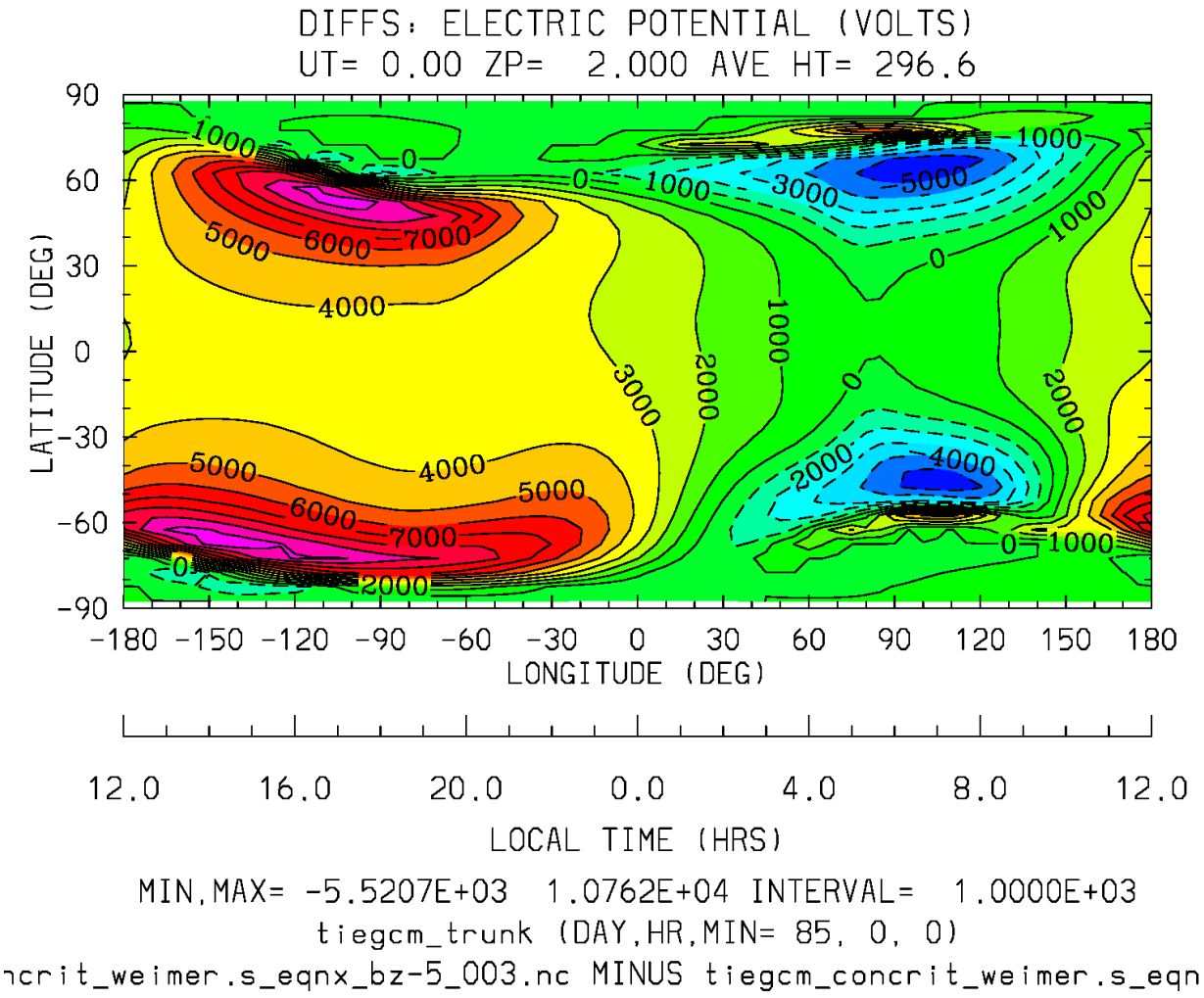
Dyncrit: Weimer BZ=-5



Min,Max = -5e+4, 4e+4

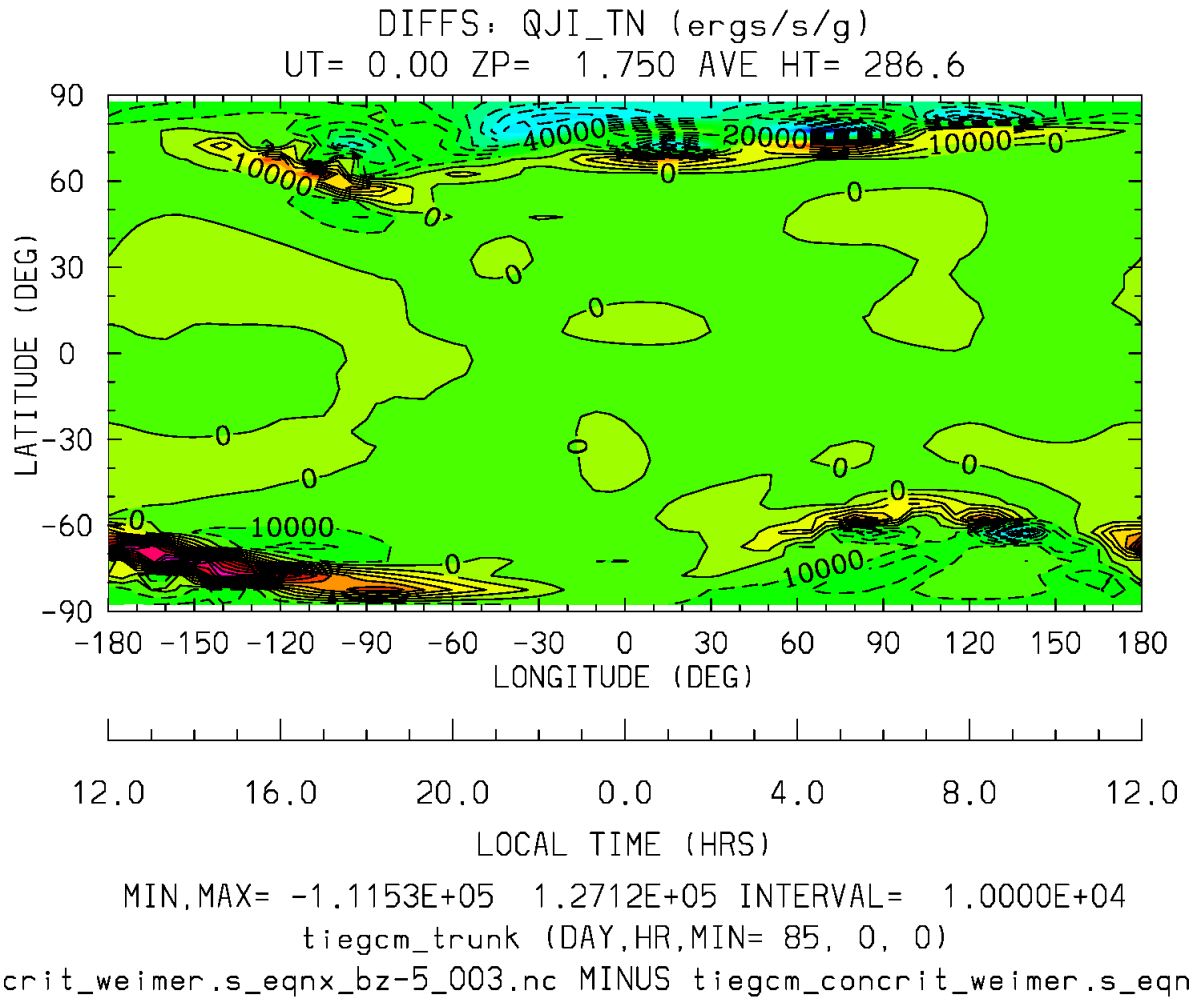
Potential fall-off is faster with dyncrit

Electric Potential
Weimer BZ = -5 (Diffs: dyncrit-concrit)



Diffs: Min,Max = -5.5,10.7 (kv)

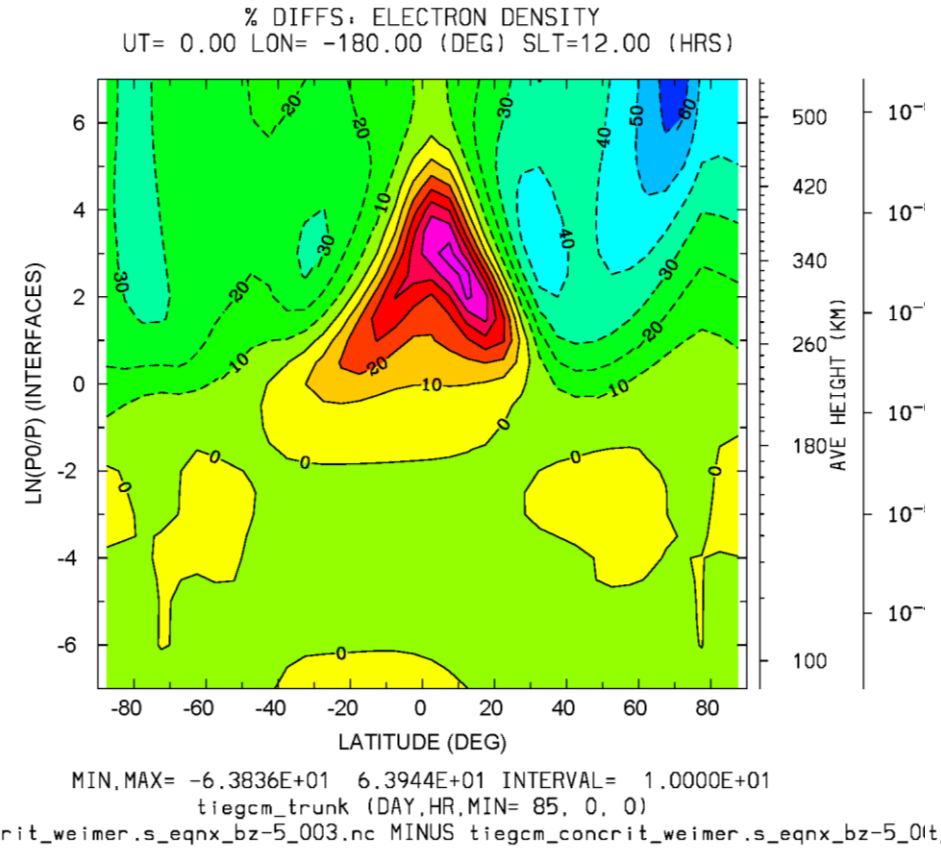
Joule Heating (TN) (Diffs: dyncrit-concrit)



Diffs: Min,Max = -1.1e+5, 1.3e+5

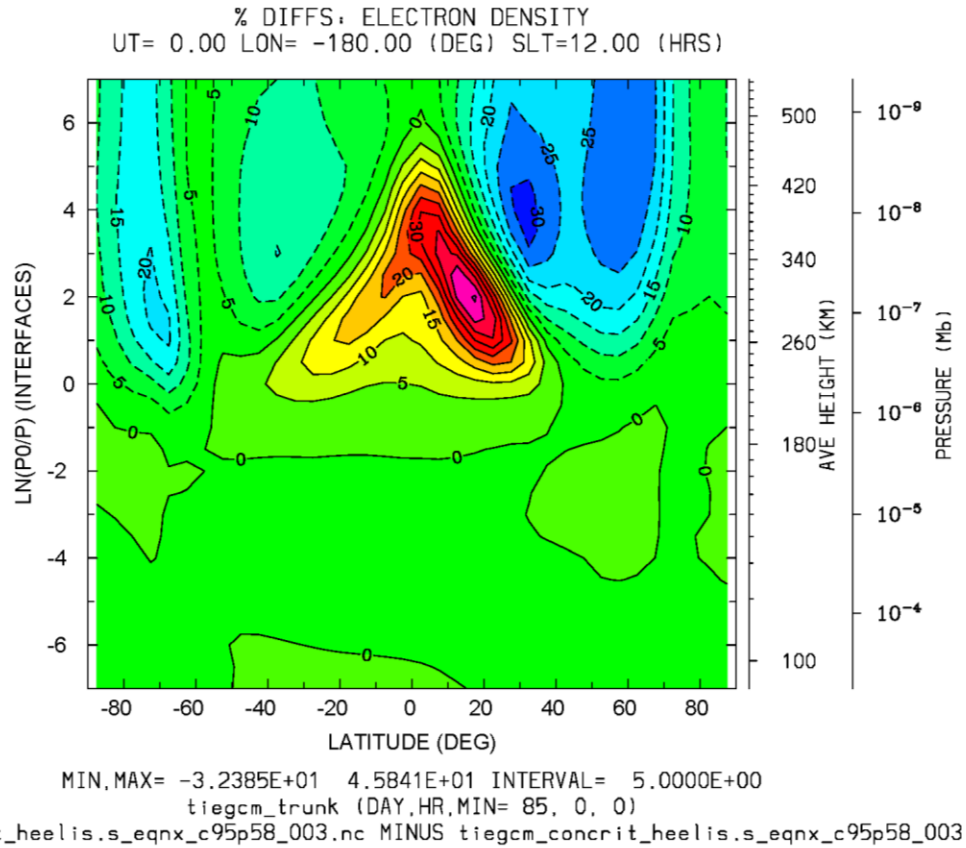
Electron Density (%diffs: dyncrit-concrit)

Weimer BZ=-5 (%Diffs)



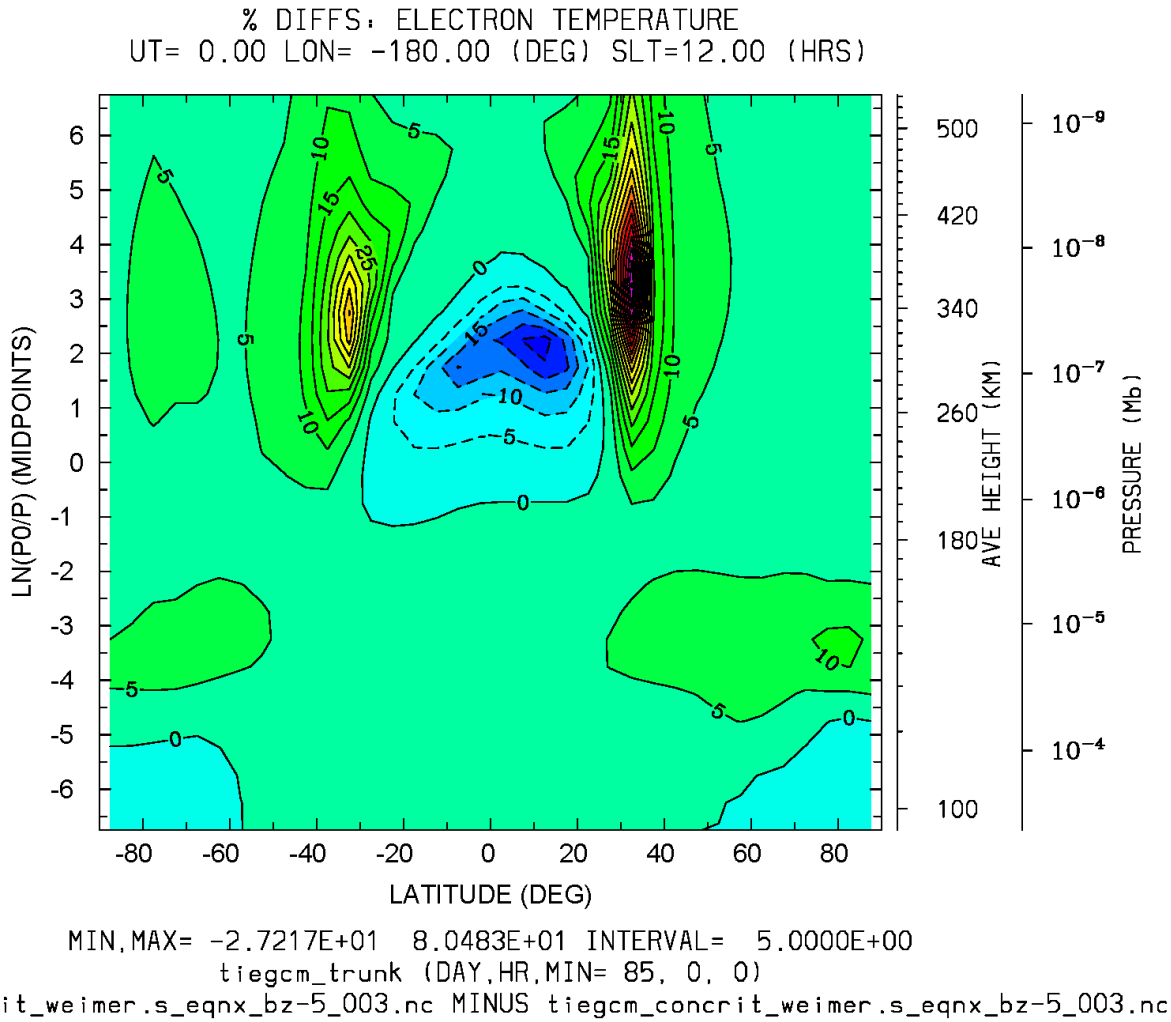
%Diffs: Min,Max = -64, 64

Heelis c95p58 (%Diffs)



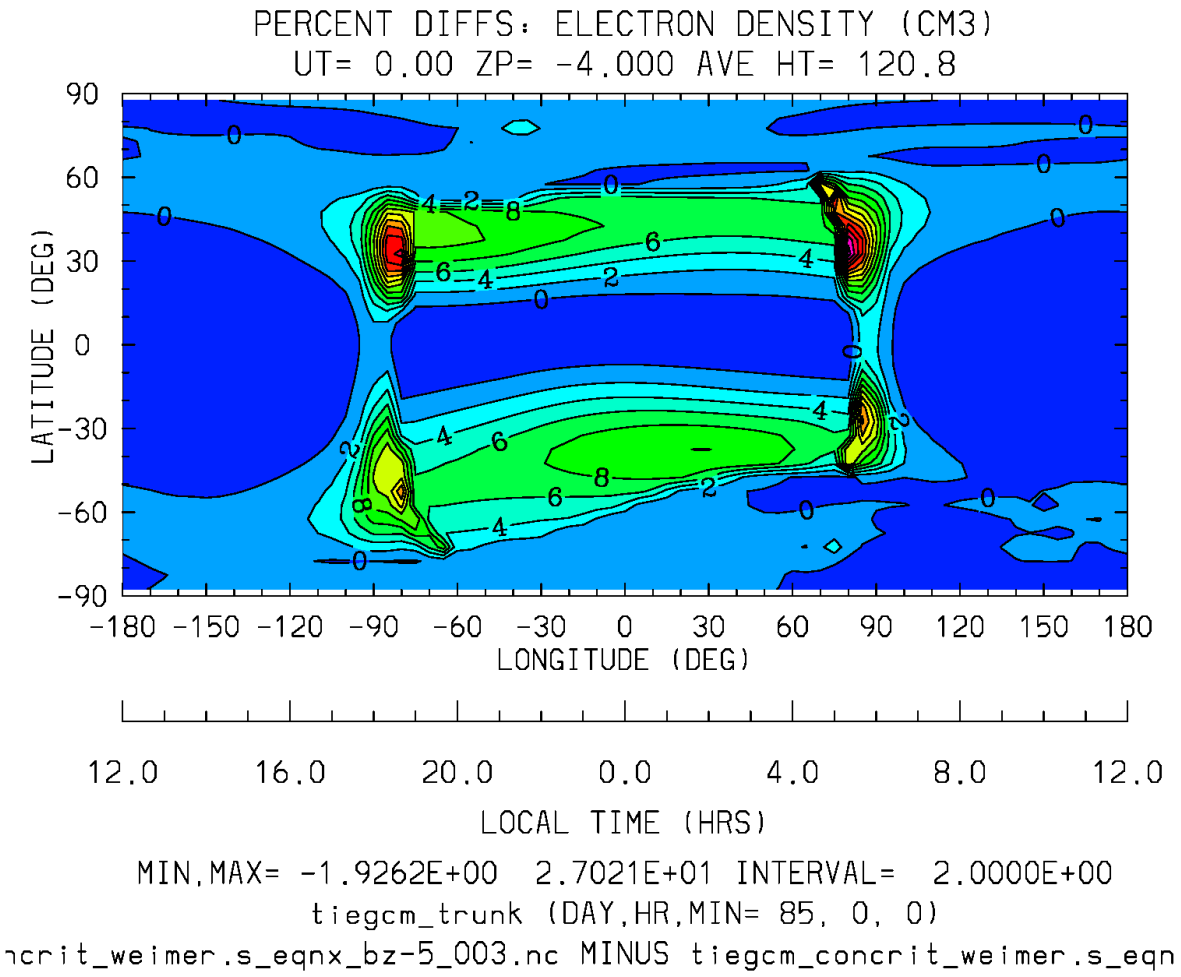
%Diffs: Min,Max = -32, 46

Electron Temperature (%Diffs: dyncrit-concrit)
Weimer BZ = -5



%Diffs Min,Max = -27, 80

Electron Density (%Diffs dyncrit-concrit)
Weimer BZ = -5



%Diffs Min,Max = -1.9, 27.0

Code structure with proposed changes:

- Critical latitudes are declared and initialized in cons.F:

```
! Critical colatitude limits (15,30 deg) for use of Heelis potential in dynamo:
   real :: crit(2) = (/0.261799387, 0.523598775/)  -> crit = 15., 30. degrees
```

- Advance calls aurora_cons, which calculates convection theta0:

```
 theta0(isouth) = (-3.80+8.48*(ctpoten**0.1875))*dtr
! Set theta0 = 10 deg so crit(1,2)=15,30 (old values in cons.F) in colath.F for CISM
#if defined(INTERCOMM) || defined(CISMAH)
   theta0(isouth) = 10.*dtr
#endif
```

- Advance calls Heelis, Weimer, or None, according to namelist input POTENTIAL_MODEL.
  - If weimer, theta0=bndyfitr/2. (wei05loc, overwriting aurora_cons)
- The potential model calls colath (which is now in its own source file colath.F)

Code structure with crit changes, cont:

- Sub colath (colath.F) calculates crit(1:2) from theta0:

```
! 01/11 bae:  Revise crit in rad so crit(1)=theta0(=crad in rad)+5deg,
! crit(2)=crit(1)+15deg
    crit1deg = max(15.,0.5*(theta0(1)+theta0(2))*rtd + 5.)
    crit1deg = min(30.,crit1deg)
    crit(1) = crit1deg/rtd
    crit(2) = crit(1) + 15./rtd
```

- Sub colath then calculates fraction of dynamo potential pfrac from crit (pfrac is declared in dynamo module):

```
pfrac(i,j) = (colatc(i,j)-crit(1))/(crit(2)-crit(1))
if (pfrac(i,j) < 0.) pfrac(i,j) = 0.
if (pfrac(i,j) >= 1.) pfrac(i,j) = 1.
```

- Dynamics calls sub aurora (aurora.F), which places cusp according to theta0.
- Advance calls sub dynamo, which calculates ion drift and potential according to pfrac.