Proposed modifications to critical co-latitudes in TIEGCM

Crit(1:2) are magnetic latitudinal boundaries at which ion drift velocities are merged from low-latitude dynamo to high-latitude empirical models.

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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 (every timestep), which calculates convection reversal boundary 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, Weimer01, or Weimer05, or None, according to namelist input POTENTIAL_MODEL.
  - If Weimer05, theta0 is reset in sub wei05loc
- The requested 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.

Procedure to obtain this code for testing:

- Check out tiegcm trunk (call it tiegcm_crit):
  - *svn checkout $SVN/tiegcm/trunk tiegcm_crit*
- Go to the source directory:
  - *cd tiegcm_crit/src*
- Copy patch file from hao ftp site:
  - *cp /hao/ftppub/foster/tiegcm_crit/crit.patch .*
- Apply the patch (unix patch command):
  - *patch –p0 < crit.patch*
- Confirm svn status:
  - *svn status*

Results of svn status after applying crit.patch:

```
?      crit.patch
M       advance.F
A      colath.F
M       aurora.F
M       heelis.F
M       wei05sc.F
M       input.F
M       cons.F
M       wei01gcm.F
M       cism_coupling.F
```