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      subroutine var(mobs,npar,iy,im,id,ih,exper,
2         idim,jdim,gscale,rmax,sdevfg,sdevob,
3         lunobs,lunfgs,lunana,lunref,
4         latm,lonm,dlat,dlon,clat,
5         lfgs,lref,maxiter,alpha)
c
c +-----+
c + A simple analysis program for VAR +
c + 1. variable declaration +
c + 1.1 dimension +
c + 1.2 namelist +
c + 1.3 grid parameters +
c + 1.4 observational data fields +
c + 1.5 observations selected for analysis +
c + 1.6 information about rejected data +
c + 1.7 covariance matrix fields +
c + 1.8 administrative parameters +
c + 2. derived parameters +
c + 3. read and write input parameters (namelist) +
c + 4. open input and output files +
c + 4.1 observation file and the reference file (BLUE) +
c + 4.2 firstguess file +
c + 4.3 result file +
c + 4.4 check file +
c + 5. read and (gross) check observations +
c + 6. analysis loop over all parameters +
c + 6.1 read firstguess +
c + 6.2 VAR analysis +
c + 6.2.1 select influencing observations +
c + 6.2.2 construct and invert covariance matrix +
c + 6.2.3 use fgs as ana before at iter=0 +
c + --- loop for minimization iterations ----- +
c + 6.2.4 transform fgs to observation locations +
c + 6.2.5 calculation innovation vector +
c + 6.2.6 cost function gradient for observation grad(Jo) +
c + 6.2.6 cost function gradient for background grad(Jb) +
c + 6.2.9 minimization step +
c + ----- end of loop for iteration ----- +
c + 7. derived variables +
c + 8. statistics +
c + 9. store analyses and observations +
c + 10. close obs, ana and chk files +
c + end of the analysis +
c + A1. write format +
c +-----+

c 1 ===== variable declaration =
implicit none
c 1.1 ----- dimension -
integer mobs,npar,idim,jdim,nhor,nho2
c 1.2 ----- namelist -
integer iy,im,id,ih
integer maxiter(npar)
real latm,lonm,dlat,dlon,rmax,alpha(npar)
real gscale(npar),sdevfg(npar),sdevob(npar)
character exper*3
logical lfgs,lref
c 1.3 ----- grid -
integer iana,jana
real lats,lonw,dlatfgs,dlonfgs
real ana(idim,jdim),fgs(idim,jdim),amb(idim,jdim)
real p_ana(idim,jdim),t_ana(idim,jdim),u_ana(idim,jdim)
real v_ana(idim,jdim),d_ana(idim,jdim)
real zana(idim,jdim)
real grad_o(idim,jdim),grad_b(idim,jdim),grad(idim,jdim)
c 1.4 ----- observational data fields -
integer nobs,iiobs(mobs),nrobs(mobs),flgobs(mobs,npar)
real oriobs(mobs,npar),latobs(mobs),lonobs(mobs)
character filnm*12
c 1.5 ----- observations selected for analysis -
integer nana,iiival(mobs),nrval(mobs)
real latval(mobs),lonval(mobs),valobs(mobs),valmean
real valfgs(mobs),valinn(mobs),valana(mobs)
c 1.6 ----- information about rejected data -
integer nskip,lskip(mobs),flag(mobs),dev(mobs)
logical skip(mobs)
c 1.7 ----- covariance matrix fields -
real bi(idim*jdim*idim*jdim)
c 1.8 ----- administrative parameters -
real lat,lon,cost,jo,jb
integer i,j,iter
integer ipar,ios
integer lunnam,lunobs,lunfgs,lunana,lunref
real clat ! cos(lat)=111111.1111
c 2 ===== derived parameters =
nhor=idim*jdim
c 3 ===== write some input parameters =
write(6,1001)
write(6,*) ' (2a)' exp : ',exper
write(6,*) ' (a,4(1x,i2.2))' date:',iy-1900,im,id,ih
write(6,1001)
write(6,*) ' parameter pressure temperature'
write(6,1002)
write(6,*) ' sdev of fg ',sdevfg
write(6,*) ' sdev of obs ',sdevob
write(6,*) ' Gaussian parameters ',gscale
write(6,1001)
c 4 ===== open input and output files =
c 4.1 ----- observation file -
write(filnm(1:12),'(4i2.2,a4)') mod(iy,100),im,id,ih,'.obs'

      open(lunobs,file=filnm,iostat=ios,status='old')
c 4.3 ----- firstguess file -
if(lfgs) then
      write(filnm(1:12),'(4i2.2,a4)') mod(iy,100),im,id,ih,'.fgs'
      open(lunfgs,file=filnm,iostat=ios,status='old')
      read(lunfgs,*) iana,jana,lats,lonw,dlatfgs,dlonfgs
      if(dlatfgs.ne.dlat.or.dlonfgs.ne.dlon) then
        write(6,*) 'from fgs, dlon and dlat =',dlonfgs,dlatfgs
        write(6,*) 'namelist, dlon and dlat =',dlon,dlat
        stop
      endif
    endif
c 4.4 ----- result file -
write(filnm(1:12),'(4i2.2,a,a3)') mod(iy,100),im,id,ih,'.',exper
open(lunana,file=filnm,iostat=ios,status='unknown')
c 5 ===== read and (gross) check observations =
call getobs(lunobs,npar,mobs,nobs,
+         iiobs,nrobs,latobs,lonobs,oriobs,flgobs)
c 6 ===== analysis loop over all parameters =
do ipar=1,2
c 6.1 ----- read firstguess -
if(lfgs) call getfld(idim,jdim,fgs,lunfgs)
c 6.2 ----- VAR analysis -
c 6.2.1 ----- select influencing observations .
      call choose_box(1,idim,jdim,0,0,
+         iiobs,latobs,lonobs,oriobs(1,ipar),
+         nrobs,nobs,latm,lonm,dlat,dlon,rmax,mobs,1,
+         iiival,nrval,latval,lonval,valobs,nana)
      write(6,*) 'selected obs : ',nana
c 6.2.2 ----- construct and convert covariance matrix .
      call binv(idim,jdim,bi,latm,lonm,dlat,dlon,clat,
+         sdevfg(ipar),gscale(ipar))
c 6.2.3 ----- use fgs as ana before at iter=0 .
      write(6,*) ' ana=fgs '
      if(.not.lfgs)
        1 call avefgs(idim*jdim,fgs,mobs,npar,oriobs,nrobs,ipar)
      call hcpa2b(idim*jdim,fgs,ana)
c ----- loop for minimization iterations .
      do iter = 1,maxiter(ipar)
c 6.2.4 ----- transform ana to observation locations (Hx) .
          call H(idim,jdim,nana,latval,lonval,
+             latm,lonm,dlat,dlon,ana,valana)
c 6.2.5 ----- calculation innovation vector .
          do i=1,nana
            valinn(i) = valana(i)-valobs(i)
          enddo
c 6.2.6 ----- cost function gradient for observation grad(Jo) .
          call hab2c(1,nana,1,valinn,valinn,jo)
          jo = jo /(2*sdevob(ipar)*sdevob(ipar))
          do i=1,nana
            valinn(i) = valinn(i) /(sdevob(ipar)*sdevob(ipar))
          enddo
          call hseta2c(idim*jdim,grad_o,0.)
          call H_ad(idim,jdim,nana,latval,lonval,
+             latm,lonm,dlat,dlon,grad_o,valinn)
c 6.2.7 ----- cost function gradient for background grad(Jb) .
          do j=1,jdim
            do i=1,idim
              amb(i,j) = ana(i,j) - fgs(i,j)
            enddo
          enddo
          call hab2c(nhor,nhor,1,bi,amb,grad_b)
          call hab2c(1,nhor,1,amb,grad_b,jb)
          jb = jb/2.
c 6.2.8 ----- cost function gradient grad=grad(Jo)+grad(Jb) .
          do i=1,idim
            do j=1,jdim
              grad(i,j)=grad_b(i,j) + grad_o(i,j)
            enddo
          enddo
c 6.2.9 ----- minimization step .
          call stemin(nhor,ana,grad,alpha(ipar))
          write(6,*) ' (a,i5,a,3e12.5) '
          +             'iter = ',iter, ' jb,jo,jb = ',jb,jo,jb+jo
c ----- end of loop for iteration .
        enddo
      if(ipar.eq.1) then
        call hcpa2b(idim*jdim,ana,p_ana)
      else
        call hcpa2b(idim*jdim,ana,t_ana)
      endif
    enddo
c 7 ===== derived variables =
      call derivf(t_ana,p_ana,
+         u_ana,v_ana,d_ana,idim,jdim,latm,clat,dlat)
c 8 ===== statistics =
      write(6,*) ' statistics : '
      call statis(' p min/max = ',idim,jdim,p_ana)
      call statis(' t min/max = ',idim,jdim,t_ana)
      call statis(' u min/max = ',idim,jdim,u_ana)
      call statis(' v min/max = ',idim,jdim,v_ana)
      call statis(' dyn min/max = ',idim,jdim,d_ana)
      write(6,1001)
c 9 ===== store the analyses and observations =
      write(lunana,'(2i4,4f10.4)') idim,jdim,
+         latm-jdim*dlat,lonm-idim*dlat,dlon,dlon
      call putfld('p',lunana,idim,jdim,p_ana,idim,jdim)
      call putfld('t',lunana,idim,jdim,t_ana,idim,jdim)
      call putfld('u',lunana,idim,jdim,u_ana,idim,jdim)
      call putfld('v',lunana,idim,jdim,v_ana,idim,jdim)

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      call putobs('obs',mobs,npar,nobs,lunana,
x   iiiobs,latobs,lonobs,oriobs,flgobs)
c 10 ===== close obs, ana and chk files =
      close(lunobs)
      close(lunfgs)
      close(lunana)
c   ===== end of the analysis =
      write(6,*)'analysis finished without any error!'
      write(6,1001)
      return
c A1 ===== formats =
1001 format("=====")
1002 format("-----")
      end
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