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c      +-----+
c      + subroutine H : observation operator      +
c      +-----+

      subroutine H(idim,jdim,nana,lat_obs,lon_obs,
+          lat,lon,dlat,dlon,f_fld,f_obs)

      implicit none

      integer idim,jdim
      integer nana
      real    f_fld(idim,jdim)
      real    f_obs(nana),lat_obs(nana),lon_obs(nana)
      real    lat,lon,dlat,dlon

      integer i,j,k
      real x,y,wx,wy
      do k = 1,nana
x = idim/2 + 1 + (lon_obs(k)-lon)/dlon
y = jdim/2 + 1 + (lat_obs(k)-lat)/dlat
i = int(x)
j = int(y)
      if(i.ge.1.and. i.lt.idim .and. j.ge.1 .and. j.lt.jdim) then
          wx = x-i
          wy = y-j
          f_obs(k) = (1.-wx)*(1.-wy)*f_fld(i ,j ) +
+              (1.-wx)*   wy   *f_fld(i ,j+1) +
+              wx   *(1.-wy)*f_fld(i+1,j ) +
+              wx   *   wy   *f_fld(i+1,j+1)
      else
          i = min(i,idim)
          i = max(i,1)
          j = min(j,jdim)
          j = max(j,1)
          f_obs(k) = f_fld(i,j)
      endif
      enddo
      return
      end

      subroutine h_ad(idim,jdim,nana,lat_obs,lon_obs,lat,lon,
+          dlat,dlon,f_fld_ad,f_obs_ad )
      implicit none
      integer idim,jdim,nana
      real    dlat,dlon,lat,lon
      real    lat_obs(nana),lon_obs(nana)
      real    f_fld_ad(idim,jdim),f_obs_ad(nana)
      integer i,j,k
      real x,y,wx,wy
      do k = 1,nana
          x = idim/2+1+(lon_obs(k)-lon)/dlon
          y = jdim/2+1+(lat_obs(k)-lat)/dlat
          i = int(x)
          j = int(y)
          wx = x-i
          wy = y-j
          if(i.ge.1 .and. i.lt.idim .and. j.ge.1 .and. j.lt.jdim) then
              f_fld_ad(i+1,j+1) = f_fld_ad(i+1,j+1)+f_obs_ad(k)*wx*wy
              f_fld_ad(i,j+1) = f_fld_ad(i,j+1)+f_obs_ad(k)*(1.-wx)*wy
              f_fld_ad(i+1,j) = f_fld_ad(i+1,j)+f_obs_ad(k)*wx*(1.-wy)
              f_fld_ad(i,j) = f_fld_ad(i,j)+f_obs_ad(k)*(1.-wx)*(1.-wy)
              f_obs_ad(k) = 0.
          else
              i = min(i,idim)
              i = max(i,1)
              j = min(j,jdim)
              j = max(j,1)
              f_fld_ad(i,j) = f_fld_ad(i,j)+f_obs_ad(k)
              f_obs_ad(k) = 0.
          endif
      enddo
      end

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