

Soil moisture feedback file composition in MEC

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- The **Model Equivalent Calculator** (MEC) applies the observation operators used in the data assimilation scheme (Nudging, EnVar, LETKF) to model forecasts (COSMO, ICON, ICON-LAM, IFS) and stores the results in verification files (NetCDF feedback file format). These data are intended to be used for verification of the forecasts with respect to observations.
- MEC is responsible for the creation of the feedback files (observation increment) for all the variables in the COSMO model.
- At the moment the soil moisture feedback file creation procedure is done with our own specific routine (not COSMO official).

Implementation of soil moisture feedback file creation procedures into the Model Equivalent Calculator



Soil moisture feedback file composition in MEC

- MEC namelist setting:
 - Addition of &OBSERVATIONS_SOIL namelist
 - In namelist &OBSERVATIONS :
 - read_cdfin = T ! to read COSMO CDFIN files
 - ! read_NetCDF = F
 - obs_files = "WSOI_2018070609-12-255-190.nc
- Creation of ***mo_soil_obs.f90*** in */analysis*

It contains the 3 main subroutines that MEC needs to process SM observations:

- Read_soil_netcdf
- Check_store_soil
- Process_soil



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- Subroutine ***read_soil_netcdf*** (*ifile, i_source, obs, head, lkeep, nkeep*) :
 - Reading of the soil moisture cdfin input:

real(sp) ,allocatable :: nssm (:)	! surface soil moisture
real(sp) ,allocatable :: nsmpf (:)	! sm processing flag
real(sp) ,allocatable :: nsmq (:)	! sm quality
real(sp) ,allocatable :: neesm (:)	! estimated errore in surface soil moisture
real(sp) ,allocatable :: nsnco (:)	! snow cover
real(sp) ,allocatable :: nflsf (:)	! frozen land surface fraction
real(sp) ,allocatable :: niawf (:)	! inundation and wetland fraction
real(sp) ,allocatable :: ntoco (:)	! topographic complexity
real(sp) ,allocatable :: nicep (:)	! ice probability
real(sp) ,allocatable :: nrfd (:)	! rainfall detection



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- Subroutine ***check_store_soil*** (*spot, obs, lkeep, nssm, nsmpf, nsmq, neesm, nsnc, nflsf, niawf, ntoco, nicep, nrfd*)
- Setting of soil moisture quality checks:
 - IF (l_err) THEN
IF (neesm>8.0) THEN
call decr_rpt_use (spot, CHK_INSDAT, STAT_PASSIVE, comment='l_err quality check')
bod%use%state = ST_PASSIVE !passive obs/report
bod%use%flags = FL_OBSTYPE !2^0 passive obs/report type (bit)
bod%use%check = CHK_NOTUSED !0 passive obs/report type

Quality checks: 5 logical variables (l_err, l_wet ...) that are in namelist &OBSERVATIONS_SOIL"

ASCAT data is rejected where:

- snow: the analysed snow amount is greater than 0.05 kg/m²
- frost: the 2m Temperature analysis is below 275.15 K
- wetlands: the inundation and wetland amount has a value greater than 15%
- mountains: the topographic complexity has a value greater than 20%
- ASCAT estimated error: the error in the ASCAT surface soil wetness is estimated to be greater than 7% (Met Office) or 8% (ECMWF). This check rejects ASCAT data from regions with dense vegetation and sand dunes.



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- Subroutine **process_soil** (*task, spot, obs, atm, cols, xi, y, Jo, Jo_atm, state*)

Main differences respect to the other observations (process_synop, _temp etc):

- TSK_Y : - Model soil moisture rescaling from mH2O to m3/m3 in the first 2 cm of the soil (model soil layer 1 + 0.5 layer2):

$$y\%x(i) = ((w_so(1)/1000) + 0.5*(w_so(2)/1000))/0.02$$

- Rescaling of SM observations (in %) to model values through CDF matching method:

$$obs\%o\%body(i)\%o = obs\%o\%body(i)\%o/100 * CDF_wsoil_slope(soiltyp,m) \& \\ + CDF_wsoil_intercept(soiltyp,m)$$

The CDF parameters (slope, intercept ...) are setted in namelist &OBSERVATIONS_SOIL”



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Main differences respect to the other observations (process_synop, _temp etc):

- TSK_Y : - Setting of obs errors using the after CDF obs values:

$$\text{obs\%o\%body(i)\%eo} = 2 * \text{obs\%o\%body(i)\%eo0} * \text{obs\%o\%body(i)\%o} / 100$$



MEC

- Implementation of mo_soil_obs.f90 ✓
- mofSOIL.nc production (det + 40 members) ✓
- Use of mofSOIL.nc in KENDA: ✓
 - Not able to read some obs standard deviation values from namelist RULES (o%stdv_oi (i)), that are instead read when using fofSOIL.nc as input

Open problems (MEC + KENDA)

- Soil moisture analysis updates in comet-sma branch, possible merge with dace-dev?
- Mec documentation uncomplete

