

# New printing of SP/GP norms, tools for analysis

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# Norms in the node

- Spectral (SP) norms:
  - Average value of 1 spectral field (2D or 3D)
  - 3D fields: optional norms per level (NSPPR > 0)
- Grid-point (GP) norms:
  - Average, **minimum** and **maximum** values (2D or 3D)
  - 3D fields: optional norms per level (NSPPR > 0)
- Remarks:
  - Printing norms depend on namelist keys (NCONF, NFRSDI, NFRGDI,...)
  - Format of lines printed can vary

# Norms in the code (1)

- Main SP/GP norms:
  - SP norms for spectral fields (YRSPEC)
  - GP norms for GFL array (YRGFL%GFL)
  - Printed from CNT4 (+ CNT4TL or CNT4AD if 4DVar)
  - Printed at the beginning of the time-step (before STEPO)
- Other SP/GP norms:
  - GP norms for surface fields, at init. time (SUINIF)
  - SP/GP norms at the end of post-processing (FULLPOS\_DRV)

# Norms in the code (2)

- Remark for GFL norms:
  - Norm for qv ("HUMI.SPECIFI") not printed when qv is spectral (LSPRT = T)
  - GFL qv is greatly used in GP part (dyn and phys)!
- Remark for other fields:
  - No norms for main GP fields GMV (except in OOPS 4DVar context)
  - No norms for fields internal to dyn/phys parts
  - No norms for fields at other time-levels (t1/t9) or for trajectory (t5)

# New norms in the code

- Changes in CY50:
  - Print GP norm for qv even when LSPRT = T
  - Print GP norms for GMV, GFL and SL buffer (Semi-Lagrangian)
  - Print GP norms after main parts of GP computations:
    - CPG, CALL\_SL, CPGLAG
  - Print SP norms after spectral transforms and SI scheme (Semi-Implicit)
    - TODO in CY50T1
- Activation:
  - 2 namelist keys: LGPDIAG and LSPDIAG (NAMCT1)
  - Follow classical frequency: NFRGDI/NFRSDI (or NGDITS/NSDITS)

# Norms: in CNT4 and in CPG\_DRV (new)

```
cnt4.F90 - /home/gmap/mrpm/petithomme/acks/cy49t1_toT2.02.IMPIIFC2018.x/ (sur belenoslo...
File Edit Search Preferences Shell Macro Windows Help
/home/gmap/mrpm/petithomme/acks/cy49t1_toT2.02.IMPIIFC2018.x/cnt4.F90 1248 bytes L: 10 C: 46
SUBROUTINE CNT4 (YDGEOMETRY, YDFIELDS, YDMTRAJ, YDMODEL, YDJOT, YDVARBC, YDTCV, YDGM5, YDODB, YDFPOS)
...
JSTEP = NSTAR2
DO
...
! * 3.8 Reset time dependent variables
LLSPNRM=ISDITS (JSTEP/MAX (1, NFRSDI)) == 1 .AND. MOD (JSTEP, MAX (1, NFRSDI)) == 0
LLGPNRM=IGDITS (JSTEP/MAX (1, NFRGDI)) == 1 .AND. MOD (JSTEP, MAX (1, NFRGDI)) == 0
...
IF (LLSPNRM) THEN
WRITE (UNIT=NULOUT, FMT='('' NORMS AT NSTEP CNT4 '', I4)') JSTEP
CALL SPNORM (YDGEOMETRY, YDMODEL*YRML_GCONF, YDMODEL*YRML_DYN*YRDYNA, YDFIELDS*YRSPEC)
ENDIF
IF (LLGPNRM .OR. LLLEVOL) THEN
CALL GPNORM_GFL (YDGEOMETRY, YDGF)
ENDIF
...
! * 3.9 Post-processing time step
IF (LLFPOS .AND. (IANATS (GET_NSIM4D ()) / NFRANA) == 1 .AND. MOD (GET_NSIM4D (), NFRANA) == 0 &
& .OR. GET_NSIM4D () == NSIM4DL) THEN
...
IF (CLCONF /= '00000000') THEN
CALL STEPO (YDGEOMETRY, YDFIELDS, YDMTRAJ, YDMODEL, CLCONF, YDJOT, YDVARBC, YDTCV, YDGM5, YDODB, Y
ENDIF
ELSE
...
NCURRENT_ITER=0
IF (CLCONF /= '00000000') THEN
CALL STEPO (YDGEOMETRY, YDFIELDS, YDMTRAJ, YDMODEL, CLCONF, YDJOT, YDVARBC, YDTCV, YDGM5, YDODB)
ENDIF
ENDIF ! pp or ordinary (predictor) timestep
! End of main loop over time steps (JSTEP)
ENDDO
...
END SUBROUTINE CNT4
```

Time-integration loop

Spectral and GFL norms

Time-step

```
cpg_drv.F90 - /home/gmap/mrpm/petithomme/acks/cy49t1_toT2.02.IMPIIFC2018.x/ (sur b...
File Edit Search Preferences Shell Macro Windows Help
cnt4.F90 cpg_drv.F90
home/gmap/mrpm/petithomme/acks/cy49t1_toT2.02.IMPIIFC2018.x/cpg_drv.F90 668 bytes L: 22 C: 0
SUBROUTINE CPG_DRV (YDGEOMETRY, YDMODEL, YDFIELDS, ...)
...
!$OMP DO
DO JKGL0 = 1, YDGEOMETRY*YRGM*NGPTOT_CAP, YDGEOMETRY*YRDIM*NPROMA
IBL=(JKGL0-1)/YDGEOMETRY*YRDIM*NPROMA+1
...
CALL CPG (YDGEOMETRY, ..., YDMODEL, YDFIELDS, ...)
ENDDO
!$OMP END DO
...
IF (LGPDIAG .AND. NFRGDI > 0 .AND. MOD (NSTEP, MAX (NFRGDI, 1)) == 0) THEN
WRITE (NULOUT, *) "GPNORM GMVT1 CPG"
CALL GPNORM_GMV (YDGEOMETRY, YDFIELDS*YRGMV, LT1=.TRUE.)
WRITE (NULOUT, *) "GPNORM GFLT1 CPG"
CALL GPNORM_GFL (YDGEOMETRY, YDFIELDS*YRGMV, LT1=.TRUE.)
WRITE (NULOUT, *) "GPNORM ZB2 CPG"
CALL GPNORM_ZB2 (YDDIM, YDGM, YDDYNA, YDMODEL*YRML_DYN*YRPTSLB2, NFLEVG, PB2)
ENDIF
...
END SUBROUTINE CPG_DRV
```

CPG (GP calcs)

New norms or new prints

# Use the norms for...

- When some code is modified:
  - Use classical norms to compare old/new versions
- When divergence appear:
  - Activate detailed norms (LGPDIAG = T)
  - Target differences with 1<sup>st</sup> diverging norms:
    - Does it come from changes in CPG?
    - Does it come from changes in SL scheme?
    - Or from changes in SI scheme?
- Tool normdiff.sh:
  - Compares norms from 2 NODE files (output on screen)
  - Displays number of digits differing between their norms

# Norms: checking differences

```
/scratch/work/petithomme/cy49t0_to_T1.01>normdiff.sh /scratch/work/petithomme/
o_T1.01/GM_FCTI_HYD_SL2_VFE_ARPPHYSFEX_WENO_TL798S/NODE.001_01 GM_FCTI_HYD_SL2_V
ENO_TL798S/NODE.001_01
. SP norms difference (up to 17):
nb of steps, file 1: 6 - norms frequency: 1 - nb of norms: 7
nb of steps, file 2: 6 - norms frequency: 1 - nb of norms: 7
step  VORT  DIVE  TEMP  HUMI  TKE  SP
0      0      0      0      0      0      0
1      0      0      0      0      0      0
2      0      0      0      0      0      0
3      0      0      0      0      0      0
4      0      0      0      0      0      0
... 2 more 0 lines
. GP norms difference (up to 17):
nb of steps, file 1: 6 - norms frequency: 1 - nb of norms: 7
nb of steps, file 2: 6 - norms frequency: 1 - nb of norms: 7
new variables : HUMI.SPECIFI
step  LIQUI  SOLID  SNOW  RAIN  TKE  CLOUD  RAD_L  RAD_S
0      0      0      0      0      0      0      0      0
1      0      0      0      0      0      0      0      0
2      0      0      0      0      0      0      0      0
3      0      0      0      0      0      0      0      0
4      0      0      0      0      0      0      0      0
... 2 more 0 lines
. Surface GP norms difference (up to 17):
Group VCLIA      Setup 1
SURFAEROS.SEA      0
SURFAEROS.LAND      0
SURFAEROS.SOOT      0
SURFAEROS.DESERT    0
/scratch/work/petithomme/cy49t0_to_T1.01>
```

All 0s for SP: no diff.

All 0s for GFL: no diff.

```
SURFAEROS.DESERT      0
/scratch/work/petithomme/cy49t0_to_T1.01>
/scratch/work/petithomme/cy49t0_to_T1.01>~/mitraille/normdiff.sh /scratch/work/pet
ref/cy49t0_to_T1.01/GM_FCTI_HYD_SL2_VFE_ARPPHYSFEX_WENO_TL798S/NODE.001_01 GM_FCTI
ARPPHYSFEX_TDK_TL798S/NODE.001_01
. SP norms difference (up to 17):
--> found 7 time-steps of SP norms - NHdyn/PC scheme: FALSE / FALSE
. file1 - nb of steps: 7 - norms frequency: 1
--> found 37 time-steps of SP norms - NHdyn/PC scheme: FALSE / FALSE
. file 2 - nb of steps: 37 - norms frequency: 1
--> different number of steps in files, limiting norms to 7 1st ones
step  VORT  DIVE  TEMP  HUMI  TKE  SP
0      16   17   13   14   15   12
1      16   17   13   14   15   12
2      16   16   13   14   15   11
3      16   16   13   14   15   11
4      16   16   13   14   15   11
5      16   16   13   14   15   11
6      16   16   13   14   15   11
. GP norms difference (up to 17):
--> found 7 groups of GP norms - NH dyn/PC scheme: FALSE / FALSE
nb of steps, file 1: 7 - norms frequency: 1
--> found 1 groups of GP norms - NH dyn/PC scheme: FALSE / FALSE
nb of steps, file 2: 1 - norms frequency: 1
new variables : CV_PREC_FLUX HUMI.SPECIFI
--> different number of steps in files, limiting norms to 1 1st ones
step  LIQUI  SOLID  SNOW  RAIN  TKE  CLOUD  RAD_L  RAD_S
0      16   17   17   17   16   17   17   17
. FP norms difference (up to 17):
--> no 2D FP norms in 1st file
```

Non 0 for SP: difference

Non 0 for GFL: difference

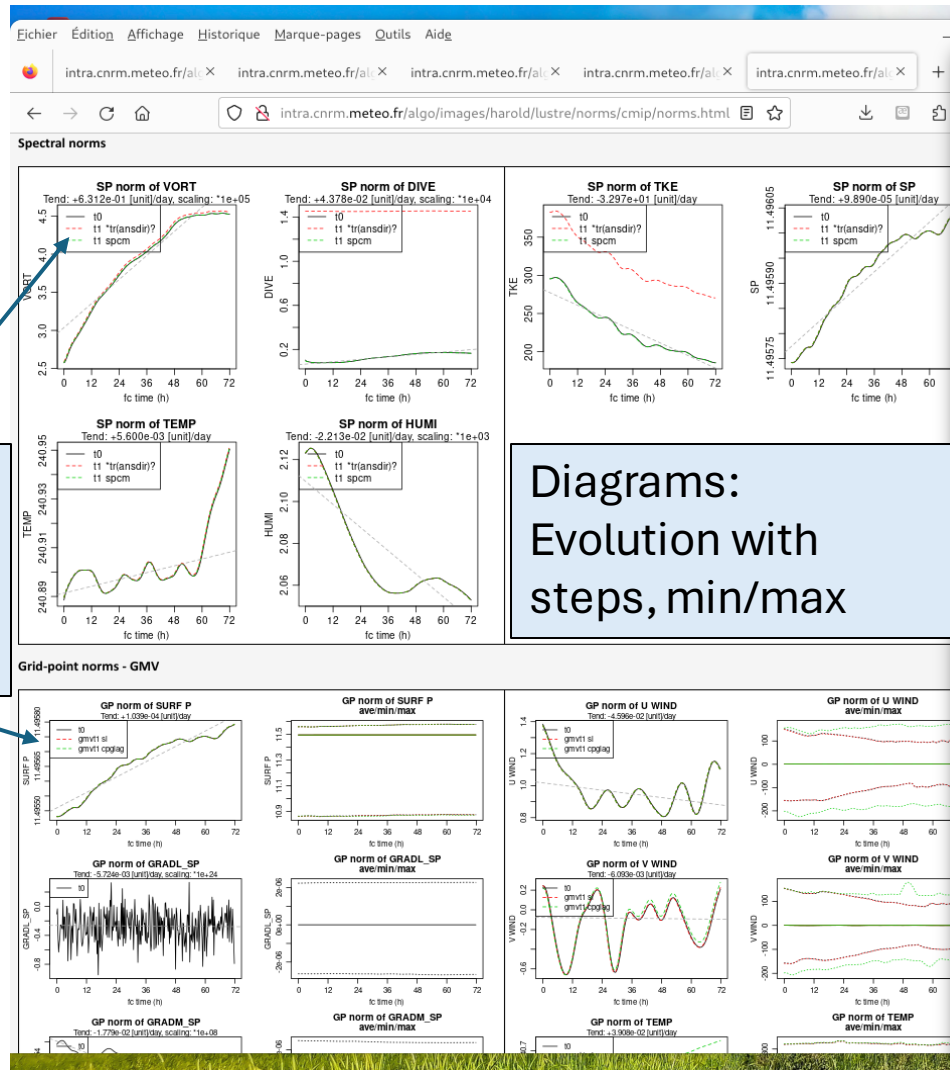
Usage: normdiff.sh NODE1 NODE2 [-nosp] [-nogp] [-nofp] [-nosurf] [-h]



# Use the norms for...

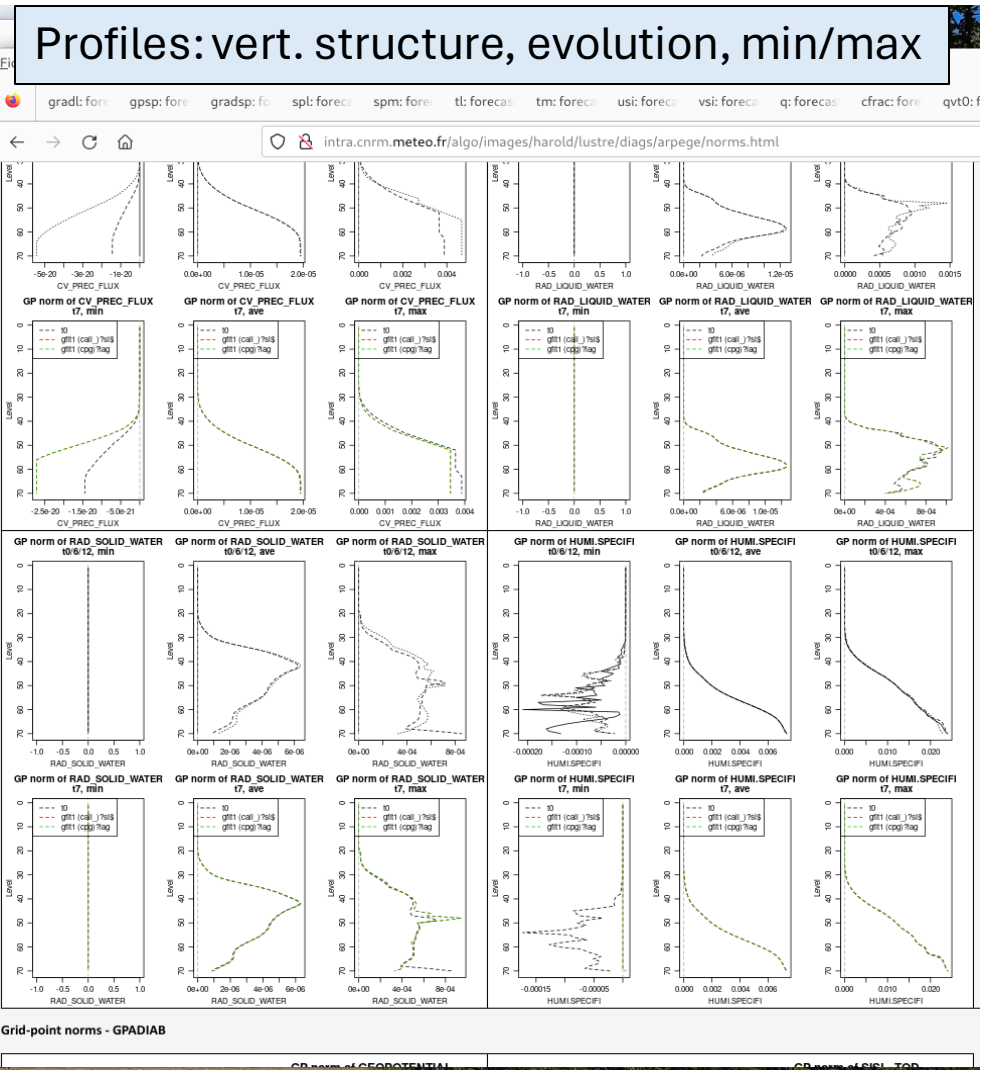
- Checking values of fields (average, extremes, 0s, NaN)
- Checking evolution with time-steps (drift, oscillation,...)
- Checking vertical structures (needs NSPPR=1)
- Compare all this between 2 (or more) experiments
- Need to turn norms into graphical views
- Tool norms.sh:
  - Produces an HTML file displaying PNG graphical files
  - Mode 1: plots for 1 NODE file, detailed norms (if present), level norms
  - Mode 2: plots for several NODE files (ie compare experiments)

# Norms: diagrams and profiles



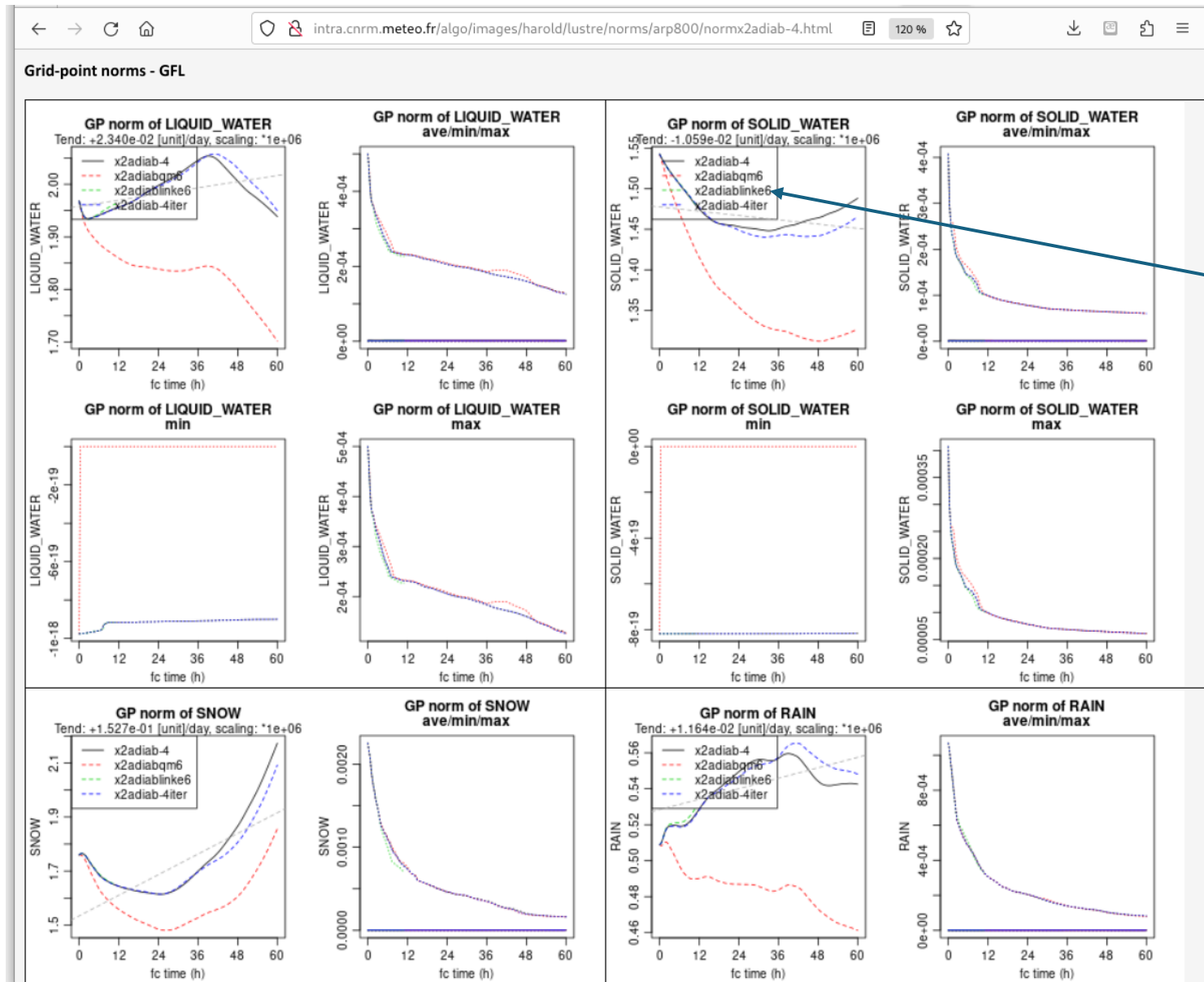
Detailed norms, coloured curves

Diagrams: Evolution with steps, min/max



Usage: norms.sh NODE -o HTML [-lev LEV] [-h] (produce an HTML file + dir)

# Norms: comparing experiments (several NODEs)



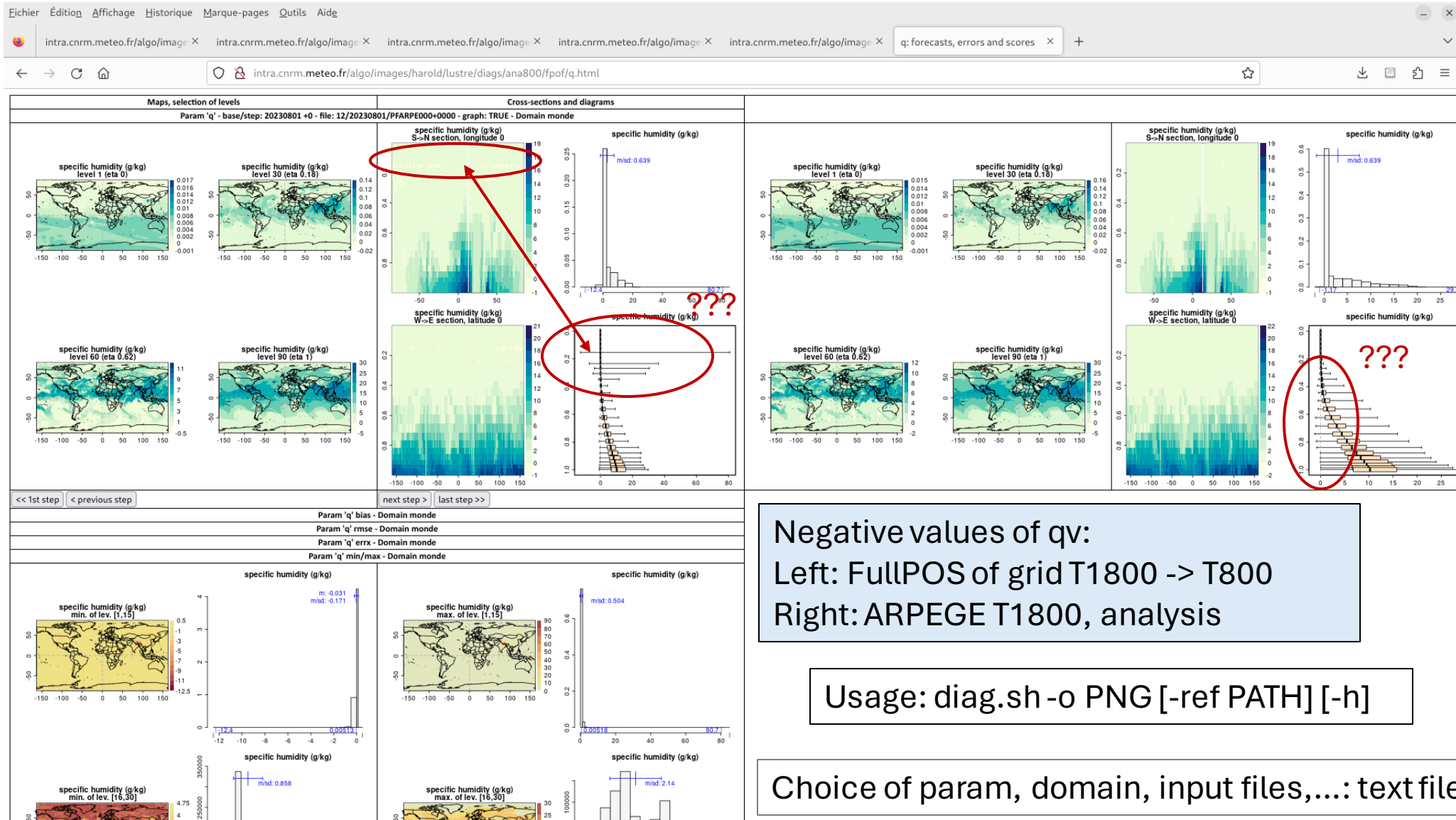
Usage: norms.sh NODE1 NODE2... -o HTML

4 experiments compared at a time,  
4 coloured curves

# Summary

- SP/GP norms:
  - Useful and cheap, new norms in CY50 (and then CY50T1,...)
  - Possible to add other places for norms ( more 'CALL GPNORM\_XXX')
- Tools for norms:
  - Adapted to current and new norms (precisely parsing NODE files)
  - Source code: very light (3 or 4 files), available at MF, on GitHub
- Other tools:
  - Tool setup.sh: display various information from NODE (NODE only)
    - Grid/wave partitionning, levels, SI/SL constants, Jo/Jb/Jc values, exec. time,...
  - Tool diag.sh: show fields, v. sections, v. profiles and statistics from GRIB/FA files

# Diagnostics: maps, sections, histograms, profiles



Negative values of  $q_v$ :  
 Left: FullPOS of grid T1800 -> T800  
 Right: ARPEGE T1800, analysis

Usage: `diag.sh -o PNG [-ref PATH] [-h]`

Choice of param, domain, input files,...: text files