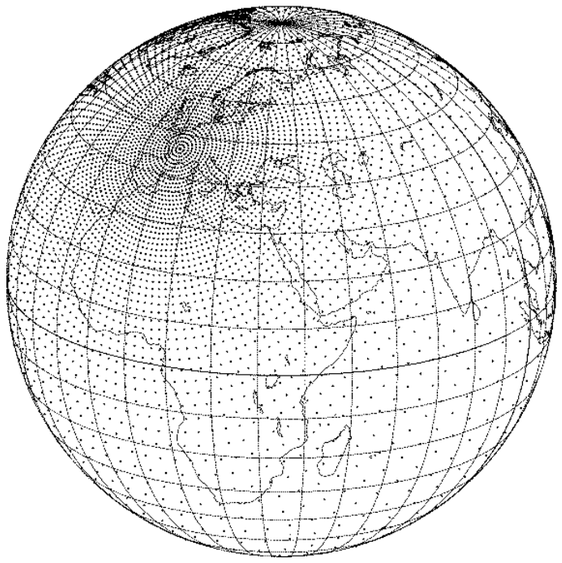
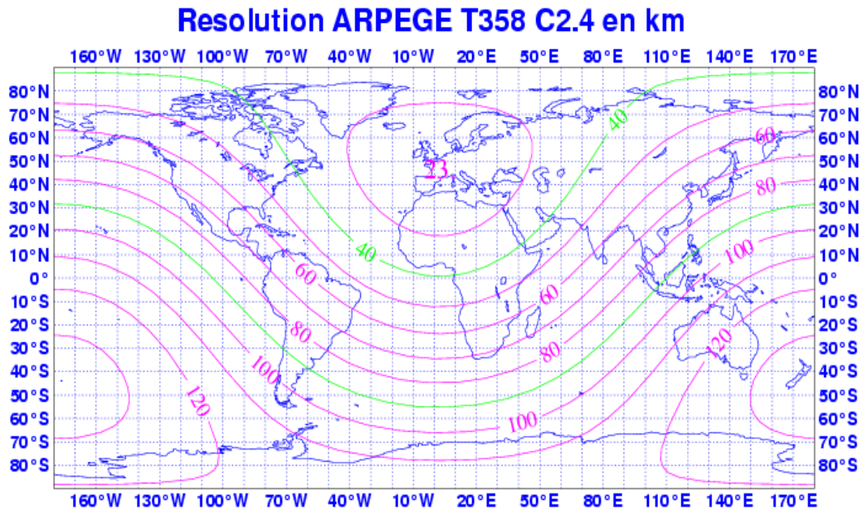
RECENT IMPROVEMENTS & NEXT CHANGES IN ARPEGE

PRESENT CONFIGURATION

- global, spectral, resolution T358L41 (increased) *(linear truncation)*, stretched (c = 2.4, reduced) and tilted *(pole over France)*
- new grid and mesh-sizes :



new ARPEGE grid : 1 point over 25



geographical variations of horizontal resolution, from 23km (T859) to 133 km (T149)

- multi-incremental 4d-var data assimilation :

  increments at resolutions T149 (decreased) and T107 *(without stretching)*, real incremental assimilation now

- 5 runs a day :

  at 00 UTC : up to 102 h *(short cut-off, 1h50)* , and up to 30 h *(very short cut-off, 1h)*

  at 06 UTC : up to 72 h *(short cut-off, 3h)*

  at 12 UTC : up to 72 h *(short cut-off, 1h50)*

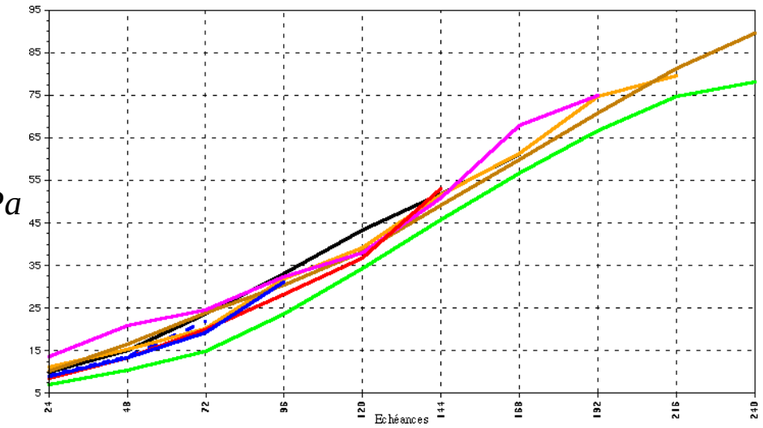
  at 18 UTC : up to 60 h *(short cut-off, 3h)*

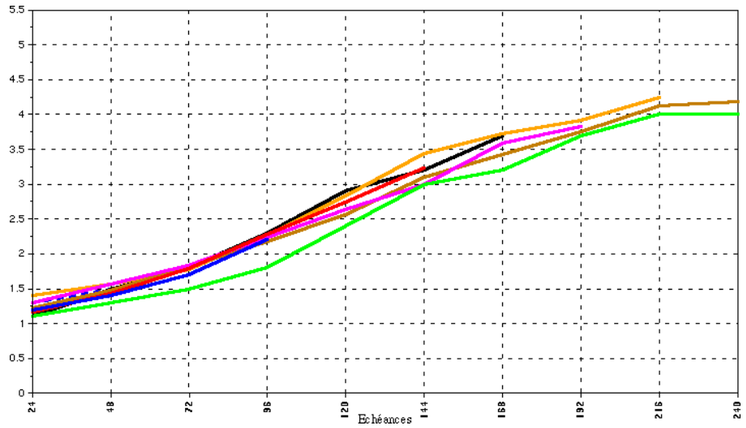
EVOLUTION OF FORECAST SKILL

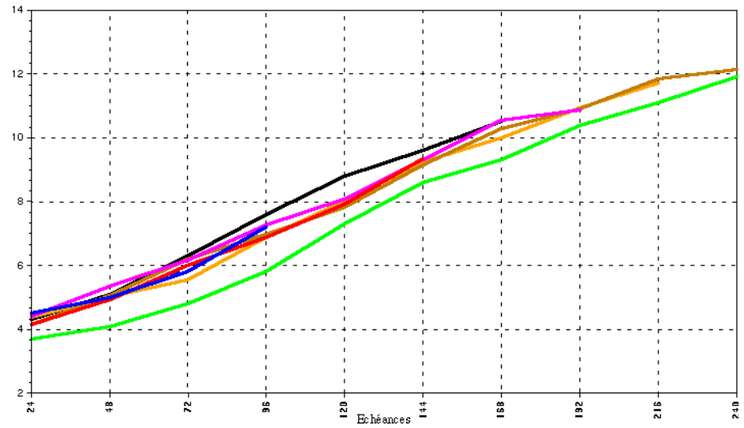
- Latest available figures (April 2004) : impact of forecast range, comparison to TEMPs and to other global models over Europe

Geopotential (rmse, m) | *Temperature (rmse, K)* | *Wind (rmse, m/s)*

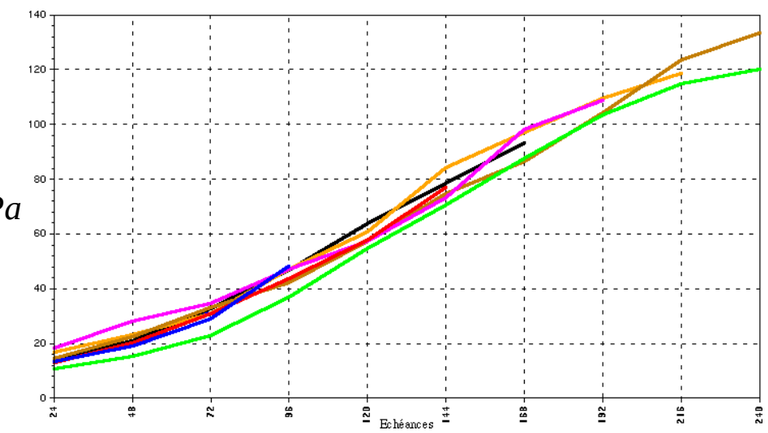
at 850 hPa

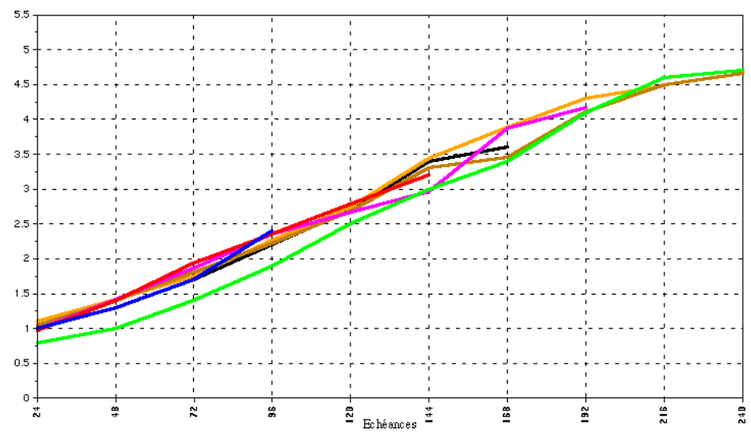


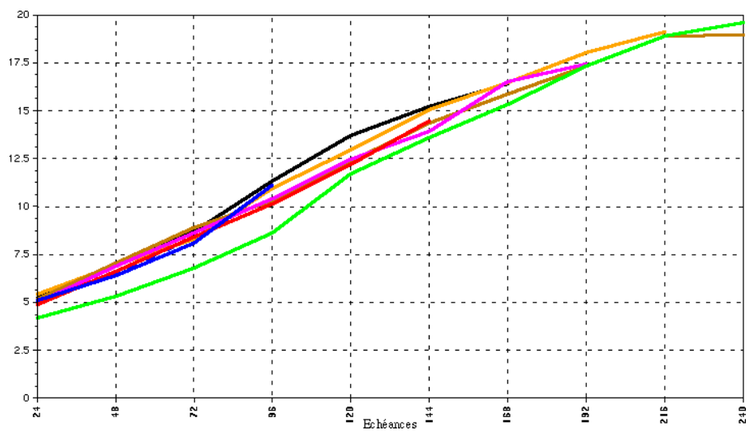




at 500 hPa





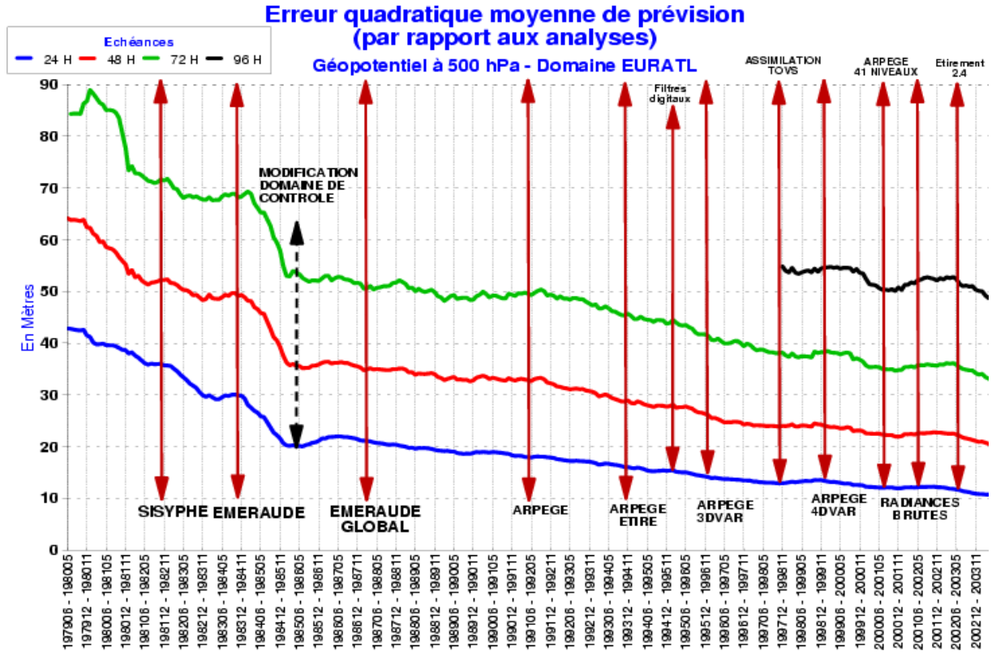


forecast range | *forecast range* | *forecast range*

FRANCE ECMWF
UKMO NCEP
CMC JMA
DWD TROPIQ

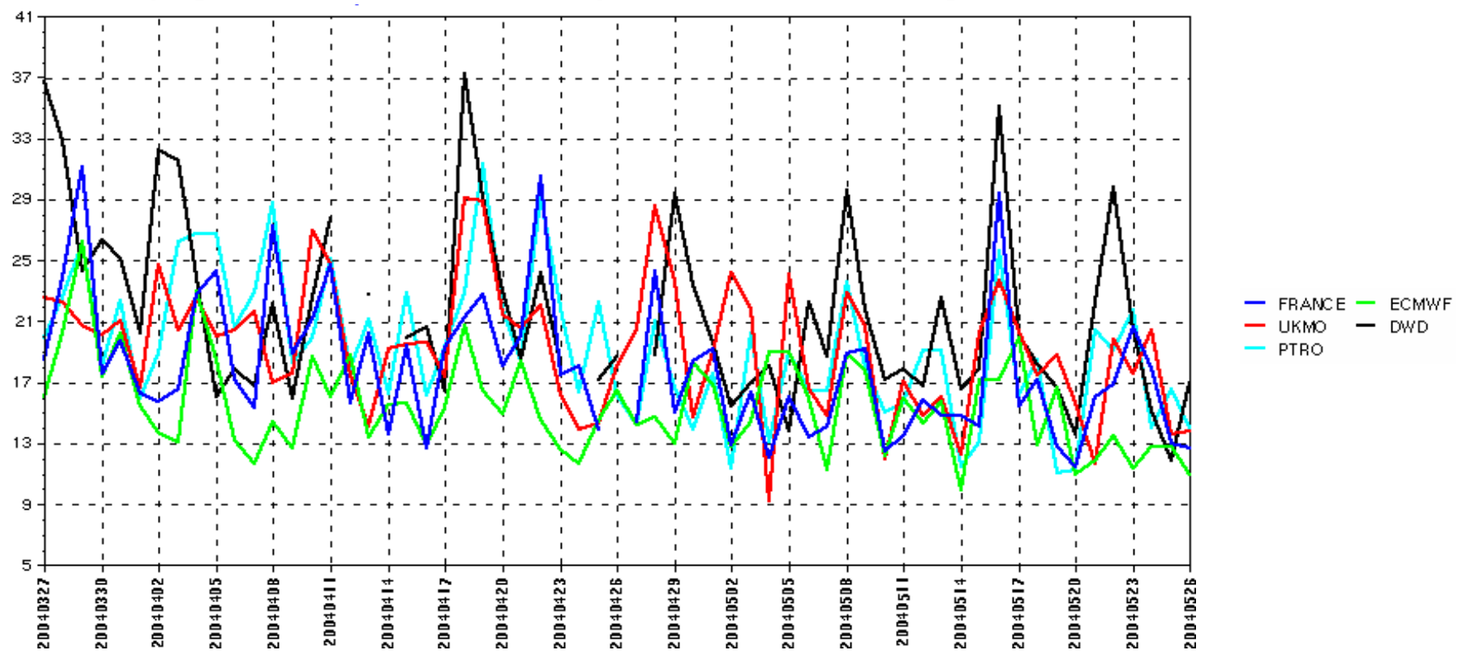
- Improvements along the 25 last years and main operational changes

geopotential at 500 hPa, rmse against analyses, over Europe & Atlantic Ocean



- Daily variations along the last month

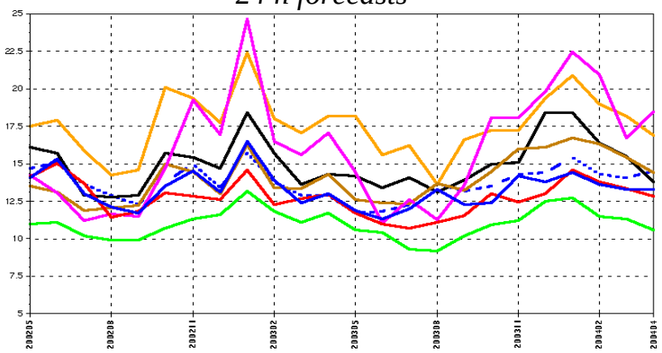
geopotential at 500 hPa, rmse against TEMPs, over Europe

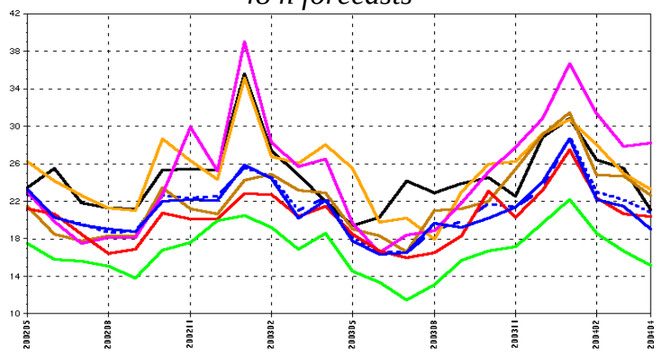


- Zoom on the evolution along the last 2 years : comparison to TEMPs over Europe, and to other global models

24 h forecasts | *48 h forecasts*

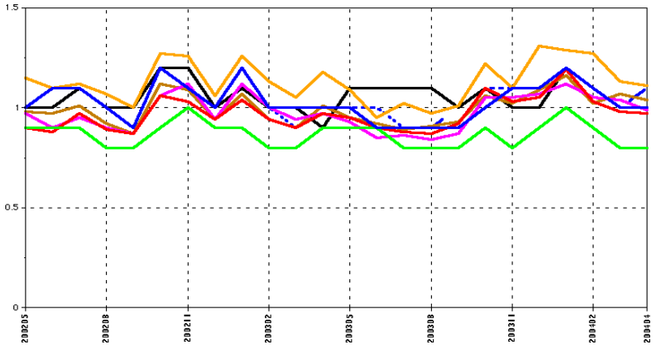
geopotential, 500 hPa (rmse, m)

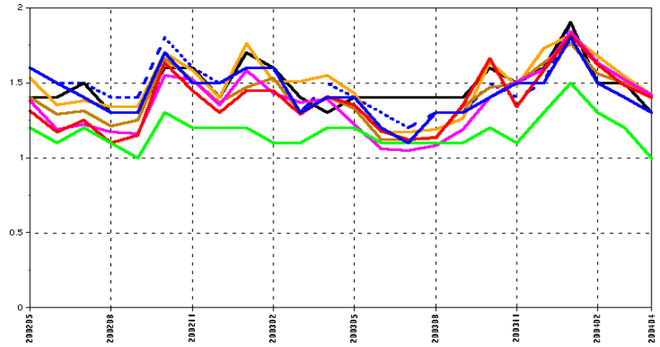




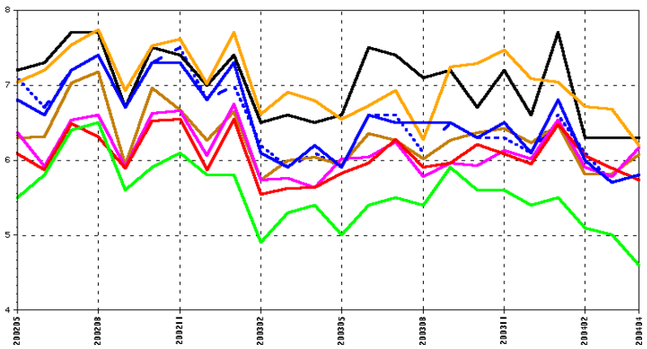
temperature, 850 hPa (rmse, K)

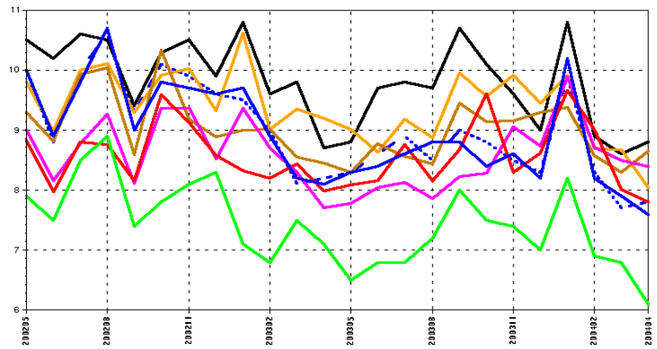
temperature, 500 hPa (rmse, K)





wind, 250 hPa (rmse, m/s)





LATEST CHANGES (since summer 2003)

Reminder : main earlier changes

- **2003, April 15th : COCONUT (physics)**
- **2003, June 2nd : New horizontal resolution**

A few "neutral" changes :

- **2003, June 30th : New computer (1)**
  VPP 5000 ➔ VPP 5000,
  slight changes in SST ⇒ non neutral,
  computer failure 2 days later !
- **2003, July 28th : New library**
  update of the source code version (CY26T1),
  slight improvements in post-processing, semi-Lagrangian advection : from 2 to 3 iterations, use of TOVS data : variable emissivity over sea
- **2003, October 6th : New computer (2)**
  VPP 5000 ➔ VPP 5000
  improvements in post-processing : filtering, wind gusts (no longer over-estimated), safety bugfixes

2003, December 8th : New observations

- improved use of raw AMSUA data (NOAA15, NOAA16, ~~NOAA17~~)
- use of raw HIRS data (NOAA16, NOAA17) ⇒ more humidity data !
- use of "GEOWIND" data (Meteosat 5-7 SATOBs in BUFR) (higher spatial and temporal (× 4) resolution, quality index
- real height for "10 m" wind SHIP observations (24 m on average !)
- ***far more observations used (~ + 17 % for the assimilation cycle), but impact mainly in the Tropics and Southern hemisphere***

2004, January 29th : Improvement of 4d-var *(et al.)*

- new background error statistics *(from an "ensemble" method, work of M. Belo Pereira)*
- improved simplified physics : *improved vertical diffusion in the two inner loops, suppression of the (expensive) radiation and convection schemes*
- new minimizer , using a preconditioned conjugate-gradient algorithm (*CONGRAD*) : *more efficient for quadratic problems, preconditioning allowed*
- lower cost : *from (45+20) to (40+15) iterations*
- improved SST analysis *(finer description of sea-ice extension)*
- use of monotonic semi-Lagrangian interpolators in dynamics
- a "few" changes in physics :
  reduction of snow-melting / rain-evaporation speeds,
  tuning of the convective cloudiness diagnostic,
  cleaning and speed-up of the radiation code,
  new computation of mixing lengths (a step towards interactive ones),
  improved robustness to changes in vertical resolution,
  new tuning parameters for cloud condensates et cloudiness
- longer forecast ranges (24 h longer at 06 and 18 UTC)
- ***clear improvement of wind field and SST, less spurious cyclogeneses***

2004, February 10th : New "production" run

- 30 h forecast from 00 UTC
- very short cut-off : 1h instead of 1h50 *(and 8h10 in the assimilation cycle)*
- *to have forecasts available early in the morning*

LAST WEEK'S CHANGE : New physics

- new, intermittent *(called every 3h)*, radiation scheme : FMR15 *("old Morcrette scheme")*
- improved cloudiness (less 0/1, more ice ⇨ *more cirrus)*

  details in the presentations of Y. Bouteloup and F. Bouyssel *(here and at the last ALADIN workshop)*

- preconditioning of the second minimization in 4d-var *(using output from the first one, allowed by CONGRAD)*

- new statistical model (forecast errors) for the analysis of surface fields (T2m, H2m) *(following the work of S. Ivatek-Sahdan)*

  correlation coefficients : $\rho_{T/H} = exp\left(-1/2 \; r/a_{T/H}\right)$

  standard deviations : $\sigma_{T/H} = \sigma^{\circ}_{T/H} \; exp(-\alpha(m-1/m))$

  characteristic lengths : $a_{T/H} = a^{\circ}_{T/H} \; exp(-\alpha(m-1/m))$

  with : *m* mapping factor, $\alpha=0.05$, $\sigma^{\circ}_{T}=1.7 \; K$, $\sigma^{\circ}_{H}=13 \; \%$, $a^{\circ}_{T}= 105 \; km$, $a^{\circ}_{H}=100 \; km$

- improved soil moisture initialization :

  from better analysis increments of T2m and Hu2m first ! *(impact on surface temperature too)*

  reduced increments (halved), direct use of the sun direction

  ➔bias correction for T2m and temporal smoothing of soil moisture increments may be suppressed

  spatial smoothing of initial soil moisture after corrections *(following the work of S. Ivatek-Sahdan and A. Dziedzic)*

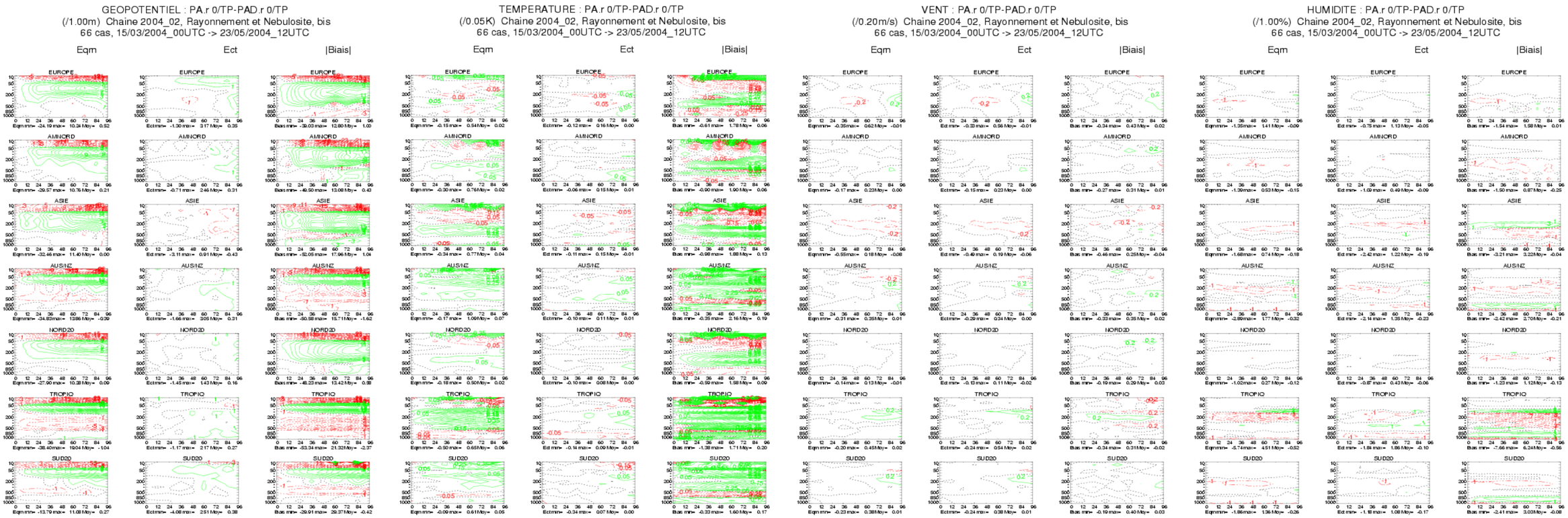
- some slight code changes

➔ change on May, 24th

➔ a positive impact !

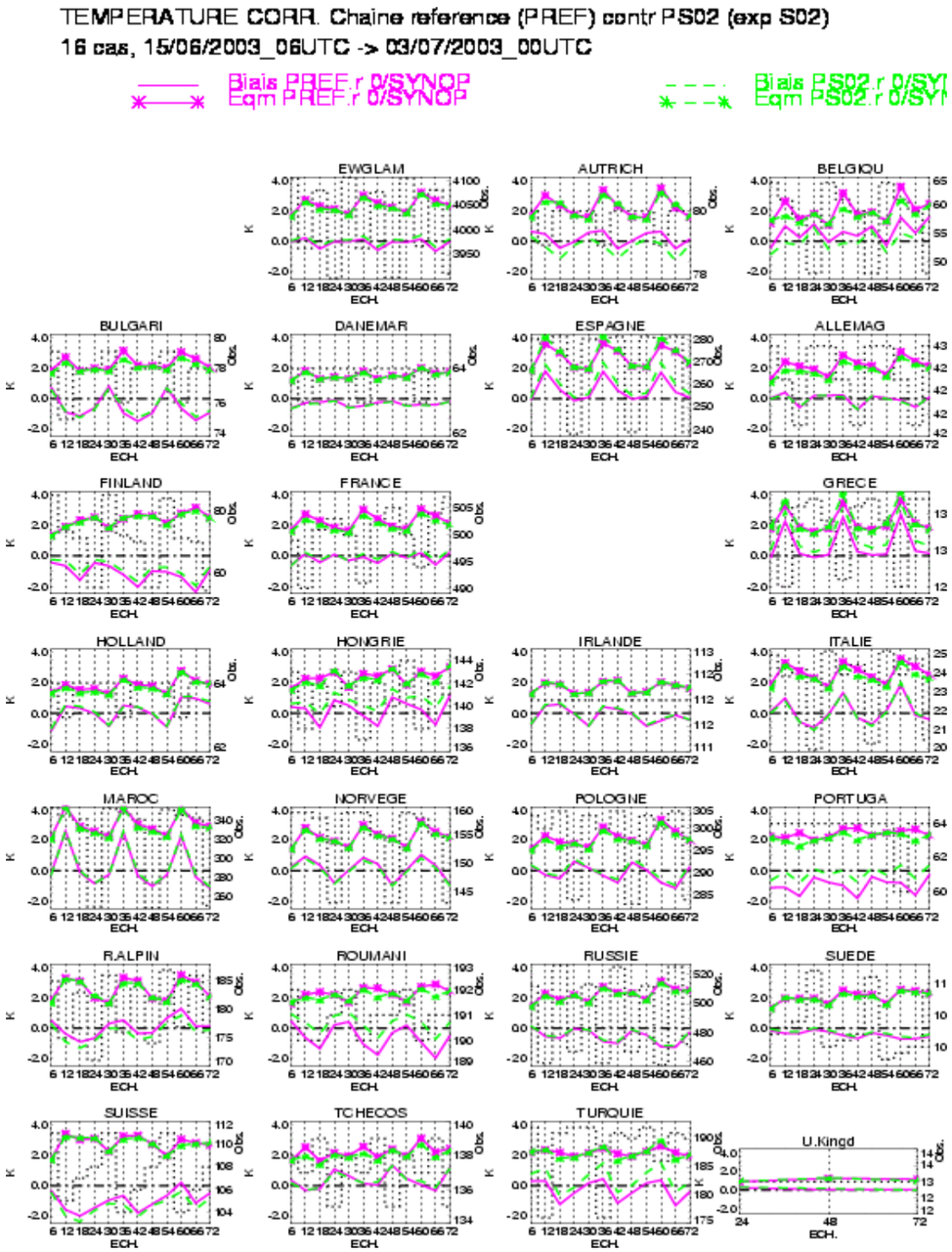
UPPERAIR IMPROVEMENTS : new against old model, distance to TEMPs (average over 2 months)

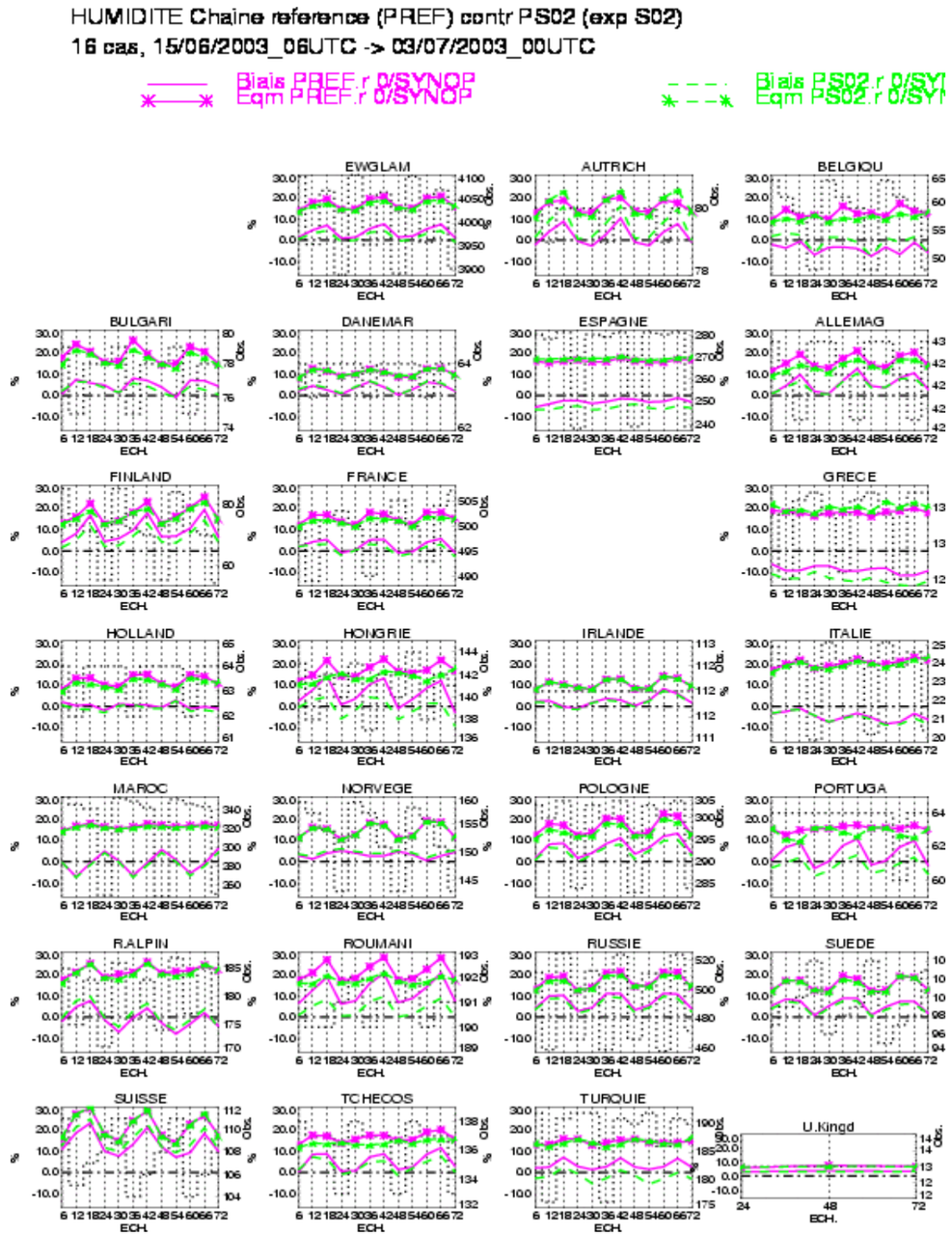
(green : improvement, red ; deterioration ; the problems in the upper levels are expected to be removed with the next changes)



SURFACE IMPROVEMENTS : new against old soil/surface analyses, distance to SYNOPS (average over 3 weeks)

(along a simplified assimilation suite covering early summer 2003)





NEXT SCHEDULED MODIFICATION : Observations & Physics

- QuikScat winds
- AMSU-B observations (➔ more informations on humidity)
- AIRS observations
- EARS(i.e. from EUMETSAT) ATOVS data
- Variational quality control *(from the work of M. Jurasek)*
- 2d climatological fields for ozone, instead of constants, to be used by the radiation scheme
- 2d climatological fields for aerosols (id.)
- improved boundary-layer description in stable cases (exchange coefficients, mixing lengths)

ABOUT THE GENERALIZED CUT-OFF CHANGE : Definitely delayed