
# Auxiliary data for CU6 : atmospheric parameters - Version 2

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## Abstract

This TN describes the second version of the compilation of atmospheric parameters (Teff, logg, [Fe/H]) from spectroscopic or photometric studies. The first version delivered in July 2013 was updated in January 2014. It has now nearly 2 million entries. This catalogue will be used at the beginning of the CU6 processing, and later for the CU8 validation.

# Document History

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# Contents

# Acronym List

The following table has been generated from the on-line Gaia acronym list:

| Acronym | Description |
|---|---|
| 2MASS | Two-Micron All Sky Survey |
| AP | Astrophysical Parameter |
| BP | Blue Photometer |
| CPU | Central Processing Unit |
| ESAC | European Space Astronomy Centre (VilSpa) |
| ESO | European Southern Observatory |
| FLAMES | Fiber Large Array Multi-Element Spectrograph (VLT) |
| GBOG | Ground-Based Observations for Gaia (DPAC) |
| GCS | Geneva - Copenhagen Survey |
| GES | Gaia ESO Survey |
| GSC | Guide Star Catalogue |
| GSPPhot | Generalised Stellar Parametriser PHOTometry |
| HR | Hertzsprung-Russell (diagram) |
| IGSL | Initial Gaia Source List |
| KIC | Kepler Input Catalogue |
| MATISSE | MATrix Inversion for Spectral SynthEsis (software) |
| MDB | Main DataBase |
| NEP | North Ecliptic Pole |
| RAVE | RAdial Velocity Experiment |
| RP | Red Photometer |
| RV | Radial Velocity |
| RVS | Radial Velocity Spectrometer |
| SDSS | Sloan Digital Sky Survey |
| SED | Spectral Energy Distribution |
| SEP | South Ecliptic Pole |
| TN | Technical Note |
| UCAC | USNO CCD Astrograph Catalogue |
| UVES | UV-Visual Echelle Spectrograph (VLT) |
| VLT | Very Large Telescope (ESO) |
| WG | Working Group |
| WISE | Wide-field Survey Explorer |

# 1 Introduction

DK-015 describes the auxiliary data necessary for the CU6 processing:

*The atmospheric parameters are used to: (i) select the stars that are valid to self-calibrate the RVS, (ii) select the synthetic spectrum to model the RVS spectra and extract their radial and rotational velocities. The atmospheric parameters will be provided gradually by CU8 (CBJ-054). The effective temperature will be available in MDB-02 (i.e. about 22 months after the receipt of the first observations). The surface gravity and metallicity will be provided in MDB-05. Before CU8 delivers atmospheric parameters, the information to perform tasks (i) and (ii) above are limited to either G, GRVS and integrated BP and RP magnitudes or to a full spectroscopic analysis of the spectra. The magnitudes will be affected by an unknown reddening and therefore would yield inaccurate/imprecise selection. The spectroscopic analysis would be very CPU consuming.*

*A library of atmospheric parameters would allow for performing the selection until CU8 delivers atmospheric parameters. It is not possible to build a 300 millions stars catalogue containing atmospheric parameters for all the RVS targets. The stars for which atmospheric parameters are the most needed are the potential RVS self-calibration stars, i.e. brighter than V = 11. The precision on the atmospheric parameters should be of the order of Teff $\simeq$200 K, log g $\simeq$0.5 and [Fe/H]$\simeq$0.2 dex.*

We are assembling various catalogues which provide atmospheric parameters in a compilation which will continue to evolve. The input catalogues included to date are briefly described below in Sect. 3 They have been combined in order to provide one single entry per star (Sect.4). The stellar content of this compilation of nearly two million stars is presented in Sect. 5. Other catalogues remain to be included (Sect. 8). This compilation will be useful for the validation of the Apsis stellar parameters in CU8.

# 2 Changes with respect to the previous version

The main change comes from additional catalogues included in this second version : Benchmark Stars, GBOG AP determinations, asteroseismic gravities, AMBRE, RAVE DR4, MILES, CFLIB, compilation of OBA stars, KIC revised effective temperatures. They are described in the next section.

In addition, the identification of stars changed. Now the HIP number is adopted preferentially if it exists, otherwise the TYC number is chosen, and the 2MASS number as the third choice. A few stars have only a UCAC or GSC number available.

The 2 MASS K magnitudes were added in the compilation.

Several format errors, wrong star names and dupplicate stars were corrected.

# 3 Catalogues of atmospheric parameters included to date

**The Gaia FGK Benchmark Stars** were carefully selected to be the pillars of the calibration of the stellar parametrizers in CU8 (Heiter et al, in preparation). These 33 stars, plus the Sun, cover well the parameter space, and have their Teff and logg determined independently of spectroscopy, from the fundamental laws which use the angular diameter, bolometric flux and parallax. Their metallicity [Fe/H] has been determined by Jofre et al. (2013).

**Spectroscopic AP determinations within GBOG CU6 and CU8 :** several observing programs have been carried out within the GBOG framework in order to secure high resolution spectra for CU6 and CU8. For CU6, the available spectra obtained for the follow-up of the radial velocity standard stars are described in Soubiran et al. (2013). Chemin et al. (LCH-001) describe the spectra used to build a library covering the RVS spectral range. For the initialization period, bright stars at the Ecliptic Poles have been observed with NARVAL in the North and with the echelle spectrograph of the 2.3m telescope at Siding Springs Observatory (RSAA/ANU) in the South. The South Ecliptic Pole area has also been observed with FLAMES at VLT in order to characterize a fraction of the stellar content of this important field for the commissioning. In CU8 the observations were intended to build a large catalogue of AP reference stars to calibrate the Apsis algorithms (Heiter et al., UH-001). The GBOG observations are supplemented with spectra retrieved from public archives of spectrographs (Soubiran & Heiter, CS-008). In total, the largest ever library of high resolution spectra of carefully selected stars covering the whole AP space is currently being assembled. Stellar atmospheric parameters are currently being estimated with several methods calibrated on the Benchmark Stars mentioned above and with common inputs. As of today, atmospheric parameters have been determined for 1014 radial velocity standard stars and 62 bright NEP stars (Chemin et al. in preparation) and for 21 bright SEP stars (Jasniewicz & Zwitter in preparation).

**Asteroseismic gravities** have been determined for Kepler and Corot stars by Creevey et al. (2013) and Chaplin et al. (2013). For this two samples we adopt their high precision logg, with the associated Teff. Creevey et al. (2013) provide 42 determinations, Chaplin et al. (2013) provide 505 determinations. These asteroseismic inputs and their use in CU8 will be detailed in a forthcoming TN (Creevey et al. in preparation).

**PASTEL** (Soubiran et al., 2010) is a bibliographical catalogue compiling determinations of stellar atmospheric parameters. It provides (Teff, logg, [Fe/H]) determinations obtained from detailed analyses of high resolution, high signal to noise spectra, carried out with the help of model atmospheres. It also provides high quality effective temperatures from various methods. The current version (2013-05-02) includes 52 045 records from 990 bibliographical sources for 26 659 different stars. Although PASTEL is made of inhomogeneous determinations due

to the variety of methods and input data used in spectroscopic analyses, we adopt a weighted average for stars which have several APs available, with weights related to the individual errors quoted in the catalogue ($w = 1/\sigma^2$) and the year of the publication. When errors are missing we adopt $\sigma_{\rm Teff}$=300K, $\sigma_{\rm logg}$=0.4, $\sigma_{\rm FeH}$=0.3, for publications before 1990 and $\sigma_{\rm Teff}$=200K, $\sigma_{\rm logg}$=0.3, $\sigma_{\rm FeH}$=0.1 for publications after 1990.

The resulting catalogue was cleaned from too incertain temperatures, with error (standard deviation of the weighted mean when available) higher than 15%. Stars with incertain coordinates or no V magnitude were also rejected to ensure a safe cross-match with other catalogues. With these rules, also applied to the other catalogues, the final averaged PASTEL catalogue includes 19 006 stars, 8 586 of which have spectroscopic (Teff, logg, [Fe/H]). Median errors of (Teff, logg, [Fe/H]) are 65K, 0.10, 0.06 respectively. The Teff listed in PASTEL with no (logg, [Fe/H]) are in general not spectroscopic, but still of high quality.

In addition Lobel & Frémat (private communication) have retrieved several references concerning OBA stars which were not included in PASTEL. This adds 3 181 more determinations of Teff, or Teff and logg for hot stars.

**AMBRE** is intended to carry out the determination of stellar atmospheric parameters for all high resolution optical spectra available in the ESO archive. The analysis of the FEROS archived spectra for their stellar parameters (effective temperatures, surface gravities, global metallicities, alpha element to iron ratios and radial velocities) has been completed in the first phase of the AMBRE Project (Worley et al., 2012). A total of 21 551 scientific FEROS spectra have been identified, corresponding to 6285 stars. After some cleaning, 3 314 stars remain in the sample. The APs were averaged in case of several determinations available for the same star.

**RAVE DR4 :** The fourth data release of the RAdial Velocity Experiment (Kordopatis et al., 2013) contains stellar atmospheric parameters (effective temperature, surface gravity, overall metallicity), radial velocities, individual abundances, and distances determined for 425,561 stars. The stellar atmospheric parameters are computed using a new pipeline, based on the algorithms of MATISSE and DEGAS. We made a selection of the most reliable parameters for 367 112 stars, following the recommendations in the paper, rejecting stars with Teff $<$ 3800 K, and stars with logg $<$ 0.5.

**Atmospheric parameters of the MILES stars** have been redetermined by Prugniel et al. (2011) using the medium resolution spectra of the library. (Teff, logg, [Fe/H]) are provided for 985 stars of O to M spectral types.

**Atmospheric parameters of the CFLIB stars** have been redetermined by Wu et al. (2011) using the medium reoslution spectra of the library. (Teff, logg, [Fe/H]) are provided for 1 272 stars of O to M spectral types.

**A compilation of OBA stars** has been done for CU8 by Lobel & Frémat (private communication). They have performed the determination of Teff and logg using a calibration of the uvby spectrophotometry for 12 744 B and A stars. In addition they have compiled 9 references from VizieR proving Teff and sometimes logg for hot stars.

**A revision of effective temperatures for the Kepler Input Catalog** was performed by Pinsonneault et al. (2012) for 161 977 KIC stars observed in long-cadence mode. They used Sloan Digital Sky Survey (SDSS) griz filters tied to the fundamental temperature scale.

**Geneva-Copenhagen Survey (GCS)**, a magnitude-complete, kinematically unbiased sample of 16 682 nearby F and G dwarfs, is the largest available sample with complete data for stars with ages spanning that of the disk (Nordström et al., 2004). It uses calibrations of uvby$\beta$ photometry into Teff, [Fe/H]. Casagrande et al. (2011) present a re-analysis of the Geneva-Copenhagen survey, benefiting from the infrared flux method to improve upon the accuracy of the derived stellar effective temperatures and using the latter to build a consistent and improved metallicity scale. We use this latest version of APs.

**Atmospheric parameters of 1 907 metal-rich stars :** Robinson et al. (2007) derive atmospheric parameters from Lick index measurements. This is part of the N2K low-resolution spectroscopic survey, designed to identify metal-rich FGK dwarfs likely to harbor detectable planets.

**Fundamental parameters of Hipparcos stars :** McDonald et al. (2012) derive the fundamental parameters (temperature and luminosity) of 107 619 Hipparcos stars and place these stars on a true Hertzsprung-Russell diagram. This is achieved by comparing BT-Settl model atmospheres to spectral energy distributions (SEDs) created from Hipparcos, Tycho, SDSS, DENIS, 2MASS, MSX, AKARI, IRAS and WISE data.

By comparing these photometric temperatures to the spectroscopic ones from PASTEL in Fig. 1, it is clear that there is a strong effect for hot stars, in the sense that photometric temperatures tend to be underestimated. In the FGKM regime (Teff $<$ 7000K), the agreement is quite good, with a mean difference and standard deviation of -44 K and 198 K respectively for ($\mathrm{Teff}_{\mathrm{PASTEL}} - \mathrm{Teff}_{\mathrm{McDonald}}$) after an iterative $3\sigma$ rejection of $\sim$ 250 outliers among 10 671 common FGKM stars. For the following, the photometric Teff higher than 7000 K were rejected.

**Teff for Tycho-2 stars :** Ammons et al. (2006) use a procedure that uniformly estimates fundamental stellar properties of Tycho 2 stars, with errors, using spline functions of broadband photometry found in Hipparcos/Tycho2 and 2MASS. They provide estimates of effective temperature for 2.4 million Tycho 2 stars. Of the positive and negative error bars which are given, we keep the largest one. As for the McDonald's stars with photometric Teff higher than 7 000 K were rejected. The catalogue was also cleaned from too uncertain temperatures, with relative errors higher than 15%. After these selection 1 548 300 Teff determinations remain.

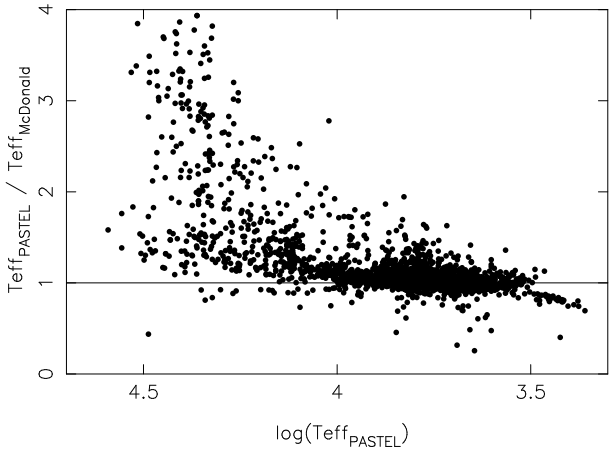


FIGURE 1: Ratio of McDonald et al's temperatures to PASTEL ones for $\sim$ 12 000 stars in common showing a general good agreement in the FGK regime but a significant underestimation of photometric temperatures for hot stars.

# 4 Combining the above catalogues

All the above catalogues have stars in common while we want to build a table with only one entry per star. The atmospheric parameters listed in those catalogues are of different quality. The spectroscopic ones are preferred to the photometric ones, especially those from high resolution and high signal to noise ratio performed by ourselves or listed in PASTEL. In the photometric catalogues, a preference is given to those providing the 3 parameters instead of Teff only. Atmospheric parameters are assigned following the priority order as listed in Table 2.

Not all the stars appear with the same name in the different catalogues, and not all the star names are resolved by Simbad. Additional difficulties come from stars listed in some catalogues with a letter attached to their name to indicate a component of a multiple system while this letter is not recognized by Simbad. To solve some problems of identification found in the previous version of the compilation, and to facilitate the cross-match with the IGSL, our strategy is to adopt the HIP number if available, and if not, the TYC number or the 2MASS, UCAC4 or GSC number, in this order of preference. Several stars with none of this identifications were removed from the compilation. The Xmatch tool of VizieR was used to find the proper star numbers, with a search radius of 5 arcsec. High proper motion stars, and those in visual multiple systems or dense area were sometimes problematic. In some doubtful cases the visual magnitude was used to discriminate between several possibilities. Visual inspection with Aladin was also used to solve difficult cases.

The final compilation includes 1 930 105 stars. They are counted by catalogue in Table 2.

To follow the requirement of DK-015, each value of atmospheric is provided with a quality flag

TABLE 2: Summary of the different catalogue contributions in the compilation of 1 930 105 stars. Teff, logg and [Fe/H] were assigned according to the priority order indicated in the first column.

| Priority | Catalogue | $N_{Teff}$ | $N_{logg}$ | $N_{[Fe/H]}$ |
|---|---|---|---|---|
| 1 | Benchmark Stars | 33 | 33 | 33 |
| 2 | GBOG AP | 1 139 | 1 139 | 1 082 |
| 3 | Seismic logg | 517 | 517 | 0 |
| 4 | PASTEL + OBA | 19 187 | 8 796 | 7 946 |
| 5 | AMBRE | 2 006 | 1 954 | 1 963 |
| 6 | RAVE DR4 | 359 229 | 349 410 | 359 694 |
| 7 | MILES | 95 | 120 | 123 |
| 8 | CFLIB | 243 | 304 | 327 |
| 9 | OBA *uvby* | 11 354 | 10 343 | 0 |
| 10 | KIC | 161 342 | 161 348 | 161 775 |
| 11 | GCS | 6 787 | 10 502 | 12 743 |
| 12 | Robinson et al. | 527 | 561 | 557 |
| 13 | McDonald et al. | 77 977 | 0 | 0 |
| 14 | Ammons et al. | 1 290 815 | 0 | 0 |

ranging from 1 (good quality) to 3 (uncertain). The 3 levels defined for CU8 in CBJ-054 are adopted : 1 for the 33 Benchmark Stars, 2 for AP reference stars ( GBOG APs and seismic logg), 3 for AP secondary stars, i.e. those included in all the other catalogues listed in Table 2.

# 5 Stellar content of the compilation

Fig. 2 displays the distribution of the compilation in equatorial coordinates. The peculiar sky distribution of several catalogues is clearly visible, such as the deep Kepler field corresponding to the catalogue of Pinsonneault et al. (2012). The histograms of Vmag and Kmag are displayed in Fig. 3. Vmag is not available for 285 982 stars, while Kmag is not available for 571 stars. The histograms of all Teff available and the logg vs Teff diagram are displayed in Fig. 4. The cuts (logg $\geq$ 0.5 and Teff $\geq$ 3800 K) imposed to the RAVE catalogue are clearly seen. The fraction of hot stars is much higher than in the previous version thanks to the bibliographical compilation and photometric determinations made by Lobel & Frémat for CU8.

Fig. 5 displays the HR diagram of stars which have (Teff, logg, [Fe/H]) known, in 4 different metallicity ranges typical of the halo, thick disk, thin disk and metal rich populations. The metallicity determinations are dominated by RAVE DR4 and KIC.

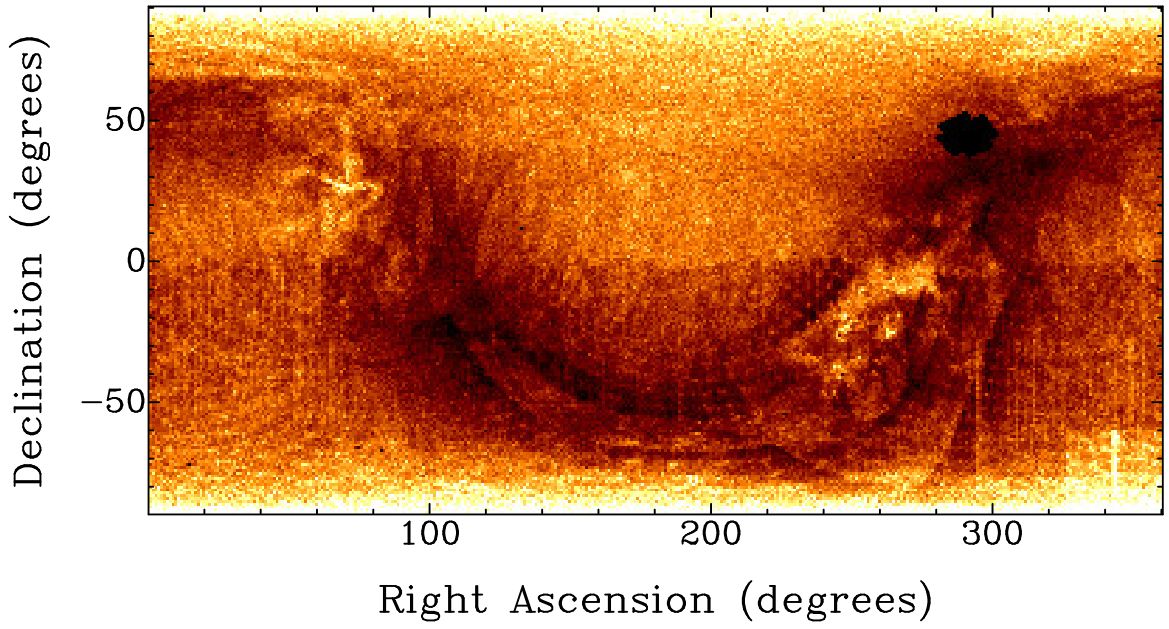


FIGURE 2: Distribution of the ∼ 2M stars of the compilation in equatorial coordinates.

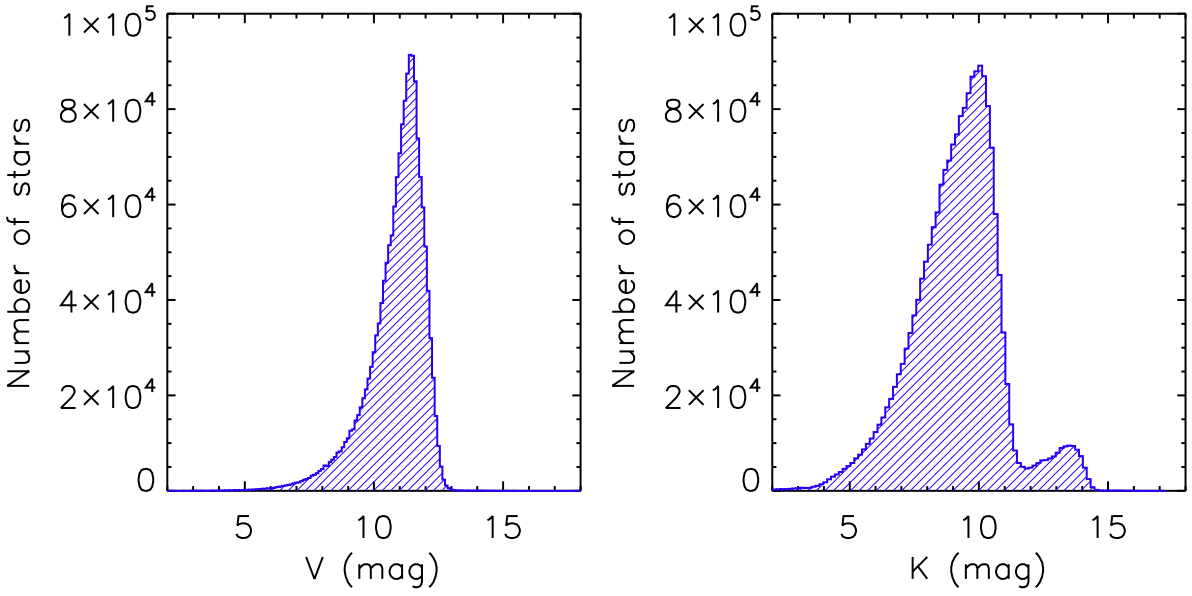


FIGURE 3: Vmag and Kmag histograms of the ∼ 2M stars of the compilation.

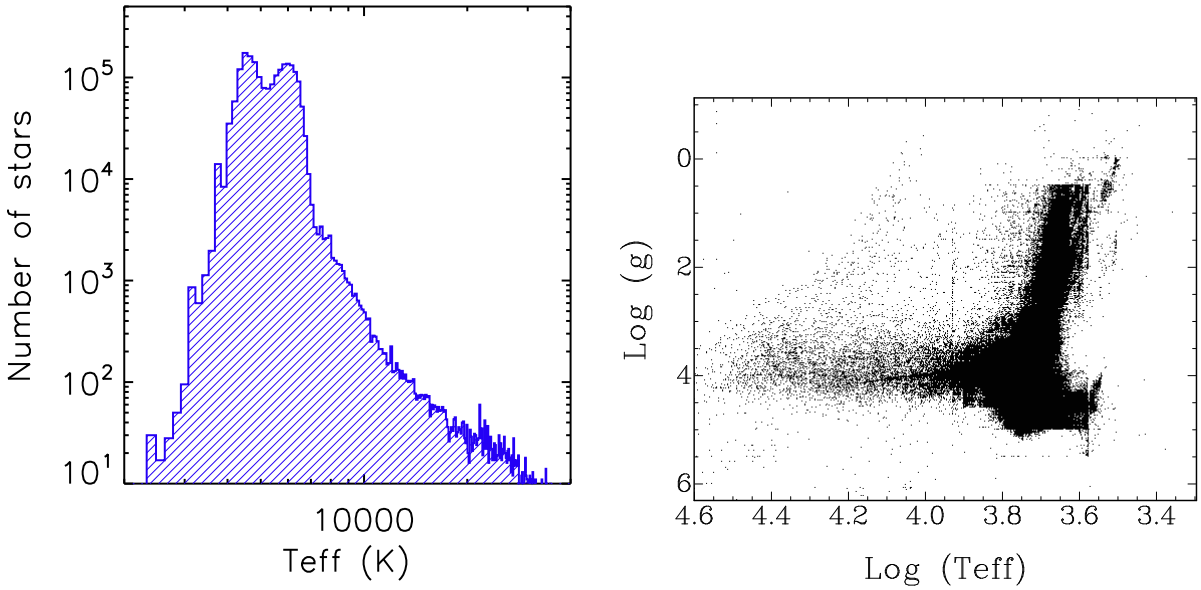


FIGURE 4: Teff histogram of the $\sim$ 2M stars of the compilation, and HR diagram.

# 6 Format and storage

The compilation of atmospheric parameters is stored on the ESAC disk space created for the GBOG WG : gbogcom at ssh.esac.esa.int, /gbog/cu6/AP (password given upon request).

It is an ascii file with a readme file (see Fig. 6) containing the information necessary for the cross-match with IGSL and other catalogues (identifier, accurate coordinates, Vmag and Kmag) and for its transformation into the gbin table auxAtmParam with the data model defined in DK-015.

# 7 Crossmatch with important samples

**IGSL :** the cross-match with IGSL is very important since it provides the SourceId of each star which allows the MDB to identify them (Marchal, in preparation). We took care to provide for each star of this compilation an identifier (HIP, TYC, 2MASS, UCAC, GSC) included in the SourceCatalogIDs table of the IGSL in order to make the cross-match easier. The cross-match of this second version of the compilation with the IGSL gave 446 unmatched sources.

**The catalogue of RV standard stars for Gaia :** according to Katz et al. (DK-015), the 1420 RV standard stars candidates are identified in the table auxRadVel in mdb.cu6.auxiliarydata. Their atmospheric parameters were previously compiled from the literature, essentially GCS,

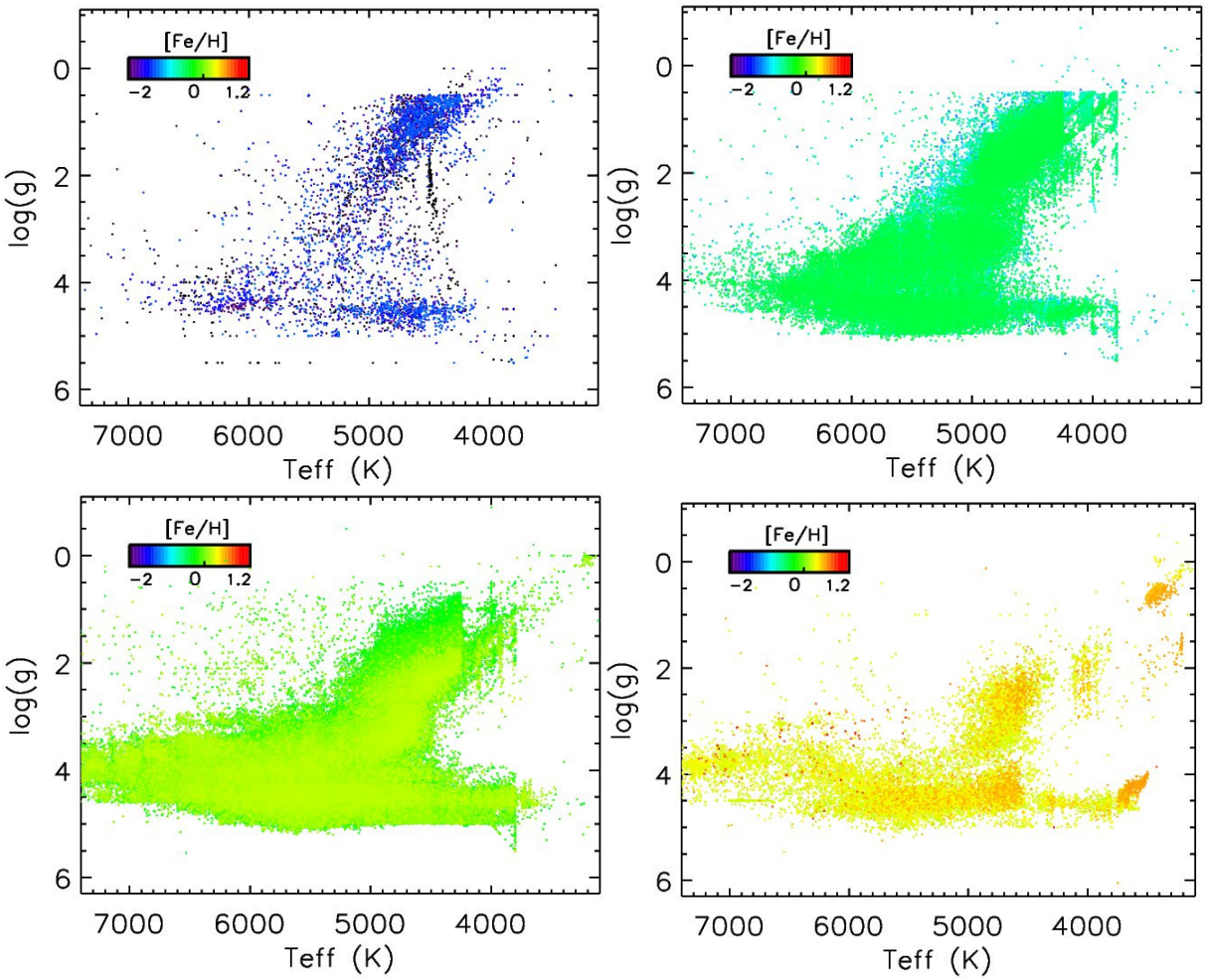


FIGURE 5: Teff vs logg in four different ranges of mtallicity : [Fe/H]< -1.2 (upper left), -1.2 ≤ [Fe/H]< -0.4 (upper right), -0.4 ≤ [Fe/H]< +0.2 (lower left), [Fe/H] ≥ +0.2 (lower right)

as described in FCO-001. Here we provide for all of them more precise parameters coming mainly from our own GBOG determinations or from PASTEL. For 21 stars we are lacking logg and/or [Fe/H].

**The Ecliptic Pole Catalogue :** the brightest stars of those regions which have been observed with NARVAL at Pic du Midi (63 stars) and the spectrograph mounted on the Siding Springs 2.3m telescope (21 stars), and their atmospheric parameters determined by ourselves (one at NEP failed). The FLAMES spectra at South Ecliptic Pole are currently being analysed to provide radial velocities and atmospheric parameters of ∼760 stars, so these data are not yet included in the compilation. Nevertheless, a good fraction of the Tycho-2 stars at the Ecliptic Poles can be found in the compilation thanks to the Ammons et al's catalogue of Teff. The Teff catalogue from Zwitter et al. (TZ-001) based on 2MASS also contains a number of stars at the Ecliptic Poles.

**Potential FGK self-calibrating stars :** such stars, brighter than V=11, can be easily selected in the proper temperature range in the compilation.

# 8 Next steps

The following catalogues will be added to this compilation :

**APs of the FLAMES GBOG program at SEP** are currently being determined. The sample consists of ∼70 stars observed at high resolution with UVES centered at 860nm, and ∼700 stars observed at medium resolution with Giraffe at medium resolution in 2 different setups.

**APs of reference stars for CU8** will continue to be determined for the calibration of Apsis. Several hundreds of high resolution spectra, obtained in the GBOG frame, remain to be analysed in a homogeneous way. A pipeline based on the iSpec tool (Blanco-Cuaresma et al., 2013) is now operationnal after some tests and calibrations with Benchmark Stars.

**The Gaia-ESO Public Spectroscopic Survey (GES)** aims to observe more than $10^5$ stars with the FLAMES fiber facility at the VLT (Gilmore et al., 2012). High-resolution UVES spectra of about 5 000 FGK-type stars in the solar neighborhood and in open clusters of different ages will be obtained. The Survey products include the reduced spectra, radial velocities, multiplicity information, rotational velocities, stellar atmospheric parameters, detailed element abundances, accretion rates and measurements of chromospheric activity. The first release of GES is now public and will be integrated in the next version of the AP compilation.

In addition to all this, photometric temperatures for $\sim$ 196M sources have been estimated from 2MASS colours (Zwitter et al., TZ-001). This large catalogue will also be used in the CU6 processing.

Other large surveys to be considered include SDSS DR10 (Ahn et al., 2013) with the first spectroscopic data from the Apache Point Observatory Galaxy Evolution Experiment (APOGEE), LAMOST (Luo et al., 2012), and ARGOS with 28 000 stars in the bulge (Freeman et al., 2013). They are part of a compilation of data for the calibration of GSP-Phot ongoing in CU8 (Andrea, in preparation).

# 9 Conclusion

The compilation presented here includes nearly two million stars with a determined $\mathrm{T_{eff}}$, among which ∼25% have also logg and [Fe/H] available. It has been prepared by combining several catalogues providing spectroscopic or photometric APs. The compilation will be regularly updated with the APs determined by ourselves from the GBOG high resolution spectra that we

have acquired from our own observations or in public archives. This catalogue is mandatory for CU6 for the begining of the processing, but it will also be used for the Apsis processing in CU8 to identify potential problems, to refine the parametrization codes and validate the stellar outputs. So the evolution of this compilation will be done in coordination with CU8. It also provides a useful external database for the validation and science applications in CU9.

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File Summary:
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AtmParam.cat 148   1930105  The catalogue of stellar atmospheric parameters
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Byte-by-byte Description of file:  AtmParam.cat
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  37- 44  F8.5  s       RAs      Right Ascension J2000 (seconds)
      46  A1    ---     DE-      Declination J2000 (sign)
  47- 48  I2    deg     DEd      Declination J2000 (degrees)
  50- 51  I2    arcmin  DEm      Declination J2000 (minutes)
  53- 59  F7.4  arcsec  DEs      Declination J2000 (seconds)
  61- 71  F11.7 deg     RAdeg    Right Ascension J2000 (degrees)
  73- 83  F11.7 deg     Dec      Declination J2000 (degrees)
  85- 90  F6.3  mag     Vmag     Johnson V magnitude (2)
  92- 97  F6.3  mag     Kmag     K magnitude from 2MASS (2)
      99  A1    ---     Qflag    [123] Quality flag (3)
 101-105  I5    K       Teff     Effective temperature (2)
 107-110  I4    K     e_Teff     Standard error on effective temperature (2)
 112-114  I3    ---   o_Teff     Origin of Teff (2,4)
 116-121  F6.3 [cm/s2]  logg     Logarithm of gravity (2)
 123-127  F5.3 [cm/s2] e_logg    Standard error on the logarithm of gravity (2)
 129-131  I3    ---     o_logg   Origin of logg (2,4)
 133-138  F6.3 [Sun]     [Fe/H]  Iron abundance relative to the Sun (2)
 140-144  F5.3 [Sun]   e_[Fe/H]  Standard error on iron abundance (2)
 146-148  I3    ---     o_[Fe/H]  Origin of [Fe/H] (2,4)
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Note (1) : ID is HIP number if available, or TYC, 2MASS, UCAC, GSC following
           this order of preference

Note (2) : Non Existing values are indicated by NaN

Note (3) : Qflag=1 Benchmark Star, Qflag=2 AP Reference Star, Qflag=3 secondary
           star

Note (4) : Origin of AP (to be completed)
      ** GBOG determinations : fundamental laws and/or spectrocopy
       * 01      : Benchmark Stars, Jofre et al. 2013arXiv1309.1099J
       * 02      : iSpec by LCH (RV Standards + NEP stars)
       * 03      : Bacchus by GJ (21 SEP stars)
      ** literature : asteroseismology or spectroscopy
       * 10      : seismic logg Creevey et al. and Chaplin et al. 2013arXiv
       * 11      : PASTEL Soubiran et al. 2010A&A...515A.111S
       * 12      : OBA compilation by Lobel & Fremat, Private Com.
       * 13      : AMBRE Worley et al. 2012A&A...542A..48W
       * 14      : RAVE DR4 Kordopatis et al. 2013AJ....146..134K
       * 15      : MILES library Prugniel et al. 2011A&A...531A.165P
       * 16      : CFLIB library Wu et al. 2011A&A...525A..71W
      ** GBOG determinations from photometry
       * 30      : uvby photometry of OBA stars by Lobel&Fremat
      ** literature : photometry
       * 40      : Pinsonnault et al.          2012ApJS..199...30P
       * 41      : Casagrande et al.           2011A&A...530A.138C
       * 42      : Robinson et al.             2007ApJS..169..430R
       * 43      : McDonald et al.             2012MNRAS.427..343M
       * 44      : Ammons et al.               2006ApJ...638.1004A

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History:
  * 29-May-2013: Version 981223 records.
  * 31-August-2013: Version 981223 records, with 2MASS id
  * 12-December-2013 : Version 2035752 records, with HIP, TYC, 2MASS, UCAC or
    GSC id
  * 24-January-2014 : Version 1930105 records, some redundancies corrected
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FIGURE 6: ReadMe file of the AtmParam compilation