WP10 REPORT about recommended parameters and individual element abundances of DR1 data

Alejandra Recio-Blanco & Carlos Allende Prieto

12 July 2013

General comments

This report is based on the results of DR1 Giraffe spectra of FGK stars observed with Giraffe.
The following groups have partecipated to the analysis (in parenthesis the number of stars with reported parameters are indicated for each node):

Atmospheric parameters

- IAC: Field and globular cluster stars in HR10+21 (4860 stars analysed) and HR10 only (717 stars)
  Open cluster stars in HR15 (3173 stars analysed)
  Benchmarks

- LUMBA: Field and globular cluster stars in HR10+21 (4367 stars analysed)
  Benchmarks

- Bologna: Field and globular cluster stars in HR10+21 (1917 stars analysed)
  Field stars with HR10 spectra only (173 stars analysed)
  Open cluster stars in HR15 (1361 stars analysed)
  Benchmarks

- ULB: Field and globular cluster stars in HR10+21 (1177 stars analysed)
  Field stars with HR10 spectra only (179 stars analysed)
  Open cluster stars in HR15 (1922 stars analysed)
  Benchmarks

- EPINARBO: Open cluster stars in HR15 (1284 stars analysed)
  Benchmarks

- Catania: Open cluster stars in HR15 (1100 stars analysed)
  Benchmarks

- Nice: Field and globular cluster stars in HR10+21 (4860 stars analysed)
  Field stars with HR10 spectra only (717 stars analysed)
  Field stars with HR21 spectra only (1935 stars analysed)
  Benchmarks

Individual abundances

In agreement with the recommended parameters, the following nodes have provided individual element abundances :
- EPINARBO : Open cluster stars in HR15N
- Catania : Open cluster stars in HR15N
- Nice : Field and globular cluster stars in HR10+21 and HR10 only
- LUMBA : globular cluster stars in HR10+21

In addition, the LUMBA node provided abundances for field and globular clusters stars in HR10+21, from their own atmospheric parameters, during the analysis run of last winter.

Science verification

Please, for the science verification issues, report to the DR1 analysis validation document of 18 March 2013

1. Atmospheric parameters and [alpha/Fe] measurements

1.1. Open clusters (HR15N data)

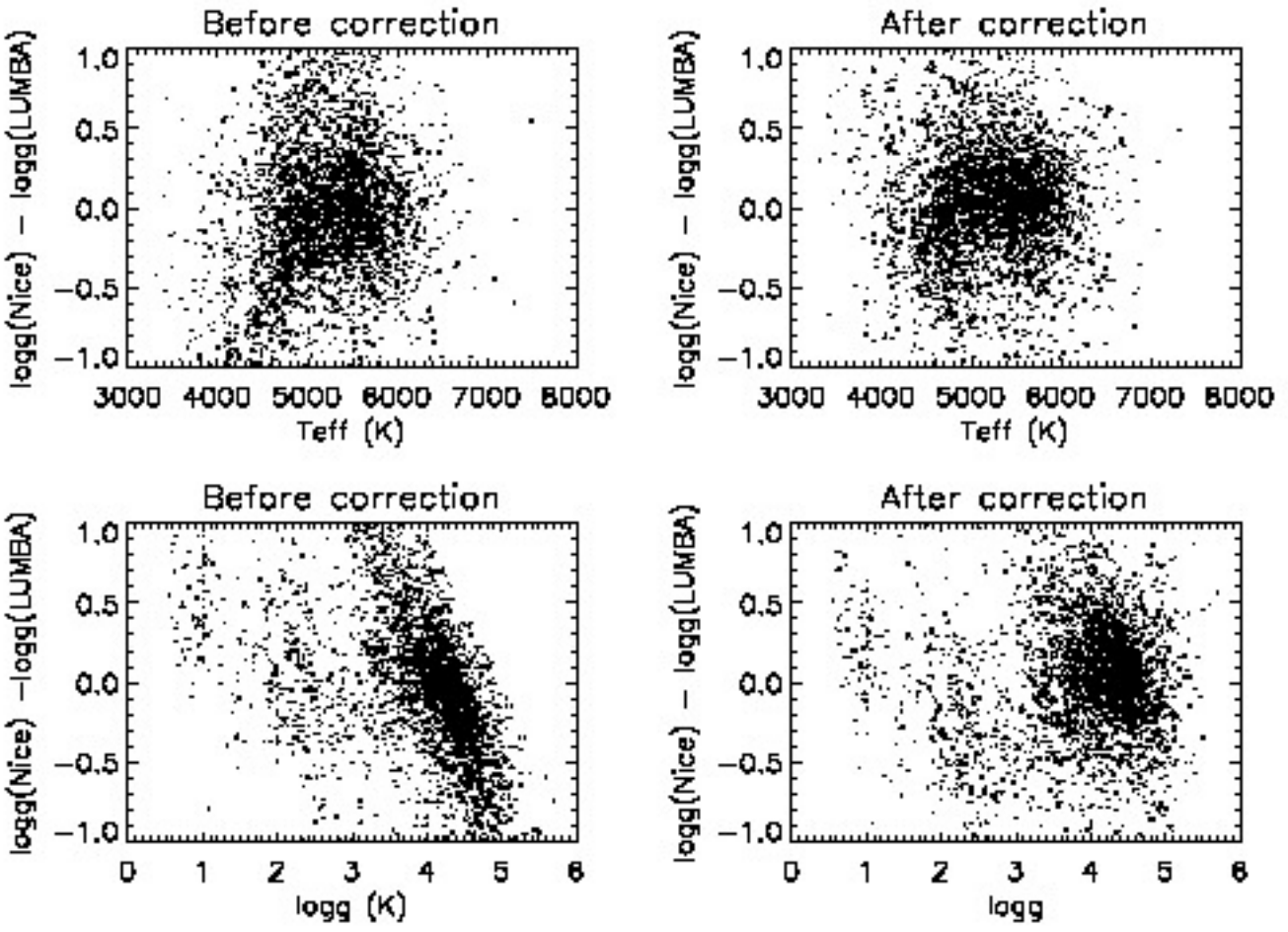
After internal discussion about the science verification tests performed for the open clusters results, the following results are recommended for the atmphospheric parameters :

- Old Open Clusters: EPINARBO results for members, IAC for non-members
- Young Open Clusters: Catania results both members and non-members

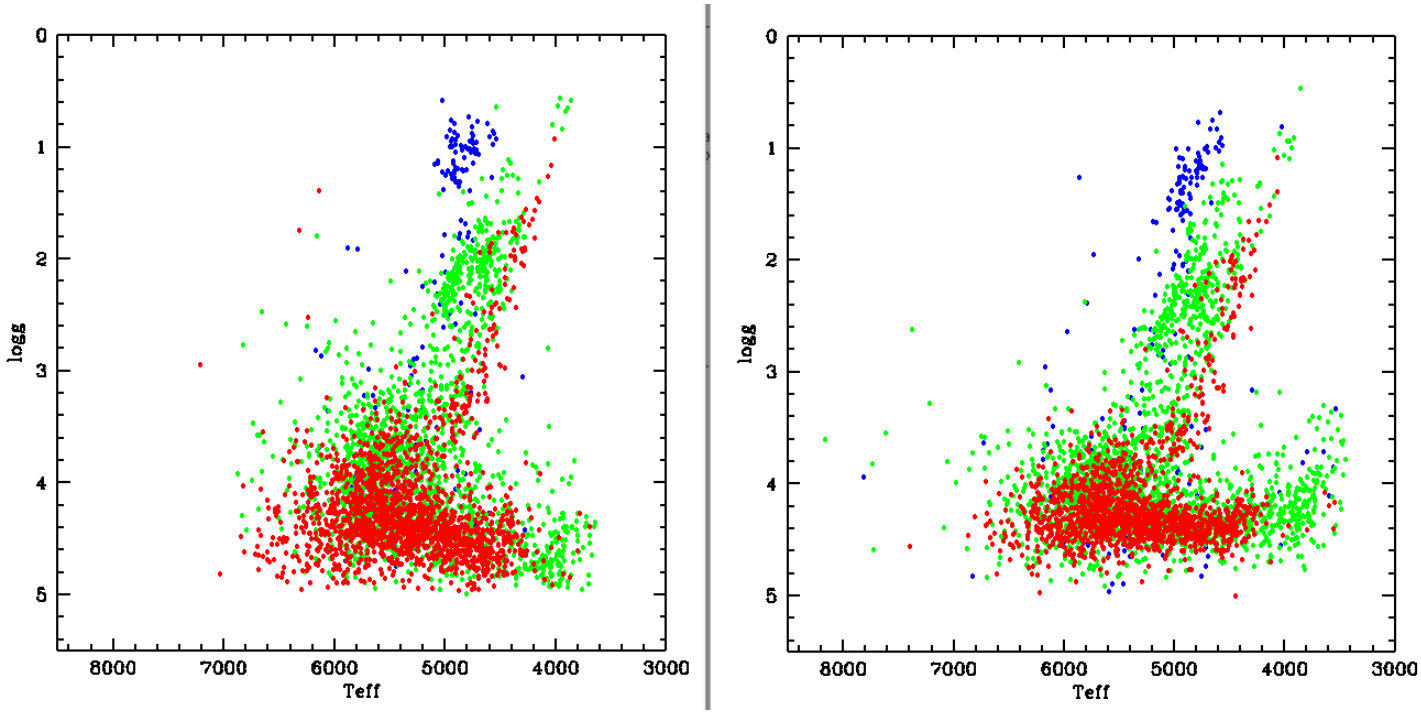
1.2. Field stars with HR21 and HR10 data

The science verification tests suggested to keep, for this DR1 data analysis, only the results of LUMBA, IAC and Nice. A specific work was done to find the best way of combining the three above mentioned results to produce a set of recommended parameters. There are systematic offsets among the parameters obtained by each of the three nodes considered for the HR10 or HR10+HR21 results. These are most prominent between LUMBA and Nice or IAC, but also significant between Nice and IAC. The offsets are mostly dependent on effective temperature (Teff) and surface gravity (logg) of the stars, and we have attempted to correct for them before combining the three sets of results. Using LUMBA as the reference, we modeled the differences between each parameter from Nice and LUMBA (or IAC and LUMBA) as a 2nd-order polynomial depending on Teff and logg.

As illustrated in the figure bellow, which corresponds to the case of the differences in logg between Nice and LUMBA, the polynomial fittings suceeded in flattening obvious trends.

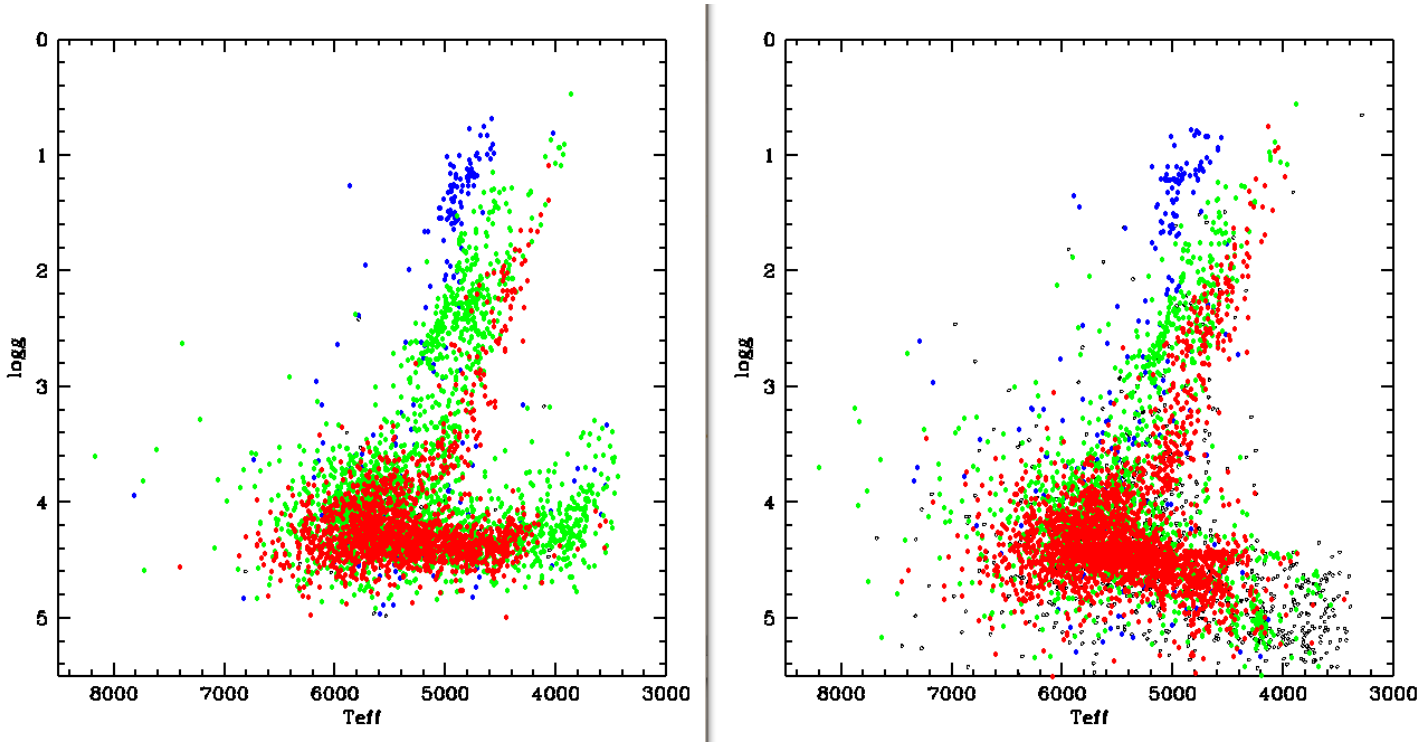


After correcting for the offsets using the polynomials, we averaged the results from the three nodes, and compared the resulting Teff-logg diagram with that from a straight combination of the three data sources, the averages with no attempt to correct for systematic offsets. The figure below compares the two sets of results of both approaches (bias corrected on the left ; no bias correction on the right). The secon option, without bias correction, was taken for the final recommended parameters for this DR1 data. We think that the bias correction procedure has to be improved, for DR2, in order to avoid possible extreme corrections (cases near the borders of the application ranges, for instance) that pollute the final results.



We warn the users of these parameters, that the results in the cool end of the main sequence (Teff<4000) are not as reliable as the others, as they deviate from the expected position of the HR diagram. The corresponding SNR values for those very cool dwarfs spectra are also lower than the mean SNR.

Finally, in the figure below, we have compared the new recommeded parameters (left panel) with the preliminary recommended ones of April 2013 (right panel). The new parameters provide better defined evolutionary sequences and a lower general dispersion.

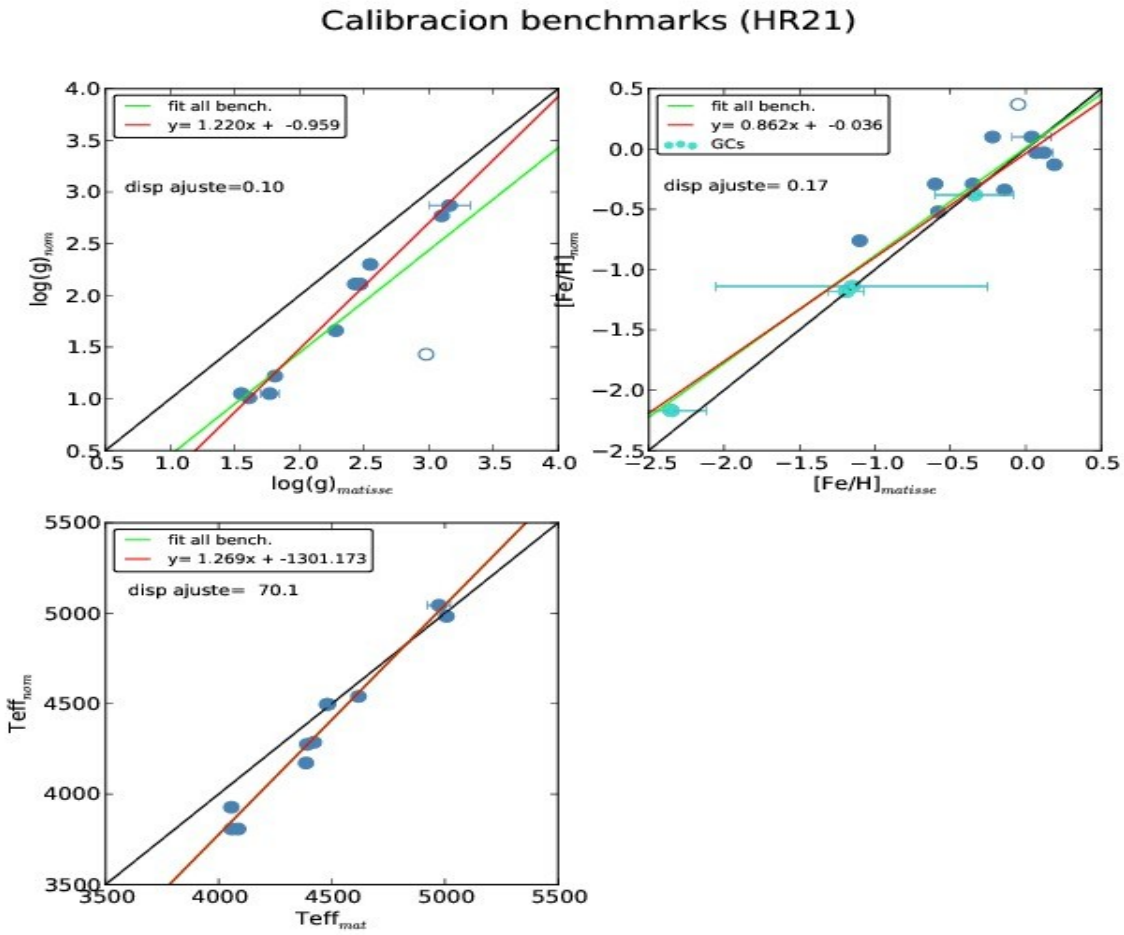


1.3. Field stars with only HR10 data

The science verification tests suggested to keep, for this DR1 data analysis, only the results of IAC and Nice. Following the results of the previously descrived combination tests performed for the data with HR10 and HR21 spectra, we have produced a set of recommended parameters from a straight combination of the two data sources, the averages with no attempt to correct for systematic offsets.

1.4. Field stars with only HR21 data

Only Nice provided results for these data. The science verification tests suggested to keep, for this DR1 data analysis, only the results for the bulge fields (1118 stars), that have a majority of giants.
As only the results of one group were available, we have performed comparisons with the results for the benchmarks stars and we have corrected by the corresponding biases as shown in the figure below :

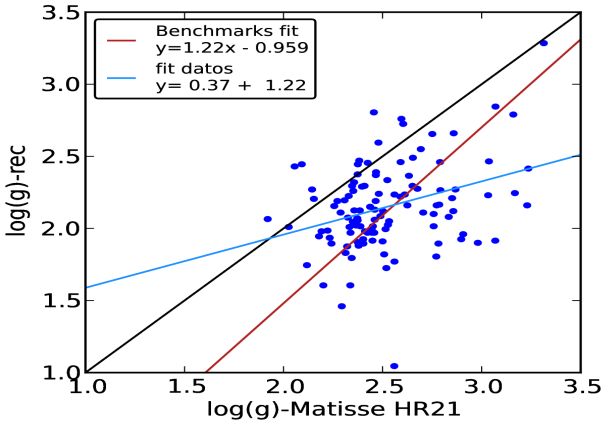


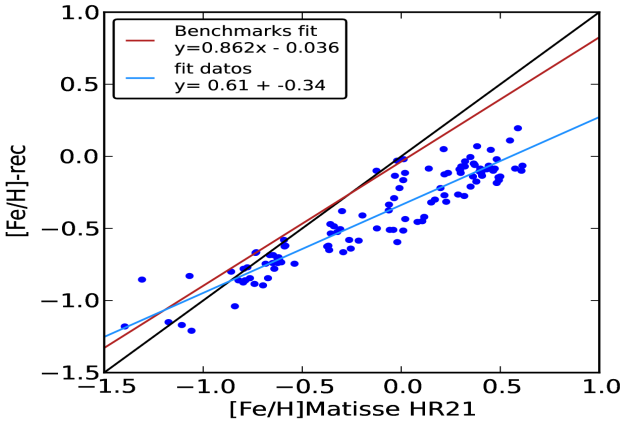
We have also compared the HR21 results for the Baade's window field with those obtained for HR10 from the mean of IAC and Nice results.

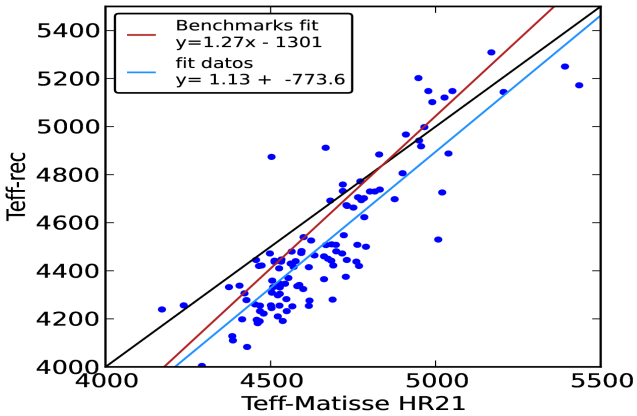
As this Baade's window data have an external parameter determination form the literature (Hill et al. 2011), we have also performed a comparison with the external parameter values. We warn however, that the Hill et al. work relies on photometric gravities determinations.

Figures in the next page.

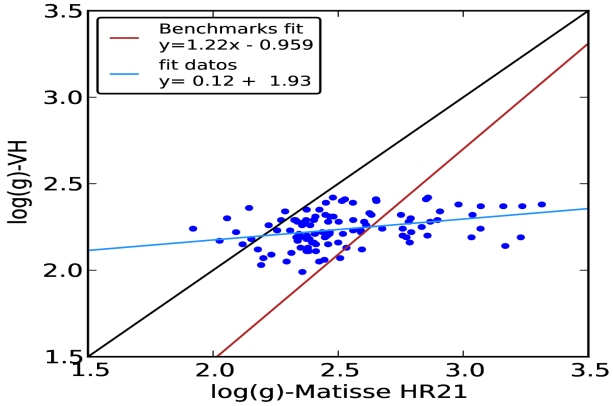
Comparison of results for the bulge RC sample of Hill et al. (2011), from Matisse parameters in HR21 and recommended parameters (Matisse+IAC) in HR10

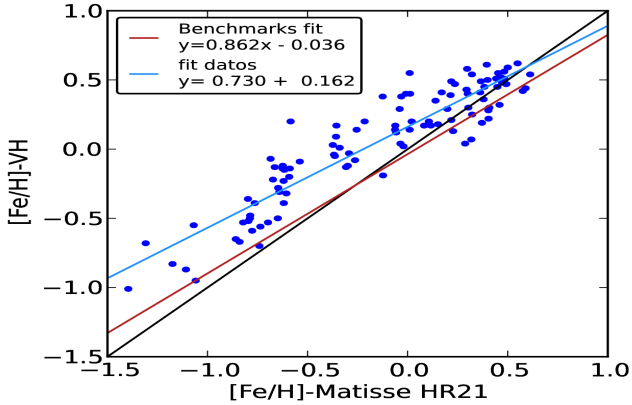


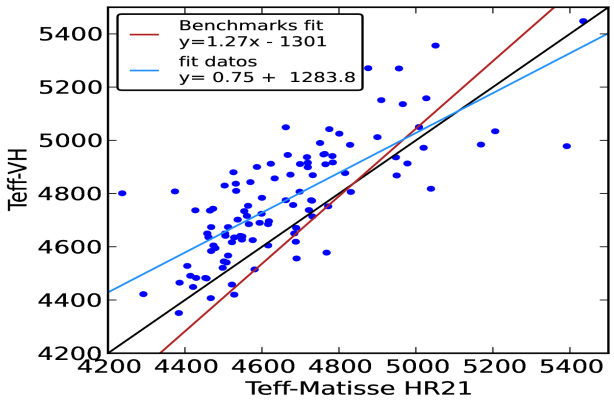




VH (2011) stars: Matisse vs published parameters







2. Individual abundances for stars observed with HR10+HR21 or HR10 only

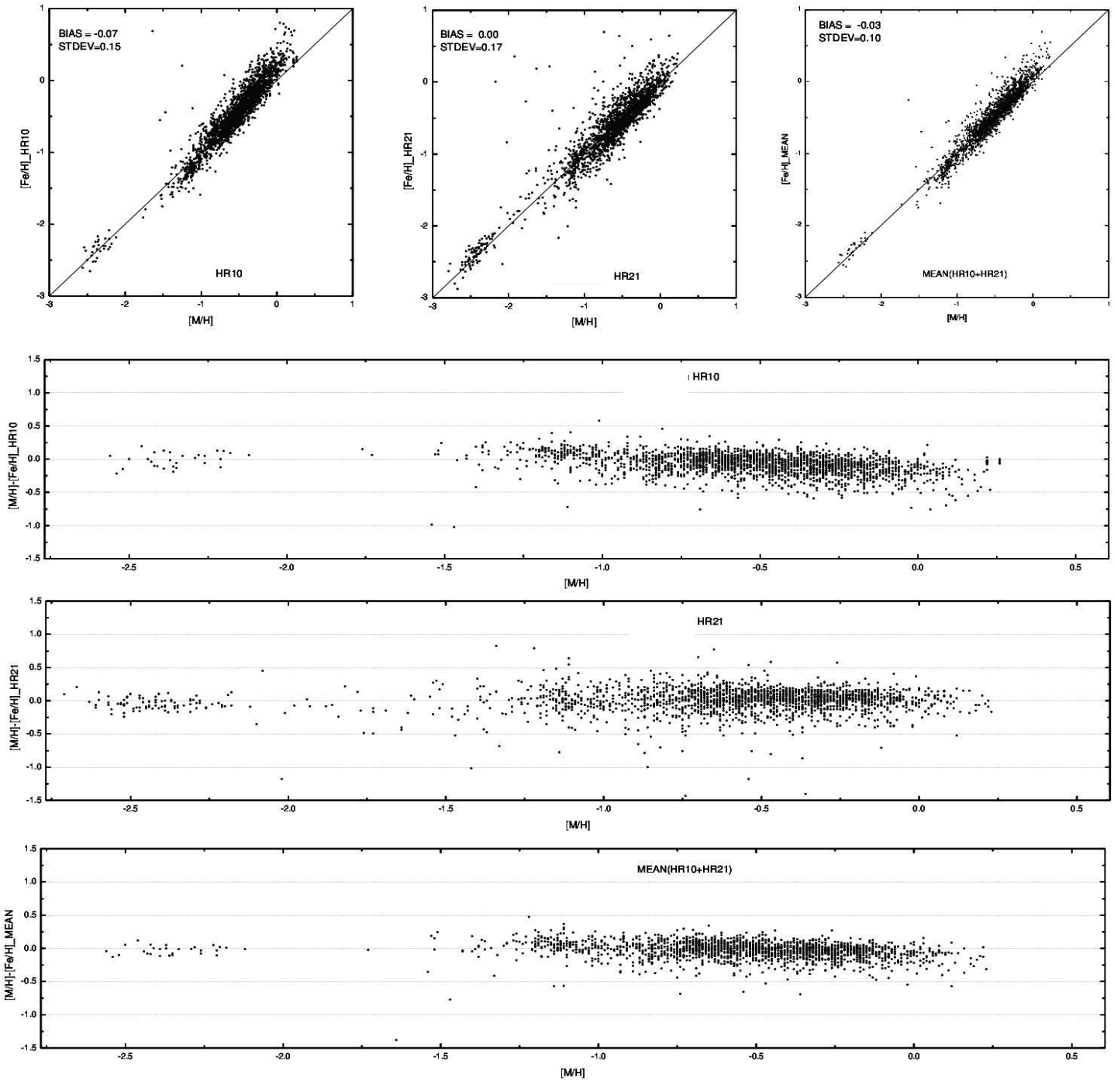
From the recommended atmospheric parameters for the stars observed in HR10+21 and HR10 only, the individual abundances of the following elements have been derived :

Stars with HR10 and HR21 spectra : Fe, Mg, Al, Si, Ca, Sc, Ti, V, Cr, Mn, Co, Ni, Y, Zr, Mo
Stars with HR10 only : Fe, Mg, Si, Ca, Ti, Ni, Y

Only the Nice and the LUMBA nodes have provided results for this analysis run. Nice has provided individual abundance measurements for both HR10+21 and HR10-only data, including globular clusters.
LUMBA has analysed the globular cluster stars observed in HR21+HR10. In the analysis run of March 2013, LUMBA had already provided individual abundances for stars observed in HR10+21 in agreement with their own determined atmospheric parameters. In the following, we keep the Nice results for the field stars as the recommended ones for DR1, because they are in agreement with the recommended atmospheric parameters.We also keep the Nice results for globular clusters stars, for homogeneity with the field.
We have also performed comparisons with the LUMBA results (the old results for the field and the new ones for the globular clusters), that are included in this report.

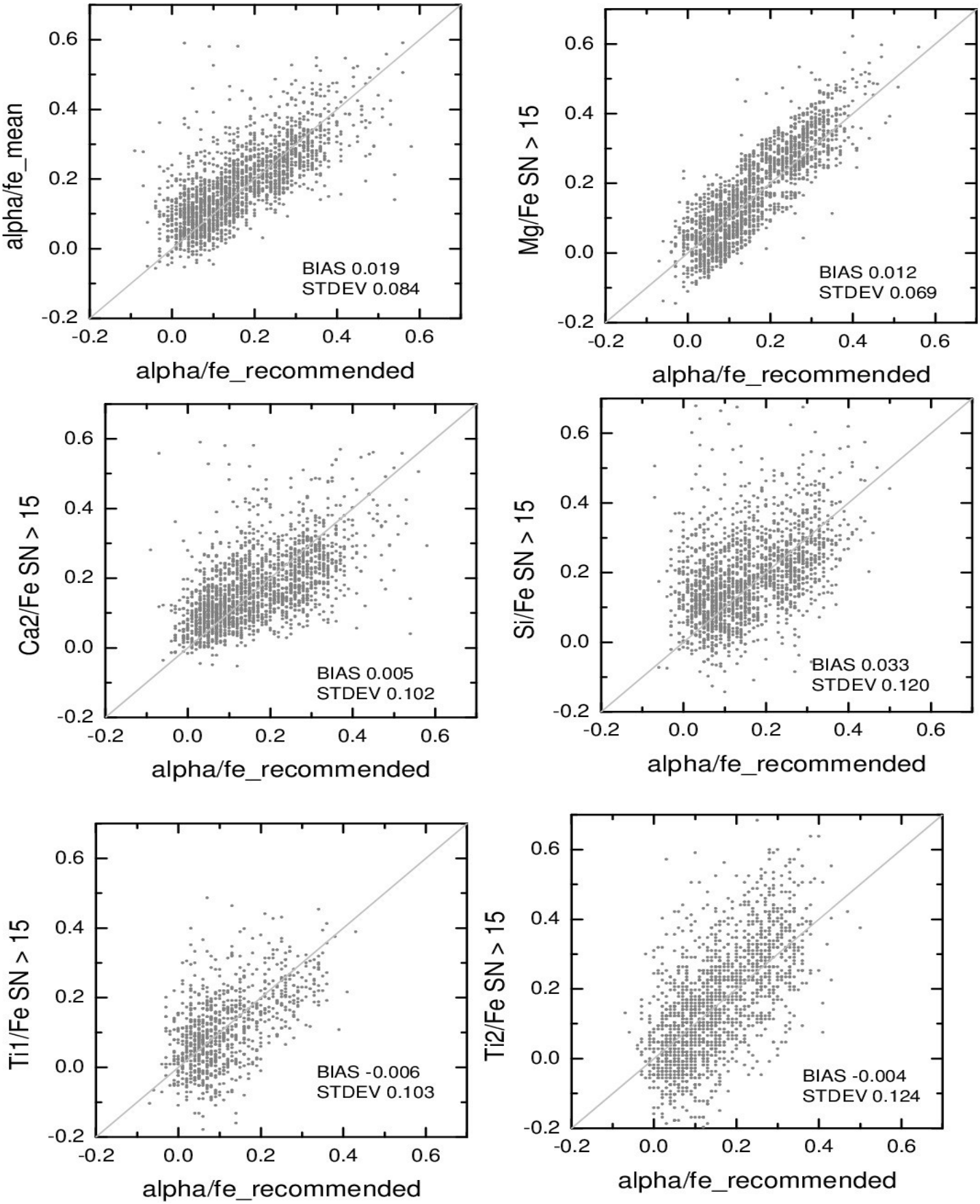
2.1. Comparison between the Iron abundance and the recommended [M/H].

The figure bellow shows the comparison of the recommended Fe abundances (from the Nice node) with the recommended values of the global metallicity. The standard deviation of the difference is 0.10 dex. For stars with only HR10 spectra, we warn from a possible bias for metal rich stars.



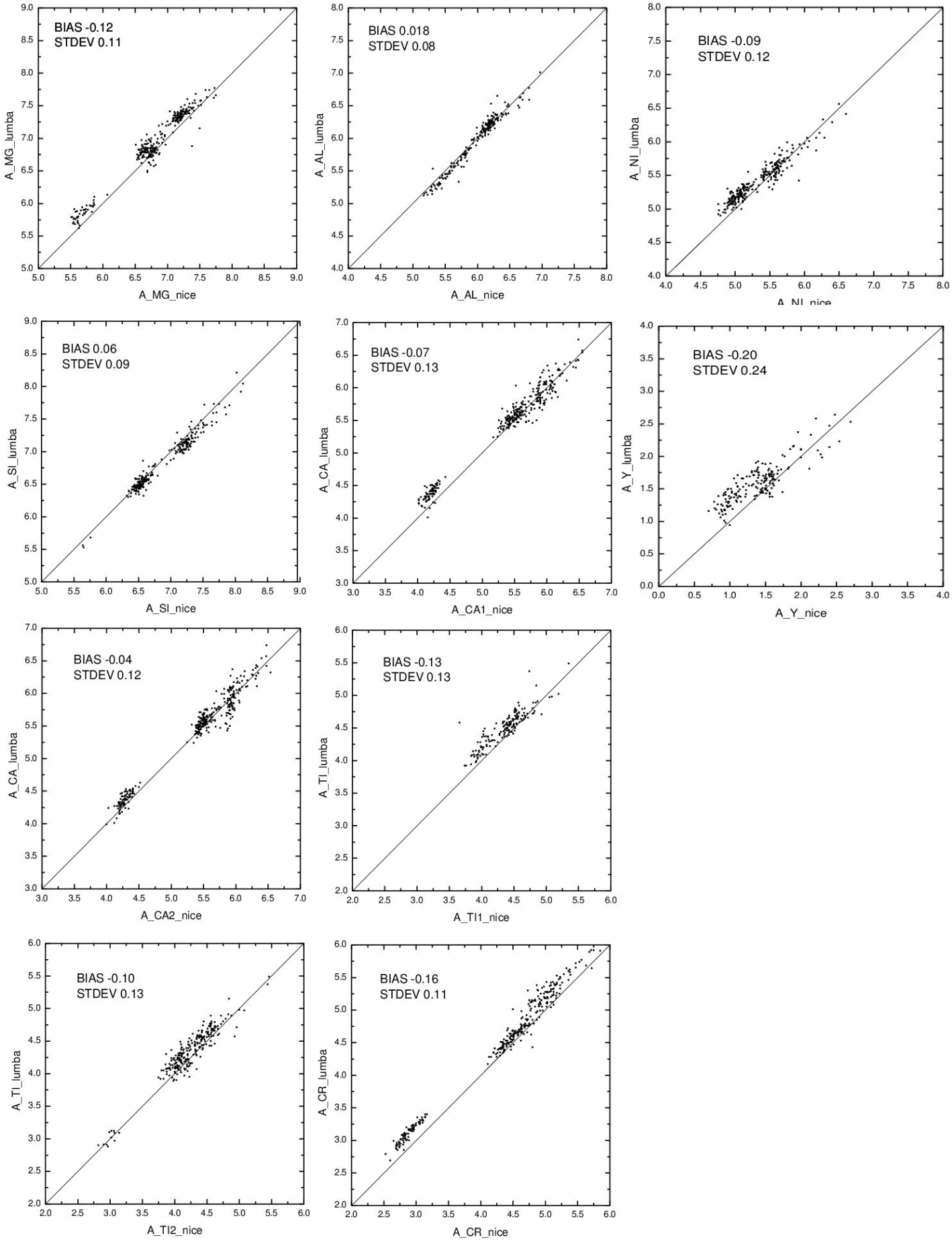
2.2. Comparison between the individual alpha-elements abundance and the recommended [alpha/Fe] values.

In order to check the consistency between the [alpha/Fe] recommended values and the new [X/Fe] recommended individual alpha-element measurements, we have compared them here bellow. The recommended [alpha/Fe] values, computed at the same time that the atmospheric parameters (run of March 2013), come for HR10+21 data from the IAC, LUMBA and Nice results; and for the HR10-only data from the IAC and Nice measurements. The corresponding bias and standard deviations are included in the figures.



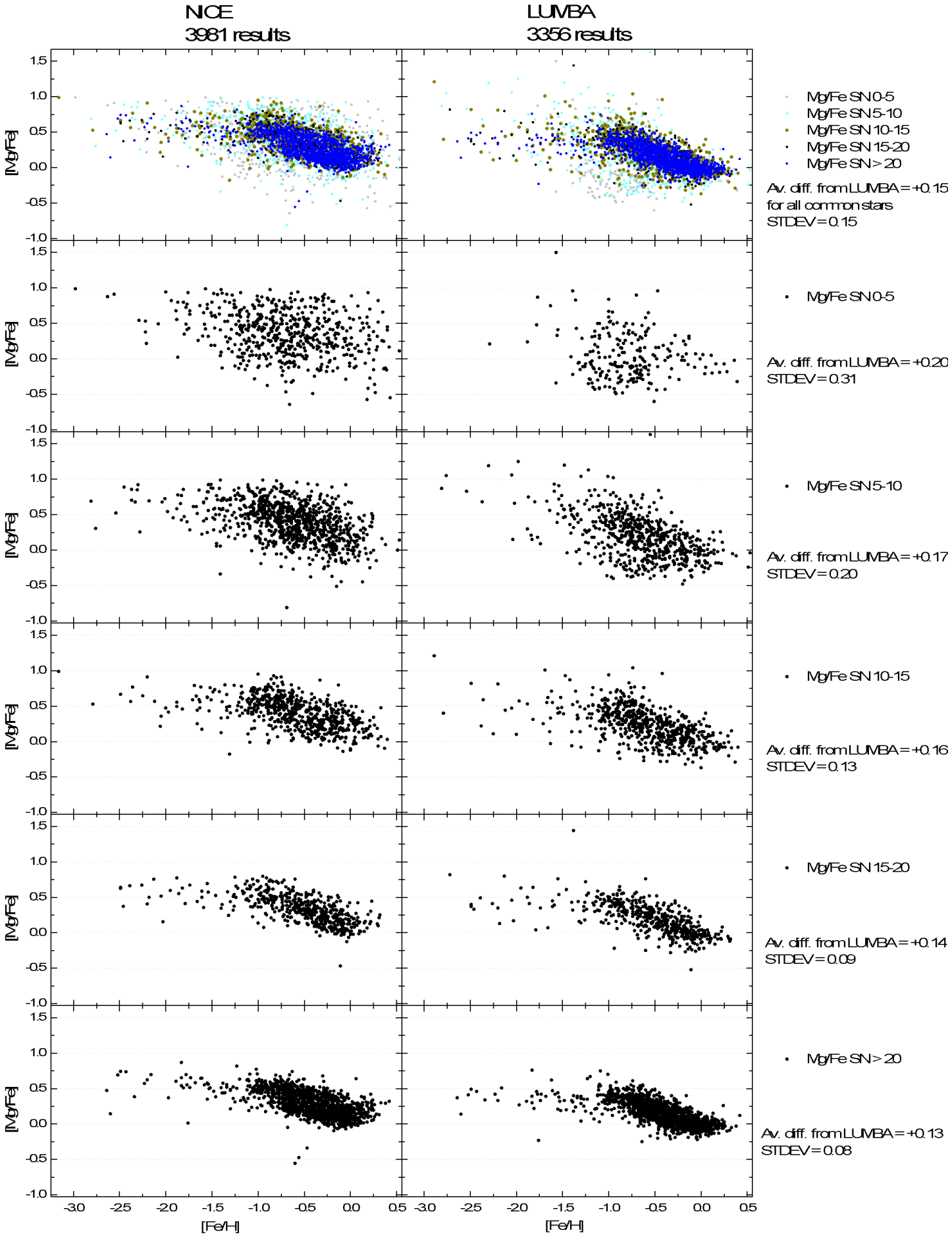
2.3. Comparison between the Nice and the LUMBA results for globular clusters stars.

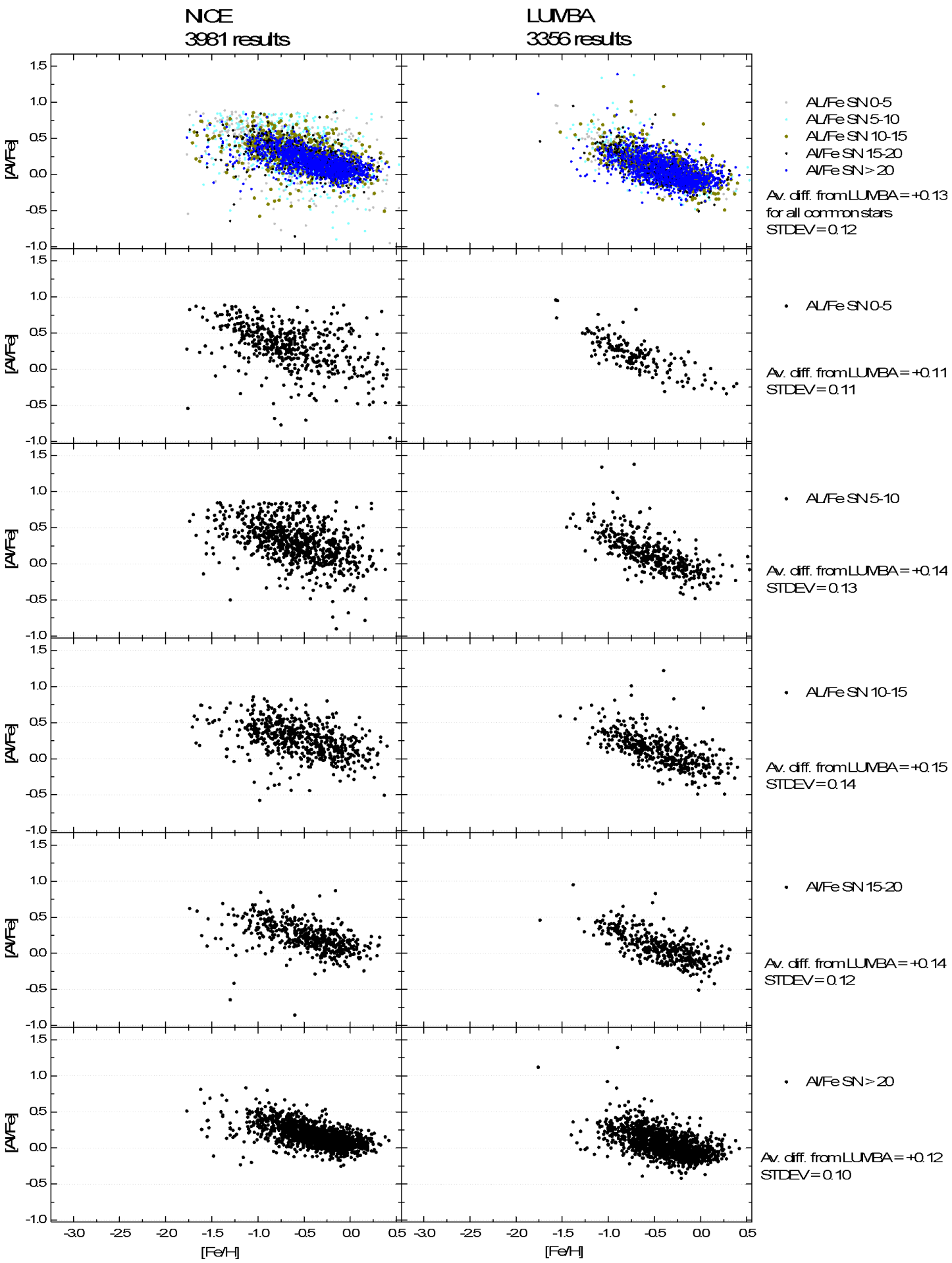
In this analysis run, both the LUMBA and the Nice nodes have provided results for the globular clusters, derived from the recommended atmospheric parameters for those clusters. The comparison between both results gives an indication of the errors associated to the methodology for globular cluster stars.



2.4. Comparison between the Nice and the LUMBA results for LUMBA atmospheric Parameters (field stars in HR10+21).

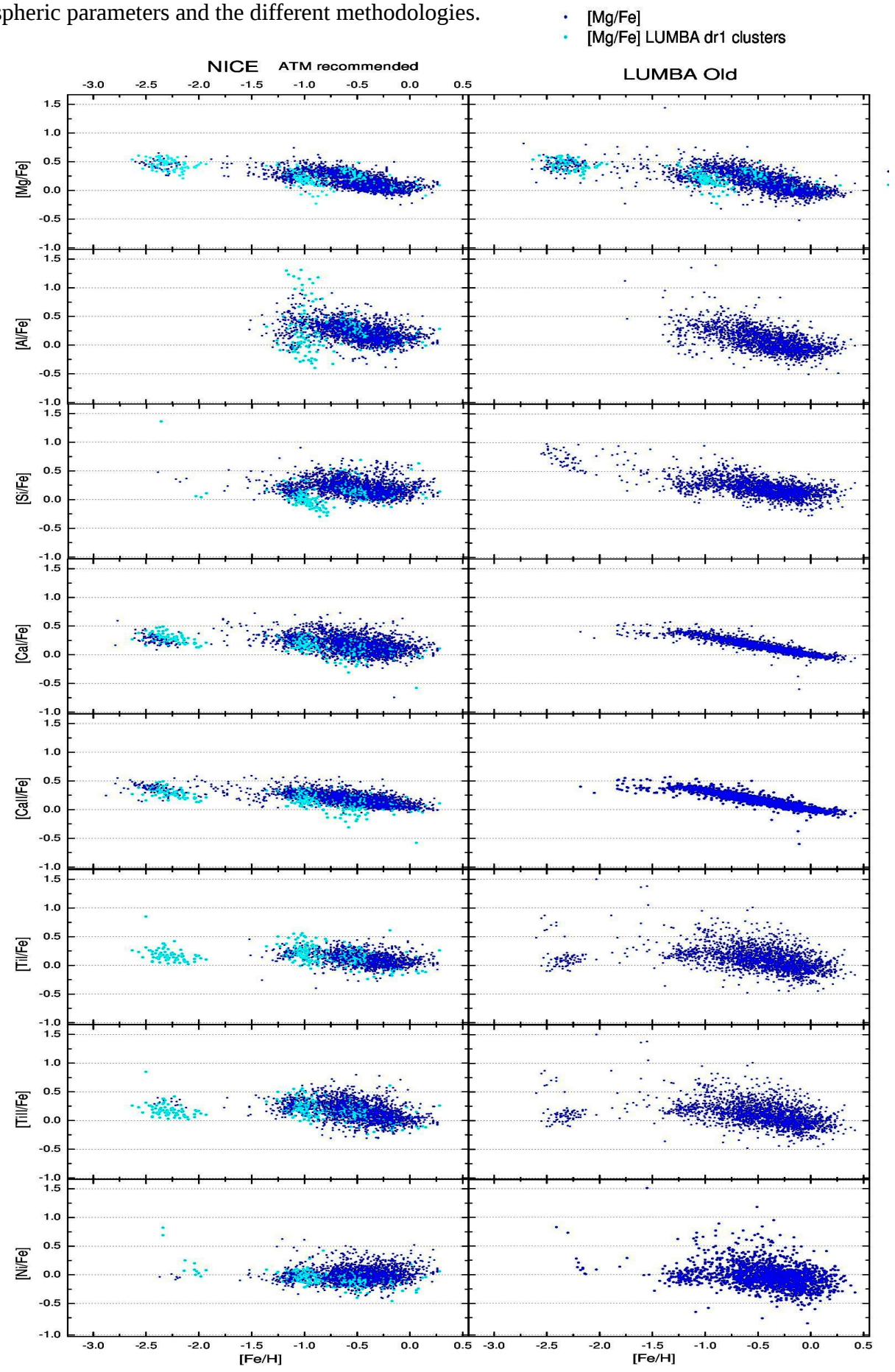
In order to extend the previous comparison, limited to globular cluster stars, and to have a better evaluation of the errors coming from different methodologies, Nice has computed the abundances of Mg and Al for field stars observed in HR10+21, considering the LUMBA atmospheric parameters (and not the recommended ones). The differences are shown in the following plots as a function of SNR.

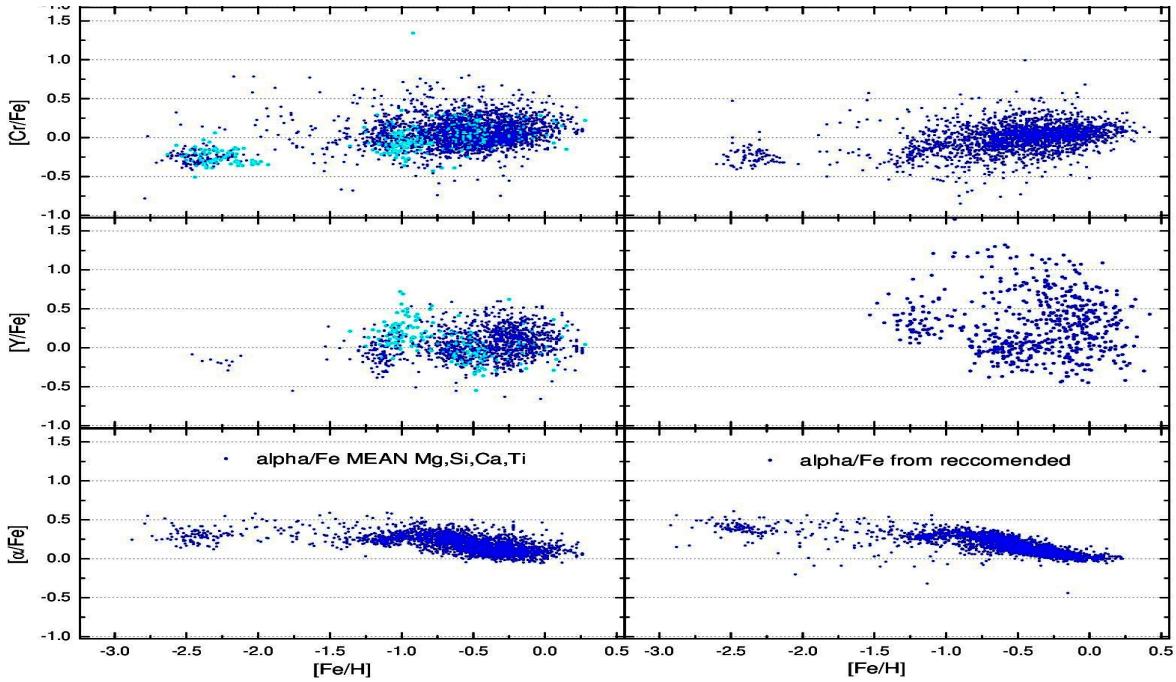



NICE
3981 results
LUMBA
3356 results
[Al/Fe]
[Fe/H]
Al/Fe SN 0-5
Al/Fe SN 5-10
Al/Fe SN 10-15
Al/Fe SN 15-20
Al/Fe SN > 20
Av. diff. from LUMBA = +0.13
for all common stars
STDEV = 0.12
Av. diff. from LUMBA = +0.11
STDEV = 0.11
Av. diff. from LUMBA = +0.14
STDEV = 0.13
Av. diff. from LUMBA = +0.15
STDEV = 0.14
Av. diff. from LUMBA = +0.14
STDEV = 0.12
Av. diff. from LUMBA = +0.12
STDEV = 0.10

2.6. Comparison between the Nice and the LUMBA results : differences in atmospheric parameters and methodology

We have also performed a comparison between the individual abundances derived by LUMBA for the analysis run of March (using their LUMBA atmospheric parameters) and those derived now by Nice with the recommended atmospheric parameters. This gives an idea of the differences due to the changes in the atmospheric parameters and the different methodologies.





3. Individual abundances for open cluster stars observed with HR15

The EPINARBO and Catania nodes provided individual abundance measurements for Fe, Ca and Li. The recommended individual abundances follow the decision taken for the atmospheric parameters for those stars:

Old open clusters stars: individual abundances from EPINARBO
Young open clusters stars: individual abundances form Catania