ing the dust contribution (Esteban et al. 1998), and (b) the $\Delta Y/\Delta Z$ value derived from the Galactic H II region M17, and the primordial helium abundance, Y_p obtained from metal-poor extragalactic H II regions (Peimbert, Luridiana, & Peimbert 2007). In Paper I, based on our GCE models and combined with the constraints available, we were not able to discriminate between the stellar evolution models assuming high wind yields for massive stars, HWY, and those assuming low wind yields for massive stars, LWY.

Previous works has focused on the test of stellar yields using GCE models constrained by chemical gradients obtained by different methods, gradients that in general show similar slopes but a considerable spread in the absolute O/H ratios, e.g., Prantzos, Vangioni-Flam, & Chauveau (1994); Carigi (1996); Chiappini, Matteucci, & Meynet (2003a); Romano et al. (2010). To test the stellar yields it is necessary to have good absolute abundance values of stars and H II regions. To determine the O/H abundances of H II regions in irregular and spiral galaxies many methods have been used in the literature. Most of them have been based on fitting photoionized models to observations or on the determination of the electron temperature, T, from the 4363/5007 [O III] ratio directly from observations. A comparison of many of the different methods used has been made by Kewley & Ellison (2008). They find that the O/H differences derived by different methods between two given H II regions amount to 0.10–0.15 dex. On the other hand for all the methods the absolute difference for a given H II region is considerably larger, reaching values of 0.7 dex for extreme cases (see Figure 2 in their paper and the associated discussion). Most of the differences among the various calibrations are due to the temperature distribution inside the nebulae. In this paper we will use only abundances of H II regions based on recombination lines of H, He, C, and O. These lines depend weakly on the electron temperature; they are roughly proportional to $1/T$, therefore the relative abundances among these four elements are practically independent of the electron temperature.

There are two frequently used methods to derive C and O gaseous abundances from H II regions: (a) the most popular one, based on collisionally excited lines (or forbidden lines) and the $T(4363/5007)$ temperatures (the FL method) and (b) the one based on C and O recombination lines (the RL method). The RL method produces gaseous O and C abundances higher by about 0.15 to 0.35 dex than the FL method. The RL method is almost independent of the electron temperature, while the FL method is strongly dependent on the electron temperature. It is possible to increase the FL abundances under the assumption of temperature inhomogeneities to reach agreement with the RL values. The temperature distribution can be characterized by the average temperature, T_0, and the mean square temperature variation, t^2 (e.g., Peimbert 1967; Peimbert, Peimbert, & Luridiana 2002). The t^2 values needed to reach agreement between the RL and the FL abundances are in the 0.02 to 0.05 range, while the photoionization models predict typically t^2 values in the 0.003 to 0.01 range. This discrepancy needs to be sorted out (e.g., Peimbert & Peimbert 2011, and references therein).

Paper I is controversial because the C/H and O/H gaseous abundances of the H II regions have been derived from recombination lines (that is equivalent to the use of $t^2 \neq 0.000$ and forbidden C and O lines) and the assumption that 20% of the O atoms and 25% of the C atoms are trapped in dust grains (0.08 dex and 0.10 dex respectively). These assumptions increase the O/H ratio by about 0.25 to 0.45 dex relative to the gaseous abundances derived from $T(4363/5007)$, the forbidden O and C lines, and the assumption that $t^2 = 0.00$.

Due to the controversial nature of the H II region abundances used in Paper I and noting that we were not able to discriminate between the two sets of stellar yields adopted, we decided to test our GCE models further by including additional observational constrains: (a) the Asplund et al. (2009) protosolar abundances that provide us with the O/H, C/H, Fe/H, and $\Delta Y/\Delta O$ in the interstellar medium 4.5 Gyr ago; (b) the C/H, O/H, and Fe/H by Bensby & Feltzing (2006) for young F and G stars of the solar vicinity; (c) the O/H, C/H, and He/H derived from B stars by Przybilla, Nieva, & Butler (2008); and (d) throughout this paper for all the H II regions we will use abundances derived from recombination lines, and to obtain the total abundances we will increase the gaseous abundances by 0.10 dex in C and 0.12 dex in O to take into account the fraction of atoms trapped in dust grains, except for the metal-poor irregular galaxies for which we will use an 0.10 dex depletion for O (Esteban et al. 1998; Mesa-Delgado et al. 2009; Peimbert & Peimbert 2010).

We also decided to compare our best models with the C/O versus O/H results derived by Esteban et al. (2002, 2009) from bright H II regions in nearby spiral galaxies based on recombination lines, and to make a preliminary discussion of a comparison between our models for $r = 3$ kpc and the stars in the direction of