INTRODUCTION

The study of preflare changes in the magnetic field and thermodynamic parameters of the photosphere in active regions is of great importance for the understanding of energy accumulation mechanisms and prerequisites for the occurrence of solar flares. The authors of [1, 2, 16] found that the spectral lines forming in the photosphere undergo changes in their shape, intensity, and asymmetry several hours prior to (and closer towards) a flare. The estimates showed that the temperature, density, and velocities in the lower photosphere were increased at the active region sites where flares later occurred [4]. Approximately half an hour before a flare, these parameters are increased significantly, and the temperature excess reaches 300 K. The authors of [9] discovered significant temperature changes in middle and upper photospheric layers occurring 30 min prior to a two-ribbon 2N/M2 flare on June 3, 1979. The observations of upward flows prior to flares were reported in [3, 8, 11, 21]. Rapid photospheric flows and changes in the magnetic field strength observed several hours prior to the onset of an X4 flare on November 26, 2000, are reported in [17]. The authors of [19] studied the changes in the photospheric magnetic field in two bright elements of the NOAA 10953 active region over a period of 12 h before a B1 microflare on April 29, 2007, using the Hinode/SOT-SP data. An increase in strength of the vertical magnetic field and angle of inclination of the magnetic field vector occurring approximately 2.5 h prior to the flare was revealed. Overall, the changes in the photospheric parameters occurring prior to flares are studied insufficiently.

The present work is aimed at analyzing the changes in the magnetic field and thermodynamic parameters in the photosphere of the NOAA 11484 active region before a weak flare on May 24, 2012, using the spectropolarimetric observation data.

OBSERVATIONAL MATERIAL

Spectropolarimetric observations of the active region were performed using the French–Italian THEMIS telescope at the Institute of Astrophysics on the Canary Islands (Tenerife Island, Spain). A weak C1 flare occurred approximately 1 h 50 min after the start of observations in the active region. Figure 1 shows the NOAA 11484 active region on May 24, 2012, and the position of the spectrograph slit.
The studied active region was located at the western edge of the Sun. The C1 flare occurred at 10$^{5}$24$^{m}$20$^{s}$ UT, reached its maximum at 11$^{9}$07$^{m}$ UT, and ended at 11$^{1}$26$^{m}$ UT (the flare coordinates were N11W67). Figure 2 shows the H$_{\alpha}$ image of the flare in the NOAA 11484 active region obtained at the Teide Observatory (Tenerife Island, Spain). Two bright plages within the spectrograph slit are labeled on the spectrogram shown in Fig. 3.

A time series of the spectra recorded in two spectral regions (H$_{\alpha}$ and $\lambda$ 630 nm) simultaneously was obtained. The parameters of spectral lines chosen for modeling (wavelengths, corresponding elements, excitation potentials of the lower level [18], and effective Lande-factors [19]) are presented in the table.

Five spectra of the best quality obtained at 8$^{5}$52$^{m}$, 8$^{5}$54$^{m}$, 8$^{5}$56$^{m}$30$^{s}$, 8$^{5}$58$^{m}$, and 9$^{5}$00$^{m}$ were selected. The Stokes profiles ($I$, $Q$, $U$, and $V$) of six lines of Fe, Ti and Cr with different intensities and magnetic sensitivities were obtained after processing. The Stokes $V$ and $U$ profiles of Fe I $\lambda$ 630.25 nm line obtained from observations are shown as an example in Fig. 4.

The time variation of the intensity $I$ profiles was marginal, and they are, thus, not shown here. The Stokes parameter $Q$ was negligible.

The $V$ profile amplitude reached its maximum at 08$^{5}$52$^{m}$ and was reduced later. The $U$ profile had the lowest amplitude at the first time point and differed in its shape from the profiles corresponding to other time points (see Fig. 4).

**MODELING AND RESULTS**

Semiempirical models of the photosphere were constructed through the inversion method using SIR (Stokes Inversion based on Response functions) code [20]. Local thermodynamic equilibrium was assumed in calculations. Each model has a two-component (a magnetic component and nonmagnetic environment) structure. The Harvard–Smithsonian model of a quiet photosphere was used to model the environment. The initial temperature in the magnetic element model was set to be equal to the temperature in the model of the environment, and the initial magnetic field value did not vary with height and equaled 0.1 T. The macroturbulent velocities and the filling factor (the fraction of the area occupied by the magnetic component) were assumed to be independent of the photospheric height. The initial macroturbulent velocity was set to be equal to 1.5 km/s (as in an unperturbed photosphere). The observed and calculated line profiles were matched with each other to achieve the best fit. Figure 5 shows the examples of this profile matching for Fe $\lambda\lambda$ 630.15 and 630.25 nm lines of the first plage at the first time point (08$^{5}$54$^{m}$).

Height distributions of temperature, pressure, magnetic field strength, angle of inclination of the magnetic field vector, and line-of-sight velocity were obtained after modeling. A total of nine models for two bright sites in the active region were obtained. The flare occurred at these sites in approximately 1 h 50 min. The fraction of areal of the magnetic component of the models equaled approximately 55%. The obtained models of the magnetic component showed that all thermodynamic parameters and characteristics of the magnetic field prior to the flare differed significantly from the corresponding values in the models of a quiet (with no flares) plage [7] and an unperturbed photosphere. It can be seen from Fig. 6 that height distributions of temperature in the magnetic component of all models were nonmonotonic. These distributions exhibit layers with increased and lowered temperature values.

The dependences of temperature on height in the model of the magnetic component of the first plage obtained at 08$^{5}$54$^{m}$, 08$^{5}$56$^{m}$, and 09$^{9}$00$^{m}$ (1 h 48 min before and closer to the flare) differ significantly from...