4 Selection and Treatment of Special Handling Sources (DG, DSM)

The radio sources observed were, in most cases, distant compact quasars or other active galactic nuclei. The positions of most of the sources were treated as global parameters in the least-squares solutions. This means that all the observations of each source in all the sessions were combined to estimate a single average position. For these global sources, the amount of data varied from as little as 3 observations in one session, to as many as ∼337300 observations in 4068 sessions (source 0552+398, which was observed in 89.6% of the sessions).

Studies of source positional stability were carried out by running solutions which generated time series of the source positions, i.e., a separate position for each observing session. Various statistics of the Right Ascension (RA) and declination of the sources were examined, such as weighted root-mean-square (wrms) variations about the mean, χ^2 per-degree-of-freedom, smoothed 2-year slopes, and other statistics. Some of these statistics were later used to identify the most stable sources—discussed later in this report. Smoothed and un-smoothed time series plots were also studied. One goal was to identify sources so unstable as to require special handling. Special handling sources were to be treated as arc parameters, with their positions estimated once for each session. A further goal was to keep this list as small as possible. Some 39 sources were selected for special handling. Most of these are sources that were observed in many sessions and which show significant positional instability in either RA and/or Declination. Some of these are strong sources that have been observed sparingly in recent years because of known adverse source structure effects on geodetic solutions (such as 3C84, 3C273B, 3C279, 3C345, and 3C454.3). A few are sources that have not been observed heavily, but still show convincing systematic position variations. Estimating the positions of these problem sources globally would yield grossly underestimated position uncertainties and could possibly distort the overall reference frame. Therefore they were treated as arc parameters. The positions given for them in the catalogs are the weighted means of their time series positions and the uncertainties are the wrms positions about the weighted means. Seven of these special handling sources were original ICRF1 defining sources (0014+813, 0235+164, 0637−752, 0738+313, 1308+326, 1448+762, and 2145+067). The 39 special handling sources are:
0014+813, 0106+013, 0202+149, 0208−512, 0212+735, 0235+164, 0238−084 (NGC1052), 0316+413 (3C84), 0430+052 (3C120), 0438−436, 0451−282, 0528+134, 0607−157, 0637−752, 0711+356, 0738+313, 0919−260, 0923+392 (4C39.25), 0953+254 (OK290), 1021−006, 1044+719, 1226+023 (3C273B), 1253−055 (3C279), 1308+326, 1404+286 (OQ208), 1448+762, 1458+718 (3C309.1), 1611+343, 1610−771, 1641+399 (3C345), 1739+522, 2121+053, 2128−123, 2134+004, 2145+067, 2201+315, 2234+282, 2243−123, and 2251+158 (3C454.3).
Time series plots of these 39 special handling sources are shown in Figure 1 to Figure 10. The plotted points are 45-day averages.

It should not be assumed that there are only 39 unstable sources among the ∼3400 available sources. The vast majority of the sources have not been observed with the frequency necessary to detect the type of small systematic position variations seen, for example, in sources like 0014+813, 0235+164, 0528+134, or 1044+719. Many other sources showed smaller position variations, but at a level that did not cause concern.

There were also many sources that were excluded from the solutions for various reasons. Included in this category were three known gravita-

tional lenses and six known radio stars. The gravitational lenses present analysis problems in assigning a single position and the radio stars were too weak to be used. Also excluded from the solution were 795 sources which had either zero or only one or two good group delay observations. A reliable position cannot be determined from only one or two observations. Most of these were sources either too weak or too spatially extended to be detected in the VCS sessions.

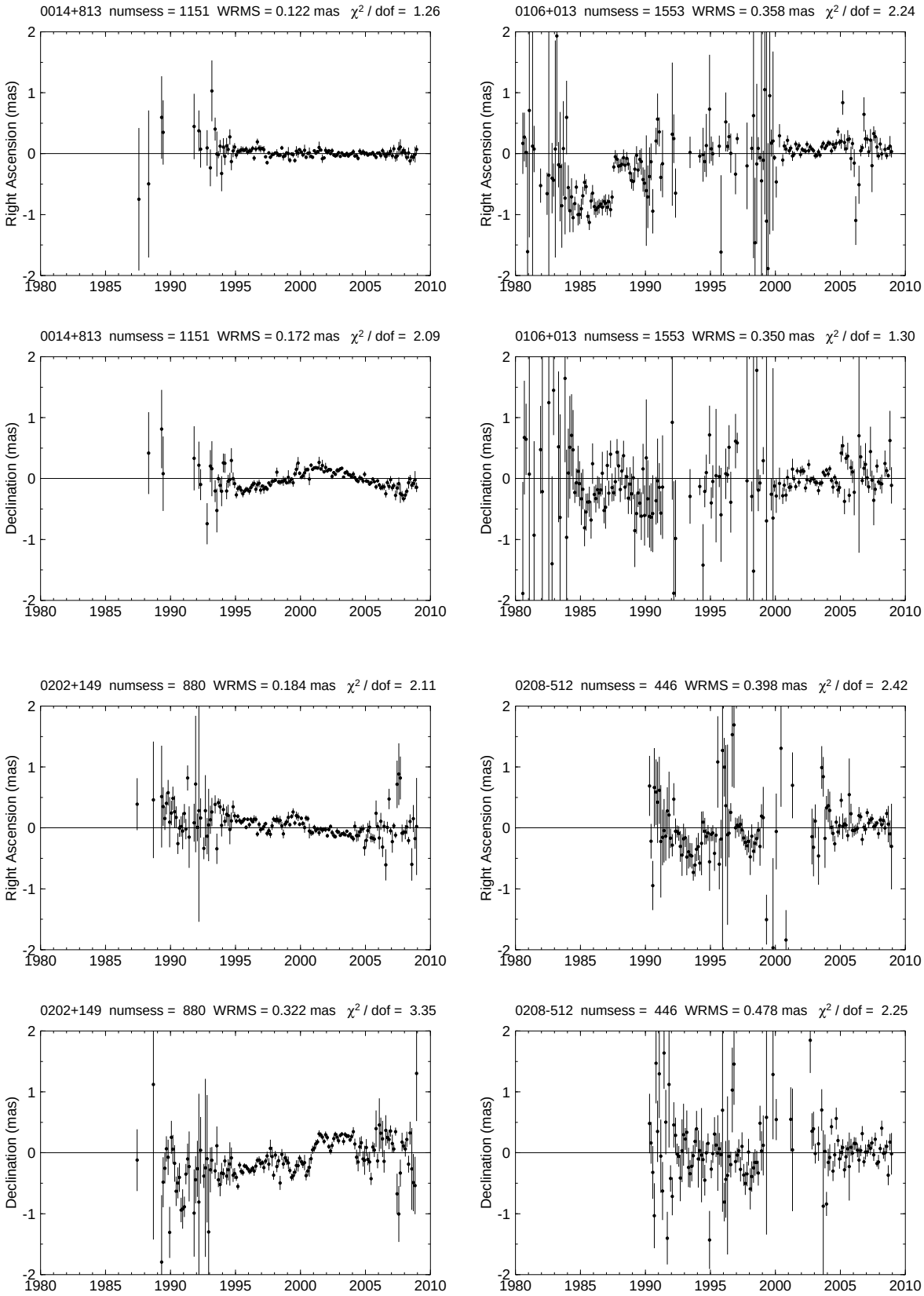

Figure 1: Time series plots of the 39 special handling sources.

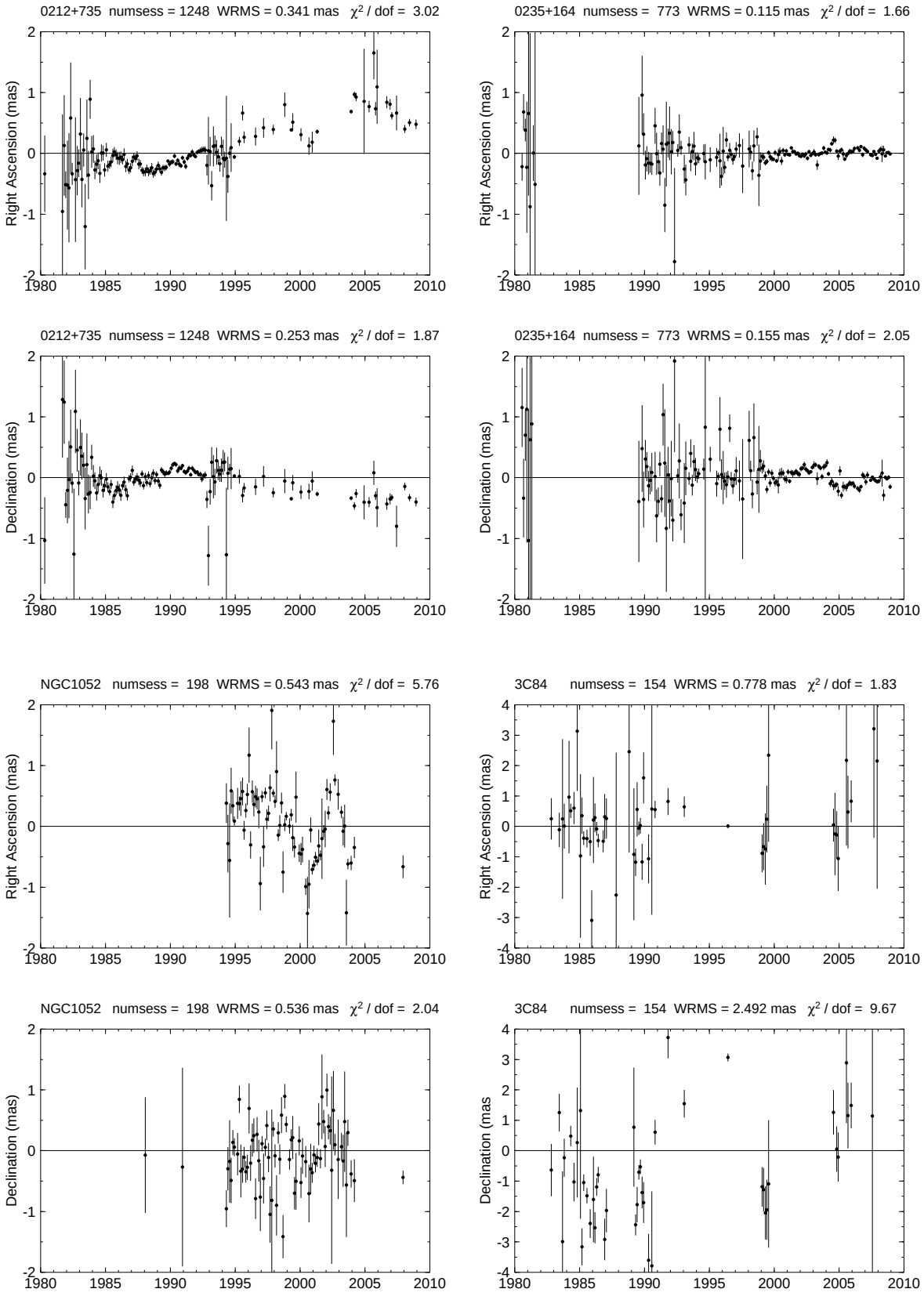

Figure 2: Time series plots of the 39 special handling sources – continued.

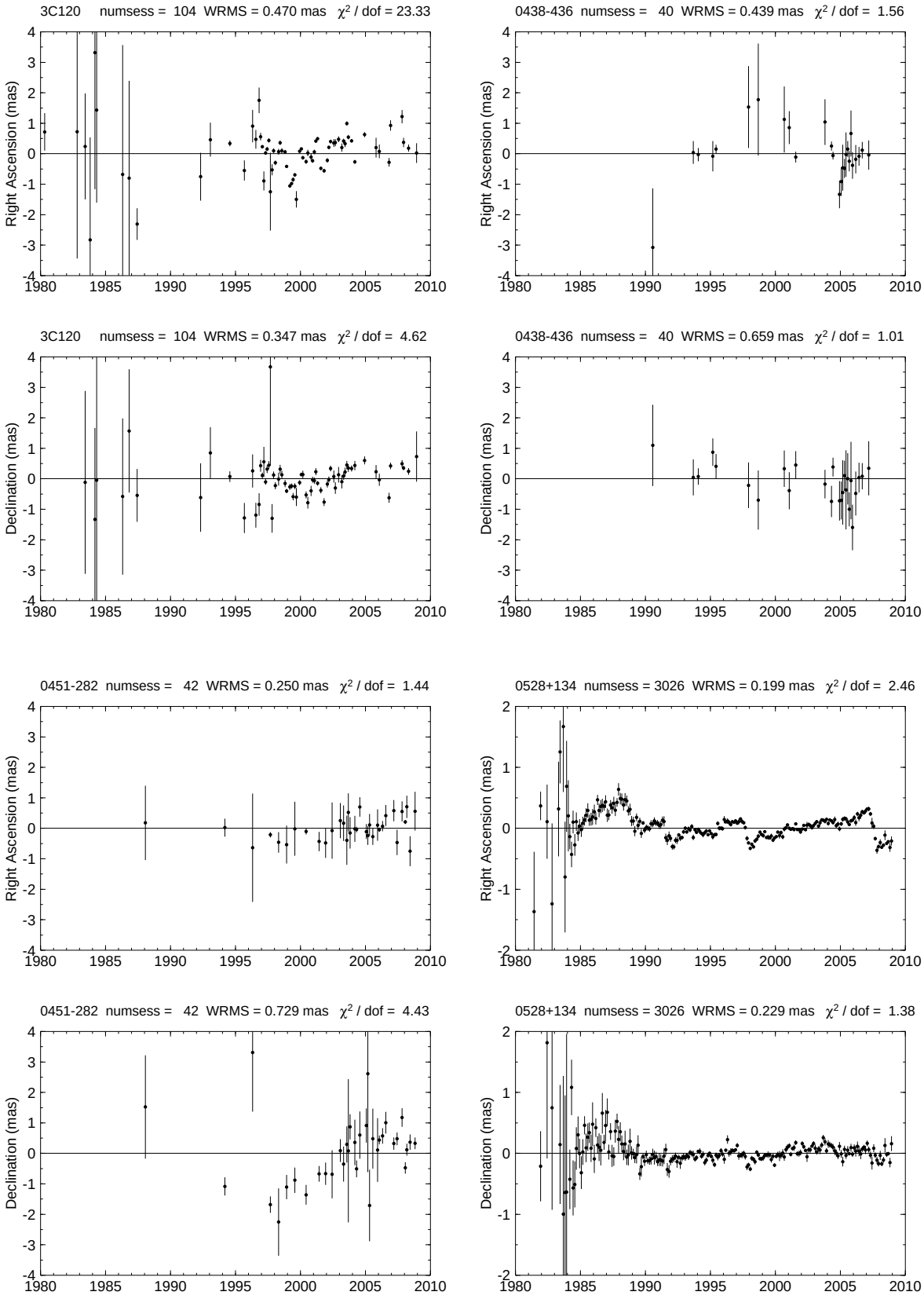

Figure 3: Time series plots of the 39 special handling sources – continued.

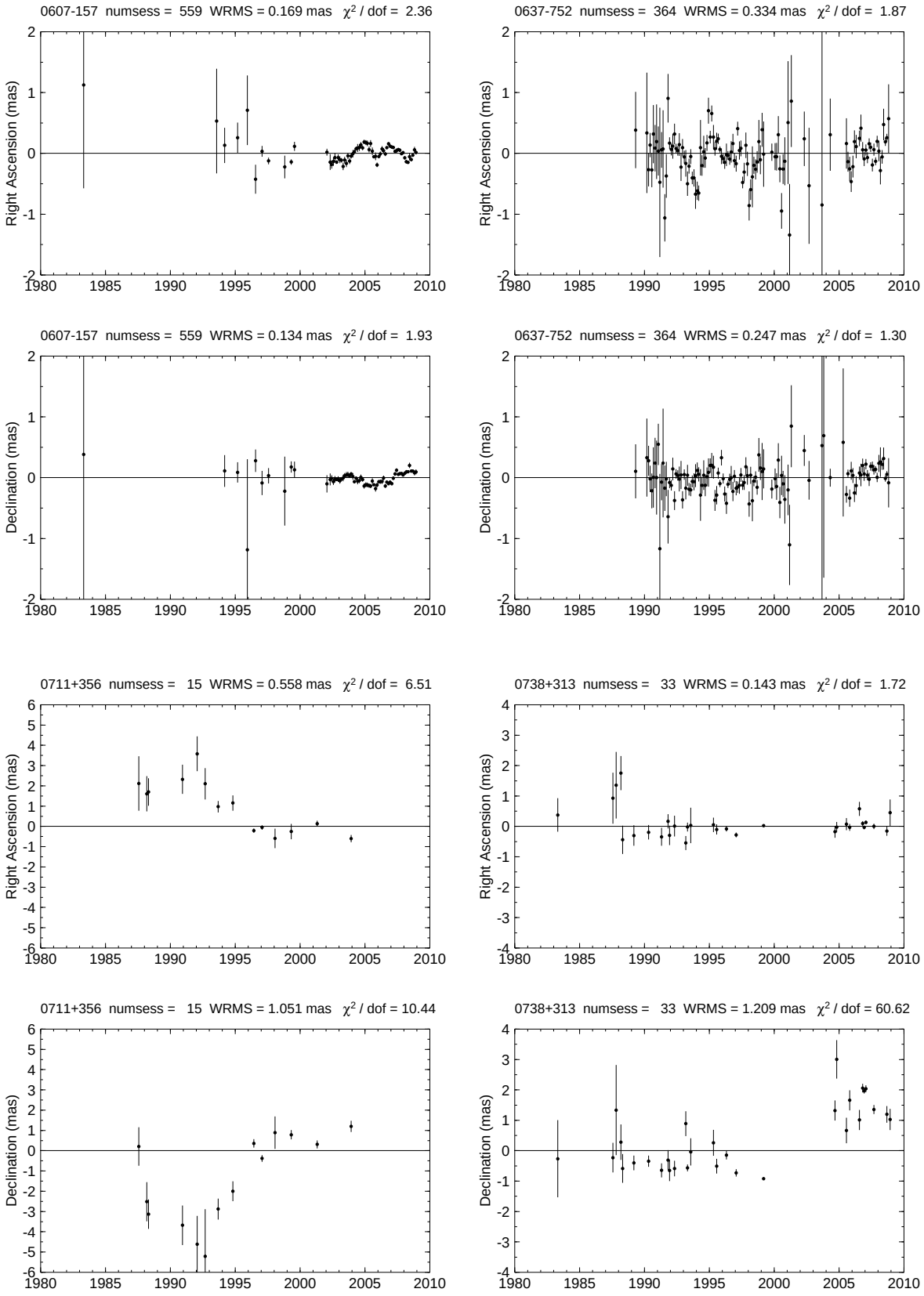

Figure 4: Time series plots of the 39 special handling sources – continued.

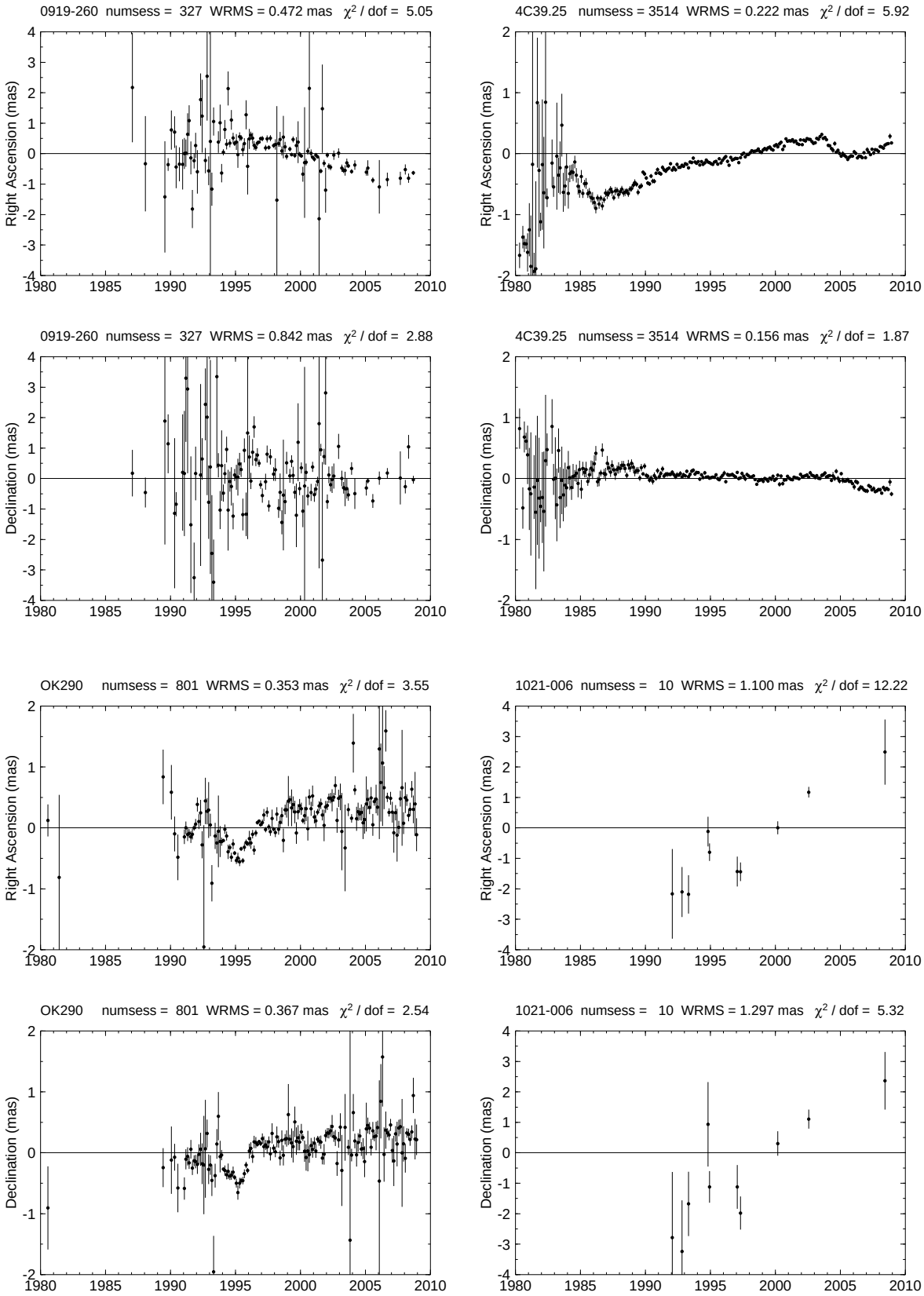

Figure 5: Time series plots of the 39 special handling sources – continued.

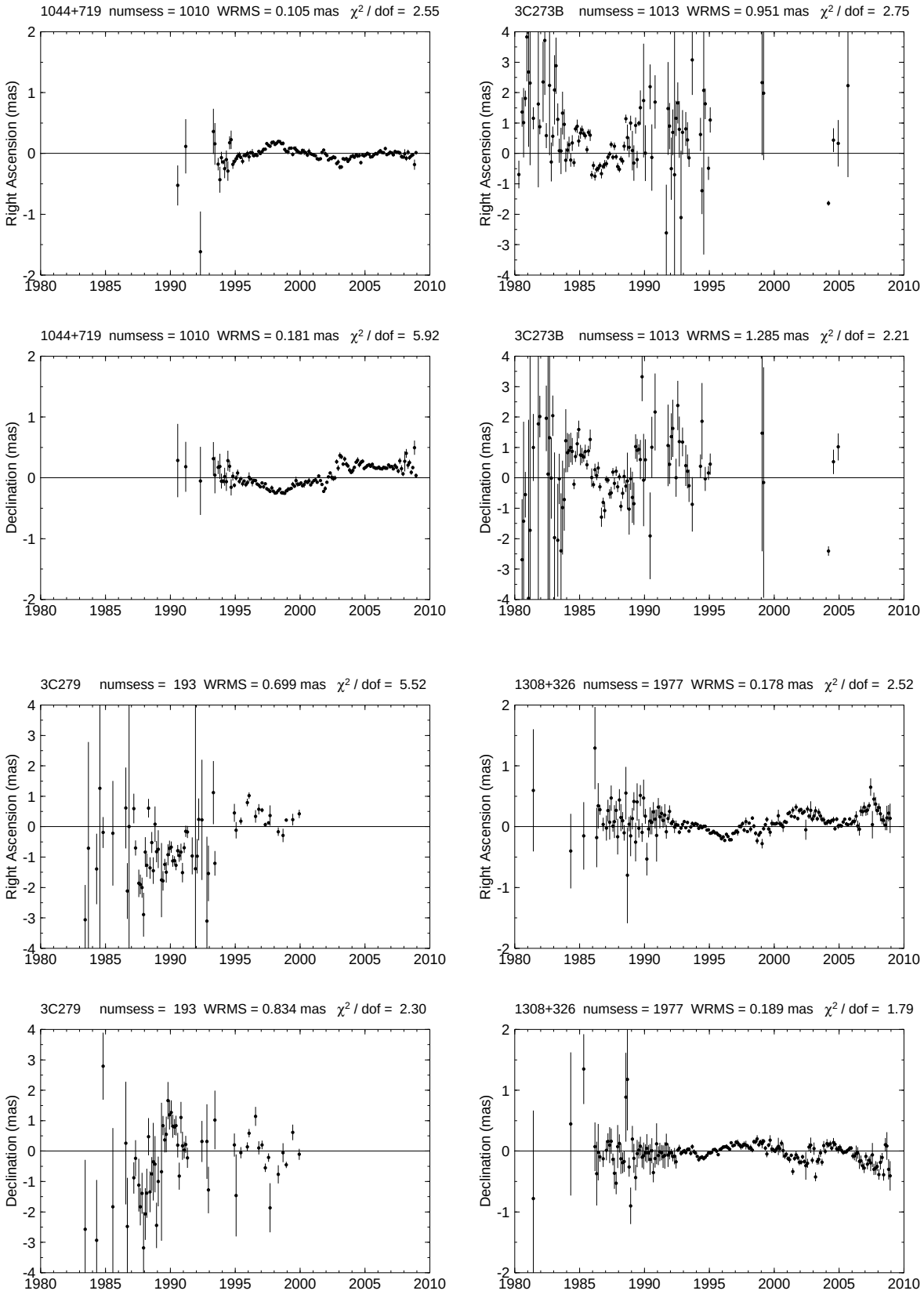

Figure 6: Time series plots of the 39 special handling sources – continued.

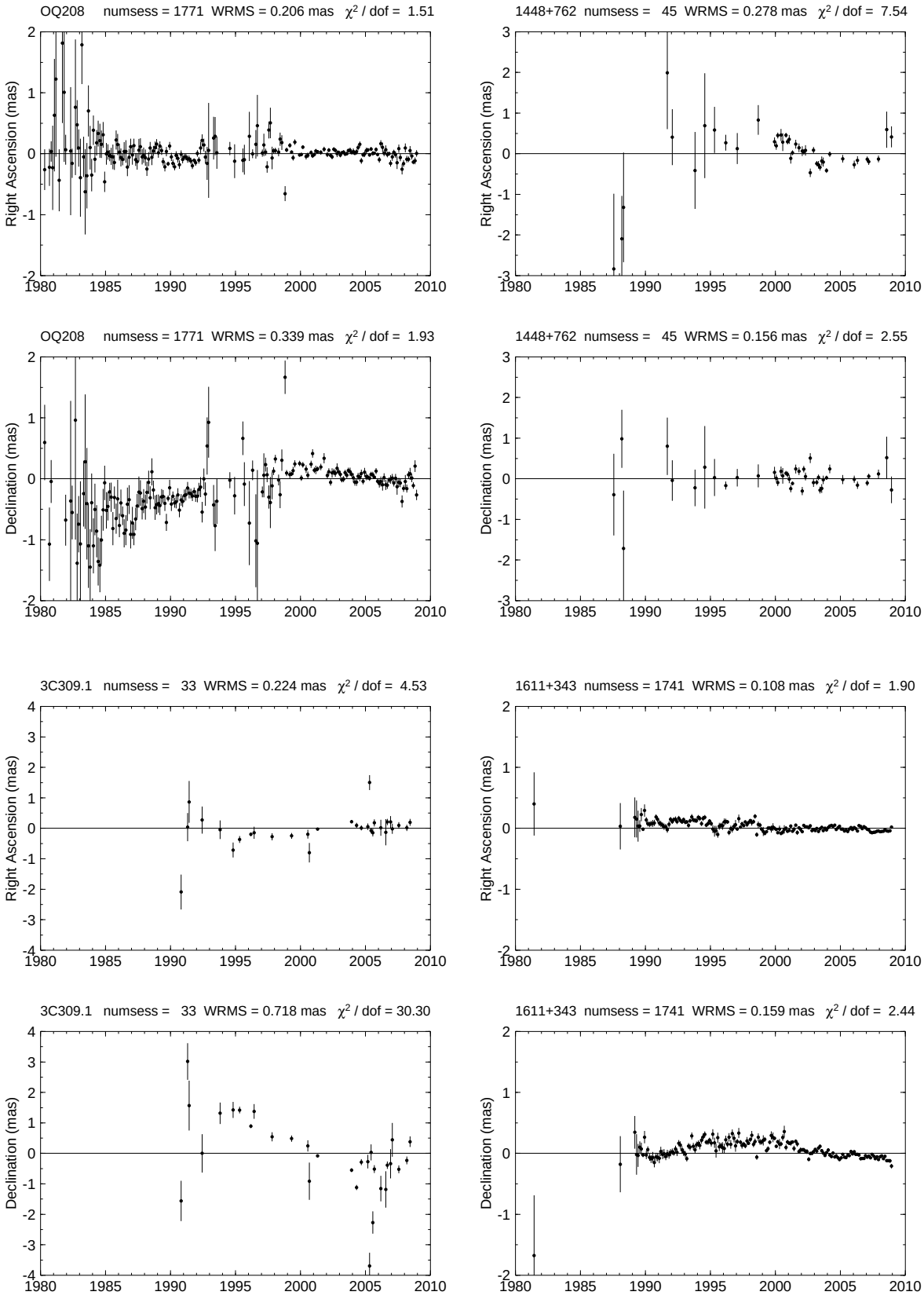

Figure 7: Time series plots of the 39 special handling sources – continued.

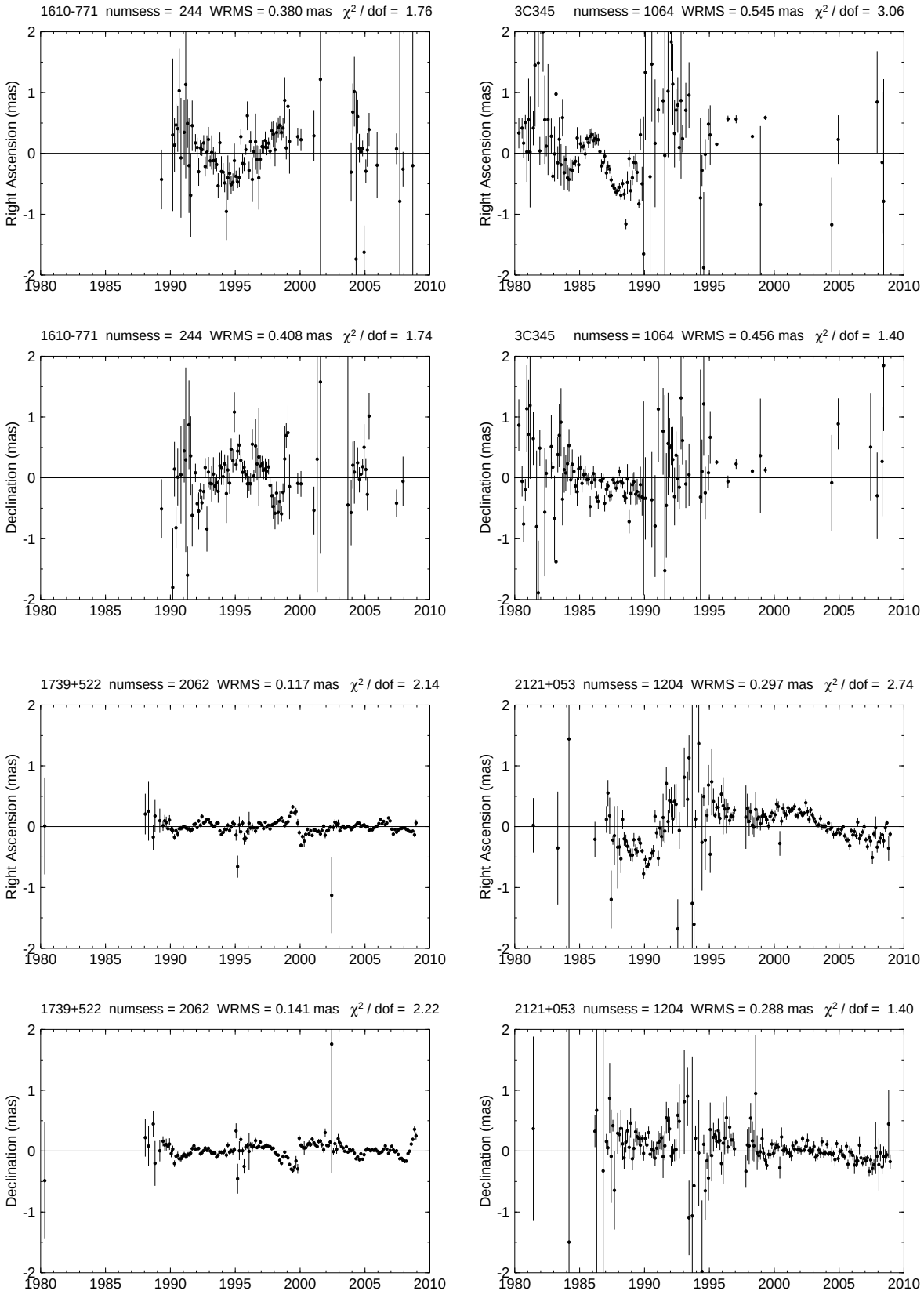

Figure 8: Time series plots of the 39 special handling sources – continued.

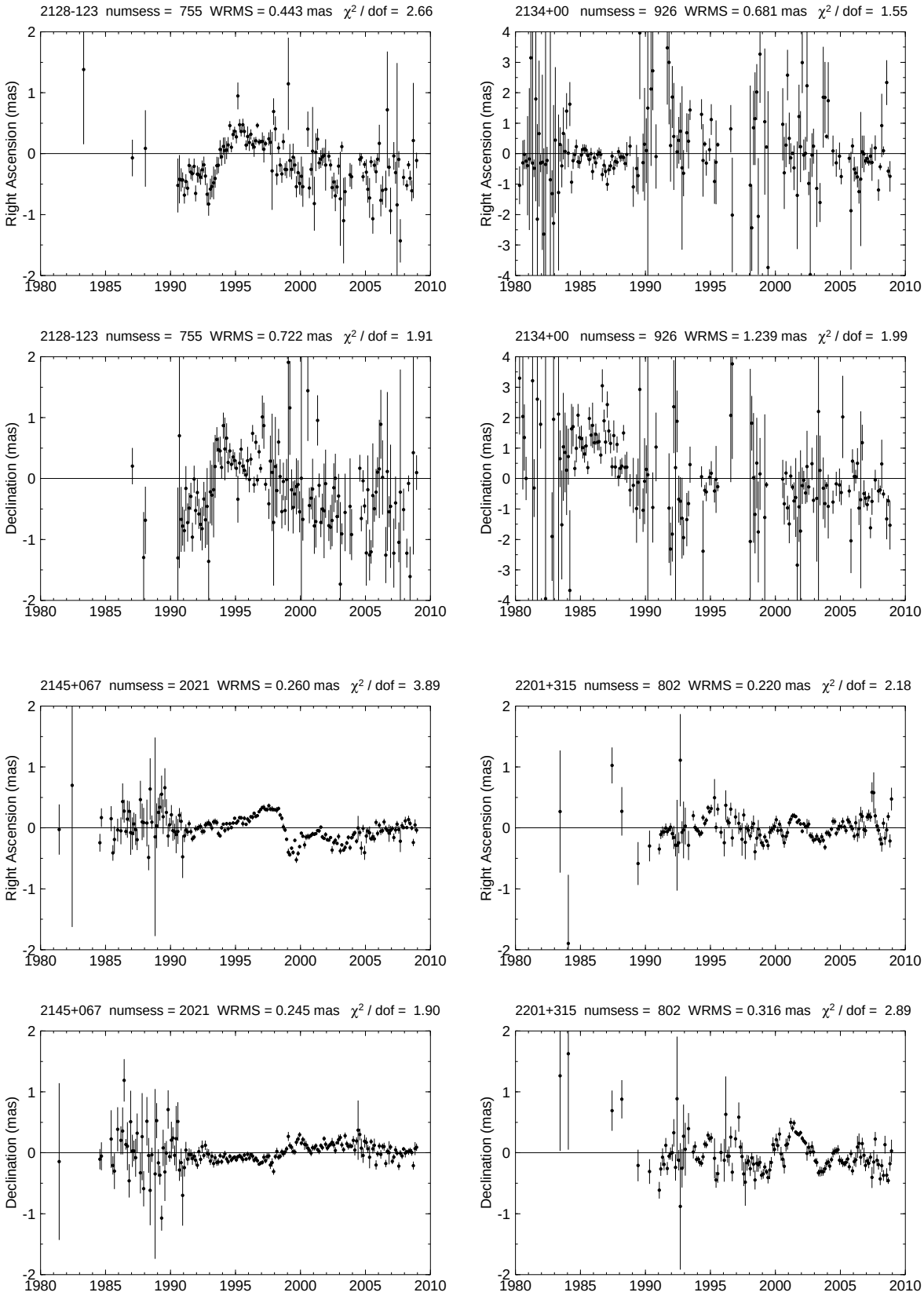

Figure 9: Time series plots of the 39 special handling sources – continued.

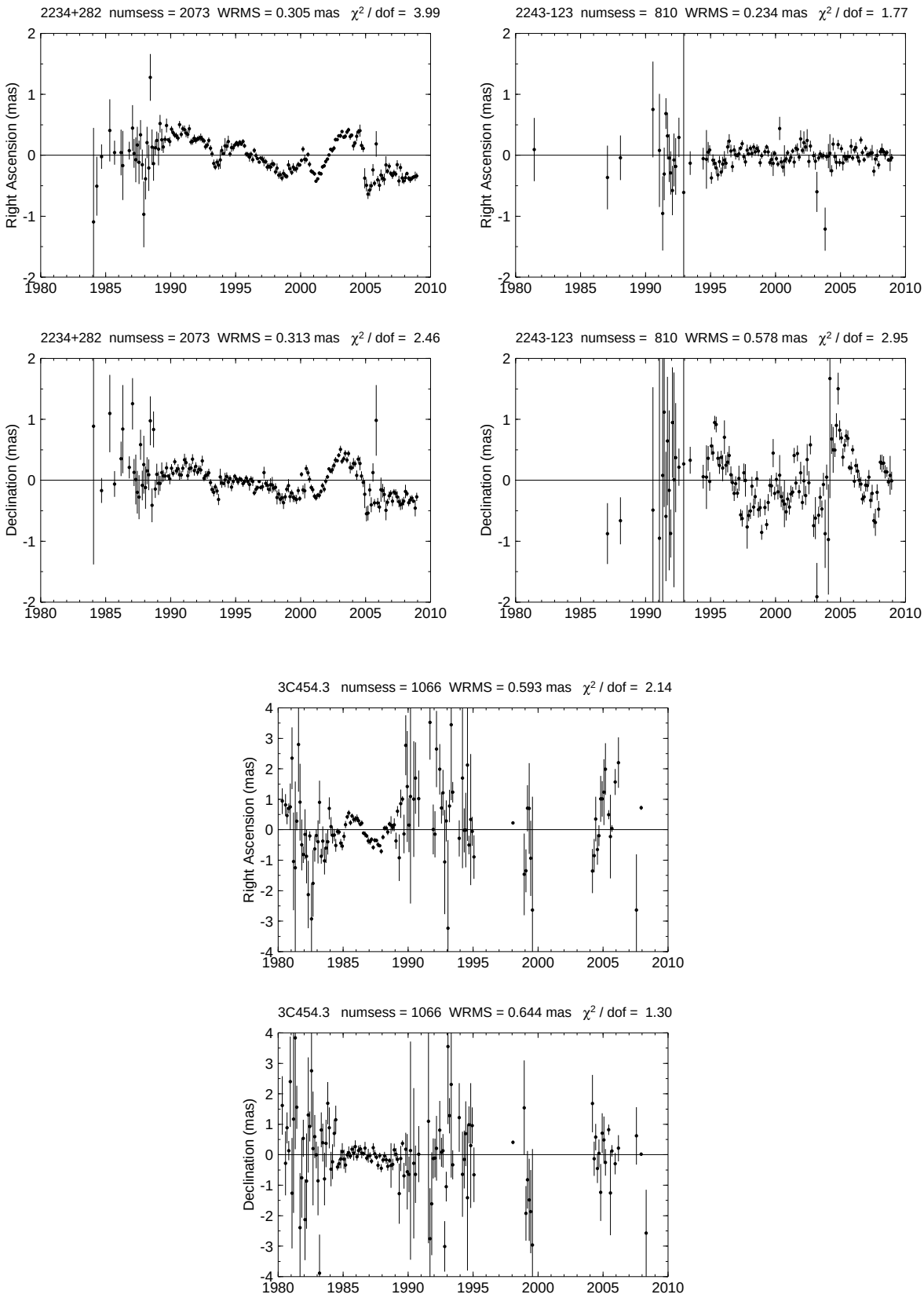

Figure 10: Time series plots of the 39 special handling sources – continued.