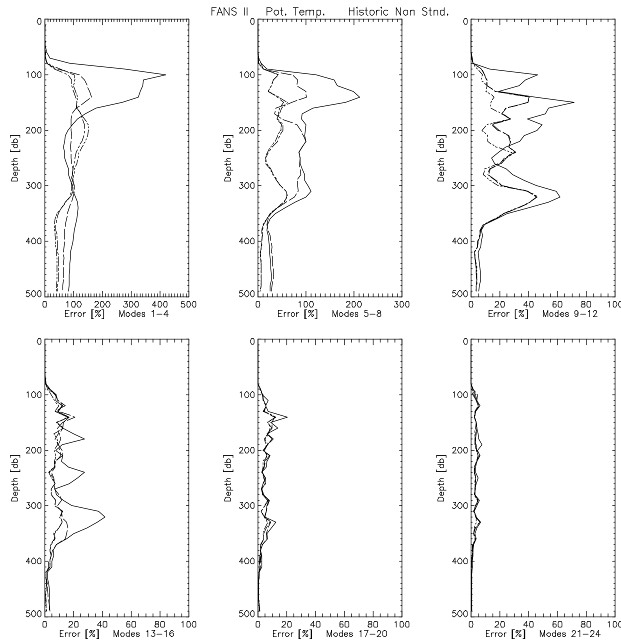
6.5.3 FANS II – Historic Winter Eigenvectors

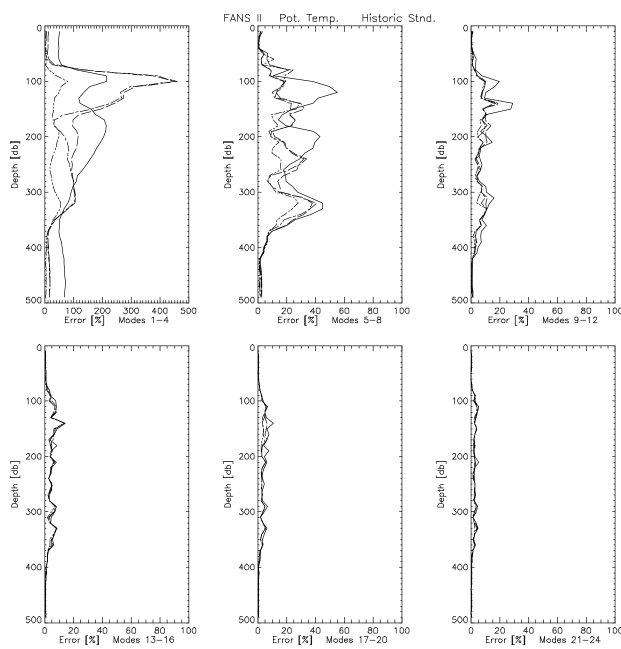
The potential temperature profiles of FANS II obtained from the non-standardized winter eigenvectors, have very small errors in the upper 60 m even with the first mode (Figure 6-87, frame a). This is by no means true for deeper waters, to the point that at intermediate levels errors below 100 % are not reached until the fifth mode is considered (below 400 m the convergence is faster). As expected, the standardized analysis (frame b), does not converge so fast towrads the data in the upper layer, but so it does in the lower 100 m. The overall error profiles seem slightly better from the inclusion of the fourth mode onwards.

The contour plots at 10 m (Figure 6-88) reflect the above situation. The non-standardized analysis with six modes has a low error value [2%], which decreases even further as more modes are considered. The standardized contour fields are not as good; with six modes the field does not resemble the data, but additional modes improve the fit [from 6.3% with 12 modes to 3.8% with 24].

The contours at 100 m (Figure 6-89) from the non-standardized analysis, tend to converge towards actual data as more modes are considered, with error values of 12% with 12 modes, down to less than 1% with 24 modes. In the standardized analysis, the largest difference with respect to data takes place with 12 modes [20%], then decreasing to 3.7% (18 modes) and 2% (24 modes).



(a)



(b)

Figure 6-87 FANS II potential temperature error profiles for the non-standardized (a) and standardized (b) analyses, considering the addition of successive modes, from 1 to 24.

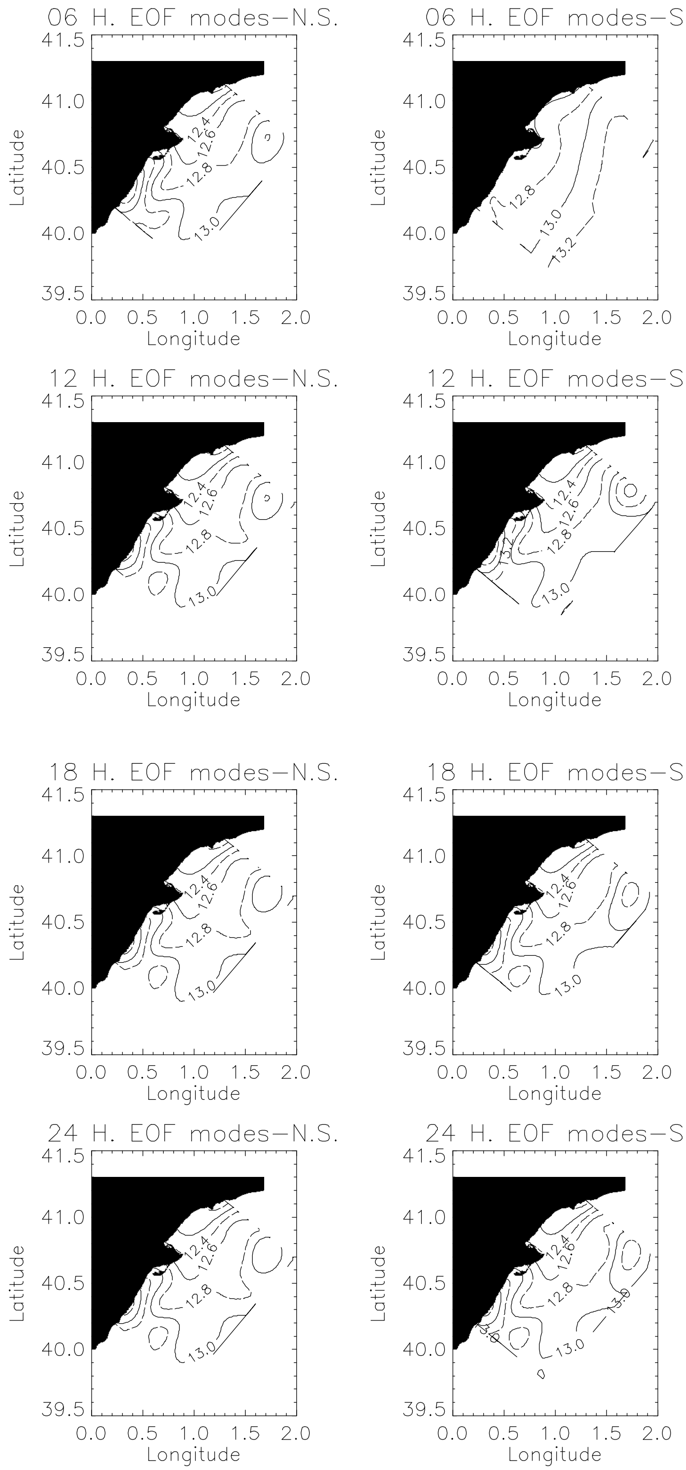


Figure 6-88 FANS II potential temperature contours at 10 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.

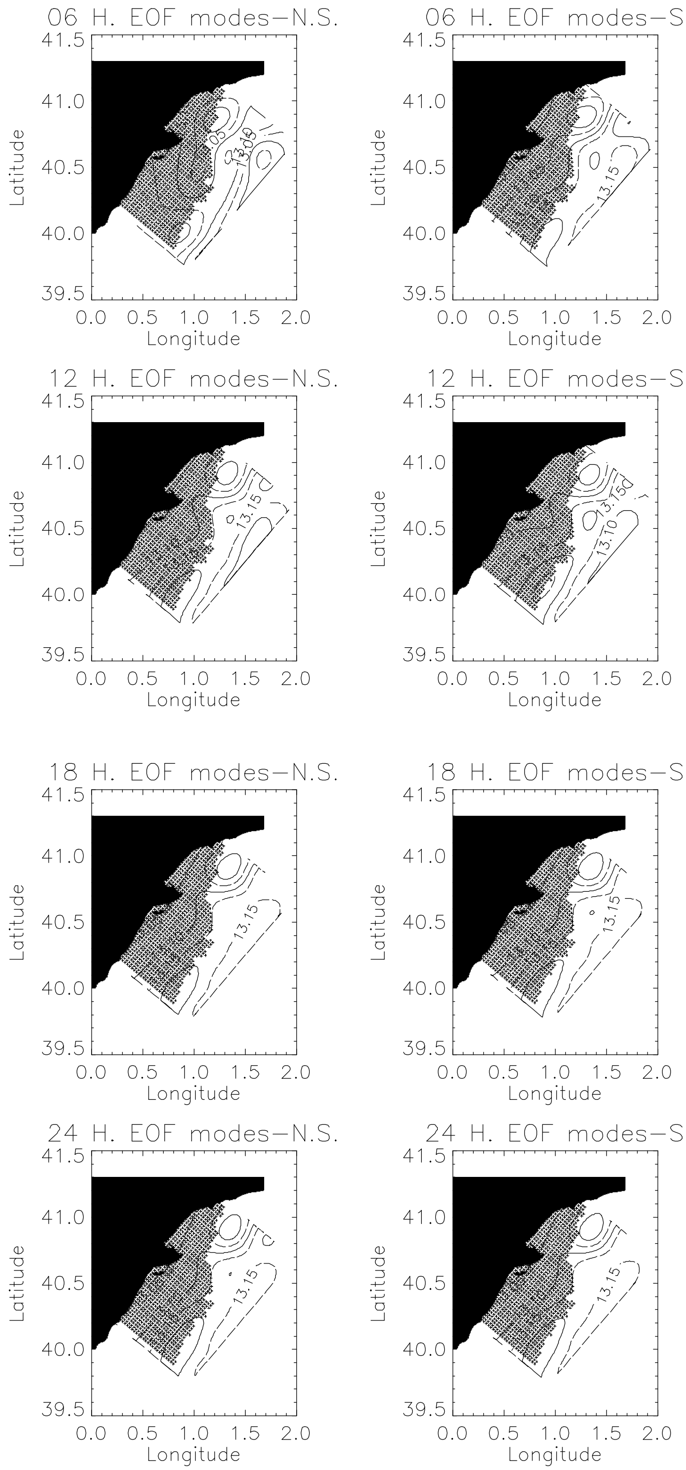
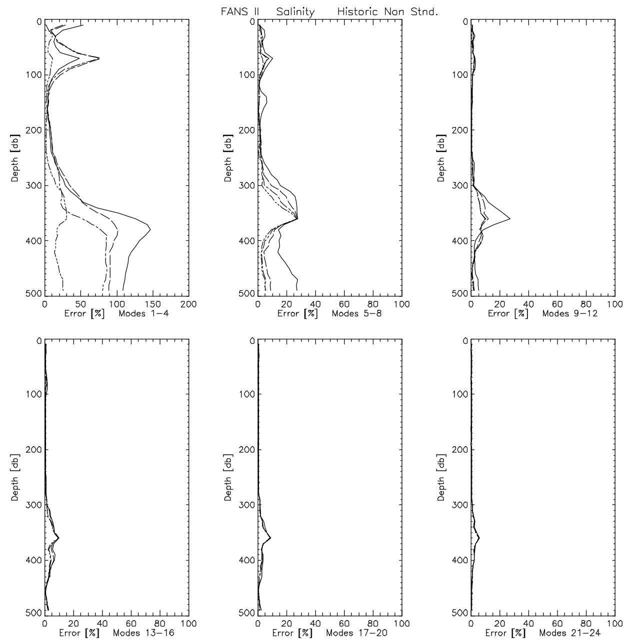


Figure 6-89 FANS II potential temperature contours at 100 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.

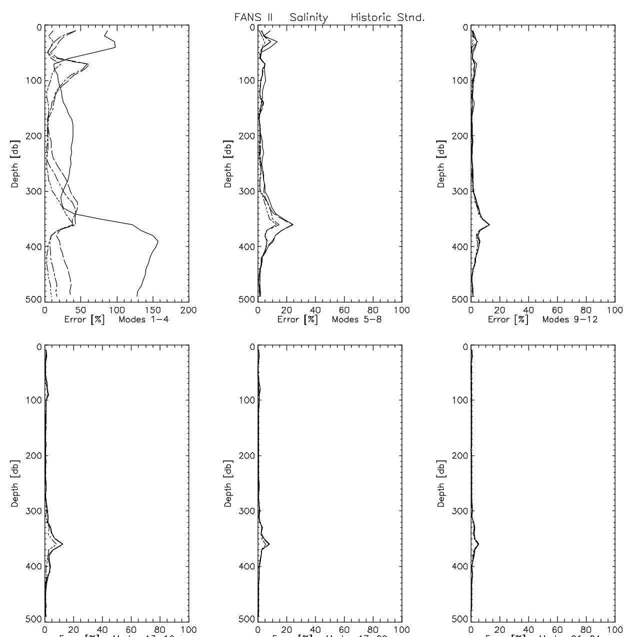
For the salinity error profiles (Figure 6-90) the very efficient convergence towards actual data observed at upper layers for the non-standardized analysis still holds, and also the standardized analysis resolves faster the lower layers. In both cases, the addition of more modes after the leading ones produces a very slow convergence. After adding the 12-th mode, error profiles are quite similar both methods.

The contour plots at 10 m (Figure 6-91) differ very significantly with the first six modes. As in previous cases, the standardized analysis results in a distribution that does not resemble the data, while for the non-standardized case errors are about 3%. As more modes are included, the errors decrease, reaching values of 1.6% (non-standardized) and 1.1% (standardized) with 12 modes, and less than 0.4% with 24 modes.

At 100 m (Figure 6-92), both methods are very efficient: contour plots show distributions that remain nearly identical as the number of modes increases. With six modes, the errors for the non-standardized and standardized analyses are 3.4% and 2.7% respectively, decreasing to less than 1% with 12 modes. With 24 modes, the lowest of all error values at this depth is obtained, 0.02% with the standardized analysis.



(a)



(b)

Figure 6-90 FANS II salinity error profiles for the non-standardized (a) and standardized (b) analyses, considering the addition of successive modes, from 1 to 24.

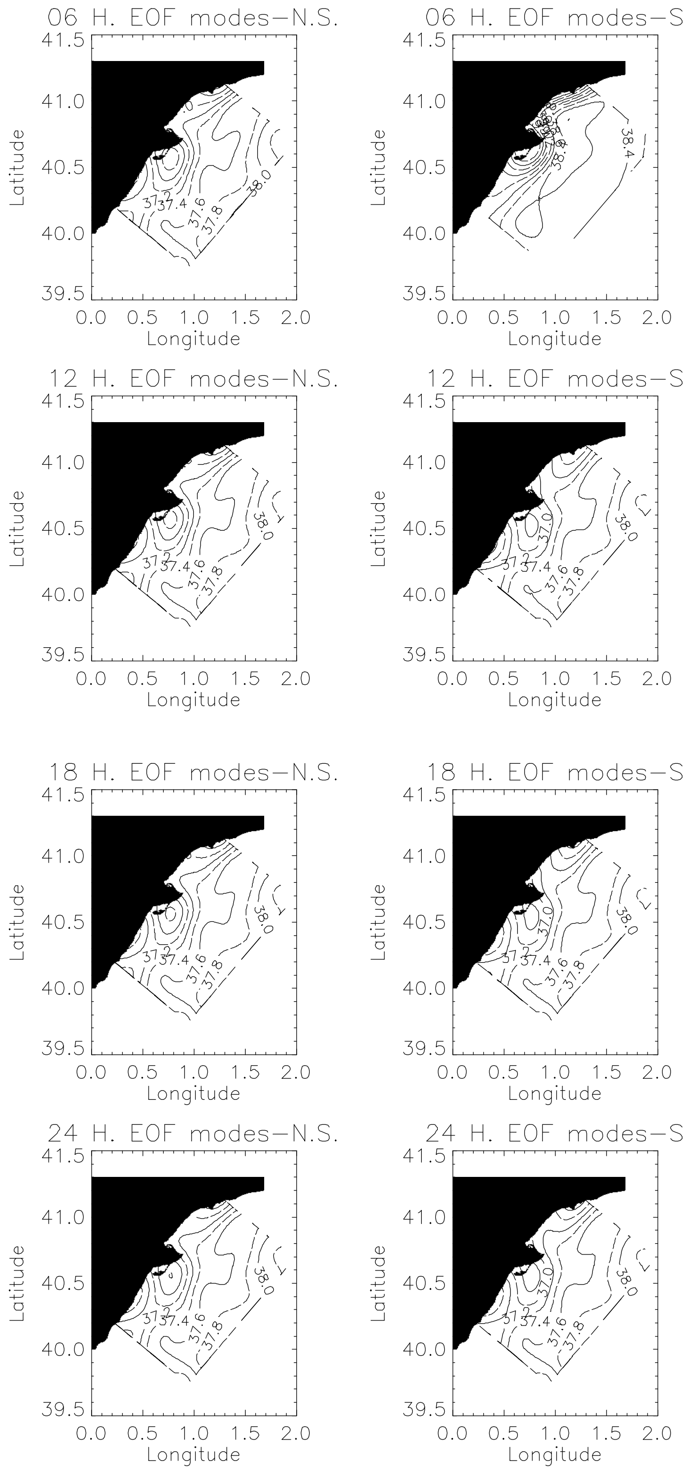


Figure 6-91 FANS II salinity contours at 10 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.

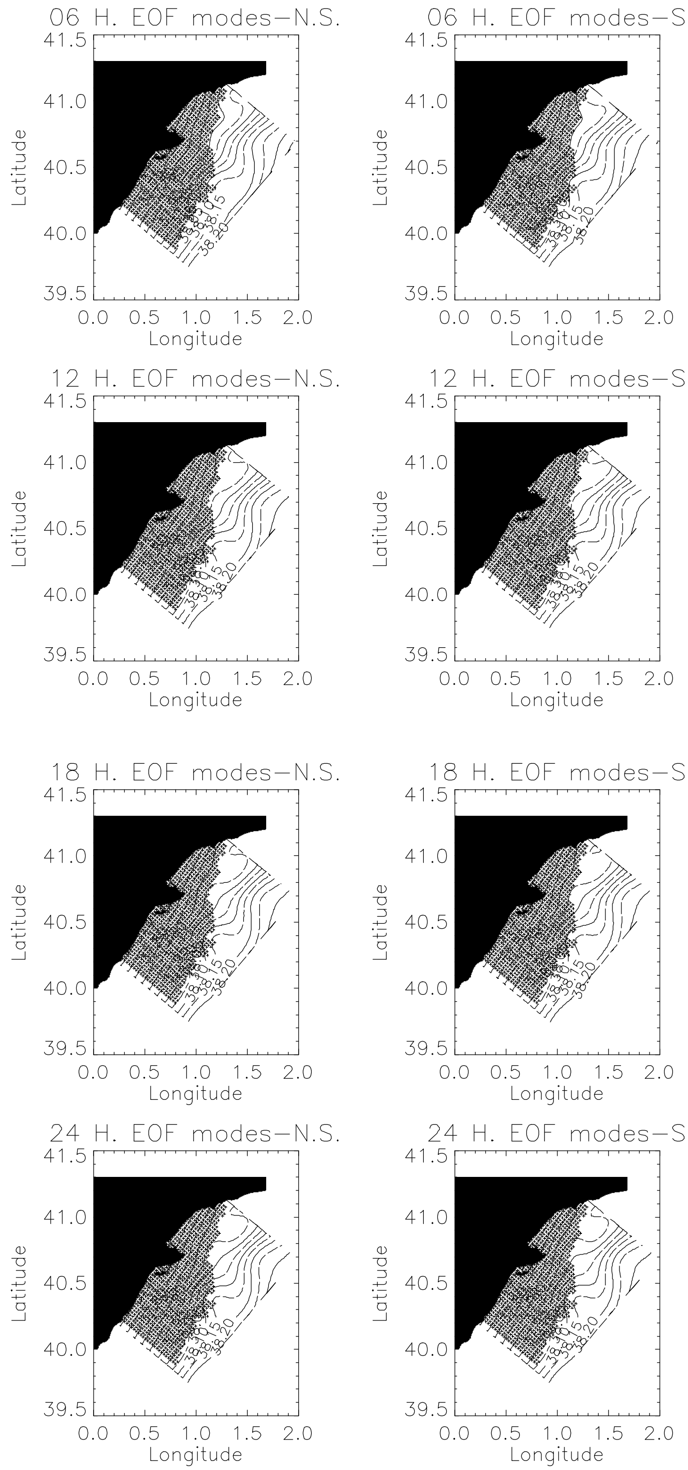


Figure 6-92 FANS II salinity contours at 100 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.

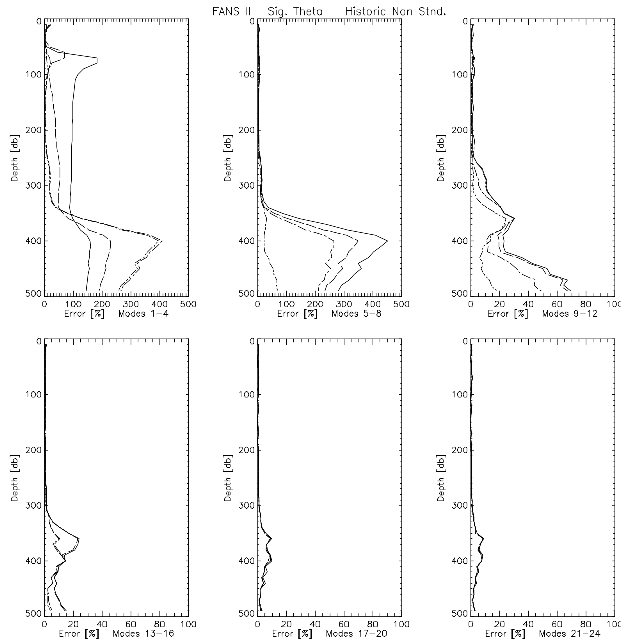
As for FANS III, density error profiles (Figure 6-93) result in high values, particularly with the standardized analysis. For the non-standardized model, the error profiles of the first modes resemble those of salinity, particularly below 300 m, but with higher values. The convergence towards actual data in the upper 250 m requires five modes only, but below that depth the errors remain high, and 8 modes are needed to get values lower than 100%. After 15 modes the convergence rate towards the data is very low, nearly imperceptible, and even 24 modes are not enough to lower the error below 10% in the range between 350 – 400 m.

The standardized analysis, on the other hand, shows a very critical layer in the upper 70 m, with very large error values that oscillate from higher to lower values as more modes are included. 18 modes are required to lower the errors below 100%, and 24 modes do not lower the highest errors below 35%.

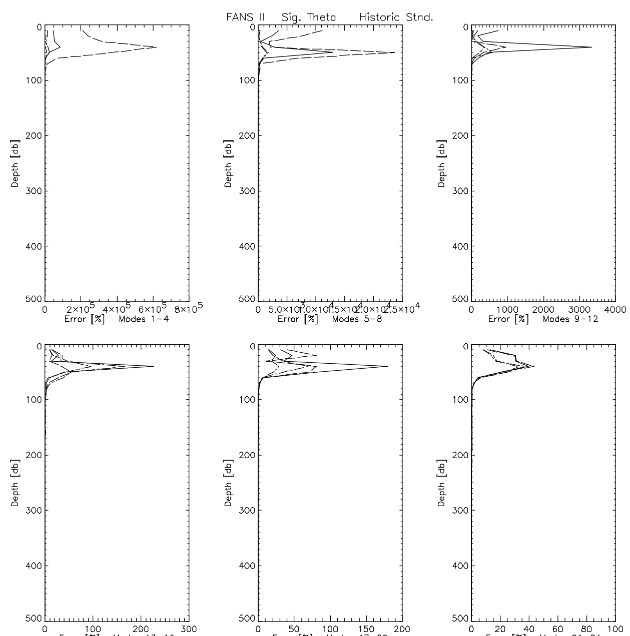
The contour plots at 10 m (Figure 6-94) reflect the conditions above mentioned. The non-standardized model considering six modes manages to represent well the data [1.7% error], and though additional modes rise this value to 4.6% (12 modes) and 2.3% (18 modes), the error decreases again to less than 1% with 24 modes. On the other hand, the standardized model considering six modes does not resemble the observed field at all. The inclusion of additional modes does improve the results in a significant way, lowering the error to 21%, 10% and 5% when 12, 18 and 24 modes are considered.

At 100 m (Figure 6-95) the non-standardized analysis resolves the data very efficiently with 12 modes [0.24% error], and additional modes still improve the goodness of the fit down to 0.06% error values when considering 24 modes.

The best fit with the standardized analysis takes place with 18 modes [6% error]. Additional modes worsen this situation, resulting in a 22% error. As for 10 m, six modes result in a field that does not resemble the data at all, producing in this case unrealistic sharp gradients.



(a)



(b)

Figure 6-93 FANS II sigma theta error profiles for the non-standardized (a) and standardized (b) analyses, considering the addition of successive modes, from 1 to 24.

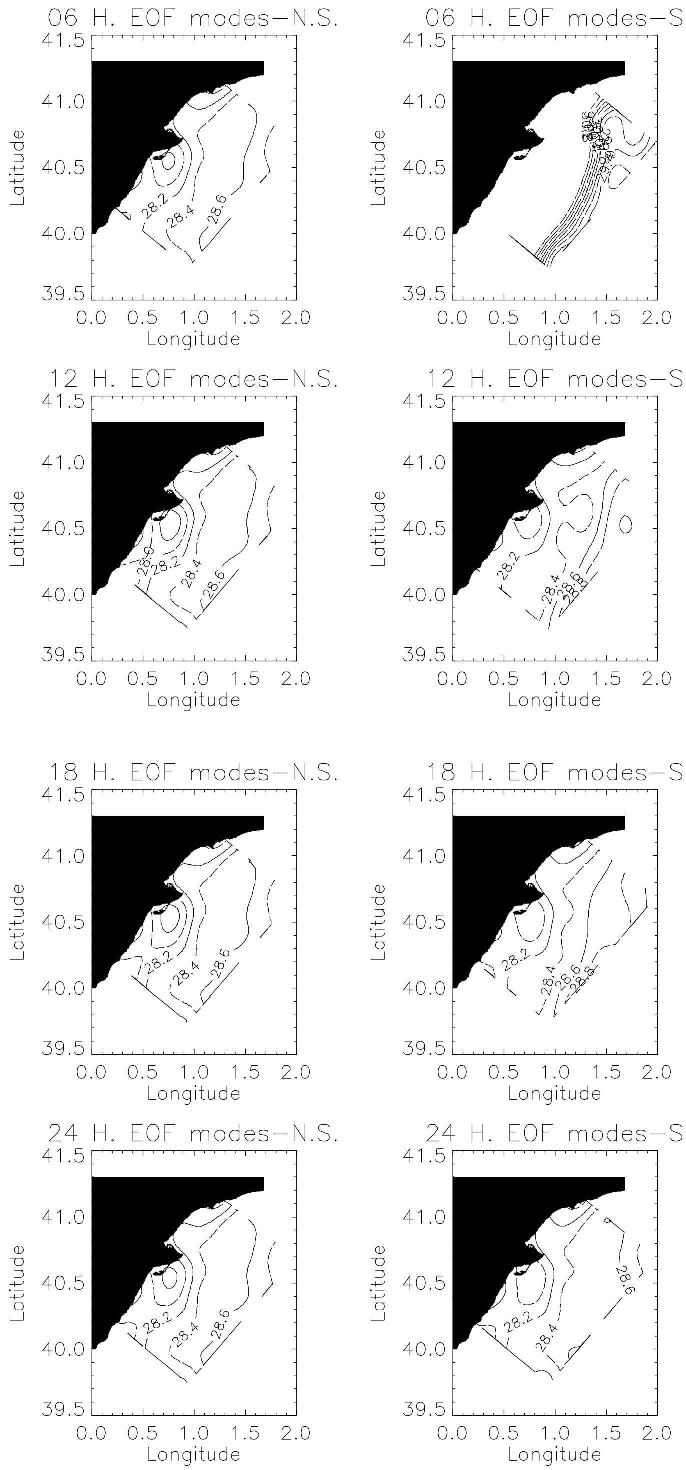


Figure 6-94 FANS II sigma theta contours at 10 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.

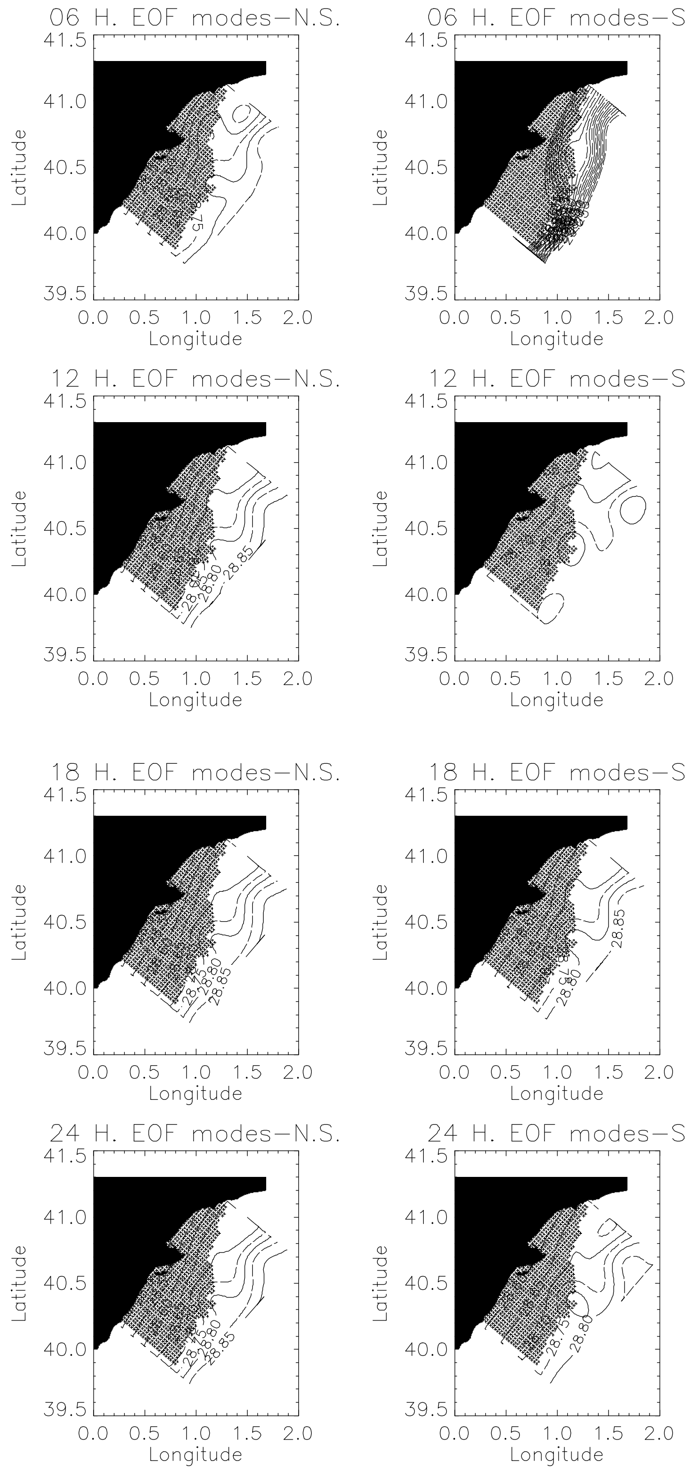


Figure 6-95 FANS II sigma theta contours at 100 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.

6.5.4 FANS I and MEGO 94

The historic eigenvectors used to represent both FANS I and MEGO 94 data are the winter ones. Since FANS I took place in autumn, it had to be checked which EOF set produced the best fit; the winter set proved to be the most efficient one in terms of explained variance.

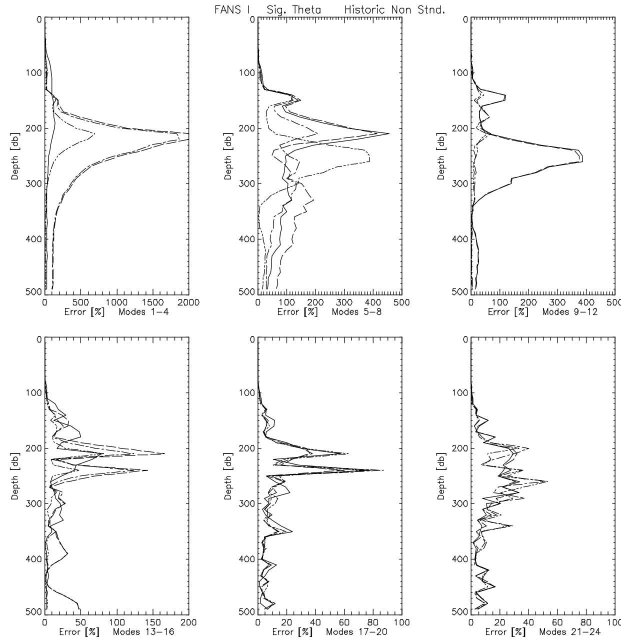
6.5.4.1 FANS I – Historic Winter Eigenvectors

The density error profiles (Figure 6-96) of the non-standardized analysis produced the highest errors of all FANS campaigns, reaching a 2000% when the second and third modes are included. Unlike for the two previous campaigns, the least explained depth range is not the deepest one, but a layer between 150 and 350 m. Pick errors lower than 100% are not obtained until the 15-th mode is included, and these only decrease to around 35% with 24 modes.

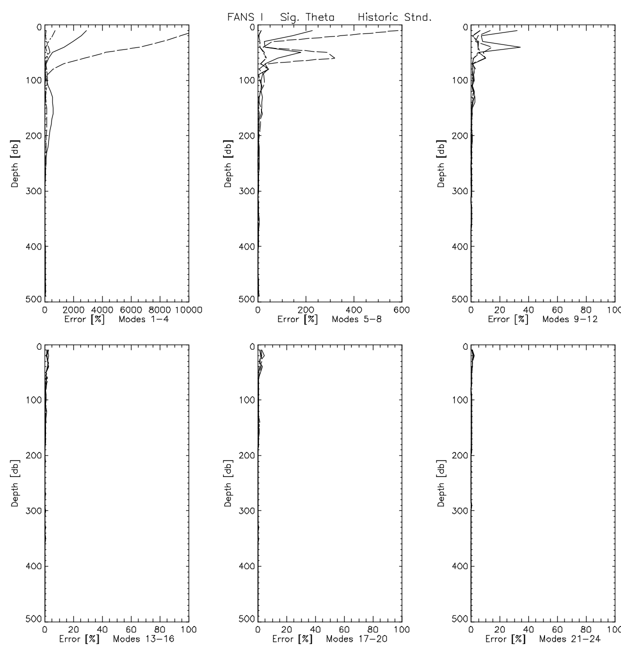
The standardized error profiles reveal, as in the previous campaigns, a critical layer in the upper 70 or 80 m, in which the error values increase and decrease as more modes are included. Pick error values less than 100% are obtained with the addition of the sixth mode, and by the eleventh mode these values decrease to less than 10%. Below 100 m, much less modes are required to approach the data.

The contour plots at 10 m (Figure 6-97) show a non-standardized model that approaches the data distribution very closely, particularly on the outer slope, but does not perform so well around the Ebro Delta. This results in on-grid error values that decrease from a 15.4% with six modes, to 4.7% with 24. On the other hand, the standardized model evolves from a six mode distribution with values outside the data range (nearly no contour lines), to one with small scale structures with 12 modes. This distribution becomes smoother when 18 modes are considered, and with 24 modes the on-grid error is about 36%.

The models give better results at 100 m (Figure 6-98). The non-standardized analysis with six modes has a 28% error, decreasing to 4.5%, 1.2% and 0.3% with 12, 18 and 24 modes. The equivalent values resulting from the standardized analysis are 853% with six modes, corresponding to a field with very unrealistic sharp gradients. When additional modes are added the errors lower to 11.3%, 2% and 4% with 12, 18 and 24 modes, respectively.



(a)



(b)

Figure 6-96 FANS I sigma theta error profiles for the non-standardized (a) and standardized (b) analyses, considering the addition of successive modes, from 1 to 24.

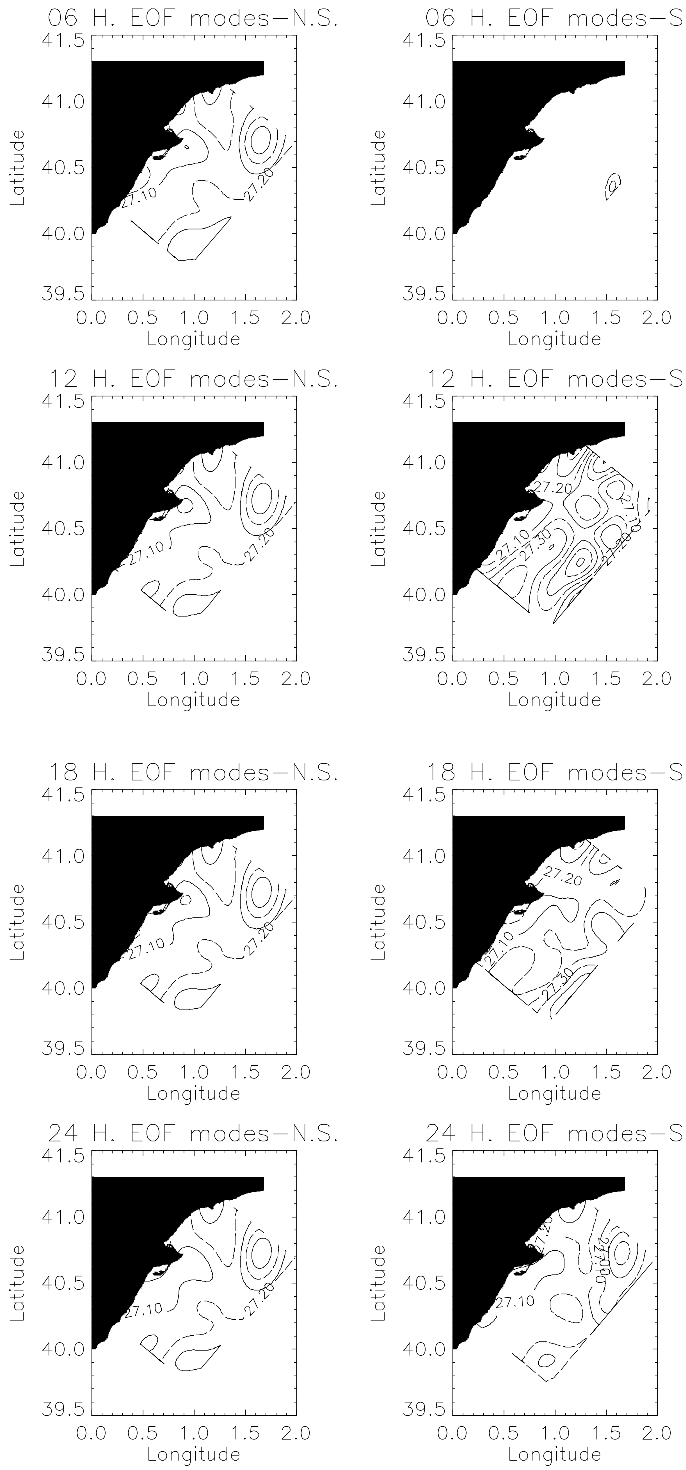


Figure 6-97 FANS I sigma theta contours at 10 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.

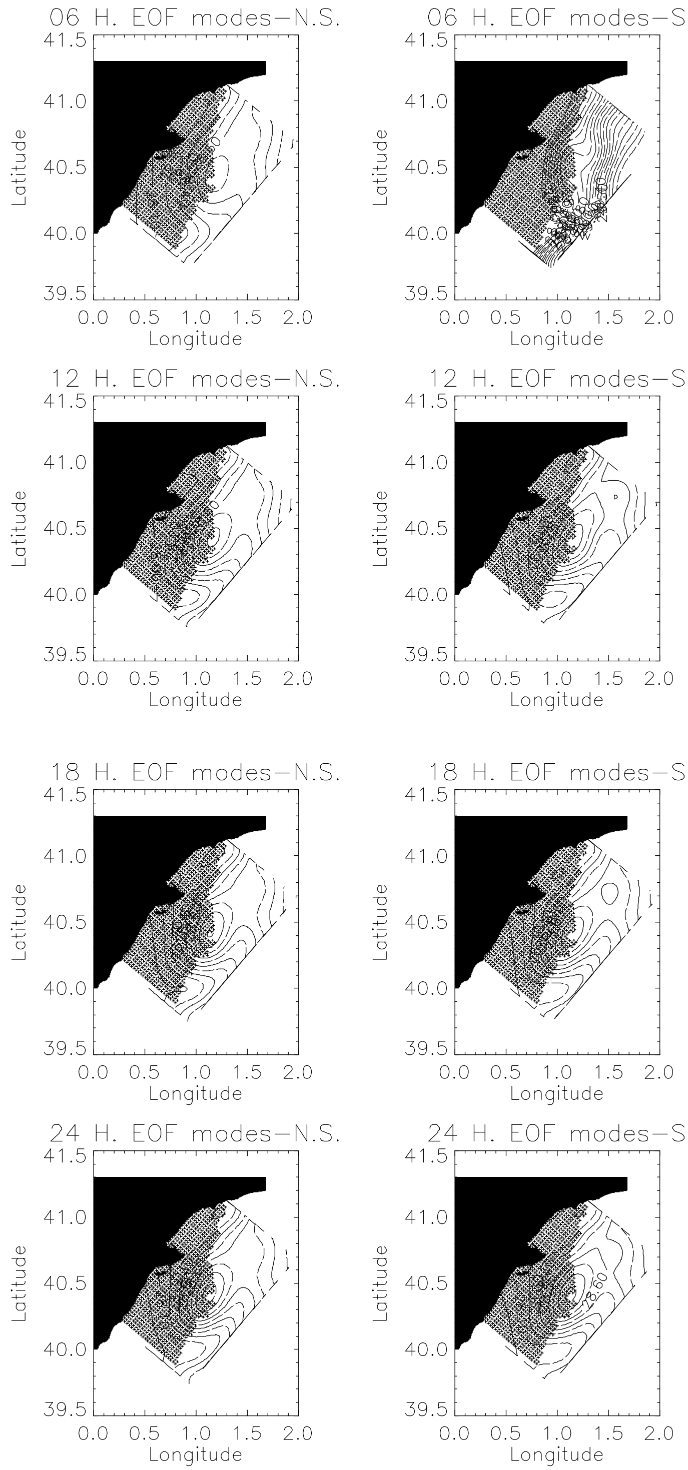


Figure 6-98 FANS I sigma theta contours at 100 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.

6.5.4.2 MEGO 94 – Historic Winter Eigenvectors

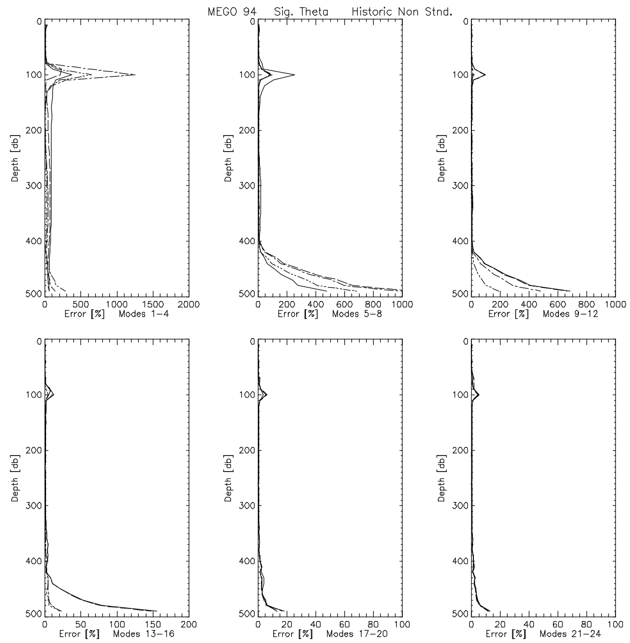
As mentioned in Chapter 5, the fields of MEGO 94 differ from FANS II in several aspects. The main one is that MEGO 94 has rather homogeneous distributions, both in the horizontal and in the vertical, which translates in significant differences in the $q-S$ diagram with respect to FANS II.

As for previous cases the error profiles show layers with very high values (Figure 6-99). With the first modes of the standardized analysis, there is a pick layer around 100 m for which error increases when adding the third and fourth modes. From the fifth mode onwards these errors decrease, but increasing errors also occur in the lowest 100 m until nine modes are considered. From there on the error decreases, reaching values less than 100% with the addition of the 15-th mode [there is a large decrease from 150% with 14 modes, to less than 25%]. Successive modes contribute little to improve the fit.

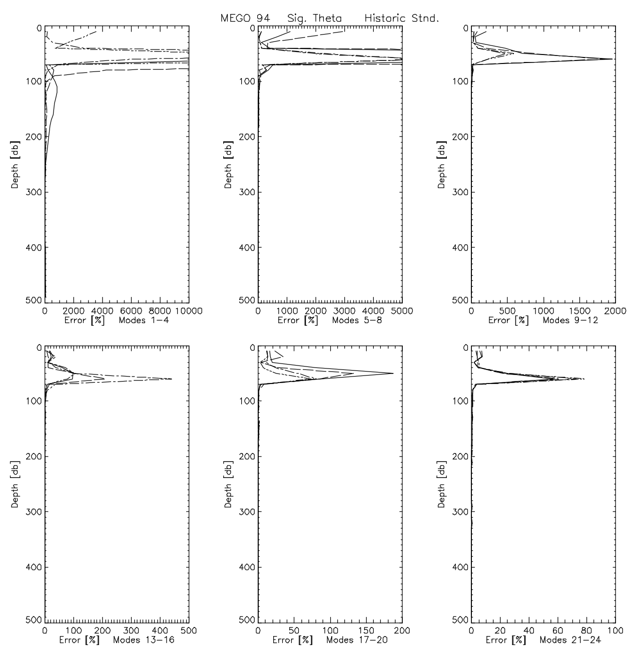
The standardized analysis error profiles show an upper layer, between 50 and 60 m, with very high, oscillating pick errors, as the number of modes increases. With 24 modes, the error is still well above 50%.

At 10 m, the contour plots (Figure 6-100) show a good representation of the data with the non-standardized model, with little changes as the number of modes increase from six to 24 [on-grid errors from 4.5% to 0.56%]. On the other hand, the standardized model results with six modes do not resemble the data, and despite the southern two thirds of the domain become well represented as more modes are included, spurious structures do appear in the northern third, which results in on-grid error values from 67% with 12 modes, down to 16% with 24 modes.

Finally, the density distribution at 10 m (Figure 6-101) is reasonably well represented with the non-standardized analysis when 18 and 24 modes are considered [17% and 5.6% error values respectively]. Instead, the lowest error for the standardized analysis is 450%, with 18 modes. In this particular case, the small variability of the data, with a standard deviation of the order of 0.008, is behind the very high errors. Nevertheless, the non-standardized analysis produces a more efficient approach to the data at this level.



(a)



(b)

Figure 6-99 MEGO 94 sigma theta error profiles for the non-standardized (a) and standardized (b) analyses, considering the addition of successive modes, from 1 to 24.

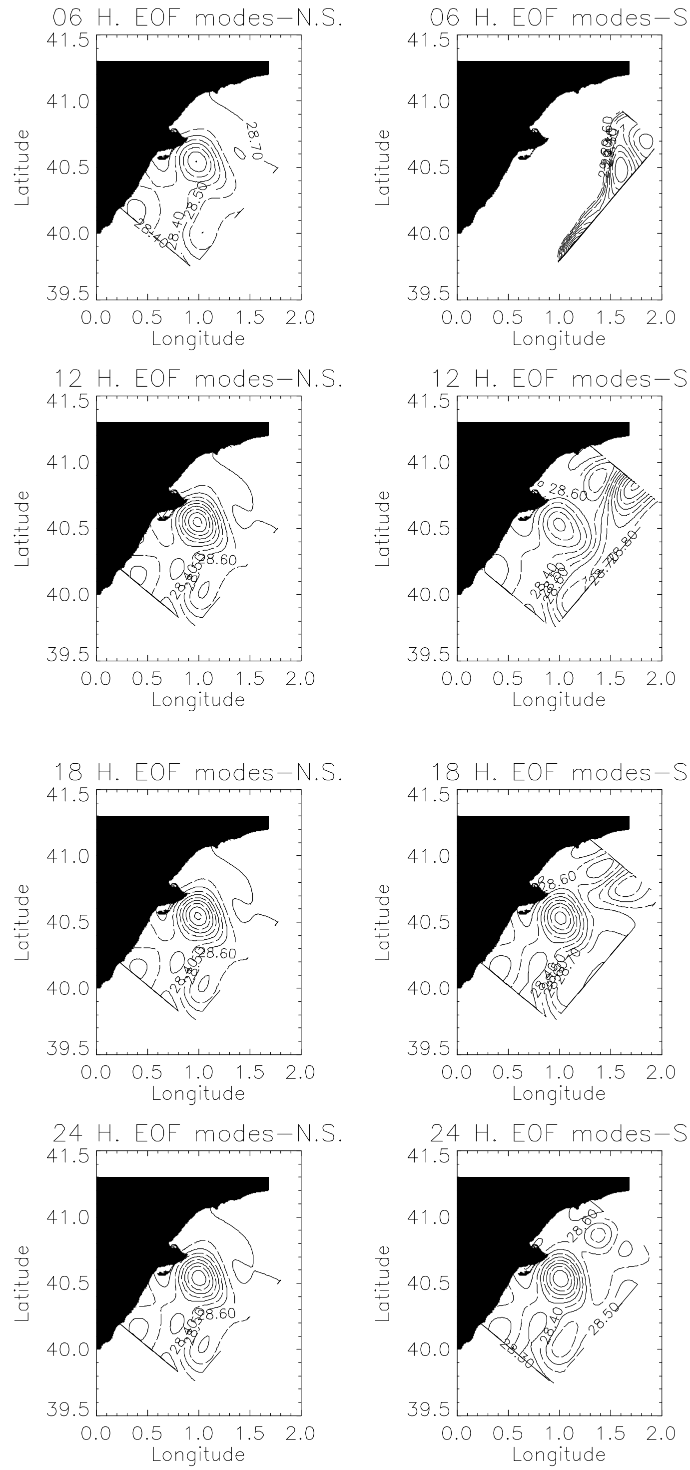


Figure 6-100 MEGO 94 sigma theta contours at 10 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.

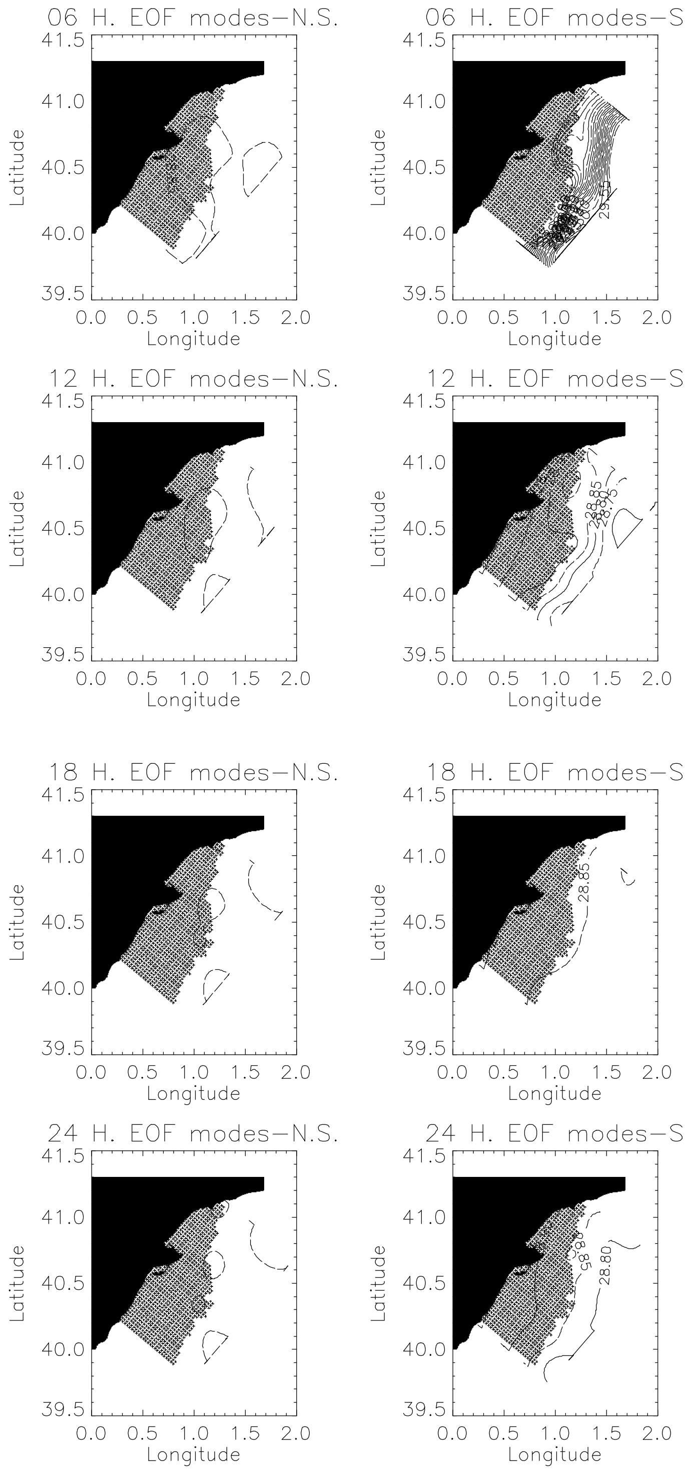


Figure 6-101 MEGO 94 sigma theta contours at 100 m considering 6, 12, 18 and 24 modes, for the non-standardized (left) and standardized (right) analyses.