7.4.3 FANS I

Amplitude Interpolation: As in the previous cases, there are similarities between the non-standardized and the standardized analyses with the campaign eigenvectors (Figure 7-15). They show enhanced gradients around and south of the Ebro Delta, wave-like patterns “perpendicular” to the coast at 10 and 50 m, and little structure on the northern part of the domain. At 100 m, these models result in rather homogeneous fields. The DT contour distributions obtained from historic eigenvectors are different from the previous ones and between themselves, with a rather smooth distribution for the non-standardized analysis that seems to follow some depth contours. The standardized analysis results in two sharp gradient areas, one that appears to follow the 100 m isobath, and the other at the northeastern part of the domain.

Profile Interpolation: The DT contour distributions obtained from the campaign eigenvectors are smooth at all depth levels, but those obtained from the historic eigenvectors are unrealistic, particularly with the standardized analysis. The error values on the outer slope and open ocean domains (Table 7-1) reveal very poor approaches to the DH data, particularly with the use of historic eigenvectors. With the amplitude interpolation, the non-standardized analysis gives the lowest errors, both with the campaign (17%) and the historic (92%) eigenvectors The profile interpolation results in a 15% value at 10 and 100 m, decreasing to 4.2% at 50 m. With the historic eigenvectors, the best fit is at 10 m (for the non-standardized analysis): 26%, increasing to 69% at 100 m. With both interpolation criteria (amplitude and profile), the standardized analyses with historic eigenvectors result in very large errors.

The geostrophic currents derived from DT fields are shown in Figure 7-17 and Figure 7-18. The high velocities observed in the upper shelf at 10 and 50 meters contrast significantly with the milder currents on the outer shelf and the rest of the domain. The peak speed at 10 m ranges from around 40 $^{cm}/_{s}$ for most cases (except with the standardized analysis with historic eigenvectors) to around 30 $^{cm}/_{s}$ at 50 m. These values are unreal for the upper shelf area, and definitely not consistent with the circulation on the outer shelf and slope domains at the same depth.

The overall largest speeds on the outer shelf, slope and open ocean result from the standardized analyses with historic eigenvectors. With the amplitude interpolation, they are around 110 $^{cm}/_{s}$, and reach significantly higher values with the profile interpolation, nearly 170 $^{cm}/_{s}$. While these values are clearly unreal for the region, we mention them for the remarkable influence of the upper shelf data on the resulting on-grid distributions at all depths, which pass from an apparently disordered flow patter with high velocities towards the north and the south (Figure 7-17, left plots on frames b, d, and f), to a well structured south-westward flow (Figure 7-18, same plots).

From all the above, it seems reasonable to conclude that, for this campaign, including the upper-shelf data in the interpolation procedure does not contribute to obtain reliable results. The profile interpolation thus appears as a better option, resulting in a circulation distribution that tends to flow towards the south and southwest, with an outflow towards the southeast in the open ocean area.

As for the poor results with the historic eigenvectors, it must be taken into account that FANS I took place during autumn conditions, therefore in a transition period from summer to winter conditions.

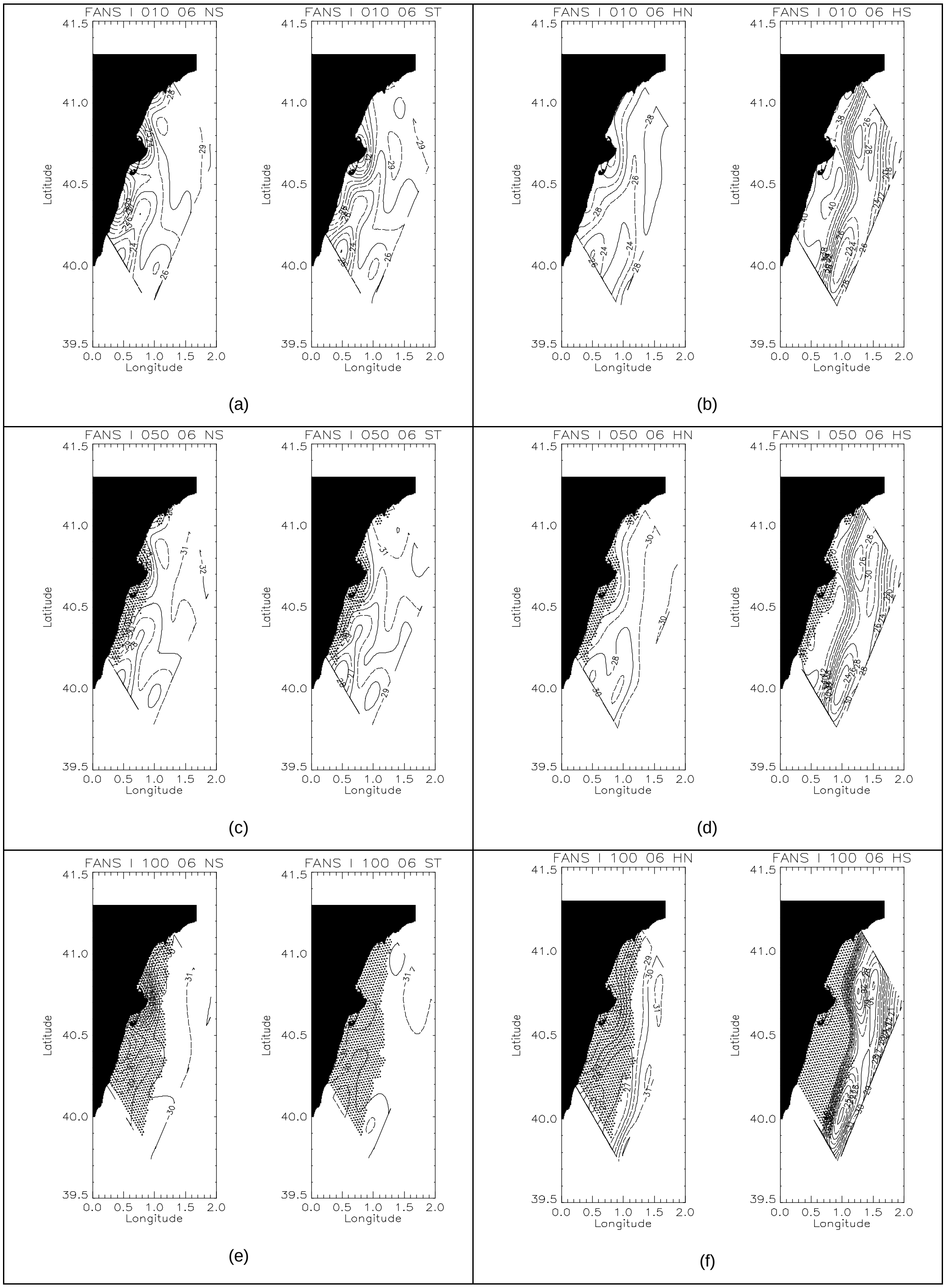

Figure 7-15 FANS I <u>Amplitude Interpolation</u> – Dynamic Thickness Distribution

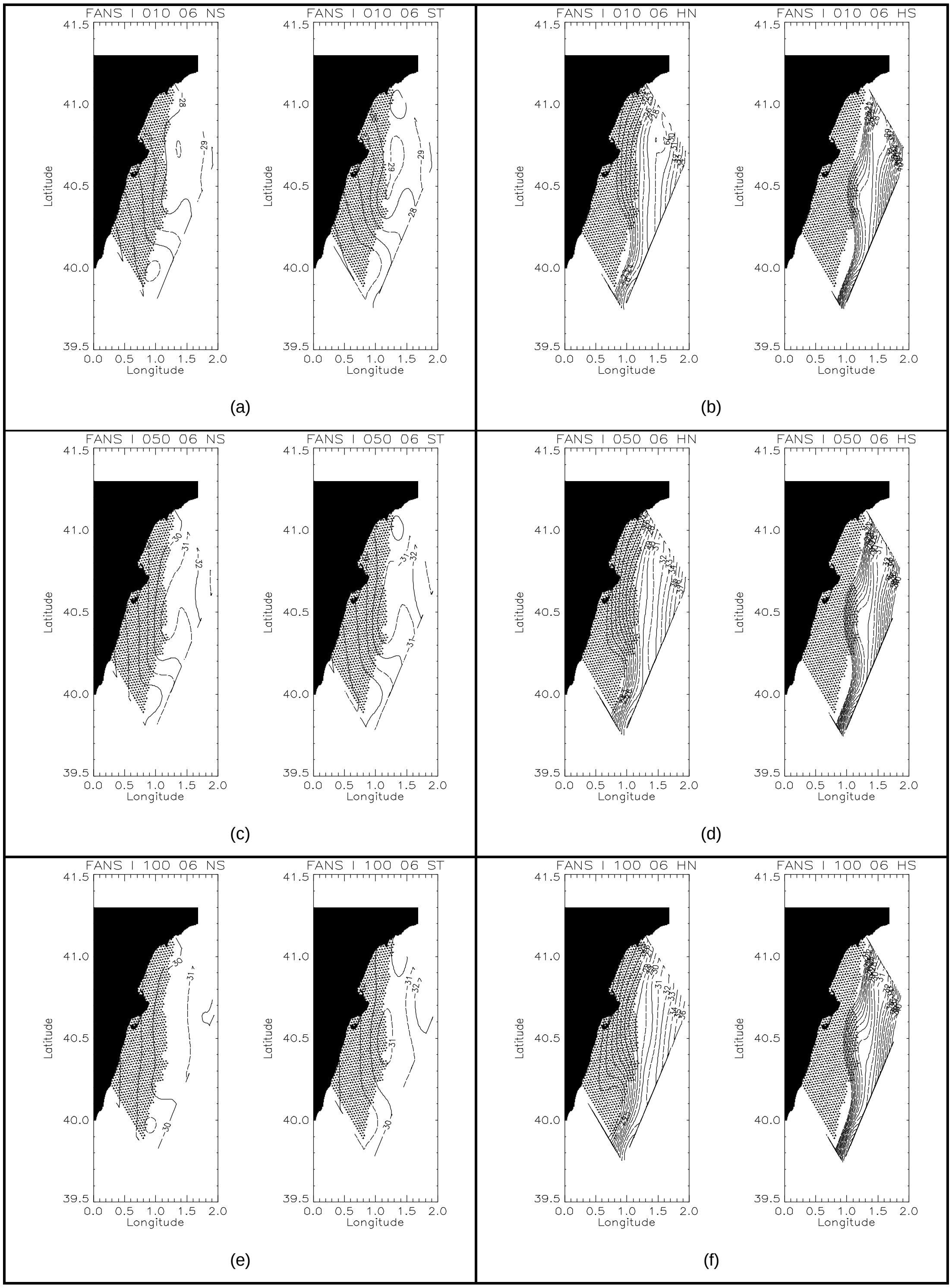

Figure 7-16 FANS I <u>Profile Interpolation</u> – Dynamic Thickness Distribution

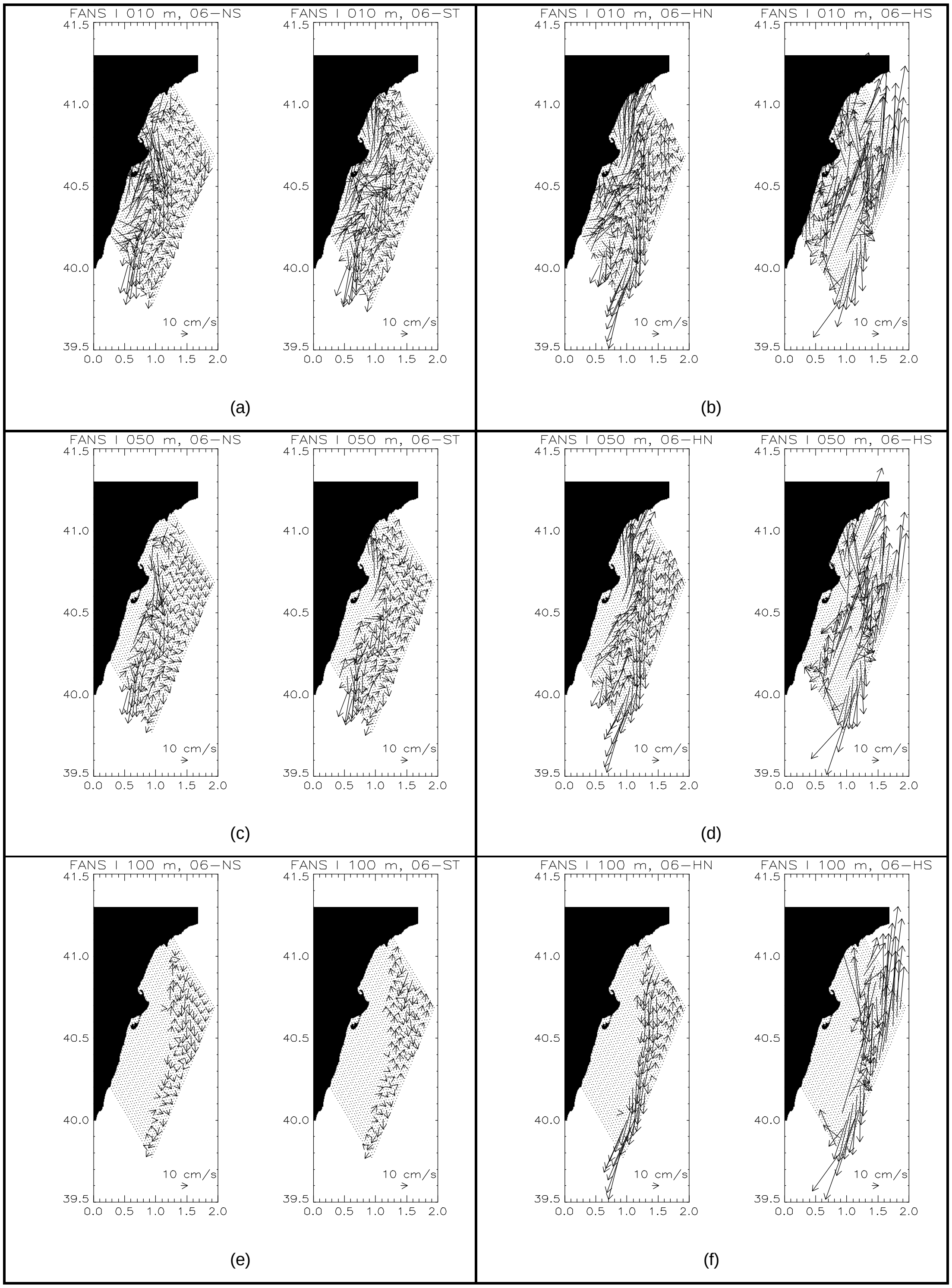

Figure 7-17 FANS I <u>Amplitude Interpolation</u> – Geostrophic Circulation

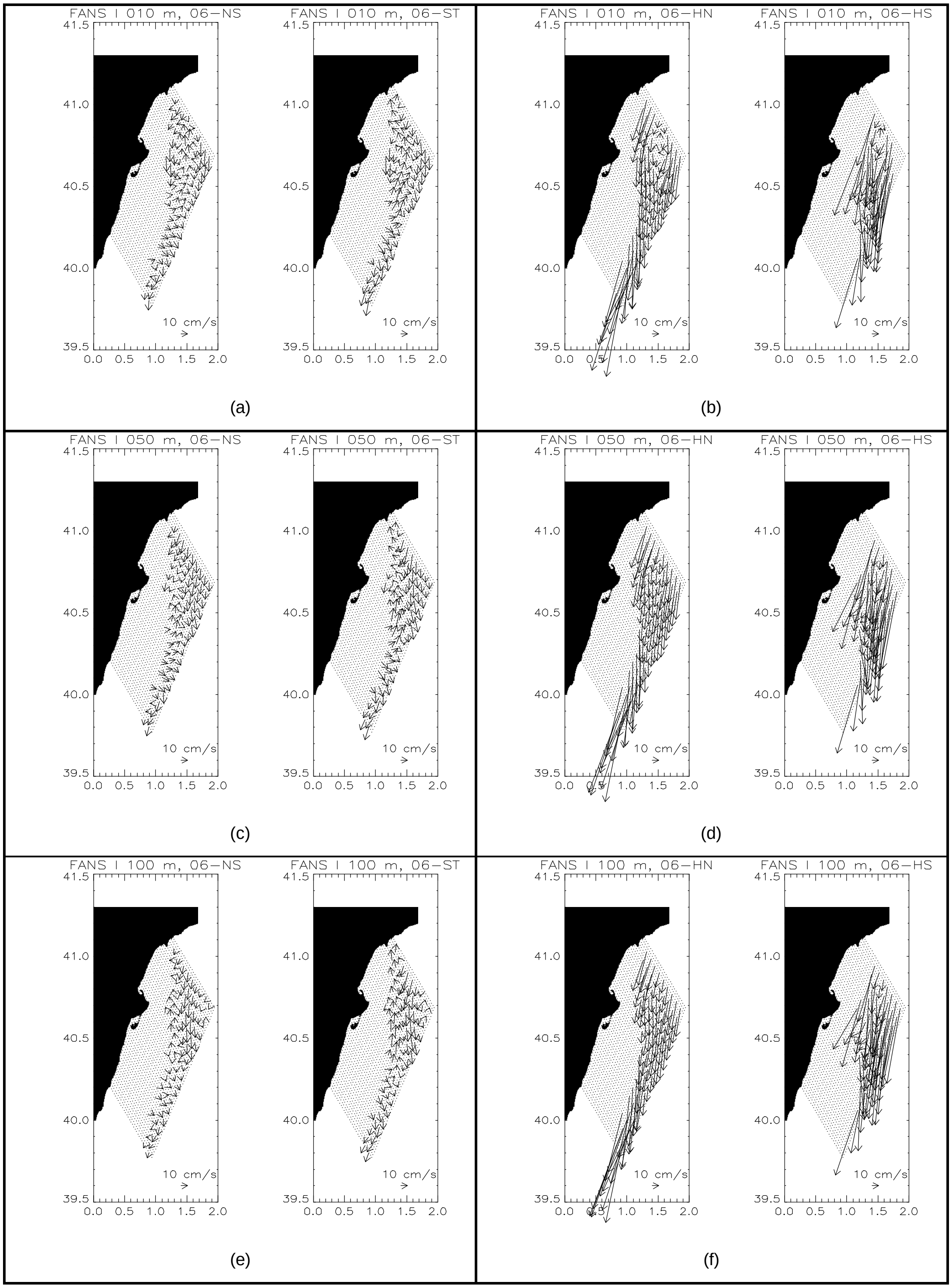

Figure 7-18 FANS I <u>Profile Interpolation</u> – Geostrophic Circulation

MEGO 94

Two particular aspects of this campaign seem to have a definite influence on the results: the (already mentioned) unusually homogeneous conditions and the fact that the open ocean structures do not seem to be representative of the shelf dynamics. Since we cannot expect good results on the shelf, the profile interpolation method seems to be the only one able to perform a good job. Nevertheless, the same, complete set of results as for the previous campaigns is presented.

Amplitude Interpolation: unlike for the previous cases, the analyses with the campaign eigenvectors are not similar (Figure 7-19). The non-standardized one results in a contour distribution with very large gradients near the coast and at the northeasternmost area, while the standardized one also has strong gradients on the upper shelf region, and a much smoother distribution to the northeast of the domain, with an insinuated eddy-like structure nearby the northern boundary of the domain. This eddy structure also appears in the non-standardized analysis with the historic eigenvectors, and is somehow depicted in the standardized one. These latter two cases have certain overall similarities, but the distributions are different.

Profile Interpolation: The analyses with the campaign eigenvectors are very similar (Figure 7-20). In the non-standardized analysis, the large gradient area at the northeastern part of the domain is absent, and the isolines are slightly smoother in the standardized one. The overall distributions with the historic eigenvectors also change, resulting in very similar patterns though with slightly larger gradients in the non-standardized analysis. With the profile interpolation the four cases show an overall similar pattern.

Comparing the resulting DT distributions with DH obtained from actual data, the largest errors (Table 7-1) on the outer slope and open ocean (depths equal or larger than 500 m) correspond to the non-standardized analysis with campaign eigenvectors and with the amplitude interpolation. With the profile interpolation, errors decrease to 20%, which is a more reasonable result. This is the only campaign for which errors derived from the amplitude interpolation are lower using historic eigenvectors than using campaign eigenvectors. Nevertheless, the best results are obtained for the profile interpolation and the standardized analysis [errors lower than 18% at all depth levels], the non-standardized values being just slightly higher.

The associated geostrophic velocities are shown in Figure 7-21 and Figure 7-22. No reasonable circulation could be expected from the amplitude interpolation for the non-standardized case with the campaign eigenvectors, and the vector plots confirm our expectations. Also the standardized case produces an unreal circulation on the shelf (10 and 50 m). The historic eigenvectors result in smoother flow patterns. The non-standardized model results in a well defined counter current which seems to follow the shelf contour, while the standardized one shows two southwestward currents divided by a northeastward one in the northwestern area.

On the other hand, the profile interpolation circulation results in similar overall currents which vary mostly in magnitude, specially the northwestward countercurrent that appears in all cases in the inner side of the shelf. While maximum speeds with the campaign eigenvectors are less than 20 $^{cm}/_{s}$, with the historic ones are around 27 $^{cm}/_{s}$.

If we consider the errors on the slope and open ocean domains, MEGO 94 is the campaign for which the EOFs methodology produces a worse performance, although the lowest error values are similar to the ones obtained in FANS I at 10 and 100 m.

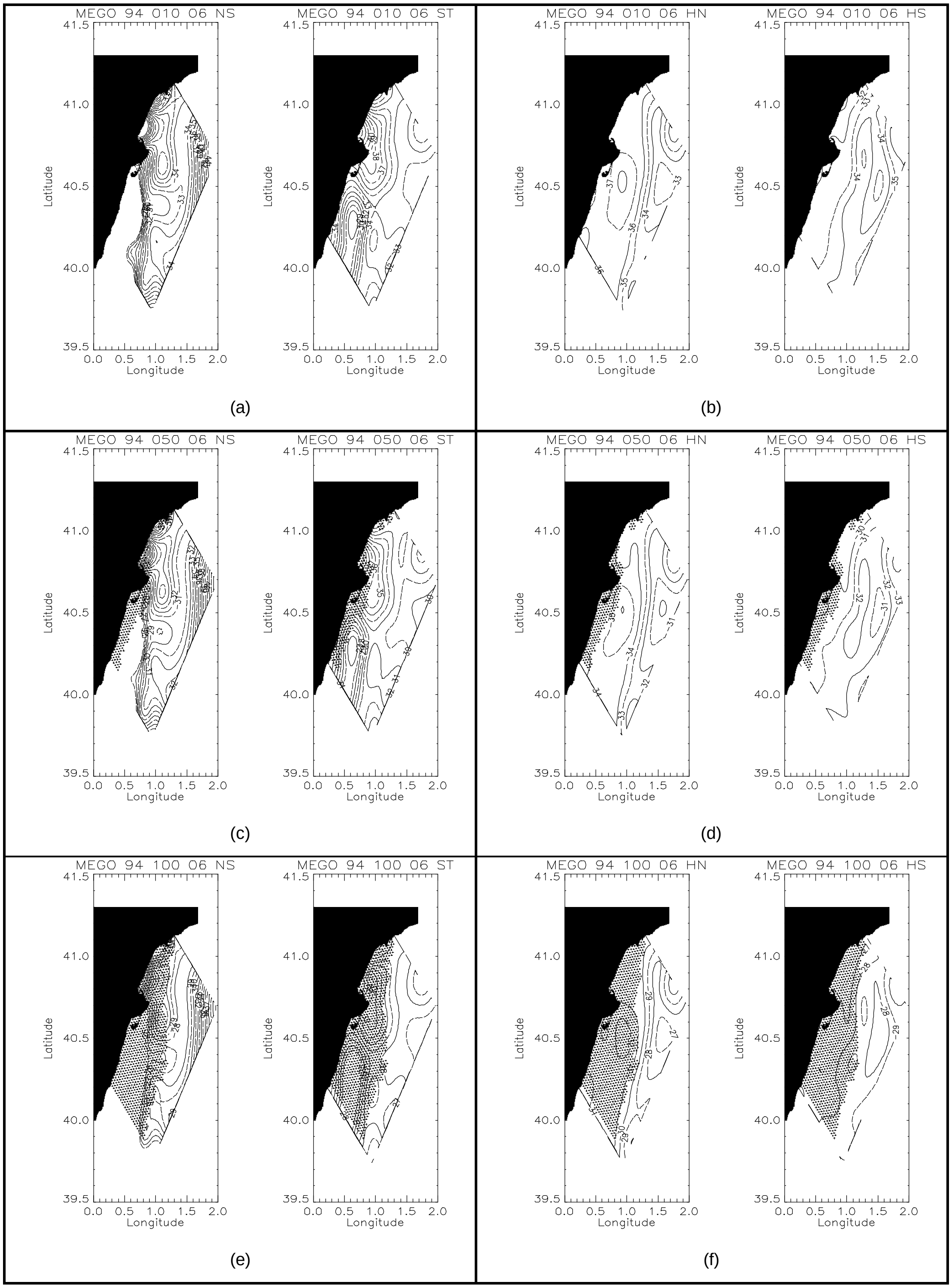

Figure 7-19 MEGO 94 Amplitude Interpolation – Dynamic Thickness Distribution

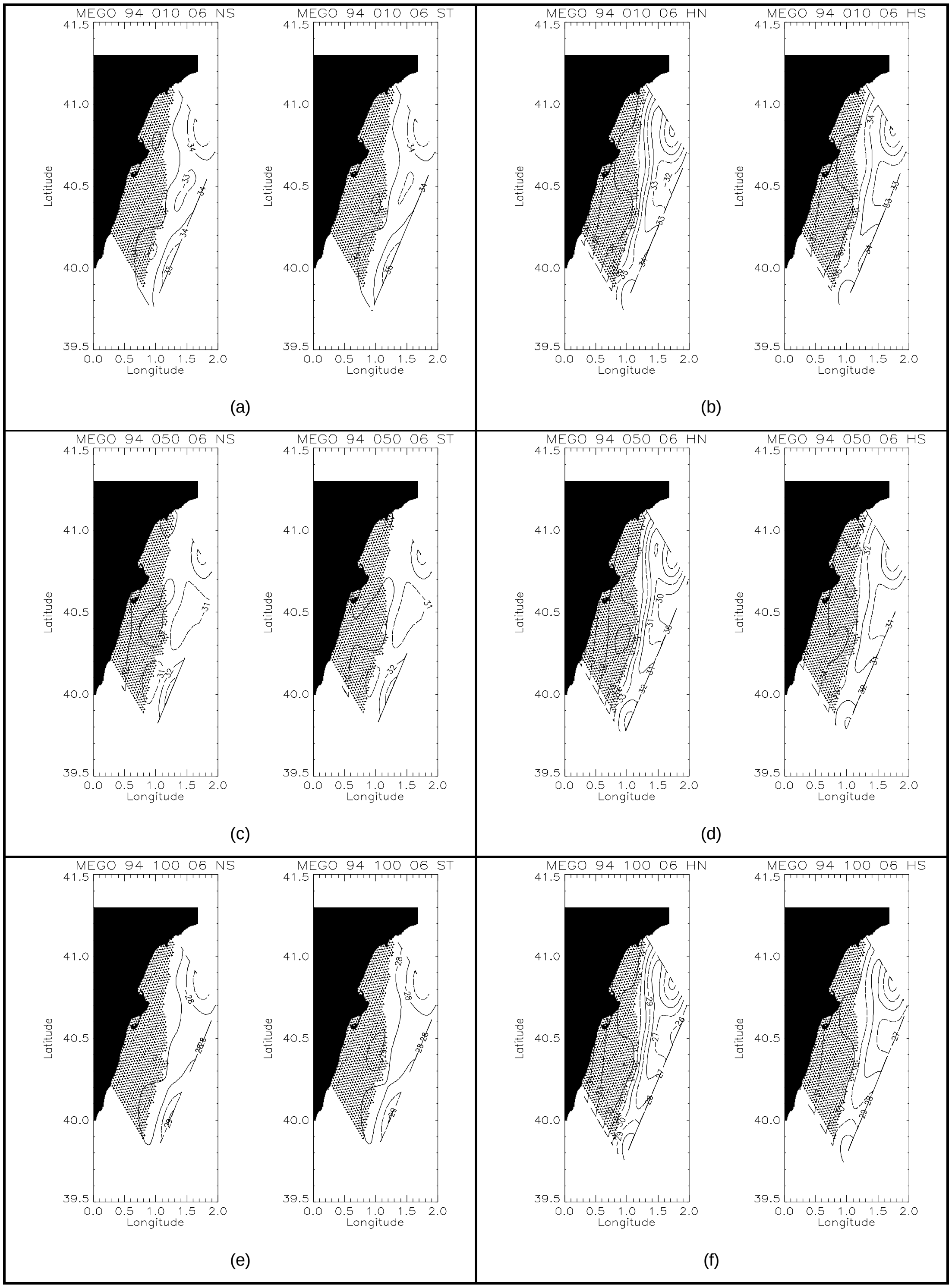

Figure 7-20 MEGO 94 Profile Interpolation – Dynamic Thickness Distribution

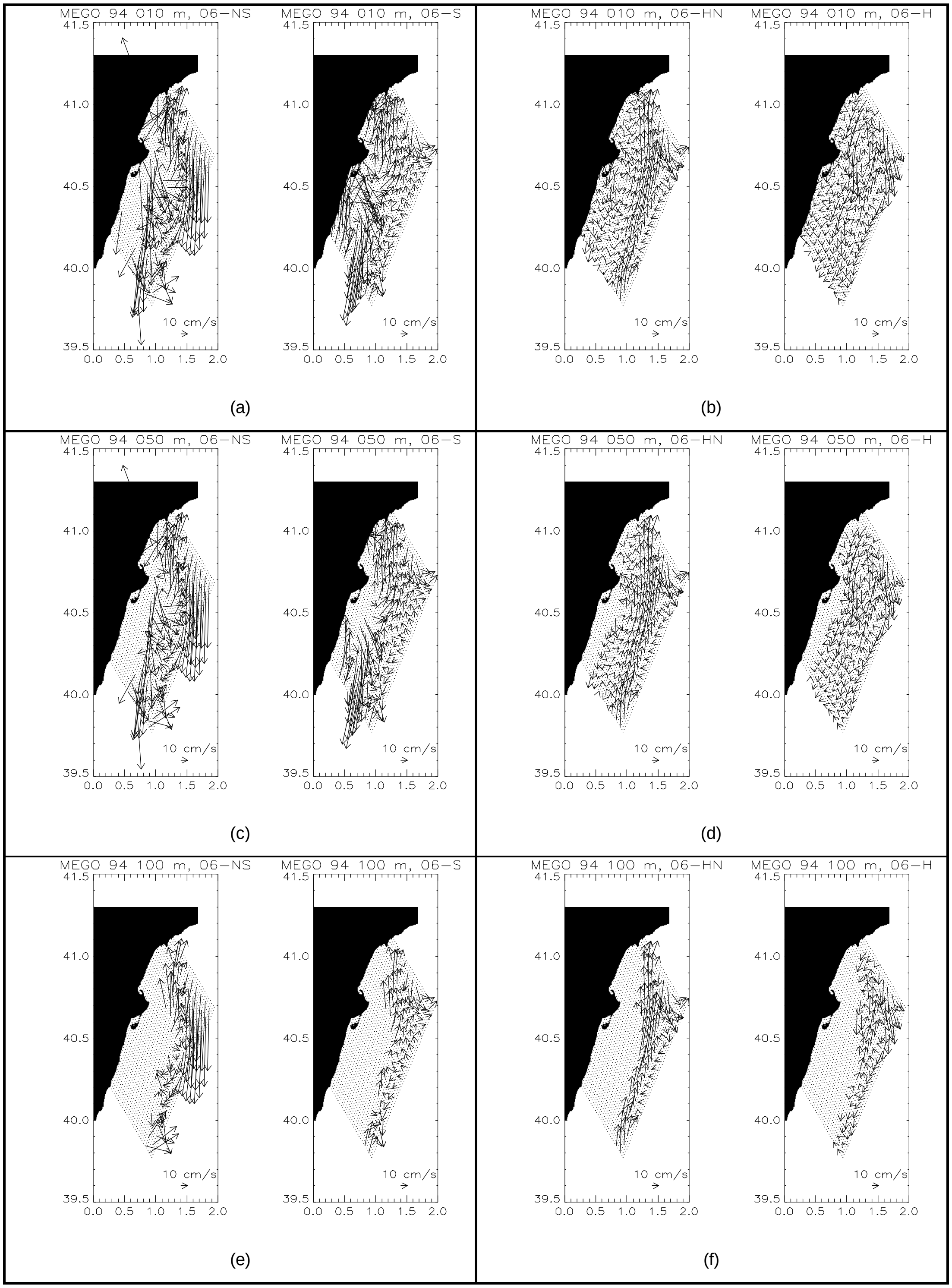

Figure 7-21 MEGO 94 Amplitude Interpolation – Geostrophic Currents

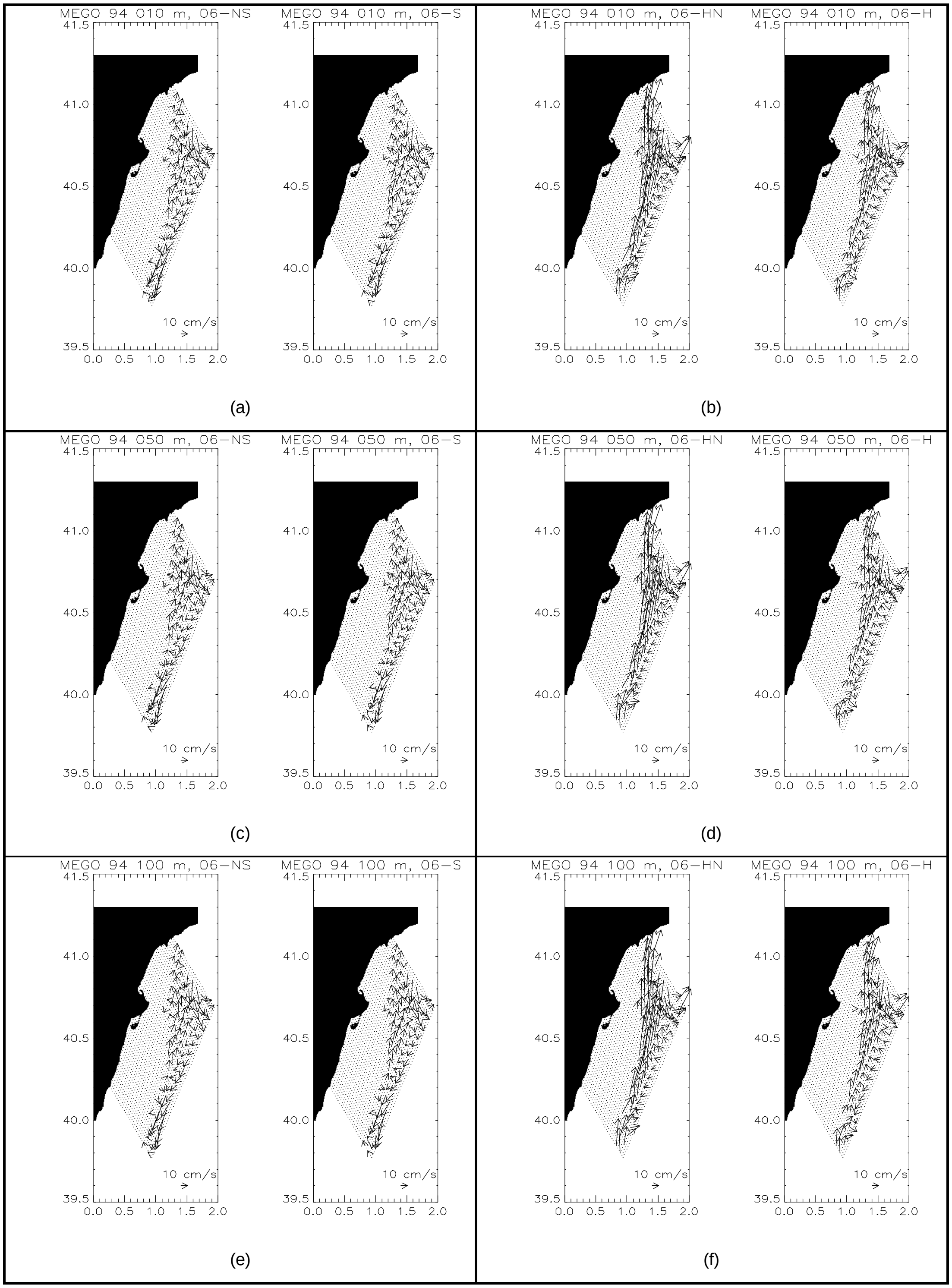

Figure 7-22 MEGO 94 Profile Interpolation – Geostrophic Currents

7.5 Comparison between both Methods

Considering only the best geostrophic velocity results obtained for each method, the most important differences between them are:

FANS III: Csanady's method shows the same overall characteristics than the EOFs method, particularly with the campaign eigenvectors and the non-standardized analyses. For both, results are very similar with the amplitude and the profile interpolations. With the historic eigenvectors, the non-standardized analysis renders the same dynamic characteristics with the profile interpolation.

As mentioned previously, the upper shelf circulation that results from the non-standardized and standardized analyses with the campaign eigenvectors seems reasonable. The data suggest the presence of a north-eastward current adjacent to the coast, to account for the intrusion of warmer waters from the Gulf of Valencia. And a southward flow north of the Ebro Delta is required to displace the plume signal to the south. Both flows are observed in the upper shelf. Csanady's method does not provide reliable information in the upper shelf.

FANS II: In general terms, the geostrophic currents obtained with both methods have a similar south-westward flow in the outer shelf/slope and open ocean domains, but with certain differences. Csanady's method results in velocities with a large, spurious component towards the open ocean, so that the flow is not along the open ocean border of the study domain as for the EOFs methodology. The eddy observed close to the northern boundary in the density and salinity distributions is also clearly depicted with Csanady's method and, to a lesser extent, with the EOF method. An eddy signal is also obtained in the non-standardized analyses with historic eigenvectors, both with the amplitude and profile interpolation, but it extends further to the south and has faster currents associated with it.

None of the methods seems to provide reasonable geostrophic circulation results on the upper shelf domain.

FANS I: The geostrophic circulation obtained with both methods is very similar (profile interpolation – campaign eigenvectors analyses) in an overall sense, but there are some differences. Csanady's method renders slightly faster velocities in general, and the direction of the velocity vectors is also slightly different. The flow obtained from the EOF method seems smoother. With no data to compare, it is not possible to decide which of the two methods is the best option.

MEGO 94: The currents on the deep regions are very similar, with minor differences in the overall velocity directions (profile interpolation – campaign eigenvectors). But unlike the other campaigns, beyond the 500 m isobath, Csanady's method shows along-transect spurious velocities.

None of the methods render any useful information for the upper-shelf circulation.