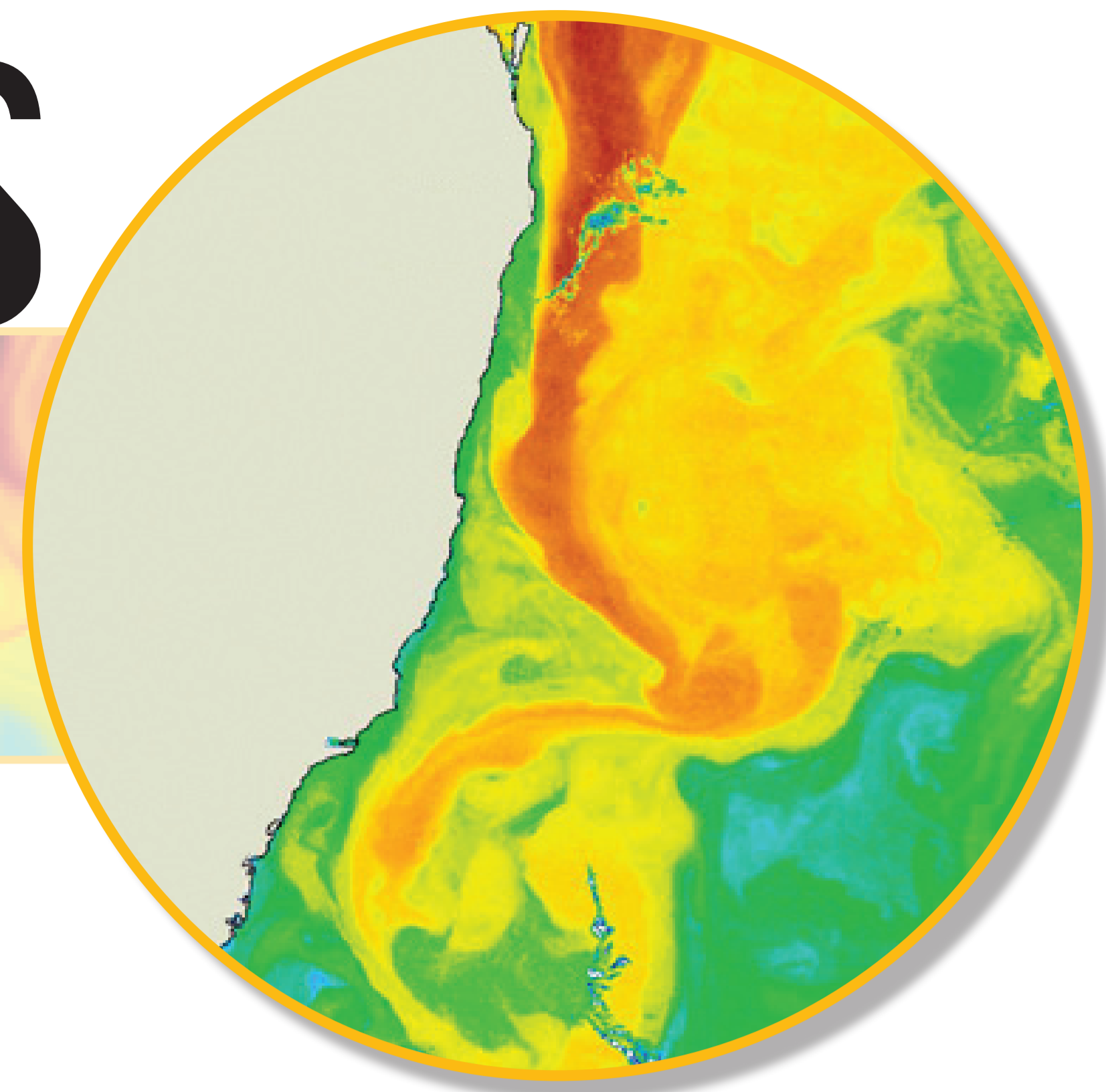


# DYNAMICS of a monster eddy

Peter R. Oke *and* David A. Griffin



A cold-core eddy with a sea-level anomaly of 1 m and a sub-surface temperature anomaly of 8° at 200 m depth lurked off the coast of Sydney, Australia for several months during the austral summer of 2006/2007. The associated cold-water anomalies disappointed beach goers and stunned scientists, attracting media attention around the world. The monster eddy is one of the most intense eddies ever observed in the Tasman Sea. An eddy-resolving ocean reanalysis system is used to recreate the eddy and to explore its three-dimensional structure.

## Reanalysis system

The BlueLink ReANalysis (BRAN; version 2.2) employs an ensemble data assimilation system together with a 0.1° resolution ocean model to synthesise ocean observations including satellite altimetry and sea-surface temperature (SST), and *in situ* T/S profiles from Argo (Oke *et al.* 2008).

## Results

Following a series of strong wind-driven upwelling events BRAN shows an intense cold-core eddy develop off the coast of Sydney (Figure 1).

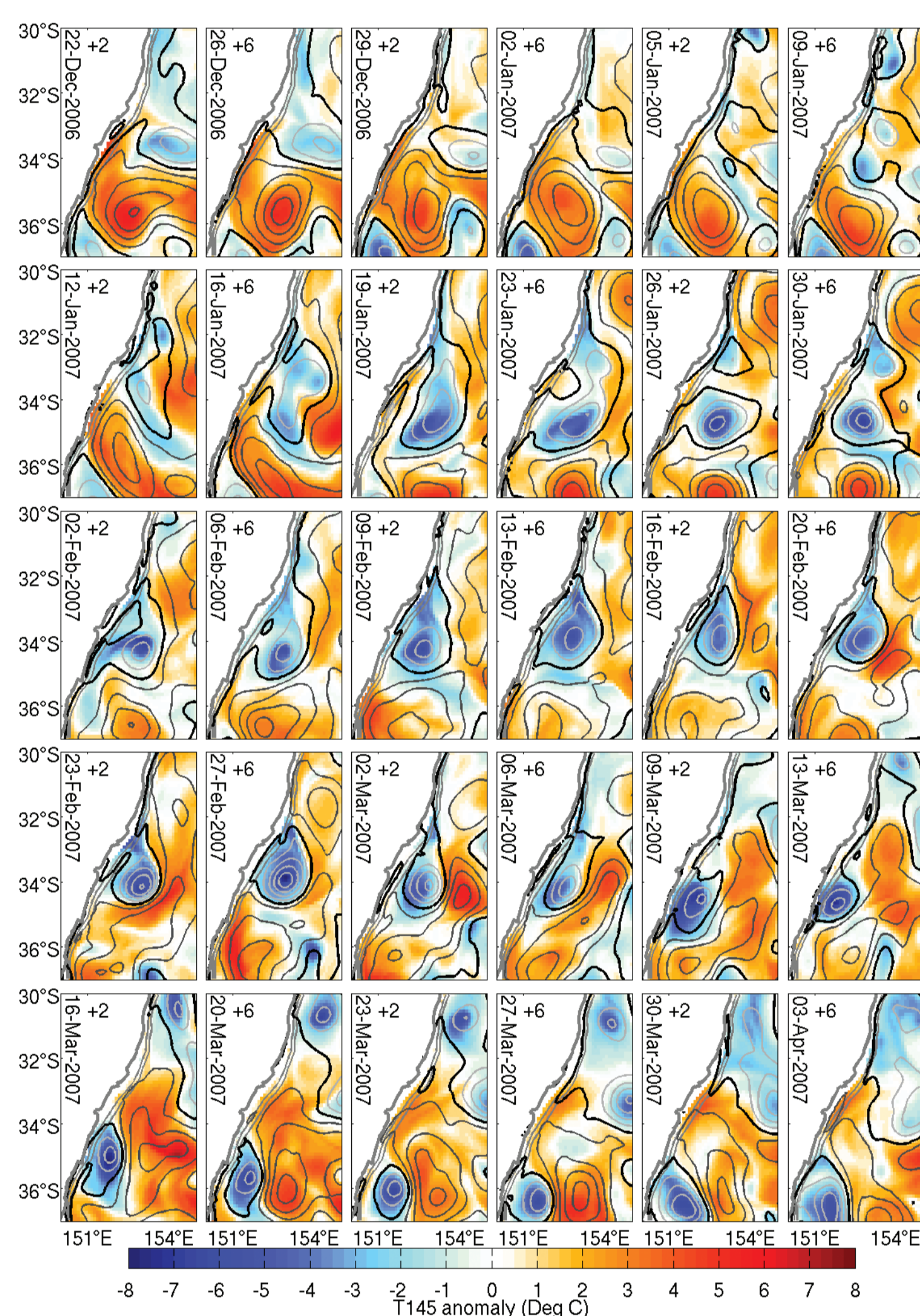
Comparisons with data from unassimilated tide gauges (not shown), SST (Figure 2) and Argo profiles (Figure 3) indicates that the circulation in BRAN is realistic.

In its first 3 weeks of "life" the currents associated with the monster eddy penetrate all the way to the ocean floor (Figure 4).

After moving towards the continental shelf, the deep currents encounter the continental slope and are squeezed for room – accelerate and induce strong vertical flows as the rotating eddy is forced to ride up the slope in the ocean abyss. The vertical flow that results extends all the way to the surface, causing upwelling to the eddy's south, and downwelling to its north (Figure 5 and 6).

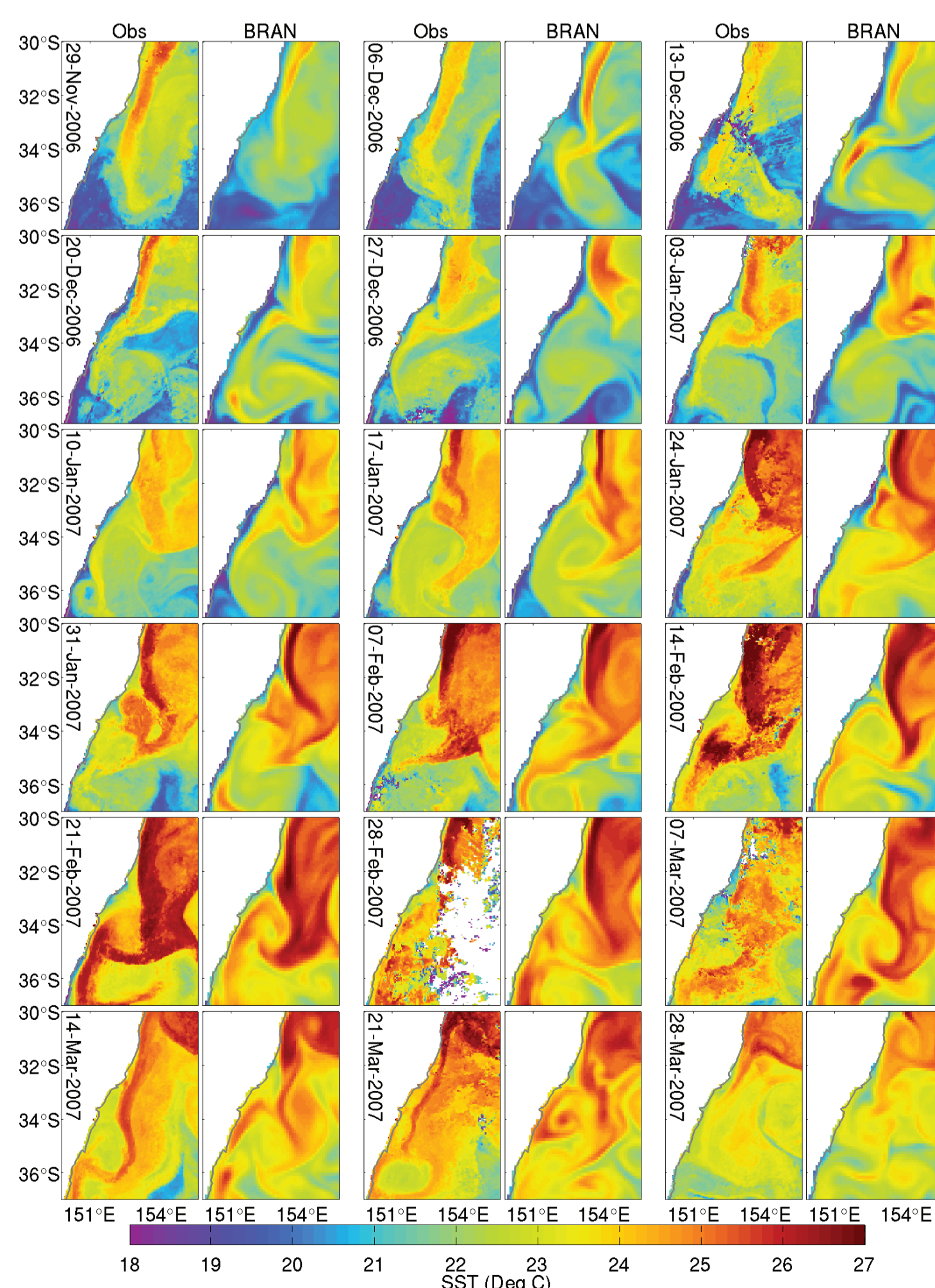
Satellite images of ocean colour (Figure 7) indicate that the monster eddy impacted not only holiday makers, but also the ocean's ecosystem.

Figure 1 >>



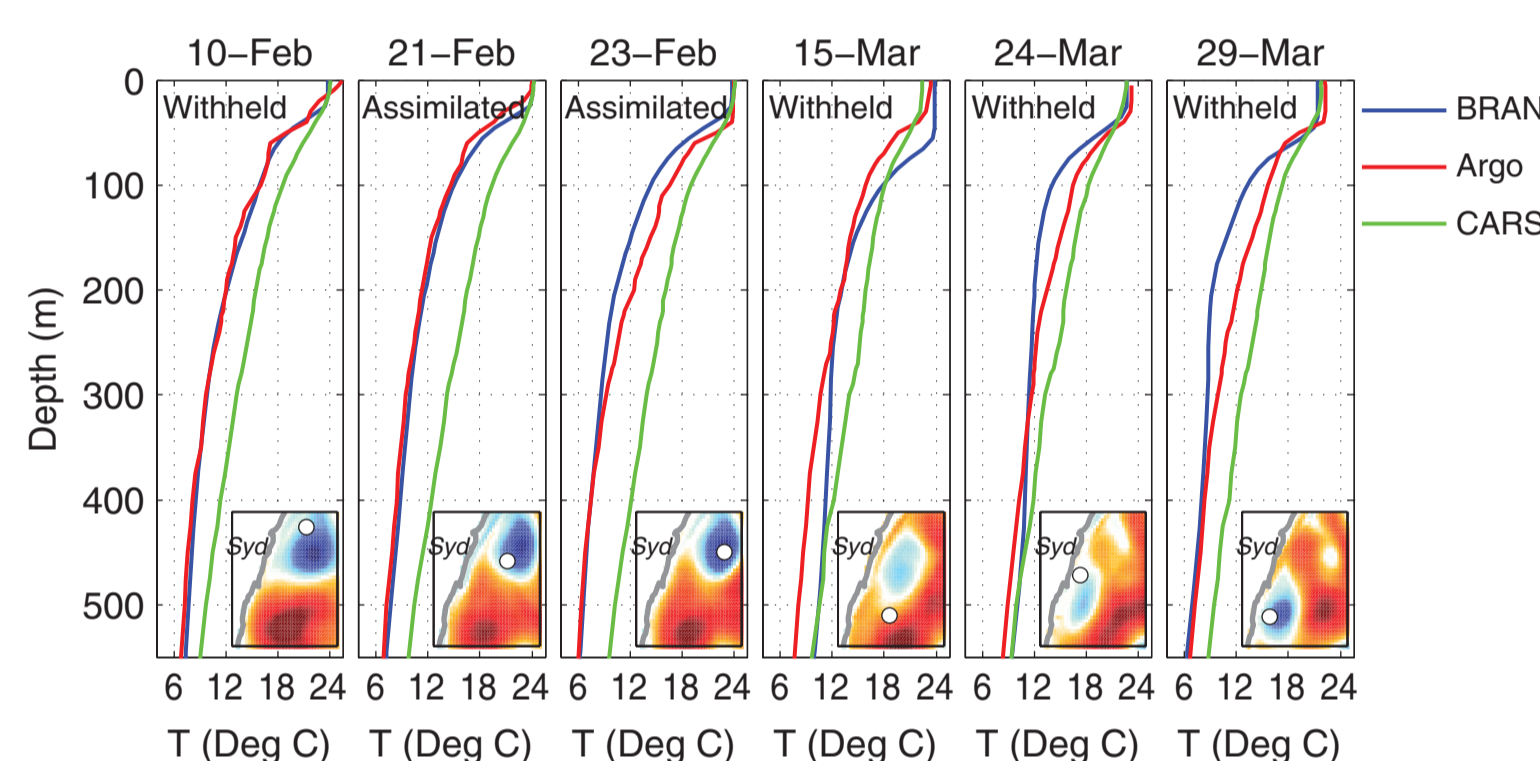
Time sequence of SLA (contoured; intervals = 0.2 m) and temperature anomalies at 145 m depth (colour).

Figure 2 >>



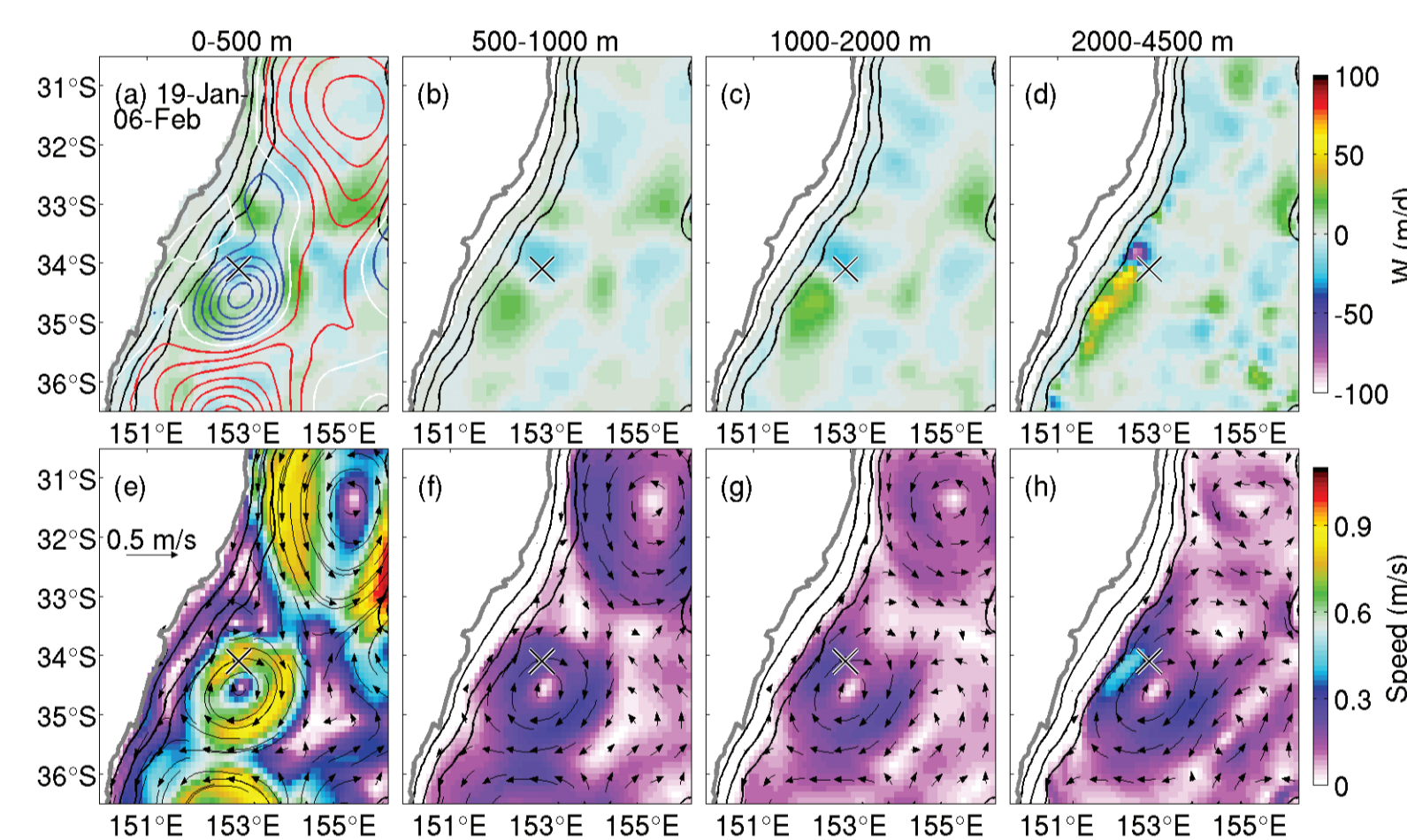
Comparison of observed (columns 1, 3 and 5) and reanalysed (columns 2, 4 and 6) SST.

Figure 3 >>



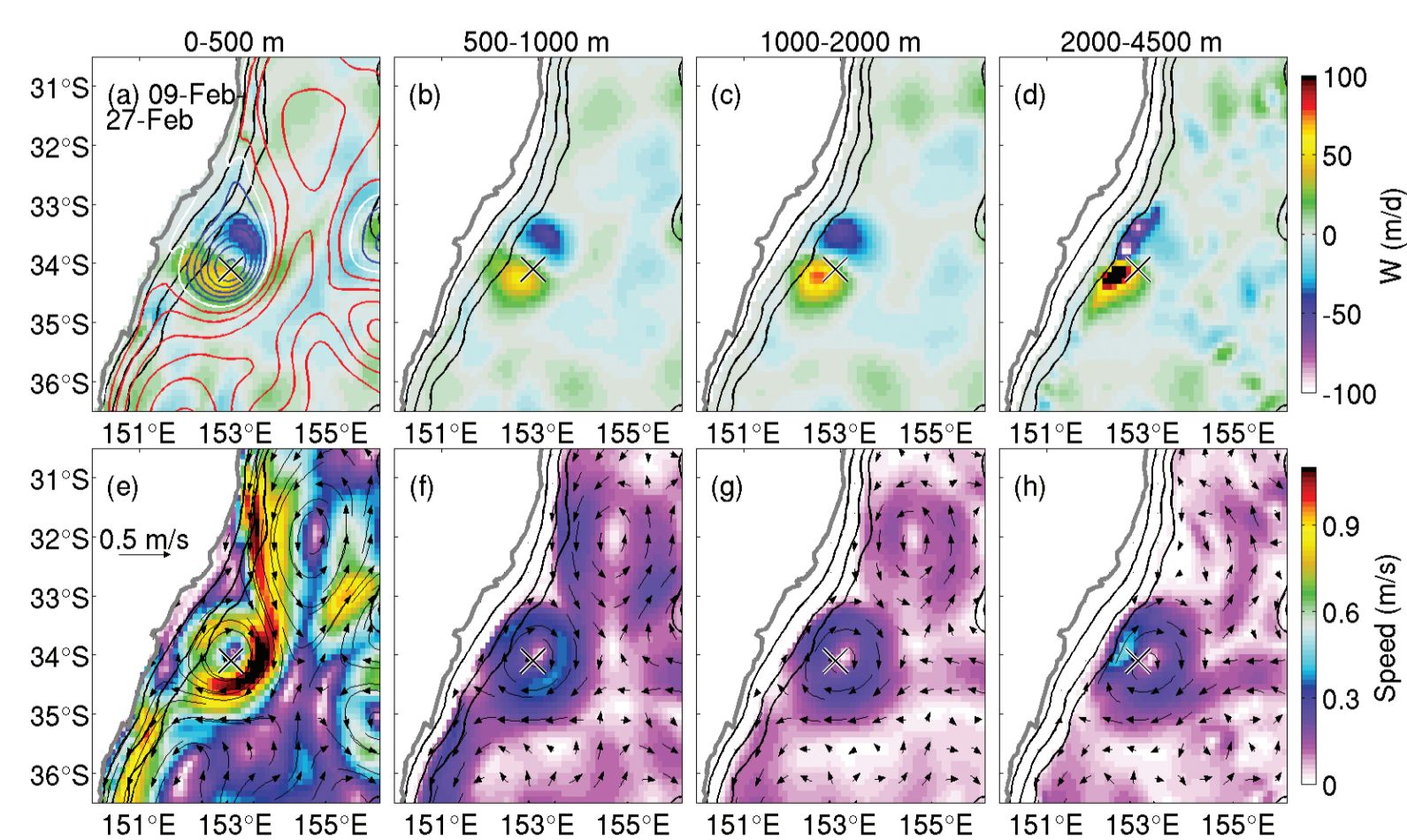
Comparisons of reanalysed (blue), observed (red) and climatological (green) temperature profiles around the eddy. The inset shows the SLA (blue is negative; red is positive) and the Argo float position.

Figure 4 >>



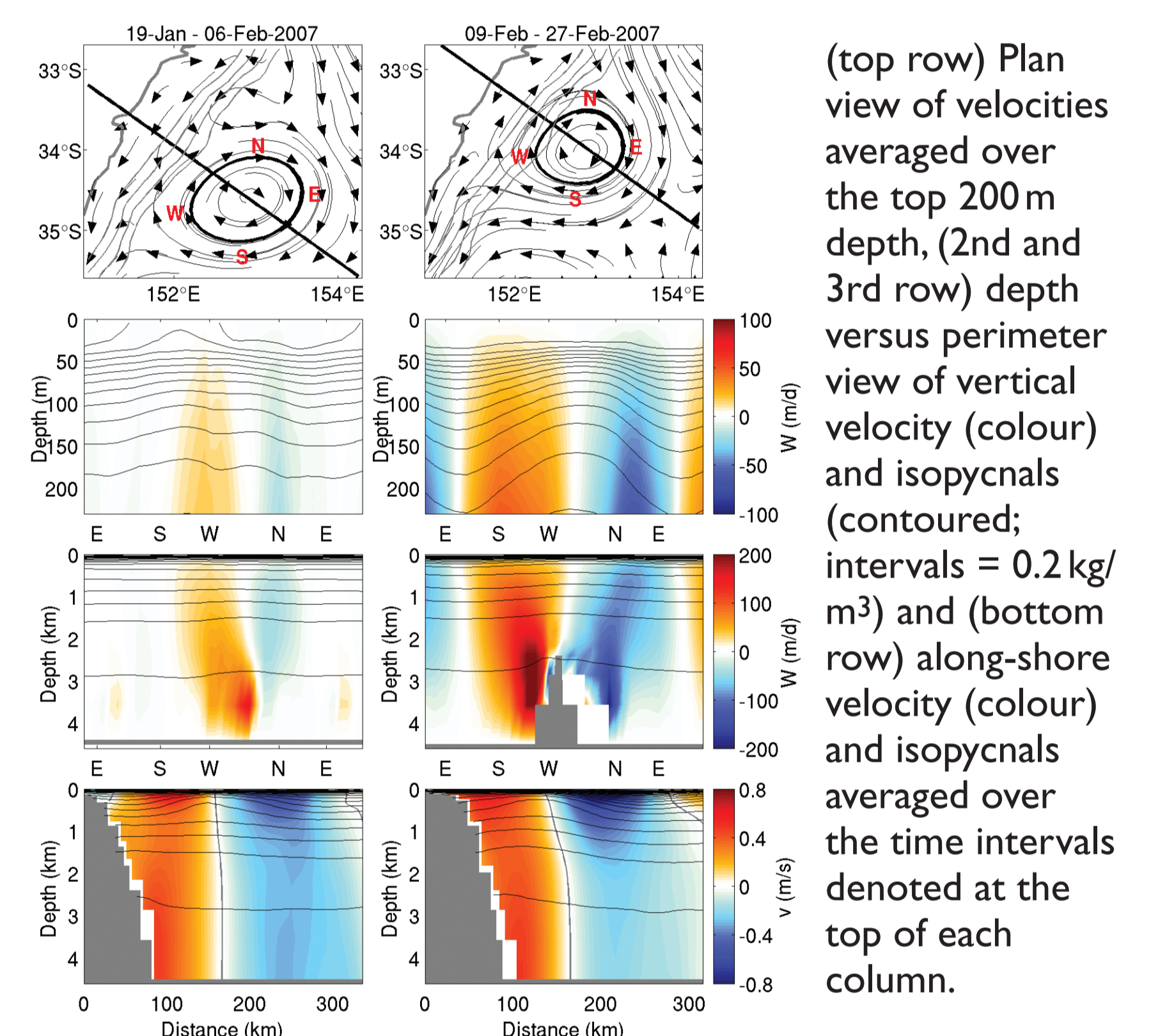
(a-d) Vertical velocity and (e-h) horizontal velocities vertically averaged between (a, e) 0-500 m; (b, f) 500-1000 m; (c, g) 1000-2000 m; and (d, h) 2000-4500 m; averaged between 19 January and 6 February, 2007. SLA is contoured in panel (a) (blue is negative, red is positive, white is zero, contour interval is 0.2 m). The 200, 1000 and 4000 m isobath is contoured in each panel.

Figure 5 >>



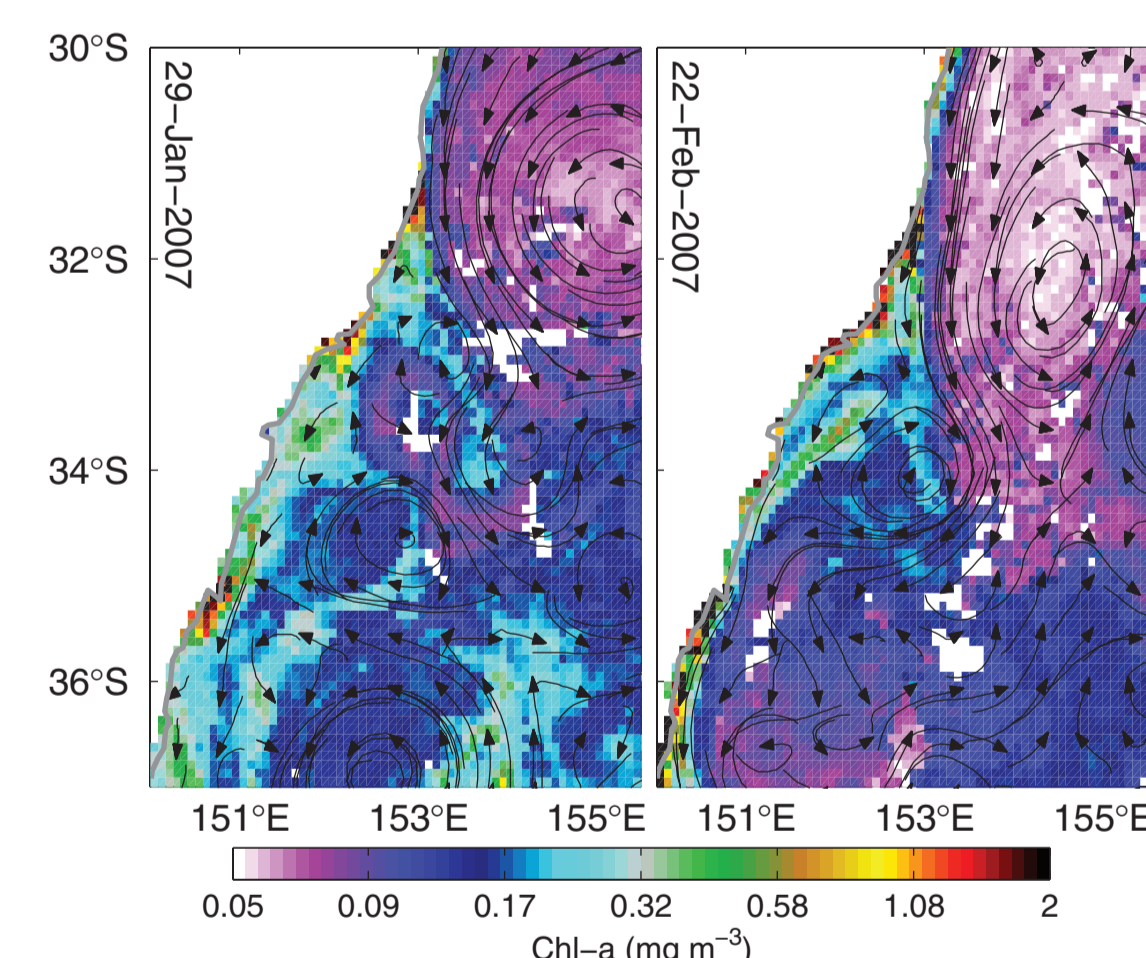
As for Figure 4, except for fields averaged between 9 February and 27 February, 2007.

Figure 6 >>



(top row) Plan view of velocities averaged over the top 200 m depth, (2nd and 3rd row) depth versus perimeter view of vertical velocity (colour) and isopycnals (contoured; intervals = 0.2 kg/m<sup>3</sup>) and (bottom row) along-shore velocity (colour) and isopycnals averaged over the time intervals denoted at the top of each column.

Figure 7 >>



Chl-a from MODIS and SeaWiFS data.

## Conclusion

The monster eddy of 2007 was a cold-core eddy off Sydney Australia. With the aid of an eddy-resolving ocean reanalysis, the three-dimensional structure of the eddy is explored – showing a surprising vertical circulation that results when the eddy encounters the deep topography of the continental slope.

## References

Oke, P.R., G. B. Brassington, D. A. Griffin and A. Schiller, 2008: The BlueLink Ocean Data Assimilation System (BODAS), Ocean Modelling, 21, 46-70, doi:10.1016/j.ocemod.2007.11.002.

## Further information

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