

Response to the 2nd Reviewer's Comments:

General Comments:

- “Regarding the BATS model, I think (but you can confirm it to me) it do not have a river routine transport but put directly the runoff at each grid cell at the appropriate river mouth.”

As mentioned by the reviewer, the BATS sub-model does not have a river runoff component to calculate the river discharge in the basins, but it calculates the surface runoff in each grid cell and this can be used as an input to a river routing model. As we indicated in the manuscript, we plan to add a realistic river runoff/routing component to the coupled modeling system in the near future.

- “You performed simulation using the ERA Interim as boundary conditions. Why did you not performed the simulating over the all period: 1979-2010? and reduce your study to 1999-2008?”

We selected the 1996-2008 periods due to the lack of the available observational data to compare the model results. For example, ARCLAKE dataset, which is used to compare the seasonal sea surface temperature, covers only 1995-2008 periods. Similarly, CSL (Caspian Sea Level) altimetry observations (Ref. 1) with high temporal resolution are also available only between 1992-present. We also compare the sea surface wind speed (not included into manuscript) with NOAA Blended Sea wind dataset (Ref. 2), which is available only for 1987-present. The selection of the simulation period was mainly driven by needs of the observational data, which is used to fully investigate the coupled model results. Limited computing resources was a secondary limitation.

Ref. 1:

http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/gr_regional_chart.cfm?regionid=stans®ion=&reservoir_name=Caspian

Ref. 2:

<http://www.ncdc.noaa.gov/oa/rsad/air-sea/seawinds.html>

Specific Comments:

- “Introduction: “the CSL has fluctuated dramatically.... increasing again by about two meters in the late 1970s and early 1980s”. If you start your simulation in 1979, you could see if you can reproduce those fluctuations and use then as a benchmark to validate your model.”

We plan to perform a simulation for the full historical period (1970-2012) after completing the implementation of the basic river runoff component. We agree that it is good idea to thoroughly investigate the extreme water drop periods of the past to see the real added value of the coupled modeling system, and assess our ability to simulate the impact of climate change on the CSL in the future.

- “You describe the different convection schemes available in your model. Did you try to test them to correct your biais in Qs and cloud cover? It would be very interesting for the reduction of the biais as the strongest biais is in your heat budget”

A wide set of sensitivity tests were performed to reduce the bias in surface fluxes and also precipitation. The detailed information about the RCM validation (both 20 and 50 km resolution) can be found in the following paper.

Turuncoglu, UU., Elguindi, N., Girogi, F., Fournier, N., Giuliani, G., 2012. Development and validation of a regional coupled atmosphere lake model for the Caspian Sea Basin, *Climate Dynamics*, doi:10.1007/s00382-012-1623-6

- “Section 3: prescribed SST: which data set did you used?”

We used weekly mean OISST dataset. Detailed information can be found in the following link.

<http://www.esrl.noaa.gov/psd/data/gridded/data.noaa.oisst.v2.html>

The sentence in page 3915 line 7 will be changed to "...simulation (ATM.STD) using prescribed SST (OISST; Reynolds et al, 2002) data for the Caspian Sea" and we will also include the following reference to the manuscript.

Reynolds, R.W., N.A. Rayner, T.M. Smith, D.C. Stokes, and W. Wang, 2002: An improved in situ and satellite SST analysis for climate. *J. Climate*, 15, 1609-1625.

- "Section 3.2.: The global river discharge data: Are they covering the all period of the simulation?"

The used river discharge data are the combination of the different data sources (Global Runoff Data Center and personal communication) and it includes main rivers. In this study we used monthly average discharge and it covers the entire simulation period.

- "Section 3.4.2.: Fig. 11: Why such a difference with the observations? The model receives river discharge from observations so the difference in SSS should not be so different?"

This is mainly discussed between page 3922-line 20 and page 3923-line 12. When we investigated the main reason of the relatively low saline water in the northern CAS, we found large differences among the observational data and in the literature. The results that are shown in this study have lower salinity values than the Ibrayev's (2001) results, but they are close to the results of the Kara et al, 2010 and Kosarev and Yablonskaya (1994). We believe that the observational data (Ibrayev et al, 2001) has high uncertainty especially in the northern Caspian Sea.

- "Section 3.4.4.: The trend in the CSL is for me a model drift? are you sure that your model is equilibrium? It would be nice to see figure of the T3D and S3D over the spin-up and simulation period."

As mentioned in the manuscript, the balance between evaporation, precipitation and river discharge is the important factor in predicting CSL. The preliminary simulation results show that the model overestimates the evaporation (25% percent), especially in winter and summer when it is compared with the Ibrayev's (2001) results, but this is not balanced with precipitation. In addition to this imbalance, we did not apply any correction to the observational river discharge data to conserve the water balance. As a result of these factors, the coupled model seems to have a negative trend in the CSL calculation, however this could be corrected by adding a correction factor to the coupled modeling system. Currently, we are trying to implement a basic river discharge component based on the balance between precipitation, evaporation and runoff over the selected basins (Volga, Kura and Ural). In this implementation, we plan to add a monthly or seasonal correction factor based on the results of our previous work (Turuncoglu et al, 2012).

In addition, especially for closed basins like CAS, it is important to use the water-balanced year (net change in the Caspian Sea Level - CSL - will be zero) for the spin-up run because the same atmospheric forcing is used in a cyclic way (in this study for 4-years) in the ocean model until it reaches a steady state condition. If the selected year has a net gain or loss in the water balance, it might produce a drift and the sea level could drop/increase a couple of centimeters, but the total loss/gain would be a few meters after 15-year simulation period.

T3D and S3D plots, which belong to the 15-year spin-up run, can be seen at the end of this document. As seen in the plots, the model is able to reproduce the main characteristics of both temperature and salinity distribution.

Turuncoglu, UU., Elguindi, N., Girogi, F., Fournier, N., Giuliani, G., 2012. Development and validation of a regional coupled atmosphere lake model for the Caspian Sea Basin, *Climate Dynamics*, 10.1007/s00382-012-1623-6

- “You can also use HOAPS for the validation. It has a higher resolution than OAFUX.”

We also considered using the HOAPS (Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data) dataset previously but unfortunately it does not cover the Caspian Sea. It only has data over oceans and the seas. The rest of the water bodies such as lakes and inland seas (CAS) have missing values.

Supplementary Plots:

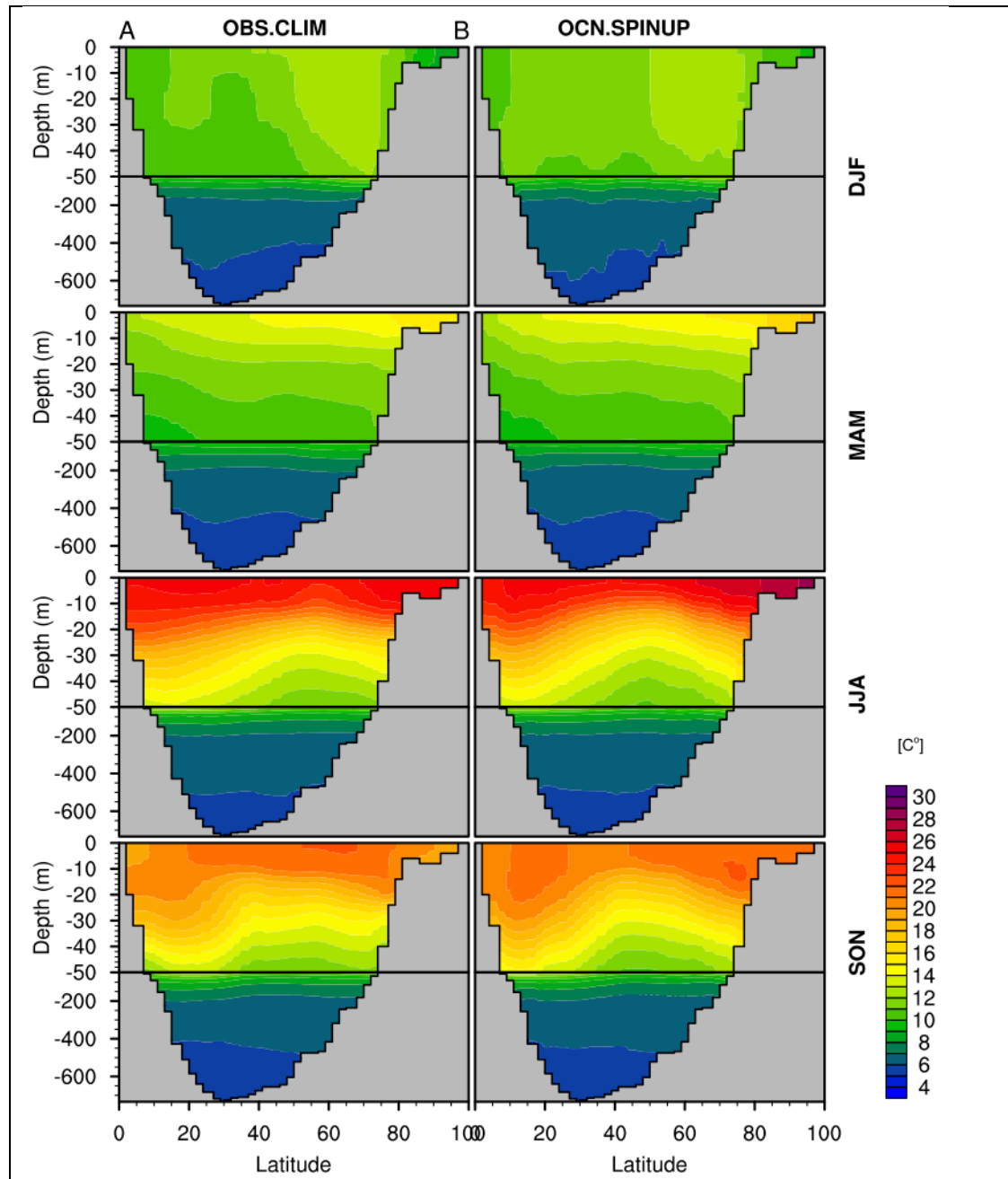


Figure 1 Vertical cross section (A-B, see Fig.3b in the manuscript) of seasonal temperature climatology of observation (from Ibrayev et al., 2001) and spin-up run. Also note that the depth axis is not monotonically increasing (zoomed in to first 50 m).

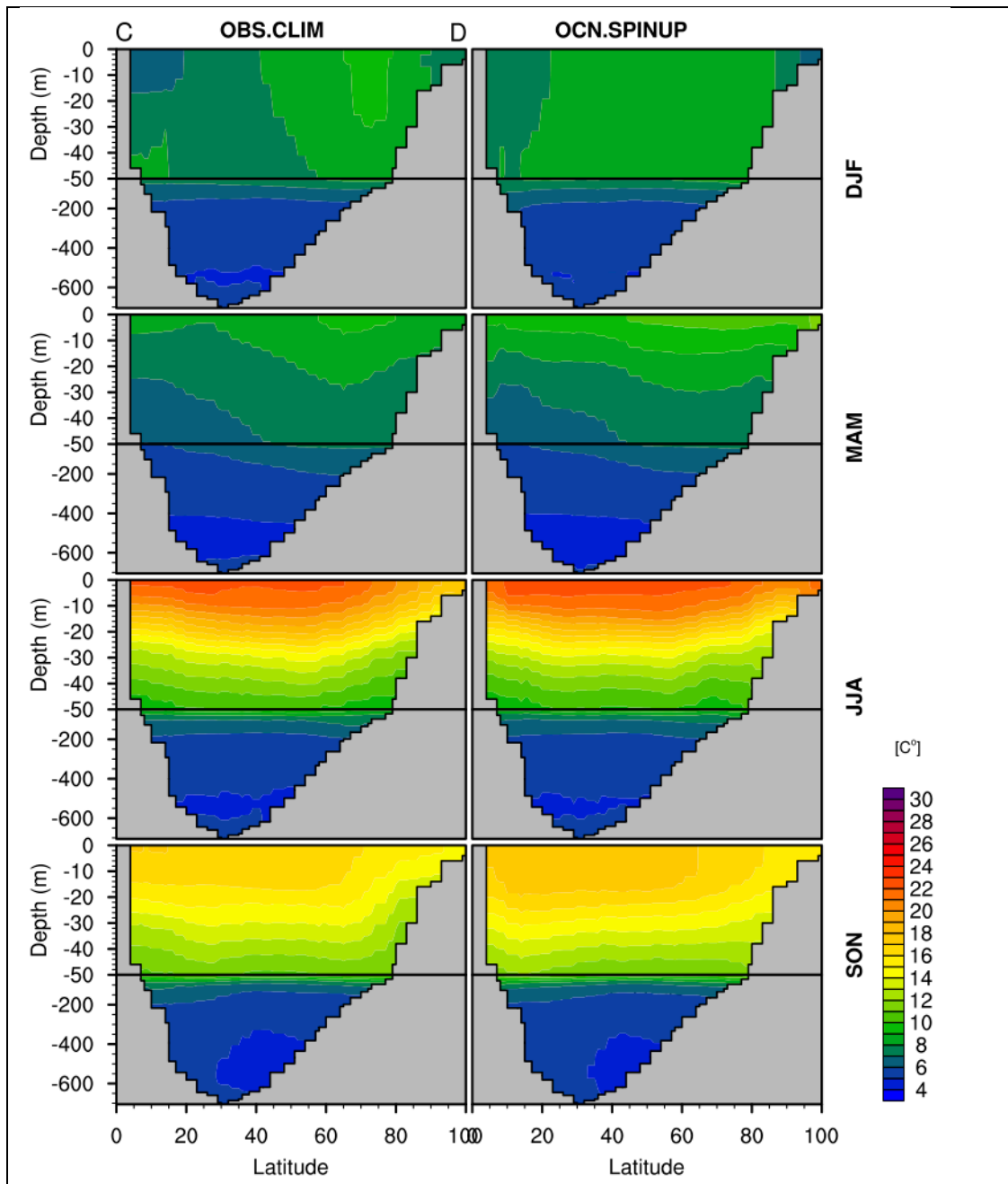


Figure 2 Same figure with Fig.1 but in this case cross section belongs to C-D direction (see Fig.3b in the manuscript).

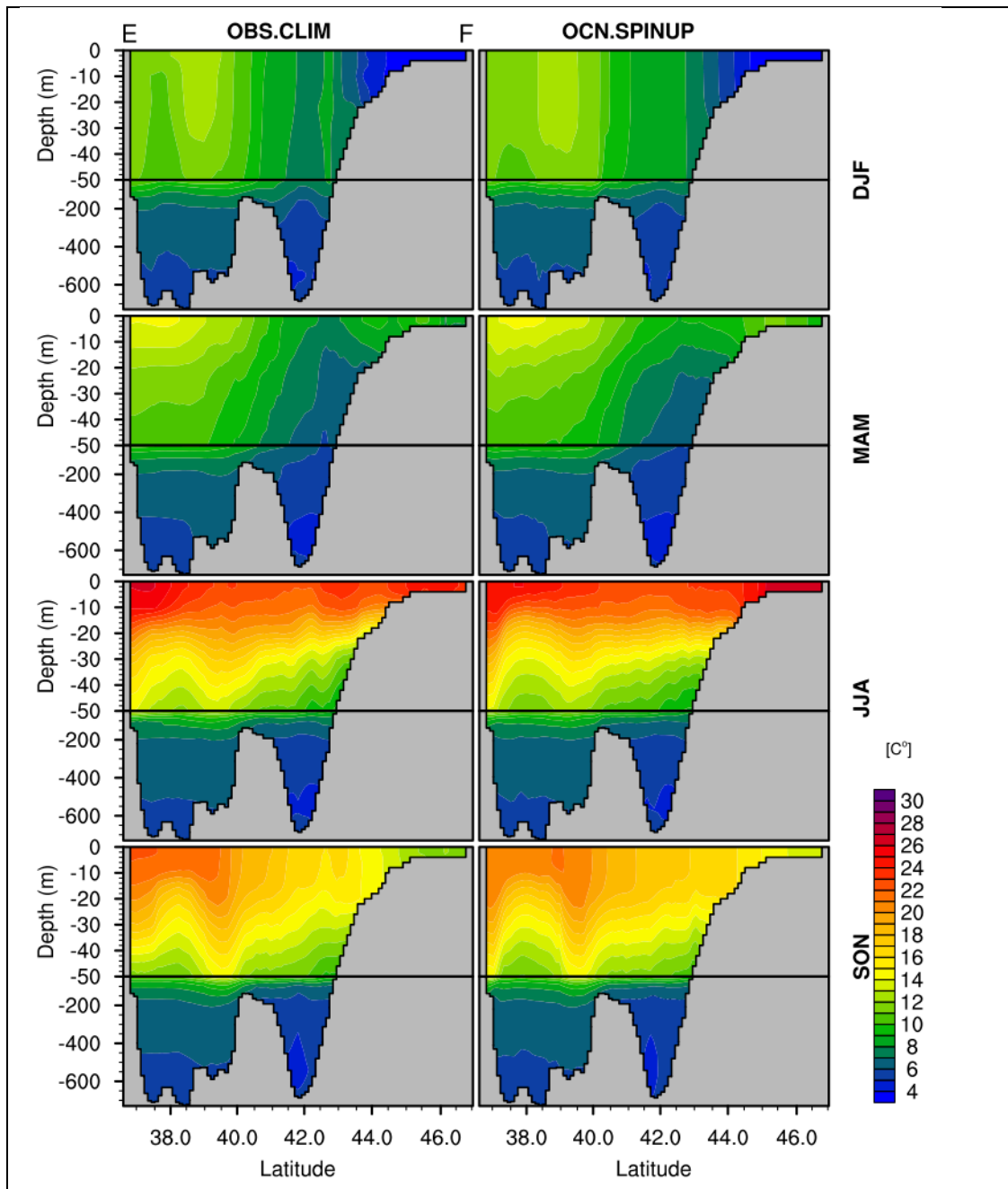


Figure 3 Same figure with Fig.1 but in this case cross section belongs to C-D direction (see Fig.3b in the manuscript).

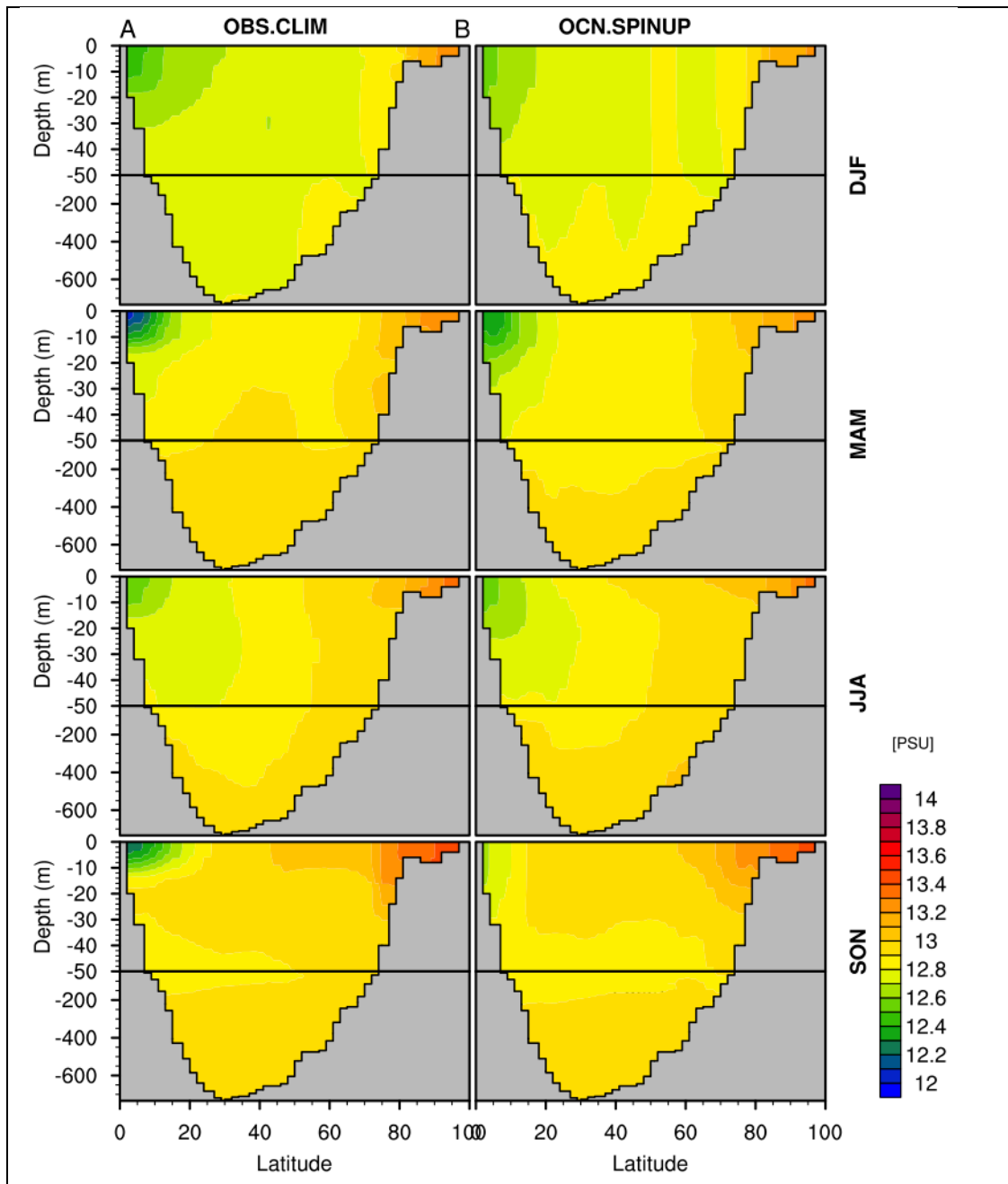


Figure 4 Vertical cross section (A-B, see Fig.3b in the manuscript) of seasonal salinity climatology of observation (from Ibrayev et al., 2001) and spin-up run. Also note that the depth axis is not monotonically increasing (zoomed in to first 50 m).

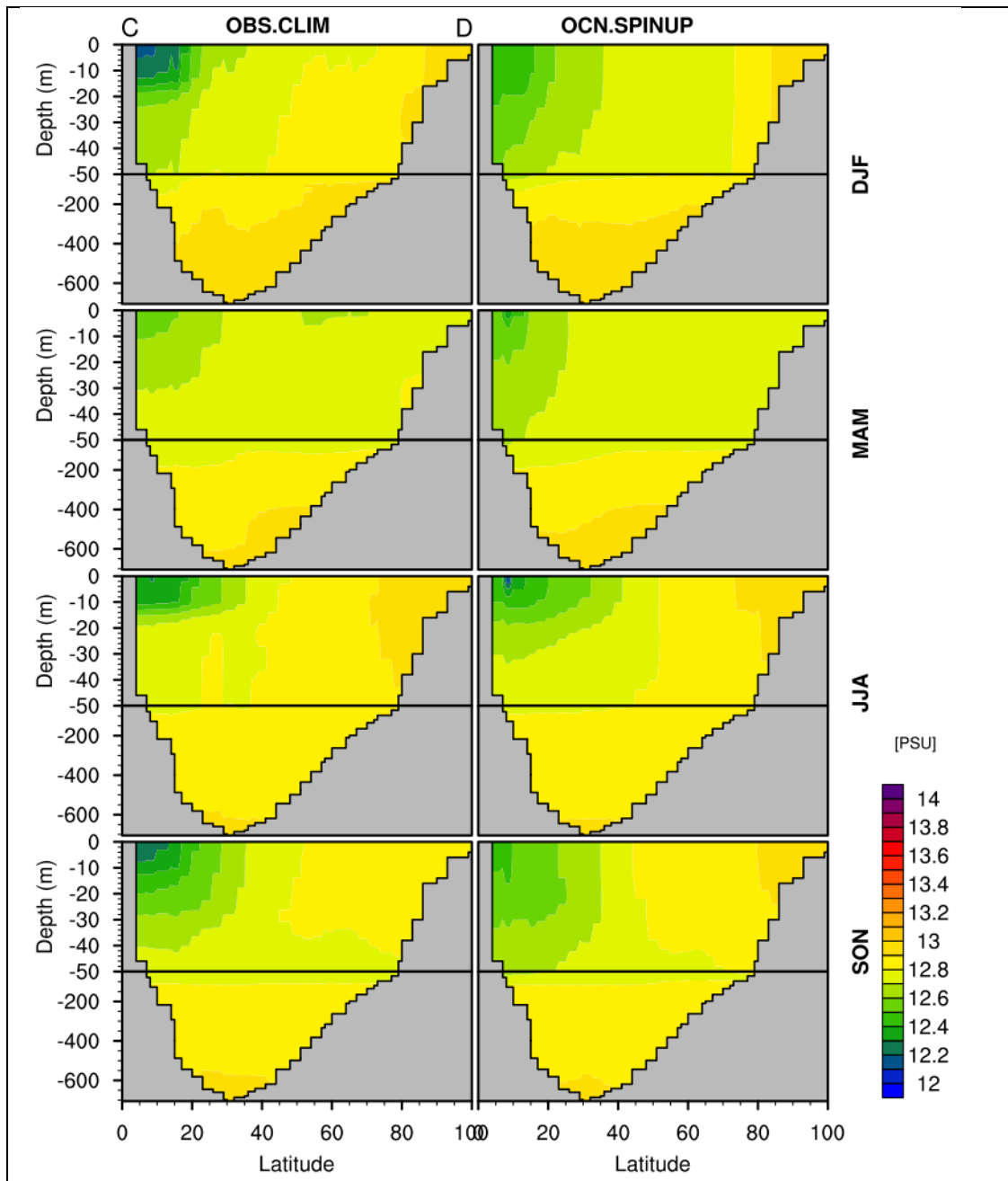


Figure 5 Same figure with Fig.4 but in this case cross section belongs to C-D direction (see Fig.3b in the manuscript).

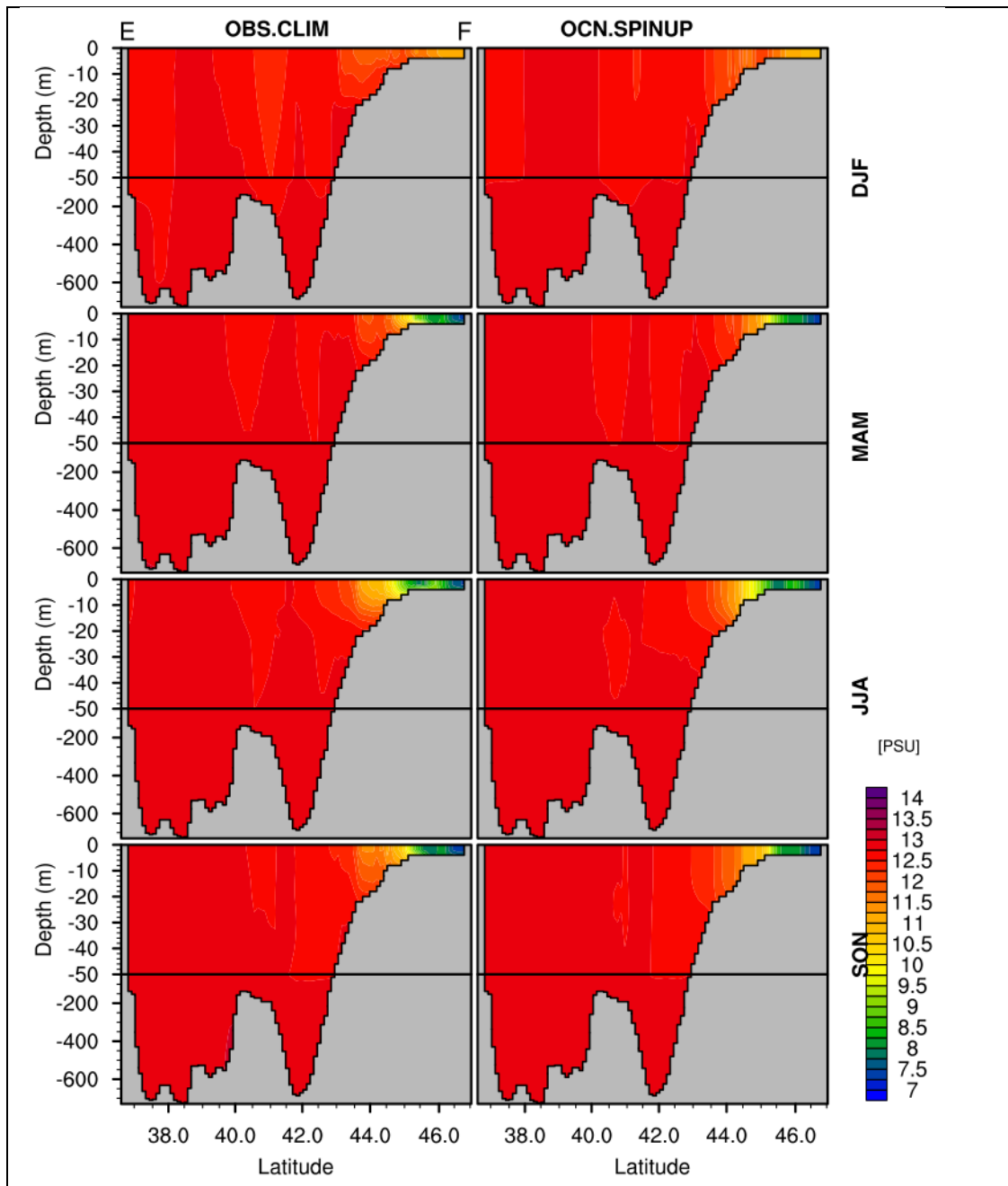


Figure 6 Same figure with Fig.4 but in this case cross section belongs to E-F direction (see Fig.3b in the manuscript).