Ocean Science

Supplement of

Dense water formation in the eastern Mediterranean under a global warming scenario

Iván M. Parras-Berrocal et al.
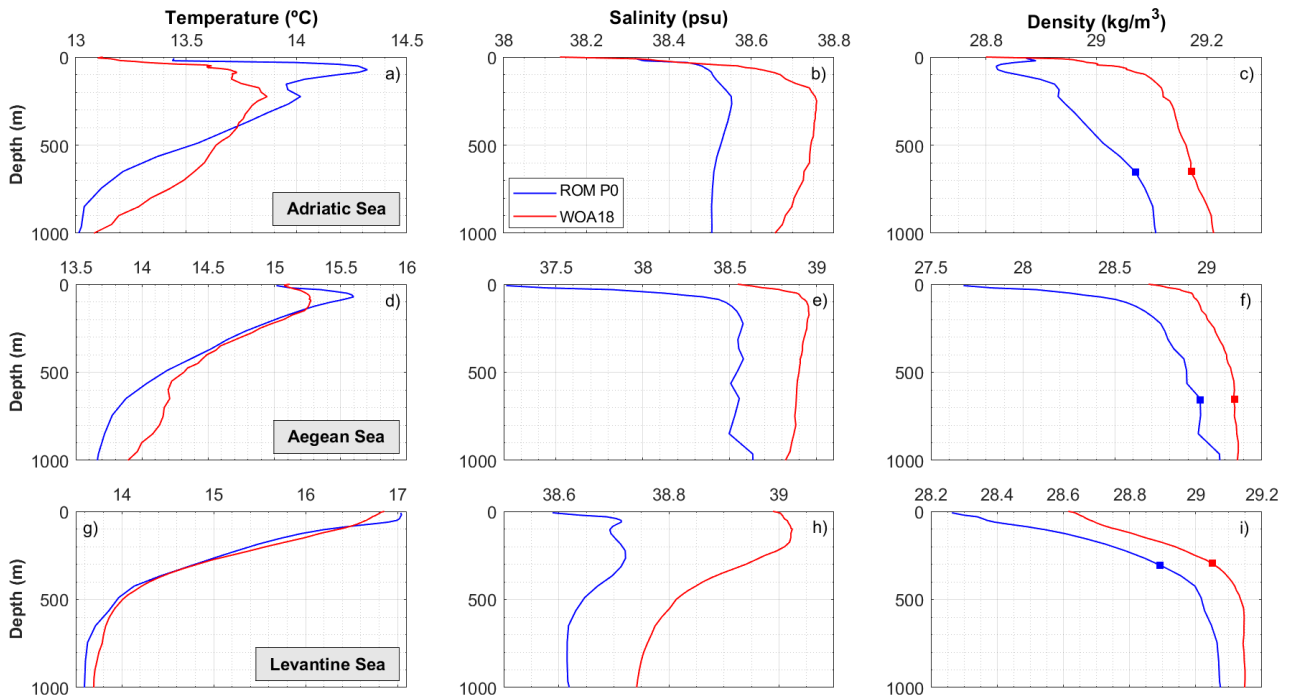
Correspondence to: Iván M. Parras-Berrocal (ivan.parras@uca.es)

Figure S1. Winter spatially and temporally averaged vertical profiles of (a, d, g) temperature (ºC), (b, e, h) salinity (psu) and (c, f, i) density (kg/m³) in the Adriatic Sea (top), Aegean Sea (middle), and Levantine Sea (bottom) for the 1980-2012 period. ROM_P0 (blue) and WOA18 (red). Note different ranges in horizontal axes.
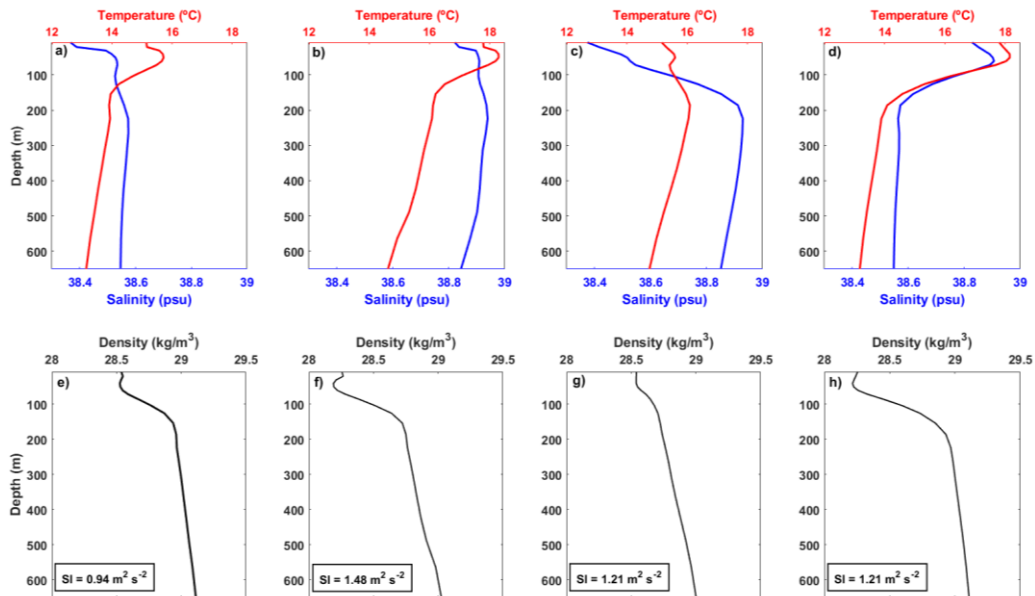

Figure S2. Spatially and temporally averaged vertical profiles of temperature, salinity and density in the Adriatic Sea values corresponding to the (a, e) historical period (1976-2005, Hist.), (b, f) future projection (2070-2099, Proj.) (c, g) Hist. features of AdSW (0-100 m depth) with the Proj. characteristics of LIW (100-650 m depth), and (d, h) Proj. properties of AdSW and Hist. for LIW. It is shown the stratification index (m²s⁻²) for each case (e, f, g, h).
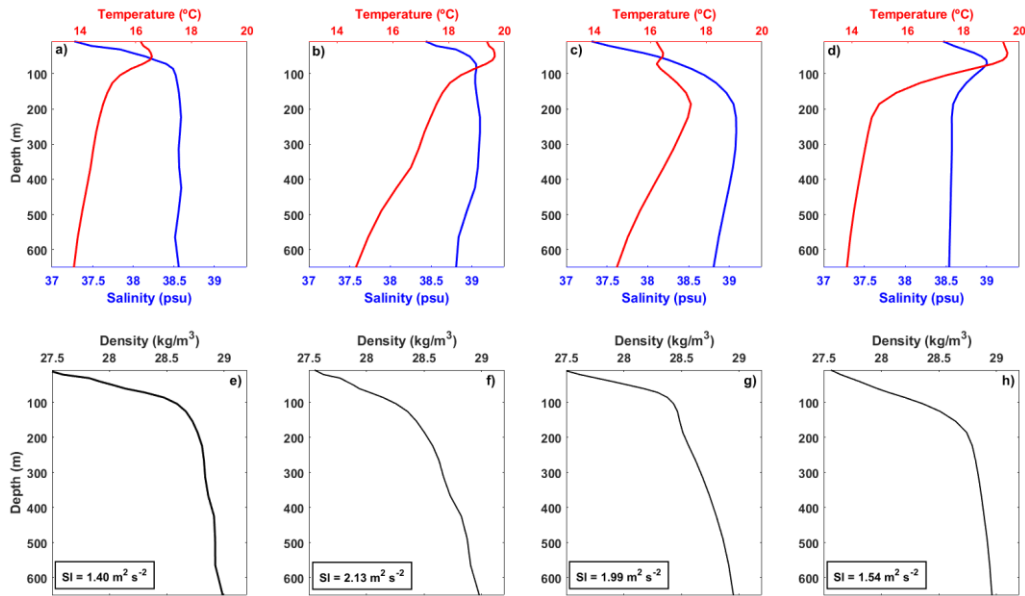
Figure S3. Spatially and temporally averaged vertical profiles of temperature, salinity and density in the Aegean Sea values corresponding to the (a, e) historical period (1976-2005, Hist.), (b, f) future projection (2070-2099, Proj.) (c, g) Hist. features of BSW/LSW (0-100 m depth) with the Proj. characteristics of CIW/LIW (100-650 m depth), and (d, h) Proj. properties of BSW/LSW and Hist. for CIW/LIW. It is shown the stratification index $(m^2 s^{-2})$ for each case (e, f, g, h).
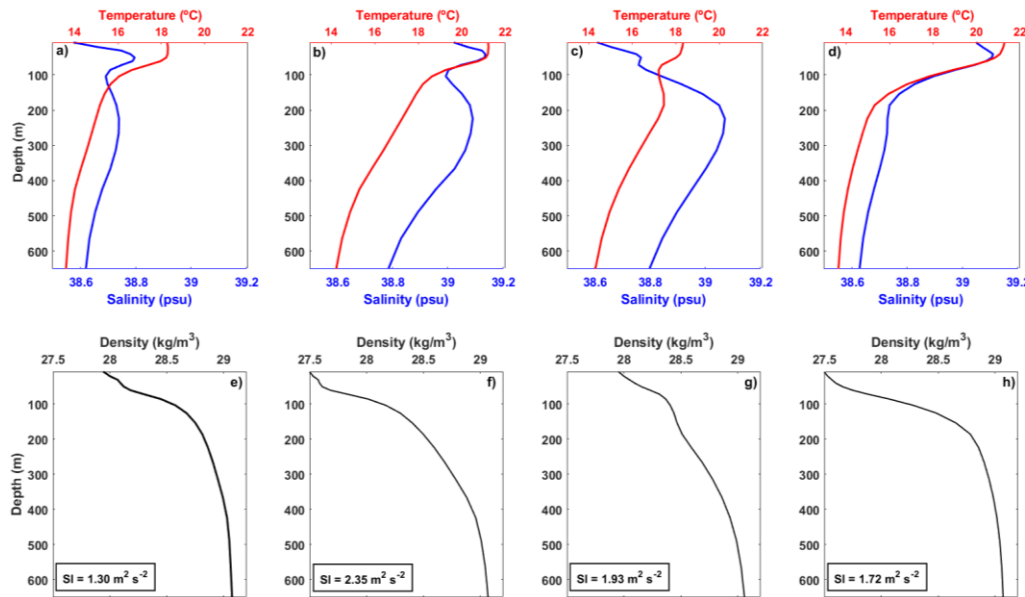

Figure S4. Spatially and temporally averaged vertical profiles of temperature, salinity and density in the Levantine Sea values corresponding to the (a, e) historical period (1976-2005, Hist.), (b, f) future projection (2070-2099, Proj.) (c, g) Hist. features of MAW/LSW (0-100 m depth) with the Proj. characteristics of LIW (100-650 m depth), and (d, h) Proj. properties of MAW/LSW and Hist. for LIW. It is shown the stratification index $(m^2 s^{-2})$ for each case (e, f, g, h).
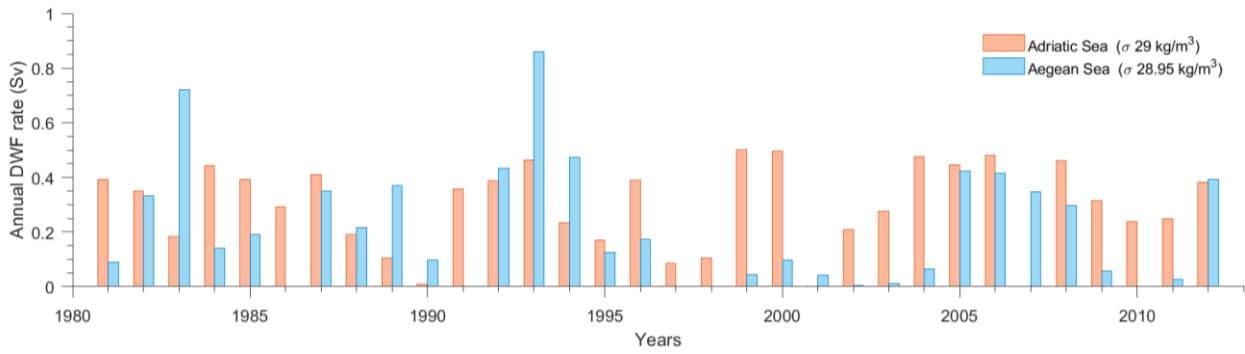
Figure S5. ROM_P0 annual formation rate (Sv) of deep water in the (a) Adriatic Sea and (b) Aegean Sea for the 1980-2012 period.
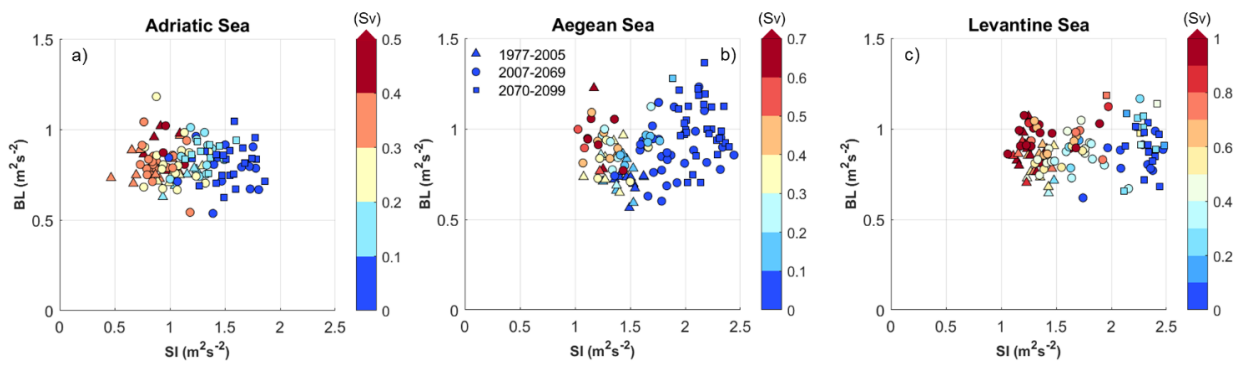

Figure S6. Scatterplots (1 marker per year) of the DWF rate (Sv) with respect to the SI in x-axis and BL in y-axis (m²s⁻²) for (a) Adriatic, (b) Aegean and (c) Levantine Seas. Triangles represent historical period (ROM_P1) from 1977 to 2005 while circles (2007-2069) and squares (2070-2099) represent RCP8.5 projection (ROM_P2).
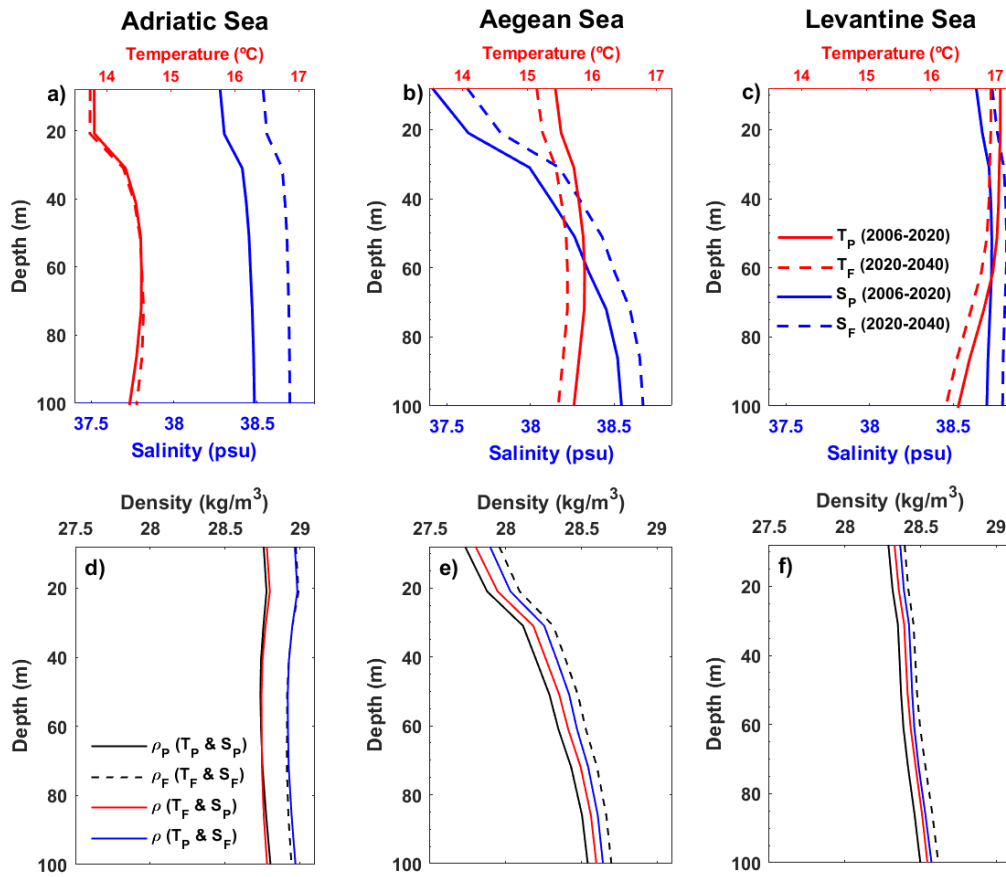
Figure S7. Spatially and temporally averaged vertical profiles (0-100 m depth) of temperature, salinity, and density for the 2006-2020 (present (p), solid lines) and 2020-2040 (future (f), dashed lines) periods in the Adriatic, Aegean, and Levantine Seas. (d, e, f) It is shown two synthetic density profiles: (red line) display the density profile keeping the salinity fixed (2006-2020) whereas the temperature is evolving (2020-2040) and (blue line) the opposite.
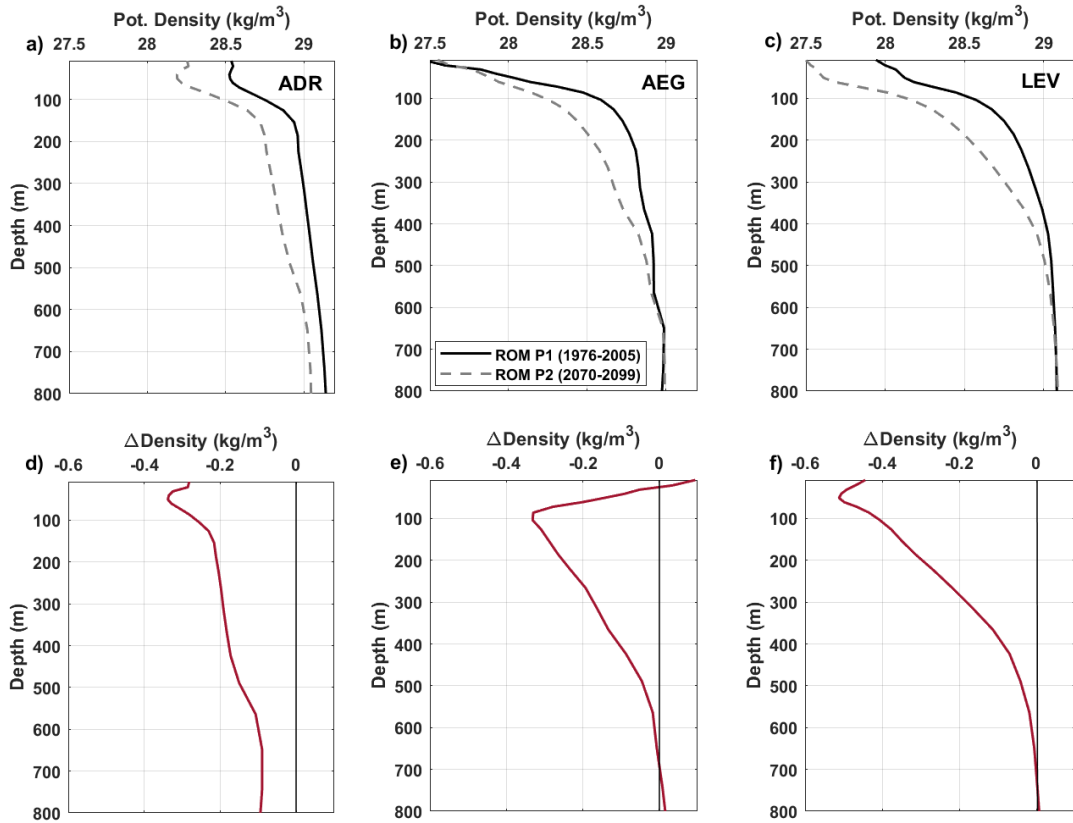
Figure S8. Spatially and temporally averaged vertical profiles of density in the (a) Adriatic, (b) Aegean, and (c) Levantine Seas values corresponding to the historical period (1976-2005), future projection (2070-2099). (d, e, f) The difference between future and historical averaged vertical profiles are also shown.
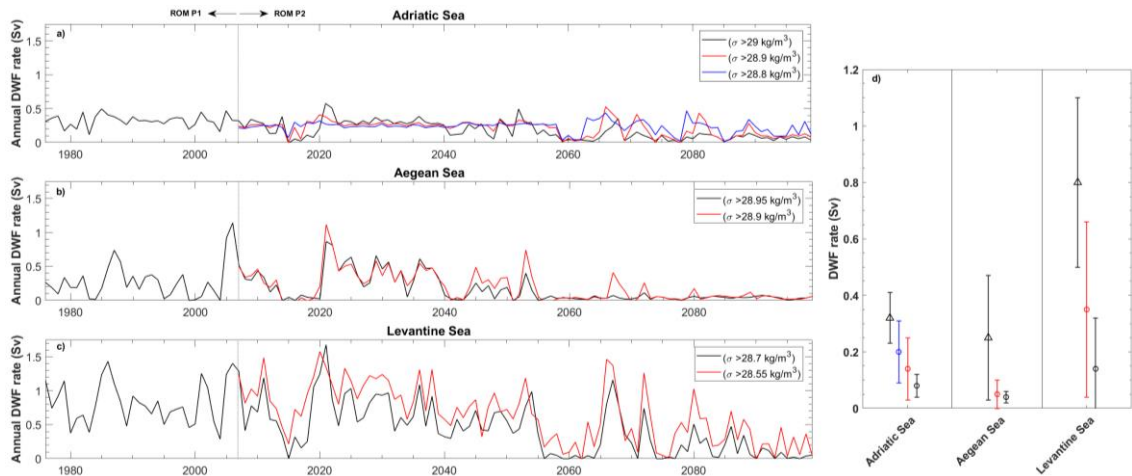

Figure S9. Time series (1976–2099) of ROM_P1 and ROM_P2 simulations of yearly DWF rate (Sv) averaged over (a) Adriatic Sea, (b) Aegean Sea and (c) Levantine Sea. d) Averaged DWF rates for 1976-2005 (triangle) and 2070-2099 (circle) periods.

Table S1. Results of Pettitt test for DWF rates and SI (calculated at 95% confidence level).

Sub-basin	DWF rates				SI			
	K	p-value	Shift	Change point year	K	p-value	Shift	Change point year
Adriatic Sea	2.94	0	Downward	2054	3.10	0	Upward	2039
Aegean Sea	2.46	0	Downward	2040	3.64	0	Upward	2040
Levantine Sea	2.92	0	Downward	2054	3.76	0	Upward	2041

Table S2. Quantification of the relative contributions of temperature and salinity to changes in density calculate from vertical profiles presented in Figure S7.

	Adriatic Sea		Aegean Sea		Levantine Sea	
	ρ (kg/m³)	% of each contribution	ρ (kg/m³)	% of each contribution	ρ (kg/m³)	% of each contribution
T_p-S_p (2006-2020)	28.76	-	28.23	-	28.38	-
T_f-S_f (2020-2040)	28.94	-	28.42		28.49	-
T_f-S_p	28.76	0%	28.29	31.6%	28.42	36.4%
T_p-S_f	28.94	100%	28.36	68.4%	28.45	63.6%