Skill Assessment of Three Earth System Model With a Common Marine Biogeochemistry - Supplementary Materials

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1. Ocean physics

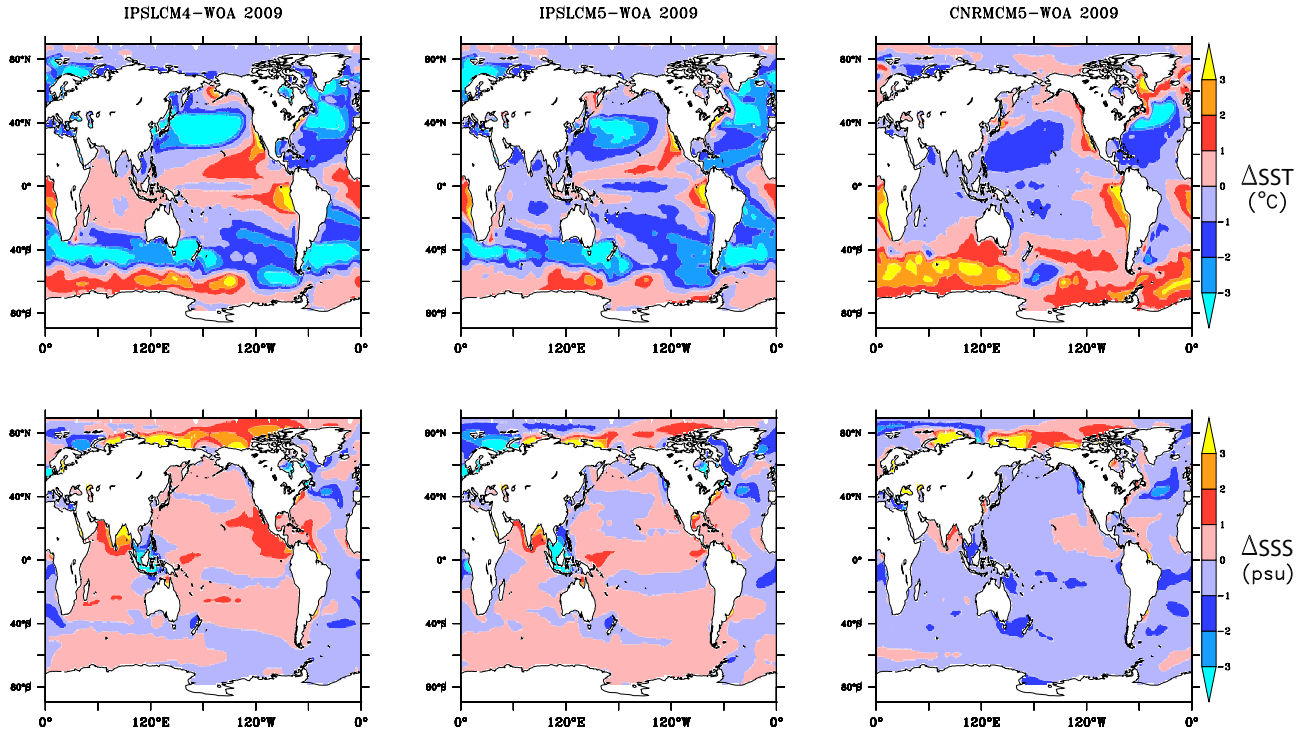

FIG. 1. Anomaly between modeled and observed annual-mean sea surface temperature (SST, in °C) and sea surface salinity (SSS) over 1985-2005 period for IPSLCM4, IPSLCM5 and CNRMCM5. Observed climatology is based on the World Ocean Atlas 2009 for SST (Loccarnini et al., 2009) and SSS (Antonov et al., 2009).

2. Marine biogeochemistry

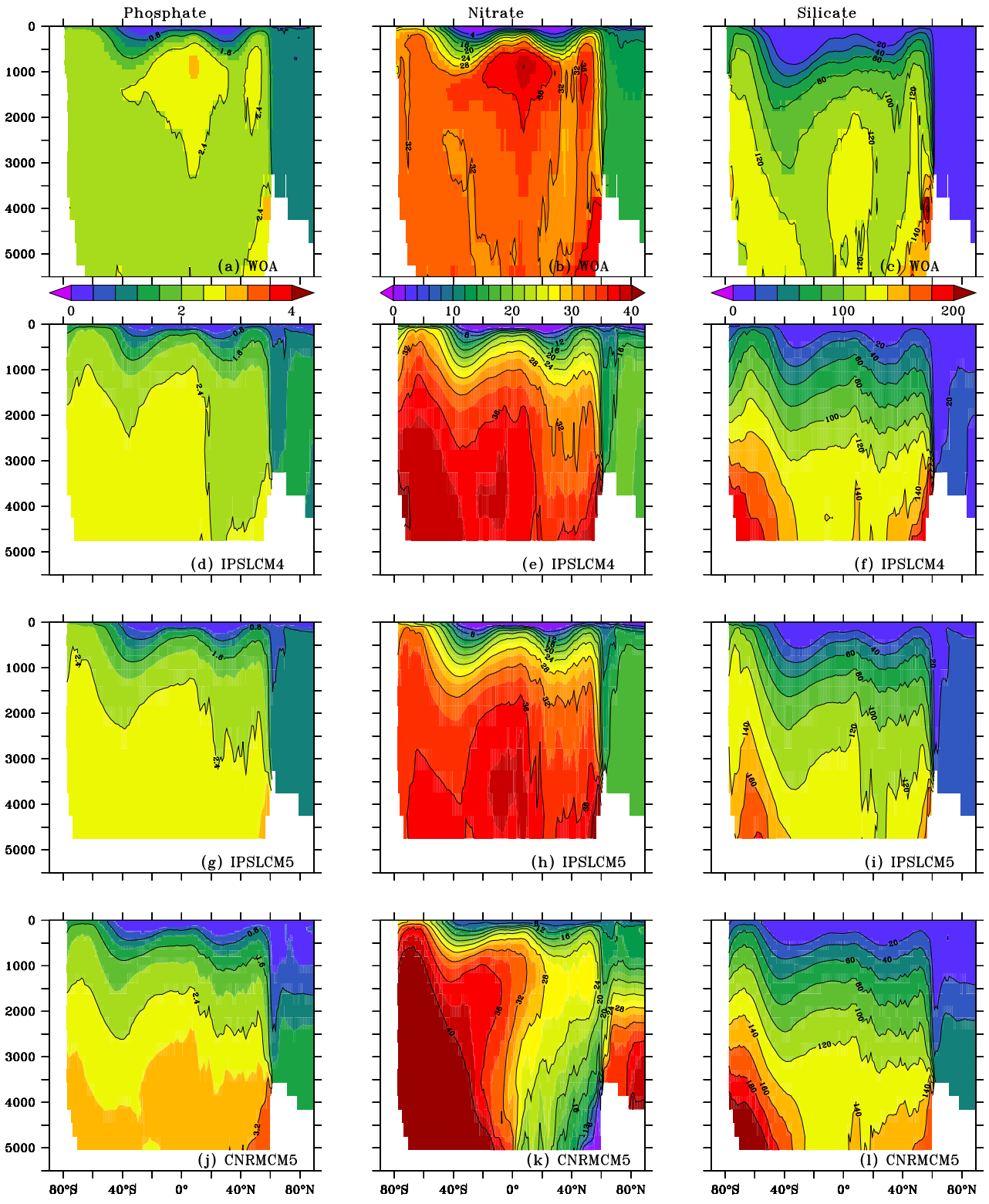

FIG. 2. Zonal average of seasonal climatology of macronutrients concentrations (in μmol L^{-1}) over 1995-2005 period. Phosphate, nitrate, silicate zonal average concentrations are presented from left to right for IPSLCM4, IPSLCM5 and CNRMCM5 (top to bottom). Observed climatology is based on World Ocean Atlas 2009 (Garcia et al., 2009).

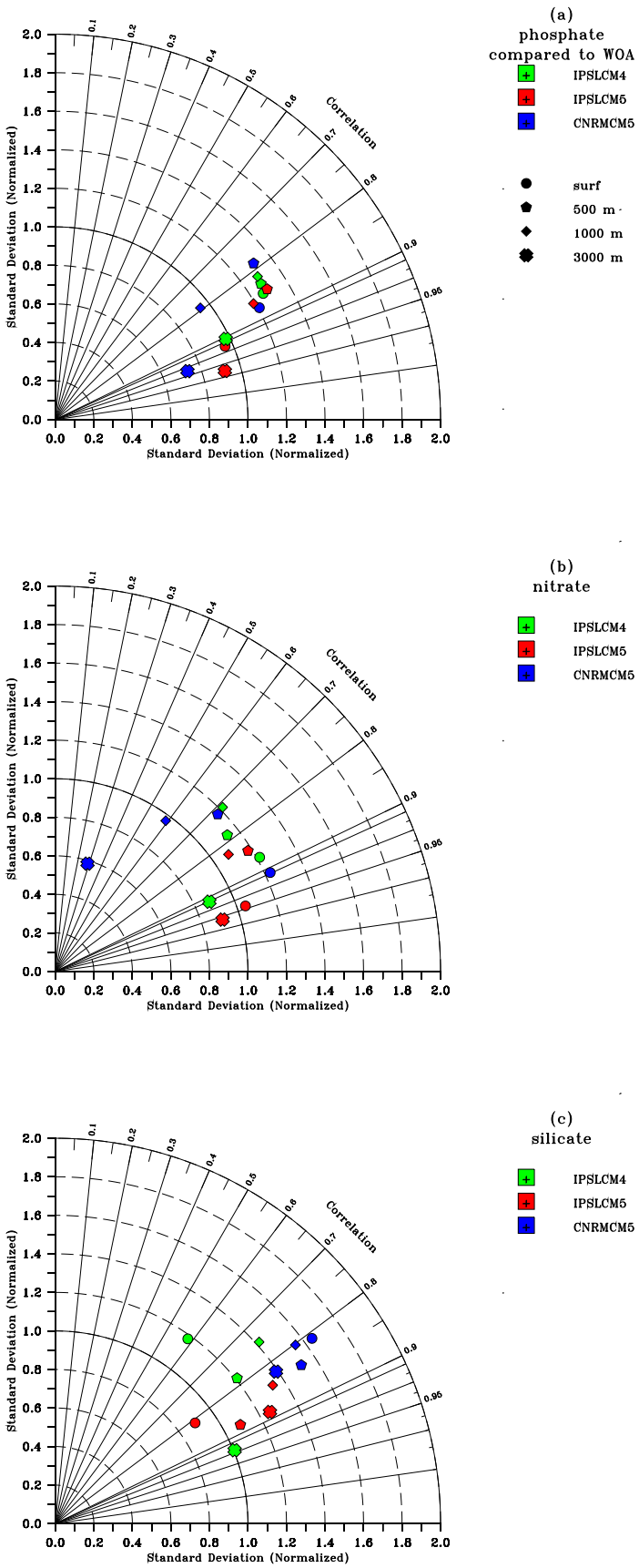

FIG. 3. Taylor diagram diagram showing the correspondence between model results and observations for (a) phosphate, (b) nitrate, (c) silicate concentrations at surface, 500 m, 1000 m, and 3000 m. Observed climatology is based on World Ocean Atlas 2009 (Garcia et al., 2009).

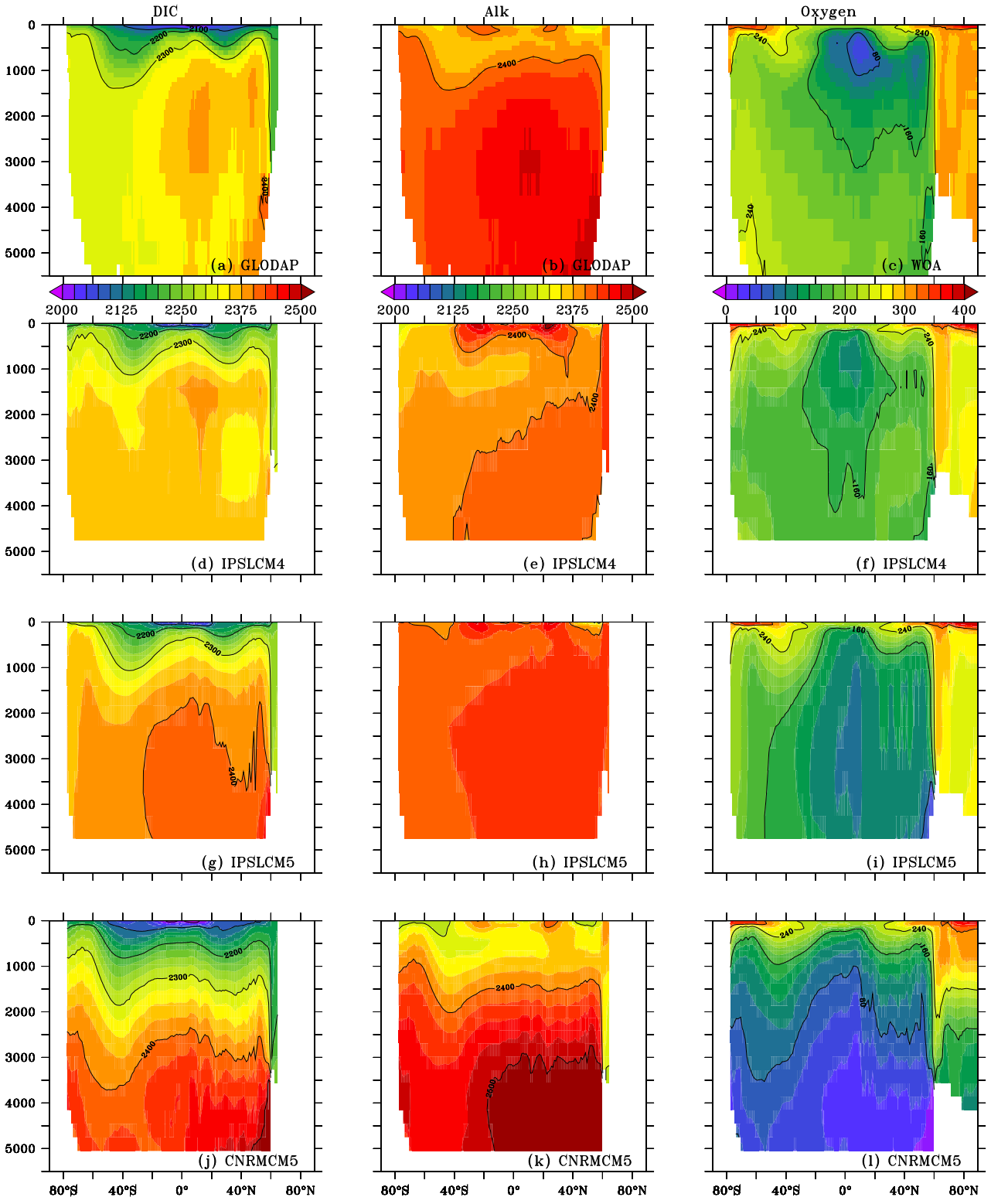

FIG. 4. Zonal average concentrations of seasonal climatology of Dissolved inorganic carbon (DIC, in μmol L^{-1}), Alkaliniy (Alk, in μeq L^{-1}) and oxygen (in μmol.L^{-1}) over 1995-2005 period. DIC, Alk and oxygen zonal average concentrations are presented from left to right for IPSLCM4, IPSLCM5 and CNRMCM5 (top to bottom). Observed climatology is based on GLODAP (Key et al., 2004) for DIC and Alk and World Ocean Atlas 2009 for oxygen (Garcia et al., 2009).

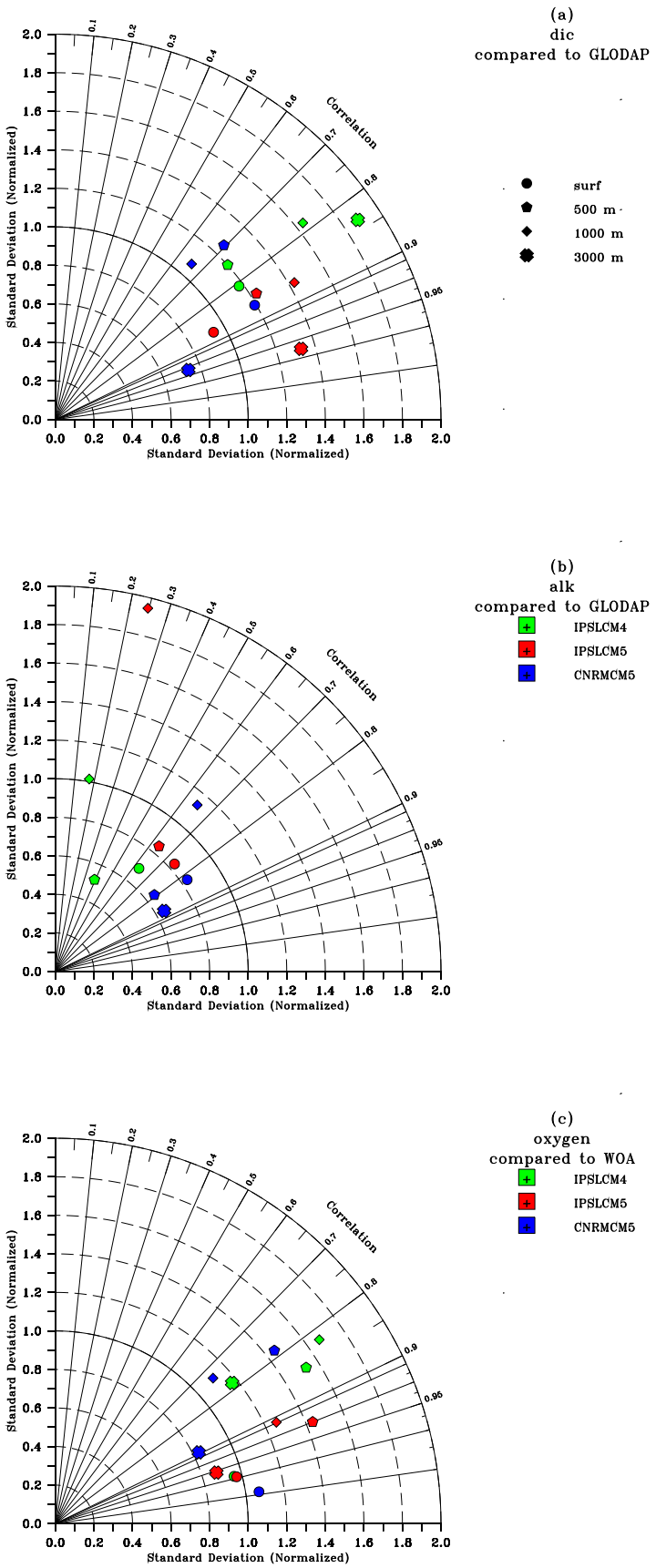

FIG. 5. Taylor diagram diagram showing the correspondence between model results and observations for (a) Dissolved inorganic carbon (DIC), (b) Alkaliniy (Alk) and (c) oxygen concentrations at surface, 500, 1000, and 3000 m. Observed climatology is based on GLODAP (Key et al., 2004) for DIC and Alk and World Ocean Atlas 2009 for oxygen (Garcia et al., 2009).

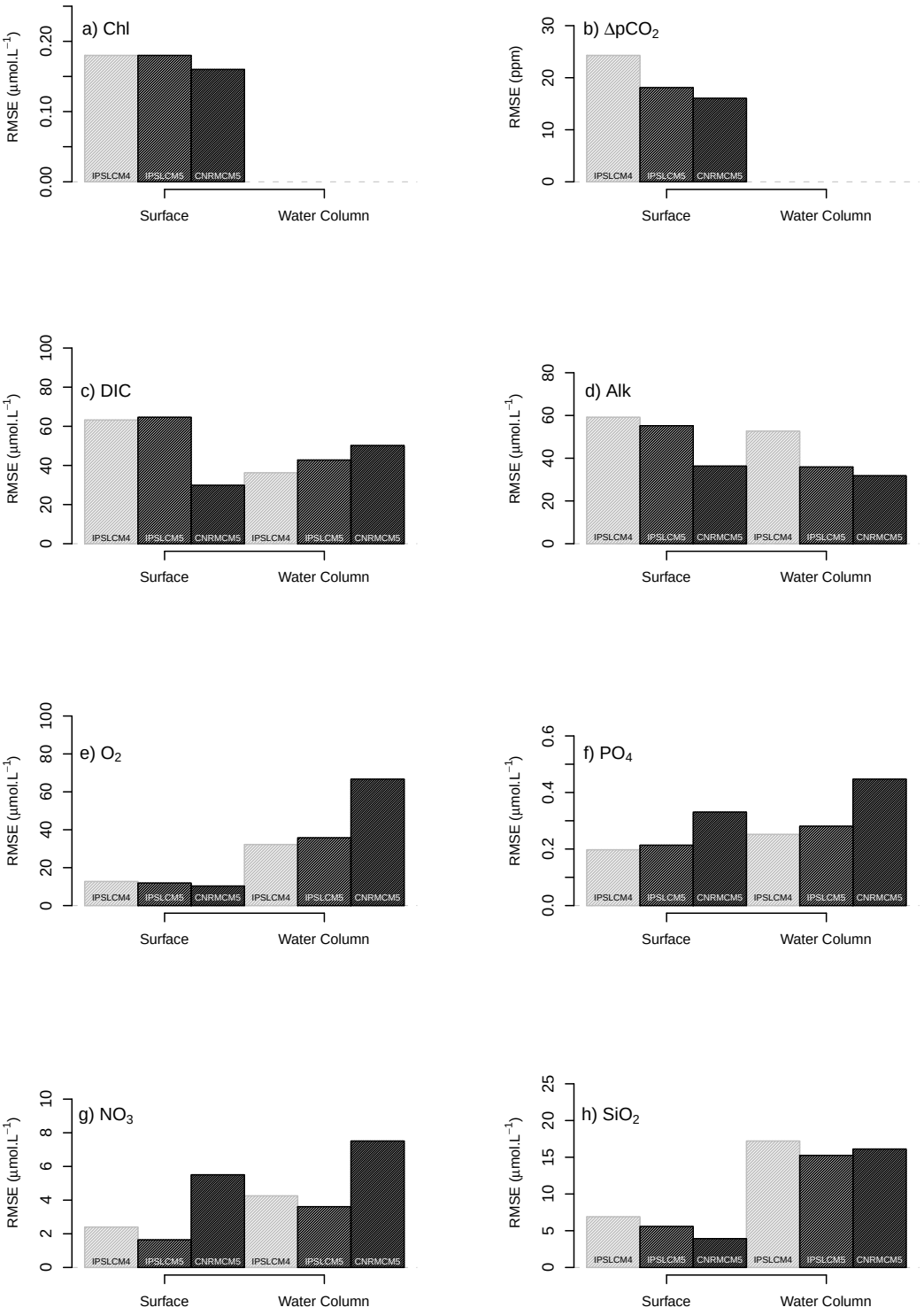

FIG. 6. Root Mean Square Error (RMSE) of a) chlorophyll concentrations (Chl), b) ΔpCO_2, c) dissolved inorganic carbon (DIC), d) alkalinity (Alk), e) oxygen (O_2), f) phosphate (PO_4^{3-}), g) nitrate (NO_3^-) and h) silicate (SiO_2) for IPSLCM4, IPSLCM5 and CNRMCM5. Observed climatology is based on GLODAP (Key et al., 2004) for DIC and Alk and World Ocean Atlas 2009 (Garcia et al., 2009) for phosphate, nitrate, silicate and oxygen, SeaWiFS for chlorophyll (Carr et al, 2006) and the database of Takahashi et al., (2009) for ΔpCO_2.

3. Temperature-Salinity-Concentration diagram

Temperature-Salinity-Concentration (Figure S7) consists in an update of the Worthington diagram (1965). It allows focussing on water mass biogeochemical properties, or here, CFC11 content. Each T-S class is obtained after weighting the tracers content (in mol) of this T-S class by its volume (in L).

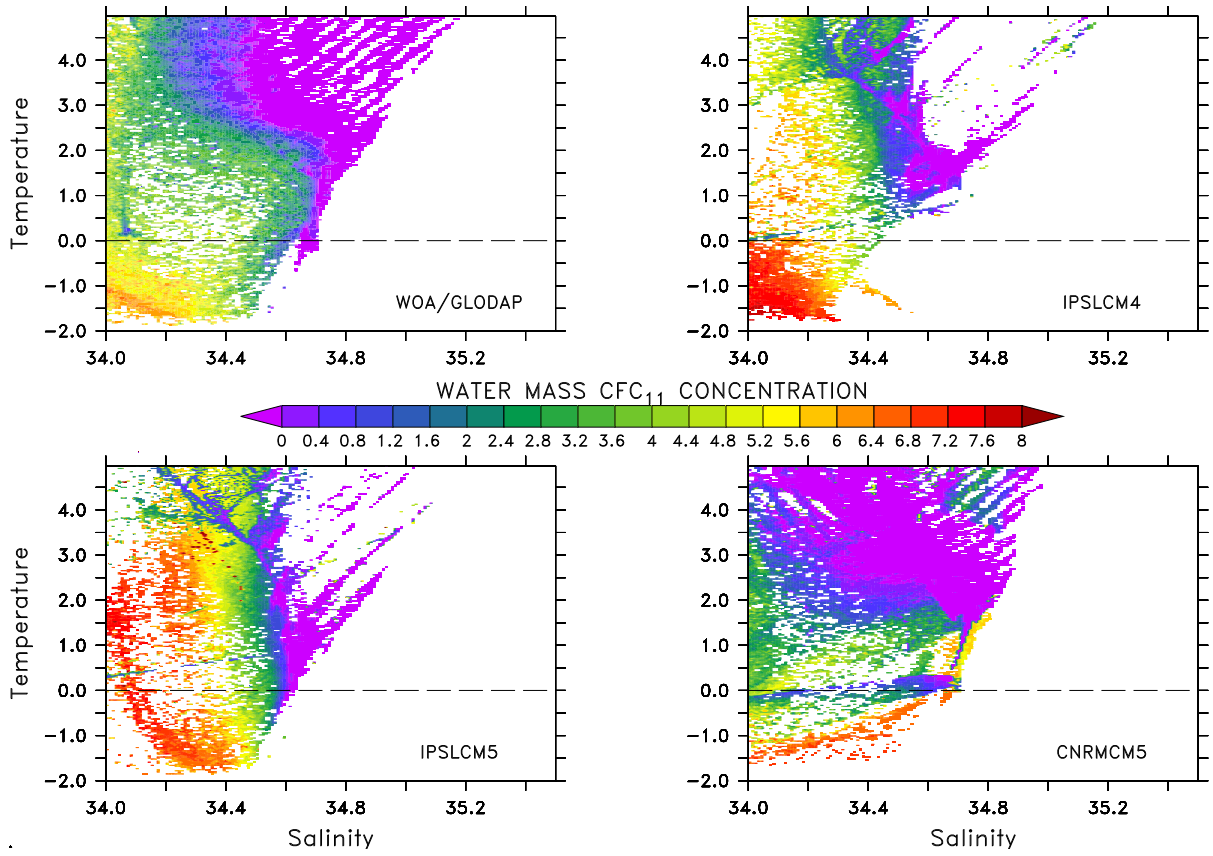

FIG. 7. Temperature-Salinity-Concentration diagram of CFC11 annual mean concentration (in mol L^{-1}) for Observation, IPSLCM4, IPSLCM5 and CNRMCM5. Observed climatology is based on GLODAP (Key et al., 2004) and World Ocean Atlas 2009 for temperature (Loccarnini et al., 2009) and salinity (Antonov et al., 2009).

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