# Supplementary Material

**Table A.1:** Synthesis of lateral (lat), seasonal (sea), interannual (int) variability and between two models (mod) and river scenarios (riv) for DIN, DIP and CHL in six assessment areas. Variability is given as standard deviation relative to mean values (as percentage). For each area the highest (dark shade) and second-highest (light shade) mean source of variability is highlighted (right columns, incl. distinction to offshore and coastal areas) as well as the area with the highest mean variability (lower row). Bold numbers indicate the source of largest variability per assessment area.

**Table A.2**: Percentage difference between various seasonal definitions and the influence on mean concentrations in region 11 (Southern North Sea): (A): (OK18-ICG)/ICG\*100 and (B) (WFD-ICG)/ICG\*100 with ICG=Dec-Feb/Mar-Sep; OK18 Dec-Feb/Apr-Sep; WFD= Nov-Feb/Mar-Oct.

**Table A.3:** Percentage difference between various periods as control simulation and influence on mean concentrations for region 11 (Southern North Sea): (A): (Early – Full)/Full\*100; (B) (Late – Full)/Full\*100 with Full=2006-2014, Late=2009-2014; Early=2002-2008.

**Figure A.1:** Percentage change between historical run (“H”) and control run (“C”) from ECOHAM based on river discharge from MONERIS (A-C) and E-HYPE (D-F) as *∆X = (Hx – C)/ C × 100*, where HX and C stand for the concentration of each variable (DIN (left), DIP (centre) and CHL (right)) in the Historic (X for MONERIS and E-HYPE) and Control state C, averaged within the respective seasons. (G-I): difference between concentrations according to the two historical scenarios normalized by the control run *(HE – HM)/ C*. Dashed lines indicate the 20% and 50% isolines. Mind the different colour scale for the lower panels.

**Figure A.2:** Bar-plots of mean and standard deviations of net primary production (NPP) for each biogeochemical model (GPM: bars 1 and 3; ECOHAM: 2 and 4) and hydrological model (MONERIS: 1 and 2; E-HYPE: 3 and 4) based on lateral, seasonal and inter-annual variability in three off-shore areas in Figure 5: Southern North Sea (A), German Bight (C), Eastern North Sea (E); and three river plume areas shown in Figure 6: Rhine plume (B), Ems plume (D) and Elbe plume (F). Numbers above the bars indicate relative variability, i.e. (std.dev/mean).