

## **Supplementary Material**

### **CSIRO CAFE-60 submissions to the World Meteorological Organization operational decadal forecasts and the international multi-model data exchange**

*Mark A. Collier<sup>A,\*</sup>, Terence J. O'Kane<sup>B</sup>, Vassili Kitsios<sup>A,C</sup> and Paul A. Sandery<sup>B</sup>*

<sup>A</sup>CSIRO Oceans and Atmosphere, Aspendale, Melbourne, Vic. 3195, Australia

<sup>B</sup>CSIRO Oceans and Atmosphere, Battery Point, Hobart, Tas. 7004, Australia

<sup>C</sup>Laboratory for Turbulence Research in Aerospace and Combustion, Department of Mechanical and Aerospace Engineering, Monash University, Clayton, Vic. 3800, Australia

\*Correspondence to: Email: [mark.collier@csiro.au](mailto:mark.collier@csiro.au)

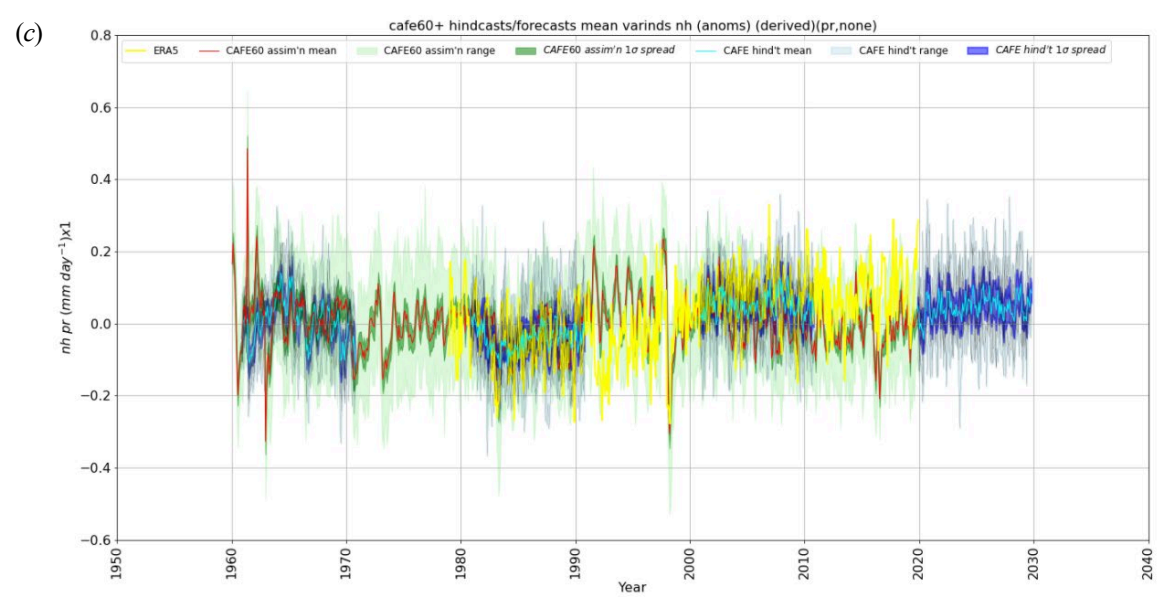
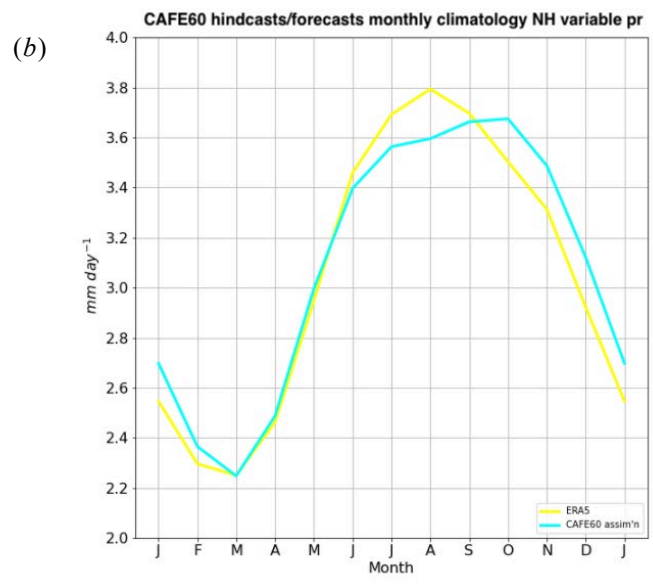
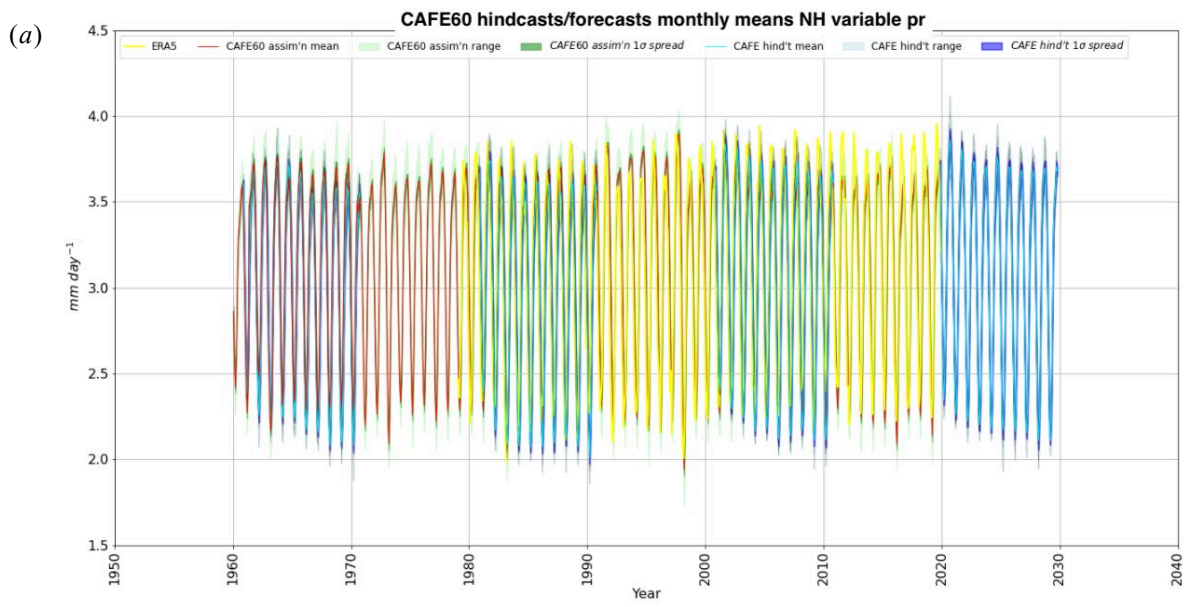


Figure 1: (a) Northern Hemisphere area averaged precipitation for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details (mm day<sup>-1</sup>).

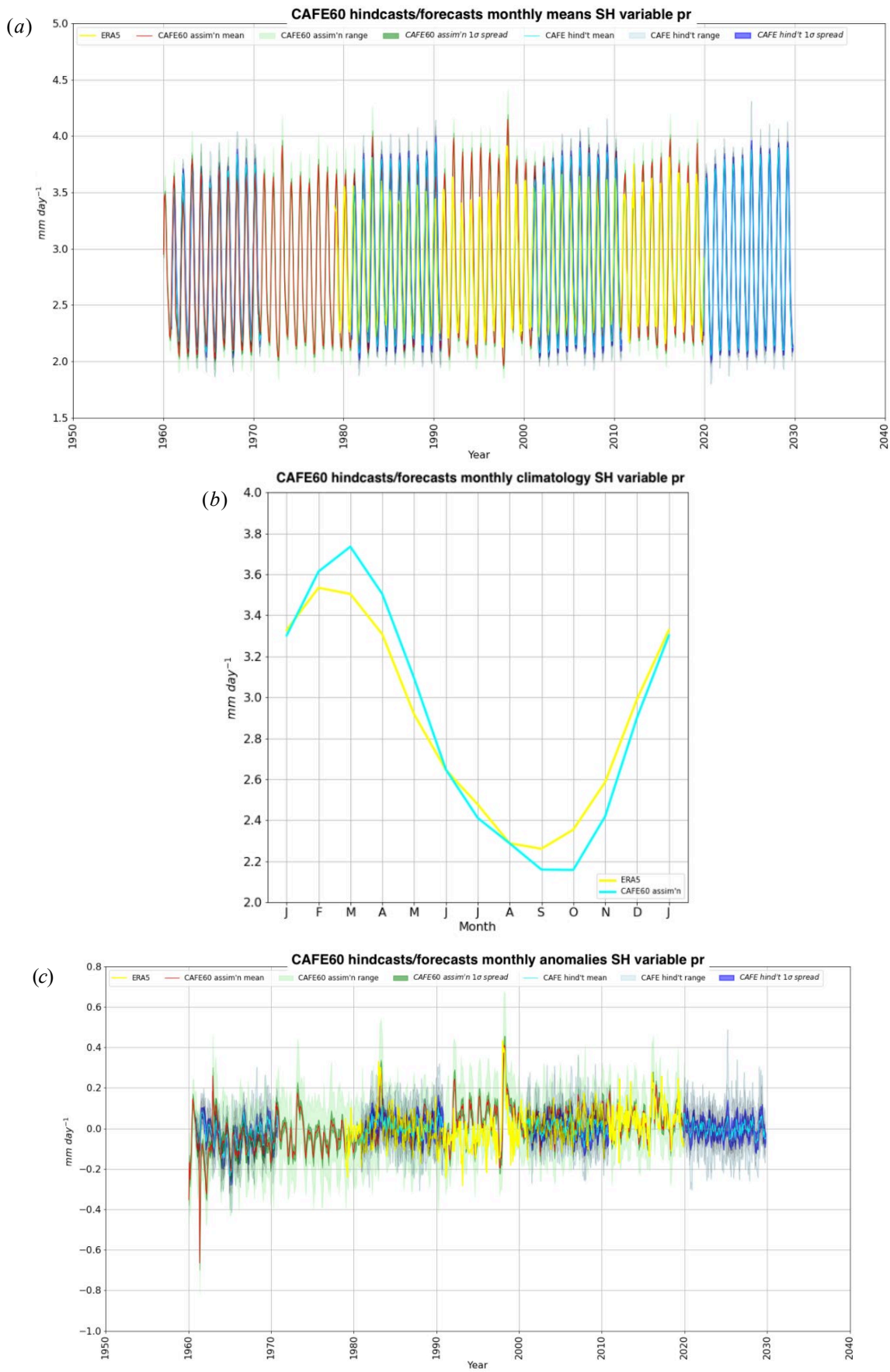


Figure 2: (a) Southern Hemisphere area averaged precipitation for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details (mm day<sup>-1</sup>).

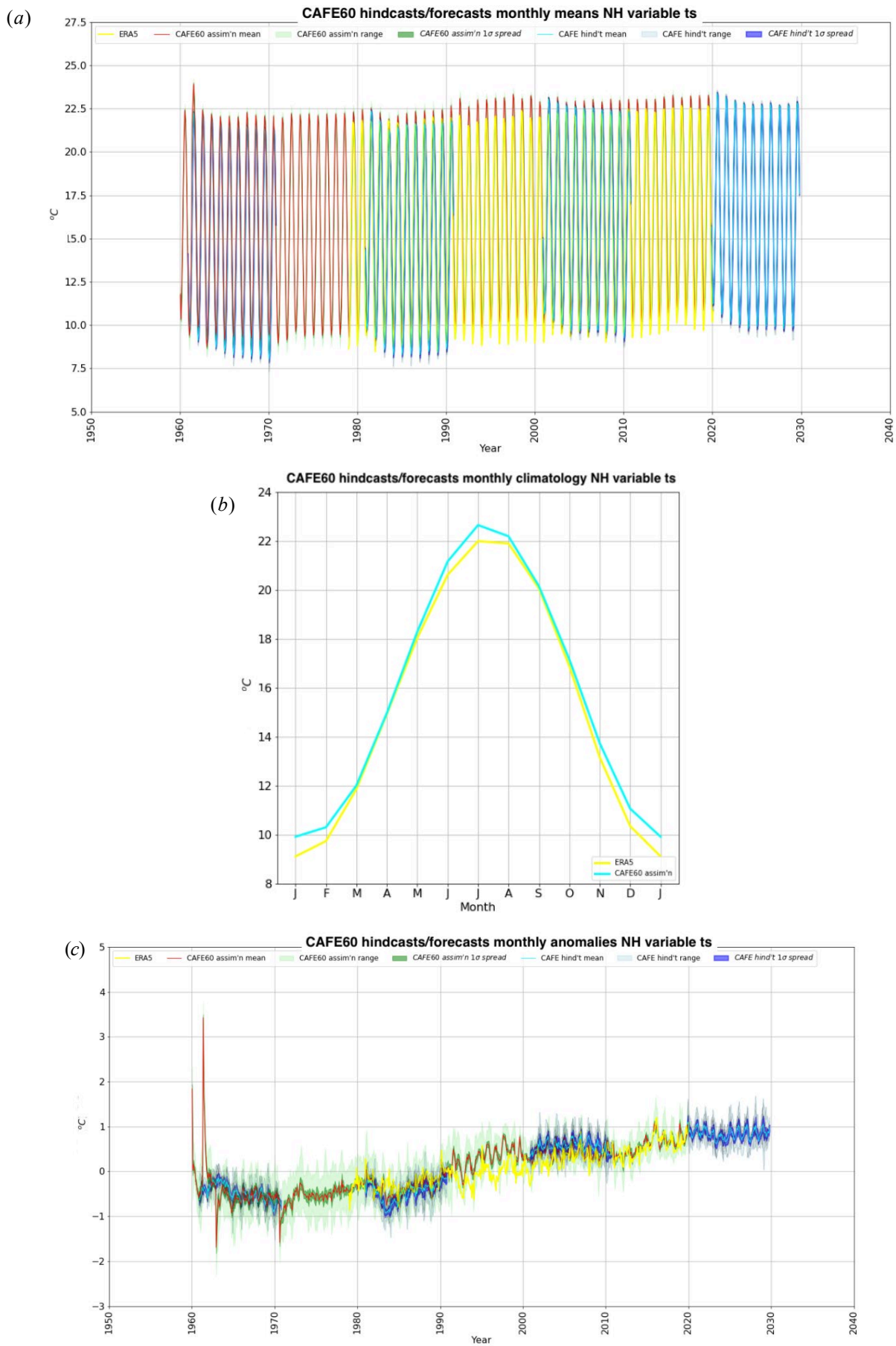


Figure 3: (a) Northern Hemisphere area averaged surface temperature for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details ( $^{\circ}\text{C}$ ).

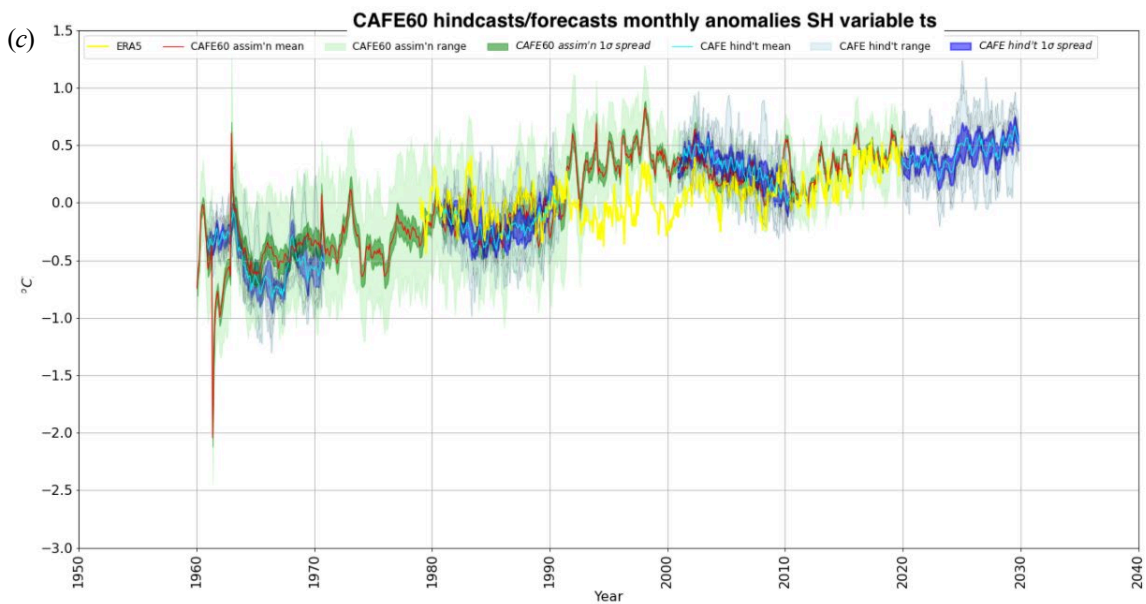
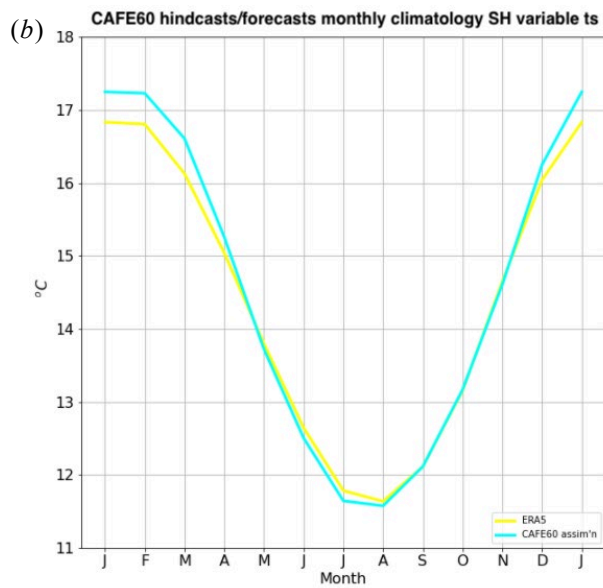
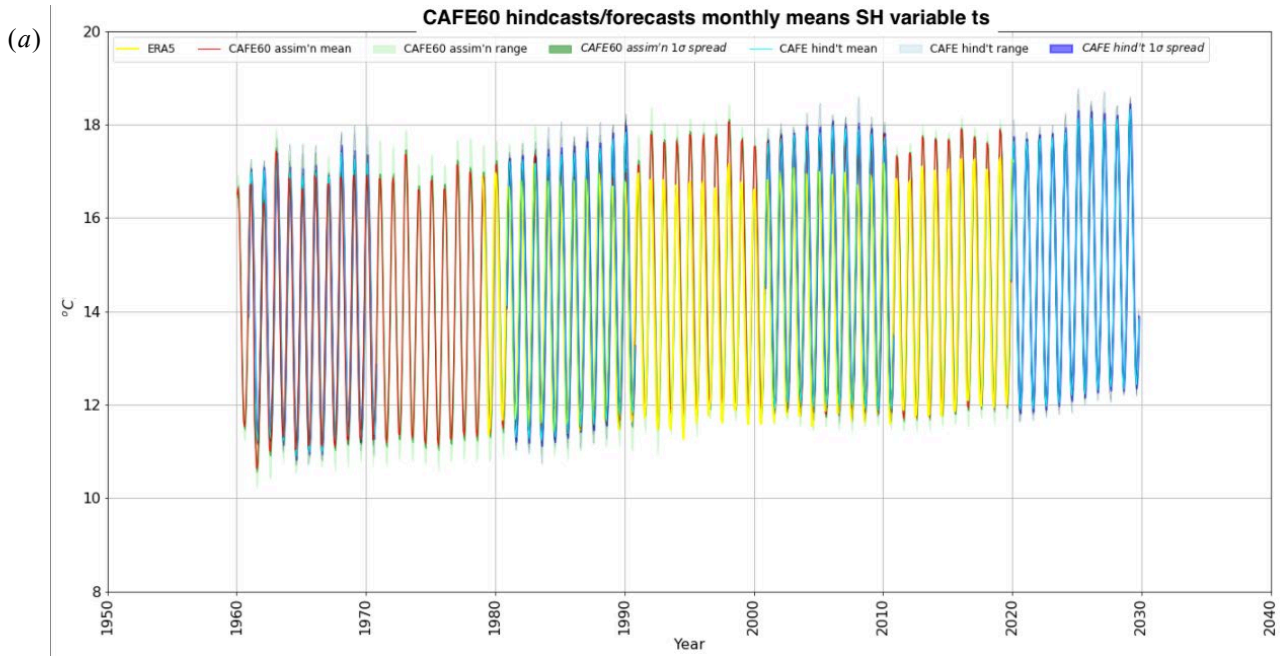


Figure 4: (a) Southern Hemisphere area averaged surface temperature for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details ( $^{\circ}\text{C}$ ).



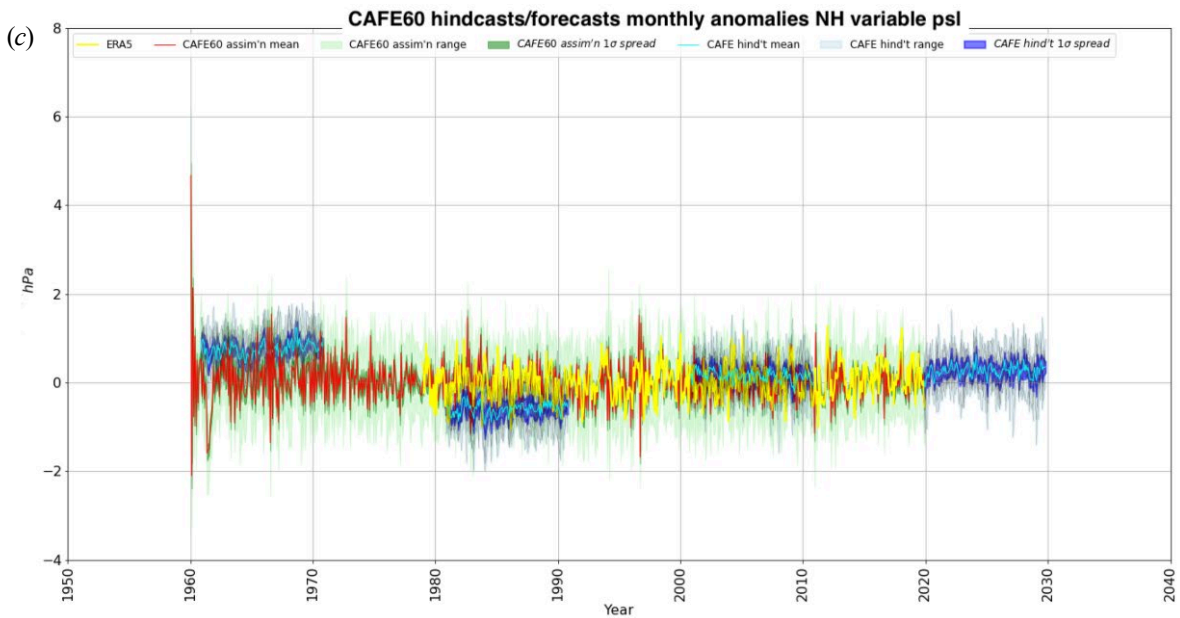
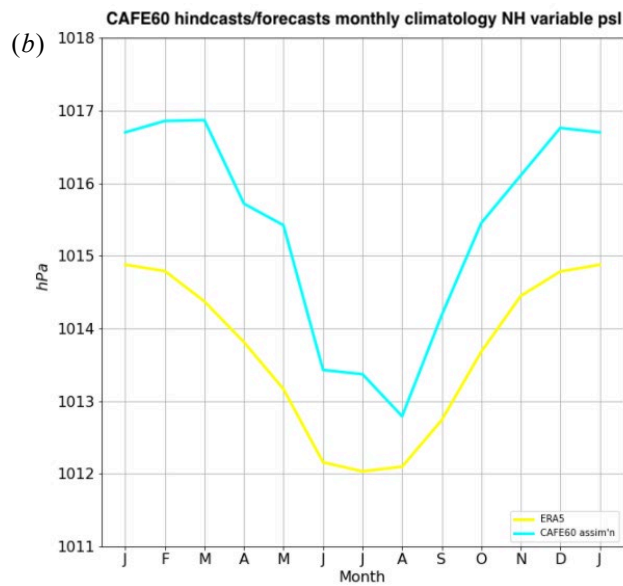
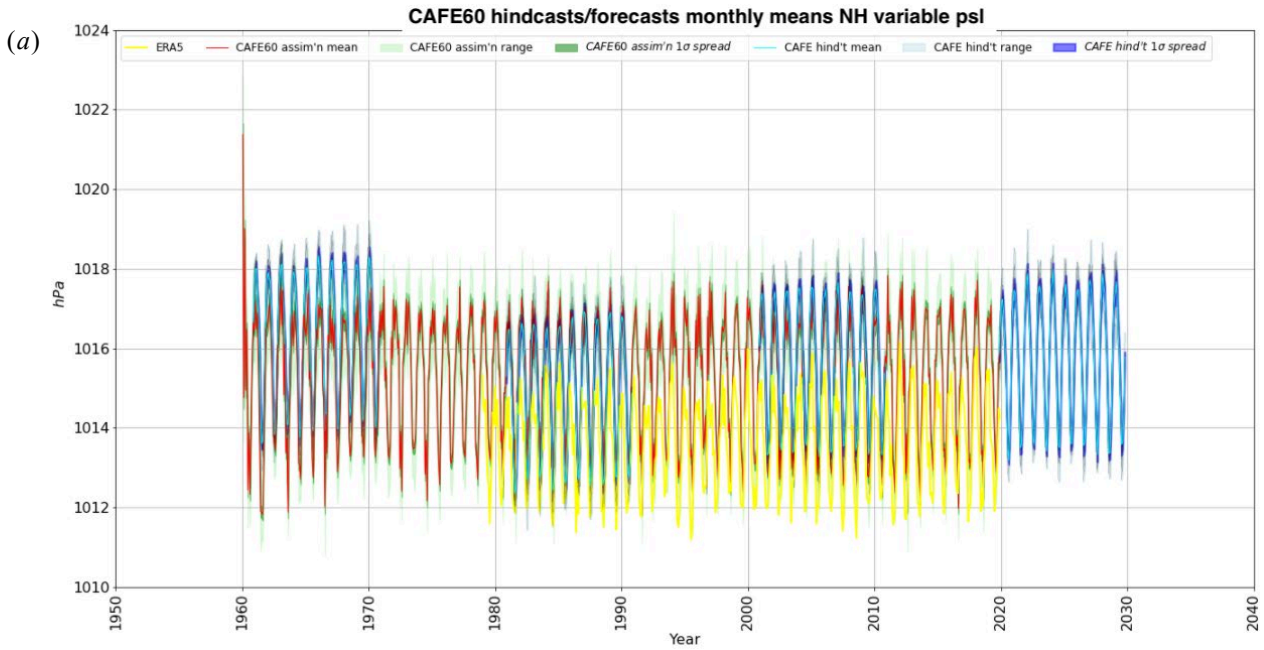


Figure 5: (a) Northern Hemisphere area averaged mean sea level pressure for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details (hPa).

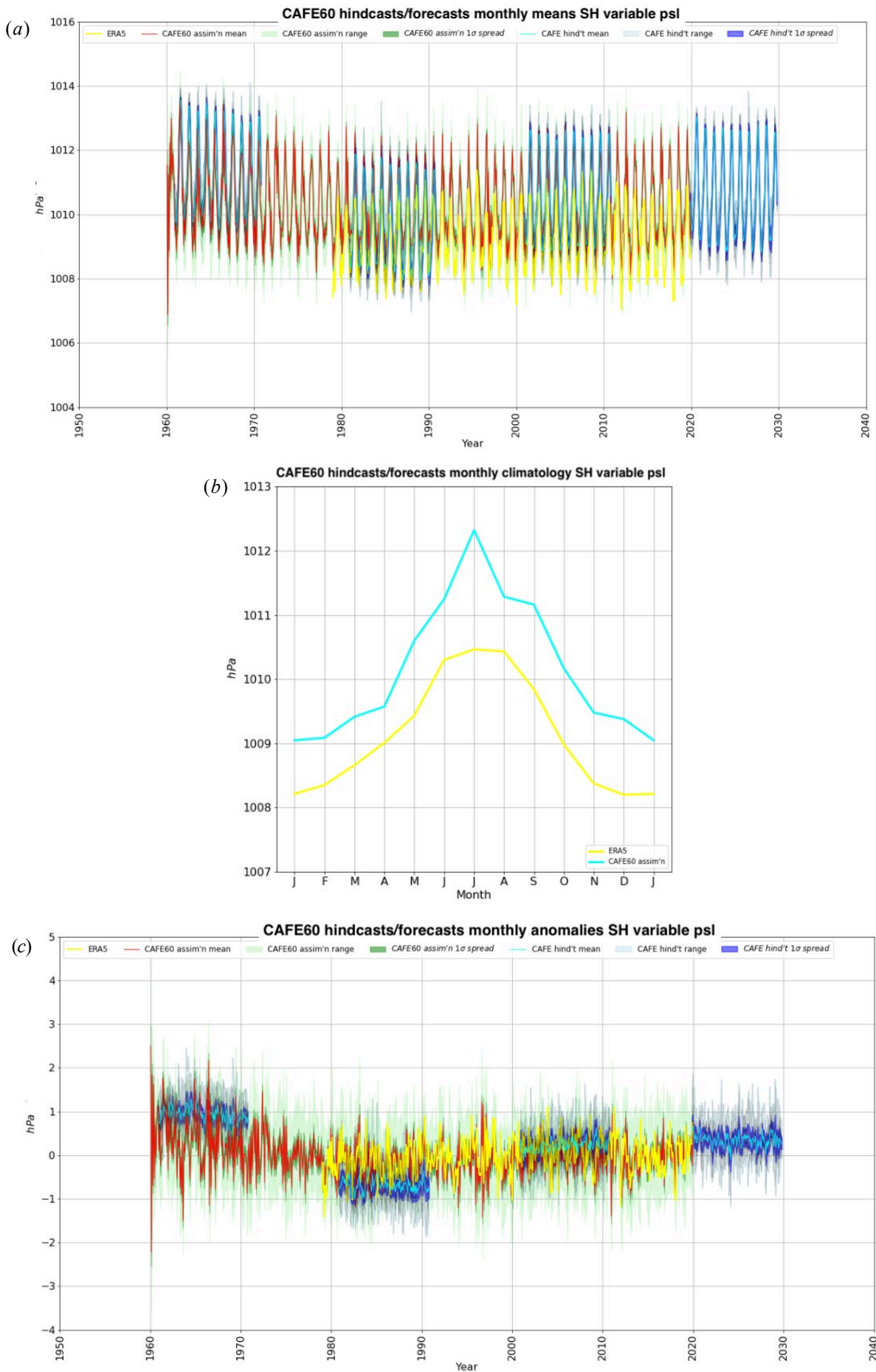


Figure 6: (a) Southern Hemisphere area averaged mean sea level pressure for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details (hPa).

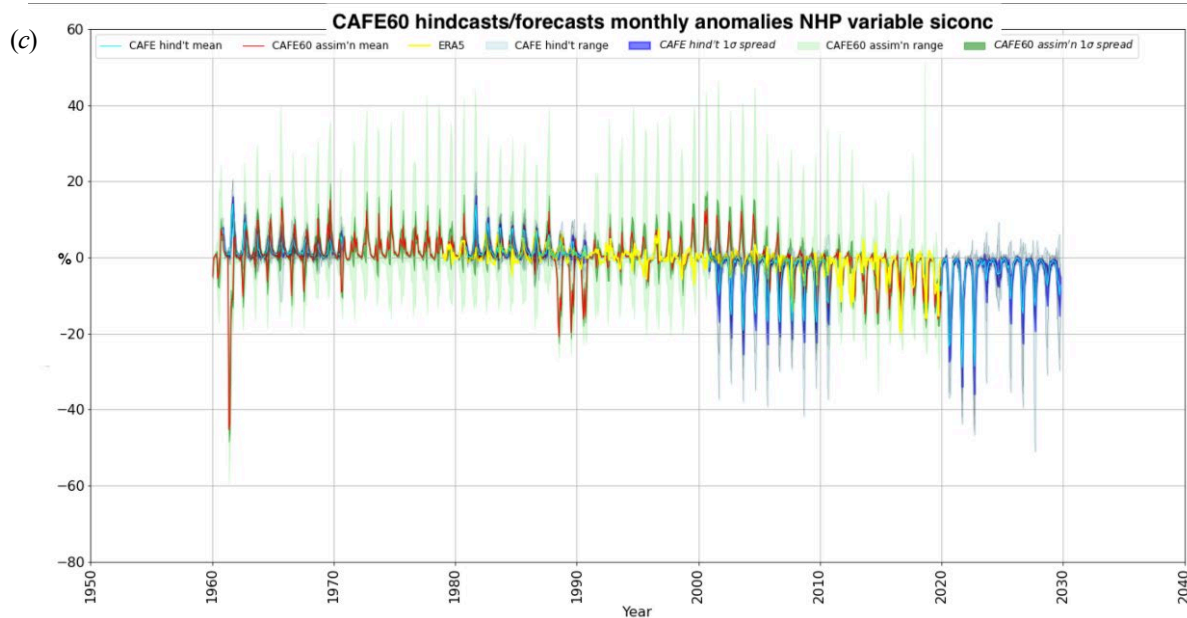
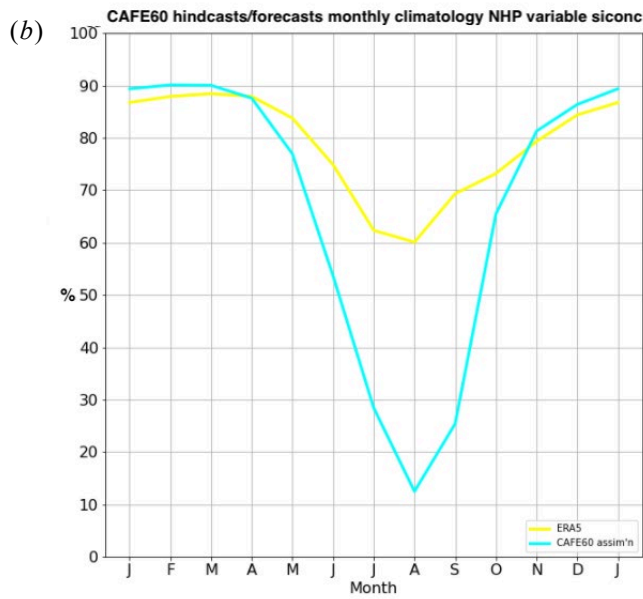
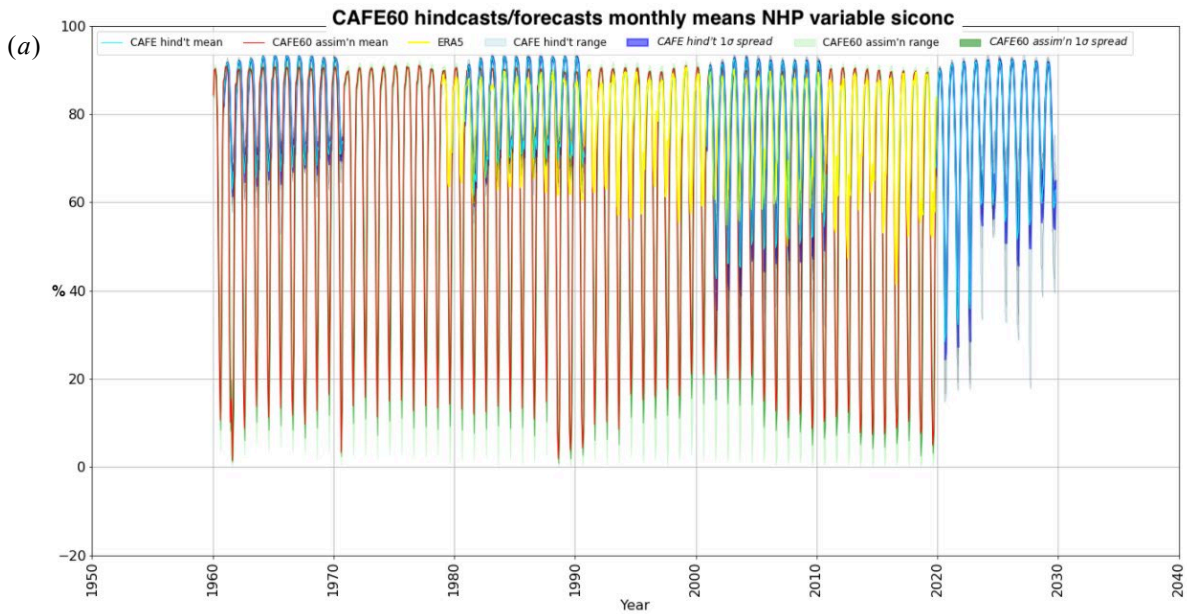


Figure 7: (a) Area averaged sea-ice concentration poleward of 60°N for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details (%).



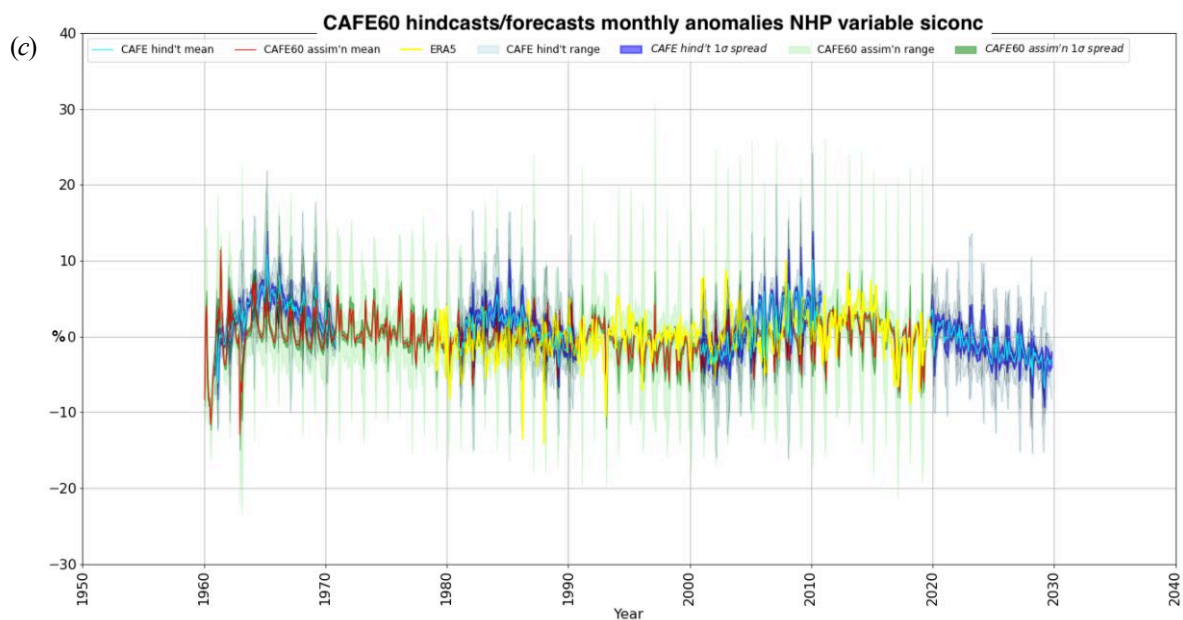
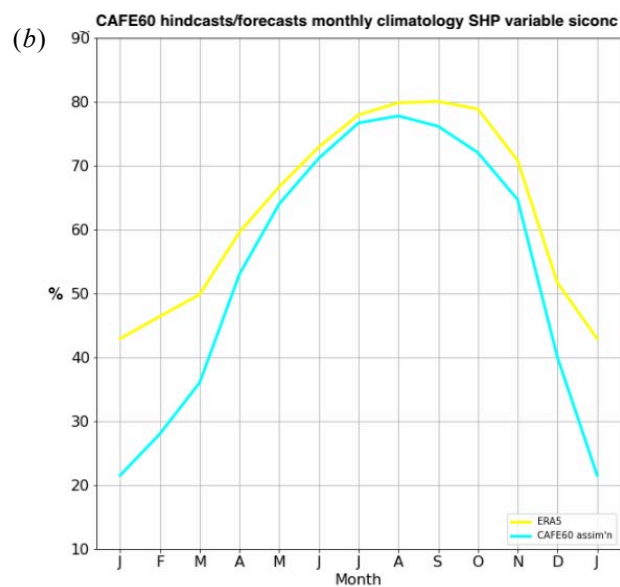
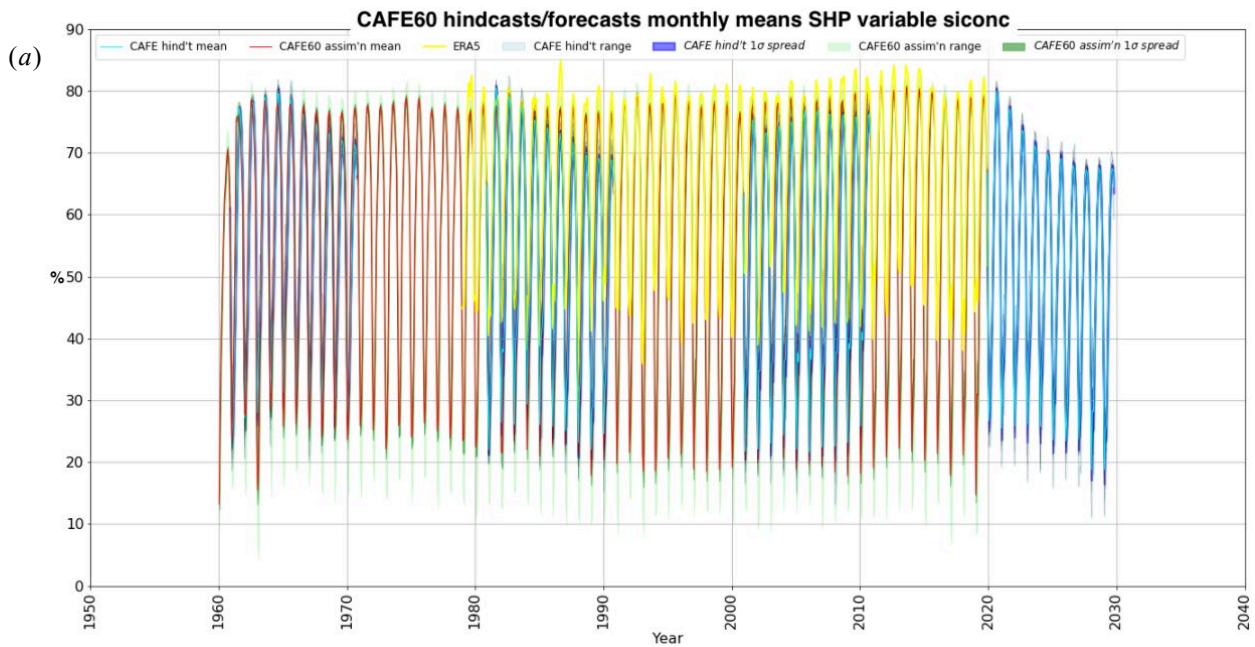


Figure 8: (a) Area averaged sea-ice concentration poleward of 60°S for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details (%).

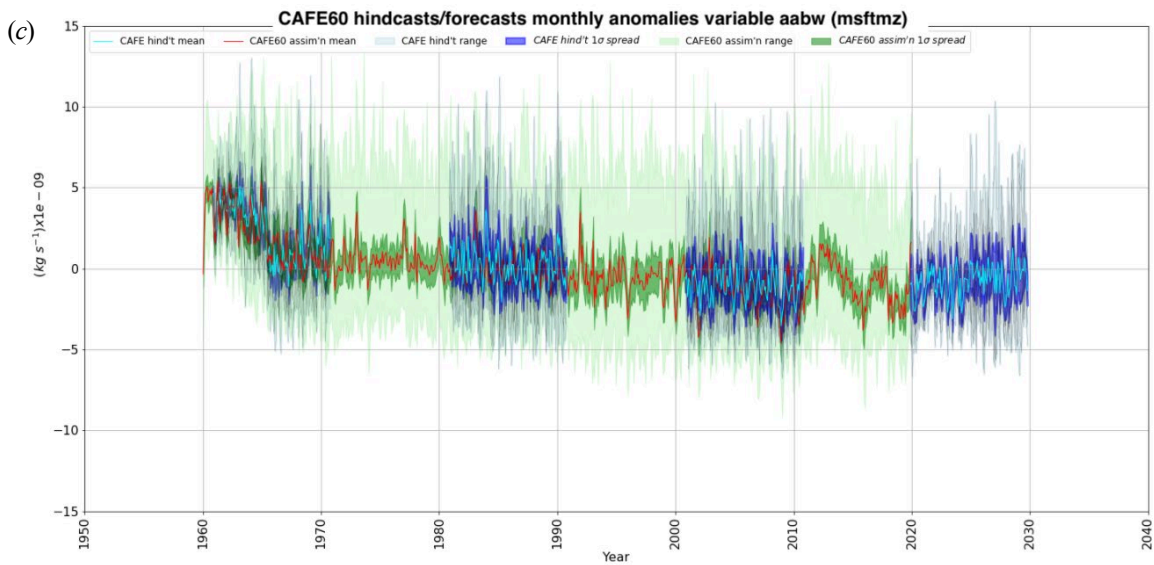
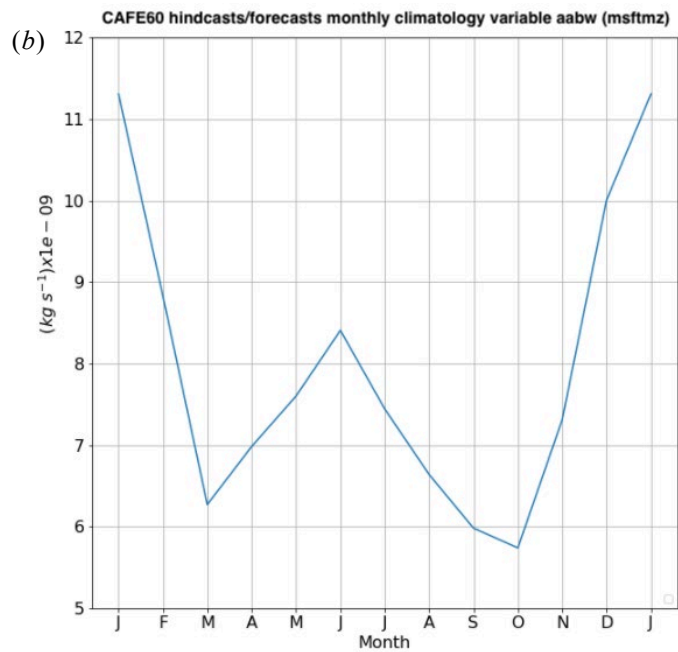
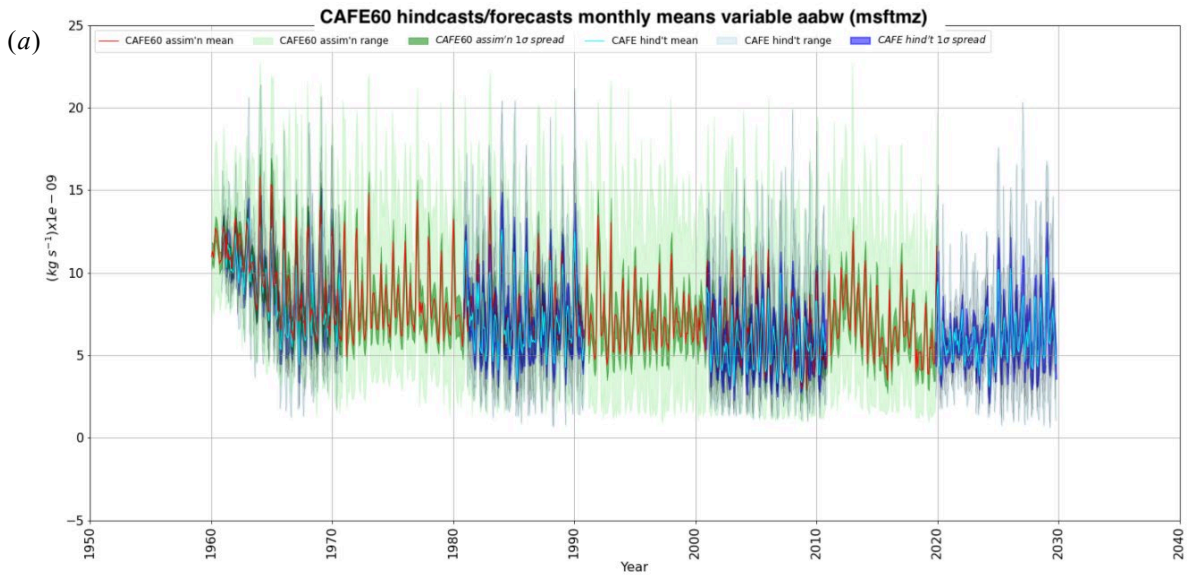


Figure 9: (a) Monthly Antarctic Bottom Water (AABW) for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details ( $\times 10^9 \text{ kg s}^{-1}$ ).

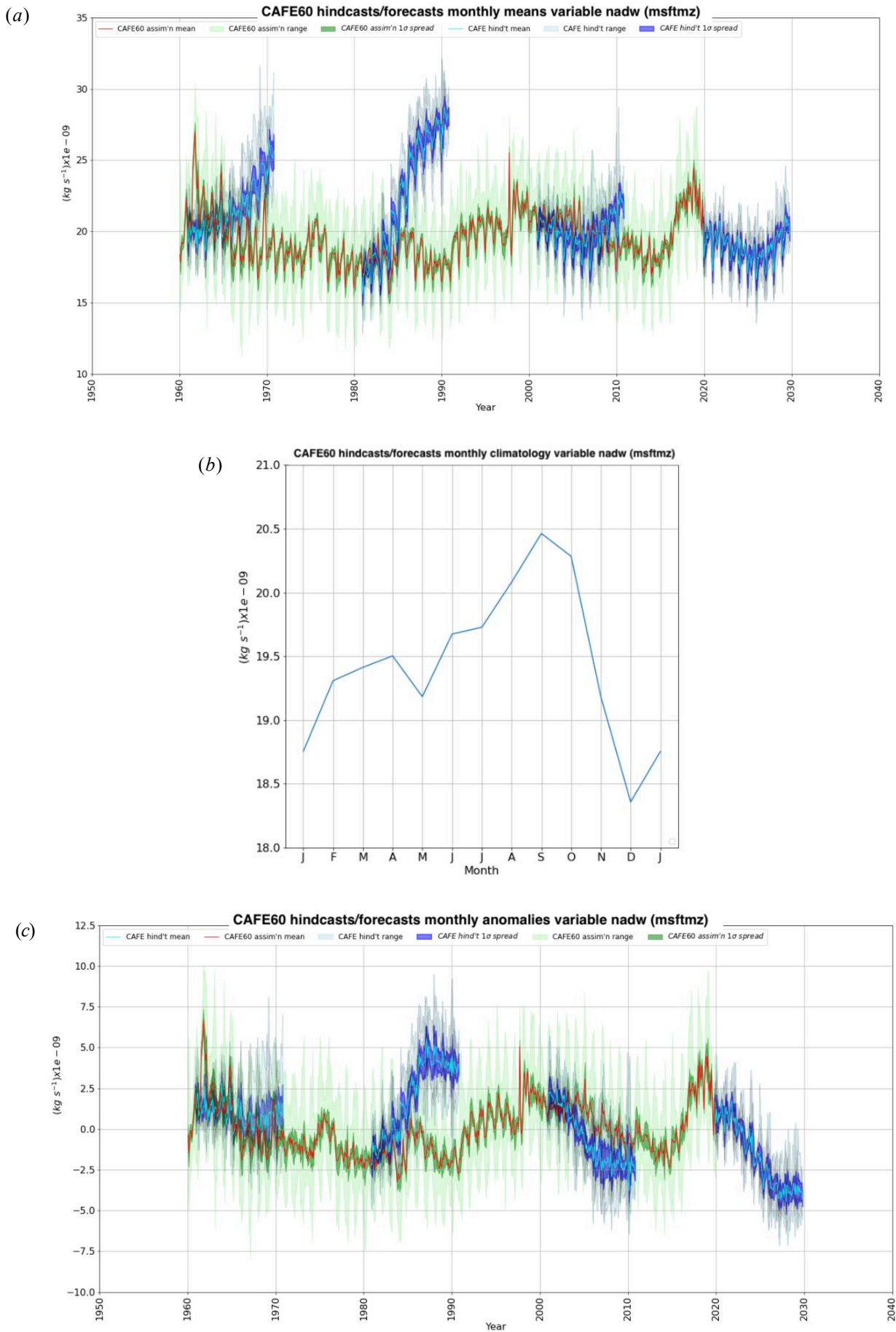


Figure 10: (a) North Atlantic Deep Water (NADW) for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology and (c) anomalous monthly version of results in panel (a), see text for details ( $\times 10^9 \text{ kg s}^{-1}$ ).

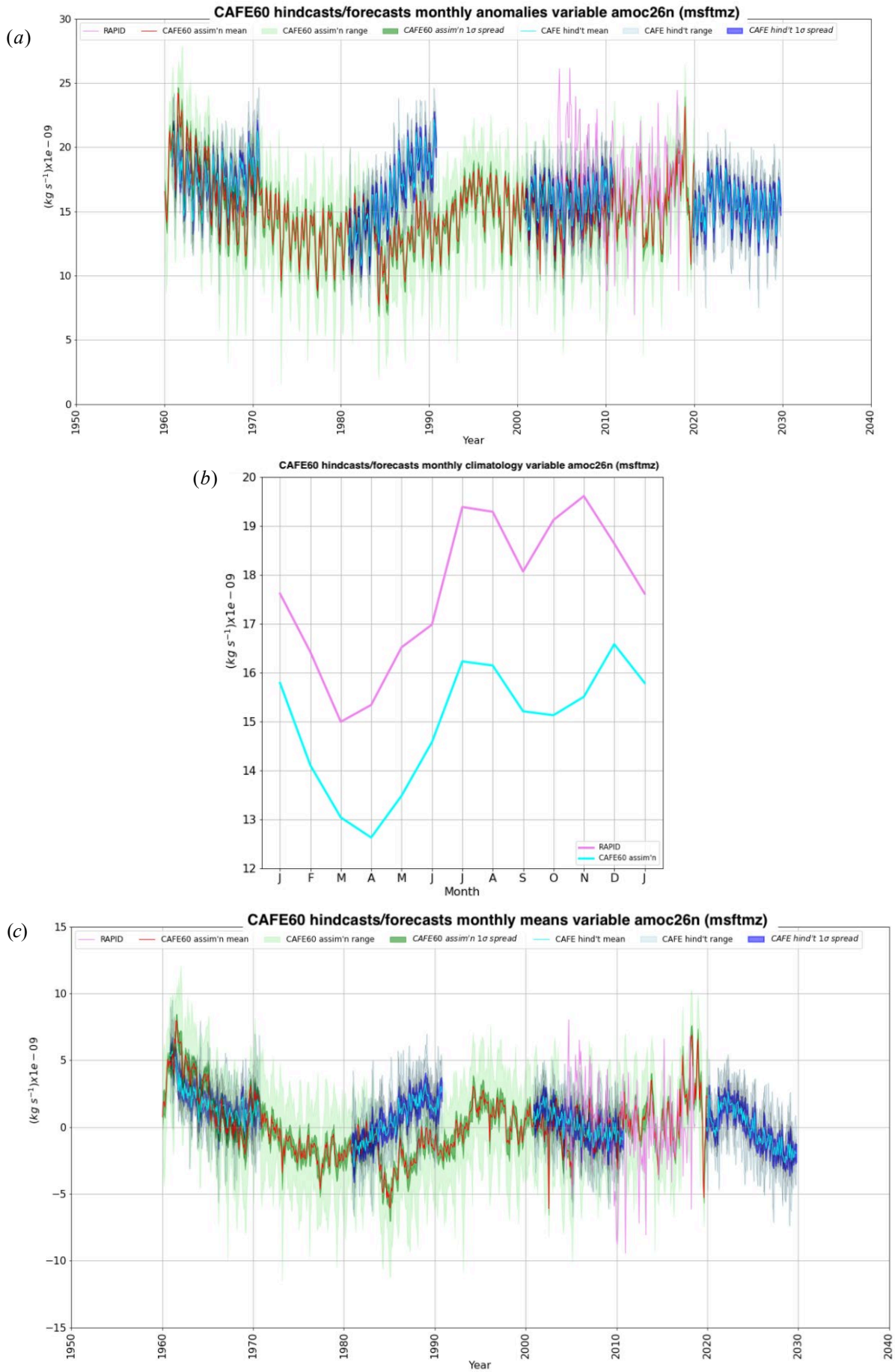


Figure 11: (a) Atlantic Meridional Circulation at 26°N (AMOC26N) for reanalysis (1960-2019), RAPID (April 2004-September 2019) and four hindcasts/forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology) and (c) anomalous monthly version of results in panel (a), see text for details ( $\times 10 \text{ kg s}^{-1}$ ).



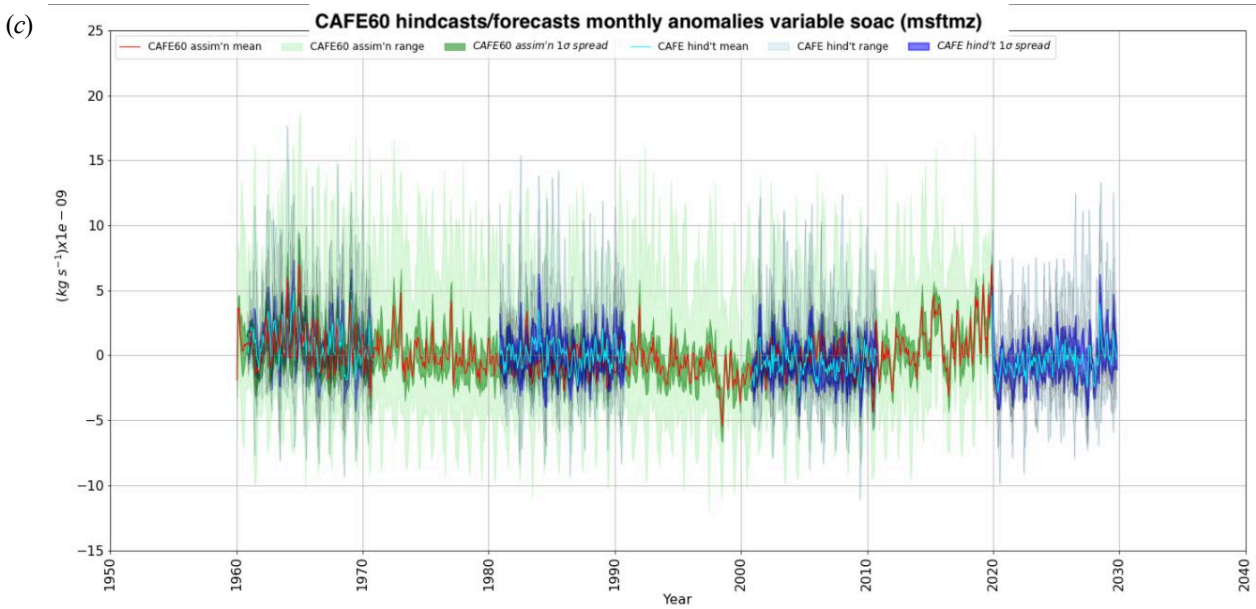
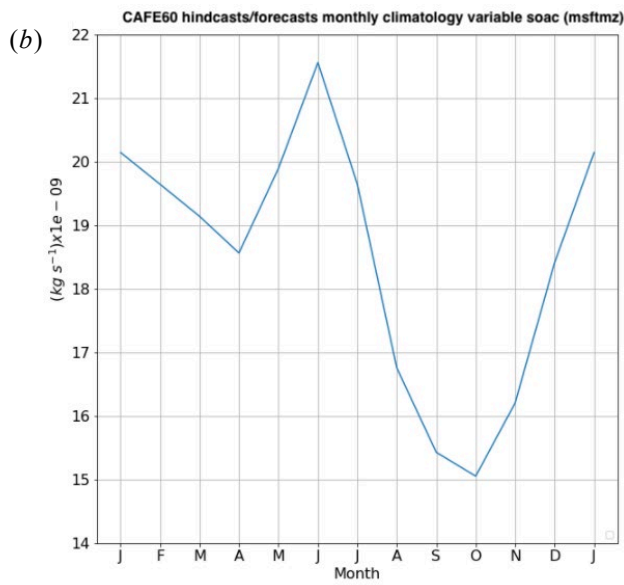
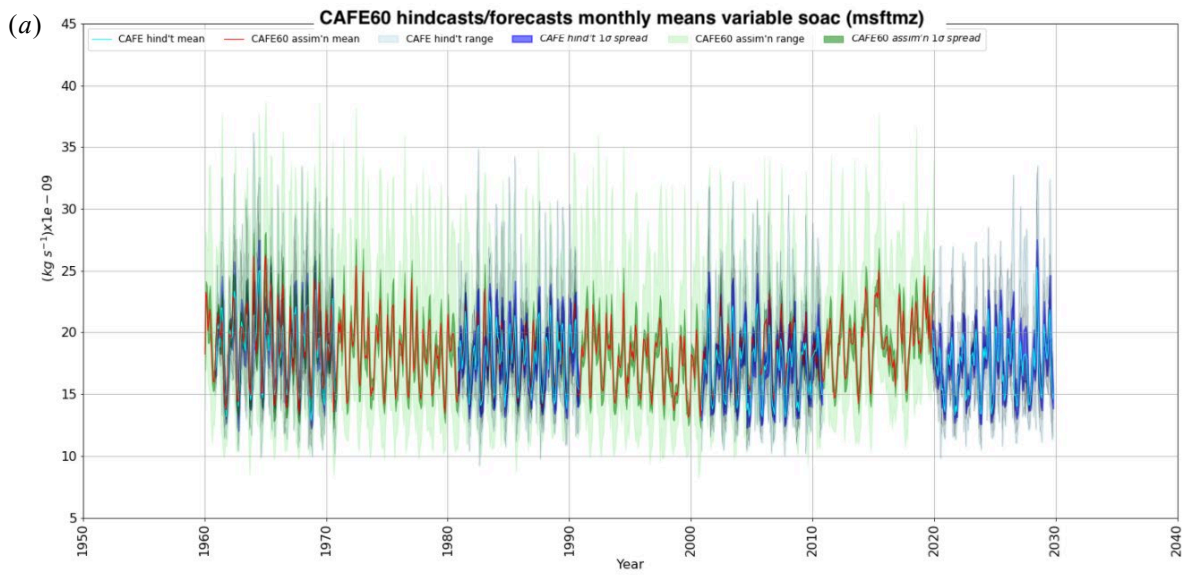


Figure 12: (a) Southern Ocean Antarctic Circulation (SOAC) for reanalysis (1960-2019) and four forecasts (1960, 1980, 2000 and 2019) (b) reanalysis annual cycle (1981-2010 climatology and (c) anomalous monthly version of results in panel (a), see text for details ( $\times 10^9 \text{ kg s}^{-1}$ )