NH-sea: absolute difference upwelling longwave flux at TOA – so2–no–season surface flux surface flux surface concentration surface concentration surface concentration of BC - so2-no-season of SO2 - so2-no-season of BC - so2-no-season of SO4 - so2-no-season of SO2 - so2-no-season 3.1e-19 0.0e + 0.0e +(kg kg - 1) $\Delta\,\mathrm{emibc}\,(\mathrm{kg}\,\mathrm{m}^{-2}\,\mathrm{s}^{-1})$ $^{-2} s^{-1}$ mmrbc (kg kg-1) $\Delta \cos (kg kg - 1)$ $\Delta rlut (Wm-2)$ -3.0e-18 2e-14 _4 7e_1 0e+00 -1.0e-0 _2 5e_1 2000 2001 2002 2003 2002 2003 2003 2004 2003 2004 2004 2000 2001 2003 2004 2000 2001 2002 2004 2000 2001 2002 2003 2004 2000 2001 2002 2000 2001 2002 Year upwelling shortwave flux upwelling clear-sky longwave flux at TOA - so2-no-season upwelling clear-sky shortwave flux at TOA - so2-no-season clear–sky net radiative flux at TOA – so2–no–season net radiative flux incident shortwave flux at TOA – so2-no-season at TOA – so2-no-season at TOA - so2-no-season 0e+00 $rsut (W m^{-2})$ 0e+00 Δ rsutcs (W m – 2) $\Delta \operatorname{rsut} (\operatorname{Wm} - 2)$ $\Delta \operatorname{rsdt}(\operatorname{Wm}-2)$ ≥ 20-07 ∆ rlutcs (W m --1e-01 -2e-01 -2e-01 -2 5e-02 -4e-01 ∆ rlut -5.0e-02 -6e-01 -6e-0 2000 2002 2003 2000 2002 2003 2001 2002 2003 2002 2003 2002 2003 2002 2003 2004 2001 2001 Year Year Year Year Year Year dry deposition rate of BC – so2–no–season implied cloud response wet deposition rate total deposition rate dry deposition rate wet deposition rate rlutcs - rsutcs (W m⁻²) of BC - so2-no-season of SO2 - so2-no-season at TOA - so2-no-season of BC - so2-no-season of SO2 - so2-no-season 1.9e-15 5.0e-16 1.4e-15 wetbc (kg m⁻² s⁻ 1 dryso2 (kg m $^{-2}$ s $^{-1}$) wetbc $(kg m^{-2} s^{-1})$ drybc (kg $m^{-2} s^{-1}$) retso2 (kg -1e-0-1e-13 -3e-14 -8.9e-10 ∆ drybc ∆ rlut + 2002 2003 2003 2004 2003 2004 2001 2002 2000 2002 2003 2004 2000 2001 2004 2000 2001 2002 2000 2001 2002 2000 2001 2002 2003 2004 2000 2003 2004 2001 Year Year Year Year Year wet deposition rate dry deposition rate total deposition rate total cloud cover - so2-no-seaso convective cloud cover - so2-no-sea ambient aerosol optical of SO4 – so2–no–season of SO4 - so2-no-season of S - so2-no-season thickness at 550nm - so2-no-seas dryso2 + wetso2)/2 + (dryso4 +0.0e+00 Δ dryso4 (kg m⁻² s⁻¹) \ cltc (percent) ∆ clt (percent) $(kg m^{-2} s^{-1})$ 0e+00 0.0e+00 0.0e+00 -5.0e-02 -5 0e-14 -5e-15 -5.0e-02 -2.5e-1 -5.0e-1 -1.0e-01 2000 2001 2002 2003 2002 2003 2000 2001 2002 2003 2004 2000 2002 2003 2002 2003 2004 2000 2002 Year Year Year Year Year Year surface cloud cover - so2-no-seas ice water path - so2-no-season surface concentration column mass burden column mass burden column mass burden of DMS - so2-no-season of SO2 - so2-no-season of SO4 - so2-no-season 5e-07 loadso2 (kg m⁻²) Δ dms (kg kg – 1) oadbc $(kg m^{-2})$ ∆ cl (percent) Δ clivi (kg m⁻²) 2e-13 0e+00 loadso4 (kg 0e+00 2e-07 -2e-02 0e+00 0e+00 2000 2001 2002 2003 2004 2000 2001 2002 2003 2000 2001 2002 2003 2000 2001 2002 2003 2000 2001 2002 2003 2002 2003 2004 2004 2004 2004 2000 2001 2004 Year Year Year Year Year wetso4) (days) SO4 lifetime - so2-no-season SO2 timescale - so2-no-season 4e+02 ∆ loadso2/emiso2 (days) 1.5e+02 3e+02 1.0e+02 A loadso4/(dryso4+ 2e+02 1e+02 2002 2003 2000 2002 Year Year CAM5 E3SM GISS OsloCTM3 - UKESM - CESM1 -GEOS - MIROC

CESM2

-GFDL

NorESM2