land: percent difference surface flux surface concentration surface flux surface concentration surface concentration upwelling longwave flux at TOA - so2-no-season 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 00+00 -1e+00-1e-02 -2e+00 2e-01 -2e-02 -2e-0 -4e-02 00+00 0e+00 -3e-02 -4e-01 -8e-02 2003 2000 2001 2003 2003 2000 2002 2003 2000 2001 2002 2004 2000 2001 2002 2003 2004 2002 2004 2000 2001 2002 2004 2000 2001 2002 2003 2004 2001 2004 Year Year Year 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 upwelling shortwave flux net radiative flux incident shortwave flux at TOA – so2-no-season at TOA - so2-no-season at TOA - so2-no-season 4e-0 4e-0 3e-01 2e-01 ∆ rlutcs 3e-01 3e-0 ∆ rlut + ı 2e-01 2e-0 2e-0 1e-01 -5e-08 0e+00 2001 2002 2003 2000 2002 2003 2000 2003 2002 2003 Year Year Year Year Year Year implied cloud response dry deposition rate wet deposition rate total deposition rate dry deposition rate wet deposition rate of SO2 - so2-no-season at TOA - so2-no-season of BC - so2-no-season of BC - so2-no-season of BC - so2-no-season of SO2 - so2-no-season  $\Delta$  (rlut + rsut - rlutcs - rsutcs) 5.0e-01 5.0e-02 2e-0 1e+00 2.5e-02 2.5e-0 ∆ dryso2 1e-01 0e+00 0e+00 0.0e+00 0e+00 -2e-01 -4e+00 \_5 0e\_02 2003 2004 2002 2003 2004 2002 2001 2002 2003 2004 2000 2001 2002 2000 2001 2003 2004 2000 2001 2002 2000 2001 2002 2003 2004 2000 2001 2003 2000 Year Year Year Year wet deposition rate dry deposition rate total deposition rate ambient aerosol optical total cloud cover - so2-no-seasor convective cloud cover - so2-no-sea of SO4 – so2–no–season of SO4 - so2-no-season of S - so2-no-season thickness at 550nm - so2-no-seas 1e-01 dryso2 + wetso2)/2 + (dryso43.0e+00 7.5e+00 0e+00 2e+00 1e-0 2.5e+00  $\triangle \, \operatorname{clt}$ 5.0e+00 2.0e+00 1e+00 -4e+01 2.5e+00 -1e-0 0e+00 -2e-01 2002 2003 2000 2001 2002 2003 2000 2001 2002 2003 2004 2002 2003 2000 2001 2002 2003 2000 2001 2002 2003 Year Year Year Year Year Year surface cloud cover - so2-no-sease ice water path - so2-no-season surface concentration column mass burden column mass burden column mass burden of DMS - so2-no-season of BC - so2-no-season of SO2 - so2-no-season of SO4 - so2-no-season 1e+00 7.5e-01 1e+00 5.0e-01 ⊲ 1e-0 loadso2 ∆ clivi ∆ dms 5e-0 5.0e+00 0e+00 2.5e-01 -2e+002 50+00 -5e-01 0.0e + 0.0-5e-01 -2e-01 2000 2001 2002 2003 2000 2001 2002 2003 2000 2001 2002 2003 2000 2002 2003 2000 2002 2003 2000 2001 2002 2003 2004 2004 2004 2004 2001 2004 2001 2004 Year Year Year Year SO4 lifetime - so2-no-season SO2 timescale - so2-no-season ∆ loadso4/(dryso4 + wetso4) 4e+00 0.0e+00 loadso2/emiso2 3e+00 -2.5e+04 -5.0e+04 2e+00 -7.5e + 0.42000 2001 2000 2002 2003 2002 2003 Year Year CAM5 E3SM GISS OsloCTM3 - UKESM - CESM1 -GEOS - MIROC

CESM2

-GFDL

NorESM2