land: percent difference surface flux surface flux surface concentration surface concentration surface concentration of BC - high-so4 of SO2 - high-so4 of BC - high-so4 of SO4 - high-so4 of SO2 - high-so4 2.5e+01 00+00 2e-05 -1e+00 2.0e+01 0e+00 mmrs04 \_2e+00 -4.8e+00 -2e-05 -3e+00 1.5e+01 26-01 -05 -4e+00 -6e-05 -5.2e+00 -5e+00 0e+00 1.0e+01 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 Year Year upwelling longwave flux at TOA – high–so4 upwelling shortwave flux at TOA – high–so4 net radiative flux at TOA – high–so4 upwelling clear-sky longwa flux at TOA - high-so4 incident shortwave flux at TOA - high-so4 1e-01 5e-08 5.0e-02 Зе \_01 3e-01 0e+00 rsut 2e-01 0.0e+00 1e-0 -5e-08 -5e-020e+00 0e+00 -1e-01 2000 2001 2002 2003 2004 2002 2003 2004 2002 2003 2004 2002 2003 2004 2000 2001 2002 2003 2004 2001 2000 2001 Year Year Year upwelling clear-sky shortwave flux at TOA - high-so4 clear-sky net radiative flux at TOA - high-so4 dry deposition rate of BC – high–so4 implied cloud response wet deposition rate at TOA - high-so4 of BC - high-so4 rsutcs) 3e-01 5e-01 rsutcs rlutcs -4e-01 √ 2e-01 1e-01 ∆ rlutcs rsut – 0e+00 2e-01 -5e-01 -1e+00 \_1e+00 0e+00 0e+002002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 Year total deposition rate of BC – high–so4 dry deposition rate of SO2 – high–so4 dry deposition rate of SO4 – high–so4 wet deposition rate of SO4 – high–so4 wet deposition rate of SO2 - high-so4 6e-01 -4.8e+00 6e+00 ∆ drybc + wetbc 3e-01 -4.9e+00 5e+00 dryso4 -4 0e+00 0e+00 2e+01 \_5 1e+00 -3e-01 1e+01 2e+00 -5.2e+00 -5.5e+00 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 Year Year Year  $\frac{1}{3} dryso2 + wetso2)/2 + \frac{1}{3} dryso4 + wetso4)/3$ total deposition rate ambient aerosol optical total cloud cover - high-so convective cloud cover - highsurface cloud cover - high-so of S - high-so4 thickness at 550nm - high-s 2e-01 0e+00 3e+01 1e+00 ∆ od550ae ا کا کا 2e+01 -2e-01 -4e+011e+01 -2.5e-01 -4e-01-6e+01 20002001200220032004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 Year Year Year Year Year ice water path - high-so4 surface concentration column mass burden column mass burden column mass burden of DMS - high-so4 of BC - high-so4 of SO2 - high-so4 of SO4 - high-so4 4e-01 2e-01 -3e+007.5e-01 2e+00 loadso2 dms 5.0e-01 -4e+00 1e+00 2.5e 5e+00 -2e-010e+00 -5e+00 0.0e+00 -4e-01 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 Year Year Year Year Year CAM5 E3SM **GISS** OsloCTM3 CESM1 **GEOS** MIROC **UKESM** CESM2 **GFDL** NorESM2