## so2-at-height: absolute difference surface flux surface flux surface concentration surface concentration of BC - NH-land of SO2 - NH-land of BC - NH-land of SO4 - NH-land of SO2 - NH-land 1.1e-18 2.5e-12 $\Delta$ emibc (kg m<sup>-2</sup> s<sup>-1</sup>) (kg kg - 1)emiso2 (kg $m^{-2}$ s<sup>-</sup> (kg kg - 1)ka ka-3.4e-19 -5 0e-12 ∆ mmrbc ( ∆ mmrso4 ∆ so2 ( -7.5e-12 -3e-09 -3.2e-20 0e+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 upwelling longwave flux at TOA – NH–land upwelling shortwave flux at TOA – NH–land upwelling clear-sky longwav flux at TOA - NH-land net radiative flux incident shortwave flux at TOA – NH–land at TOA - NH-land 0.0e + 00 $\Delta$ rlut + rsut (W m<sup>-2</sup>) 5.0e-07 1e-01 $\Delta$ rlutcs (W m-2) $\Delta$ rlut (W m – 2) Ę E 0e+00 rsut (W rsdt (W -5.0e-01 0.0e+00 -1e-01 -6e-01 -2.5e-07 -2e-01 \_8e 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2002 2003 2004 Year Year Year Year Year $' \, m^{-2}$ upwelling clear–sky shortwa flux at TOA – NH–land dry deposition rate of BC – NH–land wet deposition rate of BC – NH–land clear-sky net radiative implied cloud response flux at TOA - NH-land at TOA - NH-land ≥ 4.7e-15 4.9e-15 0.0e+0.03e-01 rsutcs ( Ē 0.0e + 00 $\Delta$ rsutcs (W m – 2) drybc (kg $m^{-2} s^{-1}$ 2e-01 rsutcs (W wetbc (kg m<sup>-2</sup> ; 1e-01 -5 0e-01 rlutcs 0e+00 -5.0e-01 -2e-0 rsnt -1.0e+00 rlut + 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 dry deposition rate of SO2 – NH–land dry deposition rate of SO4 – NH–land total deposition rate of BC – NH–land wet deposition rate of SO2 – NH–land wet deposition rate of SO4 – NH–land $\Delta$ drybc + wetbc (kg m<sup>-2</sup> s<sup>-1</sup> $\Delta$ wetso2 (kg m $^{-2}$ s $^{-}$ ∆ dryso2 (kg m<sup>-2</sup> s<sup>-</sup> wetso4 (kg m $^{-2}$ s $^{-}$ 1.5e-∆ dryso4 (kg m<sup>-2</sup> 5.0e-13 -6e-12 0.0e+00 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2002 2003 2004 Year Year Yea Year dryso2 + wetso2)/2 + (dryso4 + wetso4)/3total deposition rate ambient aerosol optical total cloud cover - NH-land convective cloud cover - NH-Ia surface cloud cover - NH-la of S - NH-land thickness at 550nm - NH-la 5.0e-02 0.0e+00 (percent) 5e-02 (percent) ∆ cl (percent) 0.0e+00 1e-01 $(kg m^{-2} s^{-1})$ -4.0e-13 -5.0e-02 0e+00 ∆ cltc ( ^ clt -8.0e-13 -1e-01 1e+35 -1.0e-01 -2e-01 0e+00 200@001200220032004 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 - NH-land surface concentration column mass burden column mass burden column mass burden of DMS - NH-land of SO2 - NH-land of BC - NH-land of SO4 - NH-land 2e-04 $\Delta$ loadso4 (kg m<sup>-2</sup>) $\Delta\,\mathrm{clivi}\,\left(\mathrm{kg}\;\mathrm{m}^{-2}\right)$ $loadbc (kg m^{-2})$ $\Delta$ loadso2 (kg m $^{-2}$ ) ∆ dms (kg kg –1) 0e+00 0e+00 -2e-04 -1e-09 1e-13 1e-06 -2e-09 -4e-04 0e+00 5.0e-07 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2002 2003 2004 Year Year Year Year Year CAM5 E3SM **GISS** OsloCTM3 CESM1 **GEOS** MIROC **UKESM**

CESM2

GFDL

NorESM2