## global: absolute difference surface flux surface flux surface concentration surface concentration of BC - so2-at-height of SO2 - so2-at-height of BC - so2-at-height of SO4 - so2-at-height of SO2 - so2-at-height $\mathrm{emibc}\,(\mathrm{kg}\,\mathrm{m}^{-2}\,\mathrm{s}^{-1})$ emiso2 (kg m<sup>-2</sup> s<sup>-1</sup> mmrbc (kg kg – 1) so2 (kg kg-1) mmrso4 (kg kg-2.4e-20 1e-13 -3.5e-20 0e+00 -9.4e-20 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 upwelling shortwave flux at TOA – so2–at–height upwelling clear-sky longway flux at TOA - so2-at-heigh upwelling longwave flux at TOA – so2–at–height net radiative flux incident shortwave flux at TOA - so2-at-height at TOA - so2-at-height 0e+00 0e+00 1e-01 -1e-01 4e-02 $rsut(W m^{-2})$ rlutcs (W m-2) -1e-01 rlut(Wm-2)sut (Wm-2)rsdt (Wm-2)5e-02 0e+00 -3e-01 -4e-0 -4e-02 -5e-02 -4e-01 -1e-07 -5e-01 -1e-0 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2002 2003 2004 2000 2001 2002 2003 2004 2002 2003 2004 2000 2001 2000 2001 Year Year Year Year Year upwelling clear-sky shortway flux at TOA - so2-at-heigh clear-sky net radiative flux at TOA - so2-at-heigh implied cloud response at TOA – so2-at-height wet deposition rate of BC – so2–at–height dry deposition rate of BC - so2-at-height rlutcs - rsutcs (W m<sup>-2</sup>) 0e+00 1e-0 rsutcs (W m<sup>-2</sup>) wetbc (kg $\mathrm{m}^{-2} \mathrm{s}^{-1}$ ) $drybc (kg m^{-2} s^{-1})$ rsutcs (W m-2) -2e-01 0e+00 -3e-01 -1e-0 -4e-01 + rsut --5e-01 큳 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 dry deposition rate of SO4 – so2–at–height total deposition rate dry deposition rate wet deposition rate wet deposition rate of BC - so2-at-height of SO2 - so2-at-height of SO2 - so2-at-height of SO4 - so2-at-height 7.6e-16 $drybc + wetbc (kg m^{-2} s^{-1})$ 4.3e wetso4 $(kg m^{-2} s^{-1})$ vetso2 (kg $m^{-2}$ s<sup>-1</sup> dryso4 (kg $m^{-2}$ s<sup>-1</sup> dryso2 (kg m<sup>-2</sup> s<sup>-</sup> 2e-13 1.0e-12 5.0e-13 -5.3e-16 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 total deposition rate ambient aerosol optical total cloud cover convective cloud cover (dryso2 + wetso2)/2 + (dryso4 + wetso4)/3of S - so2-at-height thickness at 550nm - so2-at-h percentage - so2-at-heigh percentage - so2-at-height 2e-13 0.0e+00 3e+35 expression(clt~(%) $(kg m^{-2} s^{-1})$ -2.5e-02 2e+35 0e+00 1e+35 -7.5e-02 20002001200220032004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 Year Year Year Year CAM-ATRAS E3SM GISS modelE OsloCTM3 CESM **GEOS** MIROC-SPRINTARS UKESM1

CESM2

GFDL-ESM4

NorESM2