Reference – absolute NH–land averages surface flux of BC - NH-la surface flux of SO2 - NH-la surface concentration surface concentration of BC - NH-land of SO4 - NH-land of SO2 - NH-land 2.5e-09 emibc $(kg m^{-2} s^{-1})$ əmiso2 (kg m $^{-2}$ s $^{-1}$ mmrbc (kg kg⁻¹ mmrso4 (kg kg⁻ $so2 (kg kg^{-1})$ 2.0e-09 1.50e 1.25e-12 1.00e 2000 2001 2002 2003 2004 2002 2003 2004 2002 2003 2004 2002 2003 2004 2000 2001 2002 2003 2004 Year Year Year longwave flux at TOA - NH-lai clear-sky longwave flux at TOA - NH-land shortwave flux at TOA - NH-la net radiative flux at TOA - NH-I incident shortwave flux at TOA – NH-land -340 300 -234 $rlut + rsut (W m^{-2})$ 200 rlut $(W m^{-2})$ $rsut (W m^{-2})$ rlutcs $(W m^{-2})$ $rsdt (W m^{-2})$ 100 0 -350 -259 -100 2000 2001 2000 2001 2000 2001 2002 2003 2004 2001 2002 2003 2004 2000 2001 2002 2003 2004 2002 2003 2004 2002 2003 2004 Year dry deposition rate of BC – NH–land clear-sky shortwave flux at TOA - NH-land clear-sky net radiative flux at TOA - NH-land implied cloud response at TOA – NH–land wet deposition rate of BC – NH–land rsut - rlutcs - rsutcs (W m⁻²) _320 lutcs + rsutcs (W m $^{-2}$) 1.25e-12 wetbc $(kg m^{-2} s^{-1})$ drybc (kg m^{-2} s⁻¹ rsutcs $(W m^{-2})$ 1.00e-12 -330 -335 -76 rlut + 2000 2001 2002 2003 2004 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 of BC – NH–land dry deposition rate of SO2 – NH–land dry deposition rate of SO4 – NH–land wet deposition rate of SO4 – NH–land wet deposition rate of SO2 - NH-land 2.0e-11 1.25e-11 $drybc + wetbc (kg m^{-2} s^{-1})$ 0.04 wetso2 $(kg m^{-2} s^{-1})$ wetso4 $(kg m^{-2} s^{-1})$ dryso2 (kg m $^{-2}$ s $^{-1}$) dryso4 (kg m⁻² s^{-′} 0.03 1.2e-12 0.02 1.0e-12 0.01 2000 2001 2002 2003 2004 2002 2003 2004 2000 2001 2002 2003 2002 2003 2004 2002 2003 2004 Year Year Year Year total deposition rate of S – NH–land (dryso2 + wetso2)/2 + (dryso4 + wetso4)/30.020 $(kg m^{-2} s^{-1})$ 0.015 0.010 0.005 0.000 2000 2001 2002 2003 2004 Year CAM-ATRAS CESM1-1950 **GEOS** GISS-1950

GEOS-1950

GISS

E3SM-1950

NorESM2

NorESM2-1950

CAM-ATRAS-1950

CESM1