no-so4: percent difference surface flux of BC – arctic surface concentration of BC – arctic upwelling longwave flux at TOA – arctic surface flux surface concentration surface concentration of SO2 - arctic of SO4 - arctic of SO2 - arctic 8e-04 5 0e=0° 6e-04 5e+00 2e-02 _1 0e+0 0.0e+00 4e-04 4e+00 1e+00 0e+00 -1.5e+0 3e+00 -1.0e+00 -2e-02 2e+00 0e+00 -1.5e+00 2003 2004 2002 2003 2004 2002 2002 2003 2004 2003 2000 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2000 2001 2000 2001 2000 2001 2002 2004 2001 upwelling clear–sky longwave flux at TOA – arctic upwelling shortwave flux at TOA – arctic incident shortwave flux upwelling clear–sky shortwave flux at TOA – arctic clear-sky net radiative flux at TOA - arctic net radiative flux at TOA – arctic at TOA – arctic 5e-0 4e-01 2e-02 3e-01 ∆ rlut + rsut 5e-0 5e-01 Δ rlutcs 2e-01 2e-01 0e+00 ∆ rlutcs 1e-0 1e-01 0e+00 0e+00 00+00 2000 2003 2001 2002 2003 2000 2001 2002 2003 2000 2002 2003 2002 2003 2000 2001 2002 2003 Year Year Year Year Year Year dry deposition rate of SO2 – arctic implied cloud response dry deposition rate wet deposition rate total deposition rate wet deposition rate at TOA - arctic of BC - arctic of BC - arctic of BC - arctic of SO2 – arctic Δ (rlut + rsut - rlutcs - rsutcs) 4.0e+00 6e-01 3.5e+00 0e+00∆ dryso2 3.0e+00 0e+00 ∆ drybc + 0e+00 -2e+00 -2e+00 2002 2002 2001 2003 2000 2002 2003 2004 2000 2001 2002 2003 2004 2000 2002 2000 2001 2002 2003 2004 2000 2001 2003 2004 2000 2001 2001 2003 2004 Year Year Year Year Year dry deposition rate wet deposition rate total deposition rate ambient aerosol optical total cloud cover - arctic convective cloud cover - arctic of SO4 – arctic of SO4 - arctic of S – arctic thickness at 550nm - arctic 5e-01 0e+00 dryso2 + wetso2)/2 + (dryso40e+00 0e+00 4e+00-3e+00∆ od550ae -2e+0 ö 0e+00 -2e+00 -6e+00 -3e+00 -6e-0-4e+00 -9e+00 -6e+01 2002 2003 2000 2001 2002 2003 2000 2001 2002 2003 2004 2000 2002 2003 2000 2001 2002 2003 2000 2002 2003 2004 Year Year Year Year Year Year surface cloud cover - arctic ice water path - arctic surface concentration column mass burden column mass burden column mass burden of DMS - arctic of BC - arctic of SO2 - arctic of SO4 - arctic 2e+00 1e+00 2.0e+0.11e+00 2e+01 0e+00 ∆ dms 0e+00 1.0e+01 -1e+00 5.0e+00 -2e+00 2003 2000 2001 2002 2003 2004 2000 2001 2002 2003 2004 2000 2001 2002 2003 2000 2001 2002 2003 2000 2002 2003 2000 2001 2002 2004 2004 2004 2001 2004 Year Year Year Year SO4 lifetime - arctic SO2 timescale - arctic △ loadso4/(dryso4 + wetso4) 0e+00 1.0e+01 loadso2/emiso2 -2e+005.0e+00 -4e+000.0e+00 2000 2001 2002 2003 2002 2003 Year Year CAM5 E3SM GISS OsloCTM3 - UKESM - CESM1 -GEOS - MIROC

CESM2

-GFDL

NorESM2