



Supplement of

Late-spring and summertime tropospheric ozone and NO₂ in western Siberia and the Russian Arctic: regional model evaluation and sensitivities

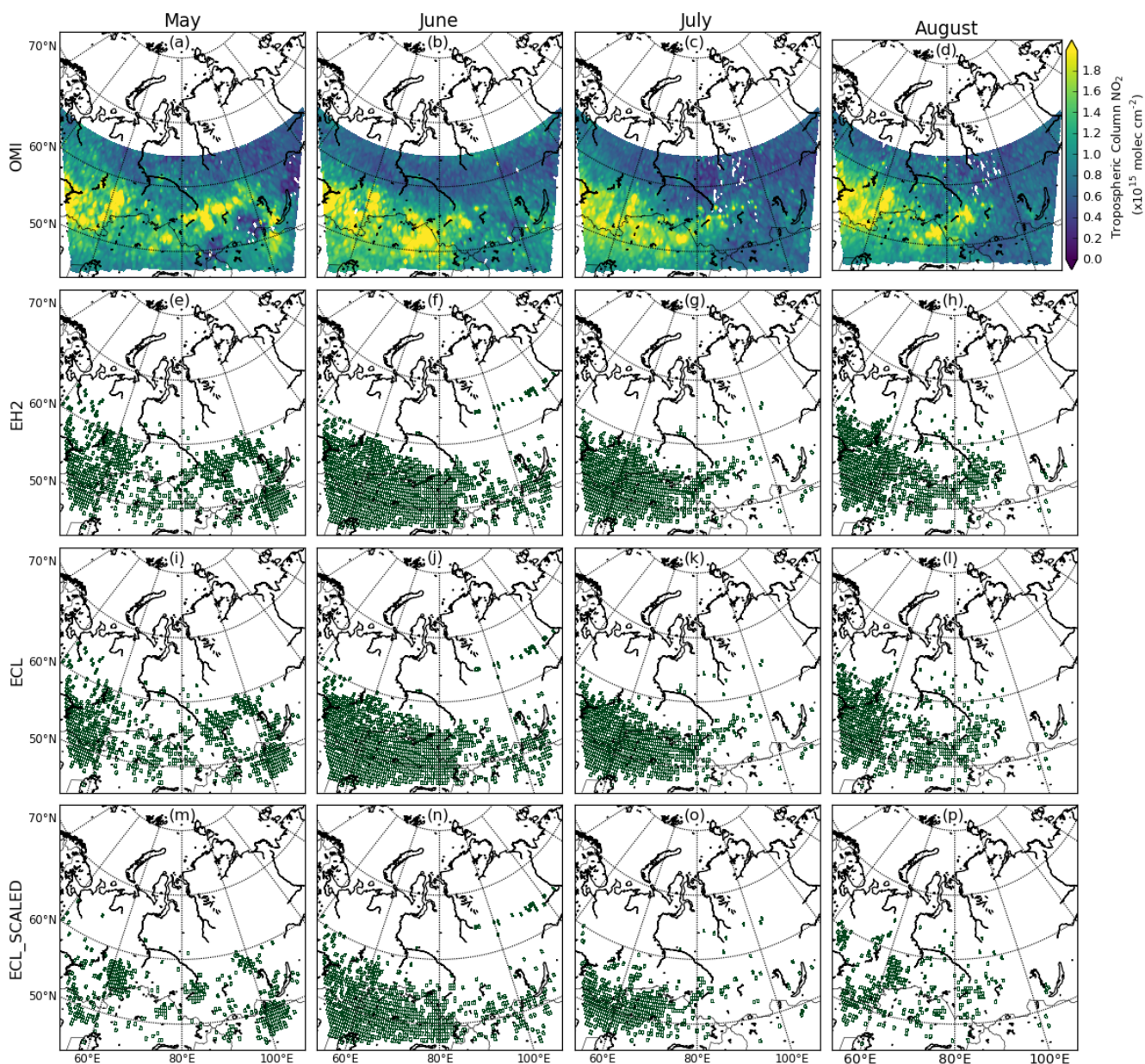
Thomas Thorp et al.

Correspondence to: Thomas Thorp (eetth@leeds.ac.uk)

The copyright of individual parts of the supplement might differ from the article licence.

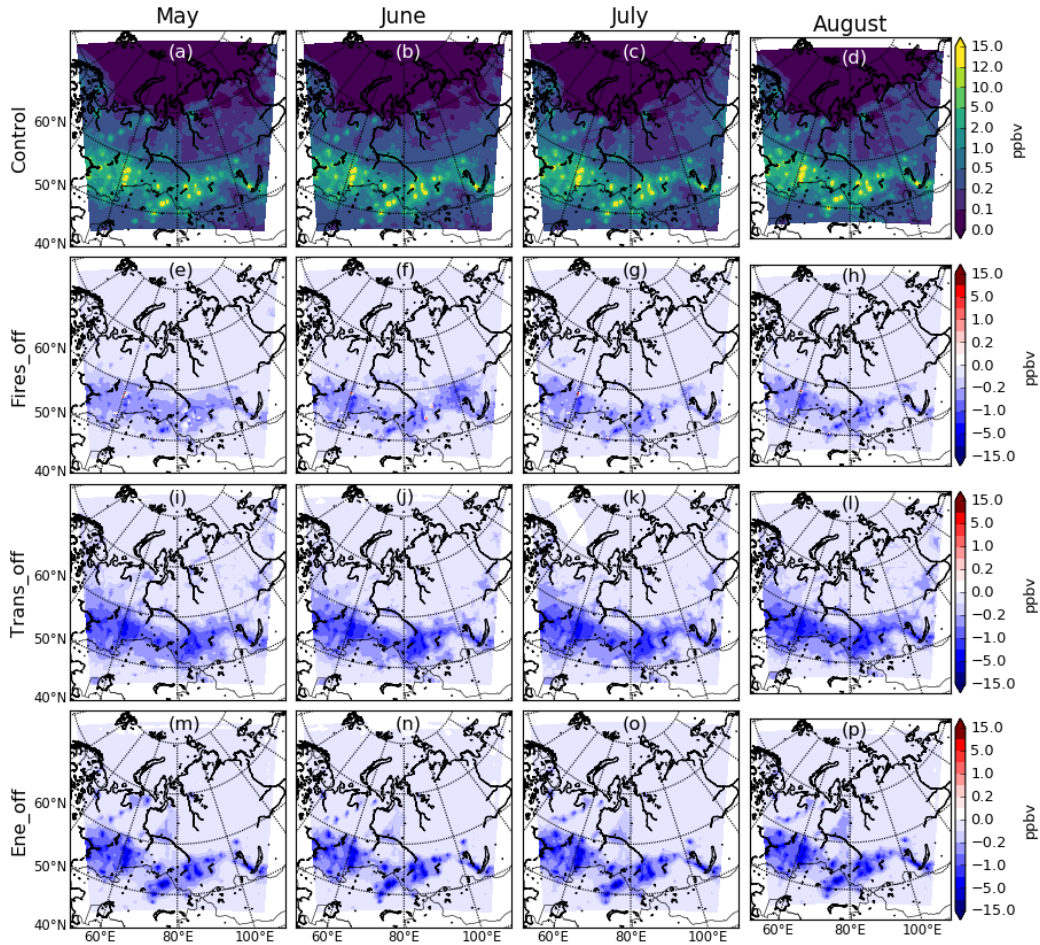
Supplementary Table S1 - WRF-Chem model setup for all simulations.

Model Parameter	WRF-Chem Option
Horizontal Resolution	30 km x 30 km (140 x 140 grid)
Vertical Levels	27 vertical levels. Model top at 10 hPa.
Projection & Domain	Polar Stereographic Projection. Domain = 44-84° North, 7-153° East
Gas Phase Chemistry	Model of Ozone and Related Chemical Tracers (MOZART) V4
Aerosol Scheme	Model for Simulating Aerosol Interactions and Chemistry (MOSAIC) 4-Bin
Mineral Dust	GOCART dust emissions with AFWA modifications
Photolysis Scheme	Madronich Fast Tropospheric Ultraviolet-Visible (FTUV)
Biogenic Emissions	Model of Emissions of Gases and Aerosols from Nature (MEGAN)
Biomass Burning Emissions	Fire Inventory from NCAR (FINN)
Planetary Boundary Layer Scheme	Mellor-Yamada Nakanishi and Niino Level 2.5 PBL
Longwave Radiation Scheme	RRTM-G (Rapid Radiative Transfer Model for GCMs)
Shortwave Radiation Scheme	RRTM-G (Rapid Radiative Transfer Model for GCMs)
Land Surface Model	Noah
Cloud Microphysics Scheme	Thompson et al. New scheme suitable for ice, snow and graupel processes at high resolution
Convective Parametrisation	Grell 3D
Initial Meteorological Boundary Conditions	NCEP GFS, supplemented with NCEP FNL
Initial Chemical Boundary Conditions	MOZART 4



Supplementary Figure S1 – Observed tropospheric column NO₂ and satellite/model uncertainty regions. Panels a-e show mean OMI tropospheric column NO₂ for April-August. Panels e-p show where modelled values of tropospheric column NO₂ are outside of the satellite uncertainty range for May to August for EH2 (e-h), ECL (i-l) and ECL_SCALED (m-p).

5

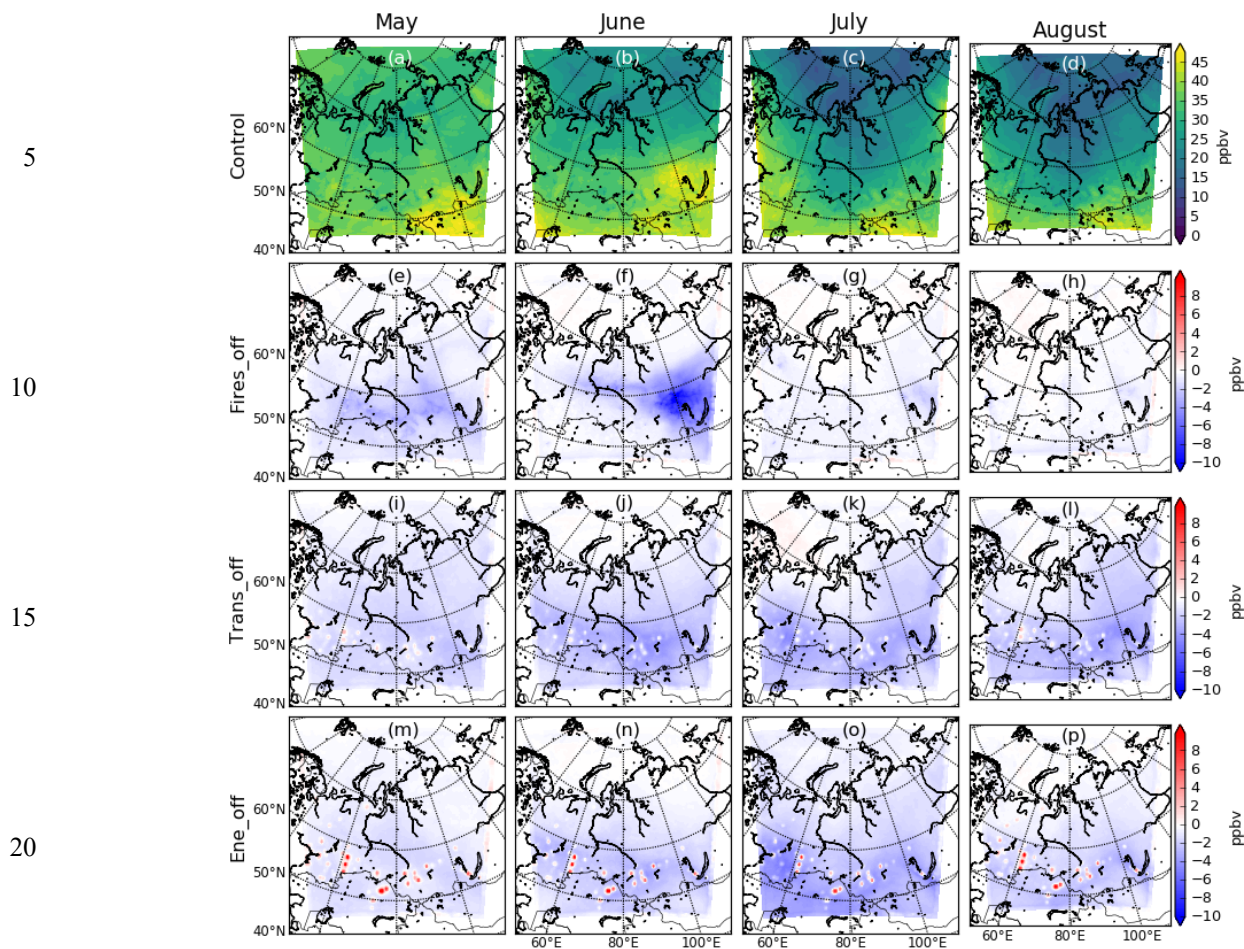


10

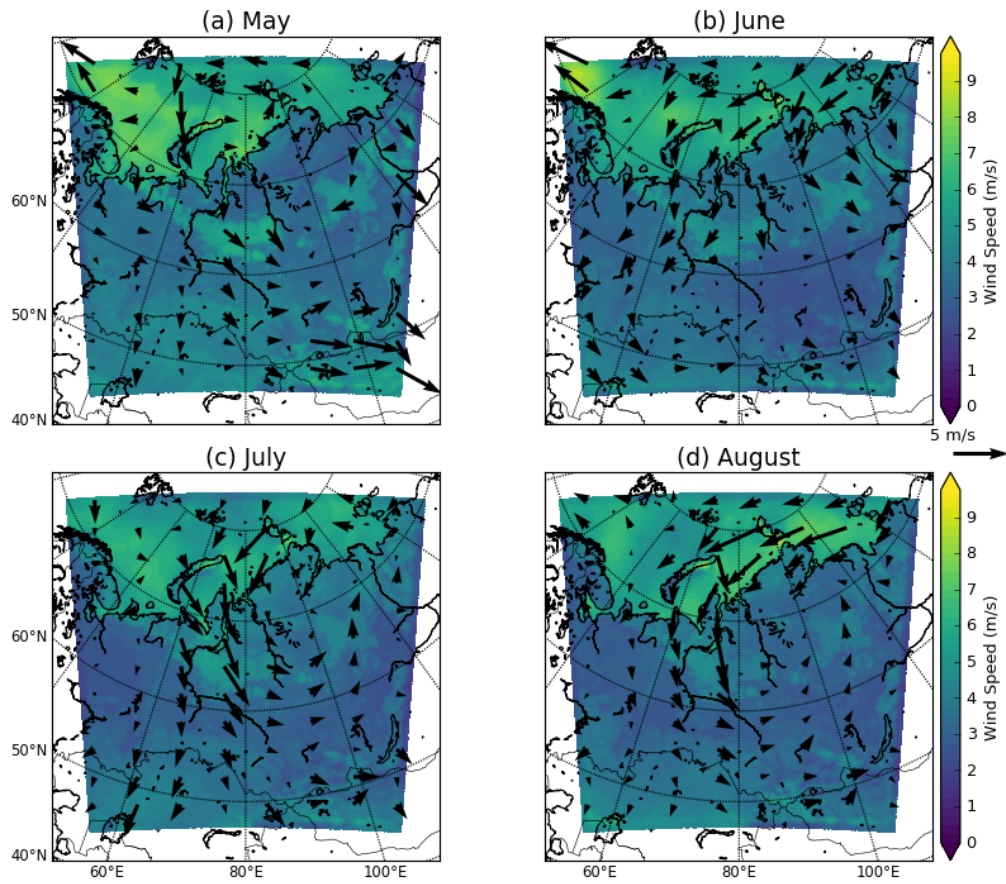
15

20

Supplementary Figure S2 – Simulated control and sensitivity run changes in surface NO_2 concentrations using standard ECL anthropogenic emissions. Panels (a)–(d) show monthly means of WRF-Chem surface NO_2 for May–August. Panels (e)–(h) show monthly means of WRF-Chem Surface NO_2 with all fire emissions switched off in domain (fires_off simulation) minus control simulation for May–August. Panels (i)–(l) show monthly means of WRF-Chem Surface NO_2 with all transport emissions switched off in domain (trans_off) minus control simulation for May–August. Panels (m)–(p) show monthly means of WRF-Chem Surface NO_2 with all energy emissions switched off in domain (ene_off) minus control simulation for May–August.



Supplementary Figure S3 – Simulated control and sensitivity run changes in surface O₃ concentrations using standard ECL anthropogenic emissions. Panels (a)–(d) show monthly means of WRF-Chem surface O₃ for May–August. Panels (e)–(h) show monthly means of WRF-Chem Surface O₃ with all fire emissions switched off in domain (fires_off simulation) minus control simulation for May–August. Panels (i)–(l) show monthly means of WRF-Chem Surface O₃ with all transport emissions switched off in domain (trans_off) minus control simulation for May–August. Panels (m)–(p) show monthly means of WRF-Chem Surface O₃ with all energy emissions switched off in domain (ene_off) minus control simulation for May–August.



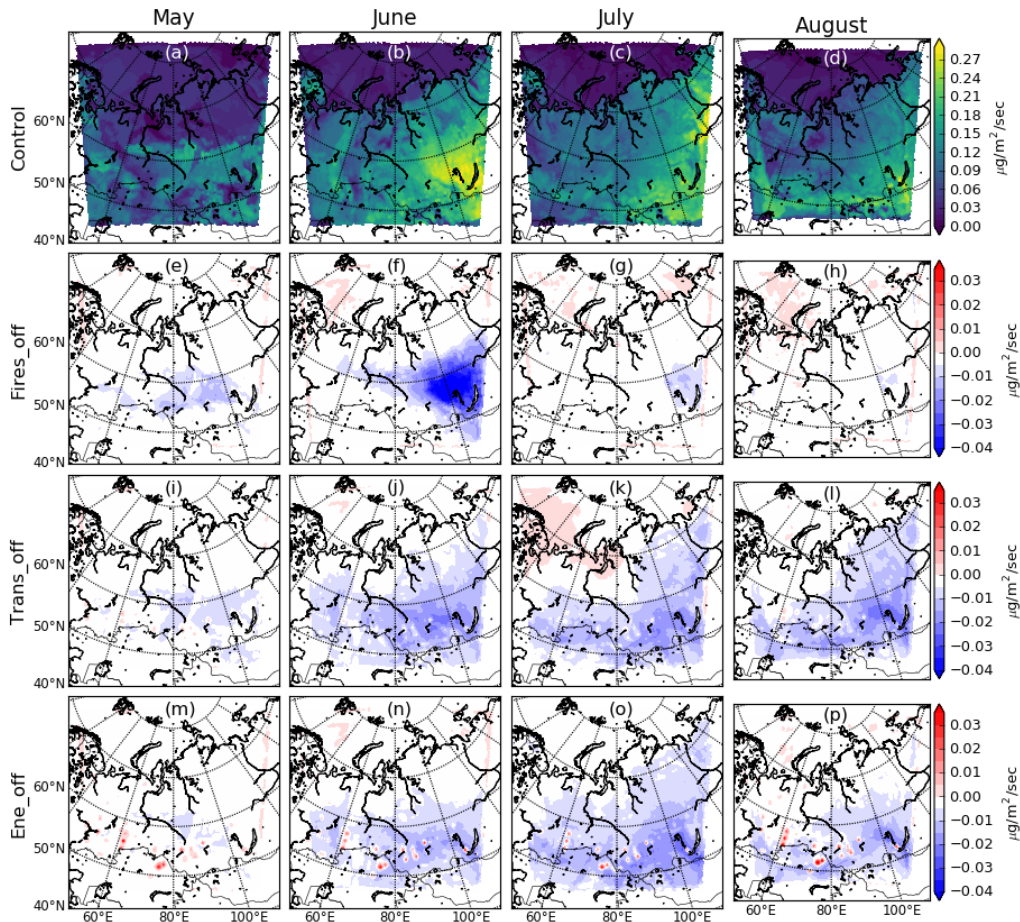
Supplementary Figure S4 – Panels (a) – (d) show monthly means of WRF-Chem surface wind direction plotted on to wind speed.

5

10

15

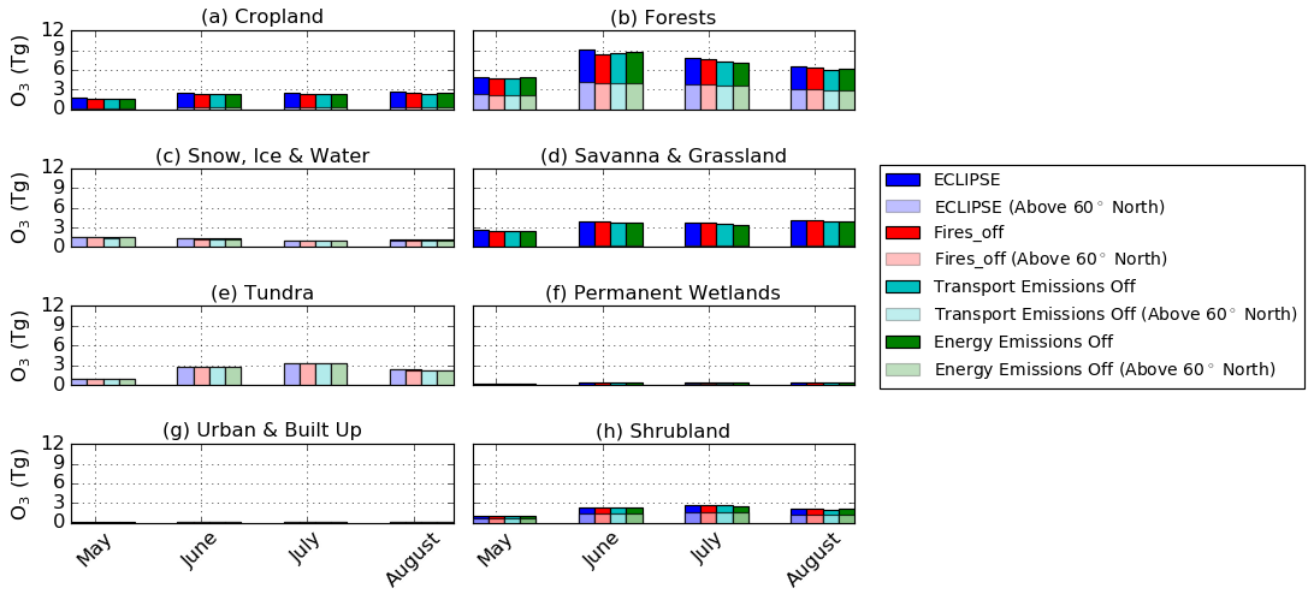
20



25

Supplementary Figure S5 - Simulated control and sensitivity run changes in surface ozone dry deposition fluxes using standard ECL anthropogenic emissions.

Panels (a)–(d) show monthly means of WRF-Chem surface ozone deposition flux for May–August. Panels (e)–(h) show monthly means of WRF-Chem Surface ozone flux with all fire emissions switched off in domain (fires_off simulation) minus control simulation for May–August. Panels (i)–(l) show monthly means of WRF-Chem Surface ozone with all transport emissions switched off in domain (trans_off) minus control simulation for May–August. Panels (m)–(p) show monthly means of WRF-Chem Surface ozone with all energy emissions switched off in domain (ene_off) minus control simulation for May–August.



Supplementary Figure S6 - Quantity of ozone deposited to modified IGBP MODIS NOAH land surface cover categories per month for total domain (solid bars) and for the section of the domain above 60°N (pale bars). Based on simulations using standard ECL emissions.