



Supplement of

Two biogenic volatile organic compound emission datasets over Europe based on land surface modelling and satellite data assimilation

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Table S1. List of VOCs and their three-letter abbreviation included in the SURFEX-MEGAN3.0 datasets.

RACM name/three-letter abbreviation	Long explanation of chemical species according to RACM definitions
ISO	Isoprene
CH4	Methane
ETH	Ethane
HC3	Sum of alkanes, alcohols, esters, and alkynes with OH rate constant (298K, 1 atmosphere) less than $3.4 \times 10^{-12} \text{ cm}^3 \text{ s}^{-1}$
HC5	Sum of alkanes, alcohols, esters, and alkynes with OH rate constant (298K, 1 atmosphere) between $3.4 \times 10^{-12} \text{ cm}^3 \text{ s}^{-1}$ and $6.8 \times 10^{-12} \text{ cm}^3 \text{ s}^{-1}$
HC8	Sum of alkanes, alcohols, esters, and alkynes with OH rate constant (298K, 1 atmosphere) greater than $6.8 \times 10^{-12} \text{ cm}^3 \text{ s}^{-1}$
OL2	Ethene
OLI	Sum of internal alkenes
OLT	Sum of terminal alkenes
ALD	Sum of acetaldehyde and higher aldehydes
KET	Sum of ketones
TOL	Sum of toluene and less reactive aromatics
HCHO	Formaldehyde
ORA1	Formic acid
ORA2	Sum of acetic acid and higher acids
API	Sum of alpha-pinene and other cyclic terpenes with one double bond
LIM	Sum of limonenes and other cyclic diene-terpenes

Table S2. Correlation scores between the SURFEX root-zone soil moisture and observations from sites within the SMOSMANIA network that showed reasonable data quality in the observations. Results for both the open-loop and analysis are presented.

	OL	Analysis
Lahas	0.87	0.86
Lezignan Corbieres	0.90	0.90
Montaut	0.85	0.84
Mazan Abbaye	0.82	0.83
Peyrusse Grande	0.90	0.90
Pezenas	0.83	0.83
Savenes	0.85	0.85
Villeville	0.87	0.87

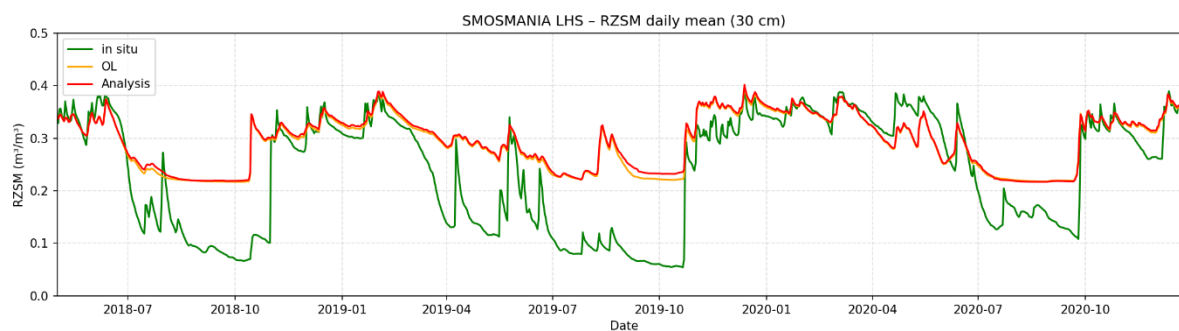


Figure S1. Time series of observed in-situ RSZM at the Lahas SMOSMANIA monitoring station (green), the RSZM from the SURFEX open-loop simulation (yellow), and the RSZM from the SURFEX analysis simulation (red).

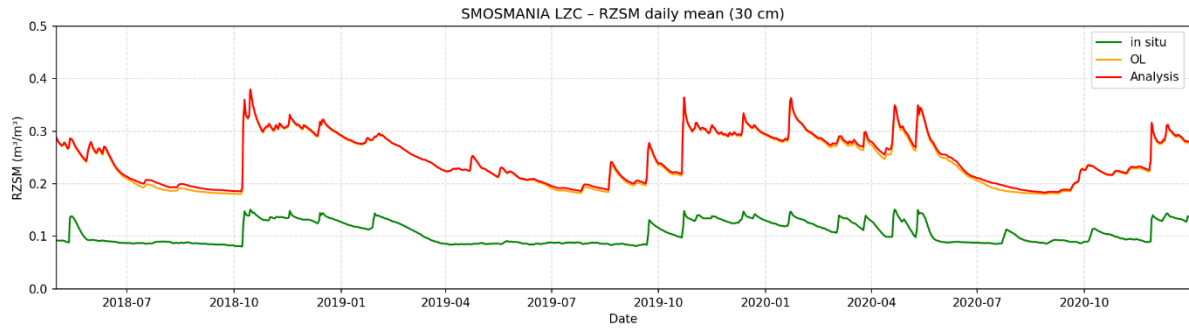


Figure S2. Time series of observed in-situ RSZM at the Lezignan Corbieres SMOSMANIA monitoring station (green), the RSZM from the SURFEX open-loop simulation (yellow), and the RSZM from the SURFEX analysis simulation (red).

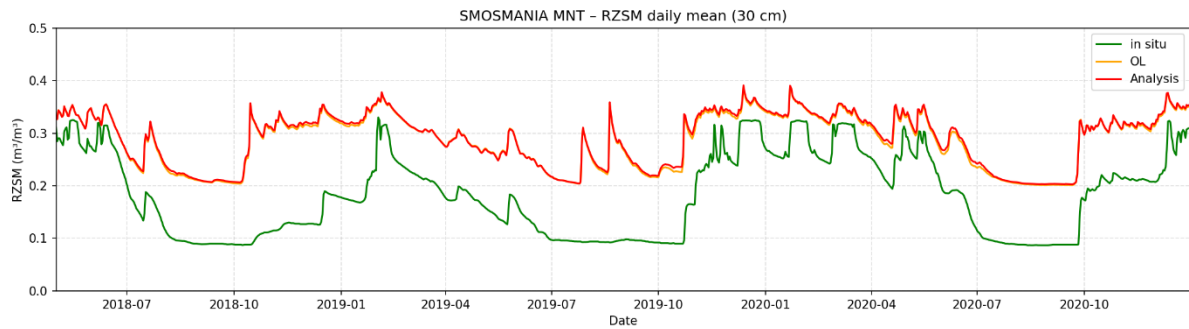


Figure S3. Time series of observed in-situ RSZM at the Montaut SMOSMANIA monitoring station (green), the RSZM from the SURFEX open-loop simulation (yellow), and the RSZM from the SURFEX analysis simulation (red).

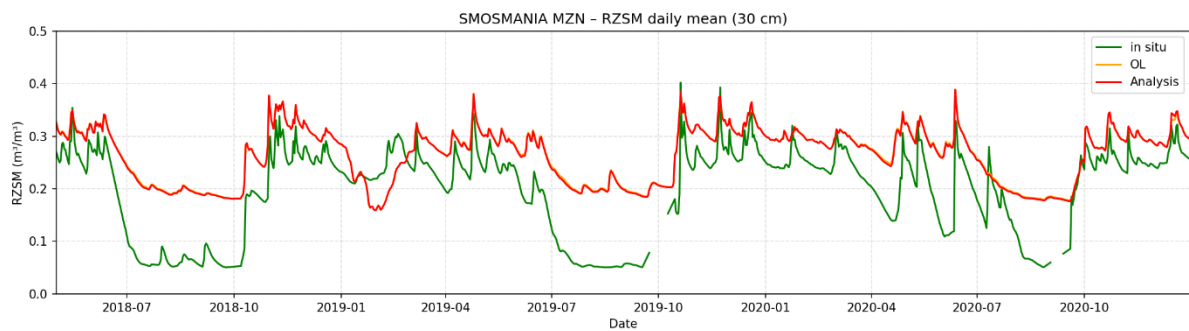


Figure S4. Time series of observed in-situ RSZM at the Mazan Abbaye SMOSMANIA monitoring station (green), the RSZM from the SURFEX open-loop simulation (yellow), and the RSZM from the SURFEX analysis simulation (red).

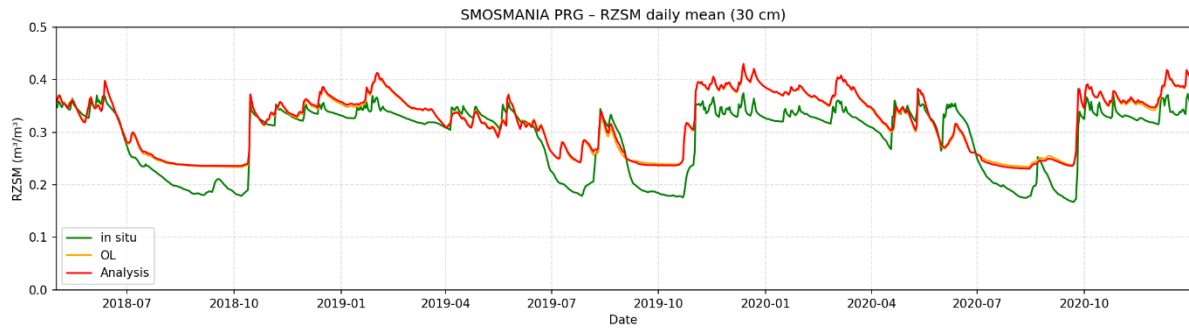


Figure S5. Time series of observed in-situ RSZM at the Peyrusse Grande SMOSMANIA monitoring station (green), the RSZM from the SURFEX open-loop simulation (yellow), and the RSZM from the SURFEX analysis simulation (red).

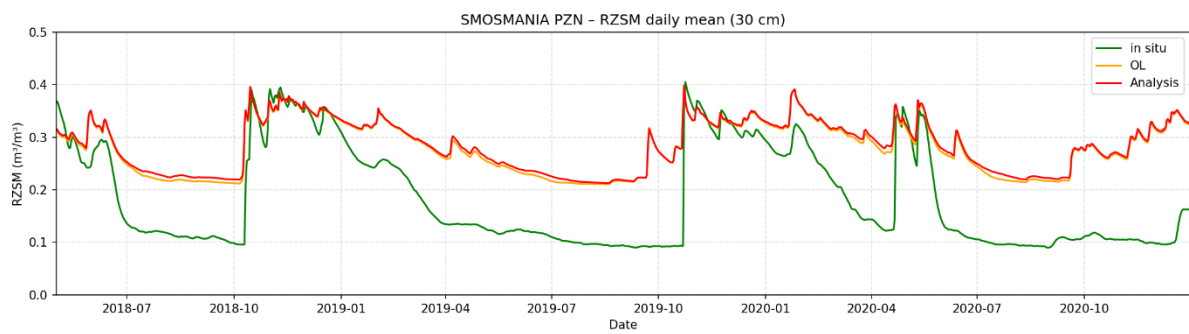


Figure S6. Time series of observed in-situ RSZM at the Pezenas SMOSMANIA monitoring station (green), the RSZM from the SURFEX open-loop simulation (yellow), and the RSZM from the SURFEX analysis simulation (red).

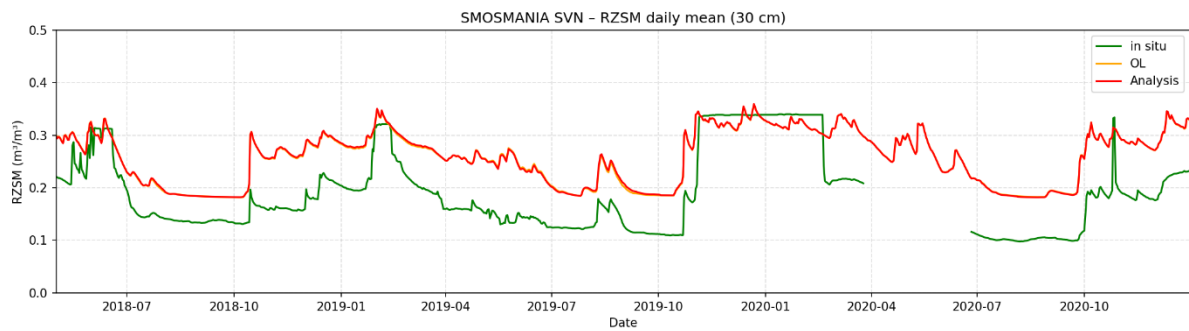


Figure S7. Time series of observed in-situ RSZM at the Savenes SMOSMANIA monitoring station (green), the RSZM from the SURFEX open-loop simulation (yellow), and the RSZM from the SURFEX analysis simulation (red).

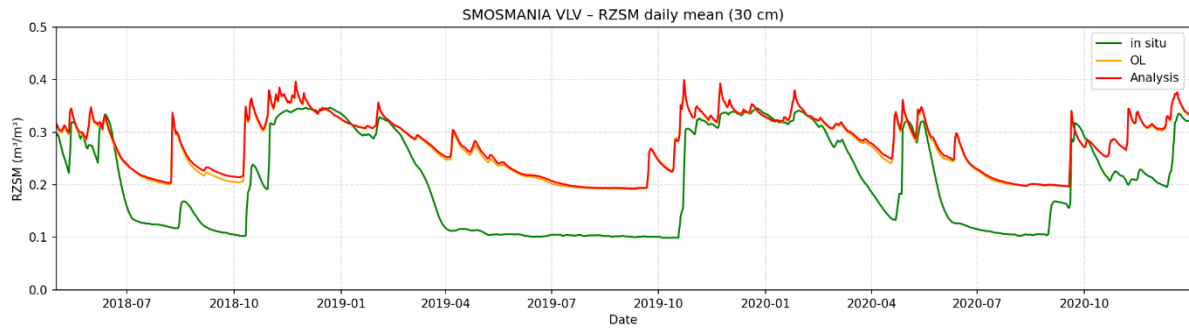


Figure S8. Time series of observed in-situ RSZM at the Villevielle SMOSMANIA monitoring station (green), the RSZM from the SURFEX open-loop simulation (yellow), and the RSZM from the SURFEX analysis simulation (red).

Monthly Mean Isoprene Emissions Over the CAMS European Domain for 2018 - Open Loop

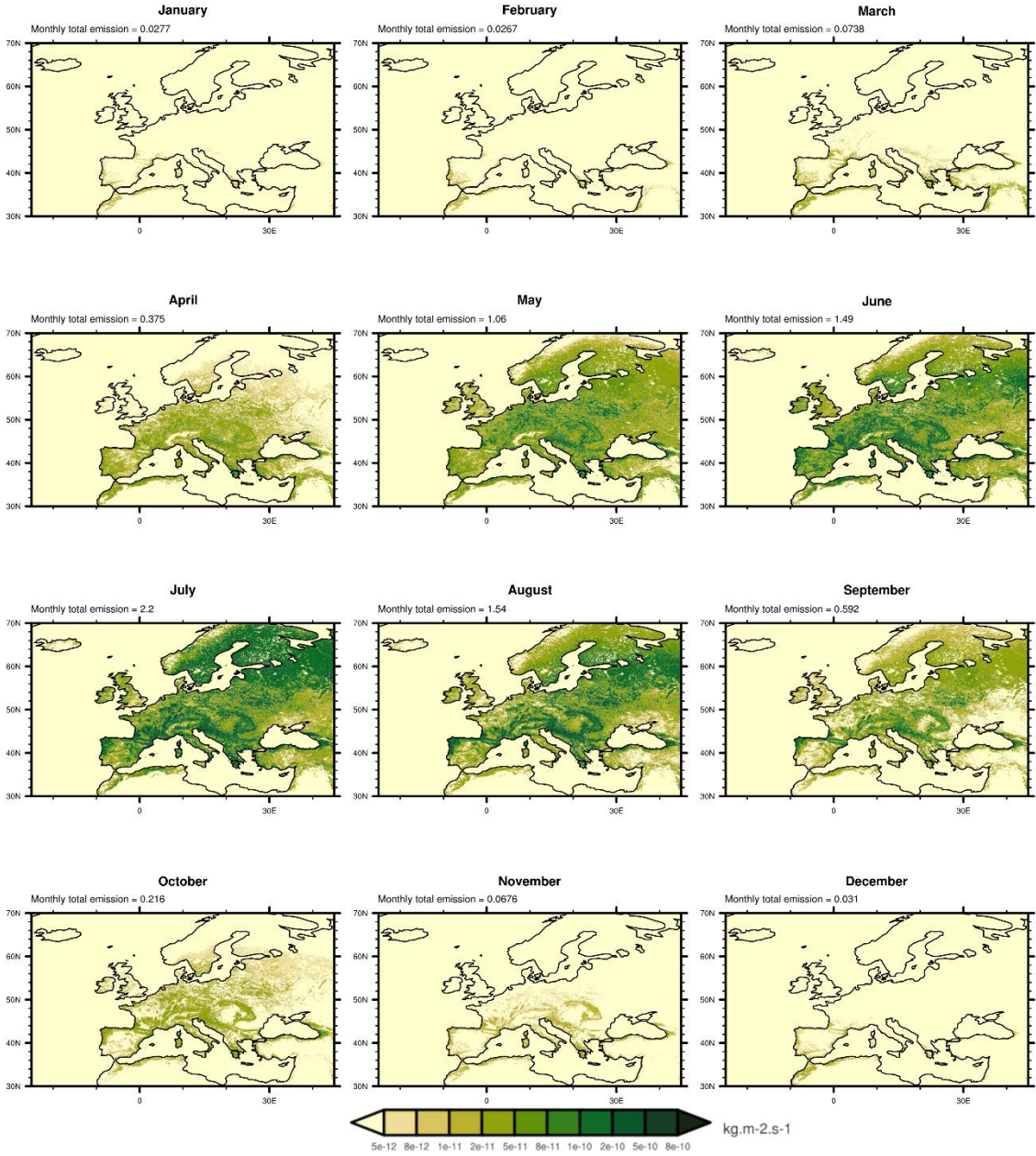


Figure S9. Maps of monthly mean isoprene emissions (units of $\text{kg.m}^{-2}.\text{s}^{-1}$) calculated using the SURFEX-MEGAN3.0 algorithms and averaged over 2018 using the open-loop configuration of SURFEX. The panels show each month moving sequentially from January to December first from left to right and then downwards from top to bottom. The colour bars indicate increasing mean isoprene emissions as the colours transition from pale yellow to dark green. Note that the colour bar has a quasi-logarithmic scale. The monthly total mass of isoprene emissions (units of Tg) are shown above each plot.

Monthly Mean Isoprene Emissions Over the CAMS European Domain for 2019 - Open Loop

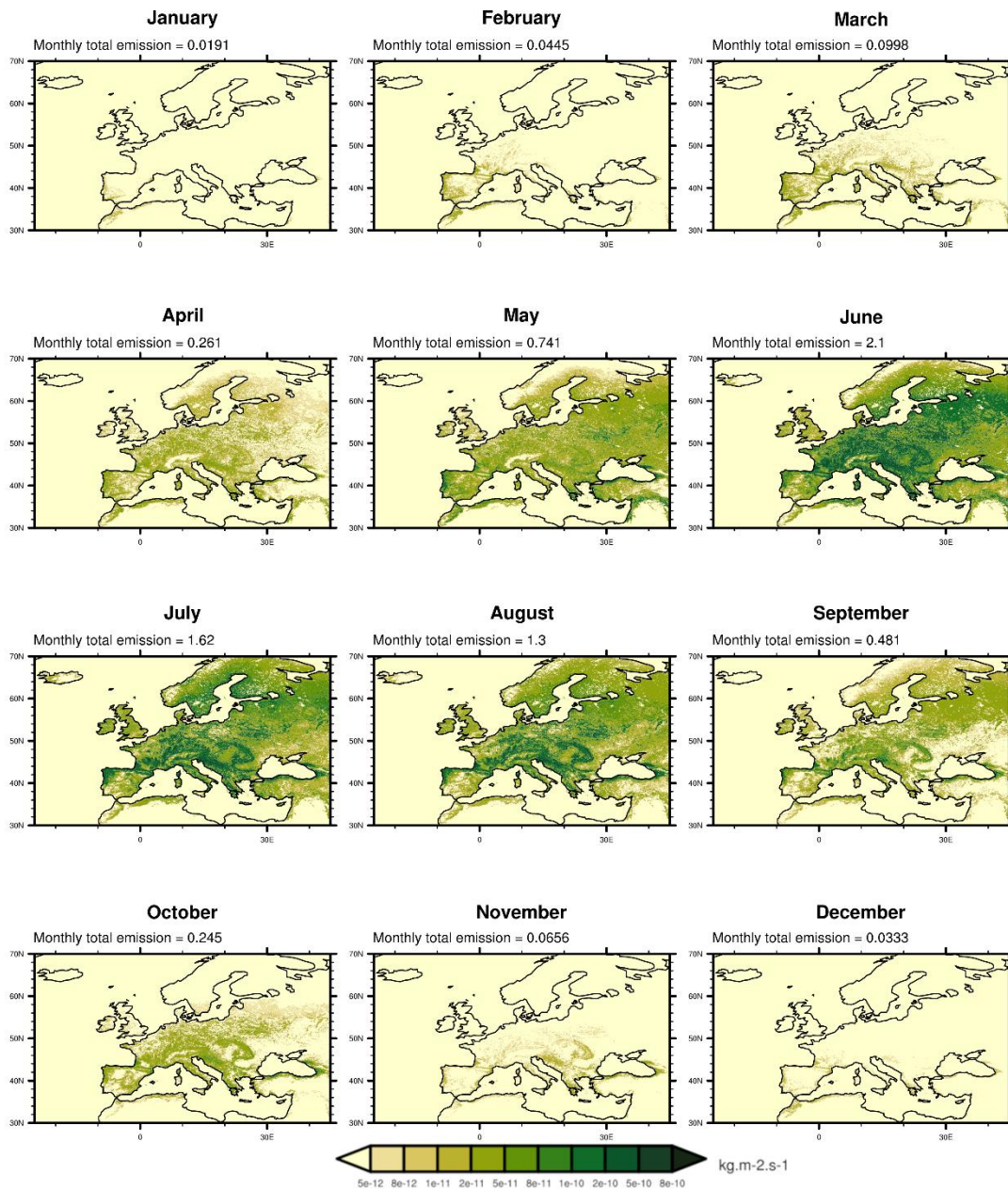


Figure S10. Maps of monthly mean isoprene emissions (units of $\text{kg.m}^{-2}.\text{s}^{-1}$) calculated using the SURFEX-MEGAN3.0 algorithms and averaged over 2019 using the open-loop configuration of SURFEX. The panels show each month moving sequentially from January to December first from left to right and then downwards from top to bottom. The colour bars indicate increasing mean isoprene emissions as the colours transition from pale yellow to dark green. Note that the colour bar has a quasi-logarithmic scale. The monthly total mass of isoprene emissions (units of Tg) are shown above each plot.

Monthly Mean Isoprene Emissions Over the CAMS European Domain for 2020 - Open Loop

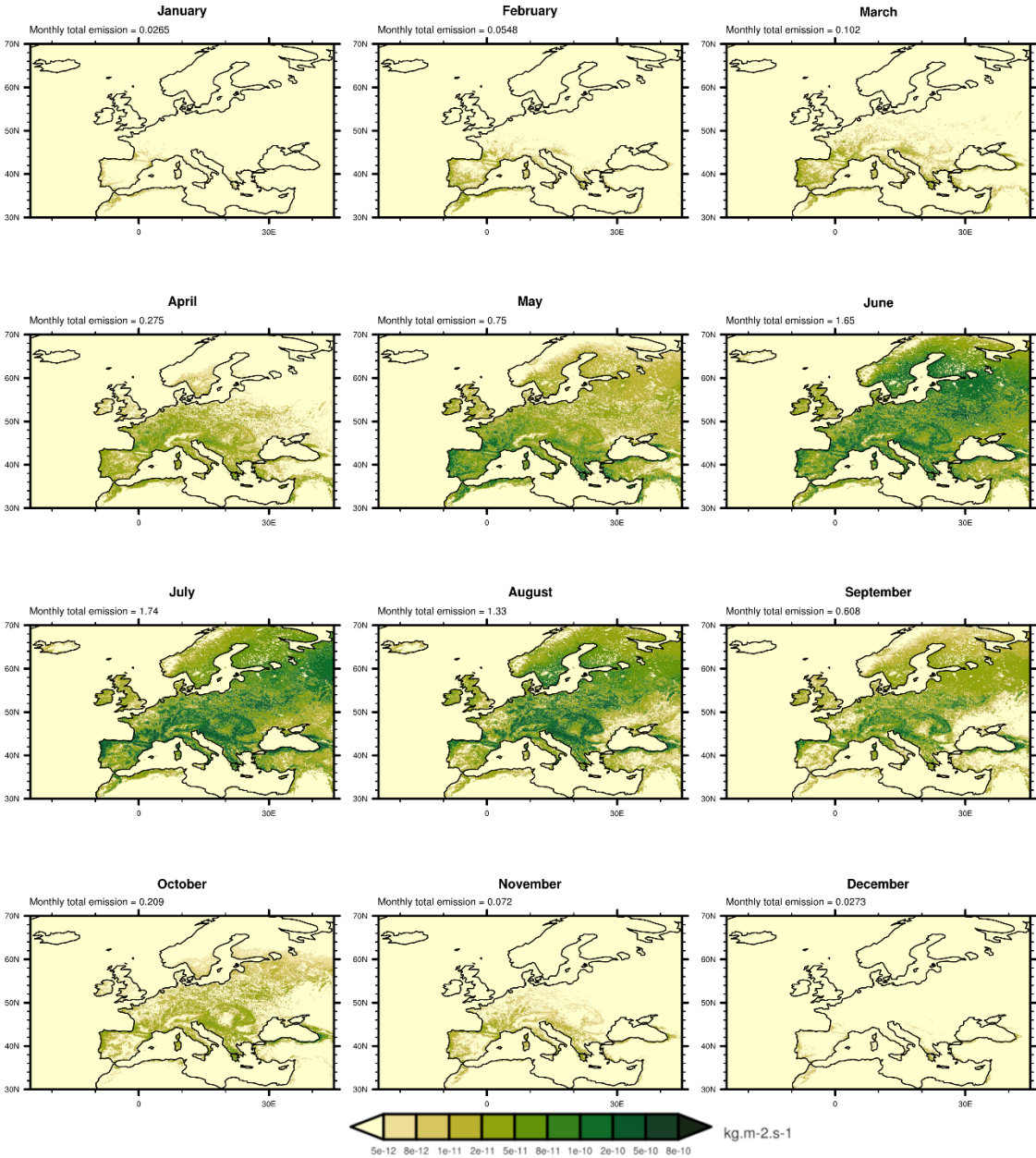


Figure S11. Maps of monthly mean isoprene emissions (units of $\text{kg}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) calculated using the SURFEX-MEGAN3.0 algorithms and averaged over 2020 using the open-loop configuration of SURFEX. The panels show each month moving sequentially from January to December first from left to right and then downwards from top to bottom. The colour bars indicate increasing mean isoprene emissions as the colours transition from pale yellow to dark green. Note that the colour bar has a quasi-logarithmic scale. The monthly total mass of isoprene emissions (units of Tg) are shown above each plot.

Monthly Mean Isoprene Emissions Over the CAMS European Domain for 2021 - Open Loop

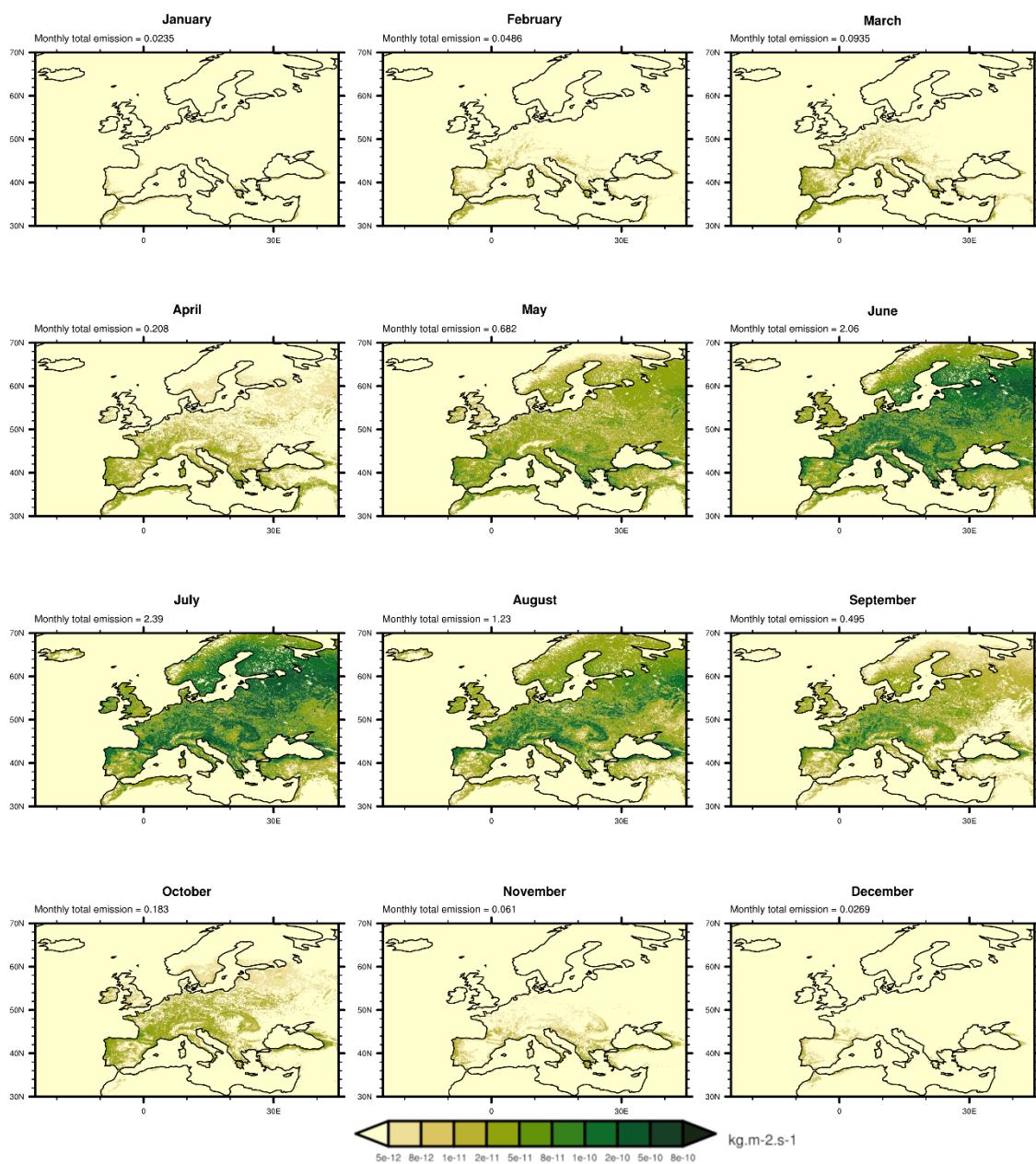


Figure S12. Maps of monthly mean isoprene emissions (units of $\text{kg.m}^{-2}.\text{s}^{-1}$) calculated using the SURFEX-MEGAN3.0 algorithms and averaged over 2021 using the open-loop configuration of SURFEX. The panels show each month moving sequentially from January to December first from left to right and then downwards from top to bottom. The colour bars indicate increasing mean isoprene emissions as the colours transition from pale yellow to dark green. Note that the colour bar has a quasi-logarithmic scale. The monthly total mass of isoprene emissions (units of Tg) are shown above each plot.

Monthly Mean Isoprene Emissions Over the CAMS European Domain for 2022 - Open Loop

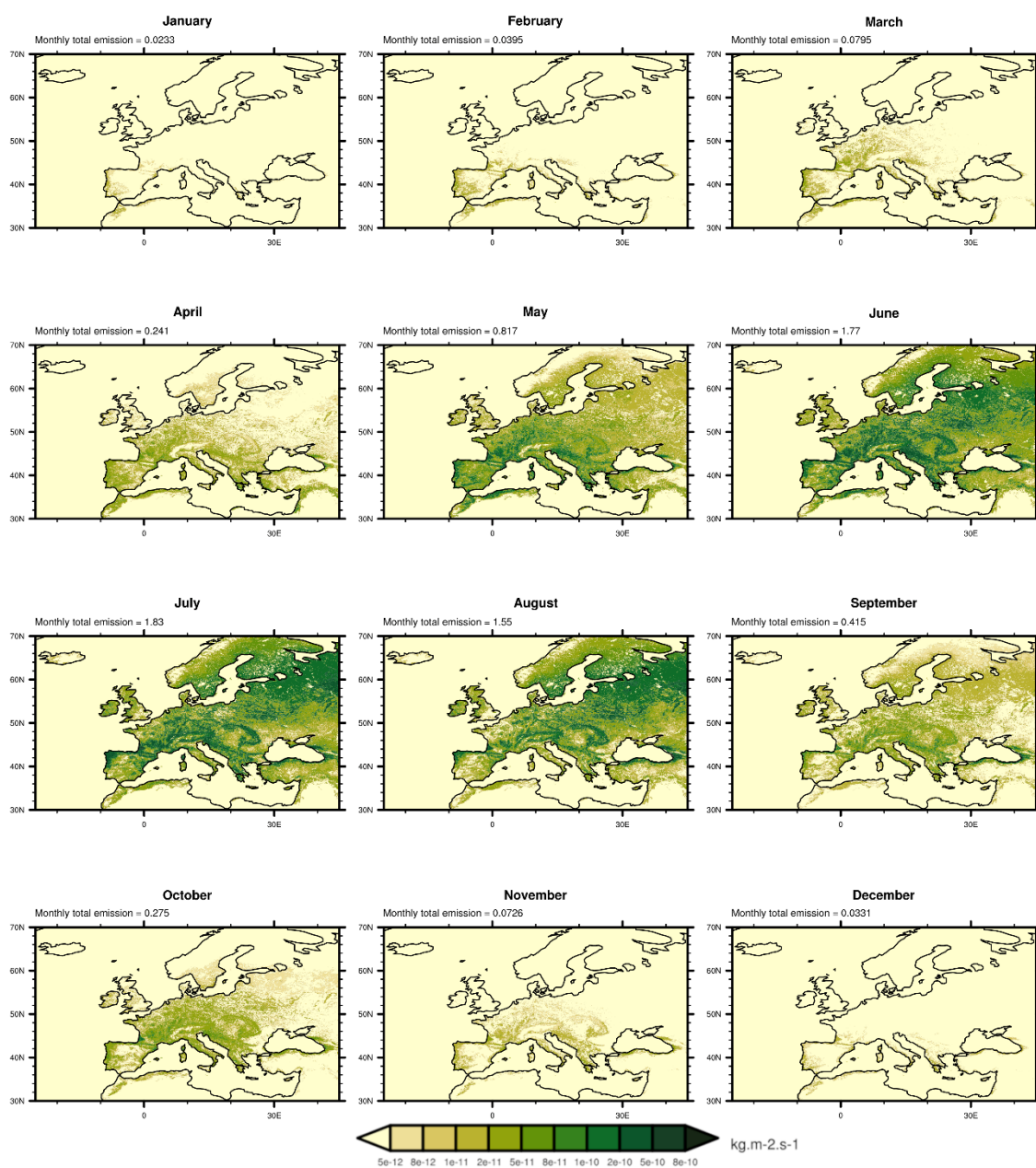


Figure S13. Maps of monthly mean isoprene emissions (units of $\text{kg}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) calculated using the SURFEX-MEGAN3.0 algorithms and averaged over 2019 using the open-loop configuration of SURFEX. The panels show each month moving sequentially from January to December first from left to right and then downwards from top to bottom. The colour bars indicate increasing mean isoprene emissions as the colours transition from pale yellow to dark green. Note that the colour bar has a quasi-logarithmic scale. The monthly total mass of isoprene emissions (units of Tg) are shown above each plot.

Monthly Mean Isoprene Emissions Over the CAMS European Domain for 2018 - LAI Analysis

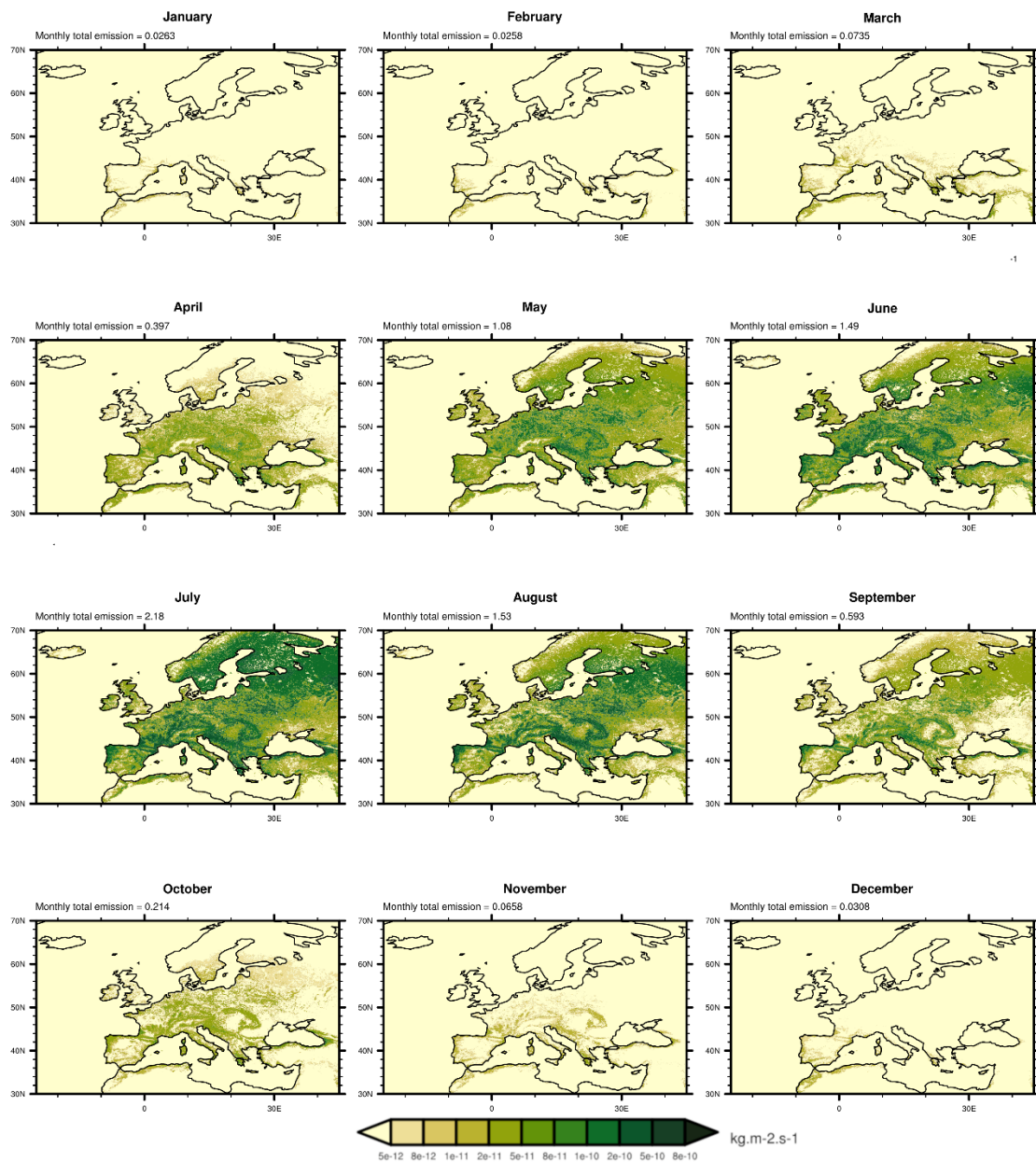


Figure S14. Maps of monthly mean isoprene emissions (units of $\text{kg.m}^{-2}.\text{s}^{-1}$) calculated using the SURFEX-MEGAN3.0 algorithms and averaged over 2018 using the analysis configuration of SURFEX. The panels show each month moving sequentially from January to December first from left to right and then downwards from top to bottom. The colour bars indicate increasing mean isoprene emissions as the colours transition from pale yellow to dark green. Note that the colour bar has a quasi-logarithmic scale. The monthly total mass of isoprene emissions (units of Tg) are shown above each plot.

Monthly Mean Isoprene Emissions Over the CAMS European Domain for 2019 - LAI Analysis

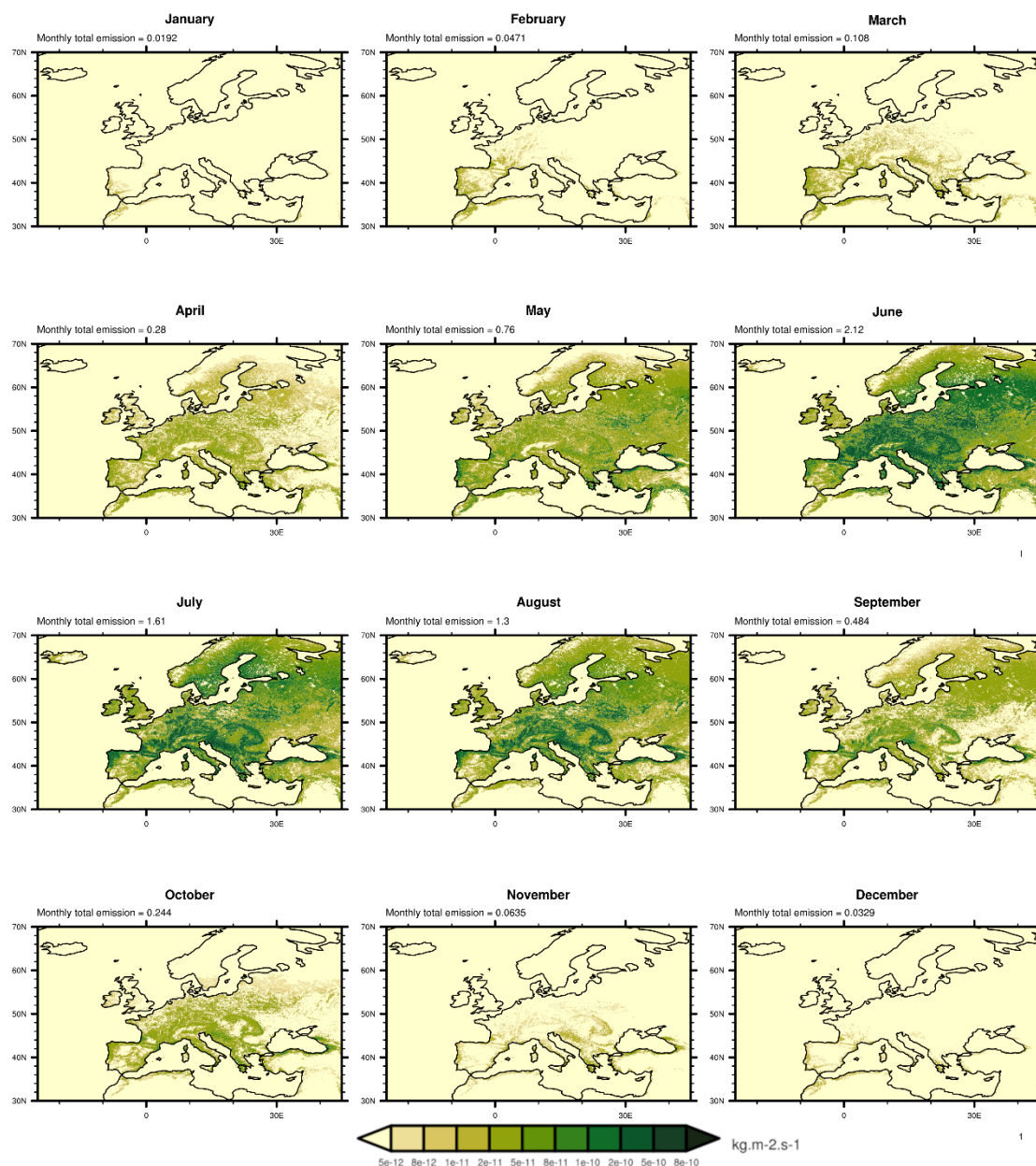


Figure S15. Maps of monthly mean isoprene emissions (units of $\text{kg.m}^{-2}.\text{s}^{-1}$) calculated using the SURFEX-MEGAN3.0 algorithms and averaged over 2019 using the analysis configuration of SURFEX. The panels show each month moving sequentially from January to December first from left to right and then downwards from top to bottom. The colour bars indicate increasing mean isoprene emissions as the colours transition from pale yellow to dark green. Note that the colour bar has a quasi-logarithmic scale. The monthly total mass of isoprene emissions (units of Tg) are shown above each plot.

Monthly Mean Isoprene Emissions Over the CAMS European Domain for 2020 - LAI Analysis

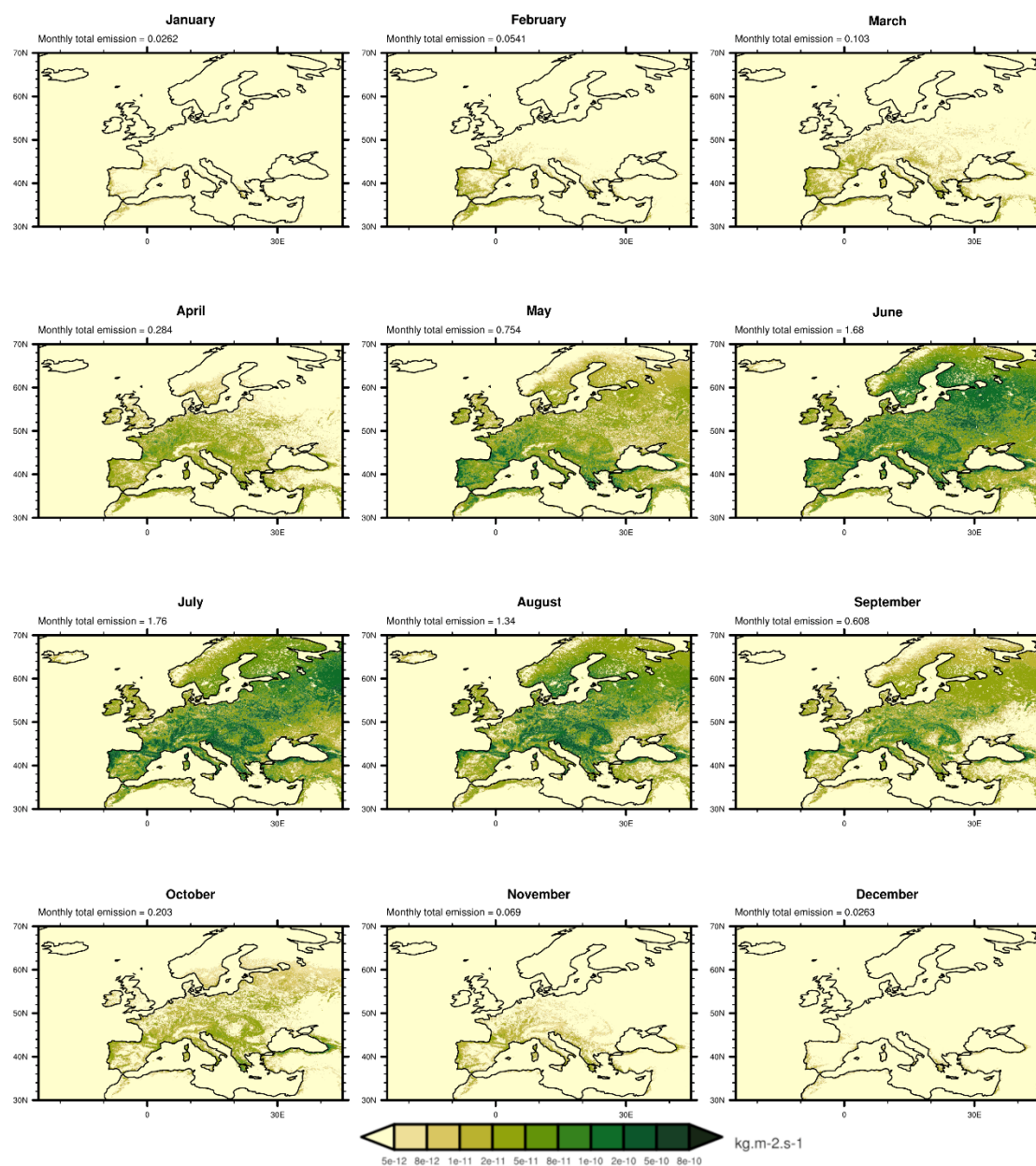


Figure S16. Maps of monthly mean isoprene emissions (units of $\text{kg}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) calculated using the SURFEX-MEGAN3.0 algorithms and averaged over 2020 using the analysis configuration of SURFEX. The panels show each month moving sequentially from January to December first from left to right and then downwards from top to bottom. The colour bars indicate increasing mean isoprene emissions as the colours transition from pale yellow to dark green. Note that the colour bar has a quasi-logarithmic scale. The monthly total mass of isoprene emissions (units of Tg) are shown above each plot.

Monthly Mean Isoprene Emissions Over the CAMS European Domain averaged over 2018-2020 - LAI Analysis

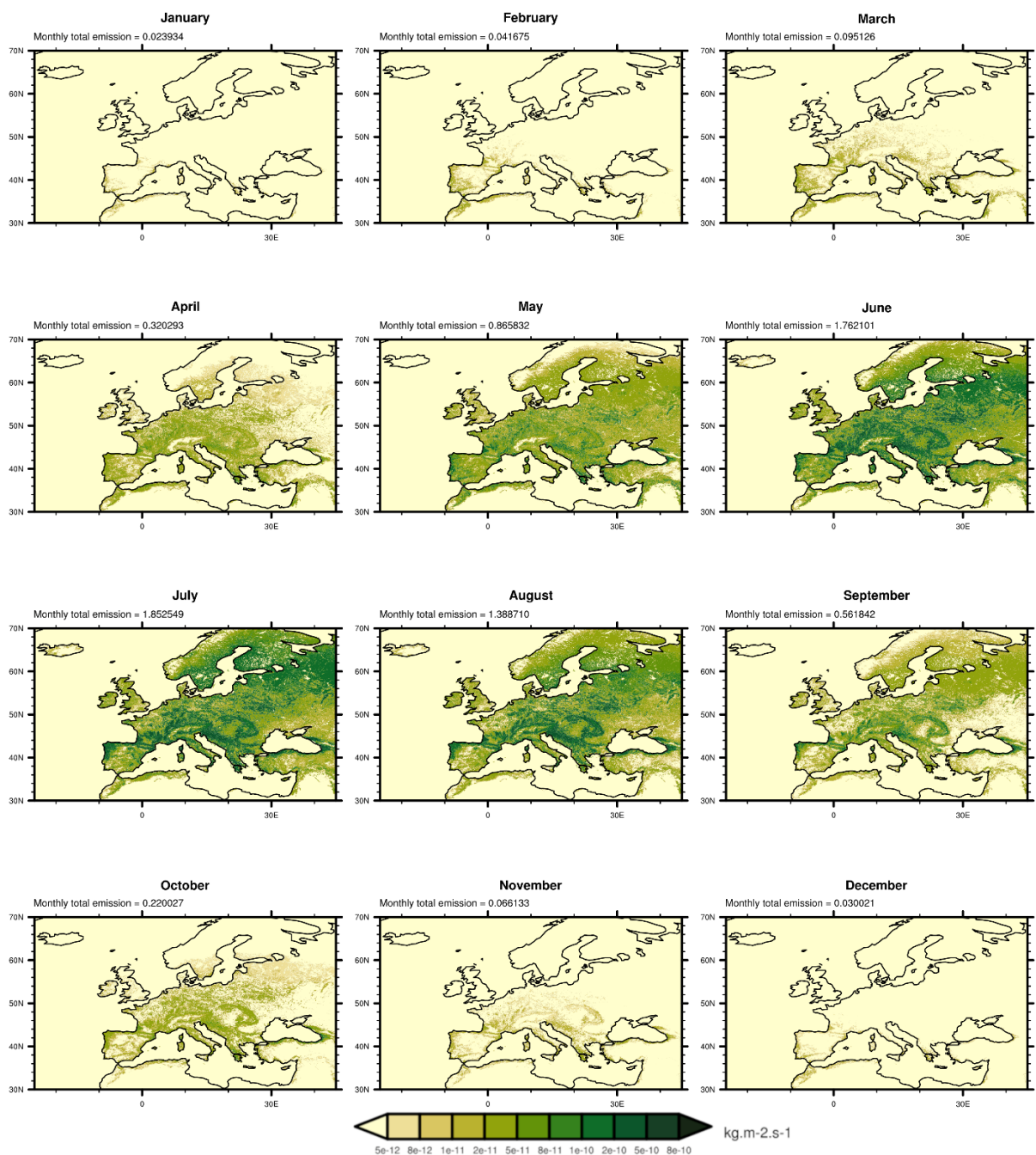


Figure S17. Maps of monthly mean isoprene emissions (units of $\text{kg.m}^{-2}.\text{s}^{-1}$) calculated using the SURFEX-MEGAN3.0 algorithms and averaged over 2020 using the analysis configuration of SURFEX. The panels show each month moving sequentially from January to December first from left to right and then downwards from top to bottom. The colour bars indicate increasing mean isoprene emissions as the colours transition from pale yellow to dark green. Note that the colour bar has a quasi-logarithmic scale. The monthly total mass of isoprene emissions (units of Tg) are shown above each plot.

Monthly Mean MEGAN3 minus CAMS-GLOB-BIO v3.1 GAMMATP Over the CAMS European Domain for 2019

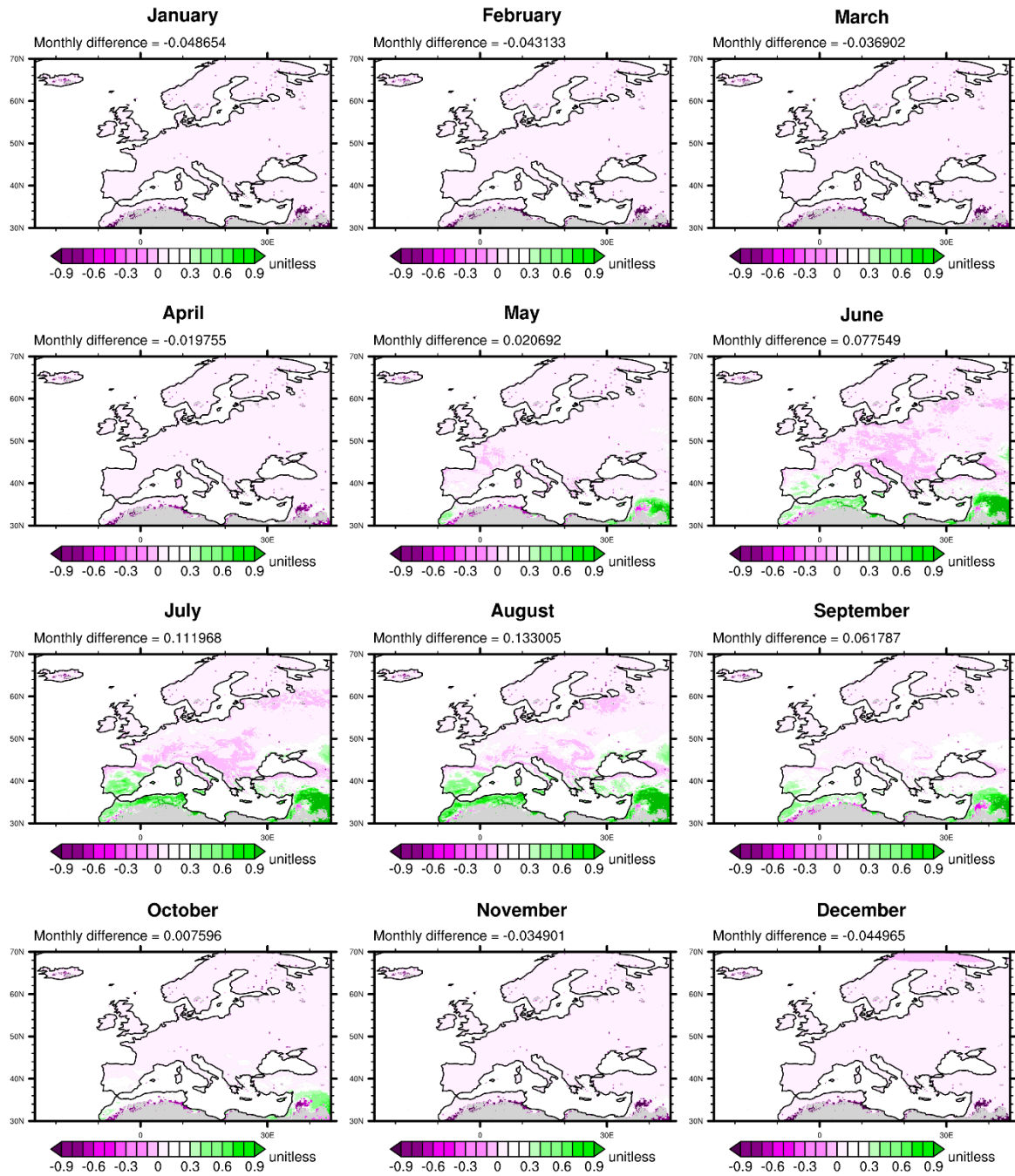


Figure S18. The monthly mean difference between the SURFEX-MEGAN3.0 and CAMS-GLOB-BIOv3.1 gamma activity factor for temperature and radiation for 2019. Areas in green indicate where the SURFEX-MEGAN3.0 values are higher and areas in violet indicate where the CAMS-GLOB-BIOv3.1 values are higher. This activity factor is unitless.

Monthly Mean LAI Gamma Over the CAMS European Domain for 2019 - LAI Analysis

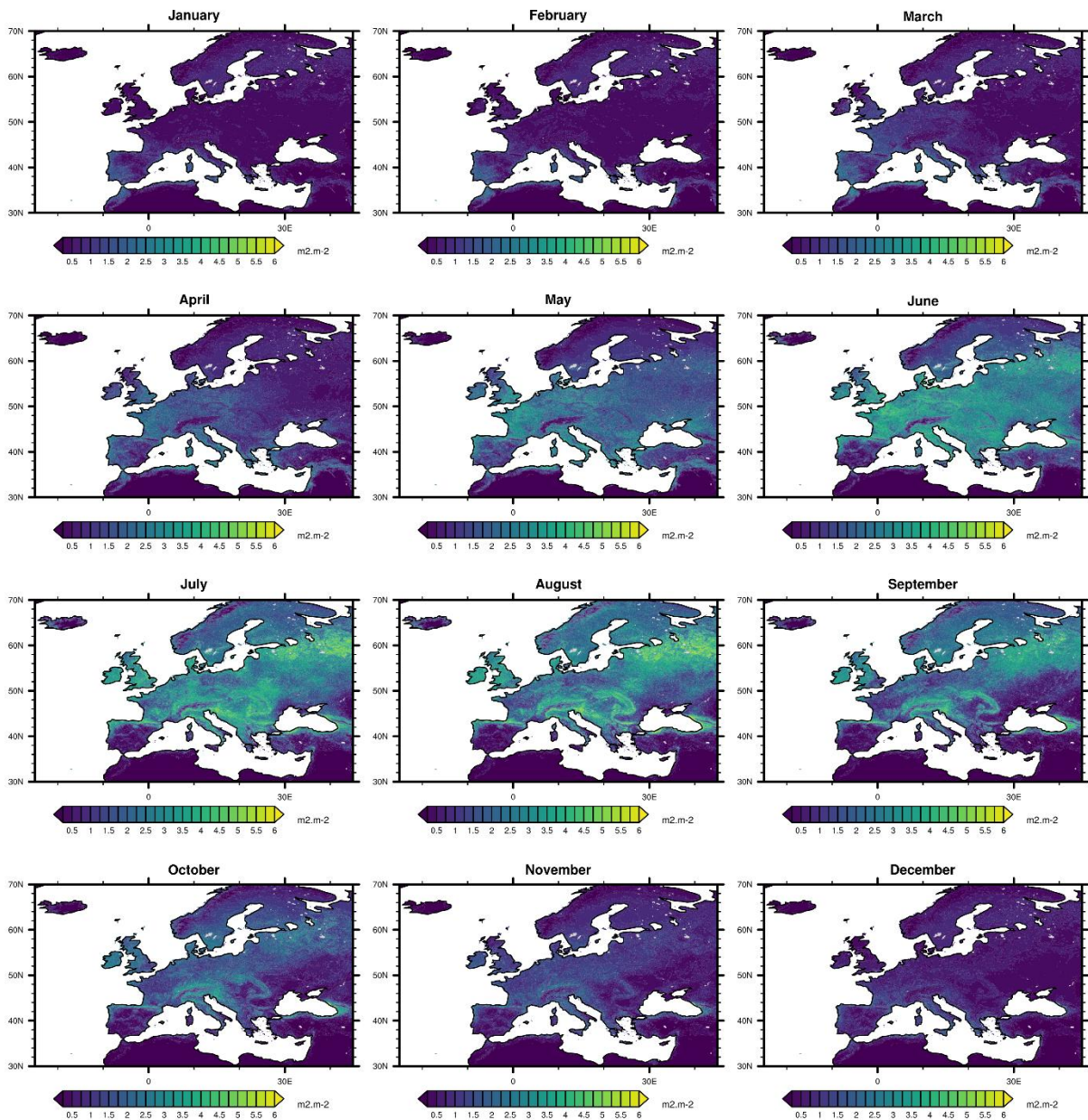


Figure S19. Maps of the monthly mean LAI (units of $m^2.m^{-2}$) from the SURFEX analysis for 2019. The colour bar indicates the LAI in each pixel with dark blue being zero and yellow being the highest levels.

CAMS-GLOB-BIO v3.1 LAI Over the CAMS European Domain

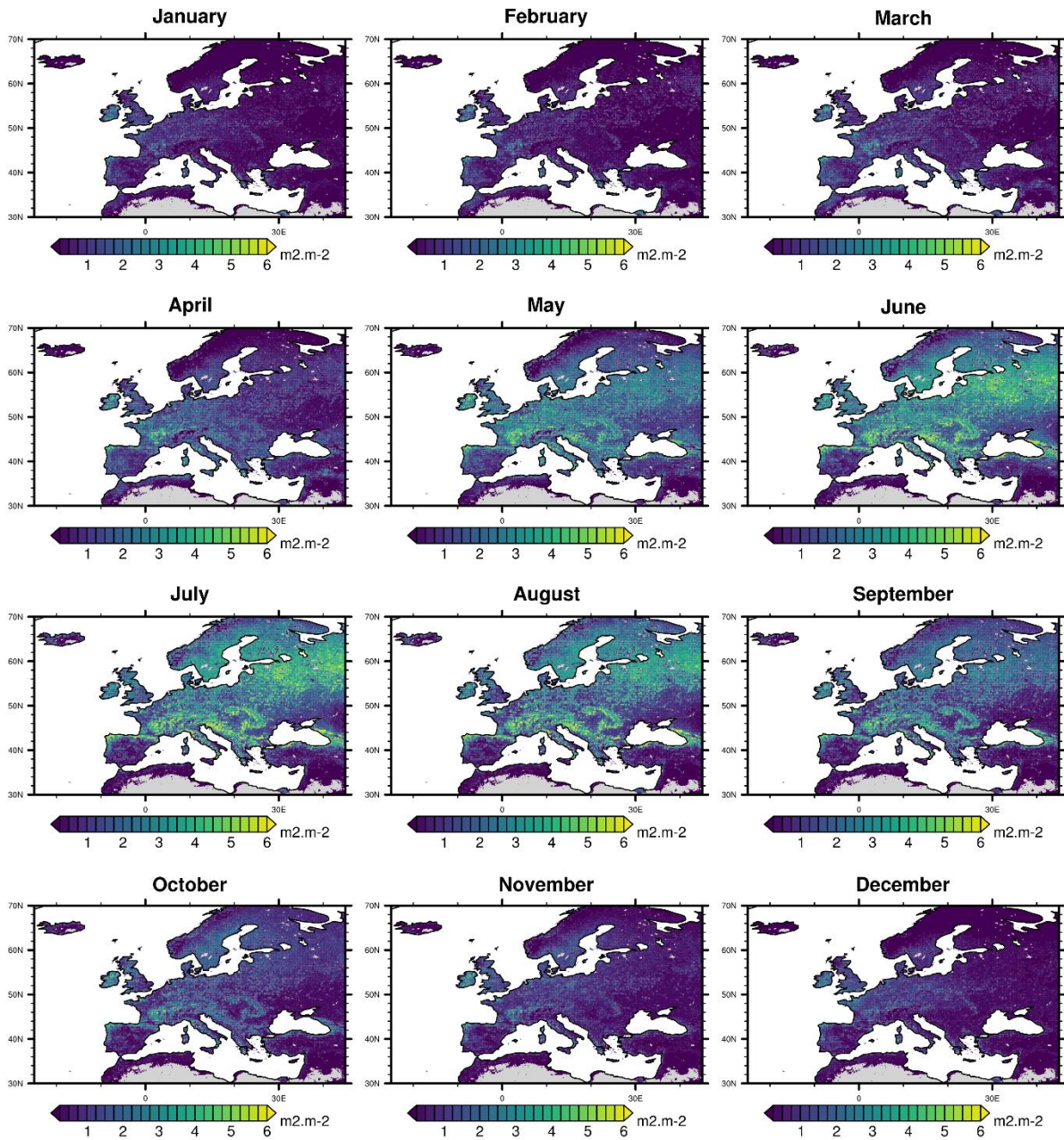


Figure S20. Maps of the monthly mean LAI (units of $m^2.m^{-2}$) from a climatology (2007-2016) of LAI built on MODIS data (Yuan et al., 2011). The colour bar indicates the LAI in each pixel with dark blue being zero and yellow being the highest levels.

2019

Average emission factor = 2.589663

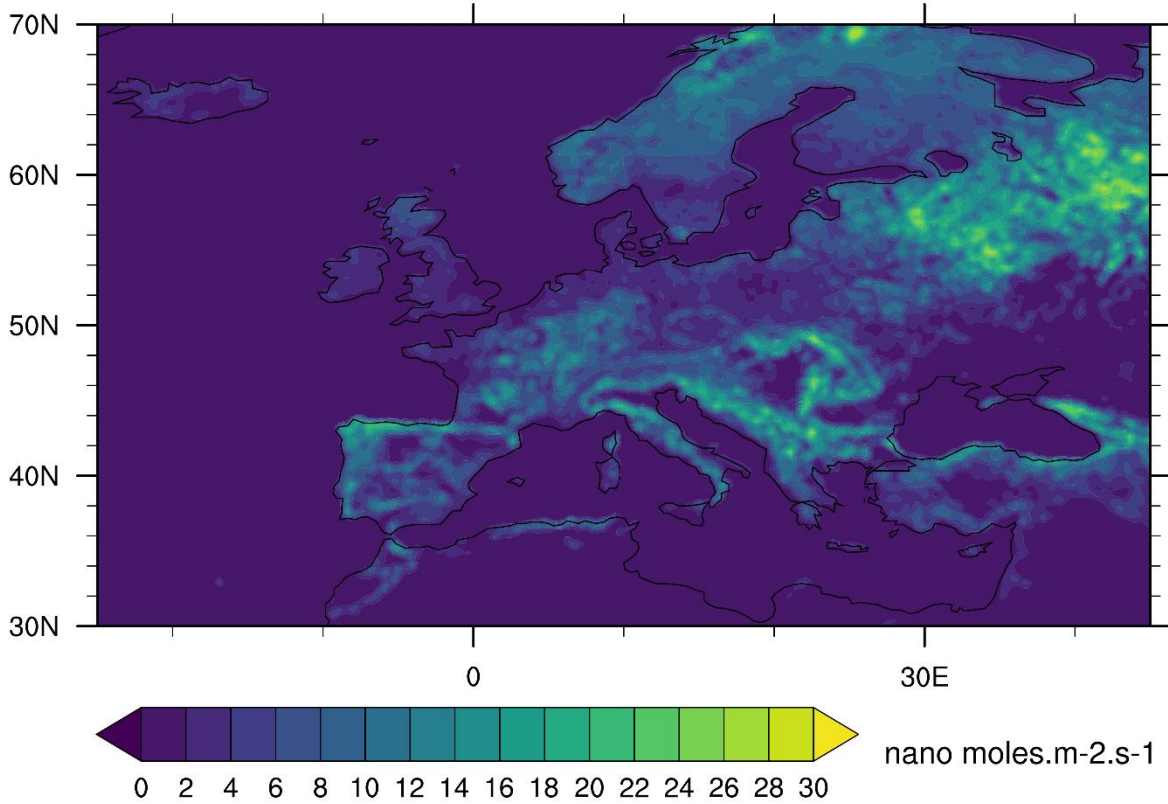


Figure S21. A map of the annual isoprene emission factors (units nano moles.m-2.s-1) used to calculate the CAMS-GLOB-BIO3.0 isoprene emissions for 2019 over the CAMS European domain. The colour bar indicates increasing mean isoprene emission factor as the colour transitions from dark blue to yellow. The mean emission factor over the land is shown above the plot.

Monthly Isoprene Emission Factors Over the CAMS European Domain

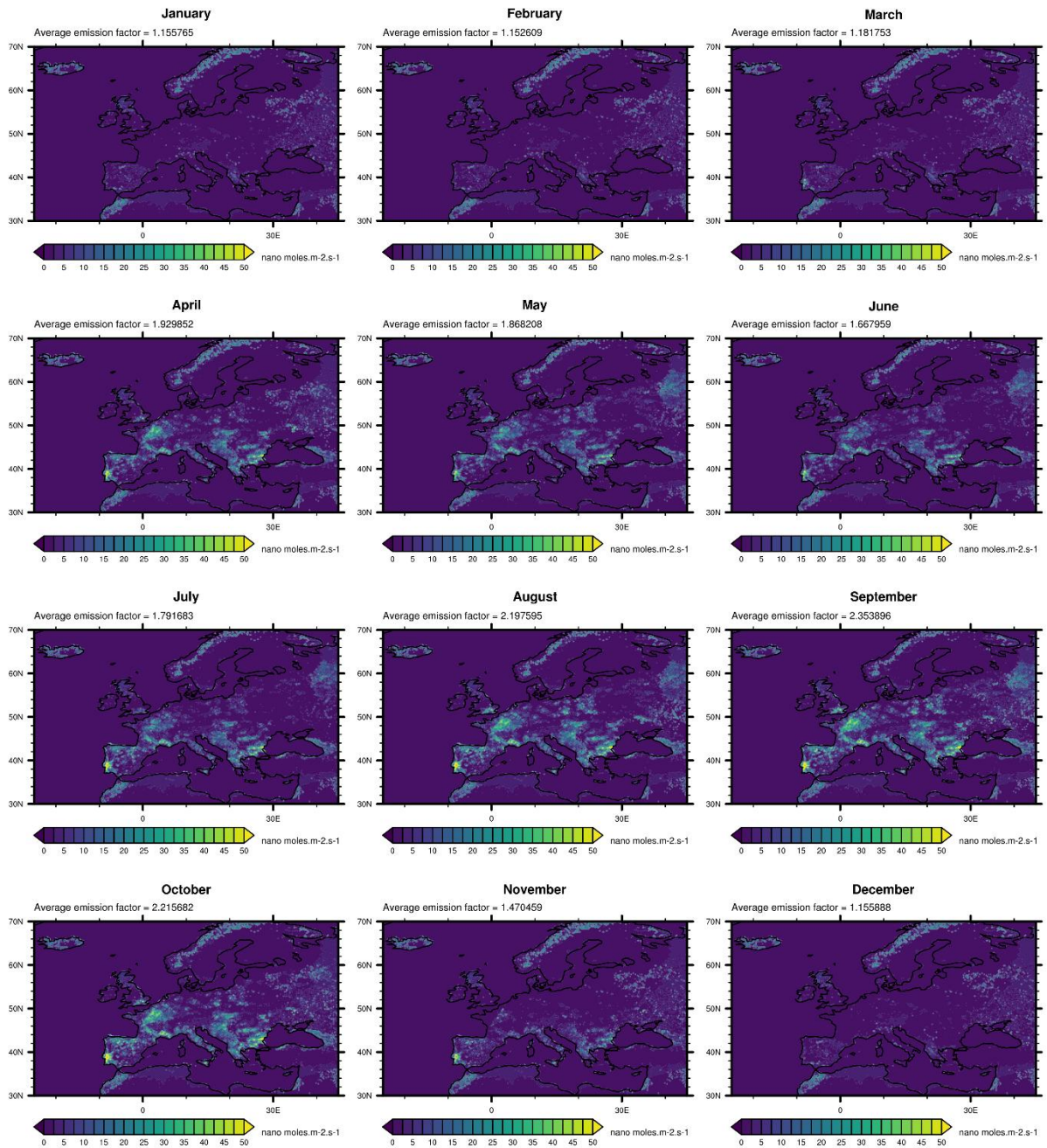


Figure S22. A map of the monthly isoprene emission factors (units nano moles.m-2.s-1) derived from the EMEP emission factors that were used to calculate the CAMS-GLOB-BIO3.1 isoprene emissions over the CAMS European domain. The colour bars indicates increasing mean isoprene emission factor as the colour transitions from dark blue to yellow. The mean emission factor over the land is shown above the plot.