

## Supplementary material for

# Global atmospheric ethane, propane and methane trends (2006-2016)

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**Text.** Code in Python for trend analysis.

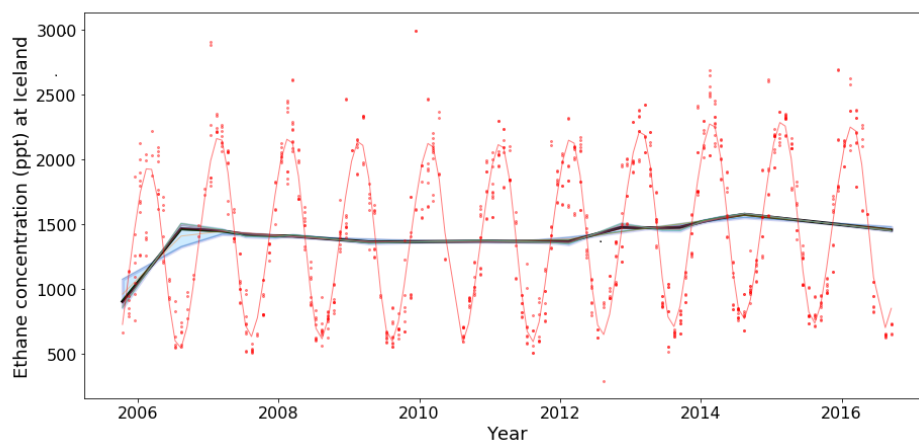


Figure S1. Ethane seasonality and trend at Iceland estimated by “Prophet” algorithm, light blue shadow indicates uncertainty from trend fittings.

Table S1. Geographical definition.

Definition	Latitude	Longitude
NAM (North America)	30~65°N	60~125°W
ASI (Asia)	15~50°N	60~140°E
EUR (Europe)	40~55°N	10°W~30°E
ROW (Rest of the world)	All regions excluding NAM, ASI, EUR	

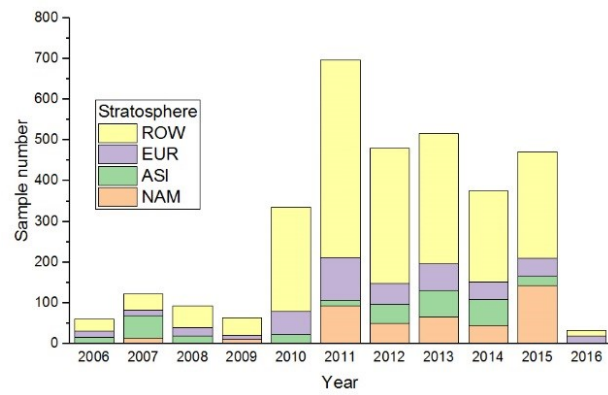
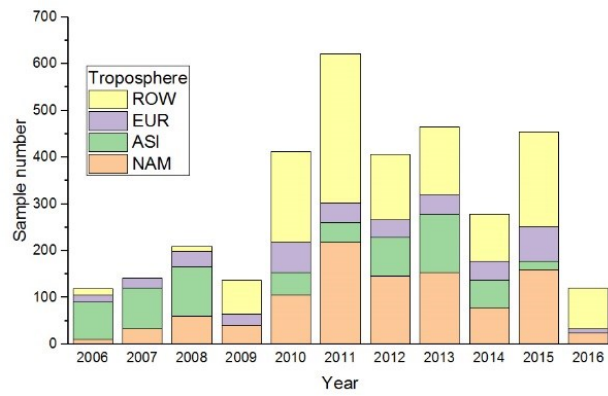


Figure S2. Temporal and spatial distribution of sample number.

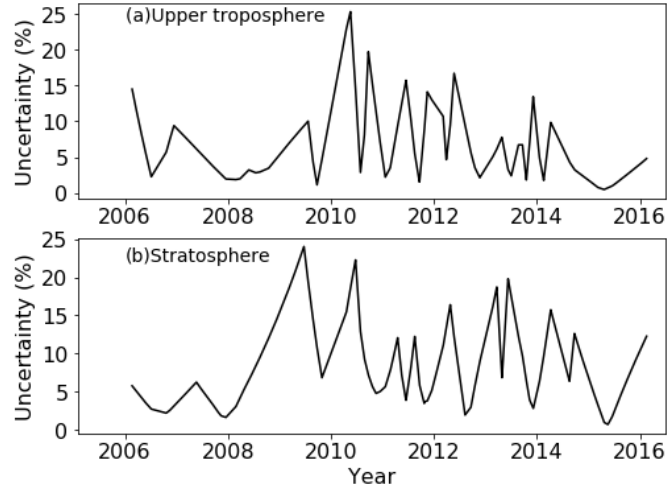


Figure S3. Trend analysis uncertainty for the (a) upper troposphere; (b) stratosphere.

Table S2. Sectoral contribution (%) to ethane trends for the upper troposphere and stratosphere in 2006-2016.

Sector	Upper troposphere				Stratosphere			
	All NH	NAM	ASI	EUR	All NH	NAM	ASI	EUR
AIR	<0.01	0.01	<0.01	0.01	0.01	0.01	0.01	0.01
BIB	15.83	14.47	12.94	13.37	14.74	15.93	12.98	14.08
BIO	9.30	8.36	10.23	6.62	7.81	7.24	8.79	8.09
AWB	1.69	1.80	1.58	2.21	2.11	2.23	2.03	2.00
ENE	1.06	1.15	1.28	1.11	1.25	1.33	1.16	1.26
FEF	14.04	12.67	14.37	11.85	12.83	12.54	13.55	12.95
IND	0.82	0.83	1.05	0.87	0.92	0.94	0.93	0.94
RES	5.96	5.67	9.79	5.17	6.81	6.68	7.40	7.20
SHP	0.50	0.53	0.64	0.51	0.56	0.59	0.56	0.56
SWD	21.74	23.55	21.15	27.16	24.35	24.64	23.89	24.07
TNR	0.32	0.35	0.42	0.35	0.38	0.40	0.36	0.38
TRO	28.74	30.62	26.56	30.76	28.24	27.46	28.34	28.45

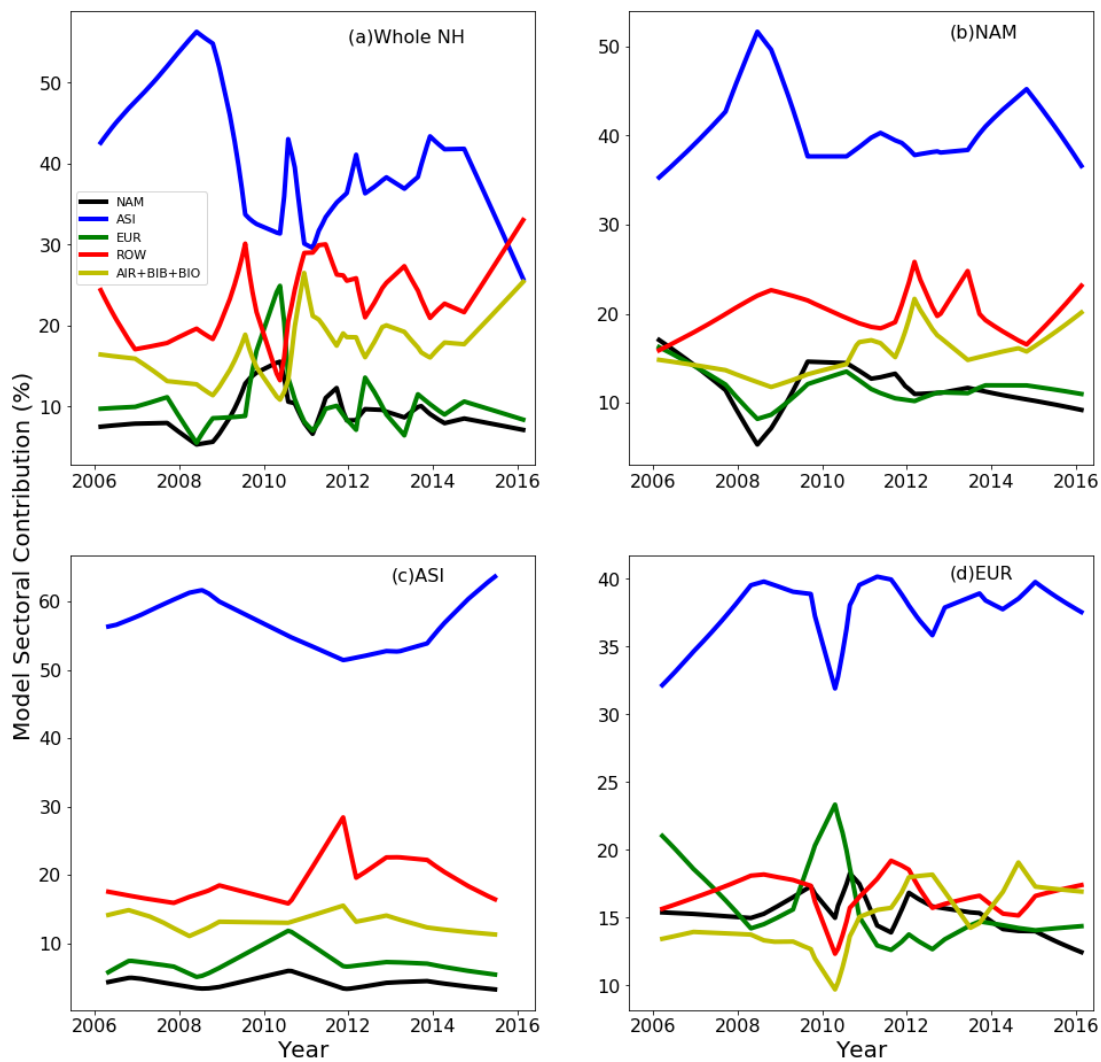


Figure S4. Optimized geographical sector contribution (%) to NH upper tropospheric ethane trends for (a) the whole NH; (b) North America; (c) Asia; and (d) Europe.

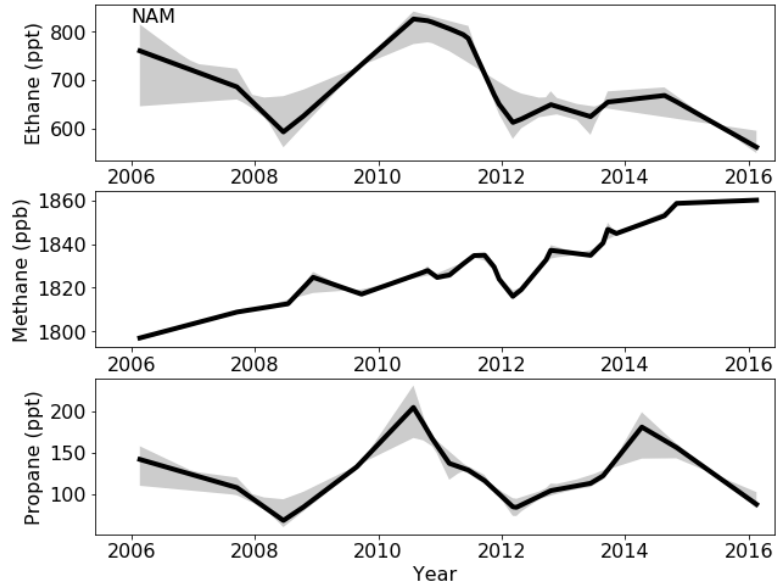


Figure S5. The observed (a) ethane; (b) methane; (c) propane trends for the upper tropospheric ethane at NAM. Light shadows indicate trend analysis uncertainty.

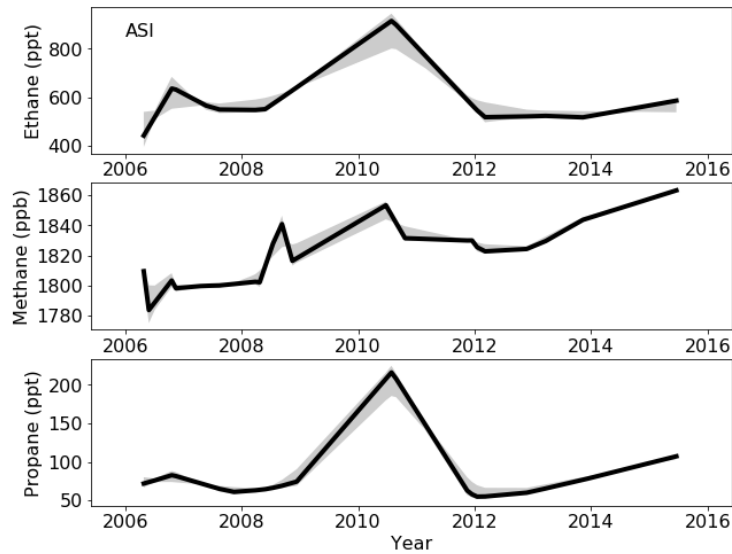


Figure S6. The observed (a) ethane; (b) methane; (c) propane trends for the upper tropospheric ethane at ASI. Light shadows indicate trend analysis uncertainty.

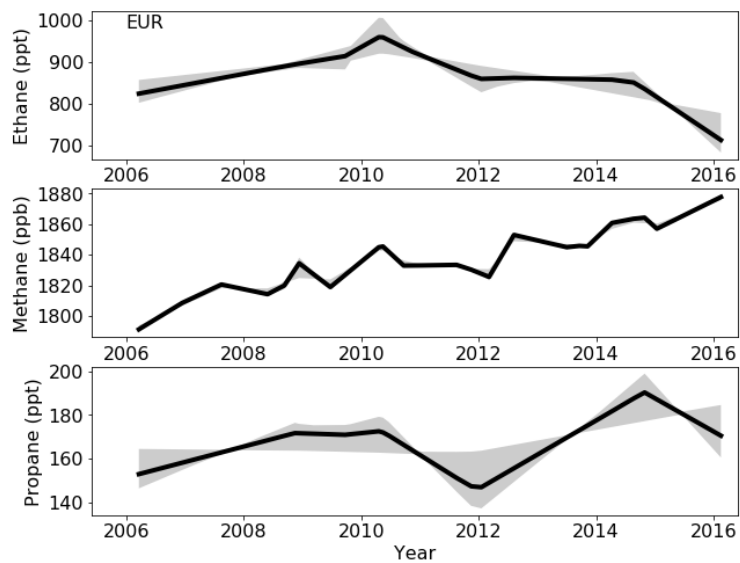


Figure S7. The observed (a) ethane; (b) methane; (c) propane trends for the upper tropospheric ethane at EUR. Light shadows indicate trend analysis uncertainty.

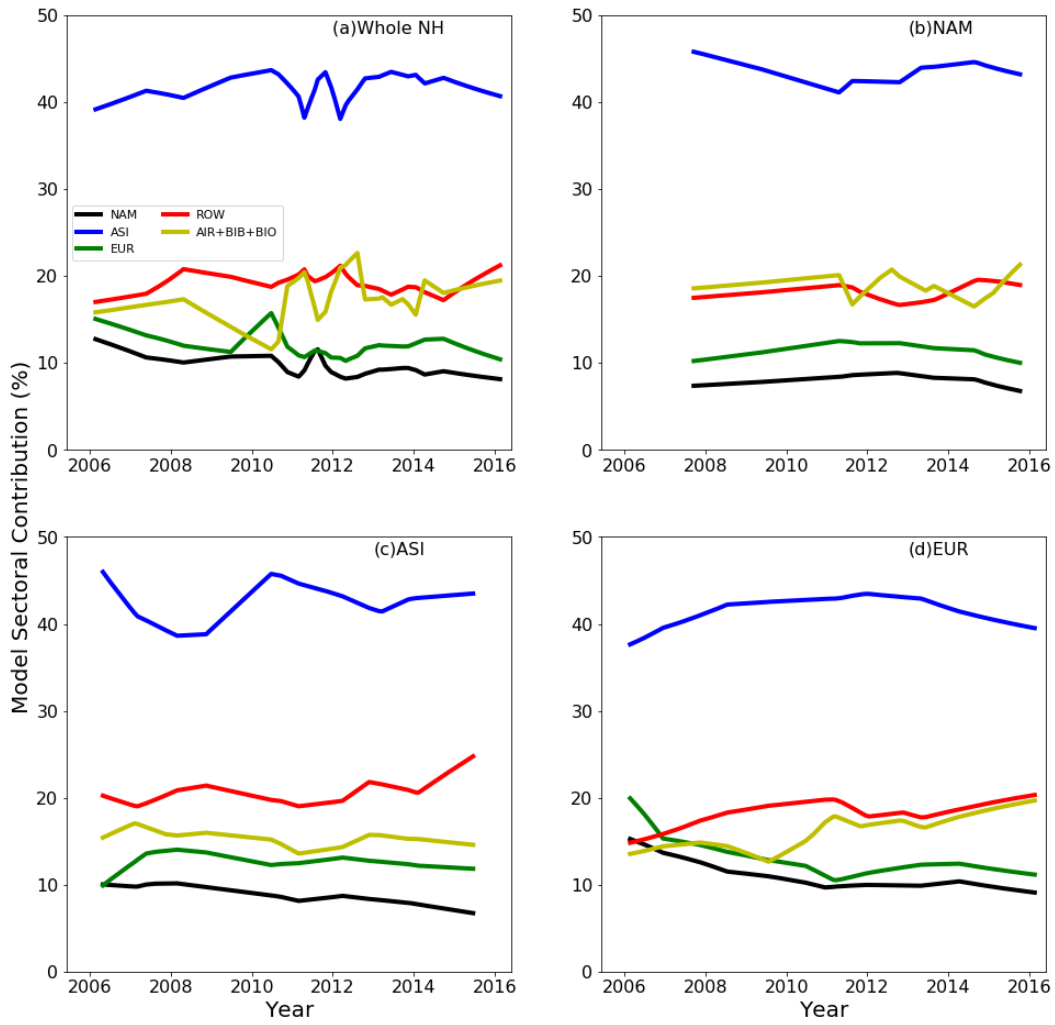


Figure S8. Optimized geographical sector contribution (%) to stratospheric ethane trends for (a) the whole NH stratosphere; (b) North America; (c) Asia; and (d) Europe.



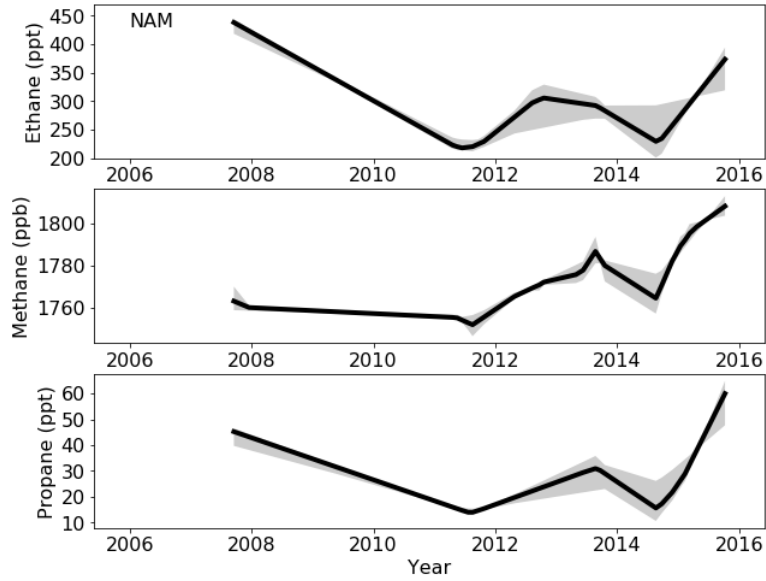


Figure S9. The observed (a) ethane; (b) methane; (c) propane trends for the stratospheric NAM. Light shadows indicate trend analysis uncertainty.

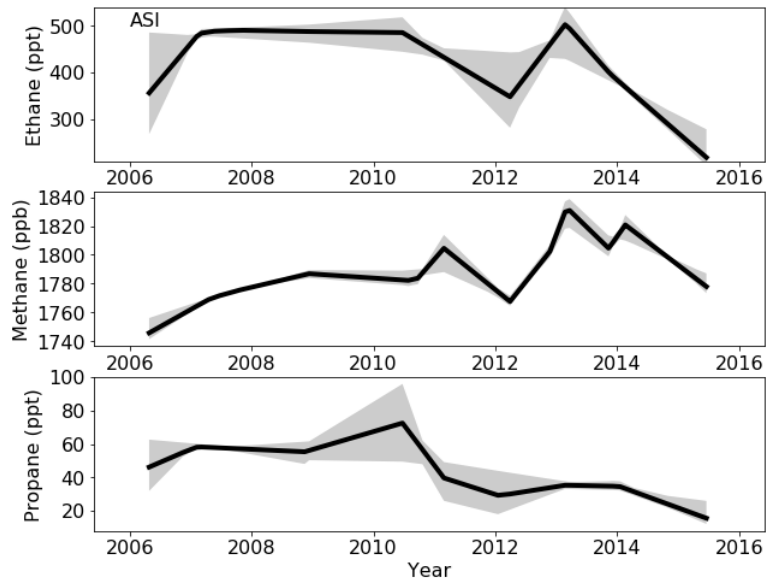


Figure S10. The observed (a) ethane; (b) methane; (c) propane trends for the stratospheric ASI. Light shadows indicate trend analysis uncertainty.

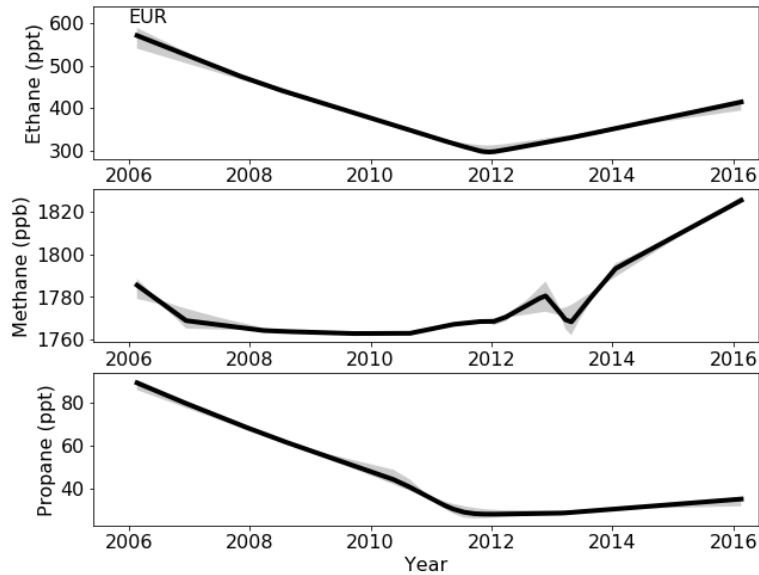


Figure S11. The observed (a) ethane; (b) methane; (c) propane trends for the stratospheric EUR. Light shadows indicate trend analysis uncertainty.

### Code in Python for trend analysis

```
import datetime
from fbprophet import Prophet
from fbprophet.plot import seasonality_plot_df
#before proceeding, please set the column "DateTime (UTC)" as "ds", "C2H6_CARIBIC" as "y"
df = pd.read_excel('Data.xlsx')
df['ds'] = pd.to_datetime(df['ds'])
m = Prophet(daily_seasonality=False, weekly_seasonality=False, yearly_seasonality=2,
seasonality_mode='additive', changepoint_prior_scale=0.5, interval_width=0.95)
m.fit(df)
```