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# A new method to detect long term trends of methane (CH4) and nitrous oxide (N2O) total columns measured within the NDACC ground-based high resolution solar FTIR network

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A multiple regression model is used to estimate linear trends of the CH4 and N2O total columns measured with the ground-based solar FTIR technique at four European stations, i.e. Jungfraujoch (47°N, 8°E, 3600 m.a.s.l.), Zugspitze (47°N, 11°E, 3000 m.a.s.l.), Harestua (60°N, 11°E, 600 m.a.s.l.) and Kiruna (68°N, 20°E, 400 m.a.s.l.). The total columns have been retrieved with a common method developed within the EU-project HYMN (Hydrogen, Methane and Nitrous oxide). Anomalies derived from air pressure, total columns of hydrogen fluoride (HF) and carbon monoxide (CO) and tropopause height is used in the regression model to reduce the time series variability and thereby estimate trustful trends with small confidence intervals.

For 1995 to 2009 and 1995 to 2007 significant positive CH4 and N2O trends are found for all stations participating in the study. For both species the strongest trends are observed at Harestua while weaker trends are observed in the Alps. The measured N2O total columns are divided into tropospheric and stratospheric partial columns and from these columns separate trends are estimated at each station. It is found that stronger stratospheric trends are present at Harestua and Kiruna than at the two Alpine stations Jungfraujoch and Zugspitze. To verify this latitudinal stratospheric trend gradient the FTIR data are compared with measurements from the SMR instrument onboard the ODIN satellite from 2001-2007. The comparison confirms the observed trend gradient in the FTIR data.