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Hydrocarbons peaks at Weybourne: What role do natural gas emissions play in the regional background?

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Detailed chemical measurements were carried out during the TORCH II (Tropospheric ORganic CHemistry Experiment) campaign at the Weybourne Atmospheric Observatory on the north coast of Norfolk, UK in May 2004. On a number of occasions, large short-lived concentrations of alkenes were observed that correlated with CO, acetaldehyde, HCHO and some alkanes. Foremost was propene, which indicated to have come from emissions from oil and natural gas industries in the North Sea. Simultaneously, a sharp increase in peroxy radicals was observed (from ozone alkene reactions that also produced secondary species such as alkyl nitrates) and subsequent ozone destruction.

These emission events were marked by O3 reduction with no corresponding NOy peaks but with extremely high levels of alkene and alkyl nitrates, implying the formation of large levels of peroxy radicals, leading to oxidation consequences in this clean marine environment.

Steady state modelling to calculate OH and RO2 values during the episodes revealed that the only source of such high OH and ROx was the ozonolysis of propene. An air mass origin study linked the hydrocarbon peaks with northerly air masses, over the path of known North Sea oil and gas fields. Analysis of VOC measurements at Weybourne during the past 15 years reveals the frequency of such VOC spikes and the impact they could have on photochemical ozone production when they to occur during the daytime and ozone-alkene reactions at nighttime.