1. INTRODUCTION

Methane is the second most important anthropogenic greenhouse gas (GHG). The current UK emissions inventory for methane carries high uncertainty levels (20% for the total emission but much higher on smaller, regional scales). The UK Climate Change Act (2008) states there should be a 80% reduction in GHG emissions by 2050 (relative to the 1990 baseline). To accurately reduce our emissions this uncertainty must also be reduced.

The project aims to develop a ‘top-down’ regional emissions estimate for methane to be used as a comparison to the current national emissions inventory. Atmospheric measurements of methane are used in an inversion model to achieve this. A measurement network of gas chromatographs coupled with flame ionisation detectors (GC-FID) have been installed around East Anglia (Figure 1) to monitor methane concentrations. This poster shows an analysis of the measurements to date.

2. THE DATA SET

Measurements are recorded every 1-2 minutes. 1 year’s worth of data has now been collected for all 4 sites, with almost 2 years of data being taken for both the Haddenham and Tacolneston sites. Figure 2 shows the raw data as a time series for all 4 sites. Periods of prolonged above-baseline concentrations of methane suggest sources from further outside the domain of interest. Short intensive periods of high methane concentrations imply nearby local sources.

3. ANALYSIS

The following analysis is with the entire dataset available. Figure 3 shows various time dependent statistical relationships derived from the 4 sites. All plots show the mean methane concentration (ppb) with the 95% percentiles as the shaded area. No strong weekly cycle is observed however a large diurnal cycle can be seen in the top and bottom-left plot where there is a peak in the early hours of the morning and a minimum during the afternoon. This corresponds to dispersion effect caused by boundary layer height change. A larger diurnal relationship is seen in Haddenham and Tilney particularly which could be the result of more local sources.

4. HADDENHAM CASE STUDY

Between November 2012 – December 2012 a SNAQ (Sensor Network for Air Quality) sensor was installed at the Haddenham site. Concentrations of carbon dioxide, carbon monoxide were measured along with the meteorological variables wind speed, wind direction and temperature. A comparison between these variables and the ones produced by the Met Office’s model NAMM (Numerical-Atmospheric Dispersion Modelling Environment – used in future Inversion analysis) is shown in Figure 5. All variables show reasonable to good correlation. It appears NAMM appears to over-estimate wind speed (or the sensor underestimated). The measured wind direction has very few northerly recordings due to an obstruction N of the site.

Figure 6 shows an anomaly time series of the measured CH₄, CO and CO₂ with windrose plots using modelled met data which correspond to the labelled subsections. Figure 7 shows correlations of CH₄ and CO subdivided by wind direction. The south and west panels show a correlation dependency on boundary layer height with the high CH₄ values due to the local sources at Haddenham. The north panel indicates a nearby CO source but no CH₄.

5. SUMMARY

All four measurement sites can monitor both local, regional and far-field sources of methane depending on the elevation above methane above the baseline value and the duration of this rise.

A diurnal, weekly and annual cycle can be observed at all sites. Concentration variations show a large dependency on wind speed, wind direction and boundary layer height.

A one month period was analysed as a case study using measured methane data, modelled meteorological data from NAME and measured CO, CH₂O, wind speed, wind direction and temperature from a SNAQ sensor installed at the Haddenham GC site.

Both measured and modelled meteorological data were compared. All three variables were reasonably compared with the most weakly correlated being wind speed. It was deemed the modelled data was accurate enough to be used in further inversion analysis.

Finally, correlation analysis with CH₄, CO and CH₂O showed a strong positive relationship between CH₄ and CO. Boundary layer height was also found to effect concentrations of the three gases measured.

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References: