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Lismore, 19 October 2012

To: Department of Climate Change and Energy Efficiency

Re: *Submission on National Greenhouse and Energy Reporting (Measurement) Determination 2012 - Fugitive Emissions from Coal Seam Gas*

This submission refers to a **new method currently being developed at Southern Cross University** to assess large scale fugitive gas emissions from coal seam gas mining.

Unintentional or fugitive greenhouse gas emissions from CSG activities are as yet poorly understood. In conventional gas fields, the fugitive emissions are relatively well constrained due to the more localised infrastructure and smaller number of high production wells. Measurement of fugitive emissions from CSG fields is more complicated due to the decentralised infrastructure, and large number of well heads. Current approaches rely mostly on upscaling average emissions from individual components (such as pumps, valves, pipelines, etc) used in the production process. These approaches are based on studies performed in the USA that may not be directly applicable to Australia and **do not account for diffuse soil fluxes**.

When techniques such as directional drilling and hydraulic fracturing are used, methane can diffuse into overlying sediments and groundwater aquifers. **The magnitude of the atmospheric flux associated with this diffuse source is currently unknown and difficult to estimate.** Clearly there is a need to adequately constrain the atmospheric flux of fugitive point and diffuse sources of greenhouse gases from gas fields, not only from an environmental, but also an economic perspective (e.g. carbon emission pricing mechanisms and more effective gas recovery).

We demonstrate a rapid qualitative approach for source assessment of greenhouse gases in the atmosphere of a large gas field. **To our knowledge, our results (Figure 1) represent the first independent observations of greenhouse gases in the atmosphere of a CSG field in Australia.**

We **drove an automobile** with a commercially available instrument (Picarro G2201-*i* cavity ring down spectrometer) and GPS. The instrumentation provided real time, high precision methane (CH_4) and carbon dioxide (CO_2) concentration and carbon isotope ratios ($\delta^{13}C$), allowing for "on the fly" decision making and therefore enabling an efficient surveying approach. The system was used to map the atmosphere of a production CSG field (Tara, Queensland), as well as various other potential CO_2 and CH_4 sources (i.e. a wetland, sewage treatment plant, landfill, urban area and a bushfire).

The results clearly showed a widespread enrichment of both CH_4 and CO_2 within the production gas field compared to outside the gas field (Figure 1). Hotspots with concentrations of CH_4 as high as 6.89 ppm and CO_2 as high as 541 ppm were identified near Tara. For comparison, background atmospheric CH_4 outside the gas fields were lower than 2 ppm. The $\delta^{13}C$ values showed distinct differences within and outside the production field, indicating different gas sources within the Tara gas field. **These results provide strong evidence for significant, but still unquantified, greenhouse gas emissions in the Tara region.**

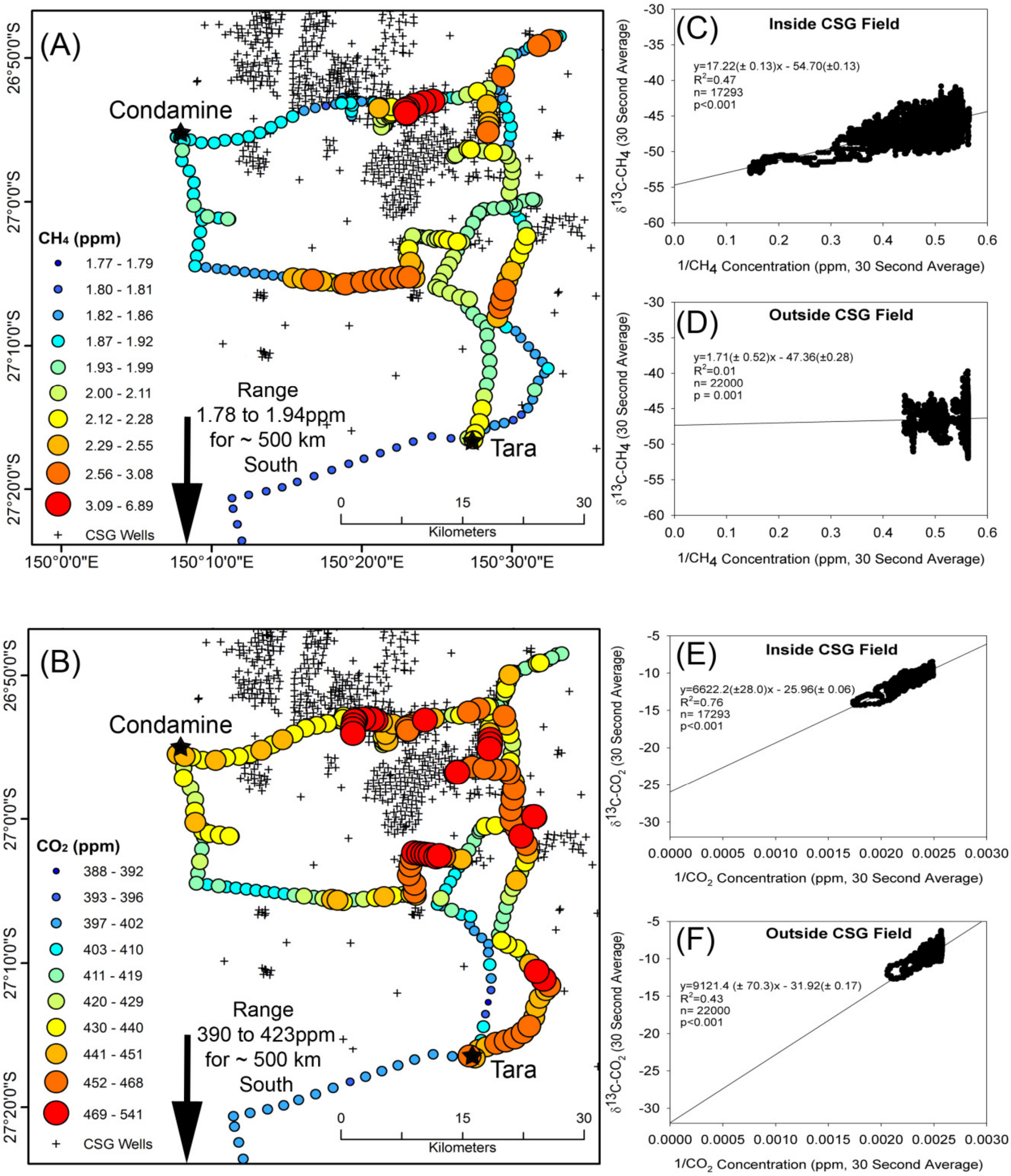

Figure 1: Spatial survey in the Tara region. (A). CH_4 concentrations, (B) CO_2 concentrations, (C) Keeling plot of CH_4 within the gas field, (D) Keeling plot of CH_4 outside of the gas field, (E) Keeling plot of CO_2 within the gas field, (F) Keeling plot of CO_2 outside of the gas field. The crosses indicate the location of CSG wells.

Our results demonstrate the need for **baseline studies before the development of gas fields**. We suspect that depressurisation (fracking, groundwater pumping) of the coal seams during gas extraction changes the soil structure (i.e., cracks, fissures) that enhance the release of greenhouse gases such as methane and carbon dioxide. Those diffuse sources cannot be quantified by conventional modelling approaches and need in situ measurements similar to the ones reported here. The lack of baseline measurements prevents a straight-forward source assessment.

In summary, **our rapid approach can be used to map sites of interest** and allow the efficient focus of further efforts to quantify emissions. We propose that this approach is used in the following applications:

1) To determine **baseline concentrations** of greenhouse gases in the atmosphere before any CSG developments.
2) To identify **gas leakages** from infrastructure, including compression stations and long pipelines.
3) To develop an **early warning system** in which action can be taken if specific methane concentration thresholds are reached.

Additional applications will likely emerge as our method becomes a widely applied prospective tool. Our results will be published in the **scientific literature** in the coming months and will be made publically available.

Our research group is interested in obtaining funding from independent sources to perform follow up studies in Australia. We are in an excellent position (i.e., access to unique technology and expertise) to develop a quantitative approach that relies on high precision greenhouse gases measurements in the atmosphere of CSG fields. Unbiased estimates of fugitive gas emissions from CSG mining are urgently needed so that the society can have a well-informed debate.

Dr. Isaac Santos

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