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15. ATMOSPHERIC MONITORING

15.1 Introduction

The CO2CRC Otway Project was one of the first geological storage projects to include comprehensive atmospheric monitoring as part of the assurance monitoring programme. This programme was designed to detect if any change had occurred in nearby soil, aquifers or atmosphere as a result of leakage of stored carbon dioxide. The development of methodologies able to attribute and quantify emissions was a major additional goal of the atmospheric monitoring research at the Otway site.

While leaks can potentially occur at various stages of the capture, transport, injection and storage process, the main focus for atmospheric monitoring is the detection of leakage of CO_2 from the geological reservoir. This is one of the main concerns of regulators, project operators and the public. Leakage associated with carbon capture and storage (CCS) in the atmospheric context is defined as the emission of gases to the atmosphere, particularly injected CO_2, but also gases that might accompany the injected CO_2 and gases such as methane (CH_4) that might be displaced from a storage reservoir. A number of potential leakage pathways have been proposed, such as via wells, faults, permeable cap rock, or a combination of these (Benson et al. 2005). Storage sites can be extensive, with subsurface reservoirs extending for several kilometres. Leakage to the atmosphere could be through point or diffuse sources and with locations that have varying degrees of uncertainty.

Although atmospheric techniques have only recently been applied to monitoring potential emissions from geological storage, gas fluxes from land surfaces to the atmosphere have been successfully determined for landfills, crop canopies, volcanoes and coal mines. These applications present some similar challenges to monitoring geological storage. A review of atmospheric monitoring techniques for measuring emissions from geological storage across a range of scales and their relevance to the Otway Project is given by Leuning et al. (2008).

Most atmospheric measurements provide composition (gas concentrations and isotopic ratios) over time from point locations. Ideally, however, atmospheric monitoring would measure land-air fluxes continuously across the storage site. The techniques that do measure flux directly, namely flux chambers and eddy covariance flux stations, have