Contaminant profiles of air and soil around Casey station, Antarctica; Discerning local and distant contaminant sources

Bengtson Nash, S.¹; Xiao, H²; Schlabach, M.³; King, C.⁴; Stark, J.S.⁴; Hung, H.²

¹Griffith University, Atmospheric Environment Research Centre (AERC), Brisbane, Australia
²Environment Canada, Science and Technology Branch, Toronto, Canada
³Norwegian Institute for Air Research (NILU), Kjeller, Norway
⁴Australian Antarctic Division, Hobart, Australia

E-mail contact: s.bengtsonnash@griffith.edu.au

1. Introduction

The primary input of Persistent Organic Pollutant (POP) contamination to the Antarctic is expected to be via Long Range Atmospheric Transport (LRAT) from emissions in neighboring Southern hemisphere nations ¹,². In addition to LRAT, system input of POPs must increasingly consider alternate pathways. Human activity in the Antarctic represents a potential direct source of both legacy and current-use chemicals.

It has been two decades since the organic chemical composition of air masses arriving in the Australian Antarctic Territory (AAT), which spans the majority of the eastern Antarctic sector, was last investigated³. The results presented here are the first atmospheric measurements made as part of a new continuous monitoring effort at Casey station (66°17' S 110°31' E), one of Australia's all-year research stations. These results are evaluated alongside POP contamination data of soil samples collected around the Casey station perimeter. Here we assess contaminant profiles for clues as to local and distant contamination sources.

2. Materials and methods

A high-volume flow-through atmospheric sampler⁴ was installed throughout 2010 in a remote location, 3km upwind from Casey station¹. In addition, four soil samples were collected at various locations around Casey station (Fig. 1). Air samples were analysed for organochlorine pesticides, including dichlorodiphenyltrichloroethane (DDT) and hexachlorohexane (HCH) isomers; polybrominated diphenyl ethers (PBDEs) and polychlorinated biphenyls (PCBs). Soil samples were analysed for dioxins and furans, PCBs, PBDEs and DDT and HCH isomers. All analyses were conducted at the Norwegian Institute for Air Research (NILU), Norway.

![Figure 1: Map of Casey Station depicting air and soil sampling locations. Map © Commonwealth of Australia 2010](image)

3. Results and discussion

The most varied contaminant profile and the highest levels of contamination where detected in the “Antenna farm” soil sample. This sampling site is in close proximity to the Thala Valley historical waste disposal site of Old Casey station, decommissioned in 1986. Local PCB contamination of abiotic and biotic matrices has previously been linked to historical waste disposal at McMurdo Station in the Ross Sea region⁵-⁷ and must also be considered in evaluation of chemical profiles of the current study. However, intermediately
chlorinated PCB homologues, expected to carry the greatest potential for LRAT, dominated the PCB profiles observed in all samples, supporting LRAT as the major input pathway.

PBDEs profiles on the other hand provide preliminary evidence of a local source with the involatile, currently produced deca-brominated congener 209 contributing significantly to both air and soil profiles (24% of $\Sigma_{16}$PBDE contamination in the air sample < 41% of “Transmitter Hut Site 2” < 58% of “Line to Jack’s” < 60% of “Antenna Farm” and 65% of “Transmitter Hut site 1”) (Figure 2). Tetra-brominated congeners BDE-66 and -47 are predicted to be the major photodegradation products of BDE-209 and were detected in all samples. These levels are likely to be the product of both in-situ processes as well as LRAT supplementation of atmospherically “aged” PBDE profiles.

Consistent profiles and contaminant levels of DDT and HCH isomers between all samples suggests long distance delivery of these agricultural chemicals whilst a dominance of Endosulfan-I in air evidences its ongoing application in the southern hemisphere.

![Figure 2. PBDE Homologue Profiles](image_url)

4. Conclusions

Data presented here are the first results of the chemical composition of air masses of the AAT measured in over two decades. Here we present preliminary air results alongside soil concentration data. Results suggest a potential local source of deca-brominated PBDE and evidences the continued input of agricultural chemicals via LRAT.

5. References


Acknowledgements: The Australian Government Department of Sustainability, Environment, Water, Population and Communities provided funding for the air sampling component. The views expressed are those of the authors only. Figure 1 was produced by the Australian Antarctic Data Centre.

---

1 Only the first three months of sampling data were ready at the time of abstract submission, however a further 9 months of data is anticipated shortly and will be incorporated into the ensuing presentation.