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Understanding the annual and seasonal trends in observations from Mace Head, Ireland using an atmospheric transport model

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The Mace Head observing station is situated on the west coast of Ireland and is part of the global AGAGE (Advanced Global Atmospheric Gases Experiment) network of sites. It is ideally situated to observe air from the Atlantic that has received no land emissions for thousands of kilometres. The majority of air therefore is a good representation of mid-latitude composition, referred to as baseline air, and can be used to assess annual and seasonal trends. The Mace Head station uses state-of-the art instrumentation to record a comprehensive set of greenhouse gases at high time resolution and high precision.

This study attempts to isolate those times from 1995 onwards that are representative of mid-latitude baseline air by using a sophisticated Lagrangian atmospheric dispersion model, NAME (Numerical Atmospheric dispersion Modelling Environment) and statistical post-processing. In this work NAME uses 3D meteorology from the UK Met Office numerical weather prediction model, the Unified Model.

NAME is run backwards in time for ten days for each 3 hour period from 1995 until the end of 2006 releasing thousands of model particles at Mace Head. For each 3 hour period a map is produced estimating all of the surface (0-100m) contributions within ten days of travel arriving at Mace Head during that 3 hour interval. By rejecting those times when the history of the air mass indicates impact from the European land mass, transport from tropical latitudes or significant local contributions, it is possible to isolate those times classed as mid-latitude baseline. The selected baseline observations

are further refined by application of a statistical filter to remove outlying data points. Monthly averages of the resulting data are used to assess the annual and seasonal baseline trends in each measured gas.

The methodology is applied to carbon dioxide, methane, nitrous oxide, ozone and a range of CFCs, HCFCs and HFCs covering the period 1995-2006 inclusive. The results indicate that all of the major CFCs are now decreasing in concentrations, the growth in the HCFCs is slowing whereas the concentrations of HFCs are showing strong growth. After early growth the current annually averaged methane and ozone concentrations are now level and falling, respectively, unlike the nitrous oxide and carbon dioxide concentrations which have continued to rise.