

Effects of Climate Induced Changes in Isoprene Emissions After the Eruption of Mt Pinatubo

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**Quantifying and
Understanding
the Earth System**

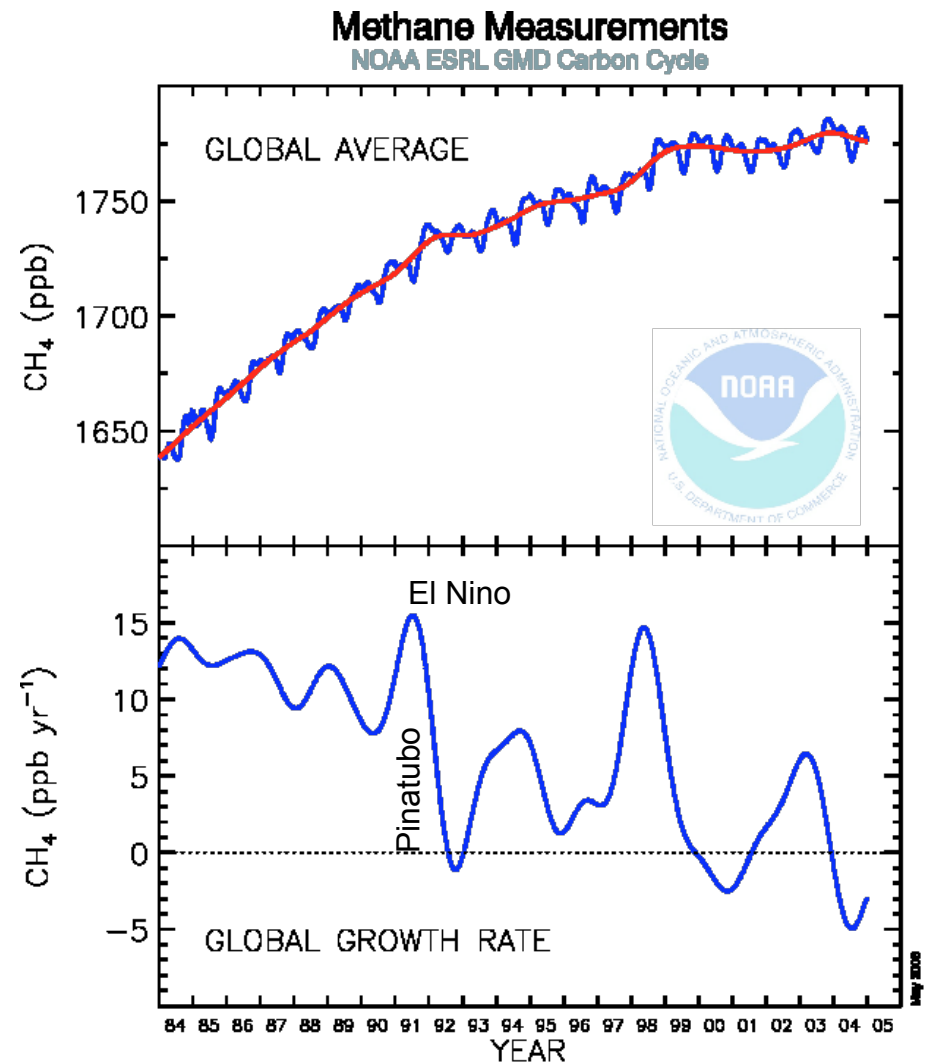


**National Centre for
Atmospheric Science**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Introduction

- Changes in **GHG growth** rates eg CH_4 in early '90s
- **Causes?**: Pinatubo, ENSO
- **Sources** (wetlands, burning) & **Sinks** (OH)
- **Isoprene** (C_5H_8), a biogenic VOC, is a competing reaction for OH
- Probe effect of **climate dependent isoprene emissions**



Method

- Isoprene emissions sensitive to **temperature, precipitation, humidity, insolation**
- Run 'Nudged' GCM (UM) to obtain these quantities
- Run **Sheffield BVOC** model for isoprene emissions
- Feed emissions back into Nudged CCM **UKCA**
- Prototype of Earth System Model (**QUEST**)

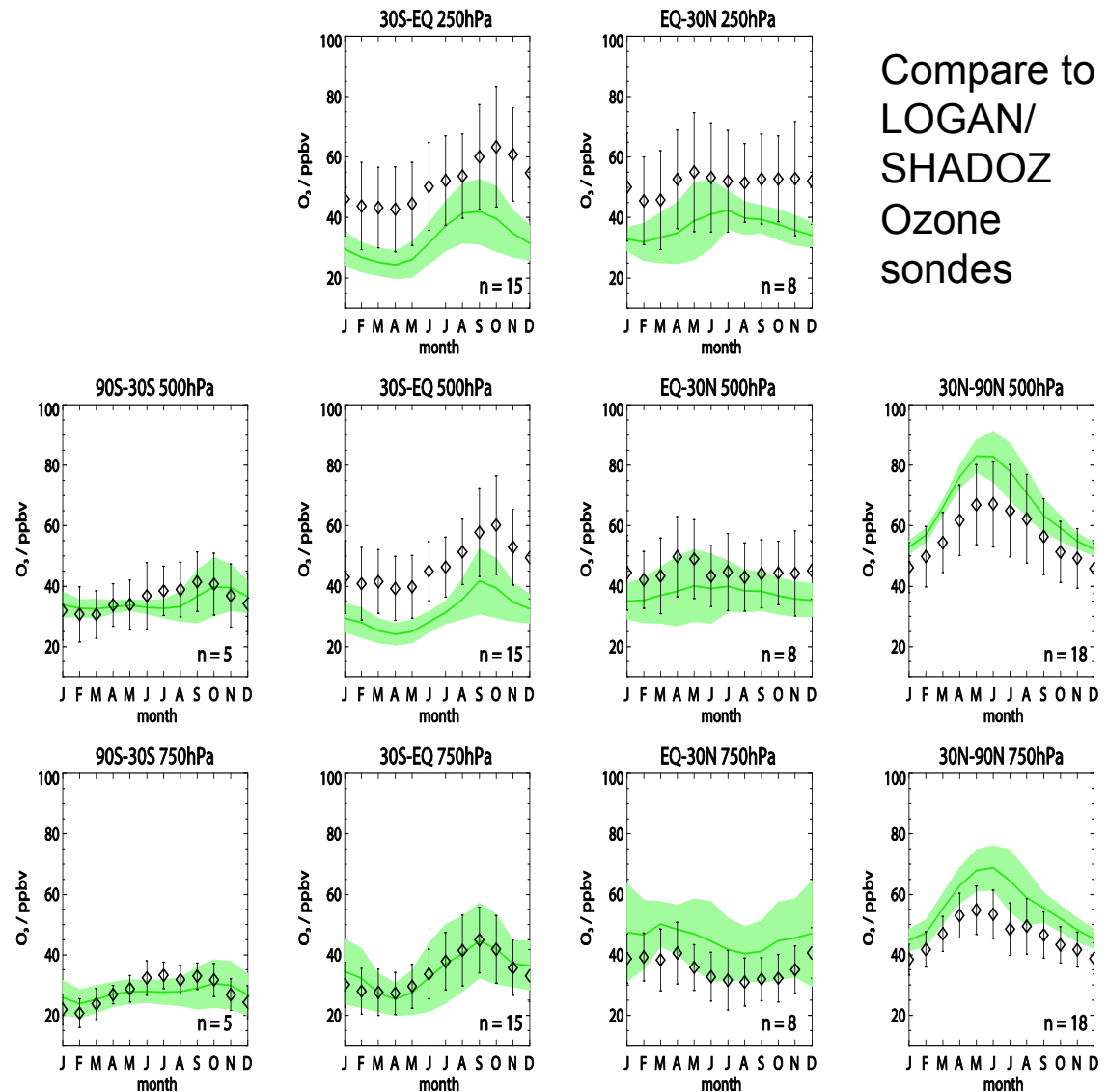
- Perform **3 runs** to probe C_5H_8/OH
- Study **global & regional** changes

	Meteorology	Emissions
Base	1990-97	1990-97
Emfix	1990-97	1990
MetFix	1990	1990-97

Model Description

- Use **UKCA** CCM with **Tropospheric** Chem.
- Compare to ozone **data**
- Mainz isoprene mechanism (**MIM**)
- Fix **Methane** to 1.76 ppmv
- Nudge to **ERA-40** to obtain dynamical changes
- Parameterise changes in **SW Flux**

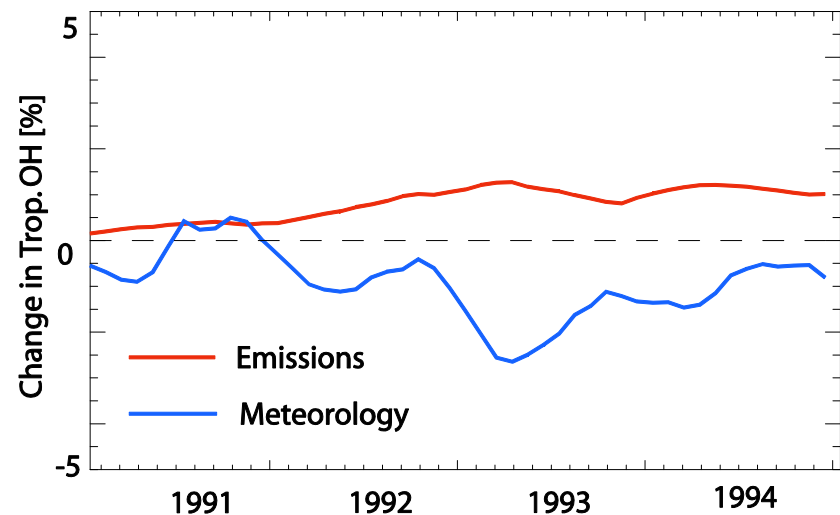
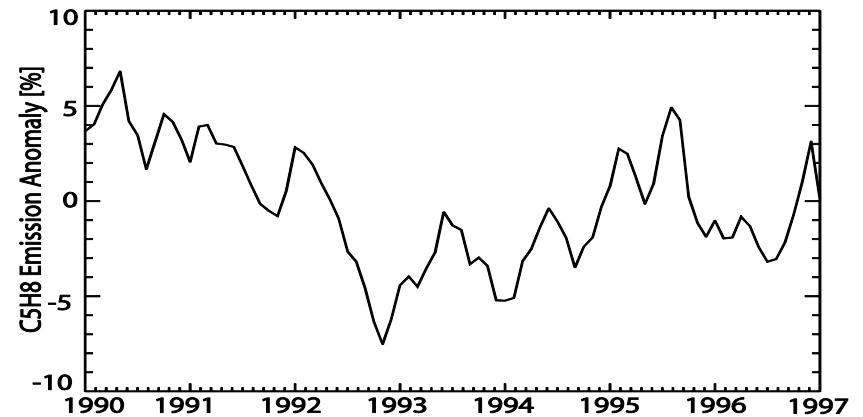
Compare to
LOGAN/
SHADOZ
Ozone
sondes



Thanks to L. Abraham

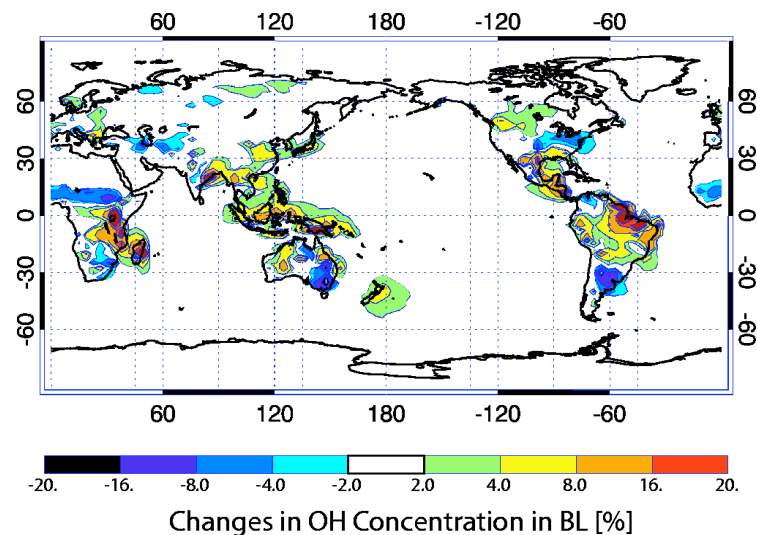
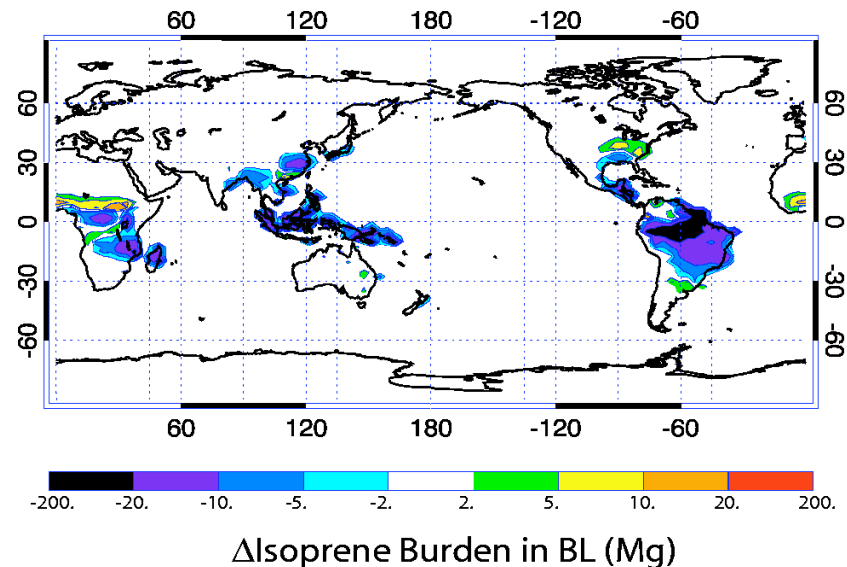
Global Variations

- Plot Isoprene emission **anomalies**
- See changes of **~10%**
- Plot effect on **OH**
- **Emissions** = (Emfix – Base)
- **Meteorology** = (Metfix – Base)
- Emissions **comparable** to meteorology



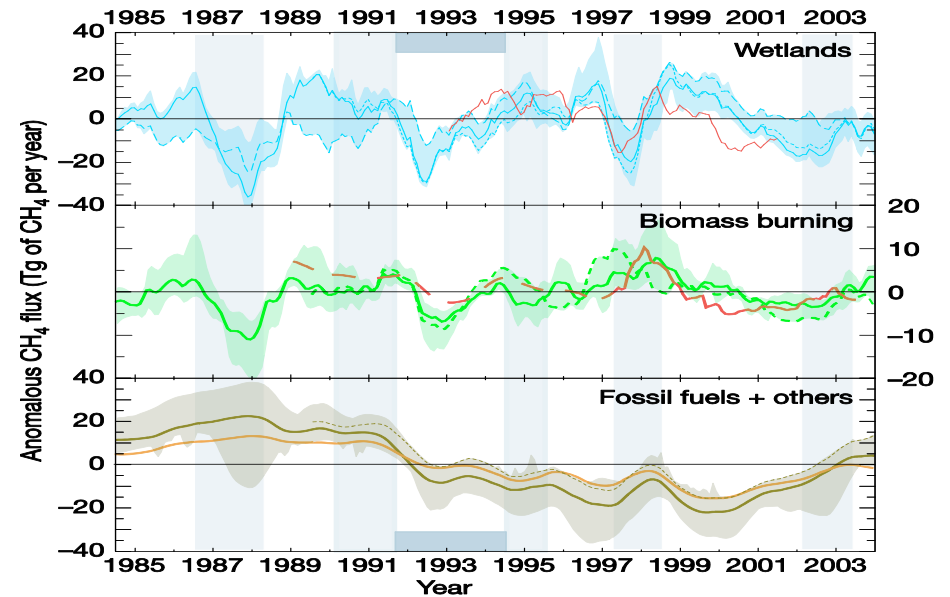
Regional Impacts

- Examine **distribution** of changes
- Plot Effect of '**Emissions**' in 1993
- Isoprene changes near **emissions**
- OH changes & C₅H₈ **anticorrelated**
- **Large** effect on OH (up to 20%)

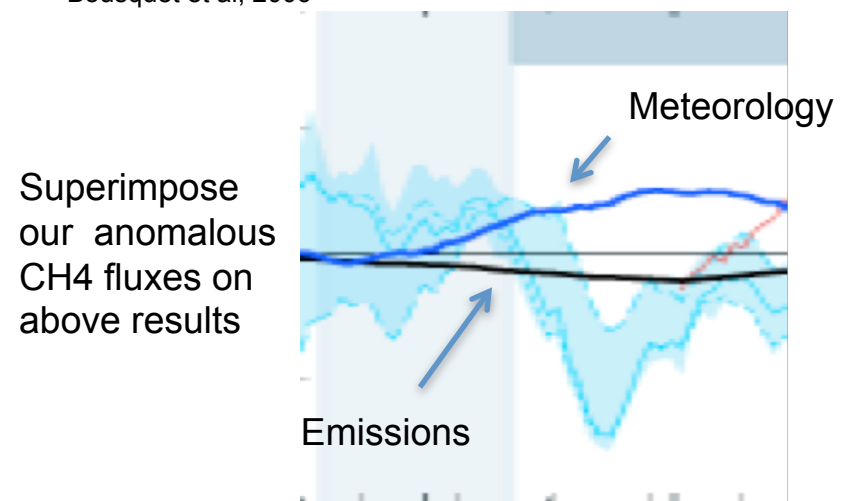


Methane Budget

- Bousquet et al have studied variability of methane **sources**
- Examine impact of **OH** changes on methane
- **Superimpose** on wetland for 1990-94
- **Comparable** to this main source of variability



Bousquet et al, 2006



Conclusions

- **Climate** changes after Pinatubo induce significant changes in **isoprene emissions**
- These impact on regional **OH** and global **methane** concentrations
- Demonstrates the importance of **Earth System Modelling**
- Also interesting effects in **stratospheric ozone** (see poster)

Back up Slides

UKCA CCM (Trop Version)

- Community chemistry model embedded in UM
- 60 levels
- O₃, HNO₃ prescribed above 10 hPa
- 2.5 by 3.75 resolution Forced with sea surface temperatures and sea ice
- Current configuration:
- 56 tracers
- 120 bimolecular, 16 termolecular reactions
- 37 photolysed, 31 dry deposited, and 23 wet deposited species
- Species emitted: NO, CO, HCHO, ME₂CO, MECHO, C₂H₆, C₃H₈, C₅H₈
- HO_x NO_x chemistry of ethane, propane & isoprene

Nudging

- Nudging reads in analyses to give model 'real climate'
- Use ERA-40
- Removes Biases
- Reproduces variability
- ACP Tech Note with details (*Telford et al 2007*)

