# Ocean Acidification and Marine Trace Gas Production

Frances E. Hopkins

Sue Turner[§], Phil Nightingale[¤], Michael Steinke*, Peter Liss[§]

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[§]Laboratory for Global Marine and Atmospheric Chemistry, School of Environmental Sciences, University of East Anglia, Norwich, UK [¤]Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth, UK. *School of Biological Sciences, University of Essex, Colchester, UK.

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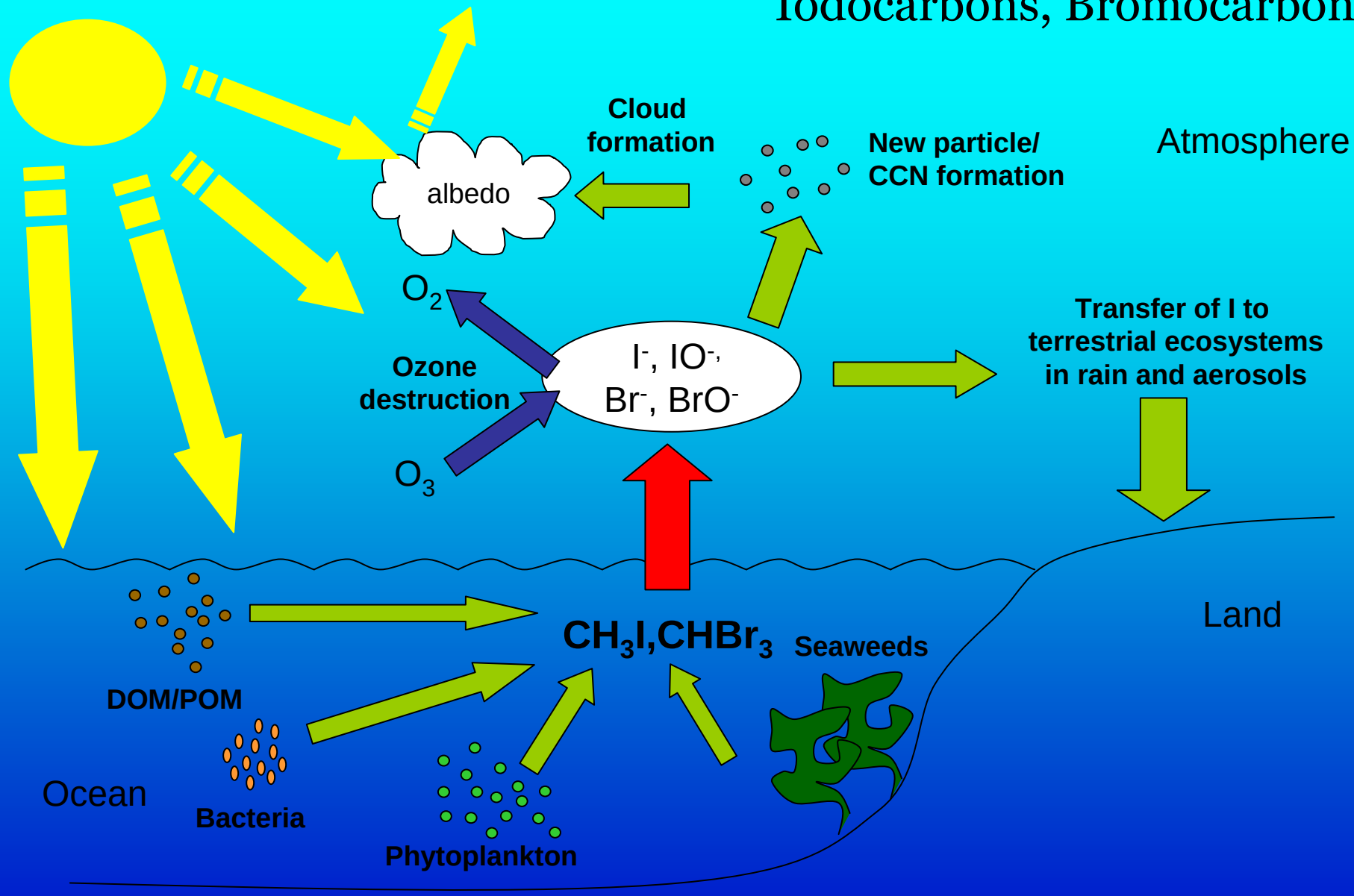
# Ocean Acidification and Marine Trace Gas Emissions

- Background to the trace gases
  - Halocarbons
  - Dimethyl sulphide (DMS)
- Mesocosm $CO_2$ perturbation experiment, Norway, 2006
  - Findings and Conclusions
- Ischia – A natural laboratory
  - Findings and Conclusions
- Concluding remarks

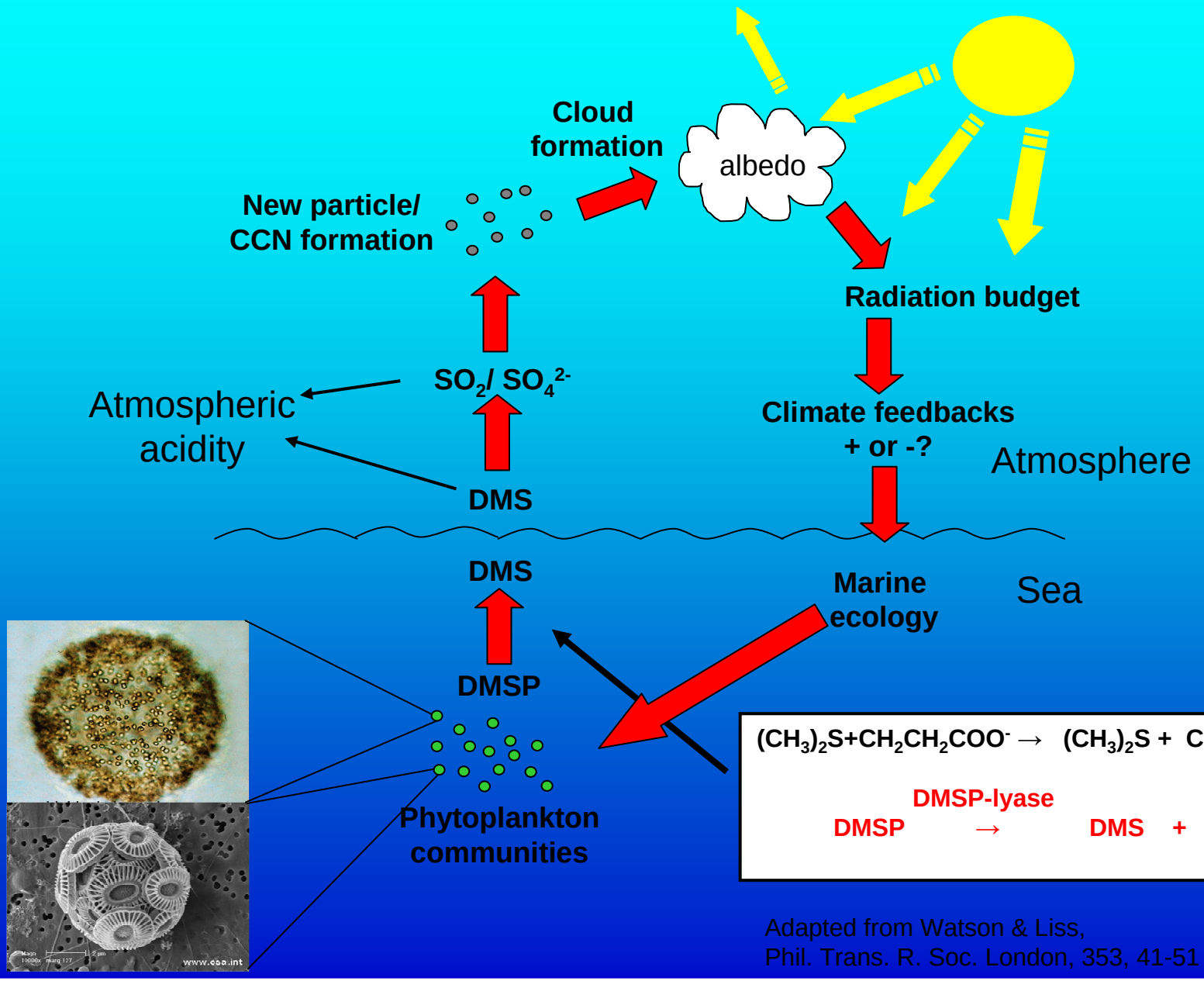
# Halocarbons

## Iodocarbons, Bromocarbons




Adapted from a schematic by Alex Baker, UEA

# Dimethyl sulphide (DMS)




$(CH_3)_2S + CH_2CH_2COO^- \rightarrow (CH_3)_2S + CH_2CHCOOH$

DMSP-lyase

DMSP → DMS + acrylate

Adapted from Watson & Liss,
Phil. Trans. R. Soc. London, 353, 41-51 (1998)

# Mesocosm $CO_2$ Experiment

## *Norway May 2006*

Two treatments:
High-CO2 (~750 ppmv, pH 7.8) M1,2,3
Ambient control (~360 ppmv, pH 8.1) M4,5,6

pH manipulated by aerating water column with $CO_2$/air mixtures

6 x mesocosms

**23-day $CO_2$-perturbation experiment – investigating impacts of high-$CO_2$ on development and decline of phytoplankton bloom.**

Impacts on marine biogenic trace gas production?

# Summary and Conclusions

- Mesocosm experiments – limitations, difficult to make global extrapolations but currently best way of assessing impacts of ocean acidification on phytoplankton blooms.

**Under high $CO_2$:**
**31 % decrease in [iodocarbons]**
**46 % decrease in [DMS]**
**11 % increase in [bromocarbons]**

- DMS – modelling study, decrease of this magnitude enough to result in net cloud radiative forcing to increase surface air temp by 1.6 ℃ (Gunson et al. 2006 GRL 33, L07701, doi:10.1029/2005GL024982).

- Combined decrease in DMS and iodocarbons
  – warming effect?

# Ischia, Bay of Naples, Italy

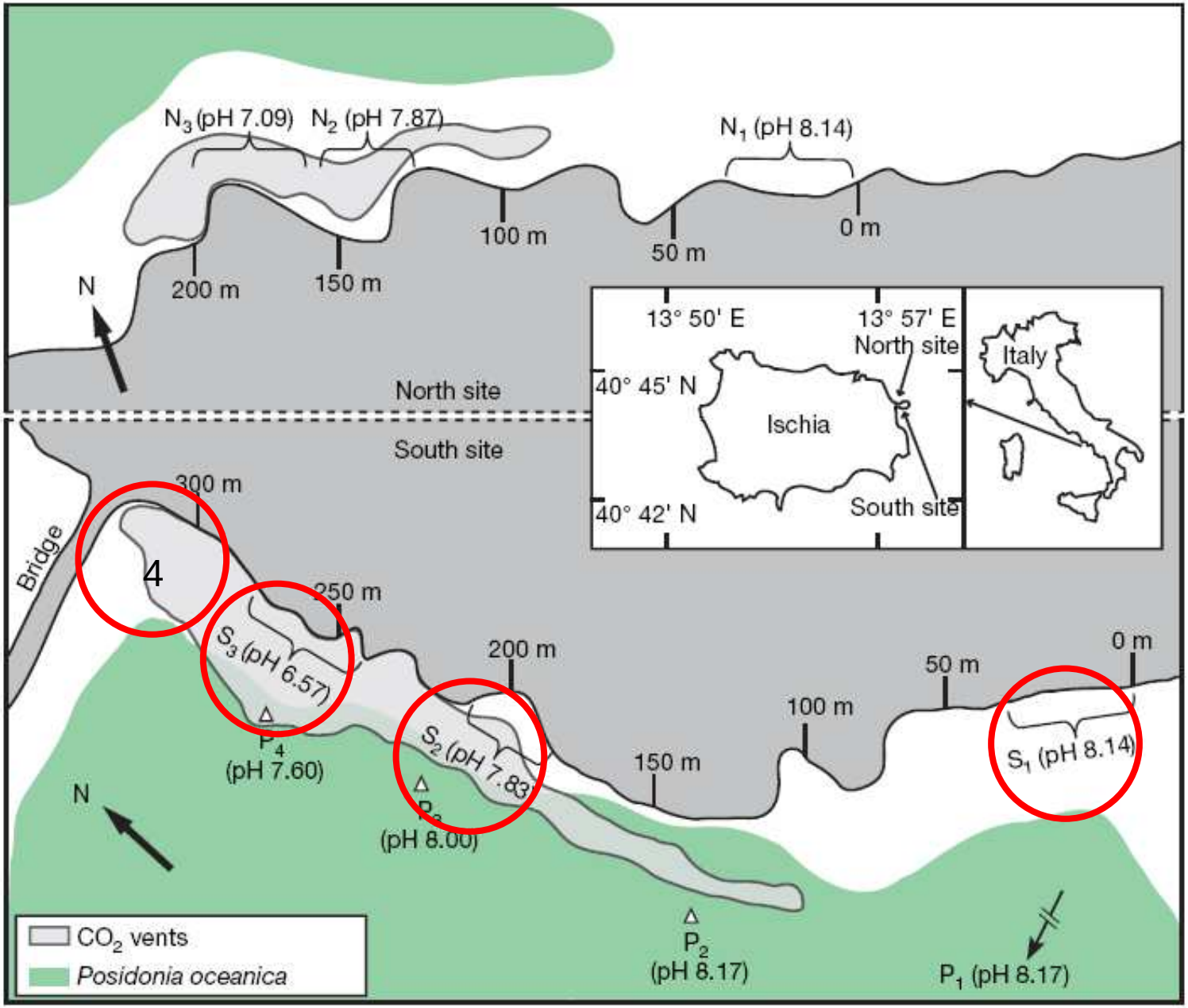
Volcanically acidified shallow marine site.

*A natural laboratory.*

2 fieldwork campaigns
Assessment of suitability of site for investigating impacts of ocean acidification on *trace gas production*

Measurements of
Halocarbons, DMS, DMSP, Chlorophyll-a, Fv/Fm, Nutrients, CHN from seawater samples.

**Preliminary data from Spring 2008 field campaign**




**From: Hall-Spencer et al., 2008**

# Summary and Conclusions

- Preliminary data from Ischia shows some affect of pH on concentrations of a number of climatically-relevant trace gases.
  - *Bromocarbons increase – increased destruction of tropospheric ozone, alleviation of global warming?*
- Further analysis of the data required in order to ascertain causes of the observed changes.
- Naturally-acidified sites represent powerful tool in exploration of future impacts of ocean acidification.

# Concluding remarks

Seawater concentrations of climatically-important trace gases balanced by **production and removal** mechanisms – changes as a result of ocean acidification have potential to impact **sea-to-air flux.**

Impacts on atmospheric chemistry and global climate, with **feedbacks** to the **Earth-climate system**

# Thank you for listening!

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