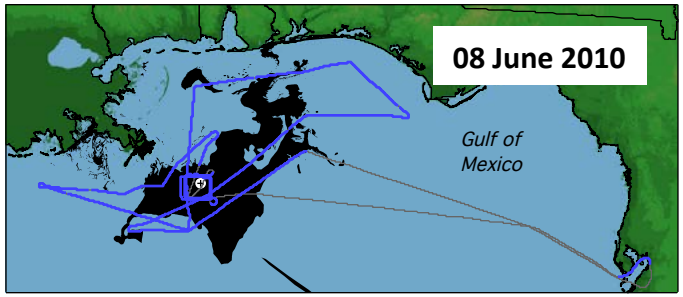
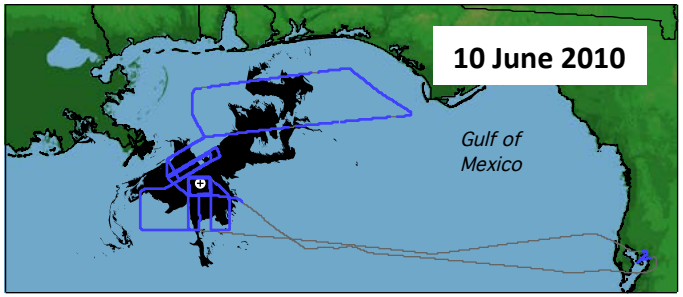
Airborne chemical measurements to assess offshore blowouts

Thomas Ryerson

Mandate: NOAA is tasked under the National Contingency Plan with providing scientific support to the On-Scene Coordinator for offshore oil spills.

CSD response: we diverted the chemically-instrumented NOAA P-3 aircraft in June 2010 from our CalNex field project to quantify atmospheric effects of the *Deepwater Horizon (DWH)* disaster.





Impacts: This led to **unexpected insights** into air quality impacts, *DWH* oil distribution in the Gulf, a **unique new approach** to quantify subsurface oil flow rates – and **an operational vision** for the future.

Stakeholders: NOAA National Ocean Service, U.S. Coast Guard, U.S. Geological Survey, Environmental Protection Agency, Department of Justice, Gulf states, response personnel, and the public.

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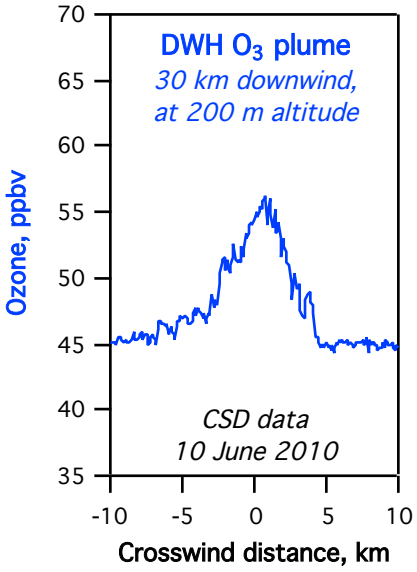
CSD research defined the air quality impacts of the *DWH* disaster

Ozone

Ozone enhancements were typically **less than 20 ppb** over fairly small areas.

Neuman et al., JGR (2012)



Soot

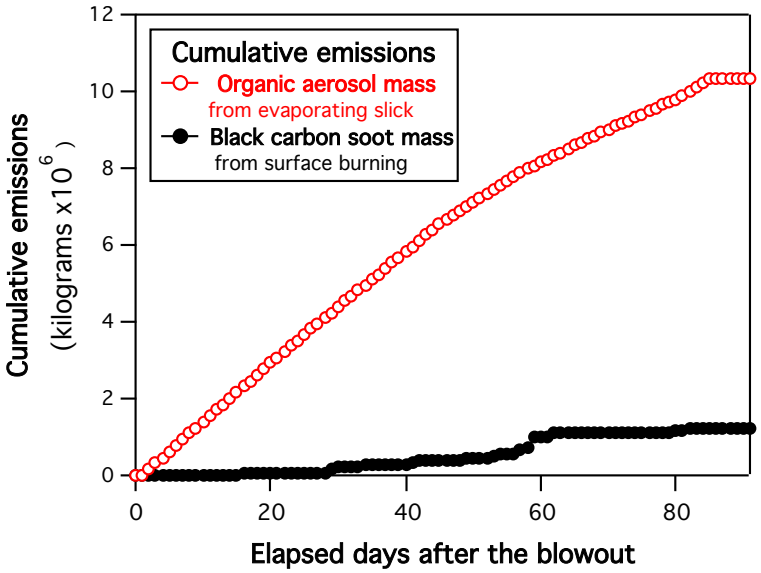
Surface oil burning released **1 million kilograms** of black carbon soot particles.

Perring et al., GRL (2011)

Organic particles

Far more particle mass came from evaporation of the oil slick; these organic aerosol particles had unknown health effects.

Middlebrook et al., PNAS (2012)



Organic aerosol formation may have had the largest impact on air quality

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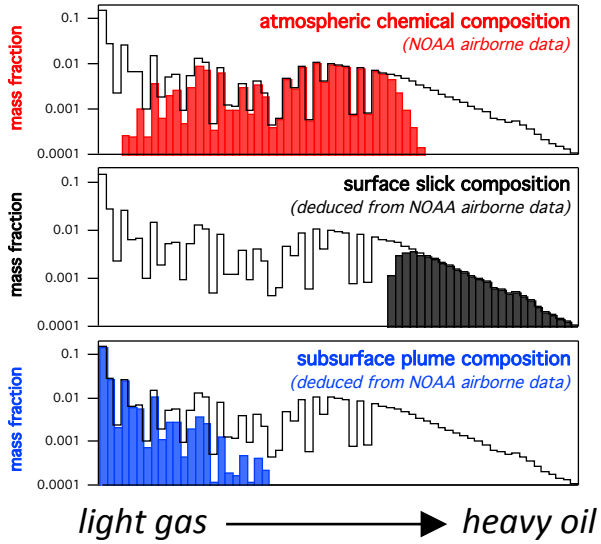
DWH oil distribution quantified

Ryerson et al., PNAS (2012)

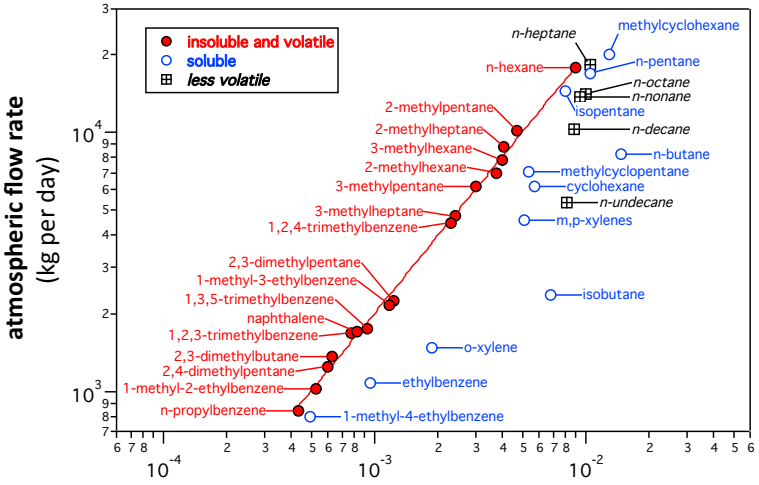


(black line in each plot shows the leaking composition)

Airborne methane and hydrocarbon data over a wide range of solubility and volatility showed **what went where**, and **why.**

DWH subsurface flow rate quantified

Ryerson et al., GRL (2011)



Subsurface flow rate, from the atmospheric flow rate of any of the insoluble and volatile hydrocarbons, **was within 5% of official final estimates.**

Airborne flow rate assessment is accurate and independent of other techniques; in future, assessment could be done in real time

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Research-to-applications demonstrated in the 2012 *Elgin* rig blowout in the North Sea

• A blowout forced the evacuation of the *Elgin* rig in the North Sea, shutting down 10% of UK gas production for nearly two months

• Within five days a chemically-instrumented research aircraft had quantified the flow rate ***(flight plans and data analysis by NOAA CSD)***

• **Based on the airborne data**, a decision was made to re-board the rig and proceed with a top kill, avoiding time-consuming relief wells

communicated to Total, DECC, and the public promptly after each of 5 flights


Elgin rig after well control restored

UK BAe-146 research aircraft

The airborne chemical response delivered:

- time-critical and actionable information.
- protection to the marine environment.
- savings of **$1.5 billion** to the UK treasury.

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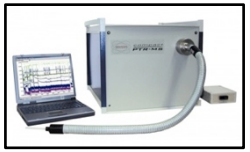
A CSD vision for transferring our research to operations:

Instruments prioritized for a spill…

Methane

Hydrocarbons →

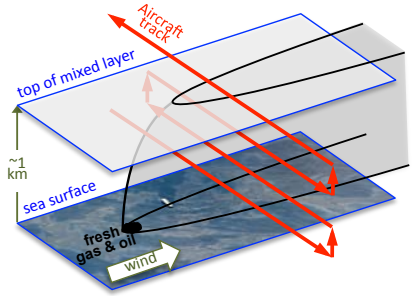


Benzene/Aromatics

…ready for rapid deployment…

configured for plug-and-play aboard different aircraft types

…to assess spill flow rates.



Interagency effort required to deploy, analyze, and effectively communicate results to public, responders, and stakeholders.

An operational quick-response airborne system

A timely National investment opportunity to provide high-profile "environmental intelligence" in future blowouts