

From the past to the future: Understanding ocean and climate variability through the Ocean Time-Series

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ESTACION DE
INVESTIGACION
DE MARGARITA

Integrated Observing Strategies

Autonomous Measurements

- High temporal resolution
- Co-location of sensors: discerning processes
- Essential to put sparse measurements in context
- Emerging biogeochemical



Ship-based Measurements

- Unrivaled quality
- Biological, chemical and geological: comprehensive information on complex processes and systems
- Easy to modify and adapt
- Human in the loop



Integrated Observing Strategies

- This is not about one being better than the other



- It's about integrating the two types of observations



- This requires common methods and data reporting

Integrated Observing Strategies

- It also requires knowing the limitations of each



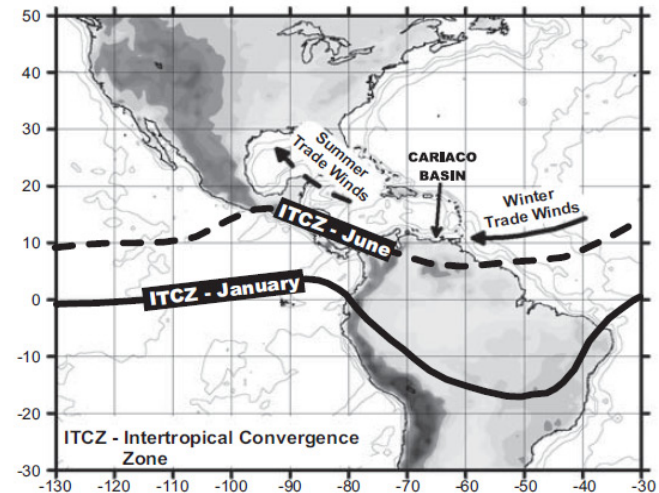
Optimal combination of observing platforms **should** be sustained - Our scientific understanding depends on the length and quality of the observational record (NRC, 2007)

The CARIACO Ocean Time-Series

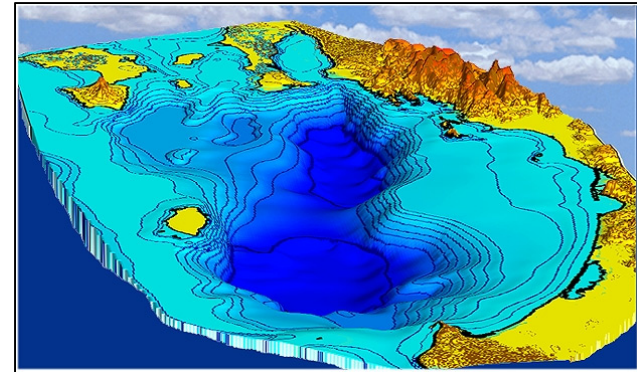
- 1995-present



- The Cariaco Basin: large tectonic depression located on the continental shelf off E. Venezuela
- ITCZ migration drives seasonality. Dry, upwelling season during the first half of the year.
- Restricted circulation and high primary production ($>400 \text{ gC/m}^2/\text{y}$) = anoxic below $\sim 250\text{m}$



Goñi et al., 2009



<http://imars.marine.usf.edu/cariaco>

The CARIACO Ocean Time-Series

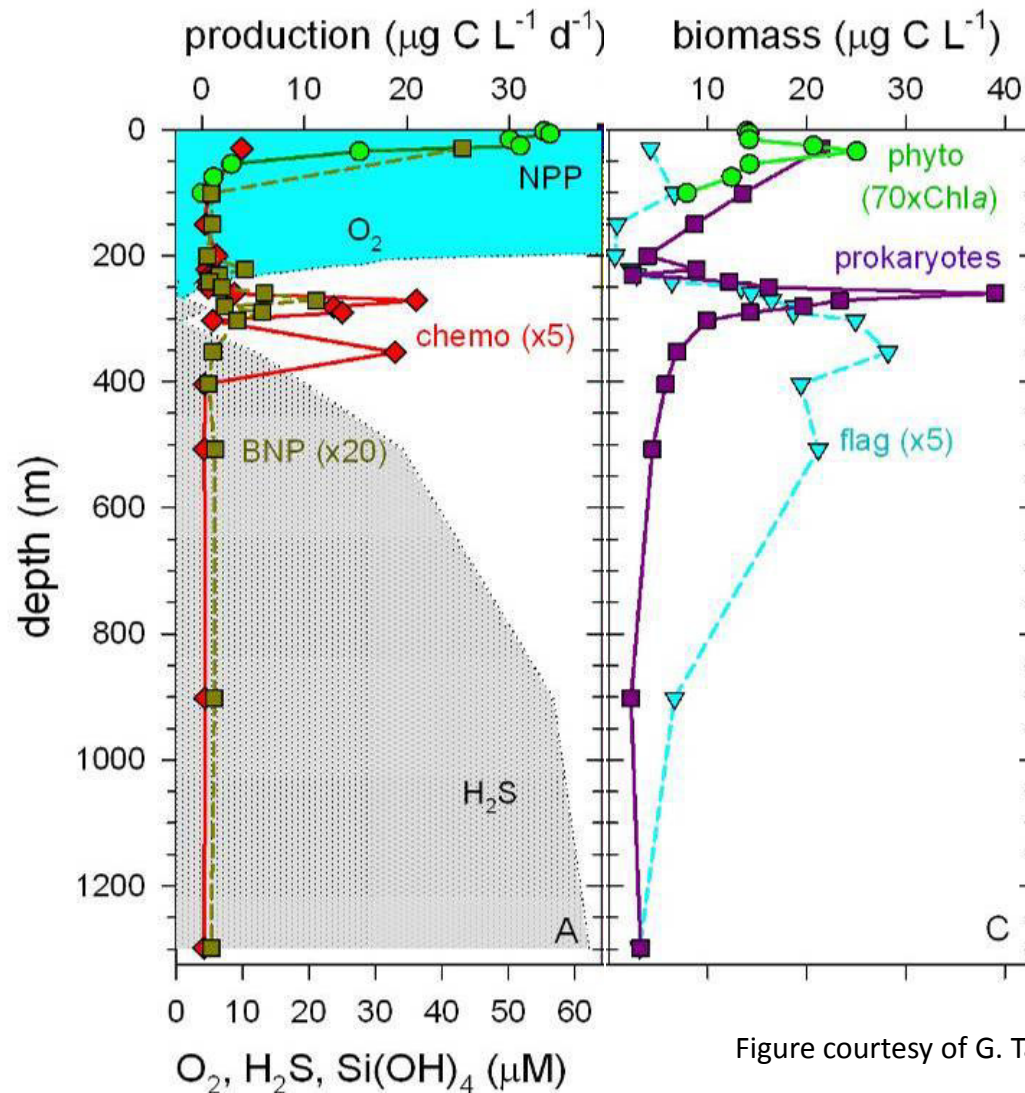
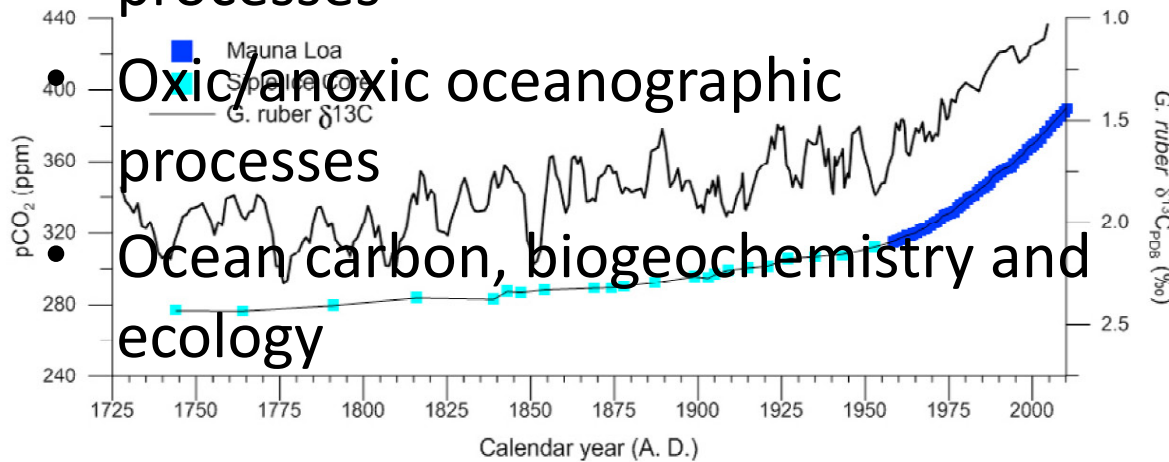
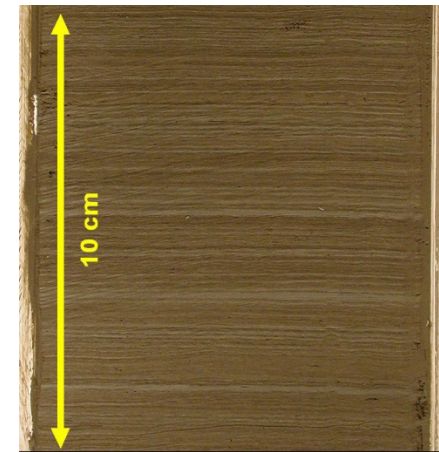


Figure courtesy of G. Taylor

The CARIACO Ocean Time-Series

- Important implications for the paleoclimatic record (light/dark laminae)
- Continental margin / upwelling processes



Black et al., 2011

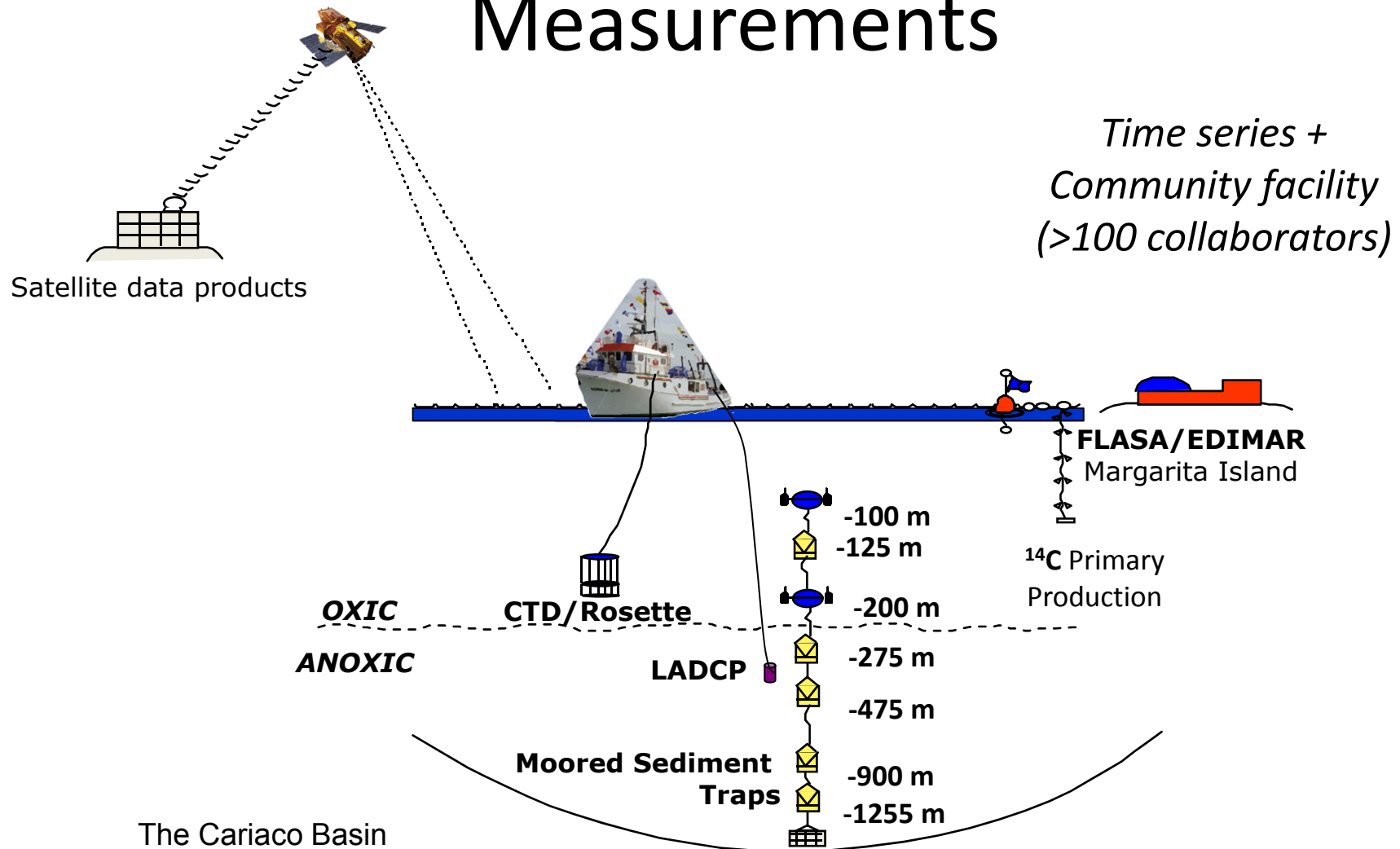
- Oxidizing/anoxic oceanographic processes
- Ocean carbon, biogeochemistry and ecology



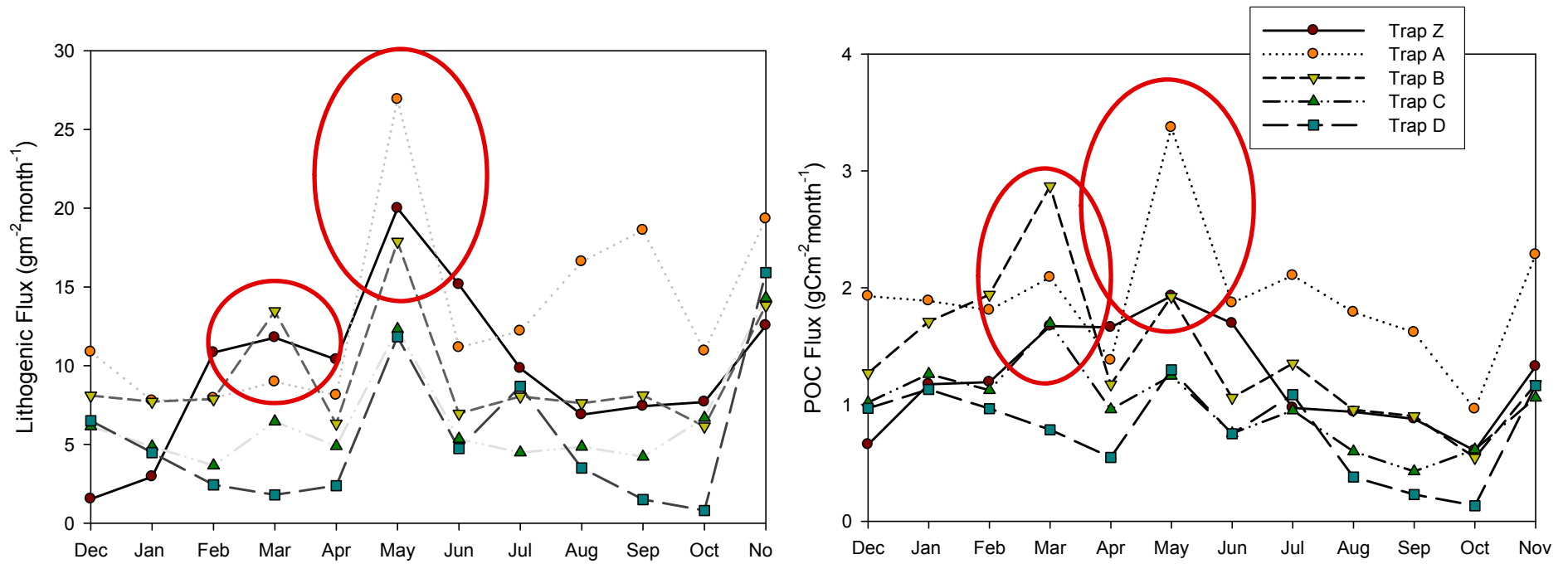
The CARIACO Ocean Time-Series: Objectives

- Understand the variability in the composition and quantity of settling particles related to
 - Ecology
 - Ocean chemistry
 - Terrigenous inputs
 - Hydrography
- Identify links between local ecosystem changes and regional/global climate processes.
- Deconvolve bacterial production and carbon decomposition across the oxic-anoxic interface

The CARIACO Ocean Time-Series: Measurements

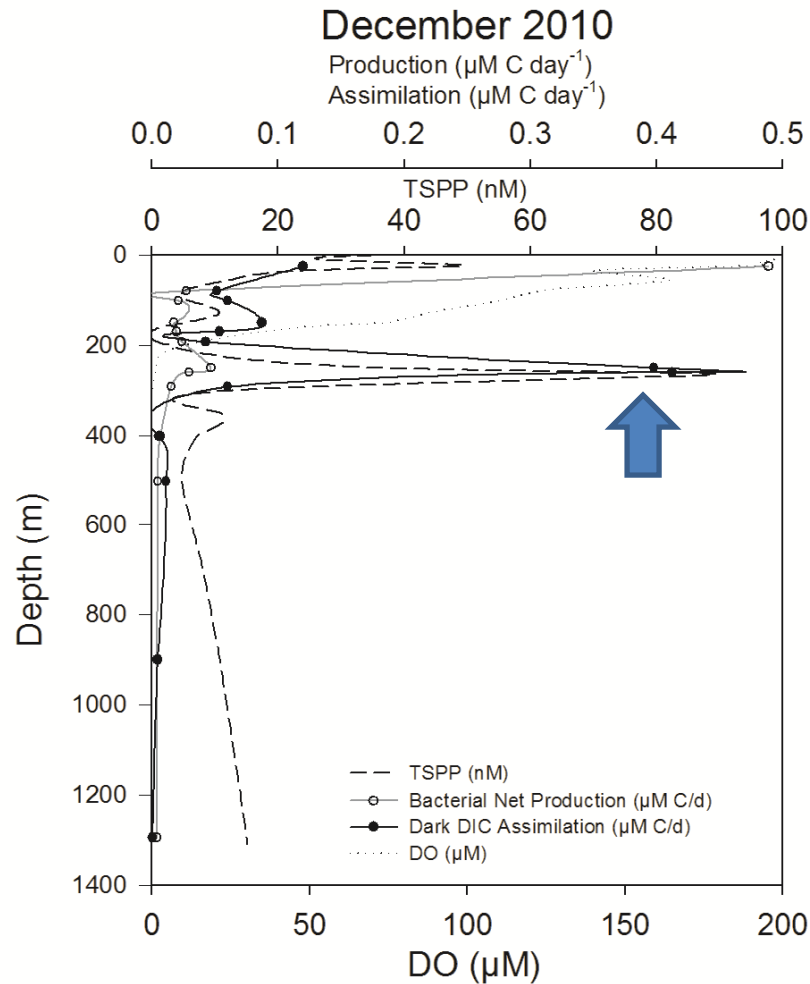


The CARIACO Ocean Time-Series: insights from integrated measurements



The CARIACO Ocean Time-Series: insights from integrated measurements

Bacterial Net Production and Dark DIC Assimilation



Heterotrophic bacterial net production,
dark DIC assimilation rate, TSPP (nM) and
DO (μM). (From McParland *et al.*, *sub.*)

The CARIACO Ocean Time-Series: insights from integrated measurements

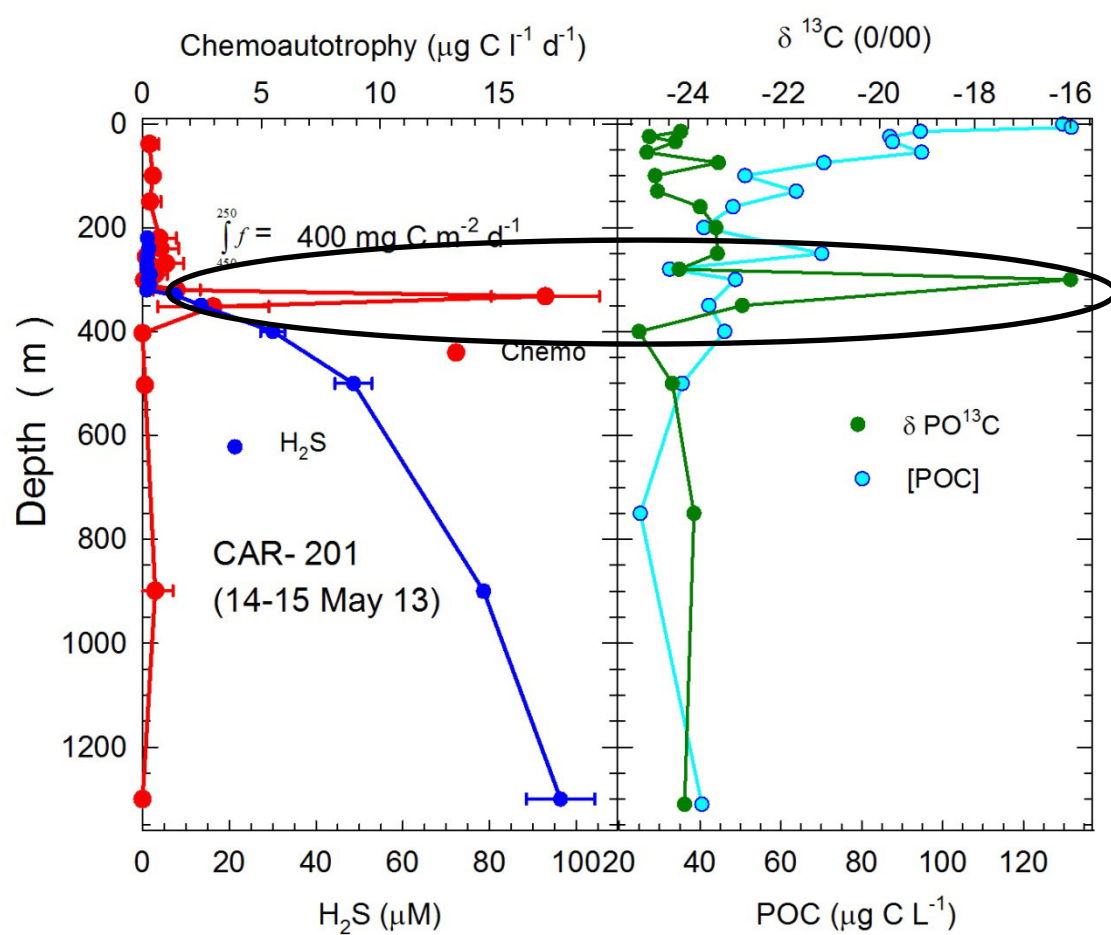


Figure courtesy of G. Taylor

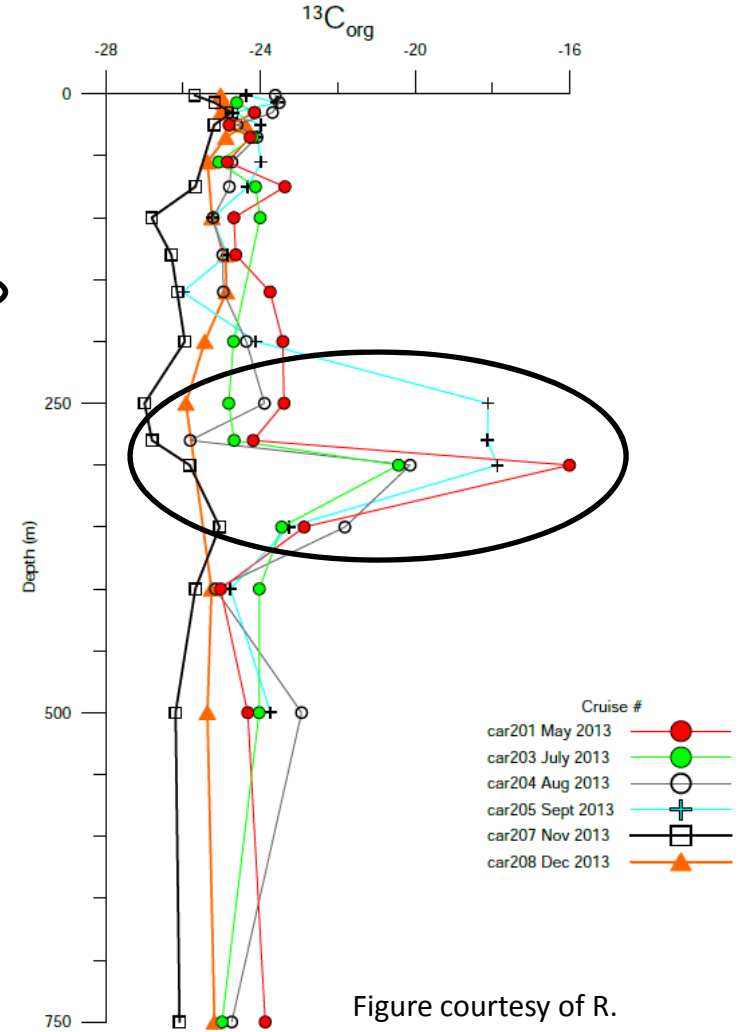
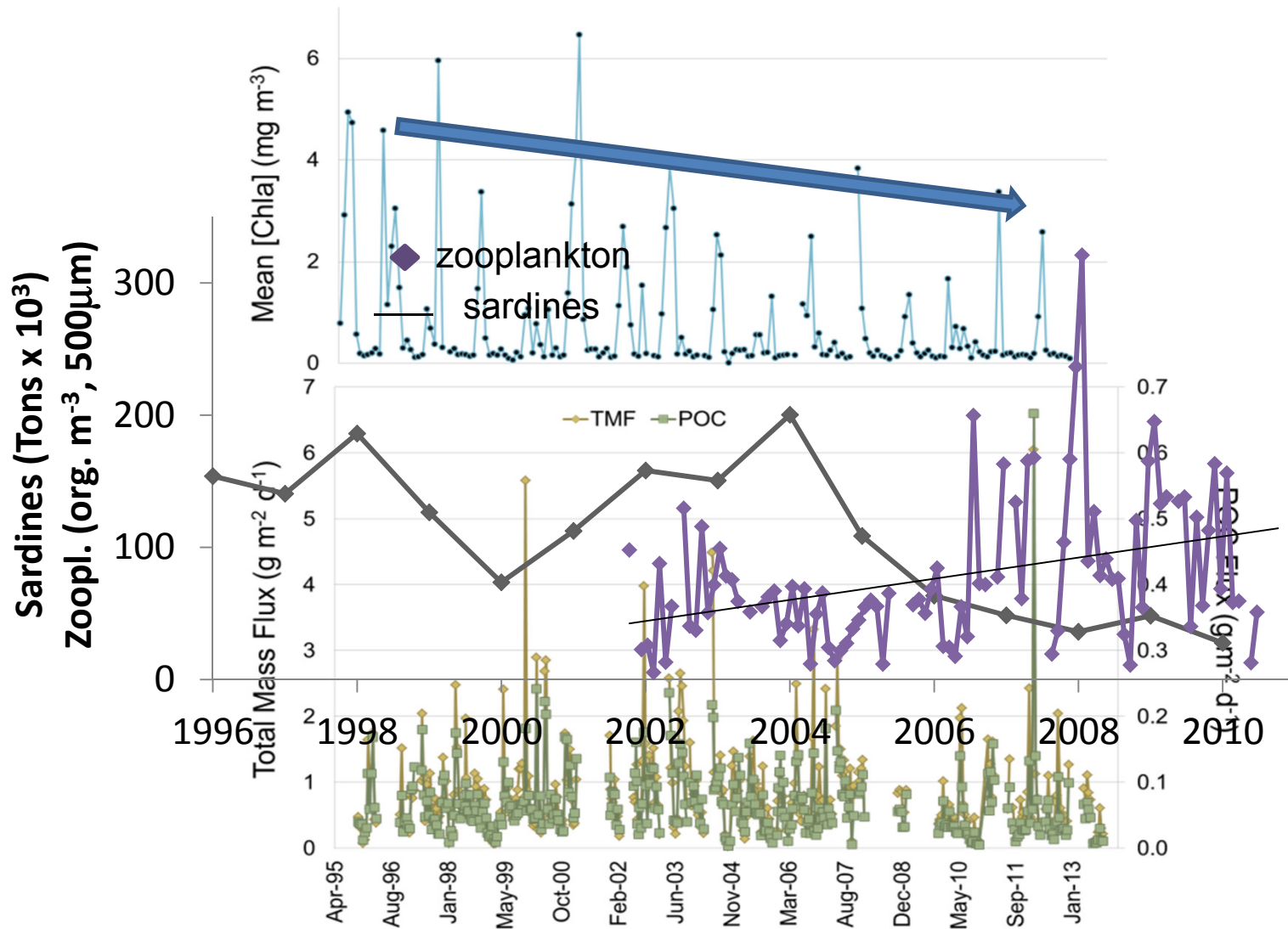


Figure courtesy of R. Thunell and E. Tappa

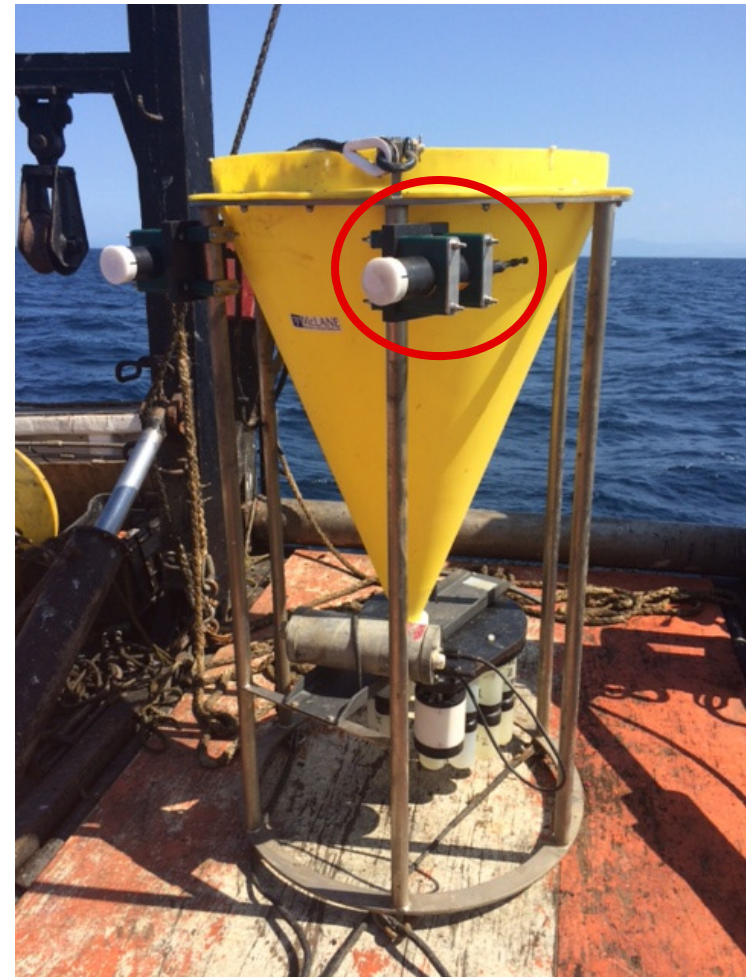
The CARIACO Ocean Time-Series: insights from integrated measurements



The CARIACO Ocean Time-Series: insights from integrated measurements

- Ship and autonomous measurements help ID gaps in knowledge

**Know what you
want to measure,
then pick your
platform/sensor**



Integrated Observing Strategies: where are we now, and where are we going?

- In CARIACO, the marriage of ship and autonomous observations has enabled us to capture and understand changes in ecosystem structure and biogeochemistry: implications for C fluxes
- **Impossible without long-term, high-res, sustained time-series measurements**
- Adequate observations require knowing what needs to be measured; this will drive the choice of platform(s).