Part II: Particle dynamics in the Eastern Mediterranean Sea

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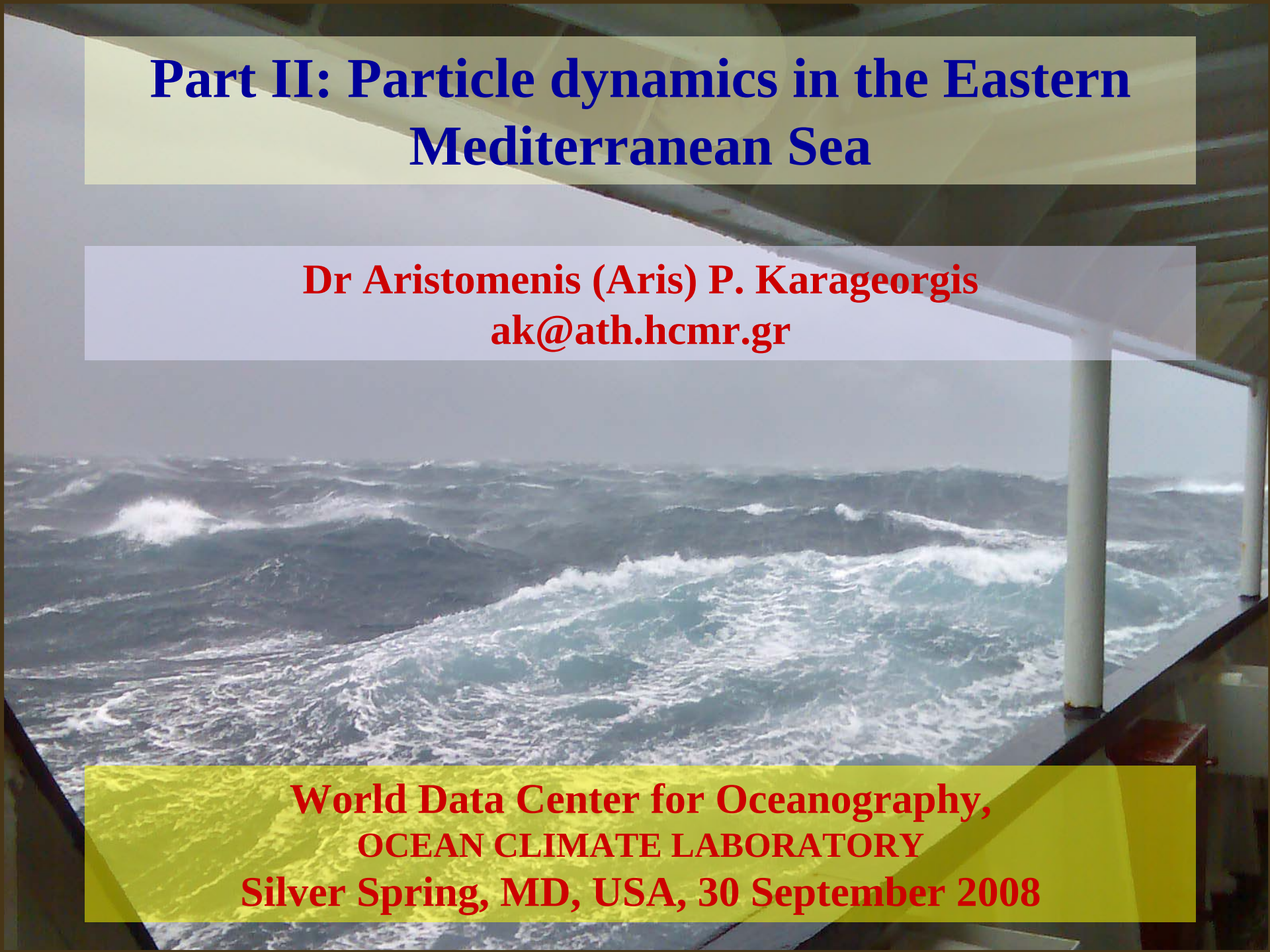


World Data Center for Oceanography,
OCEAN CLIMATE LABORATORY
Silver Spring, MD, USA, 30 September 2008

Origin of marine particles

- External
  - Aeolian
  - Riverine

Organic and inorganic

- Internal
  - Primary production (phytoplankton)
  - Secondary production (zooplankton)
  - Fecal pellets

organic

  - Hydrothermal
  - Sediment resuspension

Inorganic

Organic and inorganic

Why do we study suspended particles?

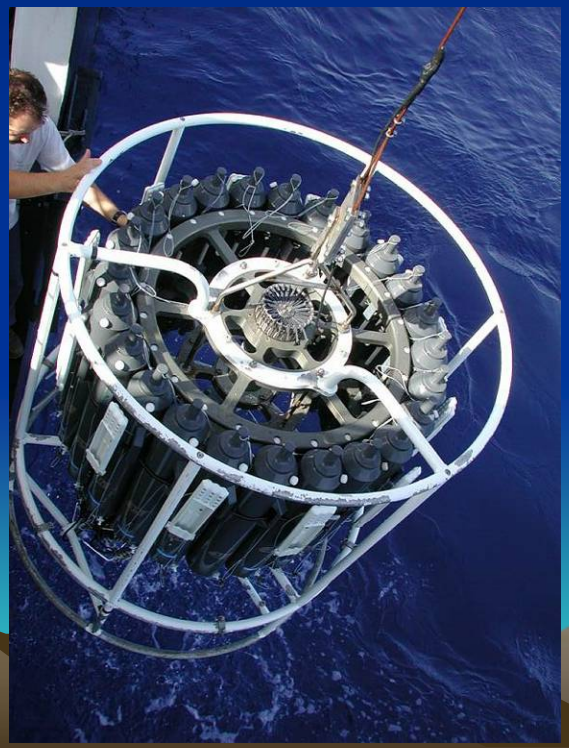
- Origin and fate of materials in the ocean
- Tracers of productivity
- Tracers of circulation
- Pollution and eutrophication
- Carbon budget
- Coastal-deep sea interactions

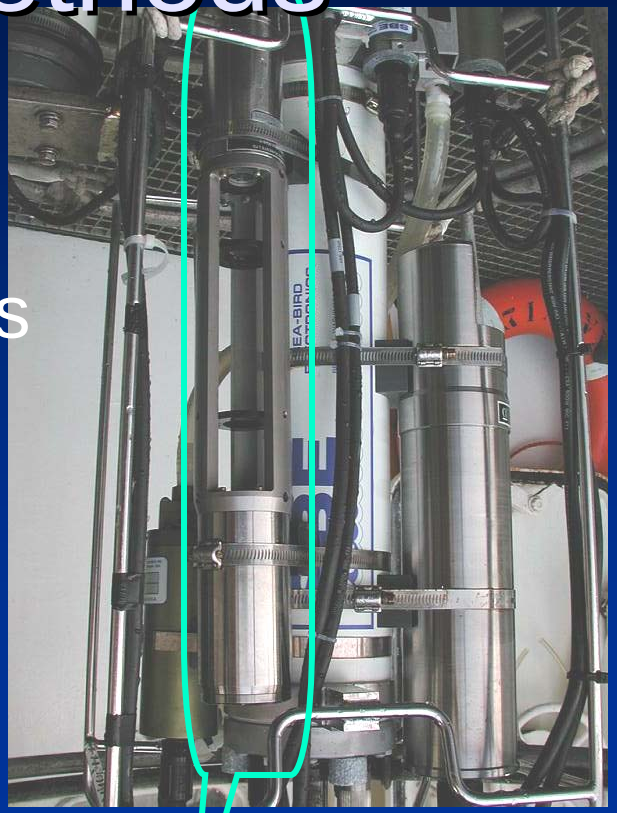
Study area

R/V AEGAEO

Methods

- Optical sensors
  - Transmissometers
  - Fluorometers



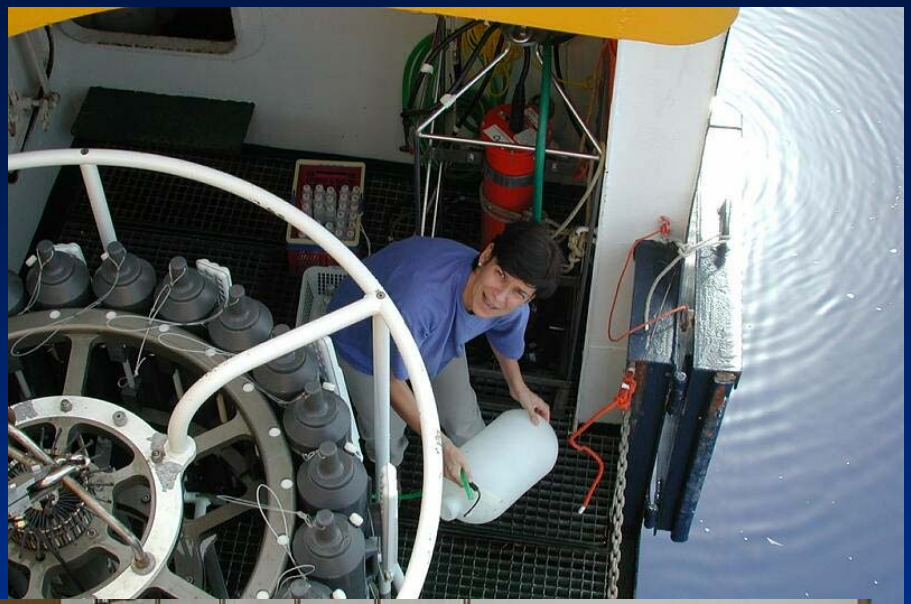


fluorometer

Chelsea 25-cm path-length
Transmissometer, 660 nm (red)

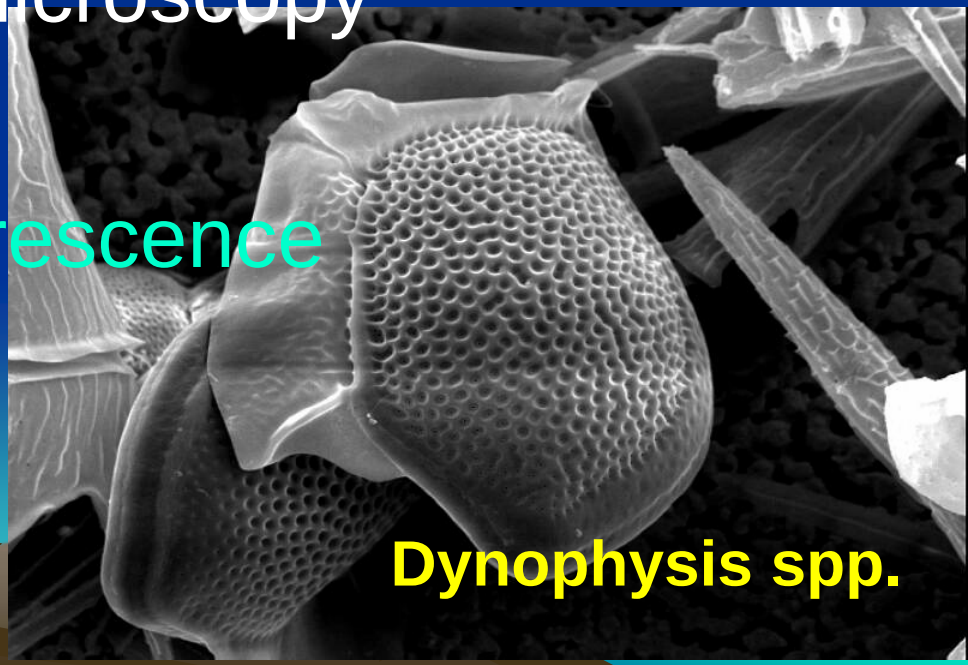
Methods

- In situ water filtration



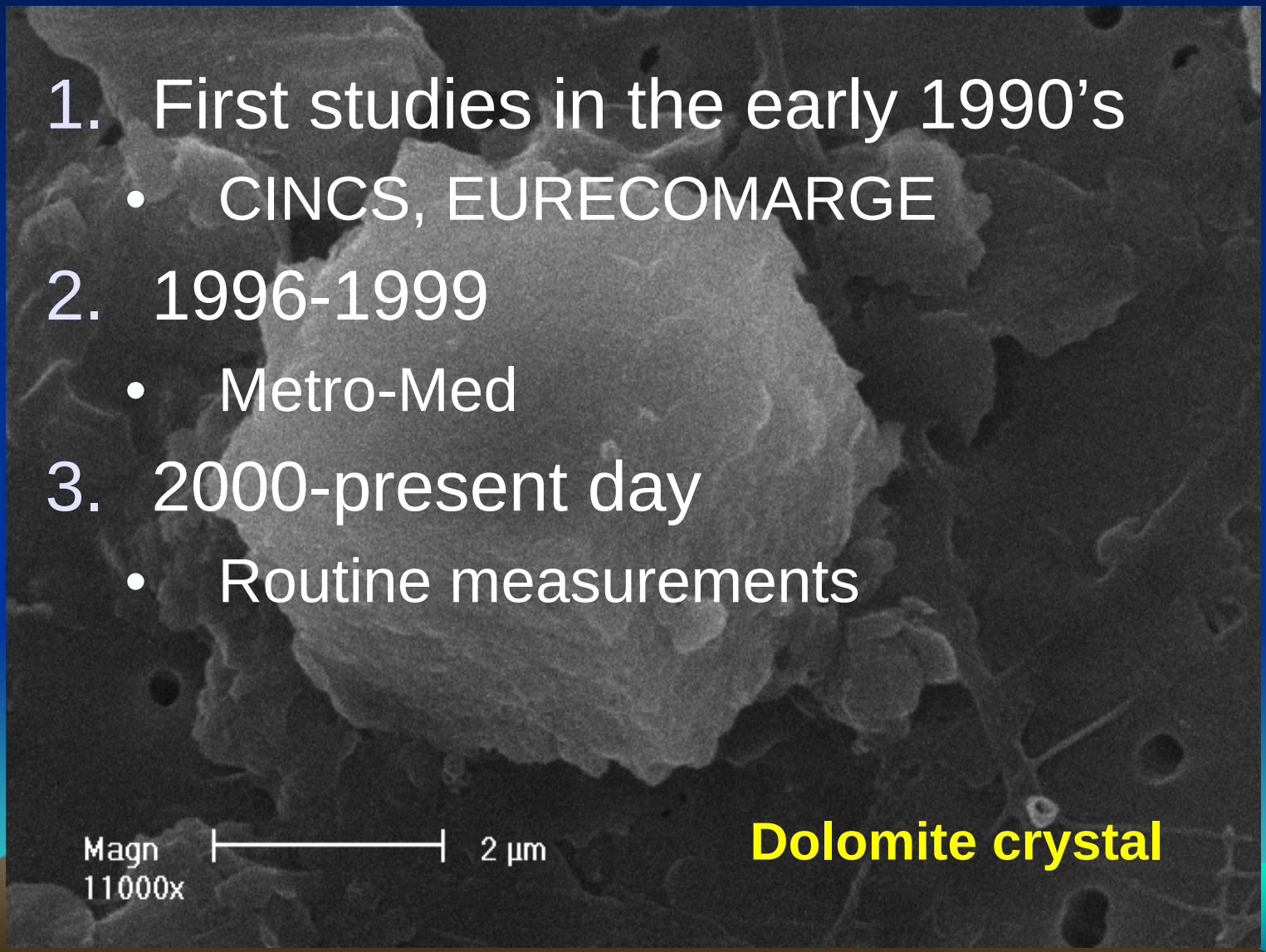
Methods

- Laboratory analyses
  - Particulate matter concentration
  - Particulate organic carbon concentration
- Scanning electron microscopy
- X-ray Diffraction
- Thin-film X-ray Fluorescence



PM dynamics studies

1. First studies in the early 1990's
   - CINCS, EURECOMARGE
2. 1996-1999
   - Metro-Med
3. 2000-present day
   - Routine measurements



Dolomite crystal

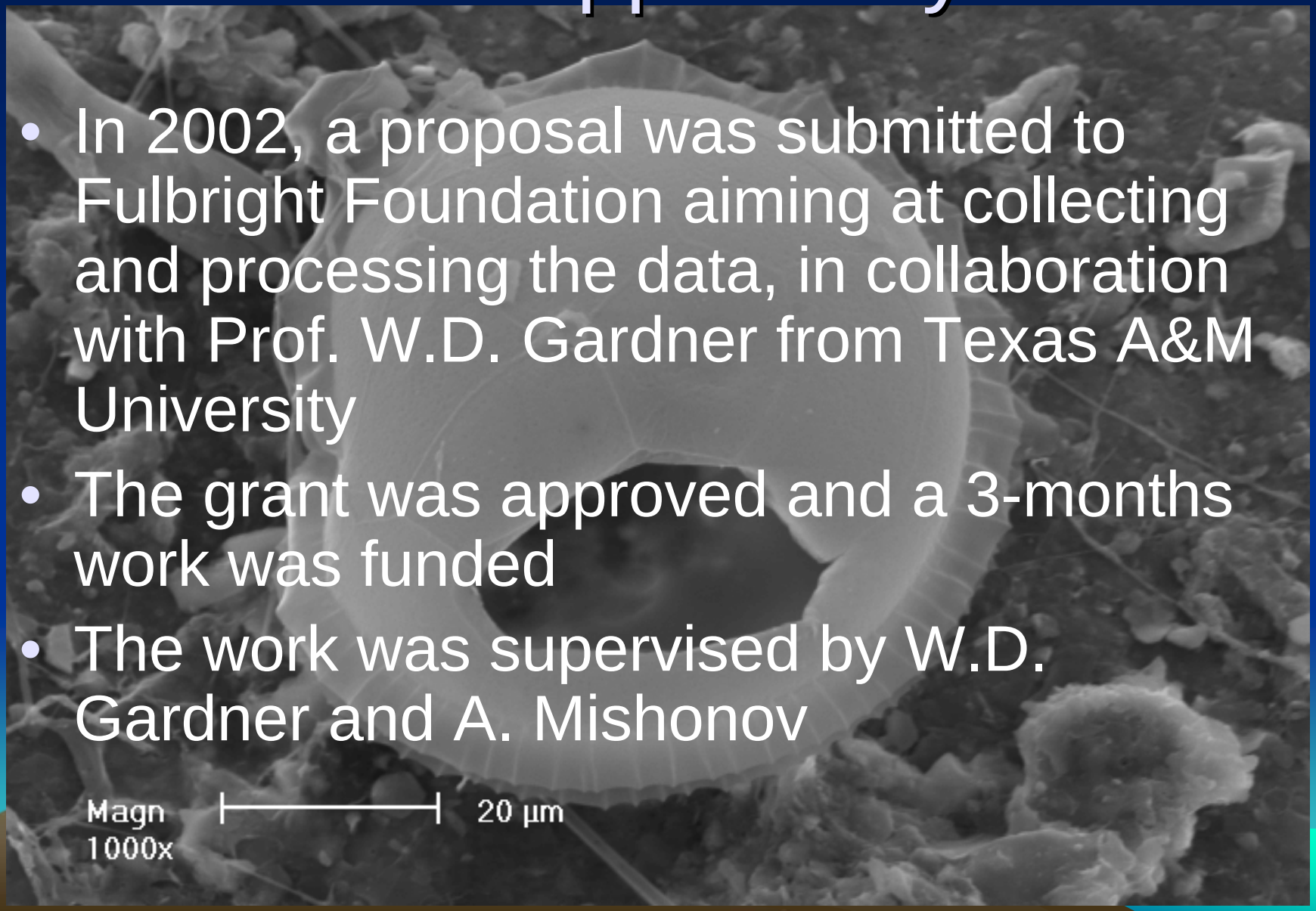
Status at the beginning of 2000

- Particulate matter distribution and their properties were random in time and space
- Many light transmission profiles had been collected, but they were virtually unexplored
- LT data were accompanied by standard CTD measurements
- LT data were collected without proper care of the instruments used

The idea

- The idea was to collect all available LT measurements, from all sensors
- And to create a data base
- Including bottle data, wherever available (PMC and POC)

The opportunity



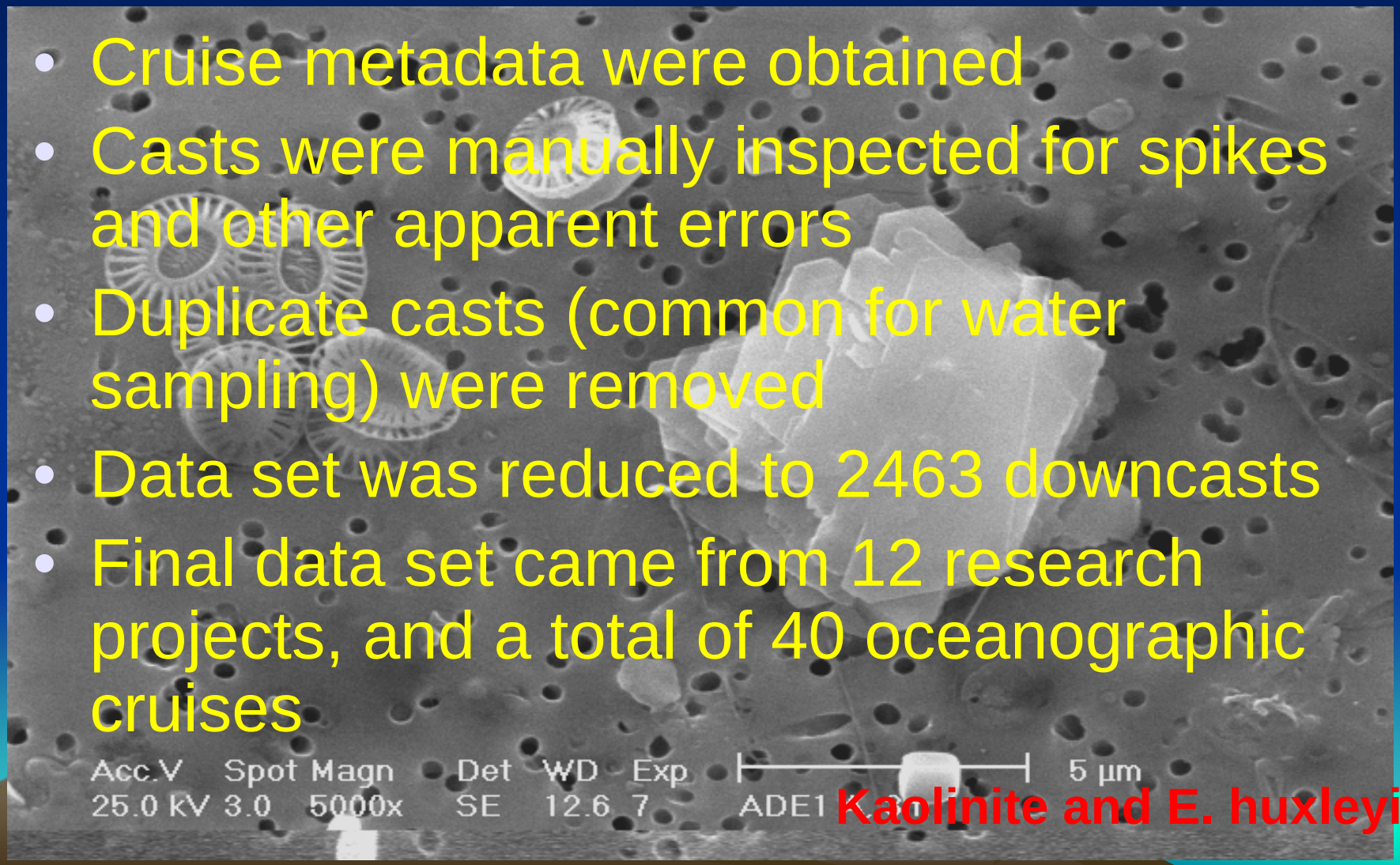
- In 2002, a proposal was submitted to Fulbright Foundation aiming at collecting and processing the data, in collaboration with Prof. W.D. Gardner from Texas A&M University
- The grant was approved and a 3-months work was funded
- The work was supervised by W.D. Gardner and A. Mishonov

Data homogenization

- By definition LT measurements are strictly cruise dependent due to the differences of particle populations prevailing in the water column
- Data collected covered a period of 11 years (1991-2001) – 3193 stations
- Data were inconsistent even within the same cruise
- First task was to put data under the same format and store them in Ocean Data View

Data set quality control

- Cruise metadata were obtained
- Casts were manually inspected for spikes and other apparent errors
- Duplicate casts (common for water sampling) were removed
- Data set was reduced to 2463 downcasts
- Final data set came from 12 research projects, and a total of 40 oceanographic cruises

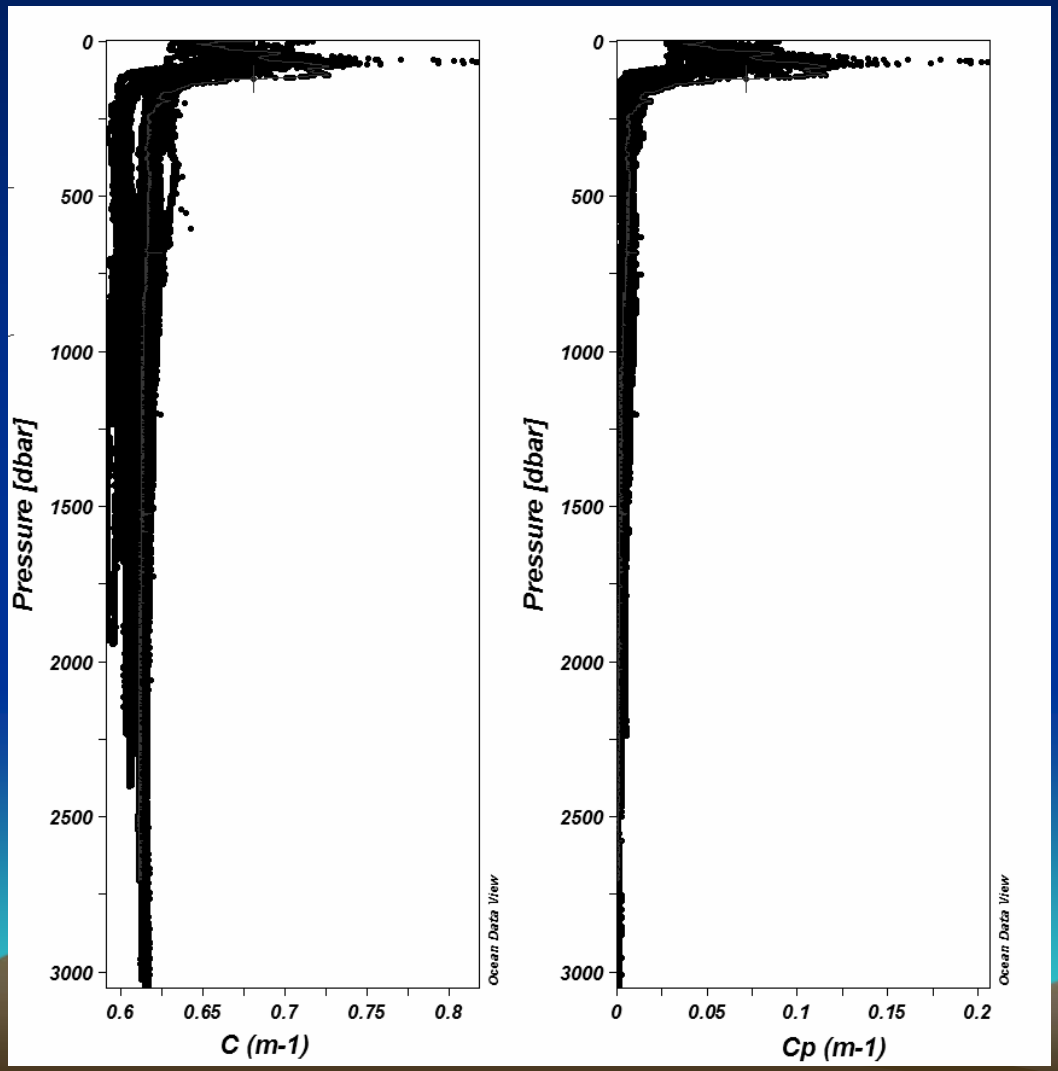


Conversions

- LT readings were converted to beam attenuation coefficient c, which is independent of the transmissometer's path-length: $c = -1/L * \ln(LT/100)$
- $c = c_w + c_p + c_{cdom}$
- Beam c_p was the parameter studied, i.e. light attenuation due to particles

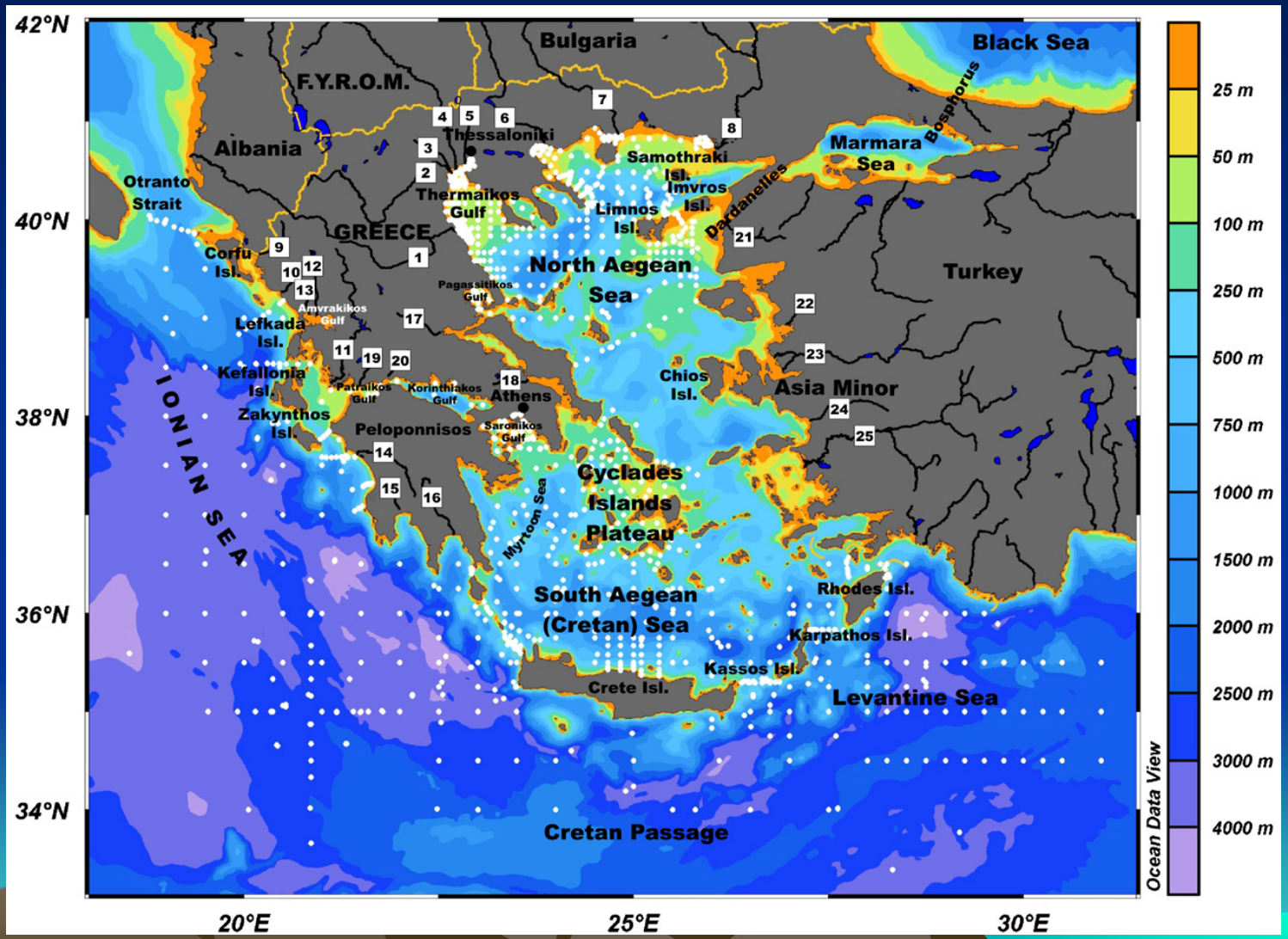
Assumption: During a single cruise the minimum beam C recorded corresponds to C_w

Profile shift

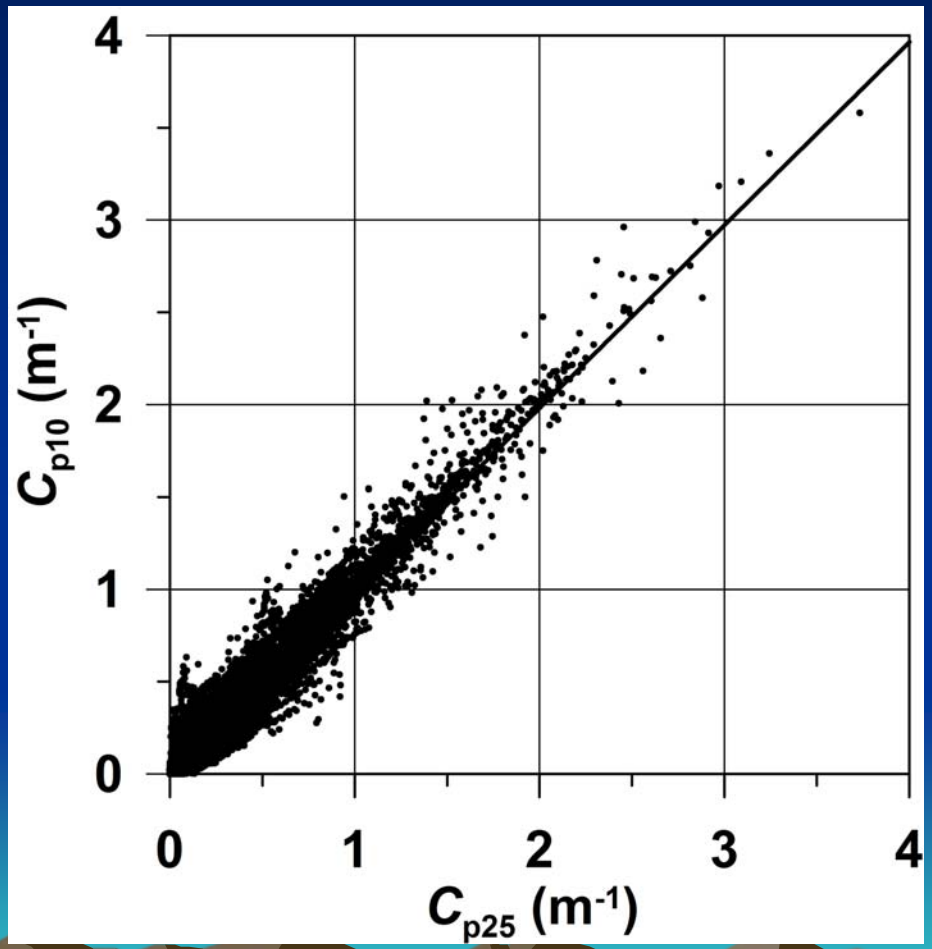


Left: total beam attenuation coefficient *c* from Chelsea transmissometer and right: beam attenuation due to particles only, c_P from the same instrument after shift and correction of the profiles

Data set spatial coverage

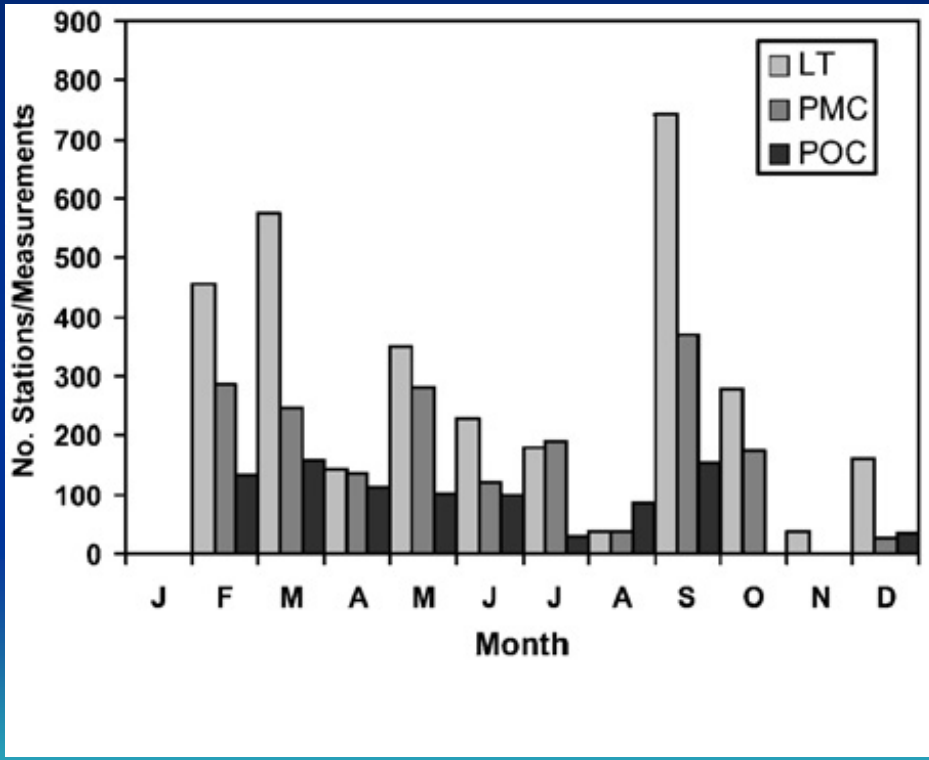


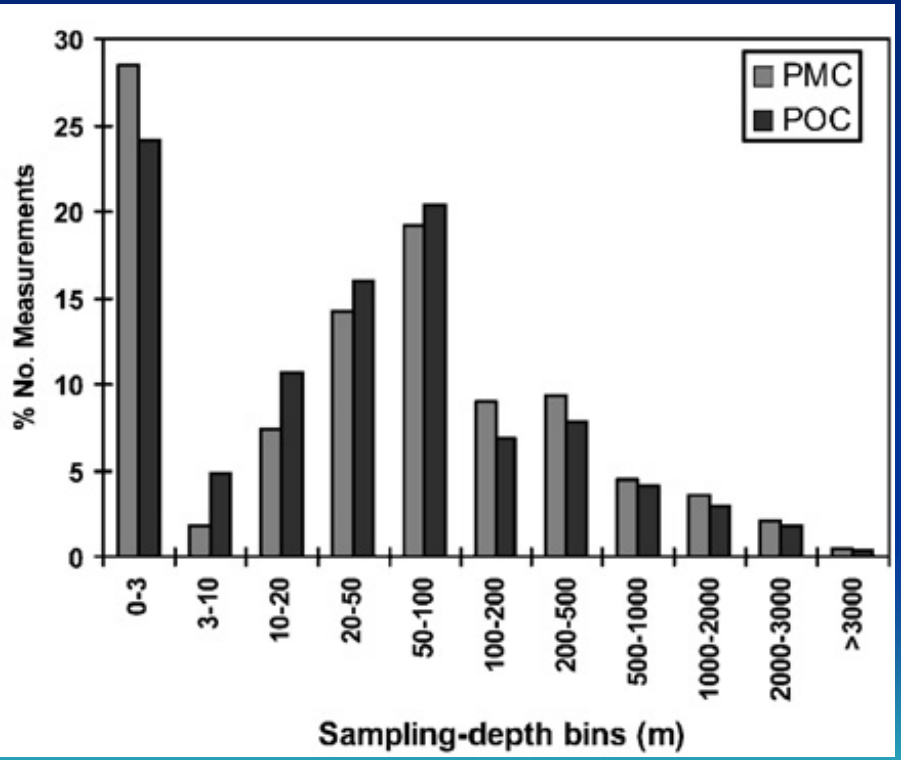
Transmissometers



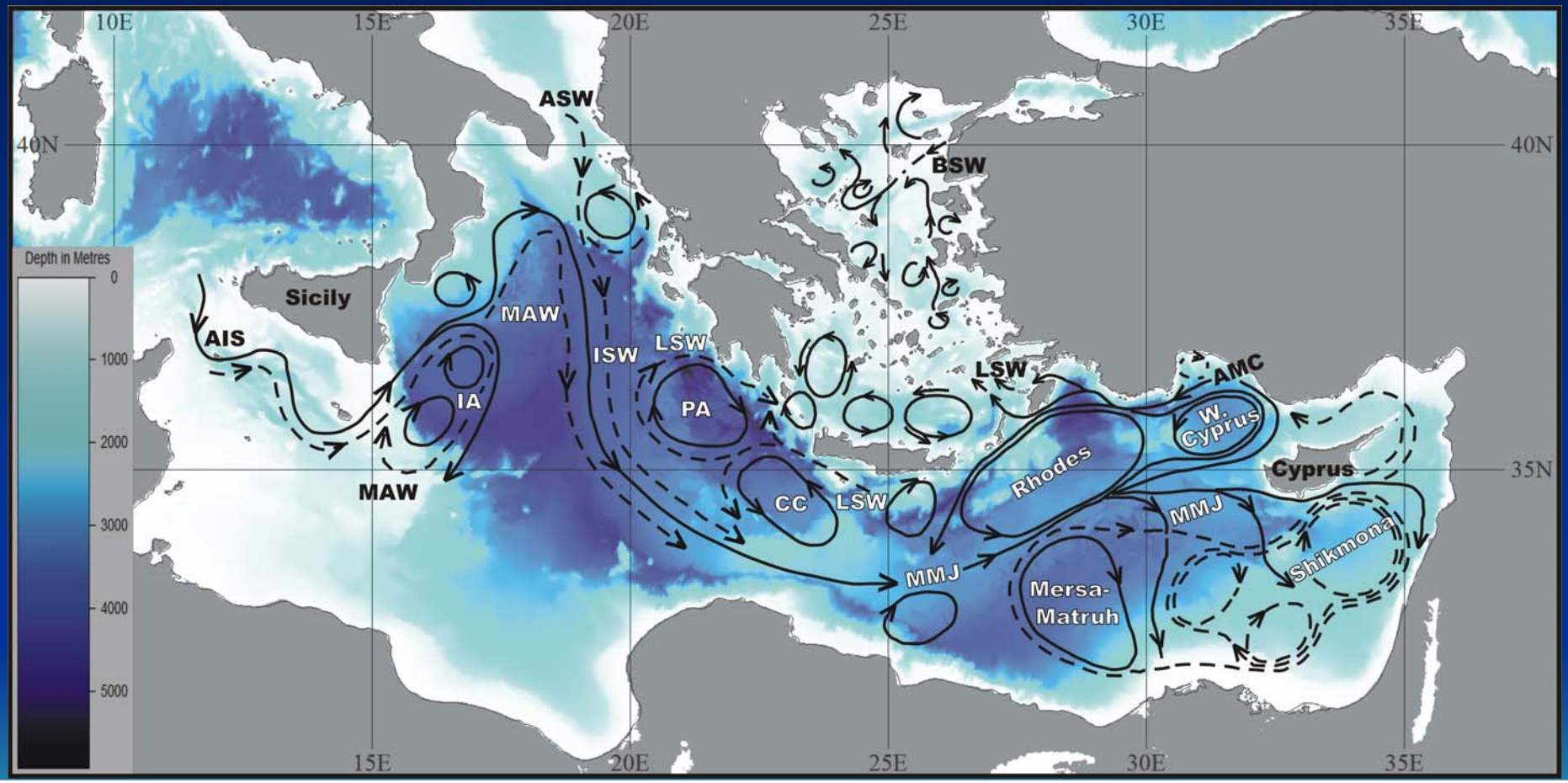
SeaTech 10-cm path-length and Chelsea 25-cm path-length transmissometers, both emitting in the red part of the spectrum showed marked relationship (R^2 = 0.918, n = 525335)

Sampling frequency distribution



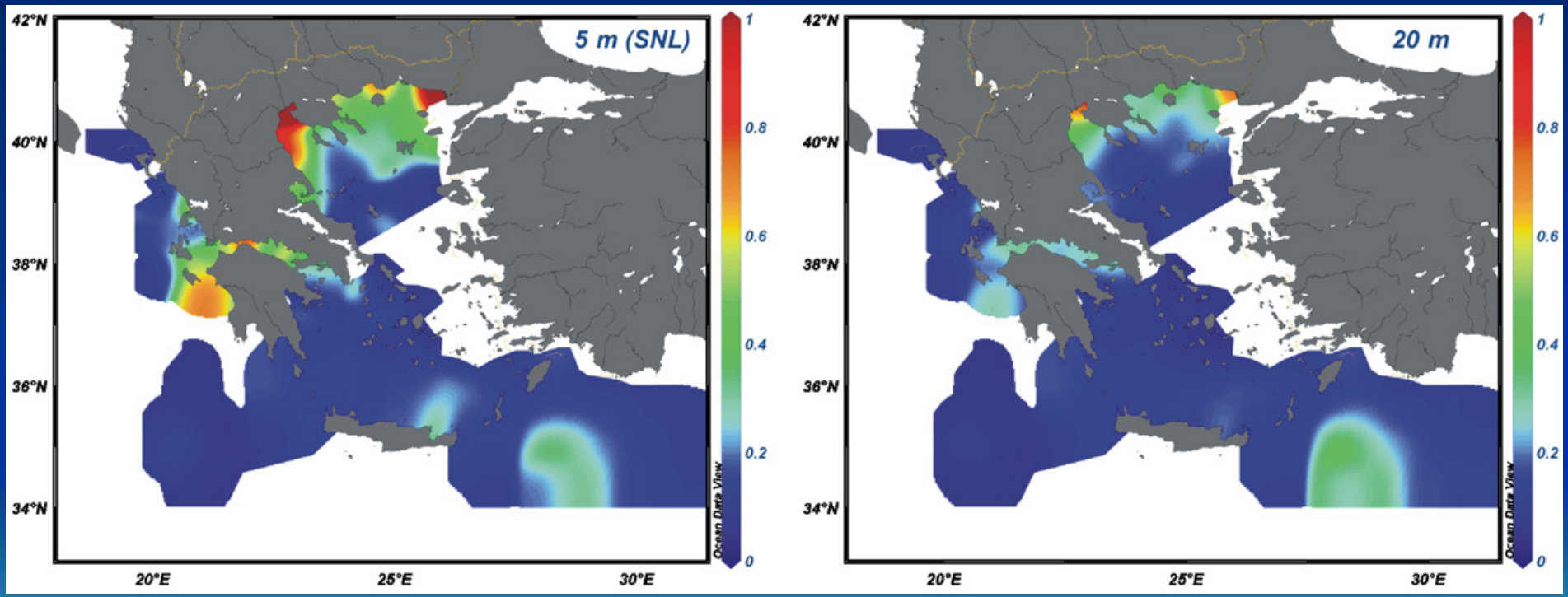


General circulation

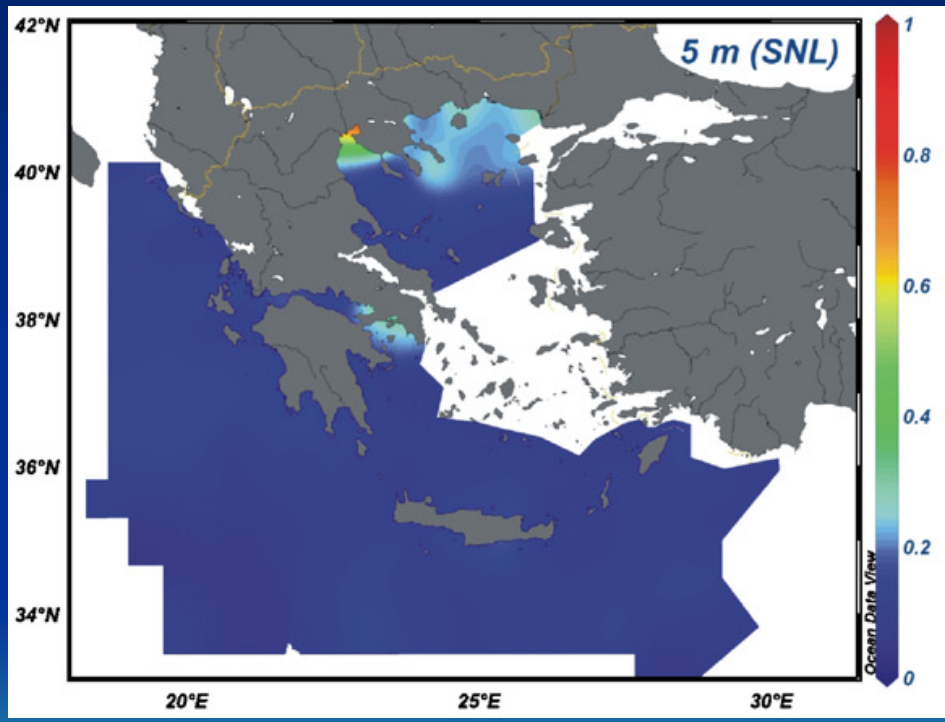


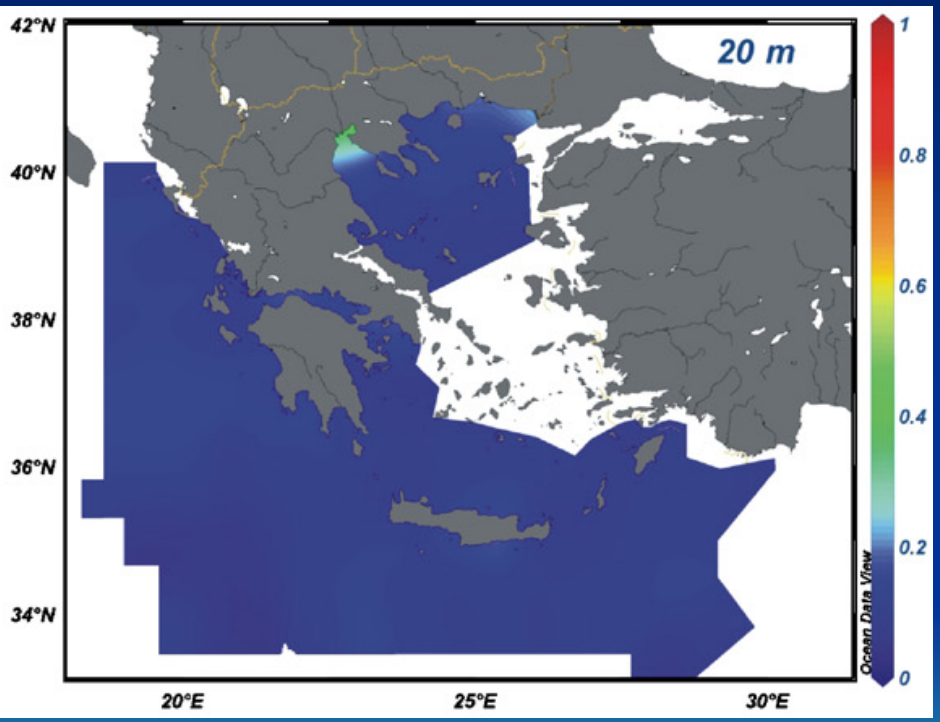
AIS - Atlantic-Ionian Stream, MMJ - Mid-Mediterranean Jet, AMC - Asia Minor Current, MAW - Modified Atlantic Water, ASW - Adriatic Sea Water, LSW - Levantine Surface Water, ISW - Ionian Sea Water, BSW - Black Sea Water, CC - Cretan Cyclone, IA - Ionian Anticyclone, PA - Pelops Anticyclone

Beam C_p during the ‘wet’ period

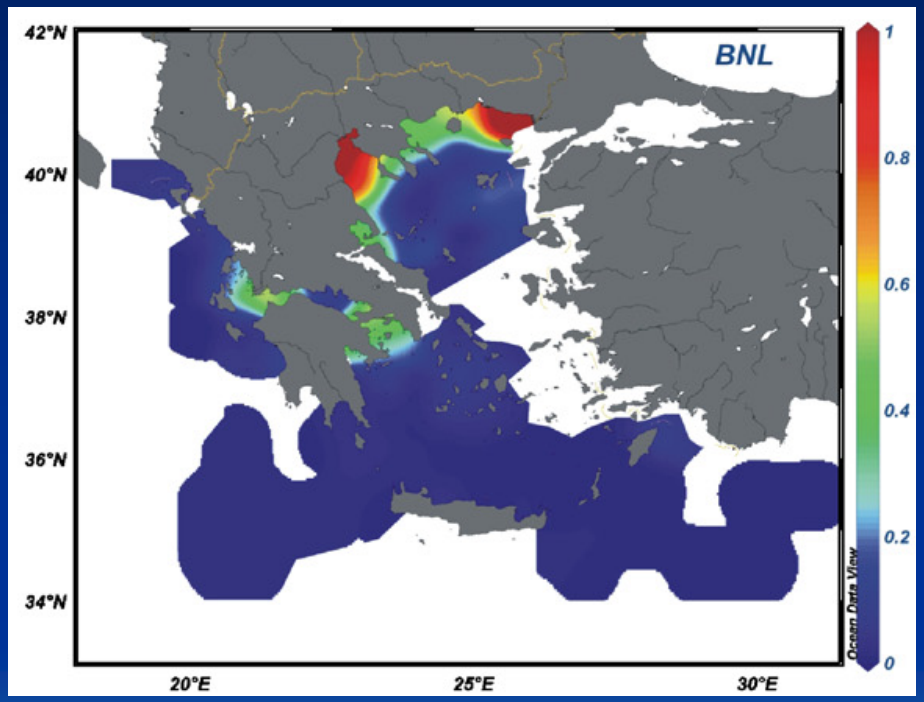


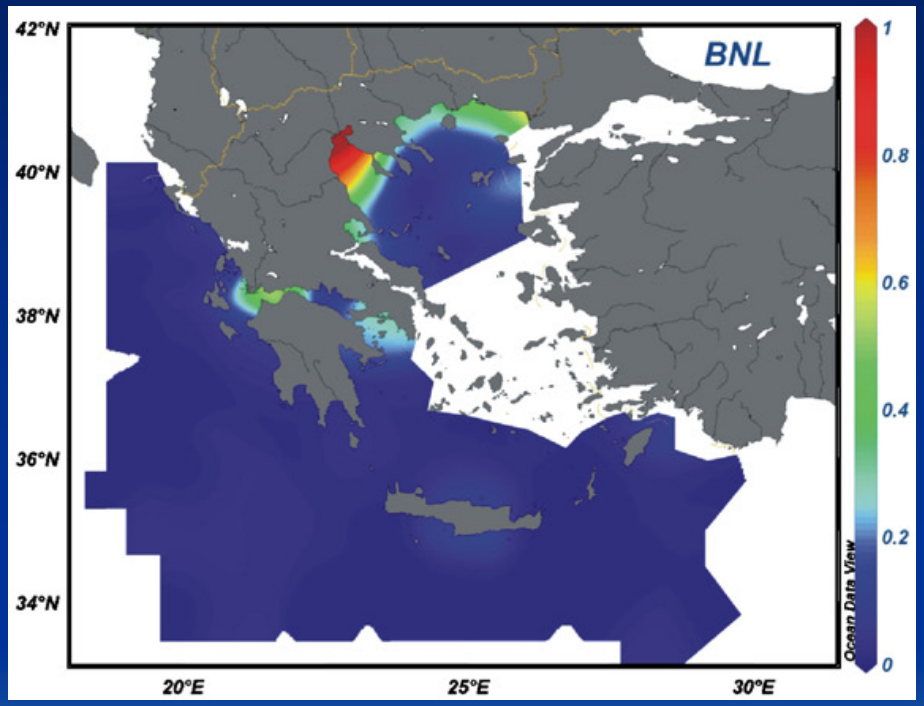
Beam C_p during the ‘dry’ period





Beam C_p near the bottom

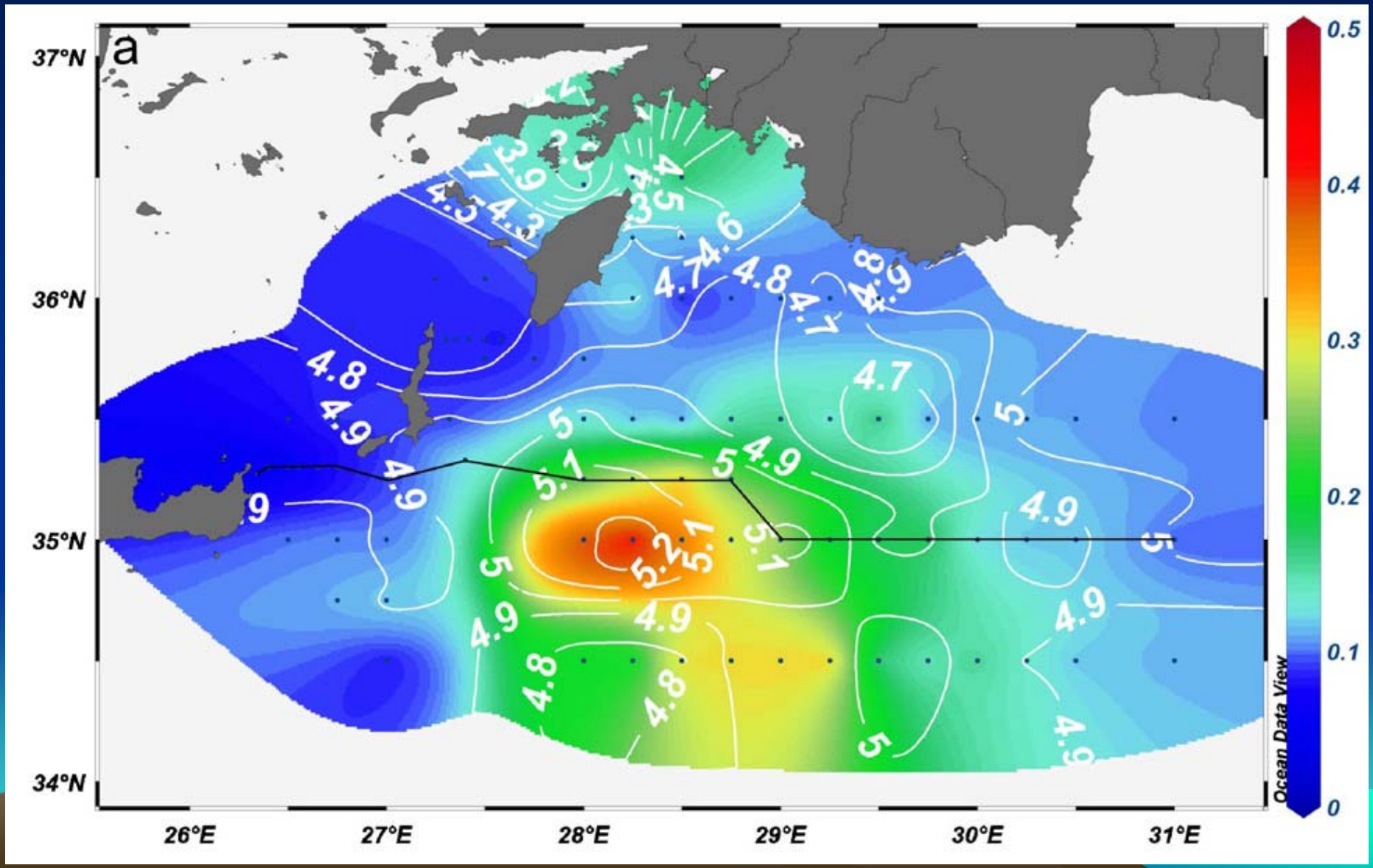




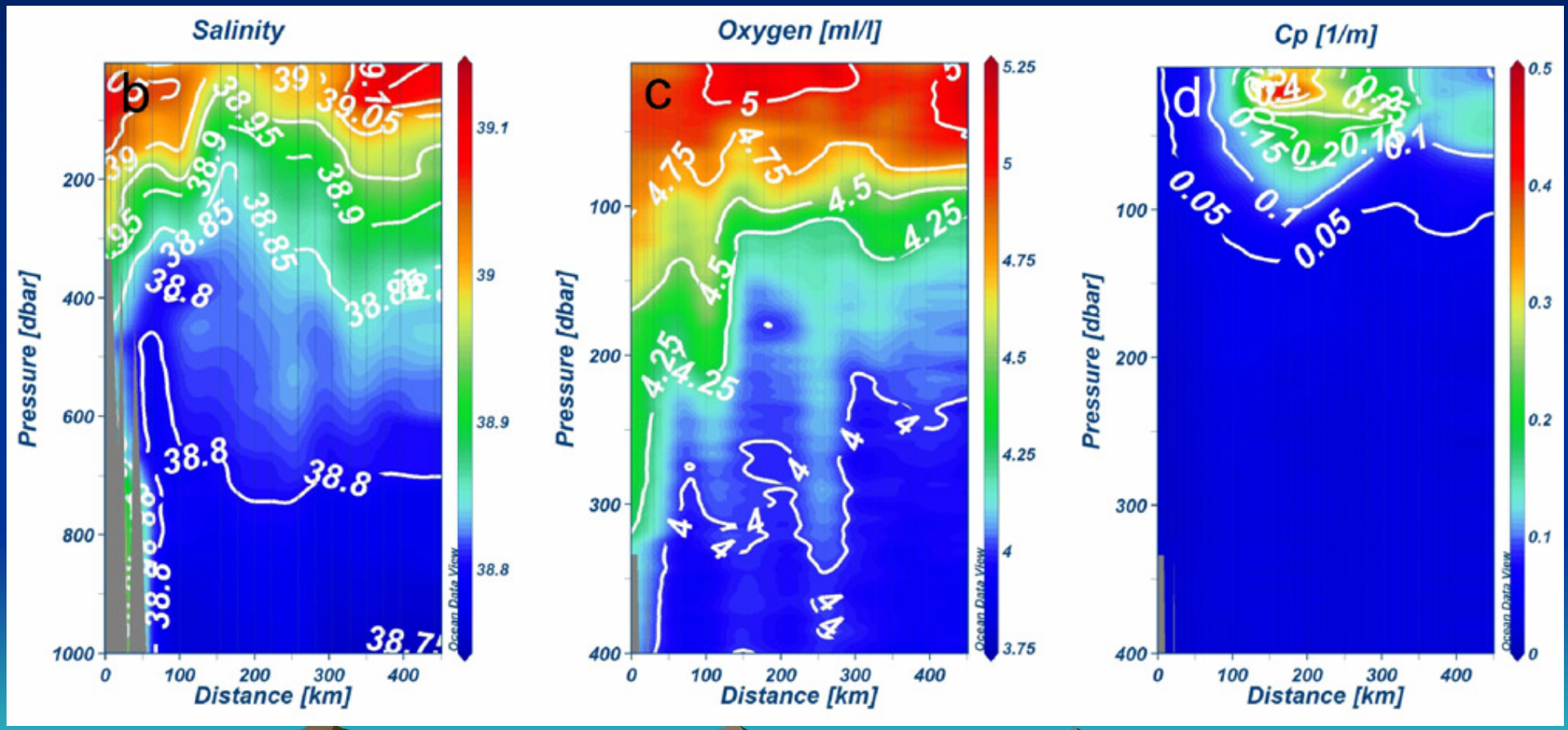
Wet

Dry

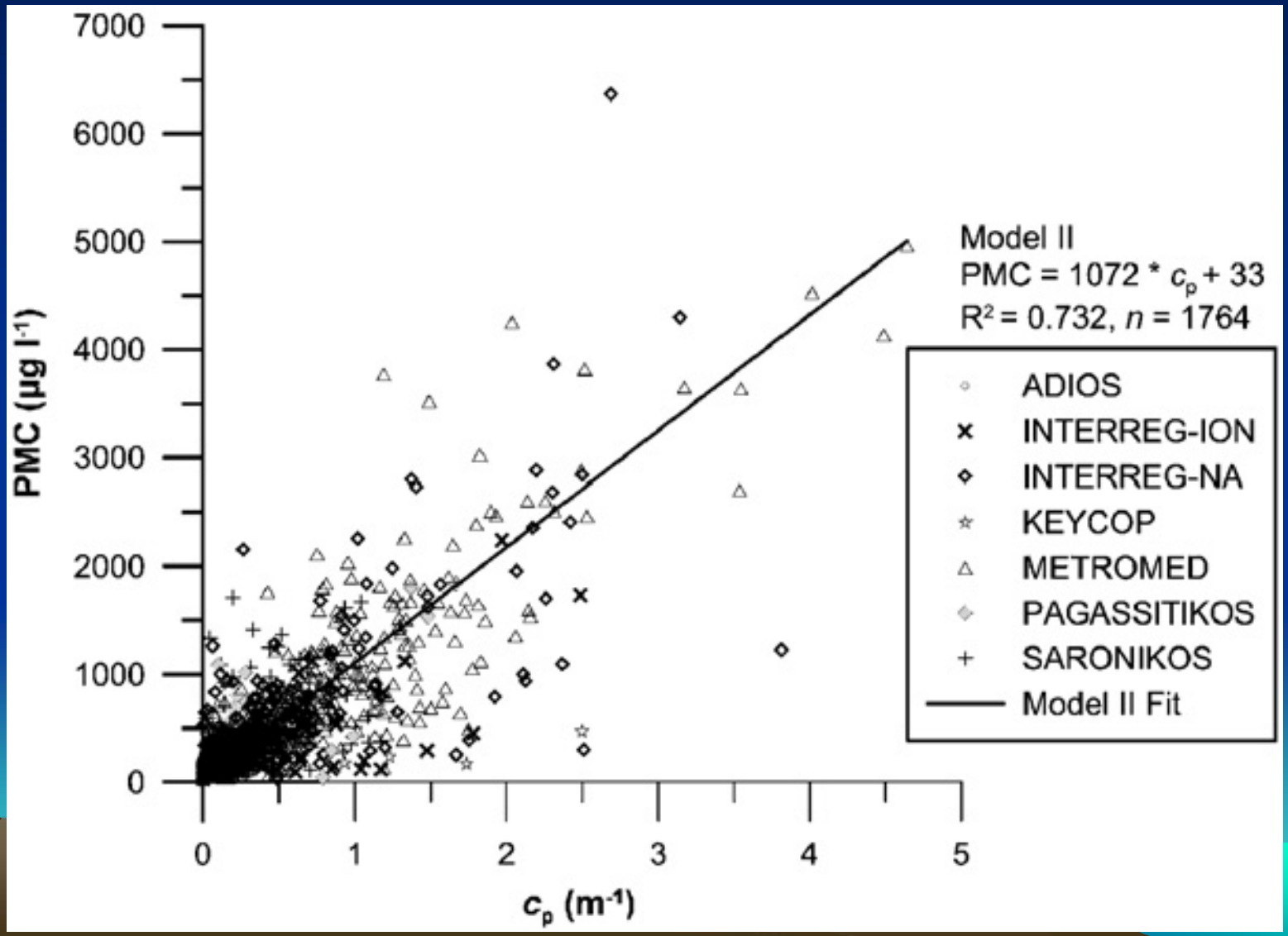
The Rhodes cyclon I



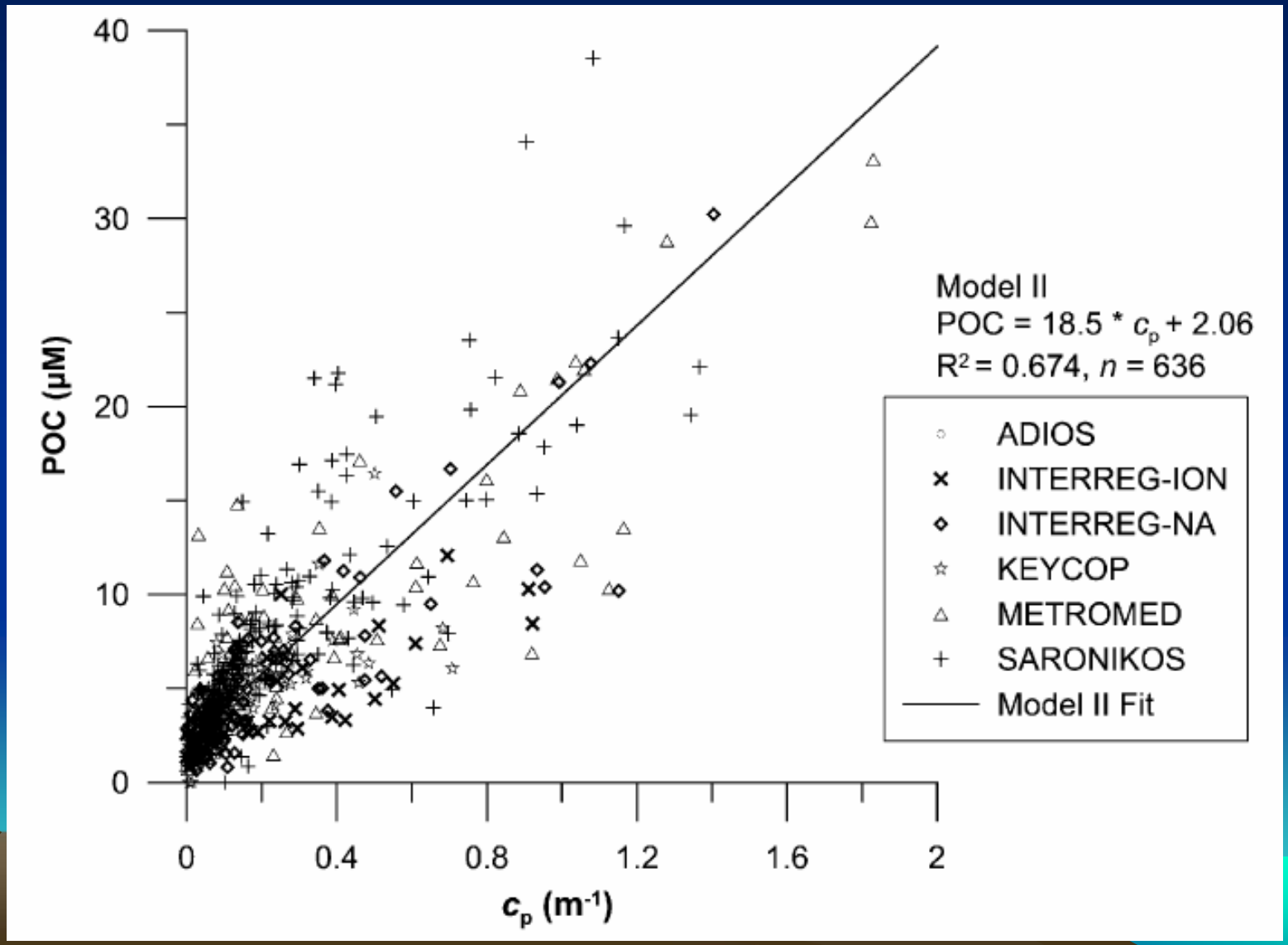
The Rhodes cyclon II



PMC vs C_p regression



POC vs C_p regression



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Particle dynamics in the Eastern Mediterranean Sea: A synthesis based on light transmission, PMC, and POC archives (1991–2001)

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The future

- The data base needs to be updated including all beam c readings obtained from 2001 until present day
- A compilation of LT measurements is underway for the NW Black Sea
- Fluorescence data and chlorophyll-a bottle data are collected and will be analyzed together with satellite images
- Simultaneous measurements in the red and blue parts of the spectrum may provide additional information about PM composition (CDOM)
- An in-situ grain-size laser analyzer (LISST-Deep) will provide information about the behavior of light attenuation vs particle size.

Thank you for the invitation and your attention