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# EuroSTRATAFORM—Po and Apennine Sediment Transport and Accumulation Experiment (PASTA)

## Introduction

The EuroSTRATAFORM Po and Apennine Sediment Transport and Accumulation (PASTA) was a large international experiment conducted in the Adriatic Sea to study processes that transport sediment and form geological strata. These processes also transport nutrients and pollutants, cause shoaling in harbors and coastal waterways, cause coastal erosion, and affect engineering, archeological, and naval activities on and near the seabed. The Adriatic Sea was selected as the study area because it has a well-defined and unusually shaped deposit of modern sediments.

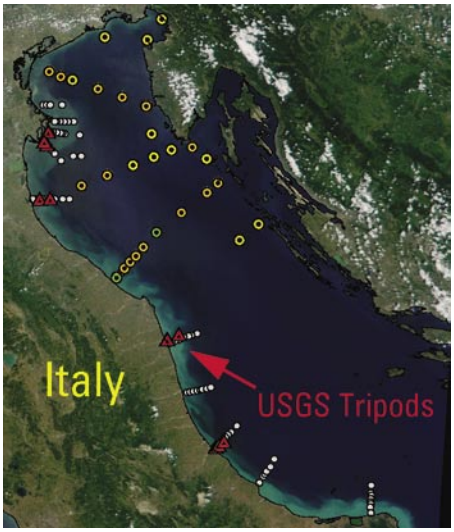


**Figure 1.** Satellite image of the Adriatic Sea showing locations of EuroSTRATAFORM tripods (red triangles) and sampling stations (gray dots), as well as current-meter moorings (yellow, green, and orange circles) of collaborating research programs.

## Adriatic Sea Data Collection, 2002–03

The PASTA experiment was carried out during the winter of 2002–03. A combination of research projects conducted by European and North American scientists produced a set of data ideal for running and evaluating numerical models of waves, ocean circulation, and sediment transport. Italian, Spanish, and North American EuroSTRATAFORM PASTA researchers from 15 institutions (see list below) deployed instrumented tripods and moorings, made water-column measurements, and collected bottom sediment cores to determine characteristics of near-surface sediments and accumulation rates over time scales ranging from weeks to centuries. Collaborating researchers from more than 20 other institutions in Italy, Croatia, Slovenia, and the United States made long-term current measurements, released and tracked more than 100 surface drifters, conducted repeated shipboard water-property surveys, mapped surface currents with radar, conducted airborne salinity measurements, and analyzed satellite images. The combined data set provides an unusually extensive description of coastal ocean circulation and sediment dynamics. PASTA researchers were supported by the U.S. Office of Naval Research and the European Union.

## USGS Sediment-Transport Measurements

The U.S. Geological Survey deployed two tripods at 10-m depth and a third at 20-m depth off the Italian coast, near the town of Civitanova Marche and the mouth of the Chienti River. The data include measurements related to coastal oceanographic properties and sediment-transport dynamics and are being used to test and improve numerical models of circulation and transport of sediment and pollutants. Acoustic Doppler current meters provide profiles of current velocities throughout the water column, and optical and acoustic estimates of suspended sediments were made near the bed. A prototype camera, nicknamed the "poking eyeball" and designed to obtain time-series

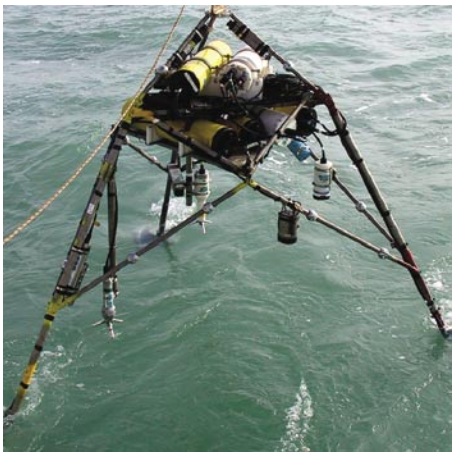

**Figure 2.** Photograph of USGS tripod designed to measure currents and sediment transport being deployed at the 10-m Chienti River site.

photographs of bottom sediment texture, was deployed with a rotating sonar that recorded changes in size and orientation of ripples at the sandy 10-m site. The data from these instruments provided direct measurements of the waves and currents that initiate sediment transport, quantitative estimates of sediment concentrations and transport rates, and information about resulting changes in seabed conditions. In addition to providing new insights into sediment transport processes at these locations, the data can be used to critically evaluate numerical models of sediment transport.

## Testing Models in the Adriatic Sea

The Adriatic is an excellent location to test oceanographic models because it is a largely enclosed sea, influenced mostly by local weather and river input. Three numerical models were used to simulate (1) wind and weather, (2) waves, (3) ocean circulation, and (4) erosion, transport, and deposition of sediment. Winds and heat content in the air were computed using the Local Area Meteorological Model Italia (LAMI). The LAMI results, provided by the Italian Ufficio Generale per la

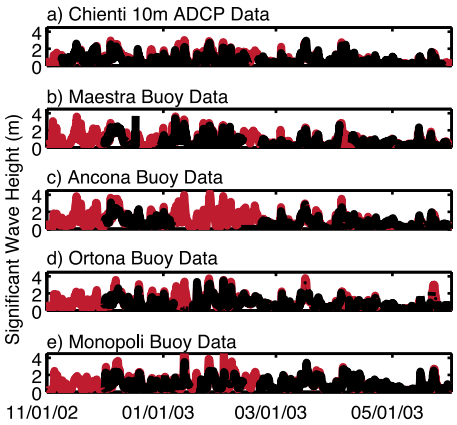


**Figure 3.** Time series comparison of modeled (red) and measured (black) time series of wave heights at several locations in the western Adriatic. (Italian buoy data provided by Dr. L. Cavaleri.)

Meteorologia, provided winds and atmospheric parameters that were used to drive the wave model SWAN (Simulation of WAves in the Nearshore) and the Regional Ocean Modeling System (ROMS). Waves are particularly important for suspended sediment from shallow regions, and favorable comparison of wave-model results with measurements made by EuroSTRATAFORM instrument and Italian buoys suggests that the meteorological and wave models work well (Figure 3.)

Currents in the Adriatic are generated by winds, tidal forces, river runoff, and heating or cooling. The Po River and cold Bora winds that blow from the northeast in winter generate a strong and persistent current that flows southward along the coast (Figure 4.) Sediment delivered by the Po River and smaller rivers draining the Apennine Mountains moves south in this current, as does material resuspended by waves in shallow water. Over the last 5,000 years or so, this material has accumulated in a long, narrow deposit just off the shelf. A goal of the project is to identify and simulate the processes that have produced this deposit.

The USGS is using the sediment-transport capabilities recently added to ROMS for these simulations. The model output is being evaluated against field measurements of processes (waves, currents, suspended-sediment concentrations) and geologic interpretations of the product (the location and composition of the deposit). Model-to-data comparisons will lead to improved understanding of coastal sediment-transport processes, improvements in model algorithms and, ultimately, the ability to make accurate, quantitative predictions of the transport and fate of sediments in coastal environments.

## Participating Institutions

The following institutions participated in EuroSTRATAFORM or collaborated with EuroSTRATAFORM investigators to study the Adriatic in 2002–03.

### EuroSTRATAFORM

Bedford Institute of Oceanography (Canada), Boston College (USA), CNR-ISMAR Venice (Italy), CNR-ISMAR Ancona (Italy), CNR-ISMAR Bologna (Italy), Dalhousie University (Canada), Institut de Ciències del Mar (CMIMA-CSIC) Barcelona (Spain), Oregon State University (USA), University of California Santa Cruz (USA), University of Laval (Canada), University of Virginia (USA), University of Washington (USA), URS Corporation, Tallahassee (USA), Virginia Institute of Marine Science (USA), Woods Hole Oceanographic Institution (USA).

### Collaborators

Dipartimento per i Servizi Tecnici Nazionali (DSTN), Rome (Italy), Hydrographic Institute of Croatia (Croatia), Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS; Italy),

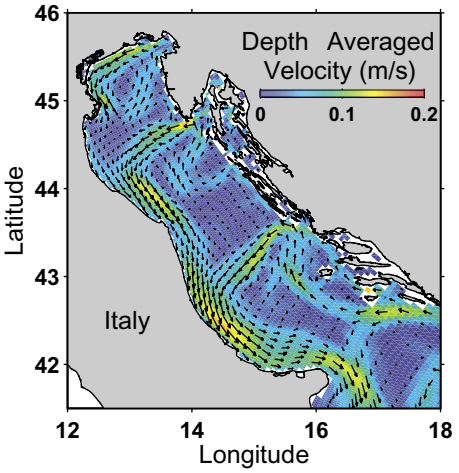


**Figure 4.** Modeled mean depth-averaged flow, November 2002–May 2003

U.S. Naval Research Laboratory, Stennis Space Center (USA), U.S. Naval Research Laboratory, Monterey (USA), National Institute of Biology (Slovenia), North Atlantic Treaty Organisation (NATO) Undersea Research Centre (Italy), Ruder Boskovic Institute (Croatia), Scripps Institution of Oceanography (USA), University of Ancona (Italy), University of Hawaii (USA), University of Miami (USA), University of Washington (USA), University of Zagreb (Croatia).

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