HF radar “Dardanos”: measuring the outflow of the Black Sea in the Aegean

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Location – Premises - Infrastructure
The Department of Marine Sciences:

- Covers all the disciplines of the Marine Sciences
- Is the single University Department in Greece offering B.Sc. Degree in Marine Sciences.
- Offers M.Sc. Degree in Coastal Zone Management
- Offers Ph.D. degrees in oceanography and related sciences

Still: a “poor” University Department of a bankrupted country
Our immediate vicinity and area of interest:
The North Aegean Sea

The North Aegean Sea: area of first inflow of Black Sea Waters into the Mediterranean

The Black Sea:
Dilution basin, mesotrophic environment

The Aegean Sea (and the Med):
Concentration basin, oligotrophic environment

Black Sea Waters outflow into the Mediterranean forms a surface layer that:
• hinders dense-water formation and
• Fertilizes the North Aegean
Since 2004 that we joined the University of the Aegean, we chose to seek low-cost solutions for collecting large amounts of information.

Concentrated on:
- Lagrangian measurements
- Coastal HF radars

Concentrating on the Dardanelles role as a potential point-source of pollution, we got two HF radar sites funded (…), one for the UAegean and one for the Hellenic Centre for Marine Research.
Two parallel calls for bid took place, each for a “HF radar measuring the radial current component….”, by UAegean and HCMR.

Helzel Messtechnik GmbH was the sole bidder.

We purchased a WERA HF radar (two sites), operating at 13.4 MHz. Each receiver has only 4 antennas (Direction Finding technique).

Communication was via GSM in the southern site (HCMR), satellite internet at the northern site (UAegean).

Operation has been continuous from November 2009 until June 2011, intermittent since then due to various causes.

The HF radar has been used by the UAegean in the projects: MedEx (EU project, nationally-funded), TOSCA (EU-funded), AegeanMarTech (Greek-funded)
The “Dardanos” HF radar system:
Quality Control and Gap-Filling procedures

- The standard WERA quality-control software was used at a first level.
- Temporal filtering and despiking followed.
- DINEOF analysis provided further spatio-temporal low-pass filtering as well as data gap-filling and reconstruction.
The “Dardanos” HF radar system: Validation: Comparing radial velocities

Used our-own design and construction CODE-type drifters
The “Dardanos” HF radar system:
Validation: Comparing real and synthetic trajectories

Used our-own design and construction CODE-type drifters
The “Dardanos” HF radar system:
Use with oil-spill models and floats

Used our-own design and construction CODE-type drifters and COSTA oil-spill drifters
Assess its use for prevention of coastal oil-spill pollution and SAR aid
The “Dardanos” HF radar system: Use with oil-spill models and floats
Assess its use for prevention of coastal oil-spill pollution and SAR aid
We used a drifting platform to measure the near-surface shear within the top 2-m of the water column and assess the windage of typical CODE drifters.

Combination of a
- UAegean drifter in a subsurface configuration and
- Nortek Aquadopp HR current profiler
The “Dardanos” HF radar system: Developing a drifter specifically-designed for HF radars

Based on the results of the above-mentioned platform, we developed STRING, a CODE-type drifter specially designed for validation of HF radars:
Proceeding towards our aim of quantifying the BSW inflow into the Aegean, we used the slab-layer model assumption to estimate mixed-layer depth:
The “Dardanos” HF radar system: Estimating MLD

Time-series of the spatial mean of MLD in the coverage region for 2010.
The “Dardanos” HF radar system: Estimating MLD

Comparison of HF radar-derived MLD to CTD-derived MLD.

![Graph comparing HF radar-derived MLD to CTD-derived MLD](image-url)
Using both MLD, surface velocities and the slab-layer assumption, we can estimate volume fluxes.
The “Dardanos” HF radar system:
Conclusions / Discussion

• The WERA HF radar “Dardanos” was installed in eastern Lemnos mainly to monitor the inflow of BSW into the Aegean
• Our gradual buildup of expertise involved not only HF radar data processing and analysis, but Lagrangian methodologies and instrumentation as well
• It is possible to estimate MLD using HF radar data
• Thus, for the first time, we can get information along the vertical axis
• The combination of HF radar-derived velocities and MLD provides volume flux estimates..

• Currently, the system is out of order for need of funds.
• We seek closer collaboration with HCMR for use of operational oceanography funds for reviving the system
• We seek partnership with HF radar experts to improve our related knowhow, as HF radar for us is the means, not the target.