Dose rate assessment of ^{137}Cs to mussels and pelagic fish from the combined use of field measurements, satellite data and the ERICA Assessment Tool

Georgia Mavrokefalou[1,2], Maria Sotiropoulou[1]

[1] *Environmental Radioactivity Laboratory, Institute of Nuclear and Radiological Sciences and Technology, Energy and Safety, NCSR "Demokritos", Patr. Gregoriou E' & 27, Neapoleos str., PO Box 60037, Postal Code GR 153 41, Agia Paraskevi, Athens, Greece (gmavrokefalou@ipta.demokritos.gr, msotirop@ipta.demokritos.gr)*
[2] *Department of Nuclear and Elementary Particle Physics, School of Physics, Faculty of Sciences, Aristotle University of Thessaloniki, University Campus, Postal Code GR 541 24, Thessaloniki, Greece*

Introduction

- ^{137}Cs → indicator of radioactive pollution in the marine environment
  - Conservative behavior in seawater → Mainly soluble form, controlled by seawater currents
- MODIS → Moderate Resolution Imaging Spectrometer, NASA→ onboard AQUA/TERRA satellites → temperature and ocean color data
- <u>Scopes of the study</u>
  - Potential relation with physicogeochemical parameters in marine environment → Investigation of the relation of ^{137}Cs in seawater with MODIS Sea Surface Temperature (SST) in the Gulf of Corinth → Creation of a model equation
  - Validation of the model
  - Calculation of the radiological dose rate to marine organisms through (pelagic fish and mussels) the application of the estimated ^{137}Cs activity concentration in seawater
  - Creation of a comprehensive and innovative system for radiological risk assessment in the area of Gulf of Corinth

Materials and Methods

- Study Area
  - Gulf of Corinth

- Statistical Analysis
  - Dependent value: ^{137}Cs activity concentration in seawater (Bq/m^3)
  - Independent value: MODIS SST (^oC)
  - 17 measurements → Time period: 2004-2005

- Model Validation
  - Measured vs Estimated ^{137}Cs in seawater
  - 8 measurements → Time period: September and November 2018

- Dose Rate calculations for marine organisms
  - ERICA Tool (v. 1.3.1.51)
  - Studied organisms: pelagic fish and mussels
  - Dose rate calculations (μGy/y) based on estimated ^{137}Cs activity concentrations

# Results

- Linear model
- Model equation:
  - $^{137}Cs = -3.52 + 0.29 \times SST$ (1)
- ^{137}Cs activity concentration estimations (2)→ follow the trends of the field measurements
- Measured vs Estimated (3)
- Relative absolute difference = 9%
- Measured and Estimated and ^{137}Cs activity concentration range: 2.0 to 3.8 Bq/m^3

1)

2)

3)
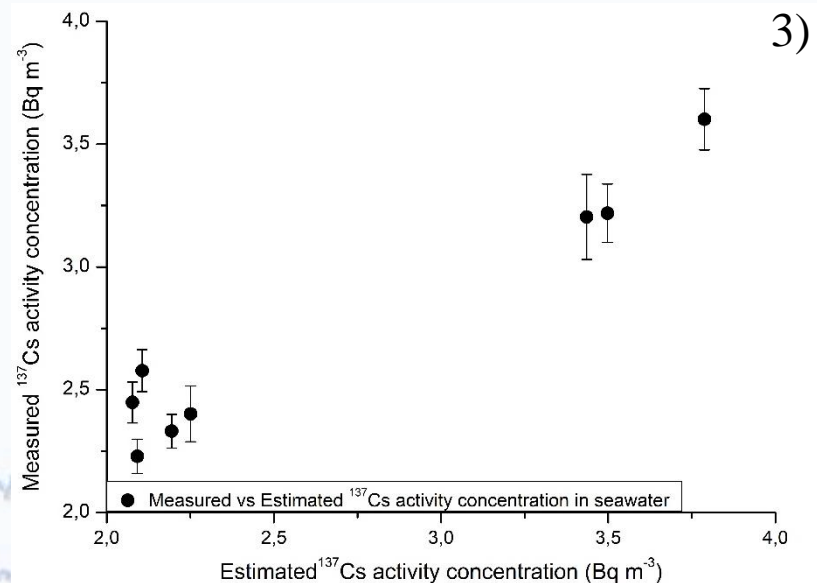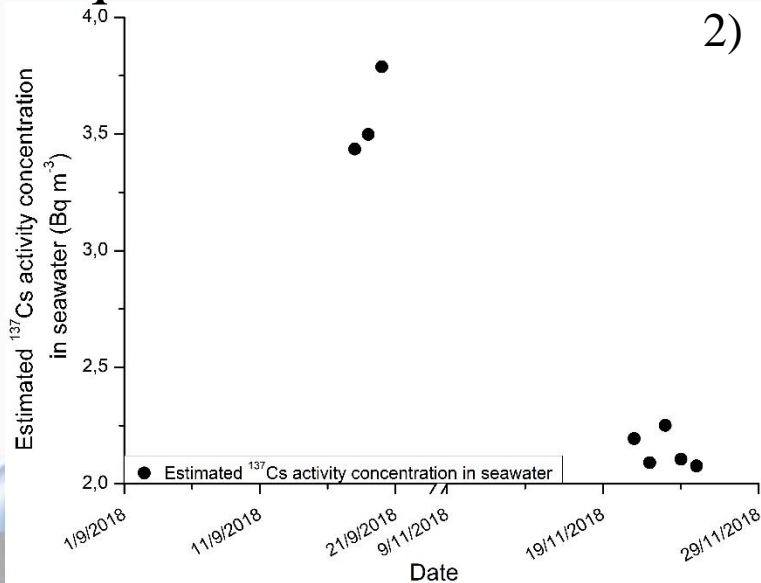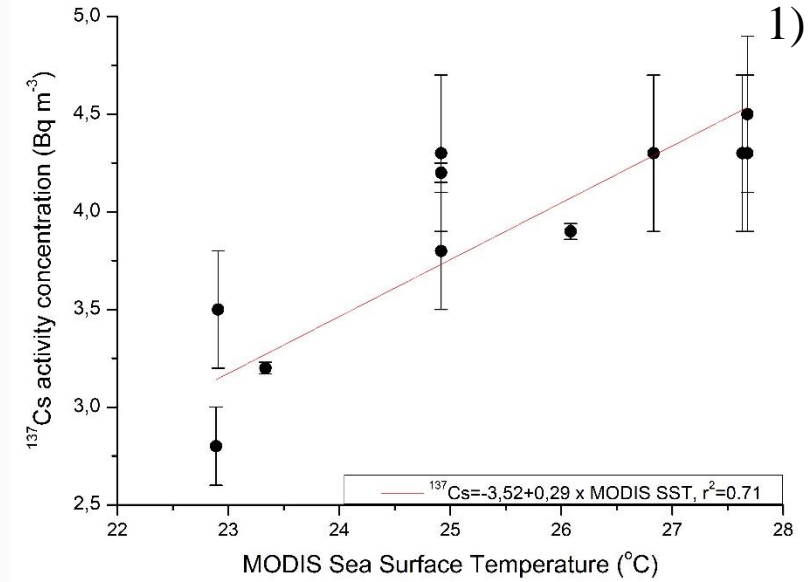
Results

- Dose rates are below than the intervention levels
- Dose rates in pelagic fish:
  - 0.28 to 0.51 µGy/y (top fig.)
- Dose rates in mussels:
  - 31.5 to 57.0 µGy/y (bottom fig.)
- Dose rates in mussels and pelagic fish → follow the ^{137}Cs activity concentration trends in seawater
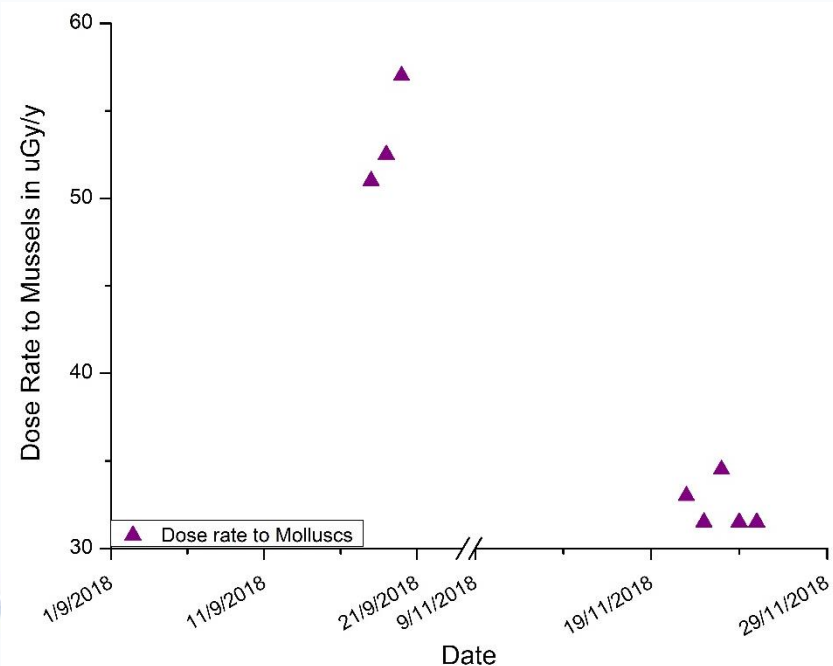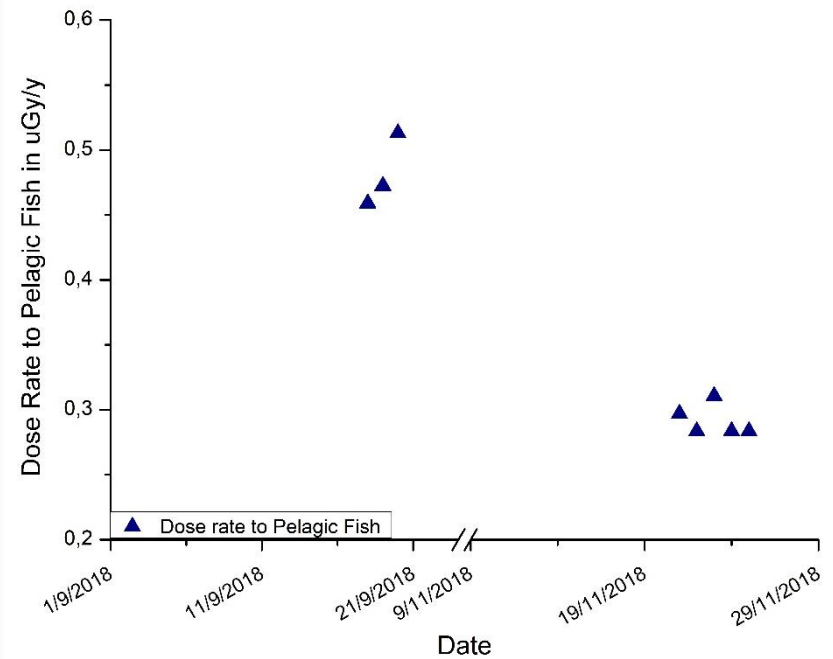
Conclusions

➢The linear model that uses MODIS SST is capable of estimating the ^{137}Cs activity concentration in the marine area of the Corinthian Gulf.

➢The dose rates in pelagic fish and mussels, in the Gulf of Corinth are below than the intervention levels, indicating low impact due to the ^{137}Cs exposure.

➢The combined use of ERICA Assessment Tool and satellite remote sensing marine data has not been utilized before and could be used in more radiation risk assessment applications.

➢Future work will include: the optimization of the models, the use of more marine parameters and the creation of an online webGIS platform for radiological risk assessment and the application of the methodology in other areas.