אוניברסיטת בר-אילן
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MINISTRY OF SCIENCE AND TECHNOLOGY

Shelf-open sea exchange processes across the narrow shelf of the southeastern Mediterranean Sea

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OceanPredict
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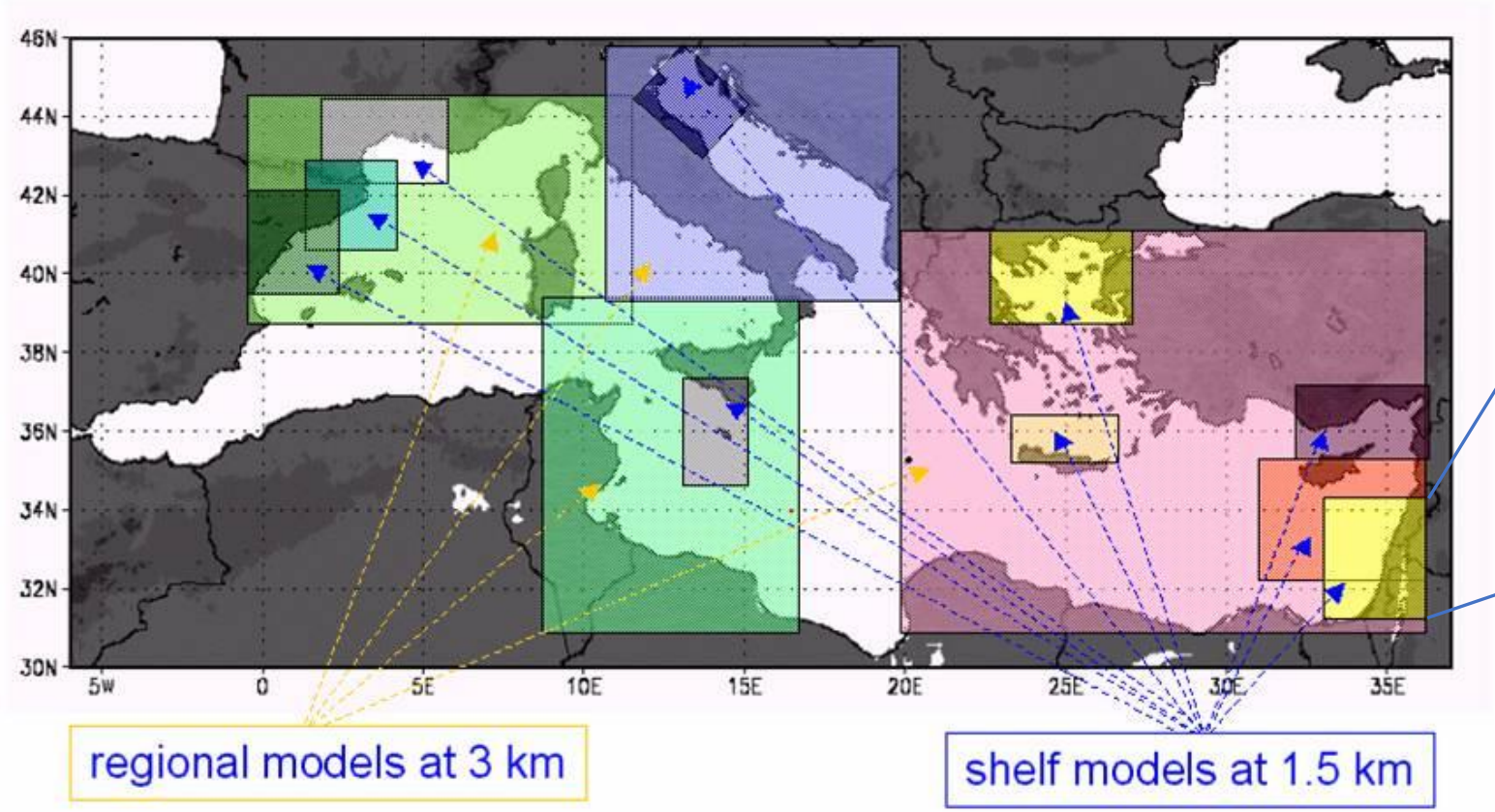
COSS-TT International Coordination Meeting 2-4 May 2023, Montreal Canada

Background and history – coastal ocean forecasting and related activities in the southeastern Mediterranean Sea

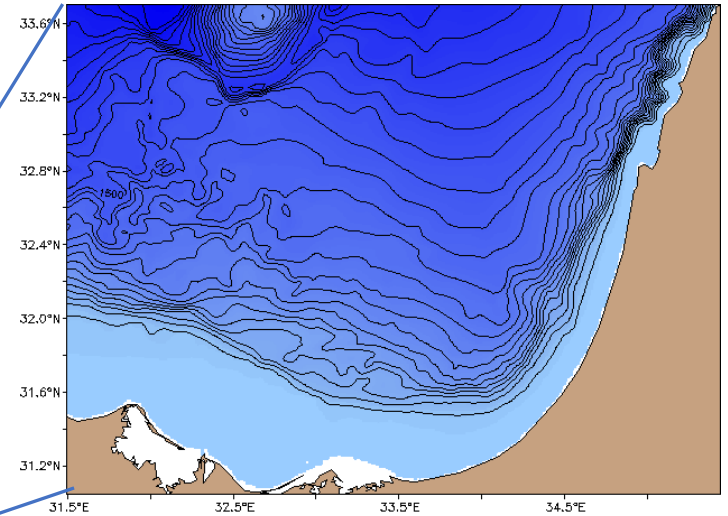
- Mediterranean Forecasting System MFSPP and MFSTEP
  - EU 6th and 7th Framework Programs MFSPP and MFSTEP
  - Hierarchy of multiscale, nested models from full Mediterranean to local shelf regions
- SELIPS
  - 4-day operational forecasts run daily at IOLR since 2005
- Downstream applications and related research
  - Oil spill modeling
  - Environmental assessment of infrastructure development such as multiple large scale desalination facilities
  - Shelf-open sea exchange processes (this study)

Components of the Mediterranean Forecasting System

MFS

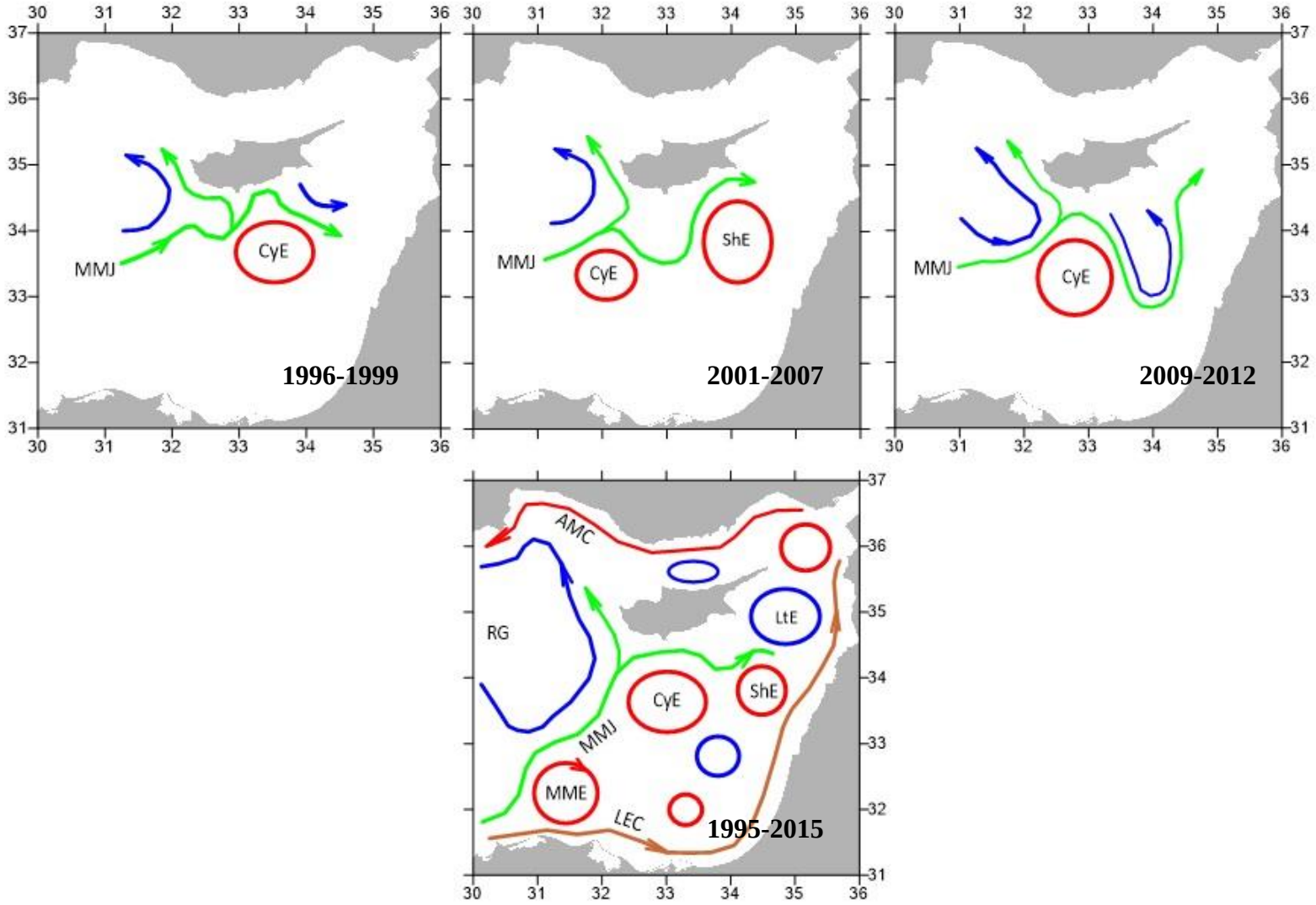


SELIPS



present resolution ~950 m

Schematic summary of the dominant circulation features in the eastern Levantine basin 1995-2015 from Zodiatis et al. (2023)

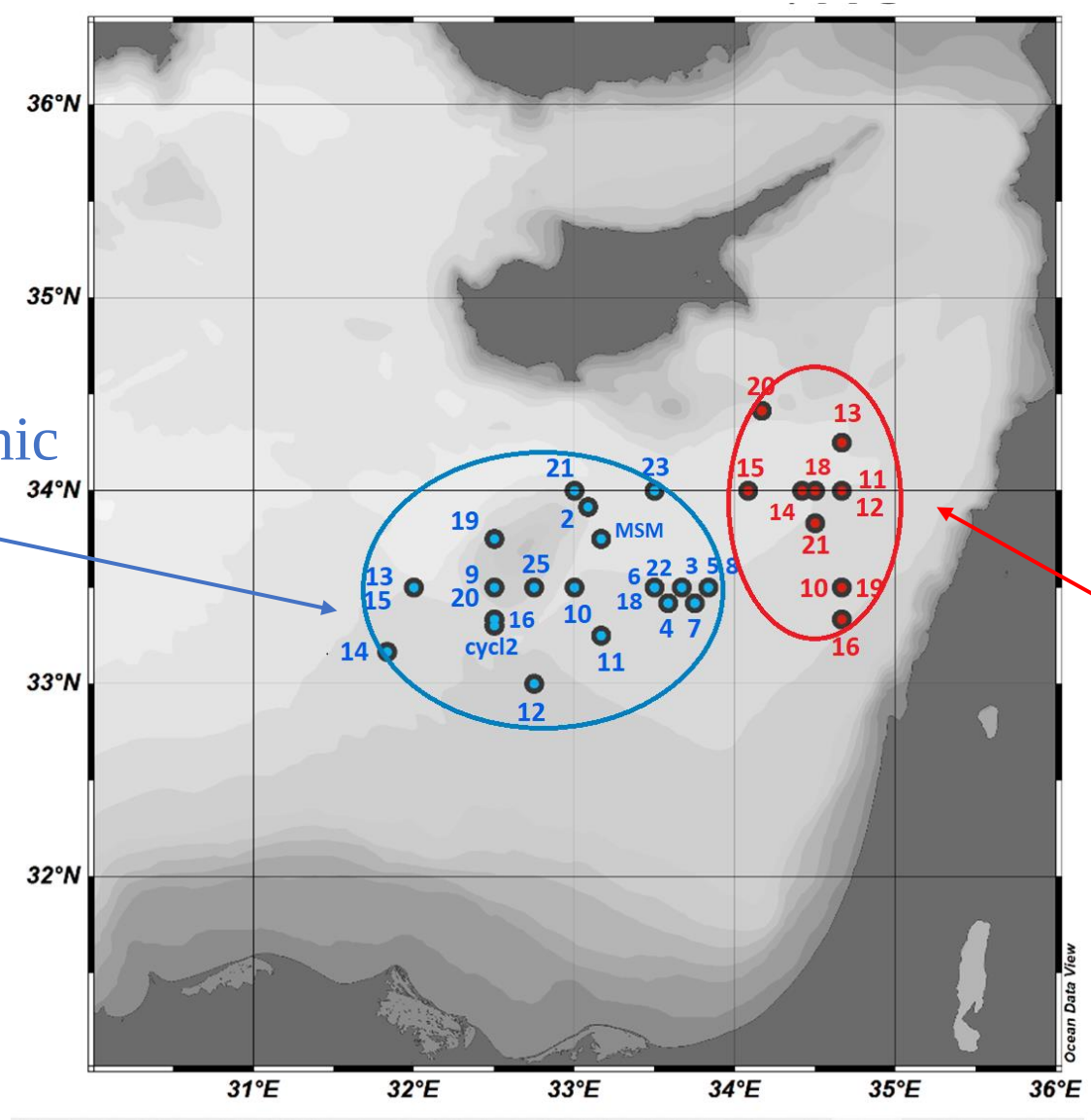


In situ data

In situ data + MEDREA16

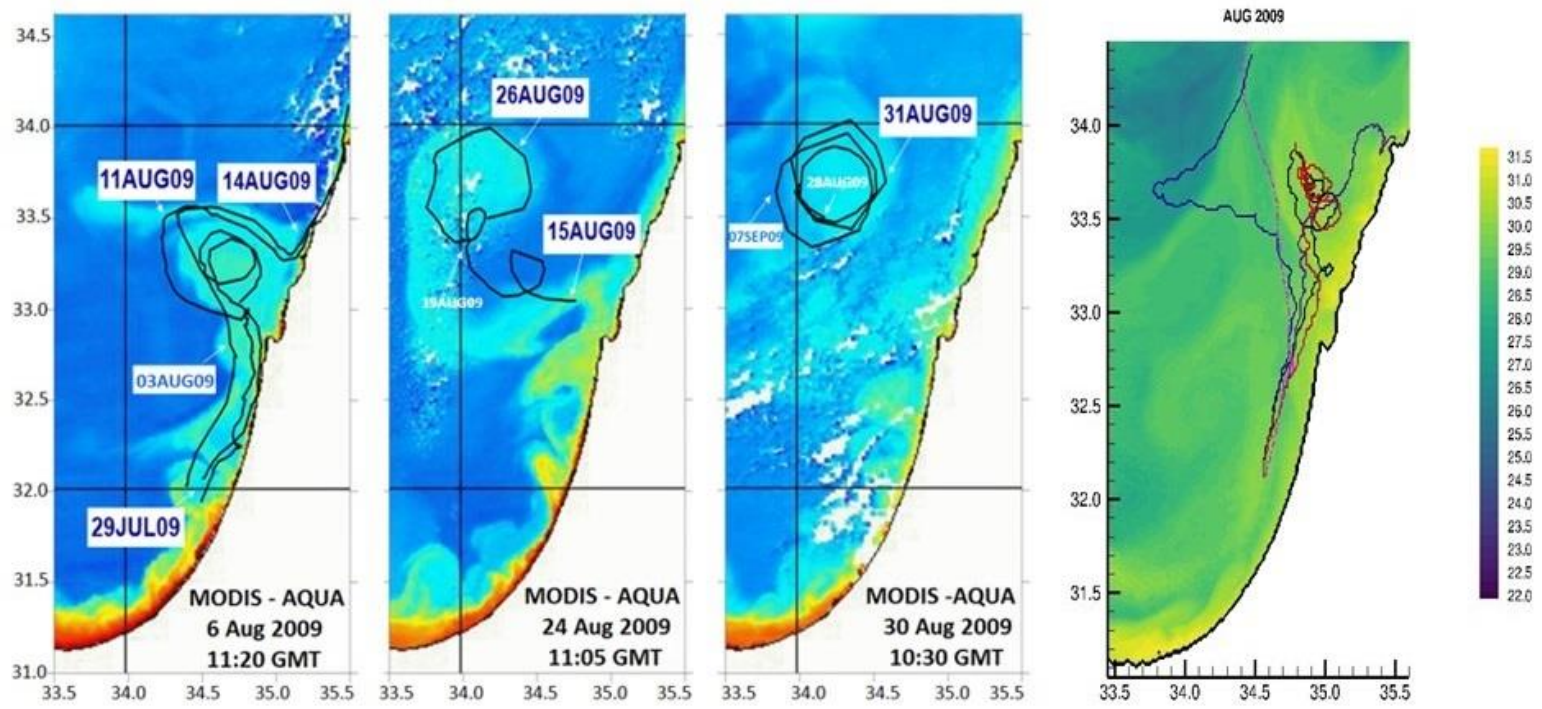
Migration of the Cyprus and Shikmona eddies between 1995 - 2012

Cyprus eddy -
-in the vicinity of the Eratosthenes SM
-suggesting topographic forcing



Shikmona eddy
-offshore from Lebanon
- apparently formed as a meander of the shelf break jet

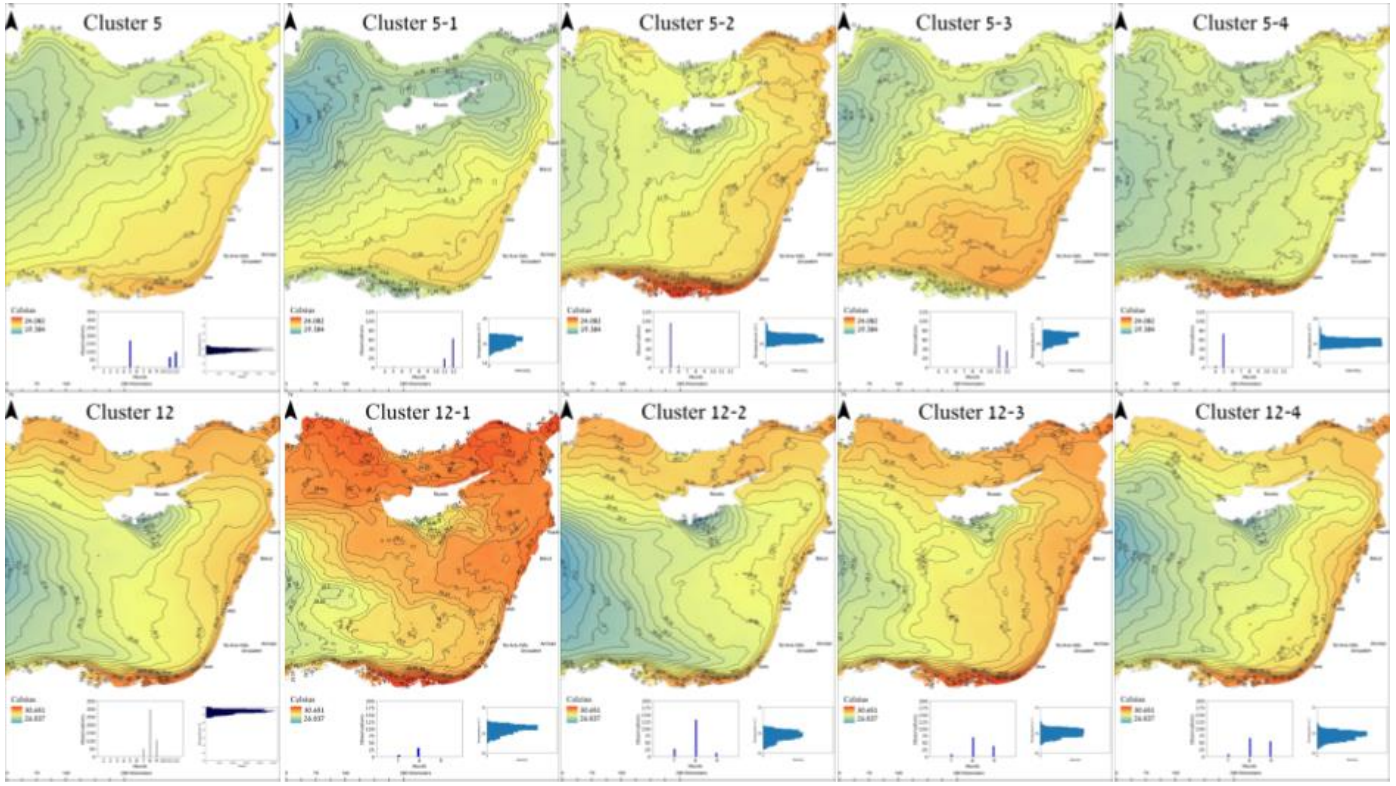
Example of the Shikmona eddy formation from a meander of the shelf break jet



SST images and SVP drifter trajectories

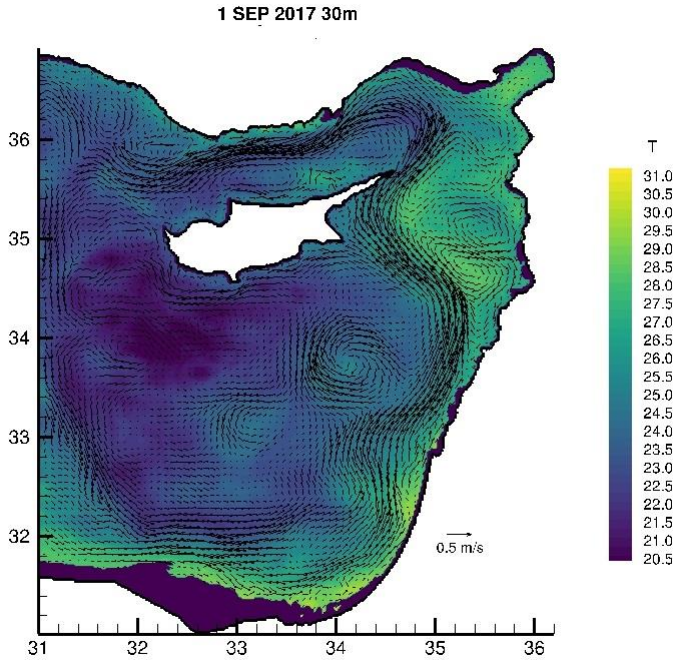
Model simulated 10 m temperature and drifter trajectories for same period

K-means cluster analysis of the remotely sensed SST data

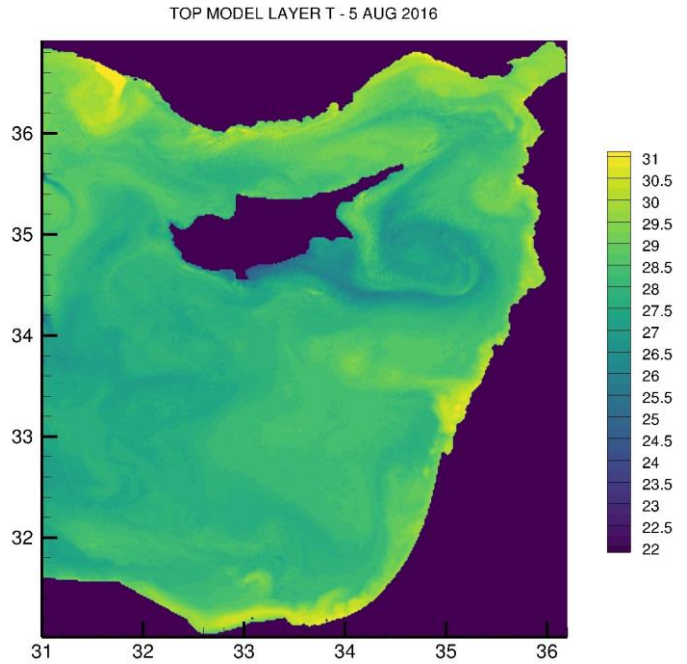


- ~3200 daily SST maps from 01/2008-07/2016
- Cluster 5 is mainly from the transition season months of May, Nov, and Dec
- Cluster 12 is from summer
- Suggests offshore flow from shelf zone of northern Israel and Lebanon
- Strong upwelling along the southern coast of Cyprus

3-year downscaling of MEDREA16 for 01/01/2016-31/12/2018

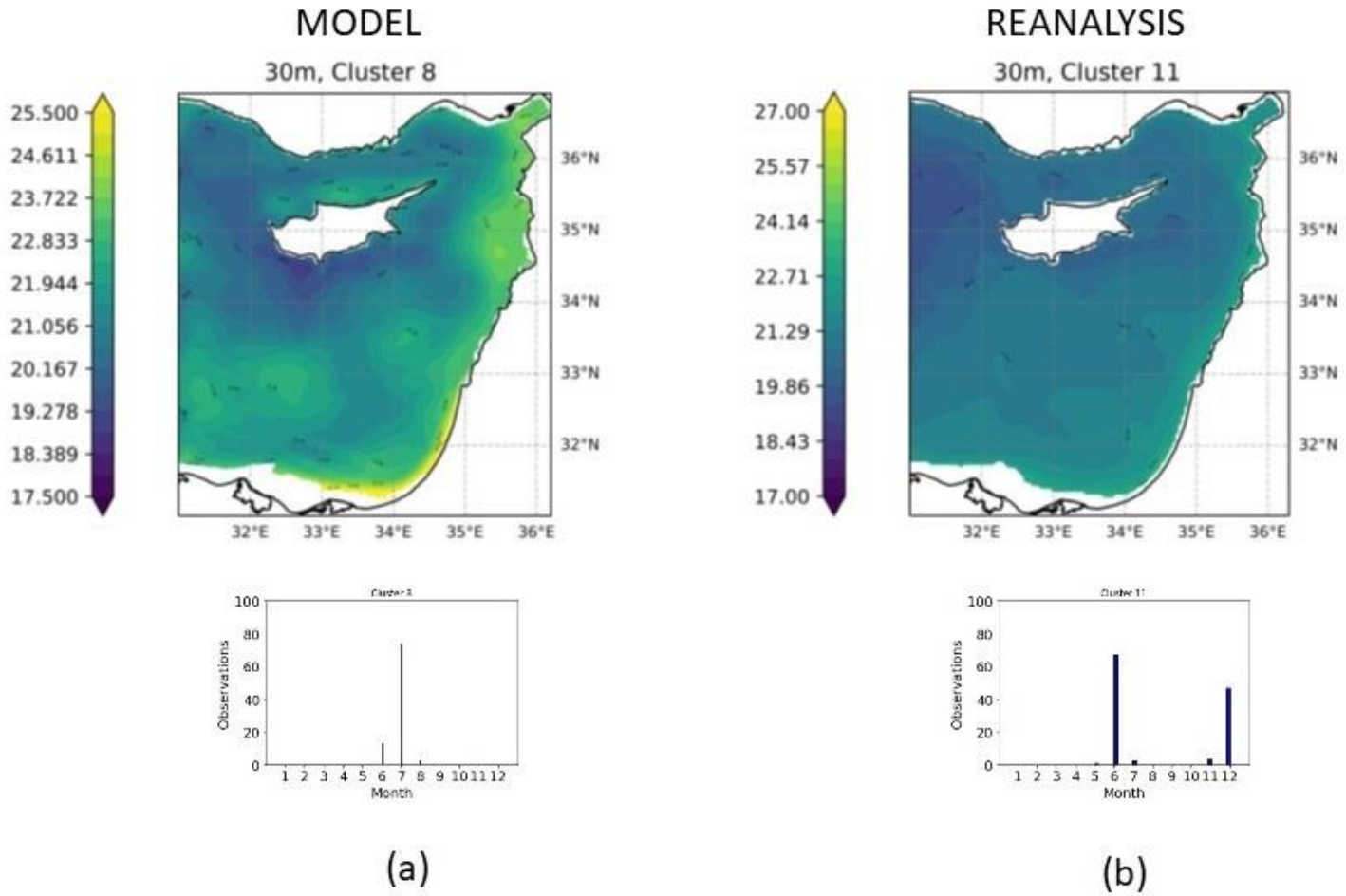


Example from 1 Sep 2017
showing:
-- Cyprus eddy
-- Shikmona eddy
-- Meander off the coast of northern Israel



Example from 5 Aug 2016
showing:
-- Meander off the coast of Lebanon
-- Upwelling along the southern coast of Cyprus

Comparison of k-means clusters of 30 m temperature from model downscaling and the CMS/MEDREA16 reanalysis



Summary and conclusions

- Application of k-means cluster analysis to remotely sensed SST highlighted two important shelf-open sea processes
  - Eddies generated from meanders of the shelf-break jet along the coasts of Israel and Lebanon, suggesting a mechanism for the formation of the Shikmona gyre
  - Intense upwelling along the southern coast of Cyprus in the summer
- Application of k-means analysis showed these processes also appear in the near surface temperature MEDREA16 reanalysis and in a 3-year model downscaling run
- Next step is to refine the k-means analysis and apply it to deeper layers