Linear trends or regime shifts: Analysis of data and simulations for the last 50 years in the Aegean Sea.

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Fig. 1 Map of the study area in the Mediterranean Sea

General Objectives:

Contribute to the ongoing controversy about statistical description of climate (linear trends versus breakpoints)

Check existence of a possible regime shift in Aegean Sea

Does it eventually correspond to the shift in the Western Mediterranean Sea

Use 50 year (from 1960 to 2010) physical-biogeochemical simulations of the North Aegean Sea (GETM) and other data

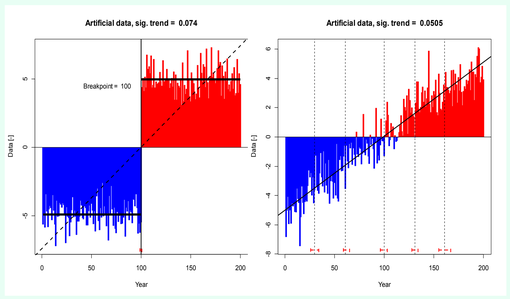

Fig. 2. Example for breakpoint (regime shift) detection method using the R-package *strucchange*. A clear breakpoint is detected when a real regime shift occurs (left), but false positive detections will happen when the signal has an underlying linear trend (right). The data must therefore be first detrended.

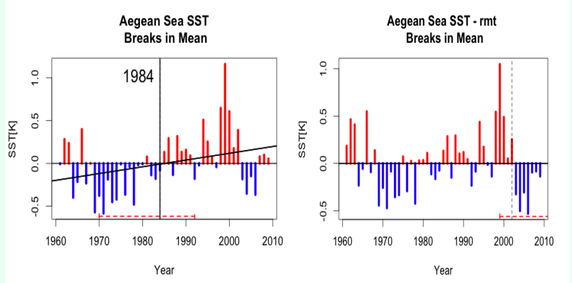

Fig. 3. The Aegean Sea has an increasing sea surface temperature (SST) trend (0.08 K/decade). Not significant breakpoint 1984 (disappears with trend removal).
SST in the last decade is cooler again!

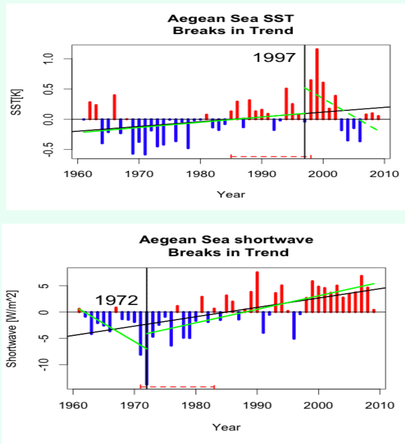

Fig. 4. Detection of a breakpoint in the SST trend (upper panel), indicating a non-significant cooling trend during the last decade. Incoming short radiation has an increasing trend as well and a change in the trend at 1972 (middle panel). Regional differences can be very strong as can be seen from the decreasing SST trend in the Dardanelles area. SST in the last decade is cooler despite the increase in short wave radiation!

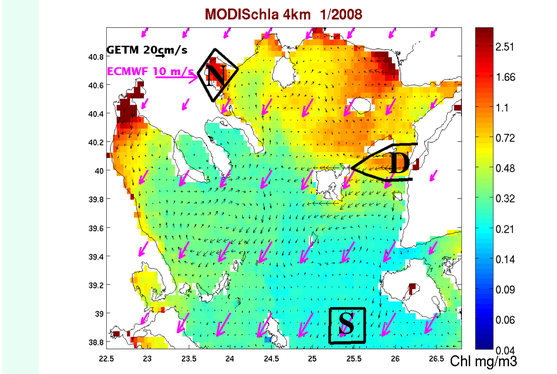

Fig. 5. Sub-regional analysis of 3 contrasting areas (**N**orth rivers, **D**ardanelles and open **S**outh sea (see upper panel). Winds tend to be stronger in the last decade, as well as the SST seasonal variability (colder summers and warmer winters).

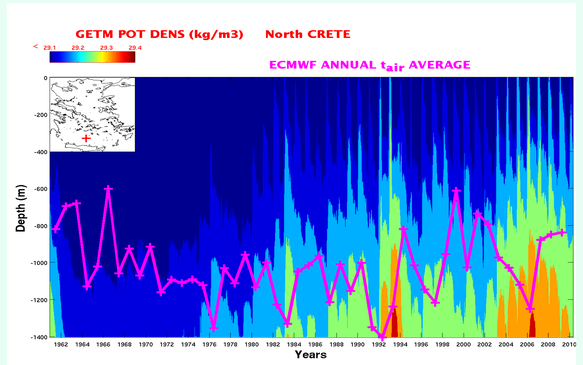

Fig. 6. Dense water formation events in the South Aegean Sea (near Crete) as indicated by the development of the potential density field in relation to the air temperature changes. See the Eastern Mediterranean Transient 1993.

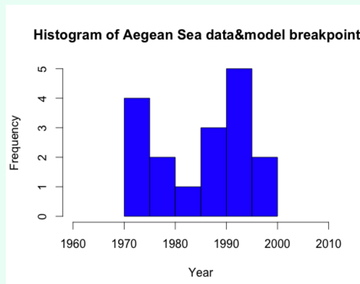

Fig. 7. The frequency analysis indicates 2 cluster of breakpoints (~1970, ~1990).

Conclusions:

- Trends in North Aegean Sea are not persistent
- Increasing temperature and wind on the scale of Aegean Sea
- But also increase in solar forcing
- Strong regional differences within the Aegean Sea
- Similar seasonal variability of first and last decade for phytoplankton and SST
- Identification of breakpoints is possible
- Wind speed has no strong breaks
- Air temperature 1970, 1993
- SST has 2 breaks ~ 1970 and ~ 1992
- Phytoplankton 2 breaks ~ 1967 and ~ 2000
- We found 2 indicative clusters of breakpoints
- At: ~1970, ~1992-
- No clear single regime shift could be identified!
- Disagreement with 1987 proposal by Conversi ea. (2010).

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