



CCI Research Fellowship FEVERSEA

Framework for marine heatwave EVEnts integrating Remote SEnsing and numericAl simulations by Giulia Bonino



Scientific advisors: Simona Masina (CMCC), Paolo Cipollini (ESA), Anna Maria Trofaier (ESA)

Background

MHW : extreme event of anomalous warmer sea surface water relative to a climatology, with a start and end dates and a persistent duration of at least five days.

Bay of Bengal	Northeast Pacific (The Blob)	Northwest Atlantic	19	997/98 El Niño
5 May 2010	8 January 2014	20 May 2012	25	December 1997
Driver: Possible links to entral Pacific El Niño* mpacts: Coral leaching in the	Driver: Persistent high pressure linked to tropical-extratropical teleconnectionsDriver: Extensive high pressure linked to jet-stream shiftImpacts: Low ocean productivity; large marine mortalities; toxic algal bloomsImpacts: Fishery disruptions; species- range shifts; low ocean productivity		ressure linked Dr ions; species- roductivity	iver: Coupled air-sea interactions pacts: Suppressed equatorial and astal productivity; fishery losses
Andaman Sea				
Mediterranean Sea				
14 June 2003	E Parts			
Driver: Blocking high and corresponding errestrial heatwave				
mpacts: Mass mortality of rocky benthic communities				
Souchallas	K-			
17 January 1998	1		1.1.1	and the second sec
Driver: Atmospheric eleconnections linked o 1997/98 extreme El Niño mpacts: Extensive coral bleaching				Moderate Strong Severe Extreme
Benguela Niño				
L6 April 1995	AU 1 AU 2	T		
Driver: Kelvin waves	Ningaloo Nino 2 March 2011	Tasman Sea	Central South Pacing	8 February 2014
riggered by tropical Atlantic-wind anomalies	Driver: Intensification of Leeuwin Current and intense low pressure linked to 2010/111 a Niña	Driver: Intensification of East Australian	Driver: Intense high pressure linked to	Driver: Persistent high pressure linked to Madden-Julian Oscillation
mpacts: Severe mpacts on sardine and other pelagic fish populations	Impacts: Destruction of kelp forests and seagrass meadows; extensive coral bleaching; widespread expansion of tropical fish: collapse of crustacean and	Impacts: Oyster disease outbreaks; mollusc mortalities; salmon aquaculture	Impacts: No reported marine-species impaction	d Impacts: No reported cts marine-species impacts
	shellfish fisheries	impacts		

GOALS OF FEVERSEA:

GOAL1: to study and to document these extreme surface sub-surface events: and observed characteristics and ecological impacts

GOAL2: to detect the local and large-scale climate precursors

GOAL3: to build a prediction framework using novel deep machine learning method

DATA:

- ESA SST CCI L4 v2.1 at 4km resolution
- ESA OceanColour CCI
- Other CCI datasets (Sea level, Sea Surface Salinity)
- **Scatterometers** •
- **Ocean and atmospheric Reanalyses**
- **CMIP6-ESM** data

Holbrook et al (2020)

Results

MHWs Detection and general characteristics

ESA CCI SST (1983-2016)

GREP-REA (1993-2018)

Frequency

- 3.0

2.5 -

- 2.0 annual event

- 1.0

>40

- 30

20

15

10





Duration





Intensity



- Detection of MHWs in ESA CCI SST and in GREPv2 Reanalysis in each grid point as events with start and end dates, a persistent duration of at least five days and anomalous warmer sea surface water relative to a threshold (90th percentile) in a 30-year baseline climatology.
- Detection of MHWs metrics and characteristics (e.g. duration, peak intensity)
- Detection of Cold Spells in ESA CCI SST

Purpose:

 To synthetize information and aggregate punctual (i.e. for each grid point) MHWs in order to identify MHWs Macro-Events in space and in time.

Method:

 Connected component analysis: Image processing algorithm running in parallel in Python which calculates connectivity of pixels to their neighbors in time and in space (MHWs occurrence). The algorithm return connected pixels with an unique label. Labels are the MHWs Macro Events.



Next steps:

- For each MHWs Macro-Events to select and to extract a set of features (e.g. mean duration, mean location etc.)
- To apply statistical clustering methods in order to identify and aggregate MHWs Macro-Events that share characteristics.
- To test labeling and clustering globally.

GOAL2: to detect the local and large-scale climate precursors

