



## **3rd ESF-MedCLIVAR WORKSHOP**

**Understanding the mechanisms responsible for the changes  
in the Mediterranean Sea circulation and sea-level trends.**

**Island of Rhodes-Greece**

**29/09 – 01/10/2008**

## **REPORT**

***Contributions from:***

- Hellenic Centre for Marine Research (HCMR)**  
(Athens headquarters and Hydrobiological Station and Aquarium of Rhodes)
- Municipality of the town of Rhodes**

# **3rd MedCLIVAR/ESF workshop on: Understanding the mechanisms responsible for the changes in the Mediterranean Sea circulation and sea-level trends.**

by

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## **1. Summary**

The 3<sup>rd</sup> ESF/MedCLIVAR workshop was held in the island of Rhodes in Greece, 29/9-1/10/2008 at the Hydrobiological Station and Aquarium of the Hellenic Centre for Marine Research (HCMR). It was the third of a series of five workshops planned by MEDCLIVAR program ([www.medclivar.eu](http://www.medclivar.eu)), which is a research networking program aiming at coordinating and promoting research on different aspects of Mediterranean climate. It was cosponsored by the European Science Foundation (ESF), the Hellenic Centre for Marine Research (HCMR) and the Municipality of the town of Rhodes.

Applicants in total were 64 (invited and keynote speakers included) from 23 countries.

The countries of all applicants (number of applicants as concerns nationality / affiliation) in alphabetical order were: Bangladesh (1/1), Belgium (1/1), China (1/0), Democratic Republic of the Congo (1/1), Croatia (1/1), Cyprus (1/1), Egypt (2/2), Ethiopia (1/1), France (7/9), Germany (2/3), Greece (14/13), India (1/1), Iraq (1), Iran (1/1), Italy (11/10), Libya (0/1), The Netherlands (1/0), Nigeria (2/2), Russia (1/0), Spain (9/7), Turkey (4/4), UK (1/3), USA (0/2). [Male: 45 (70%) and Female: 19 (30%)].

After evaluation of the applications by the Organizing Committee of the Workshop, there were 52 accepted applicants, Male: 35 (67%) and Female: 17 (33%) (invited and keynote speakers included) from 13 countries as follows (number of applicants as concerns nationality / affiliation) in alphabetical order: Belgium (1/1), Croatia (1/1), Egypt (2/2), France (6/9), Germany (2/2), Greece (14/13), Italy (11/10), The Netherlands (1/0), Russia (1/0), Spain (8/6), Turkey (4/4), UK (1/3), USA (0/1). Finally, the workshop was attended by 50 participants [Male: 35 (70%) and Female: 15 (30%)].

There were 32 oral presentations given by 8 Keynote speakers, 7 Invited speakers and 17 participants. The rest of the participants have presented 18 posters (see section 4, workshop program).

The 3<sup>rd</sup> workshop was dedicated on the “Understanding the mechanisms responsible for the changes in the Mediterranean Sea circulation and sea-level trends”. Significant changes have been documented during the past few decades, the causes of which have not yet been fully resolved. The main purposes of the meeting were: (i) to focus on the changing status of the Mediterranean Sea circulation and sea-level and their link with climate change and anthropogenic interference and (ii) to exchange expertise and knowledge among scientists, as well as development of links and close scientific cooperation, so as to promote the research globally.

The 3-day workshop has started with an introductory 40 minute talk and it was structured in six thematic sessions starting each with a key-note talk and followed by 30 minute invited talks, as well as shorter talks on the same thematic. The program included poster sessions as well, dedicated also on both the oceanographic and atmospheric components of the climate. Finally, a synthesis of the workshop was accomplished.

## **2. Description of the scientific content of the workshop and discussion at the event.**

The 3<sup>rd</sup> workshop focused on the changing status of the Mediterranean Sea and its link with climate variability and anthropogenic interference. Long-term, as well as abrupt changes were discussed. During the workshop the state of the art throughout the instrumental and in some extent in pre-instrumental periods were presented.

The introductory 40-minute talk was given by Prof. Paola Malanotte-Rizzoli (MIT/USA) who presented an overview on the Oceanic Circulation of the Mediterranean Sea and its changes over the last century. The main points were about (i) the Global importance of the Mediterranean, as defined by its impact on the Global Thermohaline Circulation (Polar Convection Cells), (ii) the role of the Mediterranean as a Laboratory test Basin for studying Global Processes “(e.g. general circulation studies, the existence of closed thermohaline cells, “Conveyor Belt”, deep water formation processes), (iii) The 80’s–90’s discovery of the important sub-basin scale and mesoscale circulation patterns, and finally (iv) The Eastern Mediterranean Transient (EMT), a unique event since 1987.

The main scientific issues that were discussed during the following sessions were the Past of the Mediterranean, the Atmospheric forcing mechanisms, the variability and trends of the circulation and sea-level, the future of the Mediterranean and the proposed monitoring strategies. At the end of the event, a synthesis of the workshop was presented by Prof. Vassilis Zervakis (Univ. of Mytilene, Greece).

There were discussions on the significant changes in the Circulation, deep-water mass production and sea-level that could be linked to local, regional and/or global atmospheric processes and anthropogenic interference (e.g. damming of major rivers). The spatial scales of the forcing factors involved also have various ranges from global warming, to the influence of the North Atlantic Oscillation and to local changes in the Nile outflow. Significant progress is being made in the effort to quantify the contribution of the various forcing parameters and the temporal and spatial scales involved. This workshop has acted as a focusing point putting the existing studies in the context of climate variability, has identified the unresolved questions and discussed the strategy that must be followed to resolve them.

The first session was dedicated to the “**The Past of the Mediterranean as revealed from the pre-instrumental records**” Dr. E. Rohling (UK) has given the key note speech on the “The past climate of the Mediterranean Sea”, followed by four participants’ talks.

Dr. Rohling presented the Mediterranean today focusing first on the Atmospheric circulation in large-scale terms. The general atmospheric circulation over basin, along with strong evaporation throughout and fresh-water input along margins, sets up underlying cyclonic circulation in surface waters. Topographic influences and regional atmospheric circulation break this general pattern up into a complex system of gyres. Strong regional airflows are critically important for Mediterranean circulation and drive intermediate and deep water formation. The main part of this presentation concerning the past was divided into two parts, (i) The cold periods and (ii) the Monsoon maxima.

The second presentation, which was a collaboration among the universities of Athens, Barcelona, Aegean, Hamburg and Pierre et Marie Curie/Paris, entitled “Late Glacial-Holocene climate variability at the southeastern margin of the Aegean Sea”, was made by Dr. Triantafyllou. High resolution paleoecological study is attempted in an expanded sediment record covering the last ~13 kyr cal.BP, from the shallow SE margin of the

Aegean. Three main questions were addressed using a combined micropaleontological and organic geochemistry multiproxy analysis: (i) what is the fingerprint of the northern hemisphere climate variability on the SE Aegean deposits, (ii) what is the interaction between primary production and organic matter preservation at intermediate depths during sapropel S1 deposition and (iii) what are the major changes in sea surface parameters (T, S and primary production, and in the regional moisture availability in the period immediately following the deposition of sapropel S1.

In the third presentation Dr. V. Livina proposes a modified degenerate fingerprinting to “Detect climate transitions and bifurcations”. He showed that the THC collapses due to linear increase of CO<sub>2</sub> and statistically perturbed increased fresh water forcing. The technique allows to study short and unevenly spaced data and was applied to GENIE model streamfunction (yearly), Greenland paleotemperature (uneven kyr) and observed daily temperature (heat wave 2003).

Dr. A. Gogou presented a multinational work on “Biogeochemical evidence of paleoceanographic and paleoclimatic instability in the Aegean Sea”. She referred to major climatic events (e.g. SST) during the last 20 kyrs, the Holocene Climate Optimum-Sapropel S1 deposition in the Aegean Sea, the Environmental and biogeochemical responses to climatic shifts and Aegean vs. open Eastern Mediterranean records in terms of timing and intensity of S1 deposition.

Dr. P. Montagna closed this session presenting the development of a new geochemical proxy in Mediterranean shallow and deep-water corals, giving a perspective for climate reconstructions. The trace element composition of those corals is potentially capable of providing marine environmental records at high-temporal resolution (i.e. 150 yrs continuous time records at fortnightly resolution for *Cladocora caespitosa* and specific time-windows in the past at sub-annual resolution for deep-water corals). The Li/Ca (Li/Mg) ratios, as a new T proxy, can reconstruct changes at different depths in the water column. Using a multi-proxy approach it will be possible to investigate the dynamics of the water masses at different depths for specific time-windows in the past.

The second session was dedicated to the “**Forcing of the Mediterranean circulation**”.

Dr. S. Josey as the key note speaker, referred to the Climatological Mean Forcing, Evaluation and Analysis of Downscaled Fluxes. He presented Mediterranean heat budgets and variability, the consequences for the deep water formation and also to the episodic and transient events, e.g. EMT, WMT. He summarizes that Air-Sea forcing of Mediterranean compared in two downscaled datasets (HIPOCAS & ARPERA) reveals (i) small scale forcing features; (ii) more variable forcing in Aegean & West Mediterranean than Adriatic. Aegean forcing is typically insufficient to produce dense water, but may do so when “long-tail” events occur. Differences between forcing distributions may explain differences in frequency of dense water formation.

Dr. K. Beranger presented interannual variability of water formation for the last decade using the high resolution MED16 model. The atmospheric forcing is of primary importance to model realistic convection. The model shows potential sources of winter intermediate water in the Tyrrhenian Sea and Ionian Sea, while different behaviors of the convection processes are modeled.

Dr. A. Elizalde presented an on progress effort to model Mediterranean climate using a coupled regional climate model” (REMO, MPI-OM, HD) driven by ERA40. This is not

able with the present configuration to reproduce circulation. The size and location of the atmospheric domain play an essential role on coupled simulations.

Dr. E. Sanchez Gomez suggested that the RCMs water budget is overestimated compared with atmospheric observations, the RCMs water budget is close to the G estimates, ERA40-driven runs and GCM-driven runs are similar and climate projections for the water budget show a relative decrease (drying, 0%-33% in 2050 and 34-49% in 2100).

Dr L. Li discussed the interactive role of the Mediterranean Sea in the Mediterranean climate and global climate through the presentation of the global atmospheric GCM LMDZ-Med model. The four topics defined as roles of the Mediterranean were: (i) Sources of Energy and Water for the Atmosphere, (ii) Sources of synoptic perturbations to regions as far as the N. Pacific, (iii) Recorder of the Decadal and long-term climate change signal over the N. Atlantic and (iv) Recorder of the Synoptic activities over the N. Atlantic. Suppression of extratropical synoptic perturbations makes a negative-phase NAO situation, i.e. more precipitation and warmer temperature in the south, but reverse in the north and suppression of tropical synoptic perturbations makes a more uniform cooling and drying (but weak) in the domain. The high-resolution and coupled Mediterranean climate modelling is the future perspective.

Subsurface Temperature Variability in the Aegean-Black Sea System during 1950-2000 and its Relation to Meteorological Forcing was presented by Dr. Kontoyiannis. Apart from the long-term decreasing trends (mid 60's to early-mid 90's) and the afterwards warming, there are differences in the two Seas in the period ~1950-65. Temperature trends were associated with major atmospheric systems. Given that the assumption of "isolation of each region/layer is not satisfied, there is remarkably negative (not surprising) Qnet values in the North Aegean, dense water formation, a key process in redistributing heat, and regions of dense water formation define sinks of atmospheric energy. While, Dr. M. Hermann has stressed the strong dependence of the interannual variability of dense-water cascading in the NW Mediterranean to the atmospheric conditions. Importantly, she estimated a decrease of 90% of the DW cascading in the future (30 year extrapolation) induced by the change of stratification.

The 3<sup>rd</sup> session was dedicated to the **variability of the physical properties and the circulation, as it is manifested by long term trends and abrupt events.**

The key-note talk, given by Dr. A. Theocharis, described the unique abrupt change of the deep thermohaline circulation of the eastern Mediterranean, called the EMT, lasted for more than 20 years (since 1987) due to the shift of the deep water source from the Adriatic to the Aegean. This was attributed to local anomalies of the buoyancy forcing due to regional variability of the main atmospheric conditions (drought, low air-temperatures). These changes caused a redistribution of the bio-geochemical properties. While, Dr. K. Schroeder referred to the very recent (2004-2006) abrupt change observed in the deep western Mediterranean that may be related to two effects, acting at two different time scales: (i) A decadal heat/salt accumulation at intermediate layers induced by the EMT and (ii) particularly severe winter conditions. It was also noted that observations and modeling studies (1985-2008) in the Mediterranean and reanalysis of time series over the past century have revealed important variability of circulation and water properties, ranging from interannual to multiannual scales. Progressive relaxation of EMT was achieved in the period 1994-2002, while after 2002 the process has stopped.

“Why monitoring of the EMT is necessary” was put as a crucial question concerning the behavior of the Mediterranean in the future in the context of the climate change. An important input to the Aegean and the eastern Mediterranean hydrodynamic variability is the Black Sea Water intruding through the Turkish Straits, the Dardanelles and the Bosphorus. Dr. E Ozsoy gave a detailed overview of the Response characteristics of the Turkish Straits system. Finally, Dr. C. Troupin presented the SST annual, seasonal and monthly variability in the west Mediterranean seen through complementary in situ, satellite and modeling approaches.

The 4<sup>th</sup> session was dedicated to the “**Sea-level variability**”. The key note speaker Dr. D. Gomis tried to stress the importance of the combination of MSL and extreme events that are due to meteorological forcing. They are particularly dangerous in combination with high waves. Moreover, the mechanisms that are responsible for the sea-level trends are: changes in the density of water masses (*steric* component), in atmospheric pressure and wind (*meteorological* component) and in the circulation (*dynamical* component). In the Mediterranean there is a partial spatial coverage by tide gauges that do not measure absolute sea level, but sea level relative to land mark and land is not static. Regarding future scenarios: IPCC models are global and do not have a proper representation of the Strait of Gibraltar. To answer if the salinity increase is realistic, it implies a very significant increase of the deficit of the freshwater budget. E. Sánchez-Gomez gave the previous day in the MEDCLIVAR workshop, values on changes in the freshwater budget: 0–33% for 2050 and 34–45% for 2100. To infer the consequent salinity changes we need to properly model the flow through Gibraltar and, hence, to input realistic boundary conditions on the Atlantic side (e.g., to take into account sea level rise due to ice melting). Dr. I. Vilibic tried to answer the question: “do the extremes in Adriatic sea-level increase?” by giving an example of the Adriatic seiche. He summarized that Adriatic seiches may be used for basin-wide tracking of long term storminess changes, with strong interannual variability (an increase after ‘90s, but less contributing to the Adriatic floods at that time) and correlated to MSL and NAOI (as expected).

The following presentation, entitled “Marseille Tide Gauge: review and rescue of its historical data (1885-1988)”, given by Dr. G. Woppelmann, was focused on Data archeology, quality controls, distribution of the rescued Marseille sea-level data and exploitation: trends in sea-level components.

A decade of daily sea-level variability in the N. Adriatic (1999-2008)” was presented by Dr. F. Raicich, who concluded that the daily sea-level variability is mainly determined by that of (i) MSL (spatial) and (ii) east-west sea-level imbalance (~gradient).

Next, Prof. P. Lionello has underlined that we expect, in future climate conditions, winter intensification of the storm track over N and NE Europe and its attenuation over S and E Europe. Particularly, significant reduction of storm track intensity is found during late summer and autumn over the Mediterranean. These changes are not linearly related to the overall number of cyclones, which generally decreases everywhere for most of months, but increases in the Mediterranean in summer. Intense events appear to become weaker in the Mediterranean. The indication of more extreme events in the Mediterranean remains uncertain, though there are some indications which may support the opposite. Along the western coasts of Anatolia data from tide gauges, satellite altimetry, GPS and leveling data, reveal Annual Amplitudes range 4-8cm, Semiannual < 3 cm, while highly positive

correlations exist between seasonal sea level and seasonal temperature cycles. The sea level trends are 2-4 times higher than global estimates; however, significant change in sea level and temperature trends took place in 1960 and 1999.

Dr. I. Papadimitrakis presented a study on “Extreme waves in deep waters. Occurrence and breaking through meteorological and other focusing”, using a statistical model that predicts the occurrence and breaking of extreme waves as a function of sea state, expressed in various ways. It also provides the breaking probabilities of extreme (rogue) waves. The breaking probabilities of dominant waves and of rogue waves are estimated based on a (new) breaking criterion that unifies kinematic, dynamic and premature breaking concepts.

The 5th session was devoted to the “**Future of the Mediterranean**”. The opening talk by Dr. S. Somot dealt with “Lessons from the first attempts to simulate the future of the Mediterranean”. He referred to the first attempts on modeling tools, design of the simulations and uncertainty. Coordinated international effort is needed to assess the future of the Mediterranean. Then, Dr. G. Sannino confirmed that the magnitude and hydrological properties of the thermohaline circulation strongly depend on the physical configuration of the Strait of Gibraltar via hydraulic controls. He further presented results of different modelling efforts, using two models (modified POM and MITgcm), proposing recipes and motivations (e.g. a direct simulation of the strait dynamic via a two-way grid-refinement). Dr. M. Marcos, comparing model output with tide-gauges data, presented the trends in mm/yr induced by atmospheric pressure and wind. Most importantly, T and S projections for the 21<sup>st</sup> century predict warming and salinification in the 3 scenarios, however the changes in the high resolution RM are smaller. Thermosteric and halosteric changes compensate keeping the steric sea-level nearly constant, while thermal expansion would induce a rise of 18-52 cm under SRESA 1B.

On the other hand, Dr. Th. Avagianou on “Assessing vulnerability to Sea-Level Rise in the Mediterranean Basin using the DIVA tool” concluded that: (i) Initial results demonstrate that the updated version, results in significant local deviations in the study area when compared to the outputs of the original version of the model, (ii) Different scales of analysis seem to define the variability of the models’ accuracy, (iii) The updated version produces more accurate patterns for given SRES scenarios of climate change and (iv) More accurate inputs produce better vulnerability indices.

The sixth session was devoted to “**Monitoring Strategies**”. Dr. K Nittis, on behalf of **MedGOOS** and **MOON** communities, opened this session with his key-note presentation entitled “Building an operational monitoring and forecasting capacity for the Mediterranean Sea”. He pointed out that the Ocean is under-sampled and he has presented the Framework and Policies of the Operational Oceanography (Rio Conference – Agenda 21: **GOOS**–UNESCO; **EuroGOOS**–**MedGOOS**; **GMES** [EU–ESA Initiative], European contribution to **GEO**; **Marine Strategy** [marine assessments, EMMA process, EEA]; **Maritime Policy** (EMODN: European Marine Observations and Data Network]. Reference was made to the EU funded research projects MFSPP, MFSTEP, MAMA, MERSEA and the National Projects: POSEIDON, ADRICOSM, ESSEO, etc. He presented an entity of future perspectives and the importance of the

Deep/Bottom Observatories. He concluded with the Euro ARGO new European contribution to a global ocean observatory and the challenge of long-term sustainability. Dr. G. Petyhakis gave all details of the design and function of a prototype buoy system to form the base of a permanent network of moored stations for continuous monitoring of open-ocean conditions in the Mediterranean. In the context of Tide monitoring system for evolution and risk scenarios in the coastlines and lagoons of the North-Western Adriatic Sea, the high risk zone in respect to the sea level rise, Dr. M. Ferla referred to the network of sea level and other parameters measuring stations, the coastal defence design and then the evolution of the lagoon ecosystem, the trends and storm surge forecasting and finally the engineering projects.

The final 7<sup>th</sup> session was devoted to the synthesis of the science and open questions presented during the three days workshop. Dr. V. Zervakis summarized the state of the art, as well as what is not yet known in the domains of (i) Variability in Geological time-scales, (ii) Improvements in methodologies and instrumentation, (iii) Forcing and Thermohaline circulation (including sea-level trends) during the instrumental period, and (iv) Future projections.

### **3. Results and Impacts**

The Mediterranean Sea dominates the environmental, cultural and economic life of its coastal states, which consist of developed European states along its northern coasts and developing states along the southern, with high vulnerability to climatic change and climate extreme events.

The 3<sup>rd</sup> ESF/MedCLIVAR workshop had succeeded to bring together scientists from both the Atmospheric and Oceanographic communities in order to discuss and analyze the changing status of the Mediterranean, in several time scales, in the context of climate variability. The main scientific issues focused on the Past of the Mediterranean, the Atmospheric forcing mechanisms, the variability and trends of the circulation and sea-level, including long-term and abrupt changes, the future of the Mediterranean and the monitoring strategies to be followed. The oral presentations along with the posters presented the overall State of the Art of the large scale Mediterranean thermohaline circulation and its variability as well as its sea-level changes throughout the instrumental period and pre-instrumental record.

From the atmospheric point of view, the Mediterranean area is under the influence of some of the major regional to large-scale circulation patterns that are modified by the interaction of the Asian, African and European continents, the Atlantic Ocean and the Mediterranean Sea itself. The strong topographic variability permits the development of localized phenomena which dominate at regional and local scales although they remain linked with larger scale and global forcing.

From the oceanographic point of view, the existence of deep water formation in both the eastern and western Mediterranean basins, and the balancing of the excess of evaporation over precipitation and river influx through hydraulically controlled straits, produce a fascinating semi-enclosed sea for studying key processes and the impacts of large and regional scale climate forcing.



Changes in the oceanic and atmospheric/climatic parameters of the Mediterranean region have been well documented although their forcing has not always been resolved in the context of climate variability.

The identification of unresolved issues and the development of observational and modelling strategies for their resolution were the main outcome of the workshop. The final executive summary and synthesis of the proposed strategies for monitoring and forecasting can be made available to research and monitoring programmes active in the Mediterranean.

The local and national media gave wide publicity to the workshop including an extensive live television interview to inform, the local community.

The programme, presentations and abstracts for the workshop can be found at the MedCLIVAR website (<http://www.medclivar.eu/>) in the “Ongoing and Planned Activities/ Annual Workshops”. Finally, a summary of the workshop aims, contents and achievements is published in the joint edition of **VAMOS No. 5** and **the CLIVAR/ Exchanges Vol.14, No.1, No: 48, p.10-11.**

#### **4. Program of the workshop.**

##### **3<sup>rd</sup> ESF-MedCLIVAR Workshop Programme**

**“Understanding the mechanisms responsible for the changes in the Mediterranean Sea circulation and sea level trends”**

##### **Day 1: 29 September 2008**

**9:00 Welcome** by Dr. Alexander Theocharis on behalf of Dr Efstathios Balopoulos, Director of the Institute of Oceanography of HCMR and Dr. Andreas Sioulas, Director of the Hydrobiological Station and Aquarium of Rhodes, HCMR

##### **9:30 – 10:10 Opening Talk:**

The oceanic circulation of the Mediterranean Sea (*Keynote Speaker: P. Malanotte-Rizzoli*)

##### **SESSION 1: THE PAST OF THE MEDITERRANEAN AS REVEALED FROM PRE-INSTRUMENTAL RECORDS (Simon Josey)**

**10:10 -10:50** The past climate of the Mediterranean Sea (*Keynote Speaker: Eelco J. Rohling*)

**10:50 - 11:20** Coffee-Tea Break

**11:20- 11:50** Late glacial-Holocene climate variability at the south-eastern margin of the Aegean Sea (*Invited: Maria Triantaphyllou*)

**11:50- 12:10** Detecting climate transitions and bifurcations using modified degenerate fingerprinting (*Valerie N. Livina*)

**12:10 -12:30** Biogeochemical evidence of Holocene paleoceanographic and paleoclimatic instability in Aegean Sea (*Alexandra Gogou*)

**12:30 -12:50** Development of a new geochemical proxy in Mediterranean shallow and deep-water coral skeletons: a perspective for climate reconstructions (*Paolo Montagna*)

**12:50 -13:50 LUNCH**

**SESSION 2: THE FORCING OF THE MEDITERRANEAN CIRCULATION (E Rohling)**

**13:50- 14:30** Atmospheric forcing of the Mediterranean Sea (*Keynote Speaker: Simon Josey*)

**14:30-15:00** Interannual variability of water formation in the Mediterranean Sea for the last decade (*Invited Speaker: Karine Beranger*)

**15:00- 15:20** Modelling Mediterranean climate using a coupled regional climate model (*Alberto Elizalde*)

**15:20- 15:40** Climate change projections of the water budget over the Mediterranean Sea from an ensemble of regional climate models (*Emilia Sánchez-Gómez*)

**15:40-16:10** Coffee-Tea Break

**16:10- 16:40** How would the Mediterranean climate be without the Mediterranean Sea? (*Invited Speaker: Laurent Z.X. Li*)

**16:40- 17:00** Subsurface temperature variability in the Aegean-Black Sea system during 1950-2000 and relation to meteorological forcing (*Harilaos Kontoyiannis*)

**17:00- 17:20** Impact of interannual variability and climate change on dense water cascading in the Gulf of Lions (*Marine Herrmann*)

**Day 2: 30 September 2008**

**SESSION 3: VARIABILITY OF THE PHYSICAL PROPERTIES AND CIRCULATION: LONG TERM TRENDS AND ABRUPT EVENTS (S. Somot)**

**9:00- 9:40** The Eastern Mediterranean Transient: an abrupt change of the deep thermohaline circulation of the Eastern Mediterranean in the last 20 years (*Keynote Speaker: A. Theoharis*)

**9:40- 10:10** Abrupt changes observed in the deep Western Mediterranean Sea between 2004 and 2006 (*Invited Speaker: Katrin Schröder*)

**10:10- 10:40** Response characteristics of the Turkish Straits system (*Invited Speaker: Emin Özsoy*)

**10:40- 11:00** The Western Mediterranean sea surface temperature dynamics seen through complementary in situ, satellite and modelling approaches over the 1985-1995 period (*Charles Troupin*)

**11:00 -11:20** Evolution of the Aegean Sea thermohaline structure in the post-Eastern Mediterranean transient period (*Sarantis Sofianos*)

**11:20- 11:50** Coffee-Tea Break

**SESSION 4: SEA LEVEL TRENDS AND VARIABILITY (Marta Marcos)**

**11:50-12:30** What do we know and what we do not know about the Mediterranean Sea level variability? (*Keynote Speaker: Damià Gomis*)

**12:30- 12:50** Do the extremes in Adriatic sea level increase? An example of the Adriatic seiche (*Ivica Vilibić*)

**12:50- 13:10** Marseille tide gauge: review and rescue of its historical data (1885-1988) (*Guy Wöppelmann*)

**13:10-14:10** LUNCH

**14: 10- 14:30** A decade of daily sea level variability in the Northern Adriatic (1999-2008)  
(*Fabio Raicich*)

**14:30-15:00** Changes in storminess (*Invited Speaker: Piero Lionello*)

**15:00-15:20** Integration of water mass variation in the Mediterranean Black Sea region  
(*Luciana Fenoglio-Marc*)

**15:20-15:40** Sea level trends along the western coasts of Anatolia from tide gauge, satellite altimetry, GPS and levelling data (*Mehmet Simav*)

**15:40-16:10** Coffee/Tea Break

**16:10- 16:30** Extreme waves in the Mediterranean basin. Occurrence and breaking through meteorological and other focusing (*Ioannis Papadimitrakis*)

### **SESSION 5: THE FUTURE OF THE MEDITERRANEAN SEA (Damia Gomis)**

**16:30- 17:10** Lessons from the first attempts to simulate the future of the Mediterranean Sea  
(*Keynote Speaker: Samuel Somot*)

**17:10-17:40** Impact of a two-way grid refinement at the Strait of Gibraltar on the thermohaline circulation of the Mediterranean Sea (*Invited Speaker: Gianmaria Sannino*)

Dinner offered by HBS-Rhodes/HCMR

### **Day 3: 1 October 2008**

**9:00-9:20** Modelling the sea level changes in the Mediterranean Sea (*Marta Marcos*)

**9:20-9:40** Vulnerability assessment of sea level rise, with the Diva Tool at the Mediterranean Basin (global to regional scale) (*Thaleia Avagianou*)

### **SESSION 6: MONITORING STRATEGIES (Karine Beranger)**

**9:40- 10:20** Building an operational monitoring and forecasting capacity for the Mediterranean Sea (*Keynote Speaker: Kostas Nittis*)

**10:20- 10:50** Coffee/Tea Break

**10:50- 11:10** Deep-sea monitoring strategy at the Cretan Sea (*George Petihakis*)

**11:10-11:20** Tide monitoring system for evolution and risk scenarios in the coastlines and lagoons of the North-Western Adriatic Sea (*Maurizio Ferla*)

### **SESSION 7: SYNTHESIS OF THE WORKSHOP**

**11:20- 12:30** Synthesis of the Workshop (*Keynote Speaker: Vassilis Zervakis*)

**12:30 -14:00** LUNCH

### **Posters:**

- Extreme sea levels in the Mediterranean Sea from observations and storm surge models (*Marta Marcos*)
- Variations of the seasonal sea level cycle in Southern Europe (*Marta Marcos*)
- Coastal sea level trends in Southern Europe (*Marta Marcos*)
- The sea level variation in Alexandria during the last decade (*Ahmed Radwan*)

- An abrupt and massive release of winter intermediate water in the NW Mediterranean (*Gabriel Jordà Sánchez*)
- Time-series analyses of measurements from monitoring stations along the Turkish coast (*Ersin Tutsak*)
- Sea level and ADCP current monitoring strategy and analyses of measurements along the Turkish coast (*Özgür Gürses*)
- Sea surface temperature alterations in the Eastern Mediterranean (Aegean Sea) in the last 21 years (*Dionysios E. Raitsos*)
- Statistics of extreme surge level values in the Venetian Lagoon (*Cosimo Pino*)
- Tools for evaluation of extreme wave in the Mediterranean Basin (*Maria Barbara Galati*)
- Distribution of sea level rise in the Mediterranean Sea and the North-Eastern sector of the Atlantic Ocean: 1945-2000 (*Francisco Mir*)
- A mesoscale index to describe the regional ocean circulation around the Balearic Islands (*Sebastian Monserrat*)
- Shipping and climate change (*Anna Kotrikla*)
- Steric contribution to sea level change in Mediterranean Sea (*Luciana Fenoglio-Marc*)
- Statistical determination of possible feedbacks from the Mediterranean Sea (*María Ortiz-Beviá*)
- Mediterranean circulation changes since the late glacial: seven time slice reconstructions (*Giuseppe Siani*)
- The Paleomex Project (*Marie-Alexandrine Sicre*)
- Modelling the Mediterranean Sea interannual variability over the last 40 years: Impact of the river runoff and of the Atlantic Waters (*Jonathan Beuvier*)