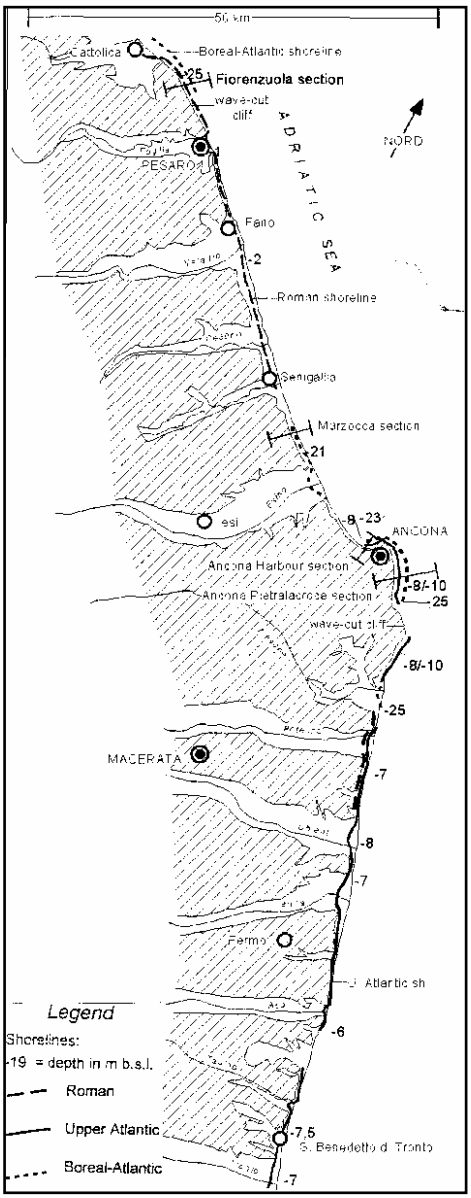
THE EVOLUTION OF THE MARCHE REGION COASTAL ZONE (ADRIATIC SEA) AND THE CLIMATE CHANGE

M.G. Angeli [(1)], A. Galvani [(2)], P. Gasparetto [(3)], F. Marabini [(4)], A. Mertzanis [(5)], F. Pontoni [(6)]

[(1)] I.R.P.I. CNR - Perugia Italy
[(2)] Facoltà di Scienze Economiche - Università di Bologna – Bologna Italy
[(3)] IQT Consulting - Rovigo Italy
[(4)] ISMAR- Marine Geology Institute - C.N.R. - Bologna, Italy
[(5)] Technological Educational Institution of Lamia - Greece
[(6)] Geoequipe STA - Tolentino (MC) Italy



Fig, 1

On the basis of the geomorphological, geological, archaeological and drilling data, three Holocene shorelines have been reconstructed along the Northern and Central Adriatic coast (C. Elmi et al., 2003 Fig. 1).

In the southern tract, next to the Marche Apennines arc, which is generally stable or involved in a slow uplift, the coast is irregular with narrow beaches intersected by large alluvial plains. Three wave-cut cliff, formed during the late postglacial rise, occur at -19/-25 m, -6/-10 m and -2 m. (fig.1).

The map and the sections show clearly oscillation of the ancient shorelines around the present day position of the shoreline. The situation changes going northward in presence of the Emilia sandy littoral and of the Venice lagoon with the Po plain on the back.

In particular, utilising the results of some studies (L.Carbognin et al. 1996 and 2004) and comparing the sea level rise from 1896 up to 2002 in Venice and in Trieste, we obtain a vision of the sea level rise (S.L.R.) in Northern Adriatic Sea evidencing the difference, due to the man activity induced subsidence in Venice, from the period 1931-1970 (tab.1). The reference of the Trieste S.L.R. for the Adriatic Sea is considered important because the long series of data from 1816 up to today gives a S.L.R. 1,13 mm/year for the Adriatic Sea.

Comparison between the sea-level trend in (mm/year) recorded at the Venice and Trieste tide gauges for different time intervals of the 20th century (updated and modified after Carbognin and Taroni, 1996)

Period	Venice	Trieste	Note
1896–1930	1.54	1.73	not statistically significant differences between Venice and Trieste
1931–1970	3.86	1.54	statistically significant differences between Venice and Trieste due to land subsidence in Venice
1971–1993	– 0.89	– 0.30	the rates are too small to show statistically significant differences: sea level is steady
1971–2002	**1.53**	**1.47**	slight sea level rise, not statistically significant difference between Venice and Trieste
1896–1993	2.52	1.13	significant difference due to anthropogenic land subsidence in Venice between 1931 and 1970
1896–2002	2.50	1.19	significant difference due to anthropogenic land subsidence in Venice between 1931 and 1970

Table 1 - Comparison between the sea level trend in (mm/year) recorded at the Venice and Trieste ride gauges for different time intervals of the 20th century (updated and modified after Carbognin and Taroni, 1996)

If we consider only this value for the future S.L.R. up to 2100 in the Marche Region coastal zone, we have not a danger vision for the future, but we cannot forget that the climate change is to day complicated involving not only natural factors, like in the past times, but even the effects of the interference of

factors due and emphasized by the man activity. This is evident by the IPCC data and scenarios (fig.2).

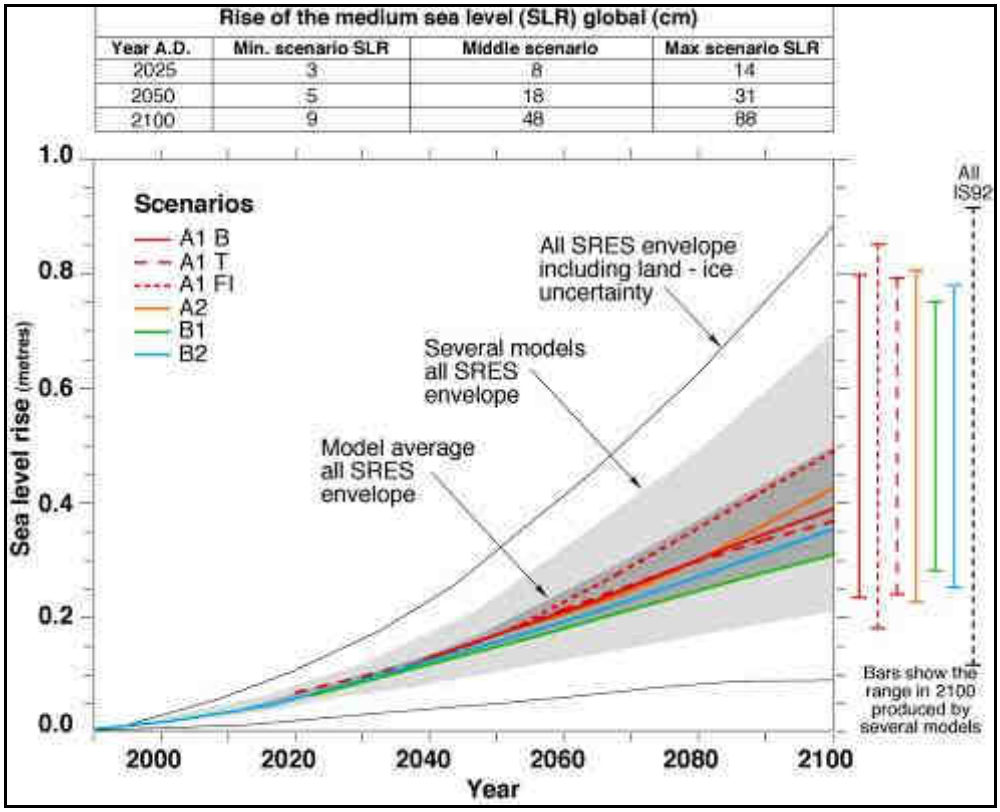


Fig. 2 - Range of the possible sea level rise up to 2100 with different scenarios (IPCC 2001).

Starting from this point of view, some considerations about the Italy and Mediterranean Sea situation can made.

According with the most dangerous scenarios of the IPCC are the results of the TOPEX/POSEIDON satellite measures (1993-98) for the Mediterranean Sea: the mean value for the entire Mediterranean Sea is > 10 mm/year with maximum 30 mm/year in the Black Sea and in the area South Creta isle. On the other hand there are negative values in the Ionian Sea and in the Western Mediterranean basin. In the Adriatic Sea and in the Tyrrhenian Sea there are positive values of S.L.R. comprised between 2 and 16 mm/year. Cazenave et al. (2002) explain these high values like cyclical oscillations (few years period) connected to thermal hydrological balance of the Mediterranean Sea water. On the other hand we consider too short the period of the measures (1993-98) and

suggest to continue the measures that can be utilised in the next time, but not to day.

Some recent studies (E. Chiarimenti et al. 1999; D.A. Metaxas et al. 1991; J.B. Palutikof et al. 1996) indicate for the italian greek and north african coast zone an increasing of 0,9° C for each 1° C of global warning.

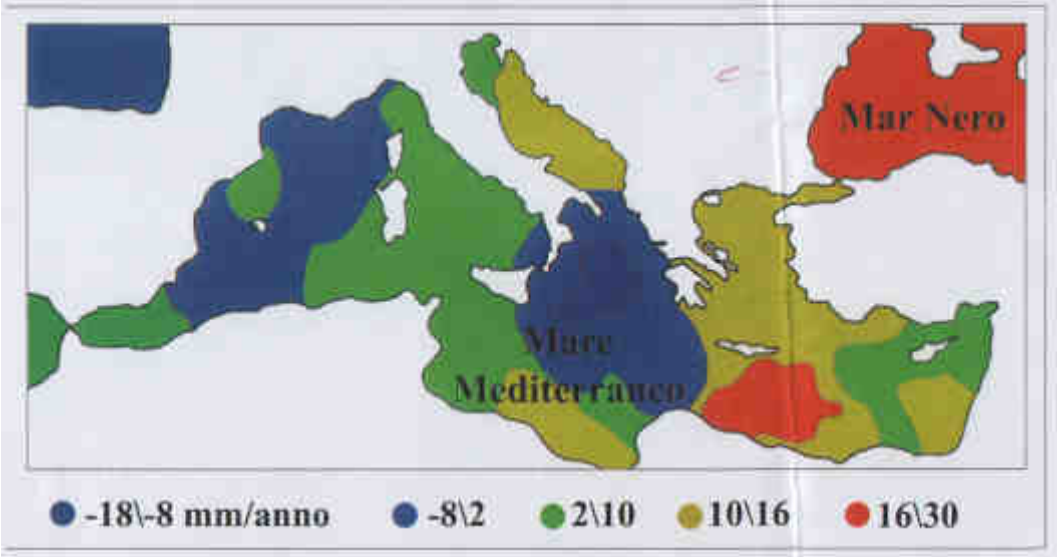


Fig. 3 - Scheme of sea level rise of the Mediterranean Sea measured by Topex-Poseidon Satellite redrawn from Cazenave et al., 2002).

A consequence of this increasing of temperature may be a diminished rain fall in south Mediterranean Sea. About this possibility V. Ferrara (2002) indicates a diminished rain fall for Italy with a dangerous increasing of desertification in South Italy. In general we can consider a shifting northward of 150 km for the climate characters for each increasing of 1° C temperature.

These examples about Italy and Mediterranean Sea to remember that many scientists agree with the IPCC data even if other scientists do not agree.

On the other hand, the possibility of the diffent scenarious with a variability interval from 9 cm up to 88 cm in 100 years indicate clearly how much the situation is doubtful.

The II scenario, considering the IPCC data (fig.2) and according with precedent studies in the area (Carbognin et al, 1996 - 2004), is based on the IS92a and the consequent S.L.R. is considered about 30 cm up to 2100.

This situation may be danger for the future of the Marche coastal zone. At the end we propose to compare the proposed scenario with the values of the maximum S.L.R. in 2100 A.D.

This solution permits a reasonable comparison of the data in different regional coastal zones and a reasonable prediction for the variability of factors not important in the past time.

On the other hand, we cannot forget that, up to the present time, the discussion about importance of these factors, depending mainly from the man activity in the next 100 years, continues and it is far from a general agreement.

The guidelines of this proposal, for the future climate change in the Marche region coastal zone, permit to utilize the local regional data of the Adriatic Sea and the IPCC data.

This solution permits even to avoid difficult discussions considering that, today, the international scientific community is divided about the evaluation of the global warming for the future.

REFERENCES

Carbognin L., Marabini F., Taroni G., Tosi L., 1999. Effetti della subsidenza ed eustatismo sul comprensorio lagunare veneziano. Le pianure, pp.18-30

Cazenave A., Bonnenfond P., Mercier F., Domini K., Toumazou V., 2002. Sea level variations in the Mediterranean Sea and in the Black Sea from satellite altimetry and tide gauces. Global and planetary change, 34, pp.59-86

Elmi C., 2003. La risposta dei processi geomorfologici alle variazioni ambientali nella pianura padana e sulle coste nord e centro adriatiche. Università e ricerca, pp.225-259

IPCC, 2001. "Climate change 2001: the scientific basis

Ortolani F., Pagliuca S., 1994. Variazioni climatiche e crisi dell'ambiente antropizzato. Il Quaternario 7, pp.531-536

Pirazzoli P.A., 2000. Cambiamenti globali e variazione del livello del mare:meccanismi e tendenze evolutive. Mare e cambiamenti globali, ed.ICRAM, pp.15-28

Silenzi S., Devoti S., Nisi M.F., Antonioli F. ,2003. Le variazioni del livello del mare come cause determinanti il rischio da RSRL. Studi costieri n.6, pp.31-56