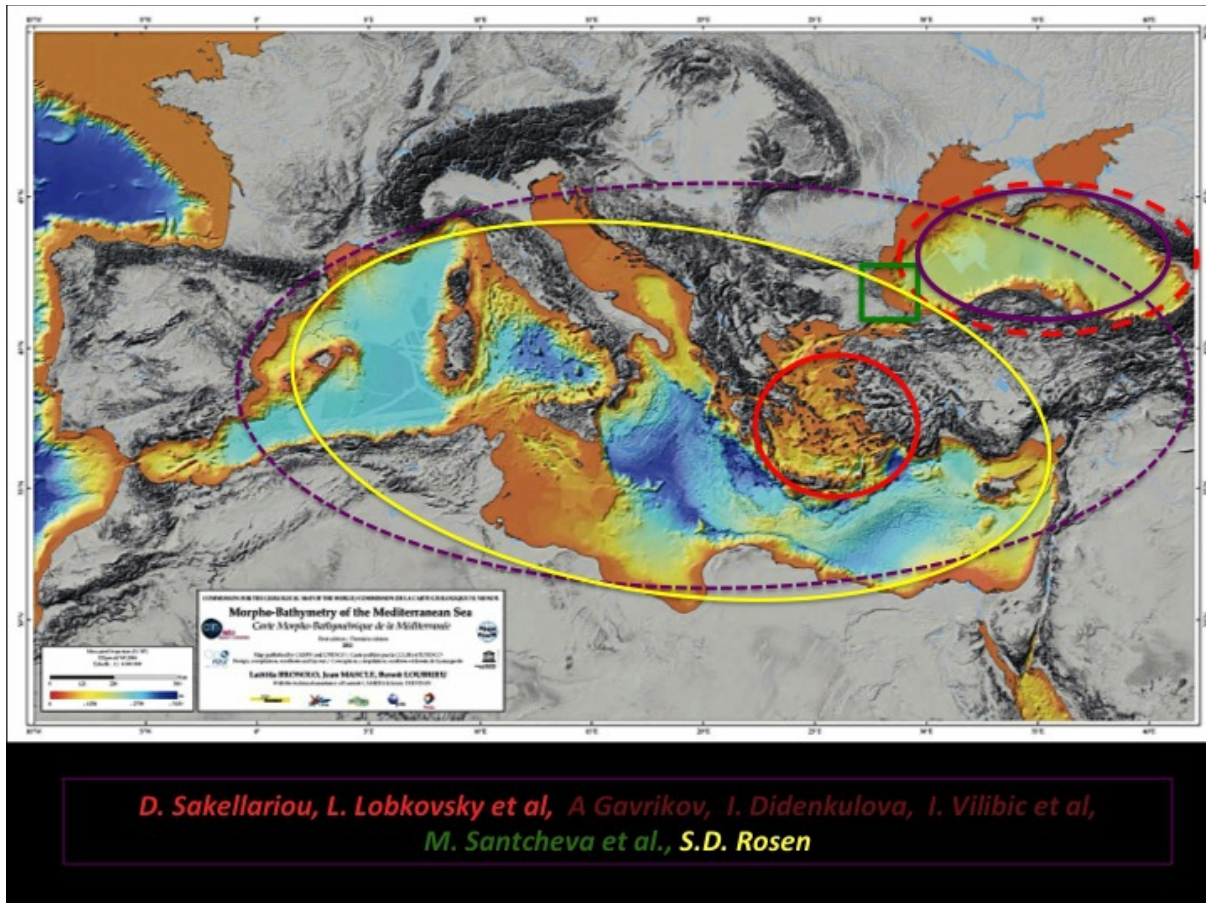


Panel B- *MARINE GEO-HAZARDS*

Co-moderators: Drs Evgeni KULIKOV and Jean MASCLE

Conclusions and recommendations from the Panel discussions

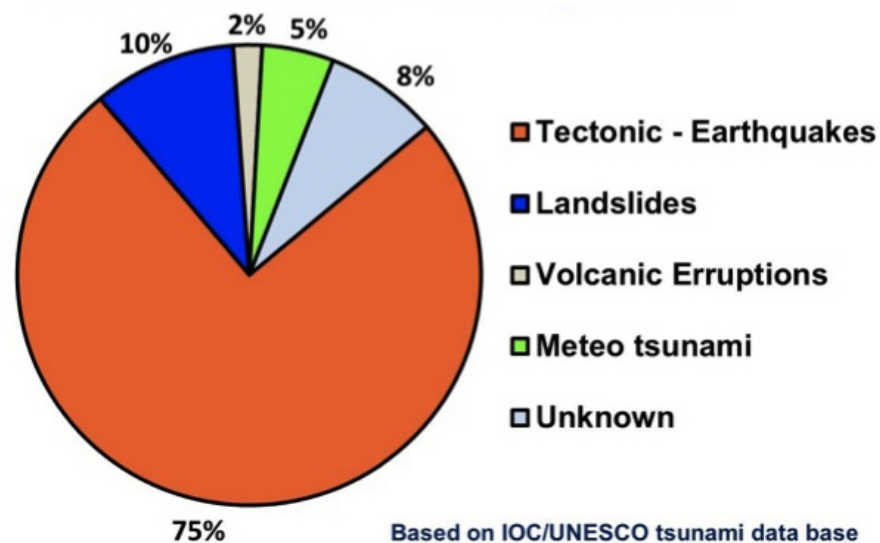


Areas of the Mediterranean and Black Seas discussed during the presentations

In the morning of December 3, the Panel B moderators did lead a general Plenary discussion on the main results to be derived from the various presentations and from the rich exchanges that followed. It was stressed that the types of geo-hazards, which may affect the two areas, Mediterranean and Black Seas, are not totally comparable.

The Mediterranean domain is mainly an area submitted to natural geo-hazards triggered by mechanisms such as seismic ruptures, various volcanic activities and sedimentary submarine instabilities, all processes able to potentially generate relatively large-scale tsunamis that may cross relatively wide basins and are historically known to have strongly damaged coastal areas around the basin. This leads to conclude that the Mediterranean Sea, and particularly its Eastern domain, is clearly an area of relatively high risk due to natural geology-driven hazards or GEO-HAZARDS.

Even if the northern coasts of the Black Sea can be hit sometimes by tsunamis generated by high level seismic activity along the northern Turkish coasts, the basin remains chiefly submitted to tsunami-like events due to extreme meteorological episodes such as extreme storms and sudden winds and/or atmospheric forcing, or METEO-HAZARDS; in both areas sub-bottom degasing, able to impact the seafloor, has also been suggested as potential trigger for tsunamis; such mechanisms still need to be supported by evidence even if degasing is a natural process documented in the Eastern Mediterranean and in the Black Sea. The participants also agreed that coastal erosion should be considered as an effectively damaging phenomenon even if not being and instantaneous catastrophic process similar to most of the natural geo/meteo-hazards.



Distribution of causes for Tsunami generation (after D. Rosen)

In concluding, E. Kulilkov and J. Mascle stressed first that coastal processes such as cliff collapses, landslides, floods, and erosion, even if not strictly entering into the category of catastrophic geo-hazards, should be considered as an important issue to be more taken in account all around the Mediterranean and the Black Seas. The most human and economically damaging geo-hazards are those related to seismicity and active tectonics, to volcanisms and to submarine landslides. Moreover these already catastrophic mechanisms may generate large-scale tsunamis, which could strongly impact coastal areas. The Mediterranean Sea has historically already paid a large tribute to such natural Geo-Hazards, which likely generate more than 90% of tsunamis on the Earth surface.

Meteo-Geohazards, consequences of extreme winds and storms, or due to atmospheric forcing, could be significant, particularly in relatively small-enclosed seas such as the Adriatic or the Black Seas. In these areas such extreme episodes are results of specific atmospheric/topographic conditions and could generate local destructive tsunami-like events hitting a few hundreds of kilometres of coastline. We must therefore investigate meteo-tsunamis in the future. From climate projections it is likely that they will be more frequent and stronger as they are the result of a «boiling» and unstable atmosphere. To tentatively prevent such events we strongly recommend to develop accurate modeling

of extreme wind generation, such as Bora, Meltem or Mistral, and to develop international meteo-tsunami warning systems.

Finally concerning the tsunamis, which constitute one of the major catastrophic consequence of both geo and meteo hazards at the scale of the Mediterranean and Black Seas, the group fully endorses the conclusions of one of the speakers (D. Rosen): there are advances and gaps! The major advance is that a NEAMTWS (North-East Atlantic and Mediterranean Tsunami Warning System) is operational since 2012 and improving.

However this system still suffers from gaps. For example: - the tsunami models allows to model only the 1st wave of a series of 3-7 waves (only sometimes the first wave is the highest!) - the NEAMTWS does not cover marine landslide or volcano induced tsunamis;; - similarly the NEAMTWS does not deal with flooding by storm surge/wave storm or extreme wind (meteo-tsunamis). - Moreover NEAMTWS still needs additional real time sea level stations, quality controlled sea level data, and data provision via GTS

To fill these gaps a multi hazards early detection and warning system should be proposed, consisting of: - (1) A network of array high frequency radars (WERA)- (2) An increase of the Real Time sea level gauges network; - (3) A few complementary DARTs and/or GPS tsunami buoys

As a summary and general conclusions, Panel B stresses that:

(1) Marine Geo-hazards (***generated below the sea surface***) such as tectonic/seismicity, volcanism, landslide and related tsunamis, generate major regional catastrophic events. The play of marine landslides in generating local tsunamis remains however largely underestimated; there is consequently an urgent need for detailed bathymetric data.

(2) The importance of various Meteo-driven “tsunamis” (***from above the sea surface***), particularly for the Black Sea, and the need for more focused studies and wind generation modeling must be emphasized.

(3) Improving and extending already existing warning systems (particularly for the Black Sea) and developing quick data exchange are three particularly important actions which have to be strongly supported.