

Delta Session DS 2: Po Delta and the Venice Lagoon

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The Po delta and the Venice lagoon session discussed a number of key issues related to climate change impacts and response strategies in the delta. First, the most recent SLR scenarios and the vulnerability of the whole Delta region to SLR were presented. Then, the management plan of the Po Delta Park and the measures for the safeguarding of the Venice lagoon were illustrated. The discussion with the audience focused on the governance of these complex systems, particularly in relation to climate change. The following paragraphs summarize the key findings of the session.

The Venice lagoon and the Po delta are located along the north-east coast of Italy. They are part of an articulated system of lagoons and deltas that mainly lays at or below the mean sea level. With its 550 km², the lagoon of Venice is the largest of the Mediterranean region hosting the historical city of Venice. Just south of the lagoon the Po river, stretching all the way from the West to the East of the Italian peninsula, flows into the Adriatic Sea through a wide delta (see Figure1).

The most recent SLR scenarios for the north Adriatic Sea foresee between -16 cm (lower bound) and +70 cm (upper bound with the ice sheets melting playing a major role) by 2100. Under certain conditions regional sea level may reach values of about 50–60 cm above present one in the second half of this century. If more conservative scenario with the current trend of 23 cm/century is considered, this level will be reached only after 2200.

Wide areas of the delta region are already experiencing flooding, erosion, and loss of habitats. Sea level rise is expected to exacerbate current trends. For example, the frequency of flooding of the Venice lagoon urban centers would increase from an average of 3 times per year at present mean sea level up to 30 times more in case of +60 cm SLR. With the same rise of the mean sea level the whole Po delta region would be exposed to high risk of inundation with consequent disappearance of wetland and coastal habitats.

The Po delta is part of the European Natura 2000 network. The Natura 2000 management plan can provide a contribution to climate protection policies which have recently entered the agenda. However, the development of a management plan of the park has been debated for more than ten years without coming to the definition of the plan and the perimeter of the park. A problem of governance has been pointed out. The constellation of small local authorities (73.000 inhabitants in 9 municipalities) and the presence of two regional governments makes it difficult to agree on priorities to pursue.

In the Venice lagoon, a wide program including local and coastal defense, morphological reconstruction measures and pollution abatement measures have been implemented since the early 80s. To protect the Venice lagoon urban areas from flooding, an integrated system of storm surge mobile barriers at the lagoon inlets (called MOSE *Modulo Sperimentale Elettromeccanico* or electromechanical module) and local defenses in the lagoon urban centers is under construction. The barriers consist of 78 independent floating gates placed at the bottom of the lagoon inlet channels. Every time a tide of +110 cm (so called safeguarding level) is forecasted the barriers are raised up to separate the lagoon from the sea for the duration of the tidal event. The system is designed to stand +60 cm SLR. In the lagoon urban areas, local defenses consist of raising as much as possible up to +110 cm public pavements and lagoon banks. The level to which it is possible to raise the urban areas, however, depends on the architectural structure of the historical centers. The coastal defenses consist of soft measures such as beach nourishment and dune reconstruction and hard measures like breakwater embankments and sea walls. Coastal defenses have also been built considering

+60 cm SRL in the project design. Finally, the morphological restoration include measures such as protection and reconstruction of mudflats and salt marshes, raising of the lagoon bed to reduce wave motion, dredging of lagoon channels, planting eel grass. In the recently updated morphological plan sea level rise is considered when planning these measures.

The storm surge barriers are expected to be completed by 2014. At present, one of the issues being discussed by local actors is the management strategy of the barriers. In particular, to keep the number of full closures the least possible as sea level rises, two possible management strategies according to different sea level rise scenarios were presented by the barriers designer (see Figure 2). In both cases initially the number of full closures will increase as sea level will rise. However, because the barriers are made up of independent gates, it is possible to introduce partial closures in the management. By using partial closures the water level in the lagoon can be reduced by 10-20 cm or even more without permanent negative impacts on the lagoon ecosystems. Then, to further bring down the number of full closures in case of eustatic scenarios above +20 cm SLR, it is possible to increase the level of the local defences. This costly solution can, however, wait until +50 cm SLR (Figure 2-right), which according to the SLR scenarios may occur by at the earliest 2070-2080. Up to +50 cm SLR the proper functioning of the barriers is, in fact, ensured and thanks to the partial closures the number of full closures would remain limited. This would reduce the impacts on the ecosystems (e.g. anoxia phenomena) and on the port activities. Against this background, according to the current climate knowledge, the mobile barriers and the local defences being built in Venice will be able to fully protect the city at least up to the second half of the 21st century and probably beyond. Later on, with more than +50 cm SLR, raising the pavements would buy extra time to the functioning of the barriers to plan further actions.

In both areas of the delta water and environmental governance arrangements are fragmented and not fully effective. This may hinder adaptive capacity of society to deal with climate change in the coming decades. In particular, a climate change adaptation strategy for the whole delta region has not entered the agenda yet.

Concluding, the delta region is dealing with climate change by implementing different types of soft and hard coastal defense infrastructures, particularly in the Venice lagoon. What seems to be missing are adequate institutional arrangements allowing effective water and environmental management of the whole delta and in particular an adaptation strategy for the whole region.

Figure 1 The Venice lagoon and the Po Delta
(Source: Google Earth image)



Figure 2 Different management strategies for the mobile barriers in Venice according to various SLR scenarios
(Source: Scotti at the Deltas in Times of Climate Change Conference, 2010)

