

Lagoons and coastal processes: Water exchange and flushing times - Venice lagoon case study

Dr. Miroslav GACIC

Water flow through lagoon inlets is to a large extent determined by tidal forcing. However, freshwater discharge, stratification and winds can occasionally modify to an important amount, tidally induced currents causing the vertical current shear as well as weakening, strengthening or even reversal of the oscillating flow. Since lagoons are usually very shallow, they are to a large degree influenced by either precipitation, freshwater inflow or evaporation. Thus, the salinity is strongly variable depending on the evaporation – precipitation differences. Lagoons are often under the strong anthropic influence and thus it is important to determine how much of a potentially harmful substances they can tolerate before their ecosystem becomes adversely affected. One of the tools for that is the flushing time concept. The flushing time is defined as the time needed for the 50% of the lagoon water to be exchanged.

In this lecture a case study of the Lagoon of Venice will be presented. The results of six years of current measurements by bottom-mounted ADCP's will be discussed. Characteristics of the flow through inlets for the time scales from tidal to annual ones will be described. The phase-lag between the tidal currents in lagoon inlets and sea level oscillations will be determined. Relationship between variance at different time scales will be discussed. Influence of prevailing winds to the water exchange pattern will be analysed. Methods for estimating of the water flux rate from current measurements will be presented. Then the yearly water balance will be calculated and discussed in terms of the freshwater inflow and precipitation. Dynamical balance will be determined in order to understand which forces control the inlet flows. Methods for the flushing time calculations will be presented and applied to the lagoon of Venice and the results will be discussed. Estimates of the annual water balance will be given and compared to the freshwater discharge. Tidal jets influence on the coastal circulation will be analyzed from the high frequency (HF) radar measurements in the area adjacent to the Venice lagoon inlet.