Austral Summer Institute XIV (ASI XIV)

Changing biogeochemical cycles in the coastal ocean

6-10 January 2014

Coastal systems (including shelf seas) are at the interface of many processes and react to short- and long-term influences acting on both global and regional scales. Pertinent examples include sea level rise, warming, climate, ocean acidification and eutrophication. Compounding such problems are the anthropogenic effects due to overfishing, pollution, transport and the construction of large structures such as wind farms. The allocation of observed change to individual drivers and detection of combined effects remains difficult. This is however, prerequisite for management of the resources provided by the coastal zone.

Energy and material transformations via chemical and biological processes, and fluxes between non-living and living states of matter are the very basis of all ecosystems on land and in the sea. Past, present and future matter cycles in the coastal ocean, the transition zone between the continental and marine spheres, are controlled by a multitude of natural processes (e.g., productivity, export, sedimentation, water-rock interactions, burial) with specific adaptations to changing boundary conditions (e.g., temperature, redox status) through variable rates (e.g., metabolic pathways, rates of assimilation and respiration of carbon, sedimentation rates).

With the onset of the Anthropocene many material cycles in the coastal ocean have seen unprecedented perturbation and acceleration by additions from pools in the geosphere (or atmosphere, in the case of nitrogen), rearrangements of fluxes between compartments of matter, and introduction of chemicals unknown in nature and with adverse effects to organisms. The human footprint in marine biogeochemical cycles is prominent on global (such as CO_2-induced warming, ocean acidification and enhanced nutrient element transport via the atmosphere), and regional/local scales (eutrophication/pollution from agriculture and industry in individual watersheds, altered nutrient ratios, coastal hypoxia).

As the coastal ocean is likely to become warmer, more acidic and more polluted, the course aims to provide participants with:

- information and techniques that enable them to appreciate the roles of shelf seas and coastal systems in material cycles, to evaluate the consequences of enhanced and altered material cycles for regional subsystems, and to anticipate the subsequent chances and risks for human society emerging from these changing biogeochemical cycles.
- In topical lectures and practical exercises, we will review some of the basics of biogeochemistry and get acquainted with some useful tools that help us in analyzing data, understanding interactions, and assessing the status of typical coastal systems.

Contents

Continental shelves – Types, processes, resources

Challenges to coastal zones

Biogeochemistry of coastal zones
- Basics of biogeochemistry – environmental stoichiometry
- The global carbon cycle and the carbonate system
- Eutrophication and oxygen
- Pollution from anthropogenic sources

Regional examples
- North Sea – an open shelf sea
- Baltic Sea – a large estuary
- Mediterranean Sea
- Benguela Upwelling System

Practicals

Biogeochemical budget methodology and applications
- LOICZ budgeting methodology

Introduction to STELLA box modeling software
- The global carbon cycle

Ocean Data View