

Lesson Plan

Environmental Geodesy

(环境大地测量学)

Offered by: Prof (Assoc) Dr. Vagner Ferreira (瓦格纳)

Part I (weeks 1 to 4): The Basics

Week 1 (Introduction): Geodesy, the science of measuring the Earth's shape, gravity field, and rotation: brief history of geodesy, introduction of today's situation with three distinct pillars (i.e., Geokinematics, Earth's rotation, gravity field). These three pillars are called the "three-pillars of geodesy", there could exist a fourth one? Remote sensing of the atmosphere! Introduction to geodetic reference systems and frames.

Week 2: (Pillar 1 – Earth's shape): Descriptive approach to changes in Earth's shape including the ice and ocean surface. The long-term mean shape of the Earth will be considered briefly. Main focus will be on changes in the shape: starting from co-seismic displacements, seismic waves and free oscillations, going over Earth and ocean tides, atmospheric, hydrological, and glacial loading, to sediment loading and tectonic changes, the various phenomena of surface displacements will be considered.

Week 3 (Pillar 2 – Earth's gravity field): Basic terms related to the gravity field will be introduced, including the geoid.

Week 4 (Pillar 3 – Earth's rotation): The principle ideas and phenomena related to Earth's rotation will be introduced, including the nearly diurnal free wobble, the Chandler wobble, and precession and nutation. The current understanding of the rotational dynamics and the origin of Earth's rotation perturbations will be presented. Earth rotation as the link between terrestrial and celestial systems.

Part II (weeks 5 to 6): The Techniques

Week 5: Global Navigation Systems (GNSS) – Observing point motion and maintaining global geodetic reference system. GNSS reflectometry – observing surface displacements with imaging geodesy. Satellite altimetry.

Week 6 (Gravity Field Missions): Basic considerations. Satellite-to-satellite tracking (SST), SST in high-low mode, the CHAMP mission and its applications on Earth system. SST in low-low mode, the GRACE mission and its application on Earth system. Satellite Gravity Gradiometer (SGG), introduction to GOCE mission.

Part III (weeks 7 to 8): The Applications

Week 7 (Applications – Hydrology): Water and society, hydrology and geodesy (Hydrogeodesy?), the water cycle and global water distribution. Geodetic products for hydrology, combining gravity and hydrology, processing GRACE data. Examples of potential applications.

Week 8 (Applications – Oceanography): Sea level changes, “barystatic” sea level changes, steric sea level changes, non-steric sea level changes.