001-2-4056 Aeolian Geomorphology

Number of credits: 2 credit hours

Number of meetings: 2 hours per week

Prior requirements: Physics – Mechanics, Calculus

Registration Limitation: None

Course goal:

Providing theoretical and practical knowledge of the basic physical principles involved in sand and dust transport by the wind, and understanding the basic bedforms formation such as ripples and dunes.

Course objectives:

- Introduction to the physics of sand and dust transport by the wind from initiation to steady state sailtation.
- Understanding the morphology of the different types sand ripples and dunes and introduction to their mathematical modeling.
- Mobility of sand dunes and the interaction between wind, sand, vegetation and biocrust.
- Dust emission and its effects on climate, ecology and agriculture.
- Introduction to planetary aeolian morphology on Mars and Titan.
- Introduction to basic experimental methods both in field and wind tunnel.

Introduction:

The transport of sand and dust by wind is a potent erosional force, creates sand dunes and ripples, and loads the atmosphere with suspended dust aerosols. This course presents an extensive review of the physics of wind-blown sand and dust on Earth. Specifically, the course will focus on the physics of aeolian saltation, the formation and development of sand dunes and sand ripples, the physics of dust aerosol emission, the weather phenomena that trigger dust storms, and the lifting of dust by dust devils and other small-scale vortices. The physics of wind erosion is complex, as it involves atmospheric, soil and land-surface processes. The research on wind erosion is multidisciplinary, covering meteorology, fluid dynamics, soil physics, colloidal

science, surface soil hydrology, ecology, etc. We will also discuss the physics of wind-blown sand and dune formation on Mars, Venus and Titan.

Course Contents:

- Basic patterns of winds, wind statistics and wind measurements.
- The physics of turbulent boundary layer and the law of the wall.
- Sand characteristics and grain size distribution, mineralogy, shape, surface textures and color.
- The initiation of sand transport, fluid and impact threshold, shear velocity.
- Modes of sand transport, saltation, reptation and suspension,
  basic equations of steady saltation flux, spatiotemporal variability of sand transport.
- Ripples, fluid drag ripples and megaripples and different modeling methods.
- Dunes morphology and dune modeling, active and stabilized dunes, global distribution of sand dunes.
- Sand seas, distribution, sand supply and flow paths, climate change and changing wind regime.
- Dunes, vegetation and biocrust dynamics under climate change, coastal dunes.
- Dust emission and transport. The effect of dust on ecosystems, dust events and weather systems.
- Wind erosion and dust production from agriculture and grazing land, the dust bowl and wind erosion in the Sahel.
- Planetary aeolian geomorphology, Mars, Venus, Pluto and Titan, dust in the martian atmosphere.
- Field methods and wind tunnel techniques. Visiting the boundary wind tunnel at BGU.
- Field trip to the Nahal Kasuy sand dunes in the southern Negev.

Course requirements:

- Exercises during the course (40%)
- Final exam (60%)