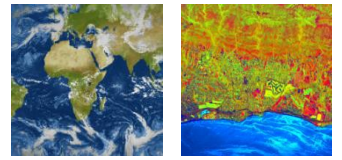


<http://teledetection.ipgp.fr/mpt>

Université de Paris, Sorbonne Université
Institut de Physique du Globe de Paris
Ecole Normale Supérieure, Ecole Polytechnique
ENSTA ParisTech, École des Ponts ParisTech



M2 Fundamentals of Remote Sensing

Last update: Thursday, July 04, 2019

Optional Module 1

Credits: 6 ECTS (choice of two lectures over three)

Remote Sensing of Tectonics and Volcanic Deformation

Teachers: Arthur Delorme (delorme@ipgp.fr), Raphaël Grandin (grandin@ipgp.fr), Romain Jolivet (romain.jolivet@ens.fr), and Christophe Vigny (vigny@geologie.ens.fr)

Credits: 3 ECTS

Summary: remote sensing of tectonics and volcanic deformation.

Organization: 14h lectures + 4h tutorials + 10h practical work.

Books

Outline

- 1 séance d'introduction à la géodésie physique (Christophe Vigny, ENS)
- 2 cours GPS + 2 TP GPS (Christophe Vigny, ENS)
- 2 cours InSAR + 2 TP InSAR (Raphael Grandin, IPGP)
- 1 cours imagerie optique + 1 TP imagerie optique (Arthur Delorme, IPGP)
- 1 cours modélisation (Romain Jolivet, ENS)
- 2 séances de TD de lecture d'articles scientifiques

Arthur Delorme is a research engineer at the [Institut de physique du globe de Paris](#) in the team "Tectonique et mécanique de la lithosphère". His research focuses on the correlation of optical images applied to the computation of digital terrain models and the measurement of deformations. He is much involved in the exploitation of very high resolution data from the Pleiades satellites.

Raphaël Grandin an assistant professor at university [Université de Paris](#) and a researcher at the [Institut de physique du globe de Paris](#) in the team "Tectonique et mécanique de la lithosphère". His research focuses on the seismic cycle and the magmato-tectonic interactions. He is also developing new methods to process Interferometric Synthetic Aperture Radar (InSAR) data, specifically applied to the Sentinel-1 satellites.

Romain Jolivet an assistant professor at [Ecole Normale Supérieure](#) and a researcher at the "Laboratoire de géologie de l'école normale supérieure" ([UMR 8538](#)). His research focuses on the seismic cycle (earthquakes and inter-seismic deformation) that he studies through a panel of geodetic data (InSAR, GPS). For this he develops Bayesian inversion tools.

Christophe Vigny is a senior researcher at the "Laboratoire de géologie de l'école normale supérieure" ([UMR 8538](#)). His research focuses on the seismic cycle in subduction zones (Andes), that he studies through networks of GPS stations to deduce deformations on time scales ranging from 1 Hz (seismic waves, static displacements) and ten years (inter-seismic loading).

Planetary Remote Sensing

Teacher: Cécile Ferrari (ferrari@ipgp.fr)

Credits: 3 ECTS

Summary: this lecture aims to give a general culture on exploration of the solar system and to further describe the remote sensing methods commonly used to study the planets and small bodies without atmosphere of the solar system.

Organization: 10x3h lectures.

Books

Outline

- Introduction et problématique scientifique : description du système solaire ; scénarios de formation et d'évolution ; stratégie scientifique et télédétection (origines, évolution, observables) ; historique de la télédétection spatiale et de l'exploration spatiale ; surfaces sans atmosphère (cratères et régolithes,

autres structures géologiques, composition, état de la surface, traces de l'origine et de l'évolution) ; évolution des surfaces (bombardement divers, érosion spatiale...)

- Imagerie et spectroscopie: principe et instrumentation associée à la télédétection multi-longueur d'onde (spectroscopie de réflectance de l'UV à l'infrarouge proche, spectroscopie thermique, spectroscopie gamma, sondage radar, techniques radio) ; complémentarité des observations du sol et de l'espace
- Modélisation des surfaces planétaires : transfert de rayonnement et d'énergie, polarisation ; physique du solide et spectroscopie (ionisation, électrons de valence, vibration, rotation et étirement des molécules)
- Applications : exploration martienne et recherche de l'eau sur Mars ; petits corps du système solaire : comètes, astéroïdes, satellites glacés des planètes géantes ou objets trans-neptuniens) ; missions spatiales vers les planètes géantes (Voyager, Galileo, Cassini) ; télédétection des planètes extrasolaires

Cécile Ferrari is a professor at the university [Université de Paris](#) and a researcher at the "Institut de physique du globe de Paris" ([IPGP](#)) in the team "Planétologie et sciences spatiales". Her research focuses on the evolution of planetary surfaces, in particular, their characterization by infrared imaging or spectroscopy.

Satellite Geodesy and Geophysical Applications

Teacher: Olivier Bock (bock@ipgp.fr), Kristel Chanard (chanard@ipgp.fr), Guillaume Lion (lion@ipgp.fr), and Samuel Nahmani (nahmani@ipgp.fr)

Credits: 3 ECTS

Summary: this lecture aims to give a general culture on the current use of space geodetic techniques in geophysics (non-tectonic deformations, meteorological and climate applications) and to open up new perspectives on their future applications.

Organization: 10x3h lectures.

Books

Outline

- How to achieve a millimetric precision with space geodetic data? (S. Nahmani)
 - GNSS Data processing (2h)
 - Application with real GNSS data (7h practical work with Matlab)
- Satellite geodesy and non-tectonic applications (sea level rise, GIA and recent ice melting, loading effects, thermo and poroelastic effects) (K. Chanard)
 - Space gravimetry, GNSS, altimetry and combination of satellite geodetic techniques for non-tectonic solid Earth applications (3h)
 - Physical models of non-tectonic solid Earth deformation (3h lecture + 3h practical work)
- Gravimetry and chronometric geodesy (G. Lion) (6h)
- Meteorological and climate applications (O. Bock) (2h)
 - From zenithal tropospheric delay of GNSS to integrated water vapor (IWV)
 - Analysis of global and regional variability of IWV using GNSS networks
- Assessment (2 x 2h)
 - Scientific articles: read and comment

Olivier Bock is a senior researcher with the Ministry of Sustainable Development. His main research interest is the study of the atmospheric water cycle at all spatial and temporal scales, using observations and models. He is also leading methodological developments for the processing and post-processing of GNSS data dedicated to monitoring the atmospheric integrated water vapor content.

Kristel Chanard is a researcher both at the "Institut de physique du globe de Paris" ([IPGP](#)) and the "Institut national de l'information géographique et forestière" ([IGN](#)) in the team "Géodésie". Her research focuses on better quantifying and understanding non-tectonic sources of deformation through a panel of geodetic data (GNSS, gravimetry, altimetry, etc.) and the development of geophysical models.

Guillaume Lion is a researcher both at the "Institut de physique du globe de Paris" ([IPGP](#)) and the "Institut national de l'information géographique et forestière" ([IGN](#)) in the team "Géodésie". His research focuses on the contribution of atomic optical clocks in geodesy and geosciences.

Samuel Nahmani is a researcher both at the "Institut de physique du globe de Paris" ([IPGP](#)) and the "Institut national de l'information géographique et forestière" ([IGN](#)) in the team "Géodésie". His research focuses on the methodology of GNSS data processing and their geophysical applications (loading deformations, meteorology and climate).