Advanced Remote Sensing

Type of Module	Module Code
Advanced Module	AM-METRS

Identification Number	Workload	Credit Points	Term	Offered Every	Start	Duration
MN-GM-METRS	180 h	6 CP	1. – 3. Semester	SuSe	Summer Term Only	1 Semester

1	Course Types	Contact Time	Private Study	Planned Group Size
	a) Lectures	45 h	45 h	15
	b) Exercise	30 h	60 h	

2 Aims of the module and acquired skills

To create understanding of:

- the remote sensing principles that enable remote sensing of atmospheric and Earth surface characteristics
- the use of different spectral ranges of electromagnetic radiation in remote sensing
- of remote sensing instrumentation and the global meteorological observation network
- the principles, development and application of retrieval algorithms

Skills:

- Ability to interpret and to quantitatively analyse remote sensing observations
- Development and assessment of statistical assumptions, numerical complexities and practical limits of retrieval and assimilation techniques
- Programming experience, presentation skills, team work in hands-on-training

3 Contents of the module

- Remote sensing principles, meteorological satellites and orbits
- Principles of retrieval algorithms for the inversion from radiances to geophysical parameters
- Passive remote sensing of the atmosphere at visible, infrared and microwave wavelengths for temperature, humidity, clouds and aerosol
- Active remote sensing of the atmosphere with cloud and precipitation radar, lidar, wind profiler, sodar and GPS, use of polarimetric techniques
- Remote sensing of the ocean (temperature, color, wind, waves) with passive instrumentation, altimeter and scatterometer
- Remote sensing of Earth Surface and vegetation (SAR, NDVI)
- Hands-on training with ground-based remote sensing instrumentation at the Jülich Observatory for Cloud Evolution (JOYCE), at the Environmental Research Station Schneefernerhaus on Mt. Zugspitze and/or the polarimetric radar Bonn
- Application of remote sensing data for evaluation of reanalysis and dynamic models, e.g. COSMO and ICON
- Excursion to ESA, EUMETSAT or DWD

4	**Teaching Methods** Lecture and project work including remote sensing measurements at ground-based sites: set-up, calibrate & carry out; interpretation and presentation of remote sensing measurements (satellite & ground-based) and model forecasts; PC-exercises on radiative transfer & remote sensing;
5	**Prerequisites (for the Module)** Formal: none With regards to content: Basics of mathematics, physics, experience in programming (mandatory)
6	**Type of Examination** Oral examination (graded) and written report (graded)
7	**Credits Awarded** Successful participation in the project work documented by a written report marked equal or better than 4.0 and passing the oral examination. The examination part may be repeated once during the semester.
8	**Compatibility with other Curricula** • Other modules of equal value can be admitted and announced by the examination board after agreement. • Suitable as an elective course for mathematics, physics and geoscience students
9	**Proportion of Final Grade** 6/114
10	**Module Coordinator** S. Crewell
11	**Further Information** **Recommended literature:** Kidder, S.Q. and von der Haar, T.H.; 1995: Satellite Meteorology: An Introduction, Academic Press, 466 pp. Rodgers, C.D.; 2000: Inverse methods for atmospheric sounding: Theory and practice. World Scientific, 238 pp.