	of Modu	le		Module Code							
Advan	iced Moc	lule		AM-METRS							
Identification NumberWorkloaMN-GM- METRS180 h		Workload	Credit Points	Term	1	Offered Every SuSe		Start Summer Term Only		Duration	
		180 h	6 CP	1. – 3	. Semester						
1	Course Types			Contact Time		Private Study		Planned Group Size			
	a) Lectures			45 h		45 h					
	b) Exercise			30 h	60 h		15				
2	Aims	of the modul	le and acqui	ired skills	1		1				
	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 										
	•	 Development 	ent and asse	essment of s	statistical ass		•		ties a	nd practical	
	•	Developme limits of re	ent and asse	ssment of s	statistical ass techniques	sumpt	ions, numeri	ical complexi		nd practical	
3	•	Developme limits of re	ent and asse trieval and as ing experien	ssment of s	statistical ass techniques	sumpt	ions, numeri	ical complexi		nd practical	
3	•	 Developmention Developments of the meteory 	ent and asse trieval and as ing experien	essment of s ssimilation f ce, present	statistical ass techniques ation skills, t	sumpt eam v	ions, numeri	ical complexi		nd practical	
3	Conte	Developme limits of re Programments of the me Remote se Principles	ent and asse trieval and as ing experien odule ensing princip of retrieval a	essment of s ssimilation t ce, present bles, meteo Igorithms fo	statistical ass techniques ation skills, t rological sate	sumpt eam v ellites on fro	ions, numeri work in hand and orbits m radiances	ical complexi s-on-training	cal pa	arameters	
3	Conte	Developme limits of re Programme ents of the me Remote se Principles Passive re temperature	ent and asse trieval and as ing experien odule ensing princip of retrieval a mote sensing re, humidity,	essment of s ssimilation f ce, present oles, meteo Igorithms fc g of the atm clouds and	statistical ass techniques ation skills, t rological sate or the inversion nosphere at waresol	eam v ellites on fro visible	ions, numeri work in hand and orbits m radiances	ical complexi s-on-training to geophysi d microwave	cal pa	arameters elengths for	
3	Conte	 Developmentimits of reprogramments of the meters Programments of the meters Remote setents Principles Passive represente Active remressodar and 	ent and asse trieval and as ing experien odule ensing princip of retrieval a mote sensing re, humidity, tote sensing GPS, use of	essment of s ssimilation f ce, present oles, meteo lgorithms fo g of the atm clouds and of the atmo polarimetri	statistical ass techniques ation skills, t rological sate or the inversion aerosol sphere with c techniques	eam v eam v ellites on fro visible cloud	ions, numeri work in hand and orbits m radiances e, infrared an and precipit	ical complexi s-on-training to geophysi ad microwave ation radar, I	cal pa e wave idar, v	arameters elengths for wind profiler,	
3	Conte	 Developmention Developmention Programments of the mention Remote set Principles Passive retemperature Active remsodar and Remote set 	ent and asse trieval and as ing experien odule ensing princip of retrieval a mote sensing re, humidity, iote sensing	essment of s ssimilation f ce, present oles, meteo Igorithms fc g of the atm clouds and of the atmo polarimetri ocean (tem	statistical ass techniques ation skills, t rological sate or the inversion aerosol sphere with c techniques	eam v eam v ellites on fro visible cloud	ions, numeri work in hand and orbits m radiances e, infrared an and precipit	ical complexi s-on-training to geophysi ad microwave ation radar, I	cal pa e wave idar, v	arameters elengths for wind profiler,	
3	Conte	 Developmention Developmention Programments of the mention Remote set Principles Passive retemperature Active remention Active remention Active remention Remote set altimeter altimeter altimeter 	ent and asse trieval and as ing experien odule ensing princip of retrieval a mote sensing re, humidity, iote sensing GPS, use of ensing of the	essment of s ssimilation f ce, present oles, meteo Igorithms fo g of the atm clouds and of the atmo polarimetri ocean (tem neter	statistical ass techniques ation skills, t rological sate or the inversion aerosol sphere with c techniques operature, co	eam v eam v ellites on fro visible cloud s	ions, numeri work in hand and orbits m radiances e, infrared an and precipit ind, waves)	ical complexi s-on-training to geophysi ad microwave ation radar, I	cal pa e wave idar, v	arameters elengths for wind profiler,	
3	Conte	 Developmention Developmention Programments of the mericiples Passive restruction Passive restruction Active remission and Remote search Remote search Remote search Hands-on for Cloud E 	ent and asse trieval and as ing experien odule ensing princip of retrieval a mote sensing re, humidity, iote sensing GPS, use of ensing of the nd scatterom	essment of s ssimilation f ce, present oles, meteo Igorithms fo g of the atm clouds and of the atmo polarimetri ocean (tem neter th Surface ground-bas DYCE), at th	statistical ass techniques ation skills, t rological sate or the inversion aerosol sphere with c techniques operature, co and vegetations sed remote so	eam v eam v ellites on fro visible cloud on (S/ ensin	ions, numeri work in hand and orbits m radiances e, infrared an and precipit ind, waves) AR, NDVI) g instrument	ical complexi s-on-training to geophysi ad microwave ation radar, I with passive	cal pa e wave idar, v instru Jülich	arameters elengths for vind profiler, umentation, Observatory	
3	Conte	 Developmention Developmention Programments of the mention Remote set Principles Passive real temperature Active remains sodar and Remote set Remote set Altimeter a Remote set Remote set Altimeter a 	ent and asse trieval and as ing experien odule ensing princip of retrieval a mote sensing re, humidity, note sensing GPS, use of ensing of the nd scatteron ensing of Ear training with Evolution (JC and/or the por	essment of s ssimilation f ce, present oles, meteo Igorithms fo g of the atmo folarimetri ocean (tem neter th Surface ground-bas)YCE), at th olarimetric r	statistical ass techniques ation skills, t rological sate or the inversion osphere at v aerosol sphere with c techniques operature, co and vegetations see Environme radar Bonn	eam v eam v ellites on fro visible cloud on (S/ ensin ental F	ions, numeri work in hand and orbits m radiances e, infrared an and precipit ind, waves) AR, NDVI) g instrument Research Sta	ical complexi s-on-training to geophysi ad microwave ation radar, I with passive tation at the ation Schnee	cal pa e wave idar, v instru Jülich	arameters elengths for wind profiler, umentation, Observatory rhaus on Mt.	

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.							