The Helmholtz Virtual Institute

Role of aerosol particles as condensation and ice nuclei in tropospheric clouds (Aerosol-Cloud Interactions VI-ACI)

Annual Report and Milestone Status 2009

Milestone status WP-L1 (AIDA)

MS	Milestone description	Month	Partner	Status
L1A	AIDA campaign 1 finished and data available for model studies	12	IMK-AAF	Achieved
L1B	AIDA campaign 2 finished and data available for model studies	18	IMK-AAF	Achieved
L1C	Report on ice nucleation workshop available	24	IMK-AAF	Achieved

MS	Objective	Status of work
L1A	Investigate hygroscopic growth, CCN and IN activation of untreated and coated soot aerosols.	AIDA campaign performed during November 2007 and data available for process modelling within WP-M1
L1B	Investigate hygroscopic growth, CCN and IN activation of organic acids and further aerosol systems.	Two AIDA campaigns (ACI01, ACI02) performed during 2008 and most data available; First process modelling results available; analysis of SID-3 data from HALO-02 and ACI-03 finished (Ulanowski 2009, 2010).
L1C	Ice nucleation workshop performed during September 2007	Overview and result papers published or submitted.

Milestone status WP-L2 (LACIS)

MS	Milestone description	Month	Partner	Status
L2A	Achievement of CCN closure for selected aerosol systems and provision of validated microphysical models / expressions and parameterizations	12	IfT	Ongoing
L2B	Determination of freezing temperatures for selected aerosol systems and provision of validated microphysical models / expressions and parameterizations	24	IfT	Ongoing

MS	Objective	Status of work
L2A	Provide detailed CCN data sets for the validation and improvement of process modelling parameterisations	CCN closure achieved for single aerosol component systems; work in progress for selected coated aerosols.
L2B	Provide detailed IN data sets for the validation and improvement of process modelling parameterisations	Successful LACIS campaigns on freezing properties of uncoated and coated dust particles; university of Hertfordshire provided SID-3 variant (LISA) for LACIS (Clauss 2010); interpretation of depolarization measurements for LISA using RTDF model (Kiselev 2010); ongoing measurements concerning the freezing behaviour of soot particles.

Milestone status WP-L3 (ZINC)

MS	Milestone description	Month	Partner	Status
L3A	Laboratory studies of freezing mechanisms	18	ETH	Ongoing
L3B	Conduct mass spectrometry studies of aerosol hygroscopicity	18	ETH	Ongoing

MS	Objective	Status of work
L3A	Provide parameters describing immersion freezing, contact freezing, and deposition freezing of different seed aerosol	New set-ups for immersion and contact freezing; first experiments on deposition freezing during ICIS; calibrations of HOLIMO with ice analogues carried out (university Hertfordshire); data analysis in progress.
L3B	Provide aerosol hygroscopicity depending on chemical composition on a single particle basis	Previous campaign data from Jungfraujoch research station, Switzerland, and Abisko, Sweden, processed and partly published (*Herich et al., JGR, 2008*).

Milestone status WP-L4 (SAPHIR)

MS	Milestone description	Month	Partner	Status
L4A	Chemical characterisation of particles at AIDA	24	ICG-II	Achieved
L4B	Chemical characterisation of particles at LACIS	24	IfT	Ongoing
L4C	Process understanding for in-situ coating of pre-existing CCN and IN assessed	30	ICG-II	Ongoing
L4D	Couple ZINC chamber to mass spectrometers	24	ETH	Initiated

MS	Objective	Status of work
L4A	Measure composition and mass of coatings on IN and CCN	Aerosol Mass Spectrometer successfully operated during first AIDA campaign. Data evaluation is in progress.
L4B	Measure composition and mass of coatings on IN and CCN	Two campaigns in April 2008 and April 2009. Different aerosol mass spectrometers and an ATOFMS were applied. Data evaluation in progress
L4C	Develop methods to generate relevant particles for IN and CCN investigations.	New method of generating $Ca(HCO_3)_2$ and $CaCO_3$ particles assessed; hygroscopic growth and droplet activation of biogenic SOA (Lang-Yona et al., 2010) and aged biogenic SOA (Buchholz et al., in prep.).
L4D	Develop methods for chemical analysis of atmospheric ice nuclei	Design discussion for coupling device started

Milestone status WP-M1 (Processes)

MS	Milestone description	Month	Partner	Status
M1A	Cirrus parameterization scheme available for use in ECHAM	6	DLR-IPA	Achieved
M1B	Model runs on aerosol mixing state in cirrus finished	12	DLR-IPA	Achieved
M1C	Validated microphysical models, expressions and parameterizations regarding CCN activation for selected aerosol systems	12	IfT	Ongoing
M1D	Ice nucleation properties in mixed-phase clouds assessed	18	FZK	Ongoing

MS	Objective	Status of work
M1A	Improve cirrus microphysics in global models	Scheme available for use in ECHAM4 (JGR, 2006)
M1B	Investigate role of (aviation) soot aerosols in cirrus cloud formation	Results published (ACP, 2007)
M1C	Provide tools for CCN growth and activation for use in large-scale models	Model describing hygroscopic growth and activation in LACIS available. Ongoing: Data analysis from campaigns IN-11, ACI-02 / AIDA and FROST / LACIS
M1D	Provide data base for process modelling	First data base complete. Initiated: Comparison of model calculations and experimental data.

Milestone status WP-M1 (Processes)

MS	Milestone description	Month	Partner	Status
M1E	Ice nucleation properties in cirrus clouds assessed	24	DLR-IPA	Ongoing
M1F	Process model with new IN schemes applied to cirrus data sets	24	ICG-I	Ongoing
M1G	Validated microphysical models, expressions and parameterizations regarding freezing temperatures for selected aerosol systems	24	IfT	Ongoing

MS	Objective	Status of work
M1E	Provide parameterized heterogeneous ice nucleation rates from AIDA measurements.	Effect of SOA coating on ice nucleation of dust investigated.
M1F	Improve understanding of cirrus formation and microphysics	Process model MAID available for use of different IN schemes and cirrus data sets.
M1G	Provide tools for determining freezing temperatures for use in large-scale models	Model simulating freezing experiments in LACIS available. Analysis of data from FROST I /LACIS campaign completed and partly published. Analysis of data from FROST II /LACIS campaign ongoing.

Milestone status WP-M2 (Clouds)

MS	Milestone description	Month	Partner	Status
M2A	Lagrangian ice crystal tracking module for small and mesoscale simulations of cirrus clouds developed	12	DLR-IPA	Achieved
M2B	Ice microphysics module for small and regional-scale contrail studies developed	12	DLR-IPA	Achieved
M2C	Case studies on cirrus clouds obtained during field campaigns	12	ICG-I	Ongoing

MS	Objective	Status of work
M2A	Develop a state-of-the-art 2D/3D model for benchmark simulations and basic UTLS studies	Validated model available (PhD thesis, paper in preparation).
M2B	Study and categorise contrail-to-cirrus transition	Results on contrail evolution available (PhD thesis, paper in preparation)..
M2C	Investigation of frontal cirrus clouds	Ongoing, first results available.

Milestone status WP-M2 (Clouds)

MS	Milestone description	Month	Partner	Status
M2D	TAU-2D model runs finished	30	TAU	Ongoing
M2E	Cloud-resolving model runs using the multi-scale dynamical model EULAG finished	30	DLR-IPA	Ongoing
M2F	Investigation and interpretation of field measurements	36	ETH	Ongoing

MS	Objective	Status of work
M2D	Investigate effect of new IN parameterisations on cloud and precipitation development	Effects of changing CCN and T-profiles (fixed IN) on surface precipitation studied (Teller and Levin, JGR 2008; Chen et al., ACP 2008); Tests with 3D configuration of WRF model initiated.
M2E	Study and analyze cirrus formation and evolution	First applications to GEWEX case study (M2A) and contrail-to-cirrus transition (M2B)
M2F	Develop new heterogeneous nucleation parameterisations for cloud-resolving modelling	New parameterizations developed, publication Spichtinger & Cziczo, 2010.

Milestone status WP-M3 (Climate)

MS	Milestone description	Month	Partner	Status
M3A	Fully coupled parameterization of cirrus cloud formation implemented in ECHAM	12	DLR-IPA	Achieved
M3B	Subgrid-scale parameterization for contrail-cirrus ready in ECHAM	12	DLR-IPA	Achieved
M3C	Simulations with varying mineral dust composition	18	ETH	Achieved

MS	Objective	Status of work
M3A	Enable climate model to simulate IN effects realistically	Scheme implemented and tested in ECHAM (paper in preparation)
M3B	Enable climate model to simulate contrail-cirrus self-consistently	Scheme implemented in ECHAM and compared with observations (paper in review)
M3C	Investigate global impact of mineral dust composition on ice nucleation in mixed-phase clouds	Results on effects of dust with different composition published (ERL 2008)

Milestone status WP-M3 (Climate)

MS	Milestone description	Month	Partner	Status
M3D	Global impact of contrail-cirrus on cirrus cover and properties quantified	30	DLR-IPA	Ongoing
M3E	Impact of natural and anthropogenic ice nuclei (including aviation soot) on global cirrus cloud properties quantified	30	DLR-IPA	Ongoing
M3F	Simulations with changed freezing efficiency due to aged aerosols	36	ETH	Achieved

MS	Objective	Status of work
M3D	Study and analyse effects of contrail-cirrus on high cloudiness and climate	Further validation of ice-supersaturation parameterization performed; sensitivity of supersaturation to the homogeneous freezing threshold analysed; radiative forcing of contrail cirrus and change in natural cirrus due to contrail cirrus evaluated; Publications in preparation.
M3E	Study and analyse effects of natural and anthropogenic IN on global cirrus properties	New method developed to assess IN-induced cirrus changes in global simulations. Global effects of heterogeneous nucleation on cirrus quantified.
M3F	Investigate global impact of aged aerosol on ice nucleation in mixed-phase clouds	Simulations with different coating thicknesses of black carbon and dust aerosols were carried out with ECHAM (Lohmann and Hoose, ACP, 2009)