

AGENDA

Version 9 (25 May 2018)

Advancing MOSAiC Science

28 May – 1 June, 2018
Alfred Wegener Institute
Potsdam, Germany

Meeting Objectives: To strengthen the links between MOSAiC science objectives and the specific plans for observing, modeling, and synthesis activities. This includes focus on: What will be observed; How interdisciplinary observations will be linked; The types of products that will be produced; Plans for how observations and models will be brought together for process understanding, model assessment, and parameterization development; Ideas on how observations can be upscaled; Plans for what activities are needed in preparation for MOSAiC.

Participation and Planning Schedule: Everyone who intends to participate in MOSAiC (observing, modeling, analysis, etc.) should submit a poster presentation. Session chairs may select specific poster submissions to also give oral presentations when appropriate.

Agenda Overview: (Breakout abbreviations are listed below)

| Session | Monday | Tuesday | Wednesday | Thursday | Friday |
|---------------|---|--|--|---|---|
| | Thematic WGs: Coordinating Science | MOSAiC Coupled System Science Questions | High-level Science Coordination | Implementing Science | Implementing Science |
| 09:00 – 10:45 | Plenary: Open meeting, agenda, objectives | Breakout: Science questions 2,3,4 | Plenary: MOSAiC status. WG summaries | Breakouts: PO1, DN1, M1 | Breakouts: RS, LS, DP |
| 10:45 – 11:15 | Coffee Break (Foyer in Building H) | | | | |
| 11:15 – 13:00 | Breakout: WGs Breakout: Models | Breakout: Science questions 2,3,4 | Plenary: WG summaries; discussion | Breakouts: PO2, DN2, M2 | Breakouts: RS, EV, CR |
| 13:00 – 14:00 | Lunch Break (Foyer in Building H) | | | | |
| 14:00 – 15:45 | Breakout: WGs | Breakout: Science questions 1,5,6 | Plenary: MOSAiC in Context | Breakouts: IC1, AC1, M3 | Plenary: Final summaries; Future steps; Close |
| 15:45 – 16:15 | Coffee Break (Foyer in Building H) | | | | |
| 16:15 – 18:00 | Breakout: WGs | Breakout: Science questions 1,5,6 | Plenary: Ideas for Synthesis | Breakouts: IC2, AC2 | |
| 18:00 – 20:00 | Poster session (with snacks and refreshments) | Poster session (with snacks and refreshments) | Meeting Dinner (19:00 – 22:00) | Poster session (with snacks and refreshments) | |

MONDAY: MAY 28th: Thematic Working Groups: Coordinating Science

Registration: 8:30 – 9:15

9:15 – 10:45: Plenary session, Lecture Hall Building H

This session is available online: <https://global.gotomeeting.com/join/142332285>

- Opening session: Open meeting, welcome (Markus Rex)
- Current status of MOSAiC (Markus Rex) (30 min)
- Russian science contributions (Alexander Makarov) (12 + 3 min)
- Chinese science contributions (Dake Chen) 12 + 3 min)
- Data management concept (Stephan Frickenhaus) (12 + 3 min)
- Workshop logistics (10 min)

Coffee break: 10:45 – 11:15, Foyer Building H

11:15 – 18:00: Breakout sessions

Lunch break: 13:00 – 14:00, Foyer Building H

Coffee break: 15:45 – 16:15, Foyer Building H

- ATMOS (Matthew Shupe, Markus Rex), (Building A43 – Lecture Hall, Alexander) APPENDIX 1
- ICE/SNOW (Donald Perovich, Marcel Nicolaus) (Building H - Lecture Hall, Verena) APPENDIX 2
- OCEAN (Benjamin Rabe, Christine Provost) (Building A45 – Conf. Room, Johannes) APPENDIX 3
- BGC (Ellen Damm, Brice Loose) (Building H – Room 1, Birte) APPENDIX 4
- ECO (Allison Fong, Anya Waite) (Building A45 – Lecture Hall, Holger) APPENDIX 5
- Modeling (Annette Rinke, Wieslaw Maslowski) (Building H – Room 2/3, Benjamin) APPENDIX 6
→ Modeling only during 11:15 – 13:00, but then distribute across the teams.

Objectives:

- Thematic teams work individually on their own priorities, needs, issues, sub-topics; link across all scales and platforms (ship, camp, network, satellites, aircraft, models, partners)
- Data and synthesis products. What products will be produced? What are high-level synthesis data products that will enable broad community science? What is the general approach for data management from the team? Anticipated timing for delivering data products?
- Model integration/synthesis: What are the key parameterizations in need of assessment and development? How can observations be made/packaged to support parameterization? How can the observations be upscaled appropriately?

18:00 – 20:00: Poster session, Foyer and breakout rooms Building H

Snacks and refreshments

TUESDAY: MAY 29th: MOSAiC Coupled System Science Questions

09:00 – 13:00: Breakout sessions

Coffee break: 10:45 – 11:15, Foyer Building H

- 2) Coupling of ice formation, drift, and deformation APPENDIX 7
(Christian Haas, Donald Perovich, Gunnar Spreen); (Building H – Lecture Hall, Birte)
- 3) Clouds, precipitation, aerosols and links to fluxes APPENDIX 8
(Julia Schmale, Ina Tegen, Matthew Shupe); (Building H Room 1, Alexander)
- 4) Interfacial gas exchanges APPENDIX 9
(Tsuyoshi Wakamatsu, Jennie Thomas, Ellen Damm); (Building A45 – Lecture Hall, Holger)

Lunch break: 13:00 – 14:00, Foyer Building H

14:00 – 18:00: Breakout sessions

Coffee break: 15:45 – 16:15, Foyer Building H

- 1) Heat & momentum budgets APPENDIX 10
(Ola Persson, Christof Lüpkes, Wieslaw Maslowski); (Building H – Lecture Hall, Birte)
- 5) Ecosystem responses to ice change APPENDIX 11
(Letizia Tedesco, Giulia Castellani, Allison Fong); (Building H A45 – Lecture Hall, Holger)
- 6) Large-scale transports/feedbacks APPENDIX 12
(Jun Inoue, Detlev Majewski, Klaus Dethloff); (Building H – Room 1, Raphael)

Objectives:

Determine how we collectively address MOSAiC science questions. Address the following points:

- How will the contributions be coordinated to address the science questions?
- Do we have the needed observations and observational design to address the questions?
- How will models contribute to, and benefit from, this research? What are the cross-cutting data/products that are needed?
- How can information from MOSAiC be upscaled and/or contribute to parameterization development?
- What preparatory analyses/activities are needed to support MOSAiC?

18:00 – 20:00: Poster session, Foyer and breakout rooms Building H

Snacks and refreshments

WEDNESDAY: MAY 30th: High-level Science Coordination

09:00 – 10:45: Plenary session, Lecture Hall Building H

- MOSAiC Status of the Logistics (Uwe Nixdorf)
- Summary from Monday's breakout sessions (Chair: Markus Rex)
 - ATMOS (Matthew Shupe, Markus Rex) (10 min)
 - ICE/SNOW (Donald Perovich, Marcel Nicolaus) (10 min)
 - OCEAN (Benjamin Rabe, Christine Provost) (10 min)
 - BGC (Ellen Damm, Brice Loose) (10 min)
 - ECO (Allison Fong, Anya Waite) (10 min)
 - Modeling (Annette Rinke, Wieslaw Maslowski) (10 min)
- Discussion

Coffee break: 10:45 – 11:15, Foyer Building H

11:15 – 13:00: Plenary session, Lecture Hall Building H

- Summary from Tuesday's breakout sessions (Chair: Markus Rex, Matthew Shupe)
 - 1) Heat & momentum budgets (Ola Persson, Christof Lüpkes, Wieslaw Maslowski) (10 min)
 - 2) Coupling of ice formation, drift, and deformation (Christian Haas, Donald Perovich, Gunnar Spreen) (10 min)
 - 3) Clouds, precipitation, aerosols and links to fluxes (Julia Schmale, Ina Tegen, Matthew Shupe) (10 min)
 - 4) Interfacial gas exchanges (Tsuyoshi Wakamatsu, Jennie Thomas, Ellen Damm) (10 min)
 - 5) Ecosystem responses to ice change (Letizia Tedesco, Giulia Castellani, Allison Fong) (10 min)
 - 6) Large-scale transports/feedbacks (Jun Inoue, Detlev Majewski, Klaus Dethloff) (10 min)
- Discussion

Lunch break: 13:00 – 14:00, Foyer Building H

14:00 – 15:45: Plenary session, Lecture Hall Building H

"MOSAIC in context: Synergies with collaborating activities." Presentations and/or discussion focused on links with collaborating activities (Chair: Markus Rex)

- SPOT/Pre-MOSAIC campaign (Thomas Krumpfen) (10 + 5 min)
- YOPP and model verification along the MOSAiC drift (Helge Gossling) (10 + 5 min)
- Nansen Legacy (Sebastian Gerland) (10 + 5 min)
- Lessons learned from N-ICE (Mats Granskog) (10 + 5 min)
- Lessons learned from PASCAL (Andreas Macke) (10 + 5 min)
- T-MOSAIC (Ulrike Herzschuh) (10 + 5 min)
- Discussions (15 min)

Coffee break: 15:45 – 16:15, Foyer Building H

16:15 – 18:00: Plenary session, Lecture Hall Building H

Ideas for Synthesis”: Presentations on high-level concepts for guiding synthesis towards science goals, communicating findings, and enabling broad community involvement/engagement.

(Chair: [Markus Rex](#), [Matthew Shupe](#))

- NWP modeling and MOSAiC ([Detlev Majewski](#)) (20 min)
- Radiosondes and data assimilations studies ([Jun Inoue](#)) (20 min)
- Integration of observations and models on climate scales ([Johannes Quaas](#)) (20 min)

Discussion about modeling (15 min)

- MOSAiC data legacy / publishing data ([Stephan Frickenhaus](#)) (15 min)
- A vision for MOSAiC communications and outreach ([Ralf Roehert](#)) (15 min)

19:00 – 22:00: Dinner on the ship SANSSOUCI

- *Meeting at 18:45 pier, next to Mercure-Hotel*
- *Boat trip through Potsdam starts at 19:00*
- *Dinner is served as a buffet*
- *Back at the pier at 22:00*

THURSDAY, MAY 31st: Implementing Science

09:00 – 10:45: Breakout sessions

- **PO1 : Onboard Polarstern:** APPENDIX 13
([Marcel Nicolaus](#), [Allison Fong](#)); (Building A43 – Lecture Hall, [Erik](#))
- **DN1: Distributed network:** Starting location, ice conditions, layout of DN APPENDIX 14
([Benjamin Rabe](#), [Ola Persson](#)); (Building H- Room 1, [Sabine](#))
- **M1: Modeling activities:** Model Overview Session APPENDIX 15
([Annette Rinke](#), [Wieslaw Maslowski](#)); (Building H – Lecture Hall, [Anja](#))
General breakout to outline various modeling activities and science questions.
Participants give short presentations addressing
 - > *What models?*
 - > What can you contribute to MOSAiC? Science questions?
 - > Relevant processes, parameterizations, coupling feedbacks? Ideas for linking observations and models?
 - > What is needed from MOSAiC? Discussion topics could cover approaches for upscaling and synthesis, preparatory model studies, etc.

Coffee break: 10:45 – 11:15, Foyer Building H

11:15 – 13:00: Breakout sessions

- **PO2: Onboard Polarstern:** APPENDIX 13
([Marcel Nicolaus](#), [Allison Fong](#)); (Building A43 – Lecture Hall, [Erik](#))
- **DN2: Distributed network:** Buoy types, data, link observational procedure to science, including autonomous measurements and calibration APPENDIX 14
([Christine Provost](#), [Benjamin Rabe](#)); (Building H- Room 1, [Sabine](#))
- **M2: Modeling activities:** Operational models / Assimilation APPENDIX 15
([Jun Inoue](#), [Tsuyoshi Wakamatsu](#)); (Building H – Lecture Hall, [Anja](#))
Model activities in support of field operations, and field data in support of operational models, include link with YOPP

Lunch break: 13:00 – 14:00, Foyer Building H

14:00 – 15:45: Breakout sessions

- **IC: Ice Camp / Central Observatory:** APPENDIX 16
([Marcel Nicolaus](#), [Matthew Shupe](#)); (Building A43 – Lecture Hall, [Erik](#))
- **AC1: Aircraft activities:** Science Overview APPENDIX 17
([Manfred Wendisch](#), [Andreas Herber](#)); (Building H- Room 1, [Alexander](#))
Focus on 6 Science topic areas
- **M3: Modeling activities:** Process models APPENDIX 15
([Christof Lüpkes](#), [Detlev Majewski](#)); (Building H – Lecture Hall, [Anja](#))
How to combine observations and models towards process synthesis. Coordination of modeling activities, working with data from MOSAiC and partners, representativeness of observations, scale dependencies, etc.

Coffee break: 15:45 – 16:15, Foyer Building H

16:15 – 18:00: Breakout sessions

- **IC:** Ice Camp / Central Observatory: APPENDIX 16
(Marcel Nicolaus, Matthew Shupe); (Building A43 – Lecture Hall, Erik)
- **AC2:** Aircraft activities: Status of MOSAiC-accompanying aircraft campaigns APPENDIX 17
(Manfred Wendisch, Andreas Herber); (Building H- Room 1, Alexander)

18:00 – 20:00: Poster session, Foyer and breakout rooms Building H
Snacks and refreshments

FRIDAY, JUNE 1st: Implementing Science

09:00 – 10:45: Breakout sessions

- **RS: Remote sensing:** APPENDIX 18
(Gunnar Spreen, Ronald Kwok); (Building H – Lecture H, Sandro)
Coordinating activities and products (field, airborne, and satellite observations and products)
- **LS: Logistics and Safety:** APPENDIX 19
(Verena Mohaupt, Bjela König); (Building H – Room 1, Verena)
General discussion of on-site logistics and safety planning, including traveling on the ice and to the distributed network
- **DP: Data Publication Policies:** APPENDIX 20
(Stephan Frickenhaus); (Building H – Room 2/3, Benjamin)
Synthesis of information from WG data meetings; central archival, publication policies

Coffee break: 10:45 – 11:15, Foyer Building H

11:15 – 13:00: Breakout sessions

- **RS: Remote sensing:** APPENDIX 18
(Gunnar Spreen, Ronald Kwok); (Building H – Lecture H, Sandro)
Coordinating activities and products (field, airborne, and satellite observations and products)
- **EV: Scientific Events:** APPENDIX 21
(Benjamin Rabe, Ellen Damm, Wieslaw Maslowski); (Building H – Room 2/3, Benjamin)
Measurement strategies to address specific, high-interest events such as lead/ridge formation, melt onset, etc.

Lunch break: 13:00 – 14:00, Foyer Building H

14:00 – 16:00: Plenary session, Lecture Hall Building H

This session is available online: <https://global.gotomeeting.com/join/827870653>

- Summary from Thursday's and Friday's breakout sessions (Chair: Markus Rex)
 - **PO:** Onboard Polarstern (Marcel Nicolaus, Allison Fong) (10 min)
 - **DN:** Distributed network (Benjamin Rabe, Ola Persson, Christine Provost) (10 min)
 - **IC:** Ice Camp / Central Observatory (Marcel Nicolaus, Matthew Shupe) (10 min)
 - **EV:** Scientific Events (Benjamin Rabe, Ellen Damm, Wieslaw Maslowski) (10 min)
 - **M:** Modeling activities (Annette Rinke, Wieslaw Maslowski, Jun Inoue, Tsuyoshi Wakamatsu, Christof Lüpkes, Detlev Majewski) (10 min)
 - **AC:** Aircraft activities (Manfred Wendisch, Andreas Herber) (10 min)
 - **RS:** Remote sensing (Gunnar Spreen, Ronald Kwok) (10 min)
 - **LS:** Logistics and Safety (Verena Mohaupt, Bjela König) (10 min)
 - **DP:** Data Publication Policies (Stephan Frickenhaus) (10 min)
- Discussion (15 min)
- Future steps (Markus Rex) (10 min)
- Closure (Markus Rex) (5 min)

APPENDIX:

Appendix 1: ATMOSPHERE:

Monday, May 28th 11:15 – 18:00 (Building A43 – Lecture Hall, **Alexander**)

Chairs: Matthew Shupe, Markus Rex

1. Review of ATMOS Activities (~2.5 hours)

- * Introduction and status of ATMOS team
- * Rapid Review of all Projects, 5-minutes each using 2-slide template.
- * Discussion of Activities: Spatial/temporal organization, scheduling, on-ice activities, discussion of critical gaps.

2. Coordination discussions on sub-themes (~1 hour, in parallel)

- * Key sub-groups meet to discuss essential coordination.
- * 1) Aerosols; 2) Met tower/Met City; 3) Balloons
- * Objectives to clarify leaders and participants, pre-mission needs and training, required field operations/tasks/scheduling

3. Models, Analyses, and Products (1.5 hours)

- * Presentation/summary of key modeling and analysis efforts
- * Discussion: linking observations and models
- * Data needs in real-time for operations, field planning, science insight.
- * Joint data products: identify collaborative linkages to address model or analysis priorities.
- * Synthesis products: How do we prepare and plan for eventual synthesis of MOSAiC data in context of past research and inter-disciplinary goals?

Appendix 2: SEA ICE:

Monday, May 28th 11:15 – 18:00 (Building H – Lecture Hall, **Verena**)

Chairs: Donald Perovich, Marcel Nicolaus

11:15 to 13:00

Objectives and goals of the meeting, short introduction (10min, Marcel & Don)

Overview presentations of main projects: science questions and approach (10min each)

1. USA (NSF) projects (Perovich)
2. German ice and helicopter work (Hendricks)
3. Work plan of the Chinese snow and sea ice group (Lei)
4. Remote sensing (Spreen)
5. Snow work (Schneebeli)
6. Russia's contributions to ICE (NN)
7. Norway's contributions to ICE (Gerland)
8. Finland & NERC (Haapala + NN)

14:00 to 15:45

Poster highlights and introduction (1 slide, 3 min per poster) with discussion

- Identification of (missing) links to other teams and models
- Needs and exchange of instrumentation
- Needs on expertise and collaboration

16:15 to 18:00

Definition of main contacts (PIs) for all the ICE tasks and data sets/parameters

- Scientific collaboration and coordination
- Data/sample flow and responsibilities
- Logistical needs

Discussion towards common publications and data sets

Appendix 3: OCEAN:

Monday, May 28th 11:15 – 18:00 (Building A45 – Conf. Room, **Johannes**)

Chairs: Christine Provost, Benjamin Rabe

The beginning of the session will include an overview of OCEAN activity and aims overall, then brief intros of each project (by those present and summaries by Christine/Ben).

- Overview of OCEAN activity by Christine and Ben
 - essential, ongoing measurements
 - weekly plan (draft)
 - list of projects
- Brief presentation (2 slides / 5 mins. each !) by each endorsed project (incl. "German", and supply icebreaker berths)
- Overarching OCEAN science questions
 - discuss existing list of overarching science questions, processes and domains (layers, horizontal distribution) of appropriate observations, including event-driven work
- Synergies with other teams
 - identify and discuss links to other in-situ and remote obs. teams with respect to science, sharing of resources and required input (e.g. boundary conditions)
 - links of physical ocean observations to modelling potential links existing projects
- Synthesis of overall results
- Implementation discussion
 - weekly plan / essential ongoing obs. (by leg / season)
 - personnel / leg plan
 - events (priority list, actions)
 - shared hardware / contributions by each participant
 - work in DN (buoys, remote sites and access)
 - participation in workshop breakouts by members of team OCEAN
- MOSAiC data policy / procedure / OCEAN data...
 - near-real-time transmission
 - to land direct
 - to ship from land
 - to land from ship
 - operators on land ?
 - where? potential share of personnel (7-days a week !)

Appendix 4: BIO-GEOCHEMISTRY:

Monday, May 28th 11:15 – 18:00 (Building H – Room 1, **Birte**)

Chairs: Brice Loose, Ellen Damm

11.15-11.25 Introduction (Overview about the subtopics)

11.25- 11.35 Review lab space allocations, workload allocations, and shared parameters

11.35-12.00 Discussion

12.00 – 15.00 (1 hour break in between) 5 min Talks + 5 min Discussions

Talks should be focused on:

link across all scales and platforms (ship, camp, network, satellites, aircraft, models, partners)

desired sampling strategy, event priorities, (yet unconsidered needs, issues, lab space, sample storage capacities)

12.00 - 12.30 Subgroup 1 (Kadko et al., Geibert et al., Bauch,)

12.30 - 13.00 Subgroup 2 (Stefels et al., Thomas et al., Abrahamson et al.)

13.00 - 14.00 Lunch break

14.00 – 14.10 Subgroup 2 (Zeppenfeld et al.)

14.10 – 15.00 Subgroup 3 (Nomura et al., Zhan et al., Uhlig et al., Loose et al., Damm et al.)

15.00 -18.00 Discussion

- **Data and synthesis products:**
- What products will be produced? What are high-level synthesis data?
- Identify the data dependencies that exist within and outside of BGC.
- Products that will enable broad community science?
- What is the general approach for data, management from the team?
- Anticipated timing for delivering data products?

- **Model integration/synthesis:**
- What are the key parameterizations in need of assessment and development?
- How can observations be made/packaged to support parameterization?
- How can the observations be upscaled appropriately?
- open questions

Appendix 5: ECOSYSTEM:

Monday, May 28th 11:15 – 18:00 (Building A45 – Lecture Hall, **Holger**)

Chairs: Anya Waite, Allison Fong

Block 1: 11:15 – 13:00

Objective – Share current status of planning, highlights of projects, and synergies for cooperation

- Progress Report (Allison, 15 mins.)
- Poster highlight presentations (12 x 3 mins.)
- Discussion

Block 2: 14:00 – 15:45

Objective – Generate roadmaps for cooperation and collaboration across MOSAiC

- Small group discussions with reporting templates:
 - 1) major events,
 - 2) coupling between habitats,
 - 3) fluxes,
 - 4) community/organismal interactions
 - 5) time-series and seasonality
- Discussion

Block 3: 16:15 – 18:00

Objective – Defining work plans, refine contact lists (PIs) for all tasks and data sets, develop publication plans, optimize sample and data flow

- Review and moving forward (Allison, 10 mins.)
- Opportunities and synergies
- Logistics of our work

Appendix 6: MODELLING:

Monday, May 28th 11:15 – 13:00 (Building H – Room 2/3, **Benjamin**)

Chairs: Wieslaw Maslowski, Annette Rinke

This breakout session aims to inform each other about the individual modeling projects to get an overview and establish linkages to each other and with the observations. In this breakout we ask the attendees to provide a ca. 5-min overview of their projects. We ask each attendee to prepare 2-3 slides summarizing his/her project, with emphasis on needs from / contributions to the overall MOSAiC program and type(s) of modeling activities. We ask to cover those questions:

- What models?
- What can you contribute to MOSAiC?
- Science questions?
- Relevant processes, parameterizations, coupling feedbacks?
- Ideas for linking observations and models?

Appendix 7: QUESTION 2 – Coupling of Ice Formation, Drift and Formation:

Tuesday, May 29th 9:00 – 13:00 (Building H – Lecture Hall, **Birte**)

Chairs: Christian Haas, Donald Perovich, Gunnar Spreen

The objectives of the science sessions are to determine how we collectively address MOSAiC science questions. During the discussion we also like to address the following points:

- How will the contributions be coordinated to address the science questions?
- Do we have the needed observations and observational design to address the questions?
- How will models contribute to, and benefit from, this research? What are the cross-cutting data/products that are needed?
- How can information from MOSAiC be upscaled and/or contribute to parameterization development?
- What preparatory analyses/activities are needed to support MOSAiC?

09:00 – 10:45

- 1) Introductions – go around the room and have people introduce themselves (name, institution, primary MOSAiC interest, level of participation) [10 min]
- 2) Summarize the objectives of the session – show list of expectations for this session [Don Perovich, 10 min]
- 3) Presentations [about 15 minutes each]
 - a) Christian Haas: Changes of the ice thickness distribution related to deformation and atmospheric forcing
 - b) Ron Kwok: Sea ice deformation during SHEBA and sub-daily ice motion from SAR
 - c) *Jenny Hutchings (presented by Don Perovich)*: Sea ice dynamics observed by an array of buoys
 - d) Chris Polashenski: Active observation of km-scale strains in a MOSAiC floe
 - e) Polona Itkin: Sea ice dynamics and its consequences across the scales
 - f) Jari Haapala: Small scale dynamics of leads and fractures, linkages to the large scale dynamics of pack ice

11:15 – 13:00

- g) Takenobu Toyota: An examination of the sea ice rheology for seasonal ice zones based on ice drift and thickness observations
 - h) Helge Gössling (to be confirmed): The Sea Ice Drift Forecast Experiment
- 4) Discussion – go through session objectives and reach a consensus on answers [1¼ hour]
 - Observations needed to observe the “coupling” between dynamics and thermodynamics
 - Spatial and temporal scales needed
 - Buoy network, ship radar, satellite observations
 - Ridge and lead distributions and relation to ice mass/volume change/growth

Appendix 8: QUESTION 3 – Clouds, Precipitation, Aerosols and links to fluxes:
Tuesday, May 29th 9:00 – 13:00 (Building H – Room 1, **Alexander**)

Chairs: Julia Schmale, Ina Tegen, Matthew Shupe

Overall Session Objective: To coordinate and leverage specific projects towards achieving cross-cutting MOSAiC science objectives focused on atmospheric composition (clouds, aerosols, etc) and its interaction with the surface (precip, fluxes, etc.).

Specific objectives:

- 1) Understand all relevant projects, observations, modeling activities, and interests. Do we have specific gaps to fill?
- 2) How do we combine these activities in an optimal way towards achieving larger goals? i.e., specific implementation details, cross-cutting data products, etc.
- 3) How do we support active exchange between relevant observing and modeling activities? Specific data products, organizational activities, targeted science questions, dealing with scaling/upscaling between obs and models, identifying specific model components/parameterizations in specific need of new information.
- 4) What is needed in preparation for MOSAiC?

(90 min) Science Drivers and Model Needs

- Welcome and session objectives
- Clouds, radiation, and fluxes - Matthew Shupe (10 min)
- Aerosol-cloud interactions - Gijs de Boer (10 min)
- Precipitation processes - Irina Gorodetskaya (10 min)
- Atmospheric Modeling Needs - Ina Tegen (10 min)
- Summary of science questions - Julia Schmale (10 min)
- Summary of relevant activities
- Thematic organization of activities

(90 min) Moderated Discussion: Combining projects to (a) serve MOSAiC objectives and (b) build linkages with other science themes.

Discussion will include setting specific goals, identifying desired data products, considering scaling issues.

- Aerosol (including aerosol links with BGC)
- Clouds and Radiation (including links with Surface Energy Budget)
- Precipitation (including links with snow on the surface)

(30 min) Moderated Discussion: Preparing for MOSAiC

Identifying/filling gaps, organization, preparatory activities, field requirements, etc.

Appendix 9: QUESTION 4 – Interfacial Gas Exchanges:

Tuesday, May 29th 9:00 – 13:00 (Building A45 – Lecture Hall, **Holger**)

Chairs: Tsuyoshi Wakamatsu, Jennie Thomas, Ellen Damm

Goals of the session:

- How will the contributions be coordinated to address the science questions?
- Do we have the needed observations and observational design to address the questions?
- How will models contribute to, and benefit from, this research? What are the cross-cutting data/products that are needed?
- How can information from MOSAiC be up-scaled and/or contribute to parameterization development?
- What preparatory analyses/activities are needed to support MOSAiC?

9:05 – 10:45 Overview talks and discussion on interfacial gas exchanges – Jennie Thomas

9:00 – 9:05 Introduction to session, Tsuyoshi Wakamatsu

9:05 – 9:25 Year-round surveys for air–sea ice gas flux in the Arctic Ocean, Daiki Nomura

9:25 – 9:45 Coupled exchanges of reactive halogens, mercury, and aerosol precursors in the Arctic, Jennie Thomas

9:45 – 10:05 Upwelling and meltwater flux inferred from helium and neon isotope measurements, Christian Mertens

10:05 – 10:25 The freeze effect: A lesson from tracing methane, Ellen Damm

10:25 – 10:45 Discussion and session wrap up

10:45 – 11:15 Coffee Break

11:15 – 12:00 Facilitated discussion on cross cutting themes

Introduction to discussion and discussion lead - Ellen Damm

- What are the unique science goals for each leg?
- How do we balance focused process studies vs. long time series?

12:00 – 12:50 Optimizing science coordination

Introduction to discussion and discussion lead - Markus Frey and Jennie Thomas

- How will the contributions be coordinated?
- How modeling and measurement activities be coordinated and optimized?
- How will measurements contribute to improved model parameterizations?
- What cross cutting data products are needed and/or will be produced by the team?

12:50 – 13:00 Session wrap up and conclusions - Tsuyoshi Wakamatsu

Appendix 10: QUESTION 1 – Heat & Momentum Budgets:

Tuesday, May 29th 14:00 – 18:00 (Building H – Lecture Hall, **Alexander**)

Chairs: Ola Persson, Christof Lüpkes, Wieslaw Maslowski

Some Guiding Questions: Are subtopics 1-4 a complete description of the heat and momentum budgets of sea ice? Do subtopics 5 & 6 represent the main processes impacting heat & momentum fluxes? Are there key concepts, processes, terms that are missing or not emphasized sufficiently? With the planned observations, will we be able to calculate, close & understand the heat and momentum budgets of the sea ice? Are the measurements planned with the right temporal and spatial/vertical resolution? Will the MOSAiC measurement plans adequately address the identified unknowns? Will observations capture key events and enable us to understand physical system processes affecting budgets? Are there missing observations; if so, what are they and how do we rectify? How are observations to be linked to modelling (for validation). Are we measuring the right parameters?

14:00-15:45 Overview (10 min); 9 x 10 min talks (8 min talks; 2 min questions/discussion)

A) Overview of Heat and Momentum Budgets of Sea Ice (15 min) – O. Persson

Heat and Momentum Budgets of Arctic Sea Ice: An Overview

B) Talks on what is known and not known of key subtopics

1) heat and momentum budgets of sea ice; conductive heat flux; ice movement; ice deformation (40 min talks)

- Sea ice/ Snow: D. Perovich – The Great Integrator: The Mass Balance of Sea Ice
- Modeling: W. Maslowski - Energy transfer across the air-sea ice-ocean interfaces in the Regional Arctic System Model
- Sea Ice/Snow: J. Haapala – Ice Motion from Ship Radar
- Sea Ice/Snow: J. Hutchings (presented by O. Persson) – Challenges in Sea Ice Dynamics

2) surface characterization relevant for heat and momentum fluxes and budgets; include air-ice/snow, ice-ocean, air-ocean interfaces (20 min talks)

- Atmosphere: T. Vihma – What is known (and not known) about the characterization of the air-ice/snow interface of importance for heat and momentum fluxes
- Sea Ice/Snow: M. Schneebeli – Spatial/temporal variations of fundamental properties of snowpack and their impact on the heat and momentum budget of sea ice

3) heat & momentum fluxes at ice-ocean interface (20 min talks)

- Ocean: T. Stanton– Stress, heat flux, salt flux measurements to 2 m; T & current profiles
- Ocean: He Hailun – Heat & Momentum Fluxes at Ice-ocean Interface; Links to Ocean Mixed-layer Structure & Processes

4) heat & momentum fluxes at air-ice interface; surface heat and momentum fluxes, including atmospheric stress and stress divergence, turbulent and radiative heat fluxes; atmospheric surface layer structure and processes; links to ABL structures and processes (10 min talks)

- Atmosphere: O. Persson – Observations of Heat and Momentum Fluxes at the Air-Ice/Snow Interface

Coffee Break 15:45-16:15

16:15-16:45 3 x 10 min talks (8 min talks; 2 min questions/discussion)

5) kinematic, thermodynamic, and salinity structure of ocean mixed layer; relationship to heat/salinity/momentum fluxes at ice/ocean and/or air/ocean interfaces; interaction with ocean eddies and deep ocean currents (10 min talks)

- Ocean: B. Rabe (or Y. Kawaguchi) – Heat & Momentum Fluxes at Ice-Ocean Interface; structures & processes in the upper ocean that impact the heat and momentum budgets of sea ice

6) ABL structure; interaction of ABL with free troposphere; thermodynamic structure; kinematic structure; cloud macro and microphysical structure – impacts on radiation; turbulent heat and momentum transport in ABL (20 min talks)

- Atmosphere: A. Schulz – The Arctic Atmospheric Boundary Layer – Recent Research Results from the AWIPEV Station (Svalbard)

- Atmosphere: Shupe/ARM (presented by O. Persson) - The Arctic Atmospheric Boundary Layer Over Sea Ice: A Modulator of Surface Heat & Momentum Fluxes

C) 16:45-18:00 Discussion

Appendix 11: QUESTION 5 – Ecosystem responses to Ice Change:
Tuesday, May 29th 14:00 – 18:00 (Building A45 – Lecture Hall, **Holger**)

Chairs: Letizia Tedesco, Giulia Castellani, Allison Fong

Guiding questions:

- How will the contributions be coordinated to address the science questions?
- Do we have the needed observations and observational design to address the questions?
- How will models contribute to, and benefit from, this research?
- What are the crosscutting data/products that are needed?

Block 1: 14:00 - 15:00

- Introduction of objectives and goals (Letizia, Giulia, Allison, 5 mins.)
- Presentation - Sea-ice ecosystem modeling: state-of-the-art, challenges, and perspectives (Letizia, 15 mins.)
- Presentation - Bridging observations and model results (Giulia, 15 mins.)
- Overview of science framework and plans; what we will measure; what we hope to generate; how we should proceed with cooperation across MOSAiC (Allison, 5 mins.)
- Discussion

Block 2: 15:00 - 15:45

- Presentation – Coupling the biogeochemical model REcoM2 to FESOM (Finite Element Sea-ice Ocean Model): Representing the Arctic in large-scale biogeochemical modeling (Vibe Schourup-Kristensen, 10 mins.)
- Redrawing the conceptual framework of Arctic ecosystem processes and cryo-pelagic coupling (moderated by Pauline Snoeijs-Leijonmalm and Hauke Flores)

Block 3: 16:15 - 18:00

- Moderated discussion period using framing questions to generate discussion on earlier presentations - focus on identifying connections, or gaps in existing plans, determine if addressing those gaps is feasible and how:
 1. What are the most exciting concepts/questions we can address with our collective expertise in the framework of MOSAiC?
 2. Create leg-specific and event-driven unique goals and outputs
 3. What preparatory analyses/activities are needed to support MOSAiC?
 4. What are the synthetic data products we aim to generate?
 5. Brainstorm a list of synthetic publication products of what we can accomplish together

Appendix 12: QUESTION 6 – Large-Scale Transports/Feedback:
Tuesday, May 29th 14:00 – 18:00 (Building H – Room 1, **Raphael**)

Chairs: Jun Inoue, Detlev Majewski, Klaus Dethloff

During this breakout session we will discuss the MOSAiC science questions with respect to large-scale transports and feedbacks.

- How will the contributions be coordinated?
- Observations and observational design to address the questions?
- How will models contribute to, and benefit from this research?
- What are the cross-cutting data and products that are needed?
- How MOSAiC data contribute to parameterization development?
- What preparatory analyses/activities are needed to support MOSAiC?

14.00-14.10 Klaus Dethloff: Introduction to the session

14.10-14.30 TOPIC: Numerical weather prediction

Detlev Majewski: Impact of MOSAiC data on NWP weather forecasts

14.30-14.50 TOPIC: Dataassimilation and hindcast topic

Jun Inoue: Impact of MOSAiC data on large-scale weather patterns in forecast/hindcasts experiments

14.50-15.10 TOPIC: Seasonal evolution of the coupled system

Raphael Köhler: Sea-ice impact on large-scale circulation feedbacks between tropo- and stratosphere

15.10-15.30 TOPIC: Improving large-scale climate models in the Arctic

Jan Kretzschmar: Improved climate model parameterizations exploiting MOSAiC data

15.30-15.45 Specifying science and synergy for TOPIC: NWP

Joo-Hong Kim: OSEs based on polar WRF and additional radiosondes
Discussion

15:45-16:15 Coffee Break

16.15-17.00 Specifying science and synergy for Topic Dataassimilation and hindcasts

Gunilla Svensson: SCMs developments
Tsuyoshi Wakamatsu: Biogeochemistry model with assimilation
Discussion

17.00-17.30 Specifying science and synergy for Topic Seasonal evolution

Michael Karcher: Ocean-sea ice feedbacks
Helge Gössling: YOPP approach for improved parameterizations
Discussion

17.30-18.00 Specifying science and synergy for Topic Improved climate models

Ralf Jaiser: Interactive ozone chemistry
Timo Vihma: Boundary-layer processes in different large-scale flow conditions
Discussion

Appendix 13: ONBOARD POLARSTERN:

Thursday, May 31st 9:00 – 13:00 (Building A43 – Lecture Hall, Erik)

Chairs: Marcel Nicolaus, Allison Fong

PO1: Thursday 09:00-10:45

- Summary of current status (Marcel/Alli, 15 min)
 - o Setting of containers, total requirements
 - o Lab situation and requirements
 - o Common spaces
 - o Visit on 25/26 June
- Container and lab requirements (discussion, 30 min)
- Holes for water access (rosette, nets, ...) (discussion, 30 min)

PO2: Thursday 11:15-13:00

- Needed installations and changes on board (discussion, 20 min)
- Anchoring to the floe (discussion, 20 min)
- Sample management and Log book (discussion, 30 min)
- Other topics (10 min)

Appendix 14: DISTRIBUTED NETWORK:

Thursday, May 31st 9:00 – 13:00 (Building H – Room 1, **Sabine**)

DN1: Starting Location, ice conditions, layout of DN

Chairs: Benjamin Rabe, Ola Persson

This session is supposed to discuss and combine clear requirements regarding preferred ice conditions in relation to the DN layout, logistics and safety.

The main deliverable of DN1 is a 1-pager document (see below) as well as a few further requirements for the preferred site locations in relation to ice conditions, with a priority wishlist.

- Brief presentation of results from DN recent telecon
 - DN map in relation to ice edge and floe distribution
 - constraints: logistical, scientific and array integrity
- Sites within DN -- any changes / adjustments?
 - science vs. logistics, available instrumentation and safety (link to breakout LS and DN2)
- Preferred ice situation at each site
 - science vs. endurance / integrity of buoy network
 - ice edge location during setup
 - ice thickness at each site and nearby
- Initial setup
- Revisits -- priority list (also tbd in DN2, link to LS)
 - Access corridors (link to LS)
 - no-go zones and priority list for site importance
 - supply vessels
 - other vehicles (e.g. hovercraft, skidoo, heli, ROV/AUV?, airc.)
- 1-pager for all of MOSAiC (incl. AWI logistics, supply ship operators...)
(strong link to LS)

DN2: Buoy types, data, link observational procedure and science, including autonomous measurements and calibration

Chairs: Christine Provost, Benjamin Rabe

This session should focus on buoy types, instruments / sensors and parameters, organising all scientific / instrumental resources and projects in the light of overall MOSAiC aims. The main deliverable of this session is an updated buoy and site location table with a coordinated parameter list for each site (conceptually, a "3-D parameter map").

- Brief presentation of buoy types and site locations by Christine and Ben
- Revisits and buoy servicing / calibration (follow-on from DN1)
- Adjustments to buoy distribution / instrumentation considering science
 - logistics and safety (link to breakout LS)
- MOSAiC data policy and archiving
- Data transmission (link to breakout DP)
 - buoy to land (IRIDIUM, ARGOS)
 - land to ship (IRIDIUM)
 - buoy to ship (WIFI, radio)
 - ship to land (IRIDIUM)

Appendix 15: MODELLING ACTIVITY:

Thursday, May 31st 9:00 – 15:45 (Building H – Lecture Hall, **Anja**)

M1: Model Overview Session

Chairs: Annette Rinke, Wieslaw Maslowski

This session plan to discuss, but is not limited to, regional-large scale modeling and model-data links. We plan with the following (15 min.) presentations:

Heinold and Tegen: Aerosol modelling in the Arctic within the framework of MOSAiC

Ganzeveld et al.: An exploratory study on Arctic surface-boundary layer exchange of climate-active trace gases

Maslowski et al: Process-resolving Model-Data Synthesis and Prediction Using Regional Arctic System Model in Support of MOSAiC Program

Rinke et al.: Arctic Cordex

Then, followed by discussion about these questions:

- How will/should the contributions be coordinated? Any common interests?
- What are the relevant processes, parameterizations, coupling feedbacks? Relations to M1-M2.
- What are the cross-cutting data and products that are needed?
- How can MOSAiC data contribute to parameterization development?
- Any preparatory analyses/activities are needed?

M2: Operational Models / Assimilation

Chairs: Jun Inoue, Tsuyoshi Wakamatsu, Linette Boisvert

During this breakout session we will discuss model activities in support of field operations, and field data in support of operational models, include link with YOPP.

11:15 – 11:20 Introduction to the session (Jun Inoue)

11:20 – 11:30 Overview of YOPP operational support (Jun Inoue)

11:30 – 11:40 Integration of observations in models on weather time scales (Detlev Majewski)

11:40 – 11:50 Copernicus marine forecasting/reanalysis service for the Arctic domain (Tsuyoshi Wakamatsu)

11:50 – 12:00 Discussion on how to support the field operations by modeling efforts

- Who needs the forecast data ? Who sends the data ?
- What is the key parameters do they need ?
- How do they receive the data/images ? (regulation of data transfer ?)

12:00 – 12:10 Assimilation of High Resolution Sea Ice Deformation into Lagrangian Sea Ice Model (Anton Korosov)

12:10 – 12:20 Improving the Prediction of Sea Ice through Targeted Study of Poorly Parameterized Sea Ice Processes at MOSAiC and Responsive Model Development (Don Perovich)

12:20 – 13:00 Discussion on how to integrate the field data

- What kind of real time observations can contribute to improving model initial fields/near real time forecast ?
(need to develop the observing network with other stations & ships)

- How do we organize observing system experiments ? (YOPP contribution ?)
- How do we coordinate with MOSAiC data management group and operational data center (e.g. GTSP for ocean)?
- Other issues

M3: Process Models

Chairs: Christof Lüpkes, Detlev Majewski

Each talk will last 10 Minutes and the following discussion will address the necessary data required as input for the models.

Dmitry Chechin, Christof Lüpkes, Janosch Michaelis (Alfred Wegener Institut)

- Multiscale Modelling of Boundary Layer Processes over Sea ice

Detlev Majewski (German Weather Service)

- Modeling meteorological processes in NWP models - What kind of observational input is useful?

Vera Schemann et al. (University of Cologne)

- Large-Eddy-Simulation for supporting Arctic cloud measurements

Micha Gryschka (University of Hannover)

- Large Eddy Simulation of convection processes over the marginal sea ice zone

Wieslaw Maslowski

- Energy transfer across the air-sea ice-ocean interfaces in the Regional Arctic System Model

Appendix 16: ICE CAMP:

Thursday, May 31st 14:00 – 18:00 (Building A43 – Lecture Hall, **Erik**)

Chairs: Marcel Nicolaus, Matthew Shupe

IC1: Thursday 14:00-15:45

- Summary of current status (Marcel, 20min)
 - o Start of the drift and installation phase
 - o Central ice floe plan
 - o Transition to distributed network (10km scale)
 - o List of installations
 - o Floe Navigation system
- Starting the drift (discussion, 20min)
- Revising the map(s) (discussion, 30min)

IC2: Thursday 16:15-18:00

- Update of huts and other installations (work on document, 40min)
- On ice “schedule” (discussion, 20 min)
- Other topics (discussion, 20 min)

Appendix 17: AIRCRAFT ACTIVITY:

Thursday, May 31st 14:00 – 18:00 (Building H – Room 1, **Alexander**)

Chairs: Andreas Herber, Manfred Wendisch

Session 1 – Research Topics, 14:00 – 15:45 (10 min + 2 min)

1. Arctic Boundary Layer (Christof Luepkes, AWI Bremerhaven)
2. Greenhouse Gases and VOC's (Rupert Holzinger, IMAU Utrecht)
3. Aerosol and Black Carbon (Andreas Herber, AWI Bremerhaven)
4. Cloud and Radiation (Guillaume Mioche, LaMP)
5. Sea Ice and Snow Thickness (Christian Haas, AWI Bremerhaven)
6. Polar Transport and Dynamics (Kathy Law, LATMOS Paris)
7. Discussion (ALL)

Session 2 – planned aircraft activity, 16:15 – 18:00 (5 min + 2 min)

1. AWI aircraft (Andreas Herber, AWI Bremerhaven)
2. ICEBRIDGE (Melinda Webster, GSFC Greenbelt)
3. JPL Proposal (Charles Miller, JPL Pasadena)
4. IGP – BAS (Alexandra Weiss, BAS Cambridge)
5. HALO activity (Martin Sinnhuber, KIT Karlsruhe)
6. PACES / IMPAACT (Kathy Law, LATMOS Paris)
7. IMPACT (Andreas Herber on behalf of Patrick Taylor)
8. Thin Ice (Manfred Wendisch on behalf of James D. Doyle)
9. CEASAR (Manfred Wendisch on behalf of Bart Geerts)
10. NERC proposal (Manfred Wendisch on behalf of Paul Field)
11. Global Hawk (Manfred Wendisch on behalf of Janet Intrieri)
12. UAV activity during MOSAIC (Gijs de Boer, NOAA Boulder)
13. Discussion and Outlook (ALL)

Appendix 18: REMOTE SENSING:

Friday, June 1st 9:00 – 13:00 (Building H – Lecture Hall, **Sandro**)

Chairs: Gunnar Spreen, Ronald Kwok

09:00 – 10:45 Coordination of Satellite Remote Sensing Activities

09:00 – 09:15

Overview of session and satellite remote sensing for MOSAiC (Kwok/Spreen)

09:15 – 09:30

Assimilation of High Resolution Sea Ice Deformation into Lagrangian Sea Ice Model (Korosov)

09:30 – 09:45

Synthetic Aperture Based Sea Ice Products for MOSAiC (Singha)

09:45 – 10:00

Satellite remote sensing of Arctic melt ponds (Oppelt; *provides slides*)

10:00 – 10:15

Assessing and improving the seasonal capability of ICESat-2 data for sea ice research (Webster/Kwok)

10:15 – 10:45

Discussion (All)

11:15 – 13:00 On-Ice Remote Sensing Activities

11:15 – 11:25

Introduction to on-ice measurements (Spreen)

11:25 – 11:35

Introduction to the ESA contribution for MOSAiC (Casal)

11:35 – 11:50

Microwave Emission of Sea Ice (Kaleschke)

11:50 – 12:05

Using GNSS-R to monitor the physical characteristic of land/snow/ice (Liu)

12:05 – 12:20

MOSAiC-Scat: a surface-based multi-frequency polarimetric microwave scatterometer system for snow covered sea ice characterization during MOSAiC (Yackel)

12:20 – 12:35

In-Situ dual-band frequency radar measurements during MOSAiC (Ricker)

12:35– 13:00

Discussion (All)

Appendix 19: LOGISTICS AND SAFETY:

Friday, June 1st 9:00 – 10:45 (Building H – Room 1, **Verena**)

Chairs: Verena Mohaupt, Bjela König

1. Main goals of this workshop
2. General logistics
3. General Safety & Health
4. Trainings
5. Safety on ice
6. Safety on board Polarstern
7. Safety in zodiacs/boats
8. Safety in heli/airplane

Appendix 20: DATA PUBLICATION AND POLICY:

Friday, June 1st 9:00 – 10:45 (Building H – Room 2/3, **Benjamin**)

Chair: Stephan Frickenhaus

- 1 Confirm status of Data Policy draft
- 2 Hear from each group about their data work wrt week plan, Sensor Registration Data, Data products and Sampling
- 3 Discuss options for using the Kepler satellite for burst data transfers and Iridium Certus
- 4 Introduce Antonia Immerz and her role as Data Science Support in Bremerhaven
- 5 Initiate planning a Data and Training Workshop for spring 2019. Foci and First ideas

Appendix 21: SCIENTIFIC EVENTS:

Friday, June 1st 11:15 – 13:00 (Building H – Room 2/3, Benjamin)

Chairs: Benjamin Rabe, Ellen Damm, Wieslaw Maslowski

Each team breakout should give a summary, -- the teams need to engage in this -- this includes the modelling team.

The aim of this breakout is to come up with a priority list of events with associated teams and actions (table).

10 min. overview of event example (e.g. storm, lead opening...)

- Define priority list of "all-team" events (35 mins.)
 - feedback needed from all obs and modelling teams
 - all 8 obs. and model teams report briefly on events
(3 mins. each! the coupled science stuff should be included in this...)
- Define small events (only affect 2-3 teams; 10 mins.)
 - how much are other teams affected?
- Assign plan of action for each event (20 mins.)
- Discuss feasibility of each plan of action based on logistics, safety and effect on other teams / overall time series (30 mins.)
 - How often do we allow event actions? (i.e. not every week)