

Atmosphere-Ocean Single-Column Model (AOSCM)

A tool to help improve coupled models in the Arctic

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Accelerating model development work

Single-column models a link between scales and models

Large-scale models contain all scales, all processes, and are expensive to run and have biases

Parameterisations are mainly distributing momentum and heat in the vertical

SCM framework allows to ***separate the scales*** using advective tendencies from the large-scale model (reanalysis, observations, full model ...) as forcing on the vertical column

NEW feature here is the Atmosphere-Ocean Single-Column Model (**AOSCM**), built within the EC-Earth development portal (*Hartung et al., 2018*)

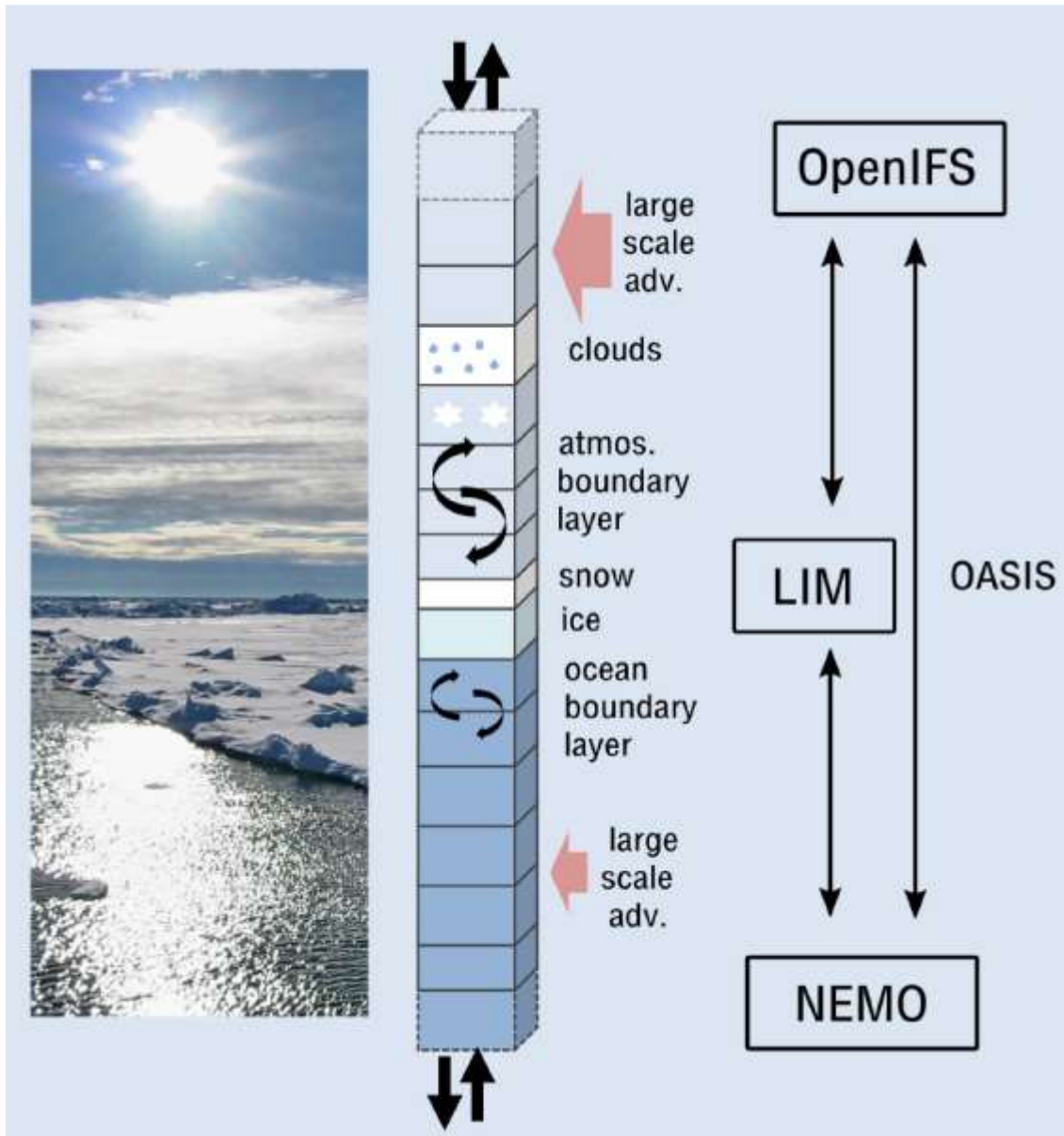
Work centered around well-observed cases (Supersites, **icebreaker Oden expedition** data, MOSAiC etc) & **LES simulations**

Atmosphere-Ocean Single-Column Model

Developed within the EC-Earth portal



Stockholm University



AOSCM.v1_EC-Earth3

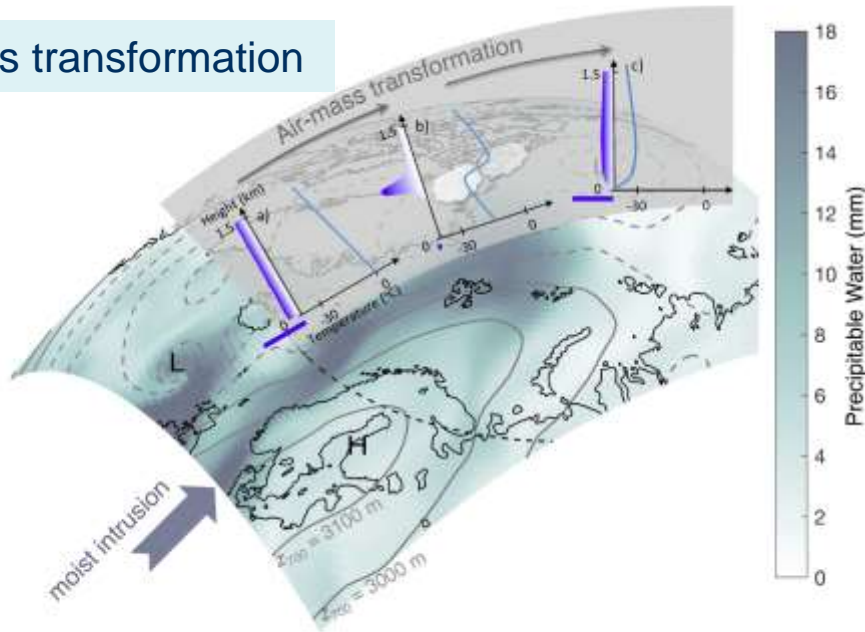
OpenIFS cycle 40r1
OASIS3-MCT
LIM3
NEMO3.6

Hartung et al., 2018, GMD

APPLICATE.eu
Advanced prediction in
polar regions and beyond

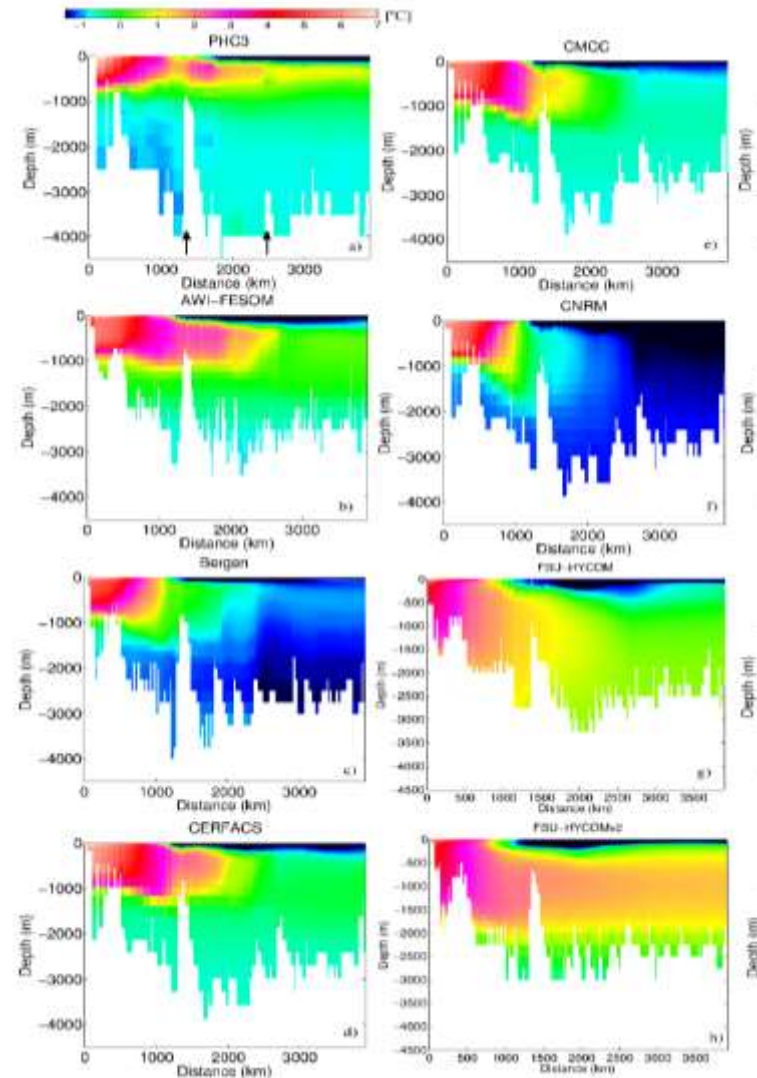
Arctic local processes

Airmass transformation



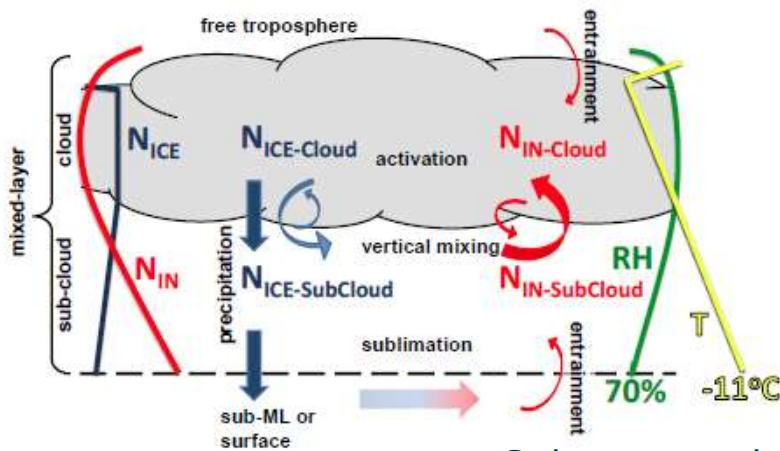
Pithan, Svensson et al., 2018

Ocean vertical mixing



Ilicak et al., 2016

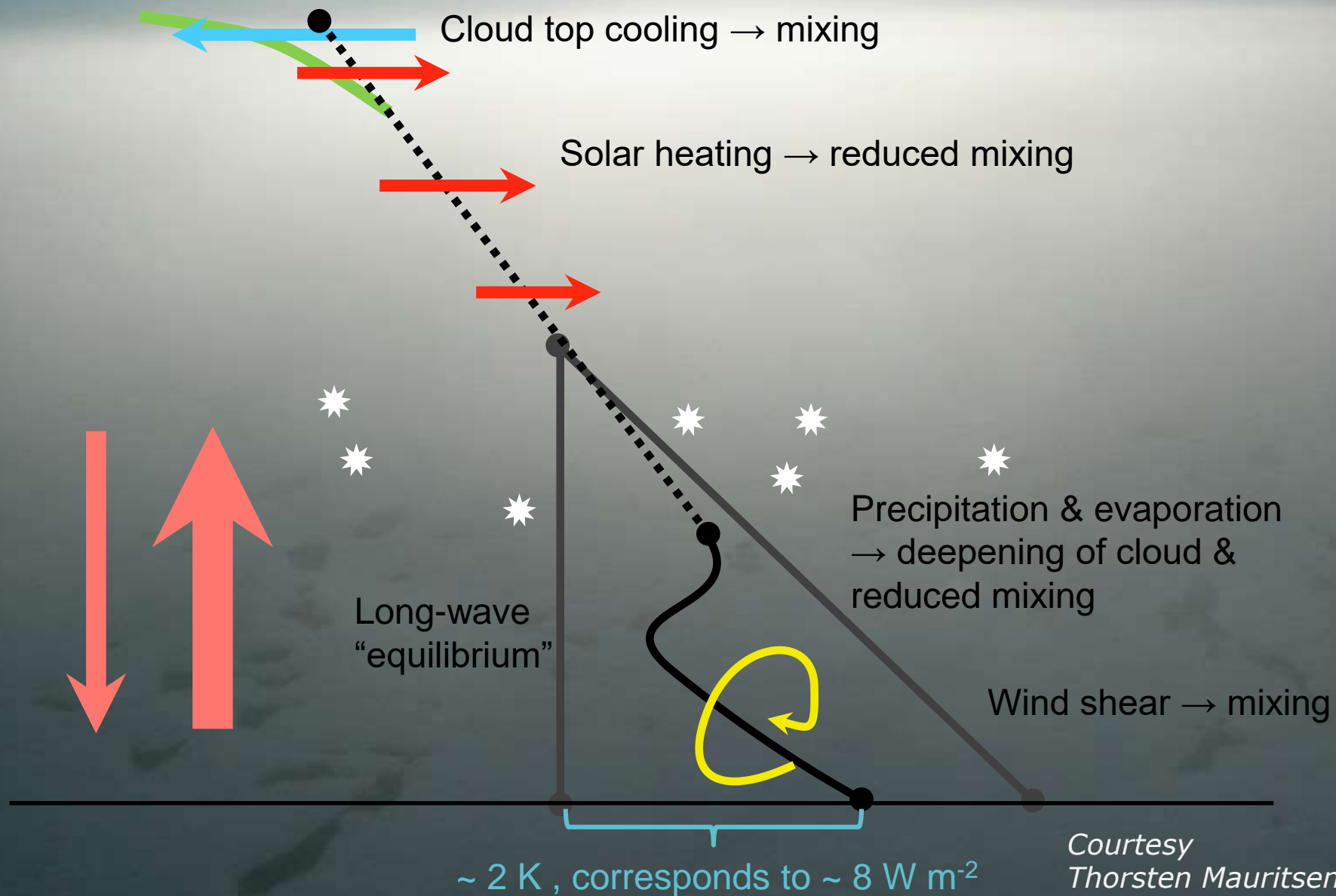
Aerosol, cloud microphysics and mixing



Solomon et al., 2015

Focusing on surface energy budget:

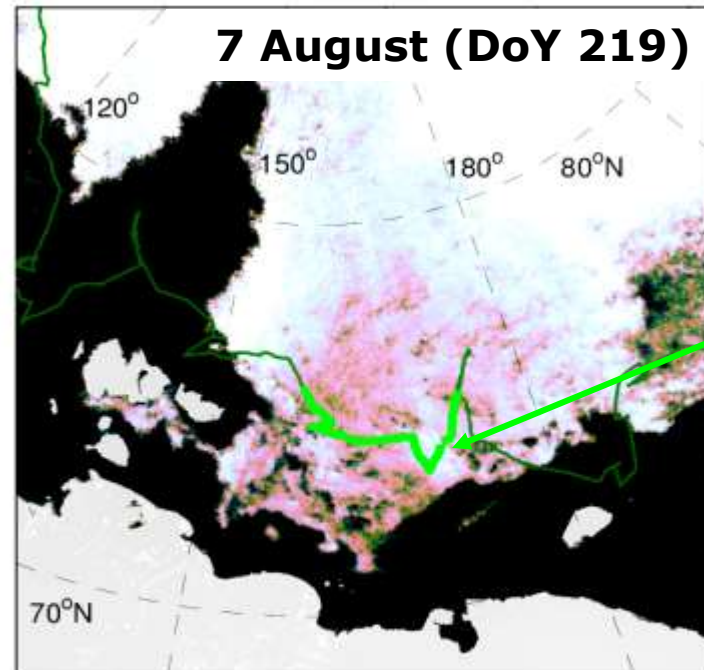
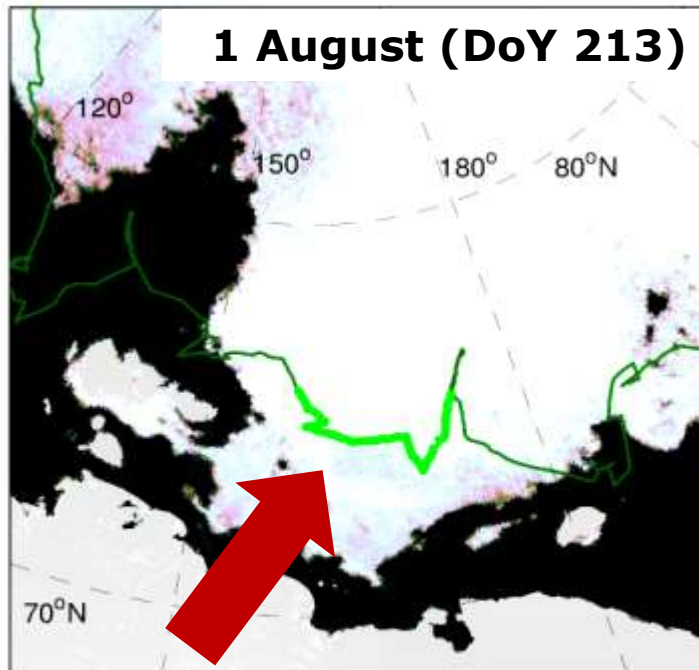
What atmospheric processes do we need to get right?



Courtesy
Thorsten Mauritsen

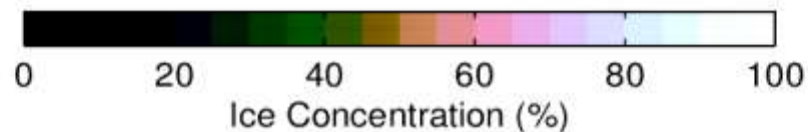
An extreme warm advection episode

Observations on icebreaker Oden, ACSE 2014

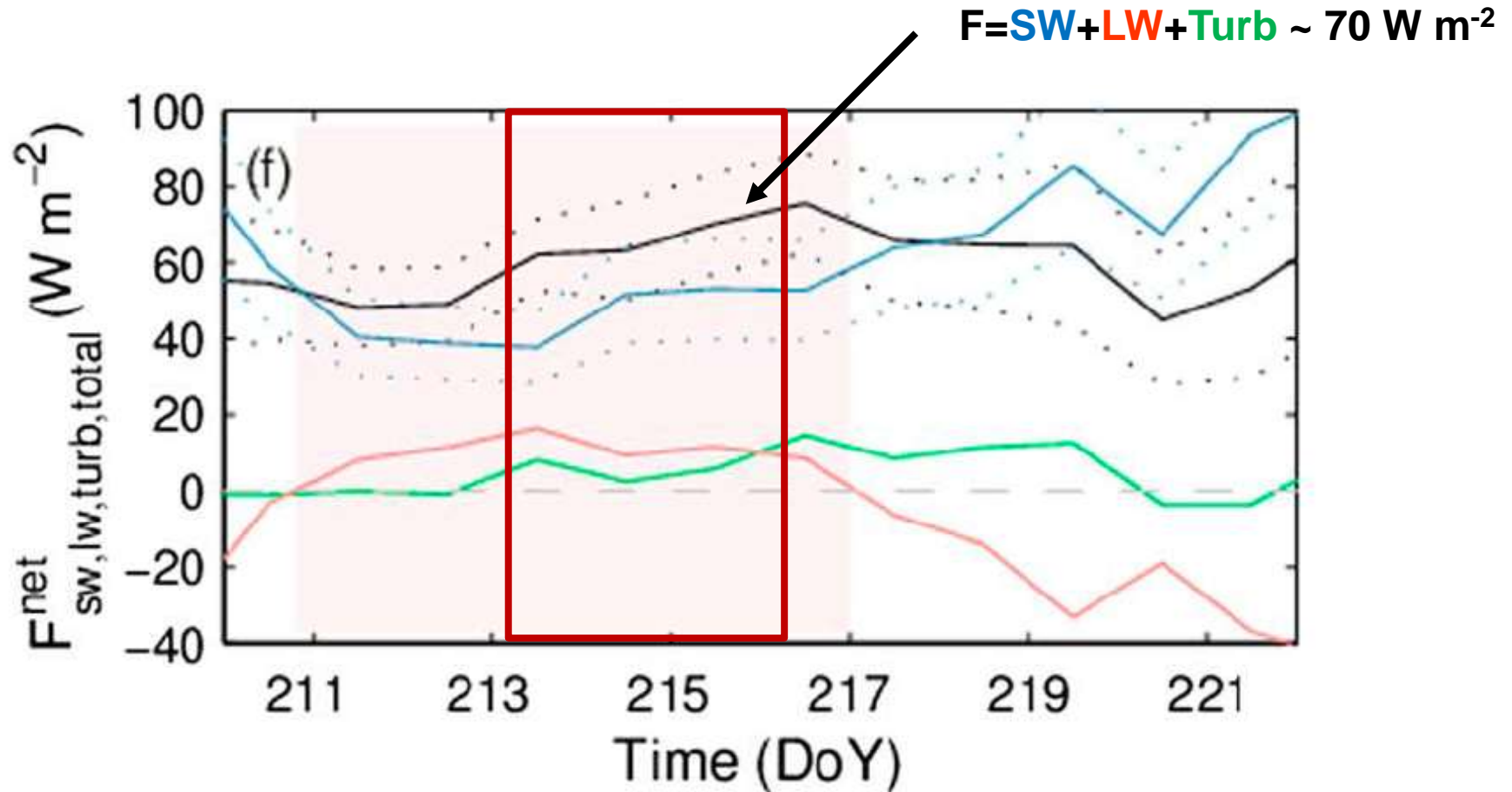


**Icebreaker
Oden track**

Siberia

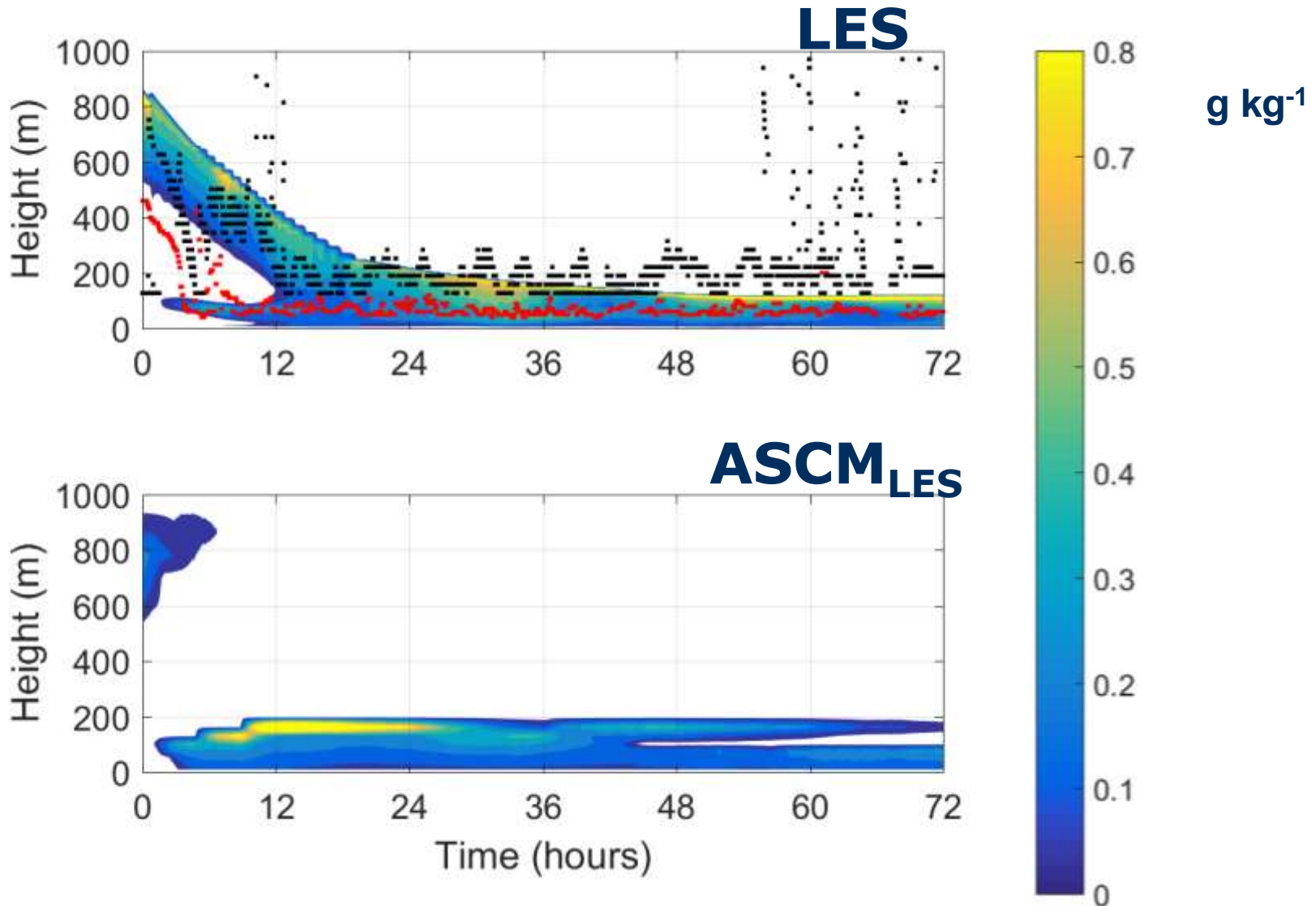


Observed surface energy budget (atmospheric point of view)



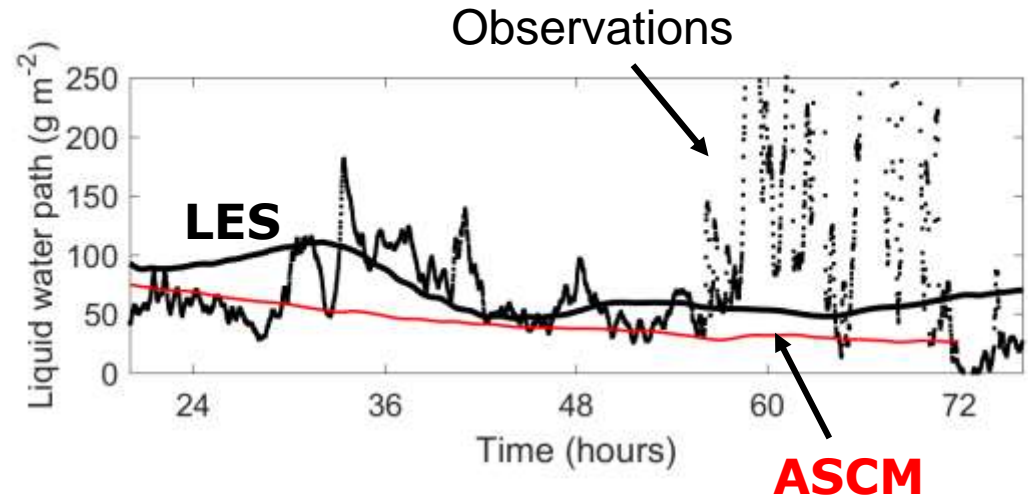
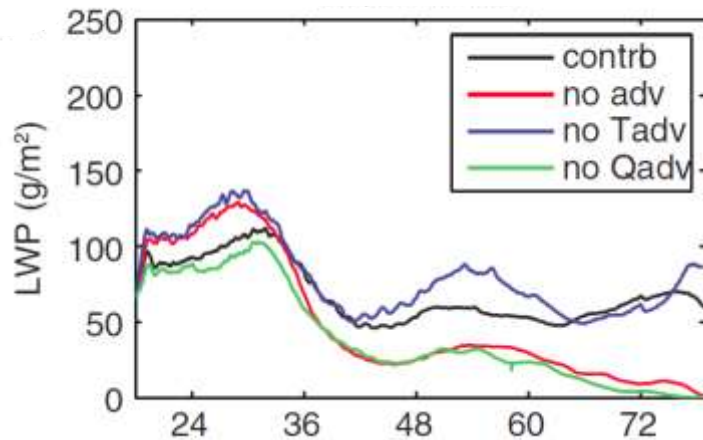
LES and ASCM

Cloud liquid water content



Sensitivity to advection

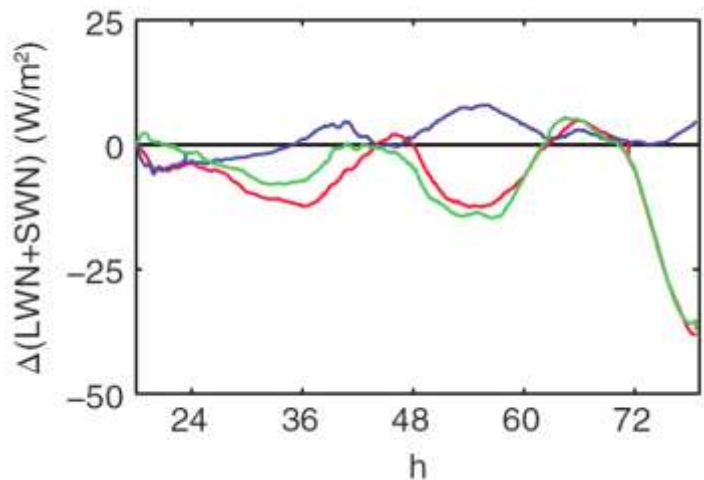
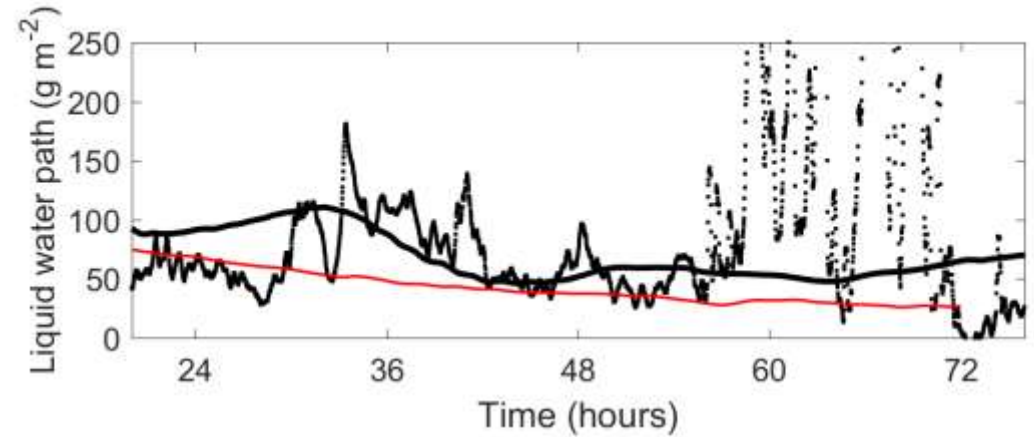
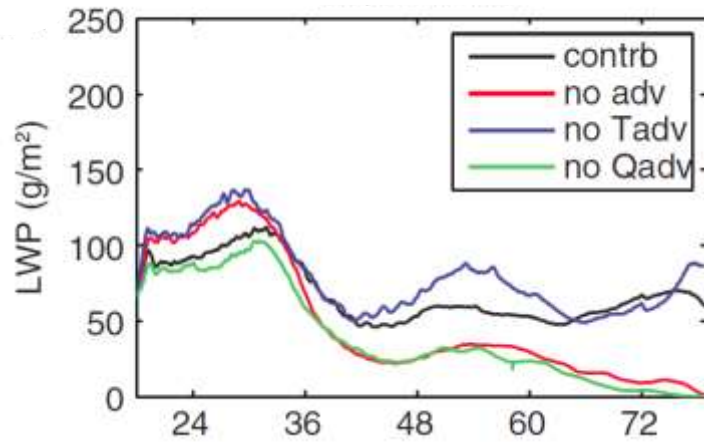
LES (MIMICA) and ASCM simulation of ACSE case



Moisture advection
necessary to maintain
the cloud

Sensitivity to advection

LES (MIMICA) simulation of ACSE case



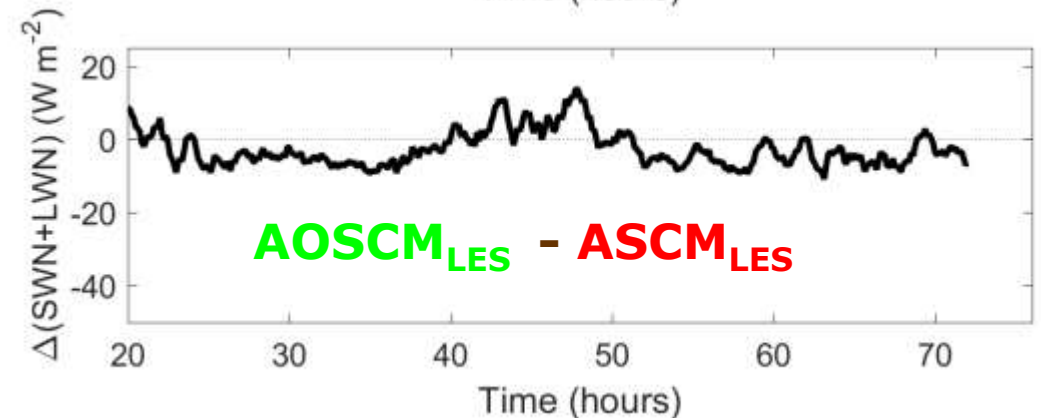
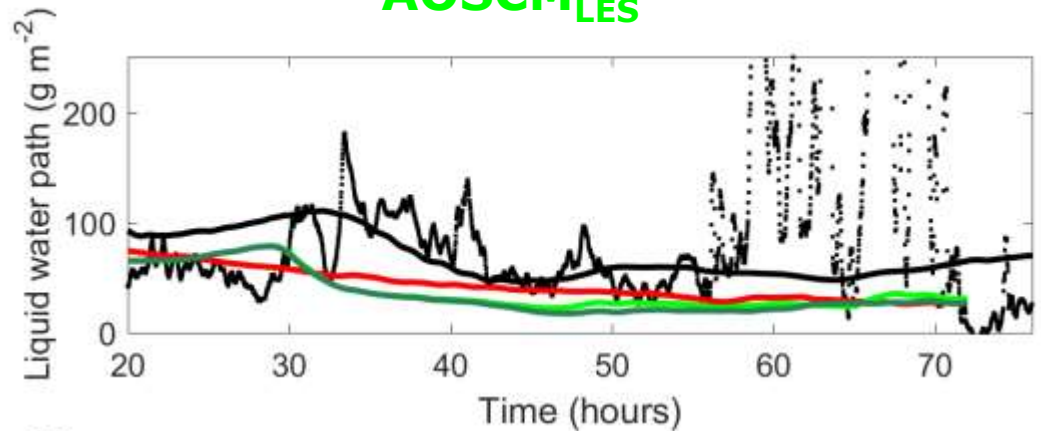
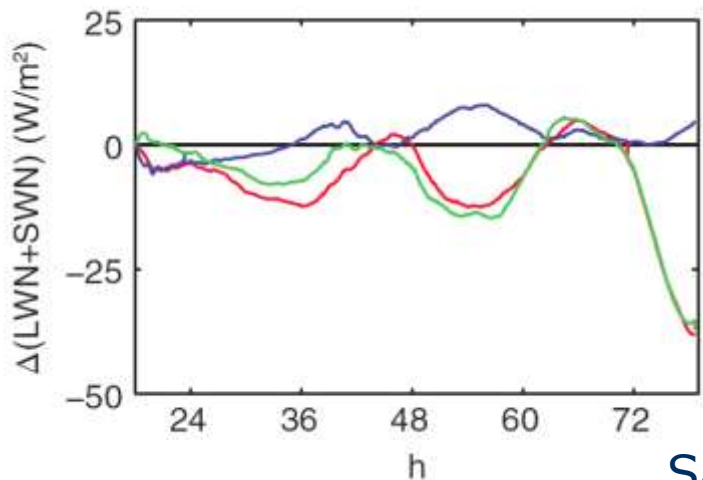
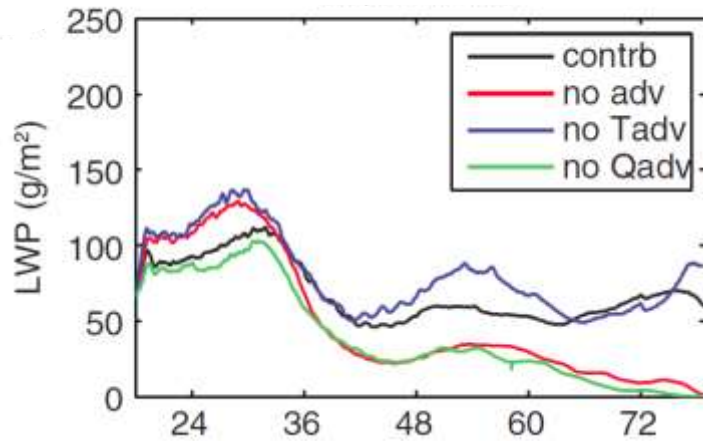
Sensitivity to coupling

LES (MIMICA) simulation of ACSE case

LES

ASC_{LES}

AOSC_{LES}



AOSC_{LES} - ASC_{LES}

Same order of change in net surface radiation coupled/uncoupled as LES with/without advection
Almost no sea-ice melt and constant mean albedo

Sensitivity to advection

LES (MIMICA) simulation of ACSE case



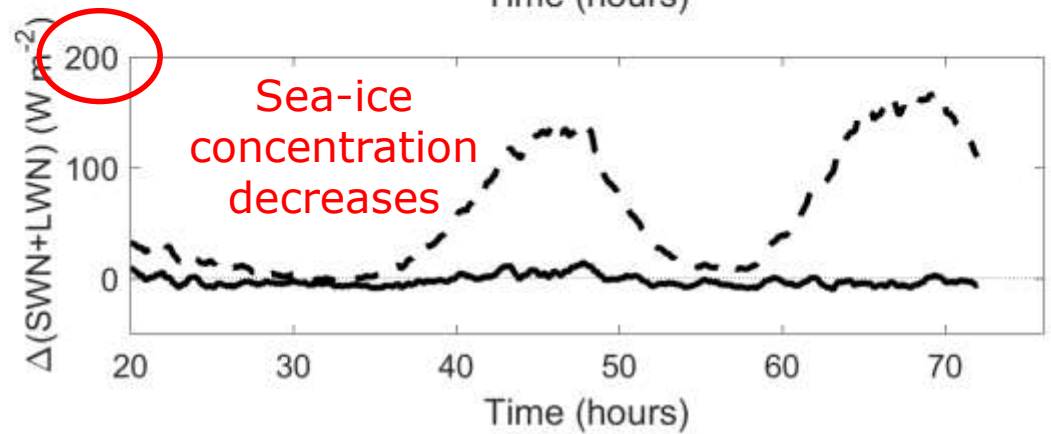
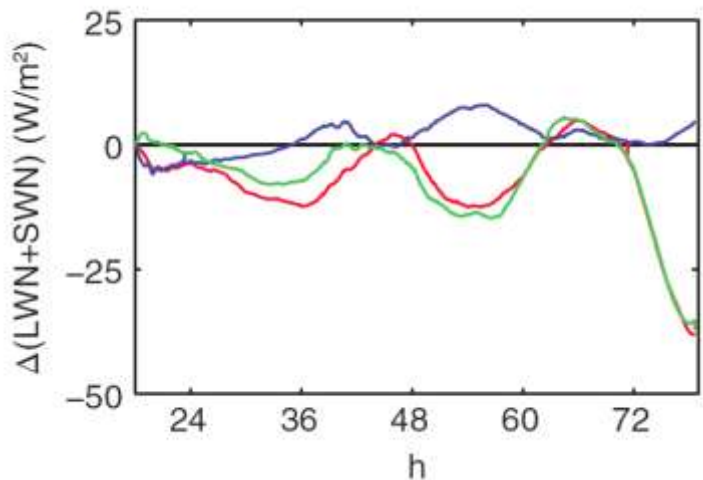
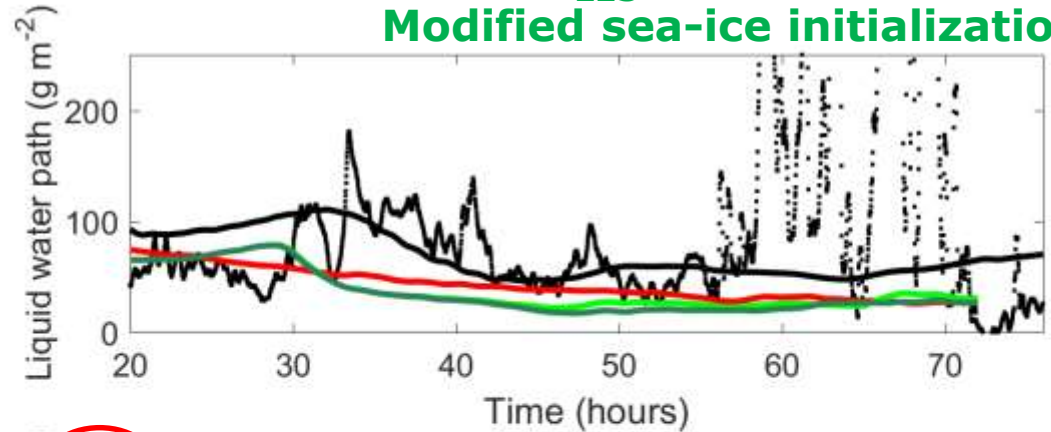
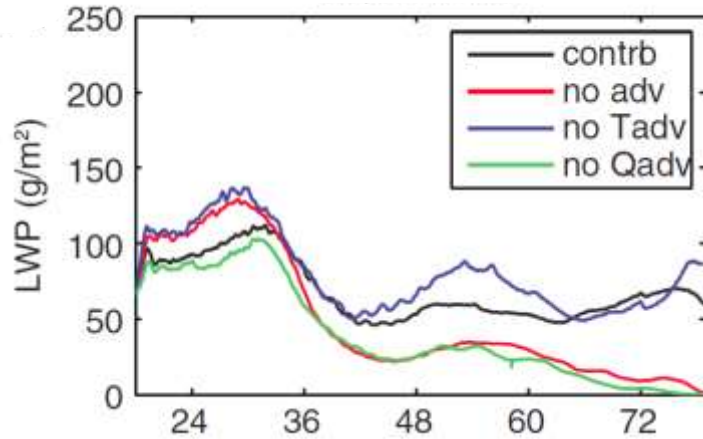
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ASCM_{LES}

AOSCM_{LES}

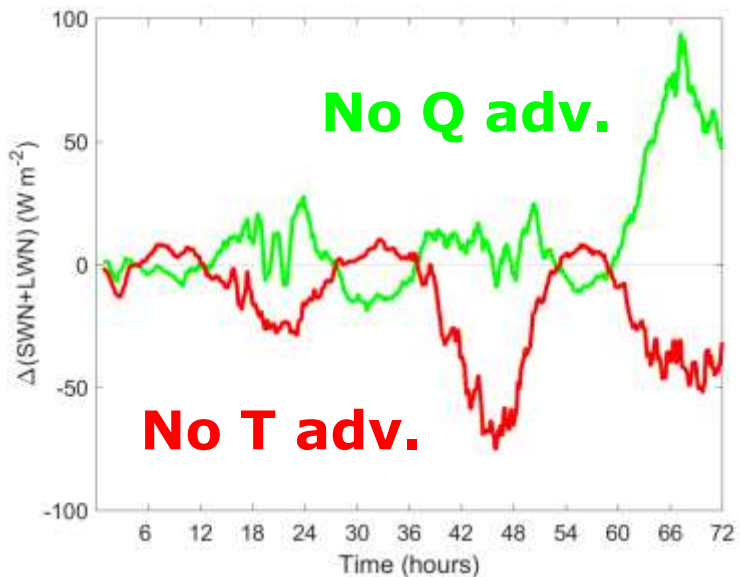
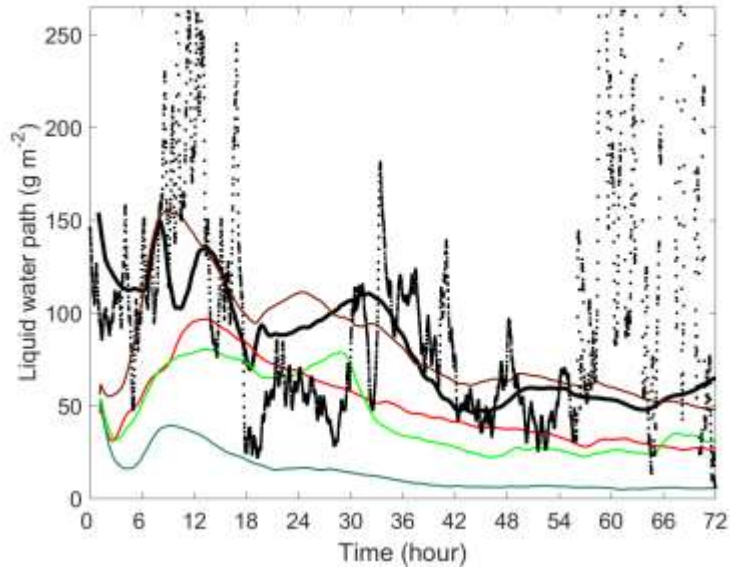
AOSCM_{LES}

Modified sea-ice initialization



When sea-ice is melting, the picture changes!

AOSCM_{LES}



LES

ASCM_{LES}

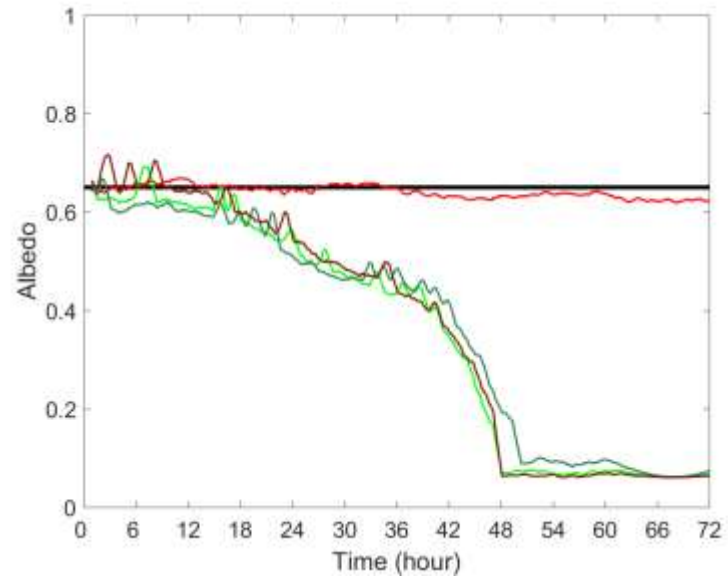
AOSCM_{LES}

AOSCM_{LES} No Q adv.

AOSCM_{LES} No T adv.



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Sea-ice is gone unrealistically fast – initialization of the ice is not adequate

Concluding remarks



SCM simulations are intended for improved understanding of parameterized processes in more controlled conditions

AOSCM makes it possible to study interactions ocean/sea-ice/snow/atmosphere with focus on vertical coupling processes, physical and technical

Large-scale advection and local vertical processes can be separated

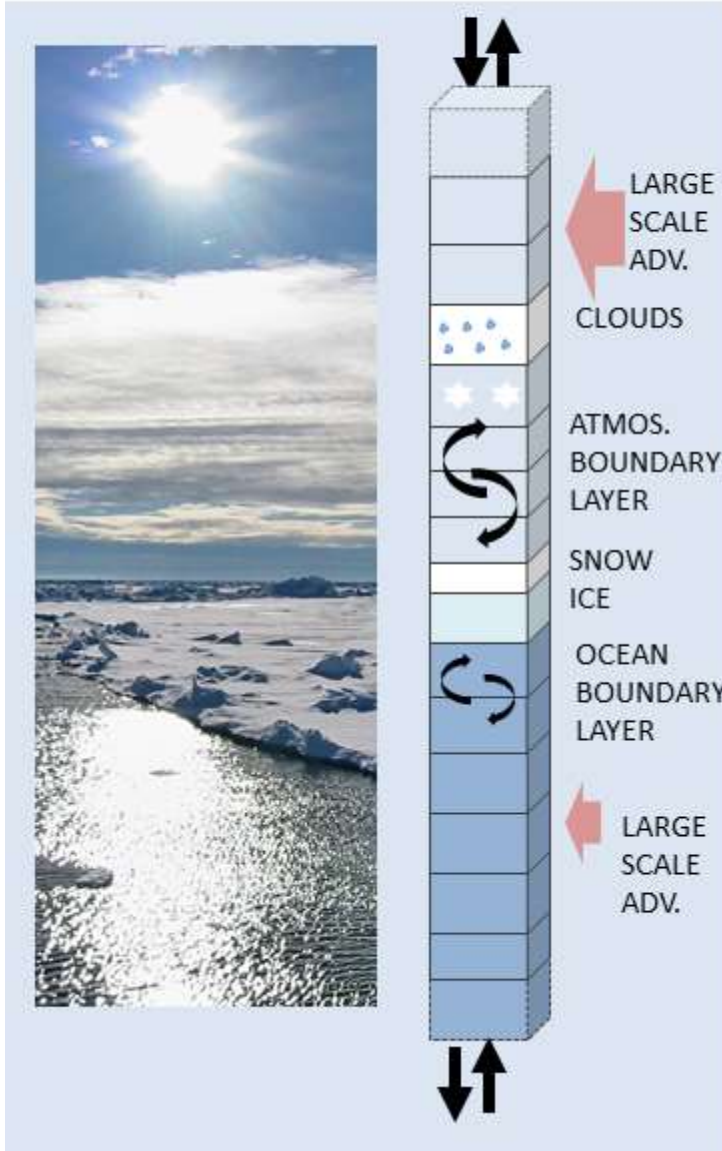
AOSCM is developed and maintained within the EC-Earth development portal, tagged version AOSCM.v1_EC-Earth3

Similar to the NWP Operational system IFS

Simulations of the ACSE case show that the coupling may have as large an impact as the advection of moisture in the LES case

Initialization, especially the cloud and sea-ice temperature, has an impact on the evolution of the cloud and the energy budget

AOSCM and MOSAiC



<http://www.mosaic-expedition.org>

MOSAiC
International
Arctic Drift
Expedition

