CliC Climate and Cryosphere

Understanding the changing cryosphere and its climate connections

CMIP6 planning – SIMIP (diagnostic sea ice variables)

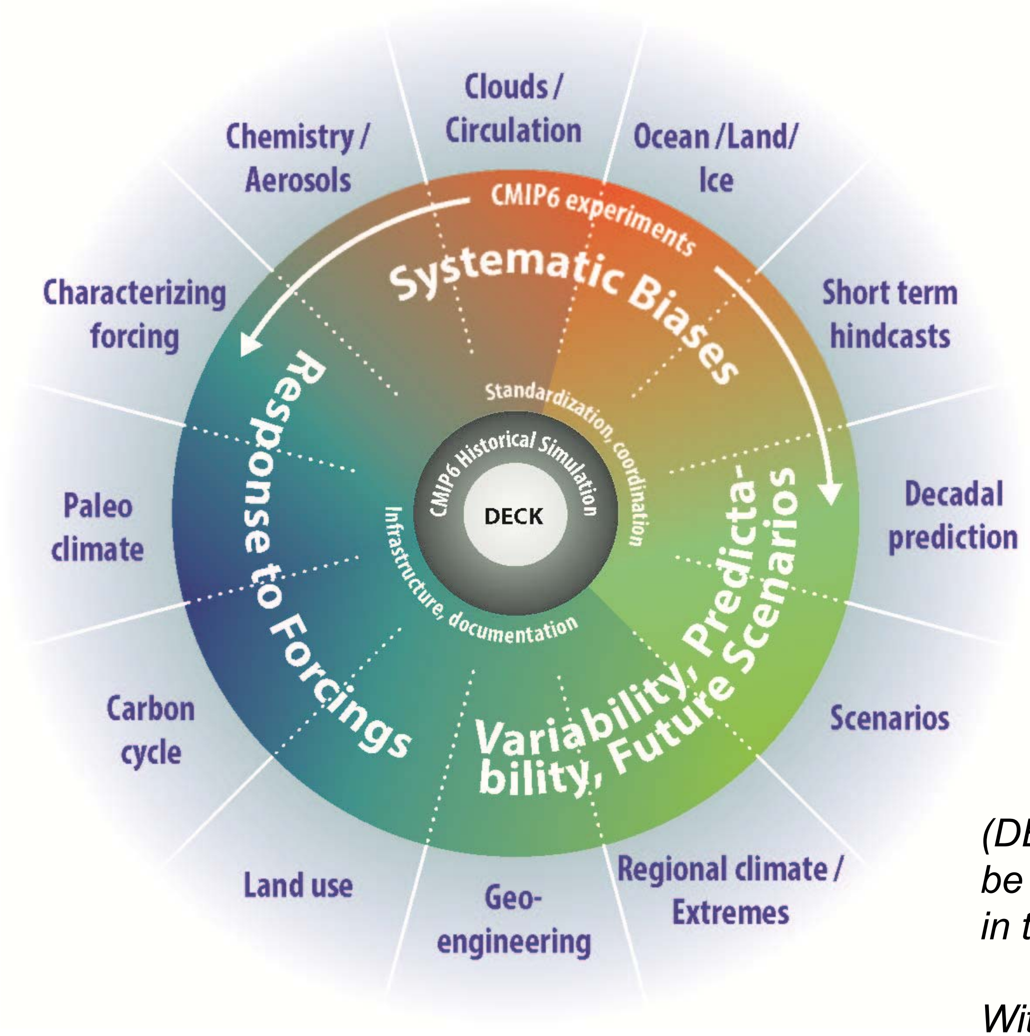
Alexandra Jahn (CU Boulder) & Dirk Notz (MPI Hamburg)

University of Colorado Boulder

Max-Planck-Institut für Meteorologie

CMIP6 Plans

WCRP Grand Challenges: (1) Clouds, circulation and climate sensitivity, (2) Changes in cryosphere, (3) Climate extremes, (4) Regional climate information, (5) Regional sea-level rise, and (6) Water availability, plus an additional theme on “Biogeochemical forcings and feedbacks”



Note: *The themes in the outer circle of the figure might be slightly revised at the end of the MIP endorsement process*

DECK (entry card for CMIP)

i. AMIP simulation (~1979-2014)
ii. Pre-industrial control simulation
iii. 1%/yr CO_2 increase
iv. Abrupt 4xCO_2 run

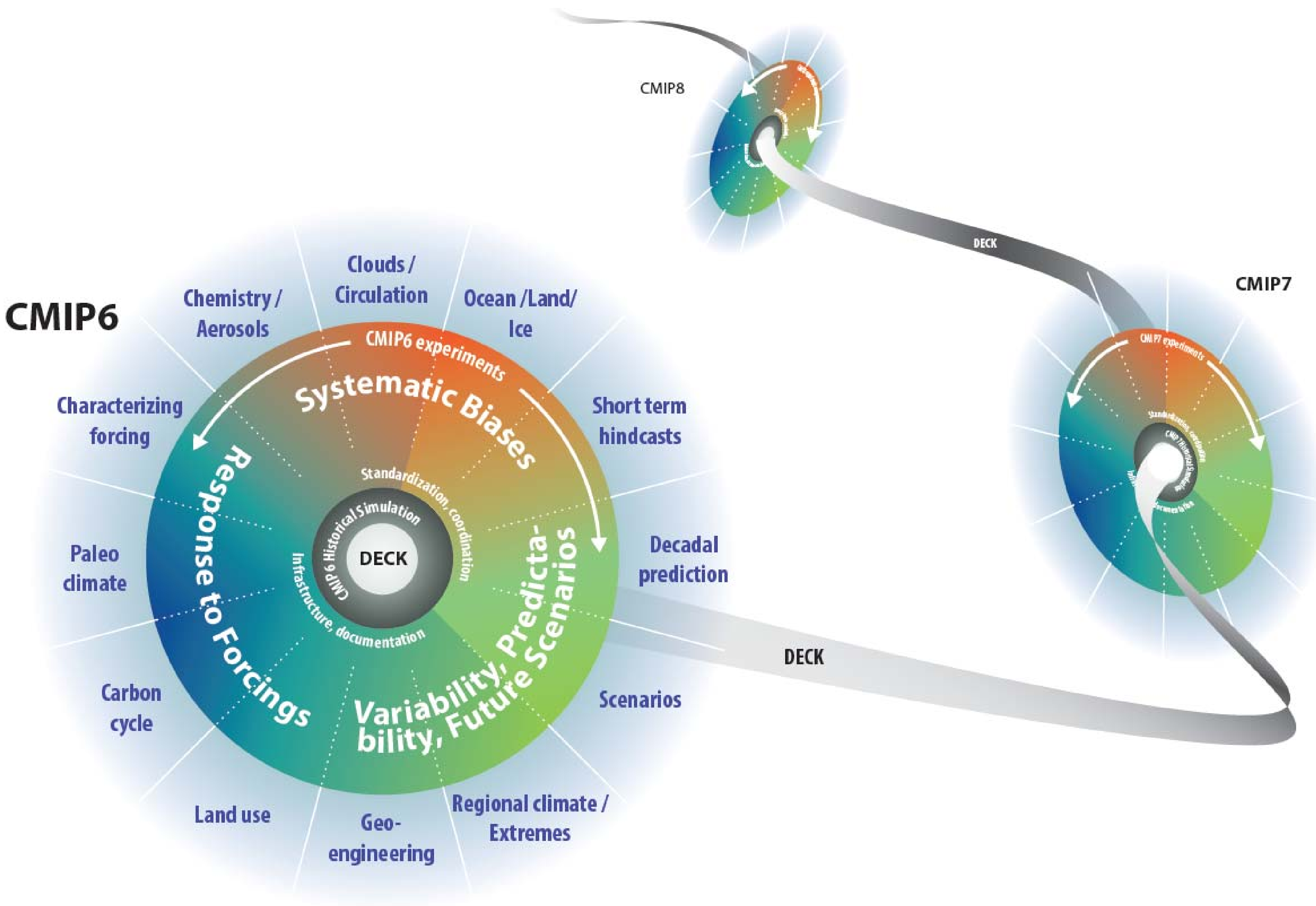
CMIP6 Historical Simulation (entry card for CMIP6)

v. Historical simulation using CMIP6 forcings (1850-2014)

(DECK & CMIP6 Historical Simulation to be run for each model configuration used in the subsequent CMIP6-Endorsed MIPs)

With proto-DECK experiments (LMIP,OMIP etc.) in CMIP6 Tier1

CMIP Continuity



Note: *The themes in the outer circle of the figure might be slightly revised at the end of the MIP endorsement process*

Overview of MIPs that have applied for CMIP6 Endorsement

Applications follow the template available on the CMIP panel website at http://www.wcrp-climate.org/index.php/wgcm-cmip/about-cmip

Date: 2 December 2014

Please send any feedback to these applications to the CMIP panel chair (Veronika.Eyring@dlr.de) or directly contact the individual co-chairs for questions on specific MIPs

	Short Name of MIP	Long Name of MIP
1	**AerChemMIP**	Aerosols and Chemistry Model Intercomparison Project
2	**C4MIP**	Coupled Climate Carbon Cycle Model Intercomparison Project
3	**CFMIP**	Cloud Feedback Model Intercomparison Project
4	**DAMIP**	Detection and Attribution Model Intercomparison Project
5	**DCPP**	Decadal Climate Prediction Project
6	**ENSOMIP**	ENSO Model Intercomparison Project
7	**FAFMIP**	Flux-Anomaly-Forced Model Intercomparison Project
8	**GeoMIP**	Geoengineering Model Intercomparison Project
9	**GMMIP**	Global Monsoons Model Intercomparison Project
10	**HighResMIP**	High Resolution Model Intercomparison Project
11	**ISMIP6**	Ice Sheet Model Intercomparison Project for CMIP6
12	**LS3MIP**	Land Surface, Snow and Soil Moisture
13	**LUMIP**	Land-Use Model Intercomparison Project
14	**OCMIP6**	Ocean Carbon Cycle Model Intercomparison Project, Phase 6
15	**OMIP**	Ocean Model Intercomparison Project
16	**PDRMIP**	Precipitation Driver and Response Model Intercomparison Project
17	**PMIP**	Palaeoclimate Modelling Intercomparison Project
18	**RFMIP**	Radiative Forcing Model Intercomparison Project
19	**ScenarioMIP**	Scenario Model Intercomparison Project
20	**SolarMIP**	Solar Model Intercomparison Project
21	**VolMIP**	Volcanic Forcings Model Intercomparison Project
	Diagnostic MIPs (i.e., no proposed experiments rather requesting that certain output is archived and/or contributing to the evaluation and analysis in a coordinated manner)	
22	**CORDEX**	Coordinated Regional Climate Downscaling Experiment
23	**DynVar**	Dynamics and Variability of the Stratosphere-Troposphere System
24	**GDDEX**	Global Dynamical Downscaling Experiment
25	**SIMIP**	Sea-Ice Model Intercomparison Project
26	**VIAAB**	VIA Advisory Board for CMIP6

CMIP6 MIPs have been proposed and are being reviewed

SIMIP is a diagnostic MIP (no experiments proposed)

→ Requesting sea ice output for all experiments using the sea ice model

Timeline for CMIP6 data request

- Online registration and CMIP5 variables which will be used again returned to WIP co-chairs and CMIP Panel Chair, c/o Martin Juckes (**31 January 2015**) – Complete SIMIP data request submitted January 30th
- Full information except the final experiment list for ***CMIP6 Data Request Compilation Template*** returned to WIP co-chairs and CMIP Panel Chair, c/o Martin Juckes (**28 February 2015**)
- Synthesized responses (i.e., 1st Draft of ***CMIP6 Data Request***) sent to MIP co-chairs with request for additional information that can be aligned only after the final experiment list is received (**15 April 2015**)
- 1st Draft of ***CMIP6 Data Request*** reviewed and returned, with additional information as requested (**15 June 2015**)
- Near-final version of ***CMIP6 Data Request*** published, **31 July 2015**
- Feedback from modelling group on the actual implementation of the *CMIP6 Data Request* returned (**15 October 2015**)
- Final ***CMIP6 Data Request*** approved at WGCM meeting (**31 October 2015**)

SIMIP proposal

- **Co-Chairs:** Dirk Notz and Alexandra Jahn
- **Steering Committee:** Marika Holland, Elizabeth Hunke, Francois Massonet, Julienne Stroeve, Bruno Tremblay, Martin Vancoppenolle
  - **SIMIP goal: Defines variables that are necessary to understand the sea-ice evolution in any CMIP6 experiment**
  - This diagnostic MIP provides a list of clearly defined variables that allow for a near-complete analysis of the evolution of sea ice in any experiment carried out as part of CMIP6.
  - To achieve this aim, we propose a list of those variables required to close the three budgets that govern the evolution of sea ice and its impact on the Earth's climate system. **These are the conservation of heat, the momentum balance and tracer conservation.** In addition, we provide a list of variables that allow for the high frequency analysis of the sea-ice state itself.

Averaging guidelines

- **Temporal averaging for all variables that do directly change with area fraction** (i.e. extensive variables such as: volume, mass, area fraction): always average in 0 for all time steps where no sea ice is present
- **Temporal averaging for all variables that do not directly change with area fraction** (i.e. intensive variables such as: temperature, albedo, speed, stress, fluxes...): All time samples are first multiplied by area fraction, then summed, and then divided by the sum of the area fractions. This will automatically result in missing values for continuously ice-free conditions (division by zero)
- **Spatial fractions** (concentrations) are always relative to full size of the grid cell. Models with multiple surface properties or multiple categories in single grid cell use area-fraction weighted spatial average of ice-covered part of grid cell

Sea ice variable categories

- Sea-ice state variables
- Tendencies of sea-ice mass and area fraction (all negative for decreasing mass)
- Heat and freshwater fluxes (all only for sea-ice fraction of grid cell, downward always positive)
- Sea-ice dynamics
- Integrated measures

Requested daily variables

1. Fraction of time steps with sea ice
2. Sea-ice area fraction
3. Sea-ice thickness (actual floe thickness, not ice volume/grid area as in CMIP5)
4. Snow thickness
5. Surface temperature of sea ice
6. X-component of sea ice velocity
7. Y-component of sea ice velocity
8. Sea-ice speed

Community input requested on SIMIP CMP6 variable list

- By March 31 2015
- Variable list available under https://www.earthsystemcog.org/doc/list/wipdatarequest/
- Email will be send to PCWG after meeting
- **Questions?**
- In the future, after list is finalized, PCWG should decide which variables should be saved from CESM

Requested monthly variables

66	**4. Sea-ice dynamics**							
67	siu	sea_ice_x_velocity	1	sea ice	$m\ s^{-1}$	X-component of sea ice velocity	x-velocity of ice on native model grid	1
68	siv	sea_ice_y_velocity	1	sea ice	$m\ s^{-1}$	Y-component of sea ice velocity	y-velocity of ice on native model grid	1
69	sispeed	sea_ice_speed	1	sea ice	$m\ s^{-1}$	Sea-ice speed	speed of ice (i.e. mean absolute velocity) to account for back-and-forth movement of the ice	1
70	sidmasstranx	sea_ice_x_transport	1	sea ice	$kg\ s^{-1}$	X-component of sea-ice mass transport	Includes transport of both sea ice and snow by advection	2
71	sidmasstrany	sea_ice_y_transport	1	sea ice	$kg\ s^{-1}$	Y-component of sea-ice mass transport	Includes transport of both sea ice and snow by advection	2
72	sistrxdtop	surface_downward_x_stress	1	sea ice	$N\ m^{-2}$	X-component of atmospheric stress on sea ice	X-component of atmospheric stress on sea ice	2
73	sistrydtop	surface_downward_y_stress	1	sea ice	$N\ m^{-2}$	Y-component of atmospheric stress on sea ice	Y-component of atmospheric stress on sea ice	2
74	sistrxubot	sea_ice_base_upward_x_stress	-1	sea ice	$N\ m^{-2}$	X-component of ocean stress on sea ice	X-component of ocean stress on sea ice	2
75	sistryubot	sea_ice_base_upward_y_stress	-1	sea ice	$N\ m^{-2}$	Y-component of ocean stress on sea ice	Y-component of ocean stress on sea ice	2
76	sicompstren	compressive_strength_of_sea_ice	1	sea ice	$N\ m^{-1}$	Compressive sea ice strength	Computed strength of the ice pack, defined as the energy (J m-2) dissipated per unit area removed from the ice pack under compression, and assumed proportional to the change in potential energy caused by ridging. For Hibler-type models, this is P (= P*hexp(-C(1-A)))	2
77	sidragtop	surface_drag_coefficient_for_momentum_in_air	1	sea ice	1	Atmospheric drag coefficient	Atmospheric drag coefficient that is used to calculate the atmospheric momentum drag on sea ice	3
78	sidragbot	surface_drag_coefficient_for_momentum_in_water	-1	sea ice	1	Ocean drag coefficient	Oceanic drag coefficient that is used to calculate the oceanic momentum drag on sea ice	3
79	siforcetiltx	sea_surface_tilt_force_on_sea_ice_x	-1	sea ice	$N\ m^{-2}$	Sea-surface tilt term in force balance (x-component)	X-component of force on sea ice caused by sea-surface tilt	3
80	siforcetilty	sea_surface_tilt_force_on_sea_ice_y	-1	sea ice	$N\ m^{-2}$	Sea-surface tilt term in force balance (y-component)	Y-component of force on sea ice caused by sea-surface tilt	3
81	siforcecoriolx	coriolis_force_on_sea_ice_x	-1	sea ice	$N\ m^{-2}$	Coriolis force term in force balance (x-component)	X-component of force on sea ice caused by coriolis force	3
82	siforcecorioly	coriolis_force_on_sea_ice_y	-1	sea ice	$N\ m^{-2}$	Coriolis force term in force balance (y-component)	Y-component of force on sea ice caused by coriolis force	3
83	siforceintstrx	internal_stress_in_sea_ice_x	-1	sea ice	$N\ m^{-2}$	Internal stress term in force balance (x-component)	X-component of force on sea ice caused by internal stress (divergence of sigma)	3
84	siforceintstry	internal_stress_in_sea_ice_y	-1	sea ice	$N\ m^{-2}$	Internal stress term in force balance (y-component)	Y-component of force on sea ice caused by internal stress (divergence of sigma)	3
85	sistresave	average_normal_stress	-1	sea ice	$N\ m^{-1}$	Average normal stress in sea ice	Average normal stress in sea ice (first stress invariant)	3
86	sistremax	maximum_shear_stress	-1	sea ice	$N\ m^{-1}$	Maximum shear stress in sea ice	Maximum shear stress in sea ice (second stress invariant)	3
87	sidivvel	divergence_of_sea_ice_velocity	1	sea ice	1/s	Divergence of the sea-ice velocity field	Divergence of sea-ice velocity field (first shear strain invariant)	2
88	sishevel	maximum_shear_of_sea_ice_velocity	-1	sea ice	1/s	Maximum shear of sea-ice velocity field	Maximum shear of sea-ice velocity field (second shear strain invariant)	2
89	**5. Integrated measures**							
90	siextentn	sea_ice_extent	1	scalar	10^6 km²	Sea ice extent North	Total area of all Northern-Hemisphere grid cells that are covered by at least 15 % areal fraction of sea ice	2
91	siextents	sea_ice_extent	1	scalar	10^6 km²	Sea ice extent South	Total area of all Southern-Hemisphere grid cells that are covered by at least 15 % areal fraction of sea ice	2
92	sivoln	sea_ice_volume	1	scalar	10^3 km³	Sea ice volume North	total volume of sea ice in the Northern hemisphere	2
93	sivols	sea_ice_volume	1	scalar	10^3 km³	Sea ice volume South	total volume of sea ice in the Southern hemisphere	2
94	siarean	sea_ice_area	1	scalar	10^6 km²	Sea ice area North	total area of sea ice in the Northern hemisphere	2
95	siareas	sea_ice_area	1	scalar	10^6 km²	Sea ice area South	total area of sea ice in the Southern hemisphere	2
96	siacrossline	sea_ice_transport_across_line	1	4 element vector	kg/s	Sea ice mass flux through straits	net (sum of transport in all directions) sea ice mass transport through the following four passages, positive into the Arctic Ocean 1. Fram Strait = (11.5◦W,81.3◦N to (10.5◦E,79.6◦N) 2. Canadian Archipelego = (128.2◦W,70.6◦N) to (59.3◦W,82.1◦N) 3. Barents opening = (16.8◦E,76.5◦N) to (19.2◦E,70.2◦N) 4. Bering Strait = (171◦W,66.2◦N) to (166◦W,65◦N)	2

6	**1. Sea-ice state variables**							
7	sitimefrac	sea_ice_time_fraction	-1	sea ice	1	Fraction of time steps with sea ice	Fraction of time steps of the averaging period during which sea ice is present (siconc >0) in a grid cell	1
8	siconc	sea_ice_area_fraction	1	sea ice	1	Sea-ice area fraction	Area fraction of grid cell covered by sea ice	1
9	simass	sea_ice_mass	1	sea ice	kg / m^2	Sea-ice mass per area	Total mass of sea ice divided by grid-cell area	1
10	sithick	sea_ice_thickness	1	sea ice	m	Sea-ice thickness	Actual (floe) thickness of sea ice (NOT volume divided by grid area as was done in CMIP5)	1
11	sivol	sea_ice_volume	1	sea ice	m	Sea-ice volume per area	Total volume of sea ice divided by grid-cell area (this used to be called ice thickness in CMIP5)	1
12	sisnconc	surface_snow_area_fraction	1	sea ice	1	Snow area fraction	Area fraction of grid cell covered by snow that lies on sea ice; exclude snow that lies on land or land ice.	1
13	sisnmass	liquid_water_content_of_surface_snow	1	sea ice	kg / m^2	Snow mass per area	Total mass of snow on sea ice divided by grid-cell area	1
14	sisnthick	surface_snow_thickness	1	sea ice	m	Snow thickness	Actual thickness of snow (snow volume divided by snow-covered area)	1
15	siitdconc	sea_ice_area_fraction_over_categories	-1	sea ice	1	Sea-ice area fractions in thickness categories	Area fraction of grid cell covered by each ice-thickness category (vector with one entry for each thickness category starting from the thinnest category, netcdf file should use thickness bounds of the categories as third coordinate axis)	3
16	siitdthick	sea_ice_thickness_over_categories	-1	sea ice	m	Sea-ice thickness in thickness categories	Actual (floe) thickness of sea ice in each category (NOT volume divided by grid area), (vector with one entry for each thickness category starting from the thinnest category, netcdf file should use thickness bounds of categories as third coordinate axis)	3
17	siitdsnconc	snow_area_fraction_over_categories	-1	sea ice	1	Snow area fractions in thickness categories	Area fraction of grid cell covered by snow in each ice-thickness category (vector with one entry for each thickness category starting from the thinnest category, netcdf file should use thickness bounds of the categories as third coordinate axis)	3
18	siitdsnthick	snow_thickness_over_categories	-1	sea ice	m	Snow thickness in thickness categories	Actual thickness of snow in each category (NOT volume divided by grid area), (vector with one entry for each thickness category starting from the thinnest category, netcdf file should use thickness bounds of categories as third coordinate axis)	3
19	sitemptop	sea_ice_surface_temperature	1	sea ice	K	Surface temperature of sea ice	Report surface temperature of snow where snow covers the sea ice.	1
20	sitempsnic	snow_sea_ice_interface_temperature	-1	sea ice	K	Temperature at snow-ice interface	Report surface temperature of ice where snow thickness is zero	2
21	sitempbot	sea_ice_bottom_temperature	-1	sea ice	K	Temperature at ice-ocean interface	Report temperature at interface, NOT temperature within lowermost model layer	2
22	siage	age_of_sea_ice	1	sea ice	s	Age of sea ice	Age of sea ice	2
23	sialb	sea_ice_albedo	1	sea ice	1	Sea-ice or snow albedo	Mean surface albedo of entire ice-covered part of grid cell	2
24	sisaltmass	sea_ice_salt_mass	-1	sea ice	kg / m^2	Mass of salt in sea ice per area	Total mass of all salt in sea ice divided by grid-cell area	3
25	simpconc	melt_pond_fraction	-1	sea ice	1	Meltpond area fraction	Area fraction of grid cell that is covered by melt ponds	3
26	simpthick	melt_pond_depth	-1	sea ice	m	Meltpond depth	Volume of water in meltponds divided by meltpond covered area	3
27	simprefrozen	melt_pond_refrozen_ice	-1	sea ice	m	Thickness of refozen ice on melt pond	Volume of refrozen ice on melt ponds divided by meltpond covered area	3
28	sirdgconc	fraction_of_ridged_sea_ice	-1	sea ice	1	Ridged ice area fraction	Area fraction of grid cell covered by ridged sea ice	3
29	sirdgthick	thickness_of_ridged_sea_ice	-1	sea ice	m	Ridged ice thickness	Total volume of ridged sea ice divided by area of ridges	3
30	sisali	sea_ice_salinity	1	sea ice	g kg^{-1}	Sea ice salinity	Mean sea-ice salinity of all sea ice in grid cell	3
31	sifb	sea_ice_freeboard	1	sea ice	m	Sea-ice freeboard	Mean height of sea-ice surface (=snow-ice interface when snow covered) above sea level	2
32	sihc	integral_of_sea_ice_temperature_wrt_depth_expressed_as_heat_content	1	sea ice	J m^{-2}	Sea-ice heat content per unit area	Heat content of all ice in grid cell divided by total grid-cell area. Water at 0 Celsius is assumed to have a heat content of 0 J. Does not include heat content of snow, but does include heat content of brine. Heat content is always negative, since both the sensible and the latent heat content of ice are less than that of water	3
33	sisnhc	thermal_energy_content_of_surface_snow	1	sea ice	J m^{-2}	Snow-heat content per unit area	Heat-content of all snow in grid cell divided by total grid-cell area. Snow-water equivalent at 0 Celsius is assumed to have a heat content of 0 J. Does not include heat content of sea ice.	3

34	**2. Tendencies of sea-ice mass and area fraction (all negative for decreasing mass)**							
35	sidconcth	tendency_of_sea_ice_area_fraction_due_to_thermodynamics	1	sea ice	1/s	sea-ice area fraction change from thermodynamics	Total change in sea-ice area fraction through thermodynamic processes	2
36	sidconcdyn	tendency_of_sea_ice_area_fraction_due_to_dynamics	1	sea ice	1/s	sea-ice area fraction change from dynamics	Total change in sea-ice area fraction through dynamics-related processes (advection, divergence…)	2
37	sidmassth	tendency_of_sea_ice_amount_due_to_thermodynamics	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change from thermodynamics	Total change in sea-ice mass from thermodynamic processes divided by grid-cell area	2
38	sidmassdyn	tendency_of_sea_ice_amount_due_to_dynamics	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change from dynamics	Total change in sea-ice mass through dynamics-related processes (advection,…) divided by grid-cell area	2
39	sidmassgrowthwat	tendency_of_sea_ice_amount_due_to_freezing_in_open_water	-1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through growth in supercooled open water (aka frazil)	The rate of change of sea ice mass due to sea ice formation in supercooled water (often through frazil formation) divided by grid-cell area. Together, sidmassgrowthwat and sidmassgrowthbot should give total ice growth	2
40	sidmassgrowthbot	tendency_of_sea_ice_amount_due_to_congelation_ice_accumulation	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through basal growth	The rate of change of sea ice mass due to vertical growth of existing sea ice at its base divided by grid-cell area.	2
41	sidmasssi	tendency_of_sea_ice_amount_due_to_snow_conversion	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through snow-to-ice conversion	The rate of change of sea ice mass due to transformation of snow to sea ice divided by grid-cell area	2
42	sidmassevapsubl	water_evaporation_flux	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through evaporation and sublimation	The rate of change of sea-ice mass change through evaporation and sublimation divided by grid-cell area	2
43	sidmassmelttop	tendency_of_sea_ice_amount_due_to_surface_melting	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through surface melting	The rate of change of sea ice mass through melting at the ice surface divided by grid-cell area	2
44	sidmassmeltbot	tendency_of_sea_ice_amount_due_to_basal_melting	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through bottom melting	The rate of change of sea ice mass through melting at the ice bottom divided by grid-cell area	2
45	sidmasslat	tendency_of_sea_ice_amount_due_to_lateral_melting	-1	sea ice	kg m^{-2} s^{-1}	Lateral sea ice melt rate	The rate of change of sea ice mass through lateral melting divided by grid-cell area (report 0 if not explicitly calculated thermodynamically)	2
46	sndmasssnf	snowfall_flux	1	sea ice	kg m^{-2} s^{-1}	snow mass change through snow fall	mass of solid precipitation falling onto sea ice divided by grid-cell area	2
47	sndmassmelt	surface_snow_melt_flux	1	sea ice	kg m^{-2} s^{-1}	snow mass change through melt	the rate of change of snow mass through melt divided by grid-cell area	2
48	sndmasssubl	surface_snow_sublimation_flux	-1	sea ice	kg m^{-2} s^{-1}	snow mass change through evaporation or sublimation	the rate of change of snow mass through sublimation and evaporation divided by grid-cell area	2
49	sndmassdyn	tendency_of_snow_mass_due_to_sea_ice_dynamics	-1	sea ice	kg m^{-2} s^{-1}	snow mass change through advection by sea-ice dynamics	the rate of change of snow mass through advection with sea ice divided by grid-cell area	2
50	sndmasssi	tendency_of_snow_mass_due_to_snow_to_ice_conversion	-1	sea ice	kg m^{-2} s^{-1}	snow mass change through snow-to-ice conversion	the rate of change of snow mass due to transformation of snow to sea ice divided by grid-cell area	2
51	sndmasswindrif	tendency_of_snow_mass_due_to_drifting_snow	-1	sea ice	kg m^{-2} s^{-1}	snow mass change through wind drift of snow	the rate of change of snow mass through wind drift of snow divided by grid-cell area	2

52	**3. Heat and freshwater fluxes (all only for sea-ice fraction of grid cell, downward always positive)**							
53	siflswdtop	surface_downwelling_shortwave_flux_in_air	1	sea ice	$W\ m^{-2}$	Downwelling shortwave flux over sea ice	the downwelling shortwave flux over sea ice (always positive by sign convention)	2
54	siflswutop	surface_upwelling_shortwave_flux_in_air	1	sea ice	$W\ m^{-2}$	Upward shortwave flux over sea ice	the upward shortwave flux over sea ice (always negative)	2
55	siflswdbot	bottom_downwelling_shortwave_flux_into_ocean	-1	sea ice	$W\ m^{-2}$	Downwelling shortwave flux under sea ice	the downwelling shortwave flux underneath sea ice (always positive)	2
56	sifllwdtop	surface_downwelling_longwave_flux_in_air	1	sea ice	$W\ m^{-2}$	Downwelling longwave flux over sea ice	the downwelling longwave flux over sea ice (always positive)	2
57	sifllwutop	surface_upwelling_longwave_flux_in_air	1	sea ice	$W\ m^{-2}$	Upward longwave flux over sea ice	the upward longwave flux over sea ice (always negative)	2
58	siflsenstop	surface_upward_sensible_heat_flux	1	sea ice	$W\ m^{-2}$	Net sensible heat flux over sea ice	the net sensible heat flux over sea ice	2
59	sifllatstop	surface_upward_latent_heat_flux	1	sea ice	$W\ m^{-2}$	Net latent heat flux over sea ice	the net latent heat flux over sea ice	2
60	siflsensupbot	ice_ocean_heat_flux	-1	sea ice	$W\ m^{-2}$	Net sensible heat flux under sea ice	the net sensible heat flux under sea ice from the ocean	2
61	siflcondtop	conductive_heat_flux_at_sea_ice_surface	-1	sea ice	$W\ m^{-2}$	Net conductive heat flux in ice at the surface	the net heat conduction flux at the ice surface	2
62	siflcondbot	conductive_heat_flux_at_sea_ice_bottom	-1	sea ice	$W\ m^{-2}$	Net conductive heat fluxes in ice at the bottom	the net heat conduction flux at the ice base	2
63	sipr	rainfall_flux	1	sea ice	$kg\ m^{-2}\ s^{-1}$	Rainfall rate over sea ice	mass of liquid precipitation falling onto sea ice divided by grid-cell area	2
64	siflsaltbot	salt_flux_from_ice	-1	sea ice	$kg\ m^{-2}\ s^{-1}$	Salt flux from sea ice	Total flux of salt from water into sea ice divided by grid-cell area; salt flux is upward (negative) during ice growth when salt is embedded into the ice and downward (positive) during melt when salt from sea ice is again released to the ocean	2
65	siflfwbot	freshwater_flux_from_ice	-1	sea ice	$kg\ m^{-2}\ s^{-1}$	Freshwater flux from sea ice	Total flux of fresh water from water into sea ice divided by grid-cell area; This flux is negative during ice growth (liquid water mass decreases, hence upward flux of freshwater), positive during ice melt (liquid water mass increases, hence downward flux of freshwater)	2