



ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

AWI-CM3 hands-on-course:

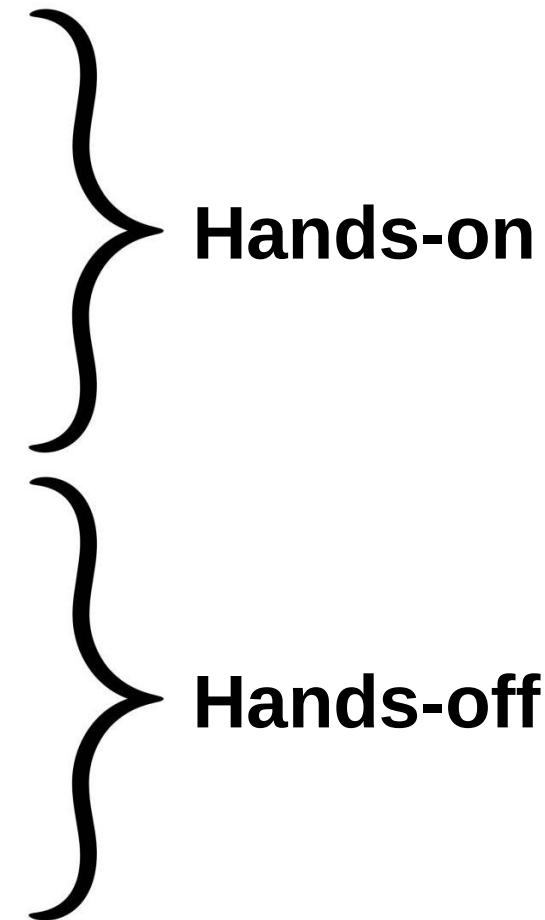
Part 1 Introduction

Jan Streffing 08.09.2022

Goals of the day



- 1) Install esm_tools
- 2) Install awicm3-v3.1
- 3) Run a default simulation
- 4) Modify namelists and run a simulation
- 5) Learn how to contribute
- 6) Learn about visualization
- 7) Learn about documentation & support



Introduction



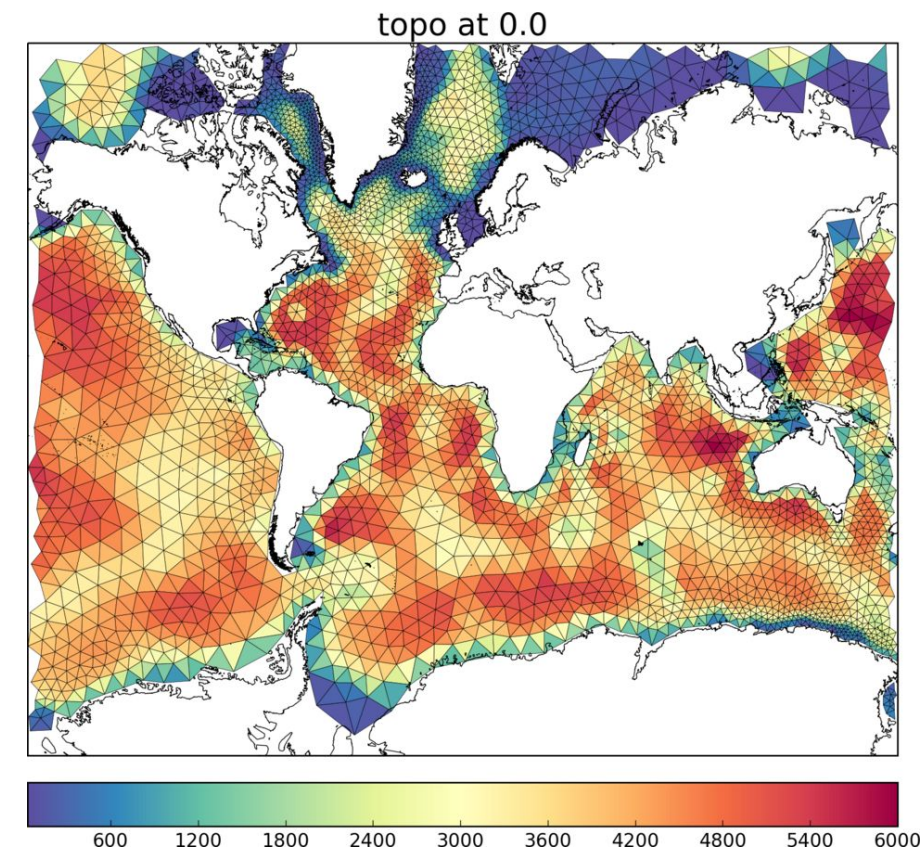
Major participating models for CMIP6:

ACCESS-CM2, **AWI-CM1-MR**, **AWI-ESM1-LR**, BCC-SM2-MR, CAMS, CanESM5, CAS-ESM2-0, CESM2, CIESM, CMCC-CM2-SR5, CNRM-CM6-1-HR, E3SM-1-1, EC-Earth3, FGOALS-f3-L, FIO-ESM-2-0, GISS-E2-1-G, HadGEM3MM, ICON-ESM-LR, IITM-ESM, INM5, IPSL-CM6A-LR, KIOST-ESM, MCMUA1, MIROC6, MPI-ESM1-2-HR, MRI-ESM2-0, NESM3, NOAA-GFDL, NorESM2-MM, SNU, TaiESM1

Practical resolutions:

AWI-CM1

FESOM1: 120-10 km
ECHAM6: 200-100 km



Introduction



Major participating models for CMIP6:

ACCESS-CM2, **AWI-CM1-MR**, **AWI-ESM1-LR**, BCC-SM2-MR, CAMS, CanESM5, CAS-ESM2-0, CESM2, CIESM, CMCC-CM2-SR5, CNRM-CM6-1-HR, E3SM-1-1, EC-Earth3, FGOALS-f3-L, FIO-ESM-2-0, GISS-E2-1-G, HadGEM3MM, ICON-ESM-LR, IITM-ESM, INM5, IPSL-CM6A-LR, KIOST-ESM, MCMUA1, MIROC6, MPI-ESM1-2-HR, MRI-ESM2-0, NESM3, NOAA-GFDL, NorESM2-MM, SNU, TaiESM1

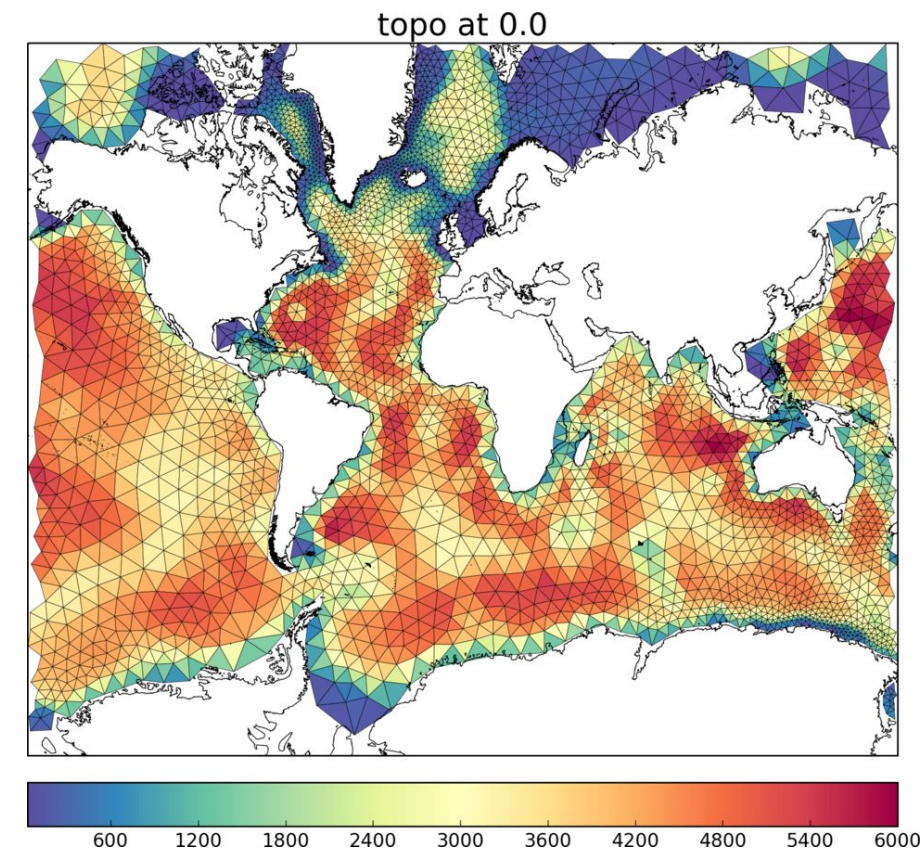
Practical resolutions:

AWI-CM1

FESOM1: 120-10 km
ECHAM6: 200-100 km

AWI-CM2

FESOM2: 120-1 km
ECHAM6: 200-100 km



Introduction



Major participating models for CMIP6:

ACCESS-CM2, **AWI-CM1-MR**, **AWI-ESM1-LR**, BCC-SM2-MR, CAMS, CanESM5, CAS-ESM2-0, CESM2, CIESM, CMCC-CM2-SR5, CNRM-CM6-1-HR, E3SM-1-1, EC-Earth3, FGOALS-f3-L, FIO-ESM-2-0, GISS-E2-1-G, HadGEM3MM, ICON-ESM-LR, IITM-ESM, INM5, IPSL-CM6A-LR, KIOST-ESM, MCMUA1, MIROC6, MPI-ESM1-2-HR, MRI-ESM2-0, NESM3, NOAA-GFDL, NorESM2-MM, SNU, TaiESM1

Practical resolutions:

AWI-CM1

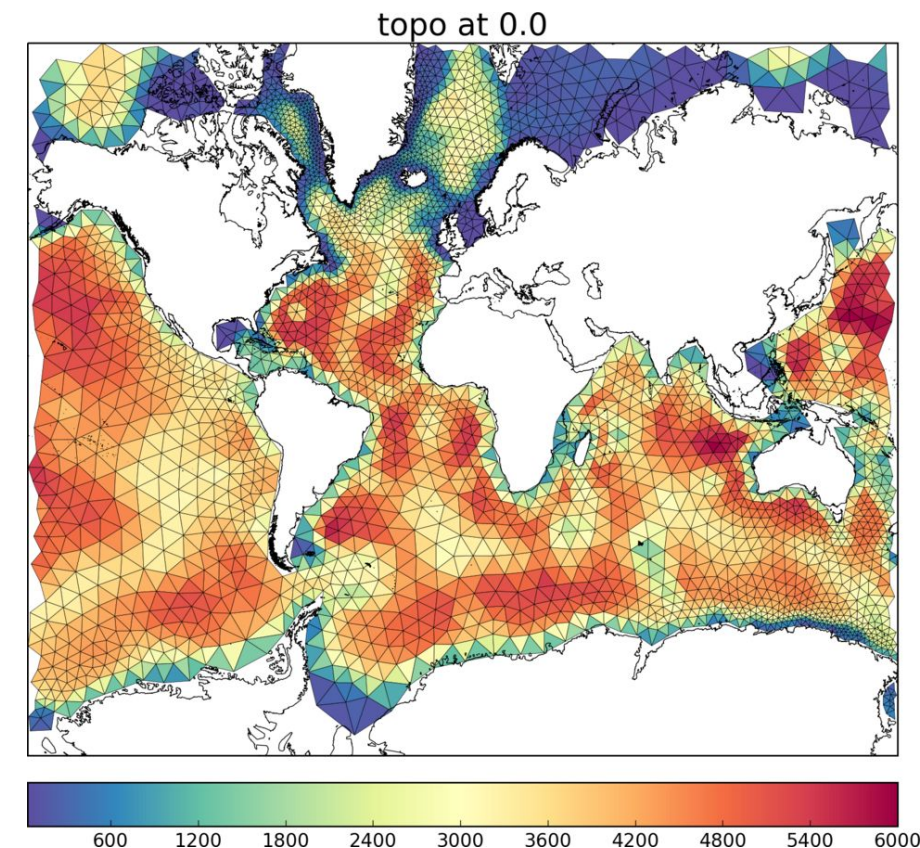
FESOM1: 120-10 km
ECHAM6: 200-100 km

AWI-CM2

FESOM2: 120-1 km
ECHAM6: 200-100 km

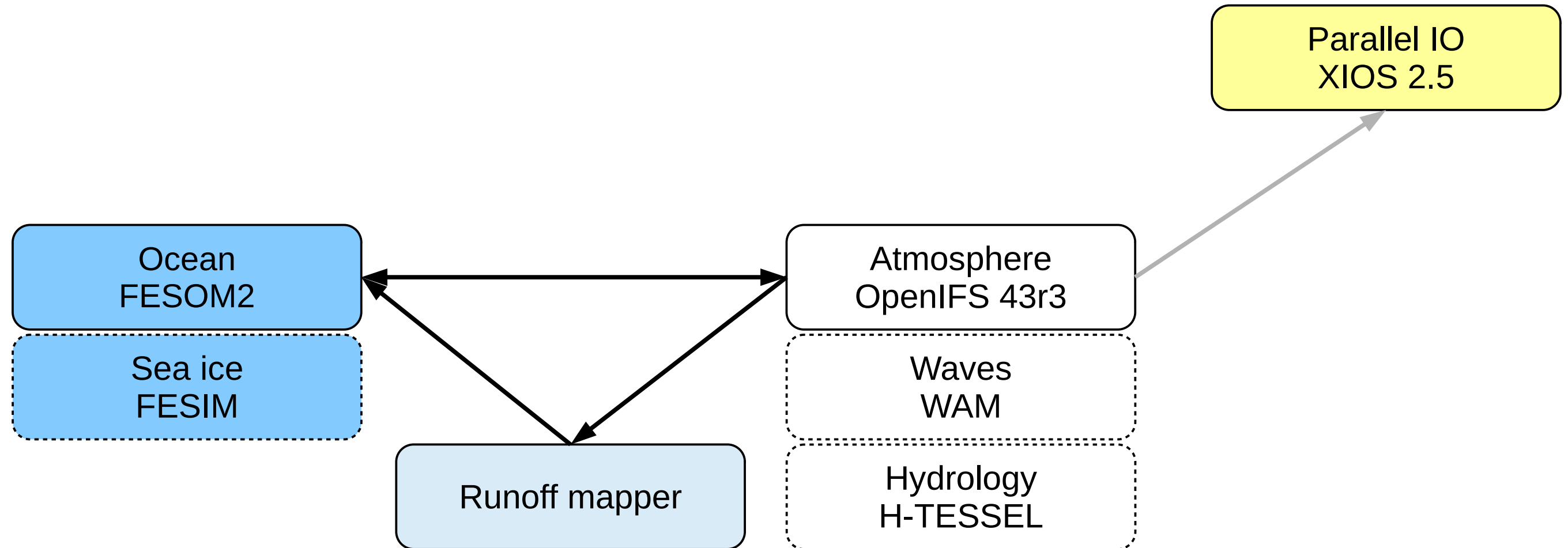
AWI-CM3

FESOM2: 120-1 km
OpenIFS: 120-9km



Introduction

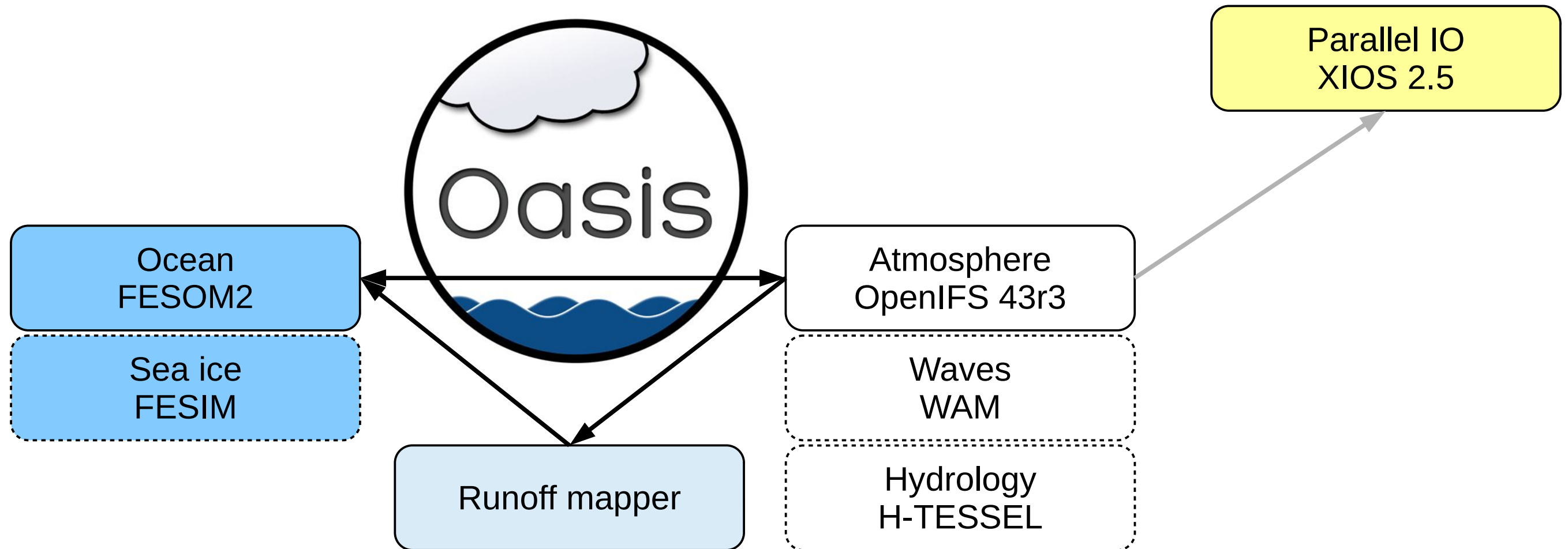
Coupling schematic



Introduction Coupling schematic



Oasis: Interpolation library by CERFACS & Los Alamos Laboratory



Introduction

Basic coupling



Computed in FESOM2	Computed in OpenIFS	Computed in Runoff-mapper
<p>Sea surface temperature</p> <p>Sea ice surface temperature</p> <p>Sea ice concentration</p> <p>Sea ice thickness</p> <p>Snow thickness</p>	<p>Zonal wind stress, ocean</p> <p>Meridional wind stress, ocean</p> <p>Zonal wind stress, sea ice</p> <p>Meridional wind stress, sea ice</p> <p>Non-solar heat flux ocean</p> <p>Solar heat flux</p> <p>Total heat flux sea ice</p> <p>Liquid precipitation</p> <p>Solid precipitation</p> <p>Evaporation</p> <p>Sublimation</p> <p>Precipitation - evaporation - soil moisture</p>	<p>River runoff</p>

Introduction v3.0 performance



AWI-CM3 CMPI: 0.931

300hPa	siconc	1.07	0.92	0.74	0.98	0.67	1.07	1.23	0.84								0.97	1.15	1.23	1.16	1.79	3.49	3.50	1.68		
	tas	1.08	0.42	0.42	0.80	0.63	0.97	0.92	0.69	0.79	0.62	0.70	0.75	0.35	1.06	0.70	0.30	1.64	1.35	1.44	1.60	1.66	1.59	1.23	0.80	
	clt	0.90	1.16	1.19	1.07	0.70	0.76	0.66	0.78	0.85	0.78	0.61	0.68	0.91	0.32	0.56	0.74	0.80	0.99	0.87	0.79	0.97	0.97	0.83	0.82	
	pr	0.77	0.87	1.02	1.07	0.87	1.22	1.10	0.91	1.11	1.00	0.90	0.84	1.38	0.91	0.96	1.00	1.17	0.73	1.10	1.08	1.11	1.19	1.04	0.79	
	rlut	1.02	0.88	0.61	0.49	1.01	0.67	0.63	0.90	1.21	1.04	0.95	0.92	1.52	0.86	0.80	1.04	0.54	0.53	0.59	0.63	1.30	1.44	0.69	0.80	
	uas	0.65	0.85	0.64	0.91	0.70	0.84	0.56	0.67	0.98	0.80	0.81	0.70	1.34	1.12	0.40	0.70	0.79	0.67	0.78	0.41	0.50	0.45	0.40	0.41	
	vas	0.62	0.80	0.69	0.82	0.73	0.74	0.74	0.65	0.95	0.80	0.81	0.74	1.21	1.25	0.81	0.65	0.88	0.93	0.68	0.47	0.52	0.50	0.39	0.44	
	ua	0.75	0.99	0.95	1.23	0.94	1.23	0.86	1.12	0.95	0.73	0.77	0.82	0.60	0.85	0.38	0.30	0.67	0.91	1.02	0.46	0.91	0.85	0.75	0.76	
	500hPa	zg	0.29	0.62	1.31	1.05	0.41	0.85	0.78	0.63	0.38	0.27	0.61	0.31	0.26	0.22	0.67	0.31	0.94	0.67	0.46	0.74	0.62	0.34	0.18	0.77
		SD zos	0.66	0.42	0.61	0.61	0.88	0.93	0.90	0.87	1.02	1.02	1.06	1.07	1.35	1.44	1.71	1.70	1.02	1.05	1.08	1.04	0.95	0.82	0.97	0.97
	SD tos	1.06	1.04	0.97	1.06	0.81	1.77	1.49	0.97	1.07	1.10	0.89	1.20	0.28	0.19	0.42	0.52	1.06	0.96	1.01	1.12	0.84	1.73	1.67	0.77	
	mlotst	1.25	0.55	0.70	1.09	2.32	0.64	0.86	1.85	1.41	1.02	1.54	1.01	0.61	0.66	0.89	0.62	0.51	1.89	2.50	1.08	1.96	2.85	2.81	3.64	
	arctic MAM	arctic JJA	arctic SON	arctic DJF	northmid MAM	northmid JJA	northmid SON	northmid DJF	tropics MAM	tropics JJA	tropics SON	tropics DJF	nino34 MAM	nino34 JJA	nino34 SON	nino34 DJF	southmid MAM	southmid JJA	southmid SON	southmid DJF	antarctic MAM	antarctic JJA	antarctic SON	antarctic DJF		

Green = better than CMIP6 average
Magenta = worse than CMIP6 average
Number = Factor by how much

<https://github.com/JanStreffing/cmpi-tool/>

Introduction v3.0 performance



AWI-CM3 CMPI: 0.931

300hPa	siconc	1.07	0.92	0.74	0.98	0.67	1.07	1.23	0.84								0.97	1.15	1.23	1.16	1.79	3.49	3.50	1.68	
	tas	1.08	0.42	0.42	0.80	0.63	0.97	0.92	0.69	0.79	0.62	0.70	0.75	0.35	1.06	0.70	0.30	1.64	1.35	1.44	1.60	1.66	1.59	1.23	0.80
	clt	0.90	1.16	1.19	1.07	0.70	0.76	0.66	0.78	0.85	0.78	0.61	0.68	0.91	0.32	0.56	0.74	0.80	0.99	0.87	0.79	0.97	0.97	0.83	0.82
	pr	0.77	0.87	1.02	1.07	0.87	1.22	1.10	0.91	1.11	1.00	0.90	0.84	1.38	0.91	0.96	1.00	1.17	0.73	1.10	1.08	1.11	1.19	1.04	0.79
	rlut	1.02	0.88	0.61	0.49	1.01	0.67	0.63	0.90	1.21	1.04	0.95	0.92	1.52	0.86	0.80	1.04	0.54	0.53	0.59	0.63	1.30	1.44	0.69	0.80
	uas	0.65	0.85	0.64	0.91	0.70	0.84	0.56	0.67	0.98	0.80	0.81	0.70	1.34	1.12	0.40	0.70	0.79	0.67	0.78	0.41	0.50	0.45	0.40	0.41
	vas	0.62	0.80	0.69	0.82	0.73	0.74	0.74	0.65	0.95	0.80	0.81	0.74	1.21	1.25	0.81	0.65	0.88	0.93	0.68	0.47	0.52	0.50	0.39	0.44
	ua	0.75	0.99	0.95	1.23	0.94	1.23	0.86	1.12	0.95	0.73	0.77	0.82	0.60	0.85	0.38	0.30	0.67	0.91	1.02	0.46	0.91	0.85	0.75	0.76
	500hPa	zg	0.29	0.62	1.31	1.05	0.41	0.85	0.78	0.63	0.38	0.27	0.61	0.31	0.26	0.22	0.67	0.31	0.94	0.67	0.46	0.74	0.62	0.34	0.18
SD	zos	0.66	0.42	0.61	0.61	0.88	0.93	0.90	0.87	1.02	1.02	1.06	1.07	1.35	1.44	1.71	1.70	1.02	1.05	1.08	1.04	0.95	0.82	0.97	0.97
	tos	1.06	1.04	0.97	1.06	0.81	1.77	1.49	0.97	1.07	1.10	0.89	1.20	0.28	0.19	0.42	0.52	1.06	0.96	1.01	1.12	0.84	1.73	1.67	0.77
	mlotst	1.25	0.55	0.70	1.00	0.33	0.31	0.33	0.35	1.11	1.00	0.33	1.01	0.31	0.33	0.33	0.33	0.33	1.00	0.33	0.33	0.33	0.33	0.33	0.33
arctic MAM																									
arctic JJA																									

More details in:

Stratigini, J., Gidonopoulos, D., Geronzi, T., Zampieri, L., Schol, P.

Green = better than CMIP6 average
Magenta = worse than CMIP6 average
Number = Factor by how much

<https://github.com/JanStreffing/cmipi-tool/>

More details in:

Streffing, J., Sidorenko, D., Semmler, T., Zampieri, L., Scholz, P., Andres-Martinez, M., ... Jung, T. (2022). AWI-CM3 coupled climate model: description and evaluation experiments for a prototype post-CMIP6 model. Geoscientific Model Development, 15 (16), 6399–6427. Retrieved from <https://gmd.copernicus.org/articles/15/6399/2022/> doi: 10.5194/gmd-15-6399-2022

Introduction v3.0 performance



AWI-CM3 CMPI: 0.931

300hPa	siconc	1.07	0.92	0.74	0.98	0.67	1.07	1.23	0.84								0.97	1.15	1.23	1.16	1.79	3.49	3.50	1.68		
	tas	1.08	0.42	0.42	0.80	0.63	0.97	0.92	0.69	0.79	0.62	0.70	0.75	0.35	1.06	0.70	0.30	1.64	1.35	1.44	1.60	1.66	1.59	1.23	0.80	
	clt	0.90	1.16	1.19	1.07	0.70	0.76	0.66	0.78	0.85	0.78	0.61	0.68	0.91	0.32	0.56	0.74	0.80	0.99	0.87	0.79	0.97	0.97	0.83	0.82	
	pr	0.77	0.87	1.02	1.07	0.87	1.22	1.10	0.91	1.11	1.00	0.90	0.84	1.38	0.91	0.96	1.00	1.17	0.73	1.10	1.08	1.11	1.19	1.04	0.79	
	rlut	1.02	0.88	0.61	0.49	1.01	0.67	0.63	0.90	1.21	1.04	0.95	0.92	1.52	0.86	0.80	1.04	0.54	0.53	0.59	0.63	1.30	1.44	0.69	0.80	
	uas	0.65	0.85	0.64	0.91	0.70	0.84	0.56	0.67	0.98	0.80	0.81	0.70	1.34	1.12	0.40	0.70	0.79	0.67	0.78	0.41	0.50	0.45	0.40	0.41	
	vas	0.62	0.80	0.69	0.82	0.73	0.74	0.74	0.65	0.95	0.80	0.81	0.74	1.21	1.25	0.81	0.65	0.88	0.93	0.68	0.47	0.52	0.50	0.39	0.44	
	ua	0.75	0.99	0.95	1.23	0.94	1.23	0.86	1.12	0.95	0.73	0.77	0.82	0.60	0.85	0.38	0.30	0.67	0.91	1.02	0.46	0.91	0.85	0.75	0.76	
	500hPa	zg	0.29	0.62	1.31	1.05	0.41	0.85	0.78	0.63	0.38	0.27	0.61	0.31	0.26	0.22	0.67	0.31	0.94	0.67	0.46	0.74	0.62	0.34	0.18	0.77
		SD zos	0.66	0.42	0.61	0.61	0.88	0.93	0.90	0.87	1.02	1.02	1.06	1.07	1.35	1.44	1.71	1.70	1.02	1.05	1.08	1.04	0.95	0.82	0.97	0.97
	SD tos	1.06	1.04	0.97	1.06	0.81	1.77	1.49	0.97	1.07	1.10	0.89	1.20	0.28	0.19	0.42	0.52	1.06	0.96	1.01	1.12	0.84	1.73	1.67	0.77	
	mlotst	1.25	0.55	0.70	1.09	2.32	0.64	0.86	1.85	1.41	1.02	1.54	1.01	0.61	0.66	0.89	0.62	0.51	1.89	2.50	1.08	1.96	2.85	2.81	3.64	
	arctic MAM	arctic JJA	arctic SON	arctic DJF	northmid MAM	northmid JJA	northmid SON	northmid DJF	tropics MAM	tropics JJA	tropics SON	tropics DJF	nino34 MAM	nino34 JJA	nino34 SON	nino34 DJF	southmid MAM	southmid JJA	southmid SON	southmid DJF	antarctic MAM	antarctic JJA	antarctic SON	antarctic DJF		

Green = better than CMIP6 average
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<https://github.com/JanStreffing/cmpi-tool/>

Introduction v3.1 performance



AWI-CM3.1_SPP CMPI: 0.895																								
siconc	1.40	0.68	0.48	1.26	0.81	1.09	1.00	0.80									0.85	1.08	0.88	0.98	0.90	0.49	0.52	0.79
tas	1.62	0.64	0.76	1.27	0.91	0.71	0.74	0.90	0.94	0.98	0.89	0.95	1.36	2.47	1.69	1.03	0.81	0.71	0.70	0.85	0.70	0.35	0.52	0.43
clt	1.01	1.20	1.24	1.17	0.69	0.79	0.67	0.76	0.81	0.78	0.63	0.68	0.81	0.44	0.66	0.67	0.82	0.79	0.72	0.87	1.01	1.00	0.82	0.81
pr	0.68	0.68	0.88	1.00	0.81	1.21	1.07	0.99	1.05	1.00	0.86	0.82	1.47	0.97	1.01	1.11	1.35	0.77	1.10	1.31	0.80	0.82	0.86	0.81
rlut	1.48	1.19	1.12	1.22	1.10	0.66	0.68	1.01	1.13	1.08	0.93	0.87	1.55	0.91	0.85	1.10	0.58	0.96	0.87	0.45	0.70	1.00	0.84	1.08
uas	0.60	0.80	0.57	0.81	0.63	0.77	0.41	0.56	1.04	0.86	0.82	0.87	1.45	1.37	0.54	1.05	0.83	0.76	0.82	0.54	0.53	0.47	0.50	0.48
vas	0.68	0.70	0.63	0.73	0.61	0.68	0.54	0.62	0.95	0.87	0.78	0.78	1.21	1.64	0.86	0.70	0.67	0.81	0.65	0.52	0.56	0.53	0.50	0.51
300hPa ua	0.59	0.96	0.59	0.66	0.69	1.08	0.51	0.66	0.83	0.70	0.65	0.71	0.54	0.77	0.48	0.61	0.64	0.77	0.96	0.56	0.74	0.58	0.61	0.71
500hPa zg	0.43	0.47	0.56	0.35	0.64	0.35	0.26	0.63	0.50	0.56	0.27	0.60	0.67	0.61	0.30	0.66	0.46	1.30	1.26	0.32	0.24	0.64	0.40	0.19
st. dev. zos	0.64	0.45	0.63	0.62	0.90	0.96	0.92	0.90	1.08	1.05	1.09	1.11	1.43	1.57	1.80	1.86	0.95	0.98	0.99	0.98	0.90	0.81	0.97	0.97
st. dev. tos	1.25	1.10	1.13	1.23	1.20	1.94	1.63	1.38	1.30	1.27	1.08	1.46	0.28	0.32	0.26	0.39	1.85	1.12	0.98	1.99	1.82	0.82	0.97	1.83
mlofst	0.93	0.45	0.59	0.94	2.93	0.55	0.77	2.48	1.41	1.06	1.66	1.05	0.54	0.72	0.79	0.64	0.58	2.30	3.18	1.13	1.00	2.57	1.34	0.36
10m thet	1.09	1.00	0.83	1.06	0.91	0.81	0.72	0.90	1.09	1.18	1.03	0.93	1.57	2.08	1.45	1.26	1.00	0.93	0.92	1.00	1.29	0.77	0.82	1.43
100m thet	0.89	0.87	0.86	0.84	1.05	1.04	1.00	1.04	1.13	1.14	1.11	1.12	0.83	0.74	1.19	1.07	0.96	1.00	1.01	0.96	1.16	1.40	1.65	1.44
1000m thet	1.31	1.31	1.31	1.31	0.47	0.47	0.48	0.48	0.45	0.45	0.45	0.45	0.07	0.07	0.08	0.06	0.52	0.52	0.52	0.52	0.60	0.63	0.61	0.59
10m so	0.98	0.85	0.77	0.94	0.96	0.95	0.95	0.96	0.98	0.95	0.95	0.95	0.63	0.62	0.67	0.81	0.73	0.70	0.73	0.72	0.63	0.97	0.88	0.68
100m so	0.41	0.43	0.45	0.42	1.16	1.18	1.15	1.16	0.94	0.95	0.94	0.95	1.11	1.06	1.07	1.08	0.78	0.75	0.75	0.77	1.42	1.42	1.40	1.44
1000m so	0.46	0.50	0.50	0.44	1.16	1.16	1.16	1.16	0.97	0.97	0.97	0.97	1.03	1.04	1.05	1.04	0.52	0.52	0.51	0.52	0.65	0.65	0.64	0.64
	arctic MAM	arctic JJA	arctic SON	arctic DJF	northmid MAM	northmid JJA	northmid SON	northmid DJF	tropics MAM	tropics JJA	tropics SON	tropics DJF	nino34 MAM	nino34 JJA	nino34 SON	nino34 DJF	southmid MAM	southmid JJA	southmid SON	southmid DJF	antarctic MAM	antarctic JJA	antarctic SON	antarctic DJF

Green = better than CMIP6 average
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<https://github.com/JanStreffing/cmpi-tool/>

Introduction

Longterm plan

