



Norwegian
Meteorological
Institute

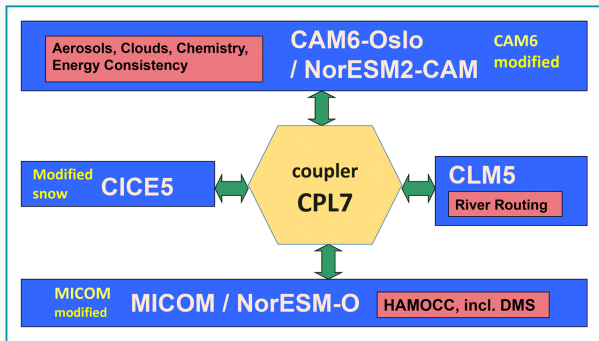
Experiments preparing for a coarse resolution NorESM2

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AMWG Meeting, 28 February 2017

The NorESM

belongs to the “family” of models based on the CESM



- ▶ **Aerosol life-cycle, physics, and cloud interactions:** CAM-Oslo (MET Norway/UiO)
- ▶ **NorESM-O:** is a modified version of MICOM (Miami Isopycnic Coordinate Ocean Model)
- ▶ **Ocean bio-geochemistry:** based on HAMOCC (HAMBurg Ocean Carbon Cycle Model)
- ▶ Adjusted processing of sea ice and **snow on sea ice**

NorESM2 – the CMIP6 versions

to be based on the CESM2 (with CLUBB or preCLUBB)

NorESM2 Based on	_MM (MH?) CESM2	_LM CESM2	_LME CESM2
Atmos. – Land	M: 0.9x1.25 deg. Atm:32 levels	L: 1.9x2.5 deg. 32 levels (48 ?)	L: 1.9x2.5 deg. 32 levels (48 ?)
Ocean - Sea-Ice	M: 1 deg. (H: 0.25 deg.)	M: 1 deg.	M: 1 deg.
GHG	Conc. driven	Conc. driven	E: Emis. driven
Ocean BGC.	ON(OFF?)	ON	ON
CMIP-DECK + CMIP6 Hist	ALL	ALL	PreInd, Historic

▶ NorESM2_MM:

- ▶ Medium resolution
- ▶ Calibration initiated with pre-release (beta) versions

▶ NorESM2_LM & NorESM2_LME:

- ▶ Low/Medium resolution with/without Emission-driven GHGs

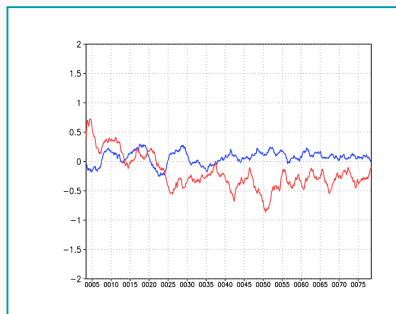
Coupled NorESM2_LM

- ▶ Atm./land res.:
1.9×2.5 degrees
- ▶ **CESM2_beta02**
- ▶ **Coupled to MICOM**
- ▶ **CAM6 with CLUBB**
- ▶ **CLM5**
- ▶ **Oslo aerosols**
- ▶ 1850 conditions
- ▶ 80 years
- ▶ clubb_gamma_coef
= 0.238

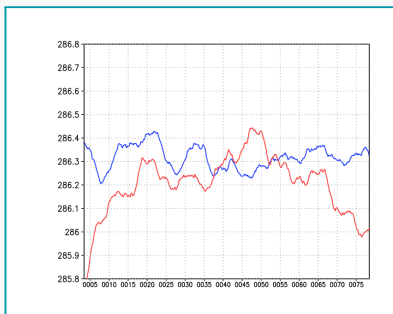
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Radiative balance (-0.35 W/m²)



2-m temperature



Blue line is for NorESM1_M and **red line** is for NorESM2_LM

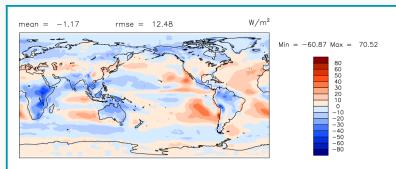
Uncoupled NorESM2_LM (REF)

- ▶ **Prescribed SSTs and sea ice**
- ▶ 2000 conditions
- ▶ 5-year runs
- ▶ Five sensitivity runs and one reference
- ▶ Land model uninitialized

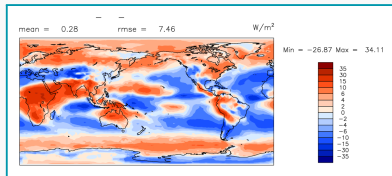
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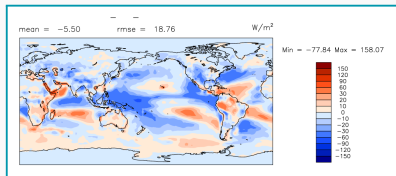
SWCF: REF – CERES-EBAF



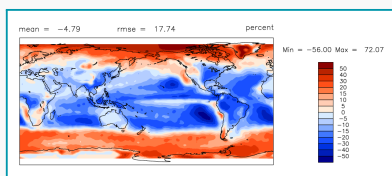
LWCF: REF – CERES-EBAF



LHFLX: REF – JRA25



CLDLOW: REF – CLOUDSAT



CLUBB parameters used for tuning

clubb_gamma_coef

Test: 0.1 and 0.6

*Controls the variance of the PDFs
in the vertical velocity coordinate*

REF = 0.29

clubb_beta

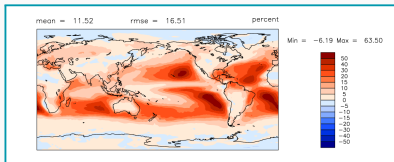
Test: 0 and 3

*Skewness of the PDF for liquid
water potential temperature and
total water mixing ratio*

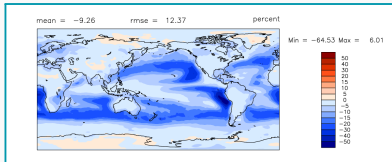
REF = 2.8

Changes in low-level cloud cover (CLDL0W)

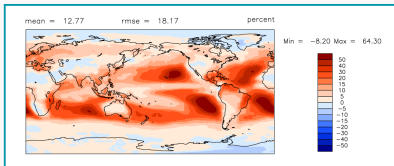
Δ CLDL0W: gamma = 0.1 vs. 0.29



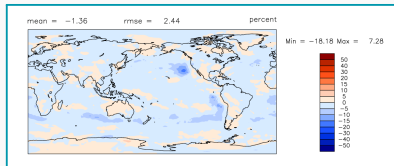
Δ CLDL0W: gamma = 0.6 vs. 0.29



Δ CLDL0W: beta = 0 vs. 2.8

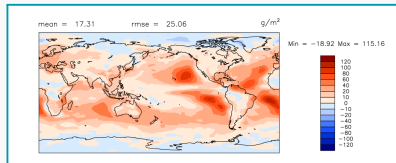


Δ CLDL0W: beta = 3 vs. 2.8

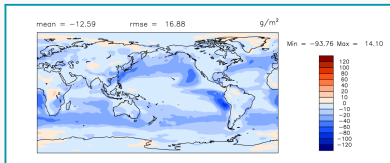


Changes in liquid water path (LWP)

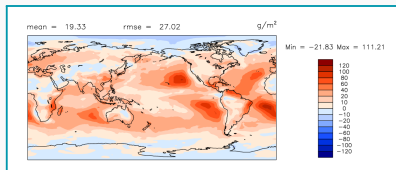
Δ LWP: gamma = 0.1 vs. 0.29



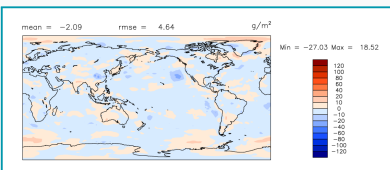
Δ LWP: gamma = 0.6 vs. 0.29



Δ LWP: beta = 0 vs. 2.8

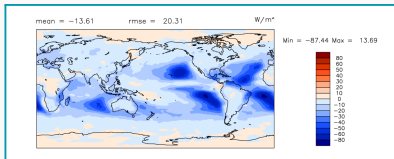


Δ LWP: beta = 3 vs. 2.8

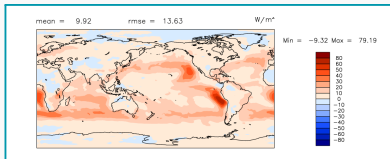


Changes in short-wave cloud forcing (SWCF)

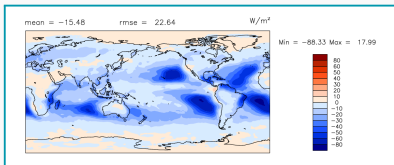
Δ SWCF: gamma = 0.1 vs. 0.29



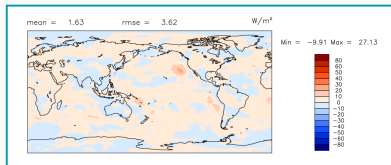
Δ SWCF: gamma = 0.6 vs. 0.29



Δ SWCF: beta = 0 vs. 2.8

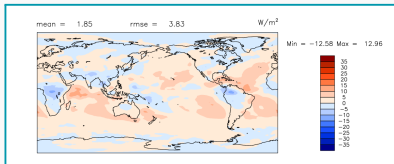


Δ SWCF: beta = 3 vs. 2.8

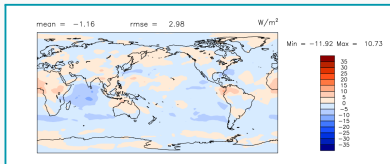


Changes in long-wave cloud forcing (LWCF)

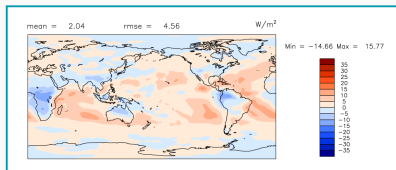
Δ LWCF: gamma = 0.1 vs. 0.29



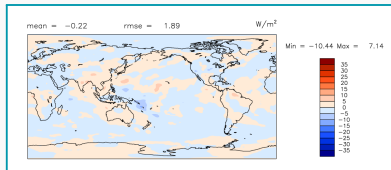
Δ LWCF: gamma = 0.6 vs. 0.29



Δ LWCF: beta = 0 vs. 2.8

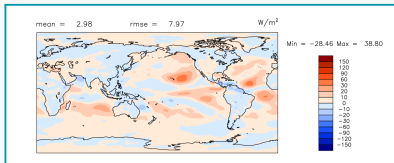


Δ LWCF: beta = 3 vs. 2.8

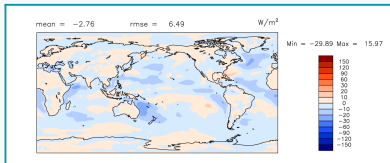


Changes in latent heat flux (LHFLX)

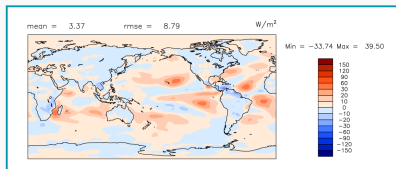
Δ LHFLX: $\gamma = 0.1$ vs. 0.29



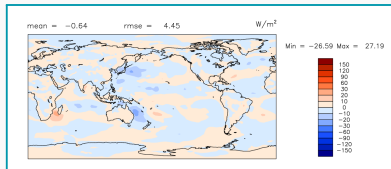
Δ LHFLX: $\gamma = 0.6$ vs. 0.29



Δ LHFLX: $\beta = 0$ vs. 2.8



Δ LHFLX: $\beta = 3$ vs. 2.8



Zhang-McFarlane parameter used for tuning

zm_c0_Ind

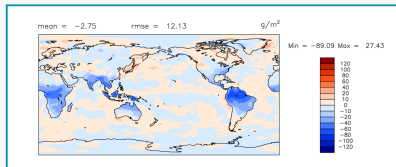
Test: 0.03

Precipitation efficiency over land

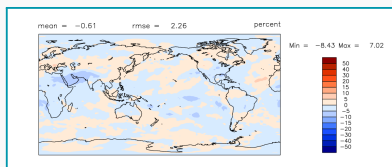
REF = 0.0075

Changes in response to modifying zm_c0_Ind

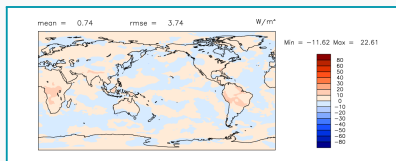
ΔLWP : $zm_c0_Ind = 0.03$ vs. 0.0075



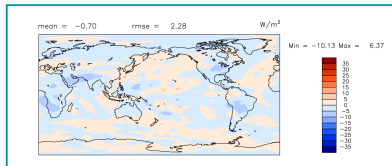
$\Delta CLDTOT$: $zm_c0_Ind = 0.03$ vs. 0.0075



$\Delta SWCF$: $zm_c0_Ind = 0.03$ vs. 0.0075



$\Delta LWCF$: $c0_Ind = 0.03$ vs. 0.0075



Changes in the globally-averaged values

	FSNT- FLNT	SWCF	LWCF	LHFLX
REF	6.8	-48.2	26.8	82.4
<hr/>				
clubb_gamma_coef				
Test: 0.1, 0.6	-11.2, 8.6	-13.6, 9.9	1.9, -1.2	3.0, -2.8
REF = 0.29				
<hr/>				
clubb_beta				
Test: 0, 3	-12.6, 1.4	-15.4, 1.6	2.0, -0.2	3.4, -0.6
REF = 2.8				
<hr/>				
zm_c0_Ind				
Test: 0.03	-0.6	-0.7	-0.7	0.6
REF = 0.0075				

Summary

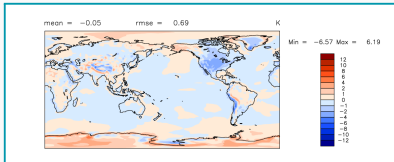
- ▶ **NorESM2** to be based on the **CESM2**, with **CAM6-Oslo**, **NorESM-O**, **CLM5**, and **CICE5**
- ▶ Reducing **clubb_gamma_coef** and/or **clubb_beta** improves the **low-level cloud cover** and **SWCF** and **LWCF** in the marine stratocumulus regions
- ▶ Increasing **zm_c0_lnd** improves the SWCF and LWCF over low-latitude continents, but **biases still remain**

Additional slides

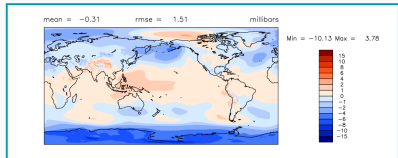
	FSNT- FLNT	SWCF	LWCF	LHFLX
REF	6.8	-48.2	26.8	82.4
clubb_gamma_coef				
Test: 0.1, 0.6	-4.5, 15.4	-61.9, -38.4	28.6, 25.6	85.4, 79.7
REF = 0.29	-11.2, 8.6	-13.6, 9.9	1.9, -1.2	3.0, -2.8
clubb_beta				
Test: 0, 3	-5.8, 8.2	-63.8, -46.7	28.8, 26.5	85.8, 81.8
REF = 2.8	-12.6, 1.4	-15.4, 1.6	2.0, -0.2	3.4, -0.6
zm_c0_Ind				
Test: 0.03	-6.2	-47.5	26.1	83.0
REF = 0.0075	-0.6	-0.7	-0.7	0.6

Resolution: 0.9×1.25 vs. 1.9×2.5

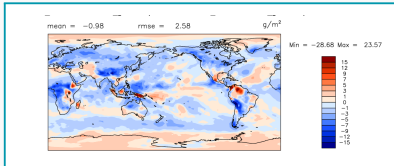
2-m T: high res - low res



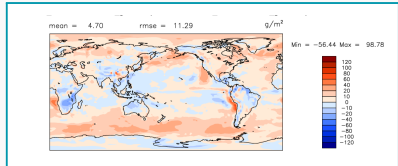
PSL: high res - low res



IWP: high res - low res

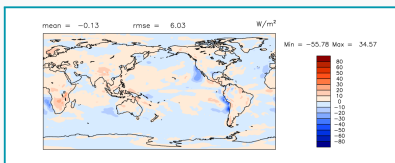


LWP: high res - low res

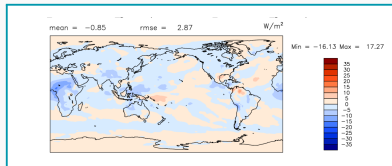


Resolution: 0.9×1.25 vs. 1.9×2.5

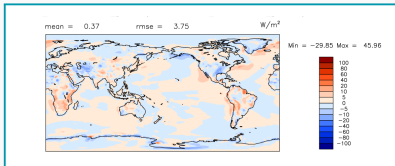
SWCF: high res - low res



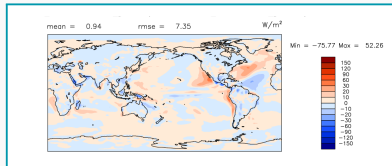
LWCF: high res - low res



SHFLX: high res - low res

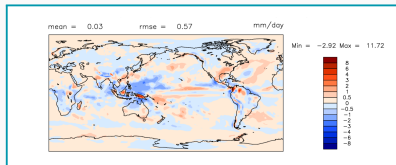


LHFLX: high res - low res

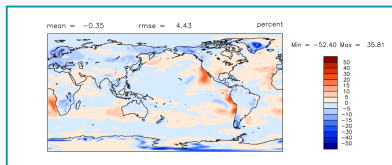


Resolution: 0.9×1.25 vs. 1.9×2.5

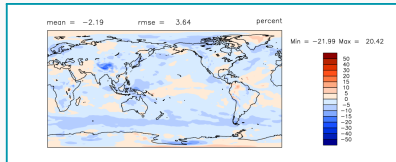
PREC2: high res - low res



CLDLow: high res - low res



CLDMED: high res - low res



CLDHGH: high res - low res

