

# Sea Ice Update

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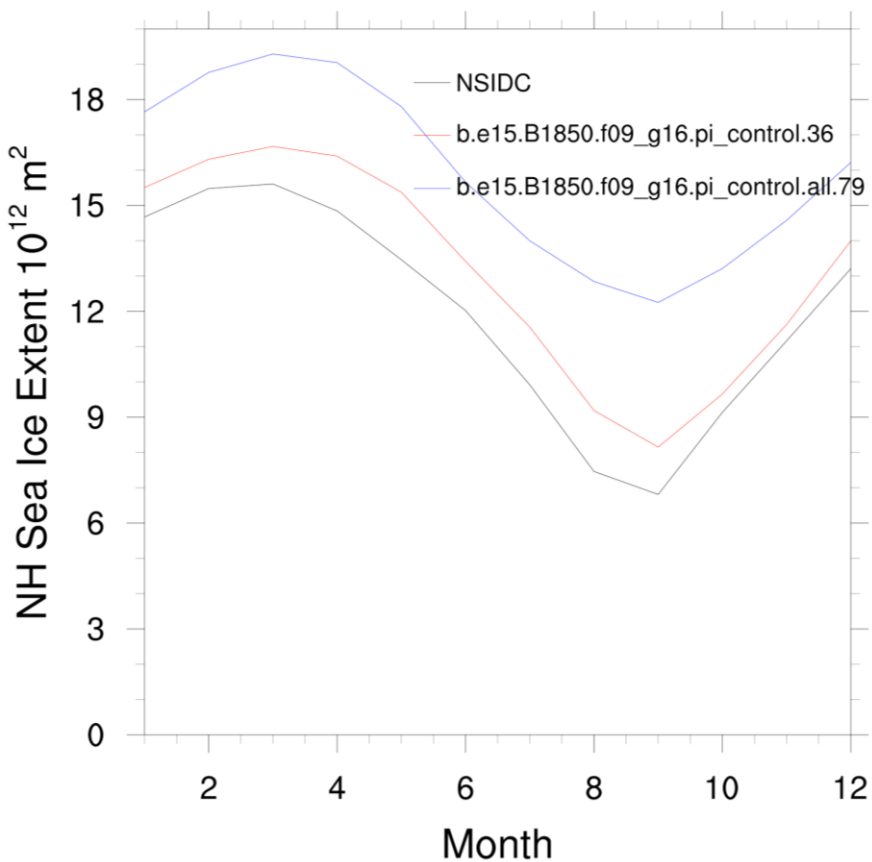


NCAR is sponsored by the National Science Foundation



# Where we were one year ago

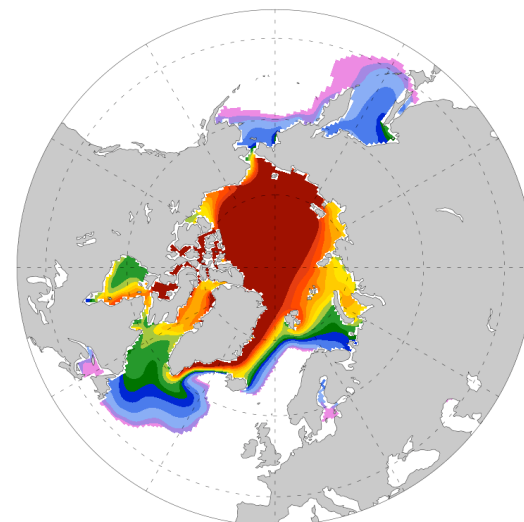
## Run 79. NH Sea Ice



## Ann Mean Thickness (Years 72-91)

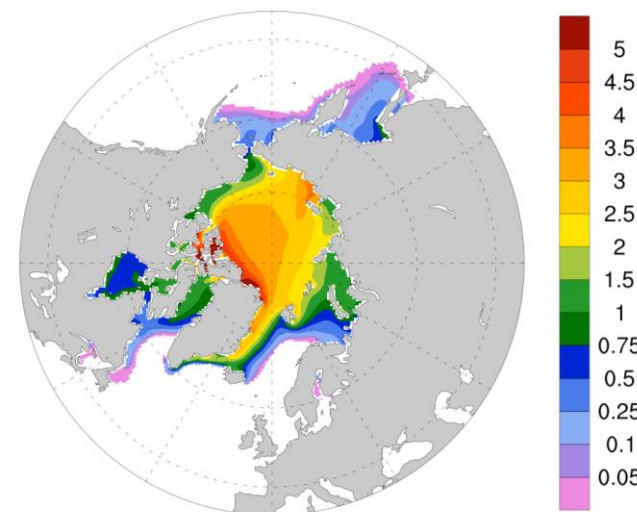
grid cell mean ice thickness m

Run 79



grid cell mean ice thickness m

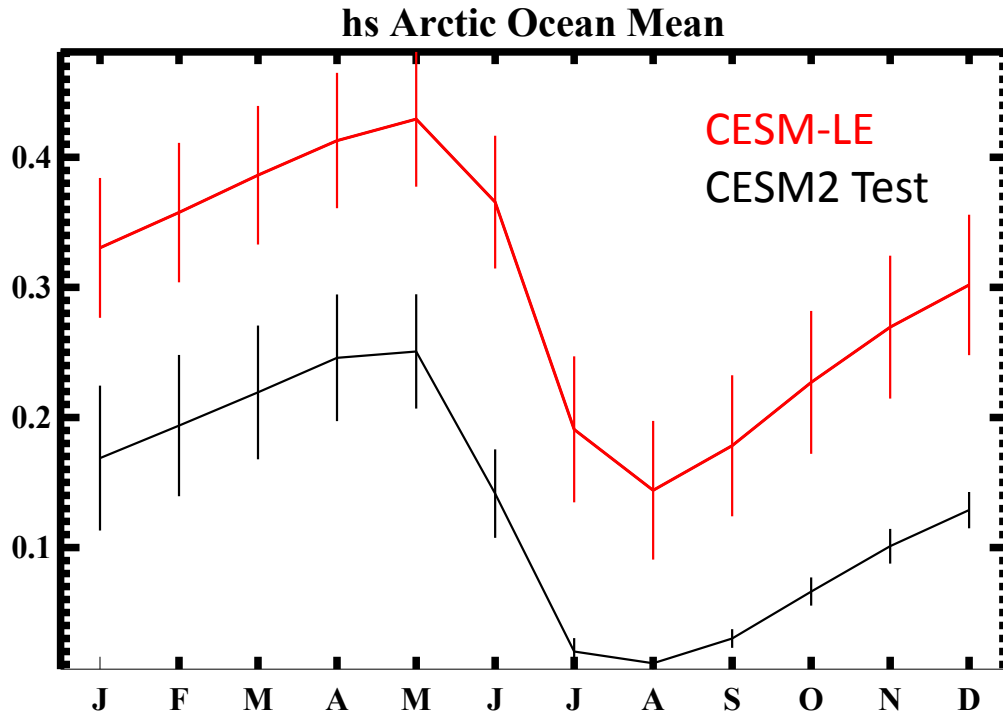
Run 36



# CESM2 Update

- Focus on aspects of the sea ice and heat budgets that seem to be robust across test runs
- Changes have been made to the land ice runoff outside of Greenland and Antarctica
- Heat is now being used from the atmosphere to melt water before it enters ocean
- No longer have excessive (~100m) thick ice in the Canadian Archipelago
- Snow cover in Arctic sea ice reduced due to changing precipitation
- Radiative fluxes over sea ice are much improved
  - Less SW and more LW
  - Associated with cloud changes

# Arctic Sea Ice – Snow Thickness

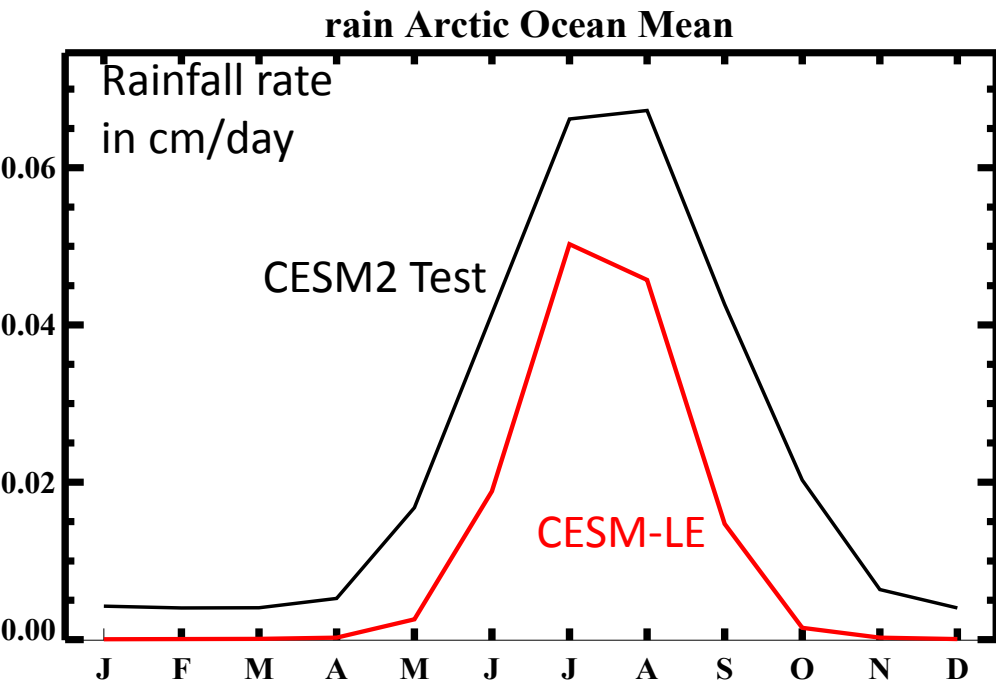
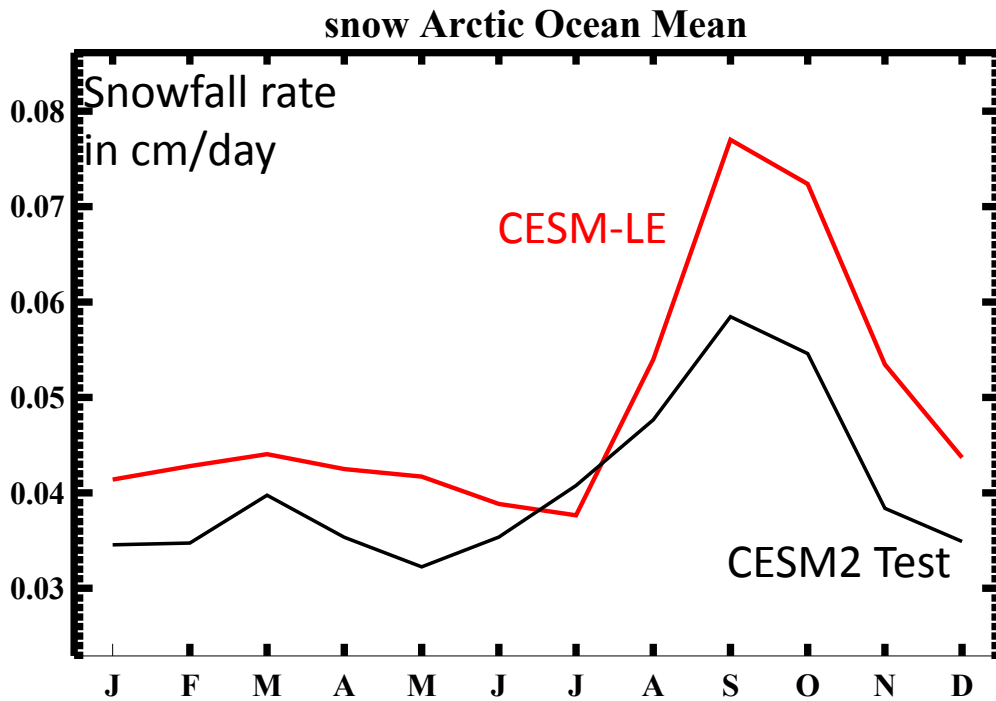


Snow thickness on Arctic Sea Ice  
Arctic Ocean Mean

## CESM2 Test Runs –

- Have thinner snow on sea ice throughout the year
- Have snow-free summers unlike CESM-LE
- May now have a bit too little snow compared to observations

# Arctic Precipitation



## CESM2 Test Runs

- Less snowfall throughout the year
- More rainfall present throughout year
- Realistic??

As discussed in Light et al. (2015) excessive snow cover in summer is related to episodic summer snowfall events

# JJA Incoming Surface SW Radiation

b.e11.B20TRC5CNBDRD.f09\_g16.001 (yrs 1981-2005)

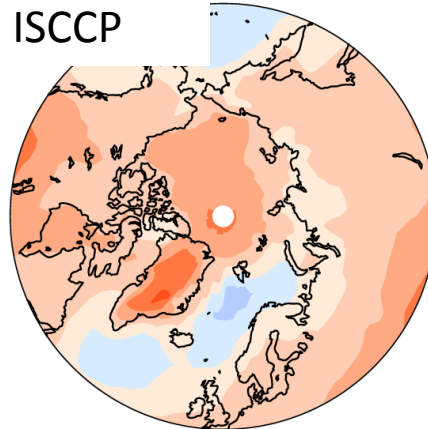
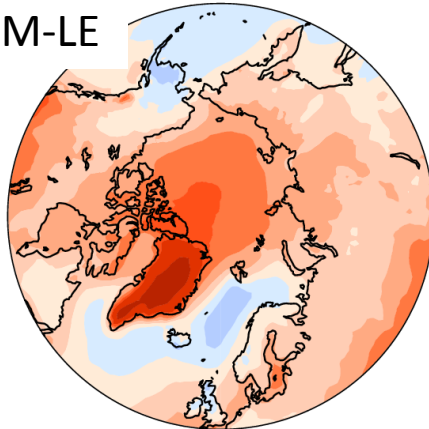
ISCCP FD

Surf downwelling SW  $W/m^2$

Surf downwelling SW  $W/m^2$

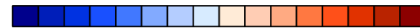
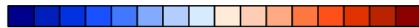
CESM-LE

ISCCP



MEAN= 217.85 Min= 134.08 Max= 334.80

MEAN= 207.44 Min= 138.29 Max= 278.66



0 50 100 150 200 250 300 350

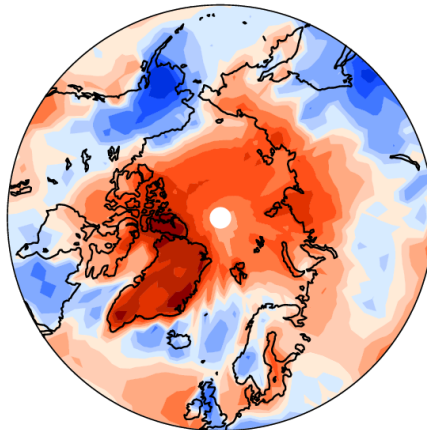
0 50 100 150 200 250 300 350

b.e11.B20TRC5CNBDRD.f09\_g16.001 - ISCCP FD

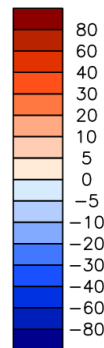
Surf downwelling SW

$W/m^2$

CESM-LE  
minus  
ISCCP



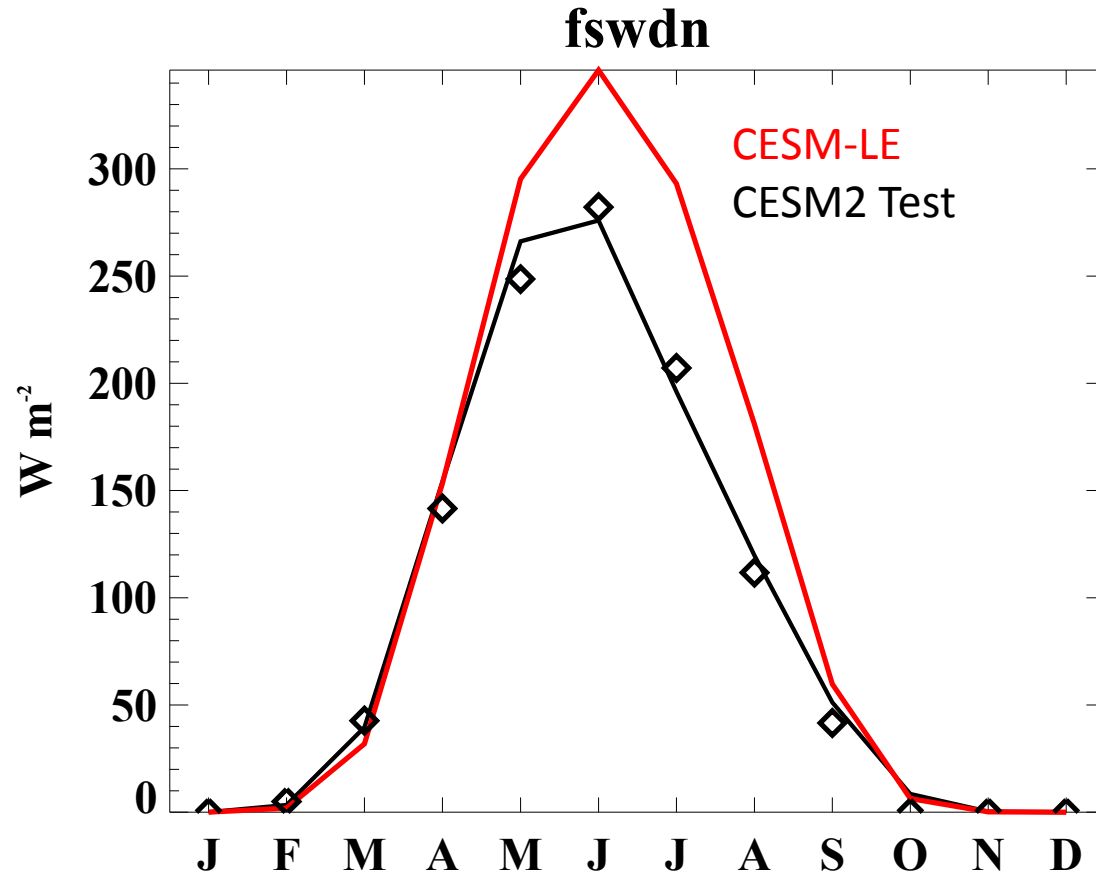
MIN = -54.09 MAX = 113.09



# Arctic Surface Heat Budget- Incoming SW

CESM-LE has  
excessive  
incoming SW  
Radiation in the  
Arctic

## Incoming SW Radiation Averaged over Arctic Ocean



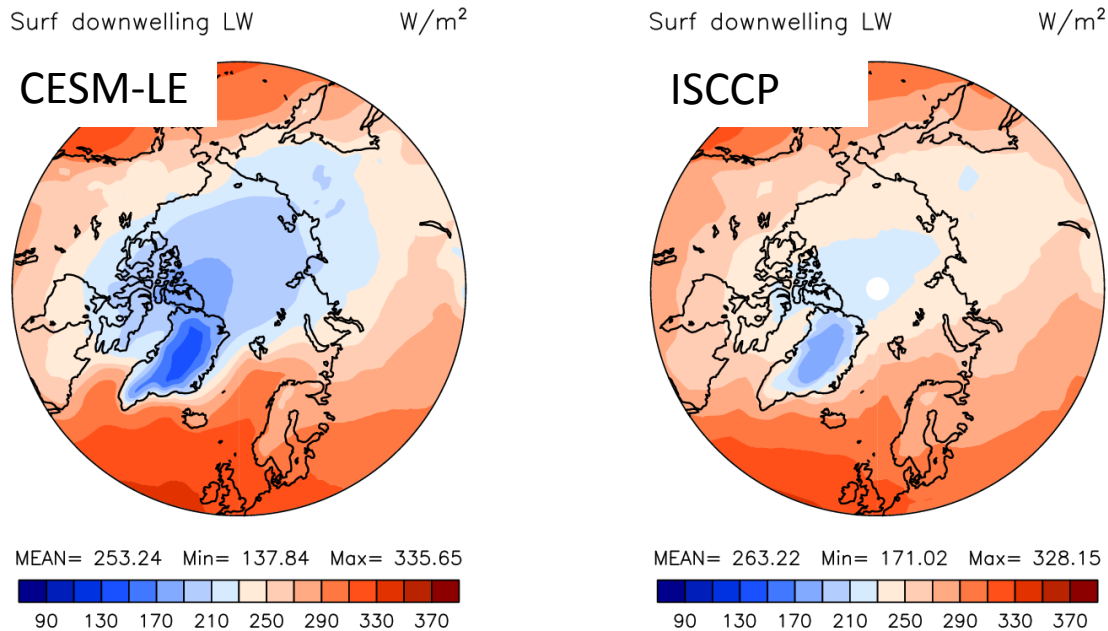
Diamonds show SHEBA data for a  
real world reference

# Arctic Surface Heat Budget- Incoming SW

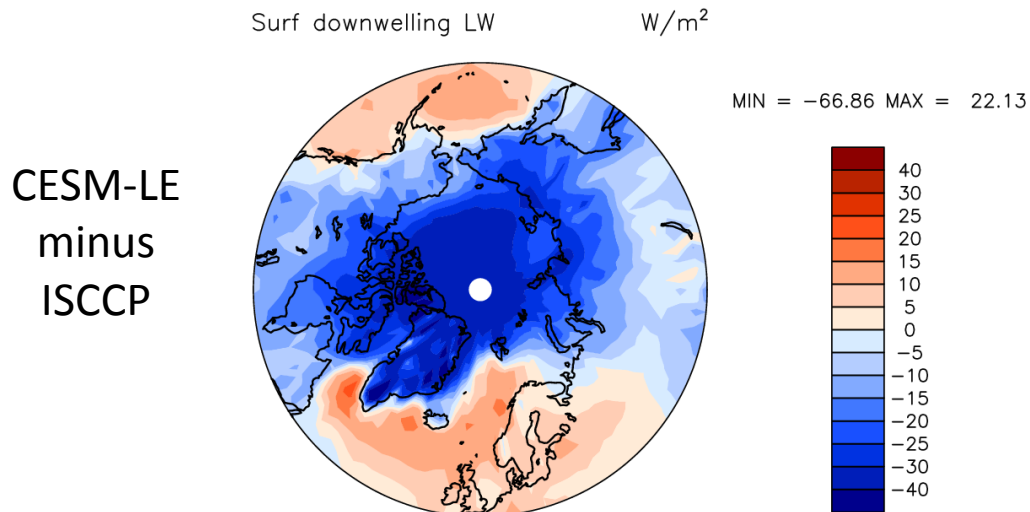
CESM2 Test Runs  
Incoming SW Bias  
is largely alleviated

- Associated with mixed phase clouds
- Increase in super-cooled water within clouds, which is more realistic

## Annual Incoming Surface LW Radiation



b.e11.B20TRC5CNBDRD.f09\_g16.001 - ISCCP FD

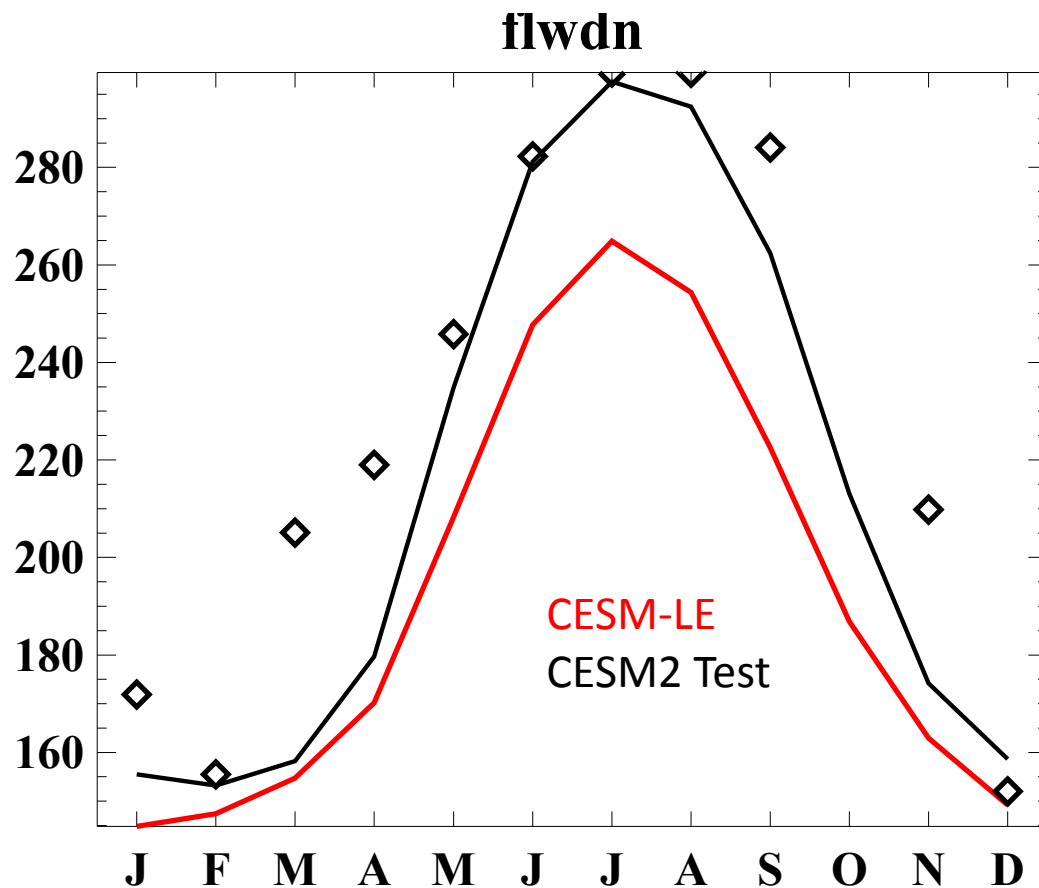


## Arctic Surface Heat Budget- Incoming LW

CESM-LE has too  
little incoming LW  
Radiation in the  
Arctic



## Incoming LW Radiation Averaged over Arctic Ocean



Diamonds show SHEBA data for a real  
world reference

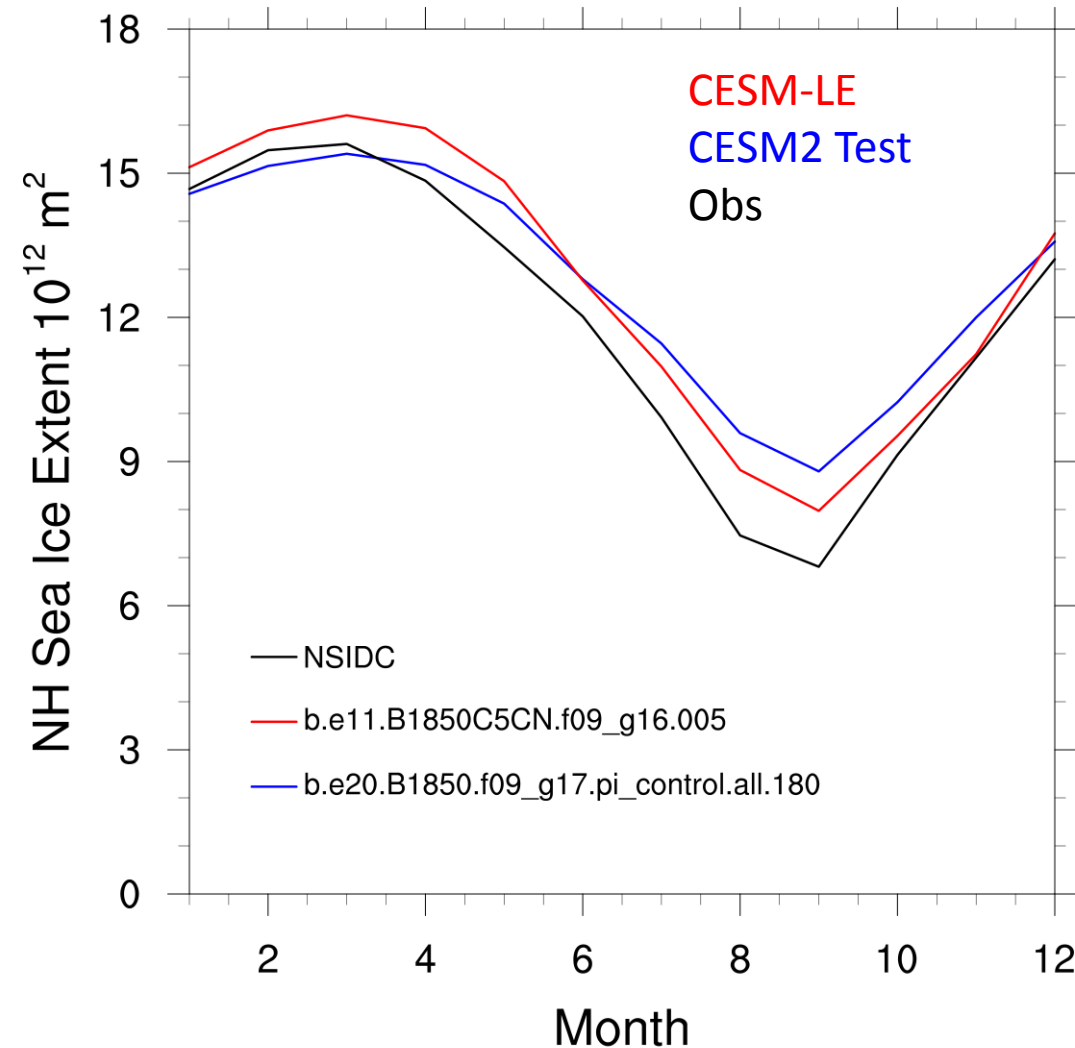
## Arctic Surface Heat Budget- Incoming LW

CESM2 Test Runs  
Incoming LW Bias  
is improved

Also associated with  
simulation of mixed  
phase clouds

Questions?  
(That I can Answer)

# NH Sea Ice Extent



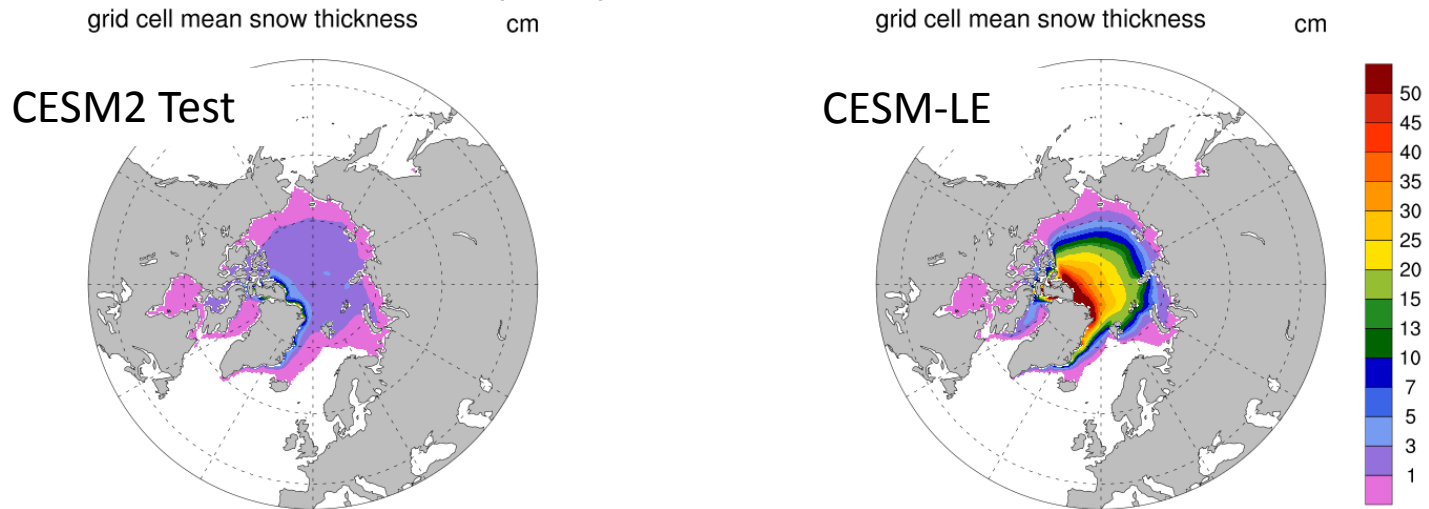
## Annual cycle of NH Extent

### CESM2 Test Runs –

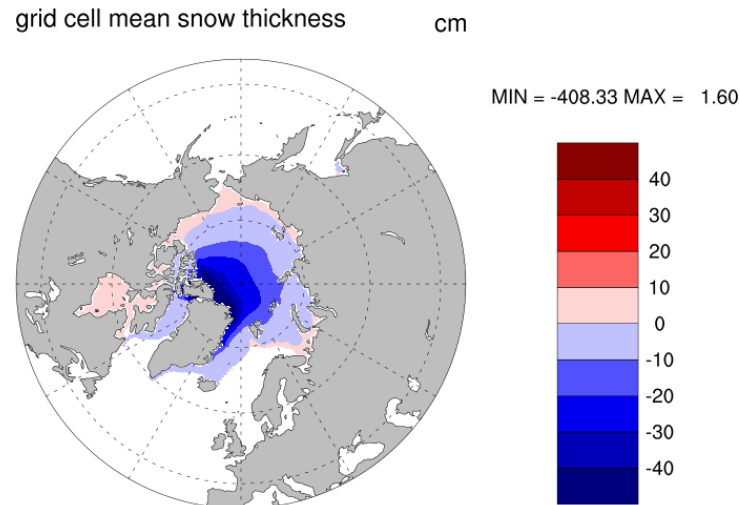
- Typically have a smaller annual cycle
- Less ice in winter than CESM-LE
- More ice in summer than CESM-LE

# Arctic Sea Ice – Snow Thickness

## Summer (JAS) Mean Snow Thickness

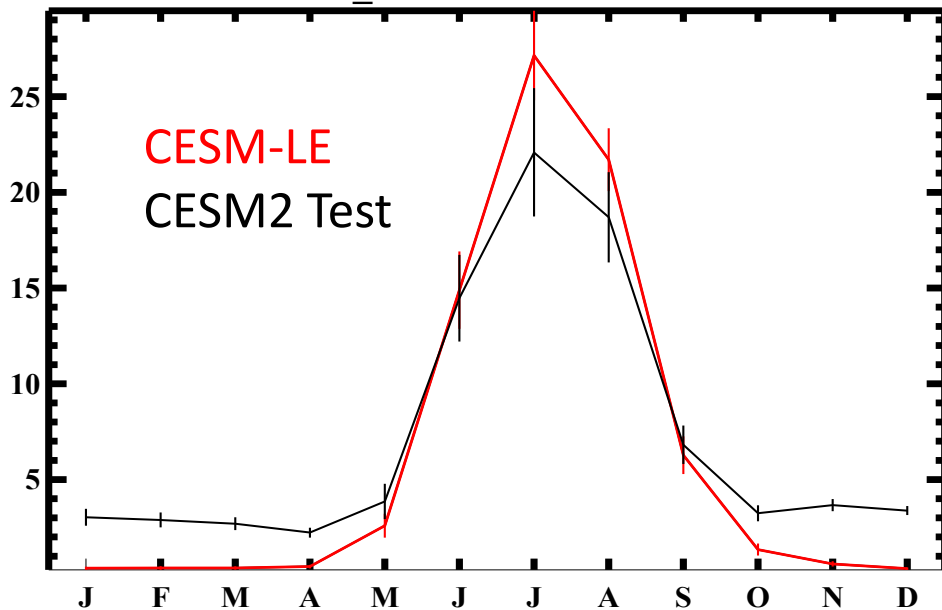


**b.e20.B1850.f09\_g17.pi\_control.all.179 - b.e11.B1850C5CN.f09\_g16.005**

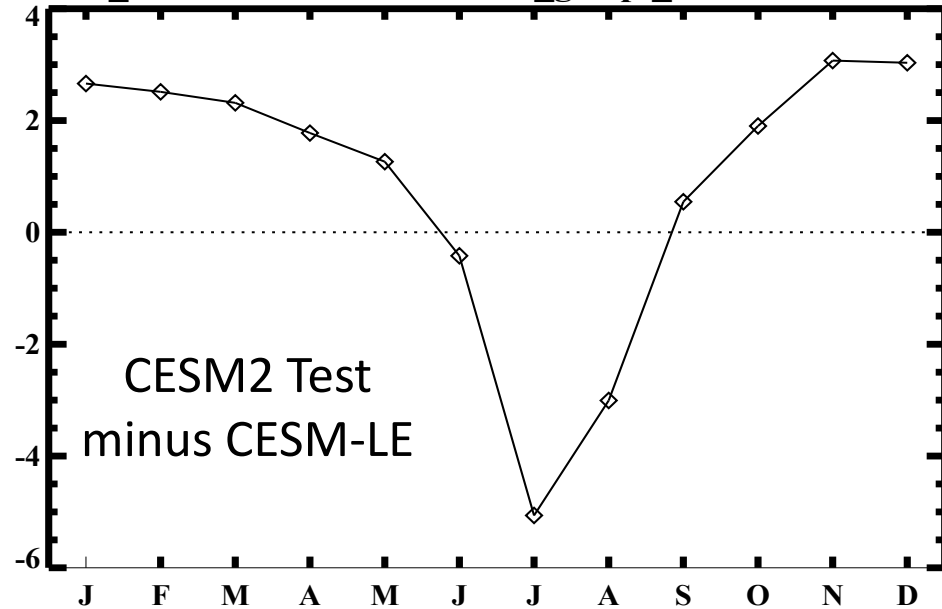


# Arctic Ice-Ocean Heat Exchange

fhocn\_ai Arctic Ocean Mean



fhocn\_ai Arctic b.e20.B1850.f09\_g17.pi\_control.all.180-LE



CESM2 has

- Less ocean heat flux to ice in summer – due to decreased incoming SW radiation
- More ocean heat flux to ice in winter
  - Due to ocean transport
  - May not be robust as ocean is still spinning up