Detecting Arctic sea ice melt onset with a satellite simulator

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Supported by NASA FINESST (80NSSC19K1324), the National Science Foundation Graduate Research Fellowship (DGE 1144083) and NSF-1847398.
Melt onset and other seasonal transition dates can be used to evaluate how well climate models represent sea ice

- CMIP6 models show realistic but varying melt onset dates

- Model differences in melt onset are unlikely due to internal variability alone

  We can use these differences to investigate other modeled sea ice characteristics

- However, comparisons between climate models and satellite observations are indirect

Smith, et al., 2020, *The Cryosphere Discussions*
Using a satellite simulator, we can compare melt onset dates between climate models and satellite observations more directly.

**Modeled**
- Global earth system models (MPI-ESM and CESM2)
- Standard model sea ice melt onset dates
  (Derived here from surface temperature)

**Observed**
- Observed brightness temperatures
- Satellite-derived sea ice melt onset products

Current method of comparison

SSM/I, SMMR, AMSR-E
Using a satellite simulator, we can compare melt onset dates between climate models and satellite observations more directly.

Modeled
- ARC30 satellite simulator\(^1,2\) → Simulated brightness temperatures → Simulated sea ice melt onset dates → Standard model sea ice melt onset dates → New comparison

Observed
- Global earth system models (MPI-ESM and CESM2) → Satellite-derived sea ice melt onset products
- SSM/I, SMMR, AMSR-E

New comparison
- Observed brightness temperatures

Current method of comparison
- Simulated sea ice melt onset dates (Derived here from surface temperature)

\(^1\)Burgard et al, 2019a, *The Cryosphere Discussions*
\(^2\)Burgard et al, 2019b, *The Cryosphere Discussions*
Using a satellite simulator, we can compare melt onset dates between climate models and satellite observations more directly.

Modeled

ARC30 satellite simulator\textsuperscript{1,2} → Simulated brightness temperatures → Simulated sea ice melt onset dates → Standard model sea ice melt onset dates

Global earth system models (MPI-ESM and CESM2) → (Derived here from surface temperature)

New comparison

Observed

Simulated brightness temperatures → Observed brightness temperatures

SSM/I, SMMR, AMSR-E → Satellite-derived sea ice melt onset products

New comparison

New comparison

New comparison

Current method of comparison

\textsuperscript{1}Burgard et al, 2019a, The Cryosphere Discussions
\textsuperscript{2}Burgard et al, 2019b, The Cryosphere Discussions
Preliminary results: melt onset dates

Average brightness temperatures
June 2003

CESM2
Satellite data

(1) Using TB 6.9 GHz  
(b) Using surface temperature

Difference in days (b) – (a)

- ARC30 can produce realistic brightness temperatures for CESM2
- By comparing melt onset date methods, we can quantify the uncertainty introduced by model/satellite definition differences