

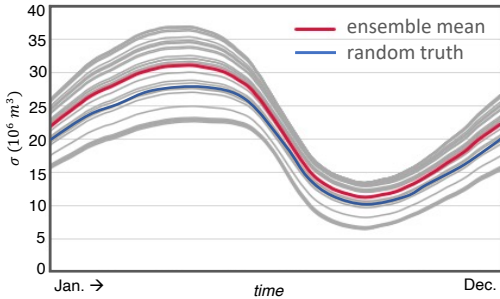
Methods

We perform a series of **Observing System Simulation Experiments** (OSSEs) that employ **Ensemble Adjustment Kalman Filtering** (EAKF) in NCAR's **Data Assimilation Research Testbed** (DART) to adjust (idealized) sea ice thickness (SIT) bias in the **Los Alamos Sea Ice Model** (CICE5).

Generating an ensemble

- Slab ocean, single prescribed atmosphere (JRA 55 reanalysis)
- CICE **parameter perturbations** generate spread: tested "interaction" vs "systemic" parameters
- Found that perturbing interaction parameters did not increase ensemble spread in sea ice volume (SIV) above the systemic perturbations performed by *Zhang et al. (2018)*; therefore, **ensemble bias relative to our randomly selected truth is systemically high.**

Ensemble Arctic SIV



Assimilation

- Assimilated increasing #s of simulated SIT "satellite tracks" taken from truth member; no other variables assimilated or updated
- Independent single-day assimilations on **April 15, 2019** (spring) and **October 15, 2019** (autumn)
- Localization radius = 0.1 (~700 km) (*Blanchard-Wrigglesworth et al., 2014*)
- Forecast forward 78 days

Future Work

- Multiple assimilations: identify the actual horizon after which a single assimilation 'wears out', test **day-by-day assimilations**
- Address representativity and forward operator errors by testing **direct assimilation of the sea ice thickness distribution**
- Transition from OSSEs to **real-world data**
- Expand to Antarctic sea ice

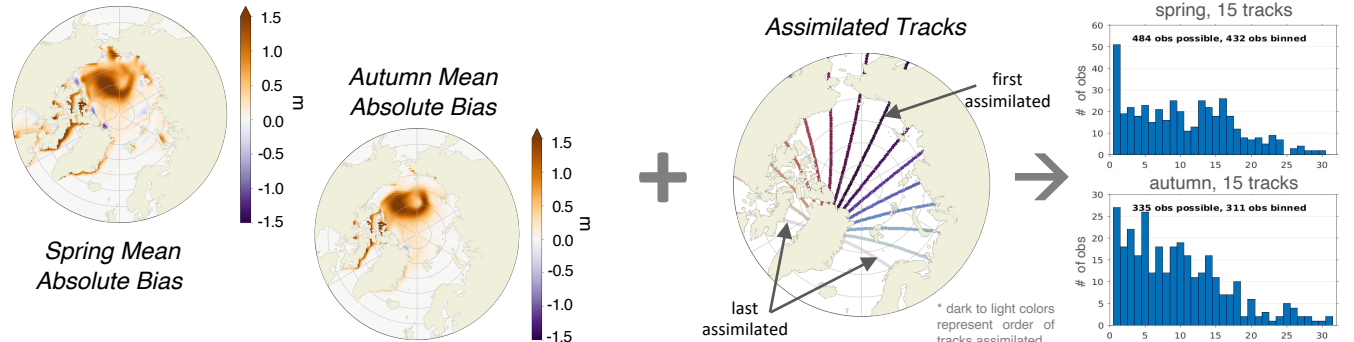
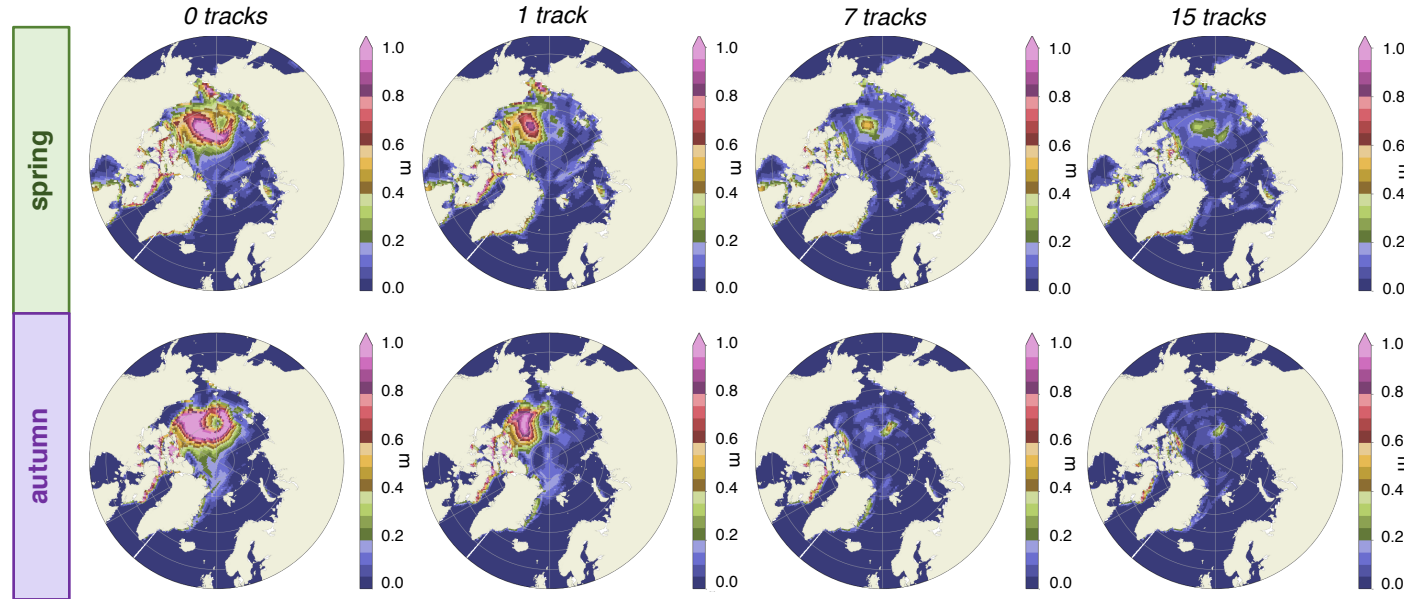
In a perfect world, assimilating along-track Arctic sea ice thickness estimates significantly and persistently reduces model bias.

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Preliminary Results

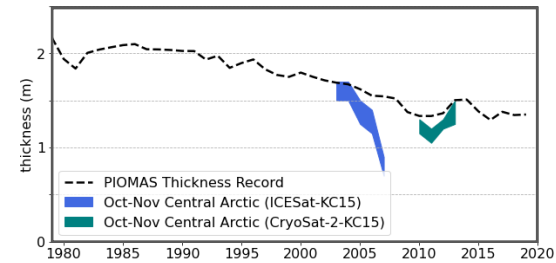
Single Assimilation SIT RMSE at Forecast Day 45



Motivation

- The accuracy of SIT initial conditions impacts sea ice model forecasts (*Blanchard-Wrigglesworth et al. 2011*)
- Community standard SIT record (*PIOMAS*, 1979-present) is generated by assimilating sea ice concentration into an ice-ocean coupled model, which does not sufficiently reduce SIT bias (*Zhang et al., 2018; Blanchard-Wrigglesworth et al., 2014*)
- A real-world SIT DA scheme using EAKF has been previously impractical due to observation error in ICESat & Cryo-Sat2 products (*see figure below*)
- **ICESat2** has unprecedented accuracy and density of SIT (freeboard) measurements

Current Sea Ice Thickness Products



ICESat-2 Along-track SIT, April 2019

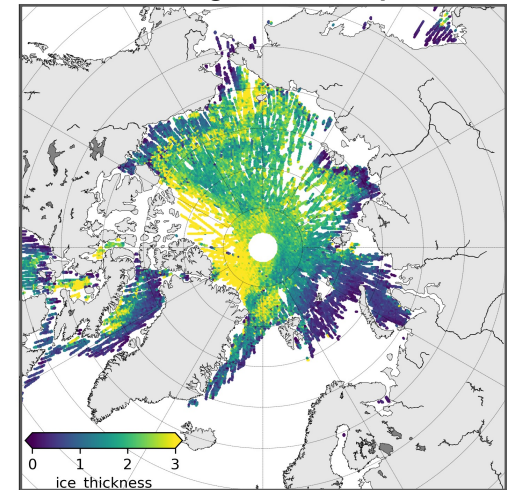


Figure credit: Dr. Alek Petty