

DYNAMICAL FORECASTS OF COASTAL UPWELLING IN THE CALIFORNIA CURRENT SYSTEM

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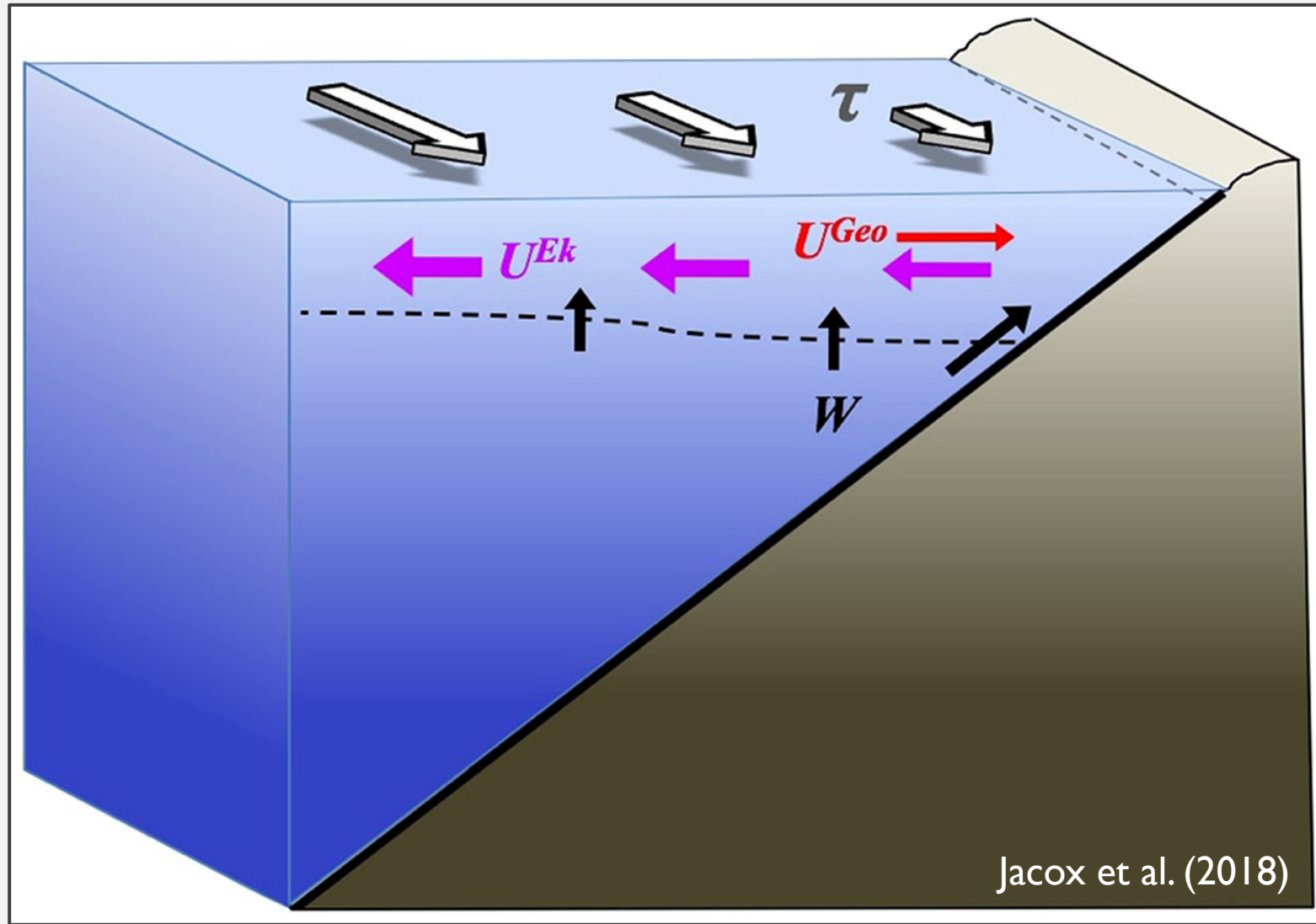
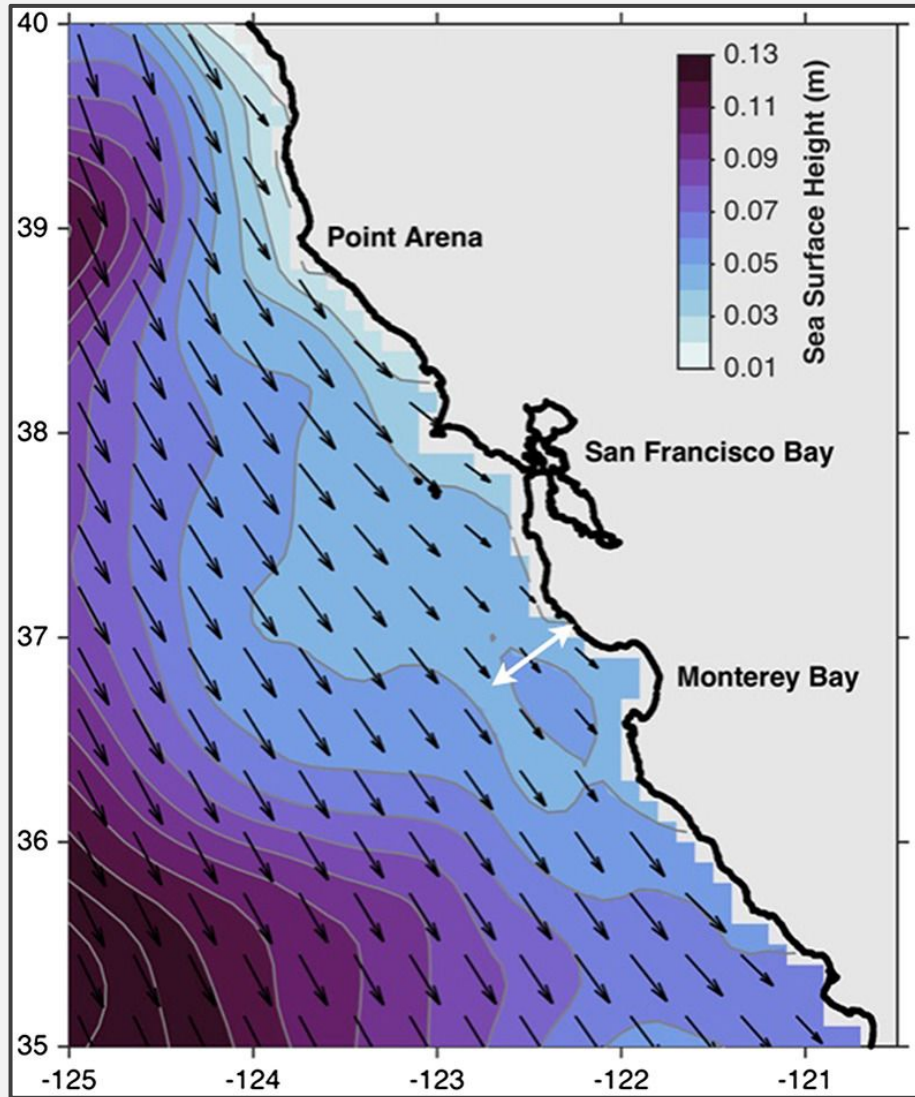
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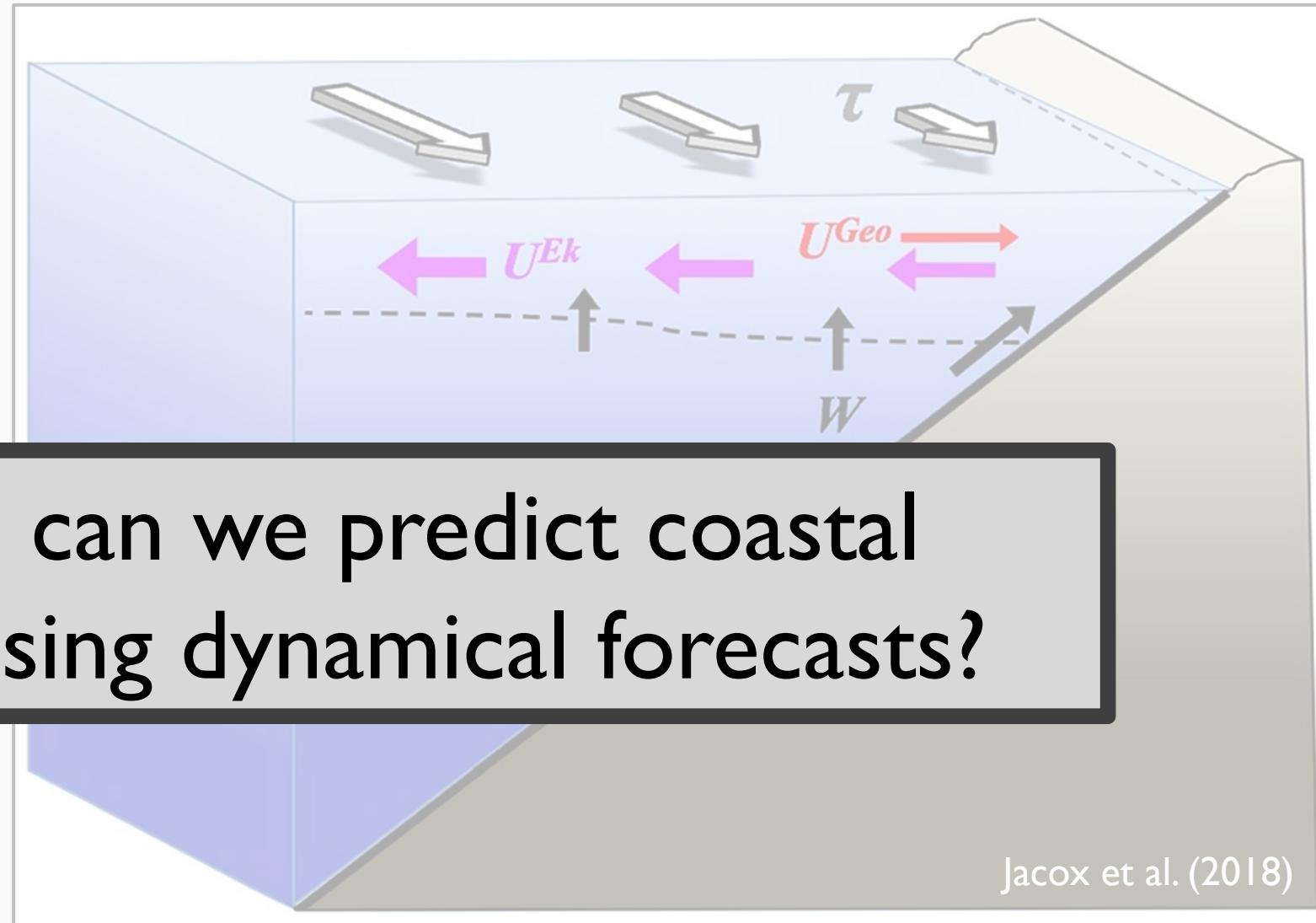
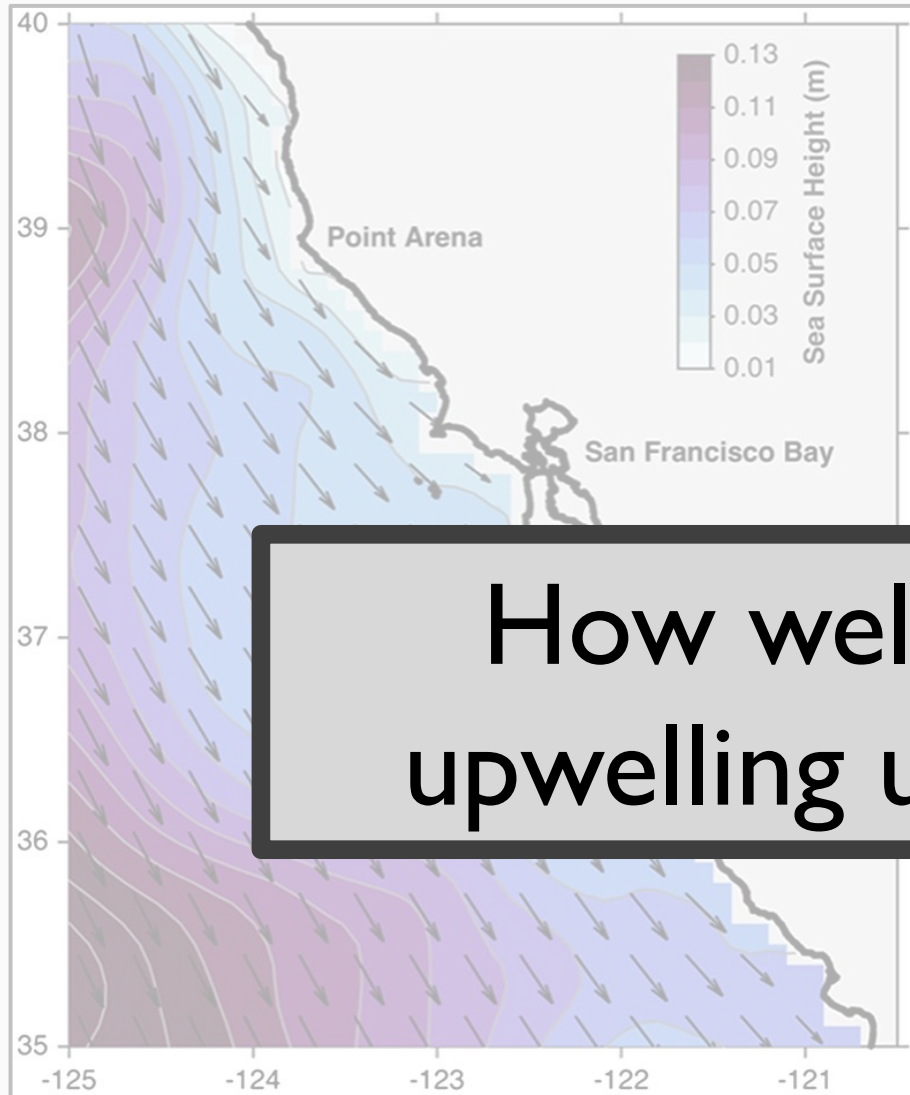
California Current Large Marine Ecosystem



Dynamical ocean forecasts can assist decision making on a variety of timescales



$$\text{Coastal Upwelling Transport Index (CUTI)} = U^{Ek} + U^{geo} = \frac{\tau_y}{\rho f} - \frac{gD}{f} \frac{\partial \eta}{\partial y}$$



How well can we predict coastal upwelling using dynamical forecasts?

Jacox et al. (2018)

$$\text{Coastal Upwelling Transport Index (CUTI)} = U^{Ek} + U^{geo} = \frac{\tau_y}{\rho f} - \frac{gD}{f} \frac{\partial \eta}{\partial y}$$

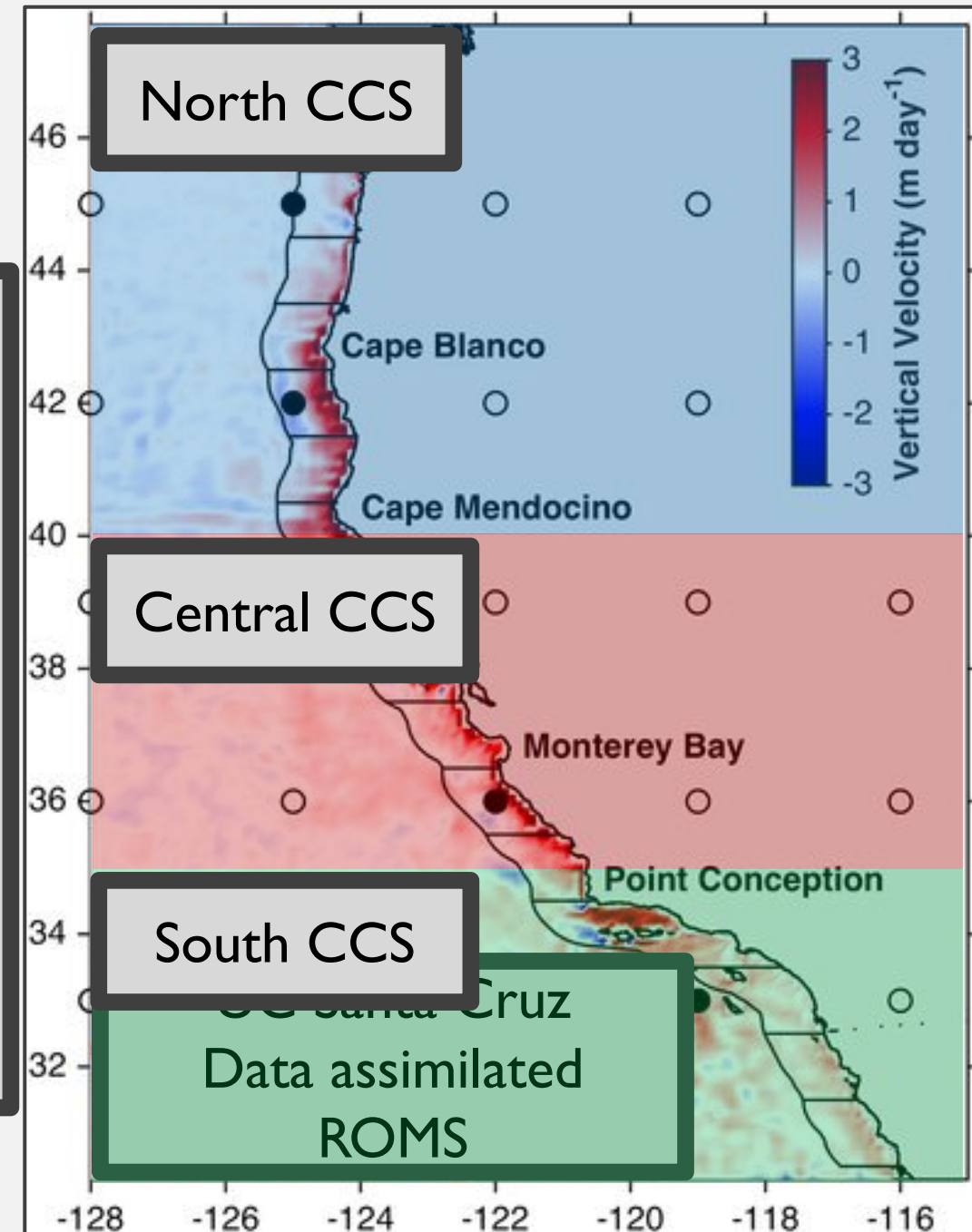
Data and Methods

Our measure of “truth”:

- Daily mean Uek from UC Santa Cruz data assimilated ROMS simulation, 1988-2018.

ECMWF seasonal forecast model:

- **Daily mean** reforecasts for 7 months, initialized every month from 1988-2017 (N = 30 years).
- 25 ensemble members on 1° grid.
- Only saved daily mean wind stress, can only evaluate Uek forecasts.

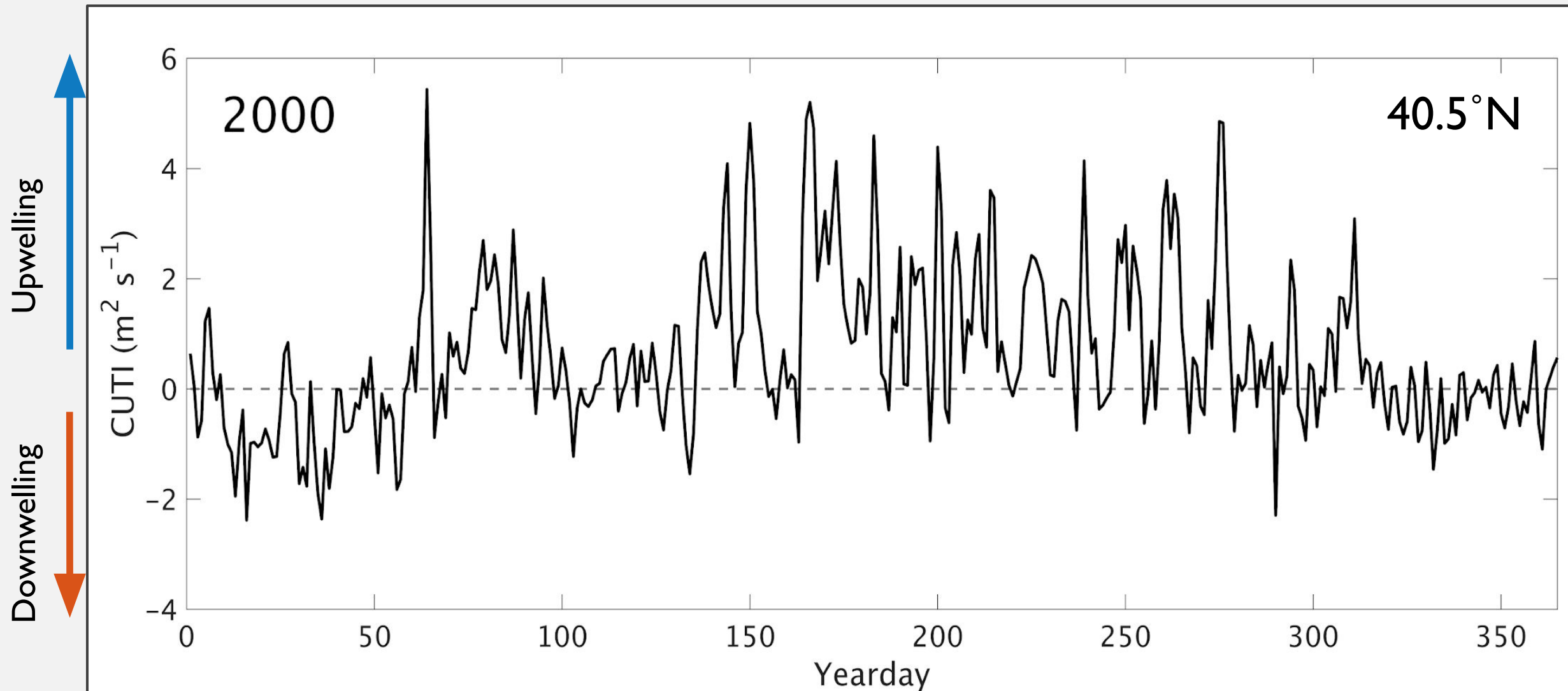


Seasonal Skill Evaluation

Uek, 1988-2017

Stipples = better than persistence, 90% confidence

Cumulative Upwelling Index



Cumulative Upwelling Index (CUI) = Integrated CUITI from January 1 each year

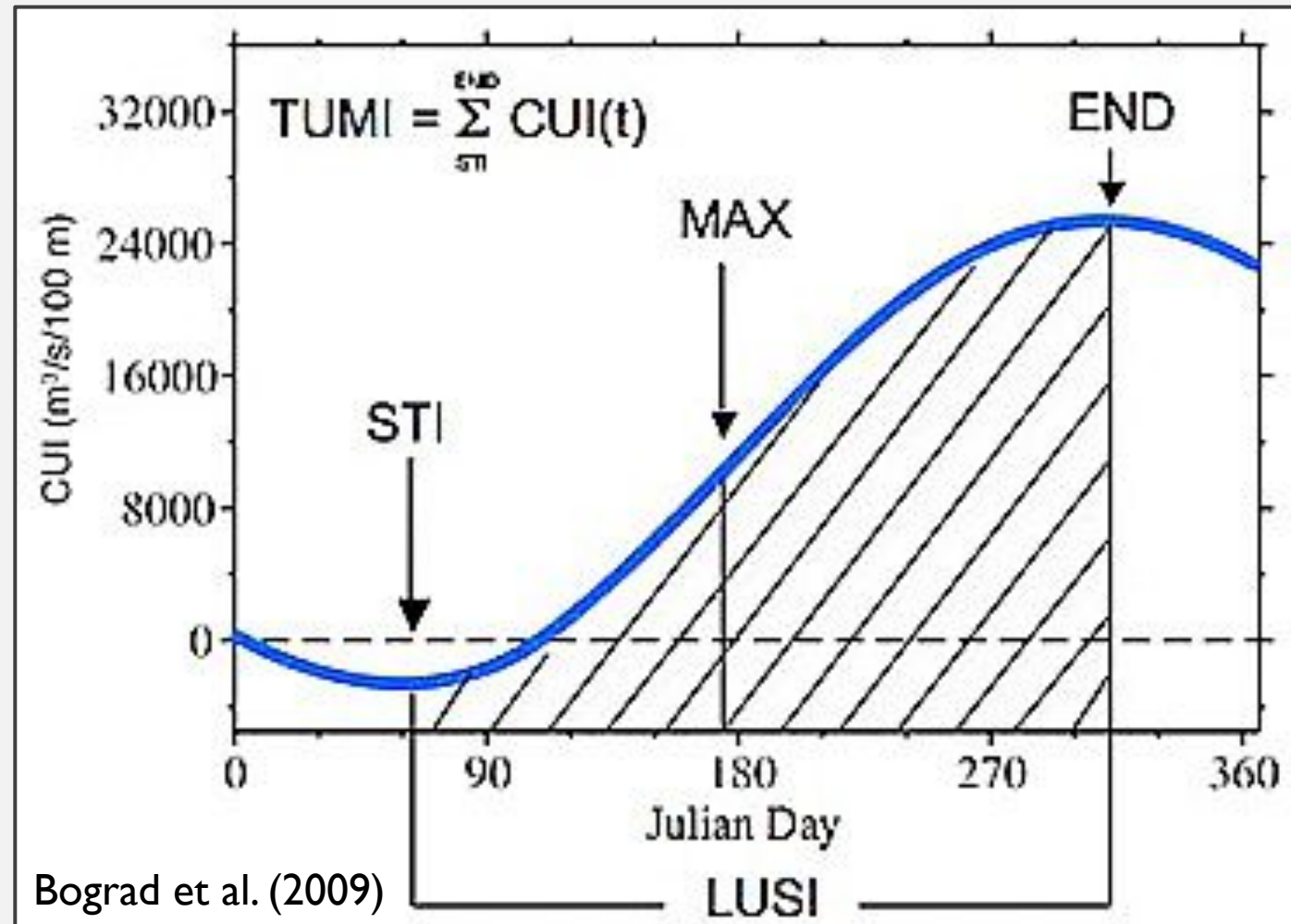
Uek

Upwelling Phenology:

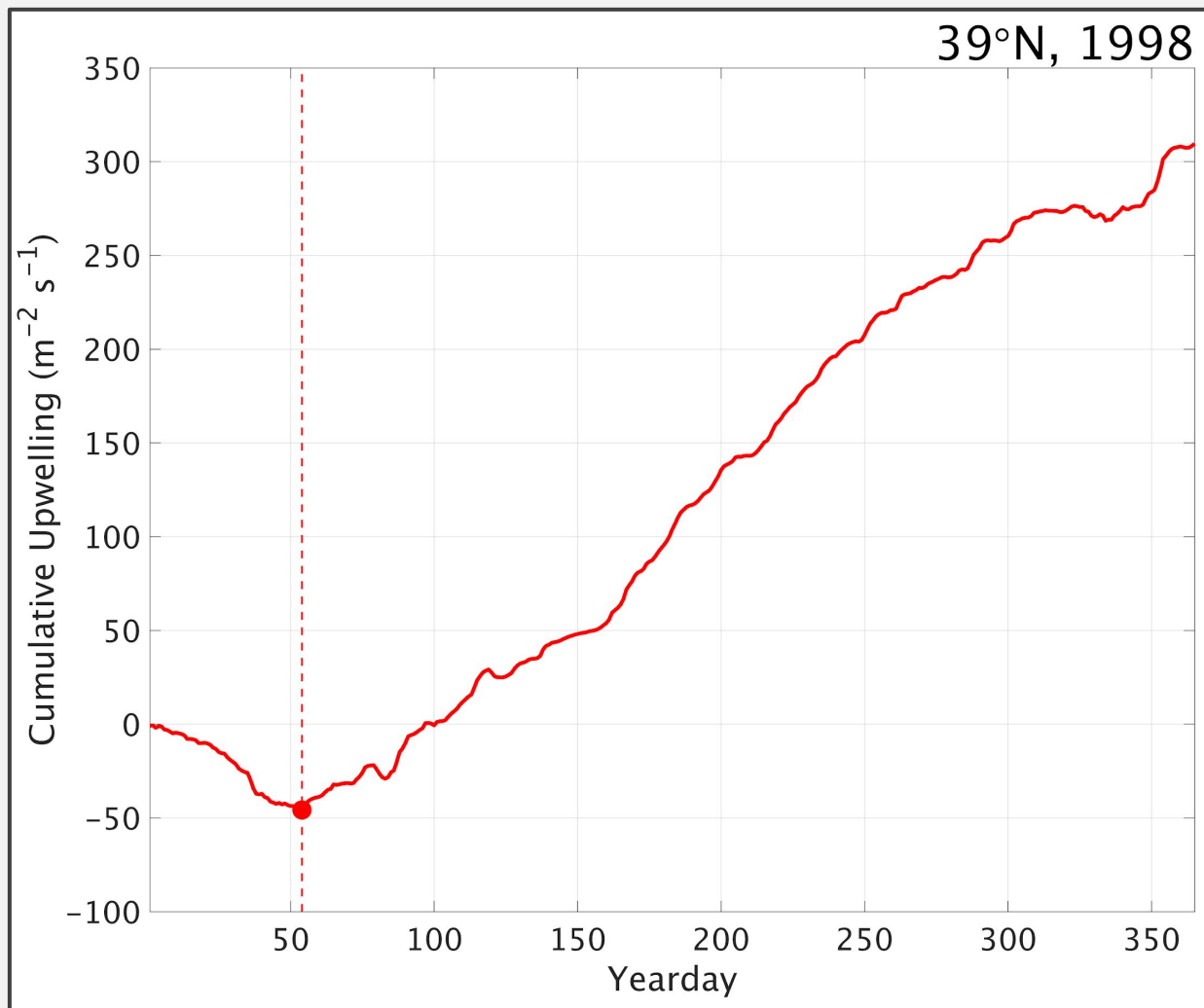
STI = Spring Transitional Index, minimum CUI

MAX = Greatest CUI rate of change

END = Upwelling end, maximum CUI



Spring Transition

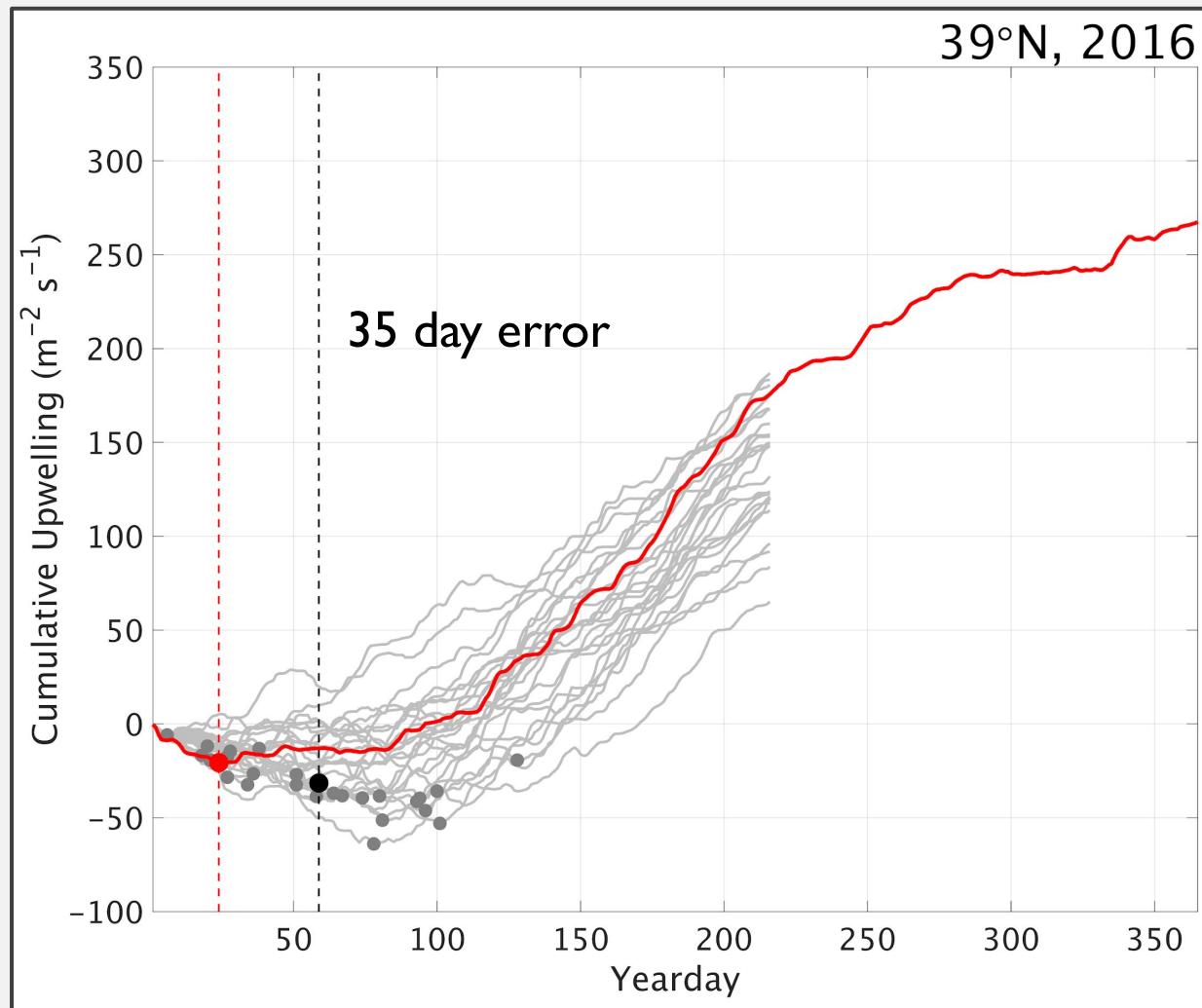
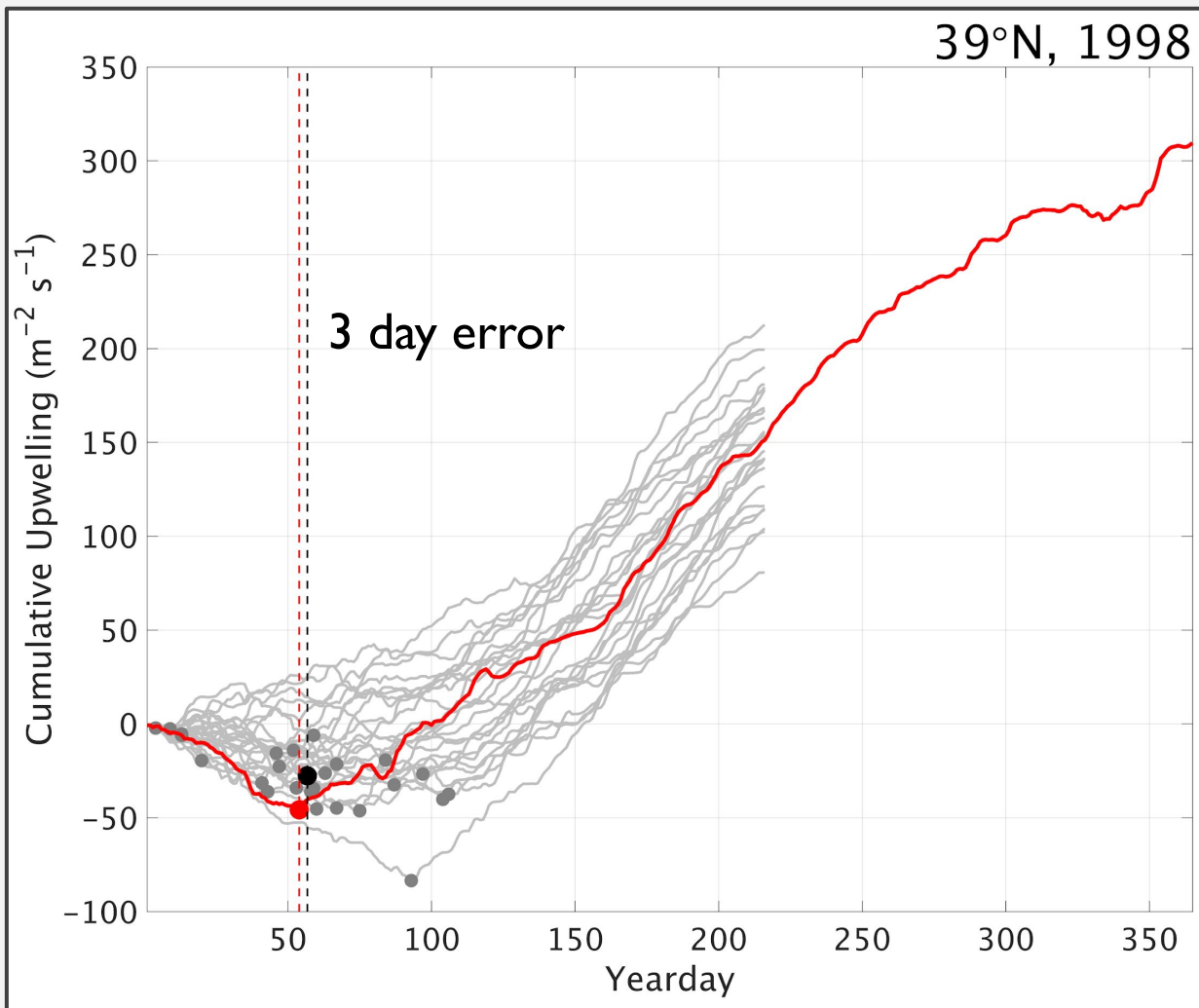


Observed CUI



Observed STI

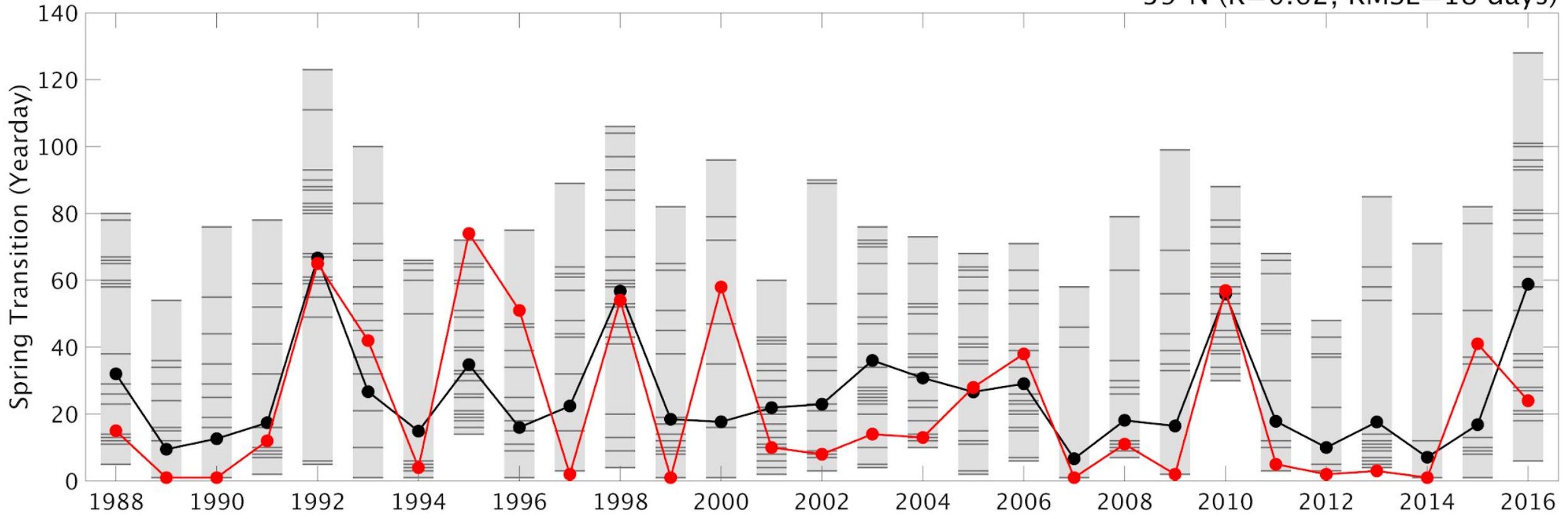
Spring Transition



Seasonal Skill Evaluation

January Initialization

39°N (R=0.62, RMSE=18 days)

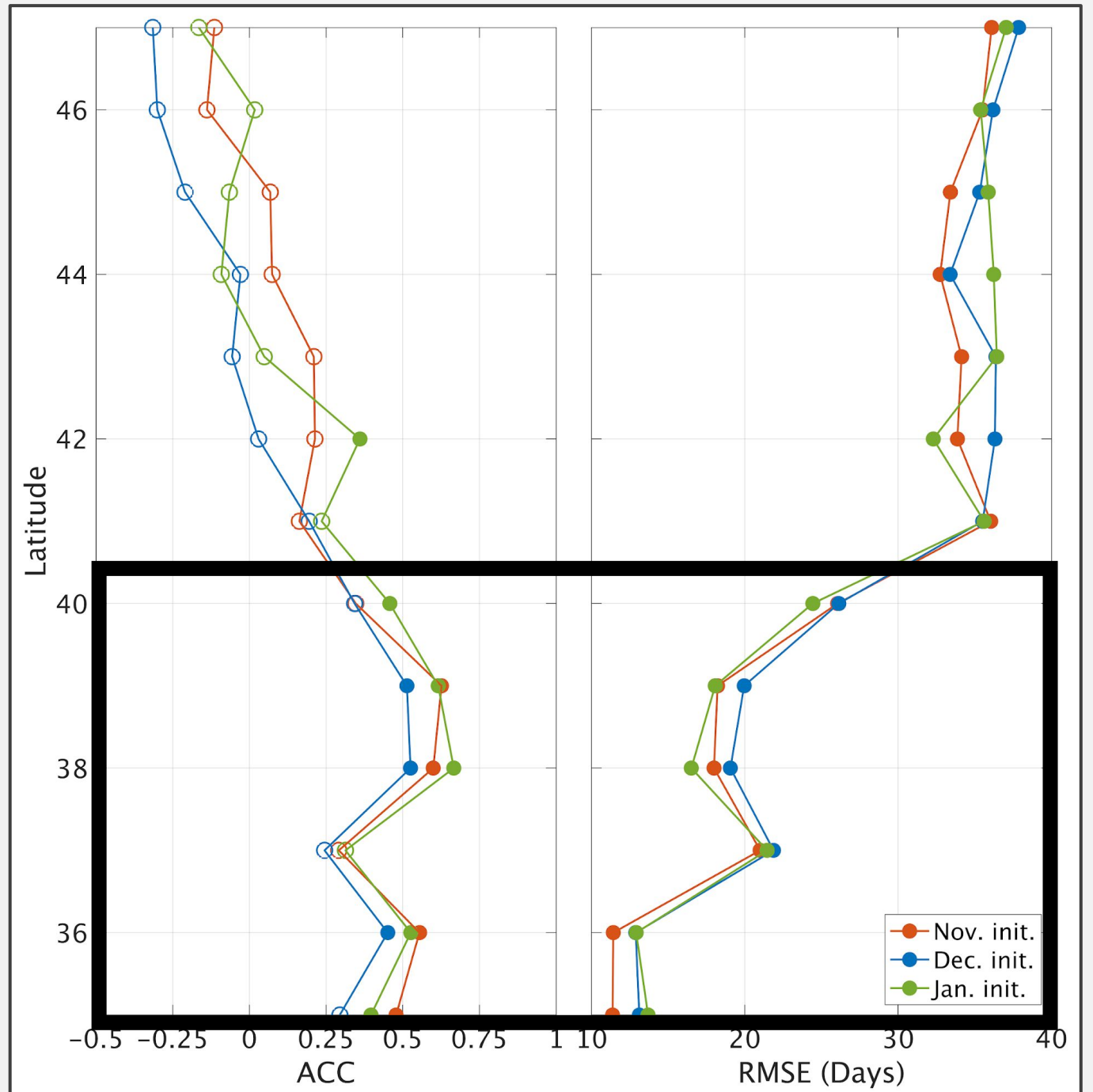


— Observed STI ■ Ens. Member STI — Ens. Mean STI

Seasonal Skill Evaluation

Model skillfully predicts Spring Transition in Central CCS

Closed circle: Significant R-value, 95% confidence



Season

Seasonal Forecast Evaluation Summary:

- ECMWF model can skillfully predict upwelling intensity 5-7 months in advance when initialized in summer.
- Forecast skill is primarily associated with ENSO.
- Model can skillfully predict the Spring Upwelling Transition in the Central CCS when initialized in November-January.

Model s
Trans

Questions?

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R-value, 95% confidence

ACC

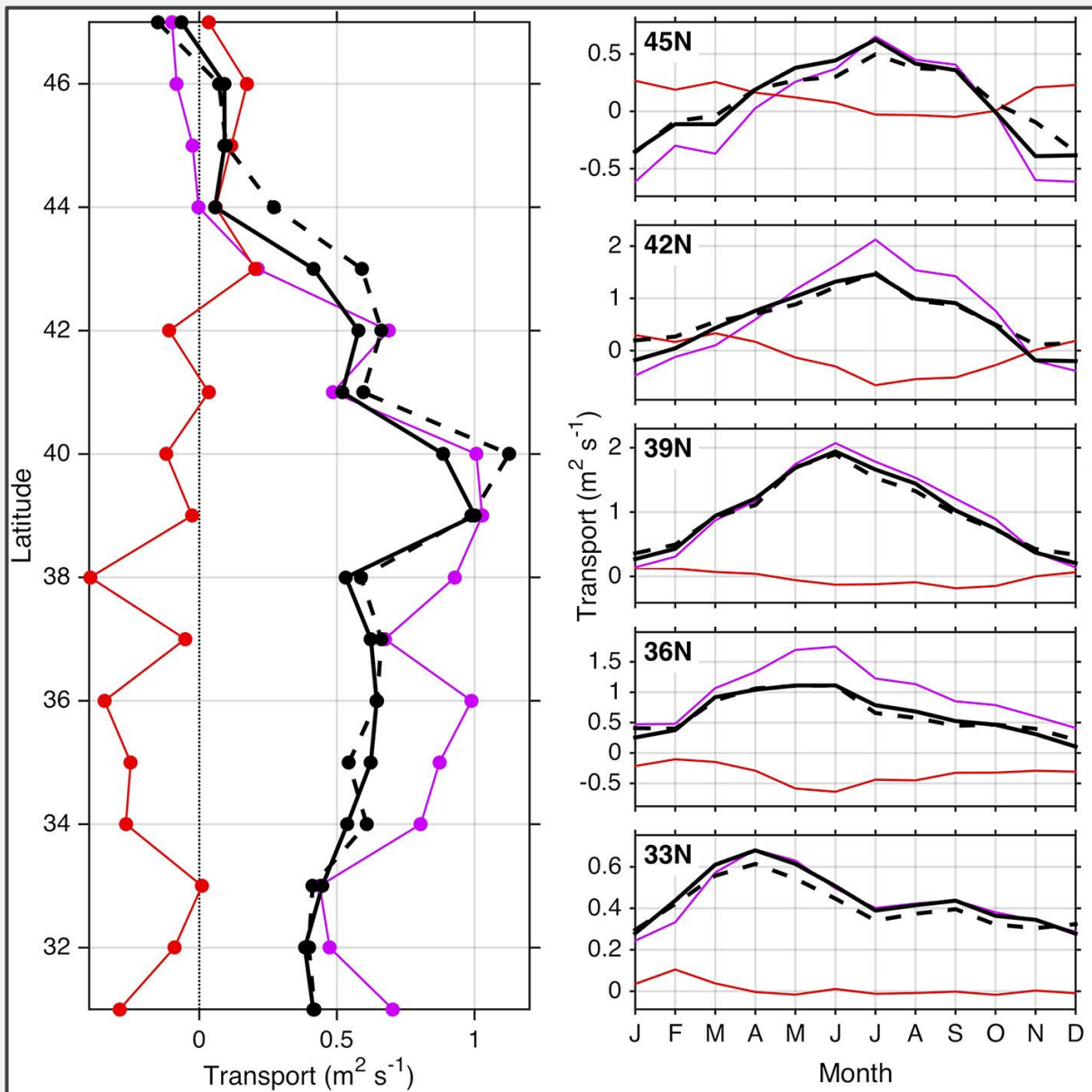
RMSE (Days)

Nov. init.
Dec. init.
Jan. init.

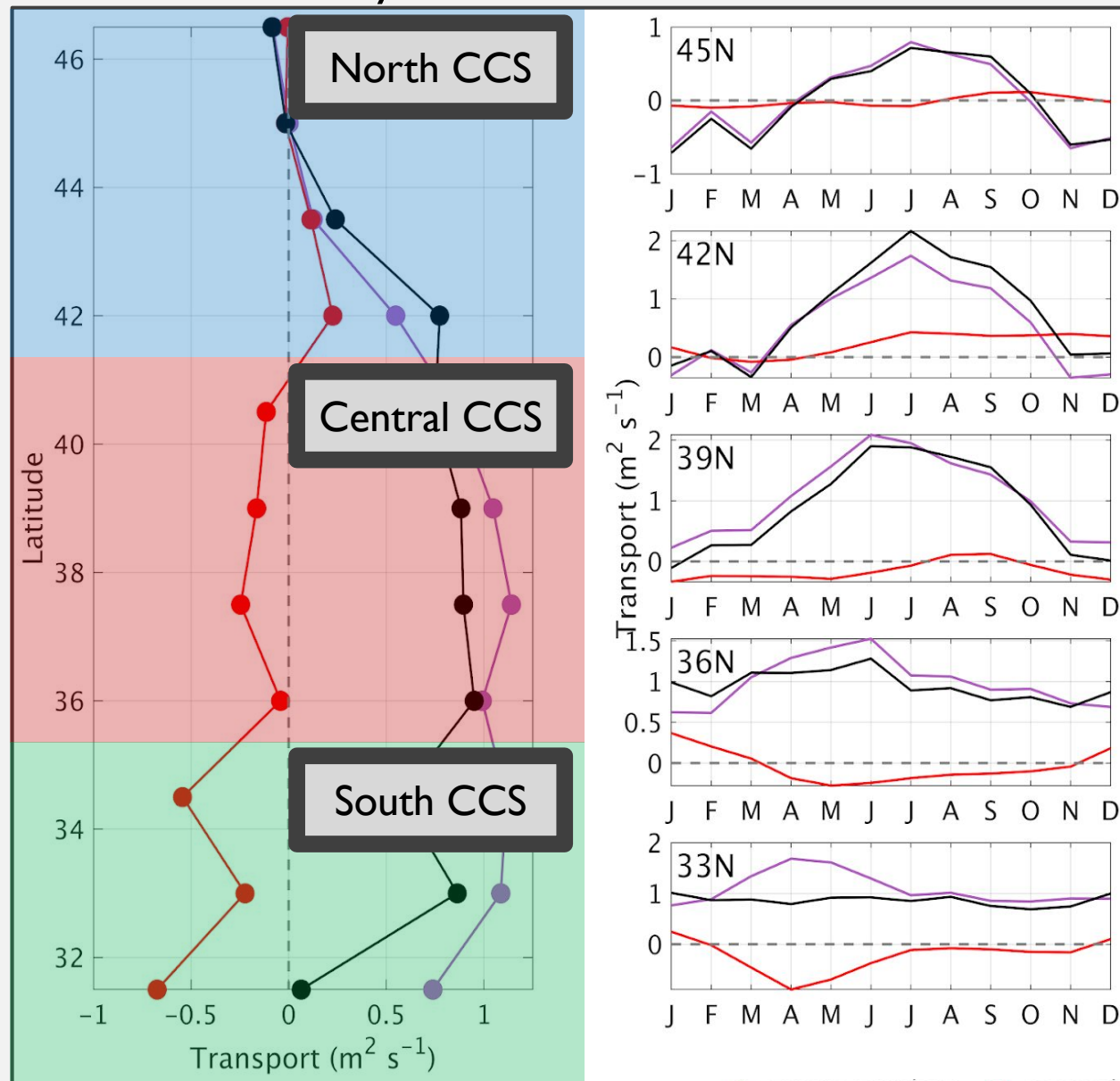
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Extra Slides

UCSC ROMS



S2S forecast at Day 0

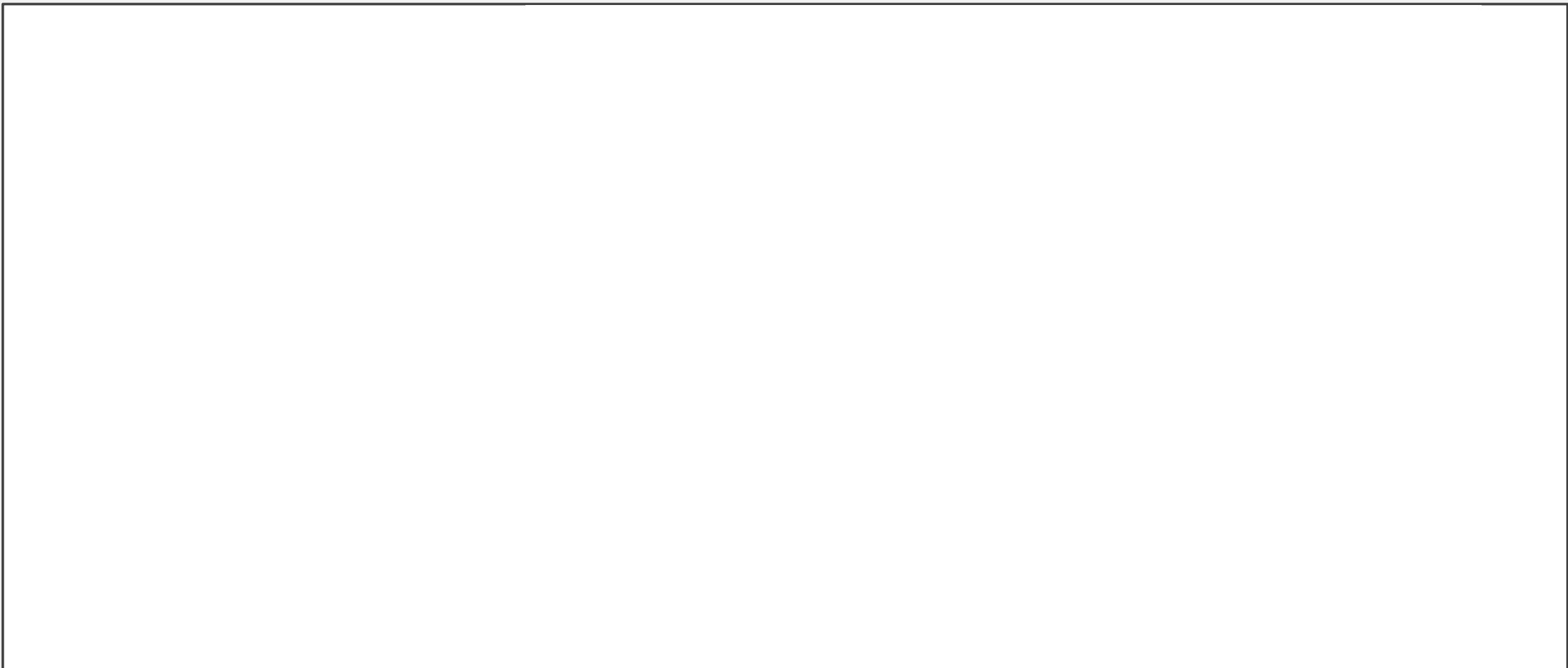


Jacox et al. (2018)

—●— Ugeo
 —●— Uek
 —●— CUTI
 - - - W

S2S Skill Evaluation

CUTI, 2000-2018



Forecasts & obs smoothed with 7-day running mean

Stipples = better than persistence, 90% confidence

S2S Skill Evaluation

CUTI forecast skill driven
by Uek forecast skill

Uek

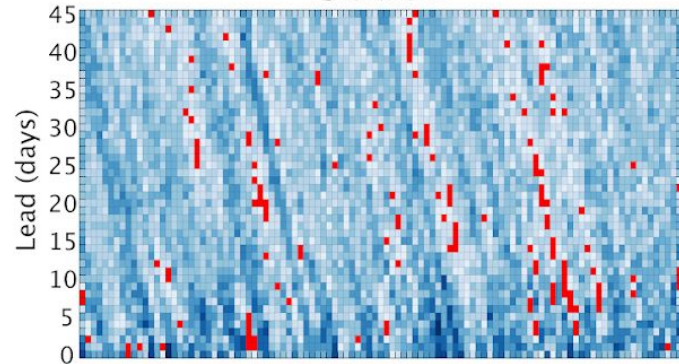
Ugeo



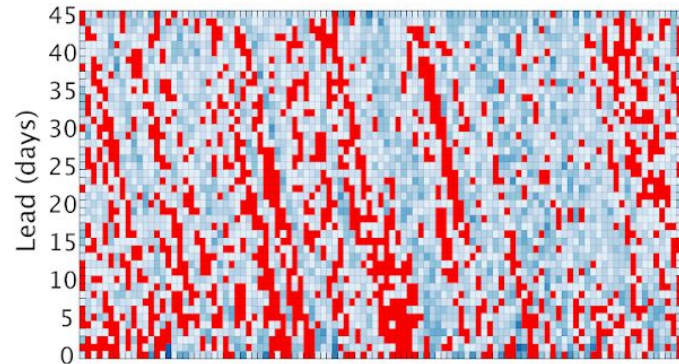
Forecasts & obs smoothed with 7-day running mean Stipples = better than persistence, 90% confidence

South

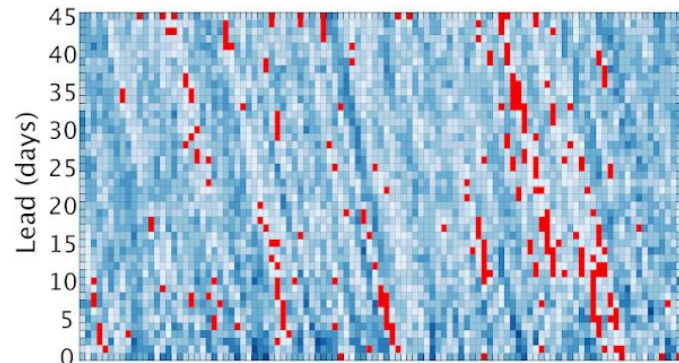
Upper



Middle

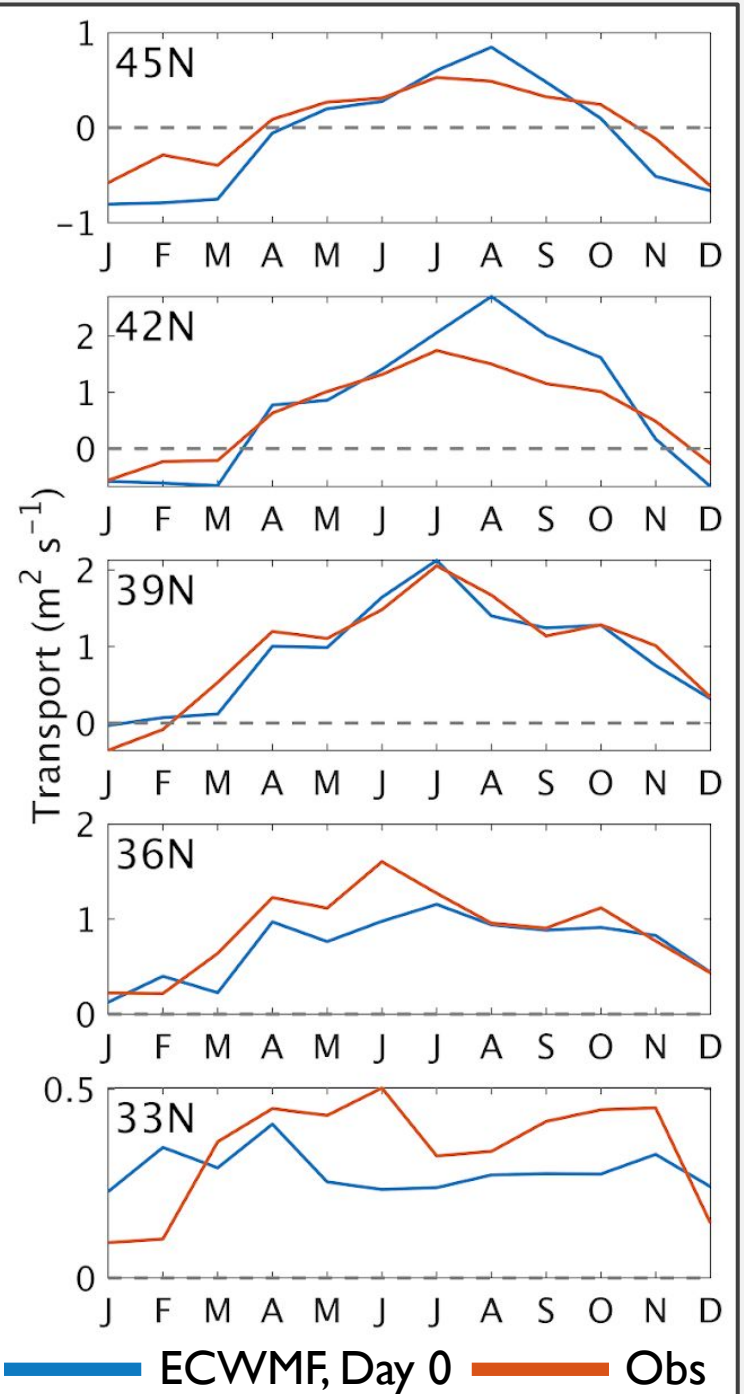
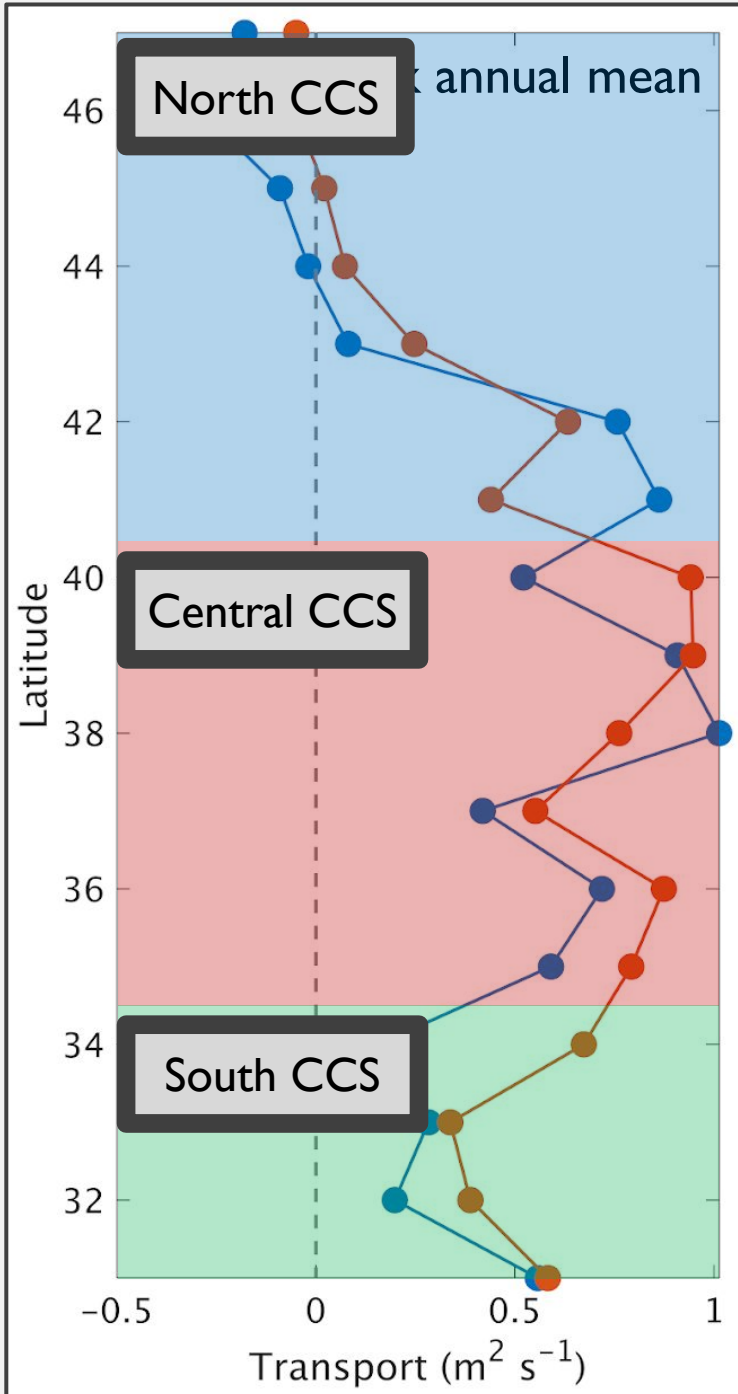


Lower

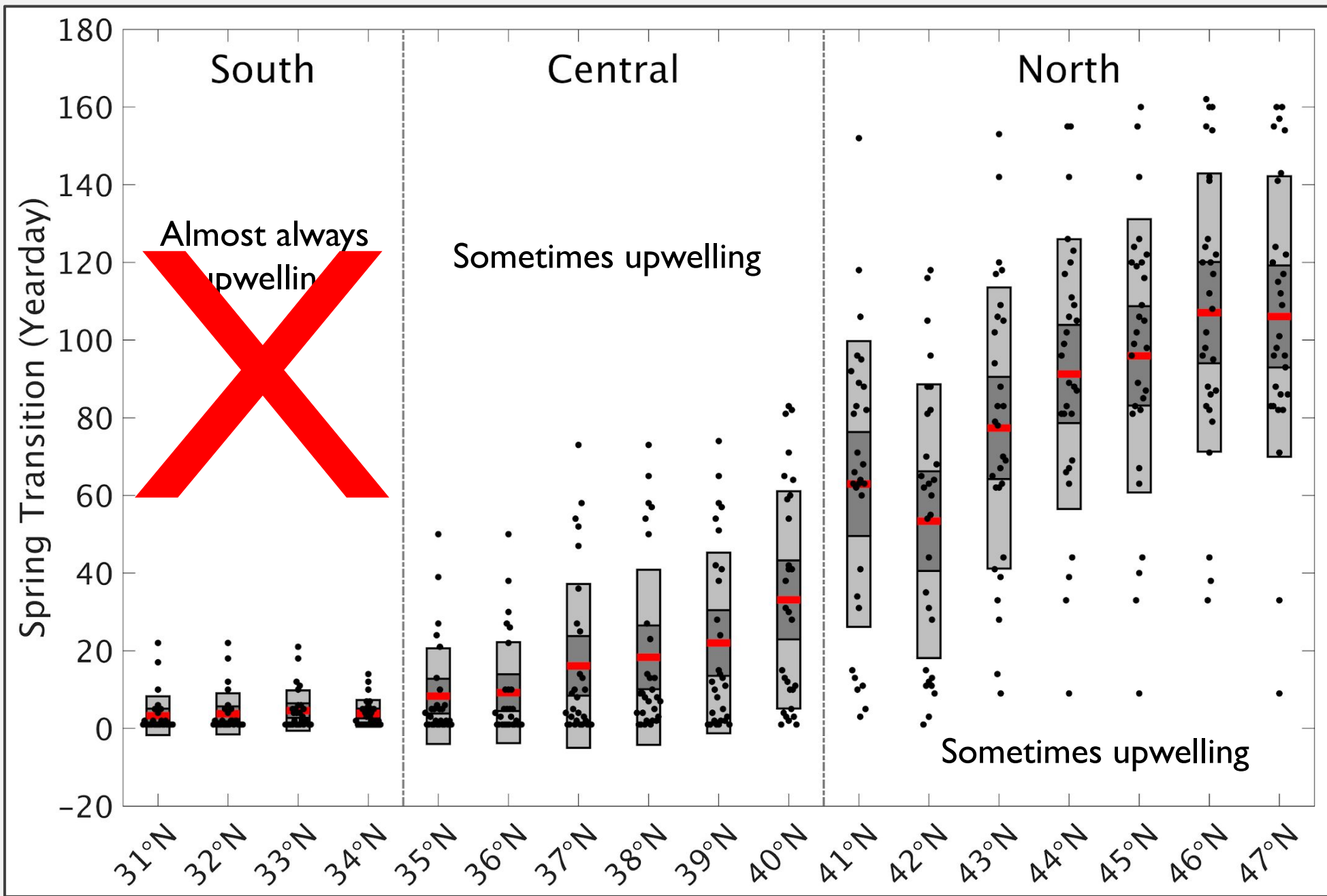


Red = Brier Skill Scores < 0
(i.e., worse than reference forecast)





Can only evaluate seasonal forecasts of Uek



Red = average STI Light gray = +/- 1 std dev Dark gray = +/- 2 std err

