Seasonal predictions of equatorial Atlantic SST in a low-resolution CGCM with surface Heat Flux Correction
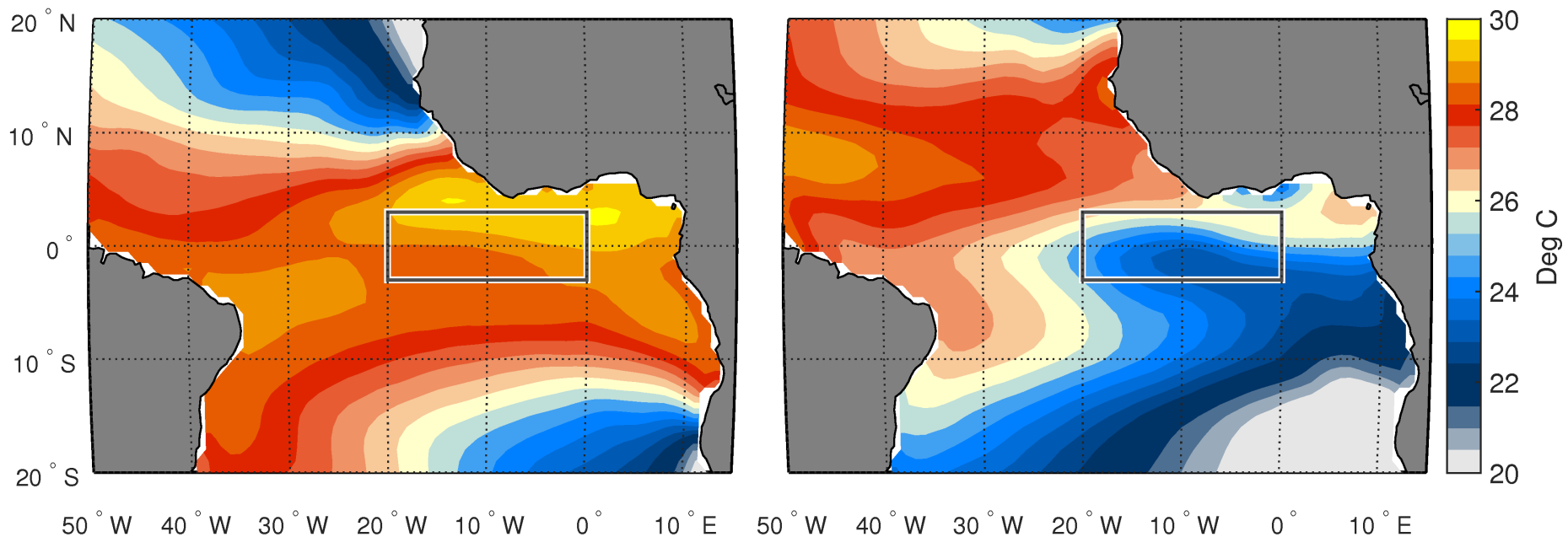
T. Dippe[1], R. Greatbatch[1], and H. Ding[2]

[1] GEOMAR Helmholtz Centre for Ocean Research, Kiel
[2] Cooperate Institute for Research in Environmental
    Sciences - University of Colorado and NOAA Earth
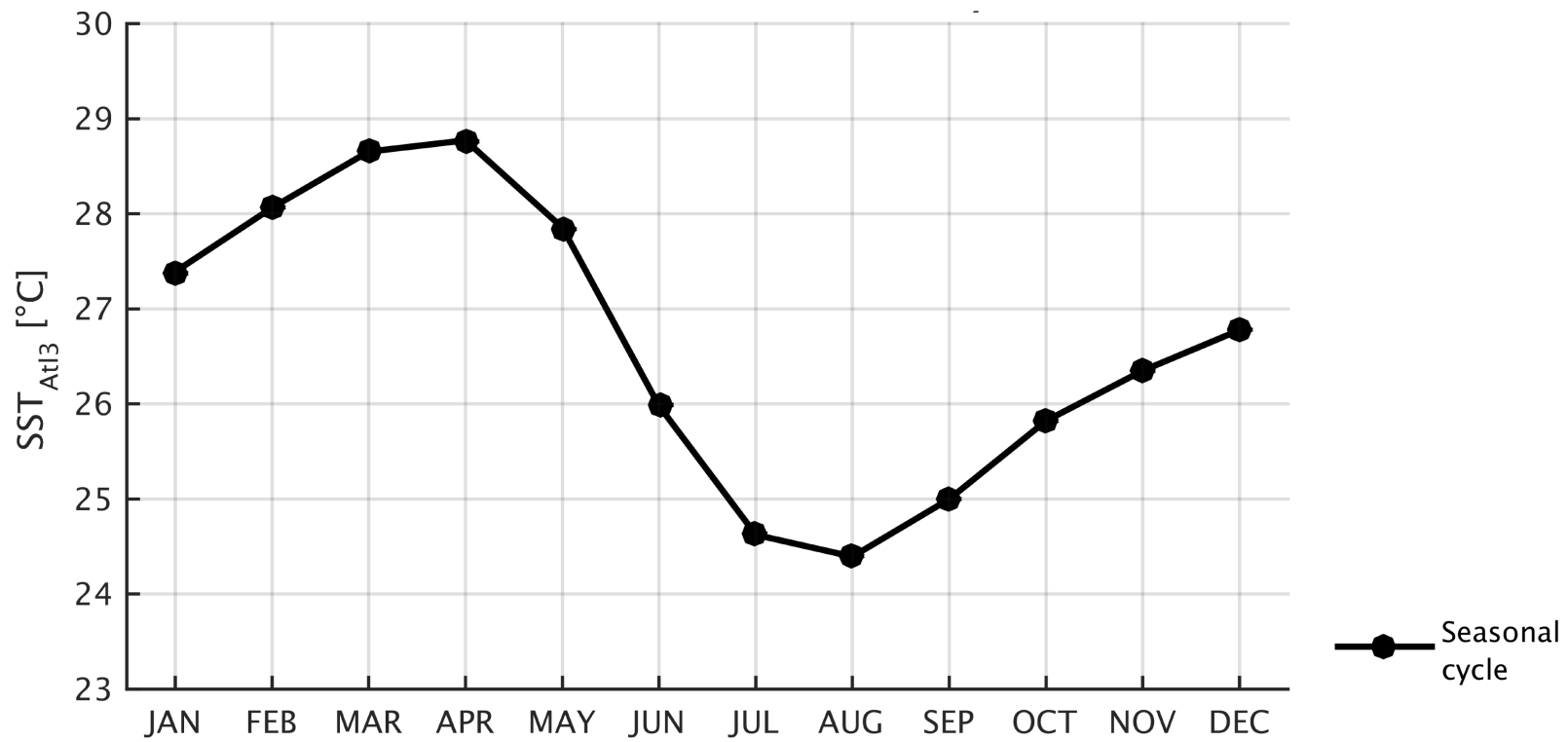   Systems Research Laboratory, Boulder, USA
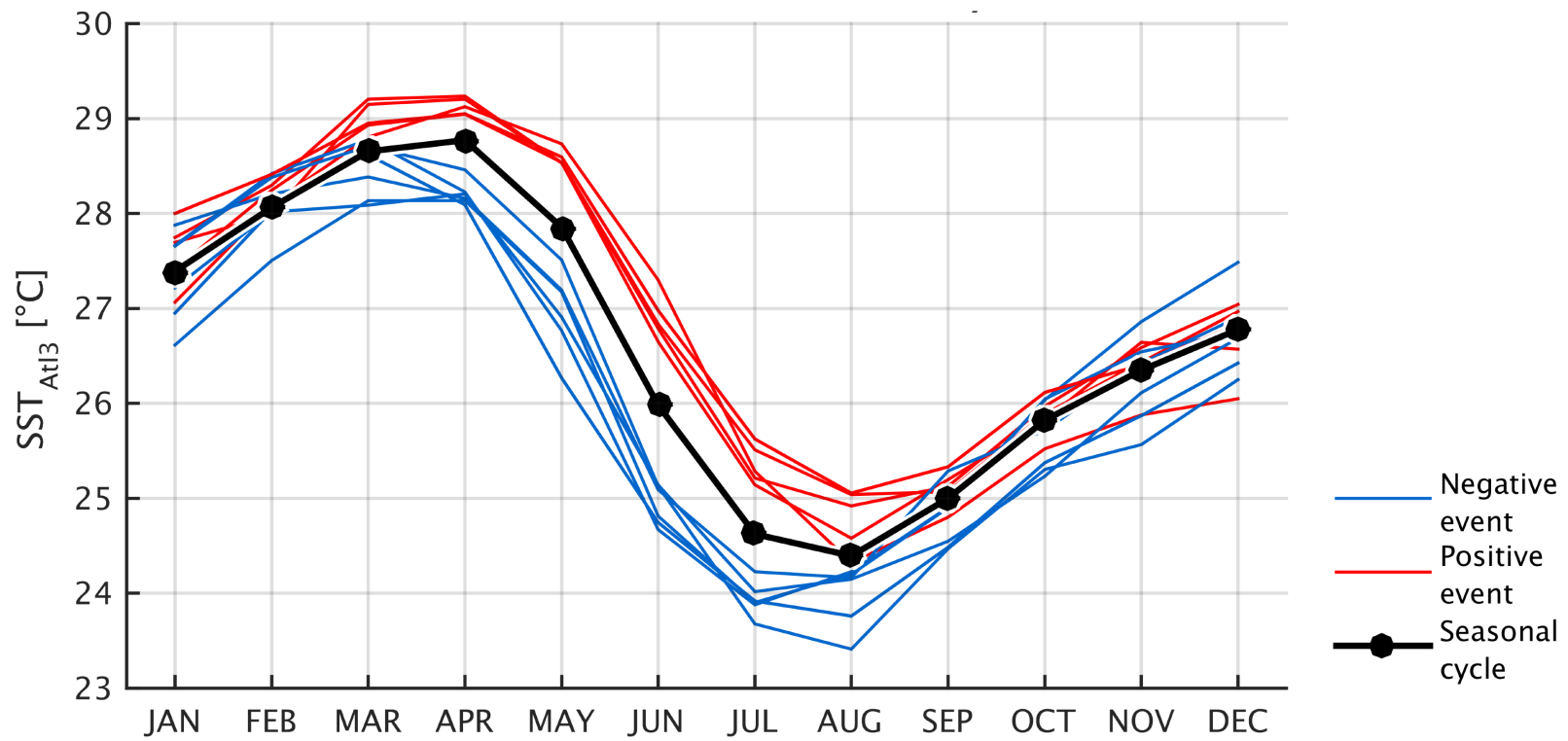
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Setting the scene

Absolute **SST** mean state in ERA-Interim for **April** (left) and **August** (fully developed cold tongue, right), 1981-2012. The box denotes the **Atl3 region**.

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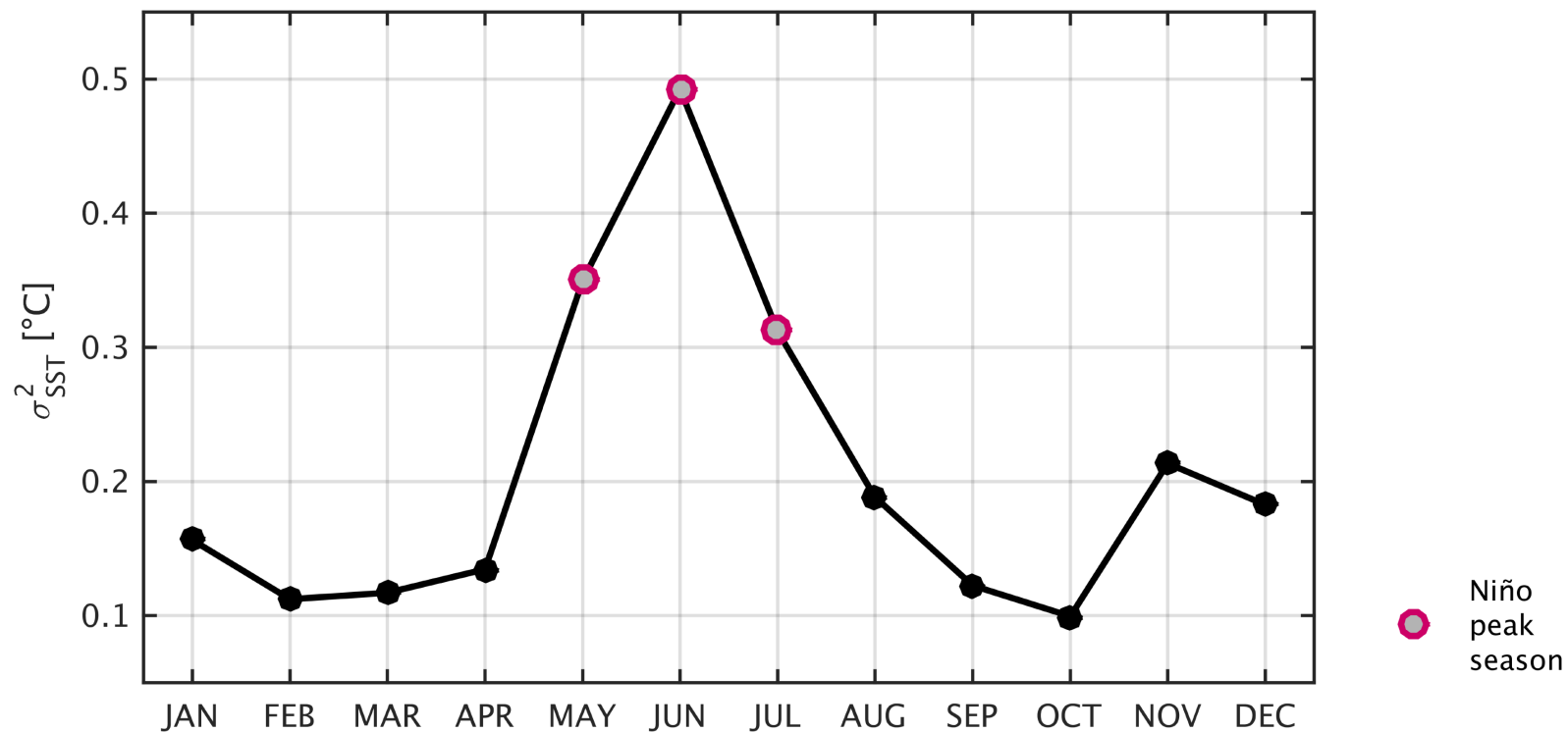
ERA-Interim Atl3 SST

GEOMAR
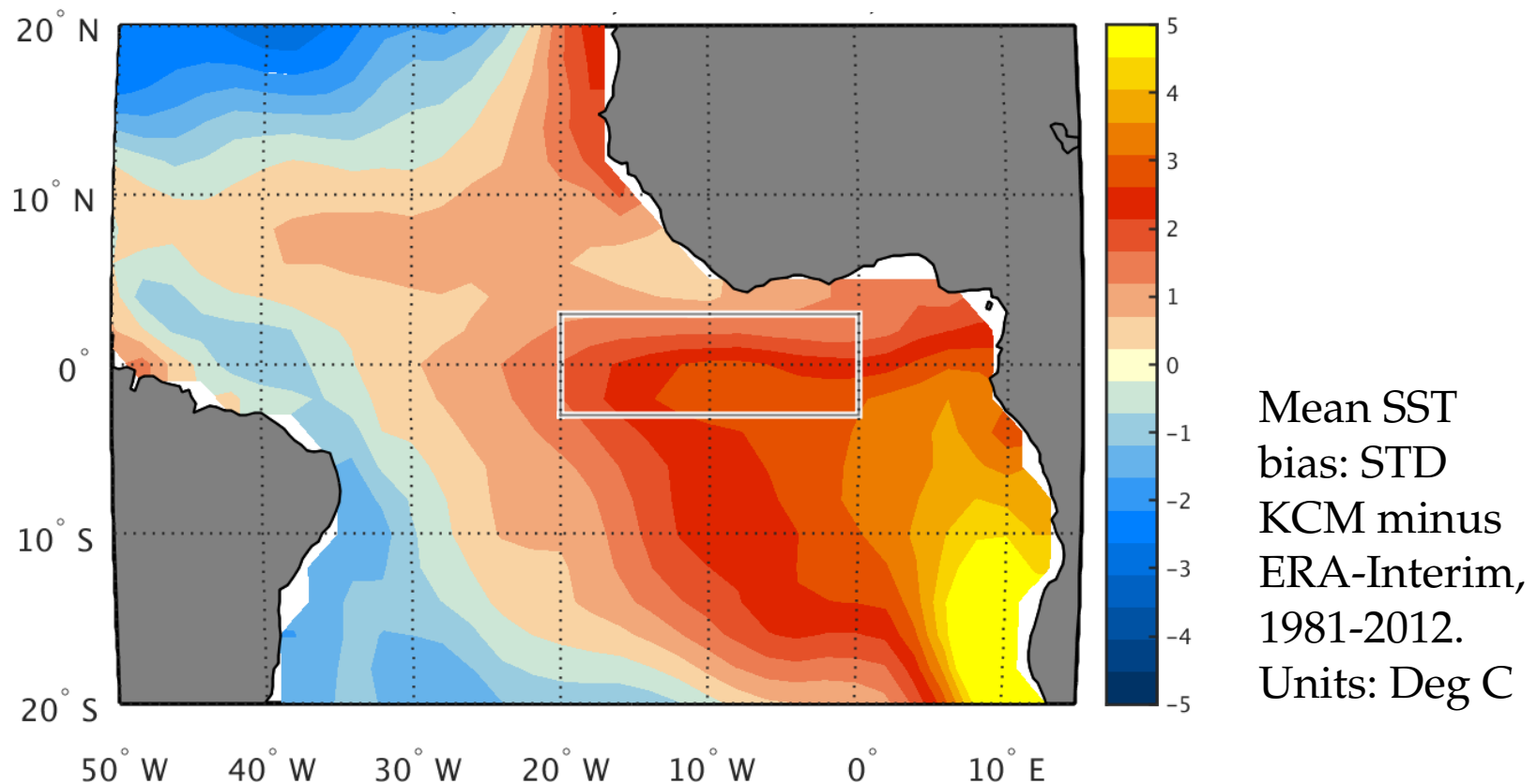
ERA-Interim Atl3 SST

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AtI3 SST: Interannual variance

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The equatorial Atlantic SST Bias: State of the Art

Mean SST bias: STD KCM minus ERA-Interim, 1981-2012. Units: Deg C

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The equatorial Atlantic SST Bias: State of the Art

Seasonality of the **SST bias in Atl3**, KCM STD run

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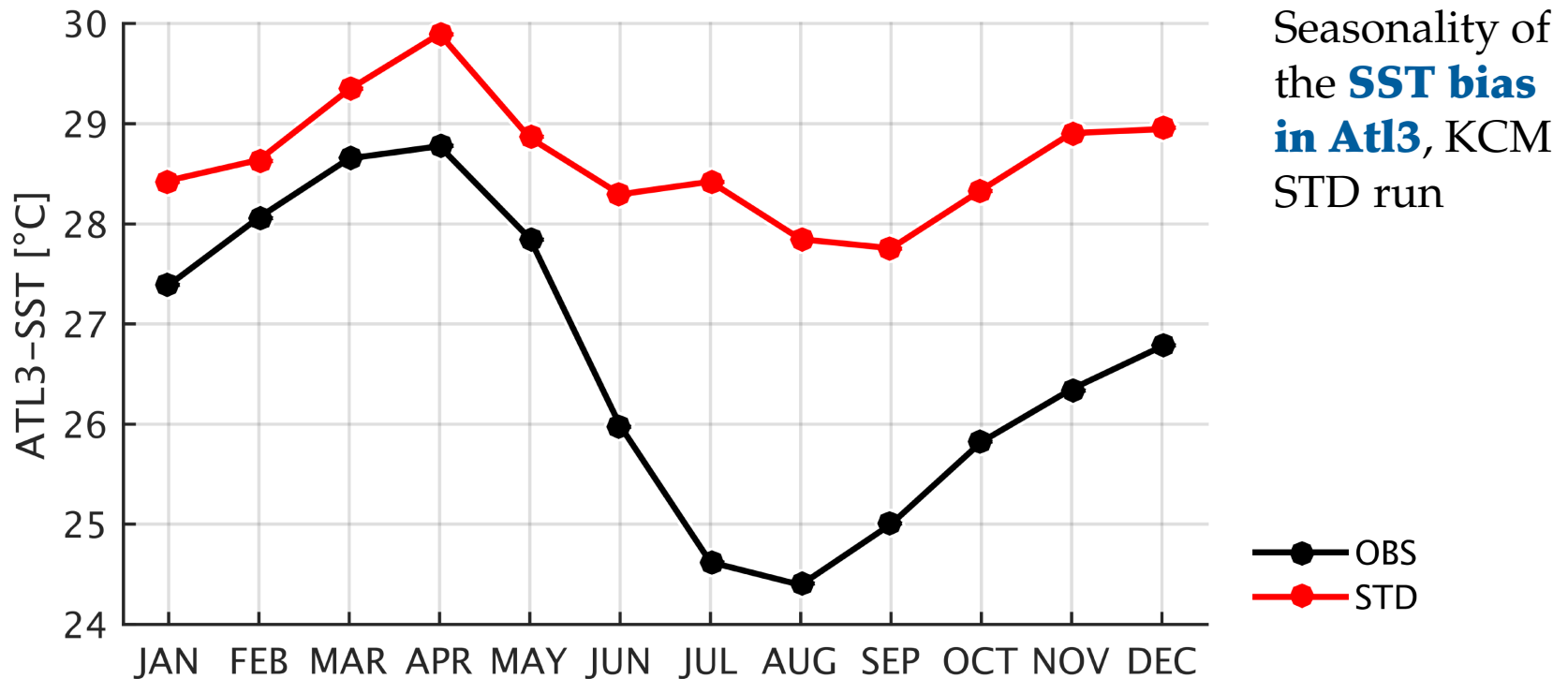
Model and experimental Set-Up

The truth:
- ERA-Interim

Model and experimental Set-Up

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The model
- Kiel Climate Model
  (**KCM**):
  - Atmosphere:
    ECHAM5, T31, 19
    levels
  - Ocean: OPA9 (NEMO),
    ORCA2, 31 levels
  - …
  - Coupler: OASIS3

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Experiments (both for assimilation runs and hindcasts)
- **STD**: Standard KCM
- **FLX**: Additional global heat flux correction

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Assimilation runs:
- Produce initial conditions for hindcasts
- Assimilated data: ERA-Interim wind stress anomalies
- Assimilation technique: Partial coupling

Model and experimental Set-Up

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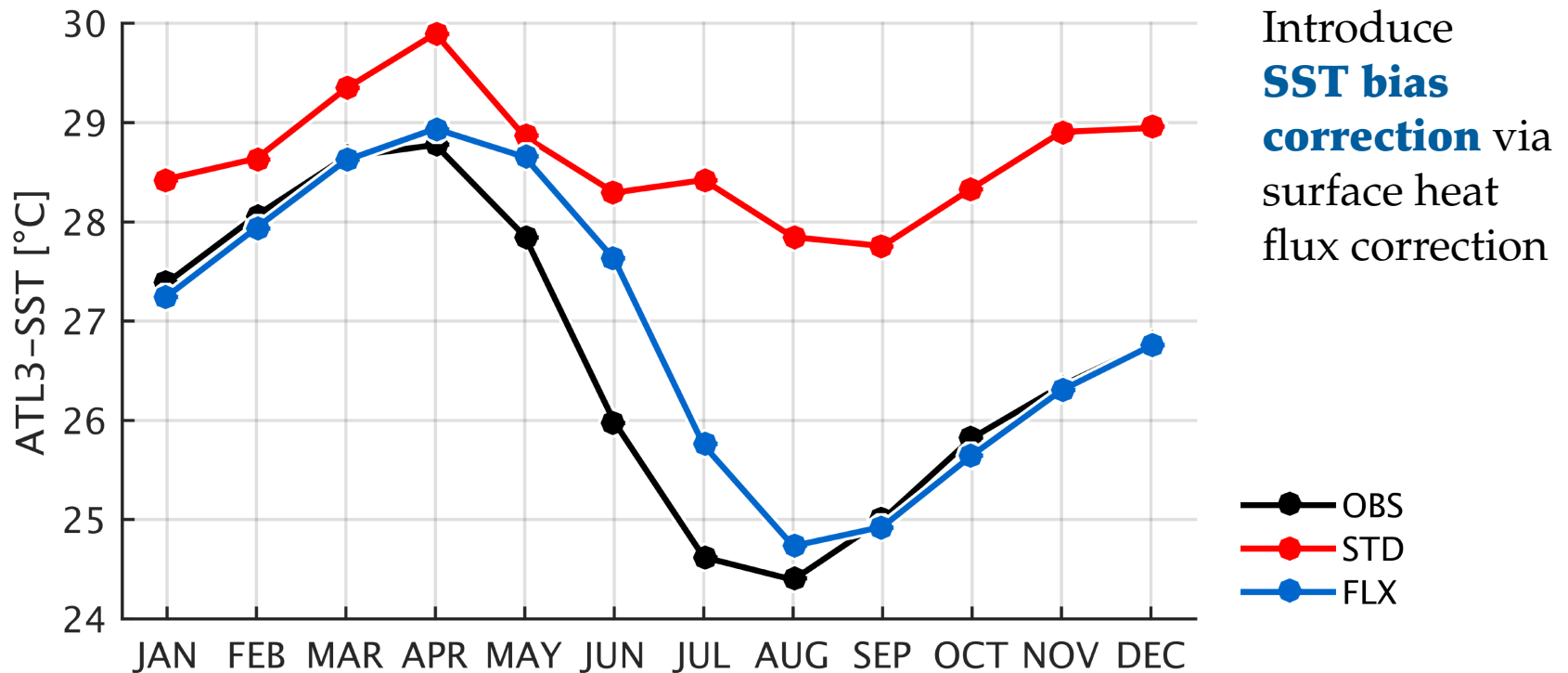**Assimilation runs**:
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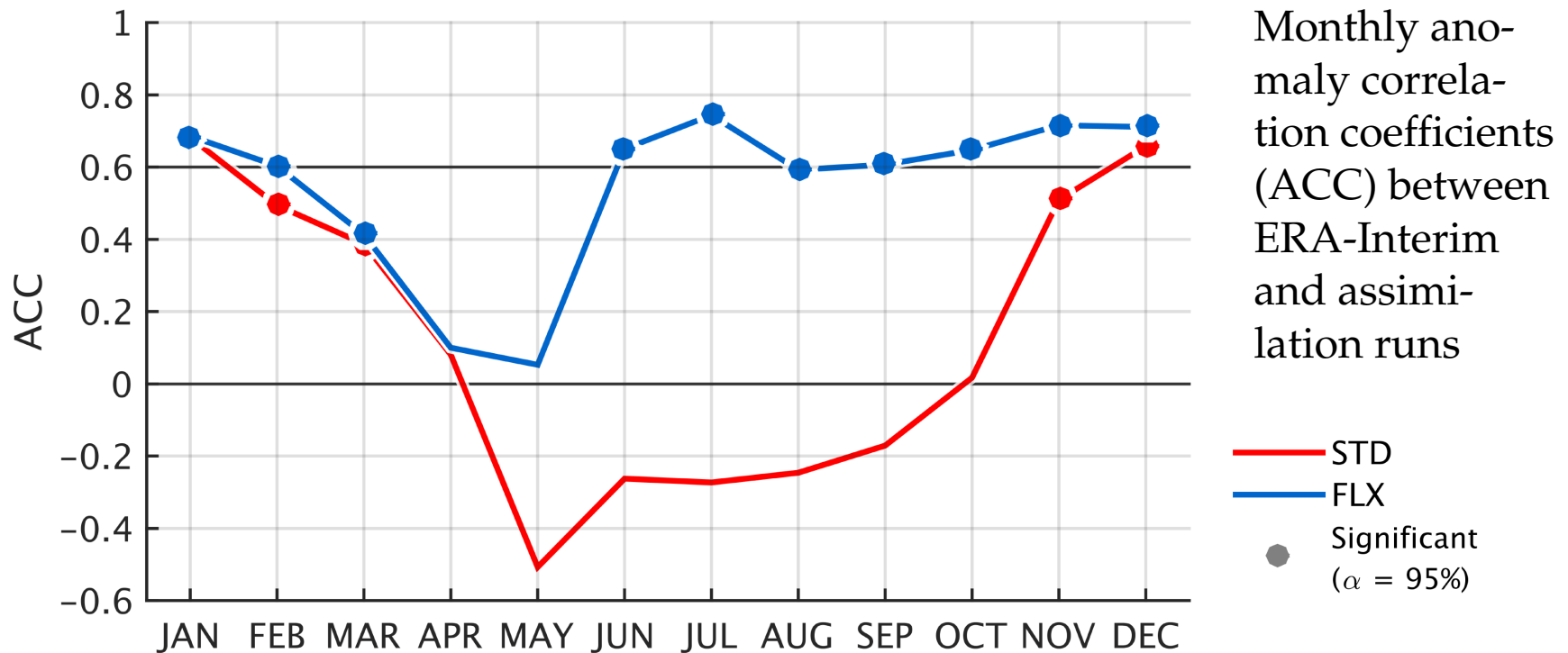- Assimilation technique: Partial coupling

Hindcasts:
- Restarted in Feb, May, Aug, Nov
- Run for 6 months: Fully coupled standard (heat-flux corrected) KCM for STD (FLX)
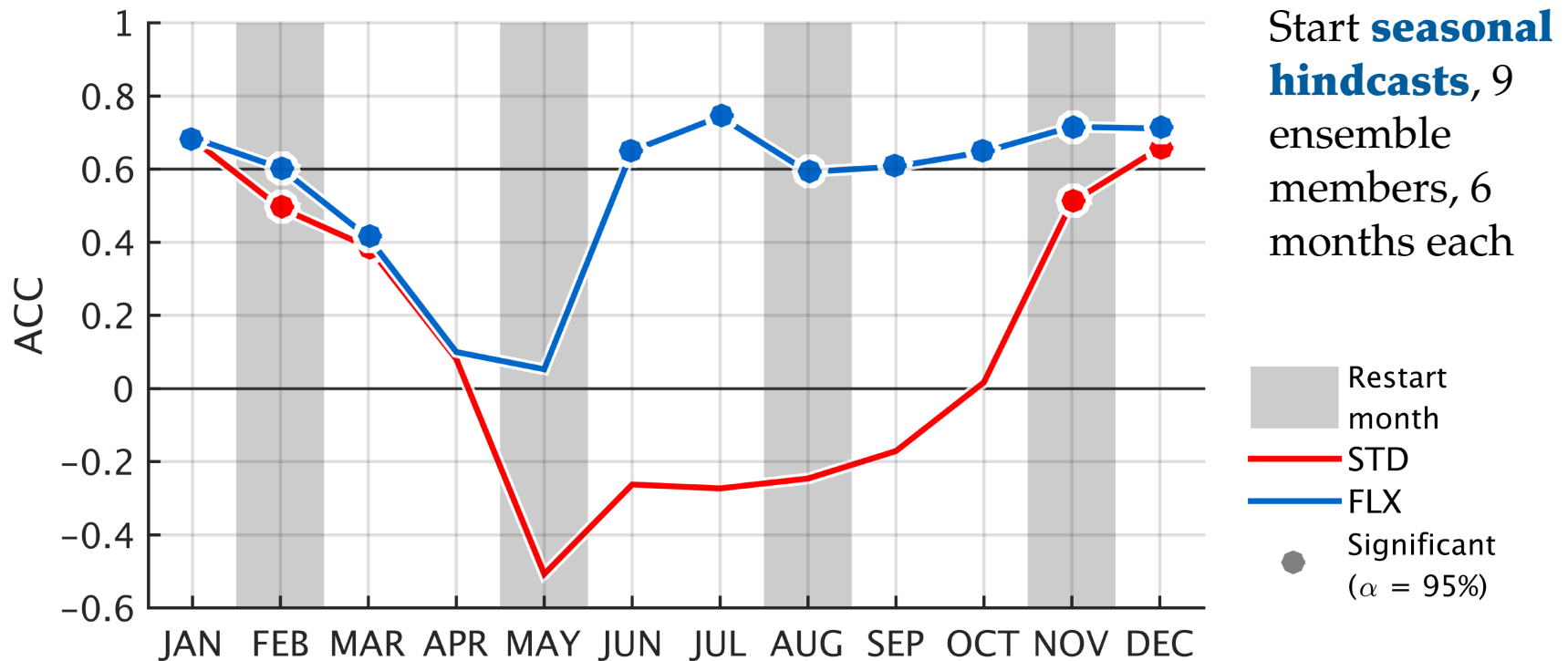- 9 ensemble members

Surface Heat Flux Correction

Introduce **SST bias correction** via surface heat flux correction

Bias correction improves summer variability in the assimilation runs

Monthly ano-maly correla-tion coefficients (ACC) between ERA-Interim and assimi-lation runs

STD
FLX
Significant
(α = 95%)

Impact on Forecast Skill?

Start **seasonal hindcasts**, 9 ensemble members, 6 months each

Legend:
- Restart month
- STD
- FLX
- Significant ($\alpha = 95\%$)

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Hindcast Skill

Persistence
(ERA-Interim)

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Hindcast Skill

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Hindcast Skill

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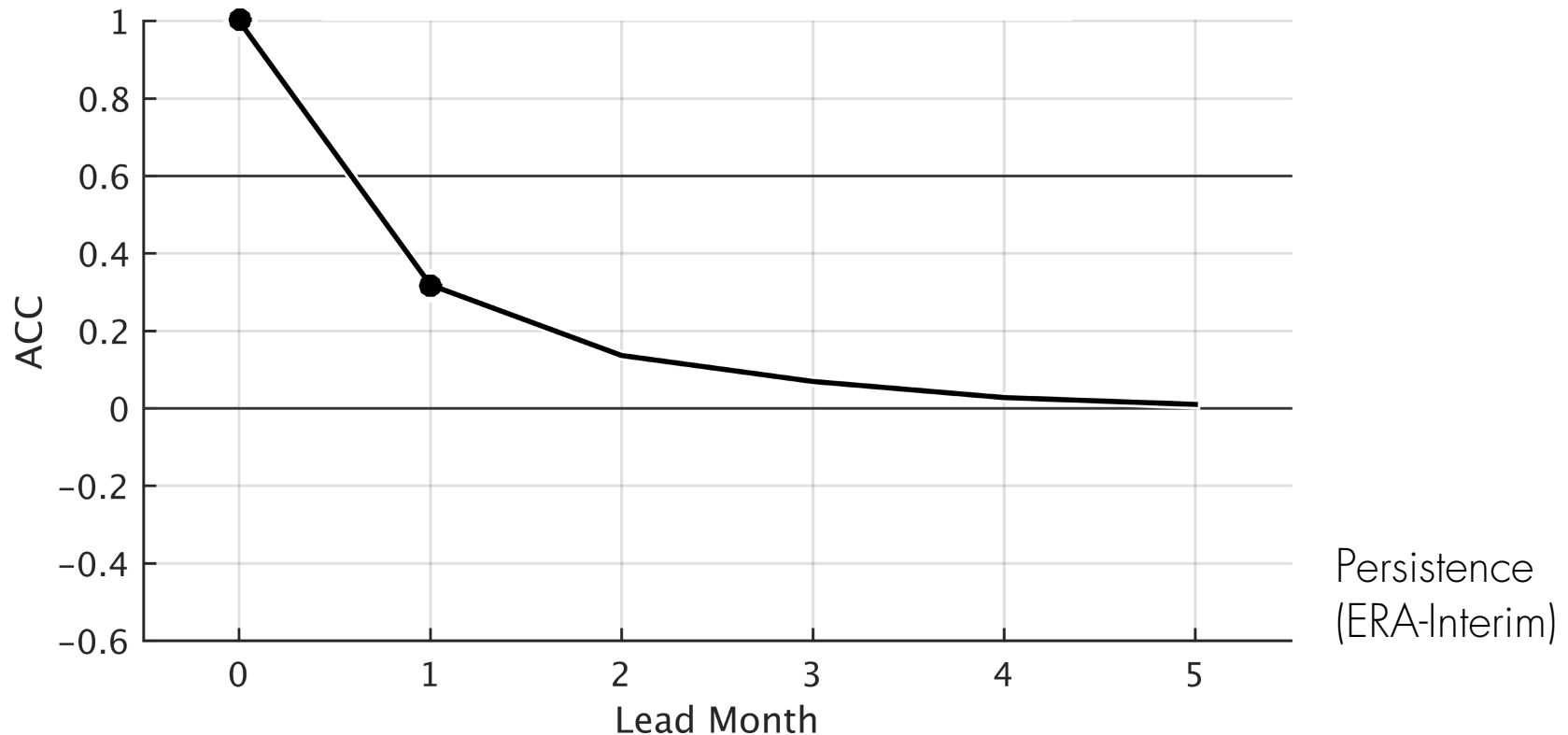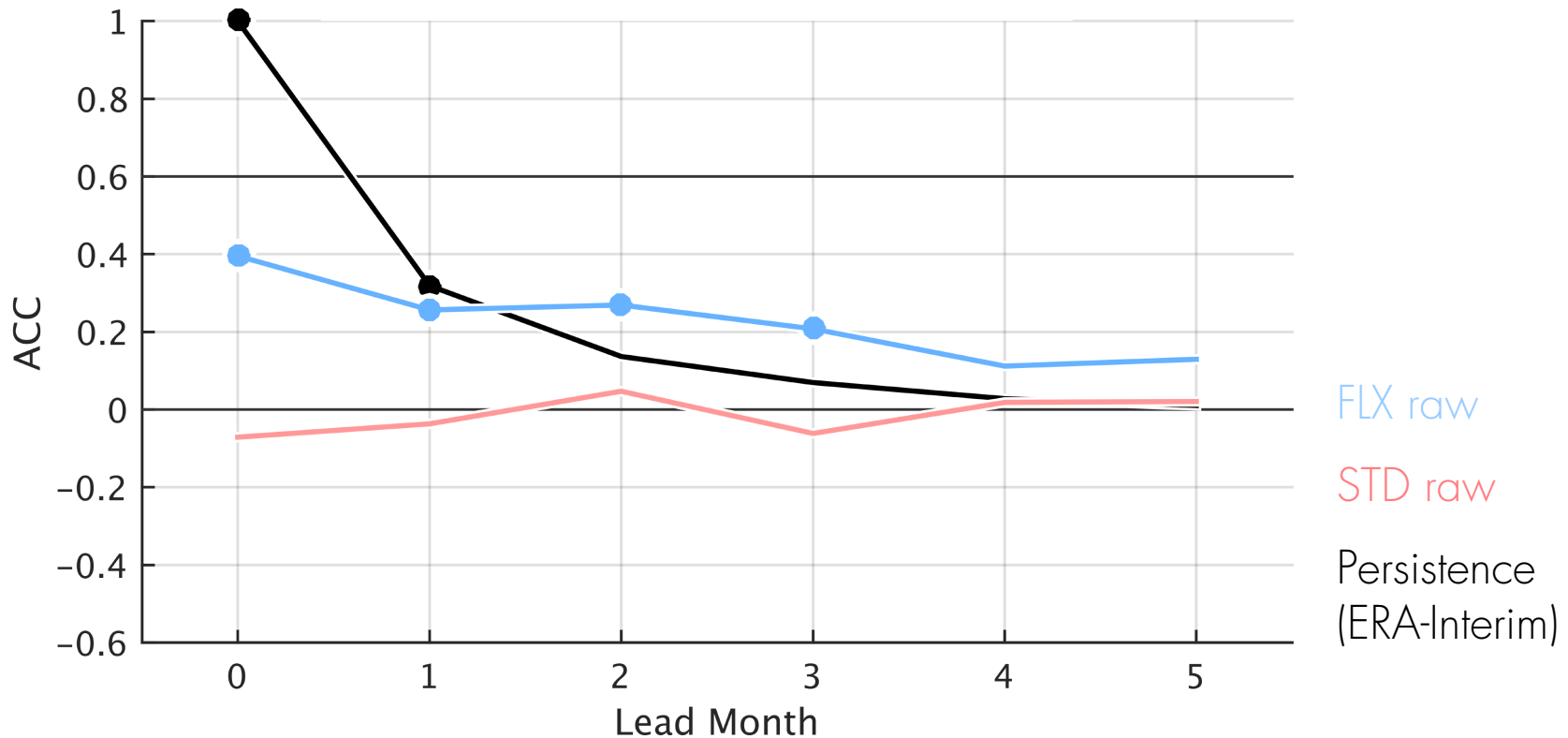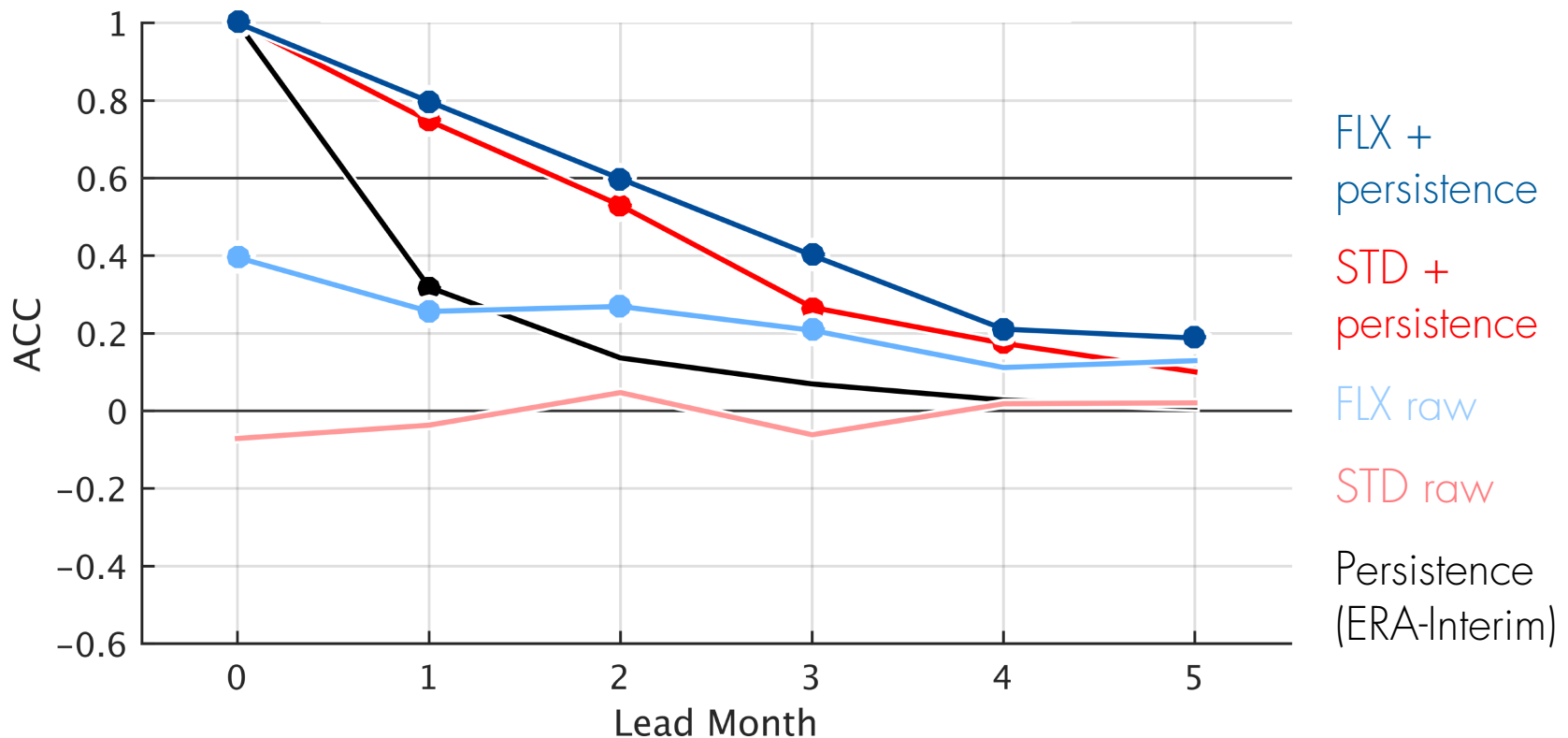
Observed Atl3 SST predictability limits

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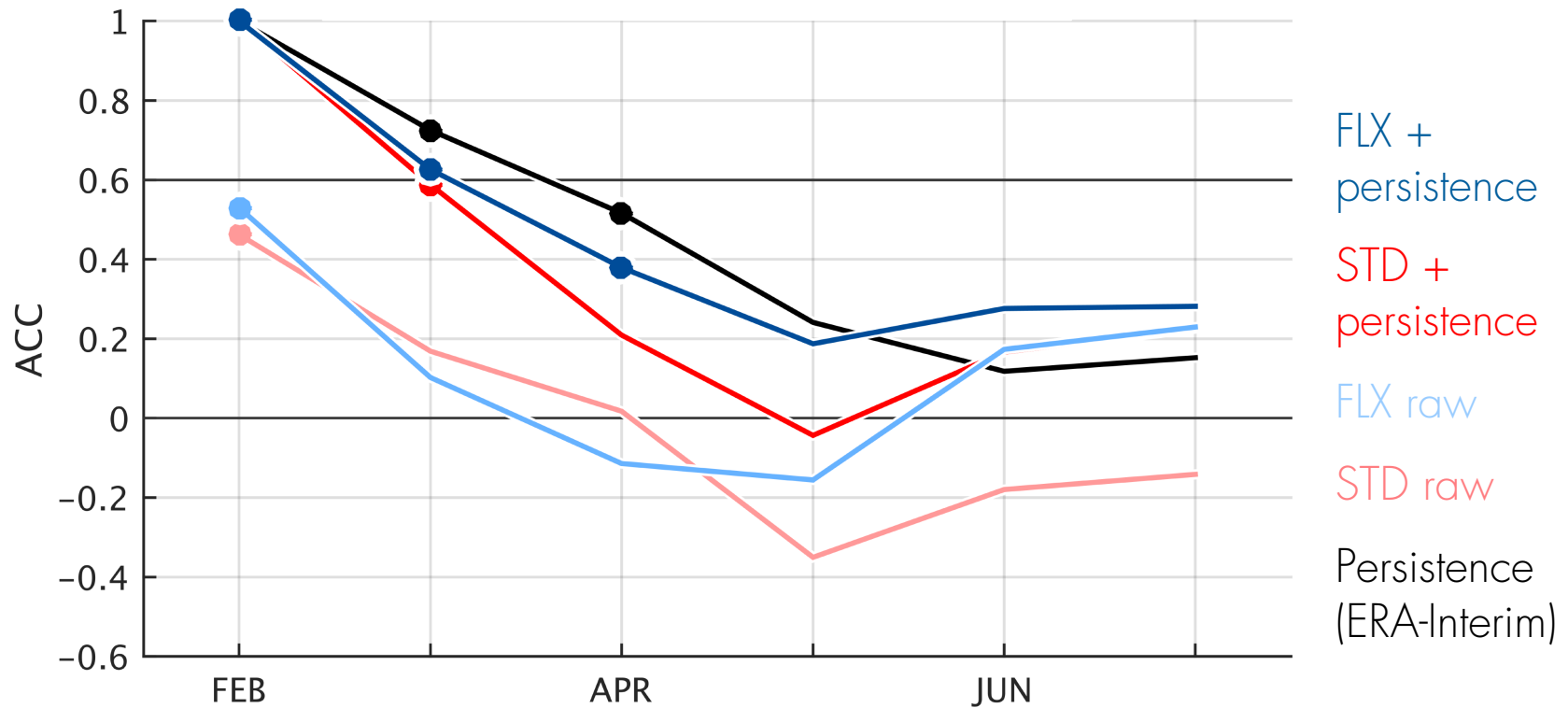**GEOMAR**
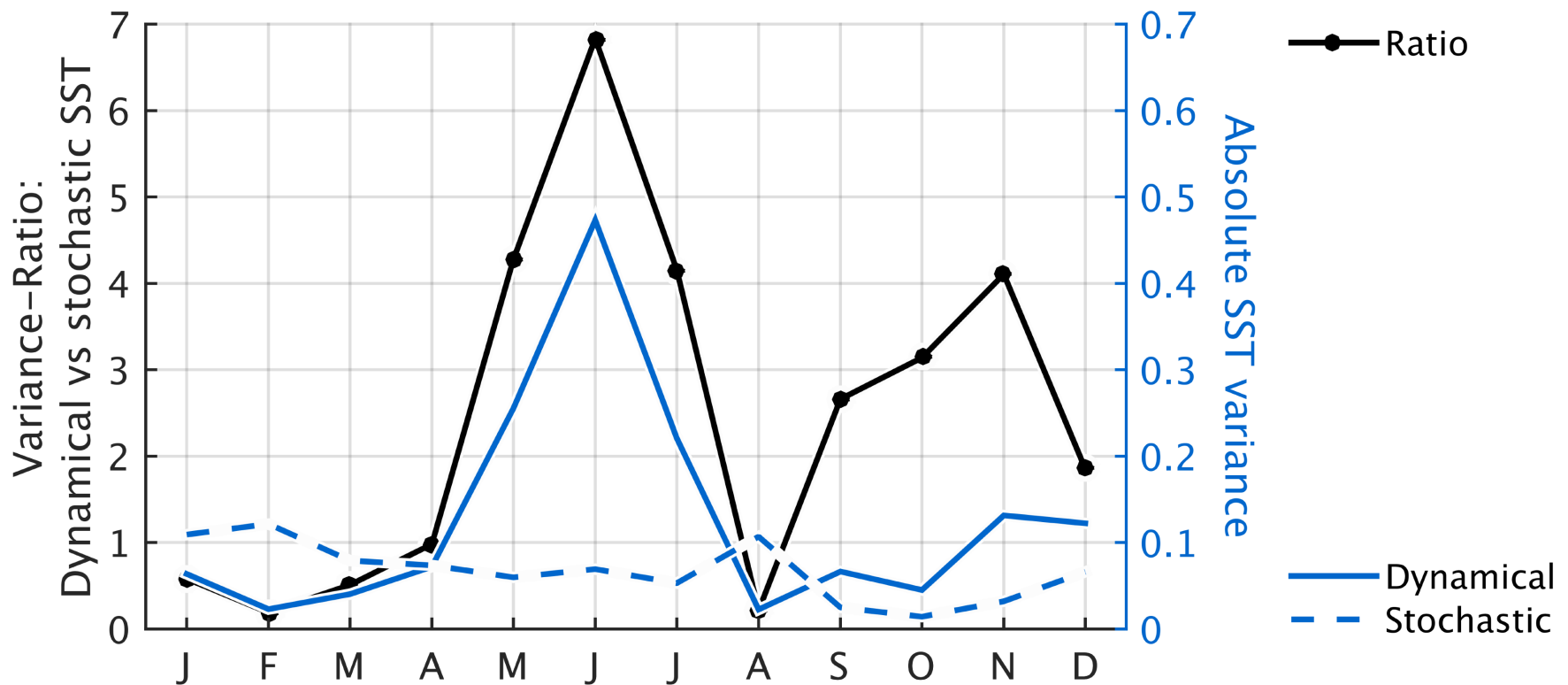
Take-Home Message

1. The **Atlantic Niño** is the dominant mode of interannual SST variability in the equatorial Atlantic.

2. SST **bias alleviation systematically improves** both the boreal summer initial conditions and seasonal hindcasts.

3. Incorporating persistence skill into dynamical forecasts allows for **useful forecasts 2-3 months ahead**.

4. Stochastic processes suggest that **SST predictions for JFM and August are greatly impaired**.

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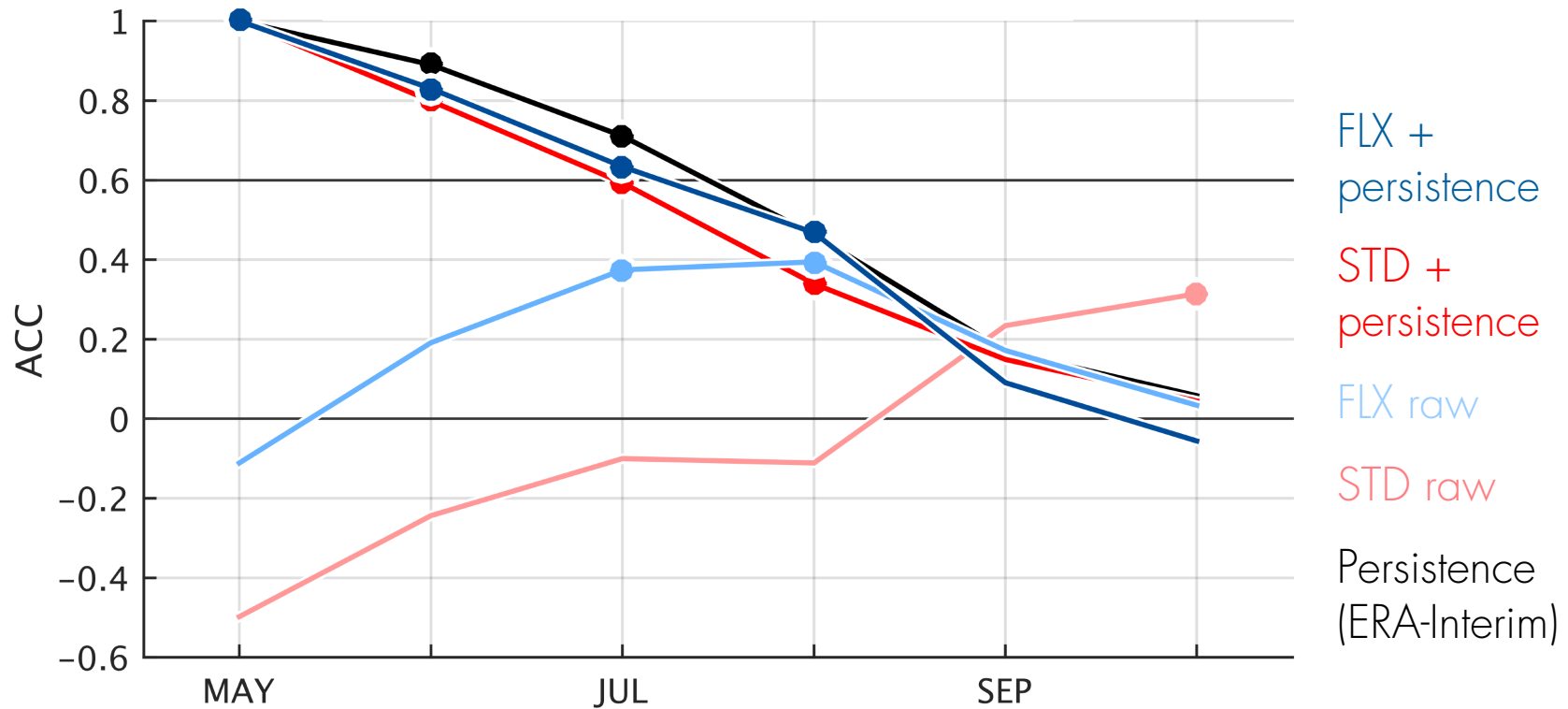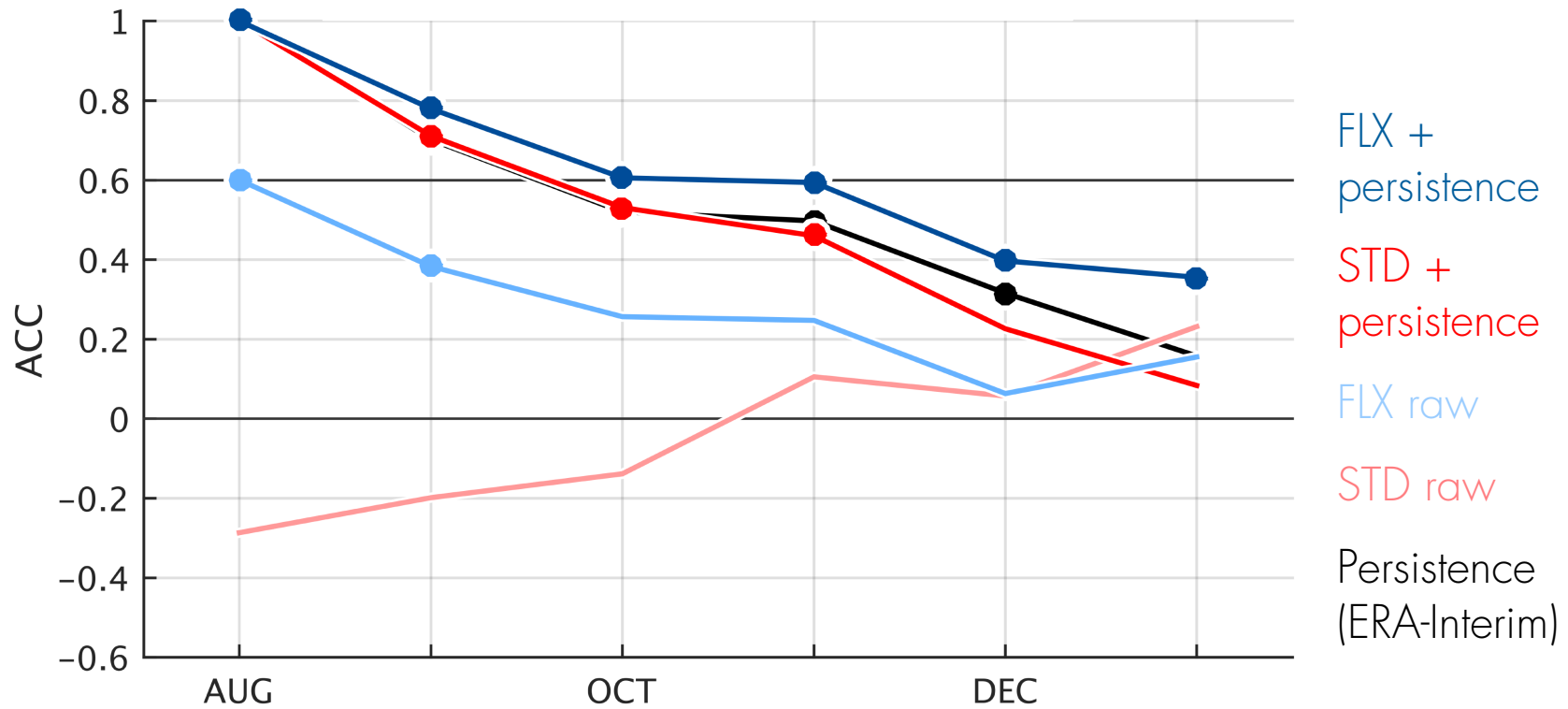# The Atlantic Niño: Composite evolution

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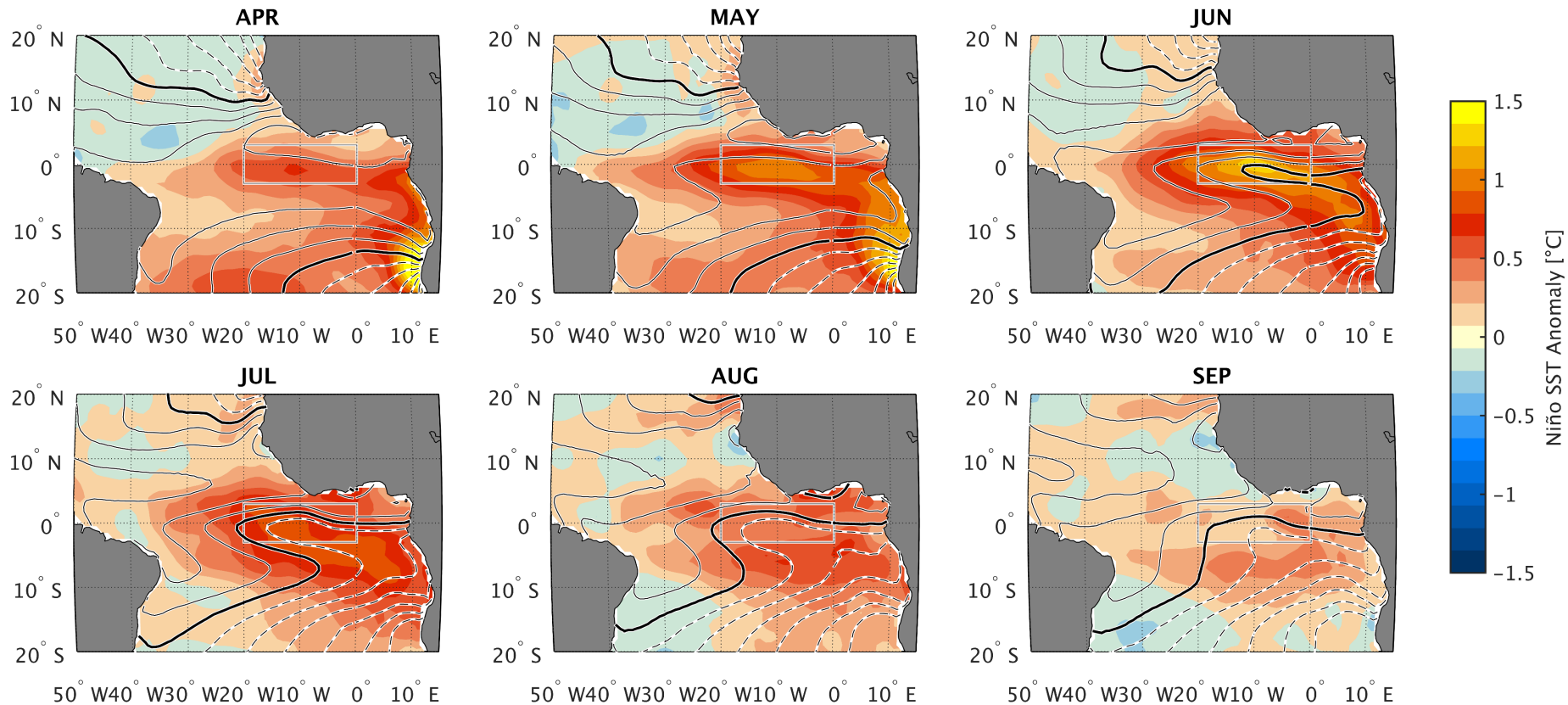
Hindcast Skill: February

FLX + persistence

STD + persistence

FLX raw

STD raw

Persistence (ERA-Interim)

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Hindcast Skill: May

FLX + persistence

STD + persistence

FLX raw

STD raw

Persistence (ERA-Interim)

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Hindcast Skill: August

FLX +
persistence

STD +
persistence

FLX raw

STD raw

Persistence
(ERA-Interim)

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Hindcast Skill: November