Seasonal predictions of equatorial Atlantic SST in a low-resolution CGCM with surface Heat Flux Correction

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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**.
Introduction | Model and Experiments | Initial Conditions | Seasonal Hindcasts | Predictability Limits | Conclusion

ERA-Interim Atl3 SST

![Graph showing SST trends from January to December.](image-url)
ERA-Interim Atl3 SST
Atl3 SST: Interannual variance

![Graph showing interannual variance of SST with peaks in June and October.](image-url)
The equatorial Atlantic SST Bias: State of the Art

### Mean SST bias: STD
Units: Deg C
The equatorial Atlantic SST Bias: State of the Art

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

- **Introduction**
- **Model and Experiments**
- **Initial Conditions**
- **Seasonal Hindcasts**
- **Predictability Limits**
- **Conclusion**
Model and experimental Set-Up

**The truth:**
- ERA-Interim
Model and experimental Set-Up

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- ERA-Interim

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

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**The time:**
- 1981-2012
Model and experimental Set-Up

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**The time:**
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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
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**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 anomaly correlation coefficients (ACC) between ERA-Interim and assimilation runs

ACC

STD

FLX

Significant ($\alpha = 95\%$)
Impact on Forecast Skill?

Start seasonal hindcasts, 9 ensemble members, 6 months each.
Hindcast Skill

![Graph showing ACC (skill) over lead months. The graph indicates a decline in skill with increasing lead months, with a clear drop from 1 ACC at lead 0 to around 0.2 ACC at lead 5.](image)

Persistence (ERA-Interim)
Hindcast Skill

- FLX + persistence
- STD + persistence
- FLX raw
- STD raw
- Persistence (ERA-Interim)
Hindcast Skill

![Graph showing Hindcast Skill](image)

- **FLX + persistence**
- **STD + persistence**
- **FLX raw**
- **STD raw**
- **Persistence (ERA-Interim)**
Observed Atl3 SST predictability limits

- Variance–Ratio
- Dynamical vs stochastic SST

Graph showing the variance–ratio of dynamical and stochastic SST from January to December.
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**.
The Atlantic Niño: Composite evolution

**April**

**May**

**June**

**July**

**August**

**September**

Niño SST Anomaly °C

T. Dippe: Atlantic Niño & SST Bias | May 10th, 2016, Barcelona

GEOMAR

Additional Material
Hindcast Skill: February

- FLX + persistence
- STD + persistence
- FLX raw
- STD raw
- Persistence (ERA-Interim)
Hindcast Skill: May

- FLX + persistence
- STD + persistence
- FLX raw
- STD raw
- Persistence (ERA-Interim)
Hindcast Skill: August

![Graph showing ACC over time with different models: FLX + persistence, STD + persistence, FLX raw, STD raw, Persistence (ERA-Interim).]
Hindcast Skill: November

- FLX + persistence
- STD + persistence
- FLX raw
- STD raw
- Persistence (ERA-Interim)