Meeting stakeholder needs with GFDL's seasonal-to-decadal forecast products

Presented by Nat Johnson

Q3: How can GFDL research and modeling be further utilized to meet NOAA stakeholder needs and enhance research partnerships to ensure GFDL's success?

GFDL provides real-time seasonal forecasts to the stakeholder community through the NMME.

- GFDL is one of 5 centers contributing experimental forecasts to NCEP through the North American Multi-Model Ensemble (**NMME**).

- **Relevance**: Provides **actionable guidance** for NOAA's climate monitoring and seasonal outlooks

- Publicly available retrospective and real-time forecasts provide scientific community with resources for **studying seasonal predictability, prediction skill, and systematic errors** in dynamical forecast models.


SPEAR Predictions (1 Dec 24 Init)
FMA 2025

5-YEAR REVIEW
JANUARY 28-30, 2025
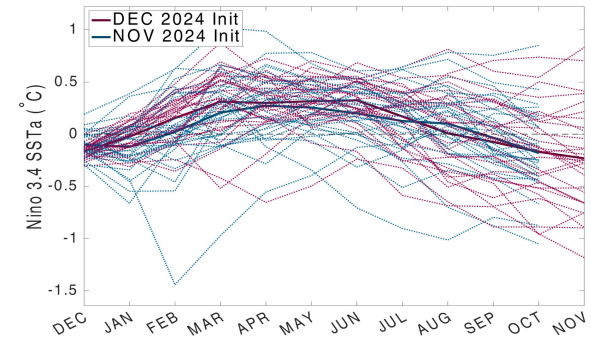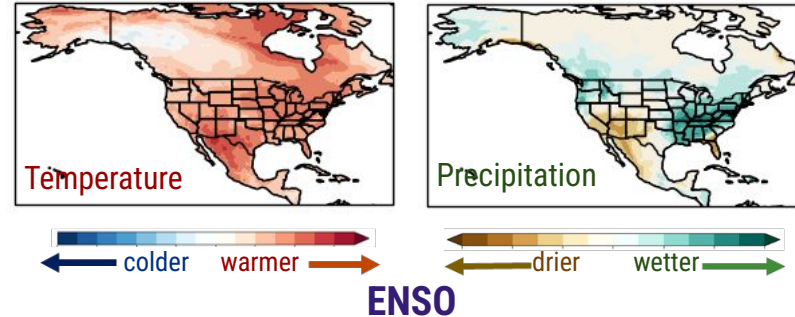
GFDL's SPEAR experimental seasonal forecasts provide routine guidance for NOAA's operational outlooks.

- SPEAR forecasts through the NMME contribute to **NOAA CPC's operational seasonal outlooks**
    - ❏ El Niño-Southern Oscillation (ENSO)
    - ❏ Seasonal Temperature and Precipitation
    - ❏ Atlantic Hurricane
- We directly engage with the **CPC ENSO forecast team** each month and contribute to the seasonal ENSO outlooks.
- Another GFDL/CPC collaboration is transitioning SPEAR **seasonal atmospheric river forecasts** into novel operational forecast guidance.

Seasonal atmospheric river forecast guidance prototype

Probabilistic Forecast of AR (target season:Jan-Mar 1995)
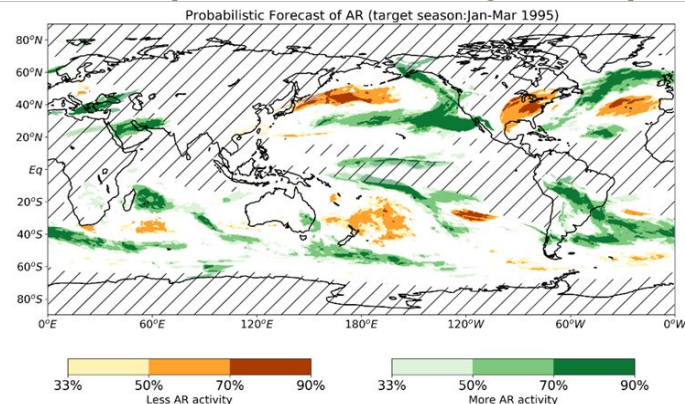
Tseng et al. (2021)

Maher et al. (2022): SPEAR singled out for "highest correlations with observations of ENSO teleconnections and the PDO."

NOAA
GEOPHYSICAL FLUID
DYNAMICS LABORATORY

GFDL has developed broad partnerships to test experimental seasonal forecast prototypes.

Advancing NOAA's mission through new partnerships that test seasonal forecast prototypes and related products, including:
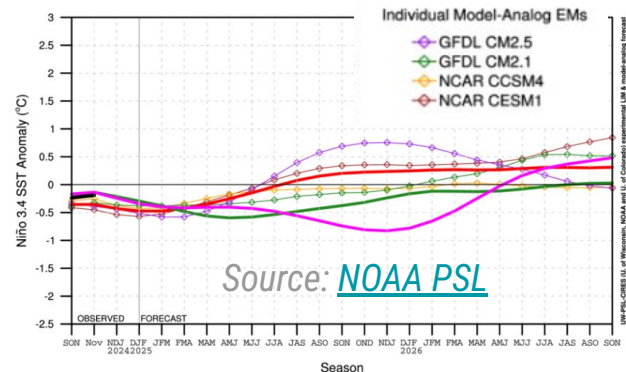
❏ Experimental Arctic and Antarctic Sea Ice Outlooks (SIPN, SIPN South)

❏ Model-analog seasonal ENSO forecasts to lead times of two years (NOAA PSL)

❏ Experimental spring CONUS tornado activity outlooks (NOAA CPC, AOML)

❏ Downscaled ocean forecasts for marine fisheries applications (NOAA CEFI; see Charlie Stock's talk)

❏ Seasonal sea level anomaly predictions (NOAA PSL; see John Krasting's talk)

❏ A rapid attribution prototype for extreme heat (NOAA NCEI, PSL, CPC; see Zack Labe's talk)

September 2024 Arctic Sea Ice Outlook
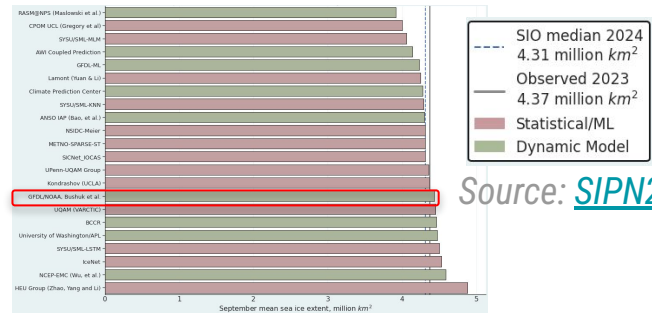
Source: SIPN2

Model-Analog ENSO Forecasts (Nov 24 Init)


Source: NOAA PSL

GFDL also provides real-time decadal predictions from SPEAR.

- GFDL is one of 20 centers that contributes to the WMO Annual-to-Decadal Climate Prediction effort, annually delivering **decadal predictions** to the UKMO (Lead Centre).

- GFDL also is participating in the SPARC/DCPP Volcanic Response Readiness Exercise (**VolRes-RE**).

- The SPEAR decadal predictions provide the input for dynamically **downscaled ocean predictions**, with potential marine ecosystem applications.
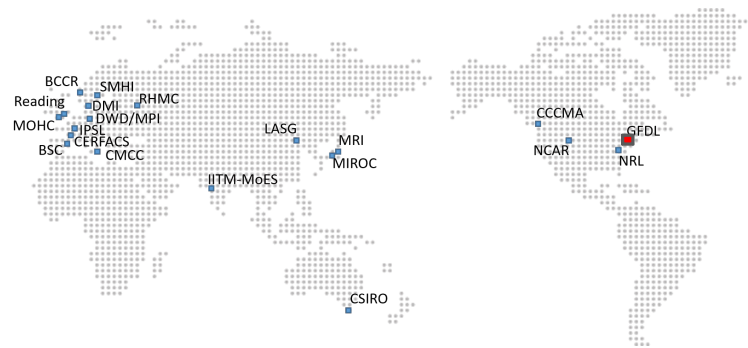
AMOC time series in SPEAR reanalysis and observation
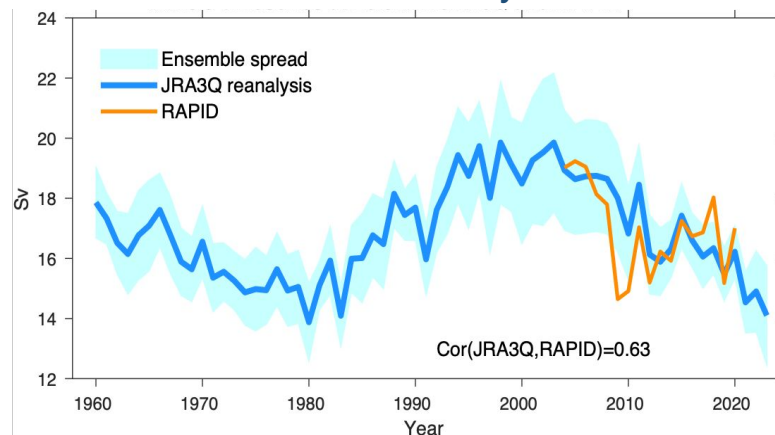
Public outreach through the ENSO Blog

❏ GFDL regularly contributes to the NOAA Climate.gov ENSO Blog to educate the general public about ENSO and other climate phenomena.

❏ Contributions include writing regular blog posts (3-4 per year), editing all other posts, and responding to public comments.

❏ Engagement with the ENSO Blog complements GFDL's real-time seasonal prediction activities and sometimes leads to new research.
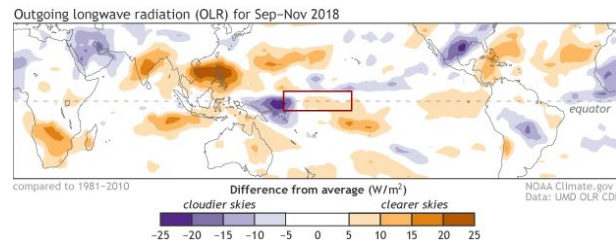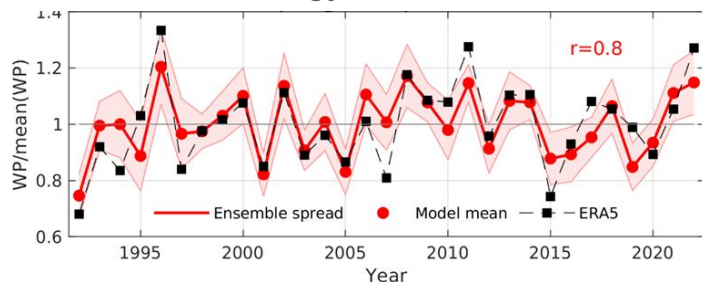
Developing novel prototype forecast products with the potential for new stakeholder engagement

Prediction Skill for Wind Energy
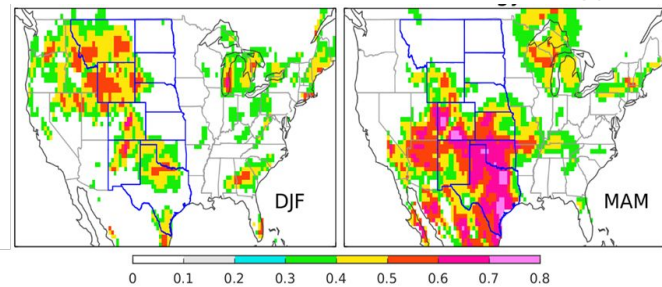
MAM Wind Energy Predictions for Texas

- Skillful seasonal predictions of wind speed with SPEAR can be translated to wind energy forecasts that are potentially useful for the energy sector (Yang et al. 2023).

- Skill particularly high over major wind energy producing regions of the central U.S.

- Demonstrates opportunities to expand stakeholder engagement where useful skill may not have been recognized previously

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Gaps:

- ❏ More avenues for stakeholder feedback: who, how, and why are the real-time seasonal and decadal forecasts used

Opportunities:

- ❏ Advancing high-resolution climate prediction of regional extremes and expanding stakeholder engagement for societal impacts (e.g., coastal flooding, landfalling TCs)
- ❏ Expanding applications of AI/ML for detection, attribution, and prediction
- ❏ Enhanced collaboration with industrial stakeholders and co-development of prediction products

Meeting stakeholder needs with GFDL's seasonal-to-decadal forecast products

Relevance:

❏ Provides actionable guidance for NOAA's climate monitoring and seasonal outlooks

❏ Expands R&D into new prototype products with potential new stakeholders that advance NOAA's mission

Quality:

❏ Demonstrated skillful extensions to new prediction frontiers that advance the science while engaging new scientific and stakeholder communities

Performance:

❏ Reliable real-time forecast delivery

❏ Seamlessness: Variety of user needs at varying time horizons (seasonal, decadal, multi-decadal) met with SPEAR

❏ Synergistic collaborations enhancing the value of the predictions