

A Dipole Index for ENSO

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Why an ENSO index?

- ~~Because numbers are more sciencey~~
- In order to quantify and compare different ENSO events
- In order to estimate the relative magnitude of ENSO impacts from ENSO events
- In order to estimate the relative magnitude of ENSO impacts from ENSO forecasts

A few existing ENSO indices

- SOI: Southern Oscillation Index
- NINOn(.n): El Niño SST box indices
- ONI: Oceanic Niño Index
 - NINO3.4
 - Minus almost centered NINO3.4 30-yr climatology
 - Except for recent years
- OLR: OLR El Niño Index, OLR La Niño Index
- ELI: ENSO Longitude Index
- EOF: Leading mode of tropical variability

Same index for models and observations

- SOI: Southern Oscillation Index
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 - Except for recent years
- ELI: ENSO Longitude Index

Robust to climate change

- SOI: Southern Oscillation Index
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 - NINO3.4
 - Minus almost centered NINO3.4 30-yr climatology
 - Except for recent years
- **ELI: ENSO Longitude Index**

Reflects nonlinearity of response

- ELI: ENSO Longitude Index

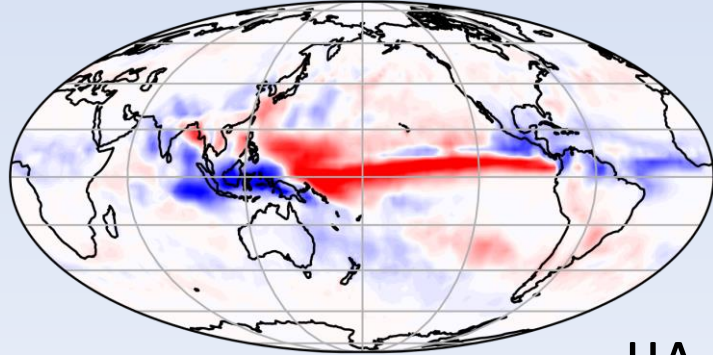
Connection to familiar indices

The Niño Difference Index

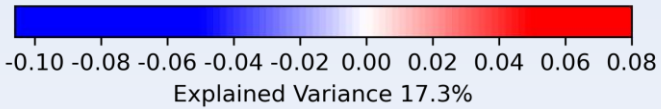
- Concept:
 - Global ENSO response due to rearrangement of tropical convection
 - Tropical convection responds to SST gradient changes
 - Base index on difference between SST in tropical Pacific and reference SST
 - Optimize to atmospheric response
- Virtues:
 - Same index for models and observations
 - Robust to climate change
 - Reflects nonlinearity of response
 - Connection to familiar indices
 - Optimized to global response

Atmospheric Response Metric: Explained Variance of Seasonal Leading GPCP EOF

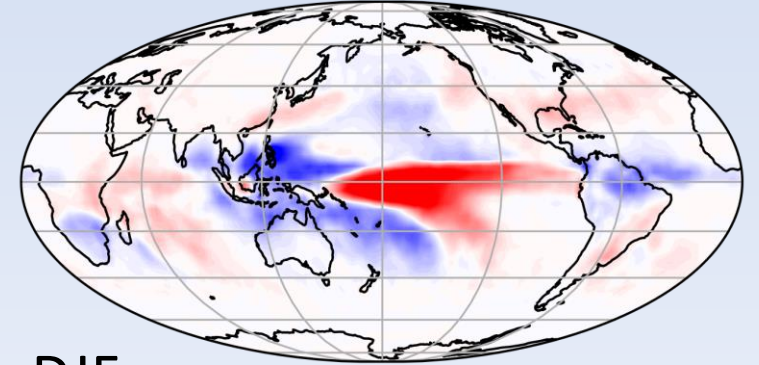
ENSO-related Principal Component during JJA



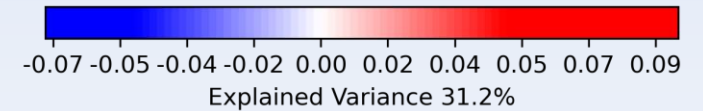
JJA



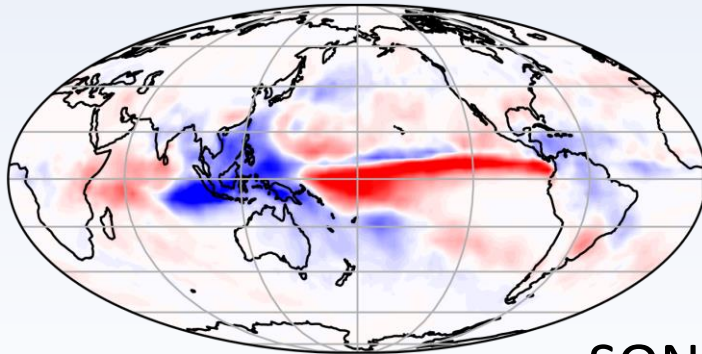
ENSO-related Principal Component during DJF



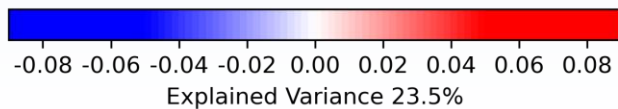
DJF



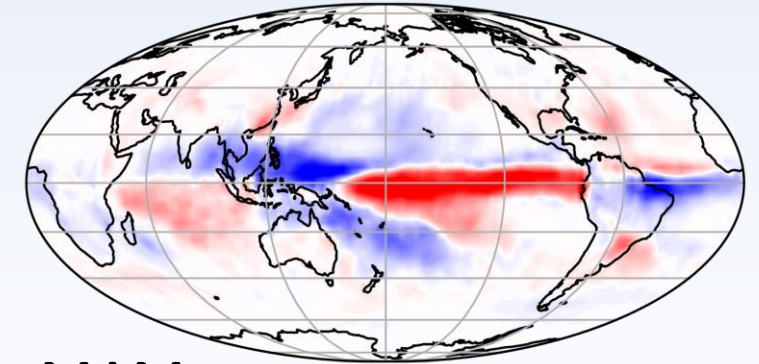
ENSO-related Principal Component during SON



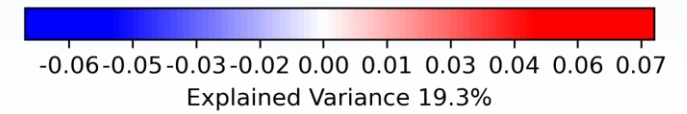
SON



ENSO-related Principal Component during MAM

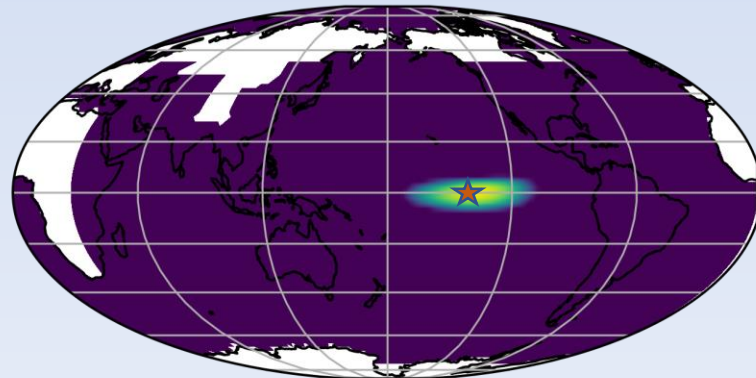


MAM

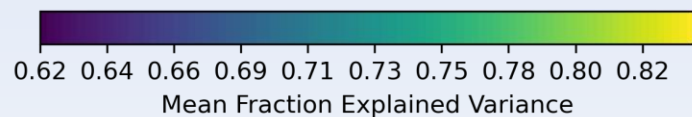


How good is NINO3.4 25 years later?

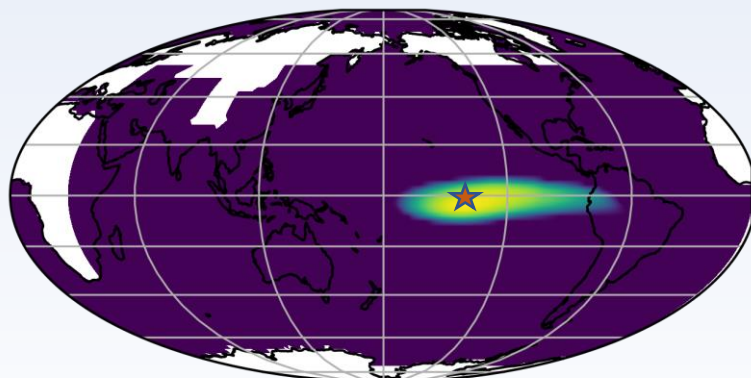
GPCP ENSO PC Variance 10 x 52 JJA



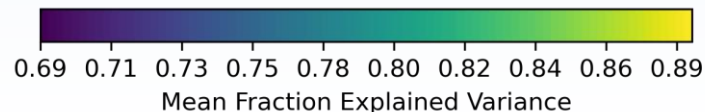
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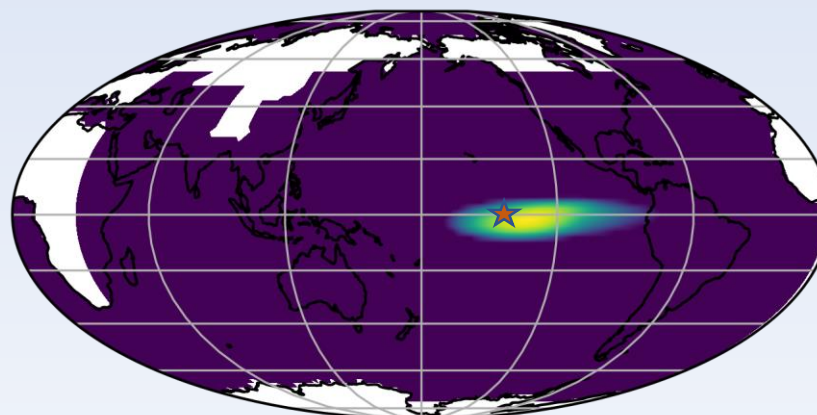
GPCP ENSO PC Variance 10 x 52 SON



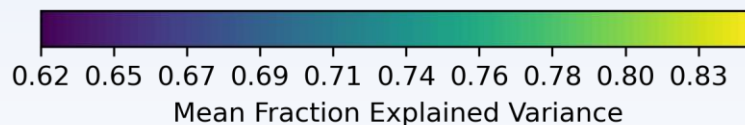
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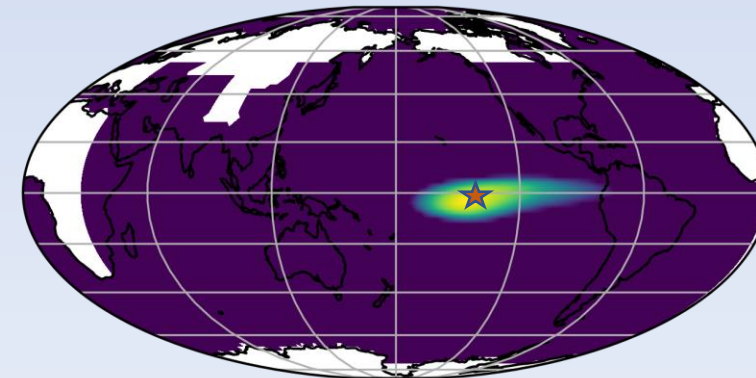
GPCP ENSO PC Variance 10 x 52 Annual



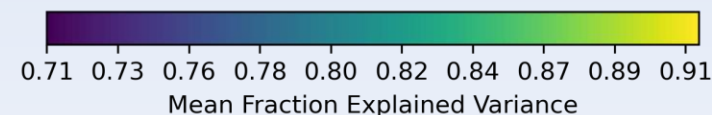
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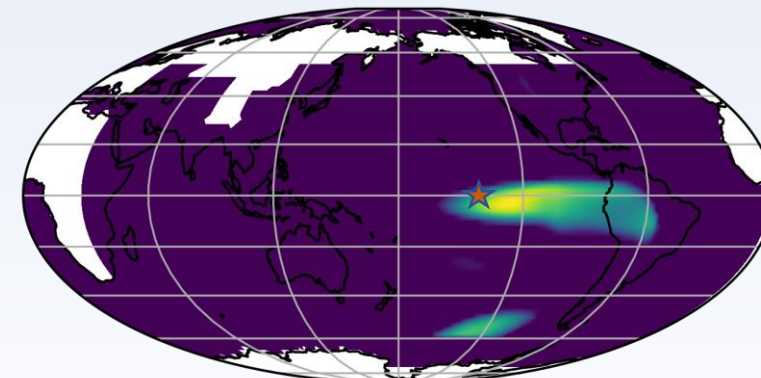
GPCP ENSO PC Variance 10 x 52 DJF



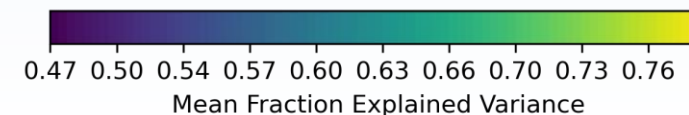
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GPCP ENSO PC Variance 10 x 52 MAM

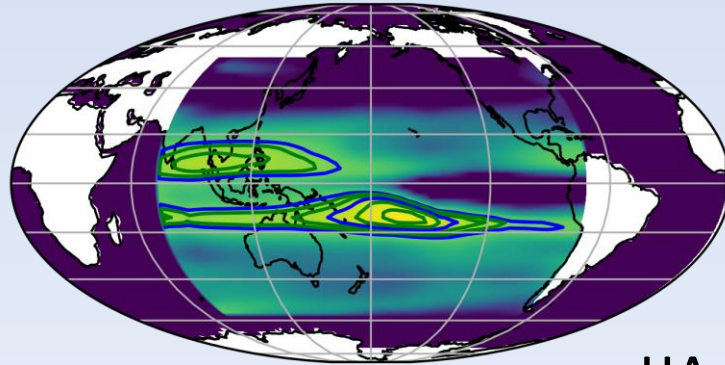


MAM

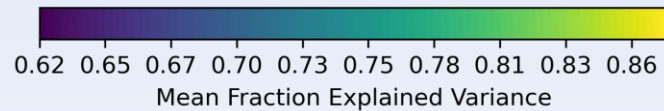


The best 2nd box for NDI using NINO3.4

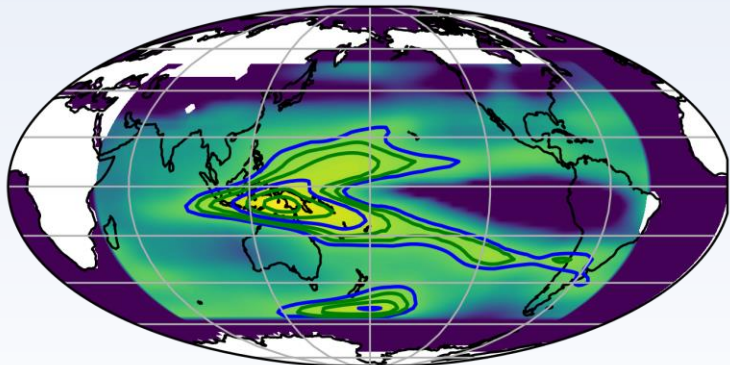
GPCP ENSO PC Variance 4 x 142 JJA



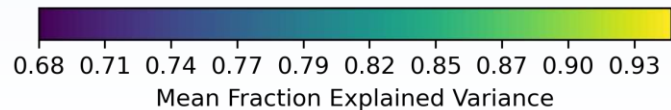
JJA



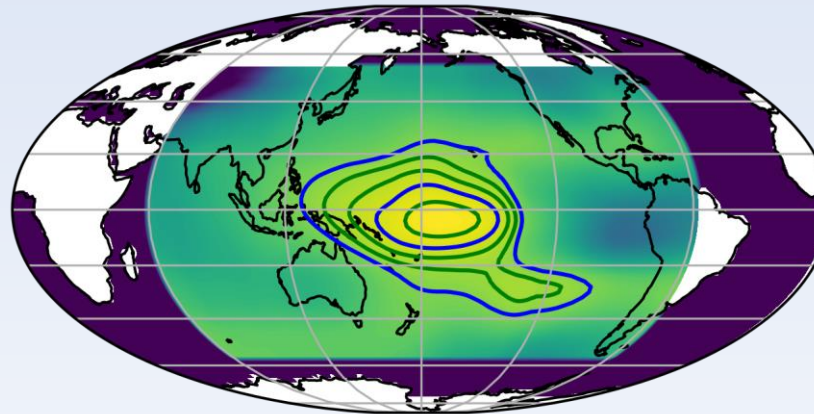
GPCP ENSO PC Variance 6 x 82 SON



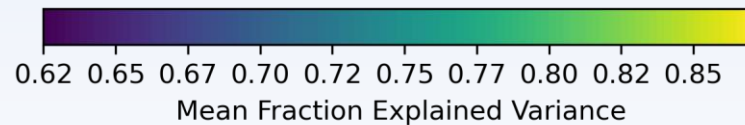
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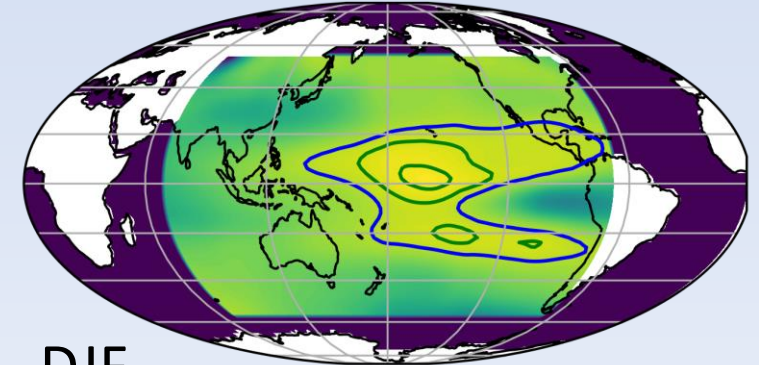
GPCP ENSO PC Variance 40 x 114 Annual



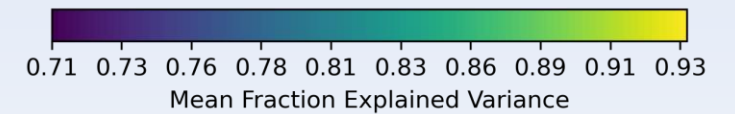
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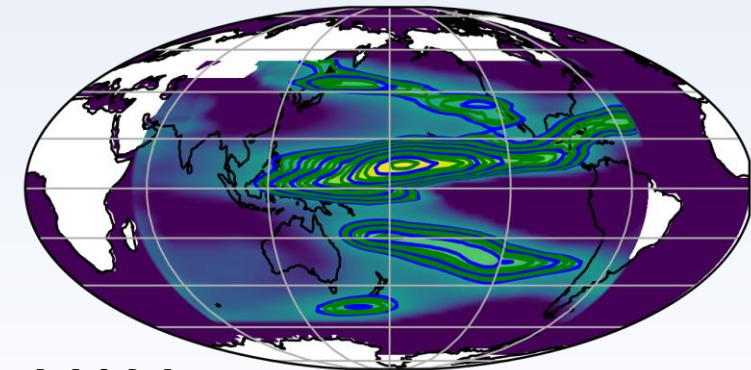
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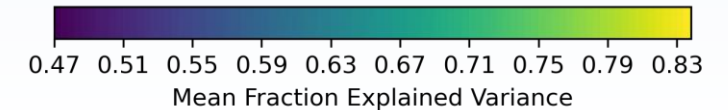
DJF



GPCP ENSO PC Variance 4 x 102 MAM

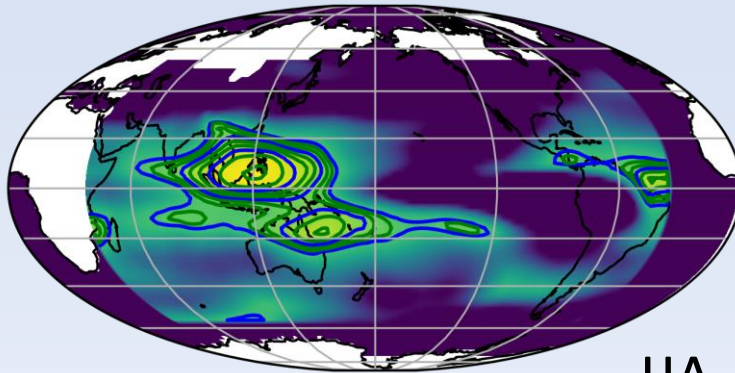


MAM

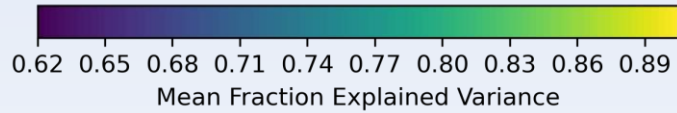


The best 2nd box for NDI

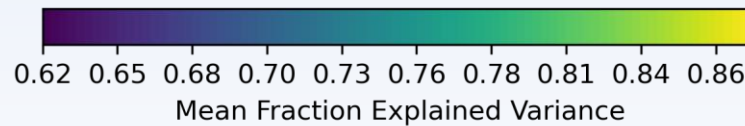
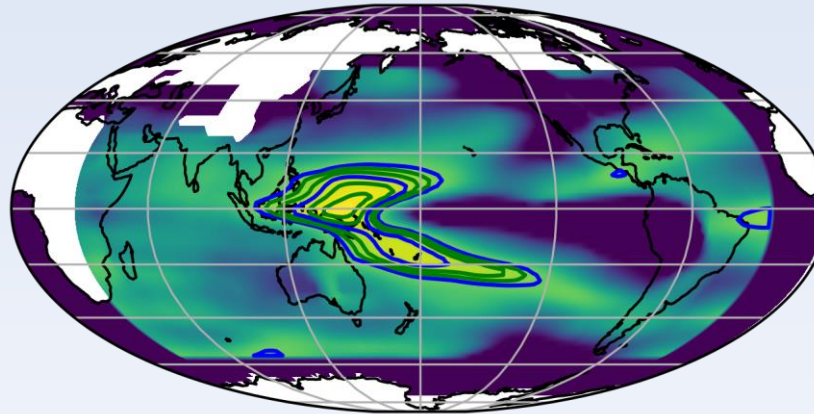
GPCP ENSO PC Variance 12 x 70 JJA



JJA

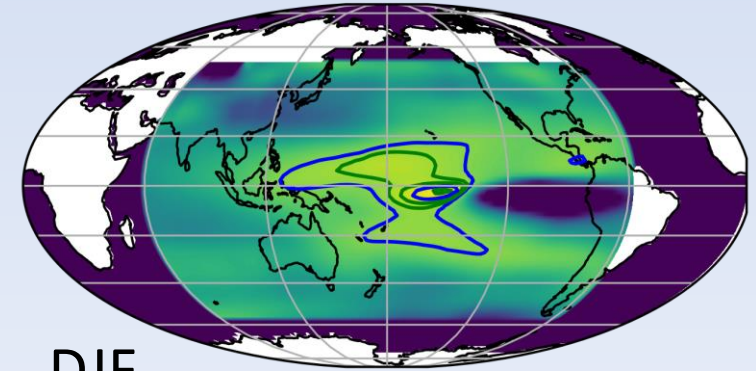


GPCP ENSO PC Variance 6 x 50 Annual

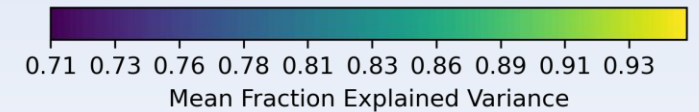


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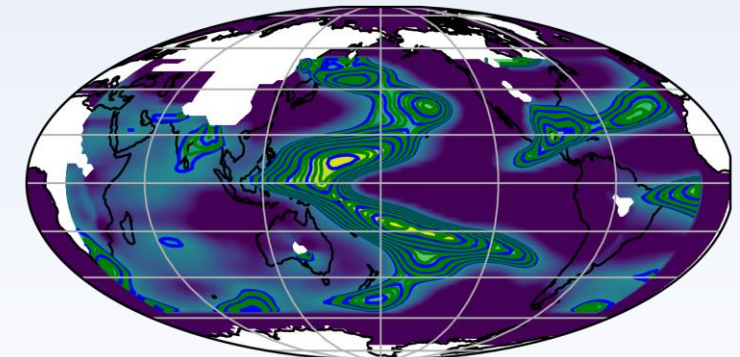
GPCP ENSO PC Variance 14 x 114 DJF



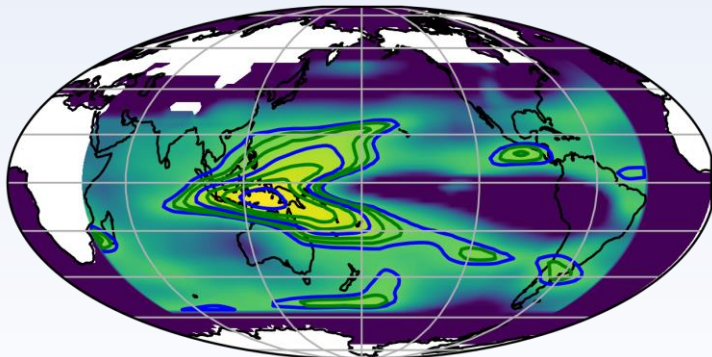
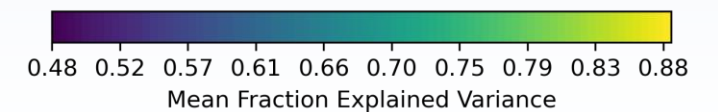
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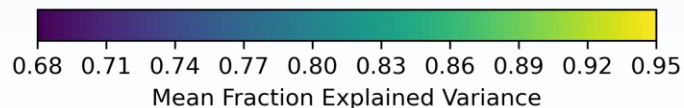
GPCP ENSO PC Variance 8 x 34 MAM



MAM

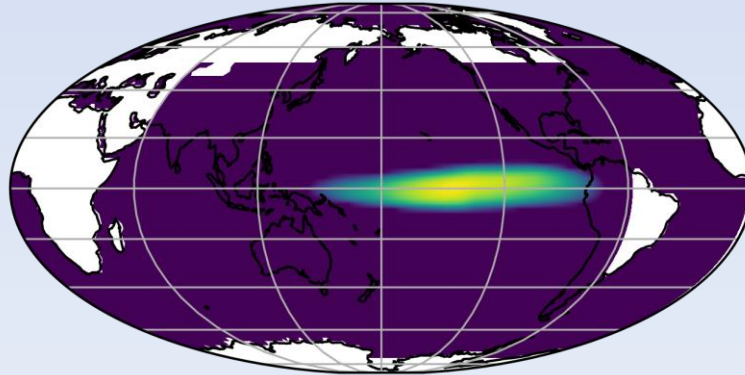


SON

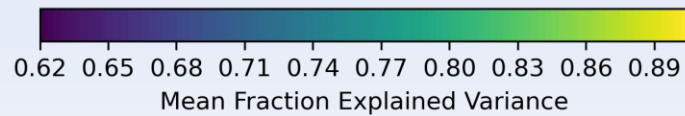


The best 1st box for NDI (instead of NINO3.4)

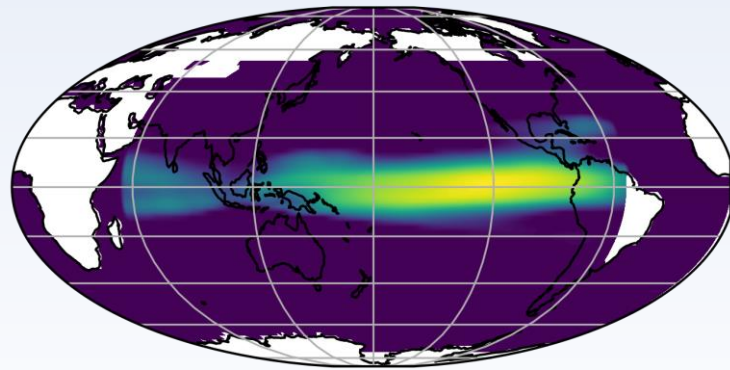
GPCP ENSO PC Variance 6 x 114 JJA



JJA



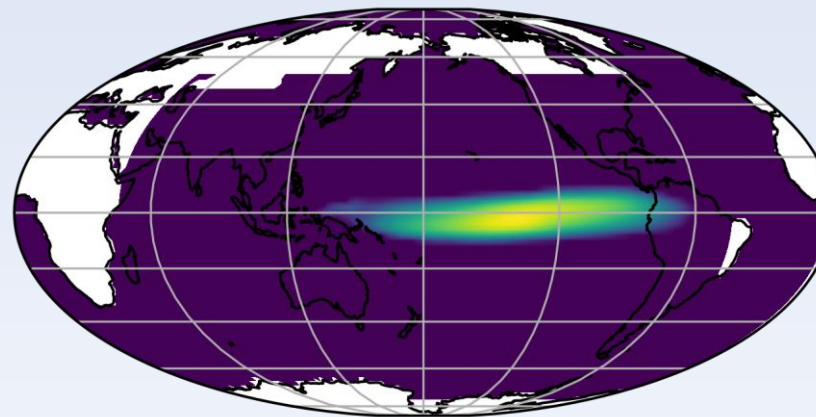
GPCP ENSO PC Variance 4 x 106 SON



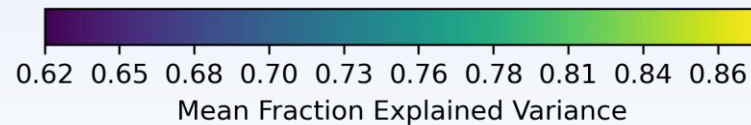
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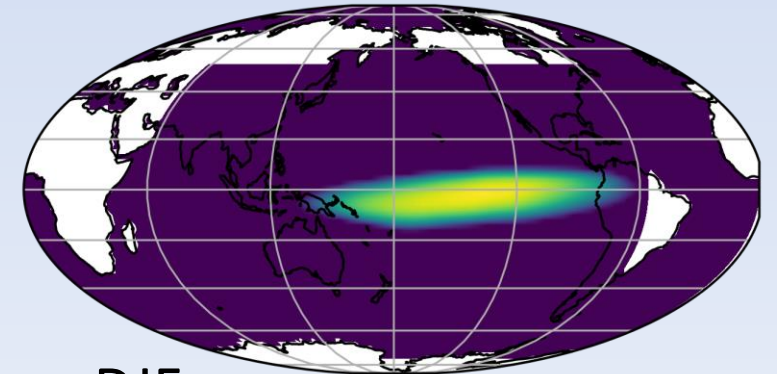
GPCP ENSO PC Variance 6 x 86 Annual



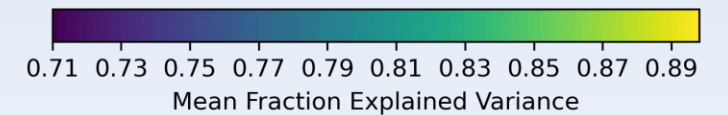
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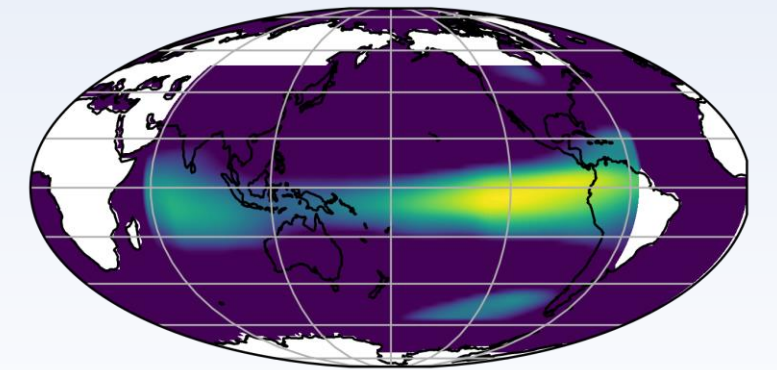
GPCP ENSO PC Variance 14 x 110 DJF



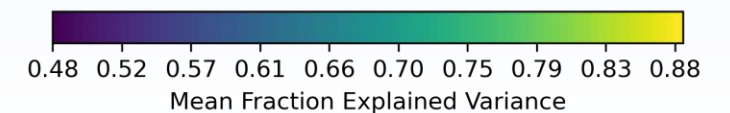
DJF



GPCP ENSO PC Variance 14 x 110 MAM

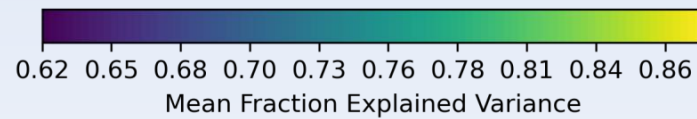
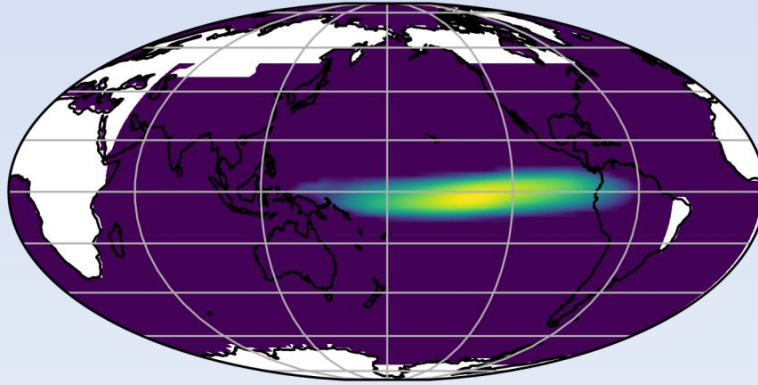


MAM

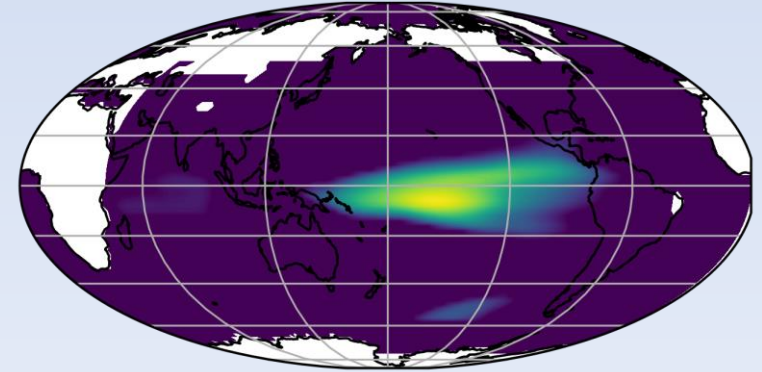


Other measures of atmospheric response: 1st box

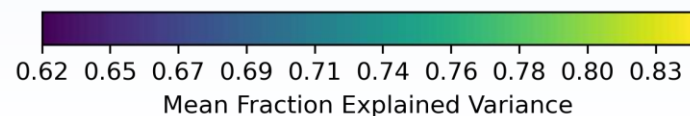
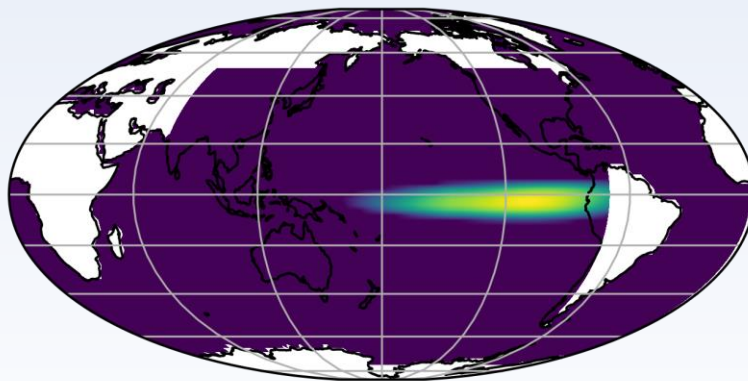
GPCP ENSO PC Variance 6 x 86 Annual



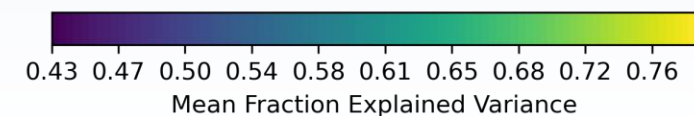
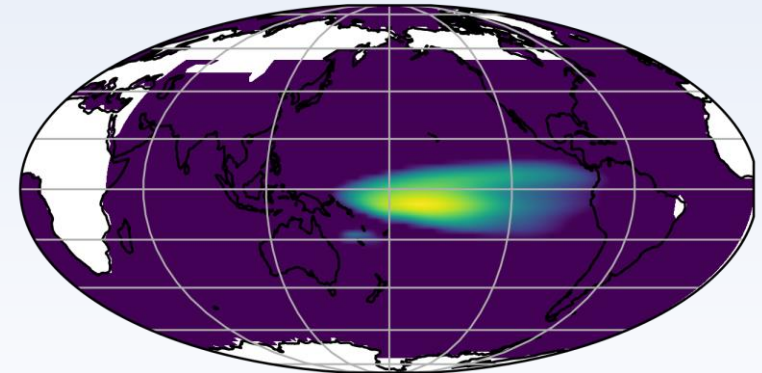
SOI 1979- ENSO PC Variance 6 x 78 Annual



GPCP25 ENSO PC Variance 6 x 138 Annual

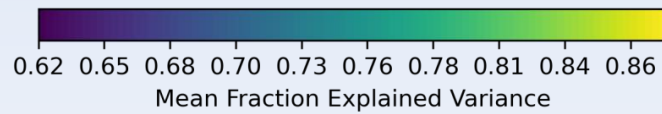
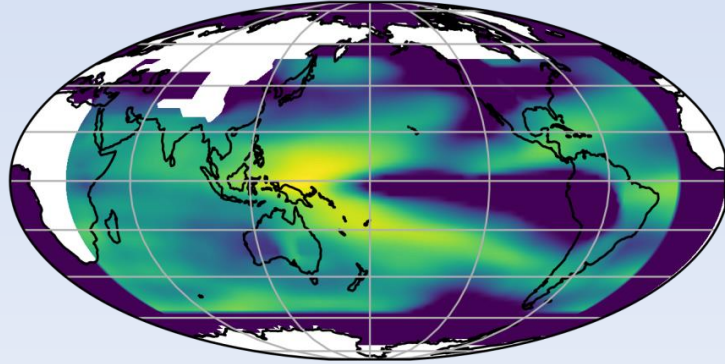


SOI 1935- ENSO PC Variance 8 x 78 Annual

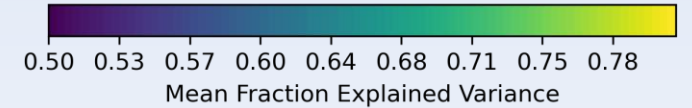
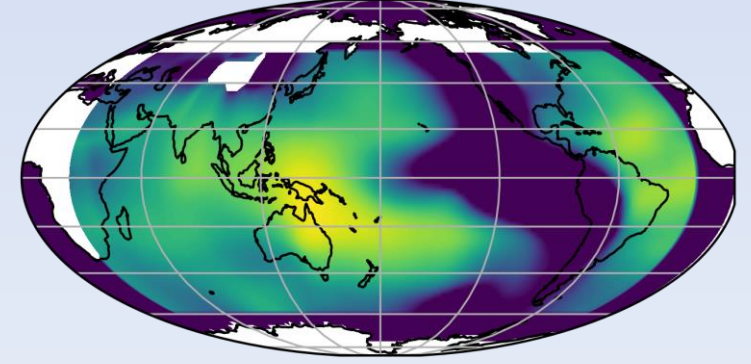


Other measures of atmospheric response: 2nd box

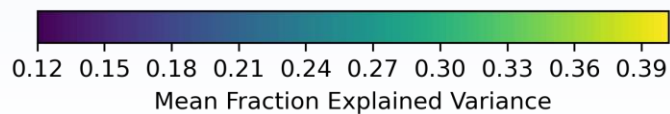
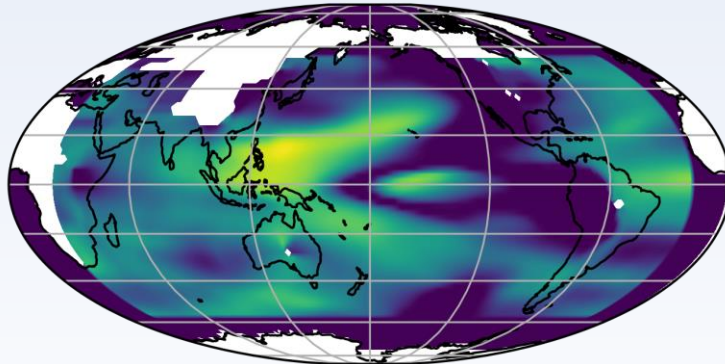
GPCP ENSO PC Variance 6 x 50 Annual



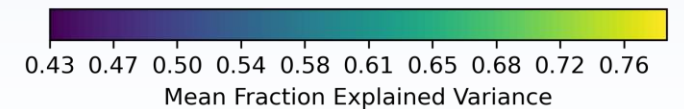
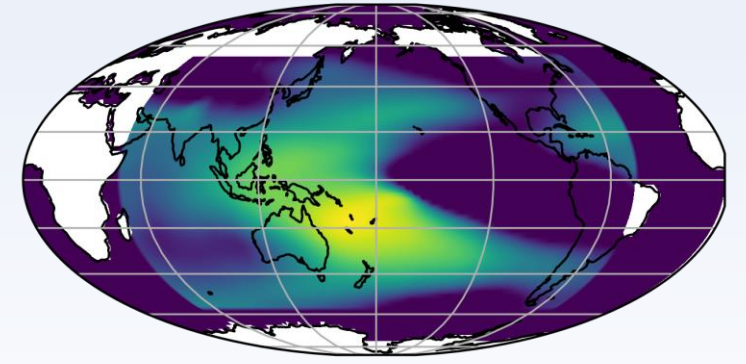
SOI 1979- ENSO PC Variance 34 x 42 Annual



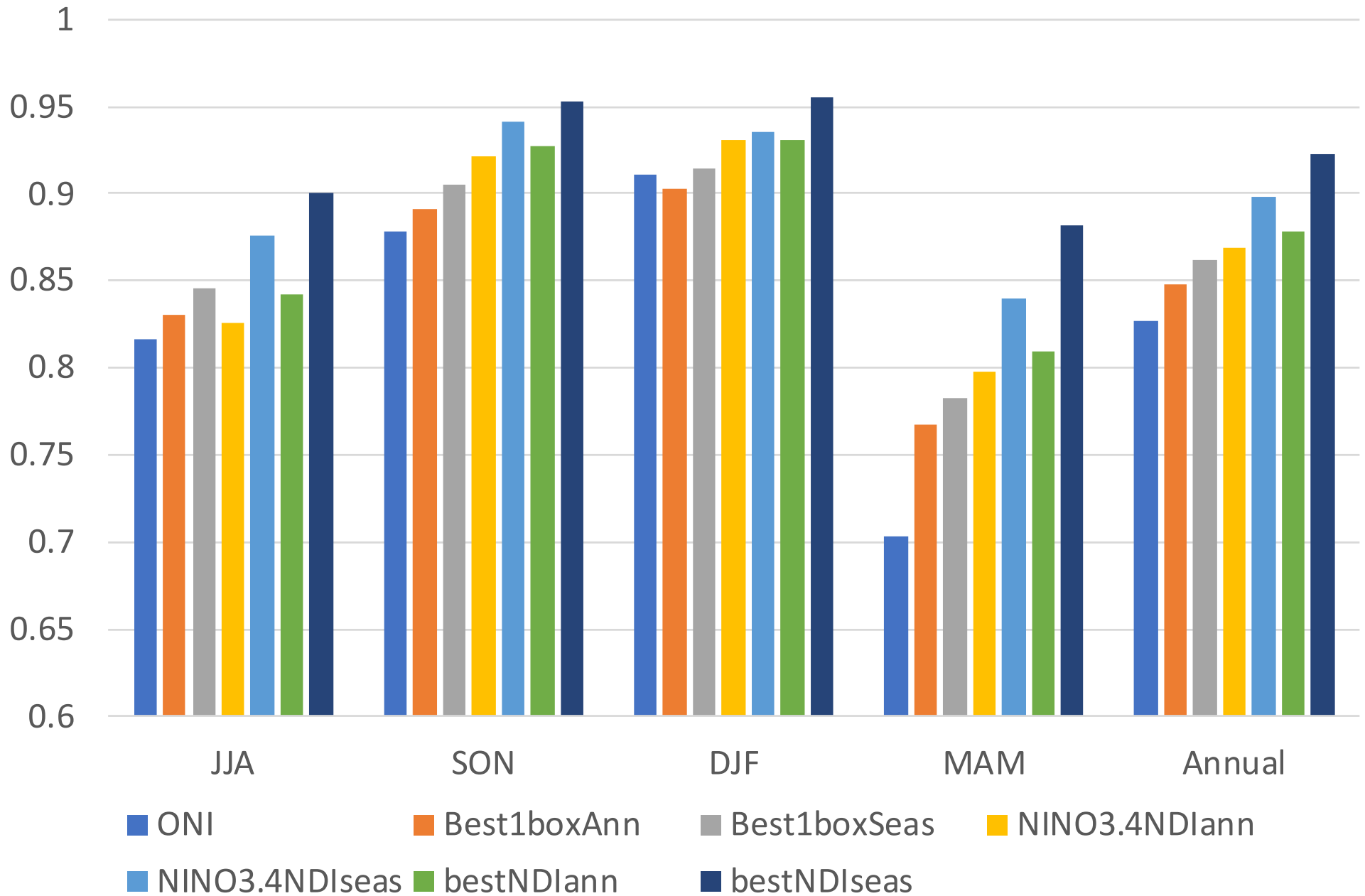
GPCP25 ENSO PC Variance 8 x 38 Annual

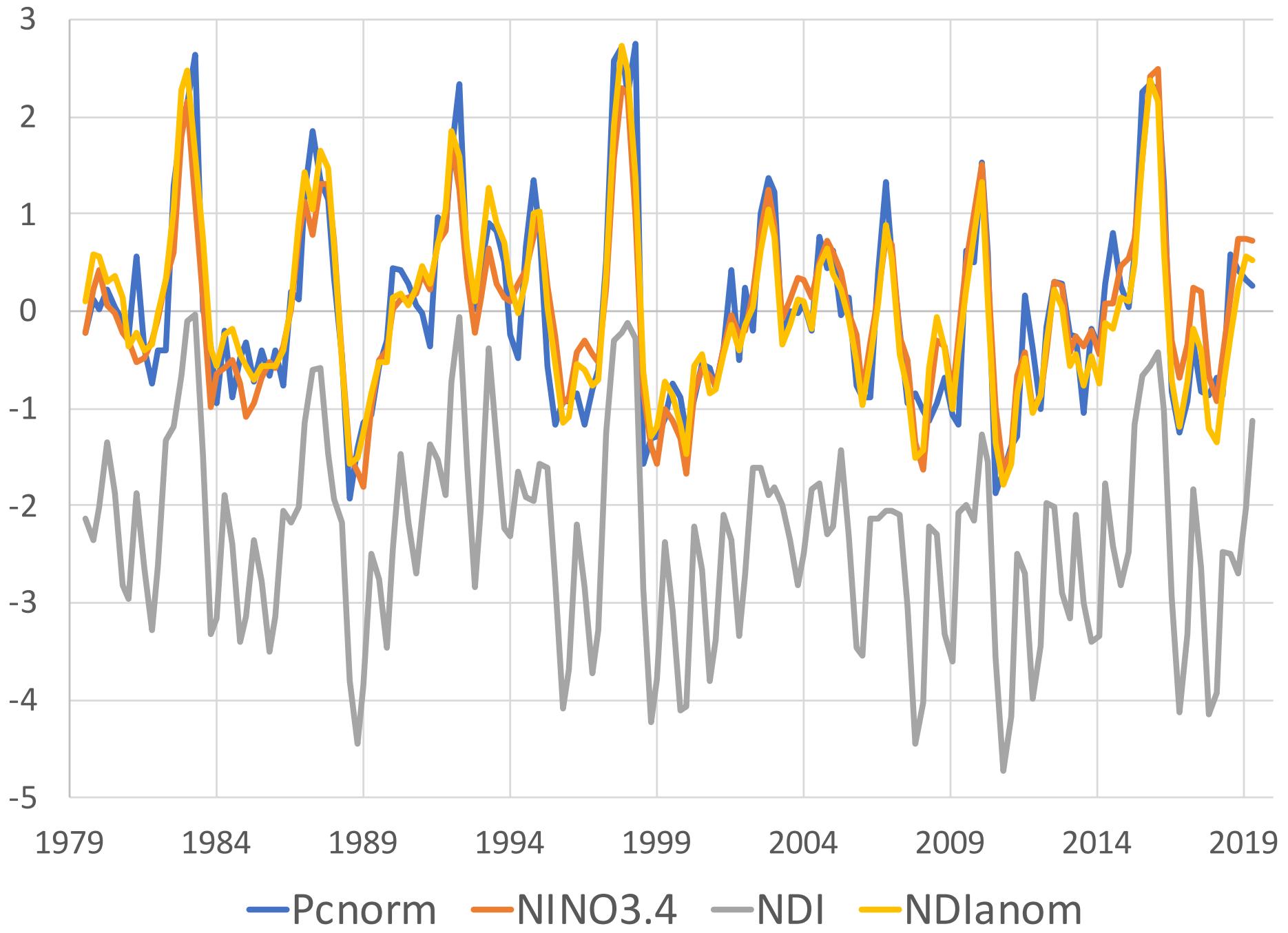


SOI 1935- ENSO PC Variance 20 x 94 Annual



Explained Variance, Leading Global GPCP Seasonal EOFs



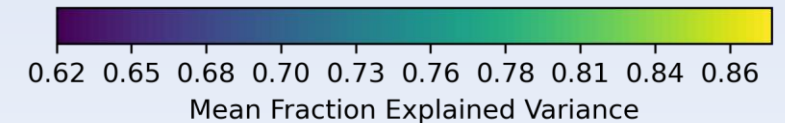
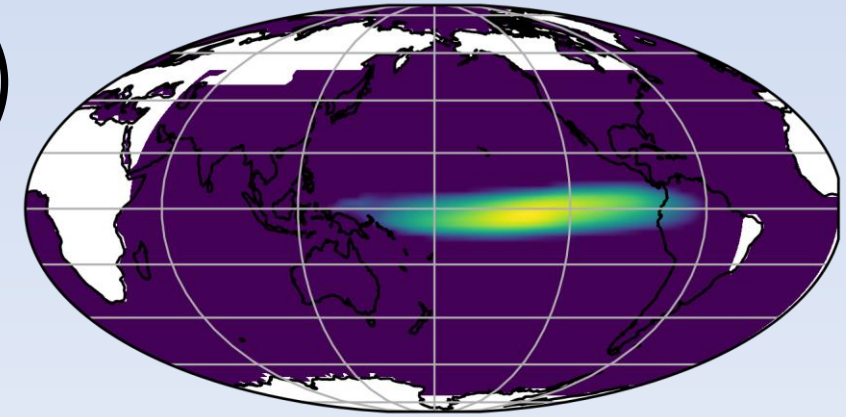


The Niño Difference Index (NDI)

- Definition: PAC-MC
- PAC Box: 3°S-3°N, 180°-95°W
- MC Box: 1°S-5°N, 120°E-170°E
- Optional: anomalies
- *Same index for models and observations*
- *Robust to climate change*
- *Reflects nonlinearity of response*
- *Connection to familiar indices*
- *Optimized to global response*

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GPCP ENSO PC Variance 6 x 86 Annual



GPCP ENSO PC Variance 6 x 50 Annual

