Tropical Pacific Forcing of a 1998-99 Climate Shift

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Motivation

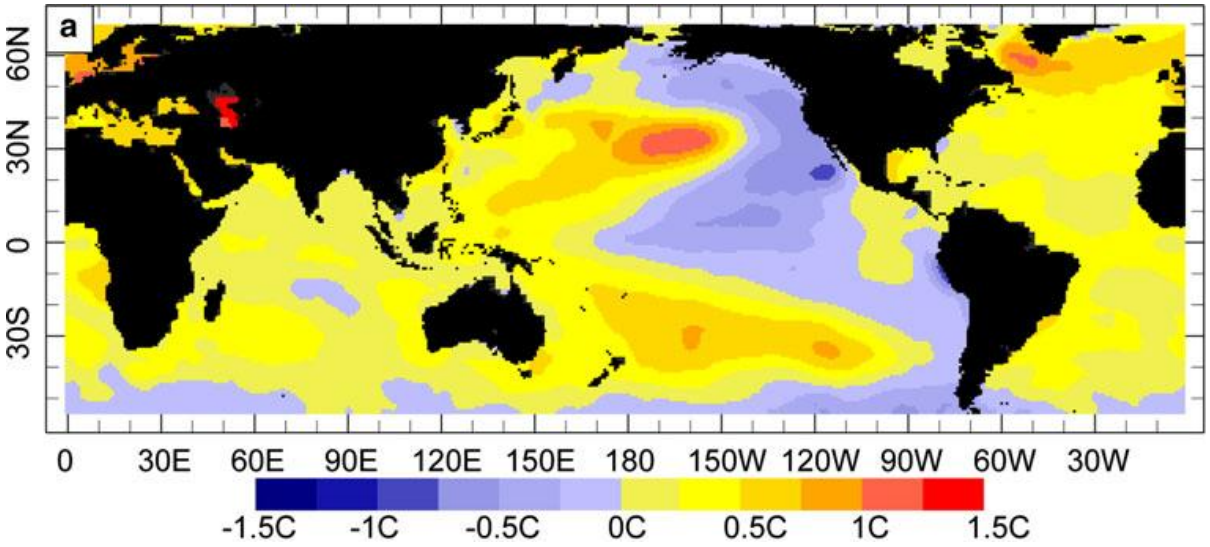
- Investigate a recent increase in the frequency of regional droughts around the globe (East Africa, South/West US, South-Central Asia…)

Outline

- Observational evidence for a recent climate shift (SST, PRCP, Winds, Stationary Waves)
- Model simulations and idealized experiments (POGA runs)
- Summary and Conclusions

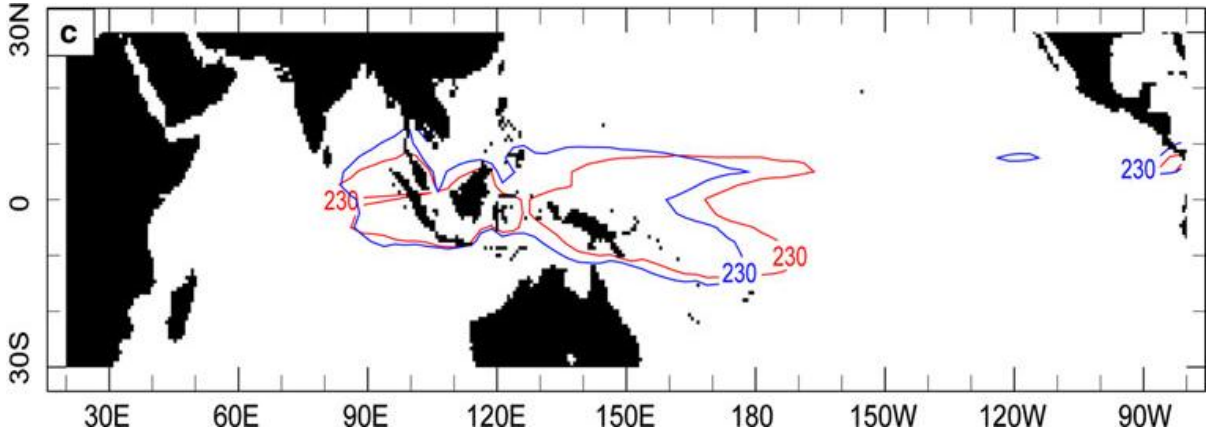
Changes in SST and OLR

Avg. SST Anomaly
1999-2012



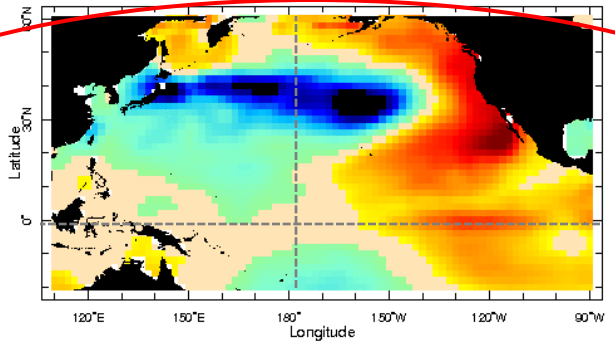
OLR = 230 Wm^{-2}

Red: 1979-98
Blue: 1999-2012

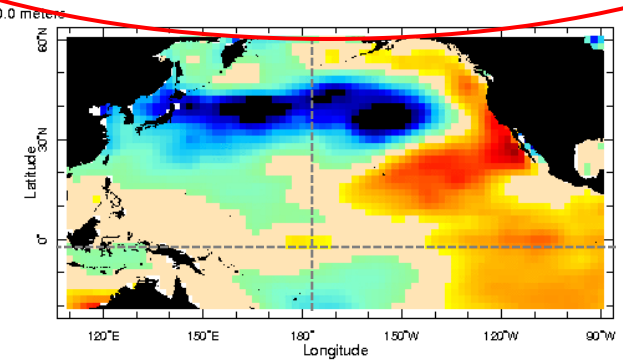


Leading EOF Patterns in ERSST after Removing Global Average Temp. & Applying 11-yr Moving Average

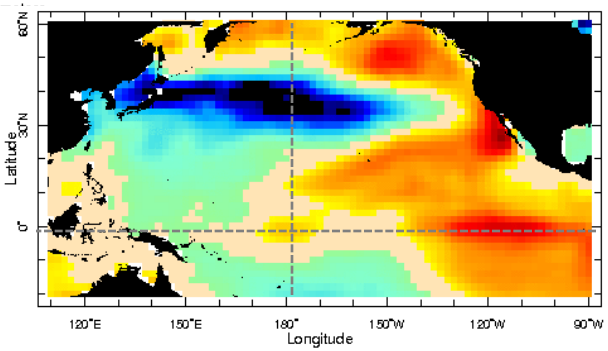
MAM



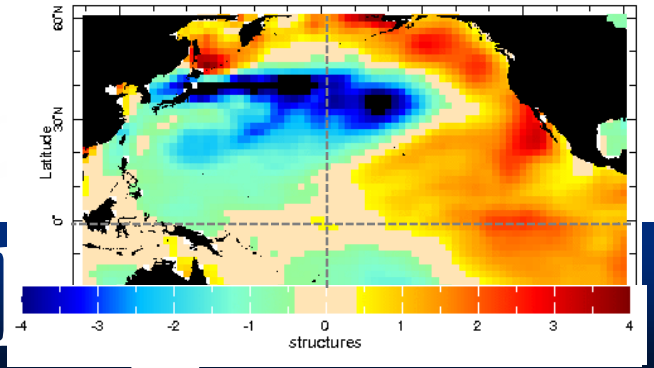
JJA



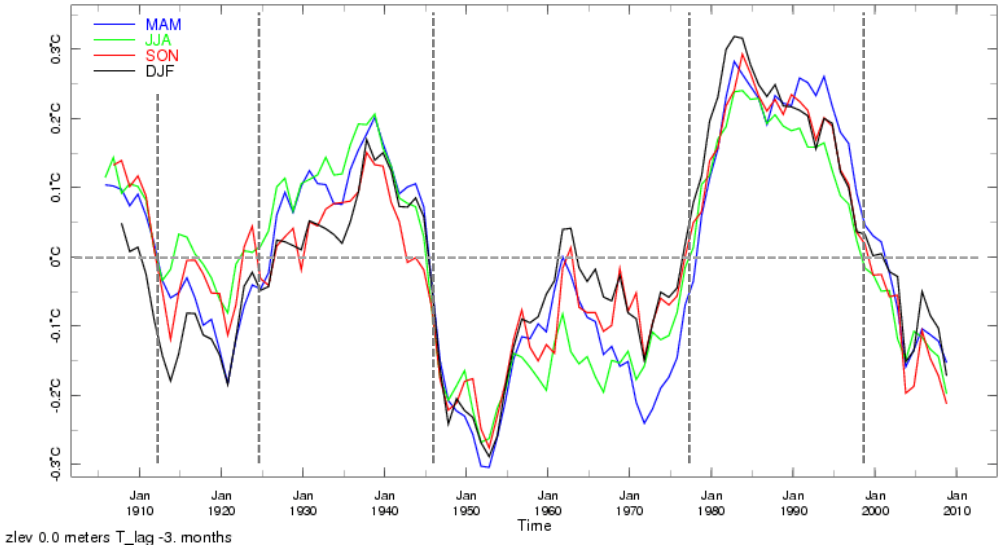
SON



DJF

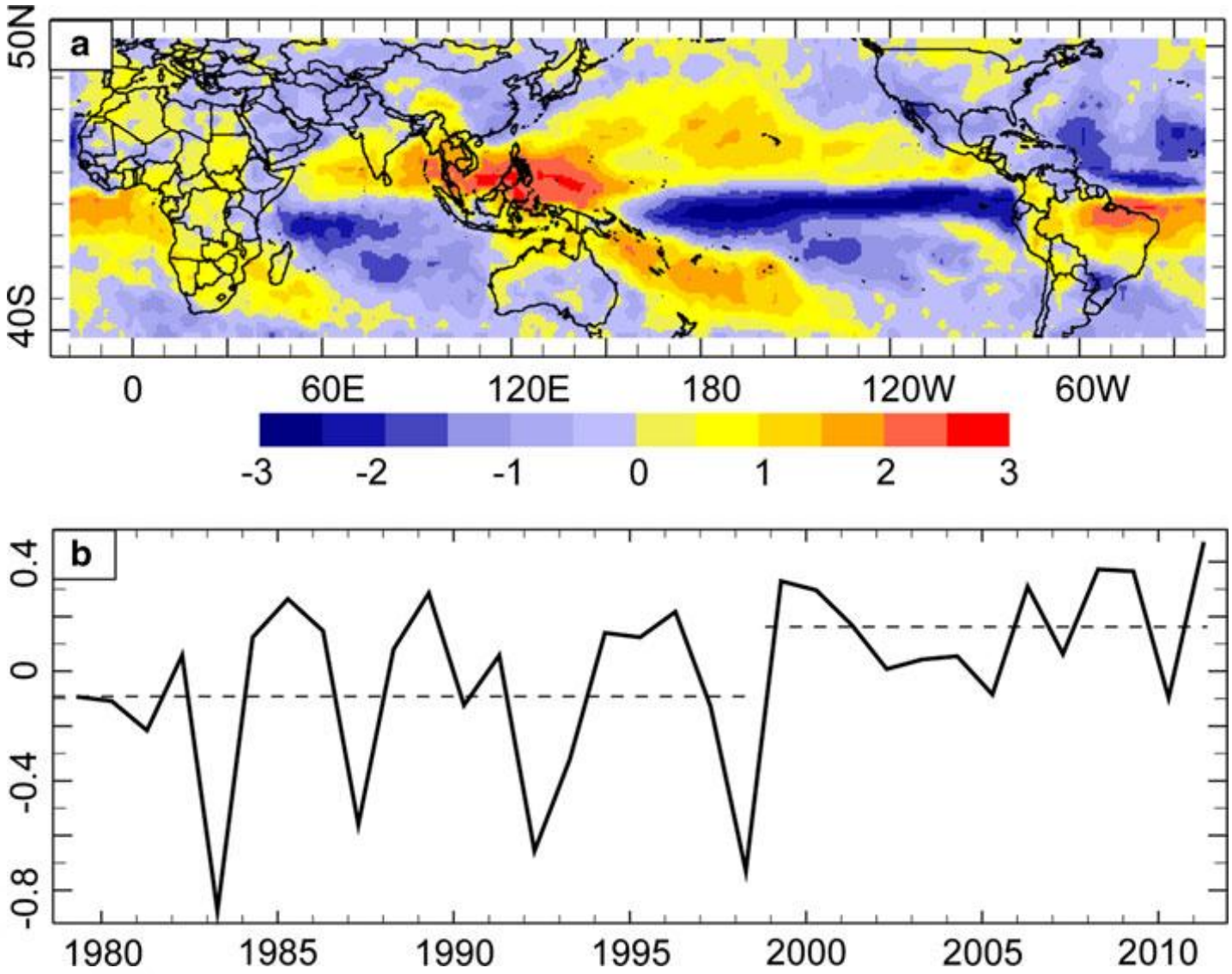


PC Time Series



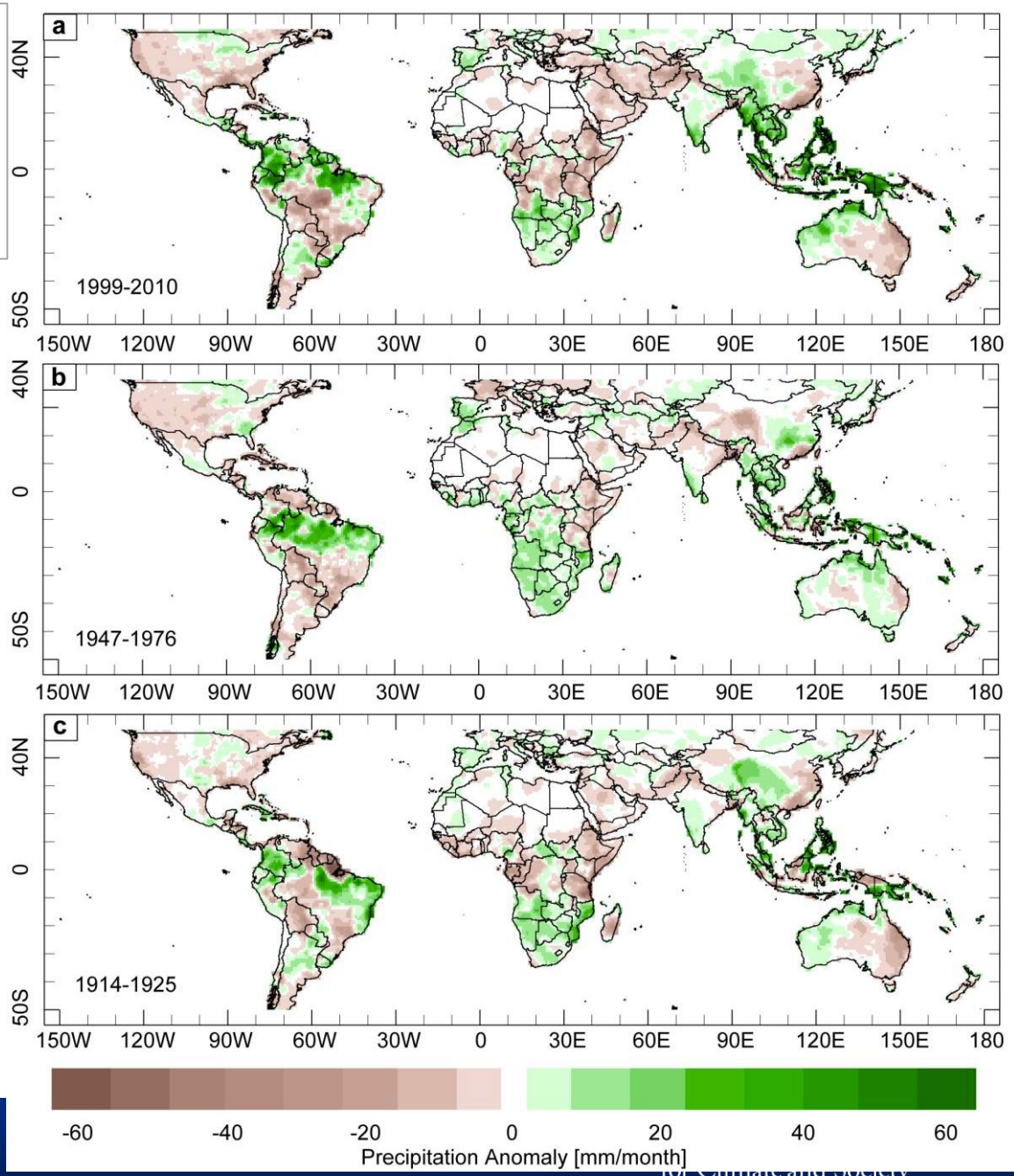
zlev 0.0 meters T_lag -3. months

MAM PRCP Leading EOF (CMAP 1979-2011)



PRCP Differences: Cold Phases Minus 1977-1998 Average

Mar-Apr-May
GPCC

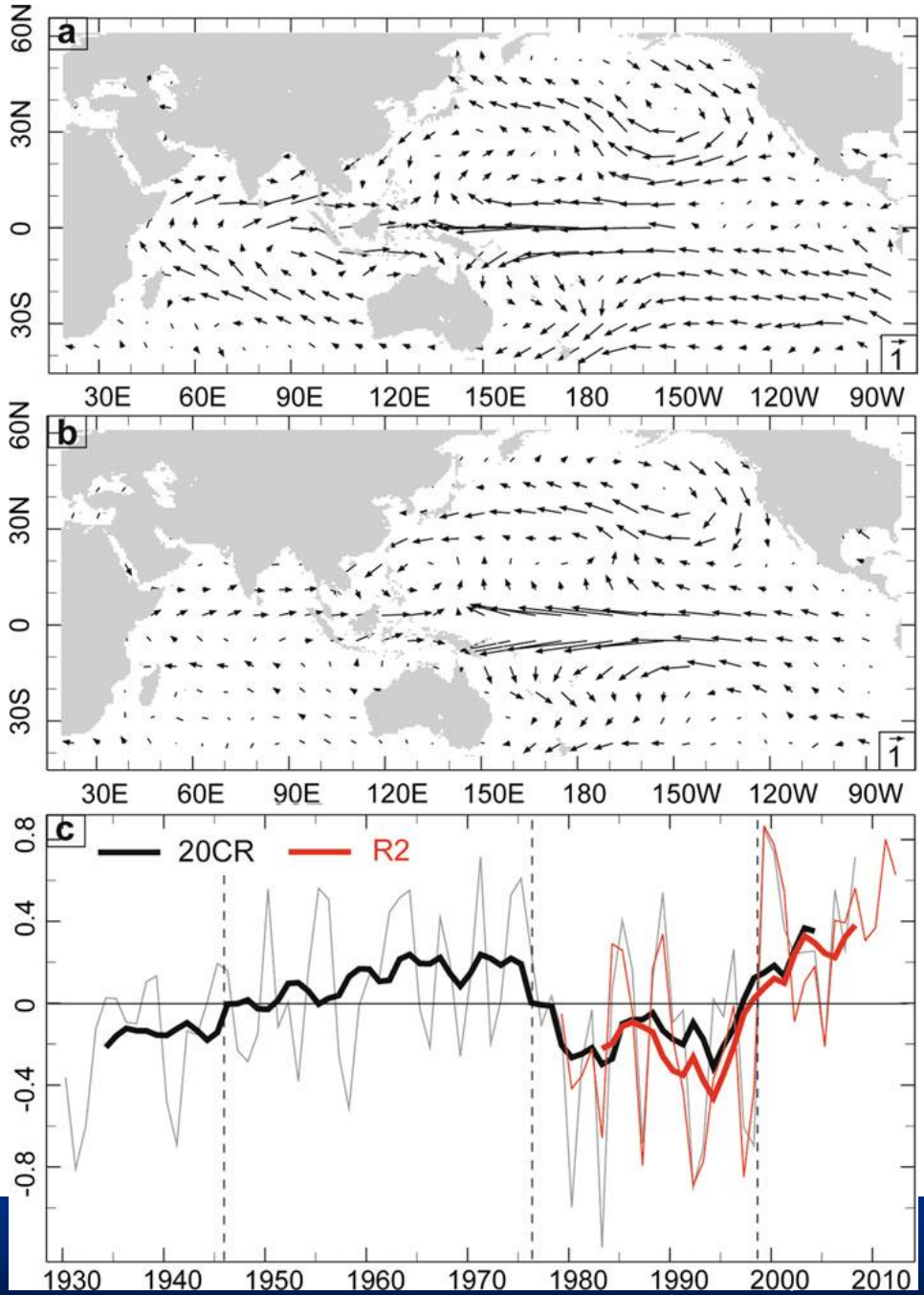


Lyon 2013, J. Clim (in review)

850 hPa {u, v} Joint EOF

R2 and 20CR

Mar-Apr-May



200 hPa Anomalous Stationary Waves

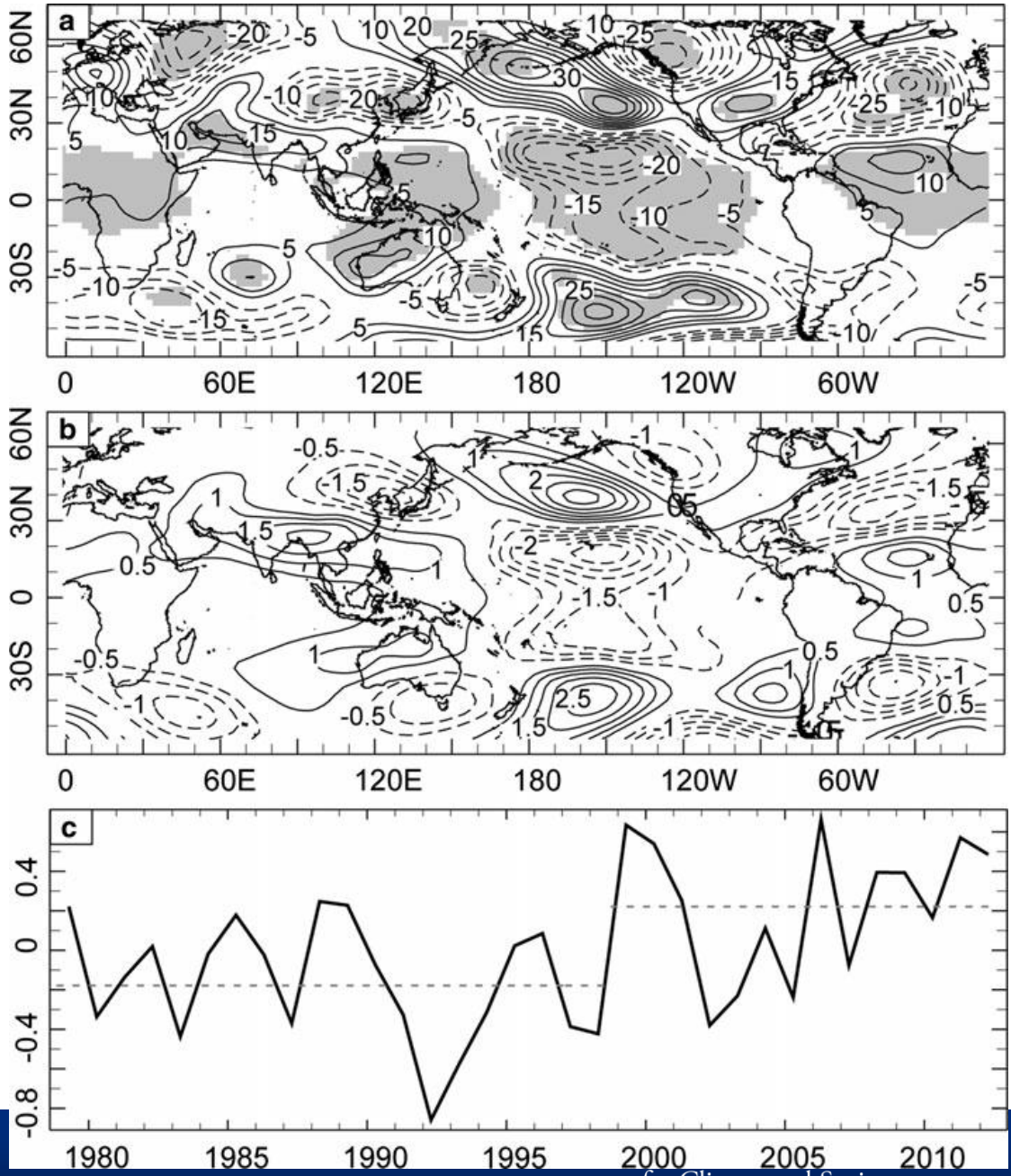
R2

Mar-Apr-May

Top:
(1999-2012) – (1979-1998)

Middle:
Leading EOF

Bottom:
PC Time Series EOF1



200 hPa Anomalous Stationary Waves

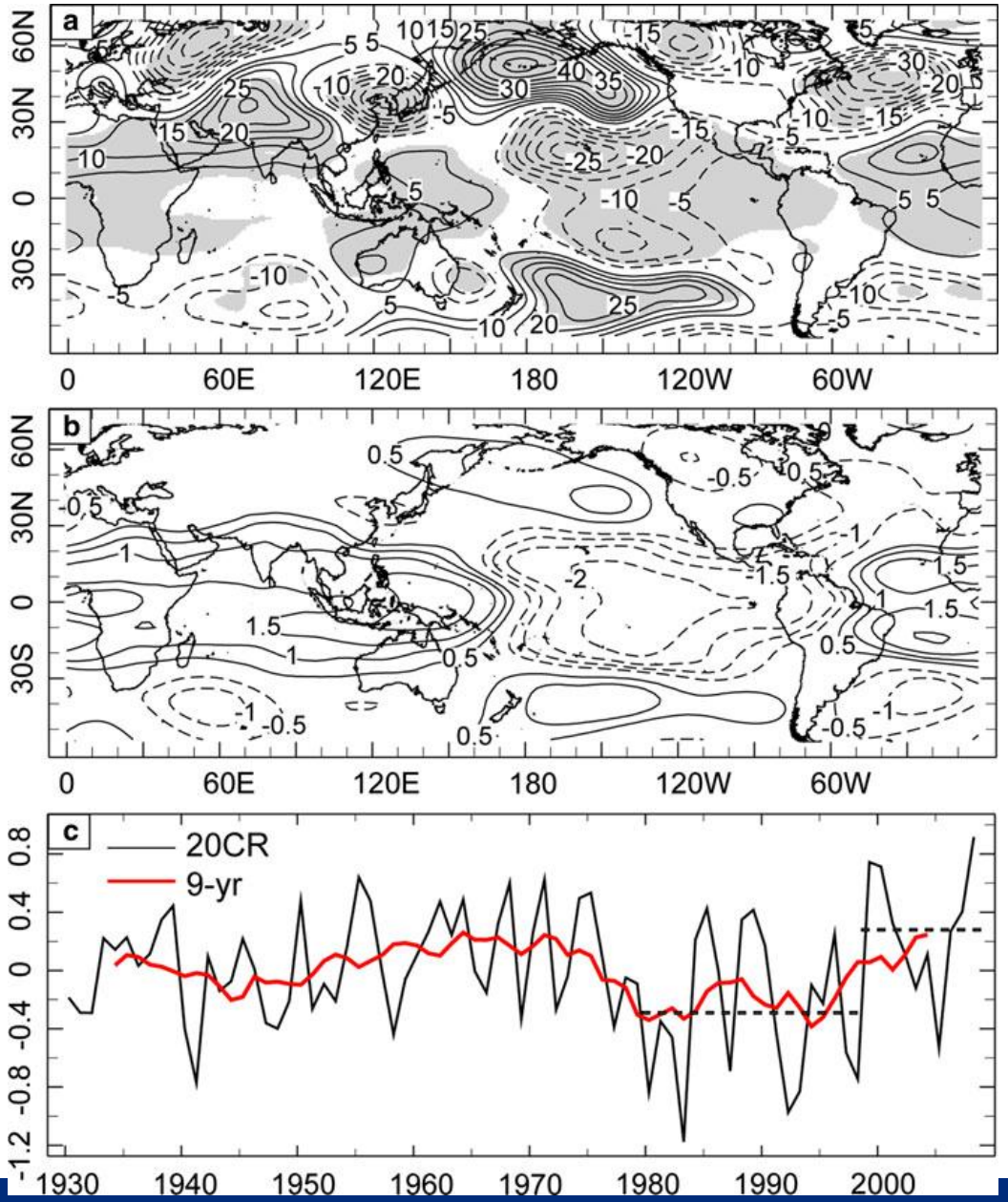
20CR

Mar-Apr-May

Top:
(1999-2012) – (1979-1998)

Middle:
Leading EOF (1930-2008)

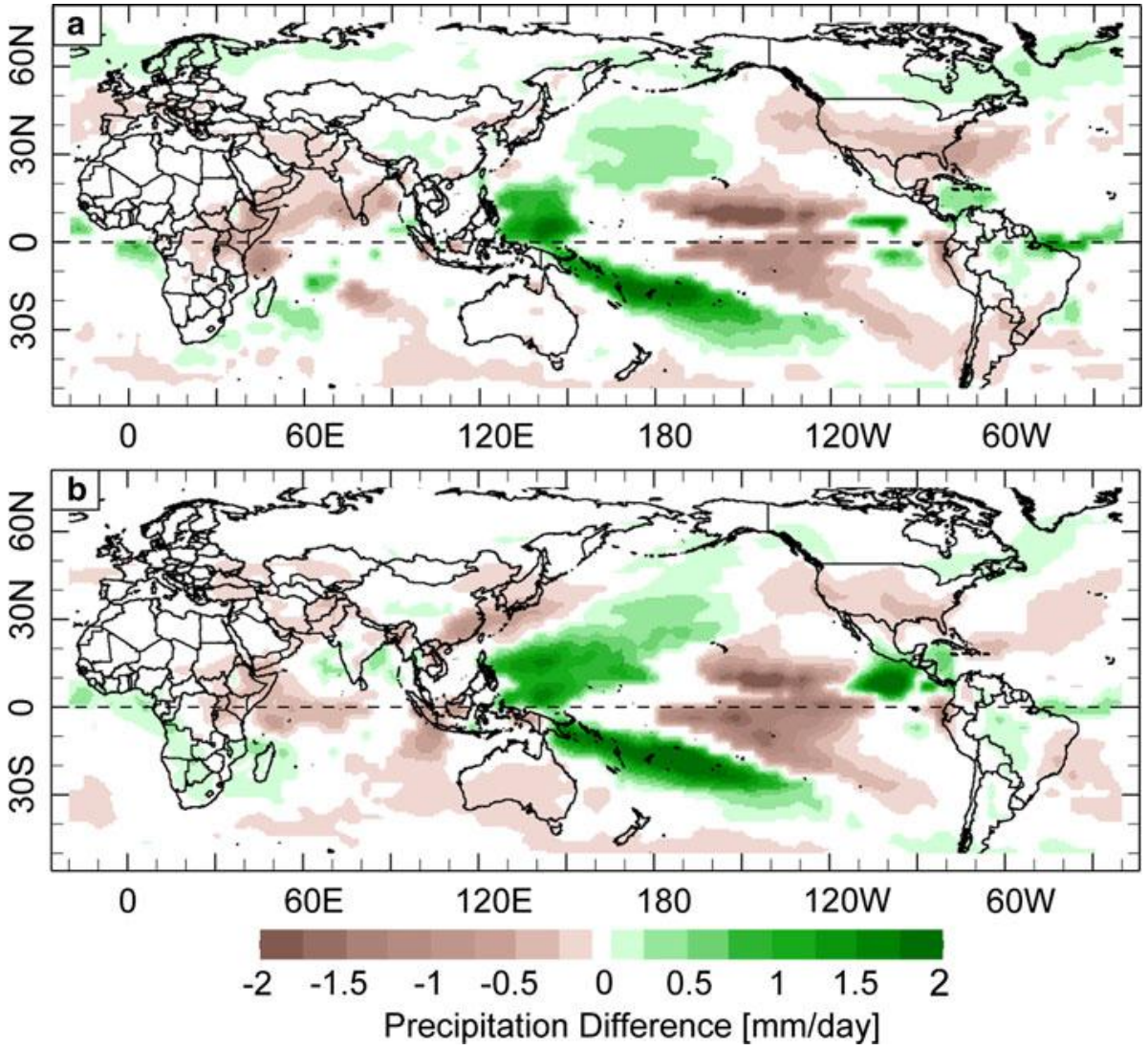
Bottom:
PC Time Series EOF1



ECHAM4.5 (M=30) MAM (1999-2012) – (1977-1998)

ECHAM4.5 forced with Global SST

ECHAM4.5 POGA 25° S-25° N

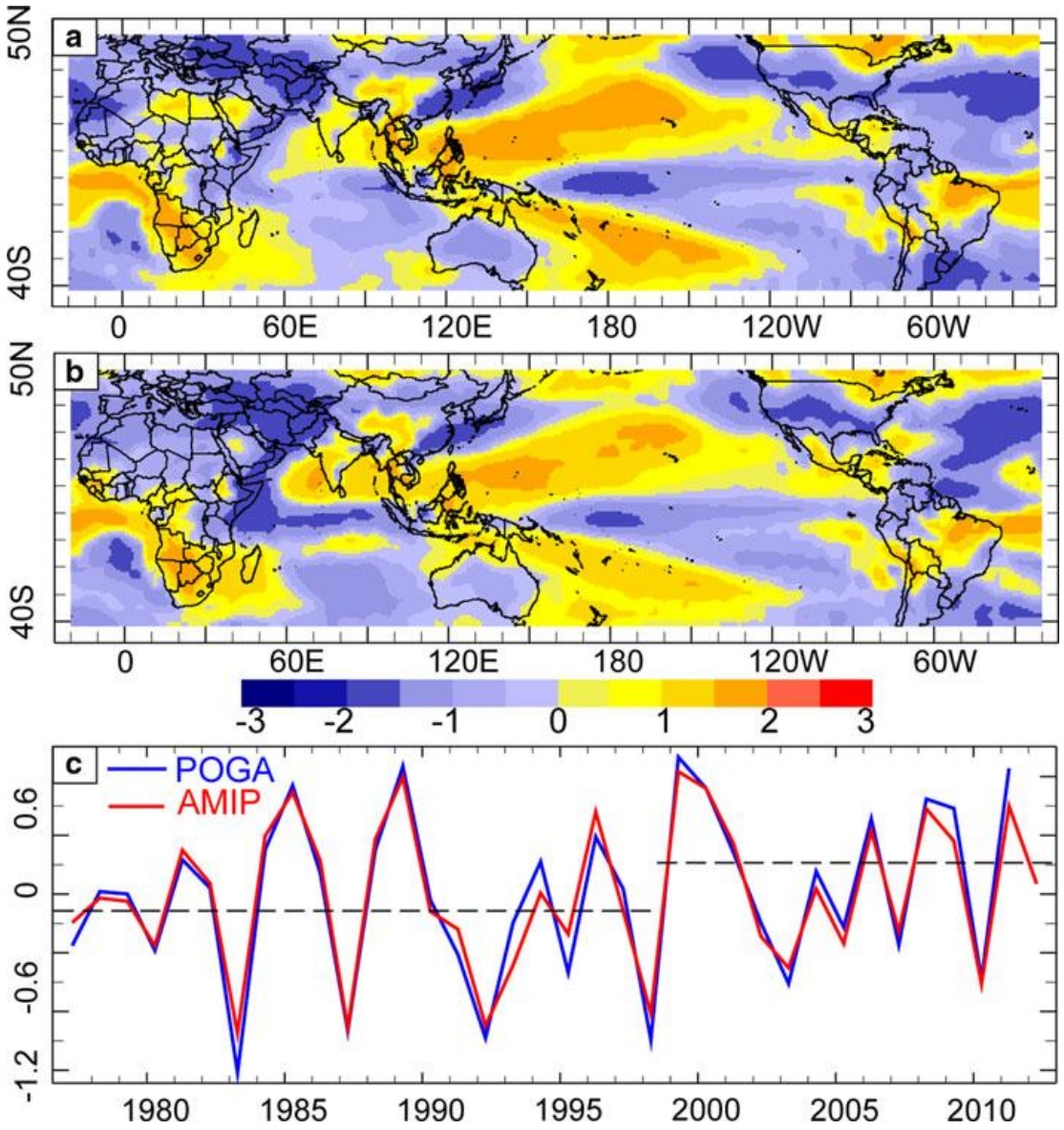


ECHAM4.5 MAM PRCP EOF1

Top:
Global SST Forcing

Middle:
POGA Forcing

Bottom:
PC Time Series

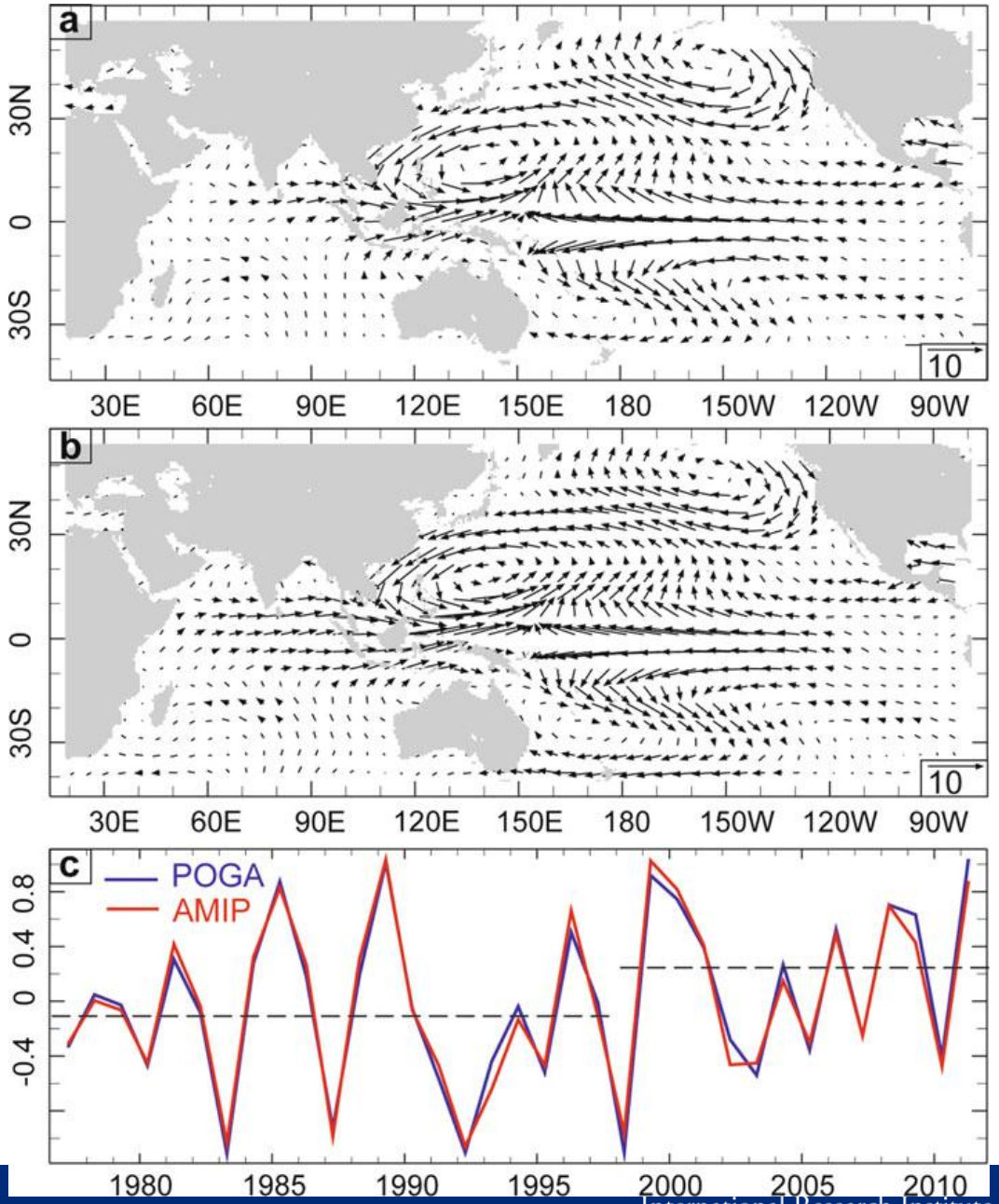


ECHAM4.5 MAM 850 hPa {u, v} Joint EOF1

Top:
Global SST Forcing

Middle:
POGA Forcing

Bottom:
PC Time Series



Lyon et al. 2013, Climate Dynamics

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Earth Institute | Columbia University

200 hPa Anomalous Stationary Waves

ECHAM4.5

Mar-Apr-May

Top:

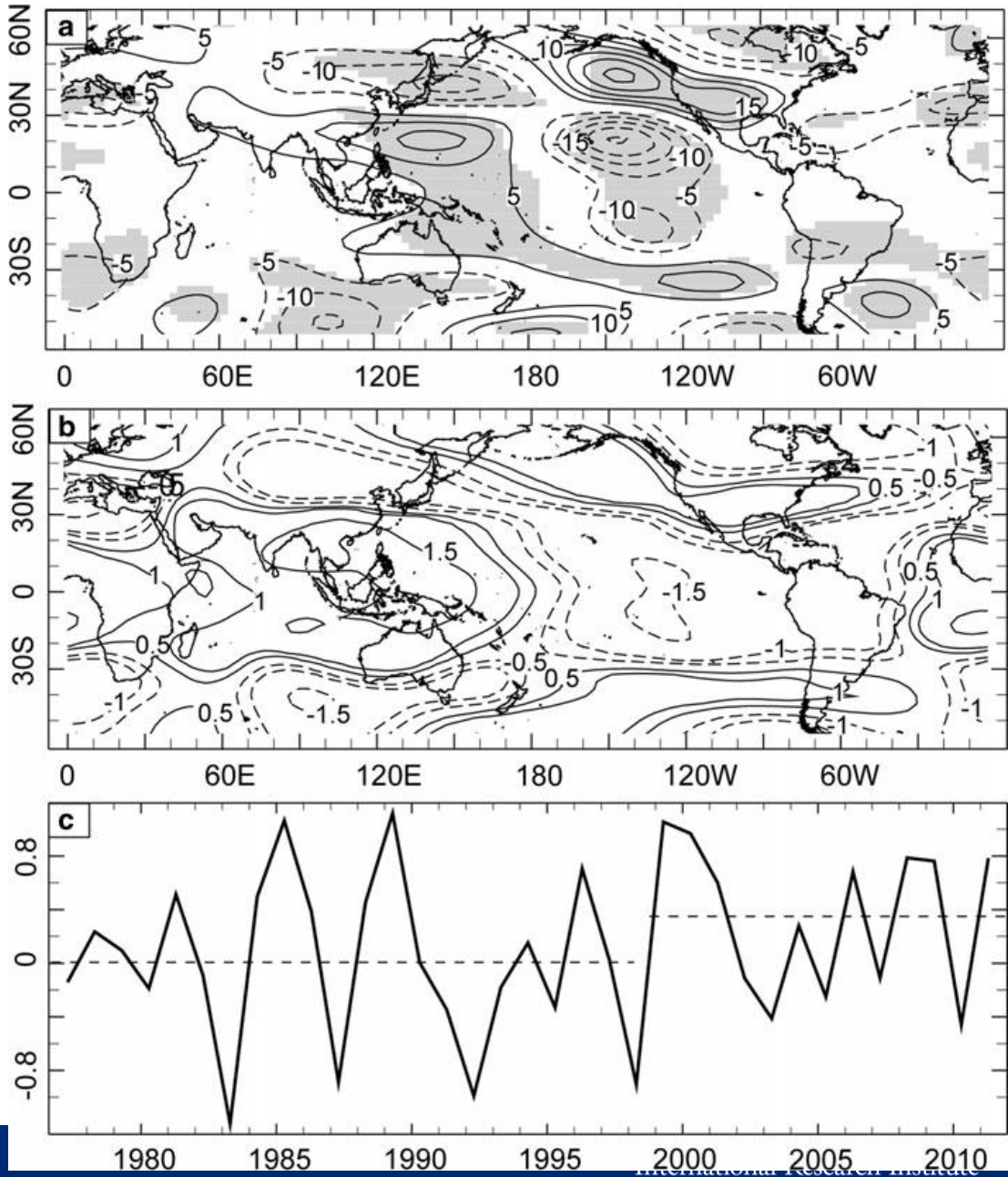
(1999-2012) – (1979-1998)

Middle:

Leading EOF (1977-2012)

Bottom:

PC Time Series EOF1



Summary/Conclusions

- Observational evidence shows 1998-99 shift in Pacific SSTs in all seasons (emphasis here on Mar-Apr-May)
- Overall pattern is similar to PDO/IPO, with earlier shifts consistent with previous studies
- Concurrent shifts seen in PRCP, low-level winds and upper-level anomalous stationary waves (R2 and 20CR)
- ECHAM4.5 runs forced with global SSTs capture many of the salient observed features of the shift (PRCP, low-level winds, upper-level SW)
- POGA runs capture most of the observed features, including the shift itself in 1998-99
- **Increased drought frequency in South/West US, East Africa, South-Central Asia… are all associated with the 1998-99 shift**