Characterization of the variability of the South Pacific Convergence Zone (SPCZ) using satellite and reanalysis wind products

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Material partially based on:
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Background for SPCZ

- The largest rain band worldwide during austral summer.
- Important to atmos, ocean & their coupling., incl. cyclone genesis.
- Previous studies mostly based on OLR/precip, yet wind convergence is the dynamical cause.
- Extensive studies of SPCZ movements, but not strength.
- Lack of systematic investigation across different time scales is lacking.
- Consistency among different wind products – implications to TPOS2020.

Wind products used for analysis

- QuikSCAT (1999-2009)
- ASCAT (2007 onward)
- ERA-Interim (1980s onward)

- This presentation focuses on QSCAT & ERA.
- Focus more on convergence strength (lack of investigations).
- Will discuss QSCAT-ASCAT consistency if time permits.

Diagnostic quantities

Divergence/convergence: $D = \partial u/\partial x + \partial v/\partial y$ (convergence when *D*<0)

Convergence area: $A = \sum a(x, y)$ for grids with *D*<0 within 130E-110W, 0-30S

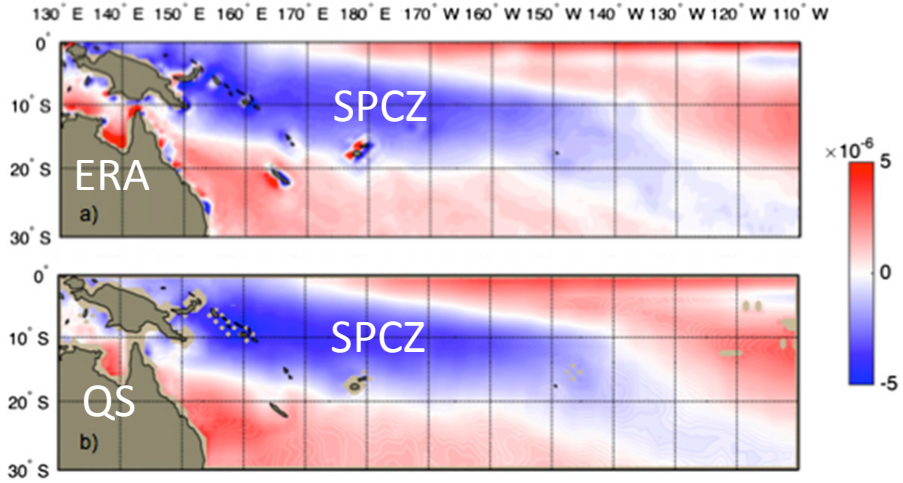
Convergence strength: $S = \frac{\sum D(x,y) \times a(x,y)}{\sum a(x,y)}$ for the grids with *D*<0 (same region)

Convergence centroid longitude & latitude:

$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \quad \bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$ for the grids with *D*<0 (same region)

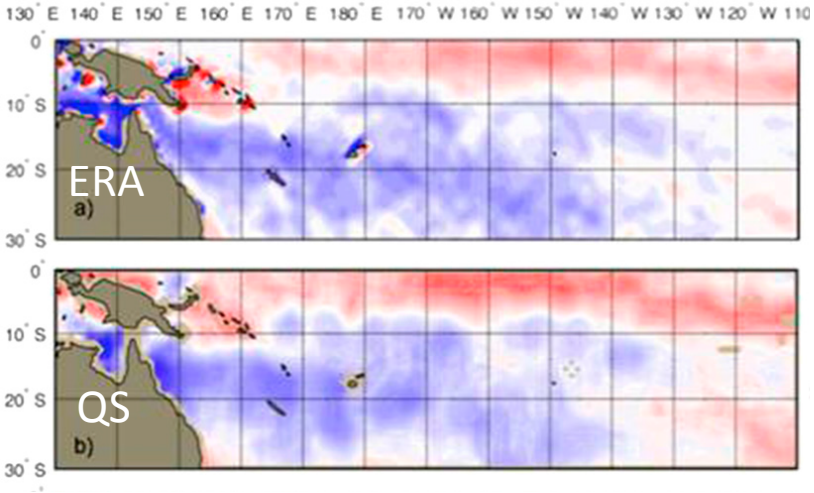
QSCAT vs. ERA-Interim comparison of divergence (D) field
(QSCAT period): good consistency for time mean & seasonal anomalies

Annual mean D

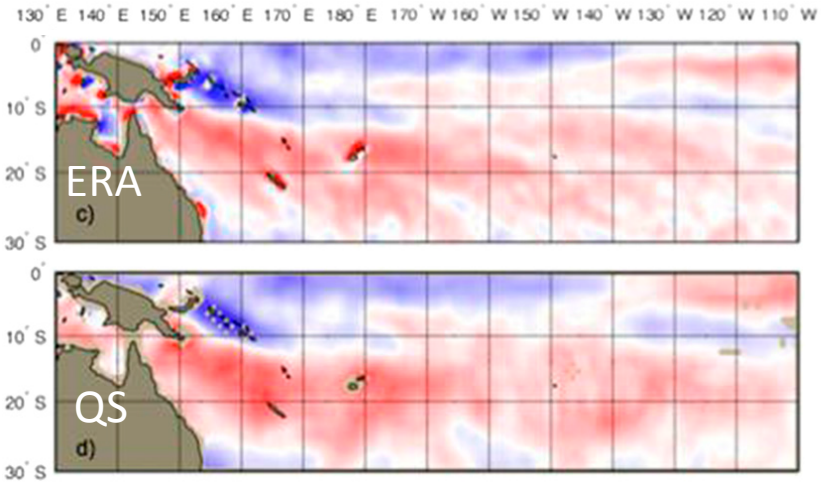


D<0 means convergence

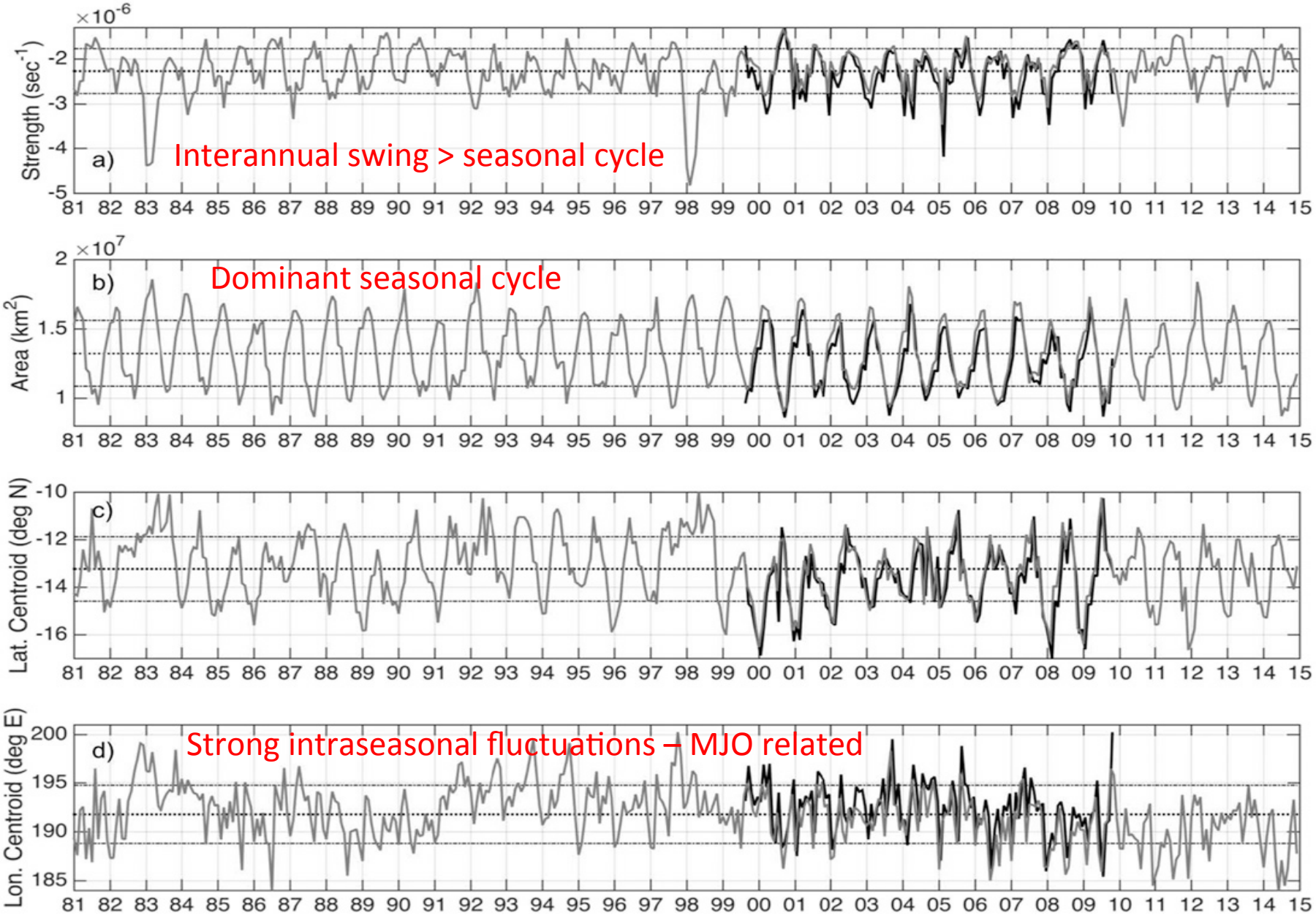
January anomaly composite



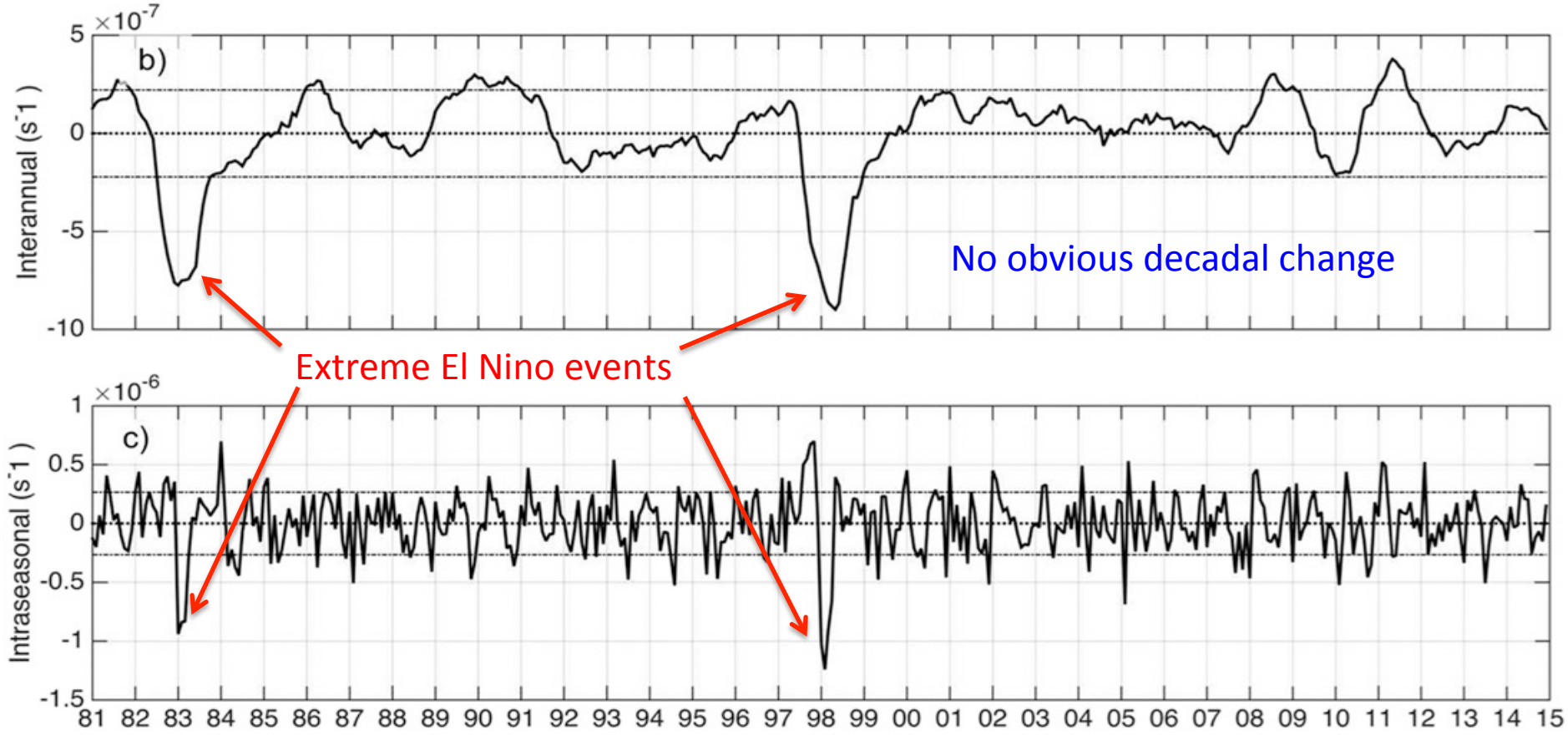
July anomaly composite



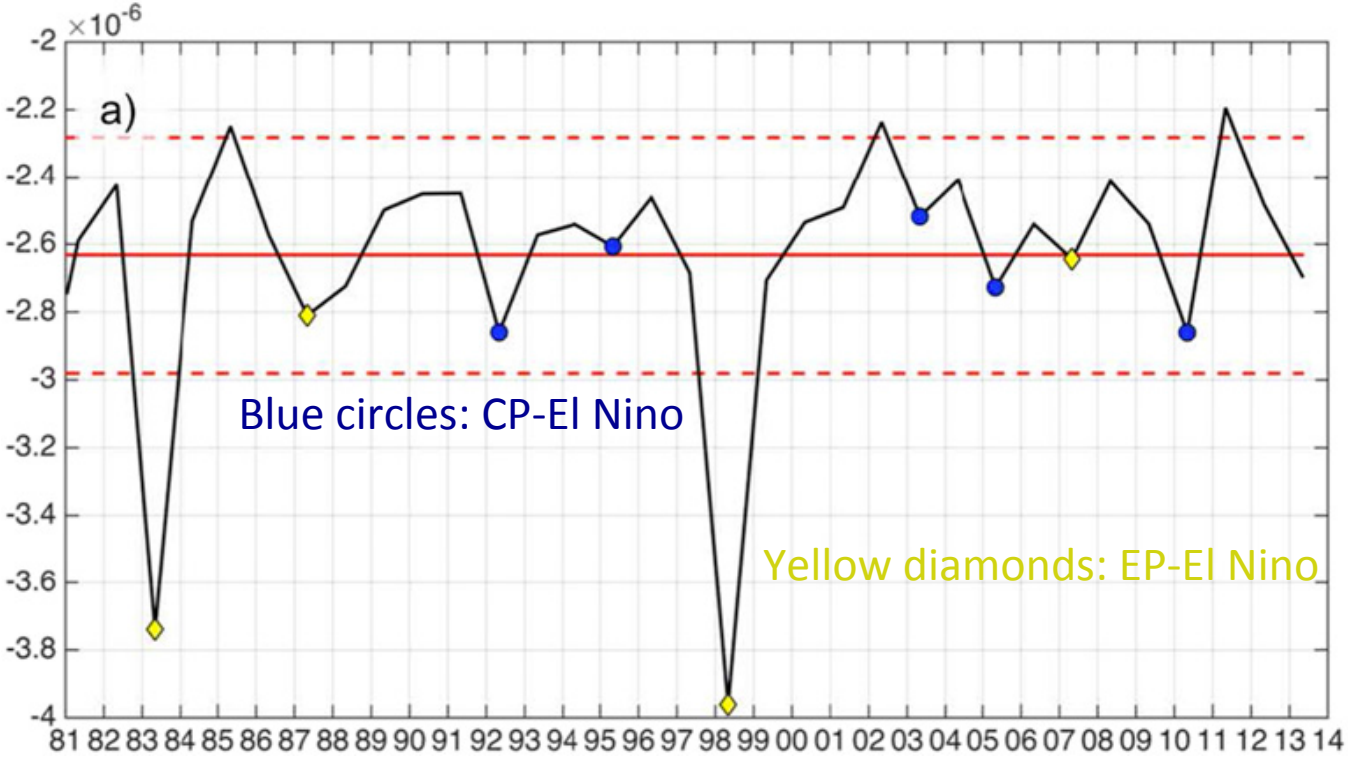
Excellent agreement between QuikSCAT & ERA-Interim for various SPCZ diagnostic quantities (use ERA to examine longer period)



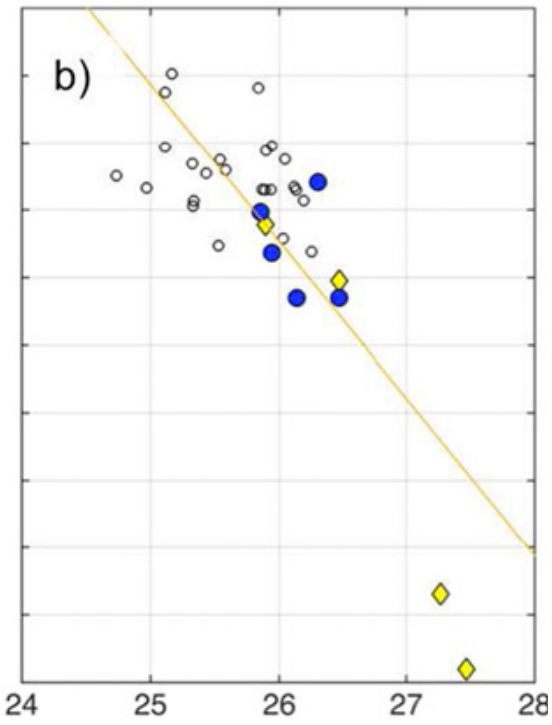
Non-seasonal fluctuations of SPCZ strength: strong convergence anomalies associated with extreme El Nino



SPCZ strength depends more on strength of El Nino (extreme vs. moderate/weak) rather than on central- vs. eastern-Pacific El Nino

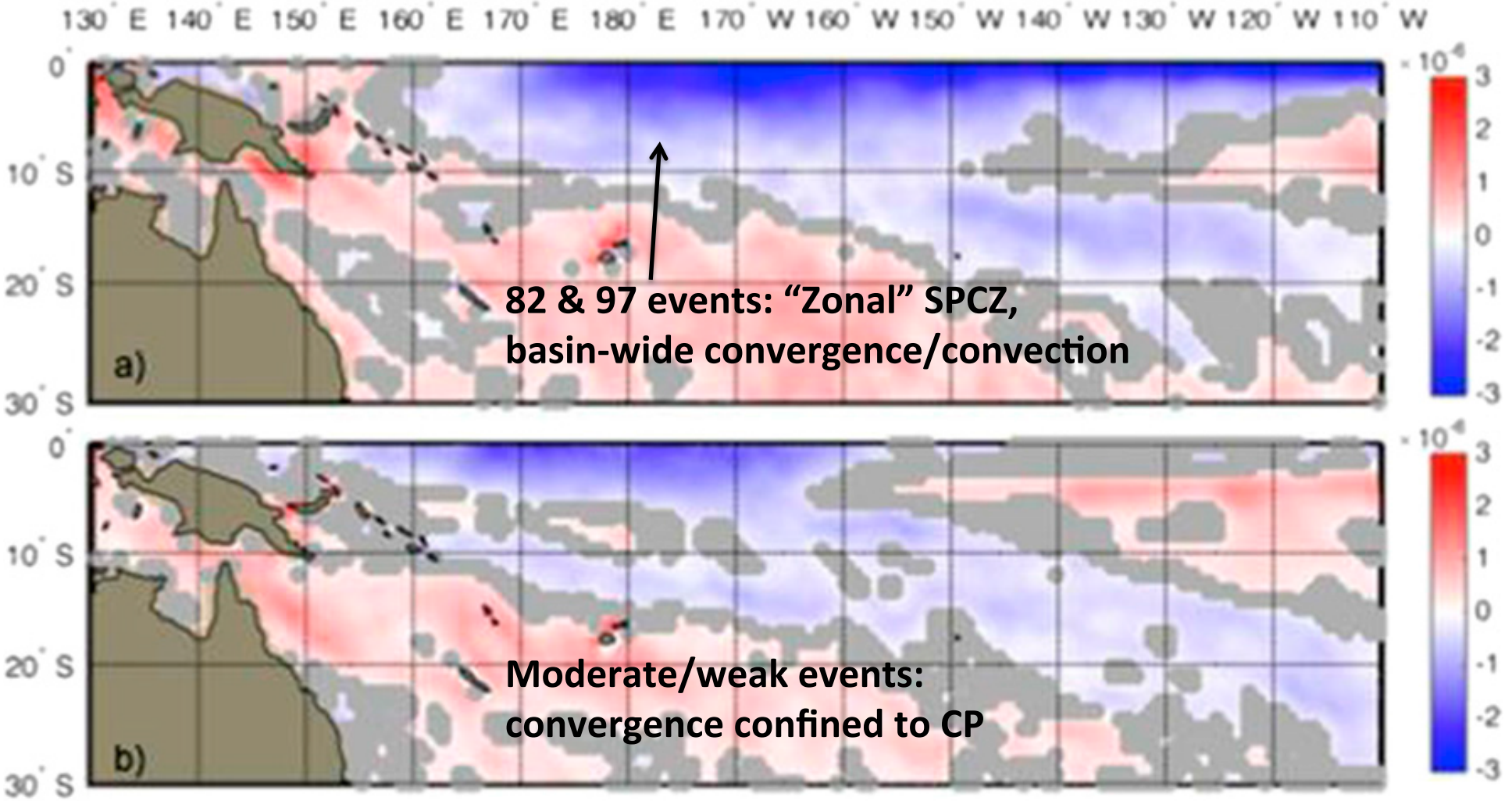


DJF SPCZ strength as a function of year

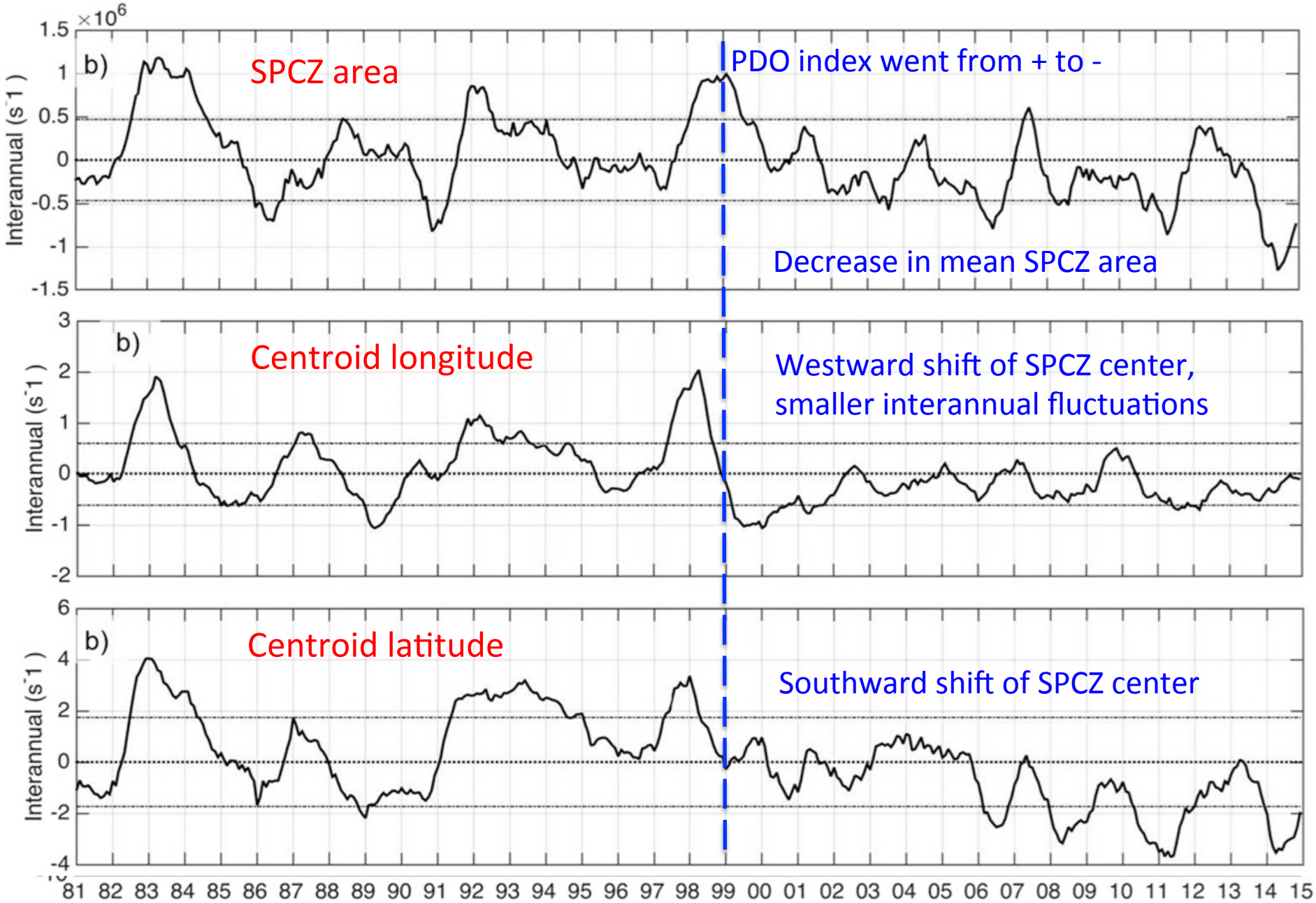


DJF SPCZ strength
vs Nino3 SST

Convergence structure during extreme & moderate/weak El Nino



PDO effects on SPCZ area & center (caution needed)

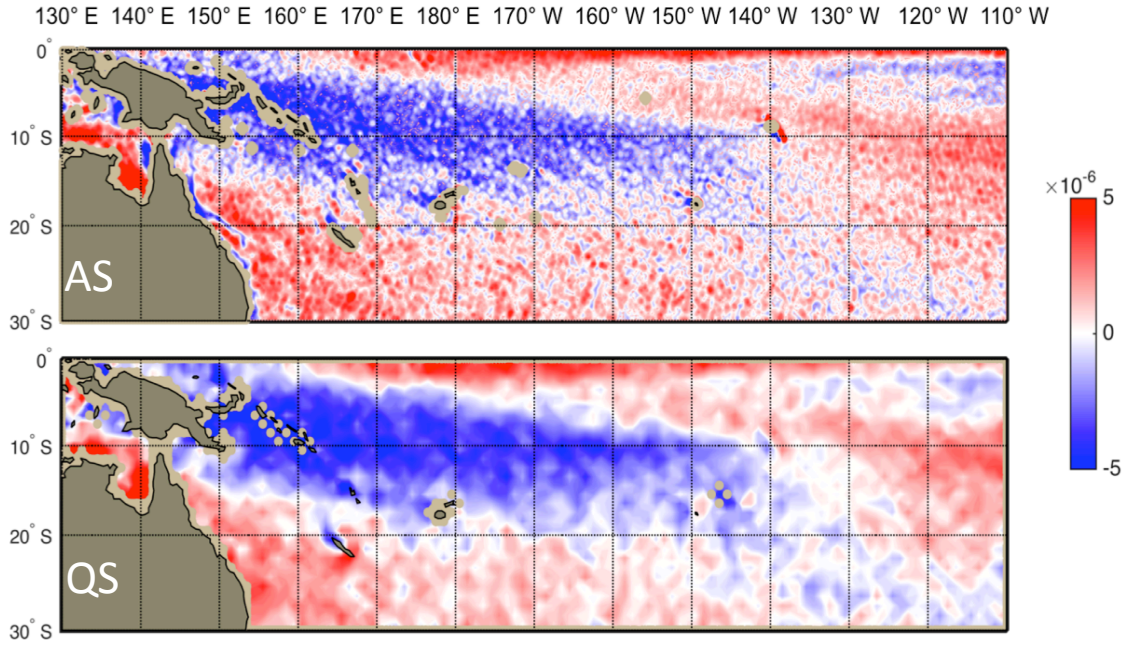


Summary

- Systematic study of SPCZ features (area, strength, centroid long & lat) for various time scales.
- QSCAT – ERA good consistency.
- Strong seasonal cycle, most dominant for SPCZ area.
- SPCZ strength: large interannual & intraseasonal variations associated with extreme El Nino, comparable to seasonal.
- SPCZ strength depends more on El Nino intensity than type.
- PDO change from + to –since 1999 caused:
  - decrease in SPCZ area;
  - southward/westward shift of SPCZ centroid with less interannual swings;
  - little effect on SPCZ strength.
- The diagnostics are useful for evaluating climate models.

QSCAT vs. ASCAT comparison

Time-mean divergence (D)
(May 2007-Oct 2009)
(D<0 is convergence)



Non-seasonal anomalies of convergence strength