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Evaluation of the equatorial current system in the POP simulations based on different wind forcings

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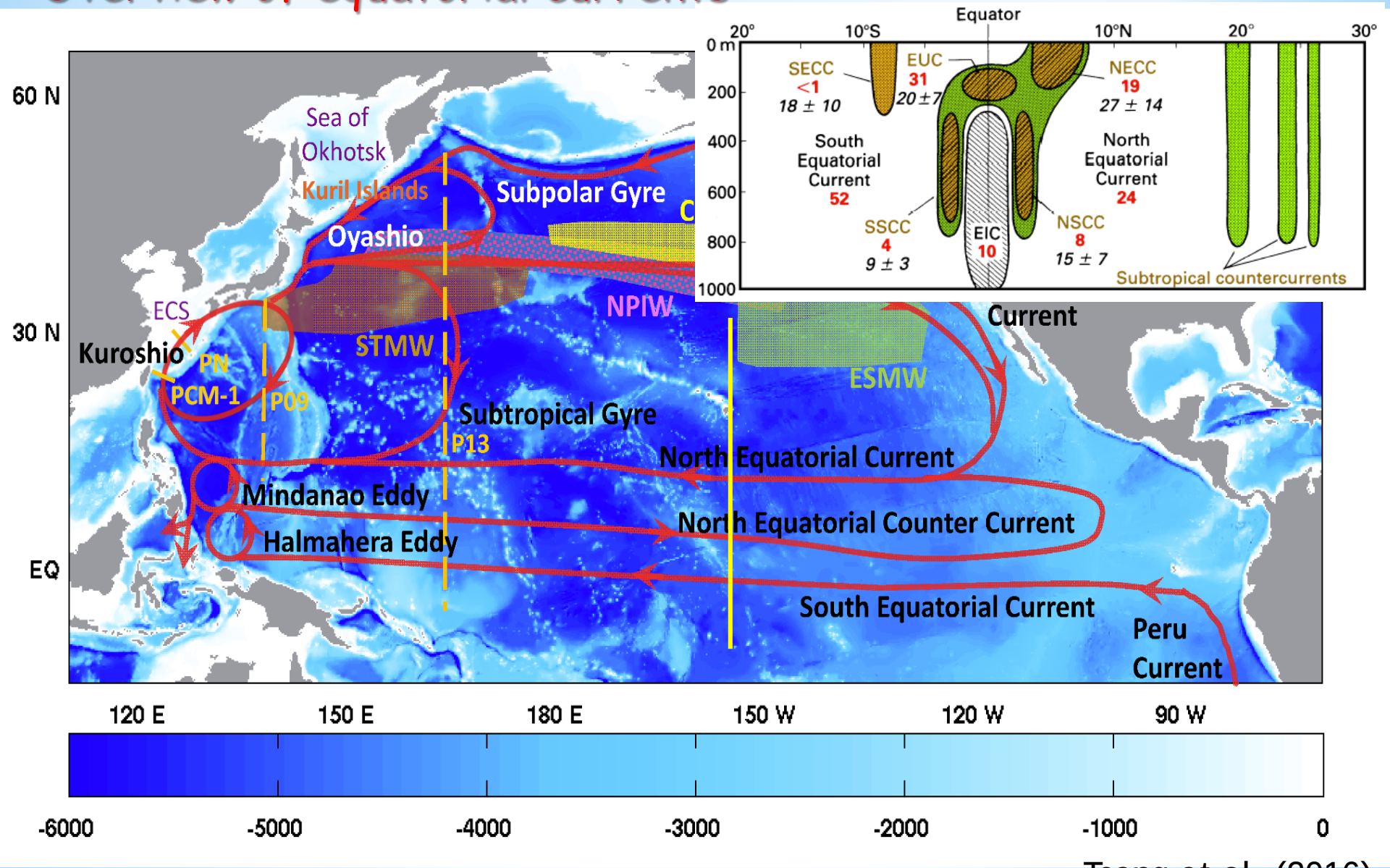
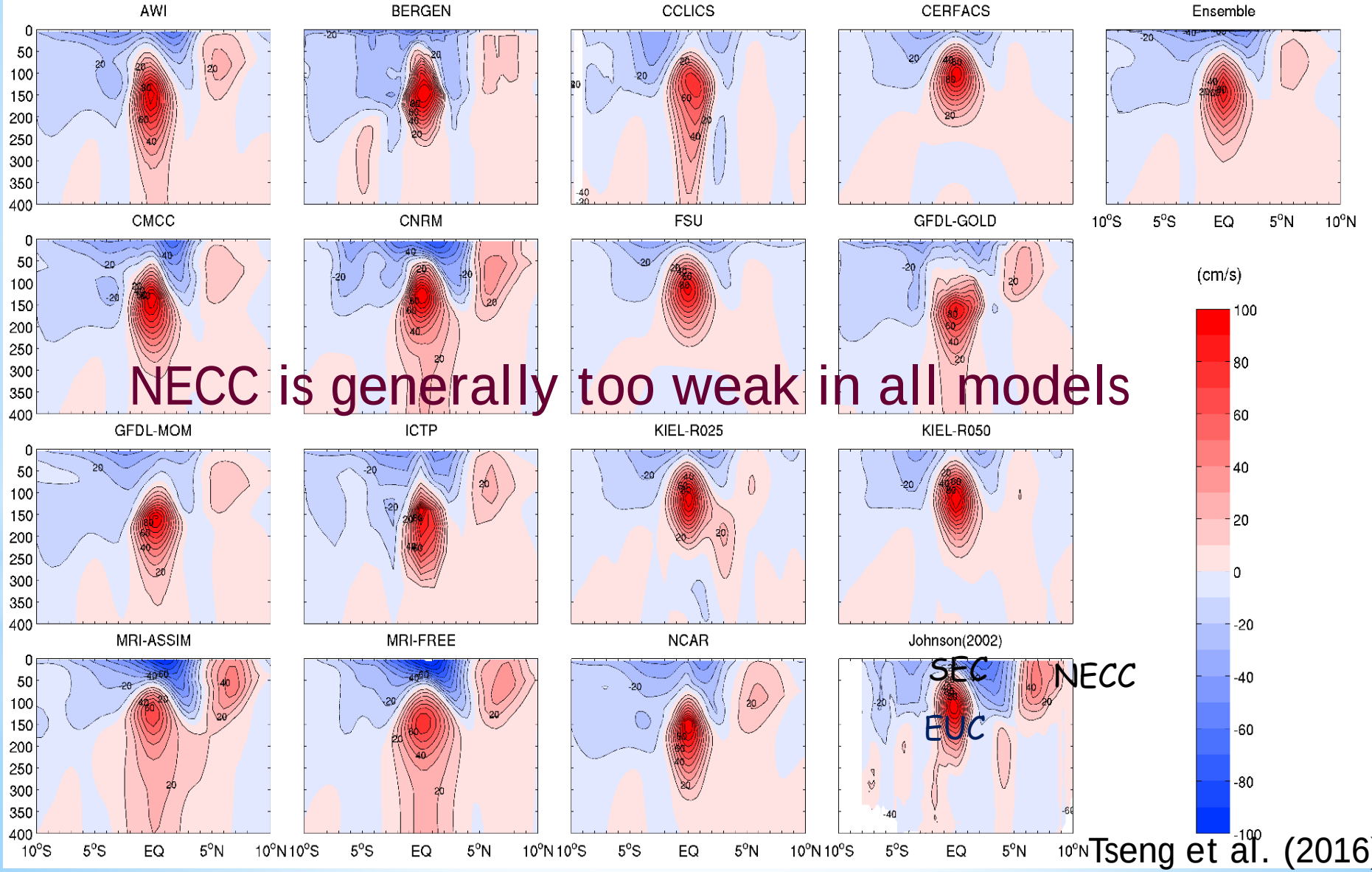
- Motivation
- Model experiments
- Results
  - Zonal transport and Sverdrup transport
  - Impacts of wind stress curl
  - Transport contributions
- Conclusion

Overview of equatorial currents



Tseng et al. (2016)

Mean zonal velocity along 140°W in the CORE-II experiments



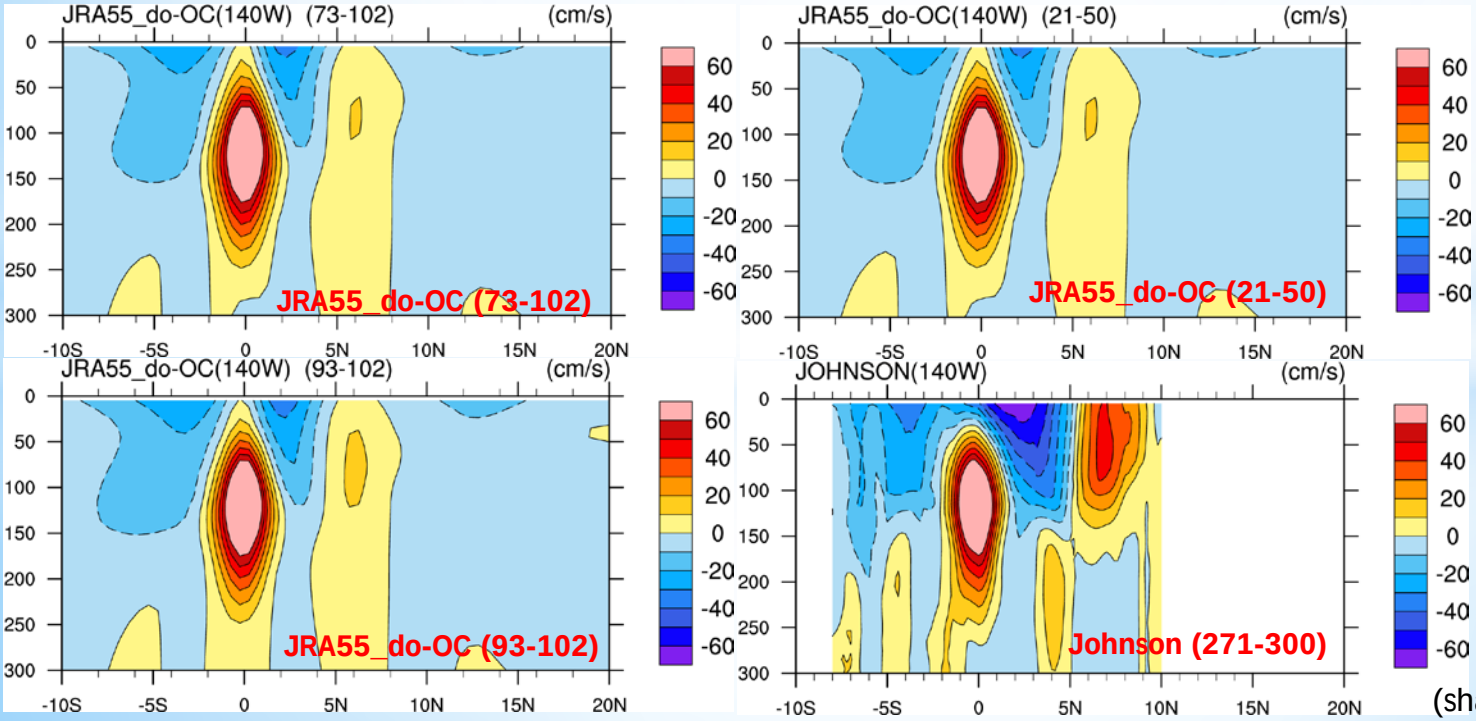
NECC is generally too weak in all models

Tseng et al. (2016)

model and data

OBS: Johnson et al. (2002)

Model	Test name	Forcing	Used time
POP	JRA55_raw-OC (S06)	JRA55	1978-2007(73-102)
POP	JRA55_raw-NC (S07)	JRA55	1978-2007(73-102)
POP	JRA55_do-OC (T03)	JRA55	1978-2007(73-102)
POP	JRA55_do-NC (T07)	JRA55	1978-2007(73-102)
POP	POP	COREII	1978-2007(271-300)



(shaded interval : 10 cm/s)

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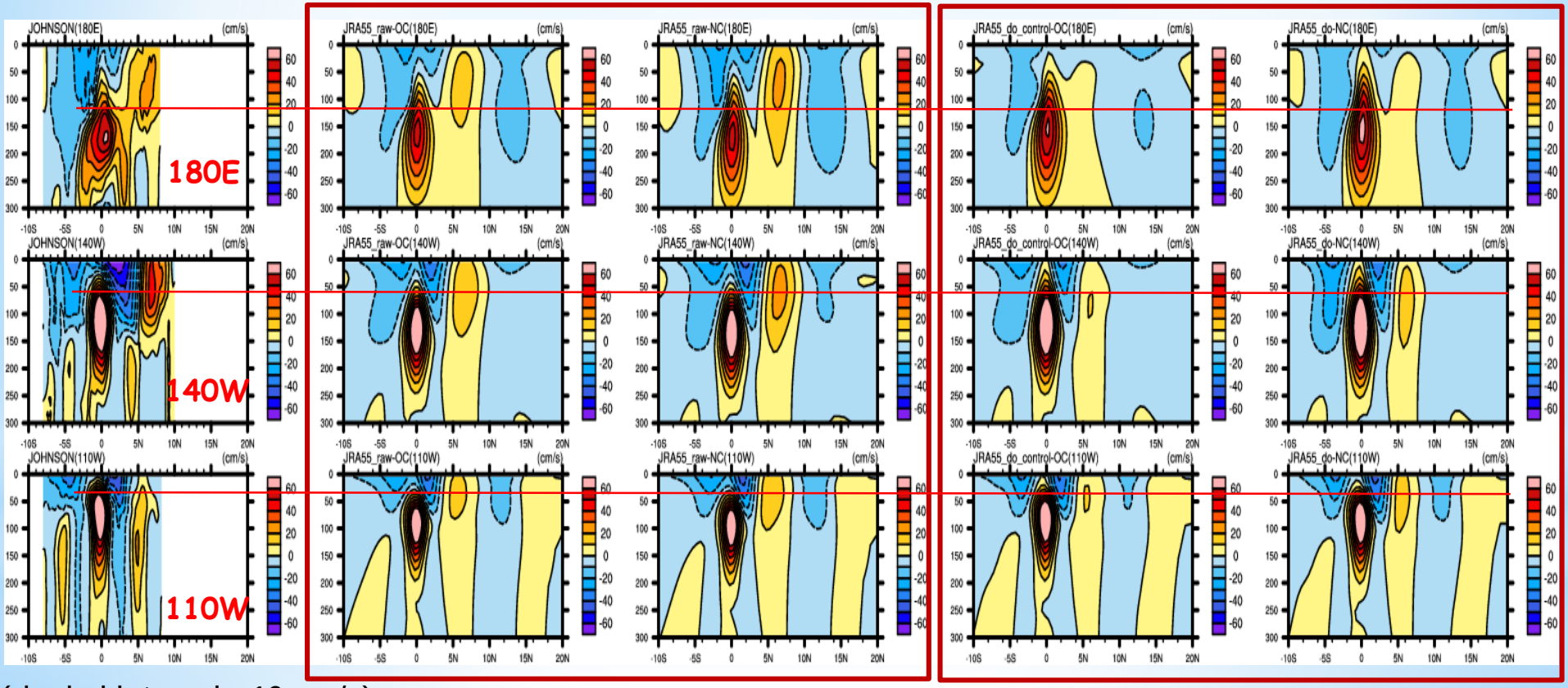
Meridional-vertical sections of mean zonal current

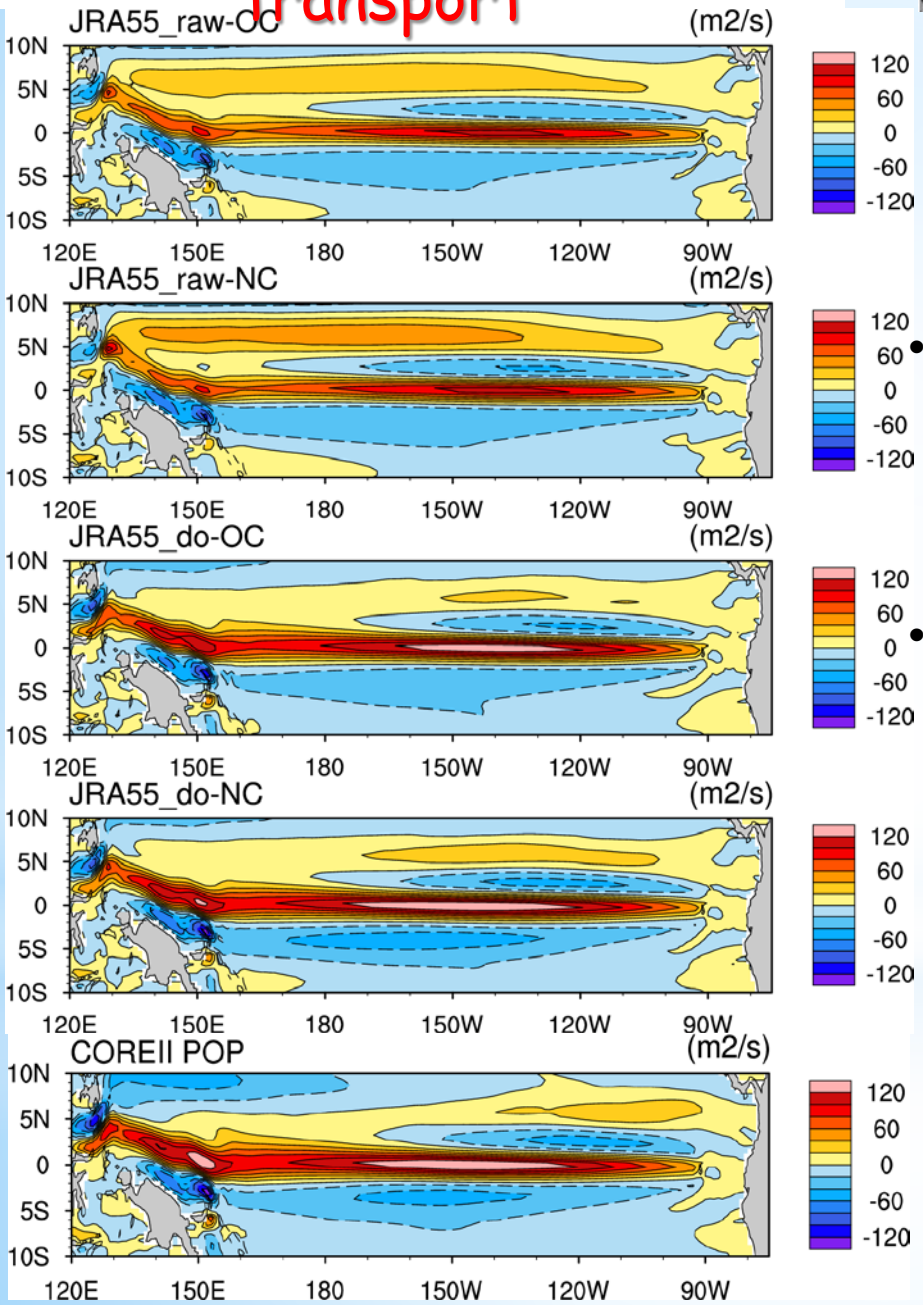
Johnson | JRA55_raw-OC | JRA55_raw-NC | JRA55_do-OC | JRA55_do-NC



(shaded interval : 10 cm/s)

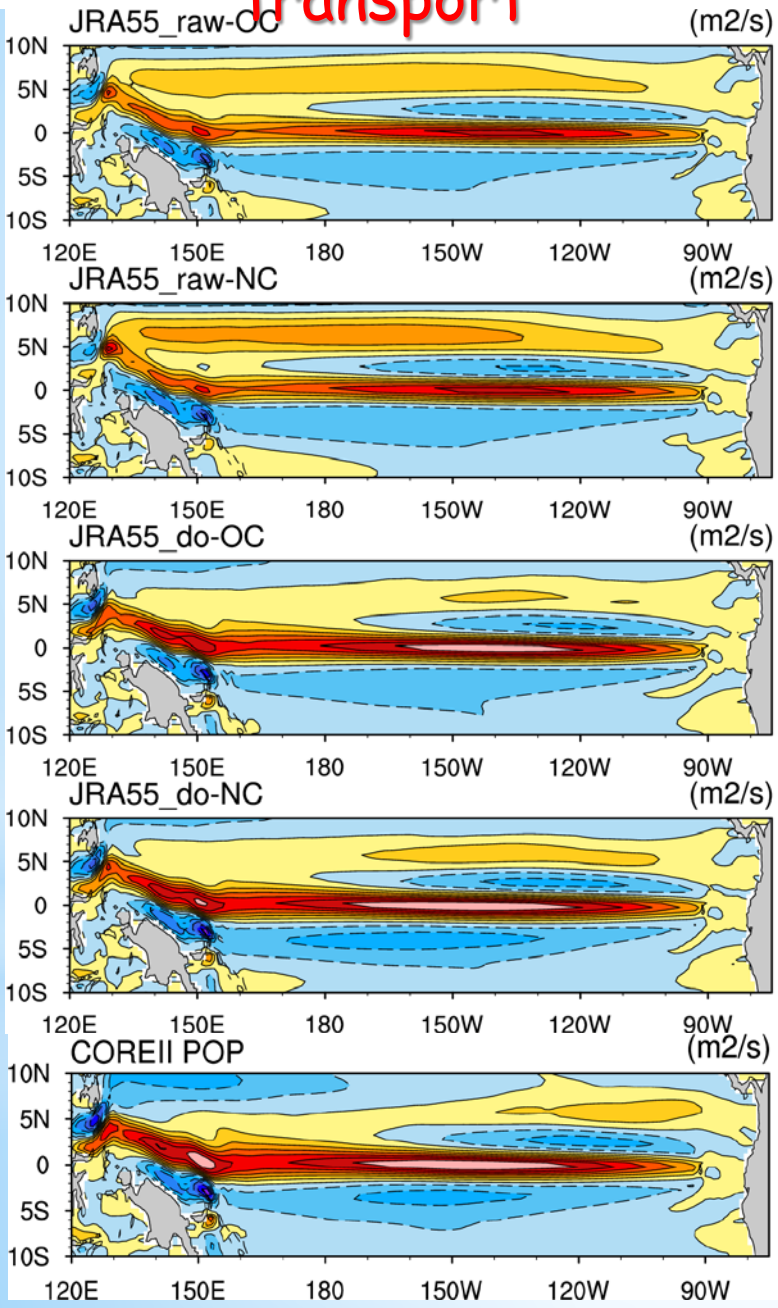
- NECC is generally stronger in NC runs
- NECC is stronger in raw data (without wind correction)
- EUC extends to the surface in the wind corrected runs

Vertically integrated zonal transport



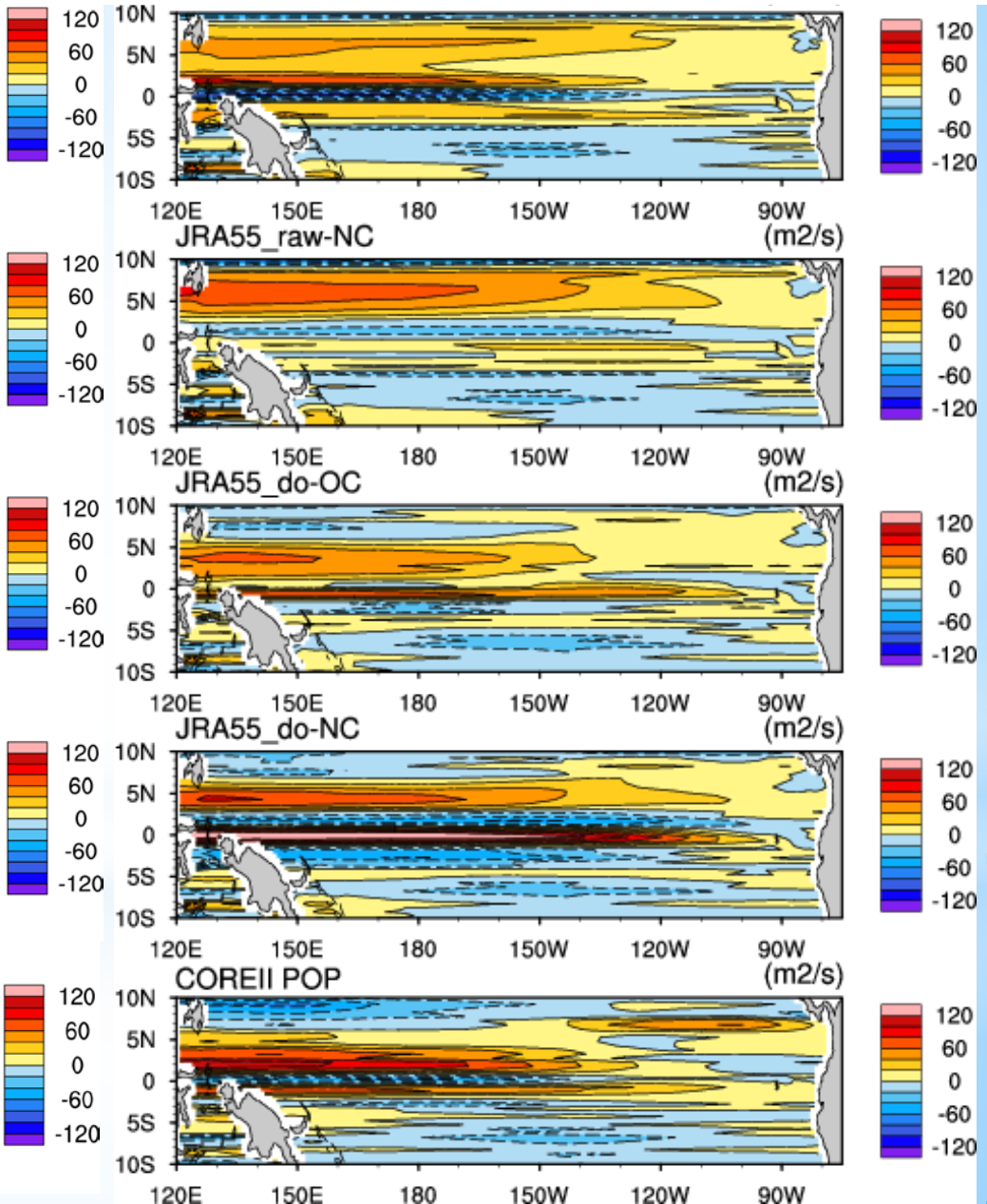
- Stronger NECC transport in JRA55
  - Stronger in raw data
  - Stronger in the NC run
- Stronger EUC in the wind corrected run
  - Maximum velocity depth differs
  - sensitive to the NC/OC

Vertically integrated zonal transport



Zonal Sverdrup transport

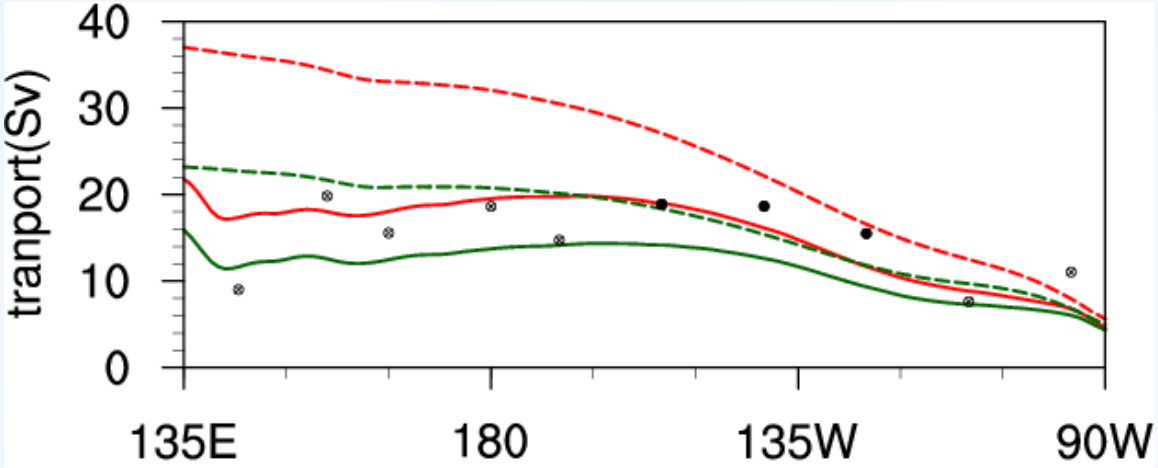
$$U = -\frac{1}{\beta}\int_{EB}^{x} curl(\tau)_y dx + U_{EB}(y)$$



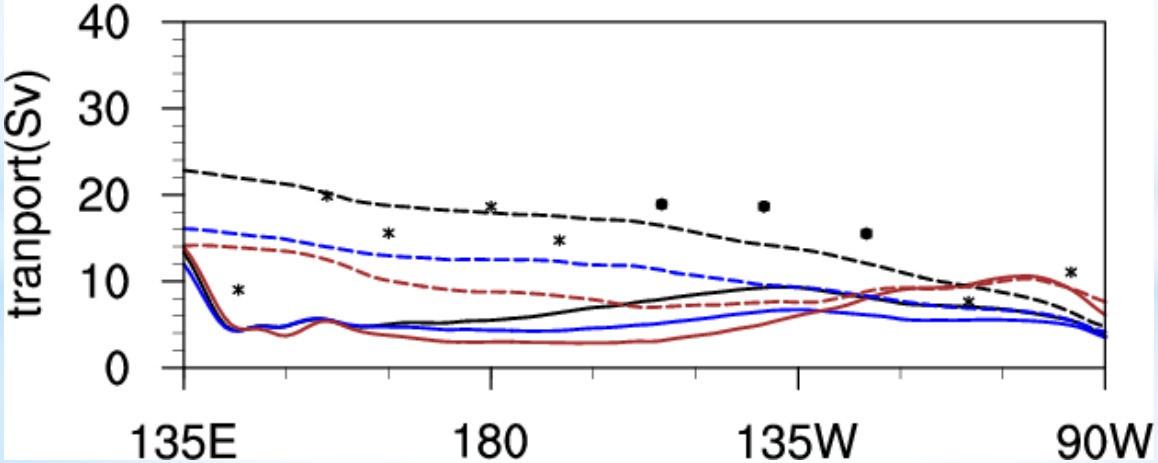
Zonal Sverdrup transport (ZST) vs modeled transport

NECC: 3-10N

JRA-raw



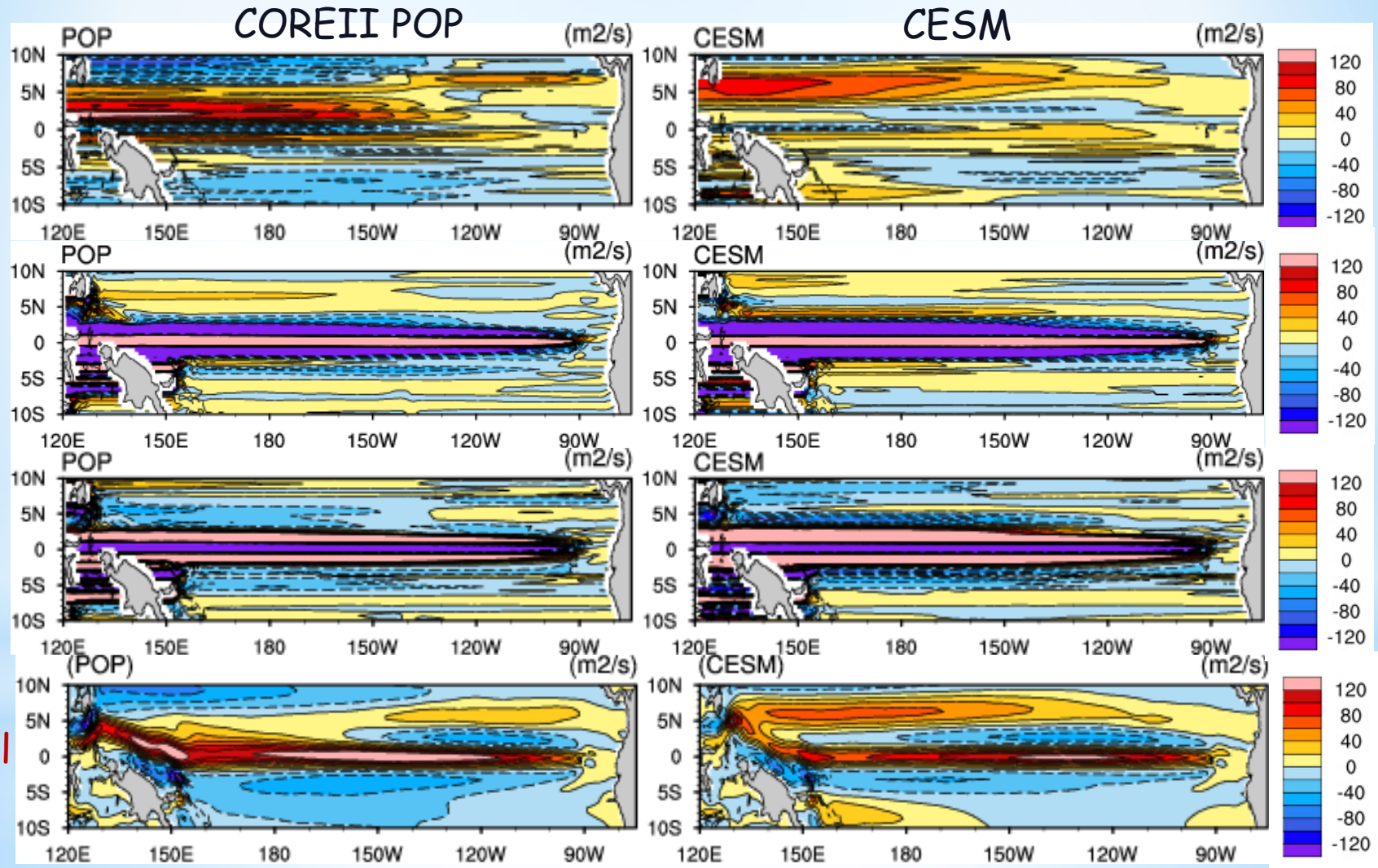
JRA-do



ZST is overestimated in all JRA

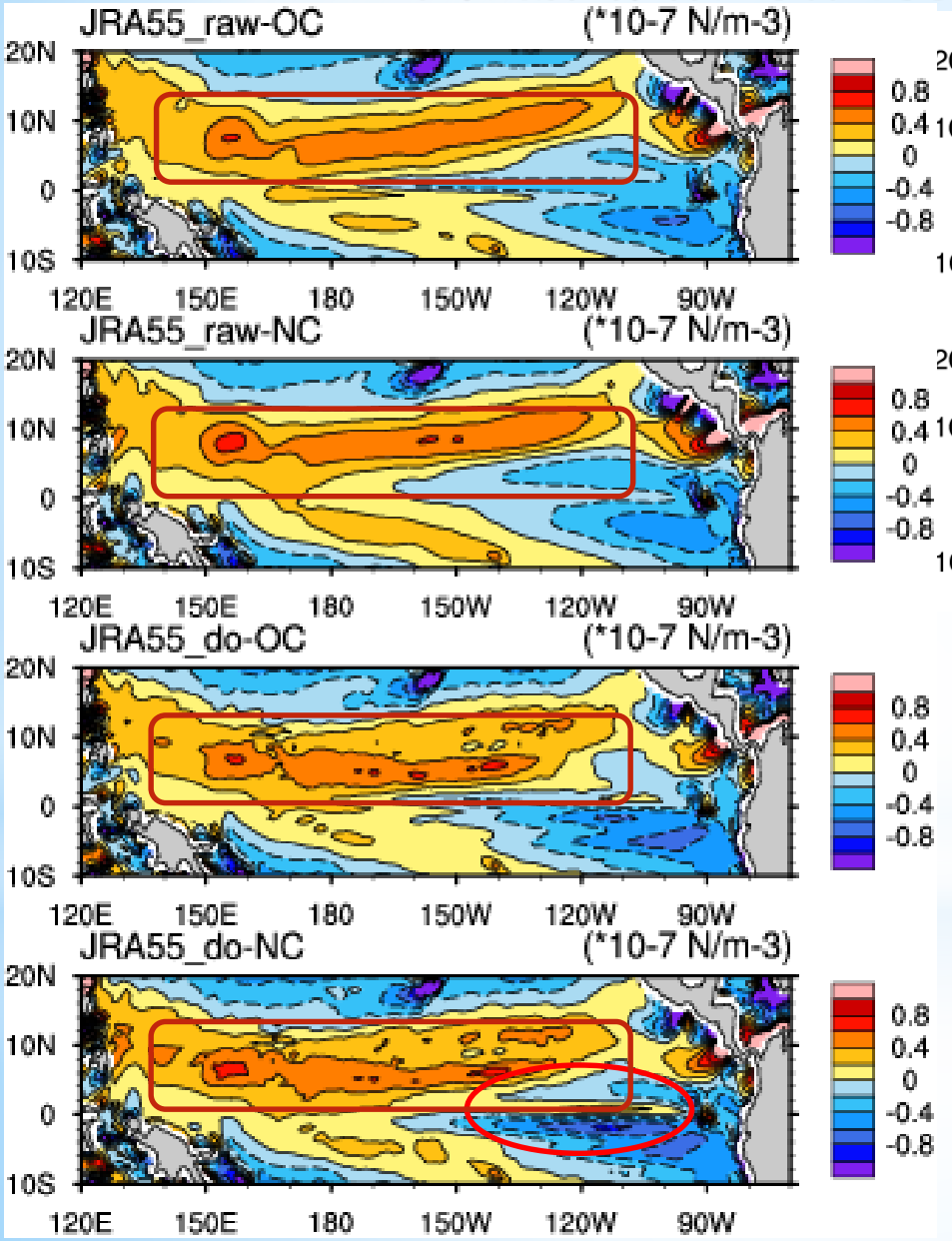
In COREII POP, ZST is overestimated west of 120W only

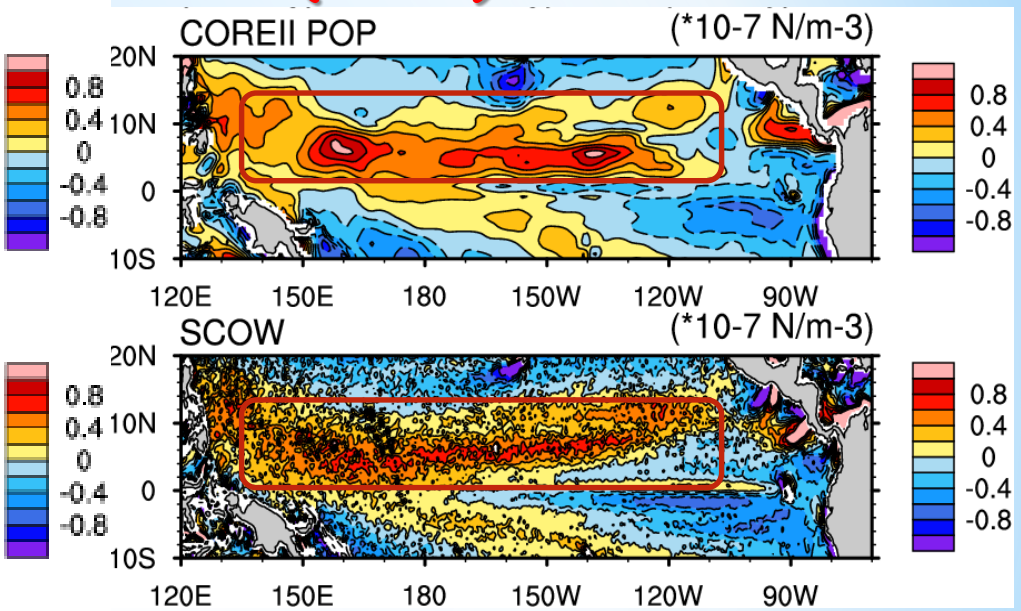
Different contributions to the zonal transport



Sun et al. (2018, in preparation)

Mean wind stress curl (WSC)





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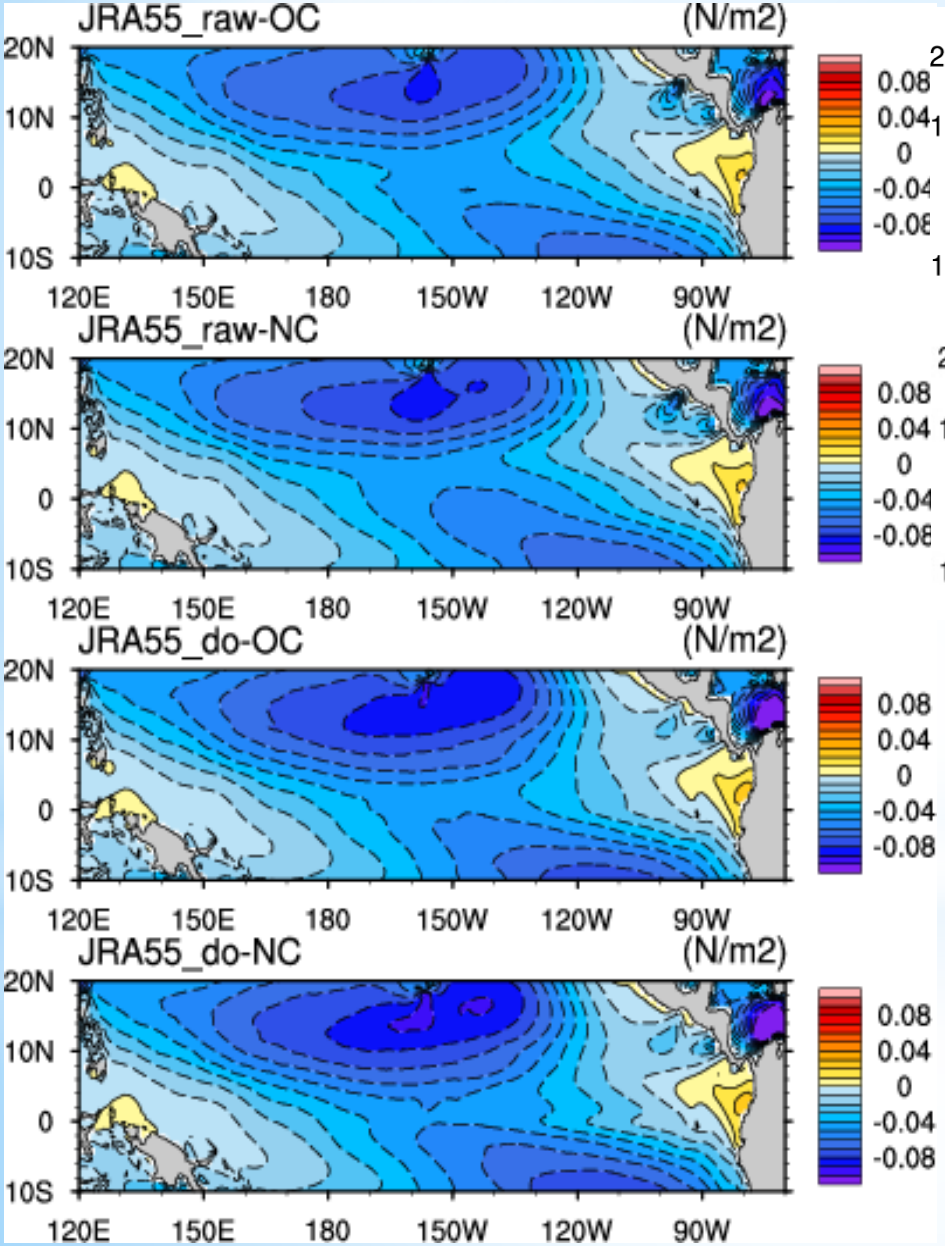
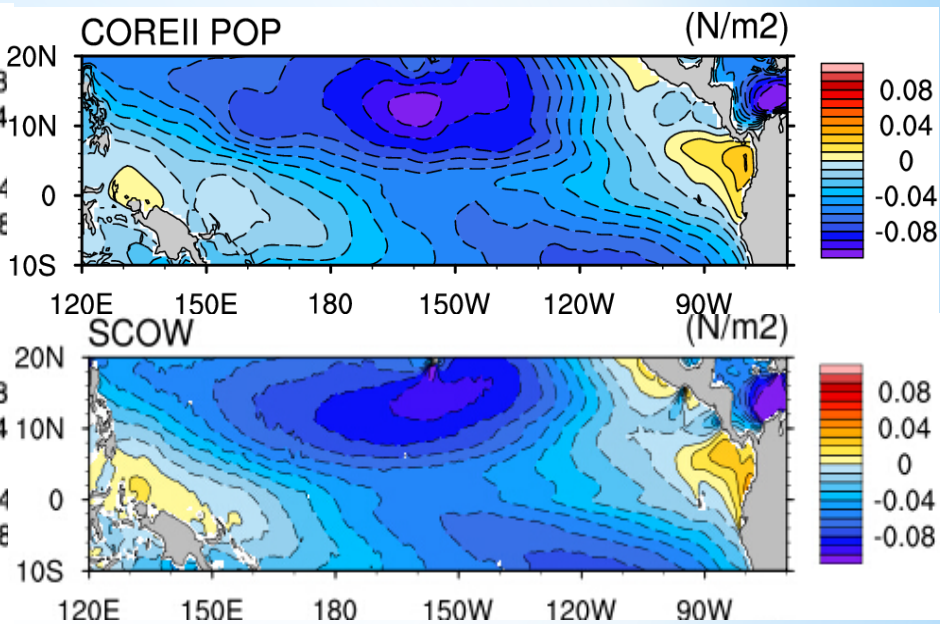
Mean zonal wind stress

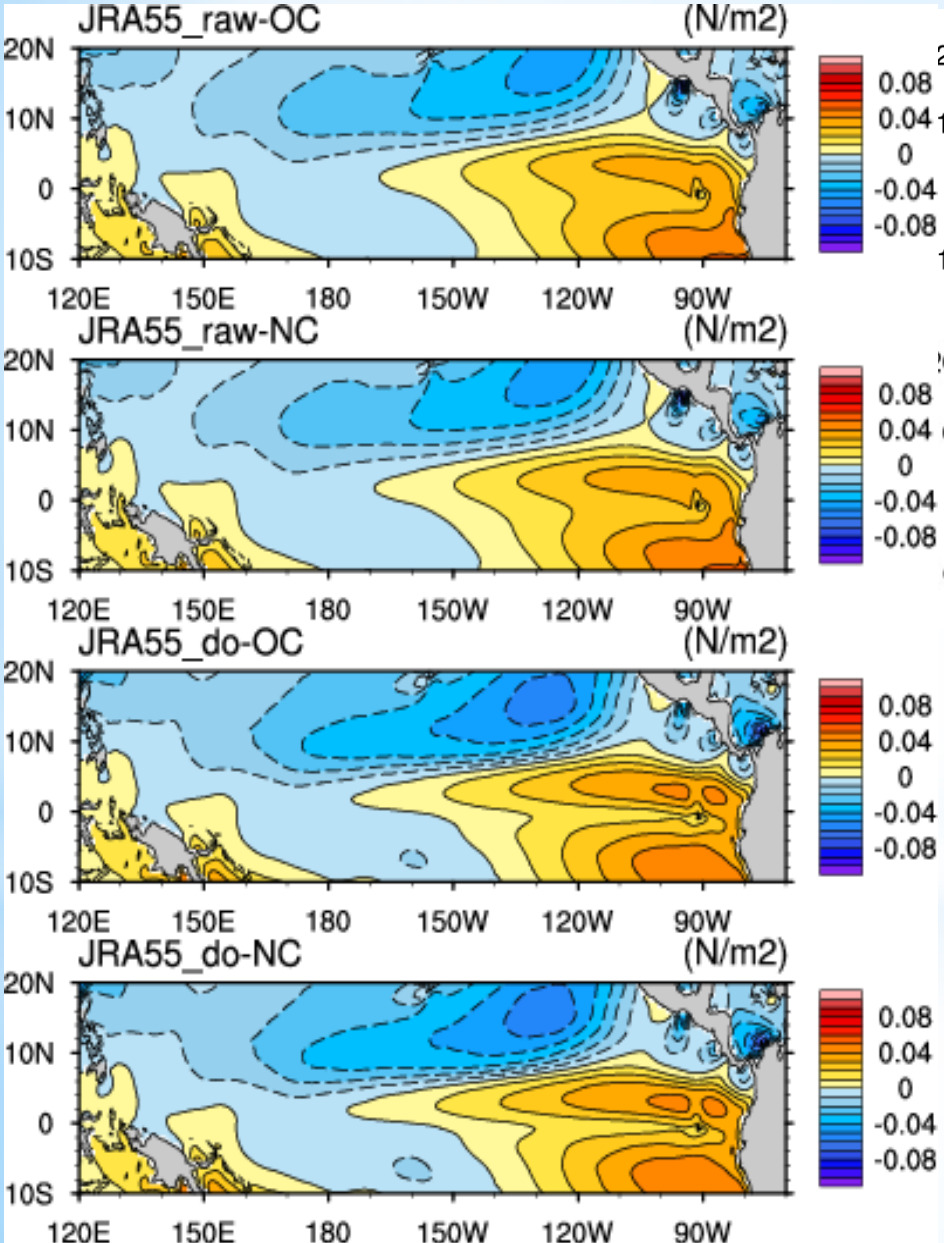


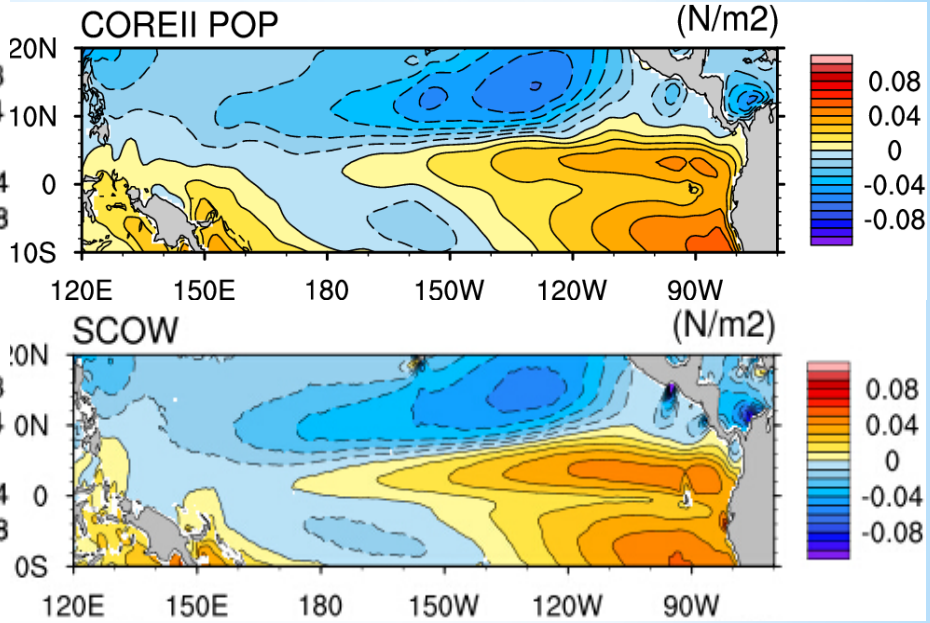


(shaded interval is 0.01 N m^{-2})

Large differences in zonal winds

Mean meridional wind stress





(The shaded interval is 0.01 N m^{-2})

Differences are smaller in meridional winds

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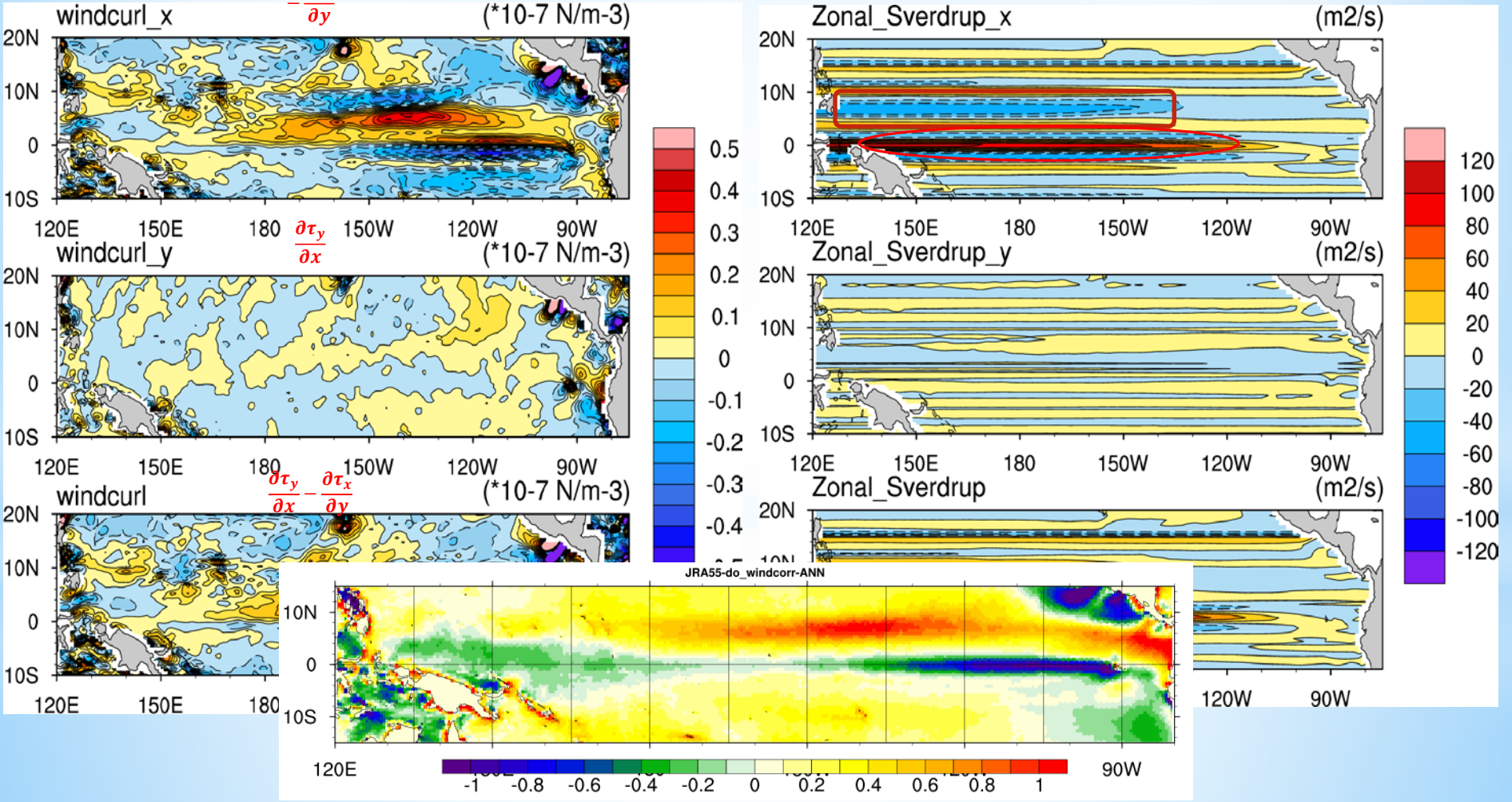
Impact of wind correction

JRA55_do-OC - JRA55_raw-OC

WSC component

Resulting Sverdrup transport



Wind speed correction offset

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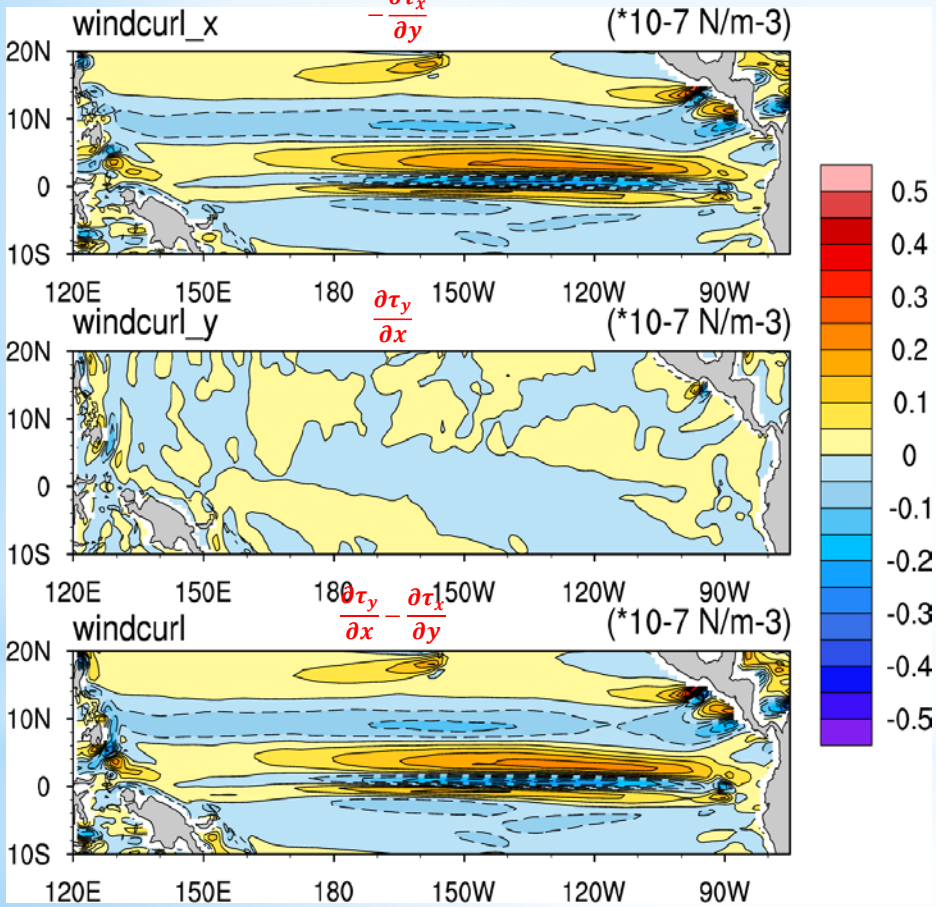
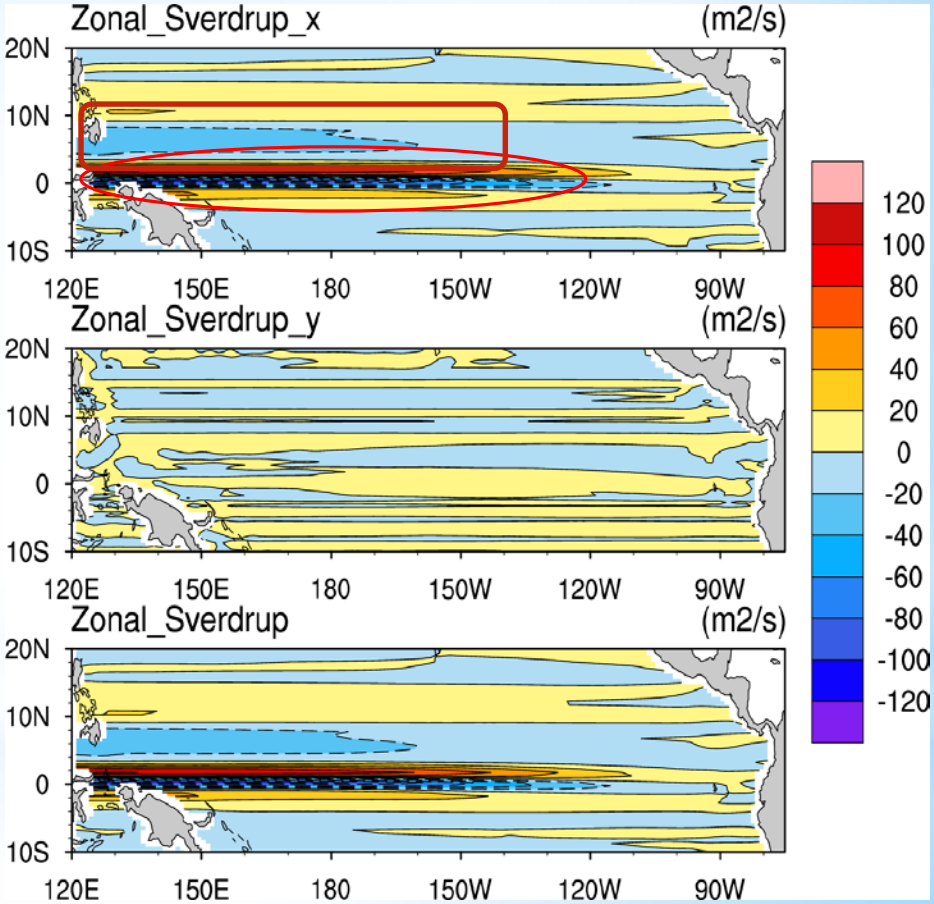
Impact of including ocean currents

JRA55_raw-OC - JRA55_raw-NC

WSC component



Resulting Sverdrup transport



Conclusion

- JRA55 corrected wind has a much closer spatial distribution of WSC to the observed wind fields (regardless of OC/NC).
  - Differences mainly from the zonal winds
  - Linear: WSC + non-linear: advection/friction
- Wind correction:
  - transport is stronger in the raw wind (magnitude is larger)
  - NECC is better but EUC extends to the surface in wind correction runs
- NC *vs* OC:
  - NECC transport is stronger in the NC (magnitude is smaller)
  - Surface currents may be counted twice in OC runs

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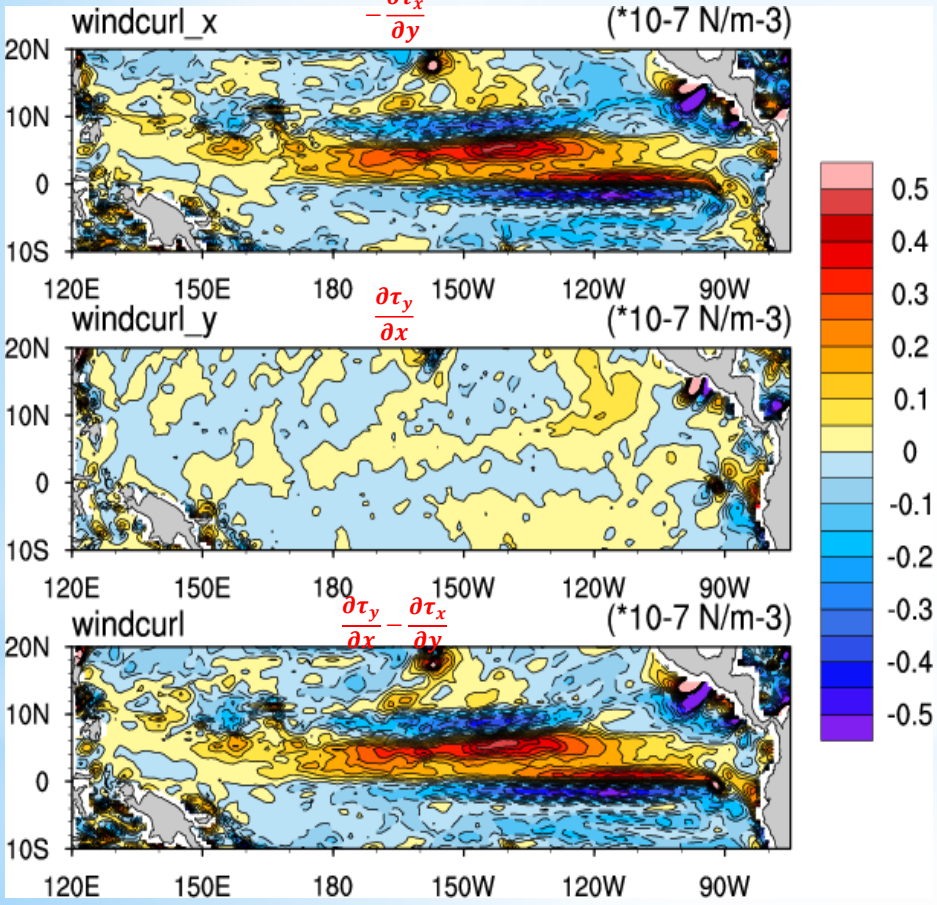
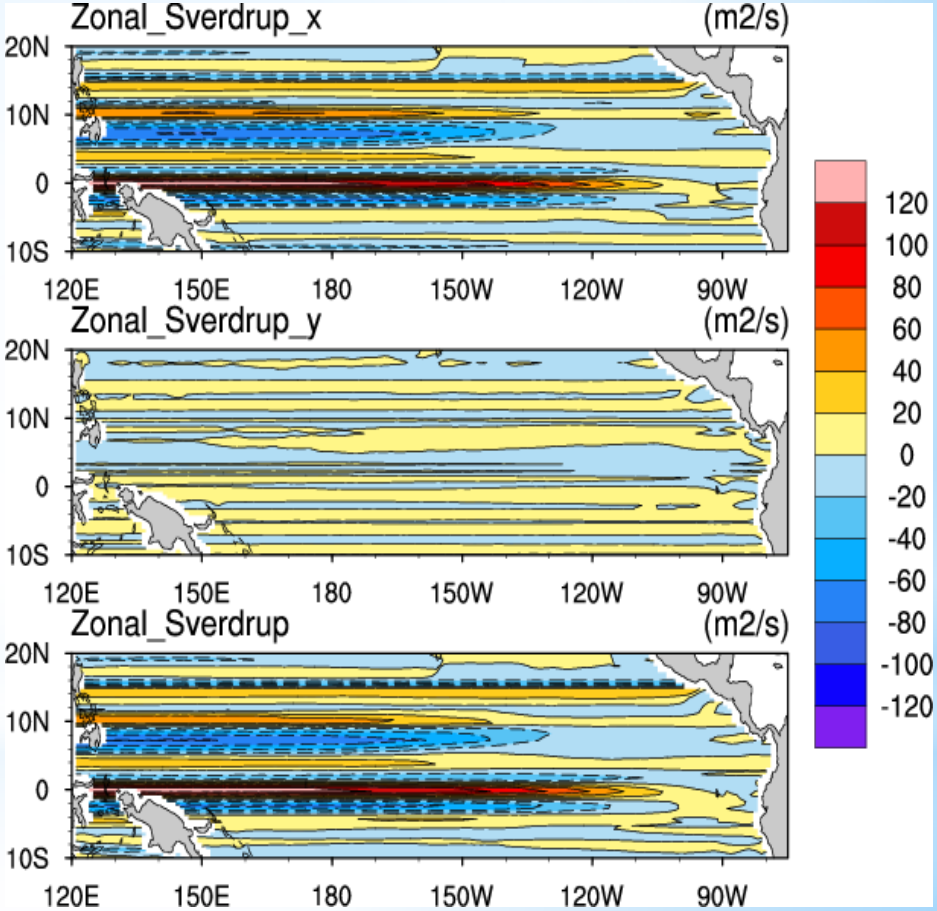
Impact of wind correction

JRA55_do-NC - JRA55_raw-NC

WSC component



Resulting Sverdrup transport



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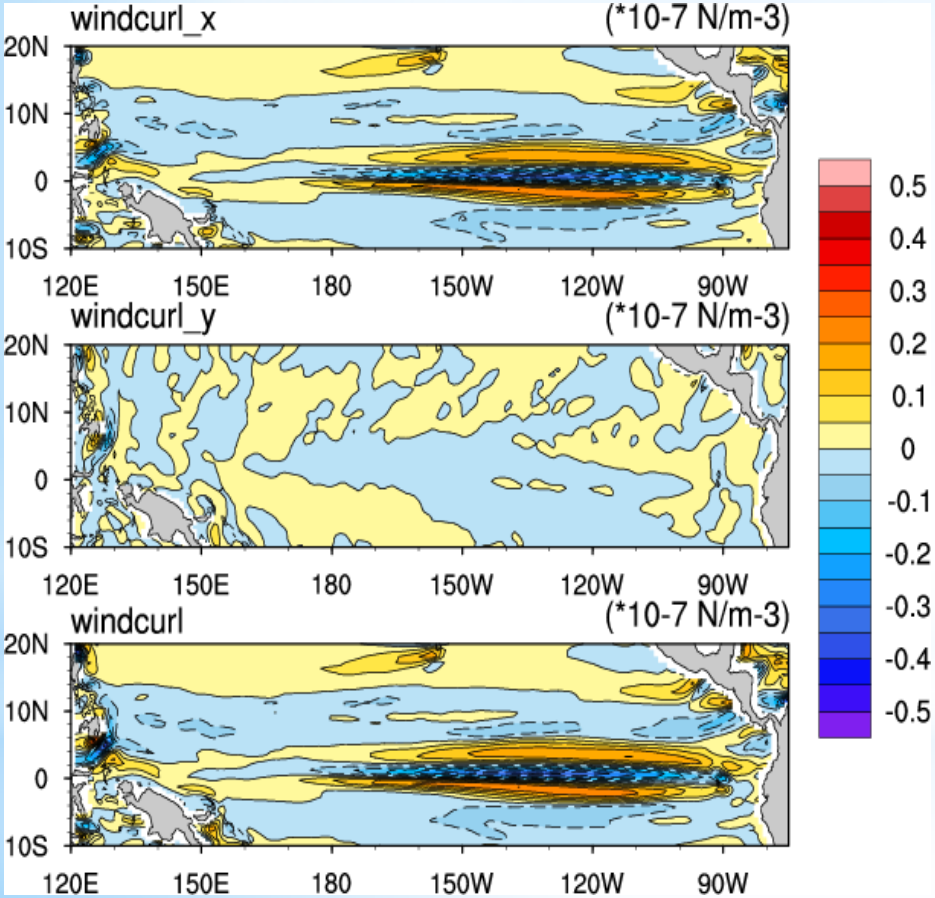
JRA55_do-OC - JRA55_do-NC

WSC component



Resulting Sverdrup transport