Mesoscale Imprints of the Kuroshio Extension and Oyashio fronts on the wintertime atmospheric boundary layer

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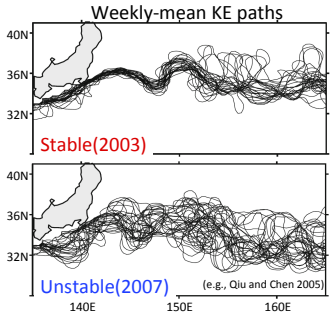
Introduction and purpose

- The Kuroshio Extension (KE) fluctuates between its stable/unstable regimes on decadal time scales, thereby causing significant local SST anomalies through modulating activity of oceanic eddies (e.g., Qiu et al. 2005; Sugimoto and Hanawa 2011; Sasaki and Minobe 2015)
- The influence of the KE regime changes on the atmosphere may extend downstream (O'Reilly and Czaja 2014; Révelard et al. 2016).
- However, local influence of the KE regime changes on the overlying atmosphere and its reproducibility in global atmospheric reanalysis have not been investigated in detail.



Purpose

- ✓ To investigate local imprints of the KE regime changes on the atmosphere
- ✓ To demonstrate the importance of high-resolution SST data in atmospheric reanalysis

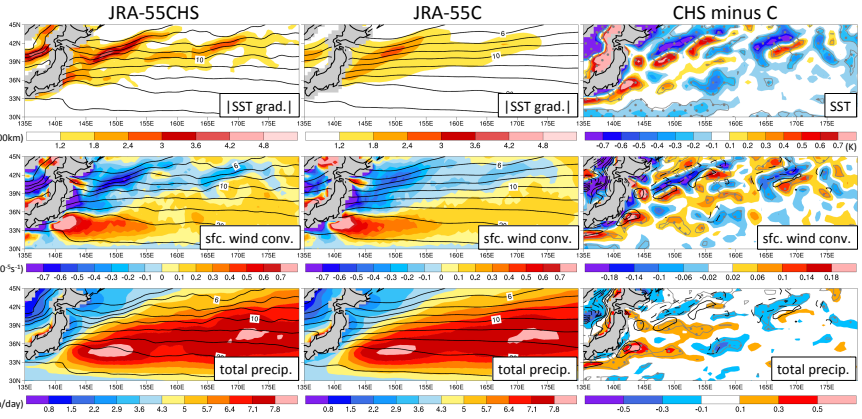
Japanese 55-year Reanalysis (JRA-55) family

Horizontal resolution : ~0.56 deg.; 60 levels up to 0.1 hPa

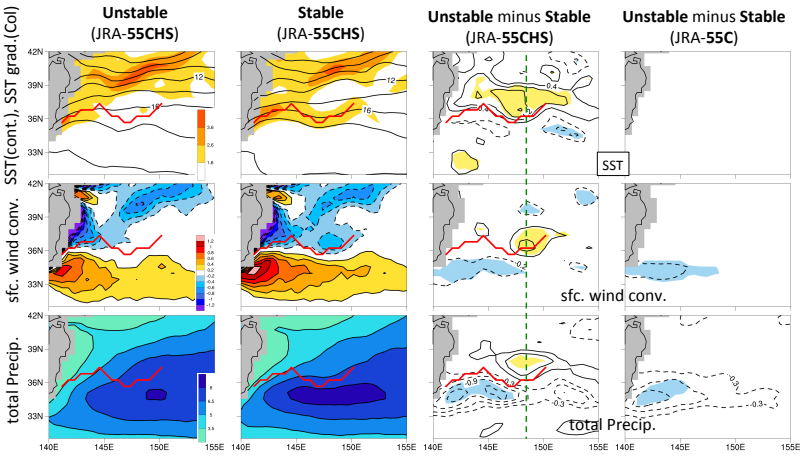
	SST data (resolution)	atmos. data assimilated	Period
JRA-55 Main	COBE-SST (1.0 deg.)	satellite + in-situ	1958-present
JRA-55C	COBE-SST	in-situ	1958-2012
JRA-55CHS	MGDSST (0.25 deg.)	in-situ	1982-2012

Major SST fronts are resolved well in MGD but not so in COBE.

DJF-climatologies →
(1986-2012; contoured for SST)
Hatched for differences with 5% significance



Variability extracted in composite maps

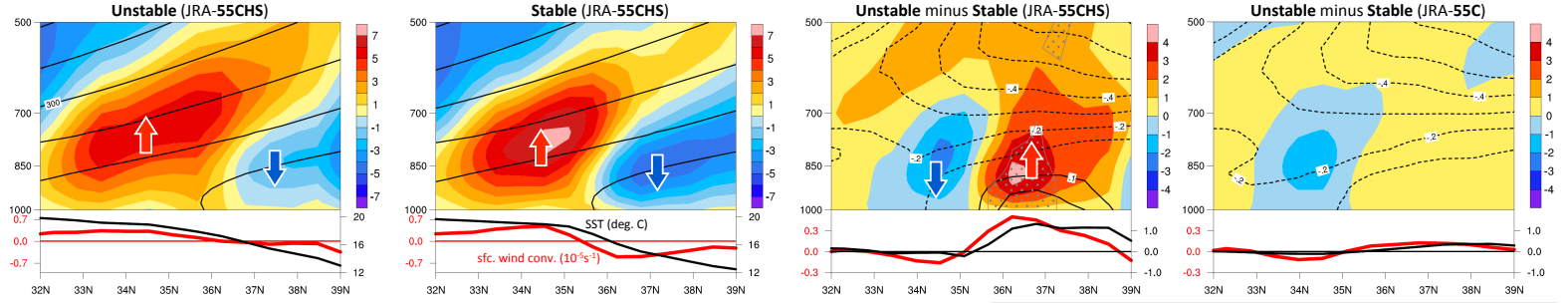


- The composited anomalies in JRA-55CHS are characterized by
  - ➢ significant SST anomalies, probably due to modulated activity of warm-core eddies in the mixed water region
  - ➢ with modulated heat/moisture release from the ocean, and
  - ➢ corresponding significant mesoscale atmospheric anomalies
- In general, they are consistent with satellite observations
- Those SST and atmospheric anomalies are, by contrast, less obvious in JRA-55C, for which low-resolution SST is prescribed

→ Improvement in SST resolution can exert significant impact on atmospheric reanalysis

DJF-composites for the KE variability (1989-2012)
(based on 10 Unstable and 14 Stable winters)
Hatched for local differences with 5% significance
Red lines: mean position of the KE front (not resolved for JRA-55C)

Variability | vertical structure (at 148.5E)



- In unstable KE regime, both ascent over KE and descent to its north are weakened
- The corresponding anomalies are missing in JRA-55C

Shade: *p*-velocity (10^{-2} Pa/s), contour: potential temperature (K)
Dotted for differences with 5% significance

Conclusions

- As well represented in JRA-55CHS, SST anomalies associated with the KE regime changes locally exert significant influence on the atmosphere through modifications in the boundary layer processes
- These anomalies are less obvious in JRA-55C, indicative of the importance of high-resolution SST data for atmospheric reanalysis