Decadal variability in a climatologically forced model

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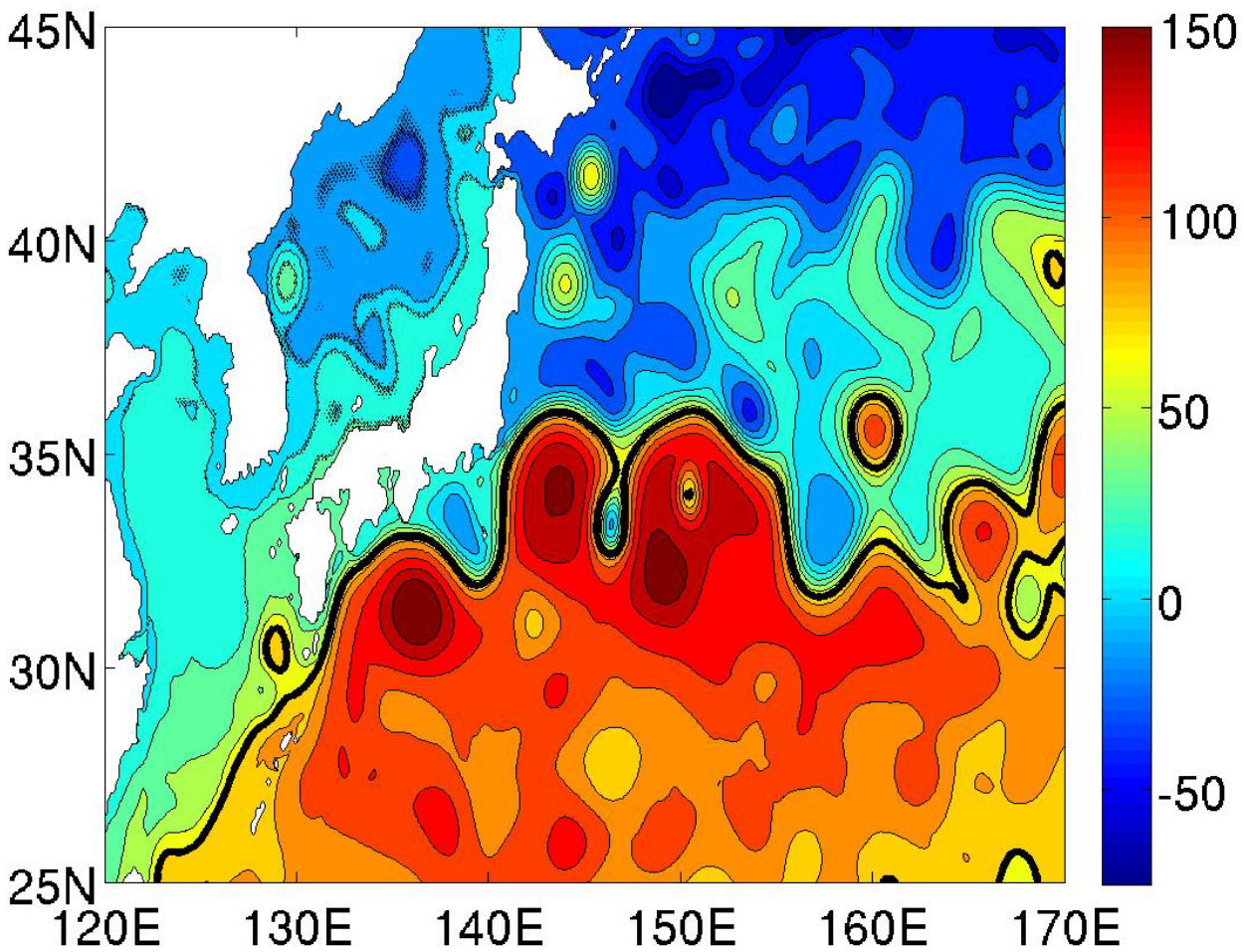
OUTLINE

- The model (POP)
- The region of interest
- The variability
  - Formation of mode water
  - Kuroshio pathway
  - Mode water characteristics
- Summary

POP

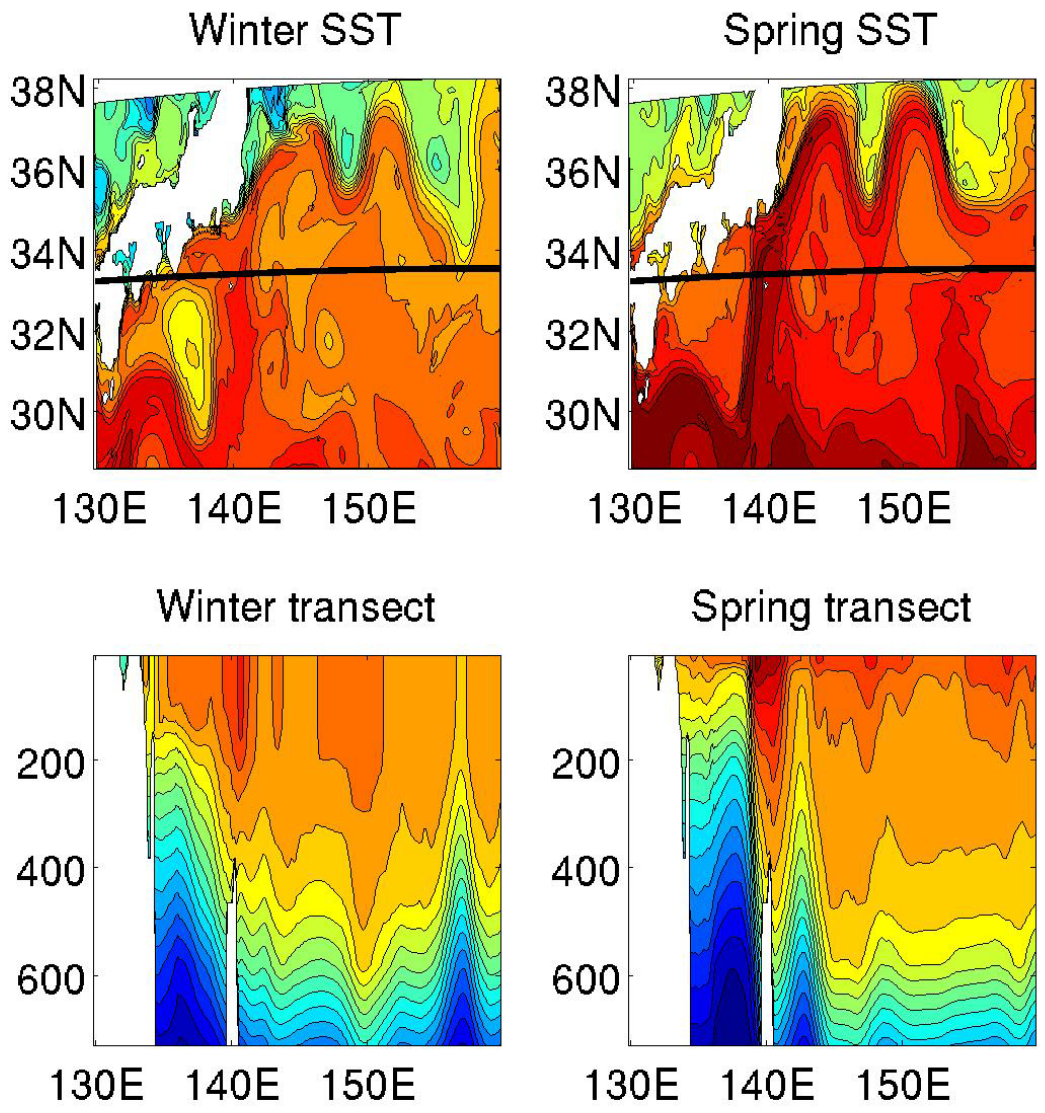
- Global run
- 100 years (used years 20 through 119)
- High resolution (~1/10° lat/lon, 42 vertical levels)
- Tripole grid (2 poles in Northern Hemisphere, over land) -- gets rid of North Pole singularity
- Climatological (“Normal year”) Forcing -- Only seasonal variability

The region: Northwest Pacific



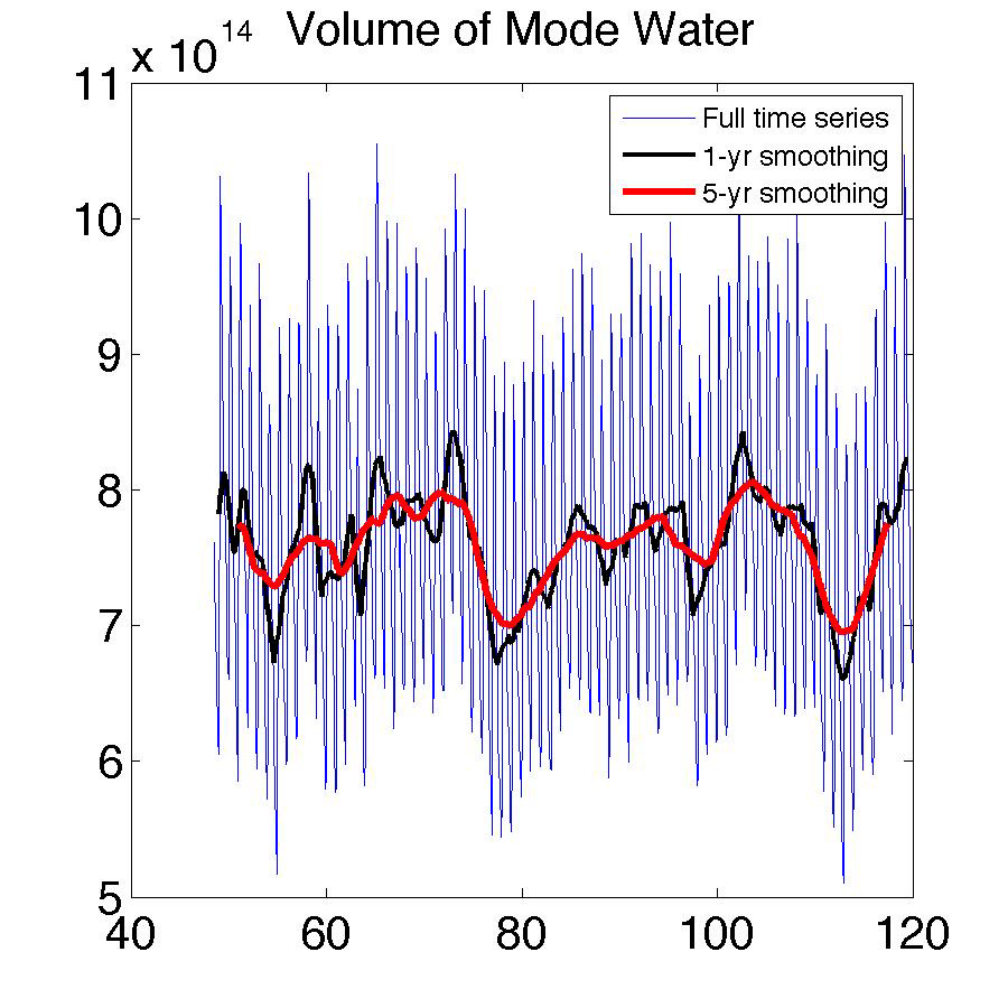
- SSH from May of year 70 is shown
- Lots of mesoscale variability
- Dark contour is the axis of the Kuroshio (western boundary current of the North Pacific)

Mode Water



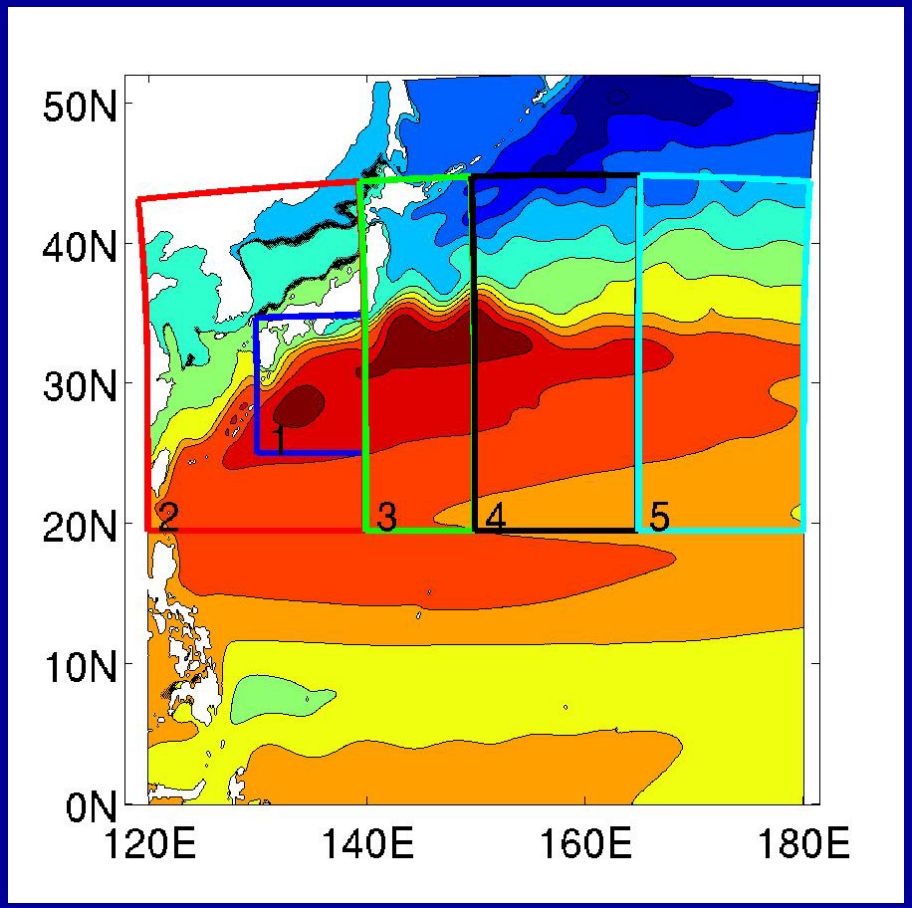
- Deep winter mixed layer gets “capped off” by spring restratification
- Thick layer with homogeneous properties => Mode Water
- Potential vorticity often used as the best indicator of mode water

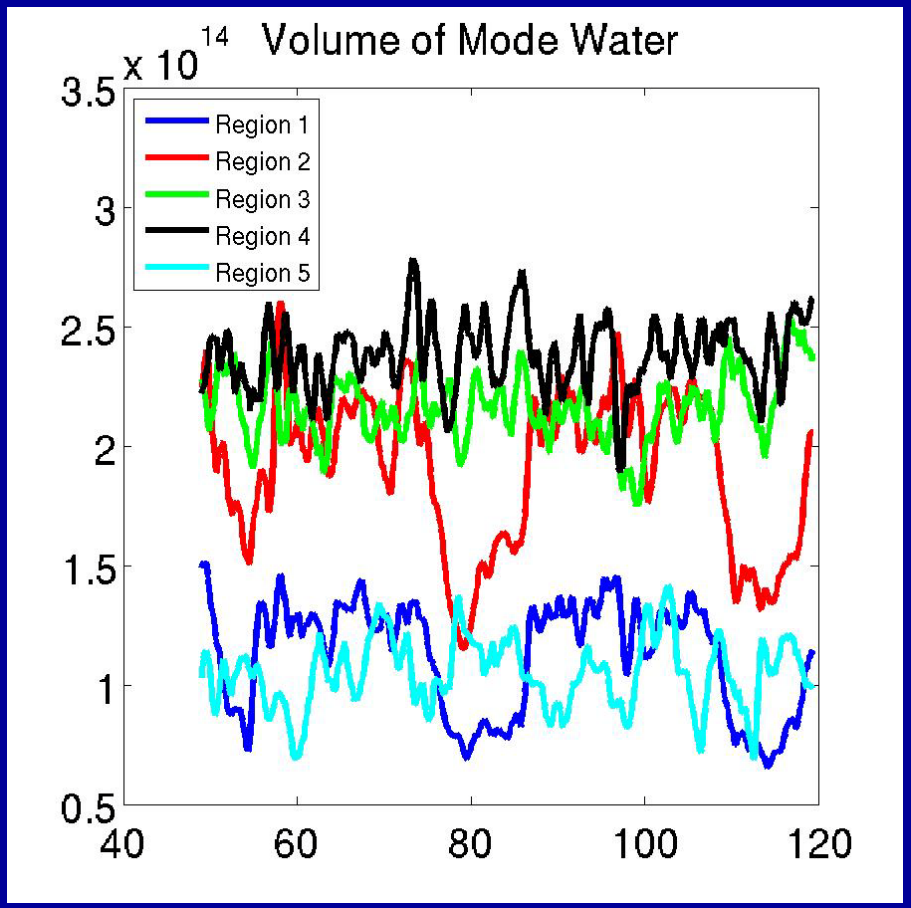
Mode Water - Volume



- Strong seasonal cycle
- Significant interannual and decadal variability
- No interannual variability in forcing -- intrinsic?

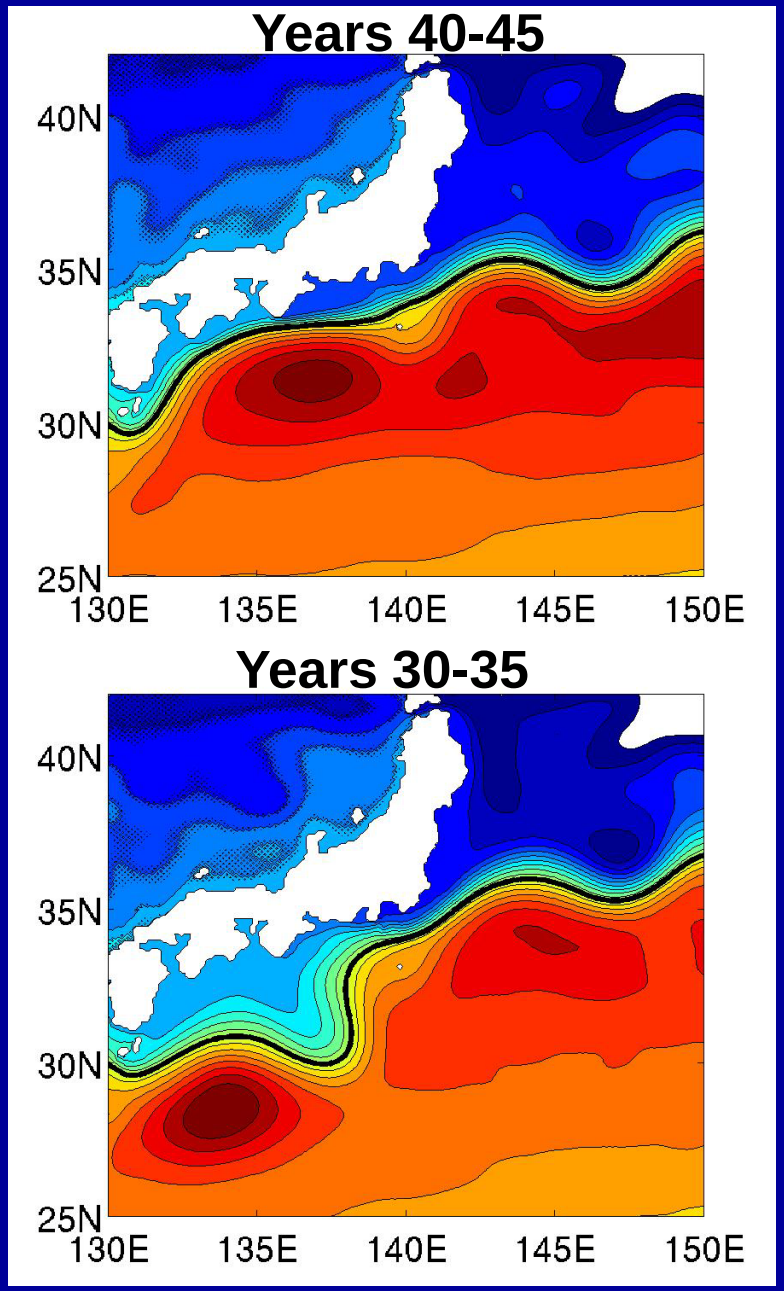
Geographical Analysis

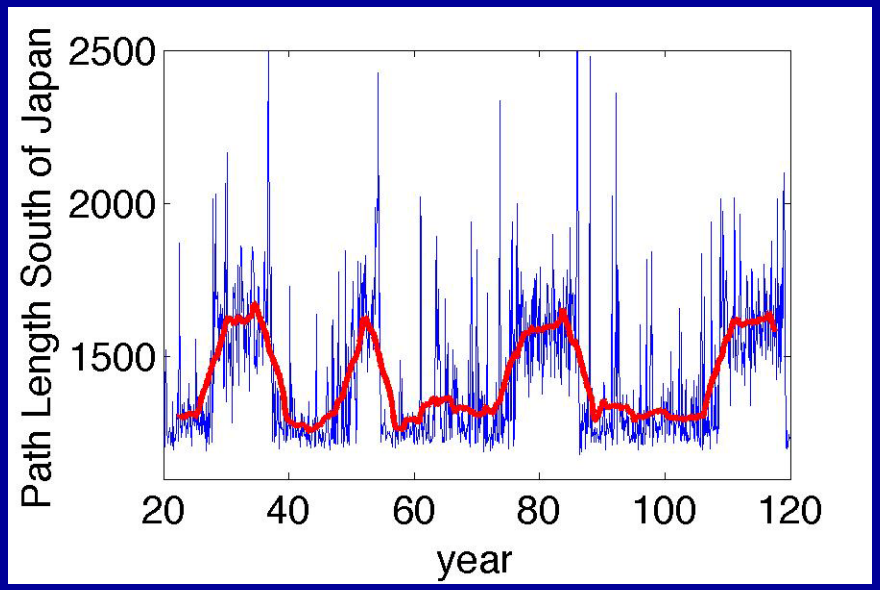




- Regional breakdown shows that the most significant mode water volume changes occur south of Japan

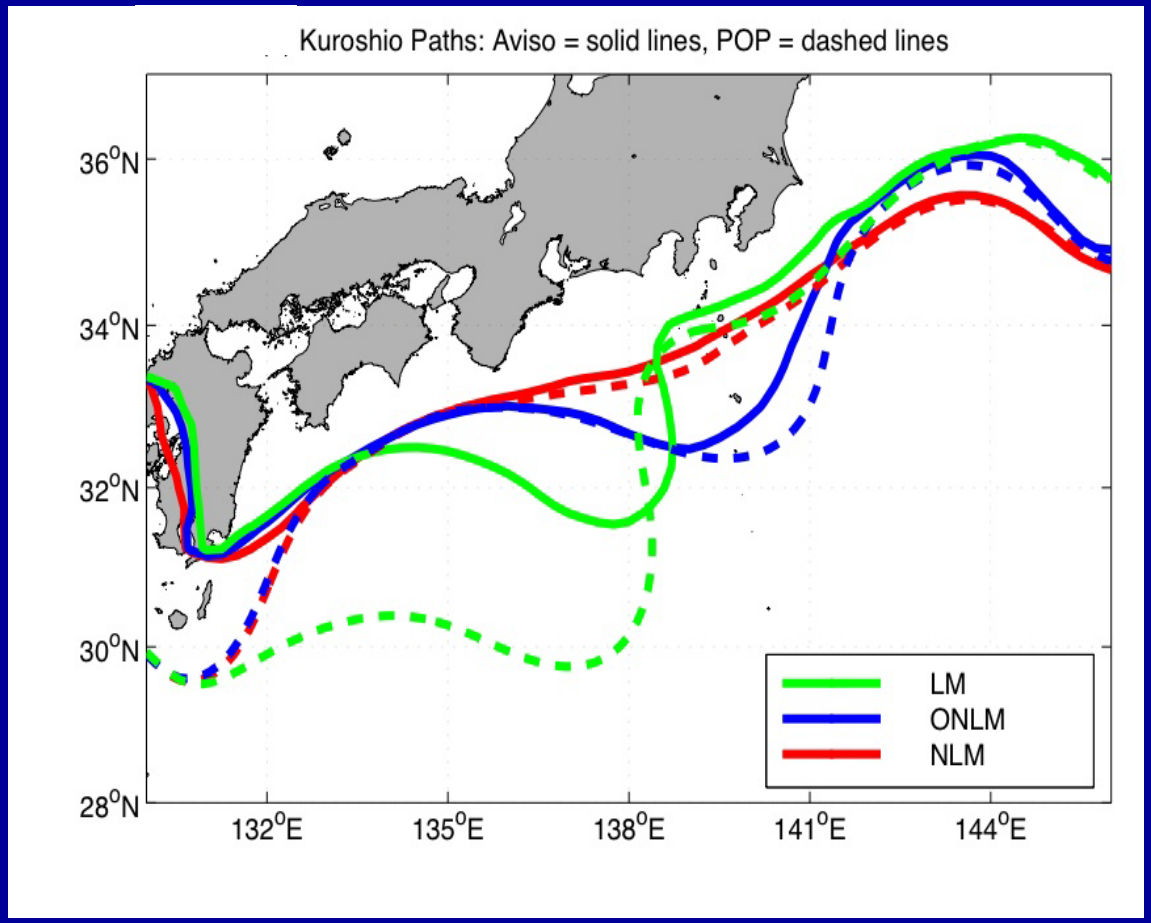
Kuroshio Pathway Variability





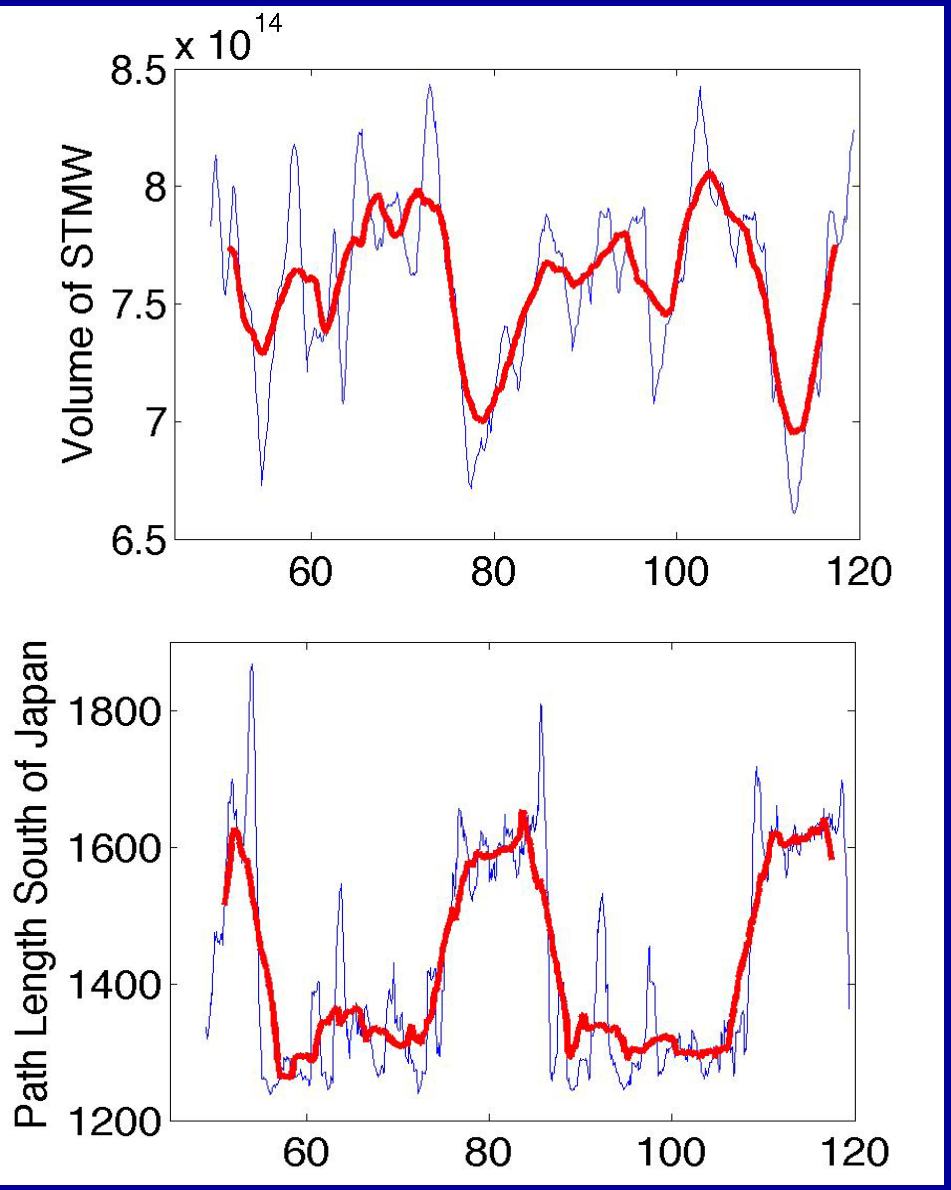
- Path south of Japan: the "Large Meander"
- This feature has been observed as well -- not just a model artifact.
- Use path length as an index

Kuroshio Variability

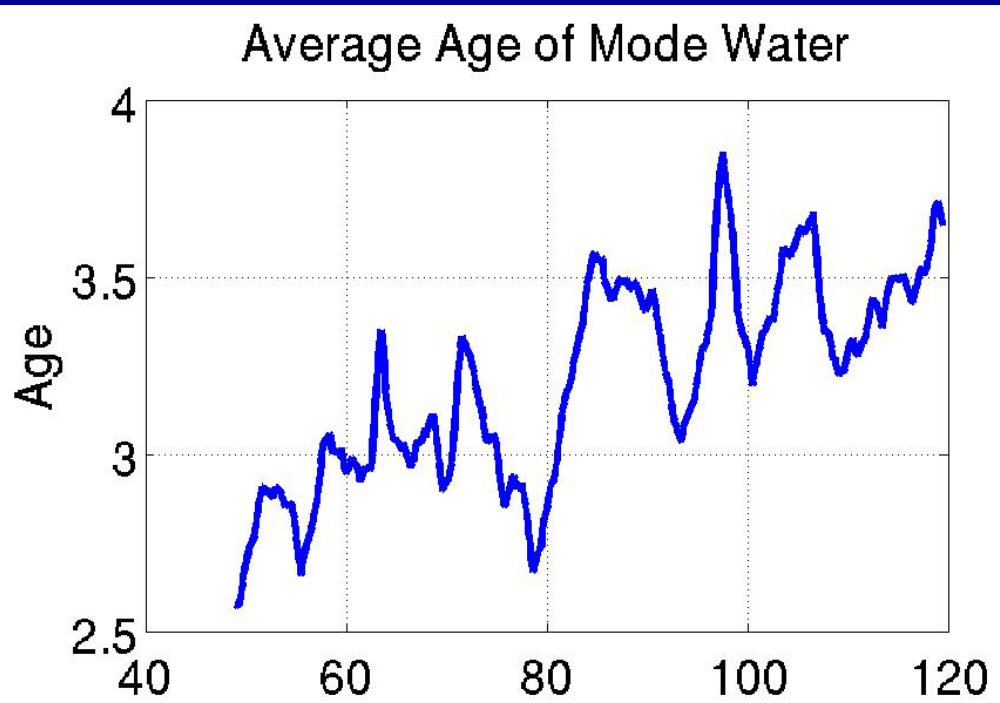


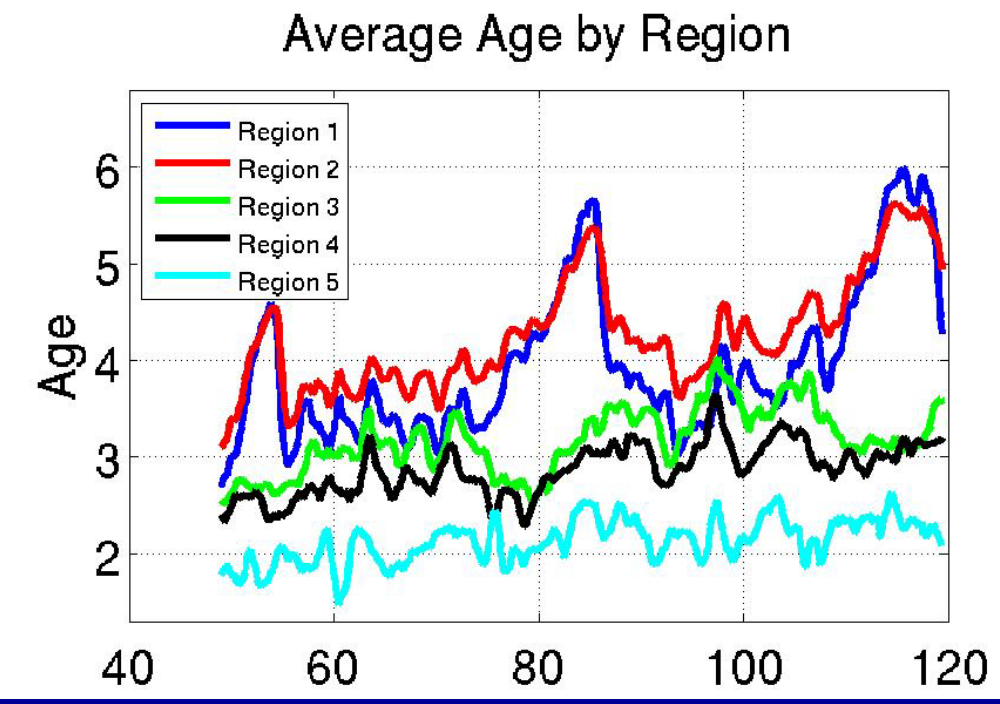
- Although the large meander does exist, it's structure is different from observations
- Separates farther south; generally much larger

STMW and the Large Meander



- Highly anticorrelated: r = -0.86 when smoothed over 5 years
- Makes physical sense: LM “cuts off” MW south of Japan

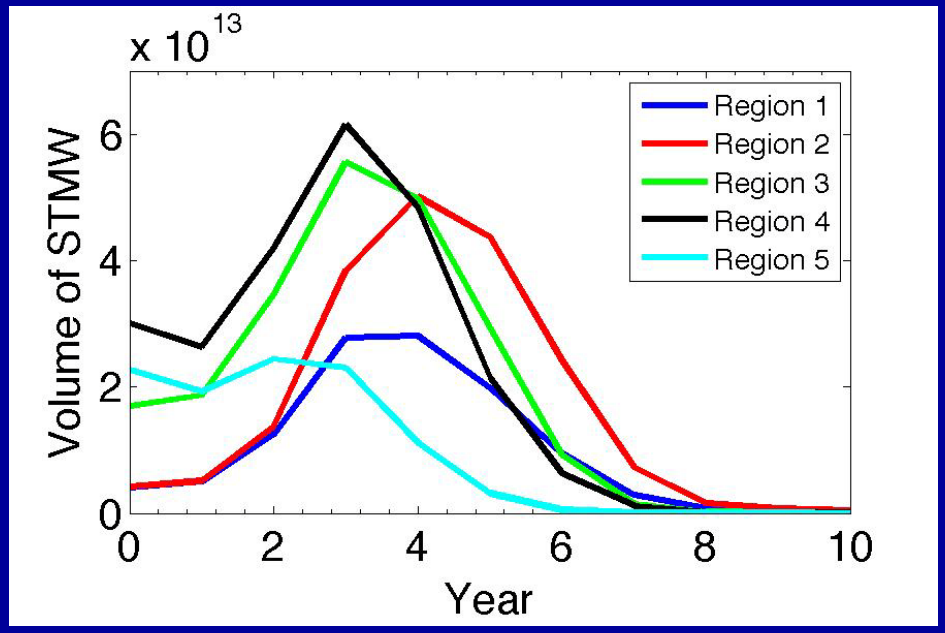


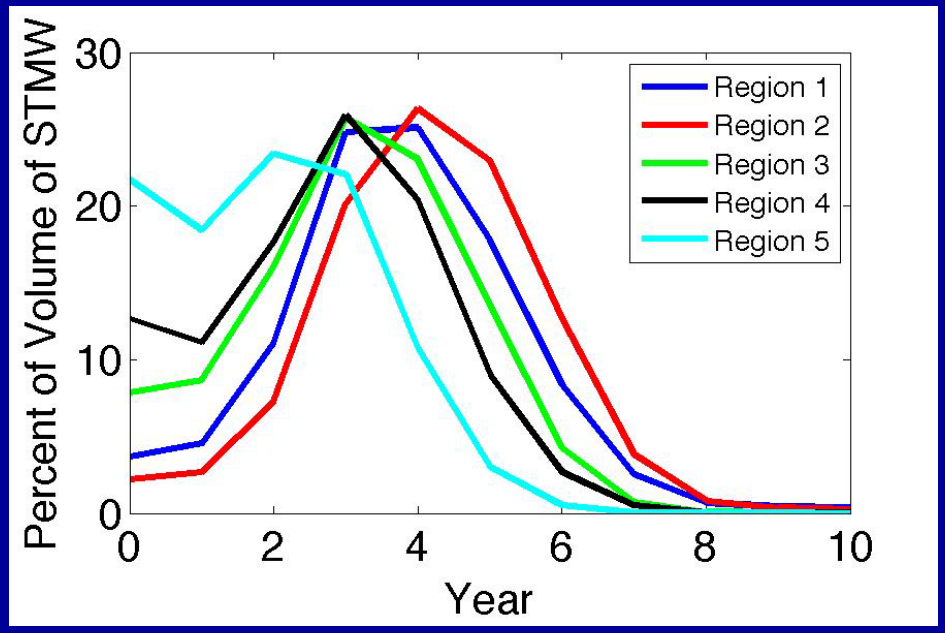


Age Analysis

- Linear trend is an artifact of the metric
- The variability in age is not correlated with age in region 1
- Highest correlation with age in region 4, where MW is formed (r = 0.83)
- Age is NOT related to the large meander

STMW: Age Distribution





- Most new water (bin 0) in the east
- Farther east => younger average age
- Mode water is formed in the east and drifts westward with time

Summary

- Intrinsic oceanic variability exists in a model with non-varying forcing
- Large meander in Kuroshio pathway south of Japan
- Mode water formation and characteristics (age) also vary
- Variability in STMW volume is controlled by the large meander south of Japan
- Variability in STMW age is controlled by a separate (unidentified) mechanism