### Consistency of AMOC estimates from global ocean data assimilation (ODA) products

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# Many thanks to the following groups that contribute their products

6 smoother-type products (adjoint, Kalman-filter/smoother, Green's Functions):

ECCO (MIT, JPL, SIO), ECCO-2, German-ECCO, Japan-K7

8 sequential-type products (OI, 3D-VAR, Kalman filter):

CERFACS, ECMWF, GFDL, INGV, MERCATOR, NCEP (GODAS), SODA, Univ. Reading

# Comparison of 1993-2001 mean meridional transport stream function of the Atlantic Ocean as a function of latitude & depth



#### MOC at 26°N 1000 m



MOC anomaly at 26°N 1000 m (relative to 1993-2001 mean)



MOC at 26°N 1000 m



MOC anomaly at 26°N 1000 m (relative to 1993-2001 mean)



MOC at 48°N 1000 m



MOC anomaly at 48°N 1000 m (relative to 1993-2001 mean)



MOC at 48°N 1000 m



MOC anomaly at 48°N 1000 m (relative to 1993-2001 mean)



#### Better consistency among smoother than among sequential products



#### r.m.s. difference among products (noise) smaller than variability (signal)



#### rms diff. for diff. time scales: seasonal < interannual < intra-seasonal



#### Difference of variability smaller among smoother than among sequential types



Averaged rms diff. of  $\psi$  anomaly for sequential products (Sv)



## Difference of time mean smaller among smoother than among sequential types for depths < 2000 m. At greater depths, the patterns of differences are different.



Averaged rms diff. of  $\psi$  anomaly among different products (Sv)

Averaged rms diff. of  $\psi$  anomaly for "smoother" products (Sv)



Averaged rms diff. of  $\psi$  anomaly for sequential products (Sv)



#### Some statistics for MOC at 26° and 48°N at 1000-m depth (in Sv)

#### 26°N:

- Averaged variability: 2.65.
- Averaged r.m.s. difference of temporal anomaly: 1.78 (1.29 for smoother, 1.91 for sequential).
- Averaged r.m.s. difference of time mean: 2.46 (2.19 for smoother, 2.66 for sequential).

#### 48°N:

- Averaged variability: 2.55.
- Averaged r.m.s. difference of temporal anomaly: 1.47 (0.84 for smoother, 1.78 for sequential).
- Averaged r.m.s. difference of time mean: 2.63 (2.73 for smoother, 2.74 for sequential).

#### Poor consistency at decadal & longer time scales

10-year low-pass MOC anomaly at 26°N 1000 m: with trend



10-year low-pass MOC anomaly at 26°N 1000 m: detrended



### Summary

- Monthly averaged meridional transport stream function estimated by 14 global ODA products are compared.
- Consistency for temporal anomaly is better than that for time mean (except within 10° of the equator).
- r.m.s. differences for temporal variability are smaller than the variability,
  i.e. signal/noise ratio > 1, for intraseasonal-to-interannual time scales.
- Consistency is the best for seasonal anomaly, followed by interannual anomaly; intra-seasonal anomaly accounts for most of the discrepancy.
- Poor consistency for decadal & longer time scales.
- Consistency for anomaly is better among the 6 smoother products than among the 7 sequential products.

Is the larger spread among sequential products caused by the assimilation? Non-assimilative runs being collected and analyzed.