THERMAL EXPANSION OVER THE PAST 50 YEARS: INERENCE ON OCEAN MASS CHANGE AND SEA LEVEL RISE

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SUMMARY

We investigate the thermosteric (i.e., due to temperature only) sea level change over the last 50 years using two global ocean temperature data sets recently published (Levitus et al., 2000 and Ishii et al., 2003). These data sets which provide gridded ocean temperatures, down to 3000 m and 500 m respectively, are based on objective analyses of raw historical profiles over 1950-1998. We find that the two data sets are compatible, both in terms of thermosteric sea level trends and global mean. In the absence of unequivocal independent evidence of the thermohaline and thermal components of the ocean deep circulation, some connection is also noticed with the North Atlantic Oscillation. As a result, regional/thermosteric sea level trends are not stationary on a multi-decadal time scale and have a typical life-time on the order of a few years.

We also compare sea level series and trends observed at a few selected tide gauges of good quality record with those obtained from the two global ocean temperature data sets. We find that the two data sets compare well, both in terms of thermosteric sea level trends and global mean, although the residual trends of the Ishii data are too small to account for the rate of sea level rise observed by tide gauges. This new analysis confirms the result of Miller and Douglas (2004), that a dominant water mass contribution is needed to explain the rate of last decades sea level rise observed by tide gauges.

CONCLUSIONS

Thermosteric sea level variations are dominated by the decadal oscillations of the main coupled ocean-atmosphere climatic perturbations PDO, NAO and ENSO. Thus thermal expansion patterns are not stationary in time. Their life-time seems to be on the order of 10 years.

SEA LEVEL COMPARISONS

Sea level records at 27 historical tide gauges display long, good quality records (blue curves). The red and green curves show the thermosteric sea level calculated using the Levitus and Ishii data, respectively, interpolated in the vicinity of the tide gauge sites.

REFERENCES

Levitus et al., 2000
Ishii et al., 2003
Miller and Douglas, 2004

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