Wind stress measurements from the QuikSCAT-ADEOSS-II tandem mission and the impact on an ocean model

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This presentation focuses on the impact on large-scale SST. Discussion for other aspects are provided in Lee et al. (2008, JGR, in press), e.g., meridional overturning ciruclation & heat transport, coastal regions, etc..

Motivation & Objectives

- QuikSCAT samples 90% of the world ocean at daily interval.
- QuikSCAT-ADEOS-II tandem mission (Apr.-Oct. 2003) covers 90% of world ocean at twice-daily interval (referred to as QuikSCAT & SeaWinds).
- What is the benefit of the increased sampling for ocean modeling?
- Lee & Liu (2005) examined the impact of twice-daily vs. daily NCEP wind; but the representativeness of the results for scat. observations is not clear.

Approach

Perform sensitivity experiments by forcing an OGCM using twice-daily & daily wind obtained from the tandem mission.

MITOGCM: 75°S-75°N, 1°x(0.3°-1°), 46 levels, KPP & GM mixing schemes.

Sensitivity experiments have identical buoyancy forcing, but different winds.

Twice-daily sampling enhances wind variability(a) r.m.s. |\tal{1}: QSdaily(b) r.m.s. |\tal{1}: SWdaily





(f) r.m.s. |τ|: NCEP twice daily



Enhancement of variability due to increased (sub-daily) sampling



SST difference with twice-daily & daily winds (08/2003) With scat. wind 60N 40N Latitude 20N 0 20S **40S** 30E 90E 150E 90W 60W 150W With NCEP wind 60N 2 40N Latitude 20N 0 0 20S 40S

1

-1

-2

60W

30E 150W 90W Impact on SST is significantly larger than SST error.

150E

90E

- Impact with scat. wind is substantially larger than that with NCEP wind. •
- Consistent with larger increase of scat. wind variability due to twice-daily • sampling (previous slide).

Differences of model state with twice-daily & daily scatterometer wind (08/2003) **SSS** difference **SST difference**

2

0

-1

-2

(a) August SST difference: QSSW2daily - QSdaily



(a) August SSS difference: QSSW2daily - QSdaily



-0.1

Vertical profiles of time-mean T, S, and vertical diffusivity with twice-daily and daily winds



- Twice-daily wind cause stronger near-surface vertical mixing, causing the negative SST & positive SSS difference.
- Consistent with the role of resonant inertial oscillations (17 hours at 45°N/S, 12 hours at the poles) e.g., Large & Crawford (1995), Stockwell et al. (2004).

Twice-daily wind improve SST simulation



Heat flux correction methods (relaxation, bulk formula, atmospheric mixedlayer model, data assimilation) can also improve SST simulation. BUT, they cause incorrect error compensation because of the source of error is the wind.



SST budget and incorrect error compensation through relaxation (09/2003)

Summary

- Twice-daily sampling from QuikSCAT-ADEOS-II enhances wind variability (more so than NCEP reanalysis) & improves SST simulation.
- Ocean models forced by daily wind would have a systematic bias in vertical mixing tendency; any heat flux correction method would cause incorrect error compensation.
- Future scatterometer missions that resolve diurnal variability would benefit ocean modeling & data assimilation.

The difference in variability between QS & SW are assumed to be primarily due to diurnal sampling. Other sources (e.g., rain contamination) need further investigation.

Backup slides

No. of observations by QS, SW, & their tandem mission over a 12-hour period





Differences between QS & SW serve as lower-bound estimates of uncertainty







