热带海洋学报
JOURNAL OF TROPICAL OCEANOGRAPHY

热带海洋学报 » 2011, Vol. 30 » Issue (5) :48-54

同化海温观测数据研究波浪破碎对海洋上层结构的影响 *

张学峰[1, 2], 韩桂军 [2], 吴新荣 [2], 李威 [2], 王东晓 [1]

1. 热带海洋环境国家重点实验室 中国科学院南海海洋研究所 , 广东 广州 510301; 2. 国家海洋信息中心 , 天津 300717

ZHANG Xue-feng[1,2], HAN Gui-jun[2], WU Xin-rong[2], LI Wei[2], WANG Dong-xiao[1]

1. State Key Laboratory of Tropical Oceanography South China Sea Institute of Oceanology, CAS , Guangzhou 510301, China ; 2. National Marine Data and Information Service, Tianjin 300171, China

摘要 首先利用考虑波浪破碎效应的Mellor-Yamada2. 5阶湍流闭合方案, 探讨了海表温度(SST)对波能因子*a*和Charnock数*b*的敏感性问题。然后采用变分数据同化途径, 基于Papa海洋天气站(OWSPapaStation)的上层温度观测数据, 对该参数化方案中的波能因子*a*和Charnock数*b*两个参数进行了最优估计。最优估计的结果表明, 当*a*约为167、*b*约为4. 1×10^{5}时, 价值函数达到最小值。利用上述参数的最优估计进行海温的数值模拟, 可以较好地反映出海表温度的日变化和月变化过程, 模拟的上混合层的温度和深度也与观测较为一致。最后利用以上参数的最优估计结果对湍动能方程进行诊断计算, 研究了波浪破碎对海洋上层湍能量收支的影响。

关键词: 海表粗糙度 波能因子 同化 波浪破碎

Abstract: Sensitivity of sea surface temperature (SST) to wave energy factor *a* and Charnock parameter *b* is discussed using Mellor-Yamada 2.5 turbulence closure model in which wave breaking is considered. The upper-ocean temperature data in summer from OWS Station Papa is assimilated to estimate *a* and *b* via a variational approach optimally. It shows that the cost function reaches minimum when *a* =167 and *b* =4.1 ? 10^5. Both monthly and daily SSTs at OWS Station Papa can be successfully reconstructed with the optimal a and *b* , and the simulated temperature and depth of surface mixed layer are also consistent with the observation. The equation of turbulent kinetic energy is diagnosed utilizing the optimal parameters, from which the effect of wave breaking on the turbulent energy budget is revealed.

Keywords: sea surface roughness, wave energy factor, assimilation, wave breaking

收稿日期: 2011-11-01;

基金资助:

国家重点基础研究发展计划项目 (2007CB816001); 中国科学院重大项目 (KZCX1-YW-12-01); 国家自然科学 (41030854 、40906015 、 40906016 、 41106005); 卫星海洋动力学国家重点实验室开放 (SODA0703)

作者简介: 张学峰 (1978 —), 男 , 辽宁省本溪市人 , 博士 , 主要从事海洋数据同化和海洋数值模拟方面研究。

引用本文:

张学峰, 韩桂军, 吴新荣等 .同化海温观测数据研究波浪破碎对海洋上层结构的影响 * [J] 热带海洋学报, 2011,V30(5): 48-54

ZHANG Hua-Feng, HAN Gui-Jun, TUN Xin-Rong etc .Effect of surface wave breaking on upper-ocean structure revealed by assimilating sea temperature data[J] Journal of Tropical Oceanography, 2011,V30(5): 48-54

链接本文:

http://www.jto.ac.cn/CN/ 或 http://www.jto.ac.cn/CN/Y2011/V30/I5/48

[1] PHILLIPS O M. Dynamtics of the Upper Ocean[M]. Cam-bridge: Cambridge University Press, 1977: 366.

[2] DRENNAN W M, DONELAN M A, TERRAY E A. Oceanic turbulence dissipation measurements in SWADE[J]. J Phys Oceanogr, 1996, 26: 808-815. 2.0.CO;2 target="_blank">

[3] CRAIG P D, BANNER M L. Modeling wave-enhanced turbulence in the ocean surface layer[J]. J Phys Oceanogr, 1994, 24: 2546-2559. 2.0.CO;2 target="_blank">

[4] CHARNOCK H. Wind stress on a water surface[J]. J Roy Meteor Soc, 1955, 81: 639-640.

[5] TERRAY E A, DONELAN M A, AGRAWAL Y C, et al. Estimates of kinetic energy dissipation under breaking waves[J]. J Phys Oceanogr, 1996, 26: 792-807. 2.0.CO;2 target="_blank">

[6] KRAUS E B, TURNER J S. A one-dimensional model of the seasonal thermocline. II. The general theory and its conse-quences[J]. Tellus, 1967, 19: 98-105.

[7] DENMAN K L, MIYAKE M. Upper layer modification at ocean station Papa: observations and simulation[J]. J Phys Oceanogr, 1973, 3: 185-196. 2.0.CO;2 target="_blank">

[8] GASPAR P. Modelling the seasonal cycle of the upper ocean[J]. J Phys Oceanogr, 1988, 18: 161-180. 2.0.CO;2 target="_blank">

[9] BYE J A T. The coupling of wave drift and wind velocity profiles[J]. J Mar Res, 198846: 457-472.

[10] STACEY M W. Simulations of the wind-forced near-surface circulation in Knight Inlet:A parameterization of the roughness length[J]. J Phys Oceanogr, 1999, 29: 1363-1367. 2.0.CO;2 target="_blank">

[11] MELLOR G L, BLUMBERG A F. Wave breaking and ocean surface layer thermal response[J]. J Phys Oceanogr, 2004, 34: 693-698.

[12] DONELAN M A. Air-sea interaction[J]. Ocean Engineering Science, 1990, 9: 239-292.

[13] SMITH S D. Sea surface wind stress and drag coefficients: The HEXOS results[J]. Bound-layer Meteor, 1992, 60: 109-142.

[14] JANSSEN P A E M. Reply[J]. J Phys Oceanogr, 2001, 31: 2532-2544. 2.0.CO;2 target="_blank">

[15] GEMMRICH J R, FARMER D M. Near-surface turbulen-ceand thermal structure in a wind-driven sea[J]. J Phys Oceanogr, 1998, 29: 480-499.

[16] MELLOR G L, YAMADA T. Development of a turbulence closure model for geophysical fluid problems. Rev[J]. Geo-phys Space Phys, 1982, 20: 851-875.

[17] ZHAO D, MEI C. Influence of air-sea fluxes and breaking waves on oceanic mixed layer, Proceedings of the Eighteenth International Offshore and Polar Engineering Conference, Vancouver, 2008, 563-568.

[18] 孙群. 海浪破碎对海洋上混合层影响的数值研究[D]. 青岛: 中国海洋大学, 2003: 53.

[19] 孙群, 管长龙, 宋金宝. 海浪破碎对海洋上混合层中湍能量收支的影响[J]. 海洋与湖沼, 2006, 37(1): 69-74.

[20] SUN Q, GUAN C L. Wave breaking on turbulent energy budget in the ocean surface mixed layer[J]. Chinese Journal of Oceanology and Limnology, 2008, 26(1): 9-13.

[1] 李毅能, 彭世球, 舒业强, 赖志娟 .**四维变分资料同化在风暴潮模拟中的平流作用分析** [J]. 热带海洋学报, 2011,30(5): 19-26

[2] 肖贤俊1，何娜2，张祖强1，刘怀明3，王东晓4.**卫星遥感海表温度资料和高度计资料的变分同化**[J]. 热带海洋学报, 2011,30(3): 1-8

[3] 冯向波, 严以新.**台湾近海水文观测体系的构建及其数据分析方法**[J]. 热带海洋学报, 2011,30(1): 35-42

[4] 舒业强1, 隋丹丹1, 王伟文1, 肖贤俊2.**南海北部集合卡曼滤波同化**SST**试验**[J]. 热带海洋学报, 2010,29(5): 10-16

[5] 陈飞1,2, 施平1,3, 杜岩1, 王东晓1.**基于**Cressman**客观分析的南海北部海区数据同化实验**[J]. 热带海洋学报, 2010,29(4): 1-7