Steric sea level change due to global climate change

Degree:	Honours or Master
Keywords:	Physical geodesy, Sea level variation, Steric effect, climate change
Entry:	For M.Sc: B.Surv, B.Sc(Catography), preferably 1st class Honours, Postgraduate Diploma
Supervisor:	Dr.-Ing. Michael Kuhn (M.kuhn@curtin.edu.au), Western Australian Centre for Geodesy, Curtin University of Technology
Project Funding:	Various
Student Funding:	Different scholarships are available from Curtin University of Technology (http://www.scholarships.curtin.edu.au/).
Resources:	Different model run outputs of the UvicESCM
Collaboration:	None

Project Description:

The composition of the global oceans will be influenced by any global environmental change such as global warming due to the so-called greenhouse effect. However, due to the different behaviour of the world's ocean as well as the presence of ocean circulation their response to short or long-term variations in global air temperature is different too. Short-term variations of some decades will affect mainly the upper part of the oceans water whereas long-term changes will affect the global oceans due to the mixing of water by the global ocean circulation. The warming or cooling of the upper ocean (e.g. down to the thermocline, approximately the first 200 m) due to air temperature change takes place with only a short time delay of one to two months (e.g. Kuhn et al. 2005, in press). The time delay will be much longer for a significant change of the mean global ocean temperature due to the mixing in deep ocean parts.

Any change in ocean temperature results in an expansion or contraction of the water the so-called steric effect (neglecting salinity changes) (e.g. Knauss 1978, Chen et al. 2000). Therefore, warming or cooling of the global oceans will alter the sea level without any total mass change. The steric effect can be determined if the change in temperature and salinity is known (e.g. Knauss 1978). Long-term projections of these parameters can be obtained e.g. by global climate models.

This project studies the response of the global oceans due to long-term climate changes. It uses the output from different model runs of the Earth System Climate Model developed at the University of Victoria, Canada (UVicESCM) referring to different greenhouse scenarios (Makarynskyy et al accepted Nov. 2004). The output should be analysed in terms of the long-term change in ocean temperature as well as the resulting steric effect.

Further Reading :

Chen JL, Shum OK, Wilson OR, Chambers DP, Tapley BD (2000): Seasonal sea level change from TOPEX/Poseidon observation and thermal contribution. Journal of Geodesy **73**:638-647.

Knauss JA (1987): Introduction to physical oceanography. Prentice Hall, Englewood Cliffs, New Jersey, 338pp.

Kuhn M, Bosch W, Kaniuth R (2005, in press): Low frequency variations and anomalous behaviour of the North Atlantic sea level measured by TOPEX/Poseidon altimetry. Marine geodesy.

Makarynskyy O, Kuhn M, Feasterstone WE (accepted November 2004): Modelling future sea level change under greenhouse warming scenarios with an Earth system model of intermediate complexity. Proceedings of the International Association of Geodesy Symposium on Gravity, Geoid and Space Missions 2004, Porto, Portugal.