Matthias Tomczak: a Distinguished Regional Oceanographer and Water-Mass Expert

Yuzhu You[1,*], Joachim Ribbe[2], Johannes Karstensen[3] and John Church[4]

[1]University of Sydney Institute of Marine Science, Building H11, University of Sydney, New South Wales 2006, Australia

[*]Corresponding author

[2]Department of Biological and Physical Sciences, University of Southern Queensland, Toowoomba, Queensland 4350, Australia

[3]IFM-GEOMAR, Leibniz-Institute für Meereswissenschaften an der Universitat Kiel, Düsternbrooker Weg 20, D-24105 Kiel, Germany

[4]CSIRO Marine and Atmospheric Research, GPO Box 1538, Hobart, Tasmania 7001, Australia and Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Tasmania, Australia

Professor Matthias Tomczak

Matthias Tomczak has devoted more than 40 years to his oceanographic career as a scientist and teacher since he first started a position as a research scientist with the naval oceanographic institution in Kiel during 1965. On October 29, 2006, he celebrated his 65^{th} birthday which marks the beginning of his official retirement as a Professor of Oceanography from the School of Chemistry, Physics and Earth Sciences, Flinders University of South Australia. This special edition of Progress in Oceanography titled "A New View of Water Masses after WOCE" commemorates Matthias' career as a distinguished regional oceanographer and well-known water-mass expert.

Matthias was born in Hamburg, the second largest and principal port city in Germany and second largest port in Europe. His childhood was influenced by the maritime culture of the city as well as by his father who himself was a physical oceanographer and who had worked for several organisations including the Food and Agriculture Organization of the United Nations in Rome. After graduation from high school, Matthias studied Physical Oceanography at the University of Kiel. He obtained his first degree (*Diplom Ozeanograph*) in 1965 and completed his postgraduate training (*Dr rer nat*) in 1968.

Matthias' work extends much beyond his documented record as a distinguished Physical Oceanographer. In particular during the last few years of his career as a university teacher, he developed an interest in communicating the contribution the sciences make to society by developing a university course on "Science, Civilization and Society". Matthias also found time to pursue his many other interests in societal activities and the following article "Matthias Tomczak" contributed by Jens Meincke and John Church will give a systematic portrayal of his European and Australian days as well as his career and scientific achievements.

Matthias' scientific interest is broad. It includes studies on internal waves, coastal upwelling, tropical oceanography, water-mass analysis and the general large scale circulation of the ocean. He is best recognised by the oceanographic community as a water-mass expert, having in particular improved our understanding of Central Water formation and ventilation. He has published 4 co-authored books and monographs, more than 100 referred papers as well as more than 50 other publications. A full list of his works follows at the end of this preface.

Matthias is a cosmopolitan with extensive international contacts. He has worked in several countries and institutes. In the late 1980s, he was appointed as a guest professor by then the Shandong College of Oceanography, now known as the Ocean University of China. He received scientific visitors and postdoctoral researchers from all over the world which resulted in a significant number of international co-authored publications in various journals. He collaborates with scientists on topics other than physical oceanography including studies in the fields of chemistry, biology, environment and climate.

To many colleagues and students, Matthias is known as an excellent teacher with a great ability to clearly communicate the physical concepts that determine the dynamics of the ocean. His book "Regional Oceanography: An Introduction", which was written initially for teaching purpose only developed into an internationally recognised text book. He also contributed several journal articles that focus on the education of students in the ocean sciences from high school onwards. Matthias has also trained many postgraduate students that are working in many prestigious research organizations and universities around the world.

This edition of Progress in Oceanography commemorates the significant contribution made by Matthias to the oceanographic community in research and education. It includes seven papers ranging from studies on mode water (Suga et al. and Holbrook and Maharaj), Antarctic Bottom Water (Zenk) and the oxygen minimum zone (Karstensen et al.) to work on long time temperature trend analysis (Sprintall), hydrographic factors affecting sea level change (Morrow et al.) and seiches in a compound harbour (Luick and Himwood).

The paper by Zenk on "Temperature fluctuations and current shear in Antarctic Bottom Water at the Vema Channel" uses moored thermistors and current meters at the Vema Channel to monitor the thermal stratification and current shear of Antarctic Bottom Water (AABW) passing through the channel from Argentine Basin to Brazil Basin. The mooring was deployed at a depth of 4580 m on April 21, 1998 and recovered on March 8, 2000. He finds that the abyssal stratification to form the AABW benthic boundary layer has a frequency of 1-2 weeks. His calculation of the bulk Richardson number indicates evidence of 15% turbulent mixing at the interface between Weddell Sea Deep Water and Circumpolar Deep Water in the two year long observation.

Suga et al. provide insight into the "Ventilation of the North Pacific subtropical pycnocline and mode water formation". They use isopycnally averaged hydrographic climatology combined with high resolution winter mixed layer climatology and various wind stress climatologies from ship reports, numerical weather prediction and satellite products to calculate the annual subduction rate of the North Pacific subtropical gyre. The resulting peaks correspond to Subtropical Mode Water (STMW), Central Mode Water (CMW) and Eastern Subtropical Mode Water (ESMW). They are able to calculate the renewal time of permanent pycnocline water, estimated as the volume of the water divided by the subduction rate, with 2-4 years for ESMW, 2 years for the lighter STMW, 5-9 years for the denser STMW, 10-20 years for the lighter CMW, 20-30 years for the middle CMW and 60 years or longer for the denser CMW.

Holbrook and Maharaj's study entitled "Southwest Pacific Subtropical Mode Water: a climatology" deals with STMW in the South Pacific. The data base used for the analysis is the Digital Atlas of Southwest Pacific upper Ocean Temperatures (DASPOT) obtained using mechanical bathythermograph (MBT) and XBT casts between 1955 and 1988 for a depth of 450 m. With a temperature gradient criterion, they present the spatial distribution of STMW thickness across the entire southwest Pacific. By quantifying volume changes for all the seasons, they derive a maximum volume in October and a minimum in May. The interannual variation of thickness is observed to correlate with El Niňo with a 20 m thicker layer.

Sprintall's paper on "Long-term trends and interannual variability of temperature in Drake Passage" employs high resolution XBT data from 1969 to 2004 in Drake Passage to examine interannual temperature variation and warming/cooling trends. She discovers statistically significant warming trends of ~0.02 ºC yr^{-1} north of the Polar Front (PF) which is largely depth independent between 100-700 m and cooling trends of ~0.07 ºC yr^{-1} at the surface and warming at depth south of the PF.

Karstensen et al. use cruise data, gridded observations and model data to study the oxygen minimum zones (OMZ) in the eastern tropical Atlantic and Pacific Ocean in a depth of 100-900 m and contribute a paper on the "Oxygen minimum zones in the eastern tropical Atlantic and Pacific Oceans" They find that the OMZ is associated with weak ventilation but is not obviously related with enhanced consumption. The relatively higher oxygen minimum values in the tropical Atlantic than the Pacific is due to the compensation of the import of water from the well ventilated South Atlantic.

Morrow et al.'s study, entitled "Observed subsurface signature of Southern Ocean sea level rise", utilises 13 years of repeat hydrographic data from WOCE-SR3 sections, the SURVOSTRAL XBT and surface salinity data. The study focuses upon the strong increase in sea level in various parts of the Southern Ocean that is shown in satellite altimetry data over the 1990s. The causes are found in changes of the vertical temperature and salinity structure which in turn are associated with changes in precipitation, wind stress and an upward trend of the Southern Annular Mode.

Luick and Hinwood apply water level data and a numerical model to study seiche modes in a compound harbour. They report their findings in a paper on "Water levels in a dual basin harbour in response to infragravity and edge waves". They discover that a variety of harbour oscillations are present with periods up to 67 minutes. Periods longer than 25 minutes exceed resonant modes of the harbour. The characteristics and causes for open basin modes are addressed. Their work has practical implications to port design.

Matthias Tomczak publications

BOOKS AND MONOGRAPHS

Boje, R. and M. Tomczak (editors) (1978) Upwelling Ecosystems. Springer-Verlag Berlin, 305p.

Cuff, W. and M. Tomczak (editors) (1983) Synthesis and Modelling of Intermittent Estuaries. Lecture Notes in Coastal and Estuarine Studies vol. 3. Springer-Verlag New York, 302p.

Tomczak, M. and J. S. Godfrey (1994) Regional Oceanography: an Introduction. Pergamon, Oxford. 422p.

Tomczak, M. and J. S. Godfrey (2003) Regional Oceanography: an Introduction. 2nd improved edition. Daya Publishing House, Delhi. 390p.

ARTICLES (refereed)

Tomczak, M. (1966) Über winderzeugte interne Wellen. *Zeitschrift der Geographie,* 32, Sonderh., 357-364.

Tomczak, M. (1966) Winderzeugte interne Wellen, insbesondere im Periodenbereich oberhalb der Trägheitsperiode. *Deutsche Hydrographische Zeitschrift*19, 1-21.

Tomczak, M. (1967) Über den Einfluβ fluktuierender Windfelder auf ein stetig geschichtetes Meer. *Deutsche Hydrographische Zeitschrift,* 20, 101-129.

Tomczak, M. (1967) Über Eigenwerte freier und Resonanz erzwungener interner Wellen in einem stetig geschichteten flachen Meer. *Deutsche Hydrographische Zeitschrift,* 20, 217-232.

Tomczak, M. (1968) Über interne Wellen in der Nähe der Trägheitsperiode. *Deutsche Hydrographische Zeitschrift,* 21, 145-151.

Tomczak, M. (1969) Über durch interne Wellen erzeugte Reibungsgrenzschichten an vertikalen Grenzflächen. *Deutsche Hydrographische Zeitschrift,* 22, 1-10.

Tomczak, M. (1969) Über interne Trägheitsbewegungen in der westlichen Ostsee. *Deutsche Hydrographische Zeitschrift,* 22, 158-162.

Tomczak, M. (1970) Schwankungen von Schichtung und Strömung im westafrikanischen Auftriebsgebiet während der 'Deutschen Nordatlantischen Expedition' 1937. *"Meteor" Forschungs Ergebnisse* A7, 1-109.

Tomczak, M. (1972) Problems of physical oceanography in coastal upwelling investigations. *Geoforum* 3, 23-34.

Tomczak, M. (1973) An investigation into the occurrence and development of cold water patches in the upwelling region off NW Africa (Robbreiten-Expedition 1970). *"Meteor" Forschungs Ergebnisse* A13, 1-42.

Tomczak, M. (1973) Note on diffusion in coastal upwelling. *Journal of Physical Oceanography* 3, 162-165.

Tomczak, M. and R. H. Käse (1974) A linear theory of stationary coastal upwelling in a continuously stratified ocean with an unstratified shelf area. *J. Mar. Res.* 32, 365-376.

Tomczak, M. (1974) Possibilities and limitations of international cooperation in the attempt to optimize the use of estuaries and lagoons by numerical modelling. *IIe Colloque International sur l'Exploitation des Océans* vol.1, Bx Ca 102, Acobor, Paris.

Tomczak, M and C. Garcia Diaz (1975) A numerical model of the circulation in Cienfuegos Bay, Cuba. *Estuarine Coastal Mar. Sci.* 3, 391-412.

Hempel, G., W. Nellen, M. Tomczak and K. Vollbrecht (1975) Bericht über den Verlauf der Expedition "Auftrieb'72". *"Meteor" Forschungs Ergebnisse* A16, 44-64.

Tomczak, M. and G. Miosga (1976) The sea surface temperature as detected by airborne radiometer in the upwelling region off Cap Blanc, NW Africa. *"Meteor" Forschungs Ergebnisse* A17, 1-20.

Keunecke, K.-H. and M. Tomczak (1976) Evidence of increased turbulent mixing in the coastal jet of the NW-African upwelling region. *"Meteor" Forschungs Ergebnisse* A17, 88-98.

Tomczak, M. (1976) A berth for a guest scientist. *CERES, the FAO review on agriculture and development* 54 (vol. 9 nr. 6), 55-57.

Tomczak, M. (1977) Continuous measurement of near-surface temperature and salinity in the NW African upwelling region between Canary Islands and Cap Vert during the winter of 1971/1972. *Deep-Sea Research* 24, 1103-1119.

Tomczak, M. (1978) De l'origine et la distribution de l'eau remontée a la surface au large de la côte nord-ouest Africaine. *Annls. Hydrogr.* sér. 5 vol. 6, 5-14.

Boje, R. and M. Tomczak (1978) Ecosystem analysis and the definition of boundaries in upwelling regions. In: *Upwelling ecosystems* (Eds. R. Boje and M. Tomczak). Springer, Berlin, 3-11.

Tomczak, M. (1979) The CINECA experience. *Mar. Policy* 3, 59-65.

Tomczak, M. (1979) Regional oceanography of African waters. *FAO/SIDA Workshop on Aquatic Pollution in Relation to Protection of Living Resources.* TF-RAF 112 (SWE) suppl 1: Scientific and Administrative Basis for Management Measures. FAOP, Rome, 1-18.

Tomczak, M. (1979) Equatorial upwelling rates. *Nature* 278, 307-308.

Tomczak, M. (1980) The IWC and the decimation of whale stocks (Comment on "the failure of the IWC, 1946-1966" by G. H. Elliot). *Marine Policy* 4, 79-81.

Tomczak, M. and P. Hughes (1980) Three-dimensional variability of water masses and currents in the Canary Current upwelling region. *"Meteor" Forschungs Ergebnisse* A21, 1-24.

Tomczak, M. (1980) A review of Wüst's classification of the major deep-sea expeditions 1873-1960 and its extension to recent oceanographic research programmes. In: *Oceanography: the past* (Eds. M. Sears and D. Merriman). Springer, New York, 188-194.

Tomczak, M. (1981) Prediction of environment changes and the struggle of the Third World for national independence: the case of the Peruvian fisheries. In: *Resources Management and Environmental Uncertainty: Lessons from Coastal Upwelling Fisheries* (Eds. M. H. Glantz and J. D. Thompson). John Wiley & Sons, New York, 401-435.

Tomczak, M. (1981) A multi-parameter extension of TS-diagram techniques for the analysis of non-isopycnal mixing. *Progress in Oceanography* 10, 147-171.

Tomczak, M. (1981) An analysis of mixing in the frontal zone of South and North Atlantic Central Water off North-West Africa. *Progress in Oceanography* 10, 173-191.

Tomczak, M. (1981) Longshore advection during an upwelling event in the Canary Current area as detected by airborne radiometer. *Oceanologica Acta* 4, 161-169.

Tomczak, M. (1981) Coastal upwelling systems and eastern boundary currents: a review of terminology. *Geoforum* 12, 179-191.

Tomczak, M. (1981) Bass Strait Water intrusions in the Tasman Sea and mean temperature-salinity curves. *Australian Journal of Marine and Freshwater Research* 32, 699-708.

Tomczak, M. (1982) The distribution of water masses at the surface from T-S diagram analysis in the CINECA area. *Rapp. P.-v. Réun. Cons. int. Explor. Mer* 180, 48-49.

Tomczak, M. (1982) New role for IOC (letter to the Editor). *Marine Policy* 6, 60.

Tomczak, M. (1983) Lessons from a multidisciplinary study of Port Hacking Estuary. *Wetlands (Aust.)* 3(1), 51-54.

Tomczak, M. (1983) Some conclusions from the Port Hacking Estuary Project. In: *Synthesis and Modelling of Intermittent Estuaries* (Eds. W. Cuff and M. Tomczak). Springer, New York, 293-302.

Tomczak, M. and X. H. Fang (1983) Attempt to determine some properties of the semidiurnal internal tide on the continental slope, Great Barrier Reef. *Australian Journal of Marine and Freshwater Research* 34, 921-926.

Tomczak, M. (1983) Coral Sea water masses. In: *Proceedings of the Inaugural Great Barrier Reef Conference Townsville Aug. 28 - Sept. 2* (Eds. J. T. Baker, R. M. Carpenter, P. W. Sammarco and K. P. Stark). JCU Press, 461-466.

Tomczak, M. (1984) Water masses in East Australian Current eddy H. *CSIRO Marine Laboratories Report* 161. 11p.

Tomczak, M. (1984) Ausbreitung und Vermischung der Zentralwassermassen in den Tropengebieten der Ozeane 1: Atlantischer Ozean. *Oceanologica Acta* 7, 145-158.

Tomczak, M. (1984) Ausbreitung und Vermischung der Zentralwassermassen in den Tropengebieten der Ozeane 2: Indischer und Pazifischer Ozean. *Oceanologica Acta* 7, 271-288.

Tomczak, M. (1984) Defining marine pollution: a comparison of definitions used by international conventions. *Marine Policy* 8, 311-322.

Tomczak, M. (1985) The Bass Strait Water Cascade during winter 1981. *Continental Shelf Research* 4, 255-278.

Gibbs, C. F., M. Tomczak and A. R. Longmore (1986) The nutrient regime of Bass Strait. *Australian Journal of Marine and Freshwater Research* 37, 451-466.

Tomczak, M. (1987) The Bass Strait Water Cascade during summer 1981/82. *Continental Shelf Research* 7, 561-572.

Mackay, D. J., R. Scymczak, M. Tomczak and Y. Gu (1987) Effects of mixed layer depth and an isolated coral reef on the strong complexing capacity of oligotrophic waters. *Australian Journal of Marine and Freshwater Research* 38, 491-499.

Tomczak, M. and Y. H. Gu (1987) Water mass properties of the permanent thermocline in the western South Pacific Ocean during WESTROPAC'82. *Deep-Sea Research* 34, 1713-1731.

Tomczak, M. (1988) Island wakes in deep and shallow water. *Journal of Geophysical Research* 93, 5153-5154.

Tomczak, M. and E. Tanner (1989) An estimate of Bass Strait Water movement in the western Tasman Sea during the Australian Coastal Experiment. *Australian Journal of Marine and Freshwater Research* 40, 465-469.

Tomczak, M. and D.G.B. Large (1989) Optimum multiparameter analysis of mixing in the thermocline of the eastern Indian Ocean. *Journal of Geophysical Research* 94, 16141-16149.

Tomczak, M. and D. Hao (1989) Water masses in the thermocline of the Coral Sea. *Deep-Sea Research* 36, 1503-1514.

Tomczak, M. (1989) Review and commentary to paper "The poleward undercurrent on the eastern boundary of the subtropical North Atlantic", by E. D. Barton. In: *Poleward Flows along Eastern Ocean Boundaries* (Eds. S. J. Neshyba, Ch. N. K. Mooers, R. L. Smith and R. T. Barber). Springer, New York, 93-95.

Ribbe, J. and M. Tomczak (1990) An impact assessment for the French nuclear weapon test sites in French Polynesia. *Mar. Poll. Bull.* 21, 536-542.

Villanoy, C. and M. Tomczak (1991) The influence of Bass Strait Water on the Tasman Sea thermocline. *Australian Journal of Marine and Freshwater Research* 42, 451-464.

Sprintall, J. and M. Tomczak (1992) Evidence of the barrier layer in the surface layer of the tropics. *Journal of Geophysical Research* 97, 7305-7316.

England, M. H., M. Tomczak and J. S. Godfrey (1992) Water mass formation and Sverdrup dynamics; a comparison between climatology and a coupled ocean-atmosphere model. *Journal of Marine Systems* 3, 279-306.

You, Y. and M. Tomczak (1993) Thermocline circulation and ventilation in the Indian Ocean derived from water mass analysis. *Deep-Sea Research* 40, 13-56.

Sprintall, J. and M. Tomczak (1993) On the formation of Central Water and thermocline ventilation in the southern hemisphere. *Deep-Sea Research* 40, 827-848.

England, M. H., J. S. Godfrey, A. C. Hirst and M. Tomczak (1993) The mechanism for Antarctic Intermediate Water renewal in a world ocean model. *Journal of Physical Oceanography* 23, 1553-1560.

Hinrichsen, H.-H. and M. Tomczak (1993) Optimum multiparameter analysis of the water mass structure in the western North Atlantic Ocean. *Journal of Geophysical Research* 98, 10,155-10,169.

Ribbe, J. and M. Tomczak (1993) Reply to A. Doury: An impact assessment for the French nuclear test sites in French Polynesia. *Mar. Pollution Bull.* 26, 530.

Luick, J. L., R. Käse and M. Tomczak (1994) On the formation and spreading of the Bass Strait Cascade. *Continental Shelf Research* 14, 385-399.

Szymanska, K. and M. Tomczak (1994) Subduction of Central Water near the Subtropical Front in the southern Tasman Sea. *Deep-Sea Research* 41, 1373-1386.

Tomczak, M., D. G. B. Large and N. Nancarrow (1994) Identification of diapycnal mixing through optimum multiparameter analysis 1: test of feasibility and sensitivity. *Journal of Geophysical Research* 99, 25,267-25,274.

Klein, B. and M. Tomczak (1994) Identification of diapycnal mixing through optimum multiparameter analysis 2: evidence for unidirectional diapycnal mixing in the front between North and South Atlantic Central Water. *Journal of Geophysical Research* 99, 25,275-25,280.

Stramma, L., R. G. Peterson and M. Tomczak (1995) The South Pacific Current. *Journal of Physical Oceanography* 25, 77-91

Krause, G. and M. Tomczak (1995) Do marine scientists have a scientific view of the Earth? *Oceanography* 8, 11-16.

Cai, W, M. Tomczak and R. J. Allan (1995) Effect of hemispheric conjugate atmospheric variations and global warming on North Atlantic Deep Water formation in a global ocean general circulation model. *Global Atmosph. Ocean Syst.* 2, 325-350.

Tomczak, M. (1995) Salinity variability in the surface layer of the tropical western Pacific ocean. *Journal of Geophysical Research* 100, 20,499-20,515.

Tomczak, M. and C. J. F. Andrew (1996) Advection and diffusion in coastal upwelling events. *Bull. Aust. Met. Oceanogr. Soc.* 9, 41-48.

Ribbe, J. and M. Tomczak (1997) On the effect of the missing Indonesian throughflow in the Fine Resolution Antarctic Model. *Journal of Physical Oceanography* 27, 445-455.

Ribbe, J. and M. Tomczak (1997) On convection and the formation of Subantarctic Mode Water in the Fine Resolution Antarctic Model (FRAM) *Journal of Marine Systems* 13, 137-154.

Karstensen, J. and M. Tomczak (1997) Ventilation processes and water mass ages in the thermocline of the southeast Indian Ocean. *Geophysical Research Letters* 24, 2777-2780.

Schodlok, M. P., M. Tomczak and N. White (1997) Deep sections through the South Australian Basin and across the Australian-Antarctic Discordance. *Geophysical Research Letters* 24, 2785-2788.

Schodlok, M. and M. Tomczak (1997) The circulation south of Australia derived from an inverse model. *Geophysical Research Letters* 24, 2781-2784.

Herzfeld, M. and M. Tomczak (1997) Numerical modelling of the sea surface temperature and circulation in the Great Australian Bight. *Progress in Oceanography* 39, 29-78.

Tomczak, M. and C. Andrew (1997) Eddy formation in the Antarctic Intermediate Water of the subtropical South Pacific Ocean. *Journal of Marine and Atmospheric Research* 1, 8-12.

Karstensen, J. and M. Tomczak (1998) Age determination of mixed water masses with CFC and oxygen data. *Journal of Geophysical Research* 103, 18,599-18,610.

Tomczak, M. and M. Herzfeld (1998) Pollutant pathways between Mururoa and other Polynesian islands based on numerical model trajectories. *Mar. Pollution Bull.* 36, 288-297.

Tomczak, M. (1999) Some historical, theoretical and applied aspects of quantitative water mass analysis. *Journal of Marine Research* 57, 275-303.

Poole, R. and M. Tomczak (1999) Optimum multiparameter analysis of the water mass structure in the Atlantic Ocean thermocline. *Deep-Sea Research* 46, 1895-1921.

Lebedev, I. and M. Tomczak (1999) Rainfall measurements with navigational radar. *Journal of Geophysical Research* 104, 13,697-13,708.

Herzfeld, M. and M. Tomczak (1999) Bottom-driven upwelling generated by eastern intensification in closed and semi-closed basins with a sloping bottom. *Mar. Freshwater Res.* 50, 613-628.

Tomczak, M. (2000) An Introduction to online physical oceanography. *Oceanography* 13, 104-105.

Mata, M. M., M. Tomczak, S. Wijffels and J. A. Church (2000) East Australian current volume transports at 30°S: estimates from the World Ocean Circulation experiment hydrographic sections PR11/P6 and the PCM3 current meter array. *Journal of Geophysical Research* 105, 28,509-28,526.

Lebedev, I., M. Tomczak and J.-L. Redelsperger (2001) Tropical ocean response to atmospheric forcing at kilometer scales. *Journal of Geophysical Research* 106, 11,399-11,410.

Tomczak, M. (2001) Upper ocean mean horizontal structure. In *Encyclopedia of Ocean Sciences, J. Steele, S. Thorpe, and K. Turekian (eds)* 3083- 3094.

Wu, W., M. Tomczak, X. H. Fang and D. X. Wu, DX (2001) The barrier layer in the southern region of the South China Sea. *Chinese Science Bulletin* 46, 1388-1392.

James, C., M. Tomczak, I. Helmond and L. Pender (2002) Summer and winter surveys of the Subtropical Front of the south eastern Indian Ocean 1997 - 1998. *Journal of Marine Systems* 37, 129-149.

Tippins, D. and M. Tomczak (2003) Meridional Turner angles and density compensation in the upper ocean. *Ocean Dynamics* 53, 332-342.

Leffanue, H. and M. Tomczak (2004) Using OMP analysis to observe temporal variability in water mass distribution. *Journal of Marine Systems* 48, 3-14.

Tomczak, M., L. Pender and S. Liefrink (2004) Variability of the Subtropical Front in the Indian Ocean south of Australia. *Ocean Dynamics* 54, 506-519.

Tomczak, M. and S. Liefrink (2005) Interannual variations of water mass volumes in the Southern Ocean. *Journal of Atmospheric and Ocean Sciences* 10, 31-42.

Henry-Edwards, A. and M. Tomczak (2005) TROMP: detecting water property changes from a time series of oceanographic data. *Proceedings of the 16th National Congress, Australian Institute of Physics, 31 January - 4 February 2005, Canberra, Australia*, 152 – 155.

Tomczak, M., L. Pender and S. Liefrink (2005) Mixing at the Subtropical Front in the Indian Ocean south of Australia. *Proceedings of the 16th National Congress, Australian Institute of Physics, 31 January - 4 February 2005, Canberra, Australia*, 218 - 221.

Schmitt, L., S. Larsson, C. Schrumm, I. Alekseeva, M. Tomczak and K. Svedhage (2006) “Why they came”; the colonization of western Sweden and its environmental context at the end of the last glaciation. *Oxford Journal of Archaeology* 25(1), 1 – 28.

Domingues, C. M., S. E. Wijffels, M. E. Malttrud, J. A. Church and M. Tomczak (2006) Role of eddies in cooling the Leeuwin Current. *Geophysical Research Letters* 33, L05603, doi:10.1029/2005GL025216.

Domingues, C. M., S. E. Wijffels, M. E. Malttrud, M. Tomczak and J. A. Church (in press) Simulated Lagrangian patterns of the large scale ocean circulation of the Leeuwin Current System off Western Australia. *Deep-Sea Research II*

Henry-Edwards, A. and M. Tomczak (2006) Remote detection of water property changes from a time series of oceanographic data. *Ocean Science* 2, 11 - 18.

Henry-Edwards, A. and M. Tomczak (2006) Detecting changes in Labrador Sea Water through a water mass analysis of BATS data. *Ocean Science* 2, 19 - 25.

Mata, M. M., J. Wijffels, J. A. Church and M. Tomczak (2006) Statistical description of the East Australian Current low-frequency variability from the WOCE PCM3 array. *Marine and Freshwater Research* 57, 273–290.

Mata, M. M., J. Wijffels, J. A. Church and M. Tomczak (in press) Eddy Shedding and Energy Conversions in the East Australian Current. *Journal of Geophysical Research*