Welcome to the summer edition of the Marine Science newsletter

Research activities have been in full swing over the spring and summer months with students and staff pursuing a wide variety of exciting projects throughout a range of environments. From Plymouth Sound to the Southern Ocean, this issue focuses on the student research experience within Marine Science here at Plymouth.

We hope you enjoy this latest insight into the activities of the Plymouth University Marine Science community.

Tim Scott

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**Front cover**: Meandering Polar and Subantarctic fronts along the Antarctic Circumpolar Current. Lagrangian drifters travel along a sharp meander that formed a closed cold-core eddy and separated from the ACC. SMILES Project.

**Contents page**: Southern Ocean during the SMILES Project.
Students wanting to pursue a career in the marine sciences now have greater opportunity to get a first-rate education after Plymouth University launched four new degree programmes.

The courses, now open for applications with the first intake in September 2015, are designed to enhance the University’s contribution to the UK’s marine science sector.

There will be three three-year BSc programmes: Ocean Exploration and Surveying, Oceanography and Coastal Processes, and Ocean Science and Marine Conservation, alongside a four-year MSci programme in Ocean Science.

The programmes deal with conventional topics such as oceanography and ocean exploration, but also address current issues such as marine ecosystem functioning, coastal processes and management, and human interactions with the marine environment.

The Marine Science group at Plymouth University comprises world-leading researchers addressing a wide range of issues in the marine environment, including ocean mixing, marine renewable energy, storm impacts, coastal erosion, ocean exploration, coastal zone management and marine conservation.

Dr Tim O’Hare, Marine Science Admissions Tutor, says:

“This is an exciting time to be starting a career in the marine sciences, which represent a growing market due to increased pressures and opportunities in coastal, ocean and marine environments. The UK Marine Science Strategy 2010-2025 highlighted the importance of the sector in terms of its significant role in employing Marine Science graduates and postgraduates. But it also indicated one of the key barriers to growth for the sector was skills shortages in science graduates, which our new courses are specifically designed to address.”

Dr Sarah Bass, Marine Science Undergraduate Scheme Manager, added:

“As Britain’s Ocean City, Plymouth provides an unrivalled location for studying in the marine sciences. Our brand new £4.85 million Marine Station, located right on the shores of Plymouth Sound, provides the only waterfront campus of its kind in the UK, housing laboratories, state-of-the-art oceanographic equipment and an academic diving centre. The University’s flagship oceanographic teaching and research vessel, the Falcon Spirit, also operates from the Marine Station so students can take their samples from the boat straight into the laboratory for analysis.”

Professor Gerd Masselink, Head of Marine Science at Plymouth University, said:

“The issues we are addressing are all of great societal significance, and incorporating this material into the new degree courses makes them cutting edge, as well as highly relevant. The overarching aim of the new set of degree programmes is to produce highly-skilled and employable graduates with the knowledge and expertise to sustainably manage marine environments. We place great emphasis on learning by doing and, in fact, a third of our modules are practically-based, using Plymouth Sound and the southwest coast of England as a natural laboratory for many of our field-based activities.”
The Ocean City of Plymouth will be the venue for Shallow Survey 2015, the 7th International Conference on High Resolution Surveys in Shallow Water.

The Conference, organised by the UK Hydrographic Office and the Maritime & Coastguard Agency in partnership with Plymouth University will take place on the University Campus from 14th to 18th September.

The event attracts professionals from across the international seabed mapping community, who come together to hear and discuss technical papers from leading experts in the field, focusing on data gathered in depths of less than 200m.

Preparations for the conference started in Plymouth last summer, when a number of hydrographic surveys were carried out in and around Plymouth Sound, using a range of methods and equipment. The resulting dataset will act as the key focus for the Conference, giving delegates the opportunity to analyse and discuss the merits of the different approaches used.

As well as the conference itself, the Roland Levinsky Building at Plymouth University will welcome a trade exhibition, where companies at the cutting edge of this technology will showcase their products and services.

Full details of the event can be found on the Shallow Survey 2015 website – www.shallowsurvey2015.org

HALCROW PUBLICATION AWARD

A Coastal Process Research Group research paper titled “Modelling storm response on gravel beaches using XBeach-G” by Prof Gerd Masselink & Dr Tim Poate of Plymouth University along with recent Plymouth PhD student Dr Robert McCall, now working for Deltares in the Netherlands, will be awarded the Halcrow Prize for their research about the XBEACH gravel model (XBEACH-G). The paper was published in the ICE journal ‘Maritime Engineering’ and, of all the papers in 2014, it received most positive scores from the reviewers. The new numerical model XBEACH-G will help agencies working with gravel beaches to assess coastal flooding hazards and improve coastal safety.

Gravel beaches absorb waves and provide a natural barrier to the ocean, but they are often vulnerable to breaching and overtopping during storms. Gravel beaches are commonly found throughout the coasts of northern Europe as well as further afield including the USA, Canada, Argentina, New Zealand and Japan.

Winning the Halcrow Prize means that the work will be publicly available in the ICE virtual library and so their insights will be shared with a large international audience. ICE is the global network organisation for civil engineers. The prize will be officially awarded on 9 October 2015 at the annual ICE ceremony in London.

Storm surveys at Westward Ho! gravel barrier

MARINE STATION

The new Marine Station is now fully online and prepared to support our exciting new courses that begin in September. To take a look inside and gain some insight into how the facility is being used by our students for teaching and research watch the new video.

https://www.youtube.com/watch?v=G01xJ8Bo4Mo

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BEACH SURVEYING from the sky

Paul Aldersley, 3rd year BSc Ocean Exploration student

“My research project evolved from the coincidence of a field week demonstration and a lecture from Dr Tim Scott about his rip current research. The demonstration was of Topcon’s Sirius Pro unmanned aircraft system (UAS) which runs photogrammetric surveys using real time kinematic (RTK) GPS. Dr Tim Scott’s research requires monthly GPS surveys of beaches in west Cornwall. These are currently completed using an RTK GPS system on a quad bike and take many hours. The aerial surveying approach would provide significant time saving and improve coverage of the digital terrain model (DTM).

My project involves running concurrent surveys of Perranporth beach with the quad bike and the UAS, and then producing DTMs to compare the accuracy of the data from the two methods. If the photogrammetric data proves sufficiently accurate, it could be an alternative to the quad bike mounted RTK-GPS survey.

However, the project has a broader benefit – there appears to be little if any research into the accuracy of UAS photogrammetry on smooth surfaces like beaches with low relief. The surveys were completed in June with perfect weather conditions. It was great to have the support of Tim, his team and fellow students, as well as Matt Kellet from Topcon who kindly provided the UAS. Practical lessons have already been learned from running the surveys. Now the data processing begins!”

QUESTIONING THE PATCH TEST

Narendra Ramal, MSc Hydrography student

Hydrographic software packages are used to carry out the calibration of multibeam survey systems by manipulating data acquired from particular manoeuvres over a patch of the seafloor. Data is then processed by aligning specific cross-sections and profiles of the seabed that are selected manually from the patch area and adjusted using a graphical display until they match. Coincidence of lines allows these errors of latency, pitch, roll and yaw to be determined.

Consideration of the standard deviations of gridded data is used as the means to assess the calibration process, where a decrease indicates that the accuracy of soundings have improved across the entire region used for calibration. However, further statistical tests suggested that significant improvement was only obtained in the areas selected from the patch for calibration, otherwise there was little consistency between data acquired amongst different runs over the same area.

Further research is needed to validate my initial findings using a properly configured system with a larger sample of data being acquired across an area suited for the purpose. The aim is to investigate the applicability of calibration procedures currently used and also test an alternative approach that semi-automates the existing process, but uses the entire patch for the calibration.
In the June of this year, myself and a fellow MSc. Student, Fiona James, were lucky enough to spend two days on the Falcon Spirit conducting a bathymetric survey of Start Bay. Fiona spent the first day running transect lines across Skerries Bank, successfully collecting data, in near perfect sea and weather conditions. 

The weather conditions were perfect, the data was solid and the company was great. We couldn’t have asked for better surveying conditions, with blue skies and calm seas! My dissertation focus is on a sand bank, called ‘Skerries Bank’, within Start Bay. Skerries Bank is the main feature determining wave propagation into the Bay. I shall therefore be undertaking a comparison of a previous dataset with the dataset collected in the June survey to determine any change in the geomorphology due to the 2013/14 winter storms. I will then be undertaking some wave modelling using the SWAN wave model to determine any change in wave propagation under differing environmental conditions.

It’s exciting working with your own data and I’ve learnt so much having to plan and undertake a survey the entire way through – from line planning to report writing. A lot of thanks to Dr Tim Scott for all his help so far.

I’m looking forward to seeing the outcome!

After berthing the University vessel overnight in Dartmouth after the first day, it was my turn to collect some data. I am investigating the response of Slapton Beach to the severe winter storms of 2013/14, looking specifically at beach erosion and accretion, and the movement of sediment on and offshore.

Although the Coastal Processes Research Group at Plymouth University conduct regular beach surveys at Slapton Sands, there is a real lack of nearshore bathymetric data. The area just below the low water line, the subtidal zone, could represent a considerable proportion of sediment movement where high volume changes can occur. In order to monitor this, I needed the survey vessel to run as close to the beach as possible. Using an R2Sonic Multibeam Echo sounder, I ran a total of four survey lines, each over 6kms long, parallel to the beach. Sediment samples and sound velocity profiles were also taken. During the survey, we were again blessed with a dead calm sea, low winds, and sunny weather conditions.

I now have enough data to compare with a pre-storm dataset acquired via the UKHO. I would like to express my gratitude to Dr. Tim Scott for his supervision, and Will Davies and David Uren, the skippers, for their company and skilled navigation of the vessel. I thoroughly enjoyed the data acquisition, for me it was the highlight of the Master’s course. 

Alan
Isobel Swinscoe, MRes Applied Marine Science student

“As an MRes Applied Marine Science student, the taught component of my course occurred in the first term, and the remaining nine months of the Masters degree has been dedicated to my independent research project. Lectures and coursework in the Autumn term were wide ranging and challenging, and provided a comprehensive introduction to marine policy, management, chemistry and oceanography.

My research project asked the question ‘Can publically-available satellite data, like GoogleEarth, be used to monitor coral reef health by small island developing states?’ It focussed on the use of open access satellite data for management of catchment-seascape interactions in tropical coastal zones, and I was lucky enough to receive a Santander scholarship of £5000 to undertake fieldwork for the project in the relatively remote island of Sumbawa, Indonesia and in the North Island of New Zealand. The opportunity to conduct research in the field, and in the case of Indonesia collect habitat data in a region for which no published data exists, has undoubtedly enriched the project, increased the likelihood of publishing my results and confirmed my goal of pursuing a career in marine research.

The fieldwork proved very challenging at times, but both the location and the numerous people who helped organise the expedition re-established my enjoyment of practical scientific research. This experience, as well as the broad marine science and management background established earlier in the course, provided excellent preparation for my PhD, due to begin in October at Stirling University, which will look at the food safety aspects of innovative feeding systems in the fish aquaculture industry.”

Isobel conducting reef surveys

Monitoring reef habitats

Fieldwork on the island of Sumbawa, Indonesia

Monitoring coral reefs with GoogleEarth

October at Stirling University, which will look at the food safety aspects of innovative feeding systems in the fish aquaculture industry.”

Isobel

Fieldwork on the island of Sumbawa, Indonesia
Smelly blooms in Fair Isle

Zetty Deraman & Germano Soru, MRes Applied Marine Science student

**Question:** Storm petrels hunt using their noses: How accurately can we map smelly dimethylsulphide-producing phytoplankton blooms using satellite data?

**Question:** What is the relationship between phytoplankton community composition, abundance and DMS production off the Fair Isles, UK?

“It’s always been a lifelong dream of mine to travel the world, embrace new culture and enjoy the change of scenery while getting the most of what life get to offer. After a week of jet leg and getting used to the colder weather, I was eager to get my good legs up and running. There’re just so much to do, new things to discover, I couldn’t ask for a better place to further my studies than here.

Studying in Plymouth University has given me opportunities to rediscover my true passion and get me started on my journey. I believe that this experience had shaped me into a much better and mature person. During this project I have come close to puffins and have had the chance to handle storm petrels in Fair Isle. Chances like this don’t come too often. These are the days that when I look back I will never regret.”

Zetty

“My project truly has me over excited! Friday 17th June we left at 6.25am and travelled ~800 miles north by three trains, two boats and a bus to get to the Fair Isle (its a little island only 3 miles by 1.5 miles in size between Shetlands and Orkney), microscope in hand, CTD in backpack. Saturday, I saw my first Puffin as we walked around the island and met most of the locals (there are only 55 of them). Last night, I met some ornithologists, who let me hold some storm petrels they had caught, even had a sniff (they smell very earthy for anyone interested!) and today I hopped on a boat no bigger then a station wagon, drove 5 miles to collect some water samples and even took a quick stop along the way for me to loose some of my lunch. I am now waiting for the phytoplankton in my water samples to settle, tomorrow I will start looking under the microscope, identifying and counting phytoplankton, I couldn’t be more eager or excited about sciencing!”

Germano
MPRG scientists Drs. Phil Hosegood, Jill Schwarz, and Kate Adams set sail to the wintry Southern Ocean last April-May as part of the NERC-funded SMILES project to identify and measure submesoscale (<10 km) features along the Subantarctic front. Large-scale ocean currents such as the Antarctic Circumpolar Current (ACC) meander rather than chart a straight course. These mesoscale, O(100 km), meanders occur at fronts, where water properties such as temperature and salinity, change sharply over a few kilometres. Smaller submesoscale (<10 km) streaks and filaments, observed along the periphery of mesoscale meanders and eddies, have strong vertical velocities important for the exchange between the atmosphere, mixed layer and below.

A meander along the ACC was targeted as a study feature during the SMILES cruise. To the surprise of everyone onboard, the meander separated from the ACC and formed a cold-core eddy. Twenty Lagrangian drifters, constructed by Plymouth University scientists and technicians, were deployed during the cruise to track the eddy and have since travelled a combined 53,000 kilometres. Perturbations in the drifter velocity time series as well as the structure of water properties in the +50 towed-CTD sections will yield information about the time and length scales of submesoscales along the edge of the eddy.

Plymouth University students Marcus Zanacchi (PhD), Ross Millar (MRes), Holly Ayres (BSc) and Zoe Waring (BSc) also joined the 5-week research cruise aboard the 100-m RRS James Clark Ross, a British Antarctic Survey vessel. Collaborators from L’Ocean, Cambridge University and PML also contributed to the round-the-clock data collection shifts, or ‘watches’.

Congratulations to Phil Hosegood, the principal science officer (PSO), for leading a successful cruise! For more on submesoscales and the SMILES cruise: www.smiles-project.org.

Dr Kate Adams

“To be involved in the SMILES Project was a unique opportunity. The cruise itself was very exciting, even with a short period of sea sickness, it still managed to make me more passionate about the ocean than ever.

Being able to experience real oceanographic research in the middle of the Southern Ocean and learning a range of sampling techniques was a life changing experience.

My project is based around the drogue drifters that were released at a submesoscale front and a mesoscale eddy. Throughout the cruise I used GPS to track their velocity to look at their interactions with these features. I have recently been looking at what they have been doing since the cruise, checking to see what drifters are still being controlled by the currents and which ones are being controlled by the wind due to losing their drogues in the rough conditions.

Overall it was an amazing experience and, given the opportunity, I recommend all students that have a passion for the ocean should try to get involved in research where they can.”

Holly

Albatross and Pilot whales seen from the boat

Left: Holly Ayres ‘mousing’ a shackle on a Lagrangian drifter drogue, a safeguarding measure to prevent drogue loss during deployment. Right: Aft deck of the JCR during one of the few snowstorms we encountered.

Left: Sea surface temperature (SST) maps, 09 and 12 May 2015, show the meandering Polar and Subantarctic fronts along the Antarctic Circumpolar Current. Lagrangian drifters (circles) travel along a sharp meander on 09 May (left). A few days later (right) the meander formed a closed cold-core eddy and separated from the ACC. A sea level anomaly contour, -0.35 m, outlines the Subantarctic front and the eddy.

Lagrangian drifter, D17, position time series shows a circulatory pattern within the eddy for about a month followed by an eastward course along the Scotia Ridge. D17 is still reporting and has travelled nearly 3500 km. Note the E-W drifter velocity oscillations, O(1 m s⁻¹), while the drifter travelled in the eddy.
PhD student Kit Stokes measured beach morphology to reveal insights into beach response to changing wave forcing.

The Wave Hub facility off the coast of Hayle in West Cornwall (www.wavehub.co.uk) is a marine renewables test site, predominantly designed for trialling wave energy converters prior to commercialisation. When Wave Hub was first proposed in 2006, concerns over the potential effects of extracting wave energy on coastal waves and beach morphology sparked an ongoing monitoring effort by Plymouth University’s Coastal Processes Research Group (www.coastalprocesses.org). Since 2008 this monitoring has included monthly topographic surveys of the popular tourist and surfing beaches of Perranporth and Porthtowan directly in the lee of Wave Hub, to monitor patterns of beach erosion and accretion. Support from the Higher Education Innovation Fund (HEIF) through the University’s Marine Institute has provided vital funding to keep these monthly beach surveys going between funding from other external projects. The resulting multi-year dataset showing how the beaches change under natural wave conditions will be invaluable for comparison with surveys when wave energy devices are deployed at Wave Hub over the coming years.

The beach surveys to date show that Perranporth and Porthtowan, along with other high energy ocean-facing beaches in Cornwall and Devon, sit at a classification boundary where they alternate between being flat and featureless or highly three-dimensional (3D) with pronounced sandbars and rip channels. Such 3D features have profound implications for coastal water-users as they enhance surf-zone hazard, in terms of the potential for rip-related drownings, whilst also improving the quality of surfing waves by increasing length of ride as the breaking waves ‘peel’ round the sandbars. As part of Kit Stokes’ recently completed PhD, the monthly beach survey data were used to show how changes in these 3D features can be predicted from changes in wave steepness; the resulting paper was recently published in the journal Geomorphology (http://bit.ly/1IQJS9T).

Kit found that the change from erosive winter conditions with high steepness waves to accretive summer conditions with low steepness waves drives the growth of the 3D sandbar features during spring each year. These 3D features persist over the summer, enhancing both rip hazard and surfing quality, before flattening again during the following autumn and winter. Using a predictive model he explored the potential effect of Wave Hub on this pattern of 3D sandbar growth and decay at Perranporth beach. Only an extreme and unrealistic level of wave energy extraction (100% energy capture at Wave Hub) was predicted to have a significant effect on the scale of sandbars and rip channels, and under more realistic scenarios (≤ 30% energy capture) Wave Hub was predicted to have an insignificant effect on beach morphology of relevance to coastal water-users. Thanks goes to all the CPRG members who have helped out with the surveys over the years, and thanks to the ongoing support from HEIF and the Marine Institute our monitoring can continue to examine the dynamics of these beaches, providing the world’s longest running dataset of beach morphology in the lee of a wave energy site.
outside, if

if i were a geometrist, or could remember pi
i could calculate the arc of the crashing bow
or if i could paint like Hokusai
i could snatch the living blues and whites
mix them and lay them on wood

if i spoke oceanographer, i could understand a crest
if i could find out where the whale goes
the great blueness might be left
a living oil slick, illuminating lamps
in the creaking mind-cabins of thinkers

if I was eloquent enough to talk about buoyancy
like Rumi, i could make all the ifs slow,
tip and ride like Dylan's curlew, on calmer sea
soft in possibility's harbour, with the gulls
squawking laddish for scraps

i heard about a colony of thinkers out in Oregon
talking fifty languages, developing an esperanto for the forest
i heard they have no word for outsider
and lots of words for outside

outside with the moss
outside with a camera
outside with a quadrat
outside breathing
outside making mistakes
outside making fires

Paul Bray