

## GOMO's Demonstration of new technologies, 2017-2021

These examples illustrate a range of Research & Development interactions with the private sector (beyond procurement), types of "transitions" including maturing of observing system capabilities/technology and transitioning of technologies, capabilities and/or intellectual property and impact of involvement with patents, Cooperative Research and Development Agreements (CRADAs) and other activities with industry, other sectors, etc. supported by GOMO.

Principle Investigator	Research & Development interactions/advances with private sector	In-house innovation achievements in sensor development, Observing platform improvements, Product development	Links/Comments/Notes
Cross, Jessica	Development of DIC sensors for Saildrone		<a href="https://www.saildrone.com/tag/arctic-missions">https://www.saildrone.com/tag/arctic-missions</a> , <a href="https://www.saildrone.com/missions/arctic-ice-dge">https://www.saildrone.com/missions/arctic-ice-dge</a>
Perovich, Don	Development of SIMB3		<a href="https://www.cryosphereinnovation.com/">https://www.cryosphereinnovation.com/</a>
Chris Meinig/Noah Lawrence Slavas	CRADA to develop Saildrone UxS as a climate observing platform	Achievements of RDT&E and conops across multiple science disciplines best summarized here - <a href="https://www.frontiersin.org/articles/10.3389/fmars.2019.00448/full">https://www.frontiersin.org/articles/10.3389/fmars.2019.00448/full</a>	Over 70 researchers and engineers involved in over effort in dozens of institutions and commercial sensor mfg globally. List of NOAA and partner pubs are found here: <a href="https://www.saildrone.com/technology/science-publications">https://www.saildrone.com/technology/science-publications</a>
Chris Meinig/Scott Stalin	CRADA to commercialize PMEL developed PRAWLER profiler	From ideation to science applications in climate and ecosystems. Realtime reporting, command and control used in over 12 sites globally	We've found this profiling platform ideal as a sensor development testbed, as it can both profile or remain clamped to the wire and report in realtime
Chris Meinig/Scott Stalin	Early stage discussions with commercial company to produce	In house PMEL innovation to replace legacy buoy controllers for	Early stage, working on internal transition plan also

	TELOS buoy data logging and telemetry system	GMTMBA, OCS, Arctic and carbon observations	
Chris Meinig/Noah Lawrence Slavas	CRADA to transition ASVCO2 system to NGO and industry. CRADA and MOU also in place with CSIRO to advance and systematize lab validation and metadata	In house PMEL innovation to replace legacy MAPCO2 system. Initial support from GOMO to integrate early prototypes into Saildrone USVs. Later transition supported primarily by PMEL and IOOS. Addition of a DIC measurement currently being supported by OAP.	Now commercially available at Saildrone and Jupiter Research Foundation has completed a comparison report on Wave Gliders. General website with PMEL carbon leads (Sutton): <a href="https://www.pmel.noaa.gov/co2/story/Buoys+and+Autonomous+Systems">https://www.pmel.noaa.gov/co2/story/Buoys+and+Autonomous+Systems</a> . ASVCO2 methods and measurement evaluation paper published: <a href="https://doi.org/10.1175/JTECH-D-20-0010.1">https://doi.org/10.1175/JTECH-D-20-0010.1</a>
Sarah Purkey/Dean Roemmich/Nathalie Zilberman/John Gllson	NOAA/NOPP development of the BGC SOLO model and commercialization through MRV systems. The BGC SOLO carries all 6 required BGC sensors with long life expectancy and increased sampling capabilities. Additional collaboration with SBS to test new pressure compensated pH sensor		
Peter Stone		GOMO funding built expertise within NOS/CO-OPS to design and install GNSS antenna and receivers at coastal water level. These installations are very difficult and each one has unique requirements.	<a href="https://www.sonel.org/">GNSS data available at: https://www.sonel.org/</a>
Nathalie Zilberman/Sarah Purkey/Dean Roemmich	NOAA/NOPP project to improve the performances of the 6000m-capable Deep Argo CTD from SeaBird called SBE-61. New pressure sensor		Ship time made available by NIWA on the Tangaroa and Kaharoa vessels for CTD cast, and Deep SOLO float deployment and recovery plays an instrumental role in the execution of this

	<p>candidates are identified for replacement of the Kistler model currently used on the CTD. Stability and accuracy of the pressure sensor candidates are assessed in the field from CTD casts and Deep SOLO float measurements.</p>		<p>project</p>
<p>Dean Roemmich/Nathalie Zilberman/Sarah Purkey/John Gilson/Daniel Rudnick</p>		<p>In house SIO improvement of the bottom detection software on the Deep SOLO float, and study of Tadiran battery efficiency on SOLO II and Deep SOLO models. SIO provides regular updates of float technology development to MRV.</p>	
<p>Susan Wijffels, Breck Owens</p>	<p>Support development of new CTDs for use in Argo; shipboard and float deployments, tank measurements, analysis.</p>		<p>RBR Canada has been a commercial partner. This activity drove an instrument redesign, overhaul of calibration procedures and onboard data treatment. Global Argo is running a pilot of these CTDs. An international TT was established to do this work- several NOAA funded Argo teams contributed. An alternative CTD is desperately needed for Argo, to end the single supplier situation we are presently in.</p>
<p>Roo Nicholson</p>	<p>Testing of sensor responses for BGC parameters.</p>		<p>Work is just starting. Stalled due to hold ups at Seabird</p>
<p>Susan Wijffels/Steve Jayne/ Pelle Robbins</p>	<p>Testing and improvement of a new Argo platform: MRV ALTO. This float has a more flexible controller, can carry larger payloads and can be more</p>		<p>MRV systems is the commercial partner. WHOI meets with MRV weekly. Float platform variety adds resilience to the Argo network.</p>

	energy efficient than the S2A. WHOI has carried out pilot deployments, tank tests, and helped debug both the hardware and software.		
Steve Riser/Alison Gray	NOAA/NOPP development of new SeaBird O2 sensor for floats that allows air calibration (SeaBird 83). This has been deployed on several floats and works well. This was one of the main goals of our NOPP project.		
Steve Riser/Alison Gray	NOAA/NOPP development of an improved pH sensor for floats, in collaboration with SeaBird and MBARI. Two versions of an improved sensor now exist and are being evaluated via test deployments off Monterey and at Hawaii.		
Steve Riser/Alison Gray	Adding radiometers to Teledyne/Webb APEX floats. These floats are built at UW from components purchased from Teledyne. This is part of our NOPP effort, with the results eventually to be added to SeaBird floats. We now have several of these in the water at Hawaii and off the west coast of the US. They are working well and imply that soon we will have true 6-sensor BGC floats.		
Steve Riser/Alison	We are working with SeaBird (part of		

Gray	the NOAA/NOPP project) to fabricate a new hull for BGC-Navis floats that can hold more batteries. This was a major goal of the NOPP project and will likely be ready for a deep ocean test this summer.		
Steve Riser/Alison Gray	Designing a new fluorometer for profiling floats (funding from NOAA/Argo) that measures chlorophyll fluorescence at a wavelength of 435 nm in addition to the present 455 nm. All of the FLBB measurements made by floats to date (in the US) have been at the longer wavelength, but the actual fluorescence wavelength is closer to the shorter one. This has involved redesign of the FLBB sensor in collaboration with SeaBird. We now have 3 of the new units in-house and will deploy these prototypes on test floats soon.		SeaBird has been the commercial partner. This work is separate from the NOAA/NOPP work that has also funded some float/sensor development.
Steve Riser/Alison Gray	UW built 4 BGC-APEX floats for Dr. Emily Osborne at NOAA/AOML. These floats were deployed in the Gulf of Mexico in the fall of 2021. The floats were built from commercially-available components and fabricated and tested at UW. They		

	were shipped to AOML and checked out by a UW engineer, then deployed by AOML personnel.		
Chris Cox/Sara Morris/Taneil Uttal	De-Icing Comparison Experiment (D-ICE) 2017-2018 tested arctic hardening technology for radiometers in collaboration with 5 manufacturers, the World Radiation Center (global cal standard), and 5 gov't/research institutes.	Atmospheric Surface Flux Stations (ASFS): autonomous, arctic-hardened, mobile, single-level flux towers deployed over sea ice (MOSAIC, 2019-2020) then modified for lower power on large buoys in collaboration with ONR-AMOS and APL-UW and deployed in Beaufort Sea (2021, exp July 2022).	<a href="https://amt.copernicus.org/articles/14/1205/2021/">https://amt.copernicus.org/articles/14/1205/2021/</a>
Don Perovich	Continuing collaboration with Cryosphere Innovation on adding sensor capabilities to the Seasonal Ice Mass Balance buoy. Radiometers have been added to the buoy due to a Senior Thesis project. Currently an effort is underway to add conductivity sensors and a local snow depth network as part of a PhD project.	In house we have developed sensors that are being integrated into the SIMB.	Cryosphere Innovation is the commercial partner.
Luca Centurioni, Rick Lumpkin	Global Drifter Program (GDP). The SVP and SVP-B drifters are prime examples of technology co-developed with private industry, the manufacturing/construction guides are lead authored by Andy Sybrandy	<a href="https://www.worldcat.org/title/wocet-oga-svp-lagrangian-drifter-construction-manual/oclc/28032829">https://www.worldcat.org/title/wocet-oga-svp-lagrangian-drifter-construction-manual/oclc/28032829</a>	<a href="https://books.google.com/books/about/The_WOCE_TOGA_SVP_Lagrangian_Drifter_Con.html?id=CHHCtgAACAAJ">https://books.google.com/books/about/The_WOCE_TOGA_SVP_Lagrangian_Drifter_Con.html?id=CHHCtgAACAAJ</a>
Robert Weller/Al Plueddemann	Work with DSA Ocean, mooring dynamics consultants	Analyses of dynamic simulations of NTAS and Stratus moorings to	

		develop risk mitigation strategies	
Robert Weller/A; Plueddemann	Work with several manufacturers of meteorological instrumentation to test and evaluate sensors for use on surface moorings	Upgrading, improving ORS surface moorings	
Robert Weller/Al Plueddemann	Work with Star Engineering, WHOI developed ASIMET system transitioned to Star Engineering for commercial production	WHOI ORS use ASIMET; NOAA Ship RH Brown uses ASIMET; Triton moorings use ASIMET	
Robert Weller/Al Plueddemann	Contracted by government of India to make for India and ORS quality surface mooring for monsoon studies	First such mooring used last year by India	
Robert Weller/Al Plueddemann	work with Kipp and Zonen Inc to acquire and implement halogen lamp based radiometer calibration facility	Will improve our efficiency in calibrating radiometers and improve accuracy of incoming shortwave observations	
Gustavo Goni/NDBC/Sippican	AOML personnel worked with Sippican at an NDBC facility to calculate the drop height correction for the XBT Fall rate equation.	This research led to the improvement of the XBT fall rate equation, providing more accurate measurements	
Ulises Rivero/Grant Rawson/Flynn Technical solutions/Severn Marine	Test experimental instrument coating that removes the need for harmful antifouling paint or other materials.	Recently recovered after a 2 year deployment, the sensor was clean enough that it could be turned right around and deployed with minimal cleaning.	
Grant Rawson/Woods Hole Group/URI	Facilitated the testing of a new glider emergency argo beacon developed by WHG.	Successful testing would lead to improved options for emergency recovery beacons for gliders and	

		other marine platforms.	
Greg Foltz/Grant Rawson/AOC/MRV Systems	Adapting and clearing the MRV ALAMO float for flight and deployment on NOAA's P3 Hurricane Hunter aircraft	Clearing the ALAMOs for flight on board the P3s allowed for the deployment of ALAMO floats closer to tropical cyclones giving the floats the best chance of collecting critical ocean data before, during, and after the passage of a tropical cyclone.	
Meghan Cronin/Dongxiao Zhang	Developing solar and longwave radiation observing capability on Saildrone	PMEL developed a stand alone radiometer package for deployment on two drones for the TPOS 2022 mission to be used as a test of sensor viability and data quality. Package included Short Wave and Long Wave radiometers, a data logger and batteries sufficient for a 6 month deployment.	If this test proves successful it is hoped that Saildrone will integrate these sensors into their system for regular usage without additional equipment.
Gustavo Goni	In-house development of a prototype AOML XBT real-time data recorder (AXR).	This low-cost option for recording XBT observation also reduces the hardware cost by ~85 times.	
Gustavo Goni	In-house development of Iridium-based transmitter	A system developed to reduce the cost of transmitting XBT observations but can be used to transmit other observations from any ocean or land-based platform, with no data restrictions on the format.	
Ulises Rivero	In-house development of Adaptable		A deep ocean data retrieval system designed to



	Bottom Instrument Information Shuttle System (ABISS)		move data from moored oceanographic instruments up to the surface and back to land via satellite
Ulises Rivero/Pedro Pena	AOML/RSMAS development of GUI for amperometric oxygen titration system	System is used to measure dissolved oxygen in seawater	
Pedro Pena	In-house development of GUI for Inverted Echo Sounder	The software is used to communicate and download data from all URI telemetry capable PIES & CPIES	