# Project CONVERGE: Estimated physical and biological decorrelation time and space scales from coordinated AUV observations in coastal Antarctica

*Matthew Oliver[1], Josh Kohut[2], Megan Cimino[1], Peter Winsor[3], Hank Statscewich[3], Travis Miles[2], Katherine Todoroff[2], Filipa Carvalho[2], Kim Bernard[4], William Fraser[5], Donna Patterson-Fraser[5]*
1. University of Delaware, Lewes, DE; 2. Rutgers University, New Brunswick, NJ; 3. University of Alaska, Fairbanks, AK. 4. Oregon State University, Corvallis, OR. 5. Polar Oceans Research Institute, Sheridan, MT.

## Abstract

Coastal ecosystems are organized around persistent and predictable environmental phenomena. Near Palmer Station, Antarctica, a large submarine canyon is associated with enhanced primary production supports top predators that feed in the water column. However, it is unknown what drives water column structures in this biological hotspot. We deployed three coordinated Slocum gliders in a high frequency radar field to estimate both the temporal and spatial decorrelation scales of temperature, salinity, mixed layer depth, chlorophyll fluorescence and optical backscatter. The along, and cross canyon transects intersected at a station-keeping glider. We used the station-keeping glider to estimate the temporal decorrelation scales of the canyon system and used this scale to interpret the spatial variability along and across the canyon. We find that despite the extreme depth of the canyon (>1000m), the upper water column structure is significantly structured by the presence of the canyon. What is not known is whether canyon circulation generates a locally productive ecosystem through upwelling, or if productive waters are trapped by canyon circulation.

## Deployment

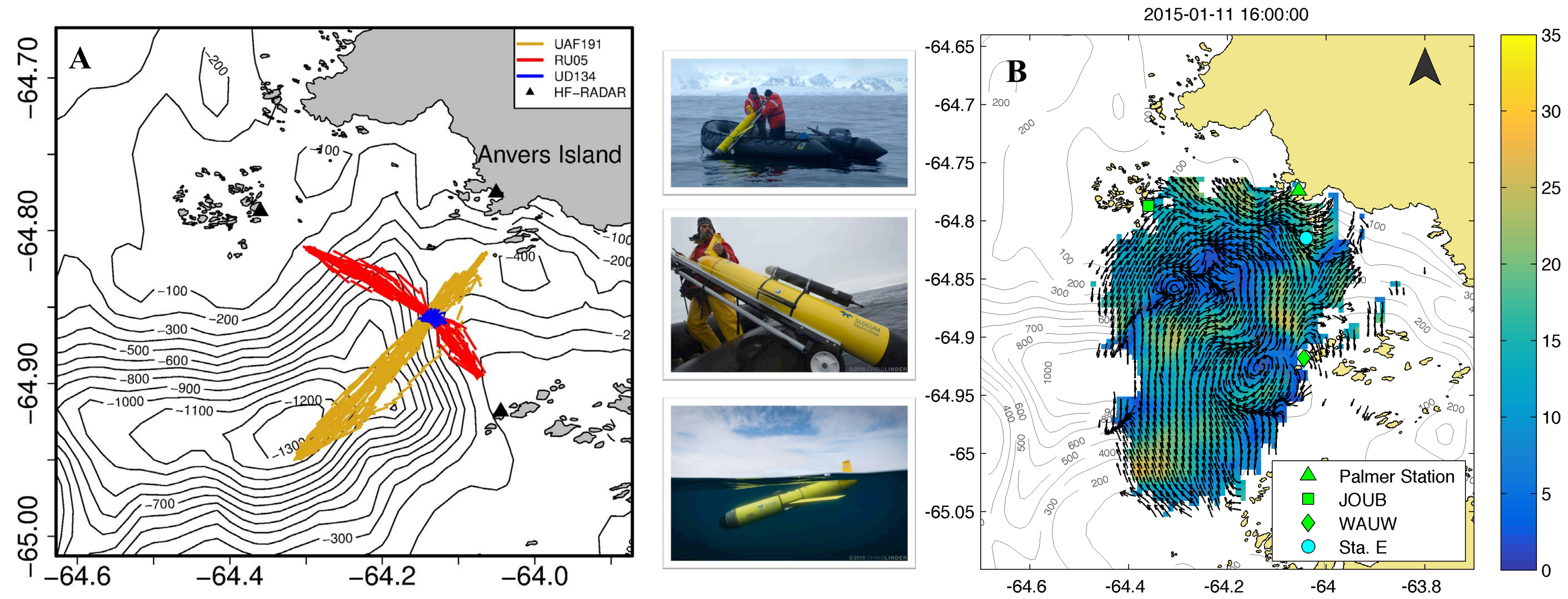


Figure 1: Three gliders flew an along (UAF191) and cross (RU05) canyon pattern with a stationary glider (UD134) at the intersection (A). This coordinated flight pattern was within an HF-RADAR field, which measured surface currents (B). Depth integrated currents estimated by the station keeping glider and HF Radar revealed a general NE flow

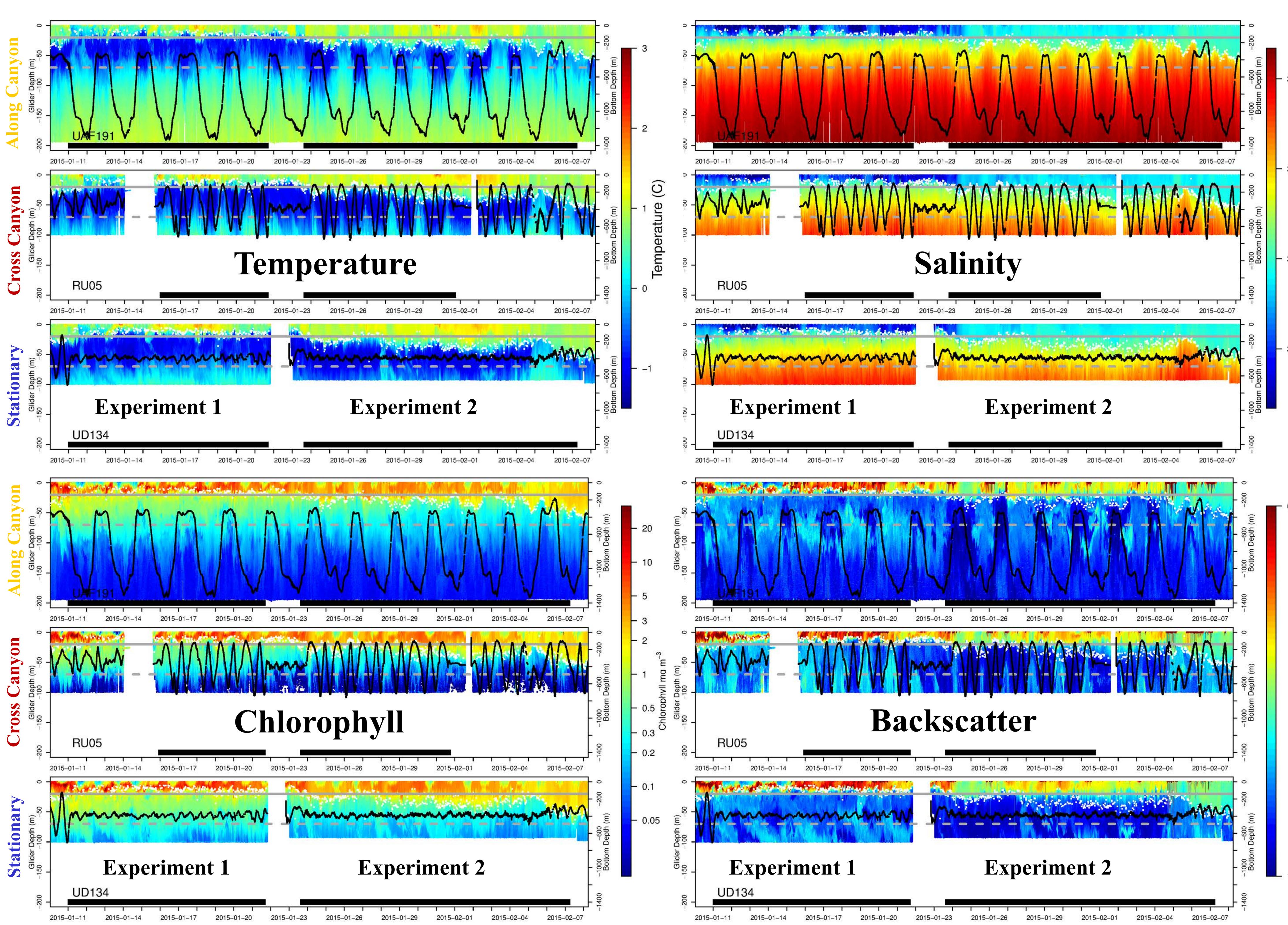


Figure 2: Glider along, cross, and stationary sections of temperature, salinity, chlorophyll and backscatter. The along section glider (UAF191) dove to 200m. The white dots are estimates of the mixed layer depth based on buoyancy frequency. The black line is the trace of the bathymetry during the glider cross section. The black bars indicate two time periods when the gliders were flying the cross pattern in Figure 1, with a stationary glider at the intersection of the crossing pattern. These two time sections captured different dynamics with respect to the mixed layer depth (white dots). The solid and dashed grey lines indicates the average forage depth of Adélie and gentoo penguins respectively.

## Glider Decorrelations

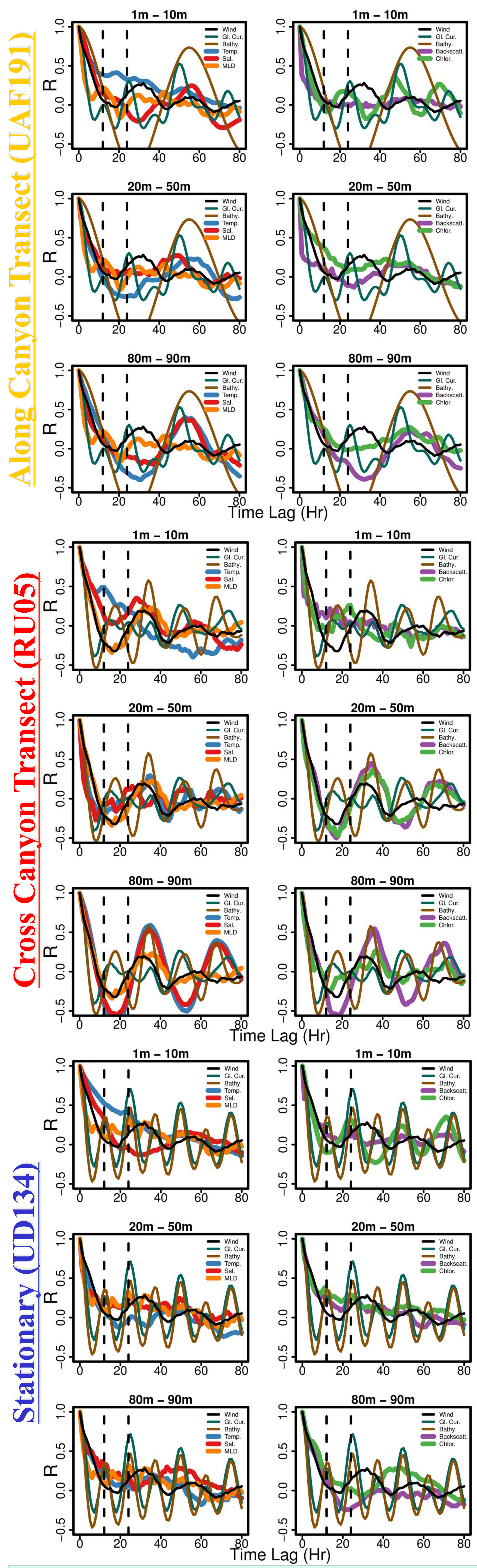


Figure 3: The decorrelation time scales for the Experiment 1 time period in Figure 2 for the stationary, cross and along shore glider transects for three different depth bins (Experiment 2 not shown). Dashed lines are 12hr and 24 hour scales. Left panels are decorrelation of physical variables and right panels are biological variables.

## Results

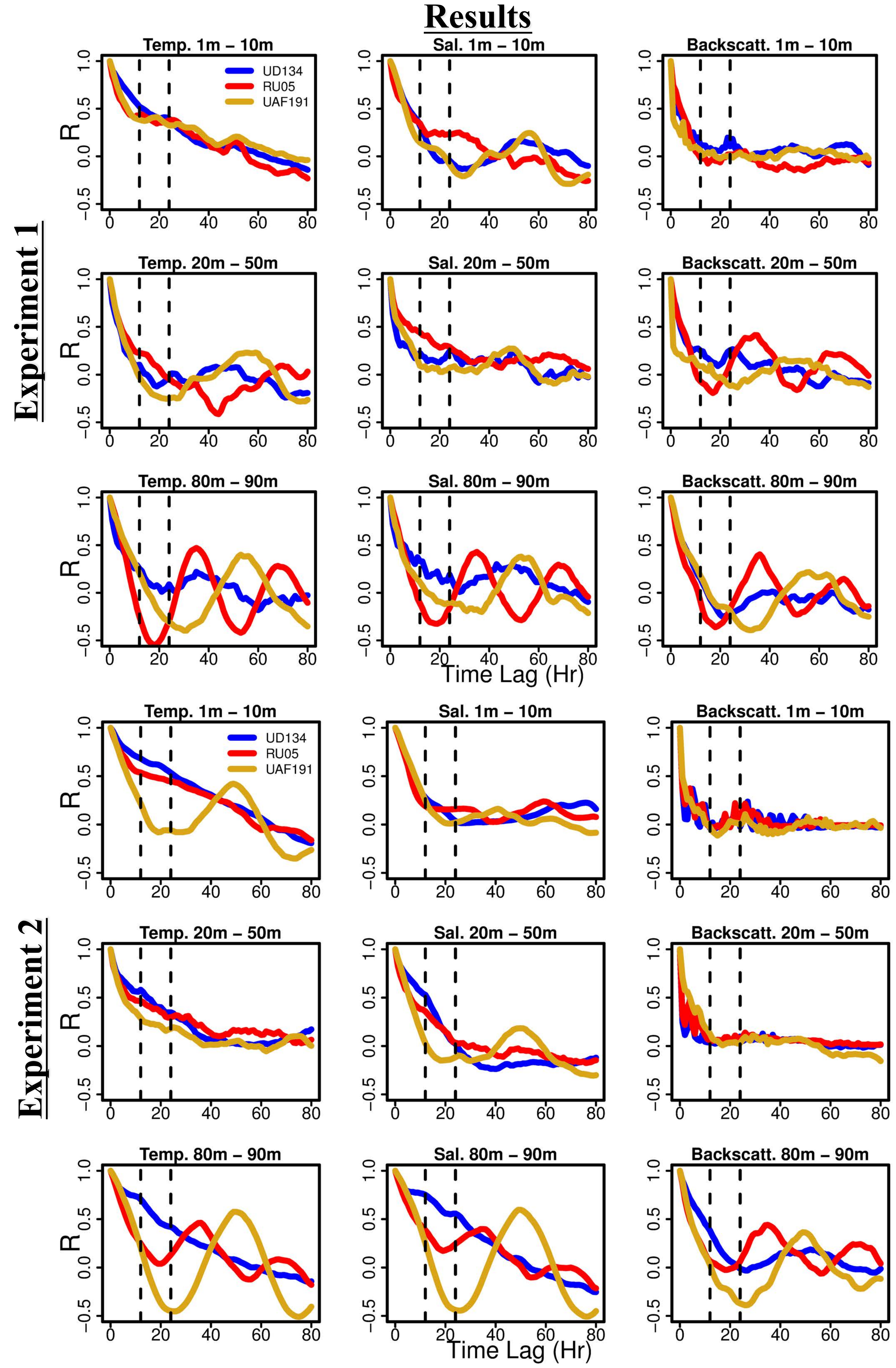


Figure 4: Comparison of temperature, salinity and backscatter decorrelation scales for the three gliders at the different depth bins during the two experimental time periods in Figure 2. UD134 represents the time decorrelation, and differences between this glider and the cross and along canyon gliders is interpreted to be decorrelation due to spatial factors.

## Conclusions

1. **Decorrelation scales in the upper 10 meters appears to be primarily due to temporal, not spatial variability.**
2. **Decorrelation scales in the lower water column are primarily driven by spatial variability which coincident with canyon bathymetry.**
3. **Decorrelation peaks in glider velocities are at the tidal frequencies.**
4. **Decorrelation patterns in MLD biological variables are related to the decorrelation of wind speed.**

Acknowledgements: This project is funded through the National Science Foundation, Award Number: ANT 1327248. We are grateful to the Antarctic Support Contractor and their teams, both in Denver, CO, aboard the RVIB Laurence M. Gould, and at Palmer Station, without whom a project such as ours would be impossible. We also thank the students and field assistants for their valued involvement in the CONVERGE project. Finally, we thank the Palmer Antarctica Long-Term Ecological Research team, for their advice, suggestions and collaboration