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Poster
The PHANTOM project is addressing some climate-relevant subjects at selected choke points in the Southern Ocean using in situ observations, altimetry, and numerical model outputs. It results from the fusion of two previous independent projects, DRAKE (PI, Christine Provost) and TRACK (PI, Young-Hyang Park), into a single bigger project to share the common methodology and personals around the central themes of the poleward heat flux and the Antarctic Circumpolar Current (ACC) variability in hitherto not well-documented, but dynamically and thermo-dynamically utmost important, choke point regions. It is designed to explore efficiently already-made in situ observations in Drake Passage and the Fawn Trough of the Kerguelen Plateau, to extend the experiments to other outstanding choke points such as the Udintsev Fracture Zone in the South Pacific and the Shackleton Fracture Zone upstream of Drake Passage via a French-Korean collaboration, and to validate and use the global datasets from altimetry and the eddy-resolving, data assimilating model MERCATOR outputs for better documenting and monitoring the Southern Ocean heat budget and the ACC variability.

The oceanic poleward heat flux in the Southern Ocean constitutes an important climate component connected with the meridional overturning circulation and has attracted ever increasing interest because of its peculiarity related to the presence of the strong eastward flow of the ACC. In contrast to subtropical regions where poleward heat flux is largely controlled by the geostrophic mean flow of the western boundary current system, the quasi zonal flow of the ACC in the Southern Ocean greatly isolates Antarctica from direct contact with warmer waters from lower latitudes (Rintoul et al., 2001). However, as the subpolar region south of the ACC loses a substantial quantity of heat to the overlying atmosphere by 0.5-0.65 PW (1 PW = 1015 Watts) south of 60°S (Gordon and Owens, 1987; Hastenrath, 1982), there should be a compensating oceanic heat flux poleward across the ACC. There are two competing but complementary views about how this occurs, i.e., by eddies or by mean flow.

Recently, we have conducted oceanographic cruises with long-term current meter moorings across two choke point sections: one across the Drake Passage in 2006-2009 (Provost et al., 2011) and the other across the Fawn Trough of the Kerguelen Plateau in 2009 (Park et al., 2009). The current meter data from these sites were analyzed in terms of poleward heat transport and ACC variability. Results from the Fawn Trough current meter data (Sekma et al., 2013) and from the Drake Passage data (Ferrari et al, in prep) indicate the overwhelming importance of time-mean flow for the local poleward heat transport due to a significant turning of velocity vectors with depth, revealing a highly non-equivalent barotropic structure.

We expect a similar situation can be observed in other topographically constricted regions with strong flow across prominent submarine ridges, such as the Udintsev Fracture Zone in the South Pacific where mooring will be deployed late 2014 from Araon Korean icebreaker in collaboration with colleagues from KIOST (Korean Institute of Ocean Science and Technology), KOPRI (Korean Polar Research Institute) and URI (University of Rhode Island, USA).
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