Extremal Currents and Fatigue Current Profiles for the New Gendalo Location in Makassar Strait, Indonesia

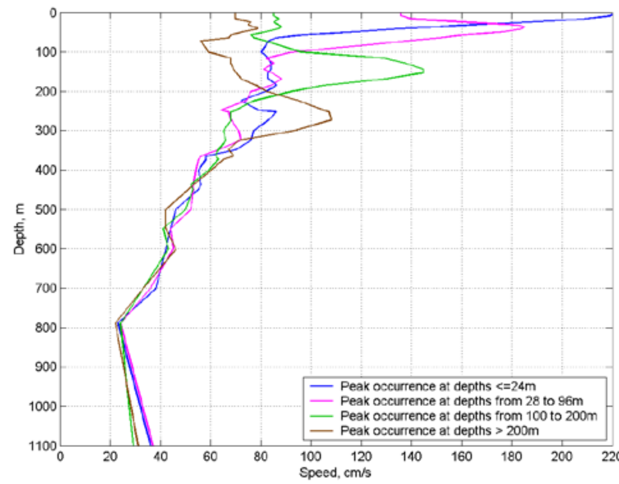
Project Characteristics:

- *Offshore Structure Design/Response Analyses*
- *Oceanography of the Western Makassar Strait*
- *Flow Field Variability*
- *Extreme Current Analysis*
- *Current Profile Selection for Riser Fatigue Estimate*

Chevron required extremal and operational current profiles at the New Gendalo site in support of their oil production activities in Makassar Strait. As a part of this effort, Woods Hole Group performed a study of oceanographic processes and extreme currents for this location. Previously, Woods Hole Group performed analyses of extreme current conditions for a close location in the Gendalo area and for several other locations in the western Makassar Strait and developed a consistent methodology for such an analysis.

Physical process analysis is used by Woods Hole Group as an inherent part of the methodology applied to produce extreme current profiles and profiles for fatigue analysis. Understanding of the physical processes is essential to determine the applicability of the extremal extrapolation methodology, ensure that all contributing processes are considered, and evaluate the reliability and robustness of the result. Purely statistical methods that do not consider the physical processes can produce unreasonable design criteria. Methodology of the process-oriented analysis comprised spectral analysis, separation of the barotropic and baroclinic currents, empirical orthogonal functions, lag-correlogram, and tidal harmonic analyses.

Currents in Makassar Strait typically contain a strong tidal component, in addition to non-tidal low frequency current variability of significant amplitude. A typical one-year dataset of current measurements includes only few low frequency, high-amplitude current events, which essentially limits the period of meaningful extrapolation if a purely statistical approach of current extrapolation is applied. To provide a realistic, physically reasonable method of extrapolating this type of observed currents to long return periods, Woods Hole Group separates the total current into tidal and low frequency bands.



New Gendalo Extreme Current Summary: Maximum Current Speed Profiles for 100-Year Return Periods Characterized by Current Intensification in Different Layers

A probability distribution function is estimated separately for each of these processes, and the separate extremal estimates are combined using joint probability of occurrence statistics.

The physical process analysis revealed a multi-layered kinematic structure of the flow with extremes confined to certain depth ranges. Four types of extreme current profiles were generated based on the finding that an extreme current speed of certain return period would occur in one of the layers characterized by a peak in the frequency of occurrence of current extremes. The associated current speeds for other depths were drawn from the ensemble of data points associated with this particular extreme. These extreme current profiles drawn from the New Gendalo dataset were then adjusted to reflect changes in flow intensity associated with La-Niña events.