NORWEGIAN ARMED FORCES

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A comparative analysis of various data sources for use in ASW operations

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The Rapid Environmental Assessment (REA) concept was designed to meet requirements for maritime environmental data arising when forces deploy to data-sparse regions.

The REA CONOPS specifies 4 categories:

Cat 1	Cat 2	Cat 3	Cat 4
- Climatology - Models - Remote sensing - etc.	Surveying before deployment	Covert surveying - Gliders - AUVs - etc.	Data collection during operation - XBT / XCTD - etc.

Cheap and (relatively) quick

Expensive.
Constraints on time, manpower, ship-time, instruments, bandwidth, personell and training.
Ultimately a funding issue.

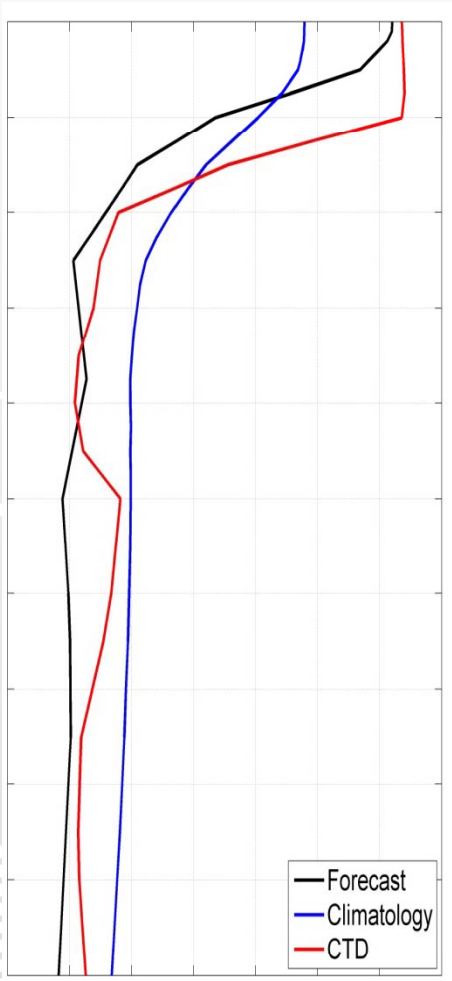
Routine work

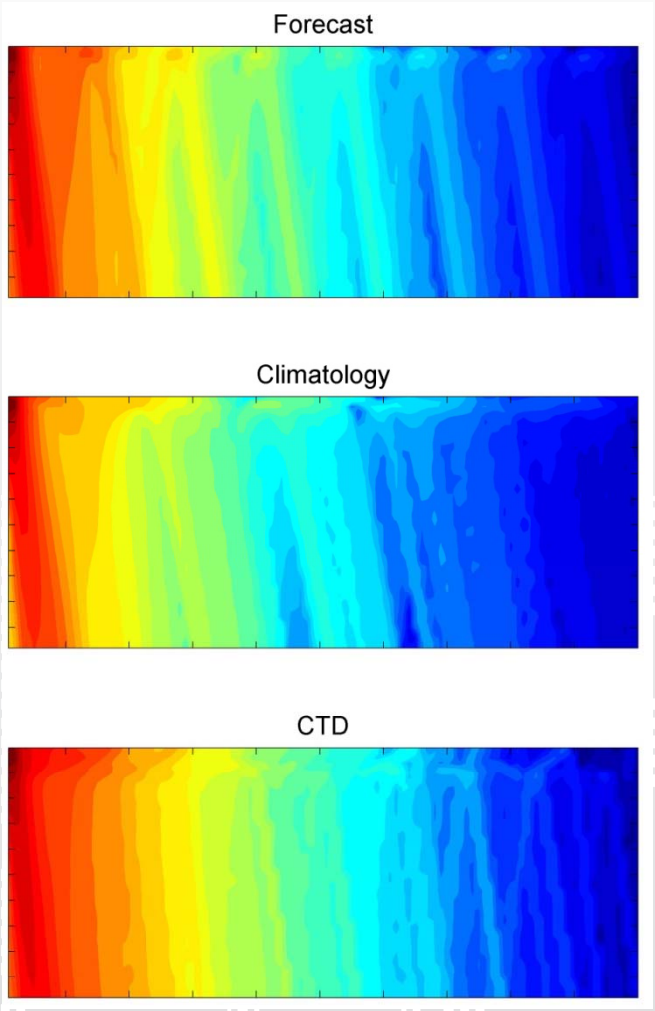
How well does climatology compare to CTD and model data?

- Transmission loss (TRL) is calculated from sound speed profiles
- TRL is compared using a variety of statistical methods
- Constant sonar parameters and seabed type
- Wind speed varies between 0 m/s and 20 m/s
- **Acoustic model:** LYBIN, adapted for MATLAB by FFI
- **Climatology:** GDEM v. 3.0, 0.25ºx0.25º from the U.S. Naval Oceanographic Office.
- **Model data:** MI-POM, 4 km resolution, from the Norwegian Meteorological Institute
- **CTD profiles:** From the Institute of Marine Research and FFI

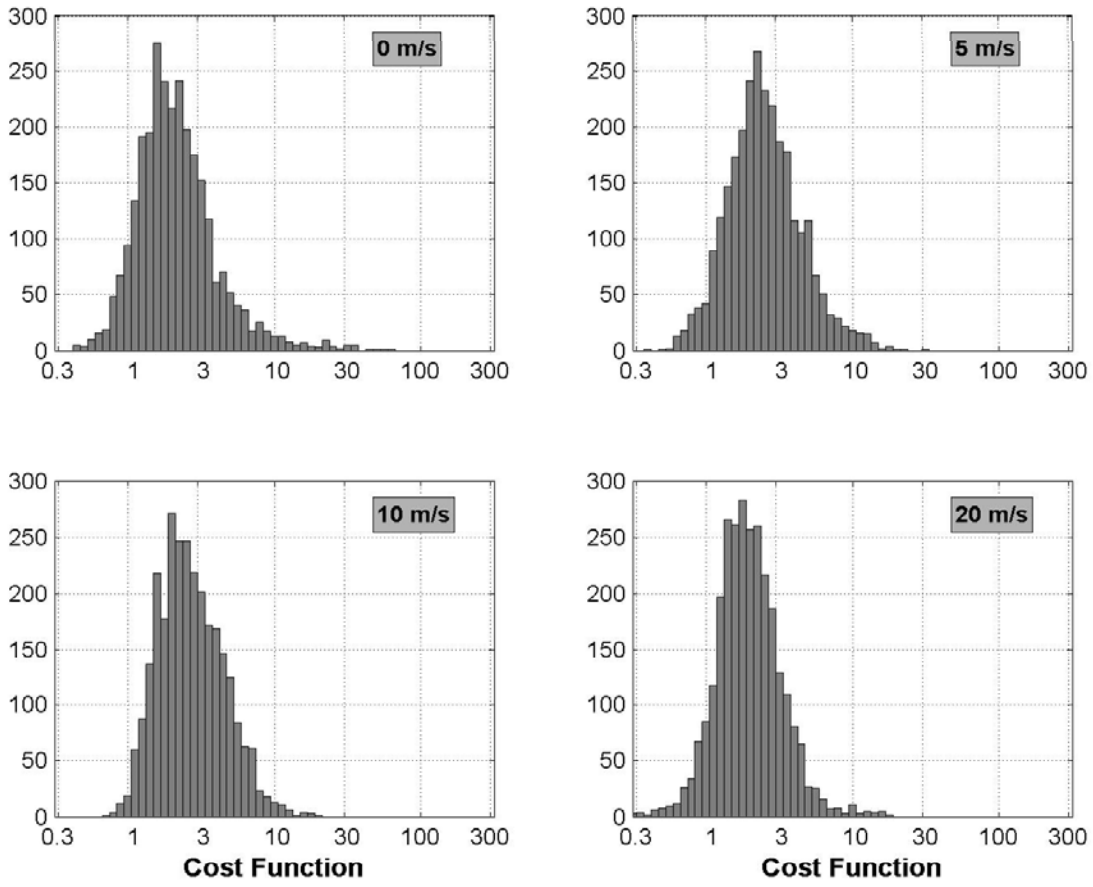
Statistics

- Correlation coefficient
- Percent error
- Normalized RMS error
- Chi-squared per DoF
- Absolute difference
- Bias
- Model efficiency
- Percentage model bias
- Cost function

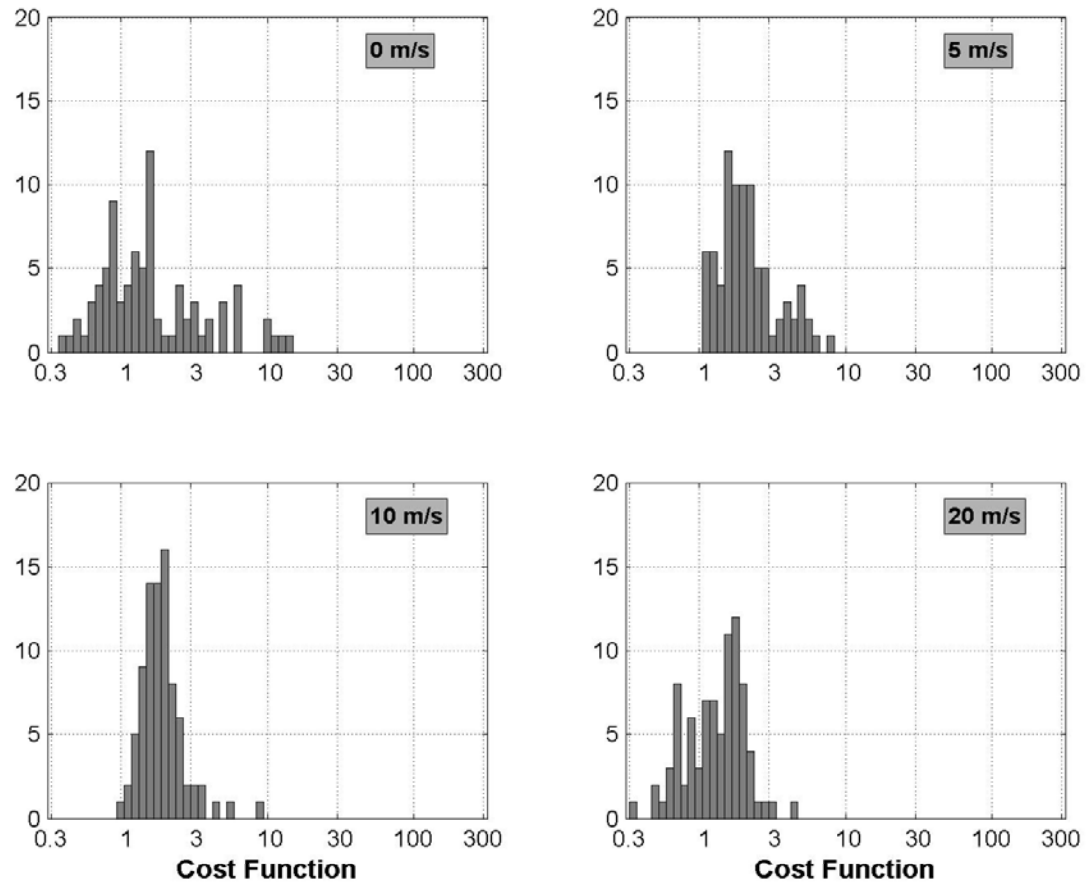




Monthly climatology vs. 2800 CTD profiles from 2009



Monthly climatology vs. numerical model forecast



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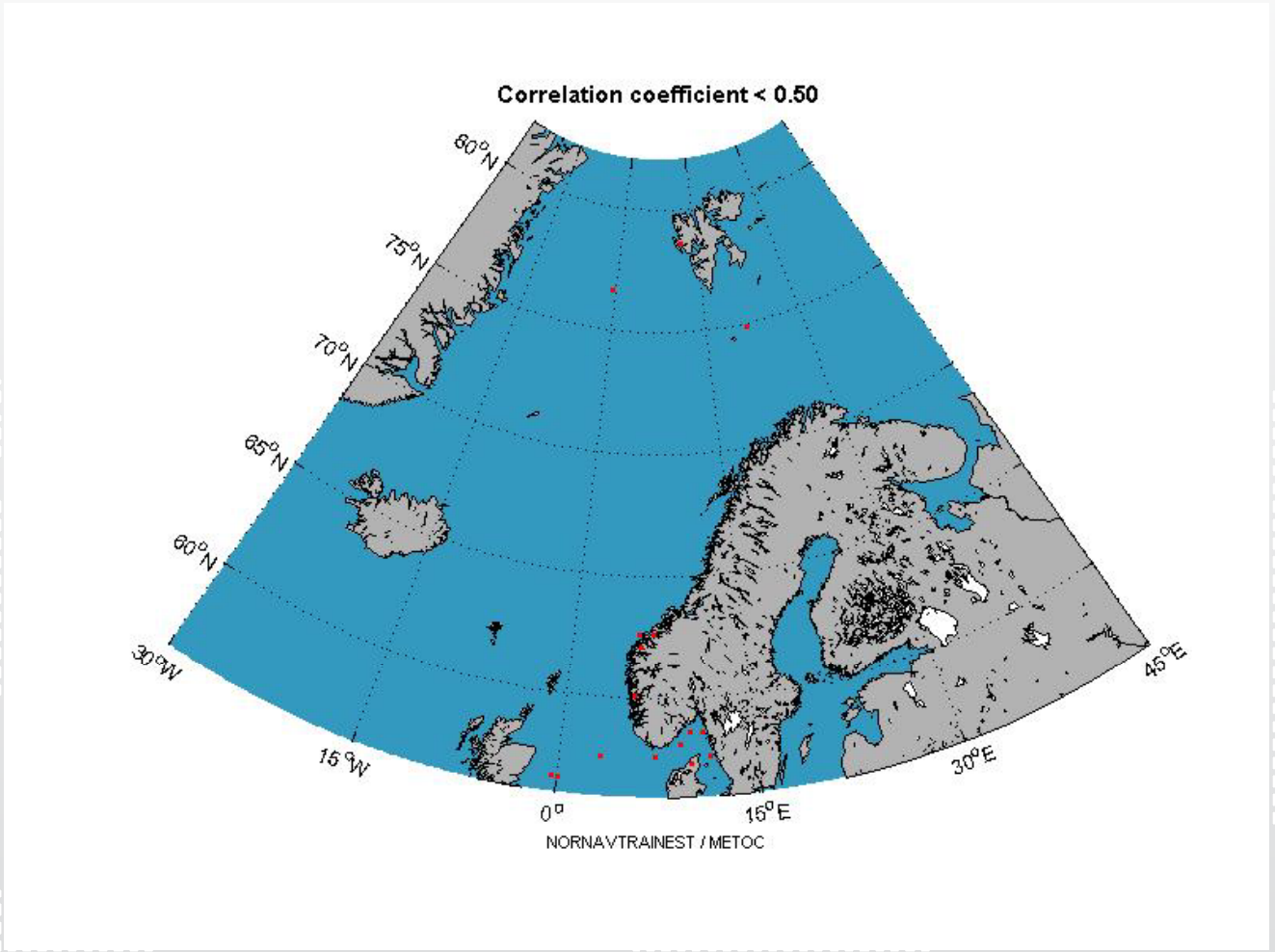

Summary

Climatological data are routinely delivered to naval forces, and it is encouraging to see that the transmission loss fields generated from climatology compares reasonably well to CTD and model data.

For planning purposes, climatology is a valuable tool for estimating the environmental impact on ASW operations, but does not replace in-situ measurements.

Care should be taken in areas with high oceanographic variability, such as frontal regions.

Useful references:

- Teague et al. 1990, A comparison between the Generalized Digital Environmental Model and Levitus Climatologies, JGR 95, C5, pp. 7167-7183
- Allen at al. 2007, Error quantification of a high-resolution coupled hydrodynamic-ecosystem coastal-ocean model: Part 2. Chlorophyll-a, nutrients and SPM, J.Mar.Systems 68, pp. 381-404

Climatology vs. CTD with increasing sensor depth