Ocean Multivariate Data Assimilation in GOAPP

Theme I.1.3

Plans and Preliminary Work

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Objectives for project I.1.3

- **Determine the means and error covariance structure of the altimeter and Argo data to be assimilated into the global ocean and basin models using 3DVar**

- **Test and compare performance of new assimilation schemes for altimeter and Argo profile data**

Milestones for year 1

(i) **Calculate the background error covariance auxiliary variables (ξ_D, ξ_T, ξ_S) using the ¼ degree North Atlantic ocean model developed in project I.1.2**

(ii) **Test and compare performance of new assimilation schemes for altimeter and Argo profile data using the new auxiliary variable- based scheme**

Reduced Order Kalman Filter

- **Forecast:**

$$x^f_{i+1} = M(x^a_i) \qquad P^f_{i+1} = M \, P^a_i \, M^T + Q$$

- **Analysis:**

$$K_{i+1} = P^f_{i+1} \, H^T \, (\, H \, P^f_{i+1} \, H^T + R)^{-1}$$

$$x^a_{i+1} = x^f_{i+1} + K_{i+1} \, (y_{i+1} - H \, x^f_{i+1})$$

$$P^a_{i+1} = (\, I - K_{i+1} \, H \,) \, P^f_{i+1}$$

- **Covariance matrix $P = L \, \Lambda \, L^T$**

- **Error subspace $S_o \approx L \, (\Lambda)^{1/2} \, , \, P = S_o S_o^T$**

Milestones for year 1

- **Calculate the background error covariance auxiliary variables (ξ_D, ξ_T, ξ_S) using the ¼ degree North Atlantic ocean model developed in project I.1.2**

- **Test and compare performance of new assimilation schemes for altimeter and Argo profile data using the new auxiliary variable- based scheme**

Milestones for year 1

- **(iii) Implement the SEEK (Singular Evolutive Extended Kalman) filter for the North Atlantic. Calculate the background error covariance auxiliary variables (ξ_D, ξ_T, ξ_S) using the ¼ degree North Atlantic ocean model developed in project l.1.2**

Preliminary work
(model setup)

- The OPA code is implemented in MUN for the North Atlantic Ocean. This model will be used in DAL and MUN for initial implementation an test of the assimilation scheme.

- T. Wakamatsu has set up a North Pacific regional model based on NEMO. The model is being tested on the IBM multi-processor computer at DFO's Institute of Ocean Sciences.

Preliminary work
(data collection and quality control)

- **Observations for data assimilation into the North Atlantic Model have been collected by Y. Liu at DAL. The ARGO vertical profile data and along - track altimetry measurements cover the 1997 – 2006 and 1992 – 2006 respectively.**

- **Quality control was applied to ARGO data at DAL. Along-track data of different satellites were merged and Lagrangian optimal interpolation was used to interpolate the ARGO data to standard times**

Preliminary work
(data assimilation)

- **Simple OI was used to make monthly mean maps of ARGO T&S and ssh. These fields will be used to remove bias in the assimilation schemes.**

- **Preliminary estimates of the observation and model error statistics, such as time and spatial decorrelation scales, have been estimated for temperature, sailinity and sea surface height for the North Atlantic.**

Preliminary work
(data assimilation)

- **The method has been implemented in a 1/3 degree model of the North Atlantic based on the POP model at DAL. (This model was developed under a CFCAS project grant that immediately preceded the GOAPP network grant.)**

- **Work on implementation of SEEK filter started in MUN**