WP4 Workshop: Assessing the predictability of seasonal forecast

December 5th 2013, Athens

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Executive Summary

A workshop was held on experimental design for the assessment of the potential for seasonal forecast of the OPEC model systems. The main goal of this activity is to explore the predictability of the system. Five model systems will be assessed; 2 in the Mediterranean, 1 in the NE. Atlantic, 1 in the Black Sea and 1 in the Baltic Sea. The existing rolling hindcast simulations (WP2) will be used to construct a climatology of the simulated ecosystem response. This will provide a reference benchmark analogous to persistence, allowing us to assess the seasonal forecast experiment. A range of seasonal forecast experiments will be carried out on the system. Each forecasting system will use a time scale of months and seasons. It was agreed that partners would follow the same common experimental approach to assess seasonal forecast, potentially supplemented by additional experiments to explore the impact of changes in meteorological forcing and as appropriate per region. In addition we wish to examine the response of HTL (higher trophic level) systems to perturbations in the physics/ LTL (lower trophic level) signal, including temperature, phytoplankton and zooplankton inputs over a number of years. Our aim is to see how much of the variation in biomass of key HTL species can be explained by variation in LTL driver variables reflecting normal inter-annual variation. The outcomes of the workshop we used to complete D4.1.

Actions

1. Jonathan to summaries ecopath and iterate with Ekin and Simone (done)
2. George to make a short note on HTL for Med (*completed*)
3. Icarus to write up notes from discussions with Asbjorn

Questions discussed

1) Does the seasonal forecast have skill
   a. Can the seasonal forecast beat persistence? i.e. is it better than climatology – benchmark
   b. Which variables should be assessed – nutrients, phytoplankton, zooplankton.
   c. At what time scales should seasonal forecast be assessed?
   d. At what space scales should seasonal forecast be assessed?
2) Why does the model have skill (not have skill)
   a. How sensitive is the seasonal forecast to initial conditions? OPEC's emphasis is on winter nutrients as these are indicative of the chemical energy available to the ecosystem for growth.
   b. How sensitive is the seasonal forecast to meteorological forcing?

c. How sensitive is the seasonal forecast to parameterisation and structure – An important issue which requires large scale ensemble simulation approach and is beyond the resources available to the OPEC project.

Experiments agreed

	HCMR	DMI	PML	OGS	METU
STD	X	x	X	x	X
Atmospheric Forcing	X	X			
Nutrient perturbation			x	x	x
NAO			x		

Partners (DMI, HCMR, PML, OGS, METU) **agreed a standard approach**

1. Common Strategic Approach

- Space scale: whole region (or sub regions as different parts are affected)
- Develop the climatology from the reanalysis
- Run a forecast and the reanalysis for 3 months to see the skill
- Use reanalysis to check the average
- Start at January 2007 until last start date of October 2008 (*Every month do a 3 month simulation run*)
- Use the reanalysis to start the second experiment (either the REA or the reanalysis)

Agreed variables: Chlorophyll (satellite and reanalysis) nutrients with in situ data (the best each region has).

2. Additional experiments:

2.1 Atmospheric Forcing

DMI will do the ensemble of atmospheric forcing using European Centre Marine Weather Forecast

HCMR will its own atmospheric ensemble forecasting system

2.1 Initial Conditions

Sensitivity to initial conditions carried out by HCMR, METU and OGS

- Analysis of the previous experiment to determine the memory in the system of the initial conditions

Sensitivity of system to nutrient initial conditions

- System is sensitive from a chemical perspective, so need to disturb the chemistry to see how it is perturbed look at Nitrate and Phosphate.
- 3 experiments: nitrate, phosphate and silicate
- Perturbation will be regionally defined. Use analysis of the hindcast to get the variability and use the upper and lower limits to find the sensitivity. I.e. use the variability in the hindcast to put the boundaries.
- Use median, and 5 and 95 percentile of the distribution.
- Use mixing from the winter period. Starting in January run for 12 months, because seasons diverge and then come back over a year period.
- Evaluate the sensitivity at a monthly time scale using reanalysis

Initial sensitivity conditions done by all but DMI, met forcing is done by DMI. It was agreed that parameterisation and structure issues are very important but the project does not have the resources to resolve this.

3. Large-scale climatic indicators

Divide atmospheric forcing data into years where there was a positive or negative NAO signal and explore the ecosystem response to climatic variability

Protocol for WP4 Perturbation Analysis for Higher Trophic Levels Using Ecospace

We wish to examine the response of HTL systems to perturbations in the physics/ LTL signal, including temperature, phytoplankton and zooplankton inputs over a number of years. Our aim is to see how much of the variation in biomass of key HTL species can be explained by variation in LTL driver variables reflecting normal inter-annual variation.

We will use the existing hindcast data with the North Sea Ecospace model as presented at the Athens meeting. There will be two protocols: Using the simple trophic interactions model, as presented, where the only interaction with zooplankton as is a food source for small pelagic fish and a new formulation, using the new habitat capabilities feature in Ecospace where zooplankton and temperature levels during and after spawning are used to determine recruitment into the juvenile class (shown to work in principle but expert knowledge needed for parameterisation). We will use existing hindcast data and bootstrap a new netCDF LTL driver dataset by taking complete years of all LTL output variables at random and replacing years at random.

Protocol is that of the 19 year run.

Years 1991 to 1999 will be run as is present.

Years 2000-2004 will be use random years taken from the whole dataset [Possibly we could draw data from extended hindcast data including 1960s with NAO negative].

Years 2005-2009 will use the existing dataset – to examine how long the system takes to return to the same state with different starting conditions.

We will change over the data at the end of February to ensure lowest level of zooplankton at time of change over, and smooth over jumps where appropriate.

We would expect to run around 20 bootstrap replicates and examine S.D / C.V. for ensemble of models, also some sort of skill assessment for predictions – e.g. is the true hindcast a better estimate of recruitment / biomass than bootstrap. Also examine time to return to baseline for the modelled species.

Similar protocols will be used for the Mediterranean system (Adriatic Sea) and Black Sea systems. In both cases the proposition is to perturb the E2E model by using primary production from BFM/BIMS, bootstrapping the years. The 4-5 bootstrapped years will be randomly chosen from the 1999-2011 years of A) the Hindcast and B) of the Reanalysis. The simulations obtained (order 20+20) will be analysed to see 1) dispersion and 2) memory (as above) plus 3) confrontation with available data for target species (anchovy and sardine for Adriatic; anchovy, sprat, turbot, whiting for the Black Sea) for 2004 and 2009 to analyse the skill of the model.

Participant List

Annika Pollani, Greece (HCMR)

Asbjorn Christensen, Denmark (DTU)

Baris Salihoglu, Turkey (METU)

Cosimo Solidoro, Italy (OGS)

George Triantafyllou, Greece (HCMR)

Icarus Allen, UK (PML)

Jessica Heard, UK (PML)

Jonathan Beecham, UK (Cefas)

Jun She, Denmark (DMI)

Kostas Tsiaras, Greece (HCMR)

Momme Butenschon, UK (PML)

Simone Libralato, Italy (OGS)

Sinan Arkin, Turkey (METU)

Sofia Kalaroni, Greece (HCMR)

Sonja Van Leeuwen, UK (Cefas)

Stefano Ciavatta, UK (PML)

Thomas Storm, Germany (BC)

Zhenwen Wan, Denmark (DMI)