Projections of Chub Mackerel Recruitment for Incorporation in Stock Assessment Models

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Recruitment projections based on empirical downscaling from IPCC climate models (CMIP5) using a generalized additive model (GAM)

Exploratory results shown here for the 2040s for the RCP8.5 scenario

Chub mackerel (scomber japonicus)

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Primary Prey – Copepods & Rotifers as Larvae; Mysids and Euphausiids as Juveniles/Adults
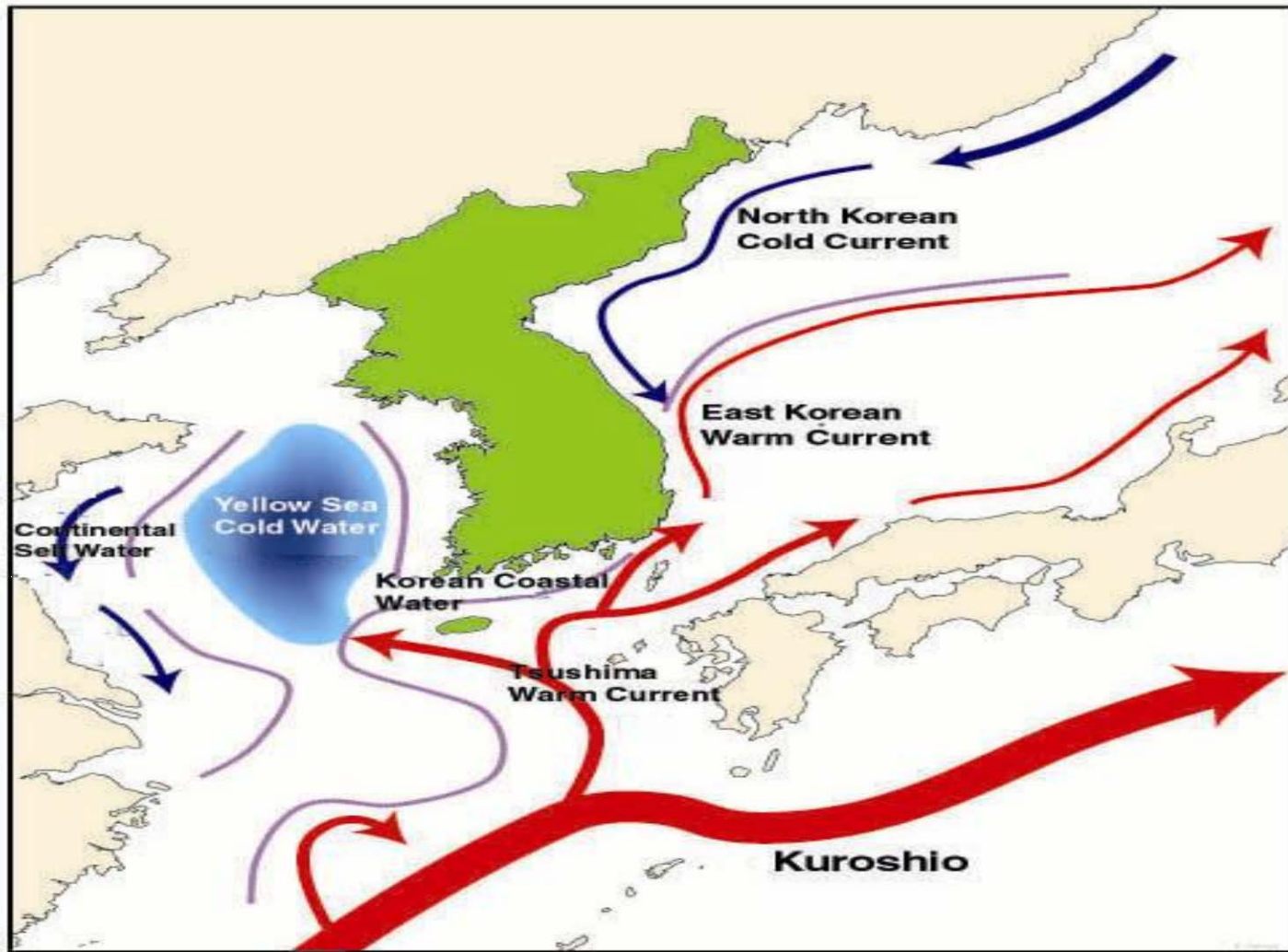
Fig. Current system around Korean peninsula(after Naganuma, 1973; Inoue, 1974).
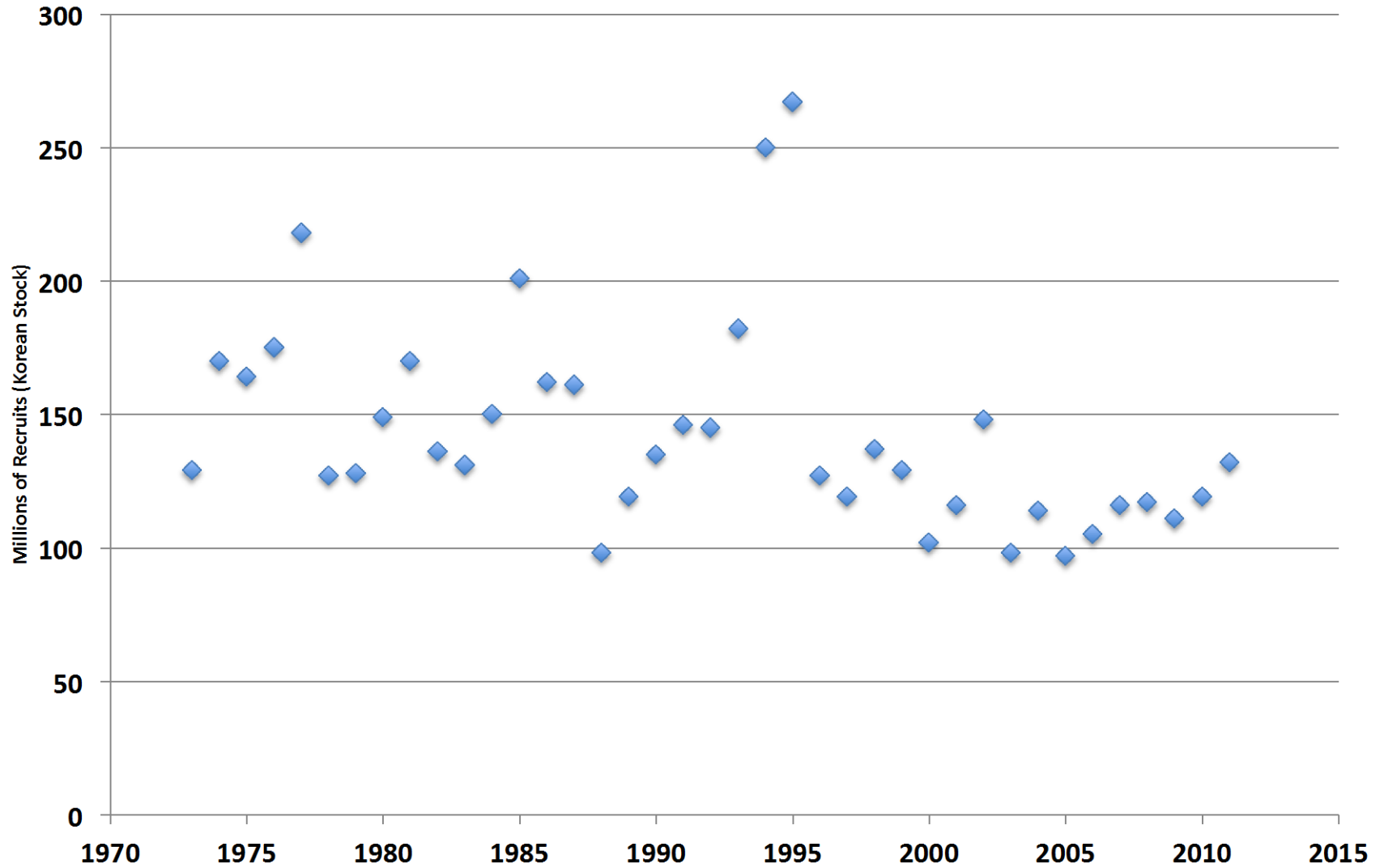
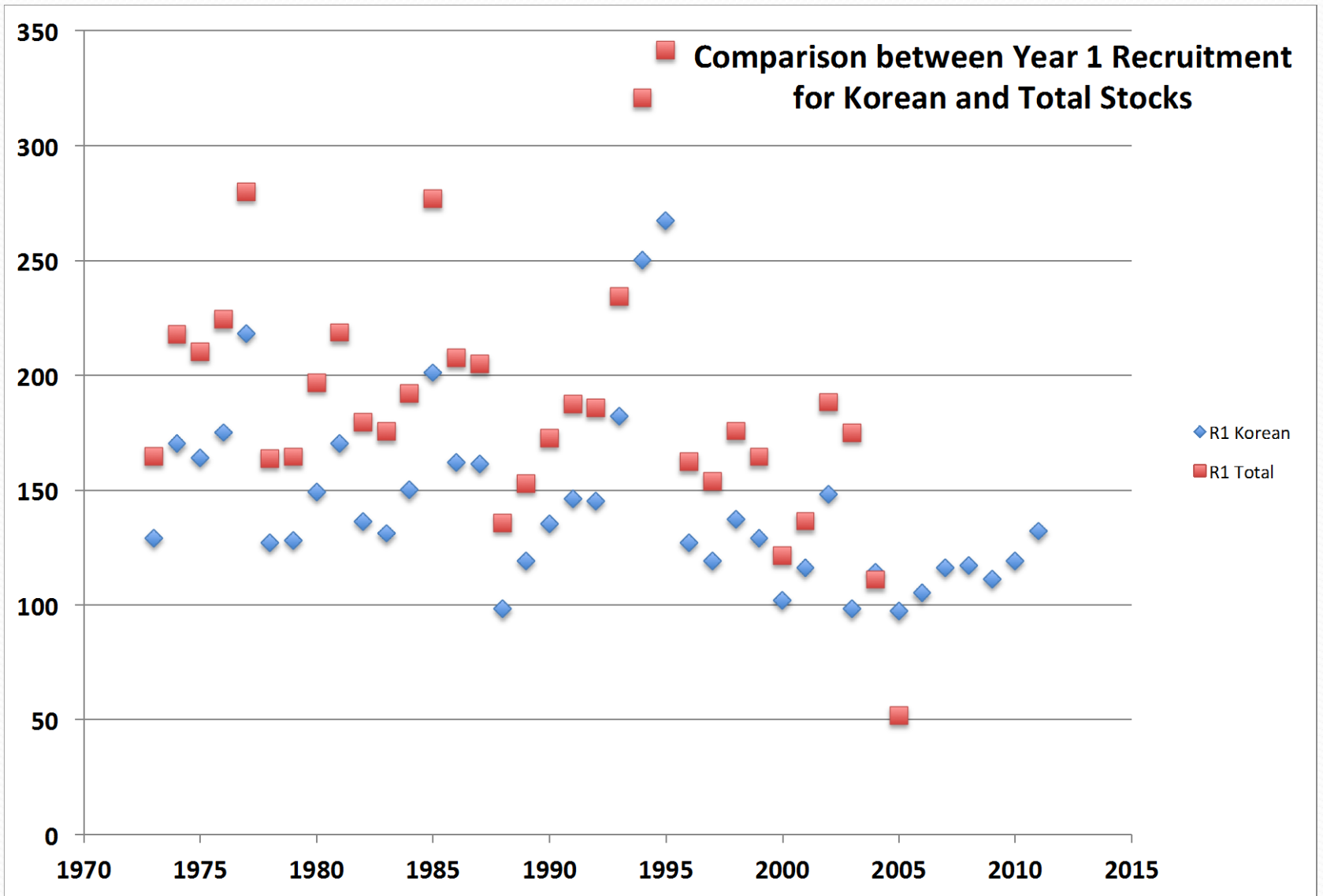# Environmental Factors Related to the Recruitment of Chub Mackerel in the East Sea

- Based on recruitment estimates and environmental data for 1973-2010
- Salinity and temperature data from GFDL Ocean Reanalysis; winds from NCEP Atmospheric Reanalysis
- Relationships between recruitment and environmental factors explored with a generalized additive model (GAM)
- GAM using upper-ocean salinities in February and temperatures in June, and N-S winds in Jan-Mar, explains ~50% of variance in recruitment
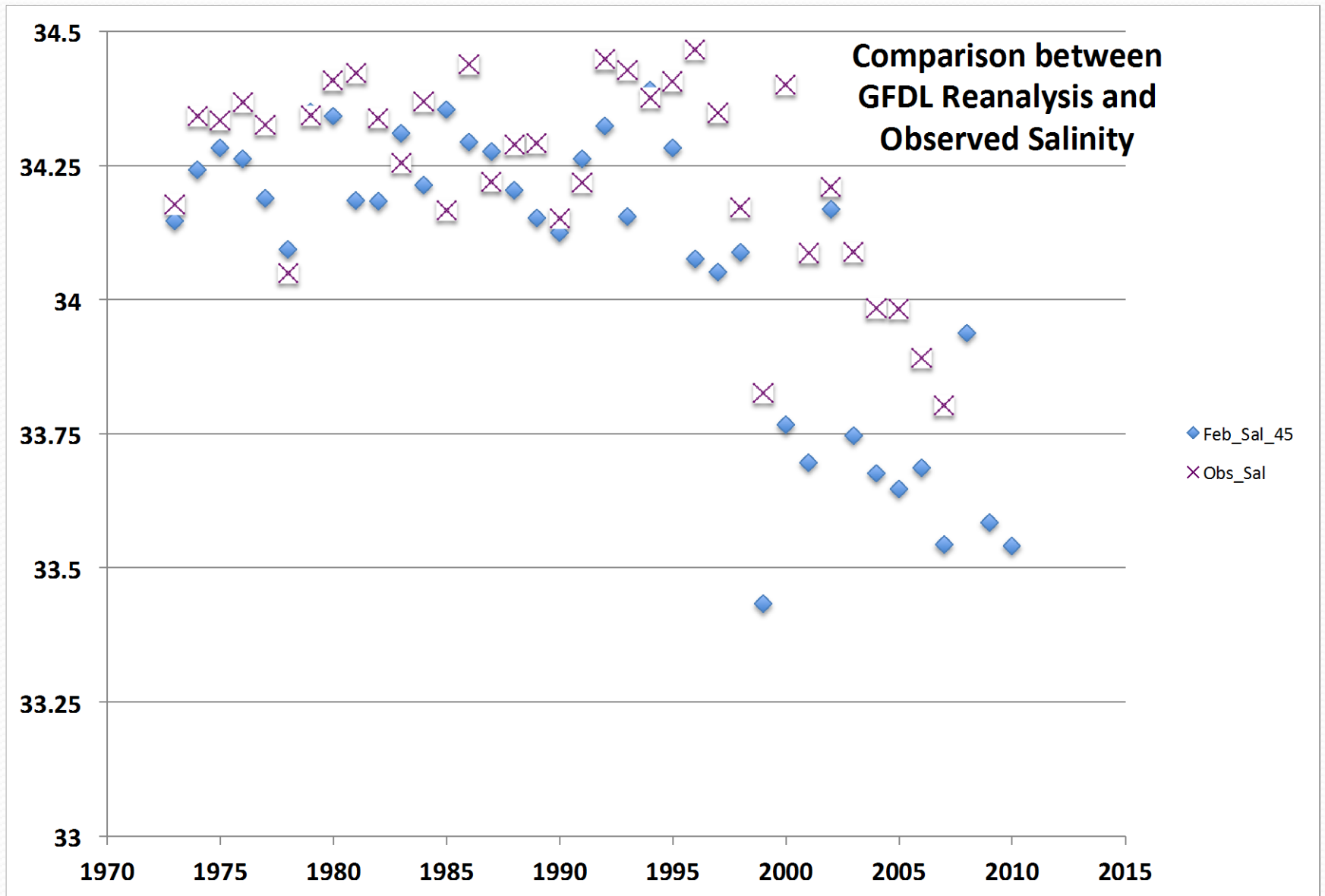
Issues

- Uncertainty in estimates of past recruitment
- Limited understanding of mechanisms important to chub mackerel recruitment
- Variety of potential environmental factors: What is the best GAM (or other type of empirical model) to use for projections?
- Current climate models indicate a substantial range of future conditions; imperative to use an ensemble of different models
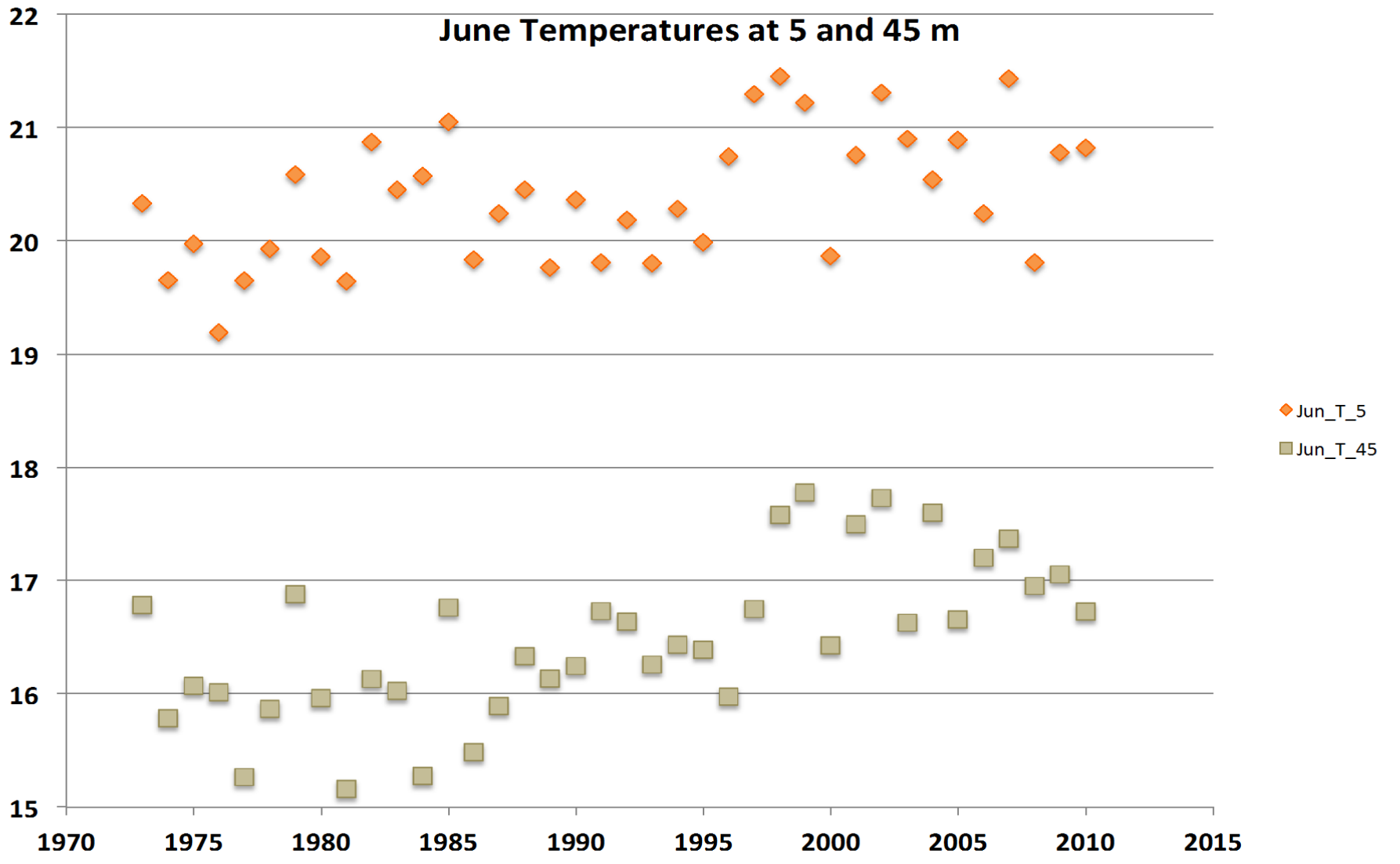
Year Class Strength (at Age 1)

Comparison between Year 1 Recruitment for Korean and Total Stocks

Comparison between GFDL Reanalysis and Observed Salinity
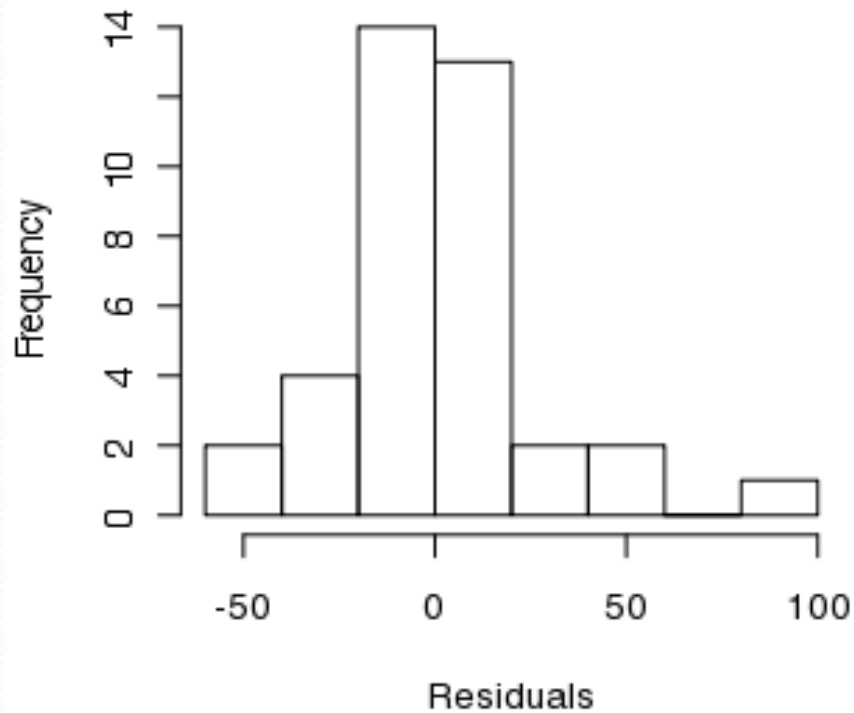
June Temperatures at 5 and 45 m

GAM Performance using upper ocean temperature and salinity and N-S winds as predictors of chub mackerel recruitment
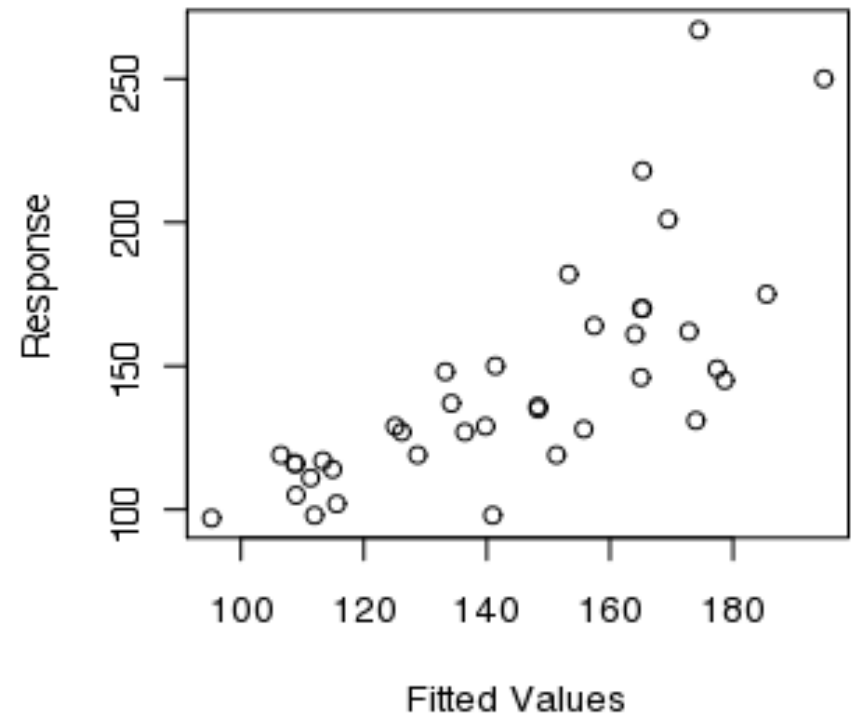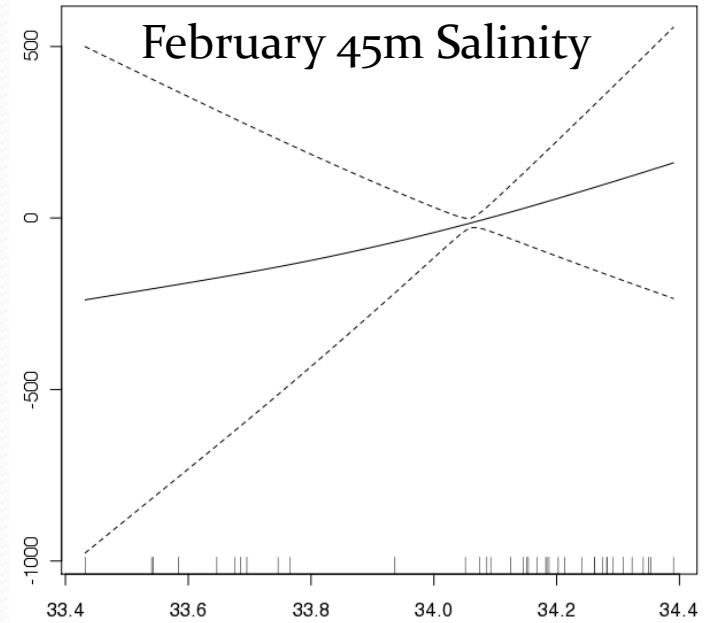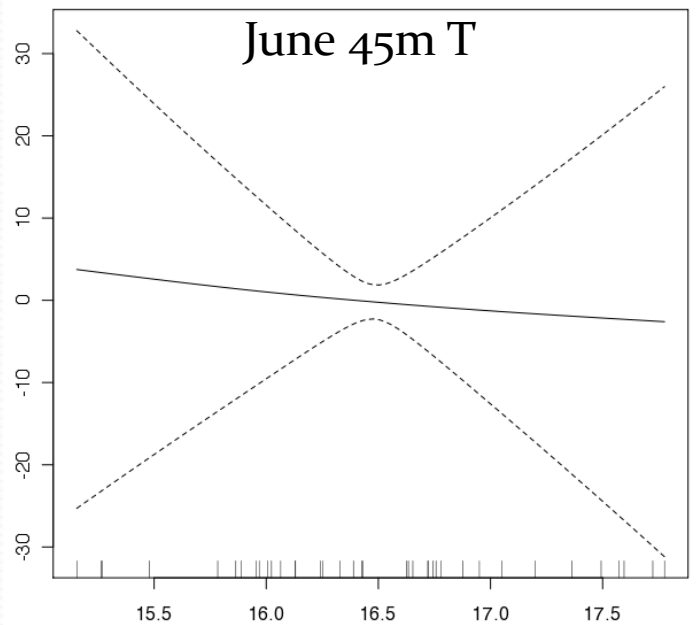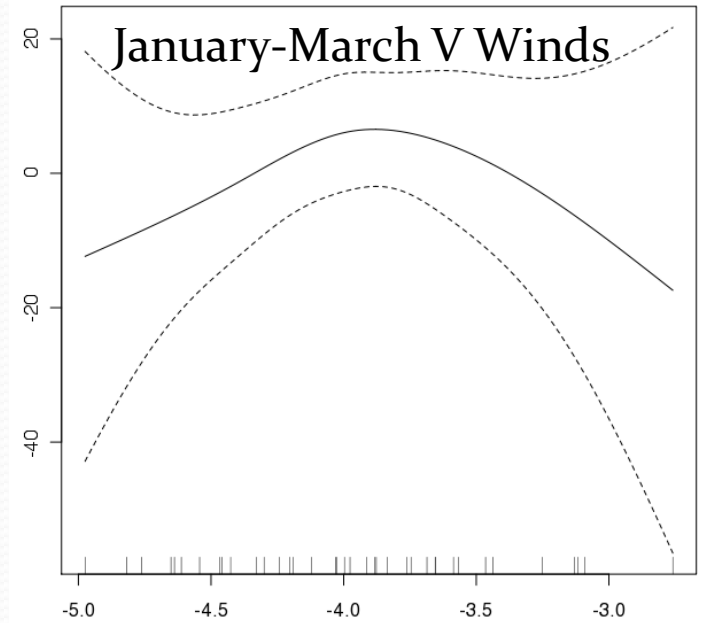
(Errors)

(Obs.)   (Model)

GAM Functional Forms

June Surface T

January-March V Winds

June 45m T

February 45m Salinity
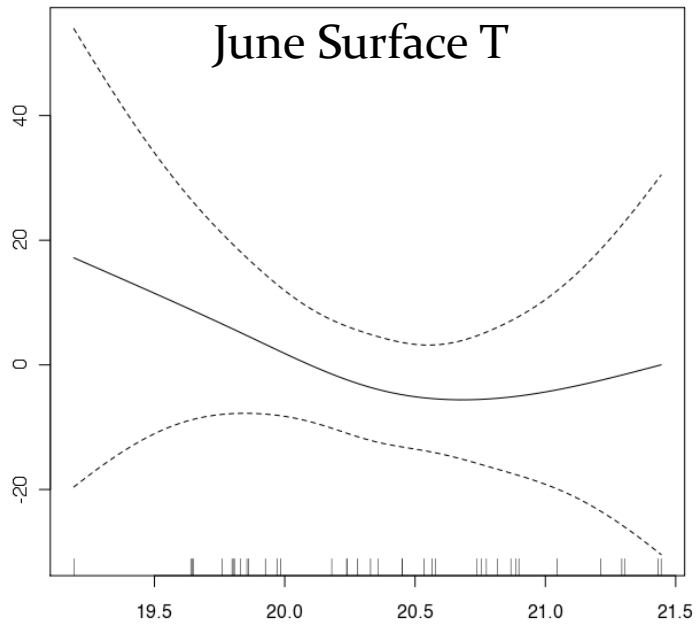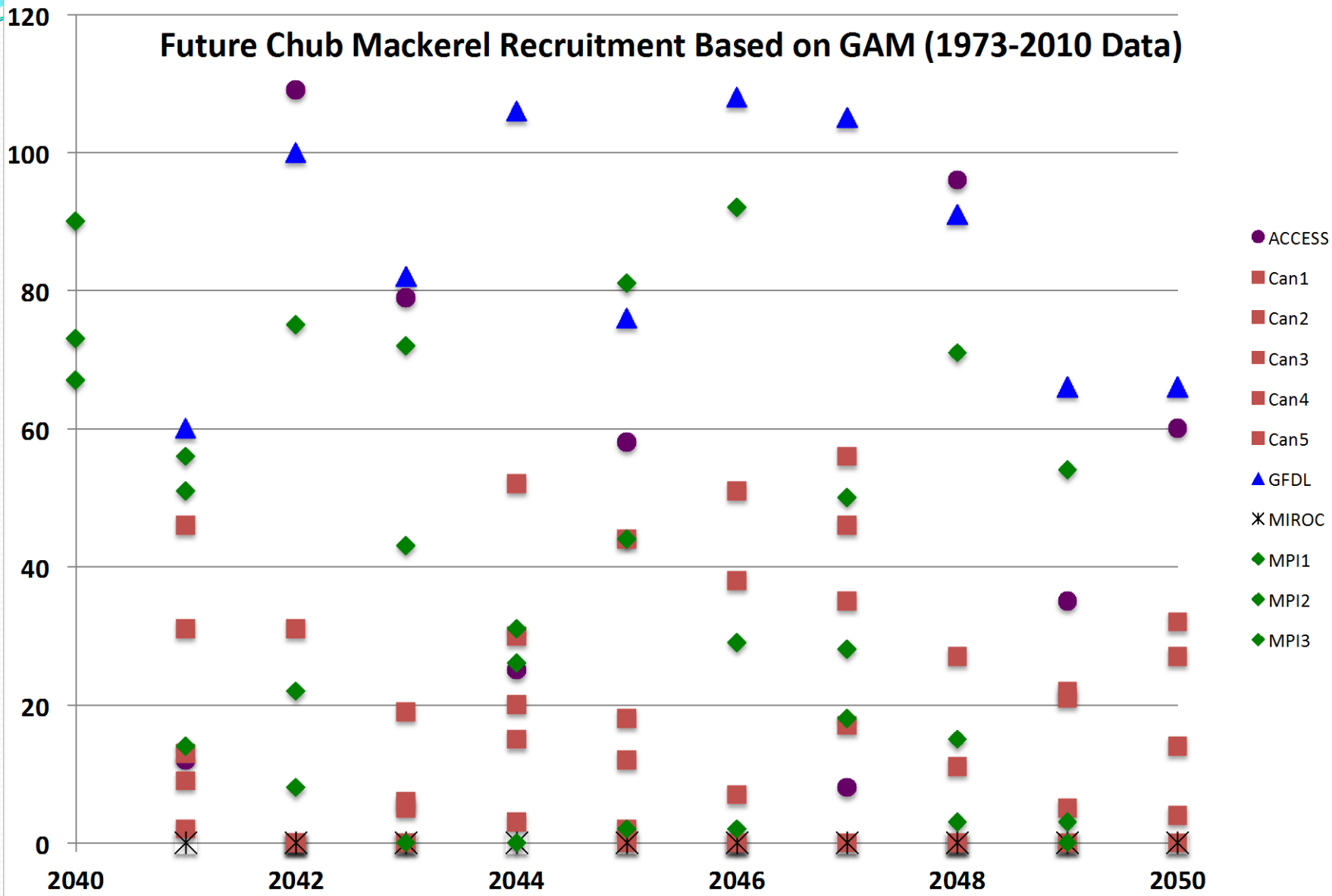
Consensus of Projected Changes- 2040s Relative to Present

- Warming (unanimous)
- Freshening in Winter (except GFDL model)
- Stabilization of Upper Water Column in Early Summer
- Weaker North Winds in Winter (especially MIROC model)

Future Chub Mackerel Recruitment Based on GAM (1973-2010 Data)

Preliminary Results

- Higher upper-ocean temperatures tend to be associated with lower recruitment in the observations
- Different GAMs have similar skill based on historical data
- The various IPCC climate model projections examined to date indicate less favorable environmental conditions for recruitment
- Additional work required to settle on recruitment time series to build GAMs; the final set of recruitment time series for MSE will include multiple GAMS incorporating different climate model forecasts