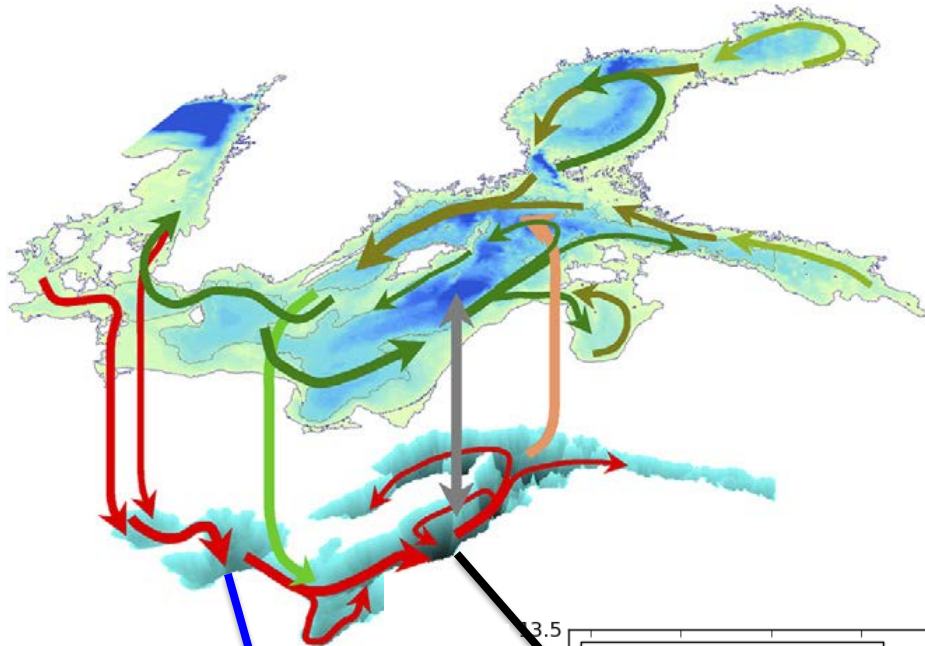# A new perspective on atmospheric requirements for major inflow events into the Baltic Sea
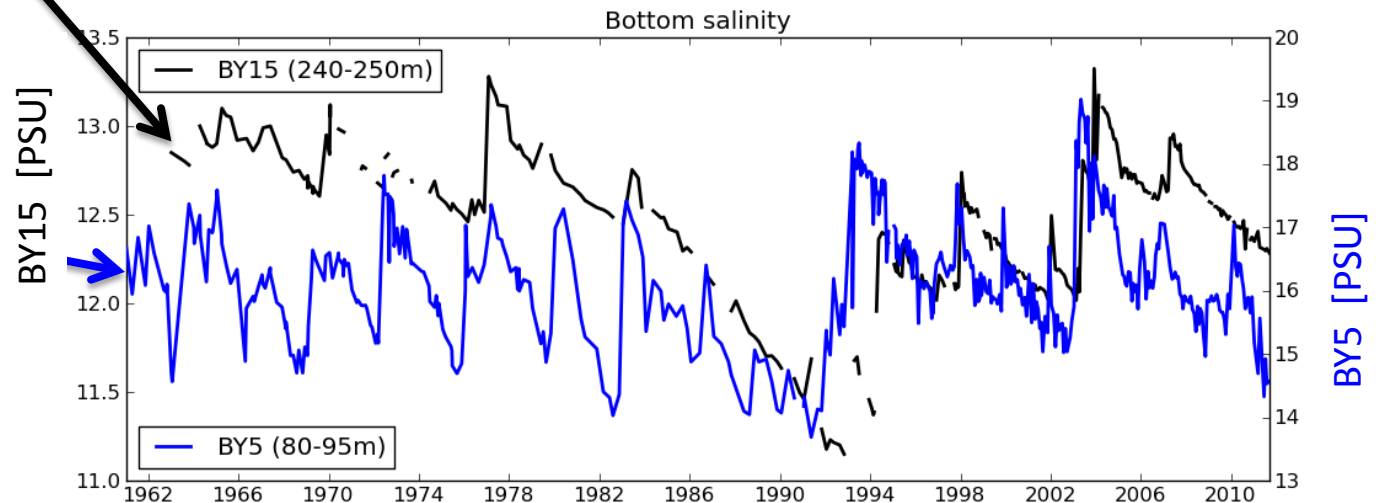
Semjon Schimanke, Christian Dieterich and H.E. Markus Meier (SMHI)

BALTEX conference, June 2013

Motivation

- Major Baltic Inflows (MBI) transport saline and oxygenated water into the deep basins of the Baltic Sea
- MBIs occur randomly in the winter half year at intervals of one to several years.

Earlier results

- MBIs develop over a period of many days (>=30) including a preconditioning phase and the main inflow period
- MBIs are likely forced by easterly winds lasting for 20-30 days followed by strong westerly winds (Lass and Matthäus, 1996)
- prevailing high pressure over the Baltic Sea from late summer to autumn favors MBIs (Schinke and Matthäus, 1998)
- increased runoff reduces the intensity of MBIs (Meier and Kauker, 2003)
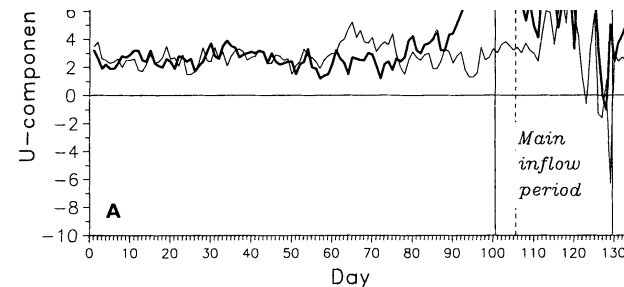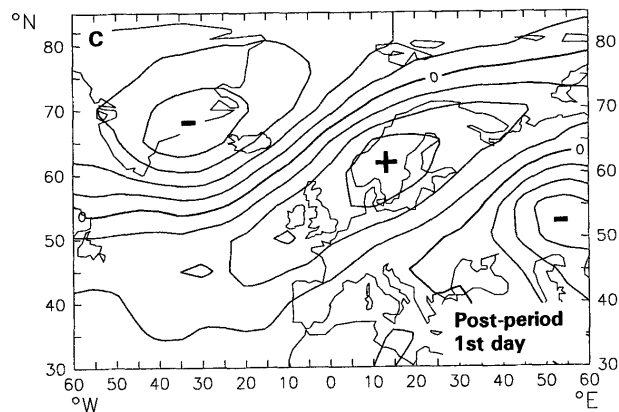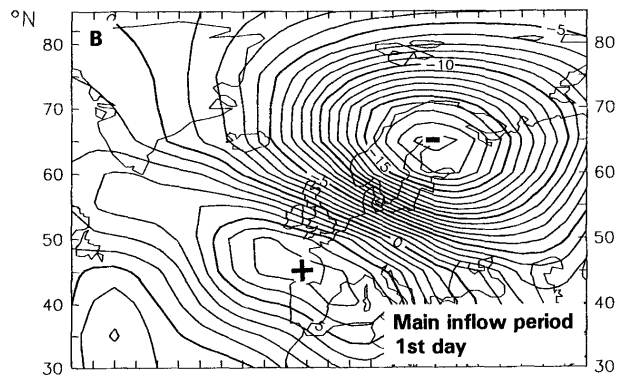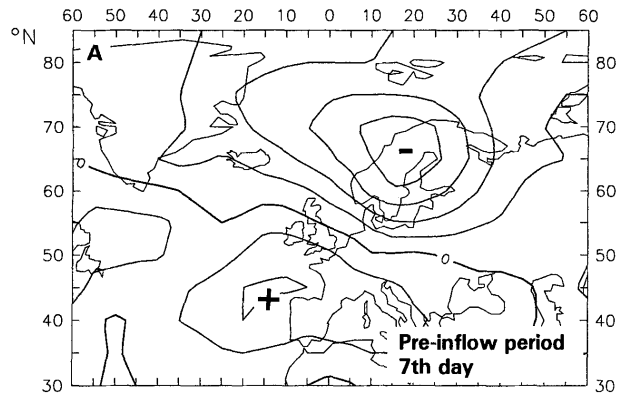

Mattäus and Schinke (1994)

Method and data

- MBIs are identified with the usage of SLP fields only
- criteria are developed from SLP fields of 13 selected major inflow events from 1961 to 1993
- an EOF analysis of these events is the basis for the analysis, the Baltic Sea Index (BSI, Lehmann et al., 2002) is used in addition
- MBIs are defined by threshold based on the PCs and the BSI

- SLP from an RCA4 simulation forced with ERA40 at the boundary
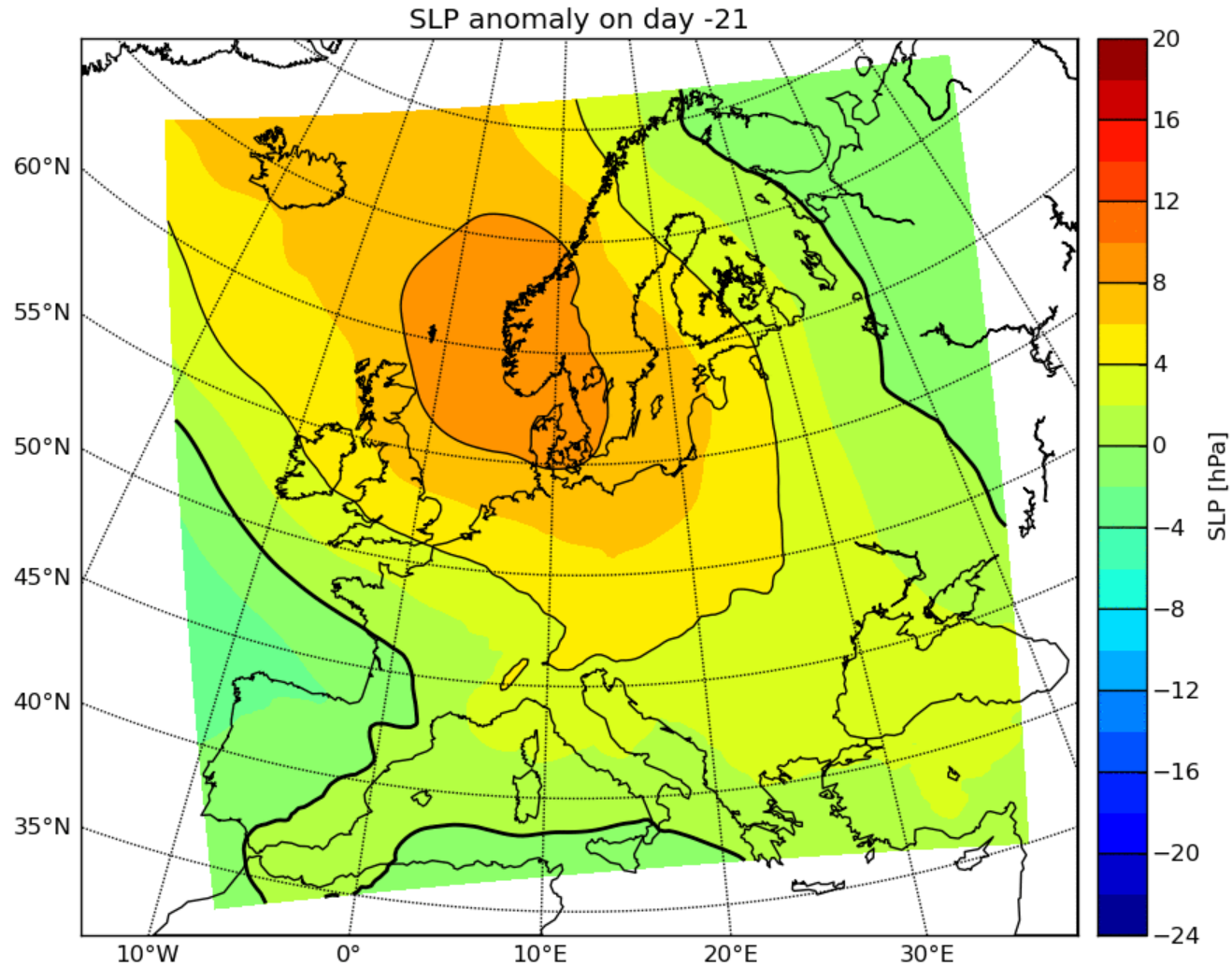- with spectral nudging

EOFs

- 30 days lead time and 10 days after the event are considered for the EOF-analysis
- Mean development reflects the suggested change from easterly to westerly winds

Mean development of PCs during inflow events
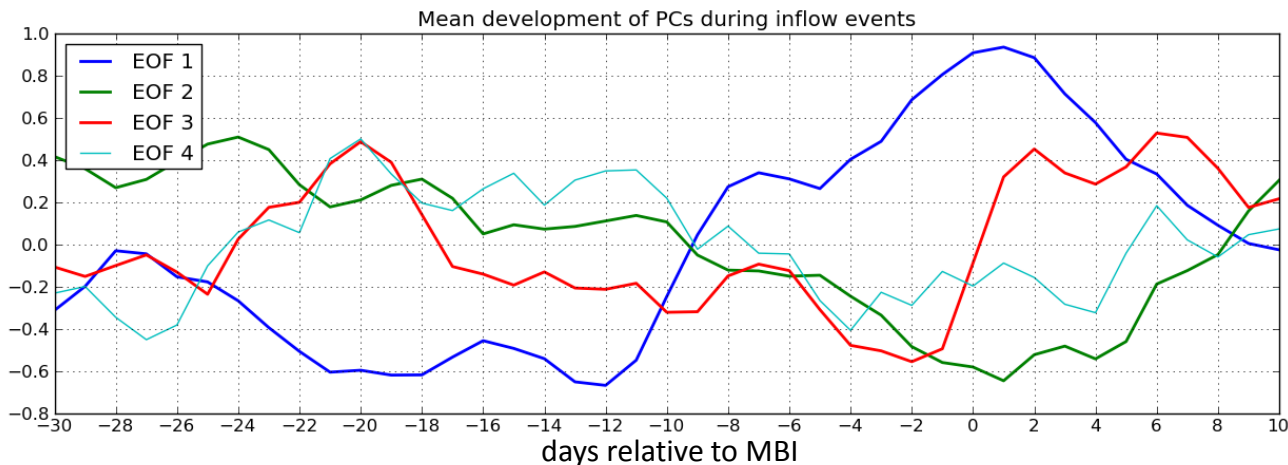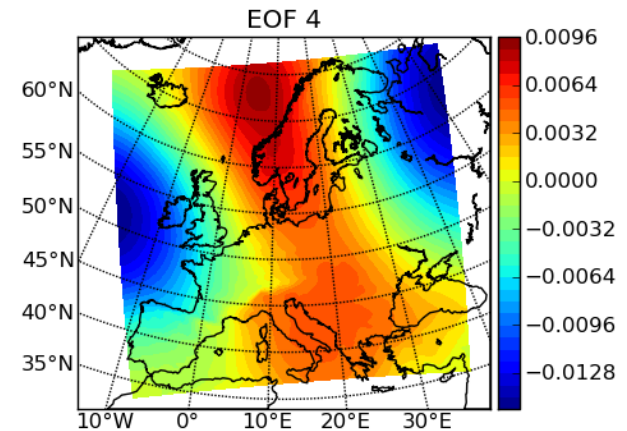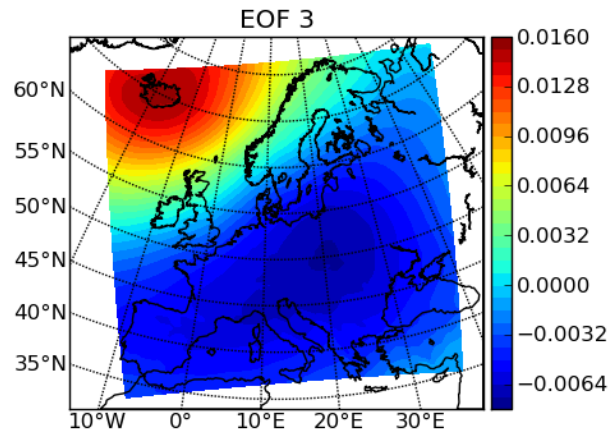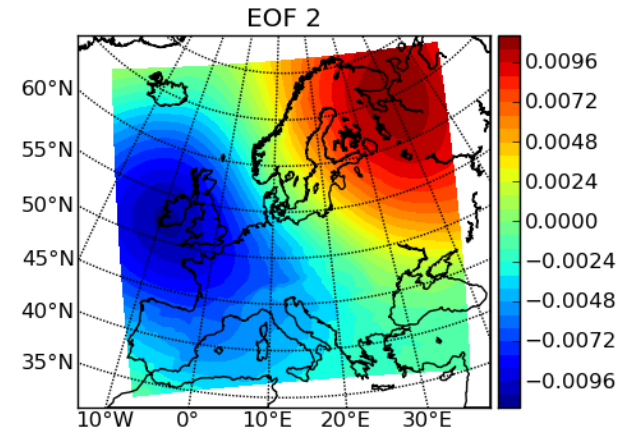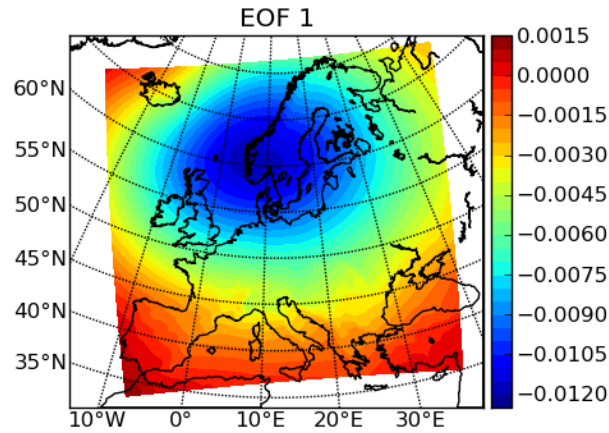
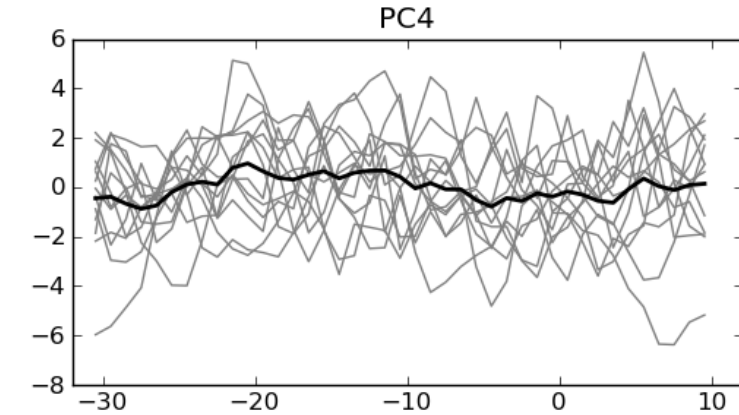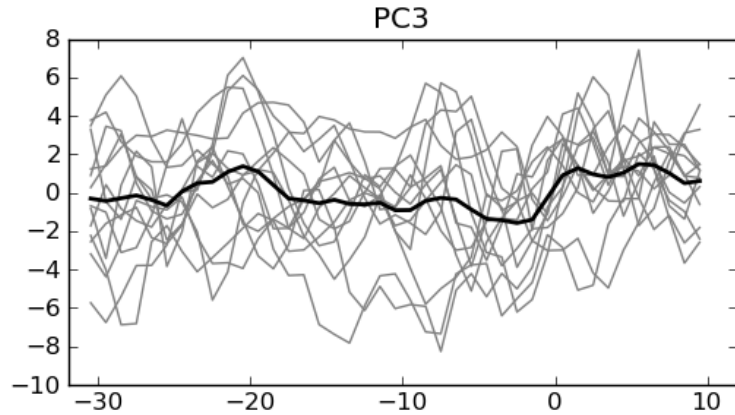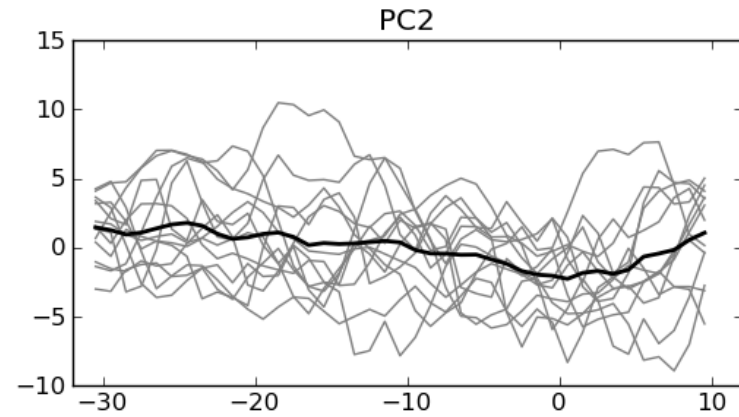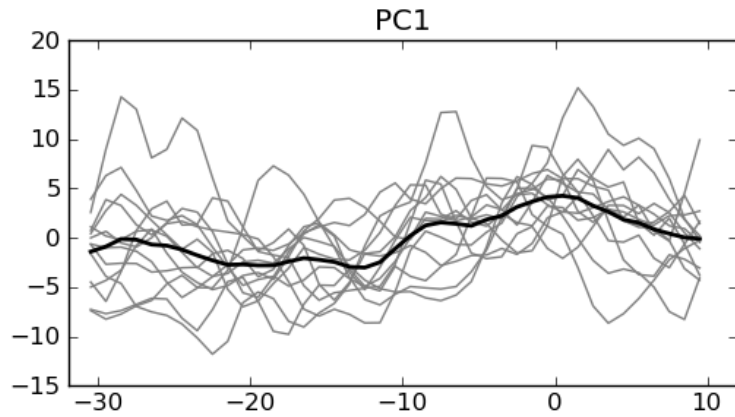## Explained variance

1. 38%
2. 23%
3. 15%
4. 7%

remainder = 17.2%

SLP anomalies related with MBIs

SLP anomaly on day -21

Single event EOFs

- Each event is individual!
- A challenge to find the similarities!

Threshold criteria for MBIs

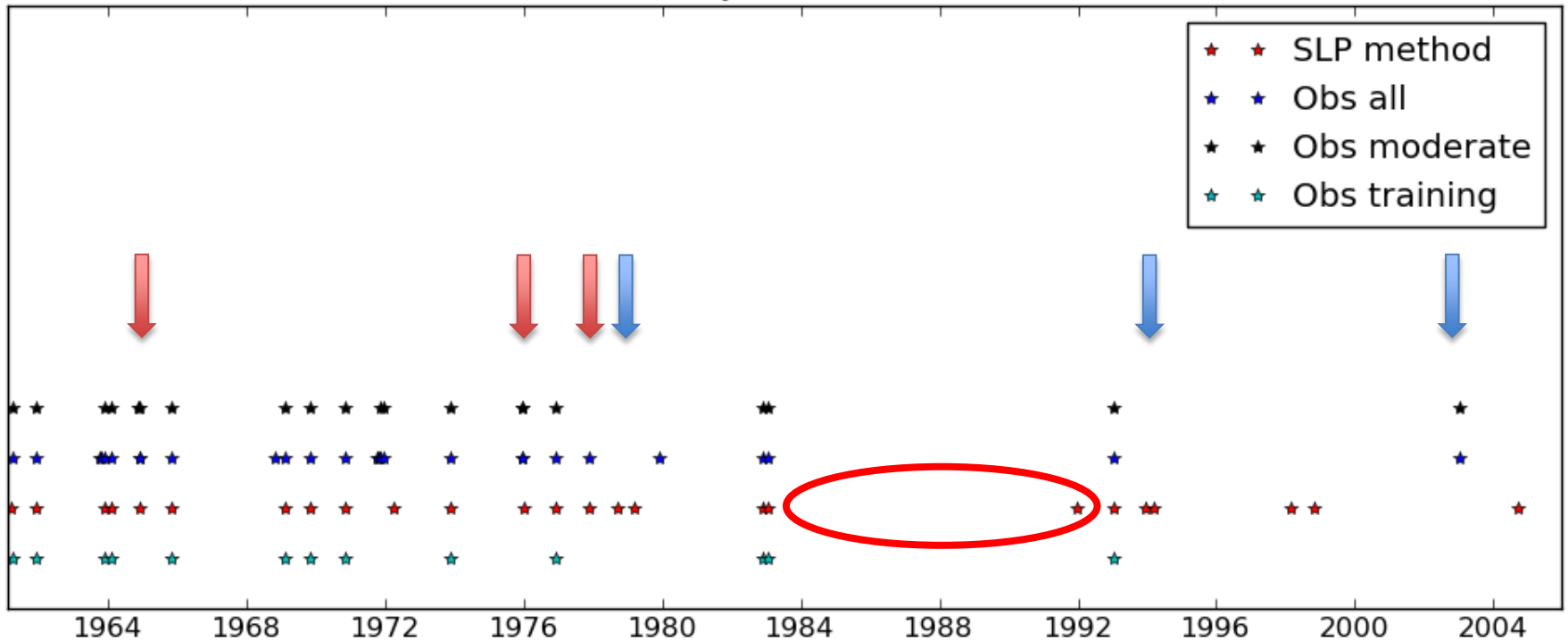Three different types are distinguished depending on the driving EOF pattern.

	Correlation with PC					Differences between certain periods			
	PC1	PC2	PC3	PC1-2	PC1-3	PC1	PC2	PC3	PC4
Type I	>0.6	>0.18	-	>0.95	- (>1.65)	>6.6 (>8.2)	<-2 (<-3)	>1 (>-3)	>0 (>-1.4)
Type II	>0.33	>0.5	-	>0.92	-	>2.4 (>5.4)	<-3.1 (<-4.3)	>0.14 (>-0.33)	>-0.7
Type III	>0.1 (0.5)	>0.1 (0.5)	>0.78	-	>1.4			>3.4 (>6)	>1.0 (>0.5)

for all: BSI (+/- 5days) > 0.1

Observed and identified events
PC1-4 & BSI
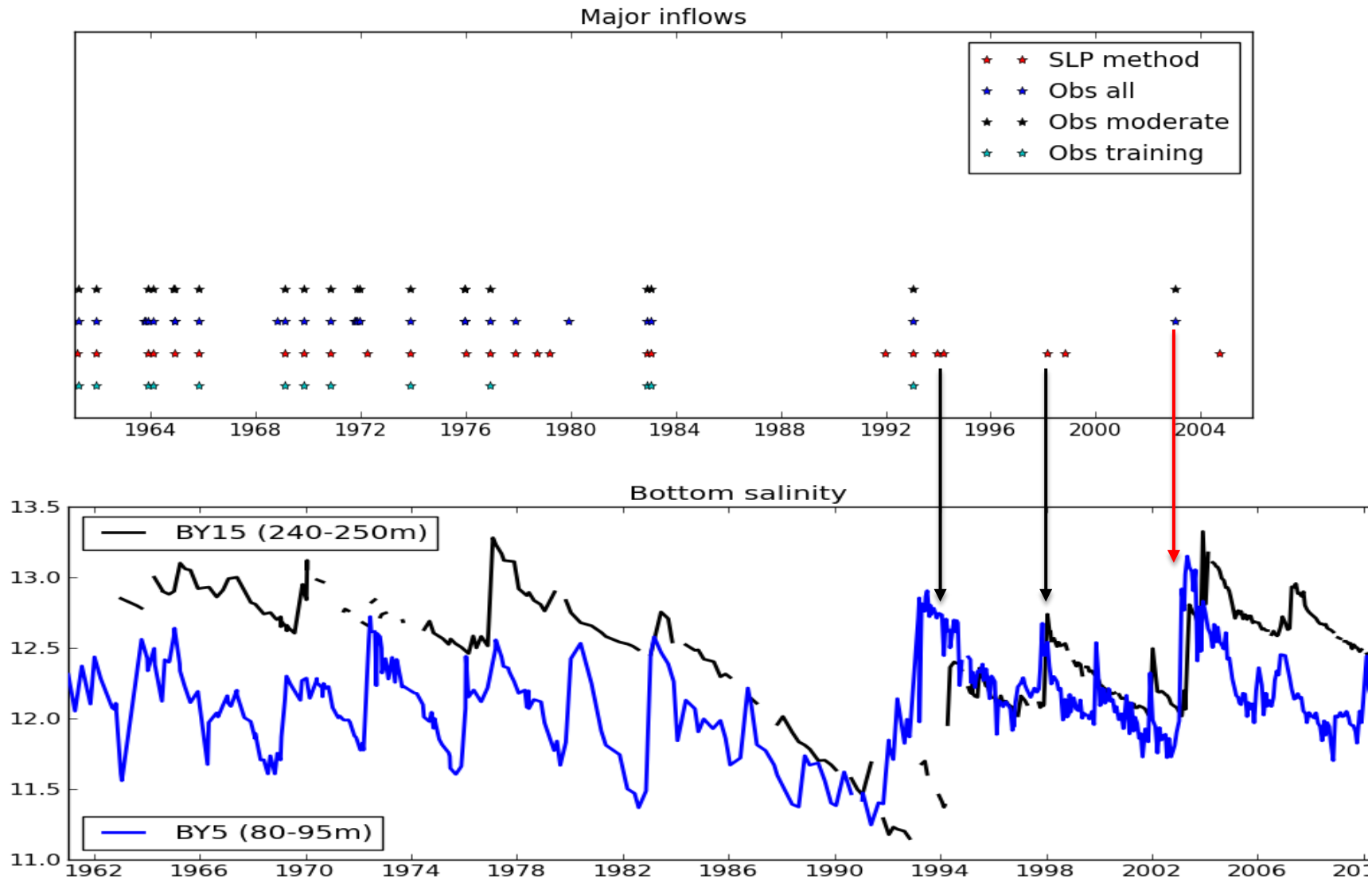

Major inflows

Observations (1961-2005): 27 in total, 20 at least moderate

	total	training	hits (+ weak)	failures	missing (+ weak)
method	25	13	2 (+1)	10	5 (+6)

MBIs and Baltic deep water salinity

Scenario simulations
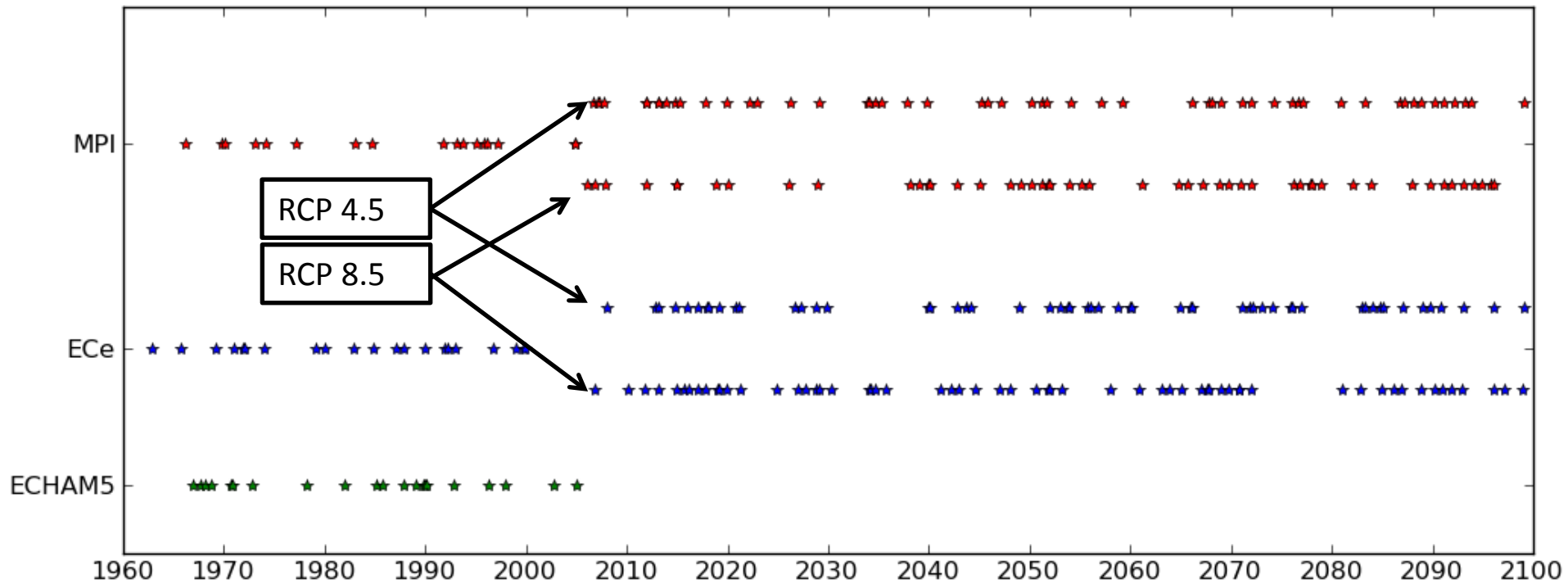
Downscaled with	Control period (1961-2005)	RCP 4.5 (2055-2099)	RCP 8.5 (2055-2099)
MPI-OM	17	24	26
EC-earth	21	29	26
ECHAM5	21	--	--

Summary

- MBIs are identified based on SLP fields only
- General distribution fairly reproduced, e.g. the stagnation period 1983-1993
- Some more tuning of the algorithm is needed including the testing of other input dates.

- Climate change could lead to a small increase in the frequency of MBIs

Thank you!