



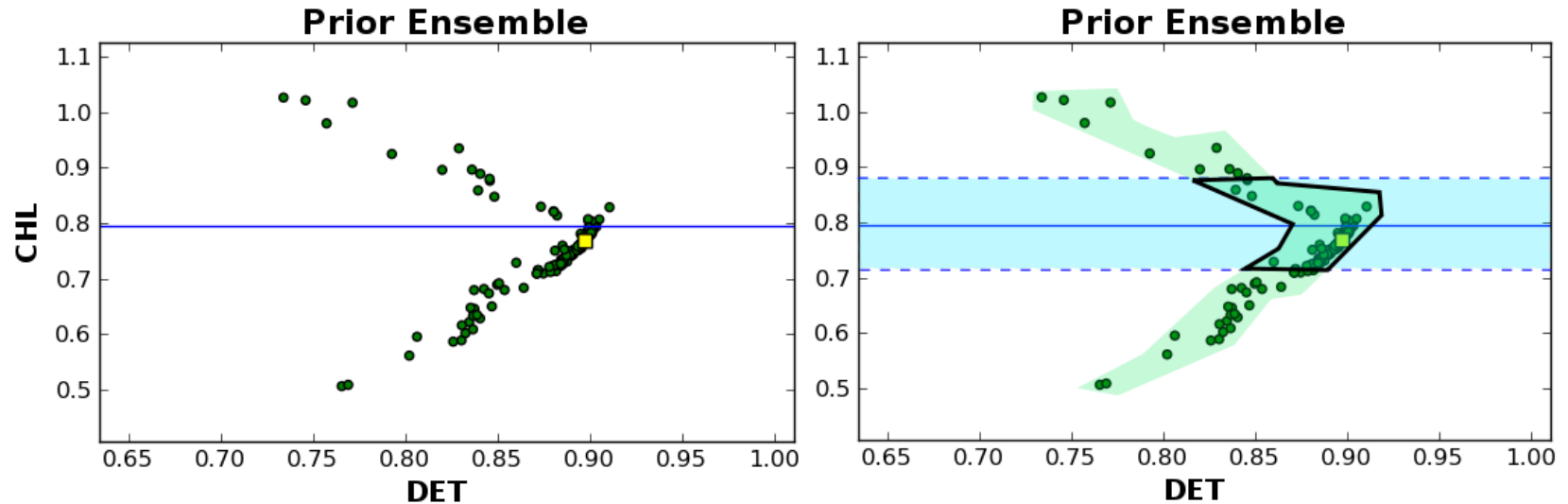
Developments in non-Gaussian ensemble DA

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CNRS-Université Grenoble Alpes, LGGE, Grenoble

Chris Snyder
NCAR, Boulder, Co

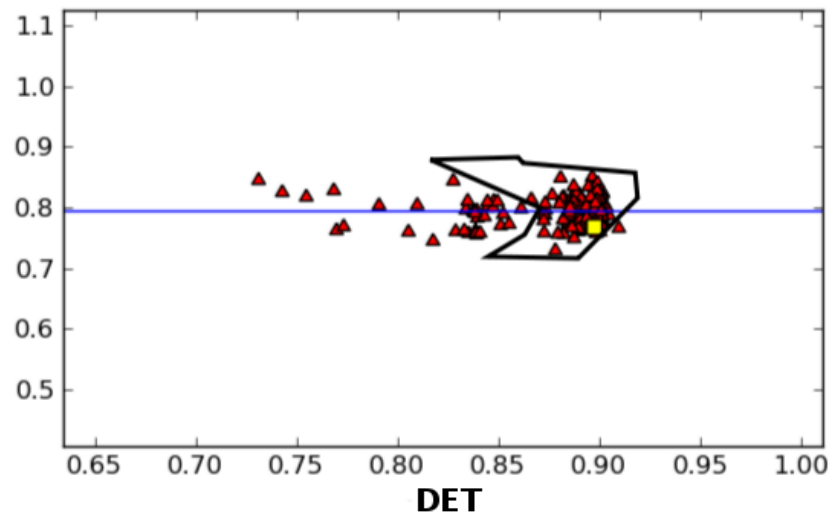
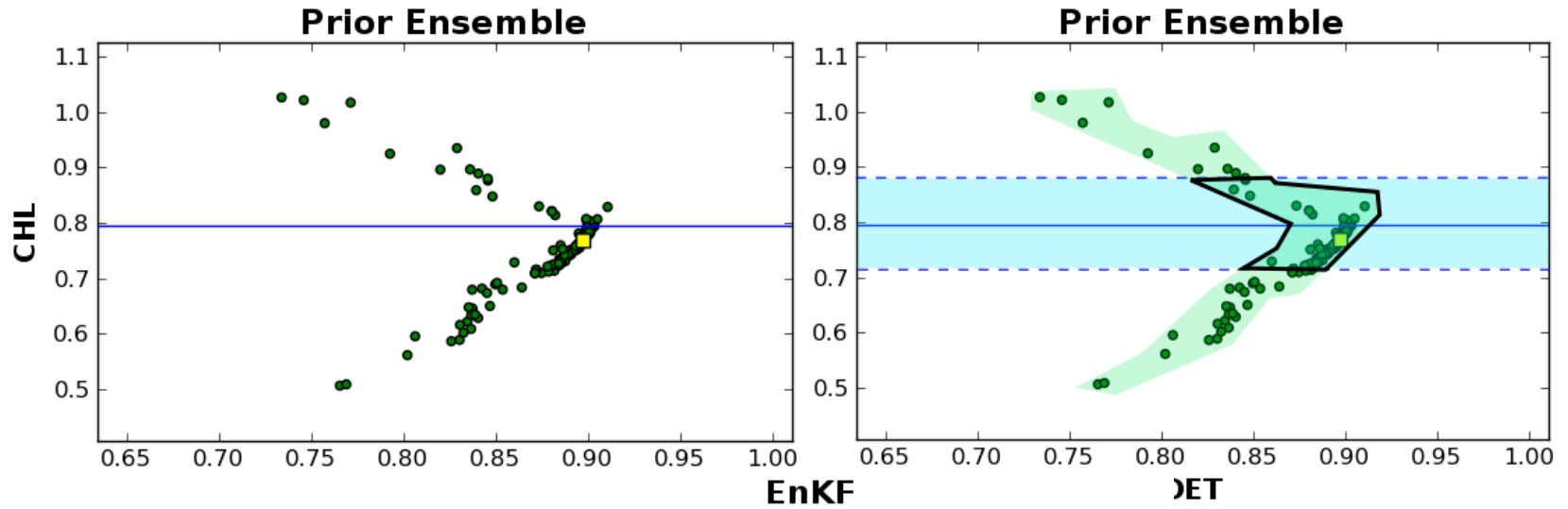
SANGOMA meeting, April 1-2, 2014, Reading

Introduction



Ensemble of NATL0.25+BGC simulations (Beal et al., 2010), Gulf Stream station (47W/ 40N). chlorophyll (CHL) / detritus (DET).

Introduction



Introduction

Limitation of the EnKF:

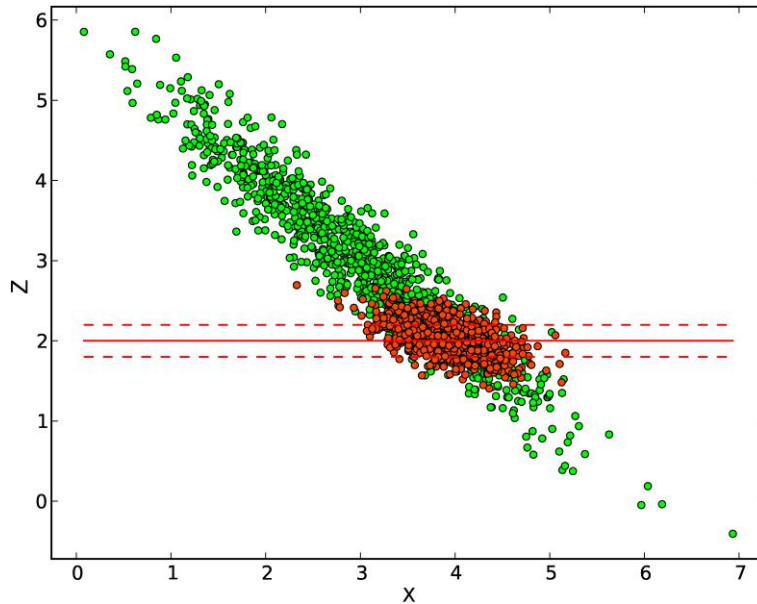
Linear correction for the **observed** variable:

$$z^a = z^b + K(z^o - z^b)$$

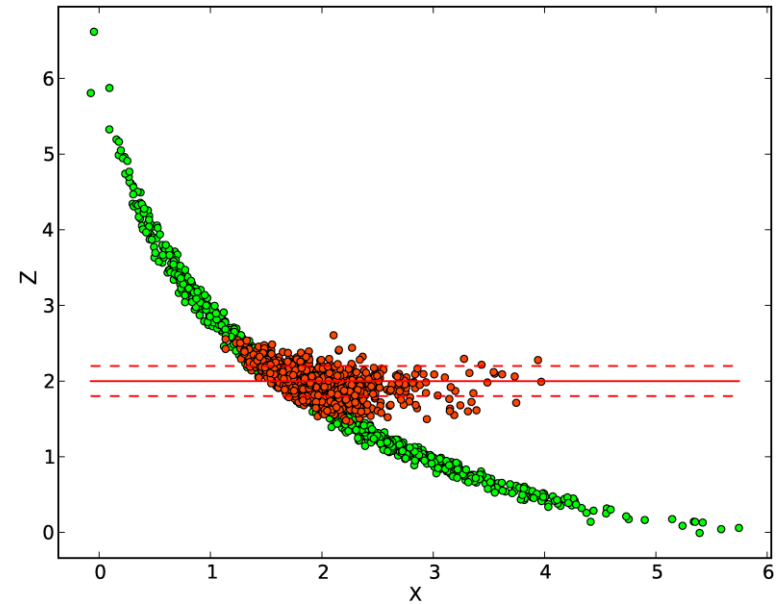
And correction for the **unobserved** variables based on a linear regression with the latter:

$$x^a = x^b + C(z^a - z^b)$$

Introduction



OK for bivariate Gaussian distributions.



Not OK for bivariate non-Gaussian distributions.

Basic idea of the Multivariate Rank Histogram Filter

For 2 variables x and z , z is observed.

Knothe-Rosenblatt rearrangement of the joint pdf

$$p(x, z|z^o) = p(z|z^o)p(x|z, z^o)$$

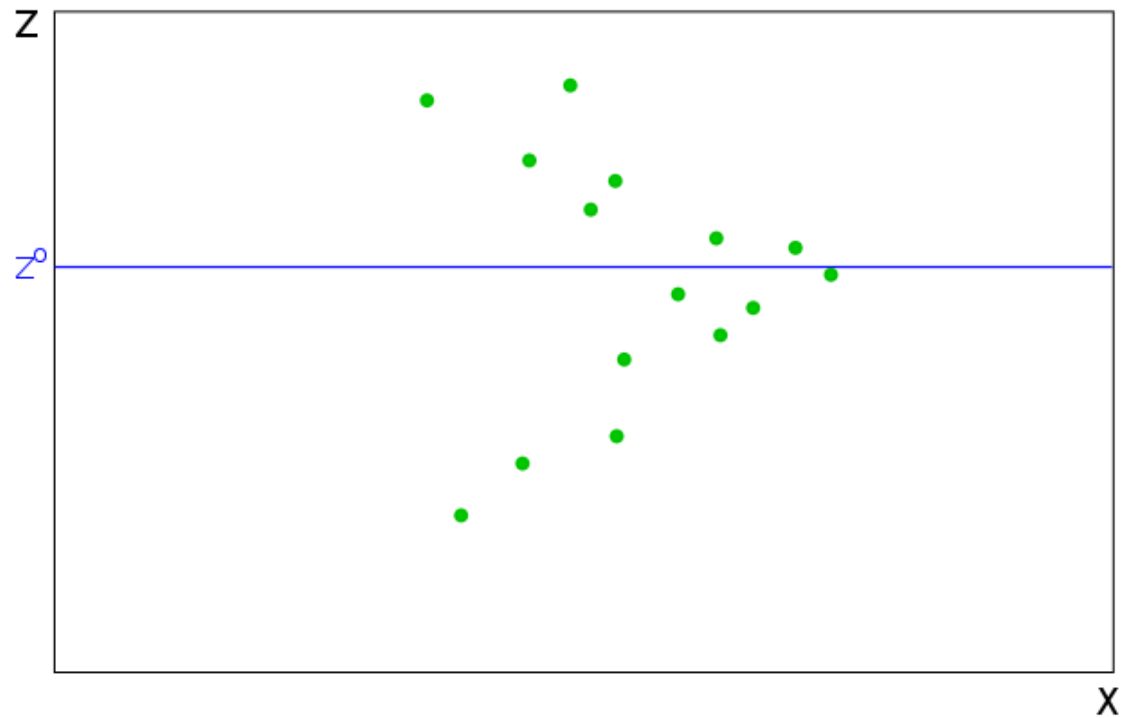
And

$$p(z|z^o) \propto p(z)p(z^o|z)$$

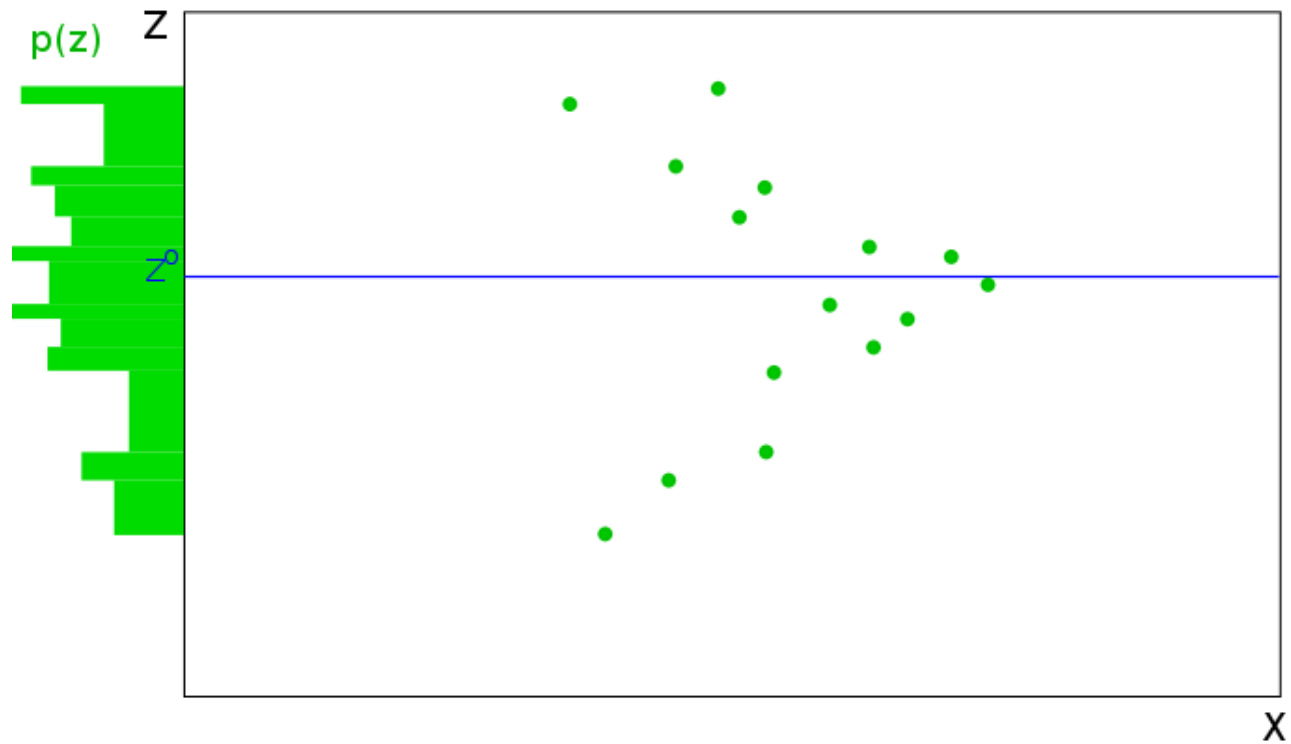
$$p(x|z, z^o) \propto p(x)p(z^a|x)$$

→ Sequential computation for z and x (as in the EnKF).

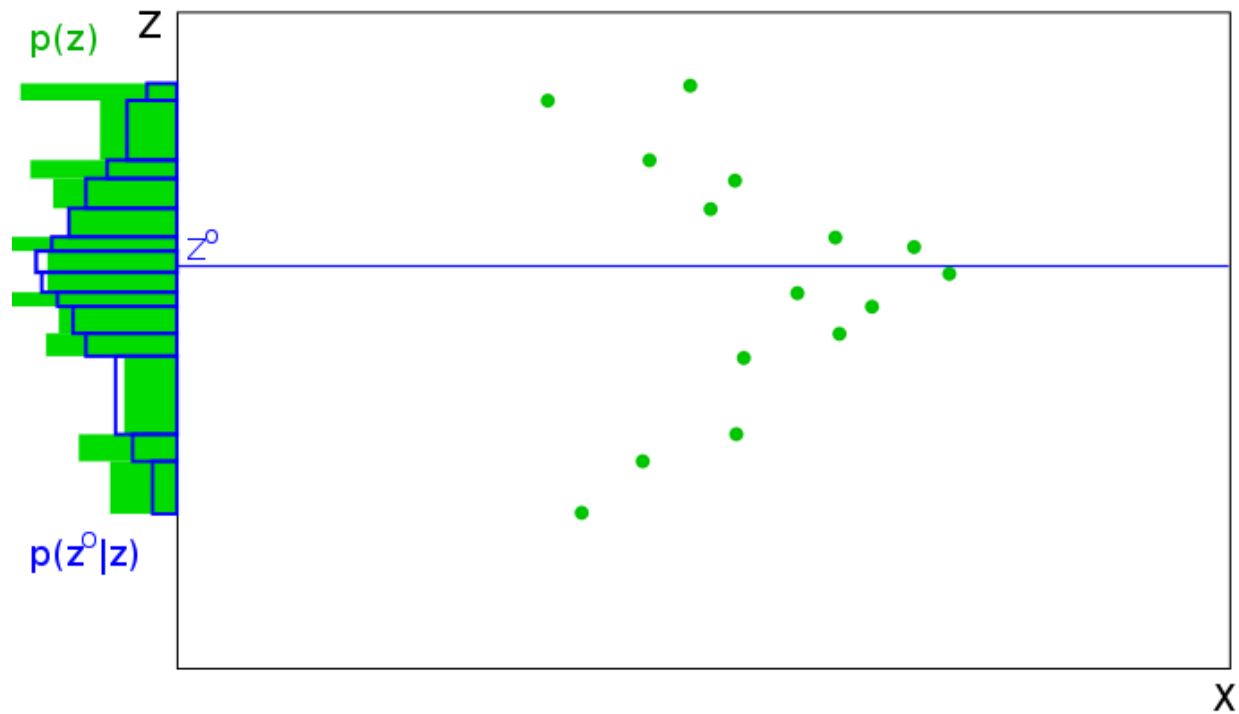
MRHF methodology



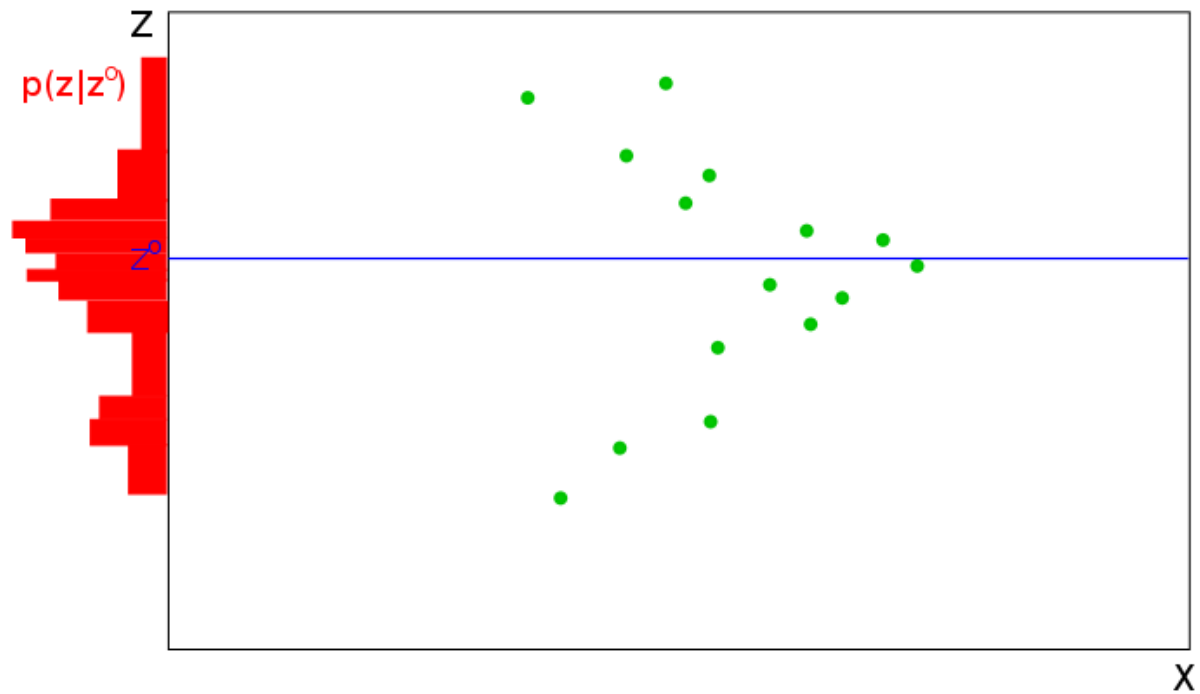
MRHF methodology



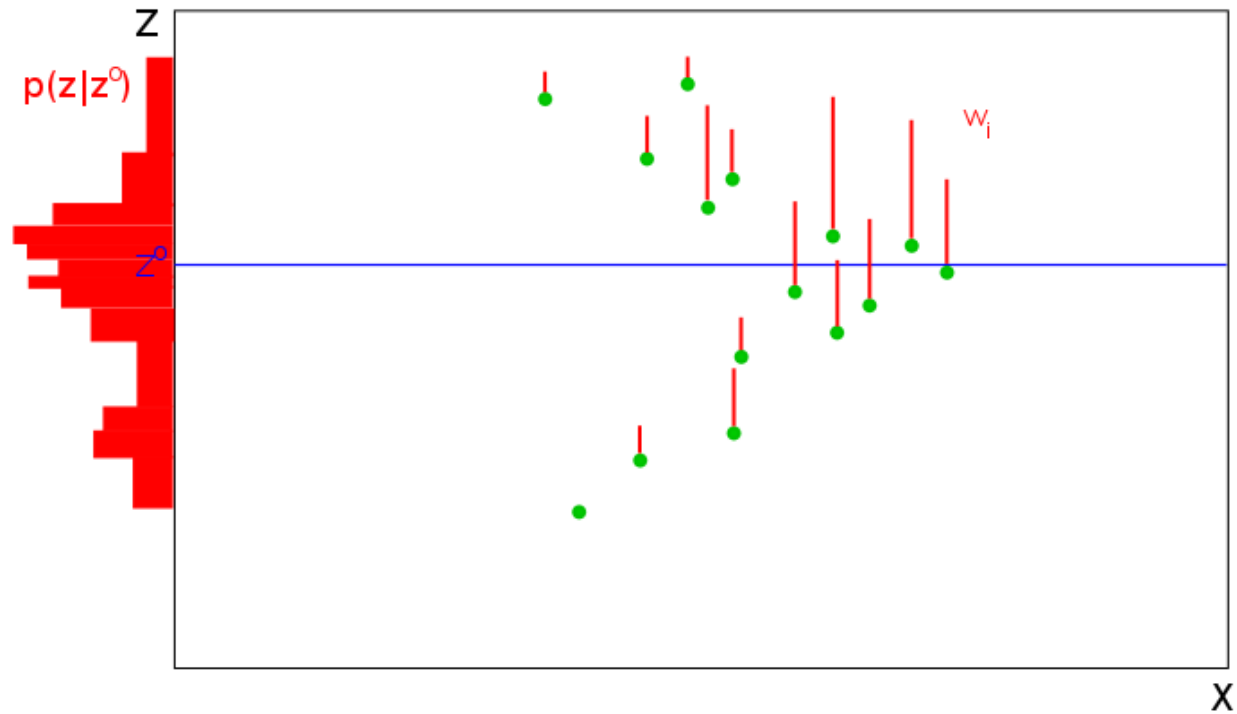
MRHF methodology



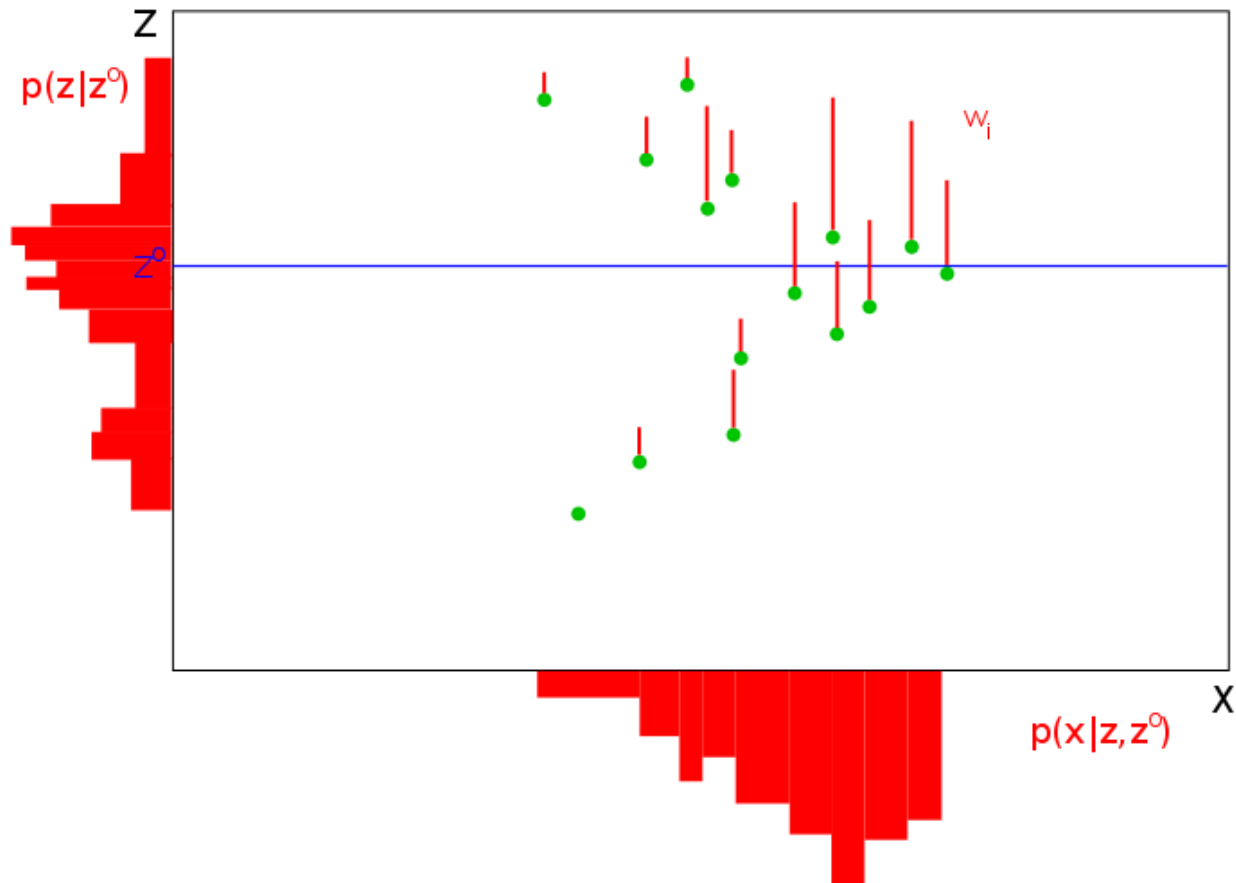
MRHF methodology



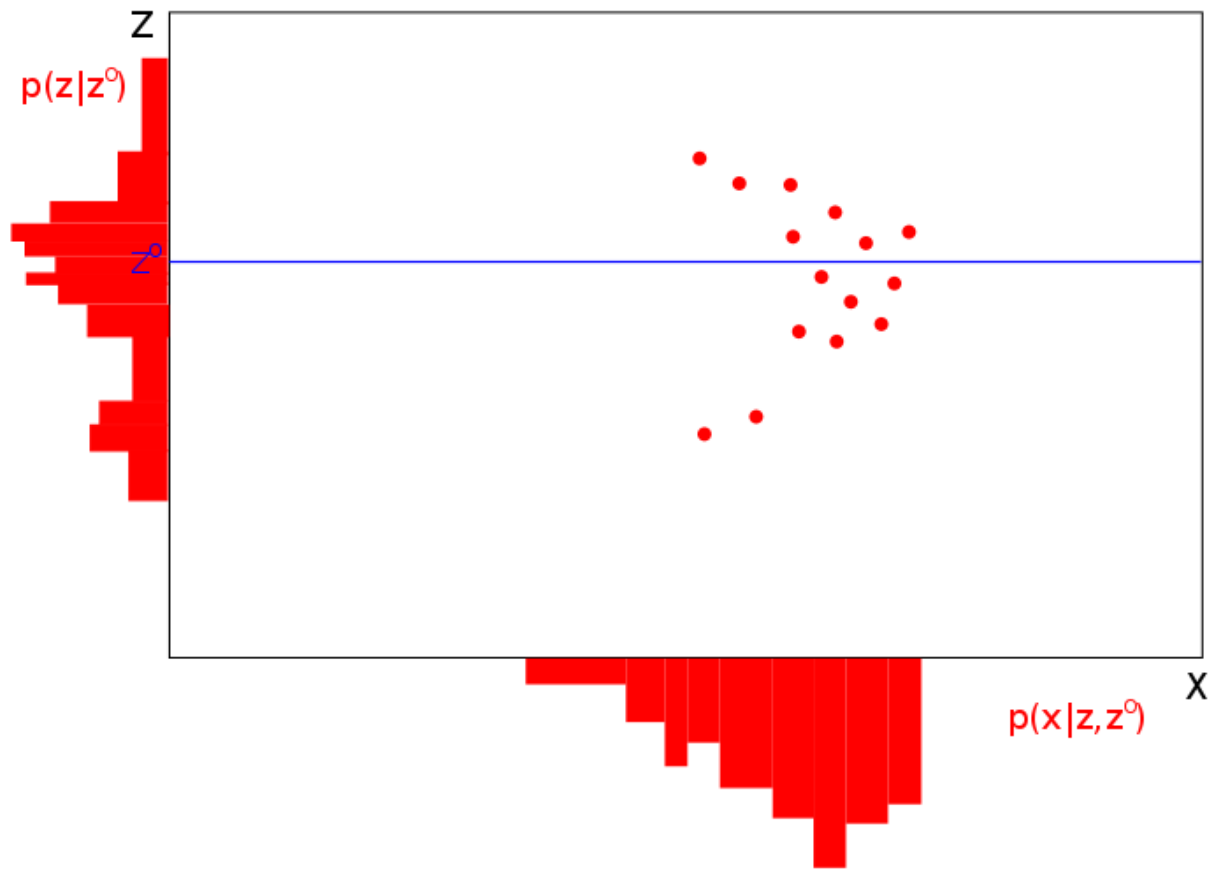
MRHF methodology



MRHF methodology



MRHF methodology



MRHF methodology

For 3 variables x, y and z , z is observed.

Knothe-Rosenblatt rearrangement of the joint pdf

$$p(x, y, z | z^o) = p(z | z^o) p(x | z, z^o) p(y | x, z, z^o)$$

Highly subject to the curse of dimensionality



Unobserved variables are neglected in the conditional statement



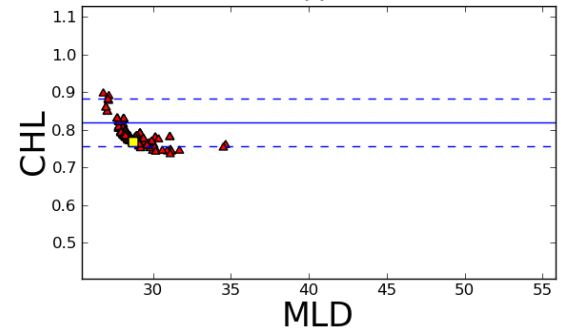
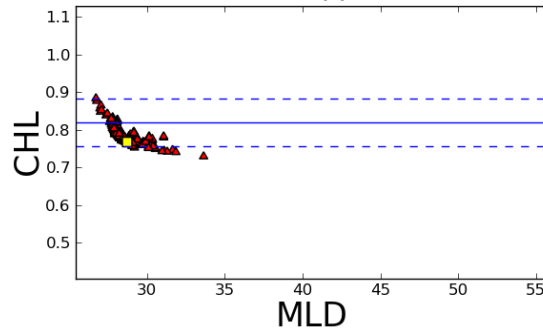
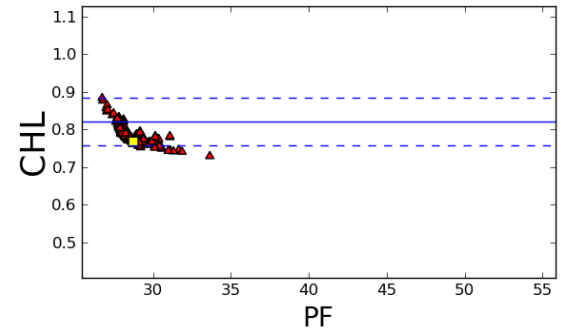
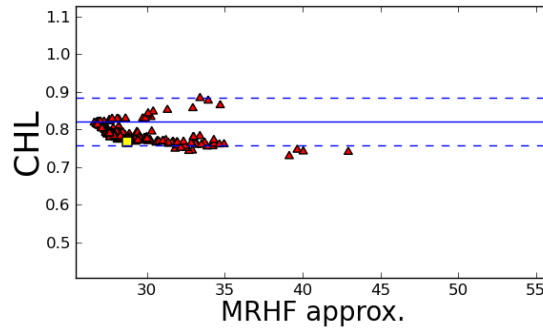
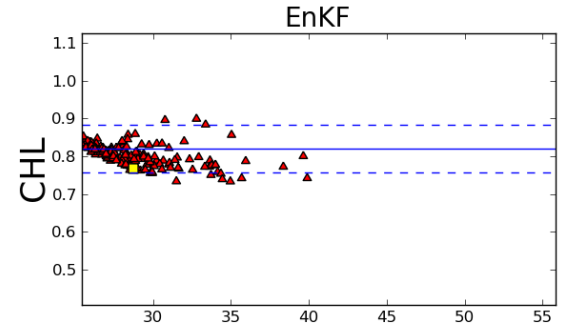
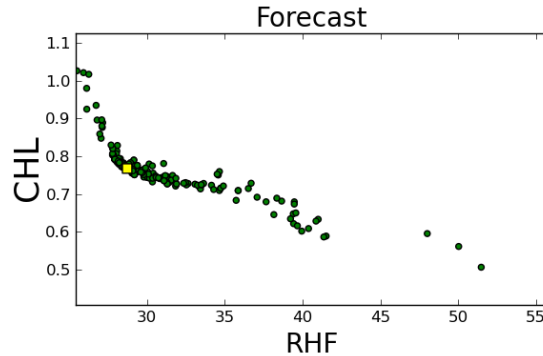
Restriction to the (nonlinear) relation between obs. and each unobs. Variable (like the EnKF)

Analysis illustration

NATL0.25+BGC

Observed: CHL

Unobserved: MLD
and DET

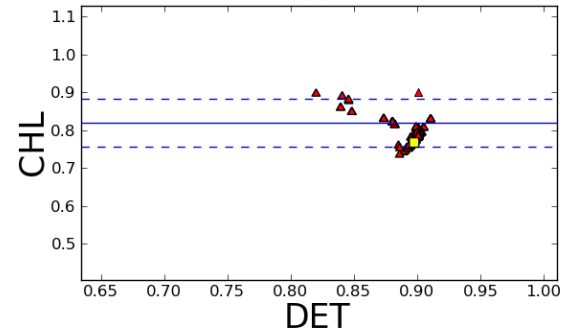
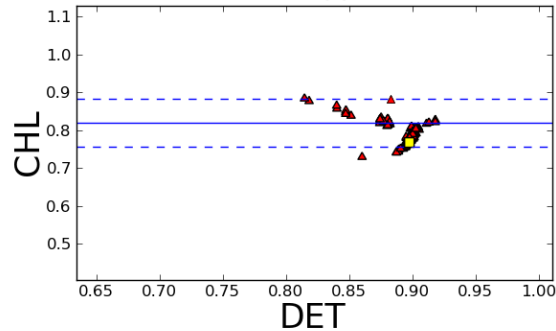
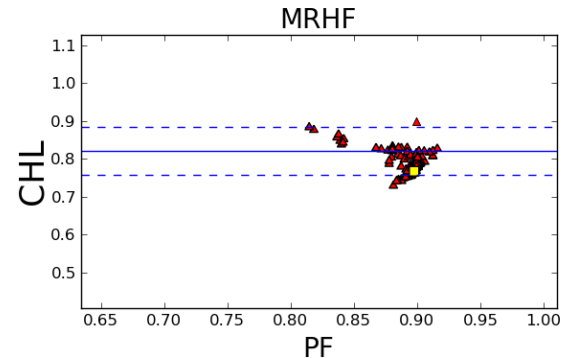
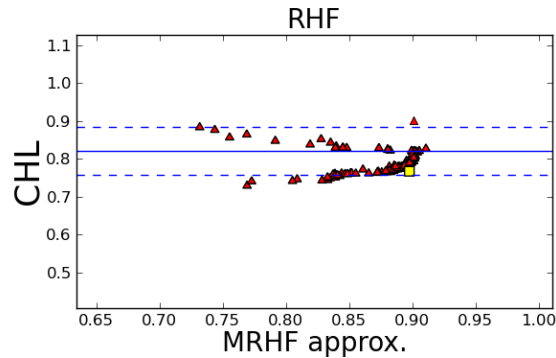
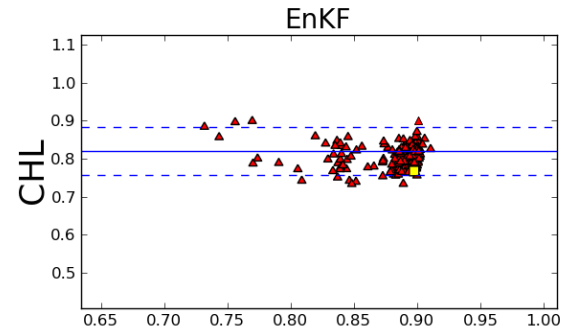
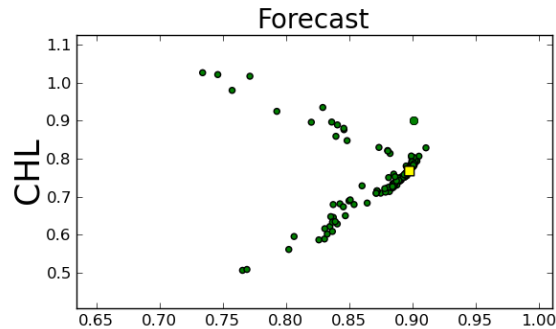


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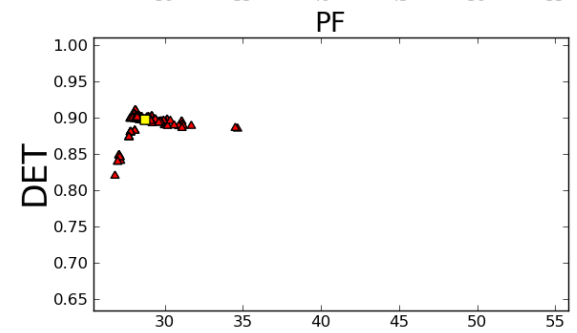
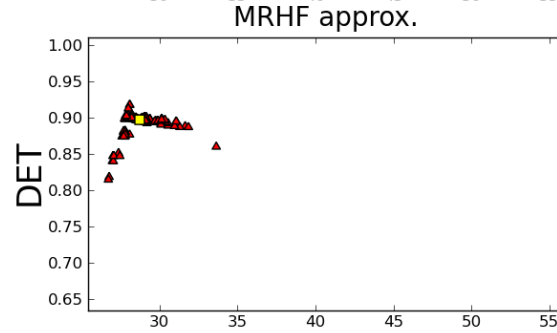
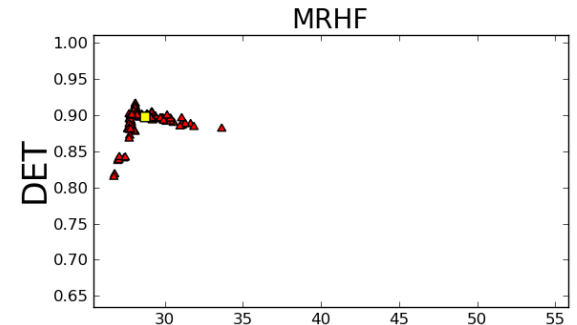
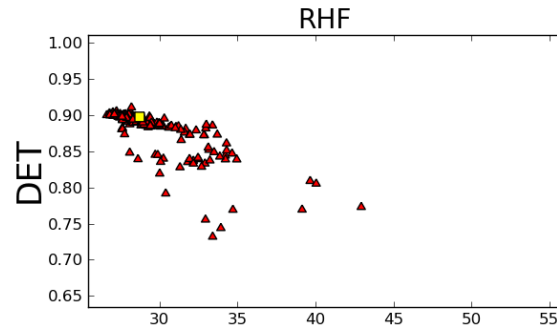
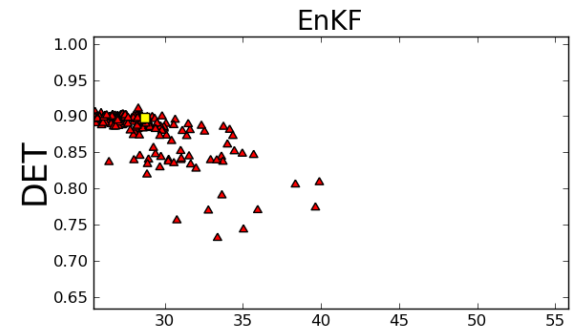
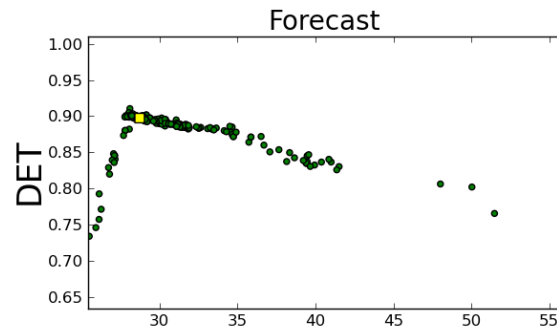


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MLD

MLD



