

Description and Verification of a Short-range Ensemble Prediction System

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Introduction

Motivation

To comply with the development of advanced solar heating units - that require forecasts of expected heat consumption and available solar radiation -, advances in NWP model calculations of solar radiation have been performed at DMI. As a mean of accessing the accuracy of the radiation forecasts, they are now output parameters from DMI's ensemble prediction system. This work aims at verifying the ensemble predictions of solar radiation.

Configuration of EPS

	STRACO		KF/RK		STRACO
	no stoc. phy.	stoc. physics	no stoc. phy.	stoc. physics	stoc. phy. + pert. roughness
IC 1	1	6	11	16	21
IC 2	2	7	12	17	22
IC 3	3	8	13	18	23
IC 4	4	9	14	19	24
IC 5	5	10	15	20	25

Table: Configuration of the 25 ensemble members in DMI-EPS; IC: Initial conditions; use "stoc. phys." and no use "no stoc. phy." of stochastic physics; cloud schemes: STRACO and KF/RK

DMI's EPS & Data

DMI's Ensemble Prediction System:

- Initialised at 00, 06, 12, and 18 UTC
- Forecast length of 54 hours

Data:

- Verification against 24 of DMI's pyranometers
- Global radiation at midday is selected for analysis with the main focus on the 24 h lead time

References

Feddersen, 2009, *A Short-Range Limited Area Ensemble Prediction System*, DMI Technical Report 09-14
 Wilks, 2006, *Statistical Methods in the Atmospheric Sciences*
 Jolliffe & Stephenson, 2012, *Forecast Verification, A Practitioner's Guide in Atmospheric Science*
 Murphy & Brown & Chen, 1989, *Diagnostic Verification of Temperature Forecasts*

Deterministic Forecast Verification

Verification of Deterministic Forecasts

Two factorizations of the joint distribution $p(x,f)$ of a forecast f and an observation x :

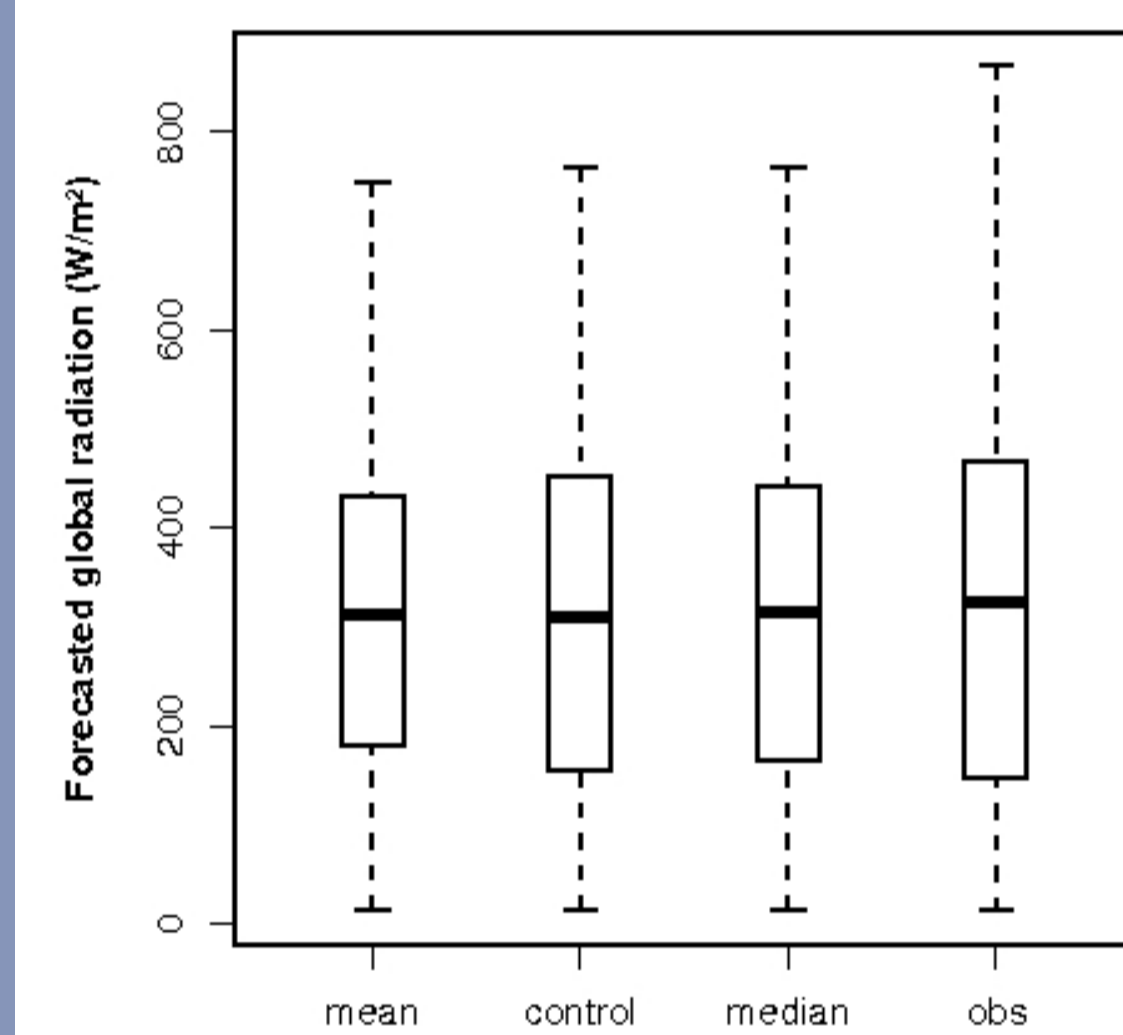
- $p(x,f) = p(x|f) \cdot p(f)$ calibration-refinement factorization
- $p(x,f) = p(f|x) \cdot p(x)$ likelihood-base rate factorization

The conditional distribution $p(x|f)$ expresses the reliability of the forecast f .

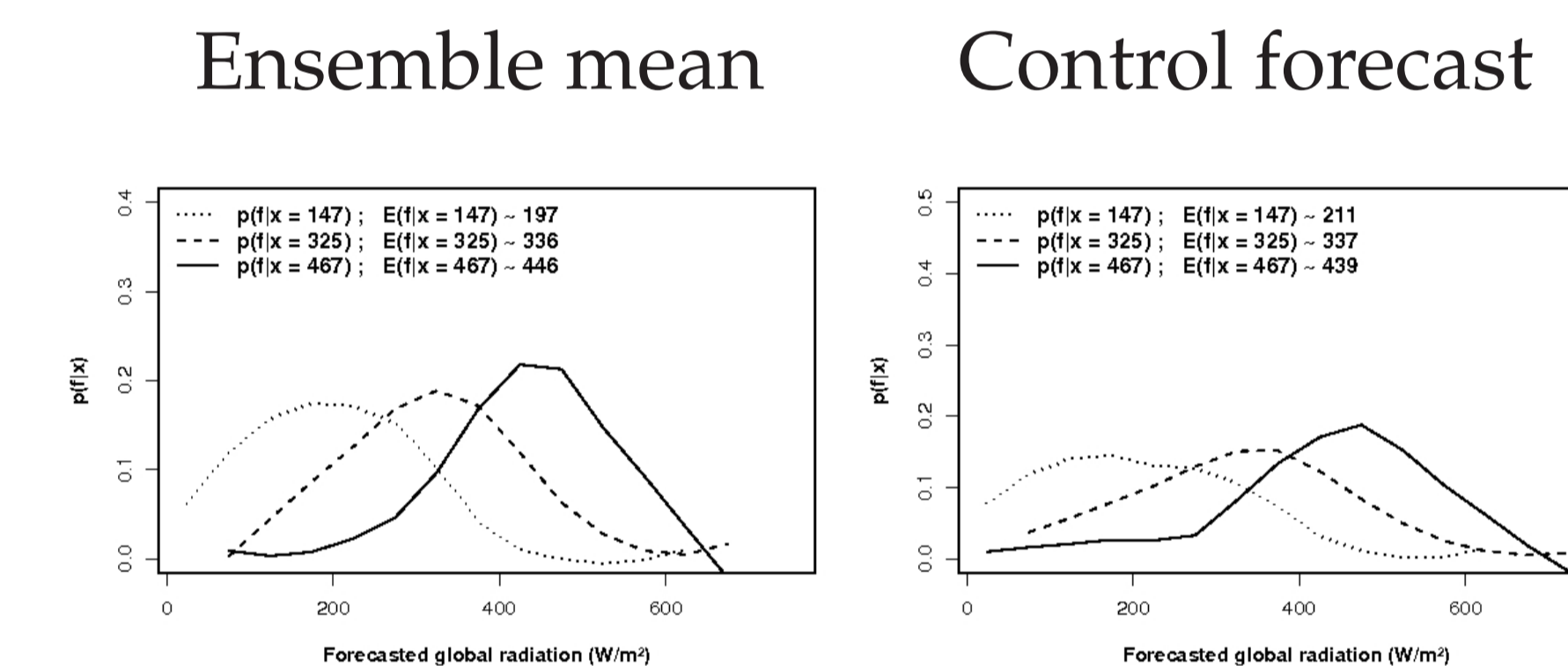
The conditional distribution $p(f|x)$ expresses the ability of f to discriminate between different values of x .

Marginal Distributions $p(f)$ and $p(x)$ Discrimination $p(x|f)$

Marginal distributions $p(f)$ and $p(x)$



Discrimination $p(f|x)$ for different values of observation

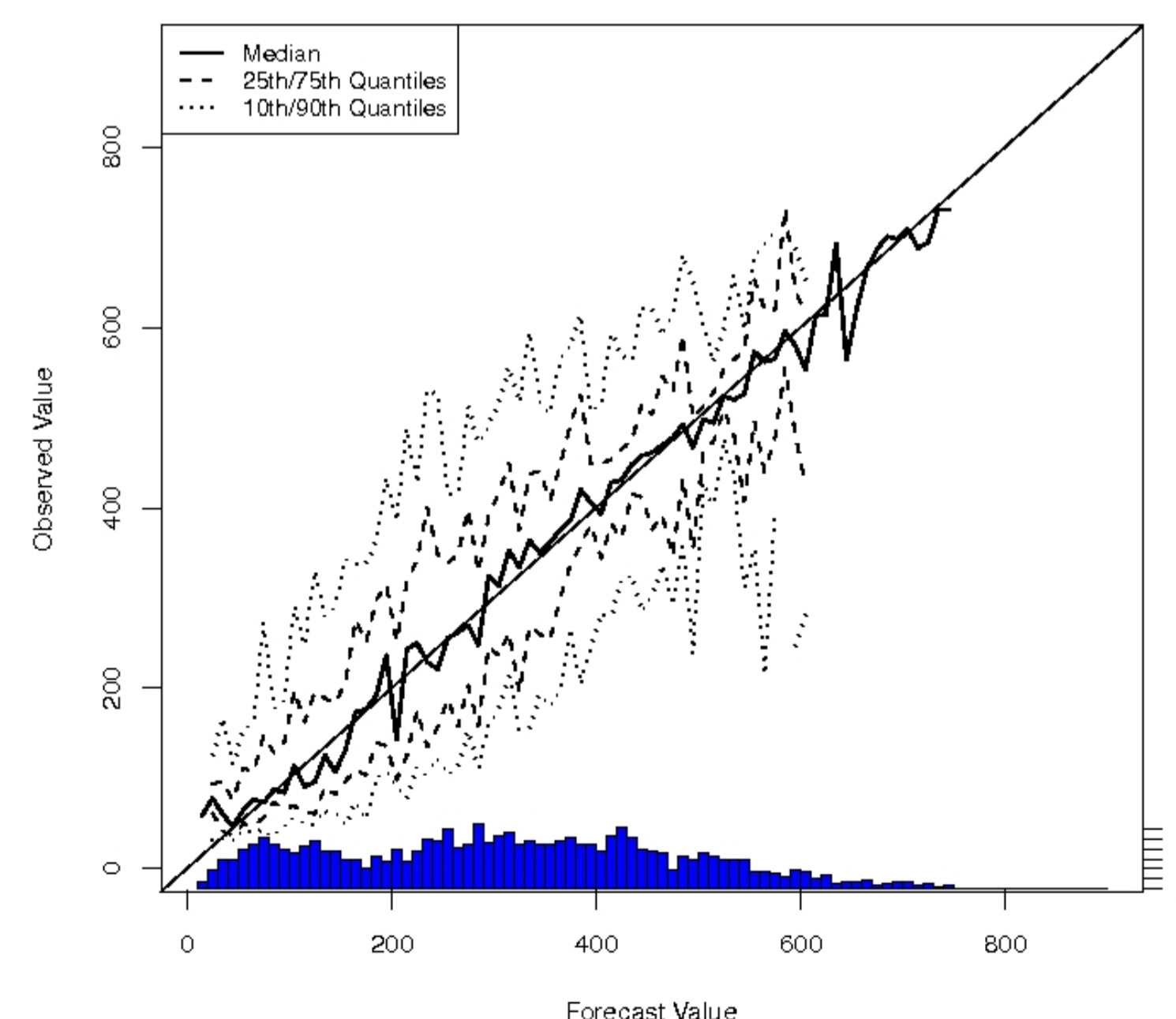


The ensemble mean seems better at discriminating between different observations than do the control forecast.

Reliability $p(x|f)$

Conditional distributions $p(x|f)$

Given a forecast value f , the figure displays various quantiles of the observations conditional on f . (Murphy, 1989)



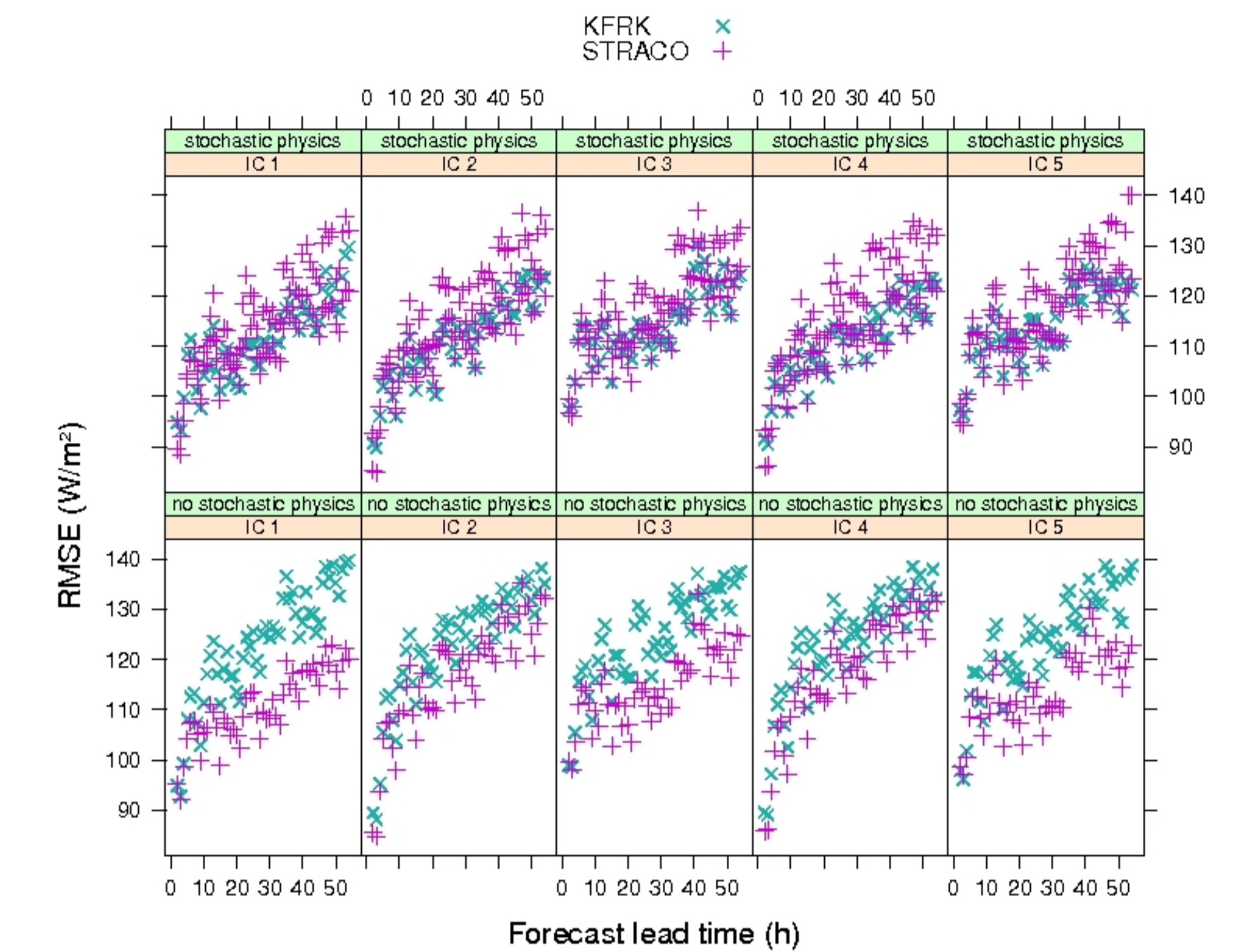
A reliable forecast has $p(x|f) = \delta(x-f)$ for all f . That is, for a given forecast, f , the expected value of the observations, $E(x|f)$, is f .

Verification of the Ensemble System

RMSE

The effect on RMSE of "use" and "no use" of stochastic physics, cloud schemes (STRACO and KF/RK) and initial conditions.

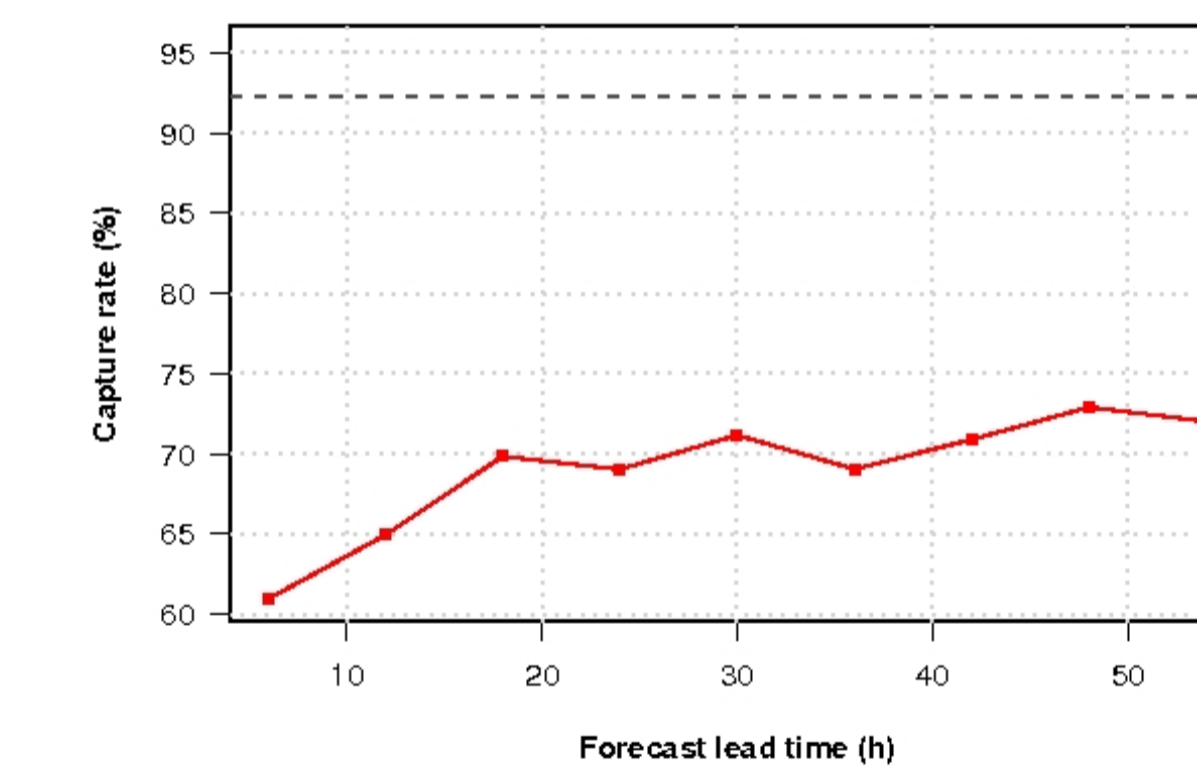
All available data is included.



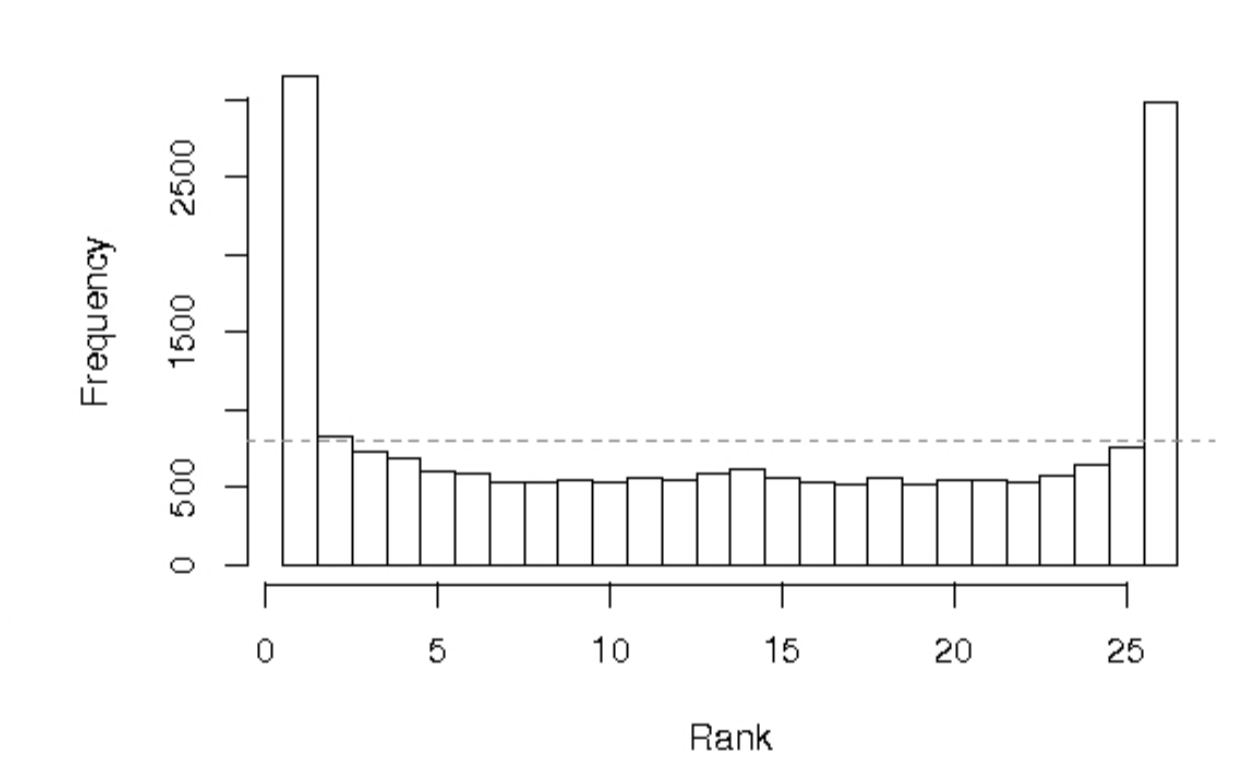
In using no stochastic physics, the two cloud schemes have different impacts on the RMSE.

Capture Rate & Rank Histogram

Capture Rate



Rank Histogram



The capture rate (left) is below the expected rate (Feddersen, 2009) shown by the gray dashed line. The rank histogram (right) reveal an under-dispersion of the ensemble prediction system.

The Generalised Discrimination Score for Ensembles

Generalised Discrimination Score for Ensembles: D (Jolliffe, 2012)

Lead time (h)	D
12	0.81
24	0.79
48	0.78

The discrimination score, D, decreases as the lead time increases.