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Thorpex Montreal 2004

# How can we best combine forecasts for added value?

J. Broecker<sup>1</sup>, L. Clarke<sup>1</sup>,  
D. Kilminster<sup>2</sup> and L.A. Smith<sup>1,2</sup>

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**How can we best combine forecasts for added value?**

**How might we use TIGGE?**

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Motivation

Forecast improvement can be achieved in two ways:

Overview

Combining

Evaluation

Example

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## Motivation

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Forecast improvement can be achieved in two ways:

- improving the models (**strategic**)

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Forecast improvement can be achieved in two ways:

- improving the models (**strategic**)
- using the available information more effectively (**tactical**)

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Forecast improvement can be achieved in two ways:

## Overview

- improving the models (**strategic**)

## Combining

- using the available information more effectively (**tactical**)

## Evaluation

## Example

### THORPEX:

“THORPEX will develop, demonstrate and evaluate a multi-model, multi-analysis and multi-national ensemble prediction system, referred to as TIGGE.”

Motivation

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Example

- Combining Simulations
  - Evaluation
    - skill scores → Broecker
    - bootstrapping and meaningful skill comparison
  - Example - combining ECMWF and NCEP
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Motivation

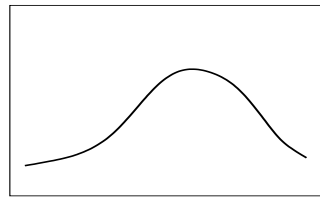
Overview

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**Climatological  
Distribution**





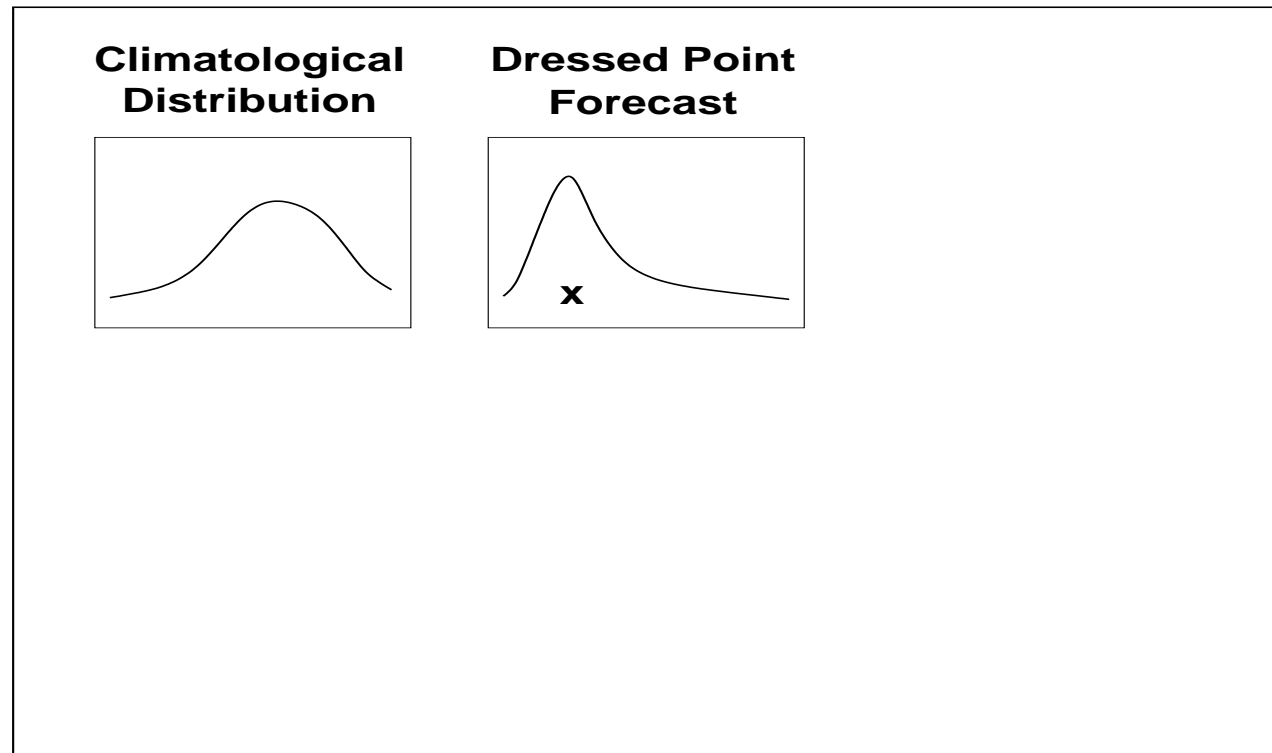
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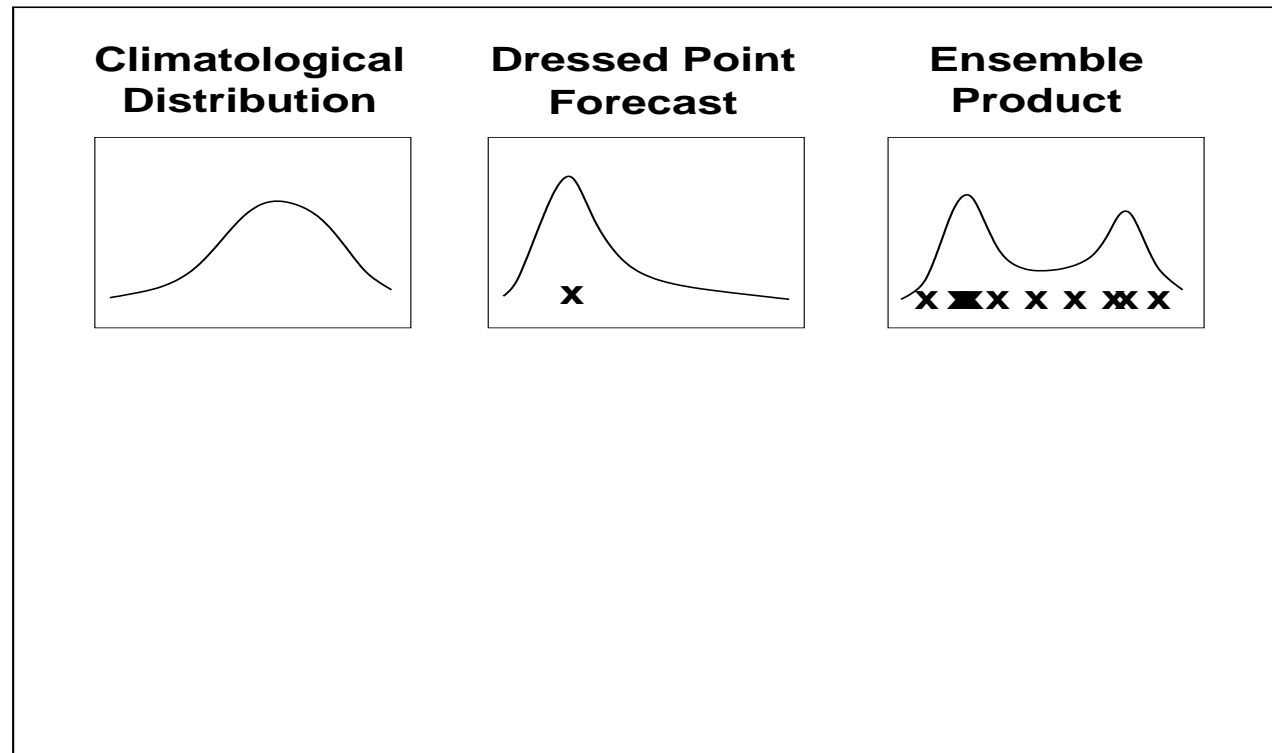
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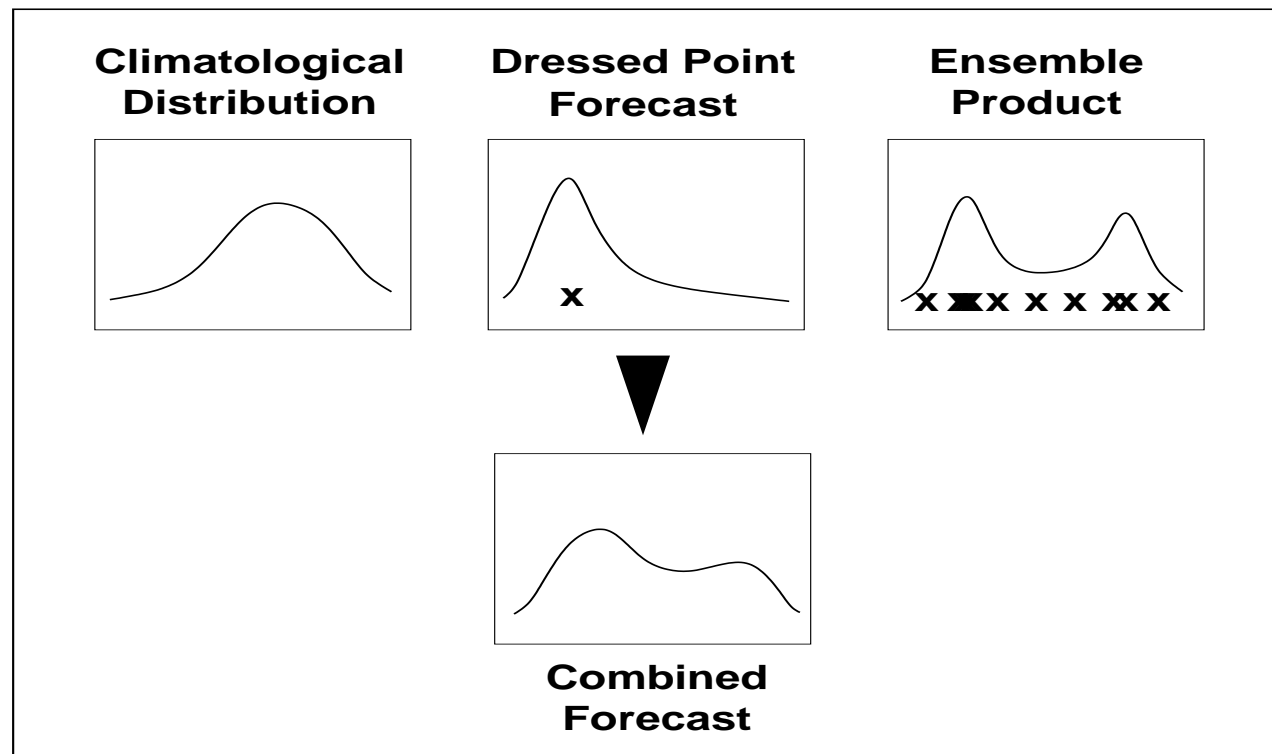
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The combination is based on the skill of the final forecast

$$s = \mathcal{S}(f, o)$$

$f$  forecast distribution

$o$  verifying observation

$\mathcal{S}$  skill score

$s$  skill of forecast  $f$

Motivation

One combination method is to take a weighted sum of the component distributions

Overview

$$f = \sum \alpha_i f_i$$

Combining

Choose  $\alpha_i$  that maximises the skill score

Evaluation

$$\langle s \rangle = \max \langle \mathcal{S}(f, o) \rangle$$

Example

over a set of historical forecast-verification pairs

$$\text{Ignorance : } s = -\log p(o)$$

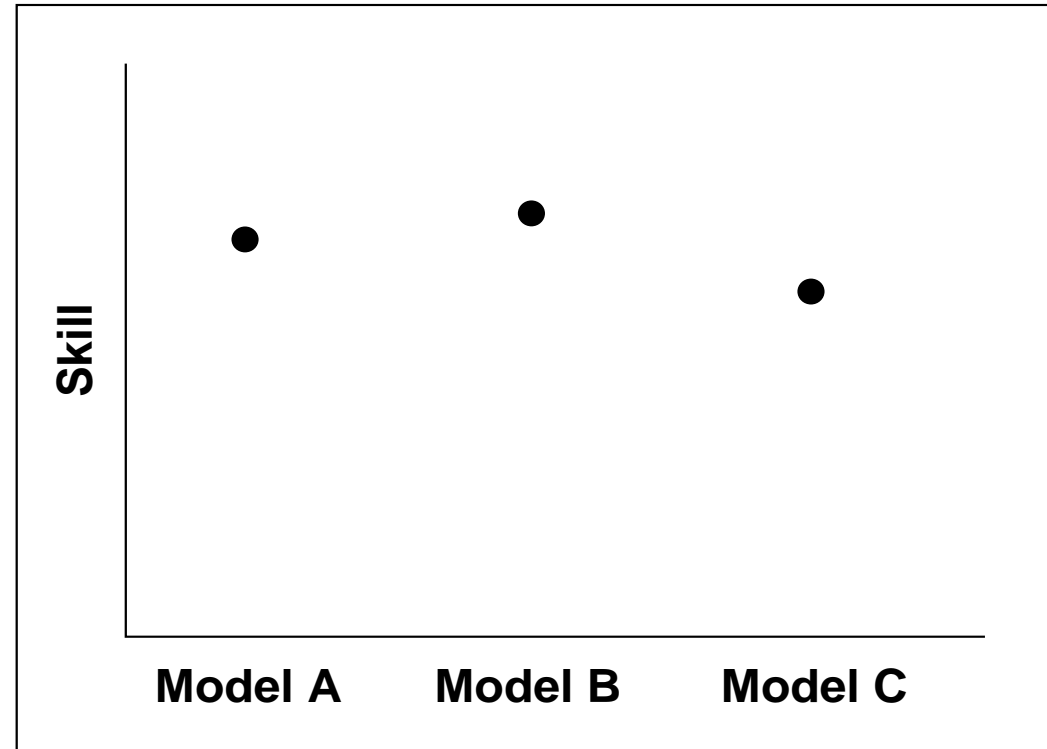
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Out of sample, particular location, particular lead time, particular target

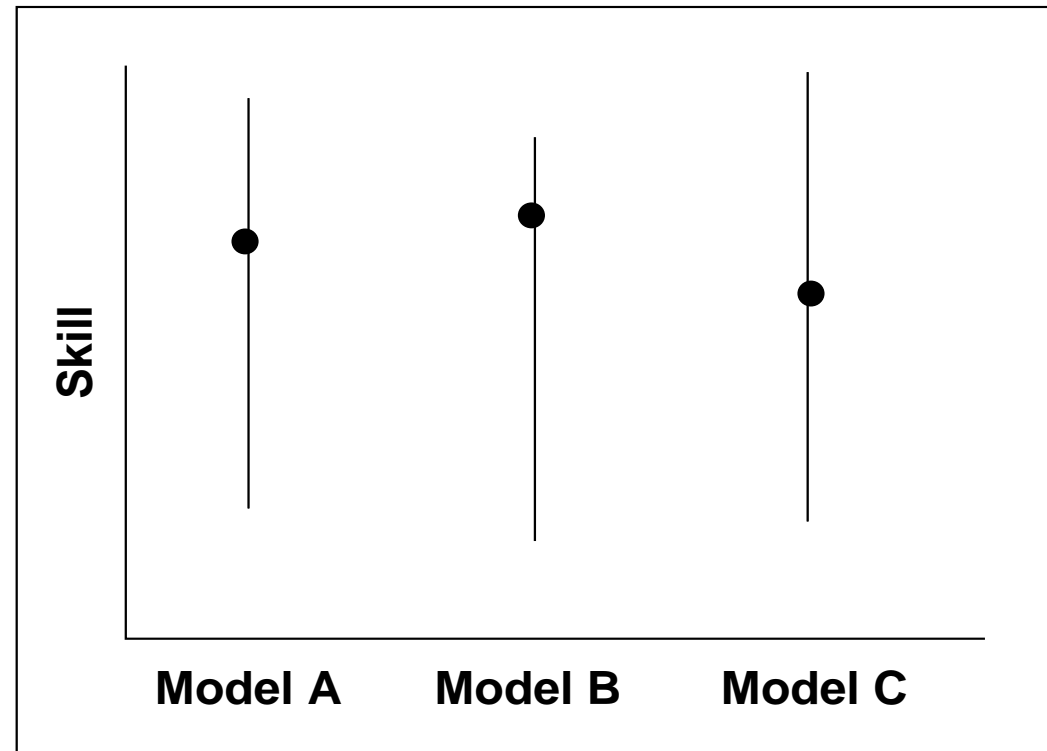
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Out of sample, particular location, particular lead time, particular target

Motivation

We do not want to compare the uncertainty in the average performance of two models.

Overview

Combining

We want the uncertainty in the comparative performance of the models to each other.

Evaluation

Bootstrap the difference:  $\langle s_A - s_B \rangle_{BS}$

Example

Not the difference of the bootstraps:  $\langle s_A \rangle_{BS} - \langle s_B \rangle_{BS}$



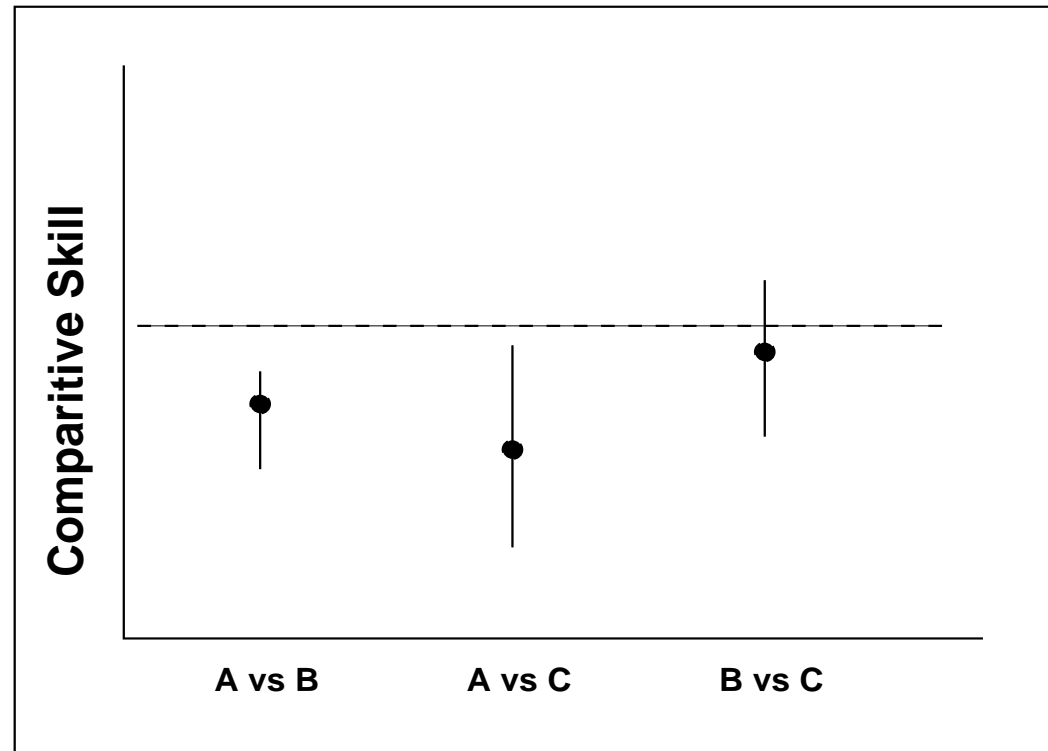
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Motivation

Predicting temperature at Heathrow.

Overview

Using

- NCEP high resolution
- NCEP ensemble
- ECMWF high resolution
- ECMWF ensemble

Combining

Evaluation

Evaluating using Ignorance - out of sample

Example

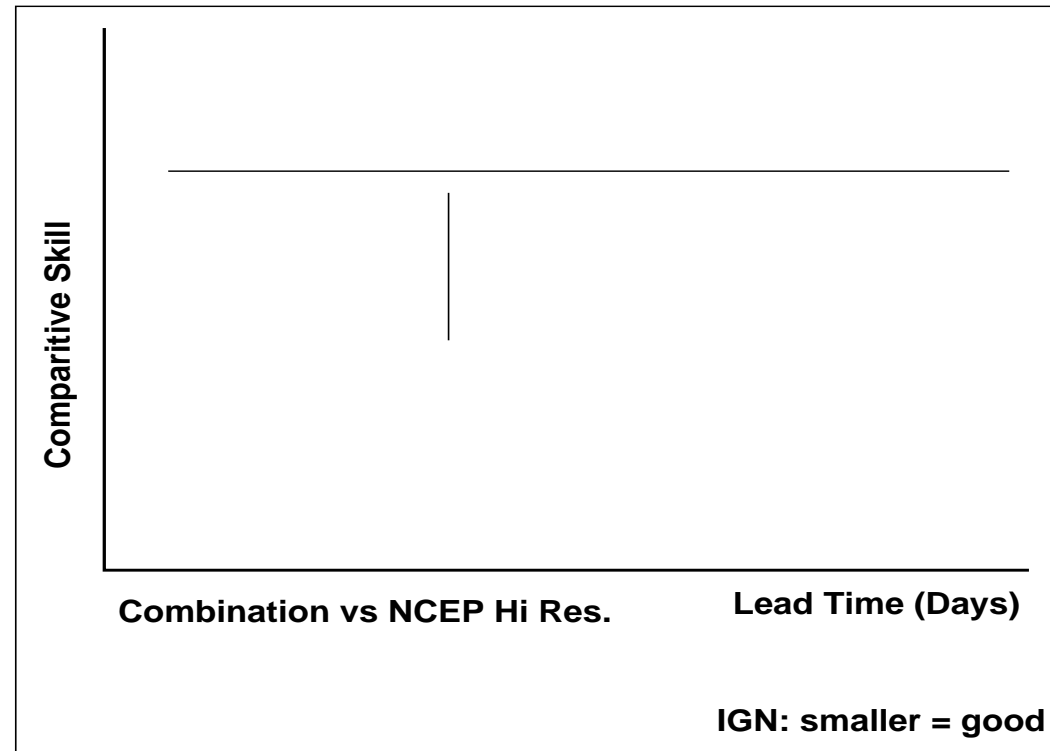
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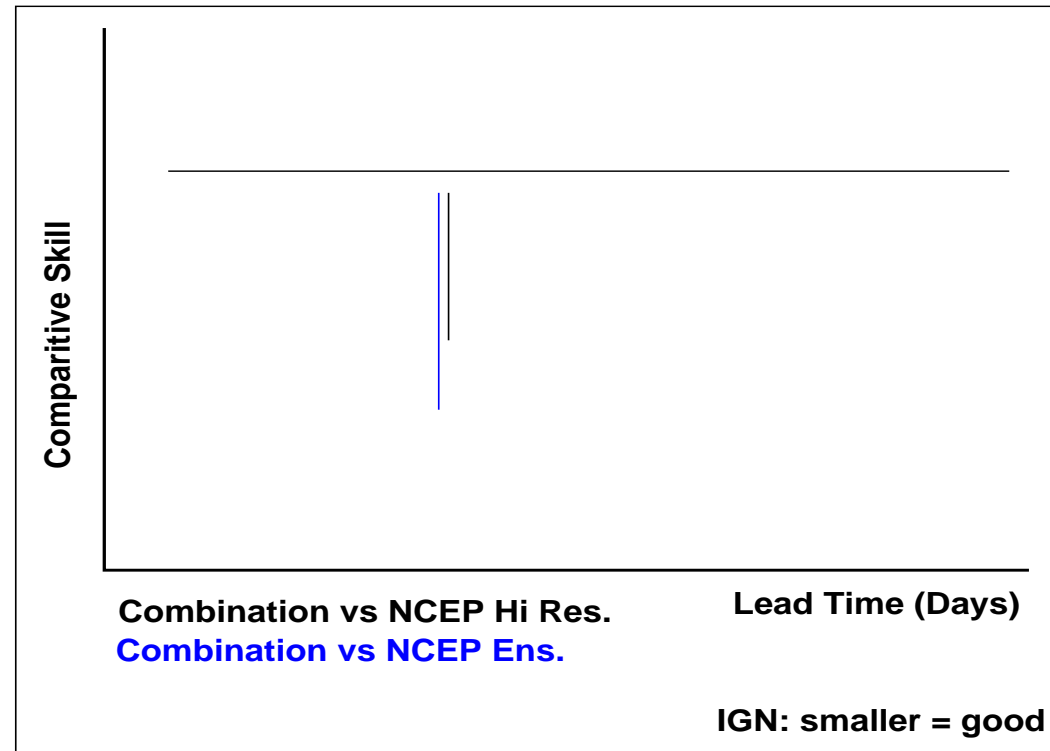
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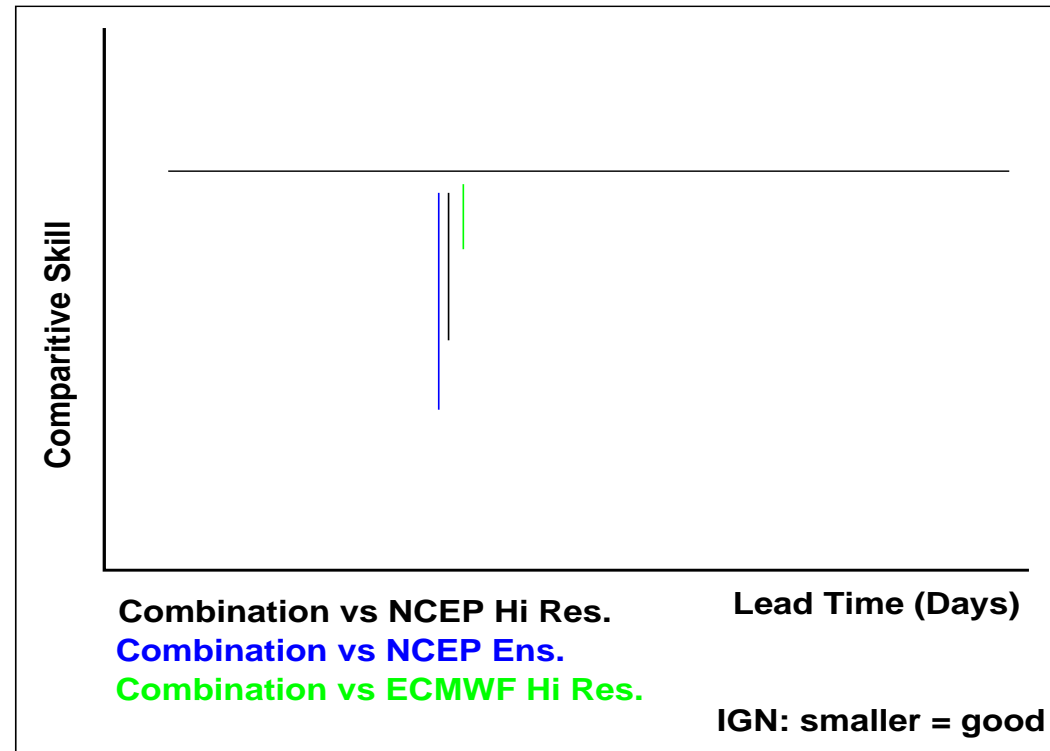
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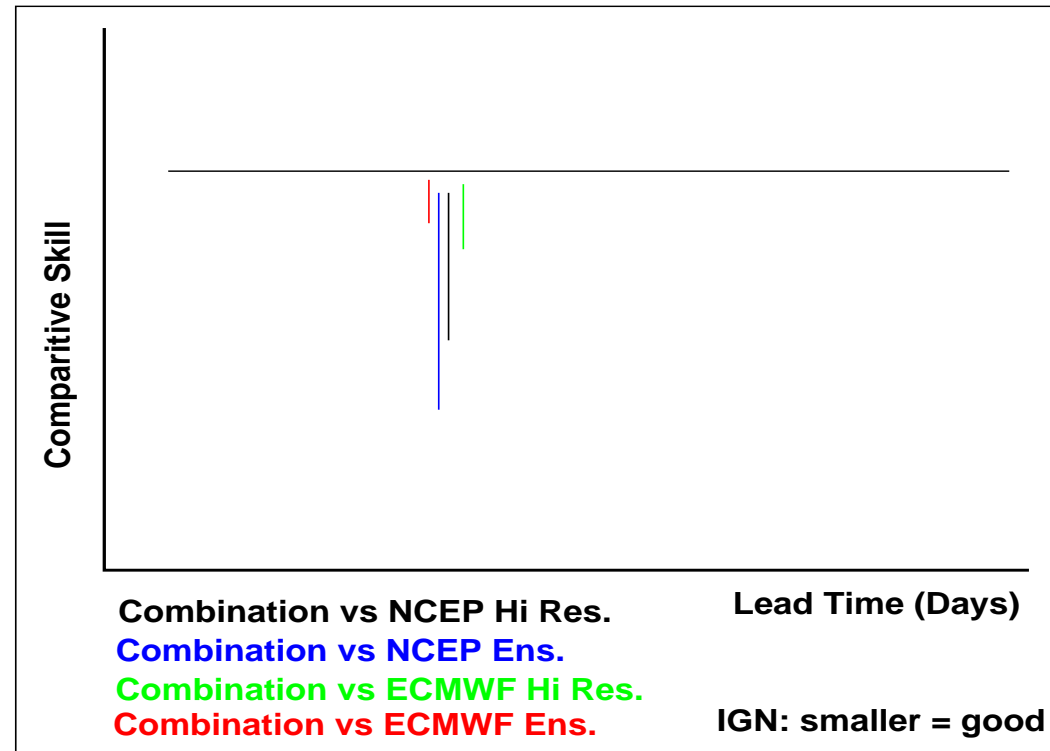
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**Example**



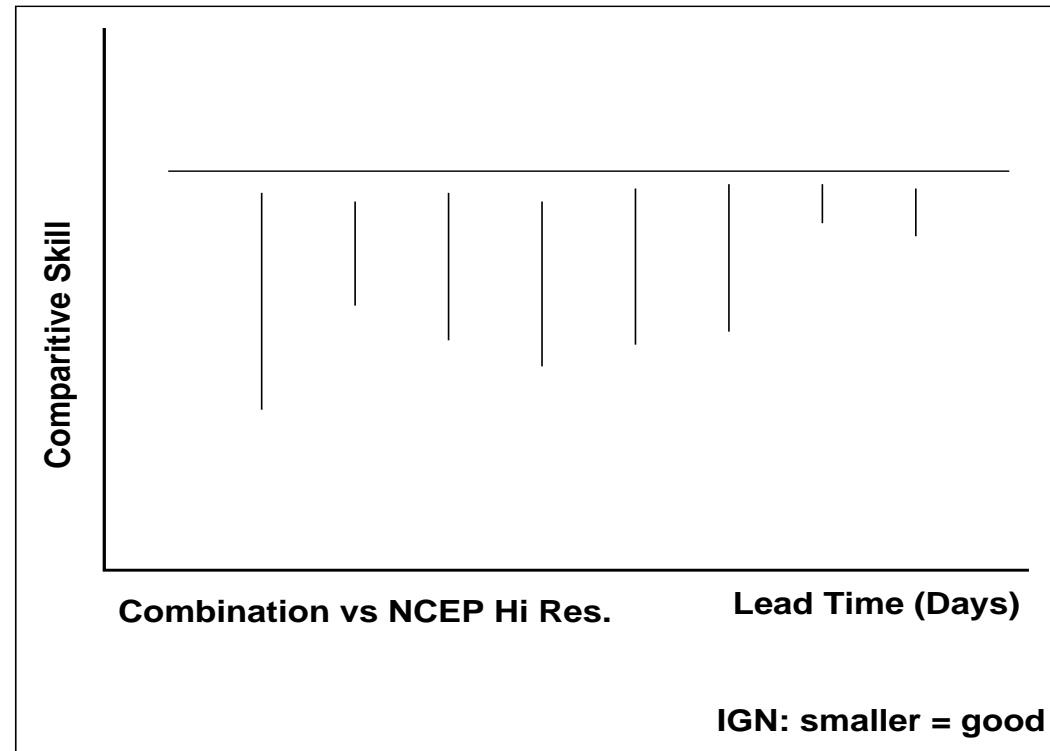
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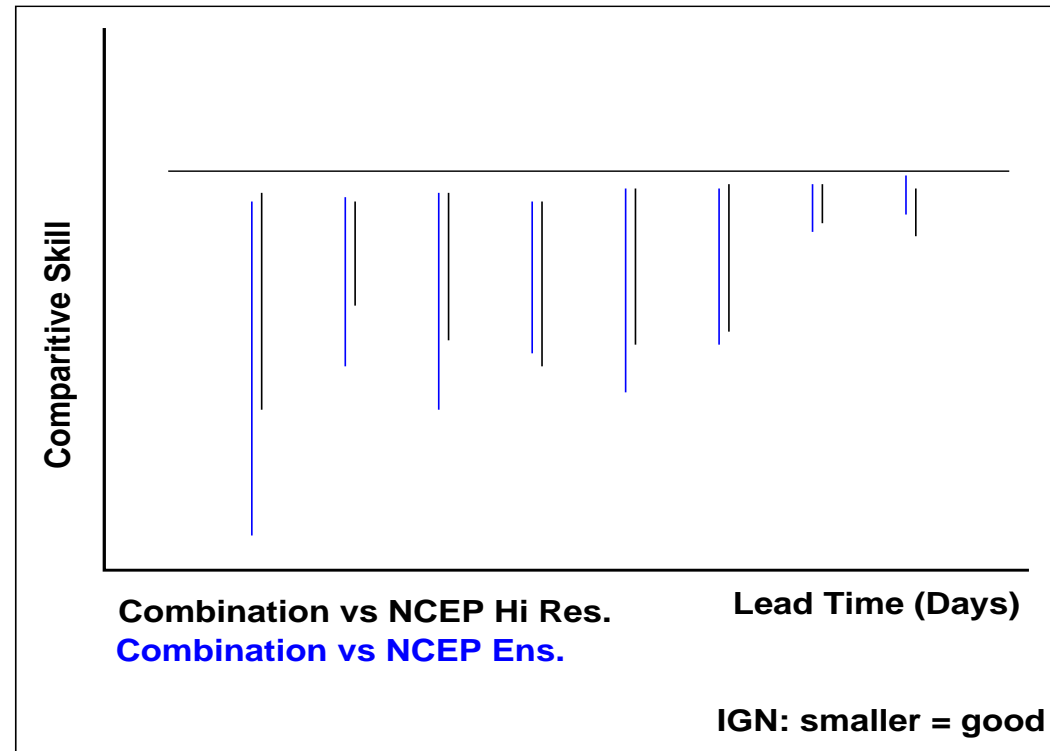
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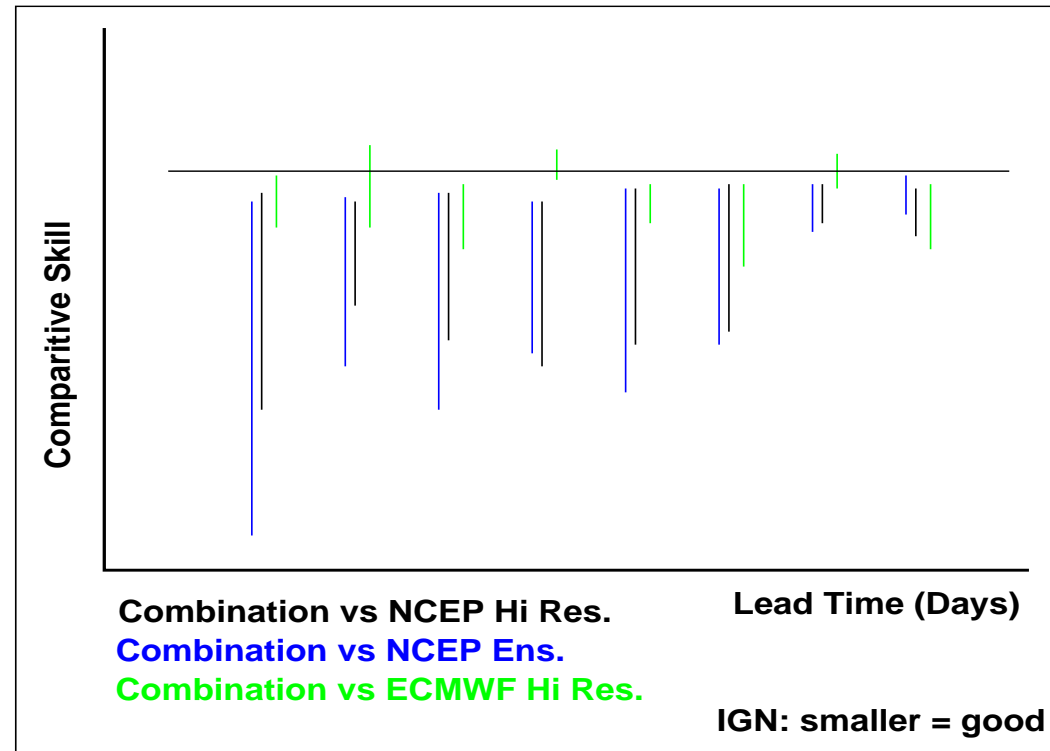
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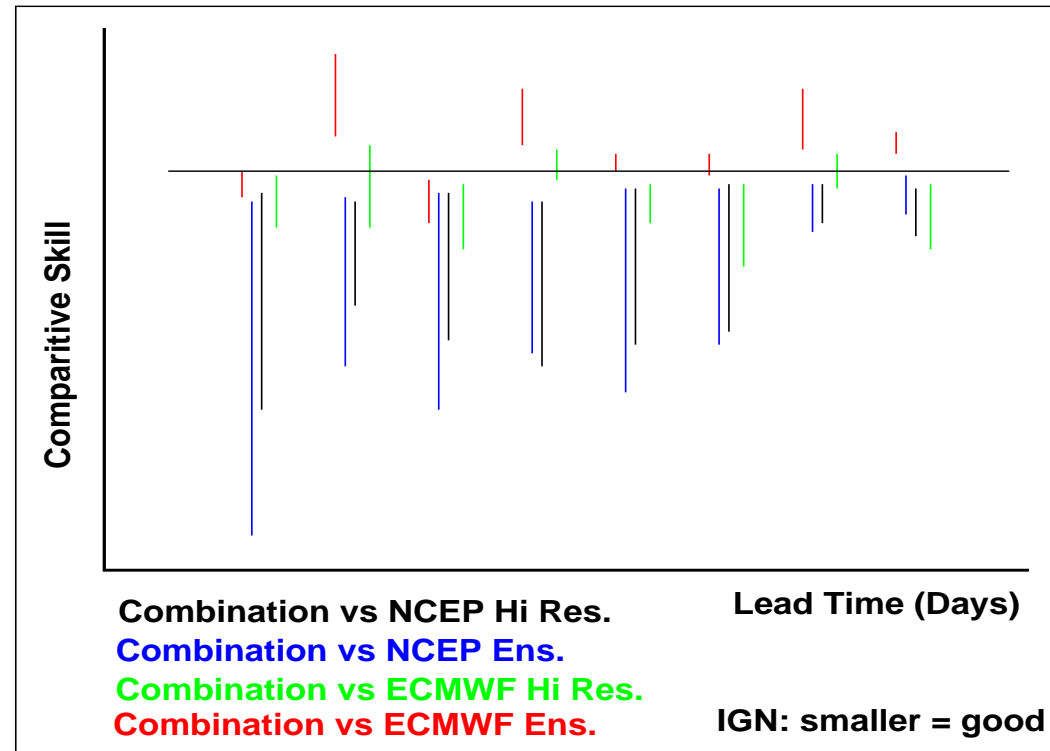
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Motivation	<p>We have:</p> <ul style="list-style-type: none"><li>● presented a user-orientated methodology for combining simulations</li><li>● whatever combination method, the evaluation must be robust</li><li>● dressing method, combination method and size of forecast-verification archive affects performance</li><li>● potential relevance to TIGGE, provides a framework for allowing users to extract the forecast information most relevant to them</li></ul>
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