

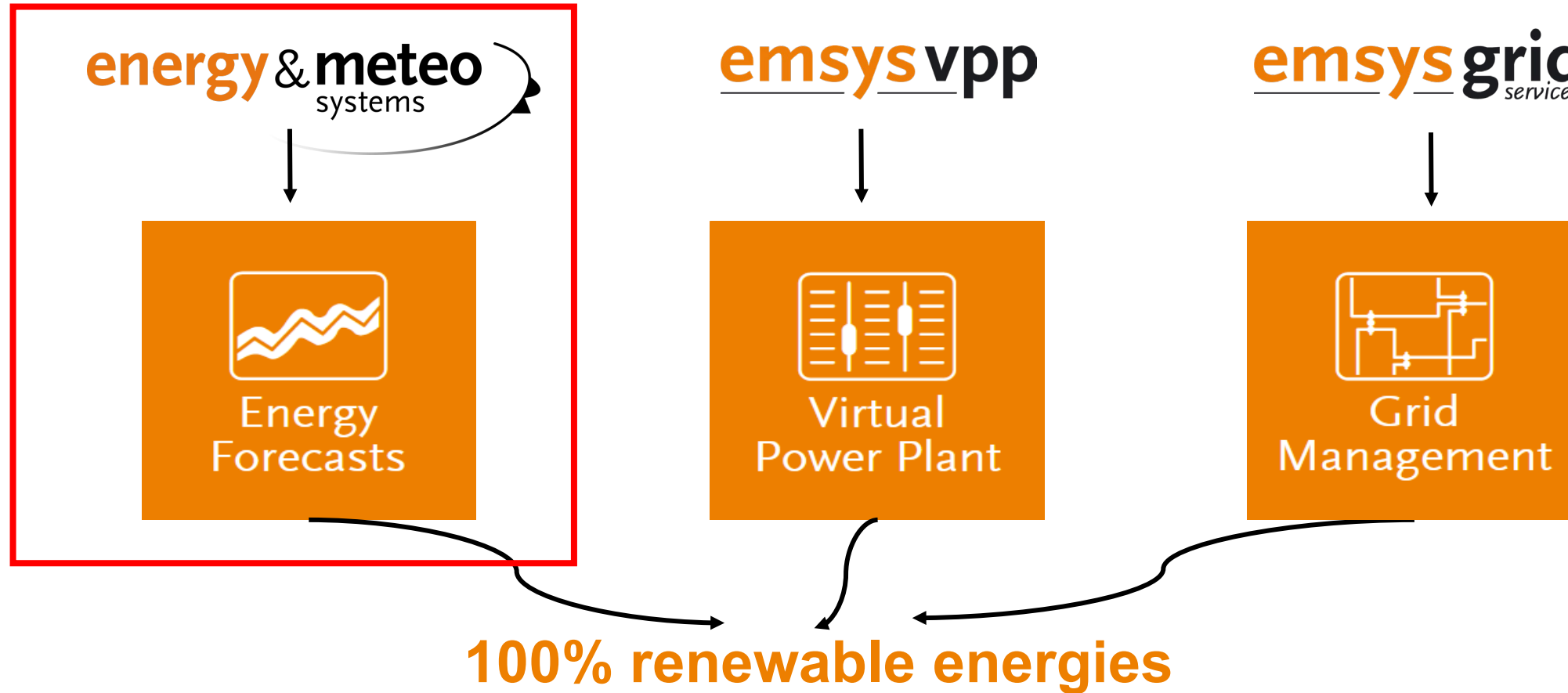
Spreads and Gradient Spreads: An Alternative to the Standard Probabilistic Forecast

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Emsys renewables: Three companies – one goal



Agenda

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- 5 Summary

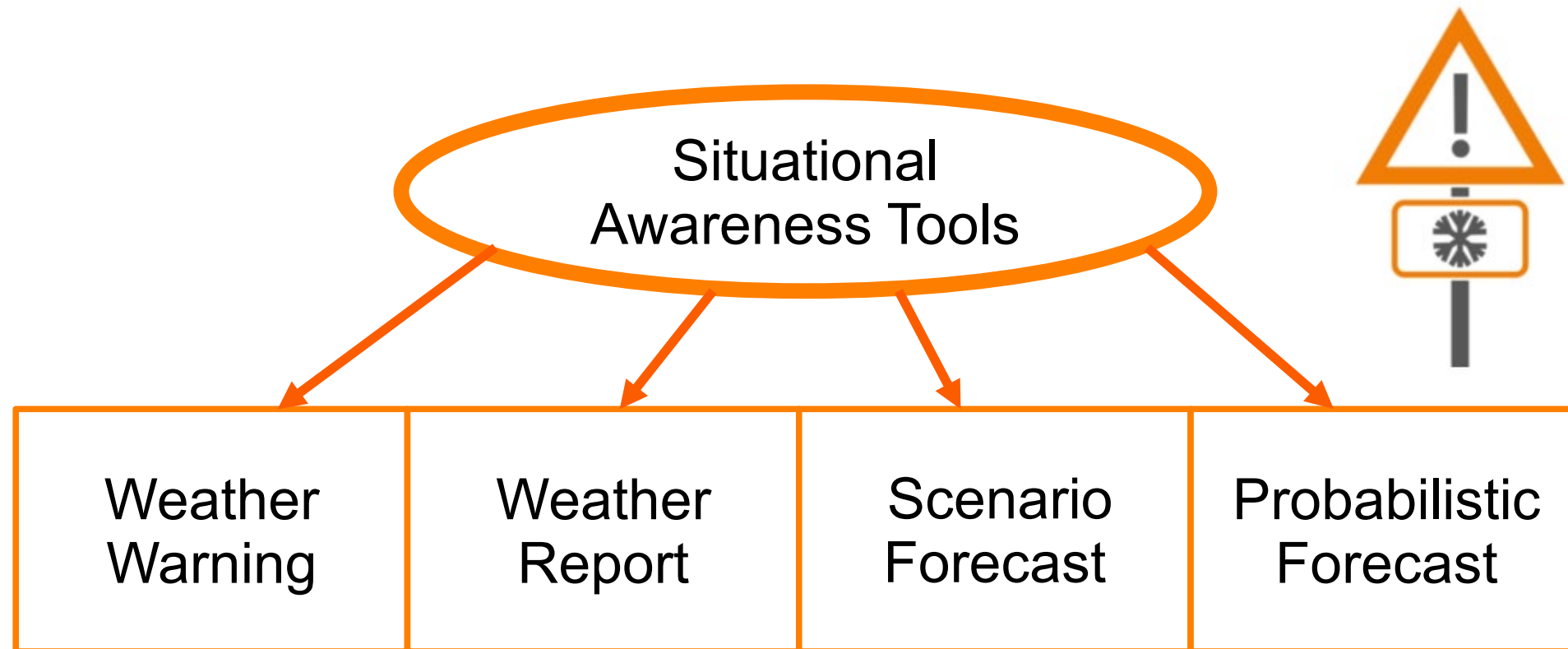
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Situational Awareness in Power Forecasting

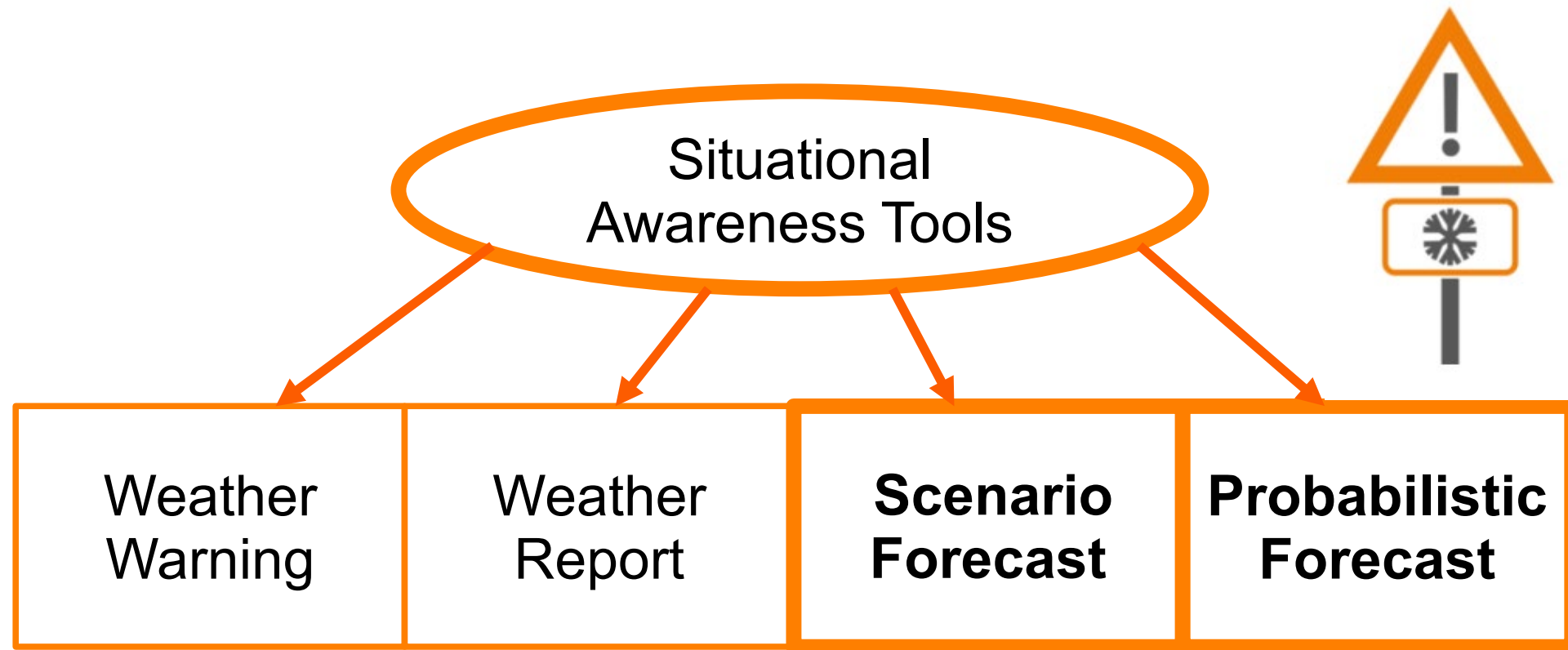
Situational Awareness in Power Forecasting

- Idea is to provide proactively information on the expected power forecast error (uncertainty information)
- Central questions:
 - How is the uncertainty information used in decision making?
 - What is the process?
 - Is it used by a human being (e.g. operator) or by an algorithm?
 - How is the uncertainty information evaluated?
- There are different ways to deal with uncertainty in power forecasts

Situational Awareness in Power Forecasting



Situational Awareness in Power Forecasting



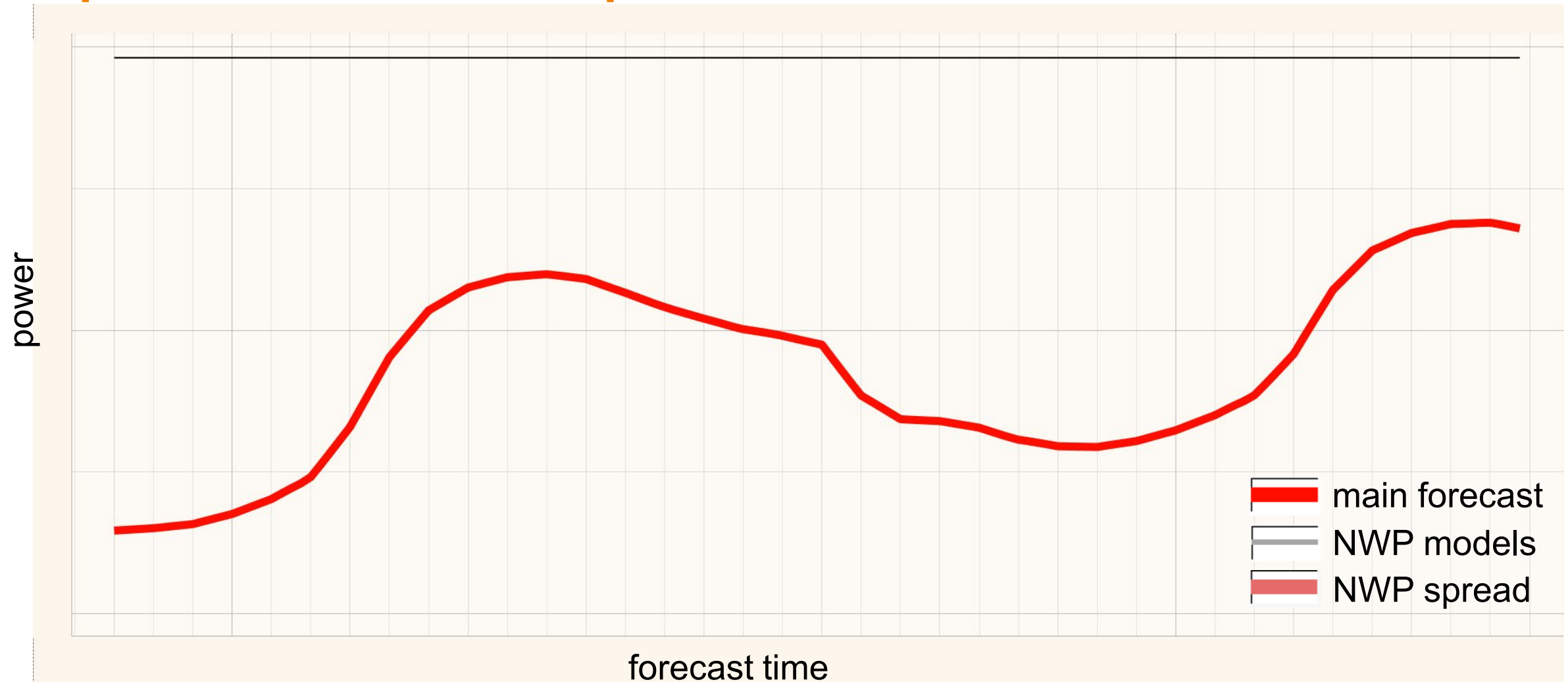
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Spreads and Gradient Spreads

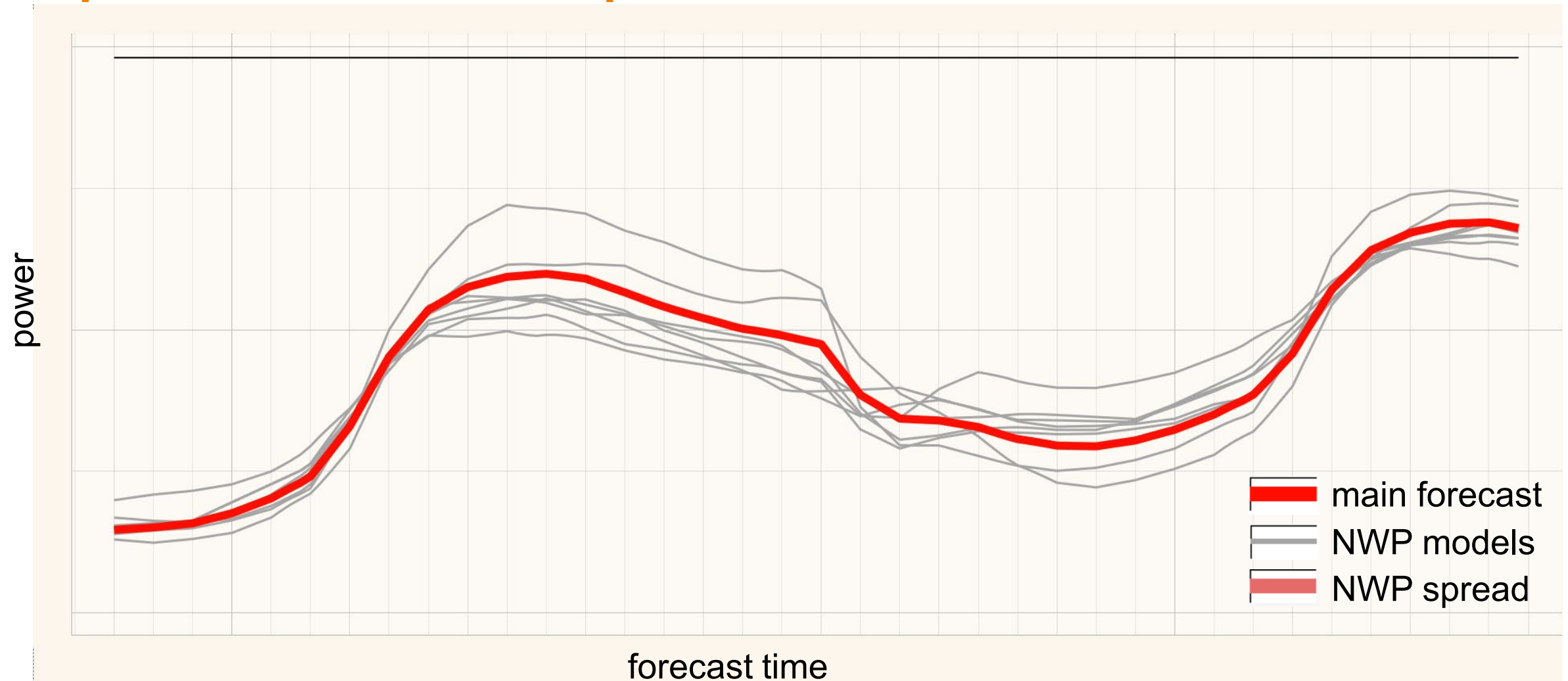
Spreads and Gradient Spreads

- Different numerical weather models (NWP) predict different „outcomes“ (scenarios) for wind and solar production
- *Spread*: Bandwidth of power production scenarios derived from the NWP
→ defines the weather-related uncertainty of the power forecast
- *Gradient Spread*: Bandwidth of ramp scenarios derived from the NWP
→ defines the weather-related uncertainty of ramps in power forecasts
- Spreads and Gradient Spreads can be used to determine the worst case risk for unexpected losses or overproductions
- Spreads and Gradient Spreads may also be obtained from „true“ ensemble prediction systems („EPS“) like the NCEP EPS

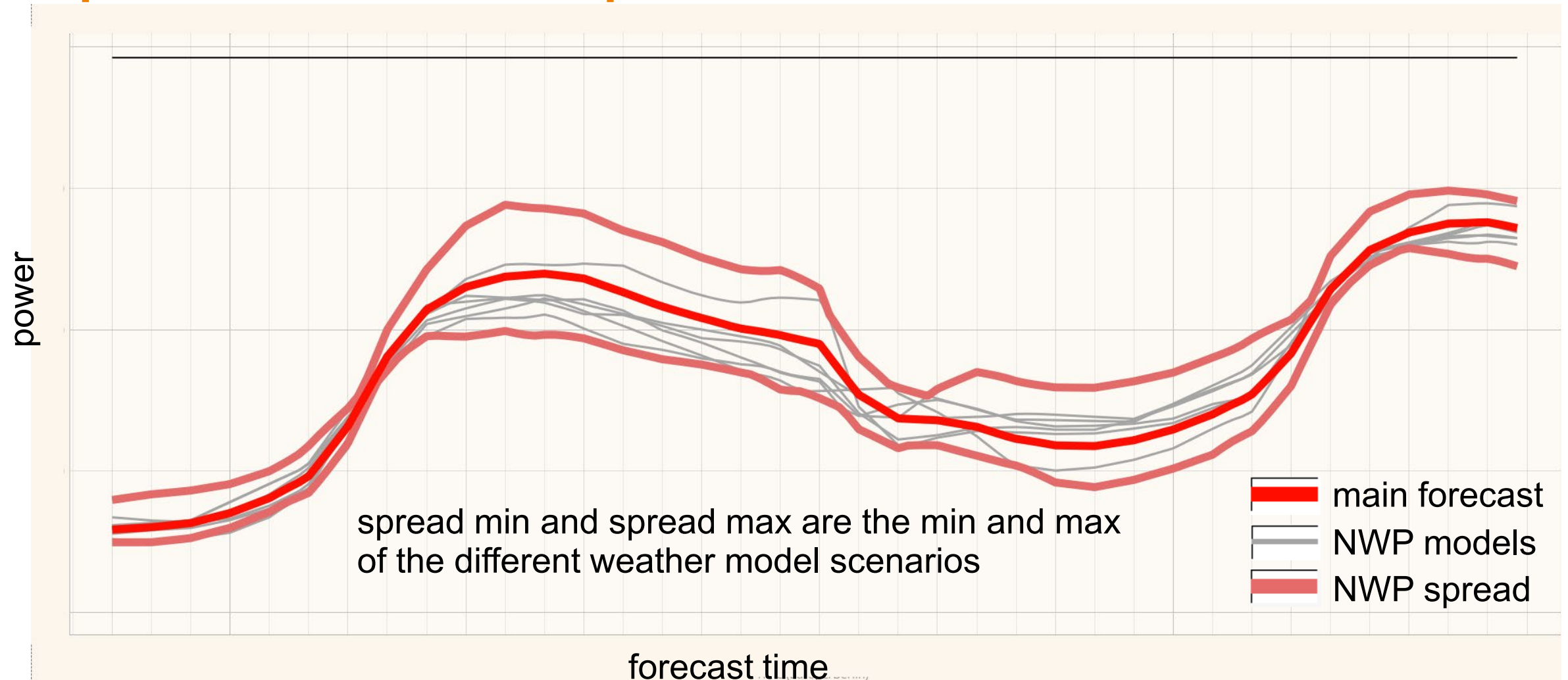
Spreads and Gradient Spreads



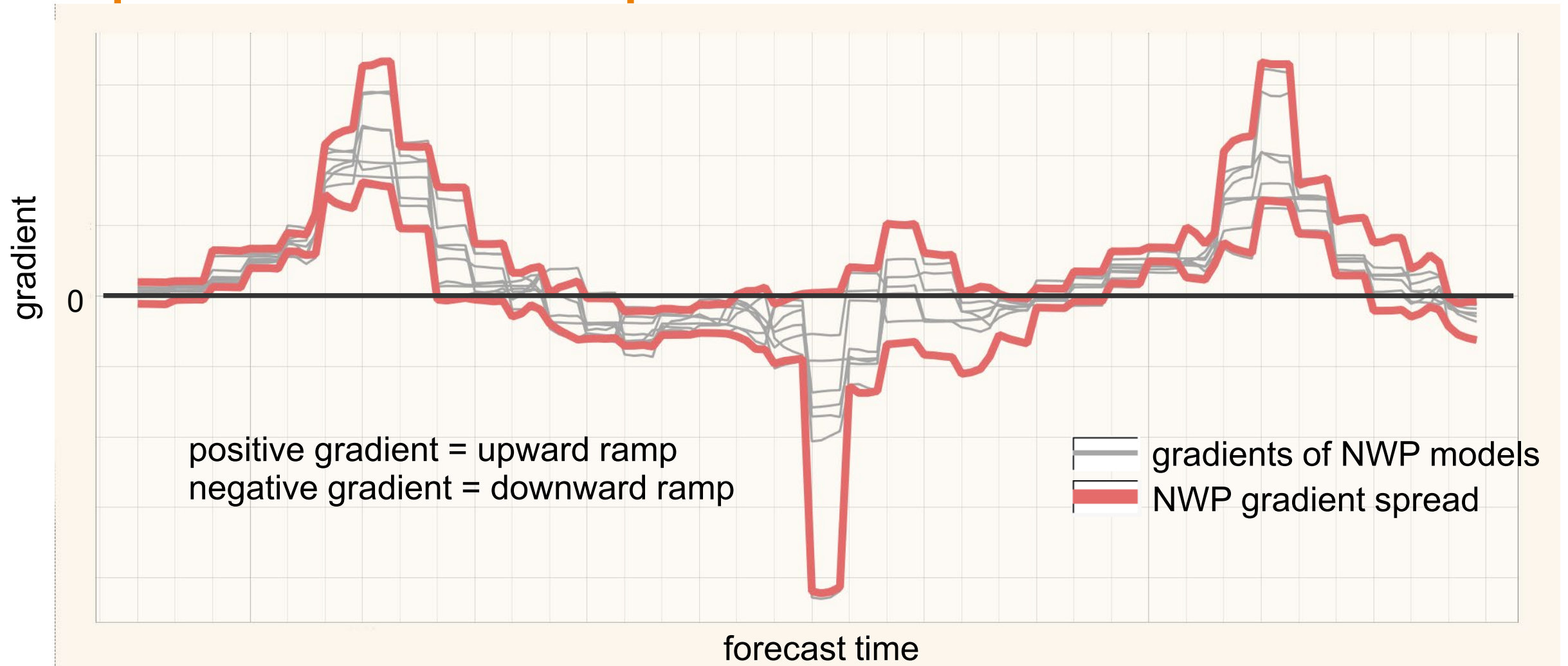
Spreads and Gradient Spreads



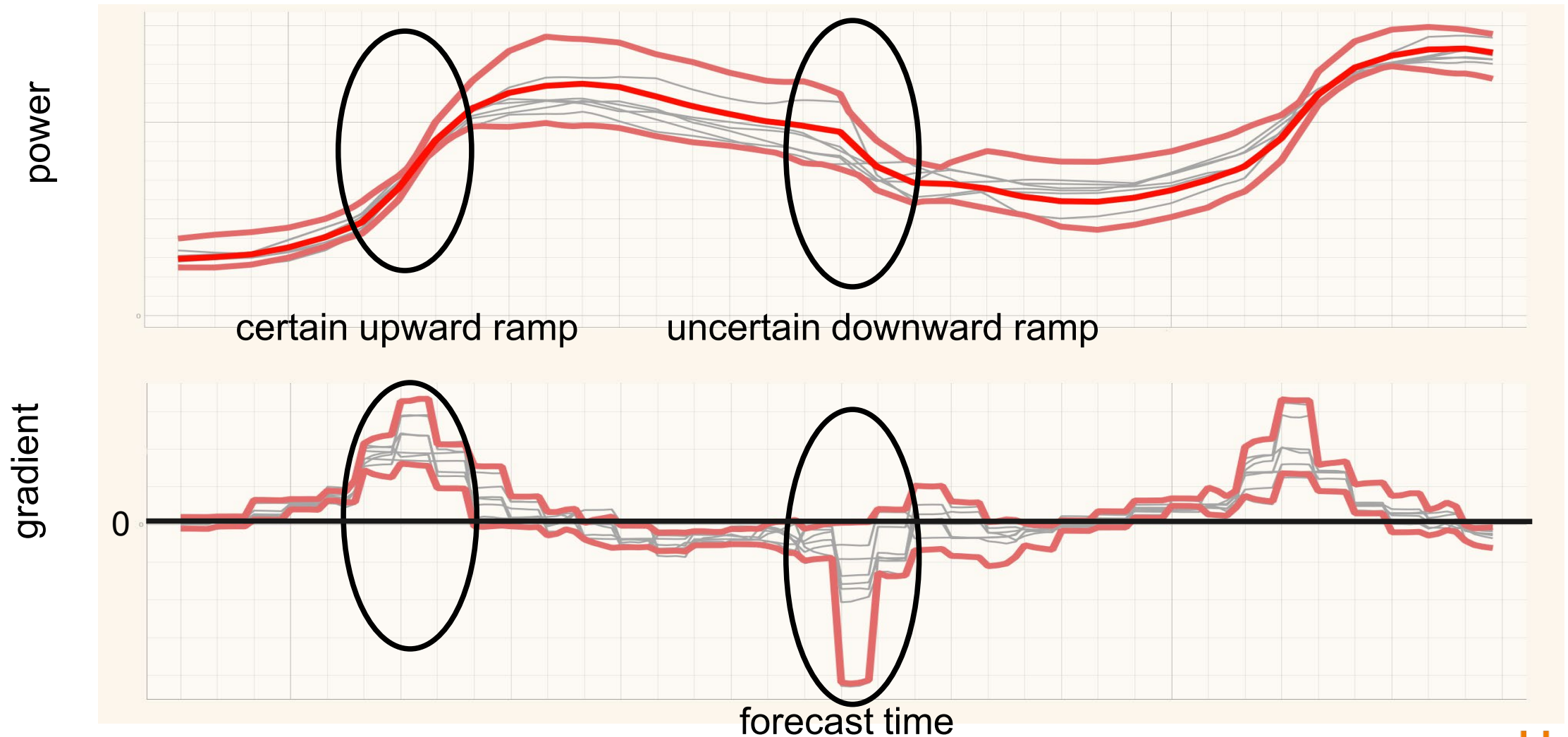
Spreads and Gradient Spreads



Spreads and Gradient Spreads



Spreads and Gradient Spreads



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Spreads vs Quantiles

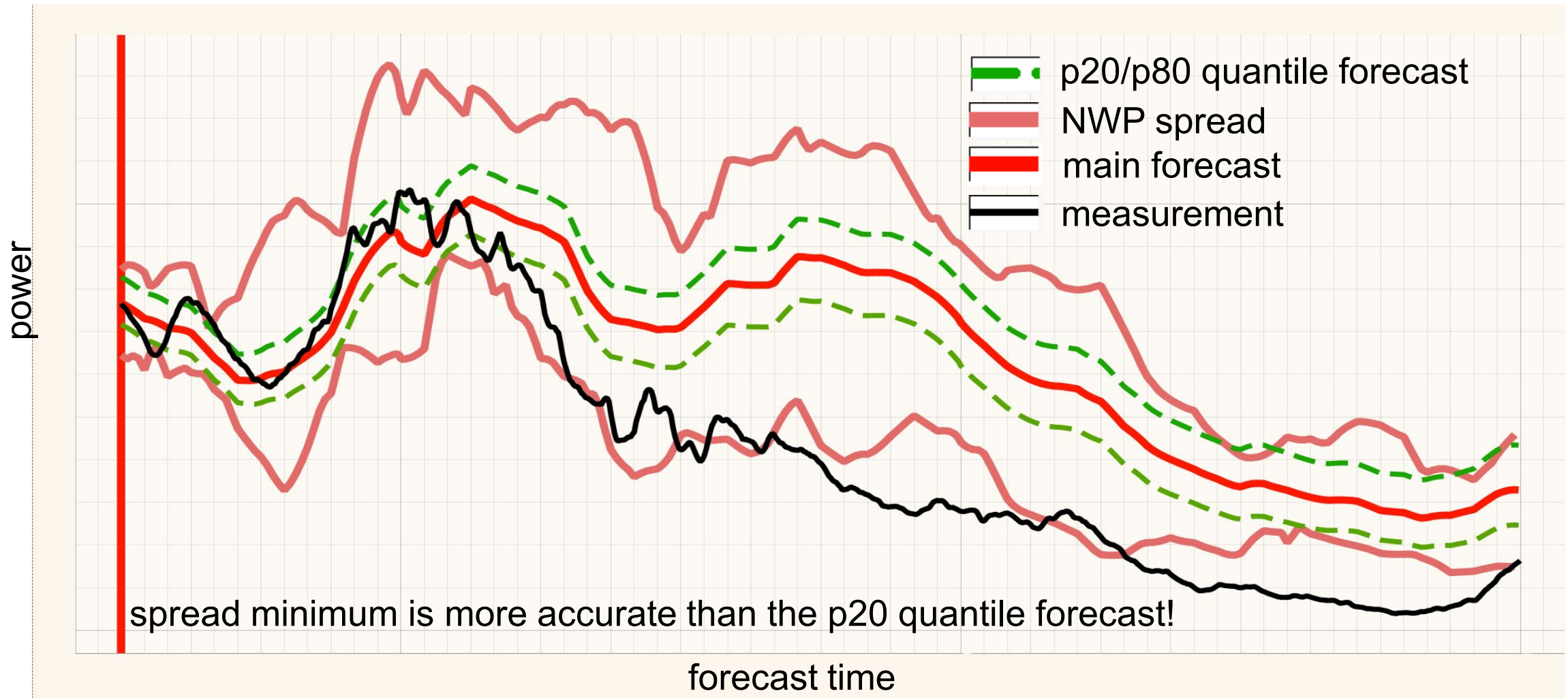
Spreads vs. Quantiles

- Quantile forecast
 - Based on average historical forecast error, i.e. observed deviations
 - Advantage: Well-defined probabilities (e.g. p80, p20)
 - Disadvantage: Weak dependence on current weather situation - often fails during extreme weather situations
- Spread / scenario forecast
 - Based on different power production scenarios derived from the NWP
 - Advantage: Clear relation to current weather situation
 - Disadvantage: So far no well-defined probabilities (can be addressed by using EPS data)

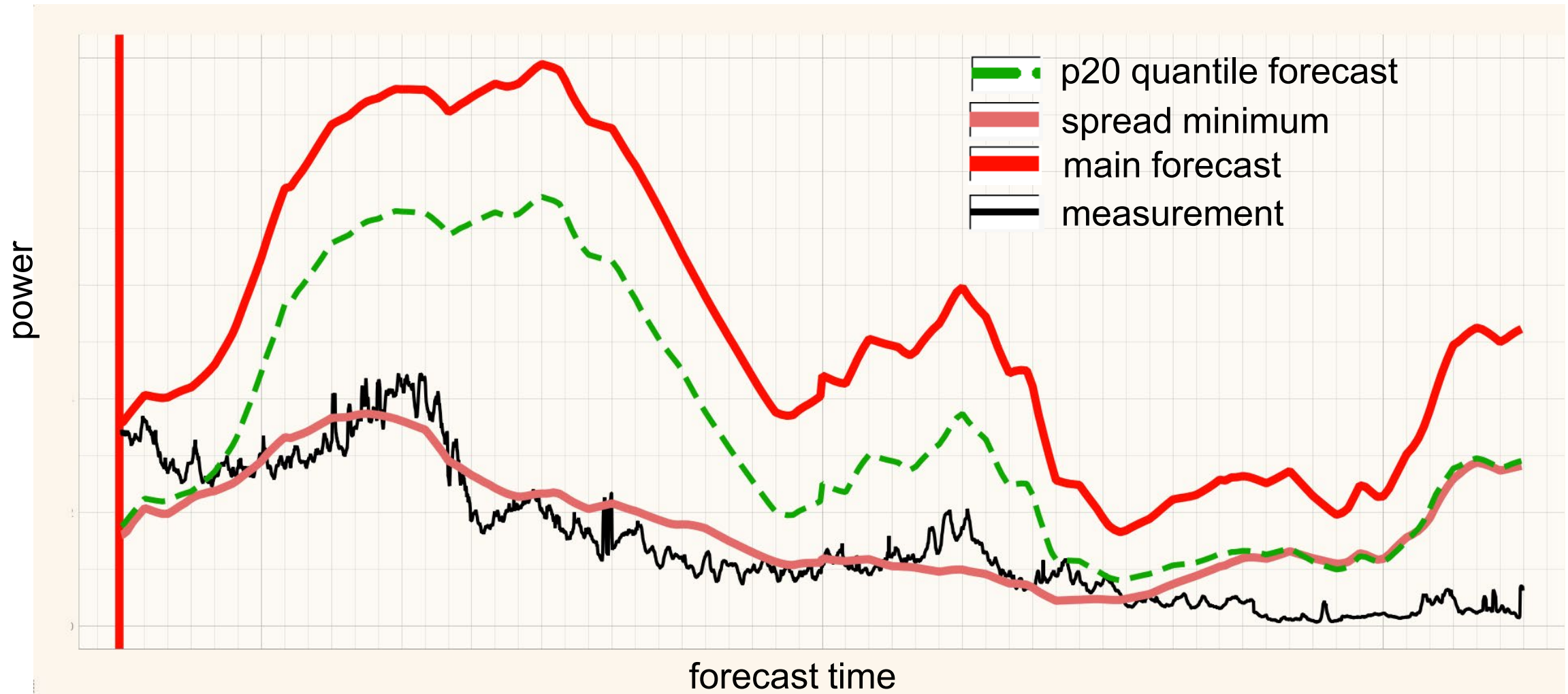
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Examples

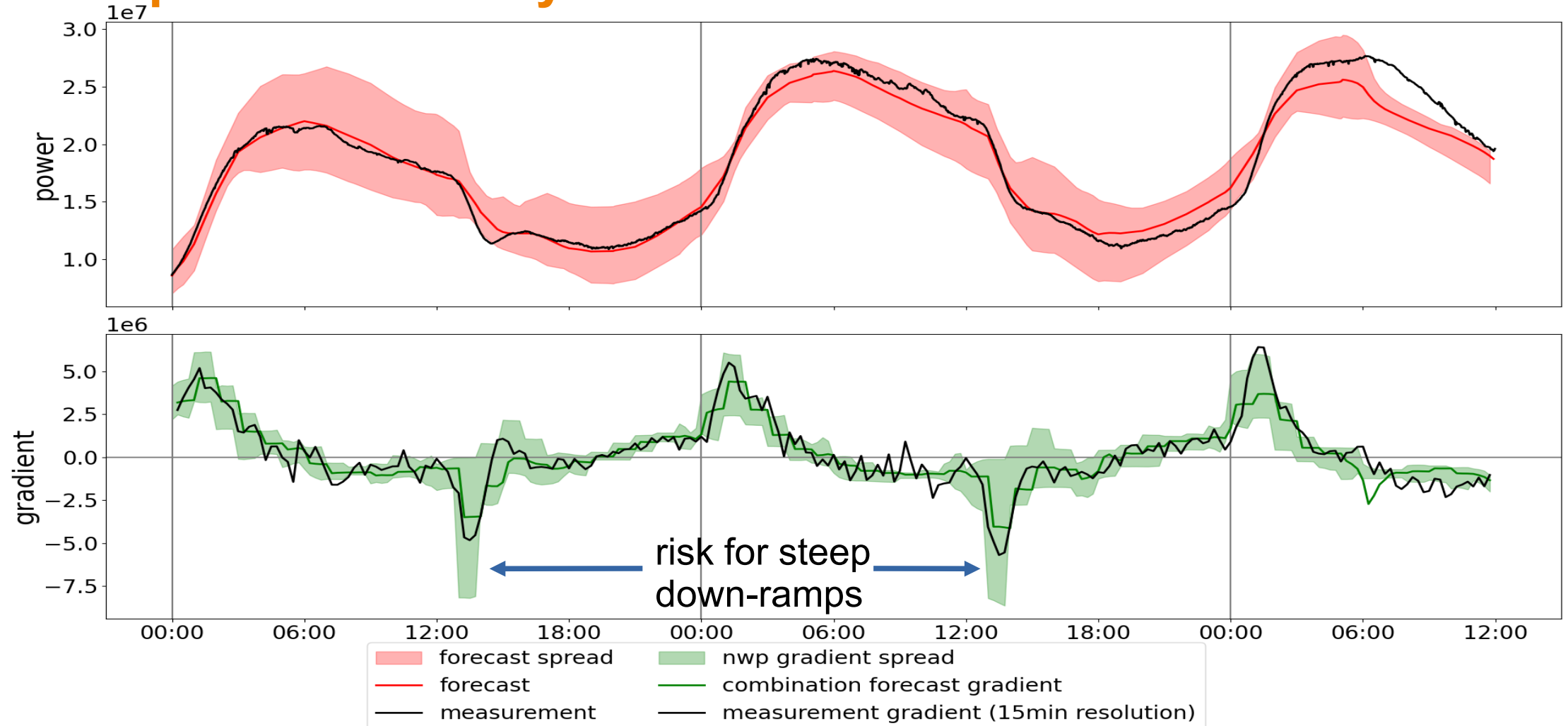
Example 1: Low pressure system over the Great Plains



Example 2: Major Icing Event



Example 3: Diurnal Cycle in Wind Power Production



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Summary

Summary

- Spreads and gradient spreads are a scenario-based approach to address power forecast uncertainty
- They are derived from the numerical weather models output
- Spreads show the uncertainty in production level whereas gradient spreads indicate the uncertainty of a ramp event in time and steepness
- As opposed to quantile forecasts, they are sensitive to the current weather pattern
- Spreads perform well during extreme events like icing, steep diurnal ramps or high-wind cut outs
- Spreads can also be used in solar forecasting for example during fog situations

Thank you for your attention!

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