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

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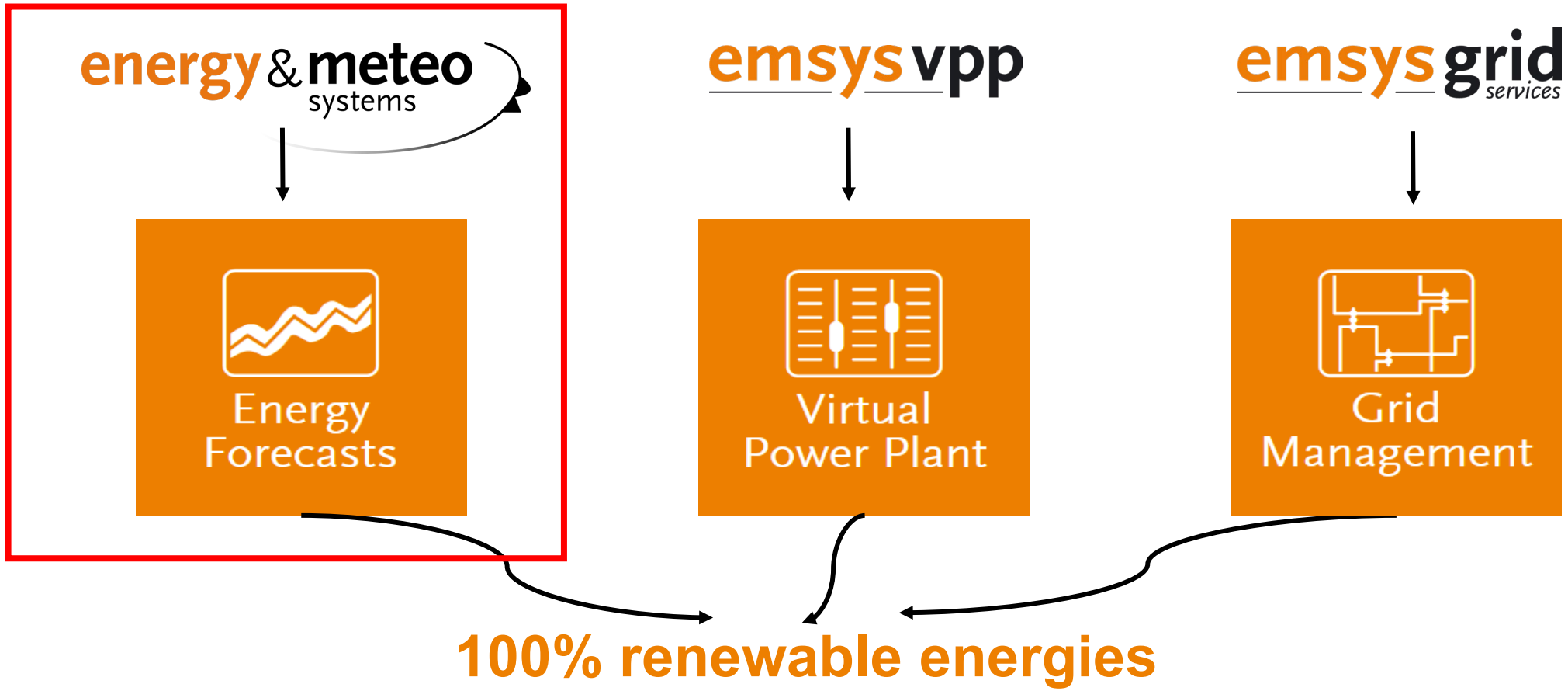
Emsys renewables: Three companies – one goal



Agenda

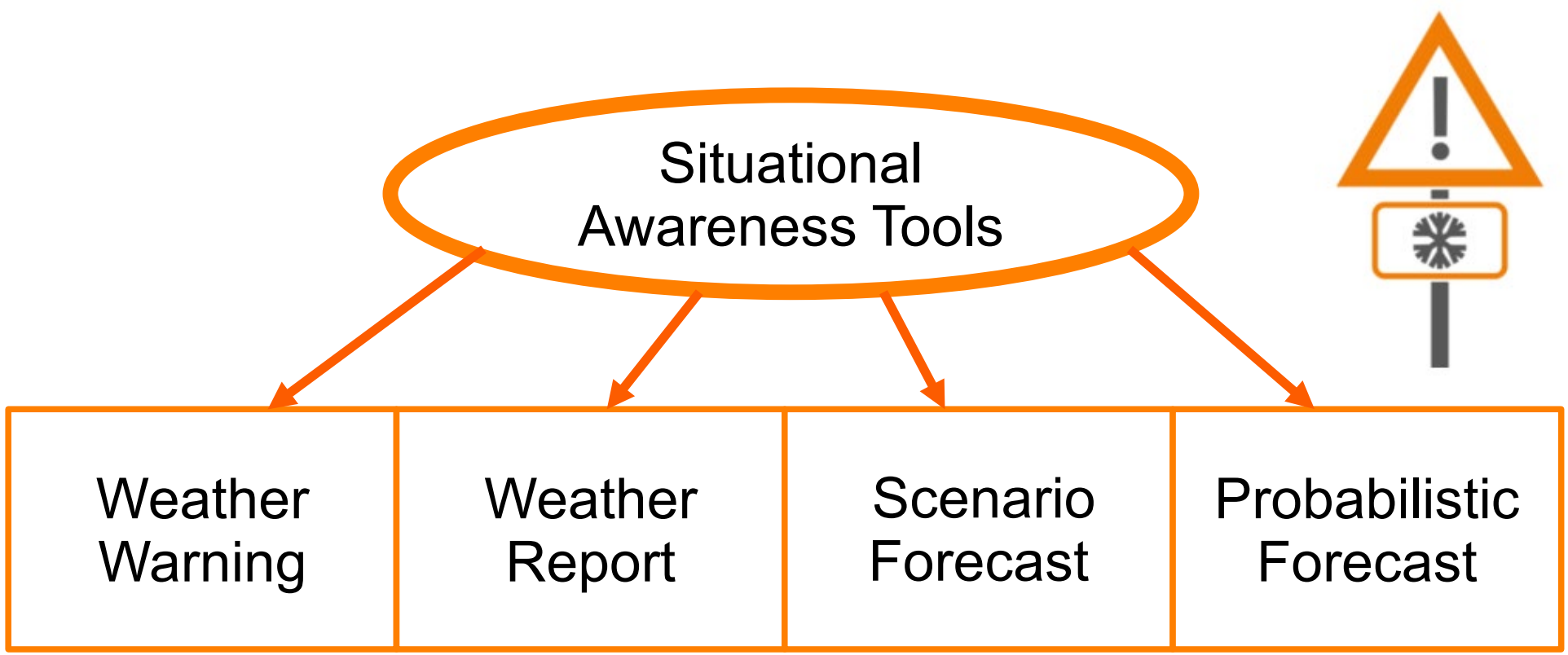
1. Situational Awareness in Power Forecasting
2. Spreads and Gradient Spreads
3. Spreads vs. Quantiles
4. Examples
5. Summary

1 Situational Awareness in Power Forecasting

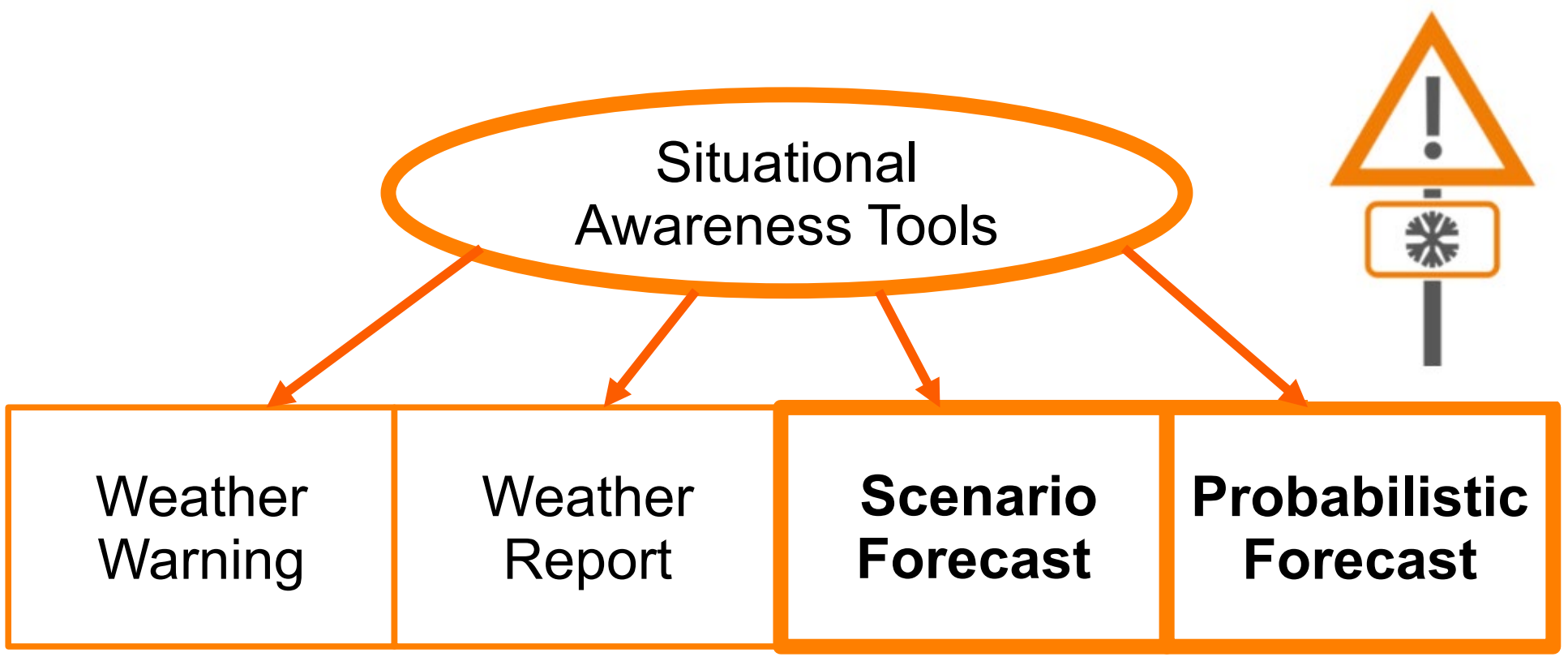
Situational Awareness in Power Forecasting

- 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



2 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

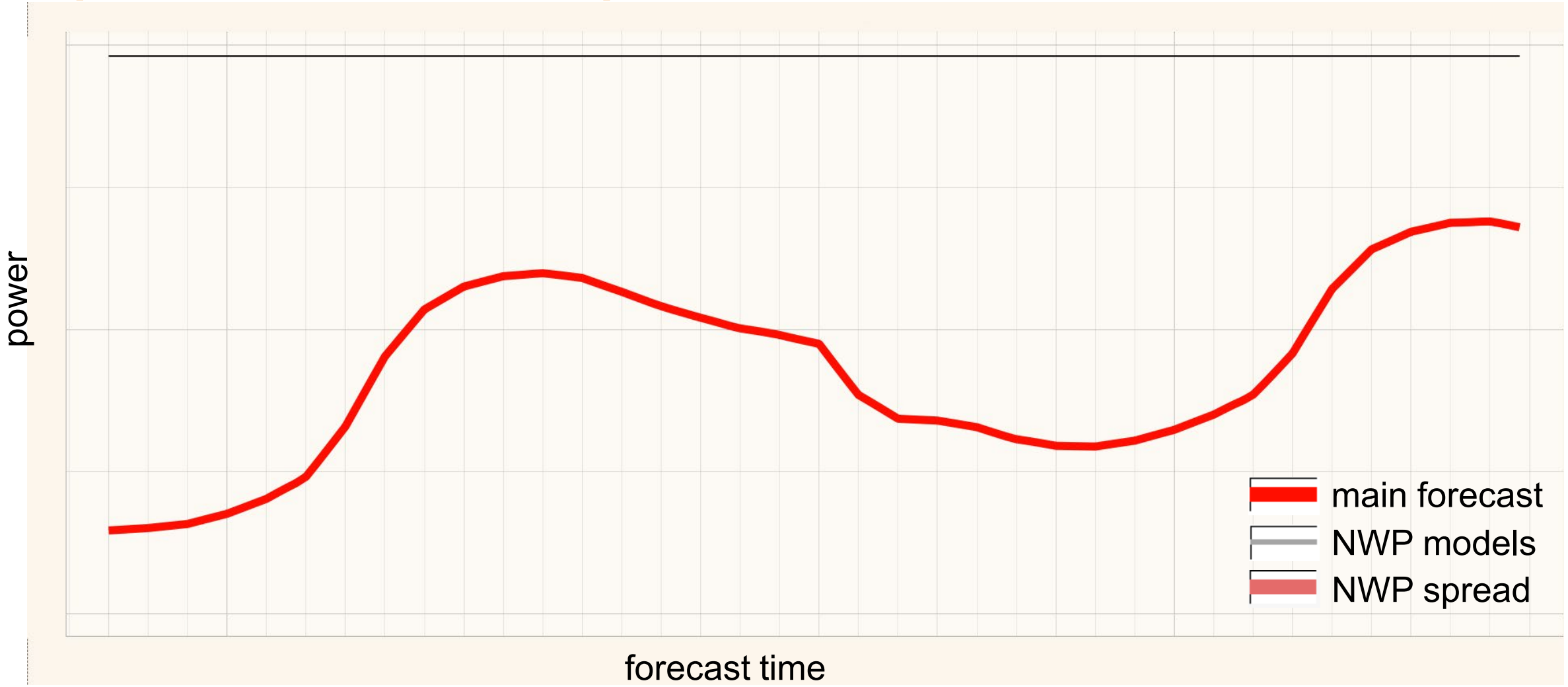
→ defines the weather-related uncertainty of the power forecast

- *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



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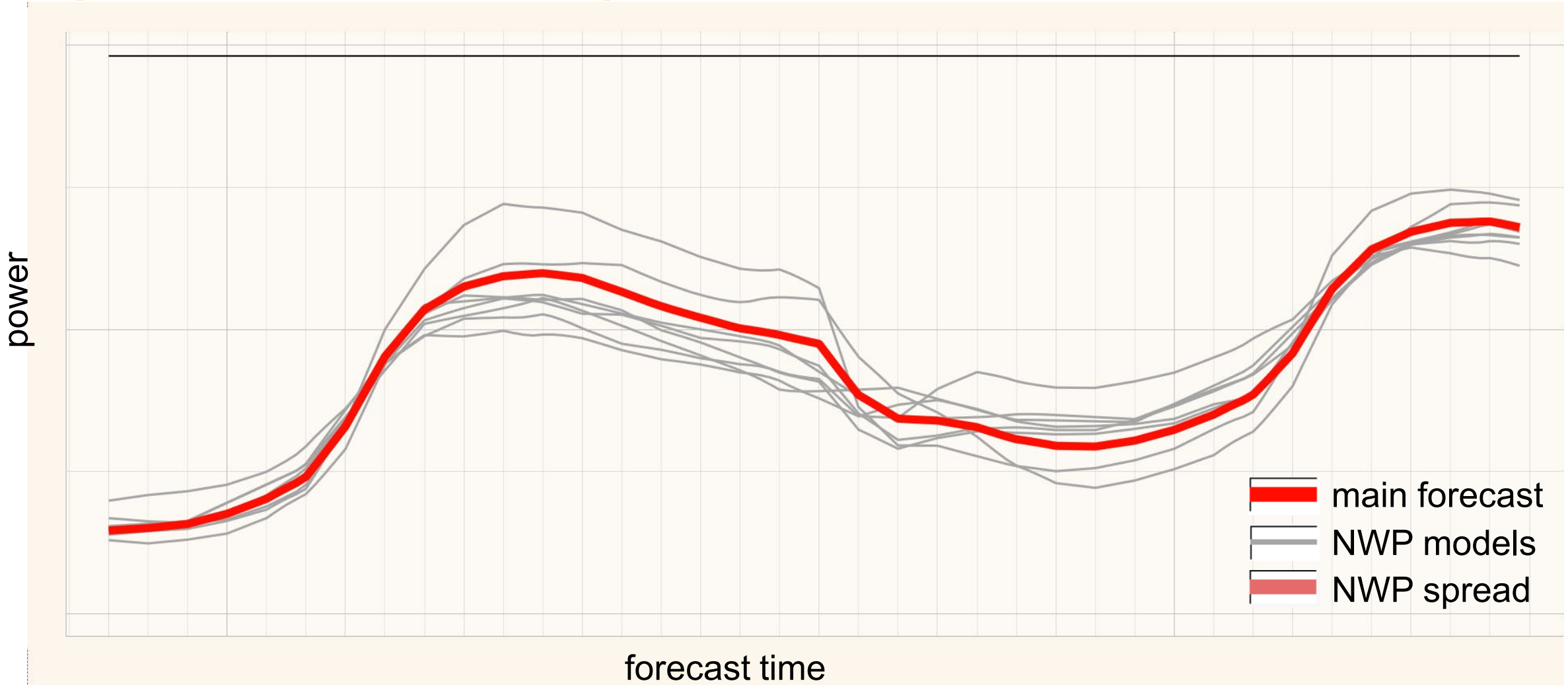
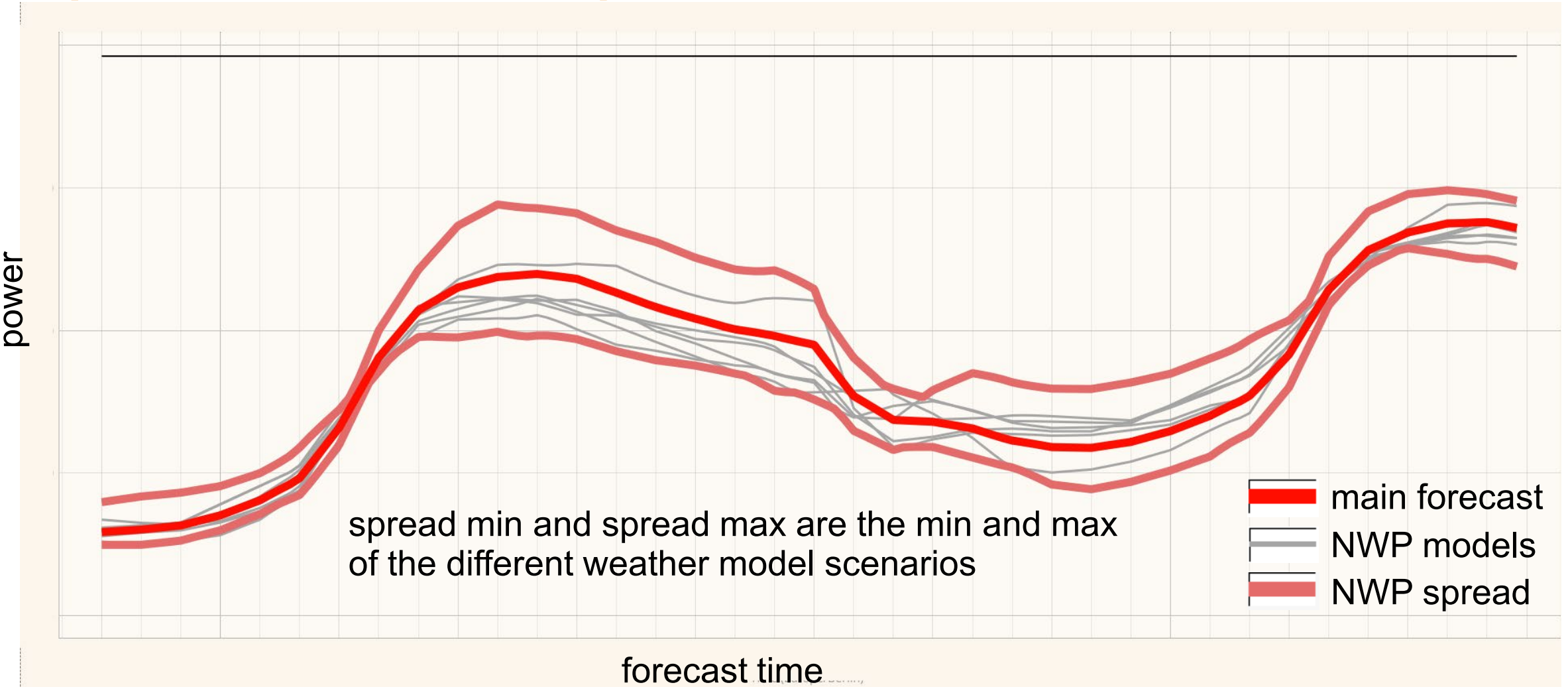
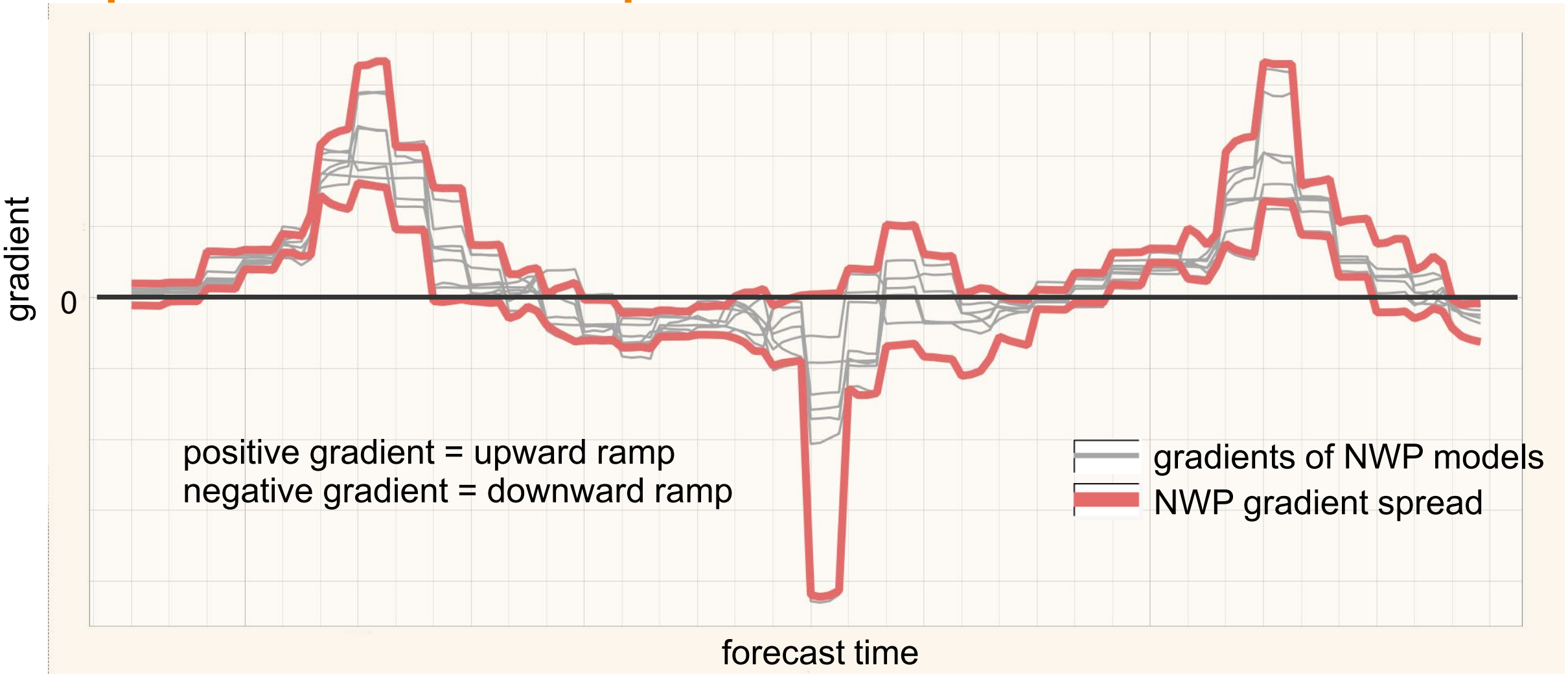


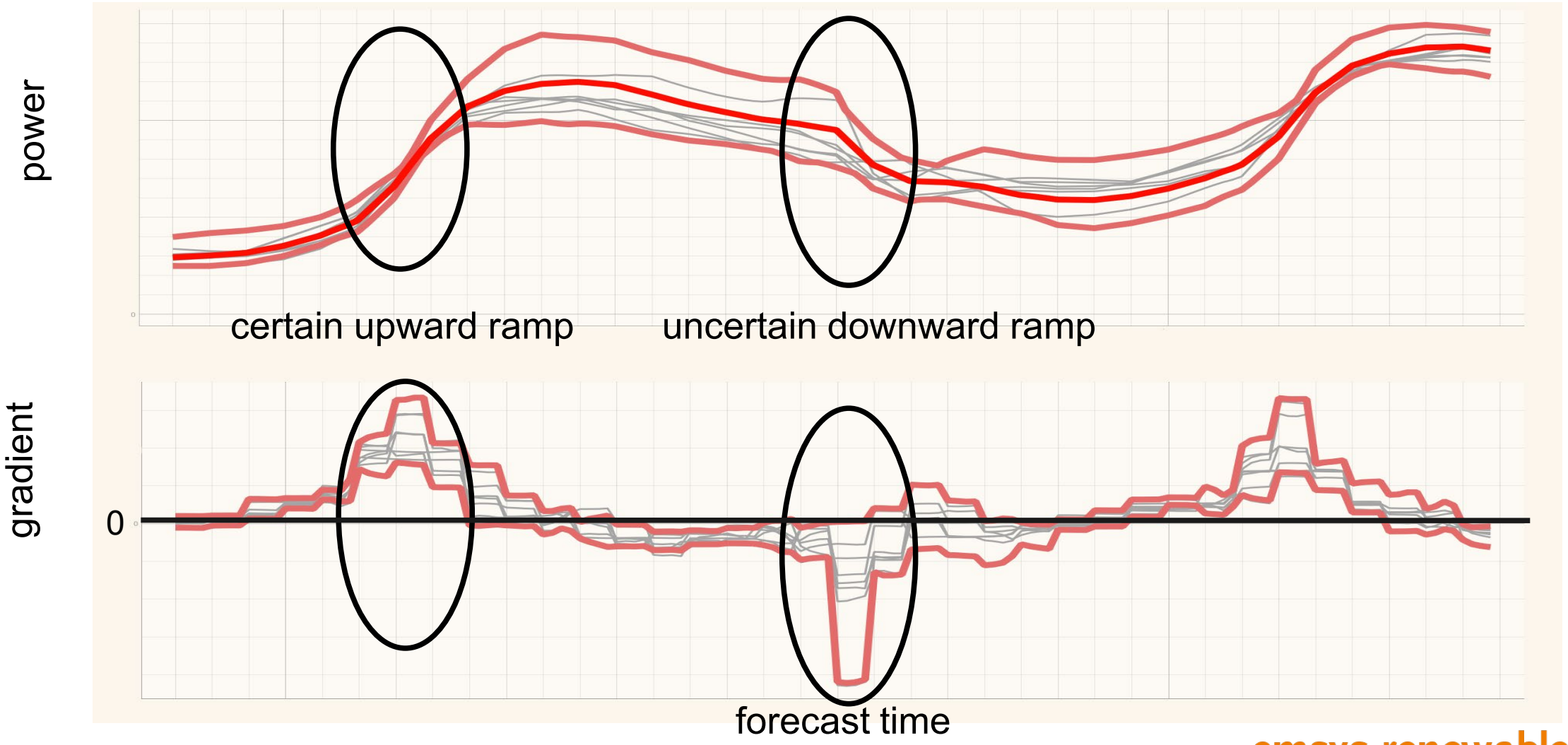
Spreads and Gradient Spreads



Spreads and Gradient Spreads



Spreads and Gradient Spreads



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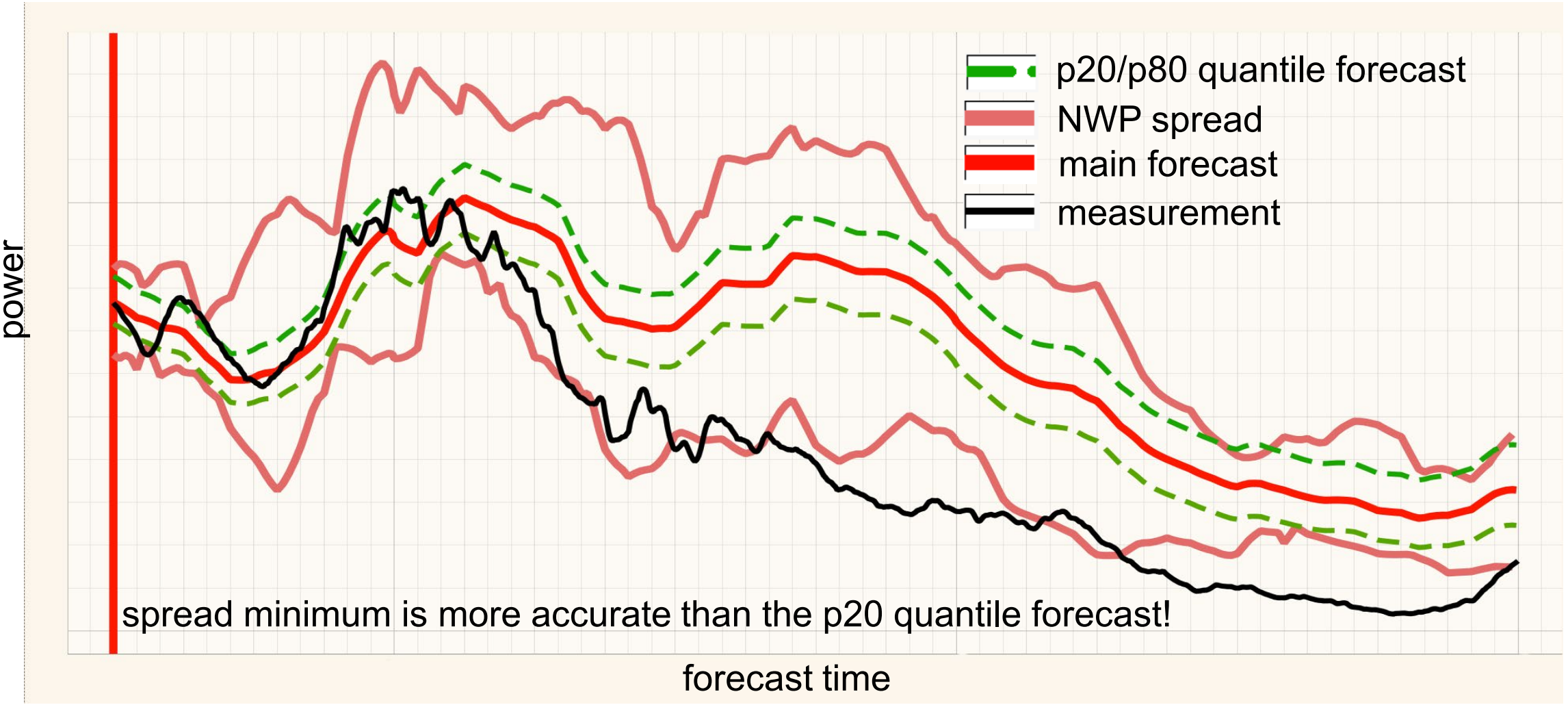
3 Spreads vs Quantiles

Spreads vs. Quantiles

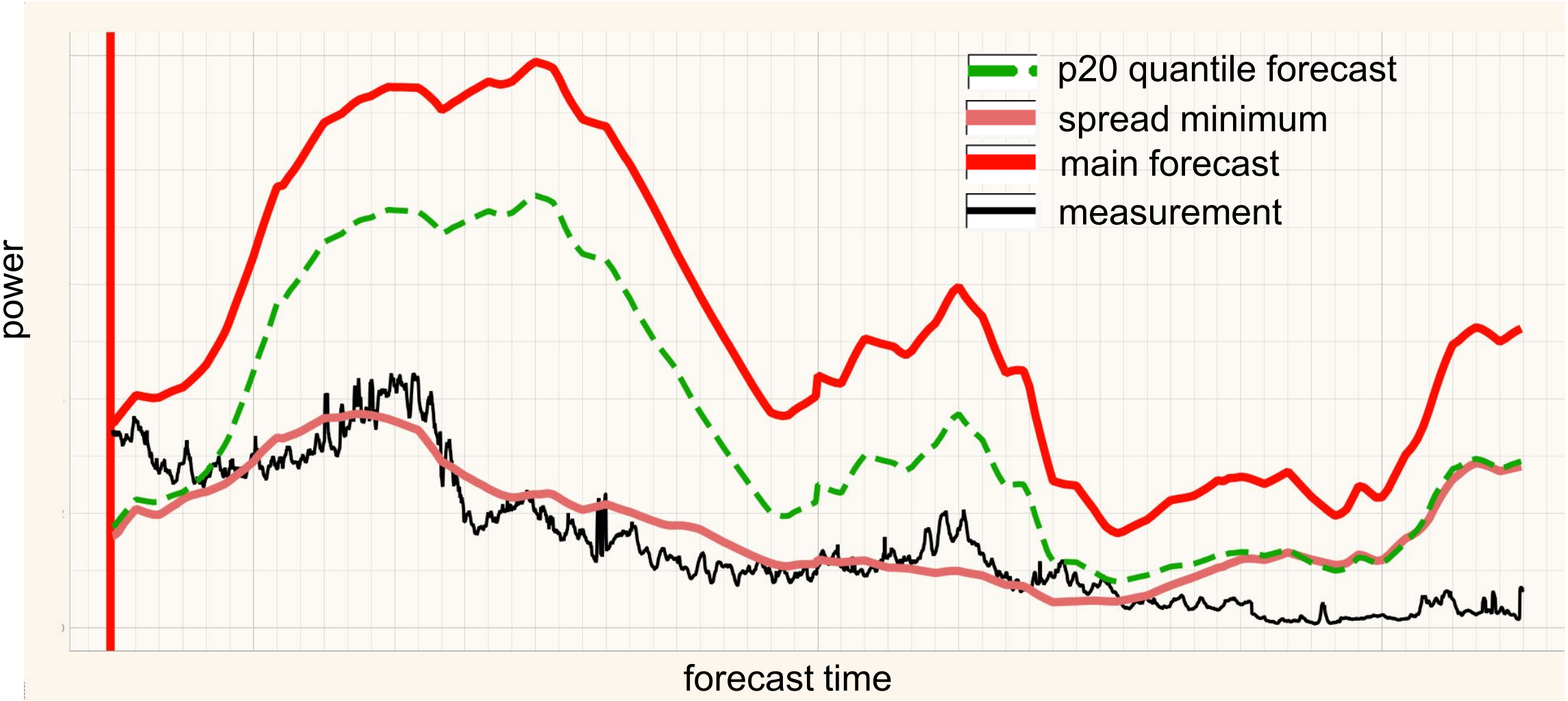
- Quantile forecast
  - Based on average historical forecast error, i.e. observed deviations
  - Advantage: Well-defined probabilities (e.g. p80, p20)
  - Disadvantage: Weak dependence on current weather situation - often fails during extreme weather situations
- Spread / scenario forecast
  - Based 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)

4 Examples

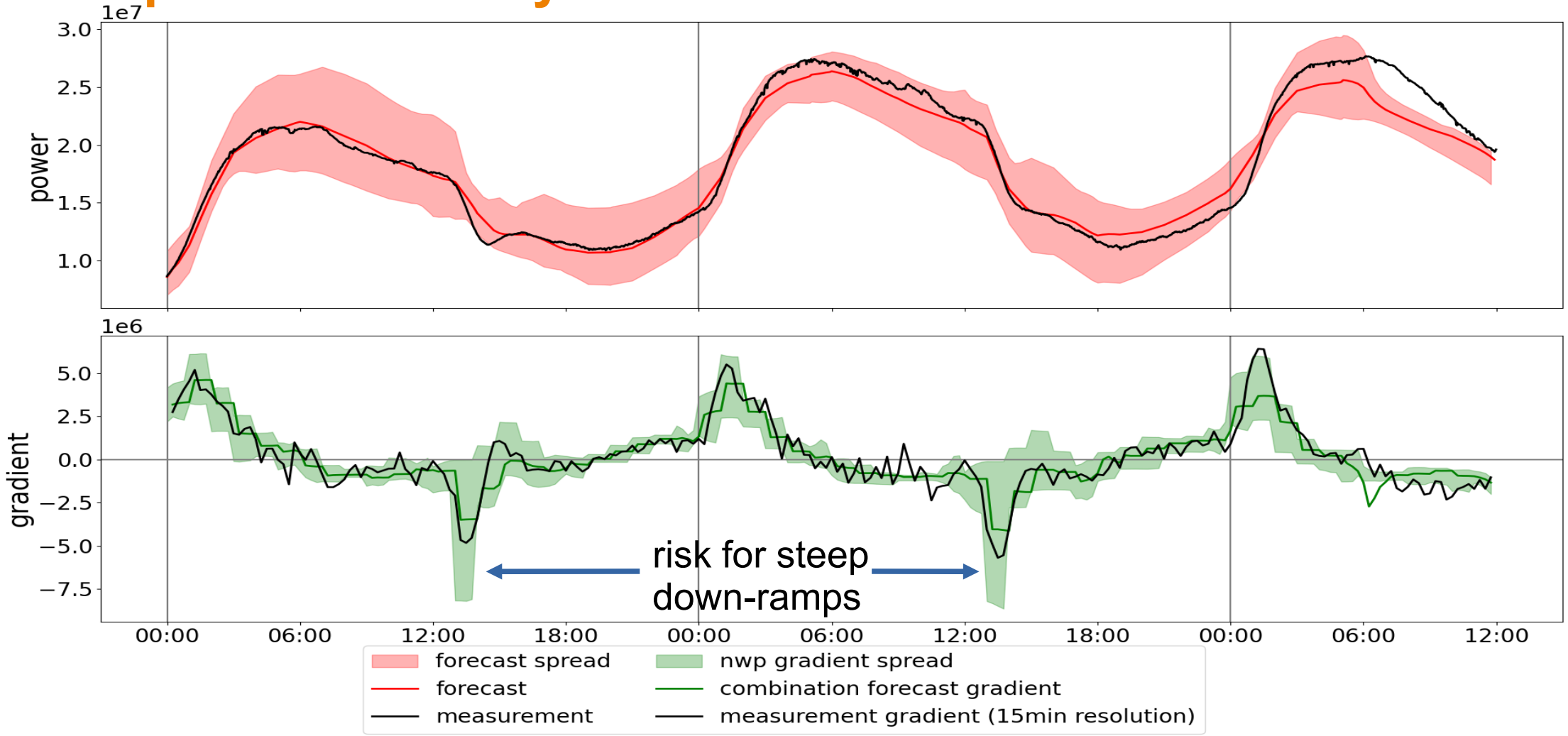
Example 1: Low pressure system over the Great Plains



Example 2: Major Icing Event



Example 3: Diurnal Cycle in Wind Power Production



5 Summary

Summary

- Spreads and gradient spreads are a scenario-based approach to adress 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, the 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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