Intercomparison of co-located Cosmic Ray Sensors

Martin Schrön, Steffen Zacharias, Peter Dietrich

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CENTRE FOR
ENVIRONMENTAL
RESEARCH – UFZ

Experimental Setup

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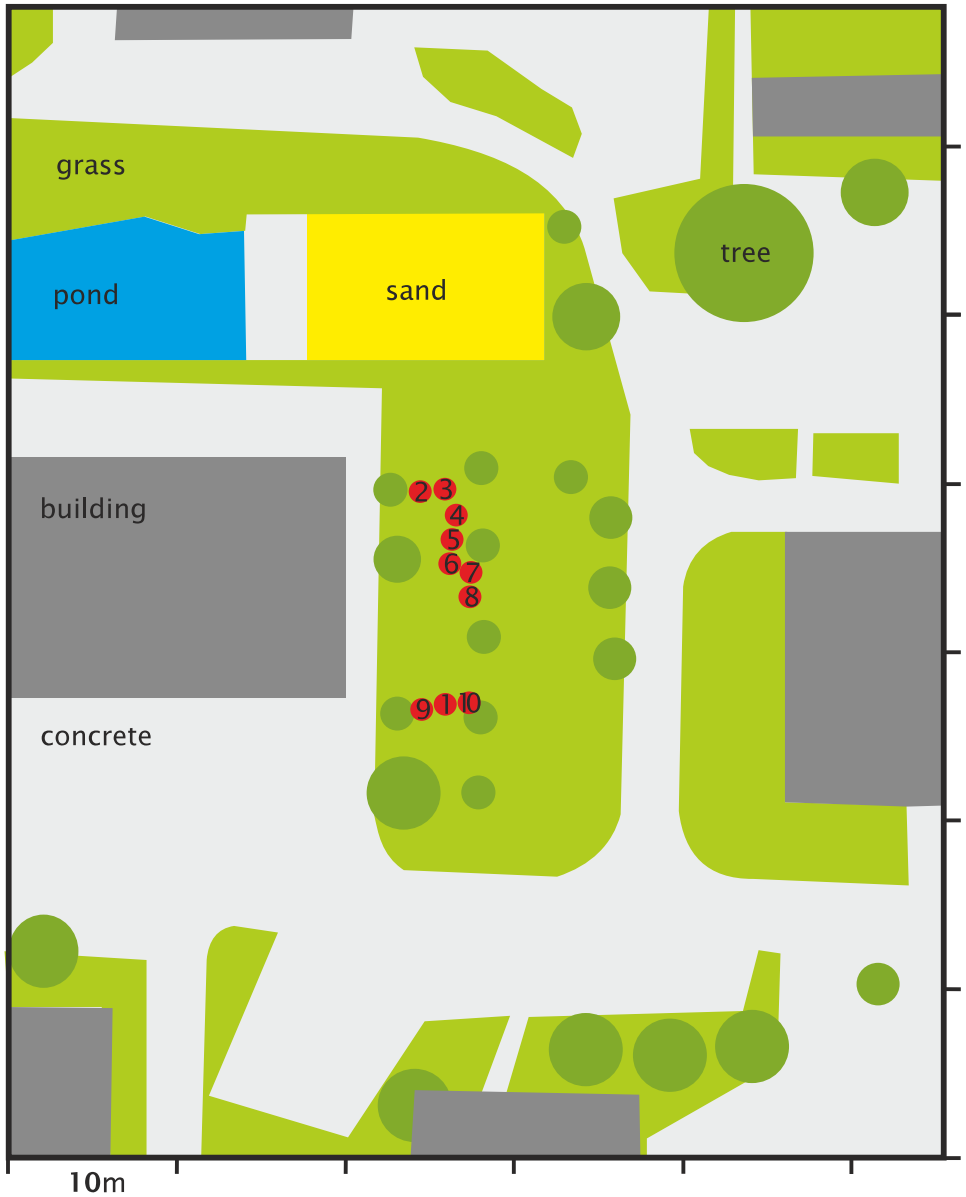

Urban Footprint

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UFZ and beyond

Neutron Signal in Detail

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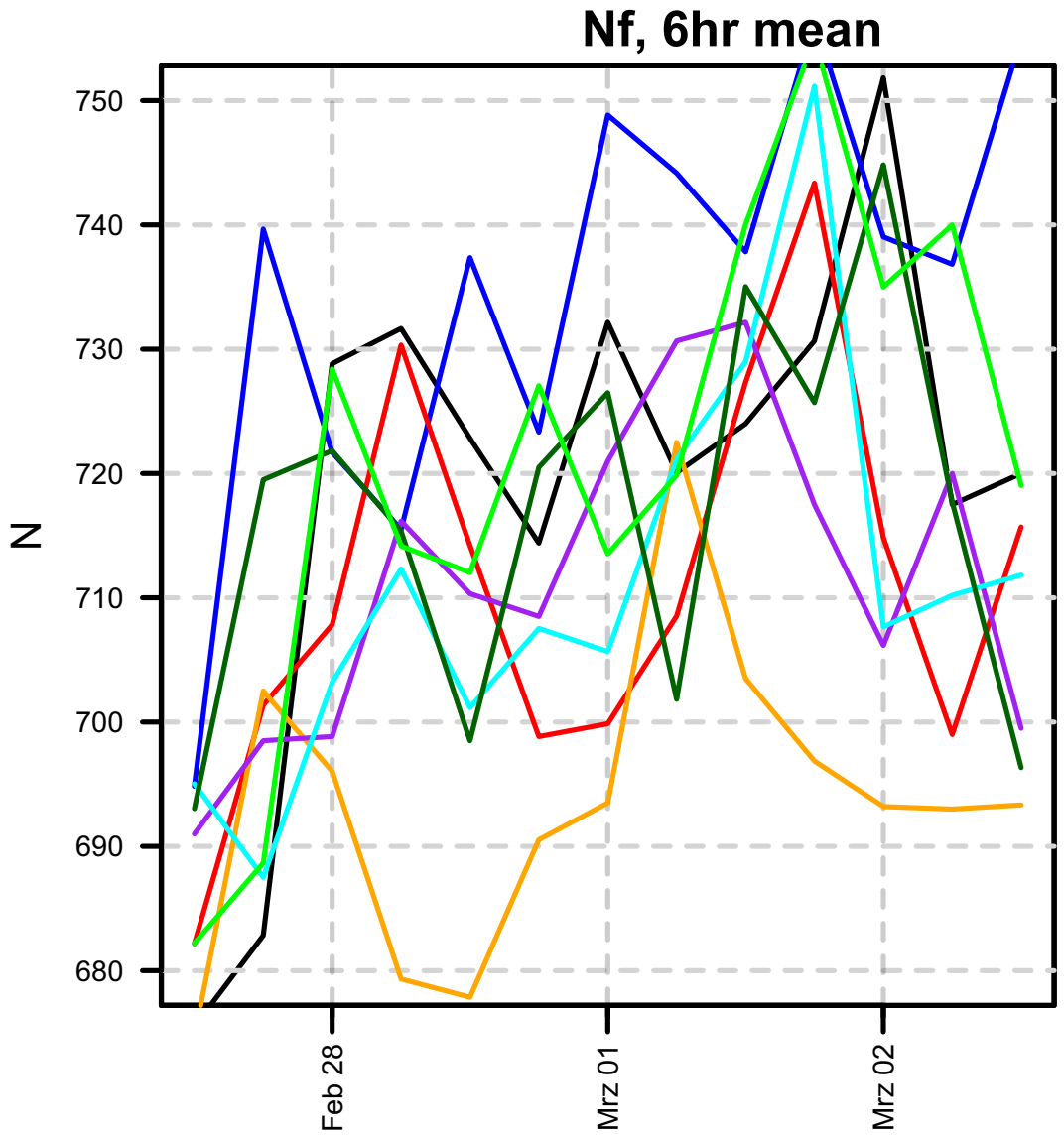
Observations:

- Variations independent of NM or water content
- Shift between sensors



Neutron Signal

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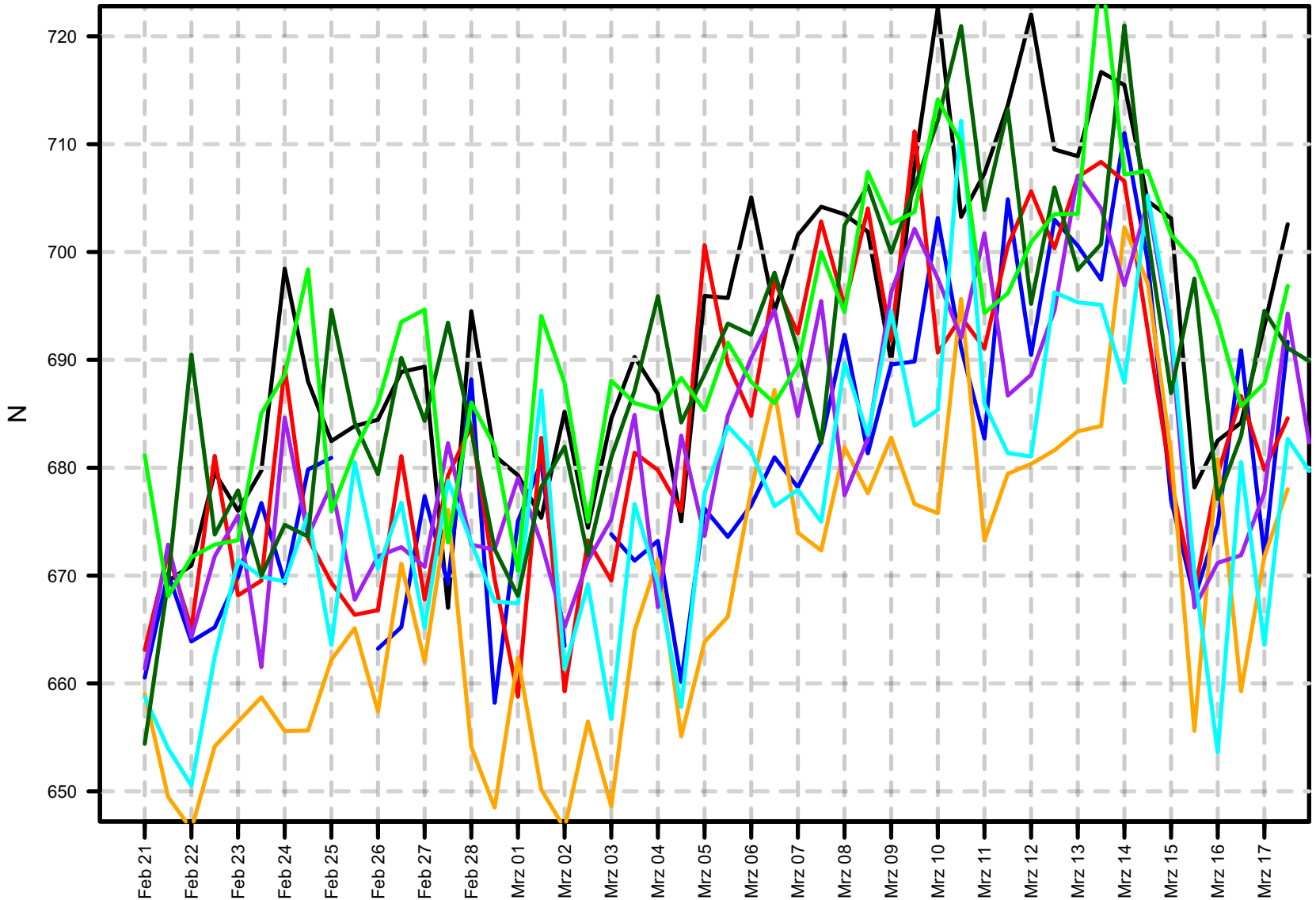
Nfphi, 12hr mean



Neutron Signal

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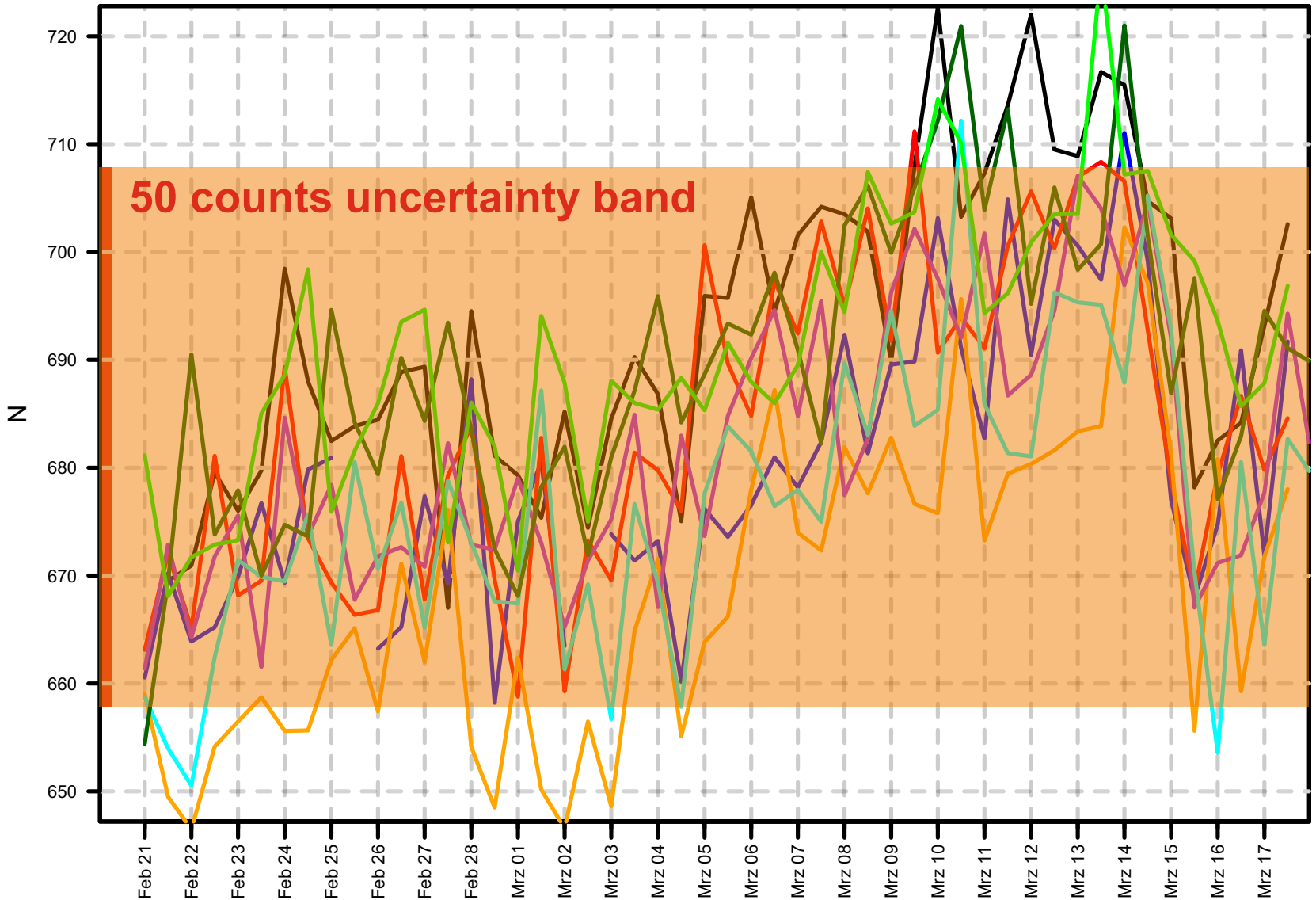
Statistical Nature



Pressure Sensor

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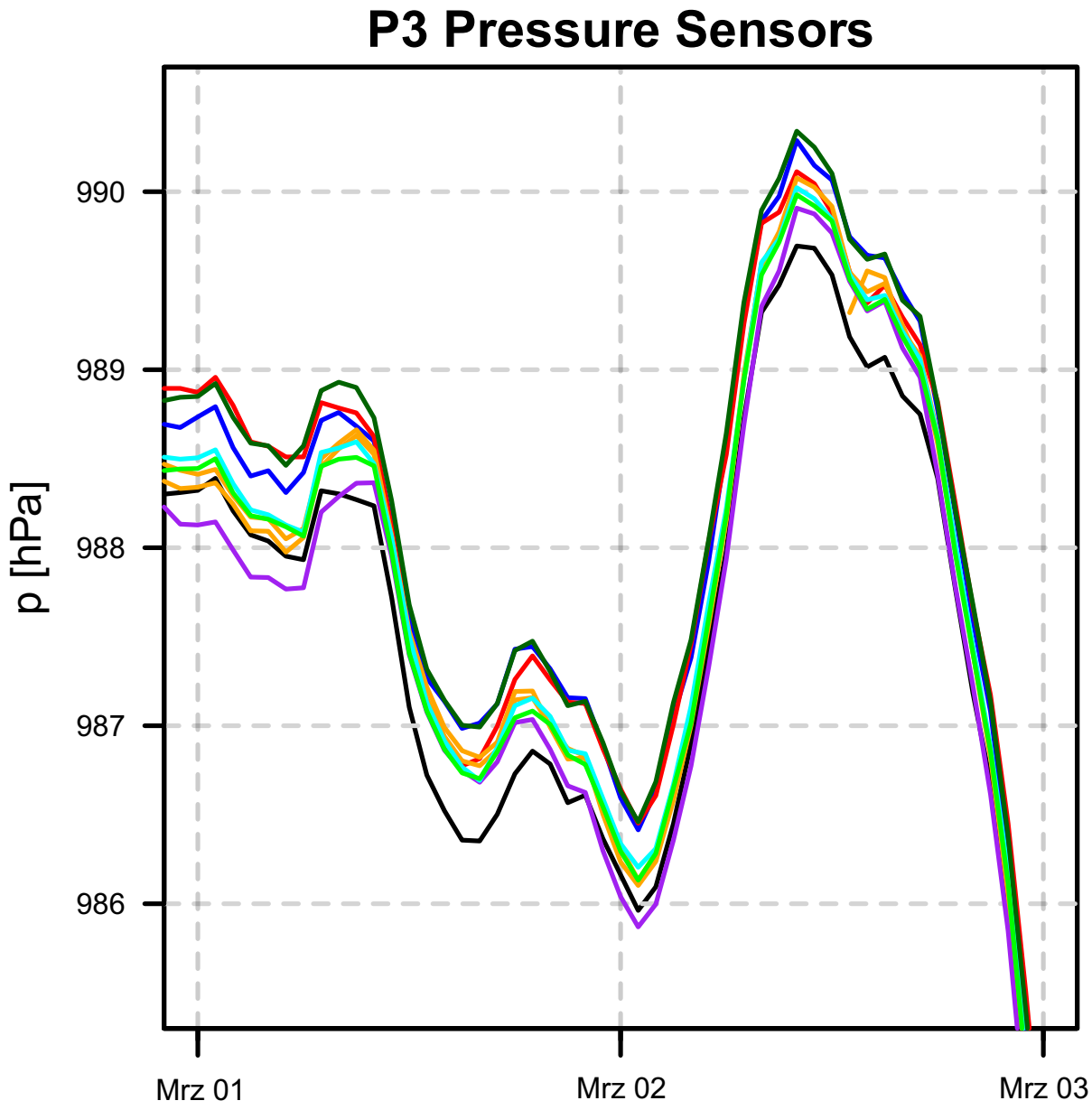
Individual Variation



within 1mbar
(0.1%) accuracy

Sensor Permutation

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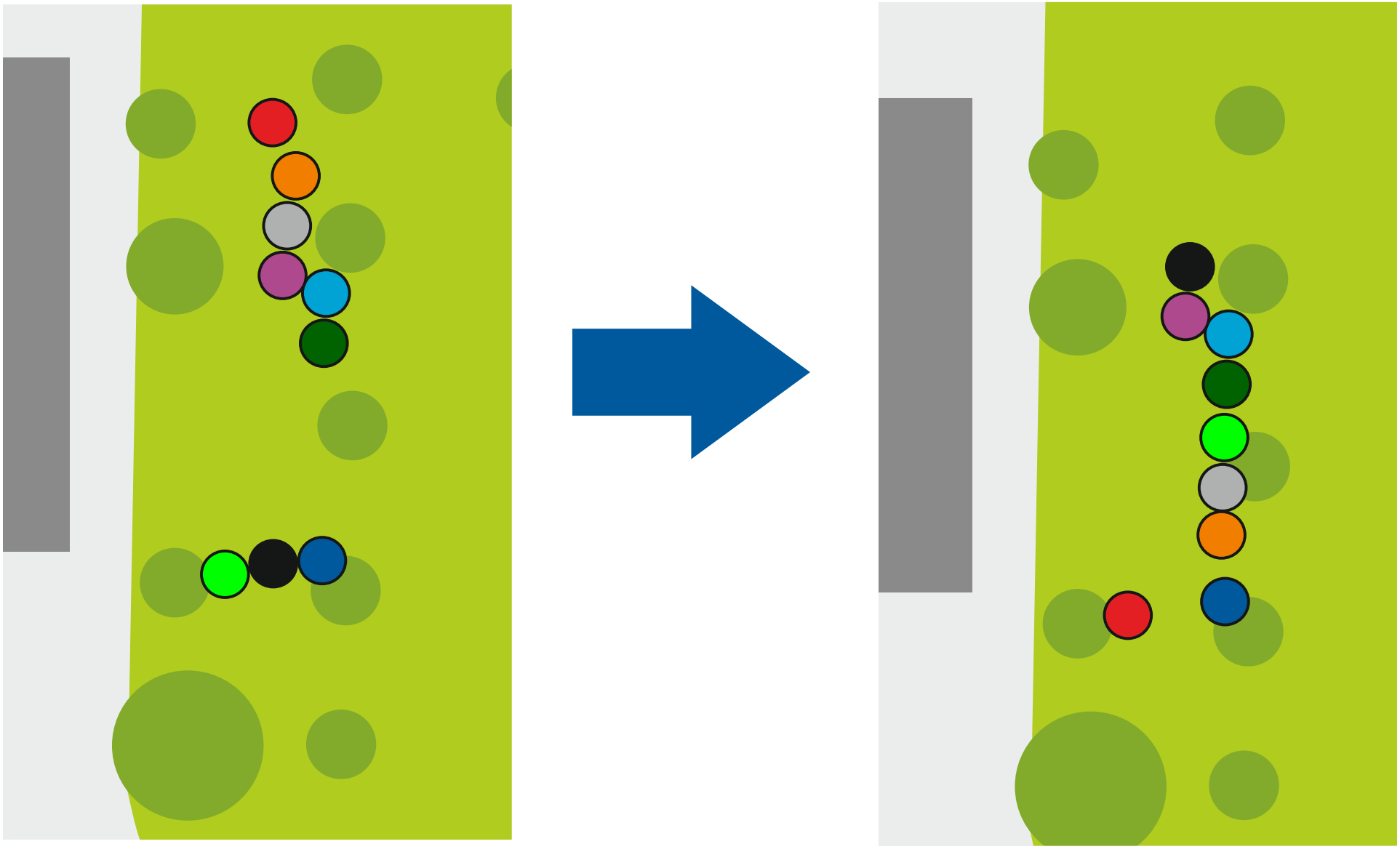

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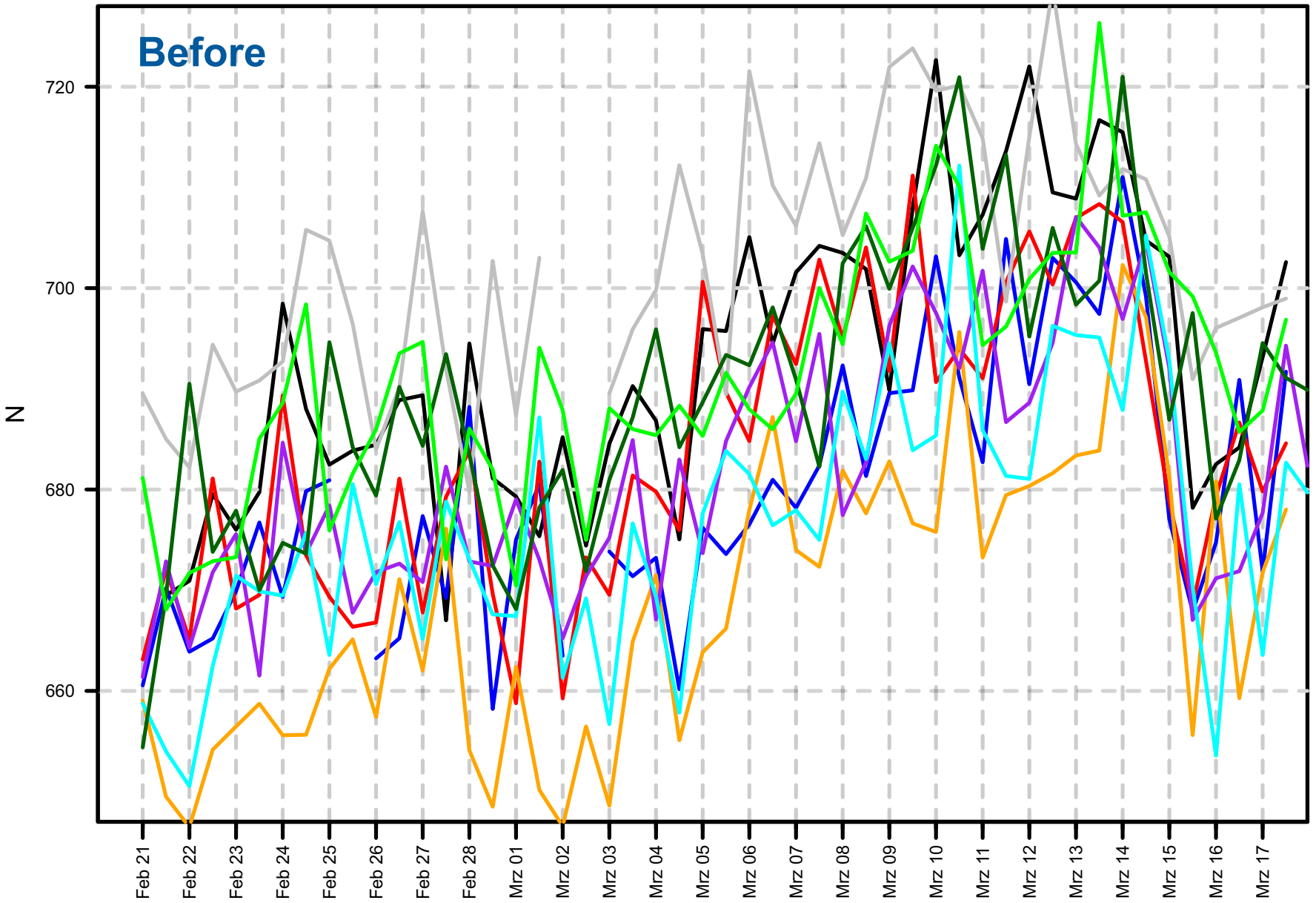

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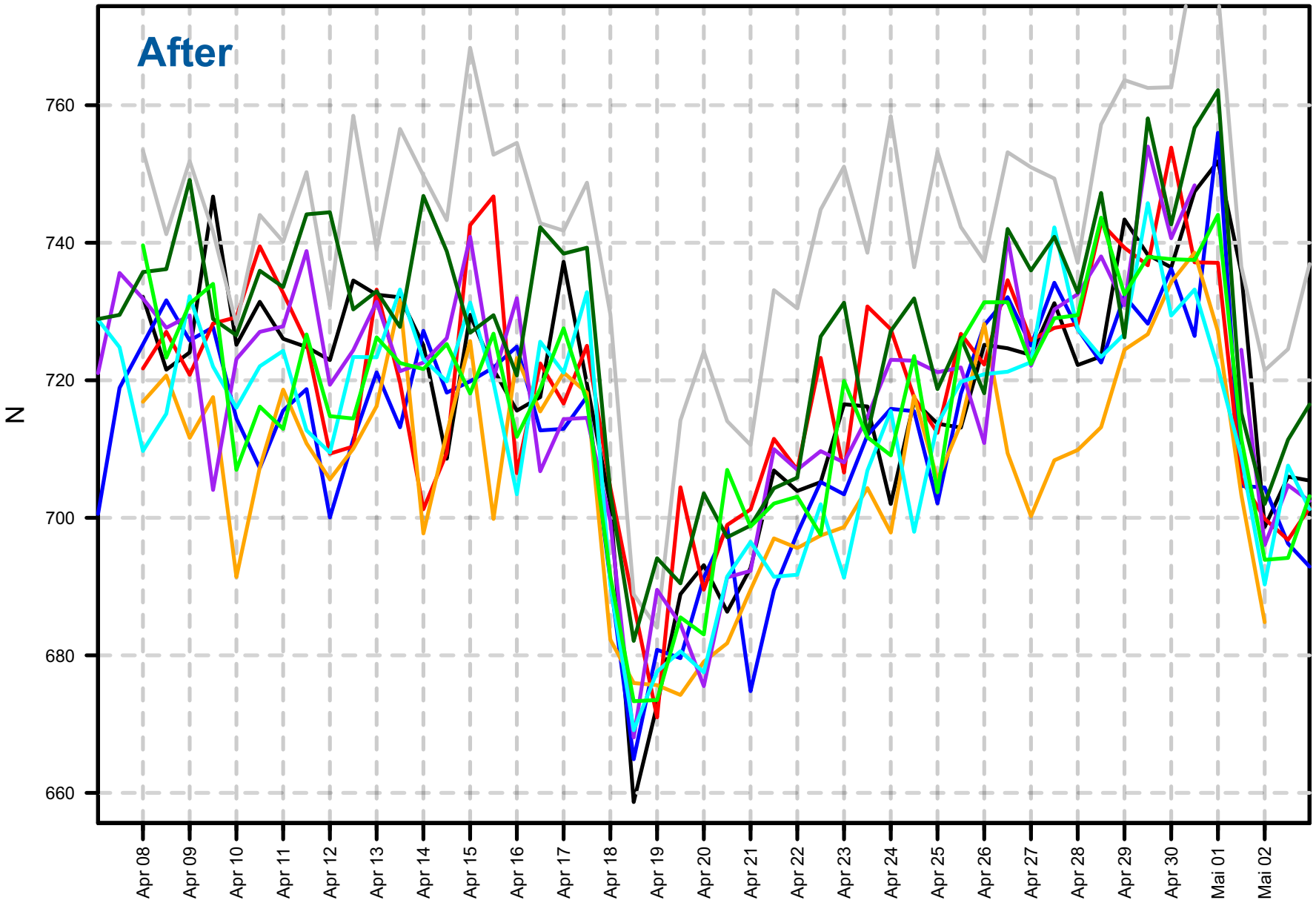

Sensor Permutation

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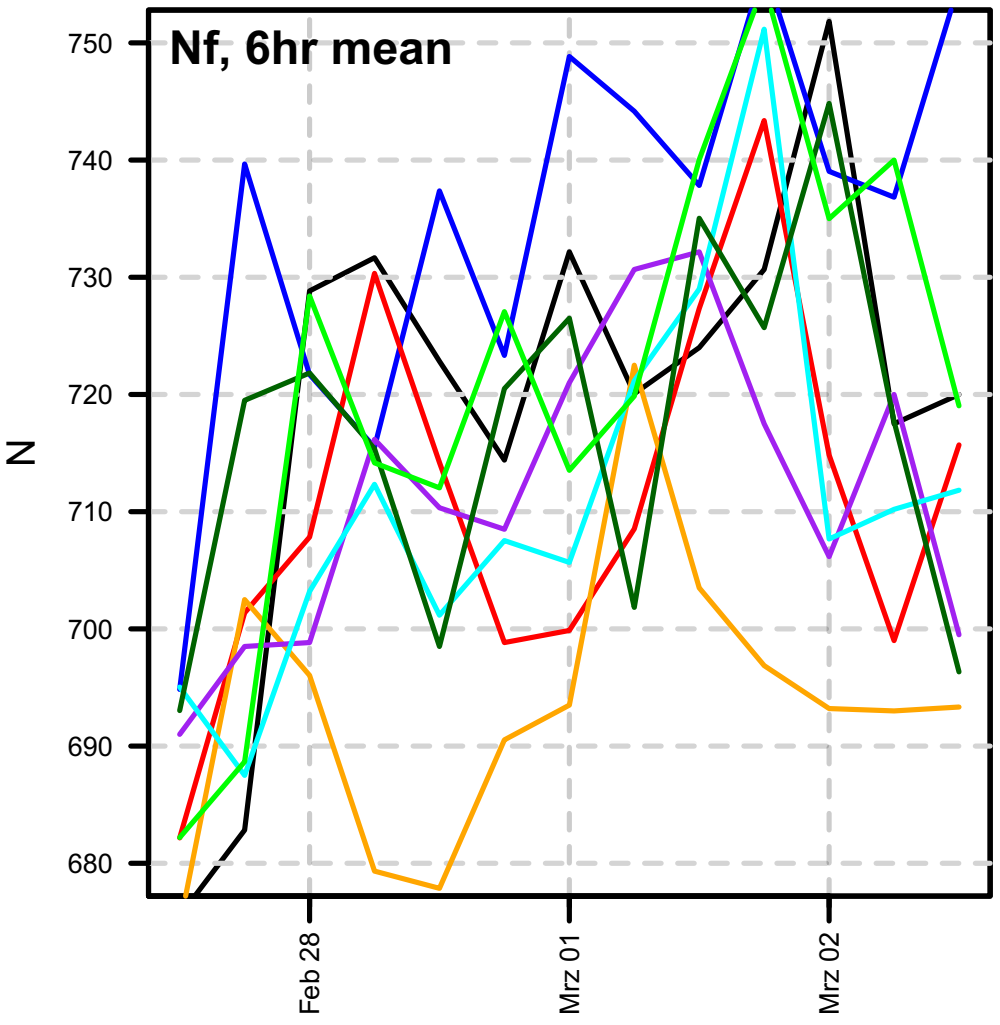
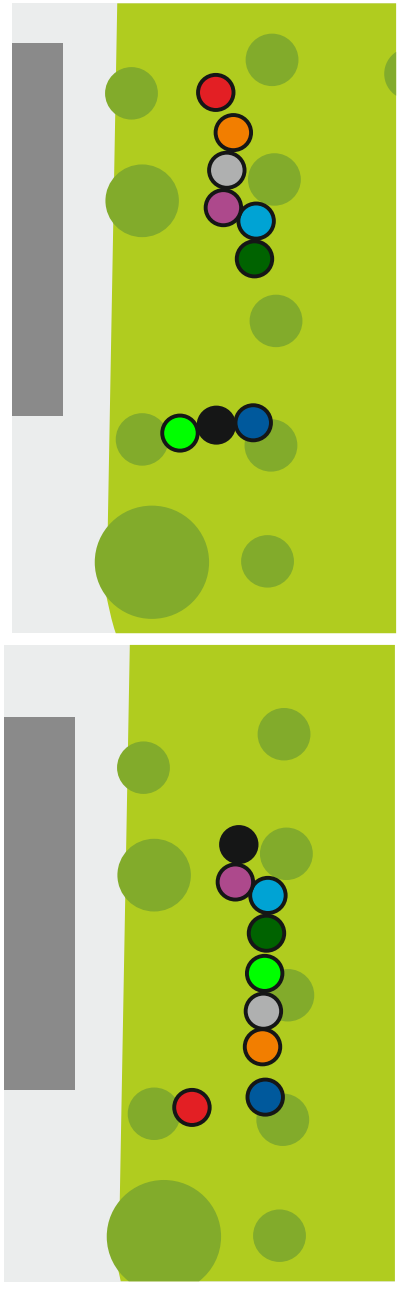
Spearman Rank Correlation

„probability of occupying a rank“





Sensor Permutation

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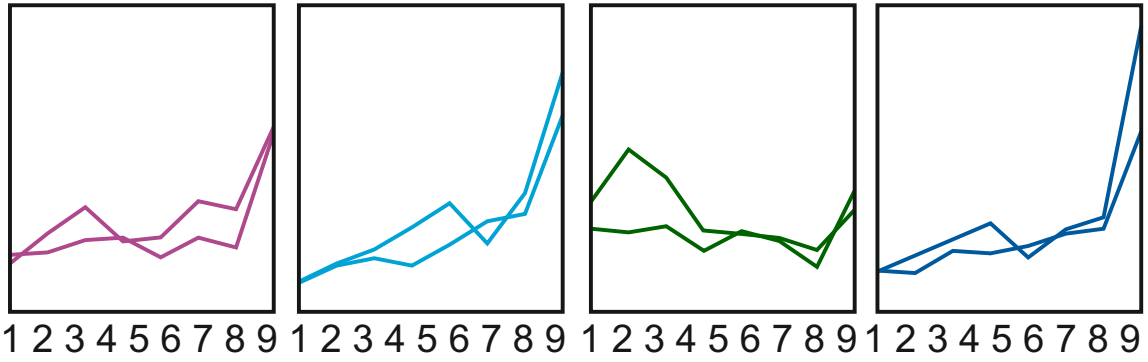
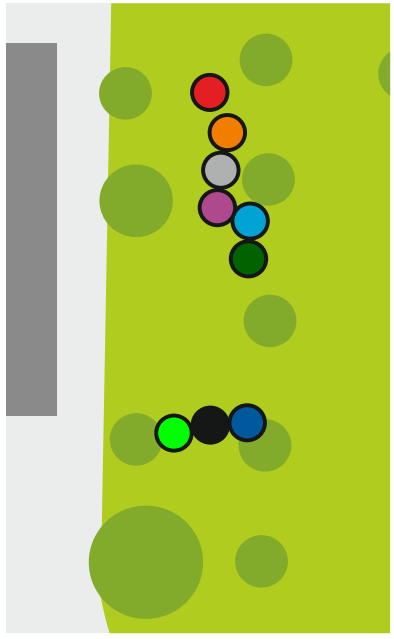
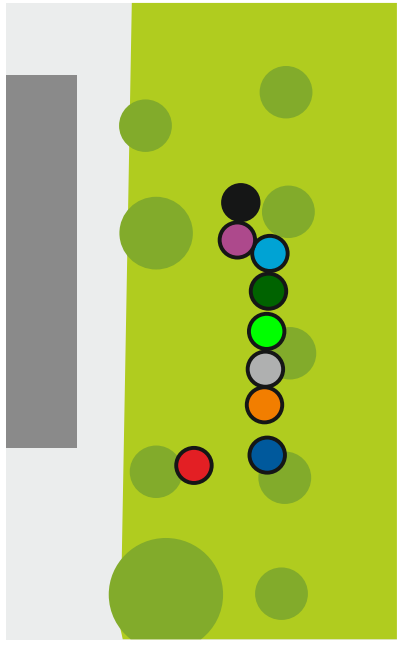
Spearsman Rank Correlation

„probability of occupying a rank“

position not changed







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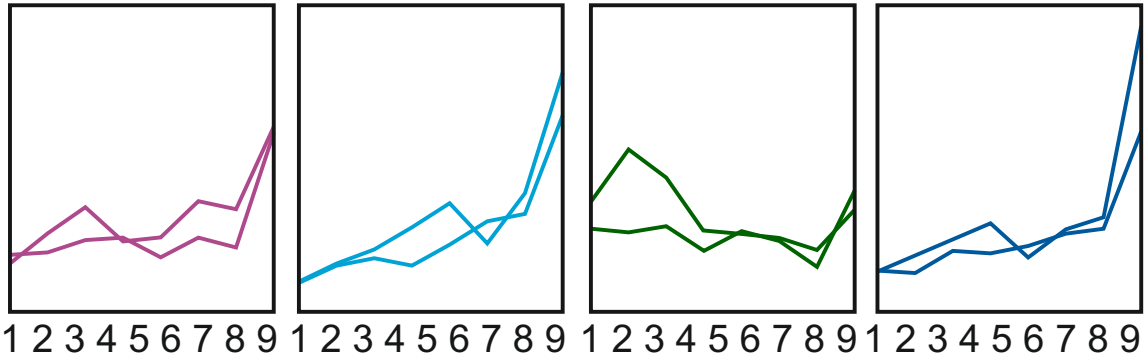
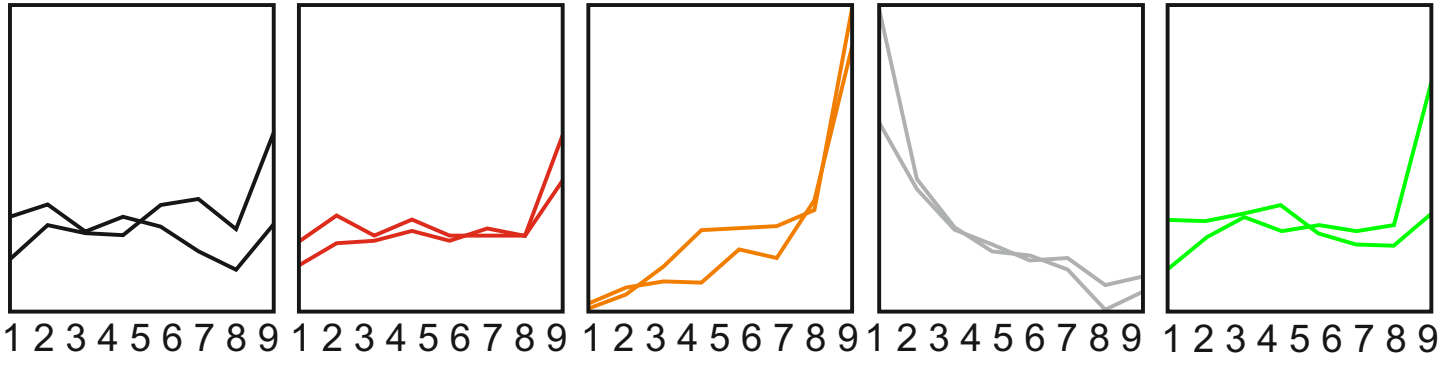
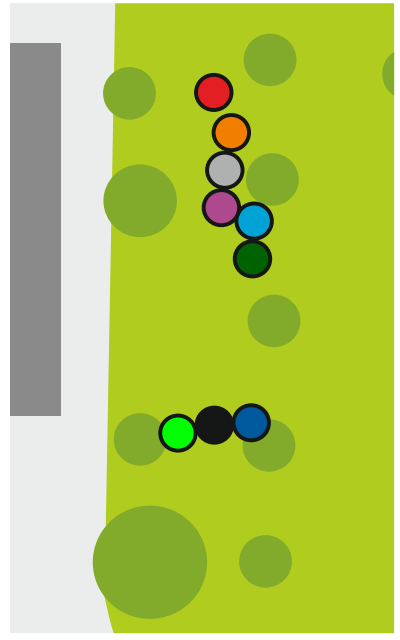
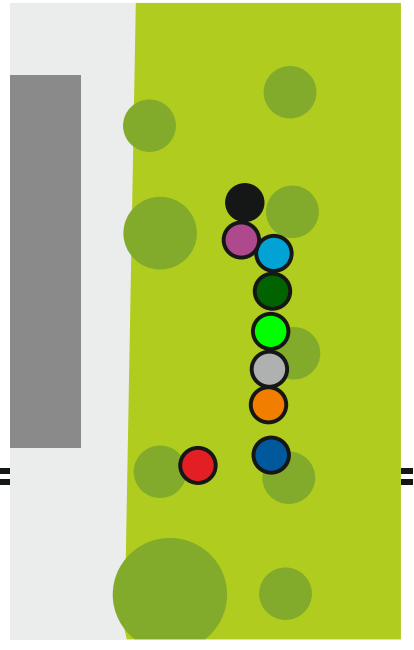


position changed







Individual ranking is independent of position

Pulse Height Spectra

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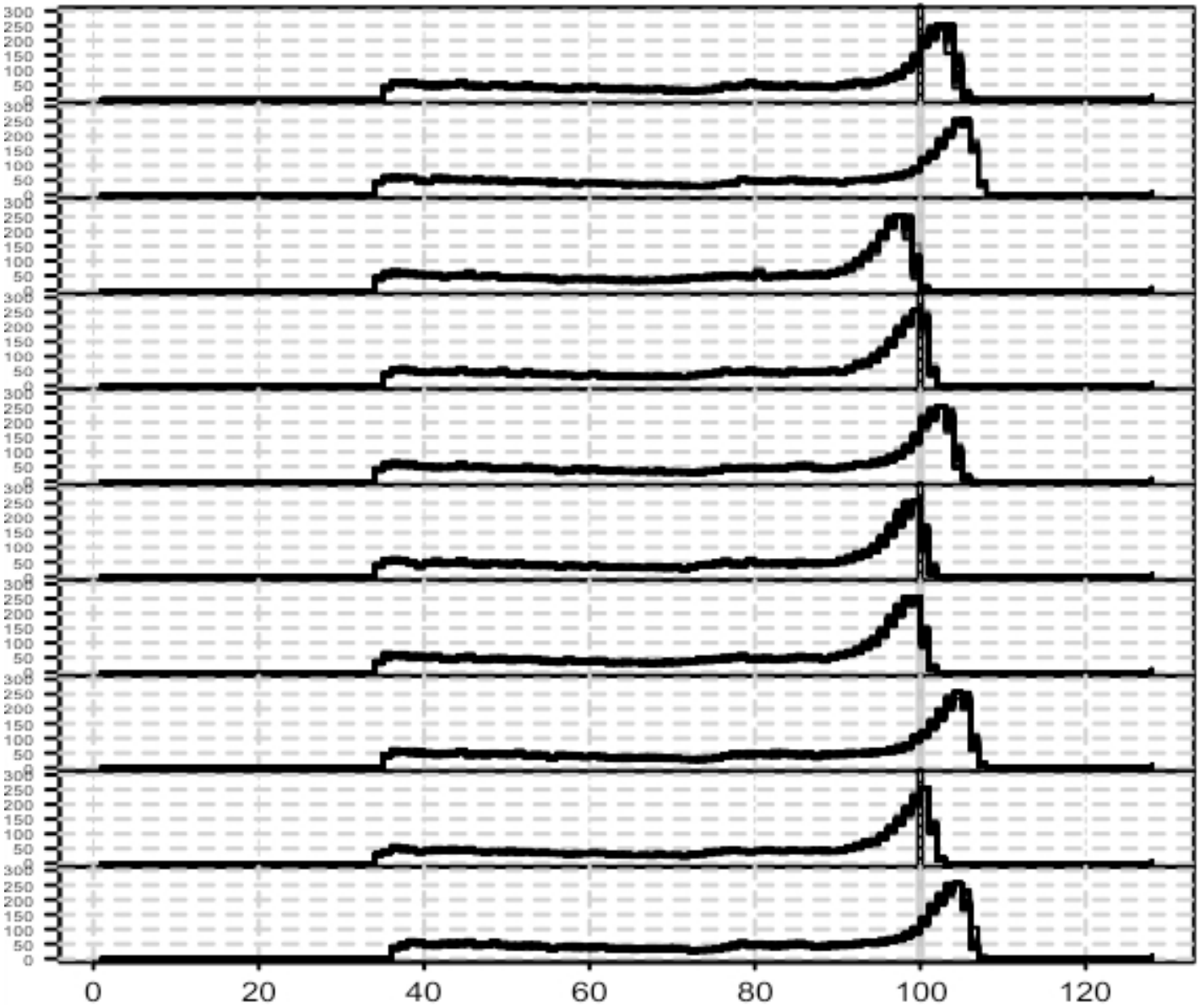
„Current produced during detection of a neutron“



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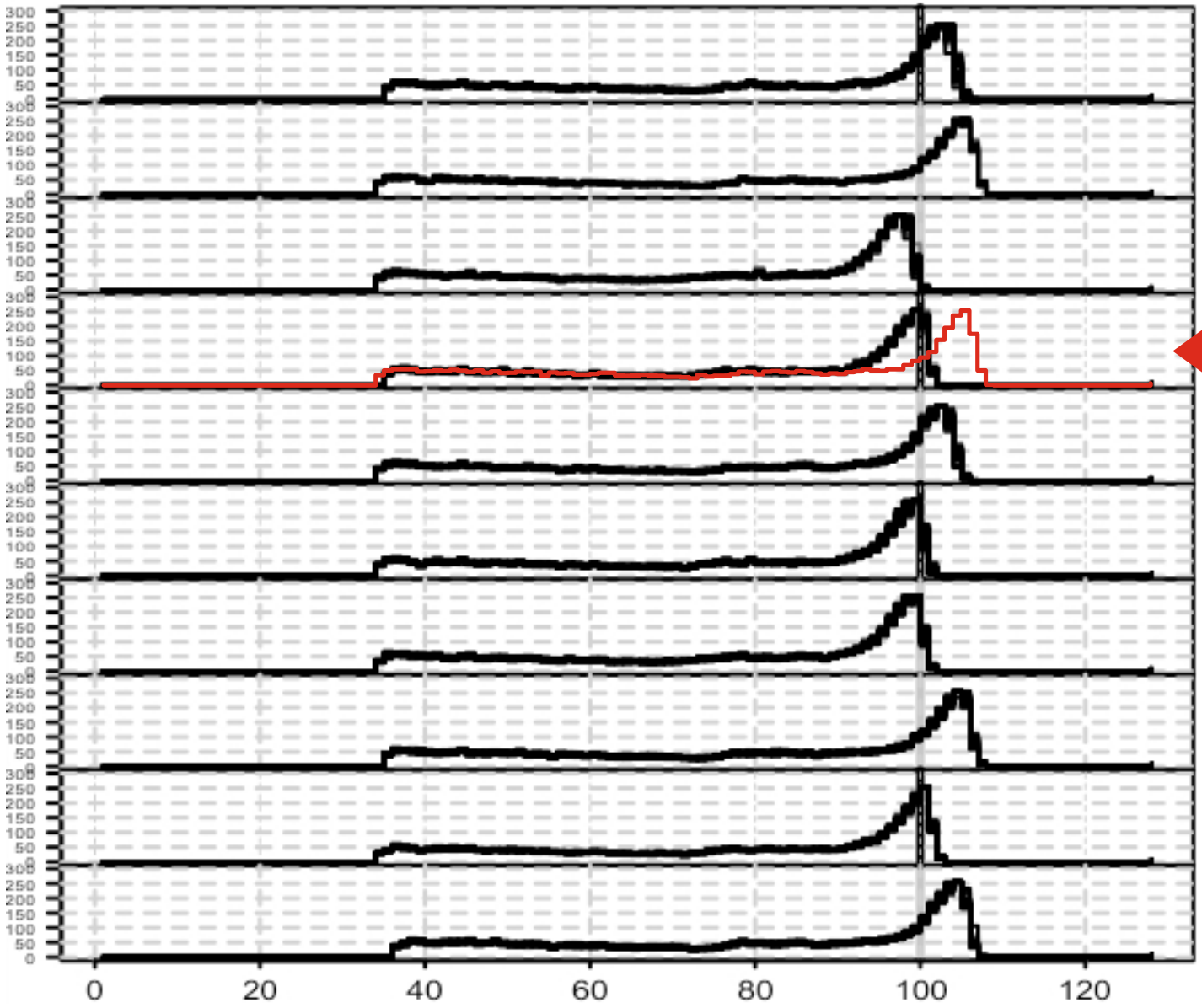

another NPM (Pulse Module), another spectrum

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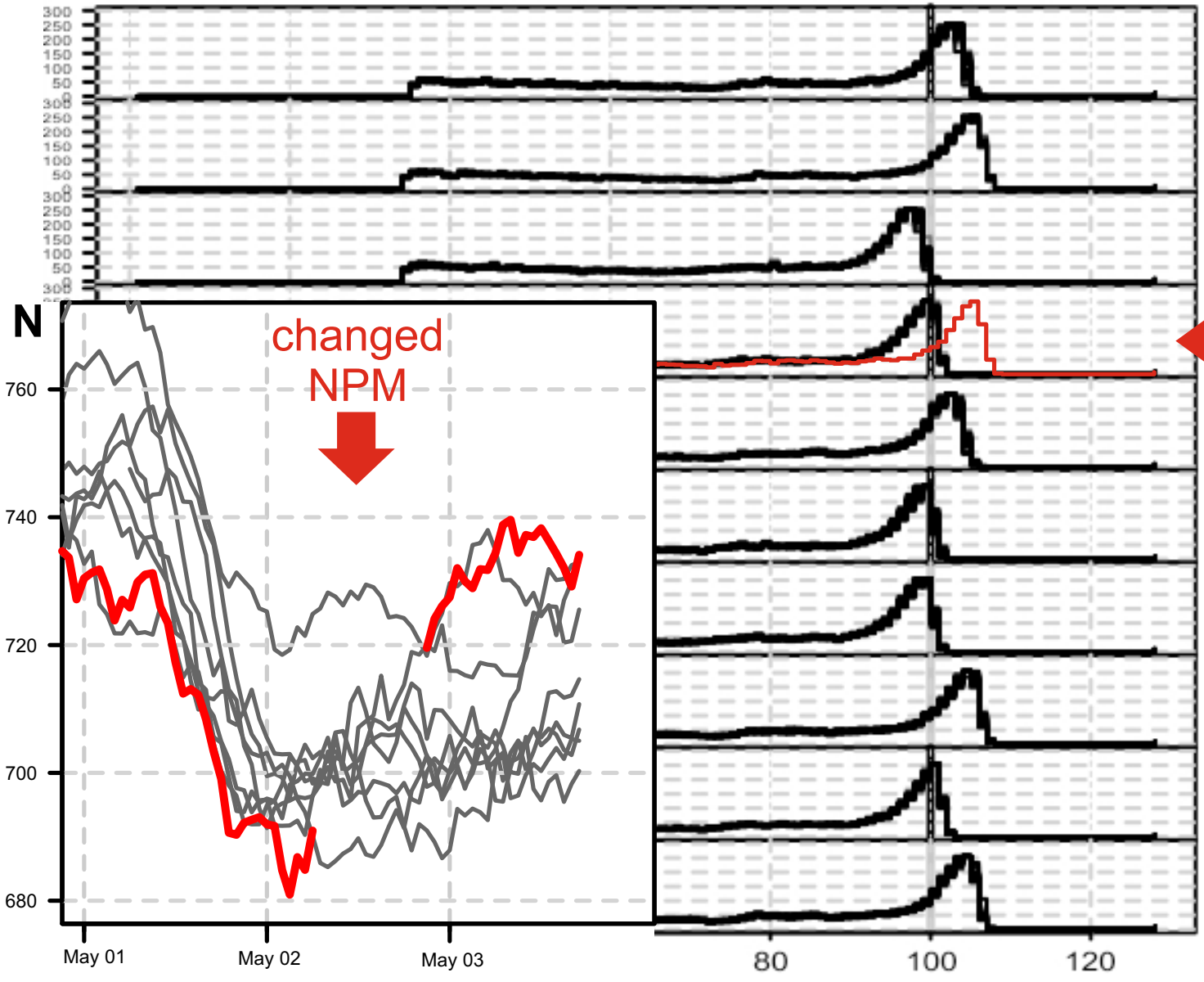

another NPM (Pulse Module), another spectrum

Probes with same PHS

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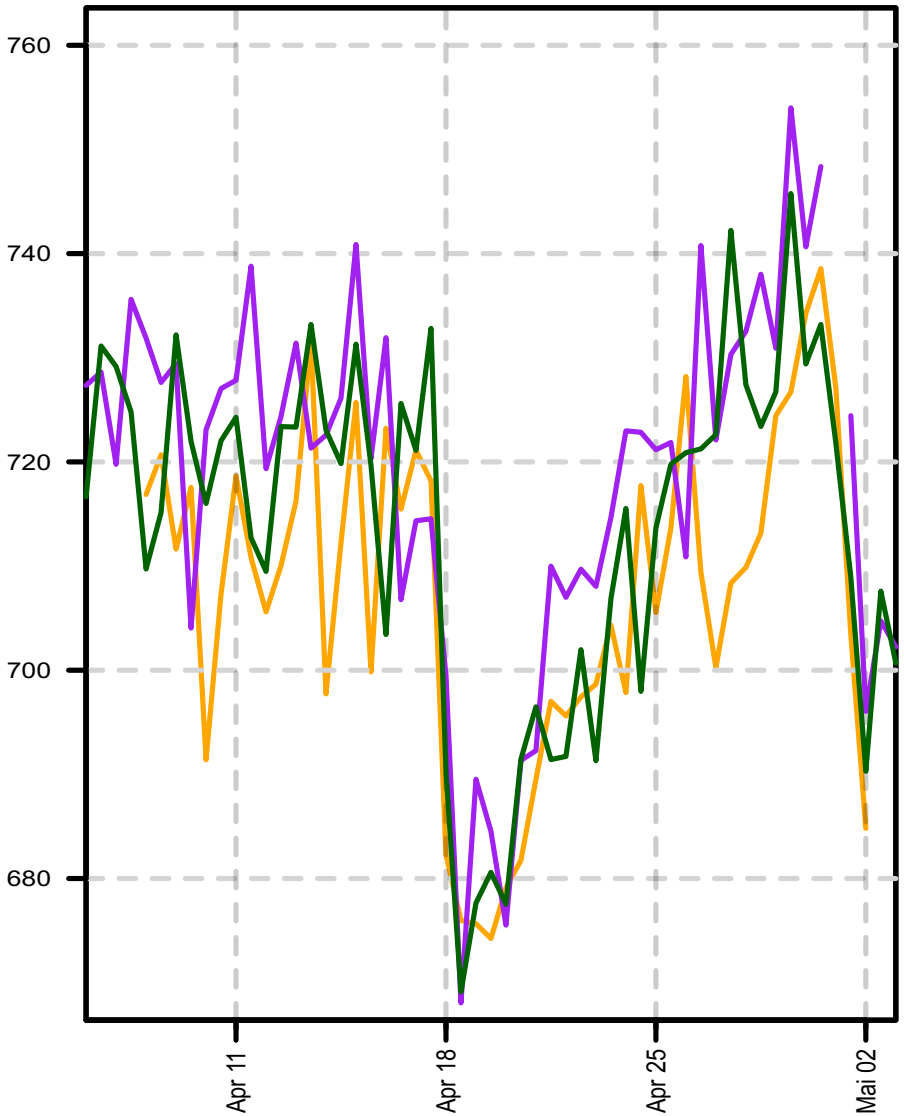
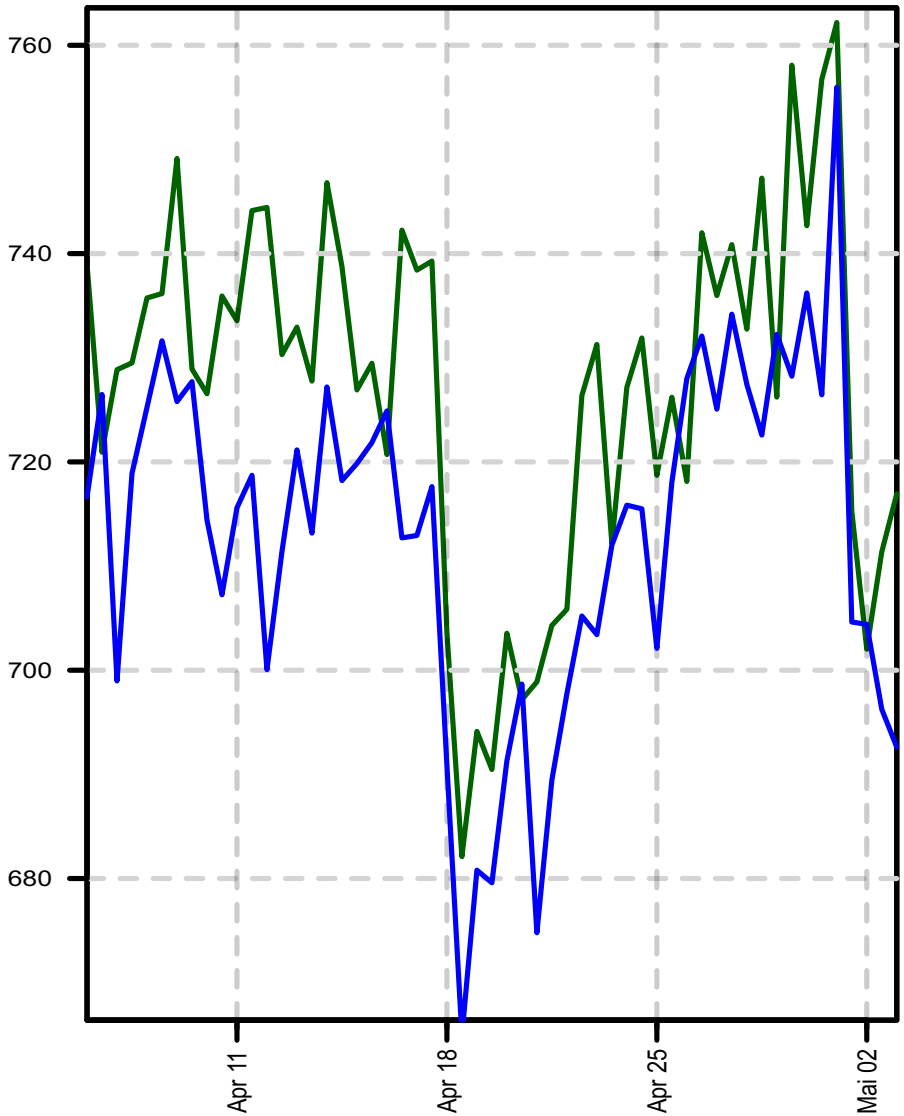
...still behave differently





Correlation

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How well do probes correlate regarding integration time?

Correlation

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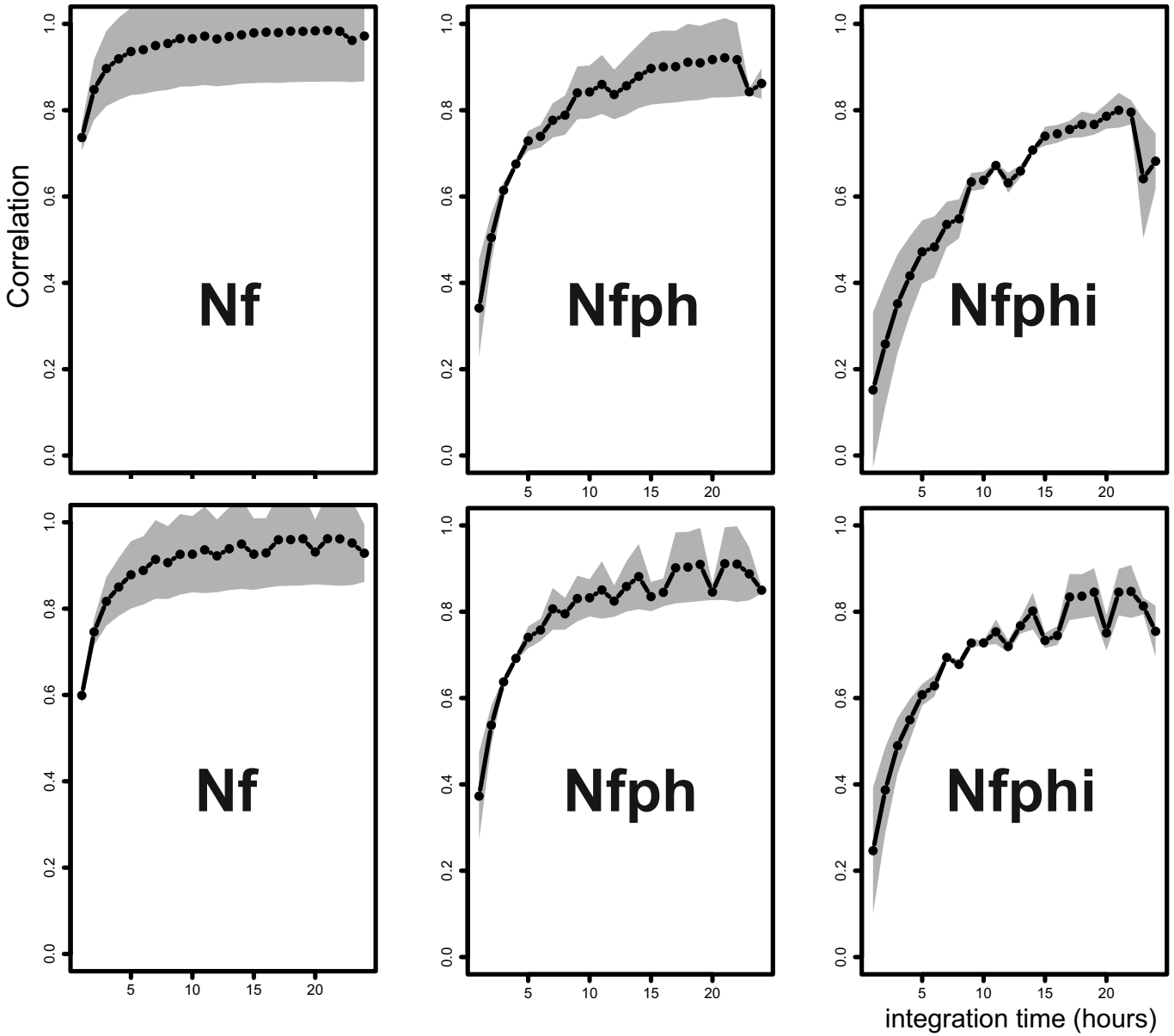

After correction the correlation between probes weakens.

Correlation

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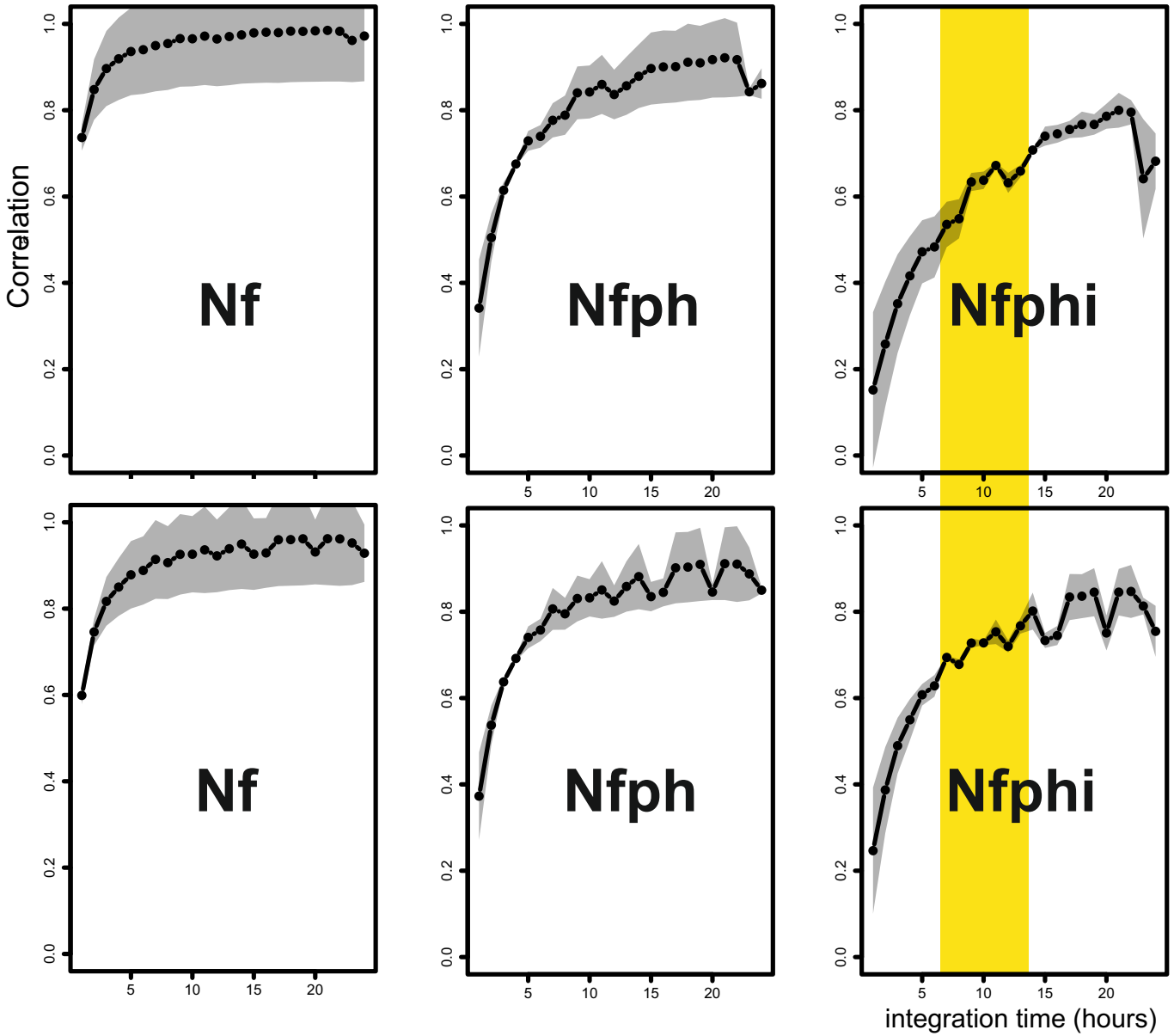
How well do probes correlate regarding integration time?

Feb/Mar

April



After correction the correlation between probes weakens.

High correlation and low deviation for 12h

Integration Time

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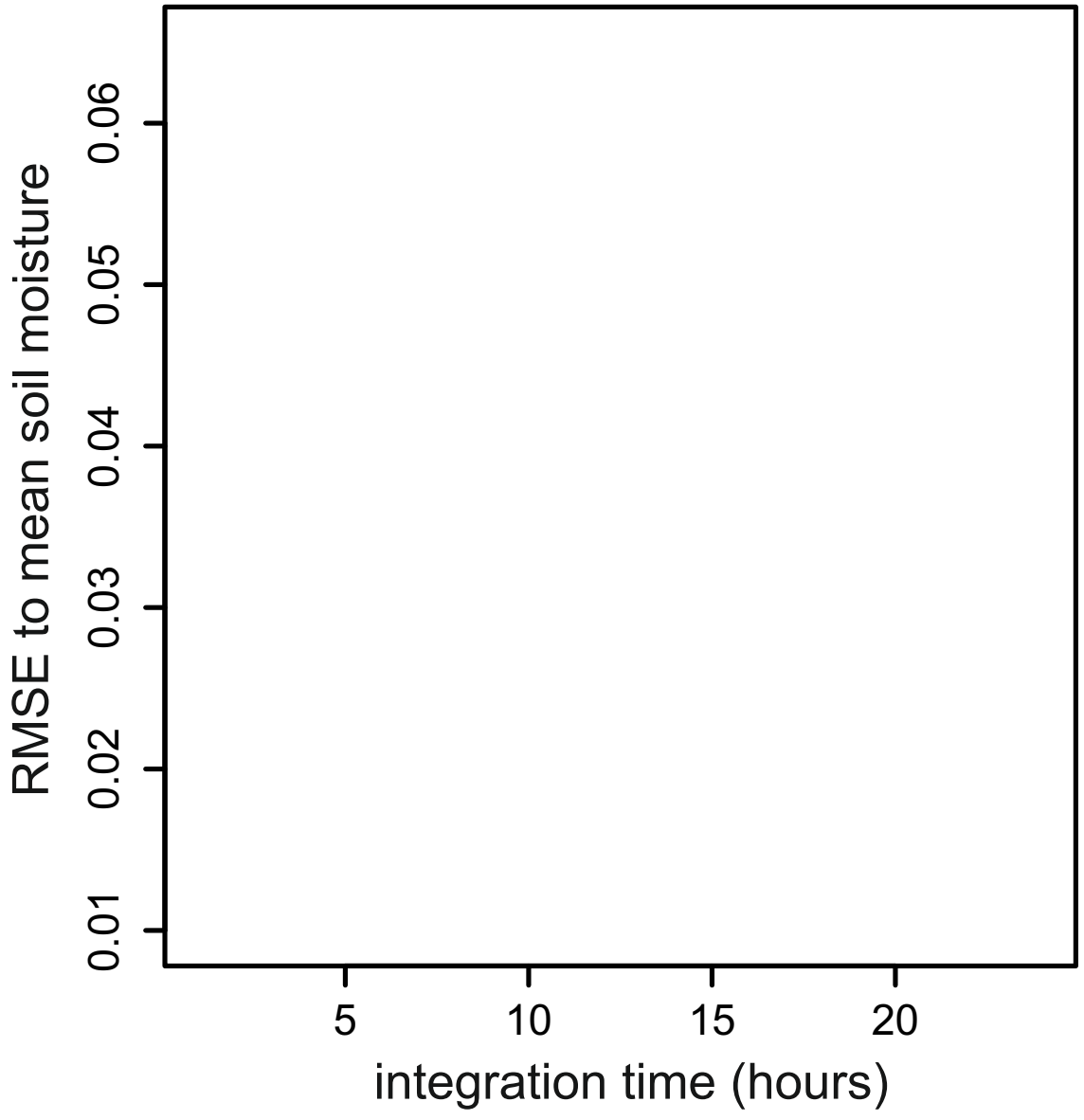
effect on soil moisture prediction

$SM_i = f(N_i, N_0)$ ⇨



Integration Time

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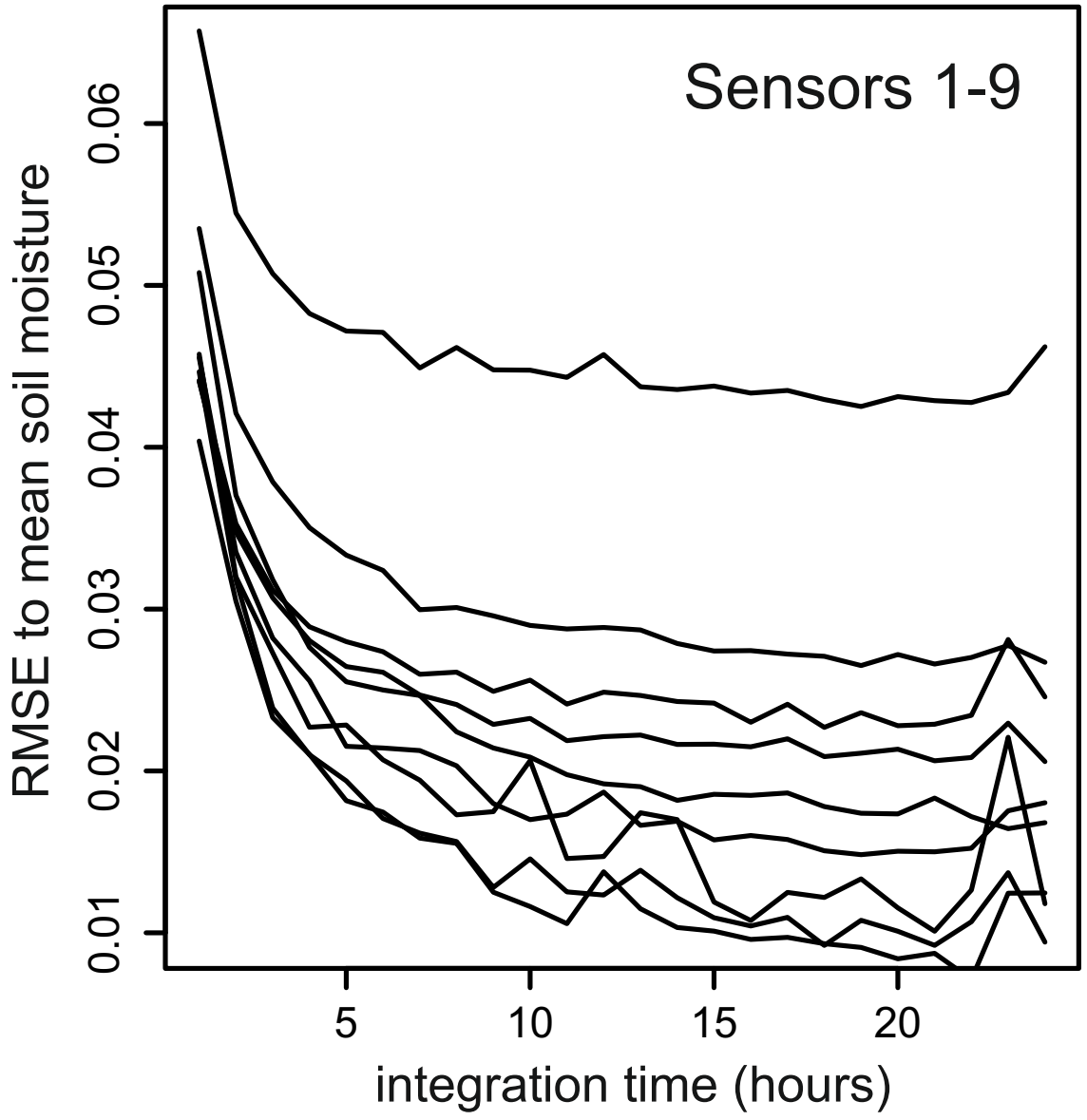

Integration Time

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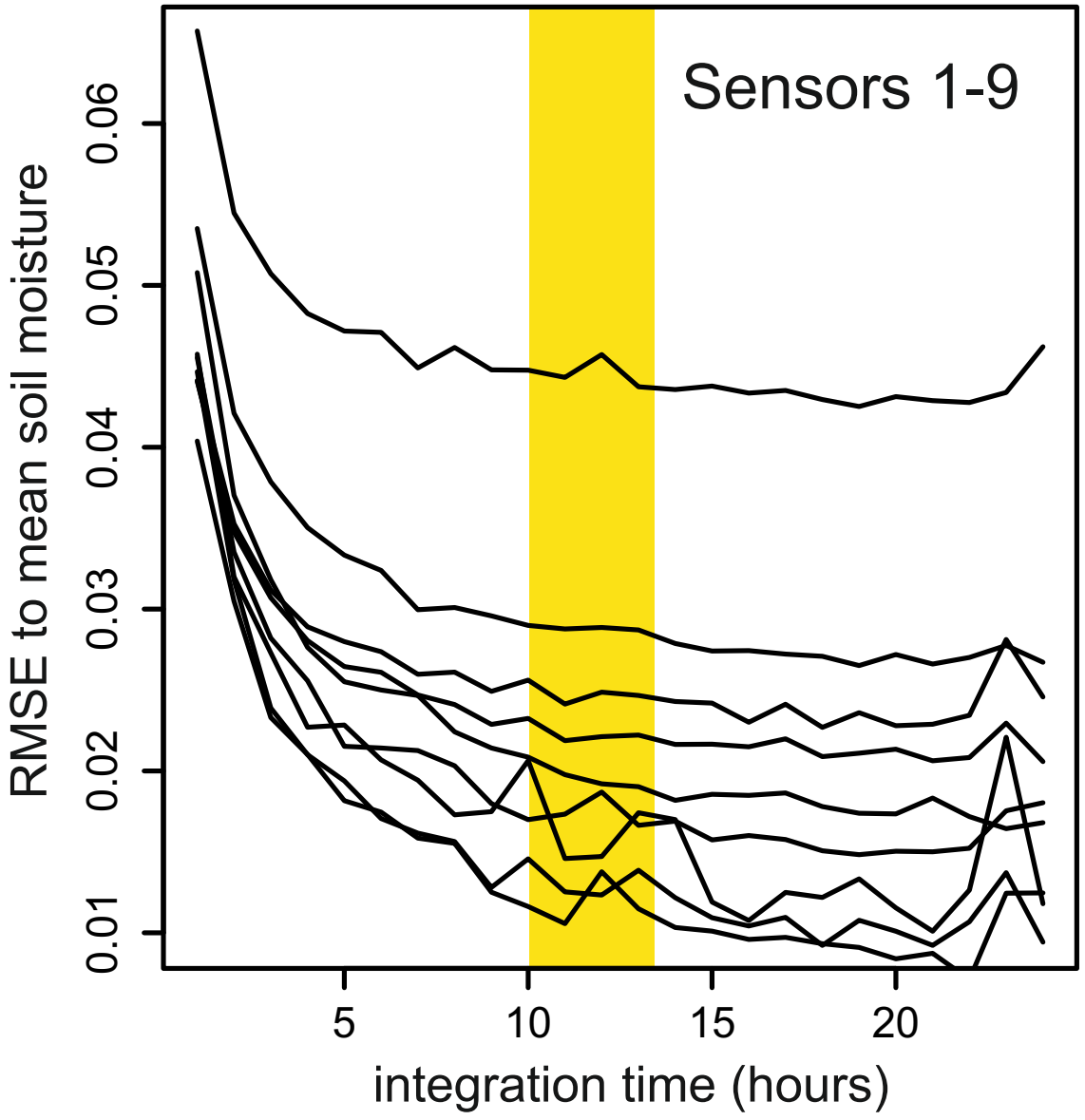
effect on soil moisture prediction

$SM_i = f(N_i, N_0)$ ⇨

A sensor could fit real SM just by a proper integration time.

There is a shift, each sensor will measure a different N0 in the dry state.



Results

- **Every sensors has its individual count rate**

  Conclusion:
  - Pulse height spectra should be calibrated, but still unknown factors out there...
  - N_0 calibration is sensor-specific!

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- **Every sensors has its individual count rate**

  Conclusion:
  - Pulse height spectra should be calibrated, but still unknown factors out there...
  - N_0 calibration is sensor-specific!

- **Probes correlate only for large integration times**

  Conclusion:
  - Short-term processes are hard to detect
  - In order to extract e.g. soil moisture signal, a single sensor is only reliable if integration time is large.