Training the TraP

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The Transients Pipeline (TraP):

Swinbank (2011)

The Transients Pipeline (TraP):
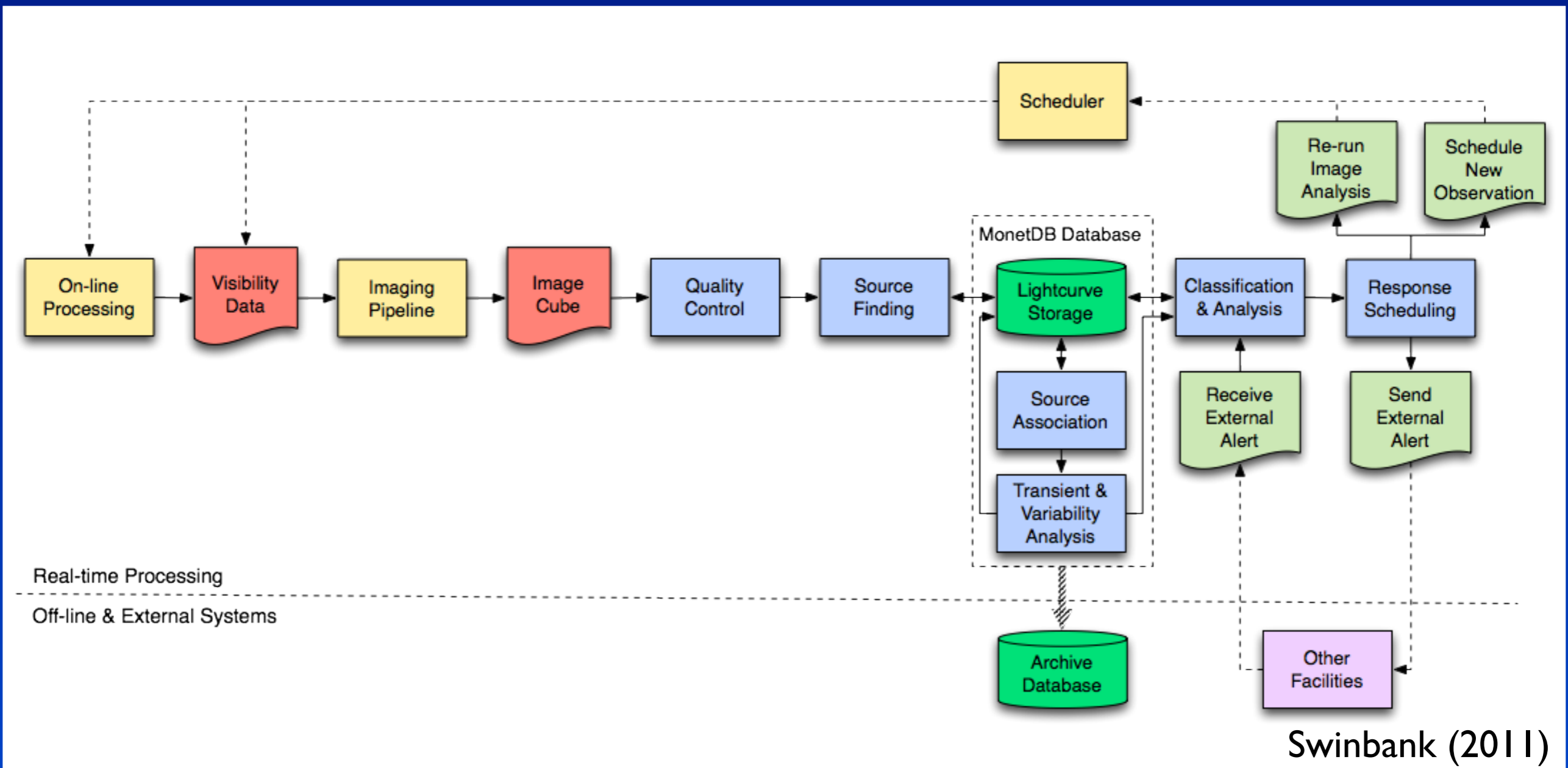
Swinbank (2011)

The Transients Pipeline (TraP):

See talk by A. van der Horst

Focus of this Talk
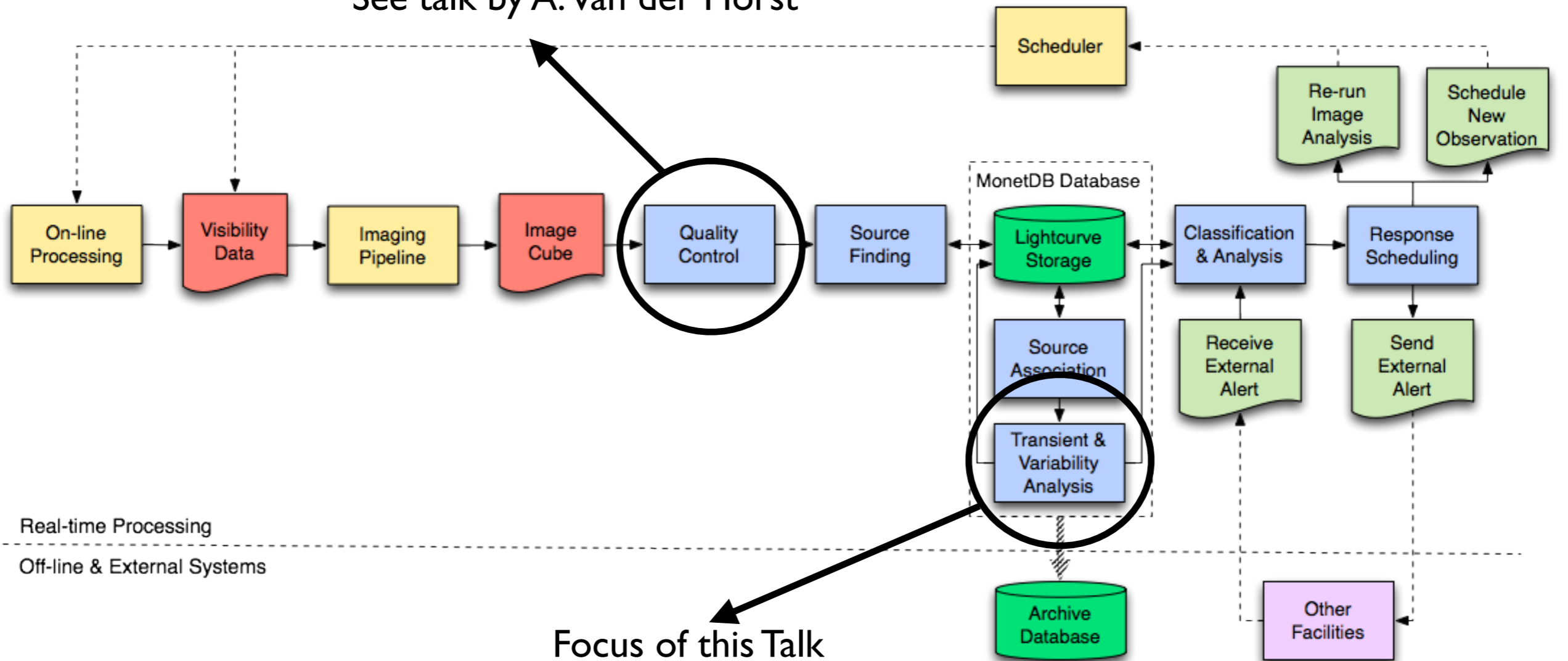
Swinbank (2011)

Transient parameters:

S = Unbiased standard deviation
I = Integrated flux
N = Number of datapoints
$$\omega = \frac{1}{e^2} = \frac{1}{(\text{Flux error})^2}$$

Transient parameters:

- Weighted χ^2 of a fit to a constant flux:
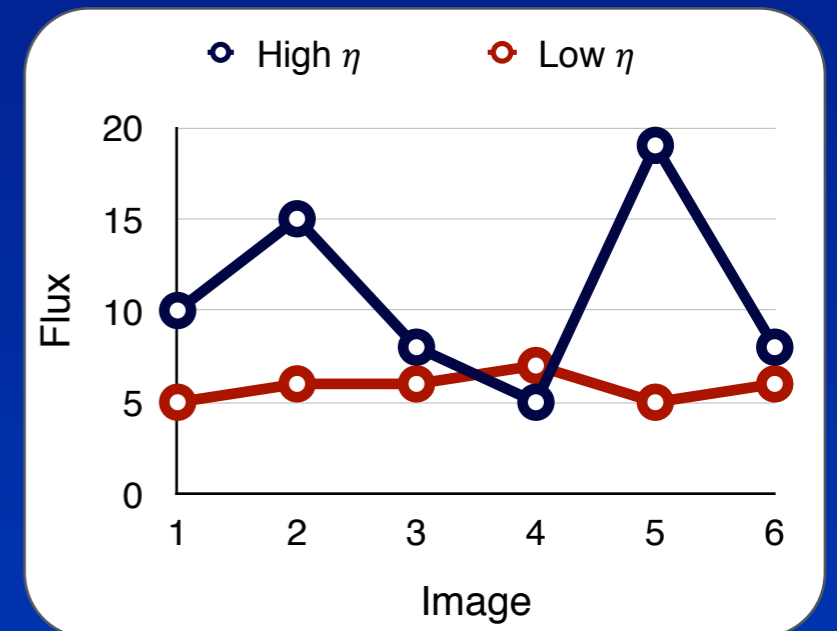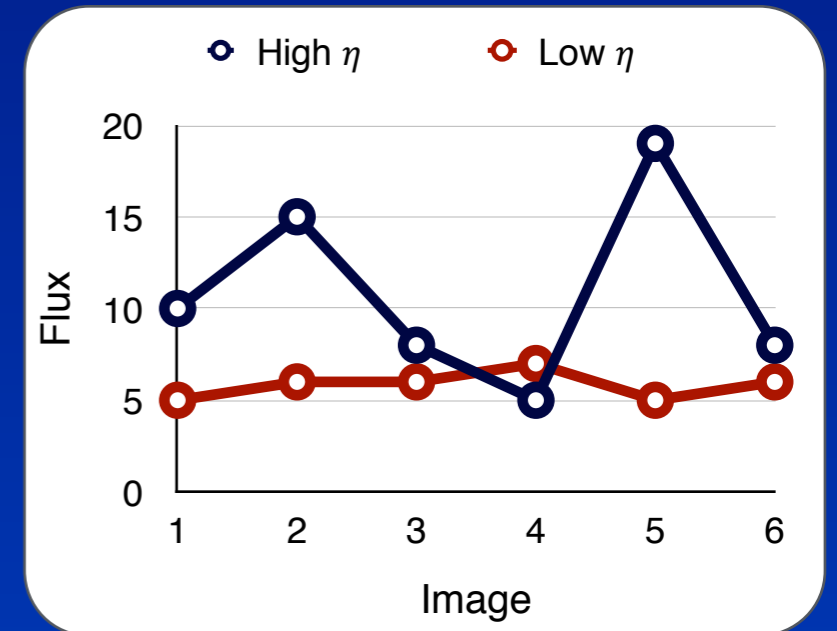
$$\eta_\nu = \frac{N}{N-1}\left(\overline{\omega I^2} - \frac{\overline{\omega I}^2}{\overline{\omega}}\right)$$
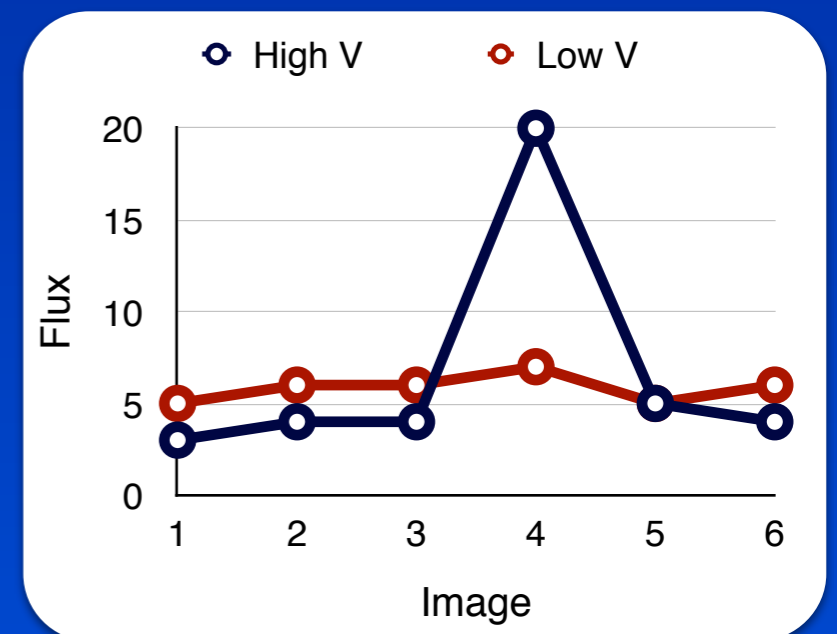
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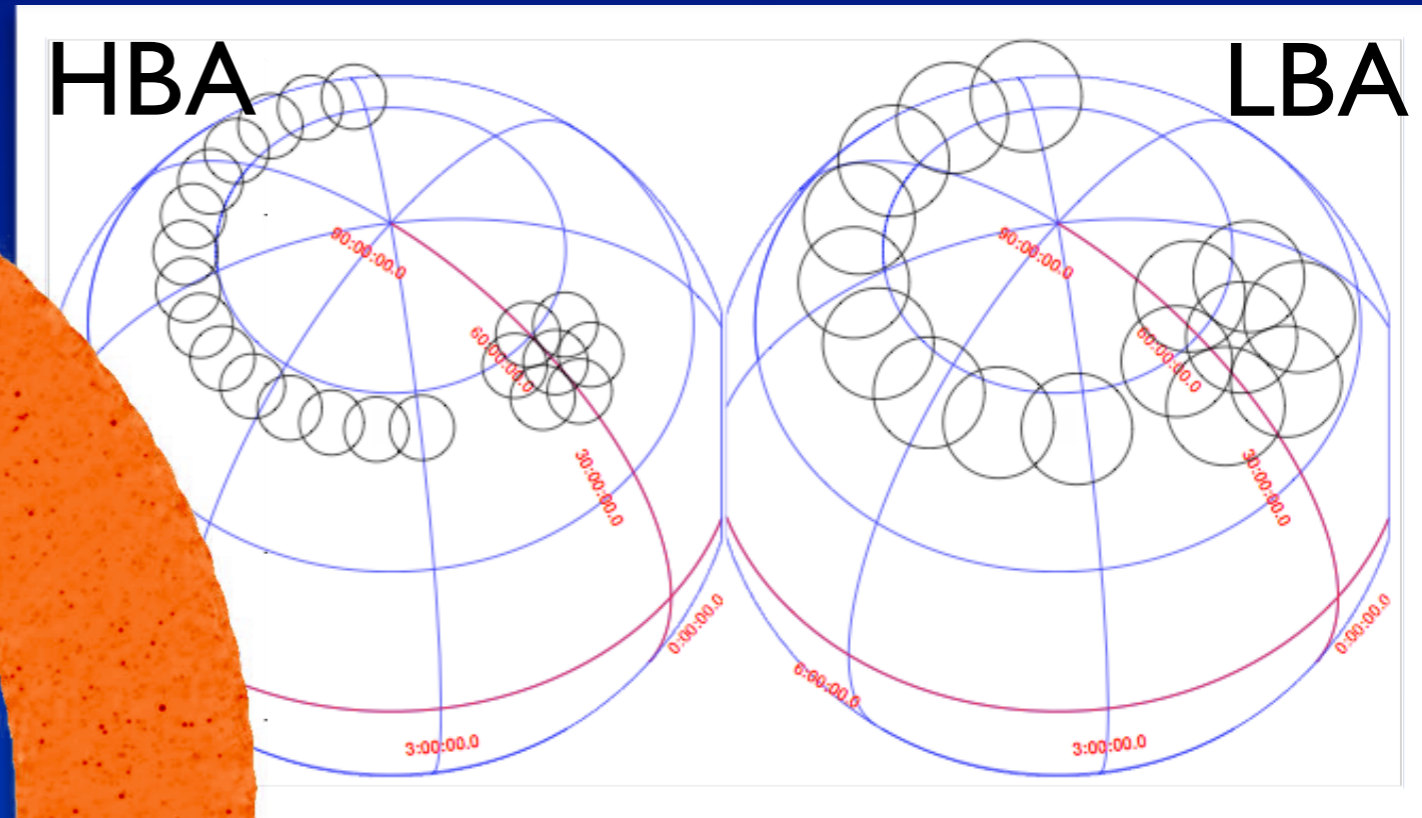

- Variability index:

$$V_\nu = \left(\frac{S}{\overline{I}}\right)$$

The Radio Sky Monitor:

HBA

LBA

24 hour observation, once per month for 6 months

4 frequencies (124, 142, 156 and 185 MHz)

2x11min consecutive snapshots per pointing direction

Credit: R. Breton

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The Radio Sky Monitor:

HBA   LBA
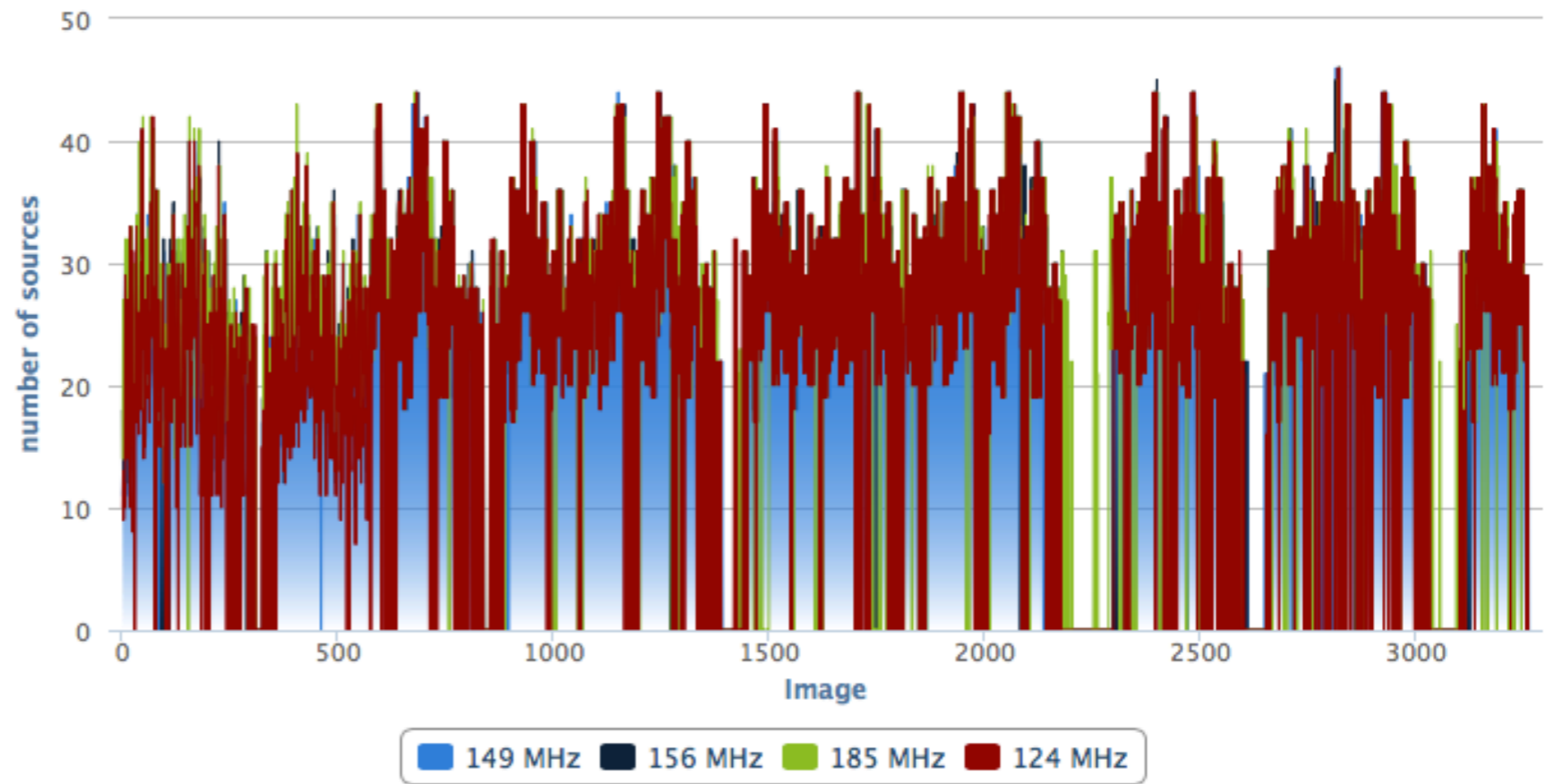
Screenshot from Banana
G. Molenaar & TraP developers

Credit: R. Breton

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The

LBA
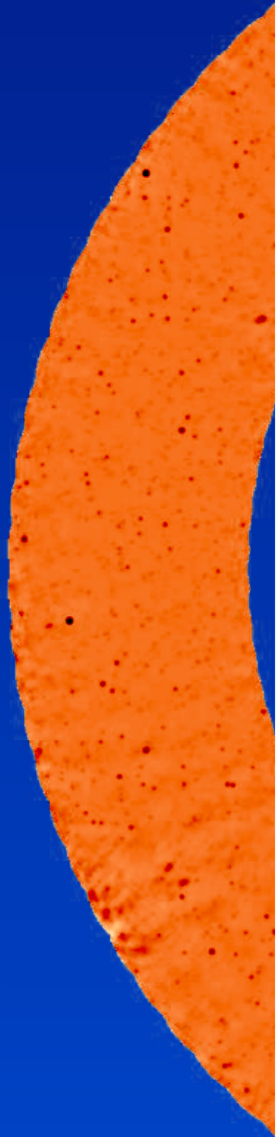
Credit: R.

Antonia   @uva.nl
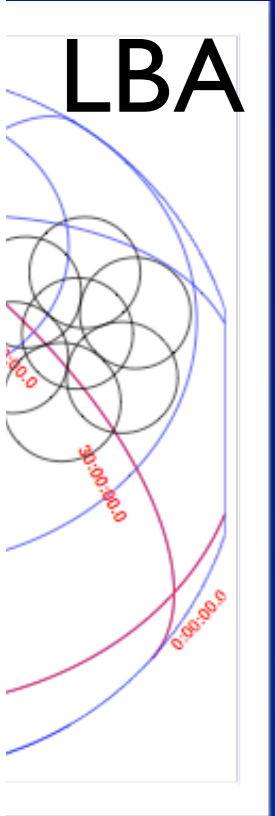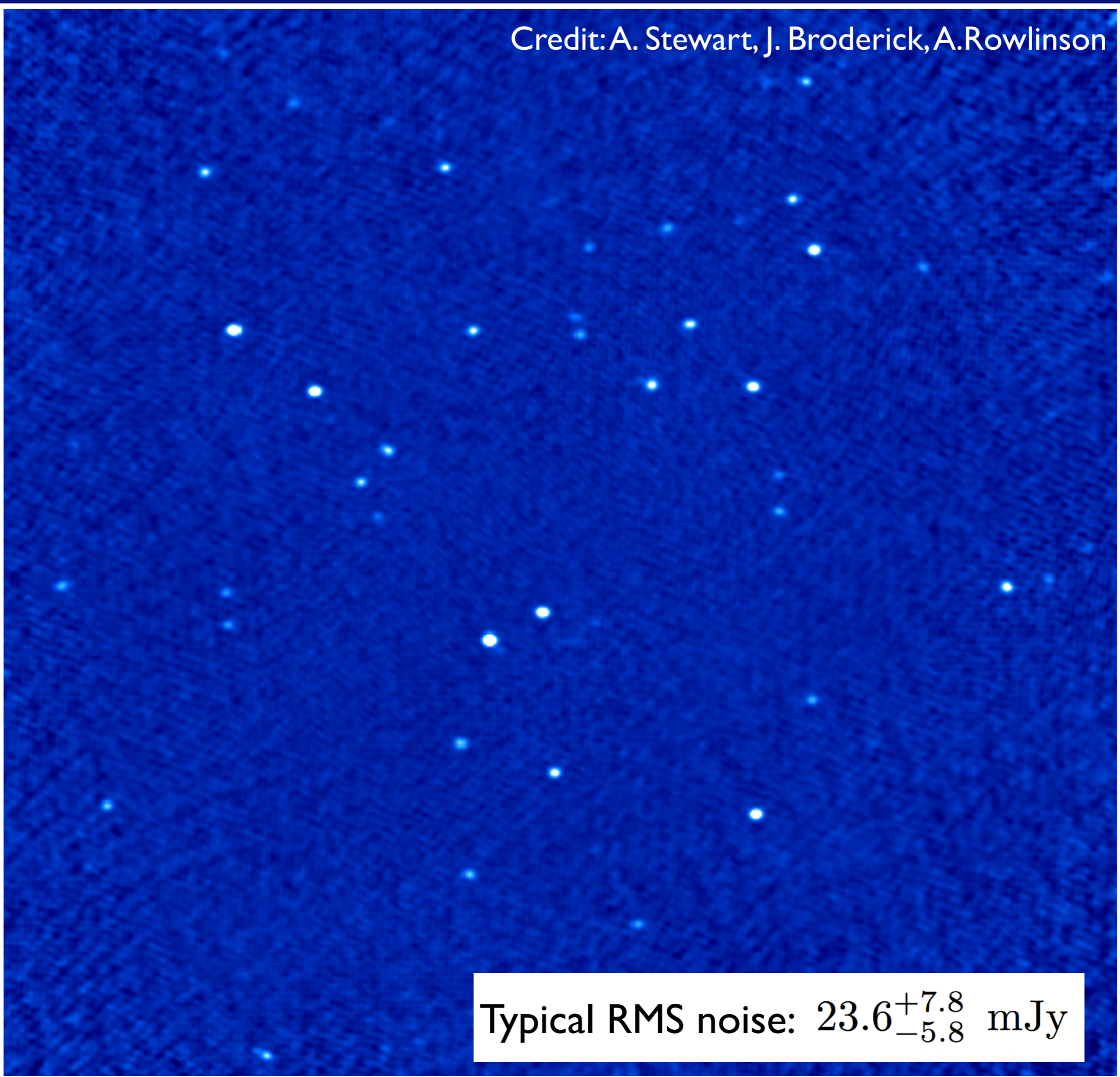
Typical RMS noise: $23.6^{+7.8}_{-5.8}$ mJy
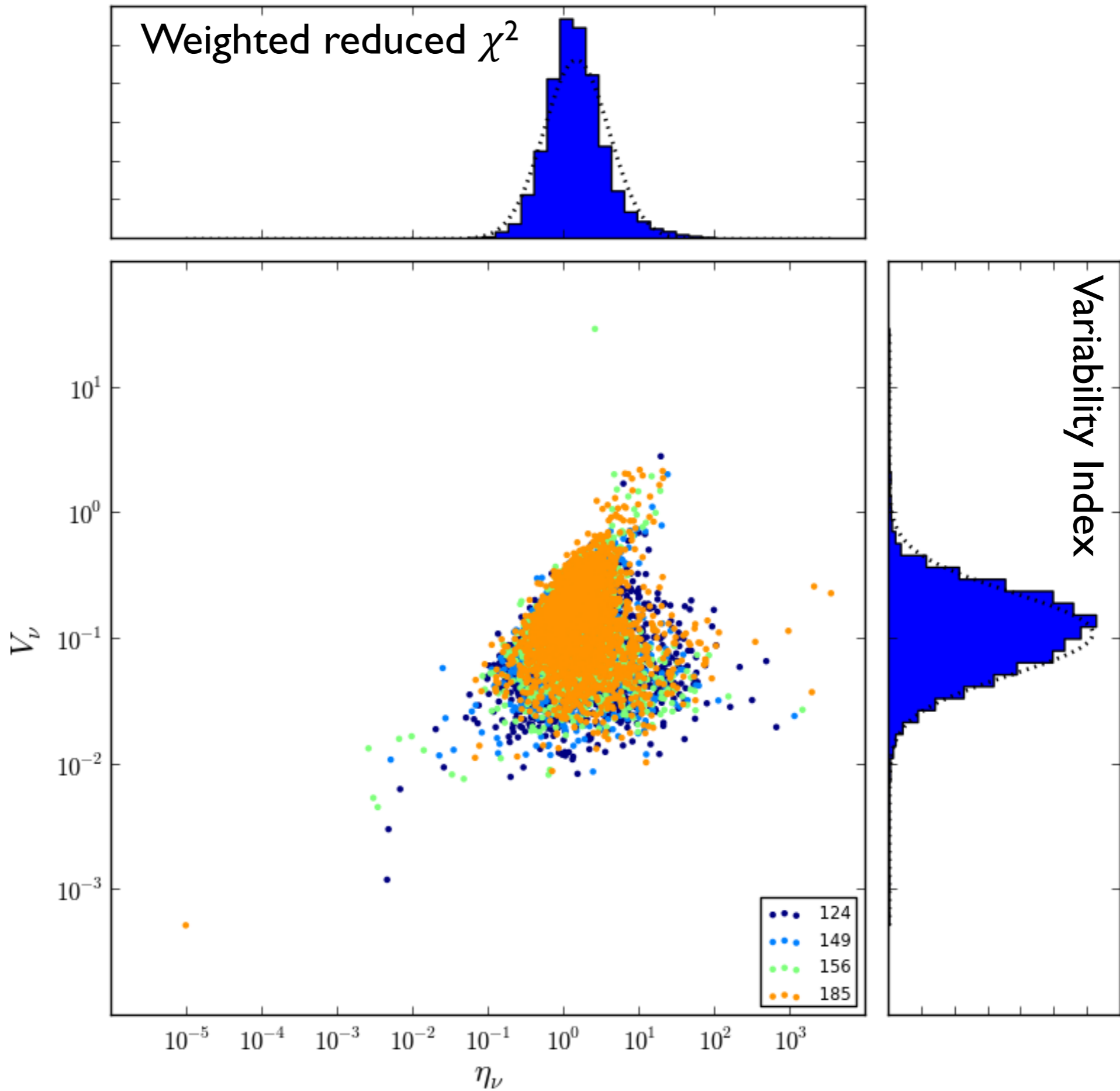
The Radio Sky Monitor:

The Radio Sky Monitor:

Weighted reduced χ^2

Variability Index

V_ν

η_ν

124
149
156
185

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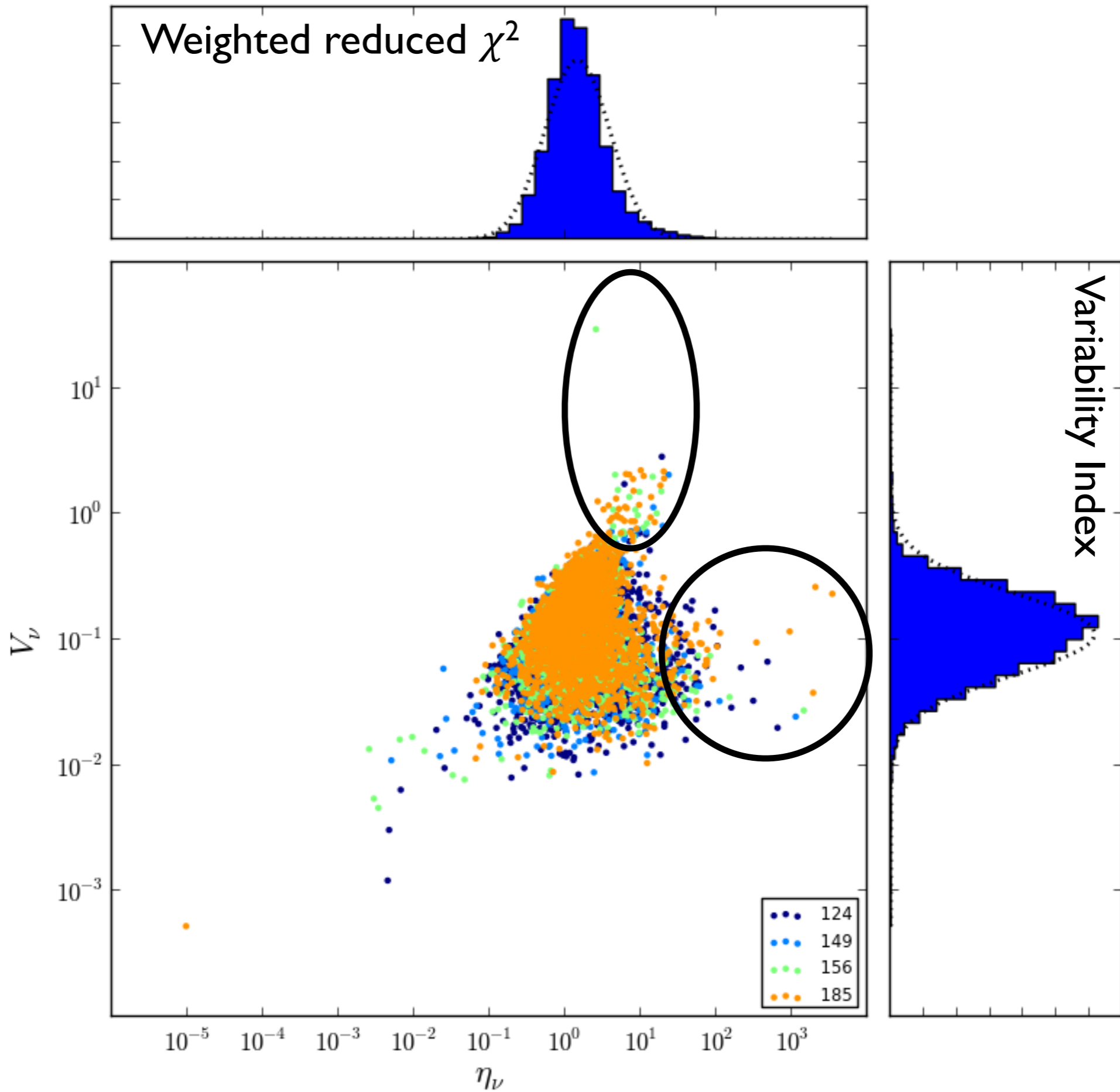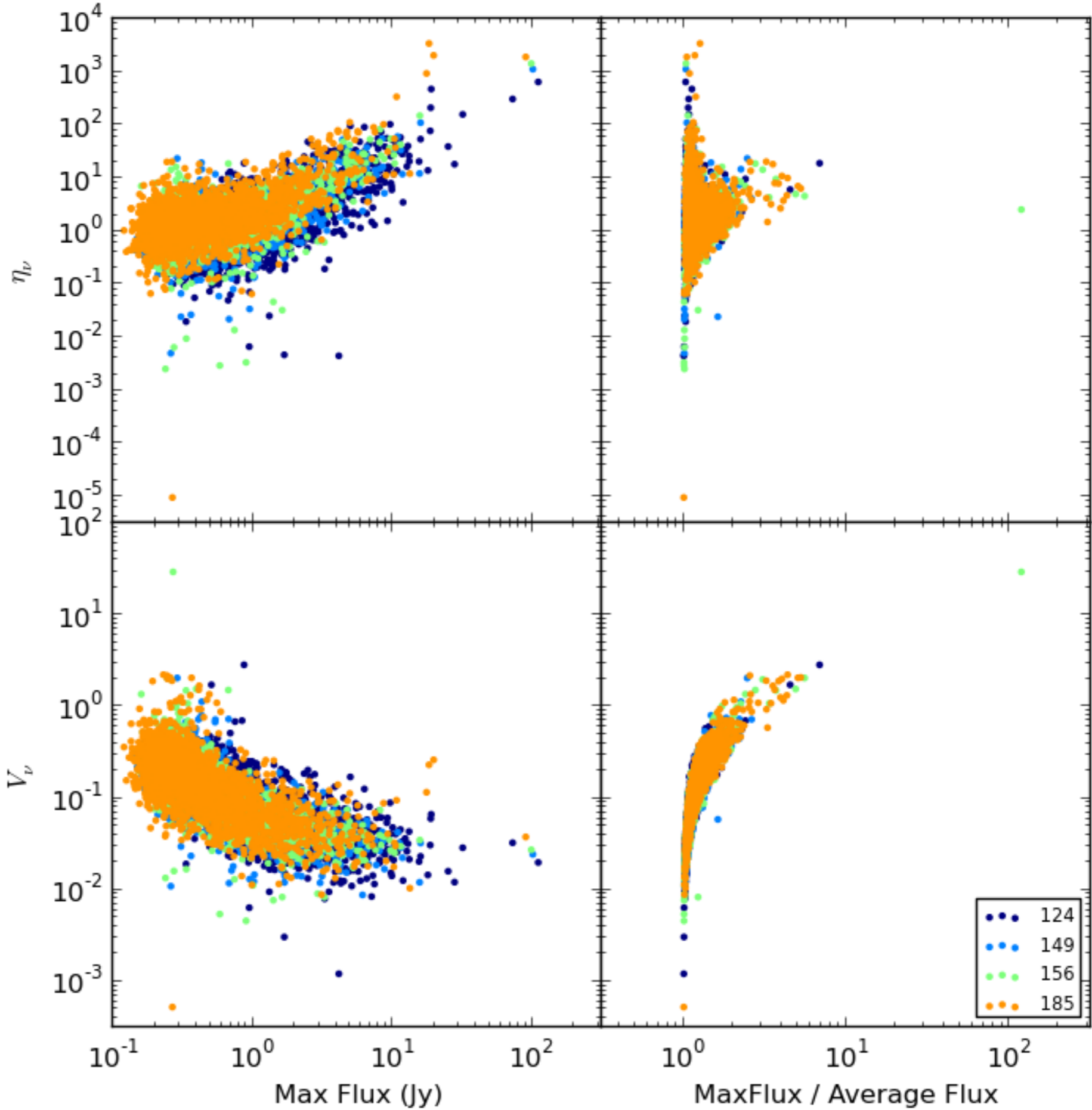
Weighted reduced χ^2

Variability Index

The Radio Sky Monitor:

Weighted reduced χ^2 Variability Index

Bright sources - statistical flux errors very small, systematic errors dominating

The Radio Sky Monitor:

Weighted reduced χ^2

Variability Index

Bright sources - statistical flux errors very small, systematic errors dominating

Faint sources - likely imaging artefacts

η_ν

V_ν

Max Flux (Jy)

MaxFlux / Average Flux

124
149
156
185

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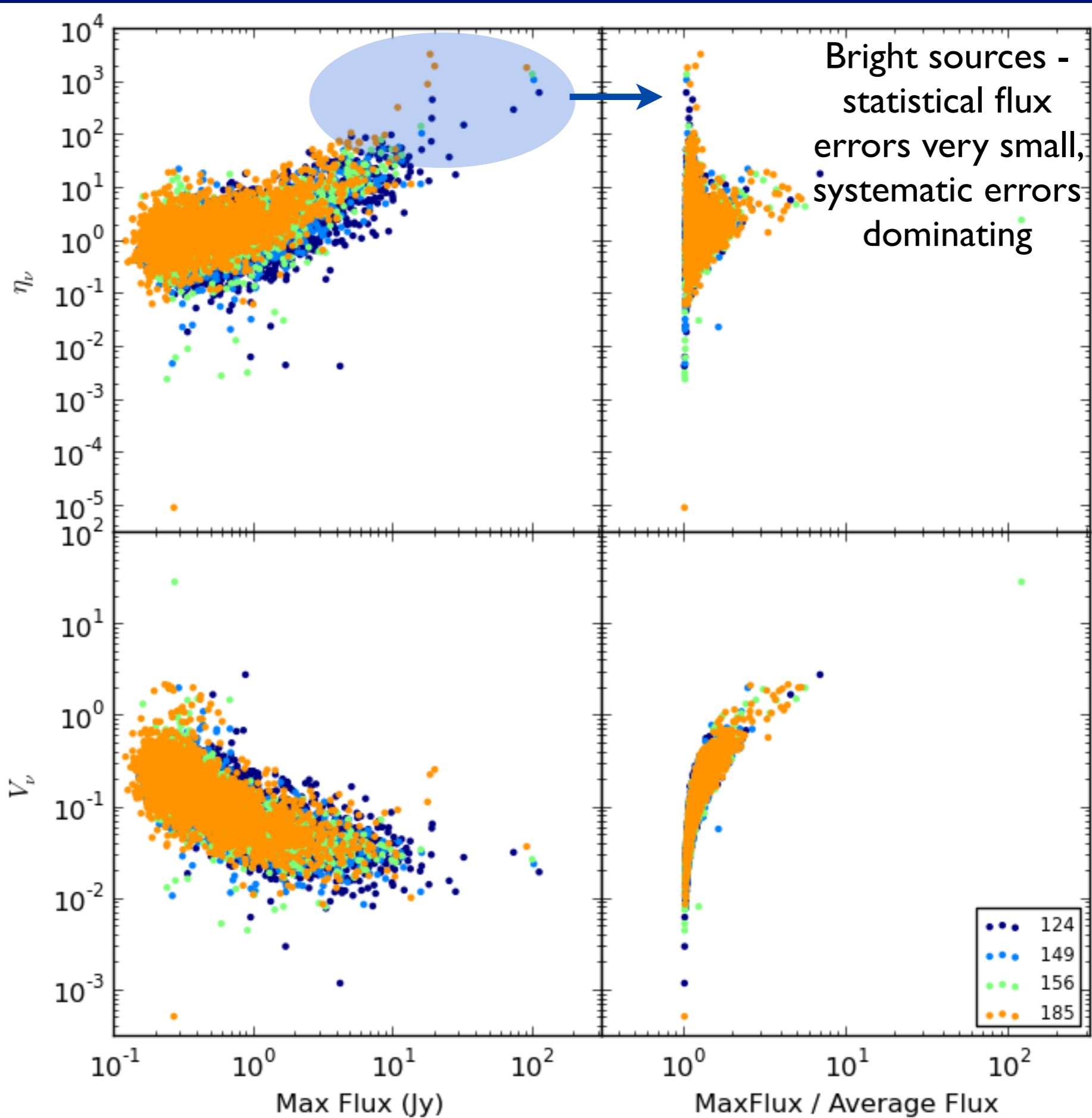
Simulations:

- 4400 images
- 440 unique transient sources
- 55 different combinations of max flux and quiescent flux for each type

Simulations:

Weighted reduced χ^2

Variability Index

Stable sources are taken from the Radio Sky Monitor

V_ν

η_ν

stable
periodic
fred
turnon
slowfall
turnoff
slowrise
gaussian
singleflare

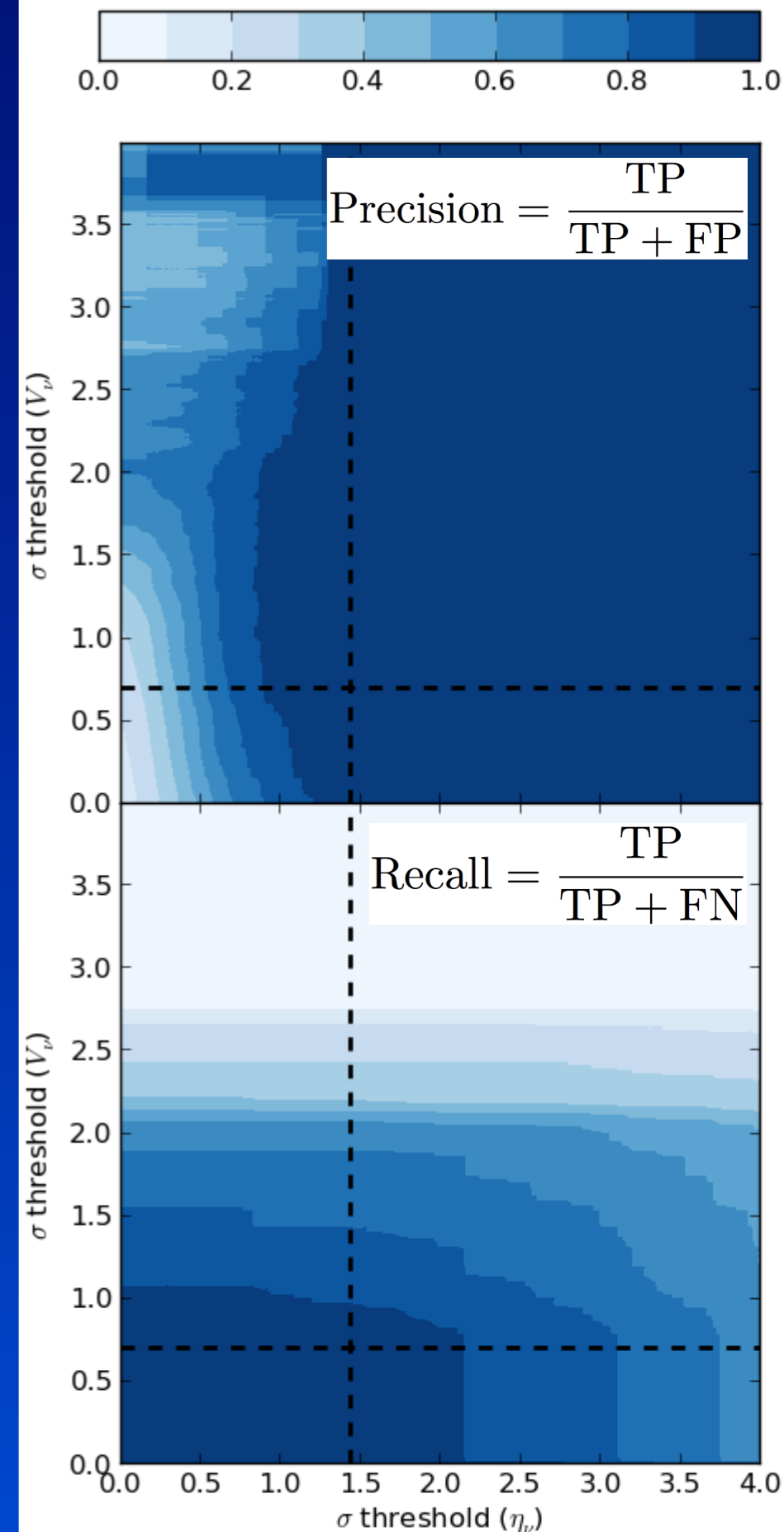Antonia Rowlinson   University of Amsterdam   b.a.rowlinson@uva.nl
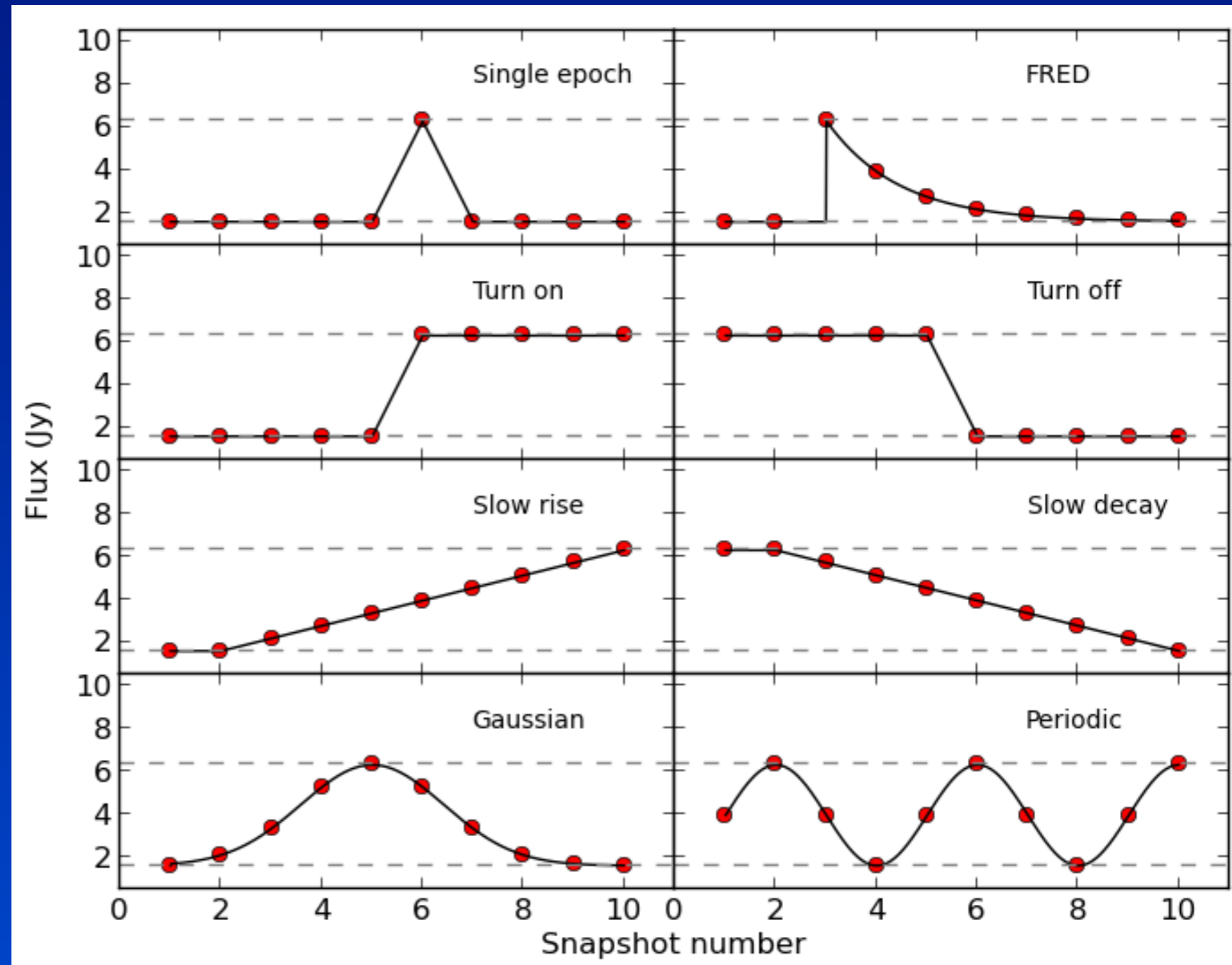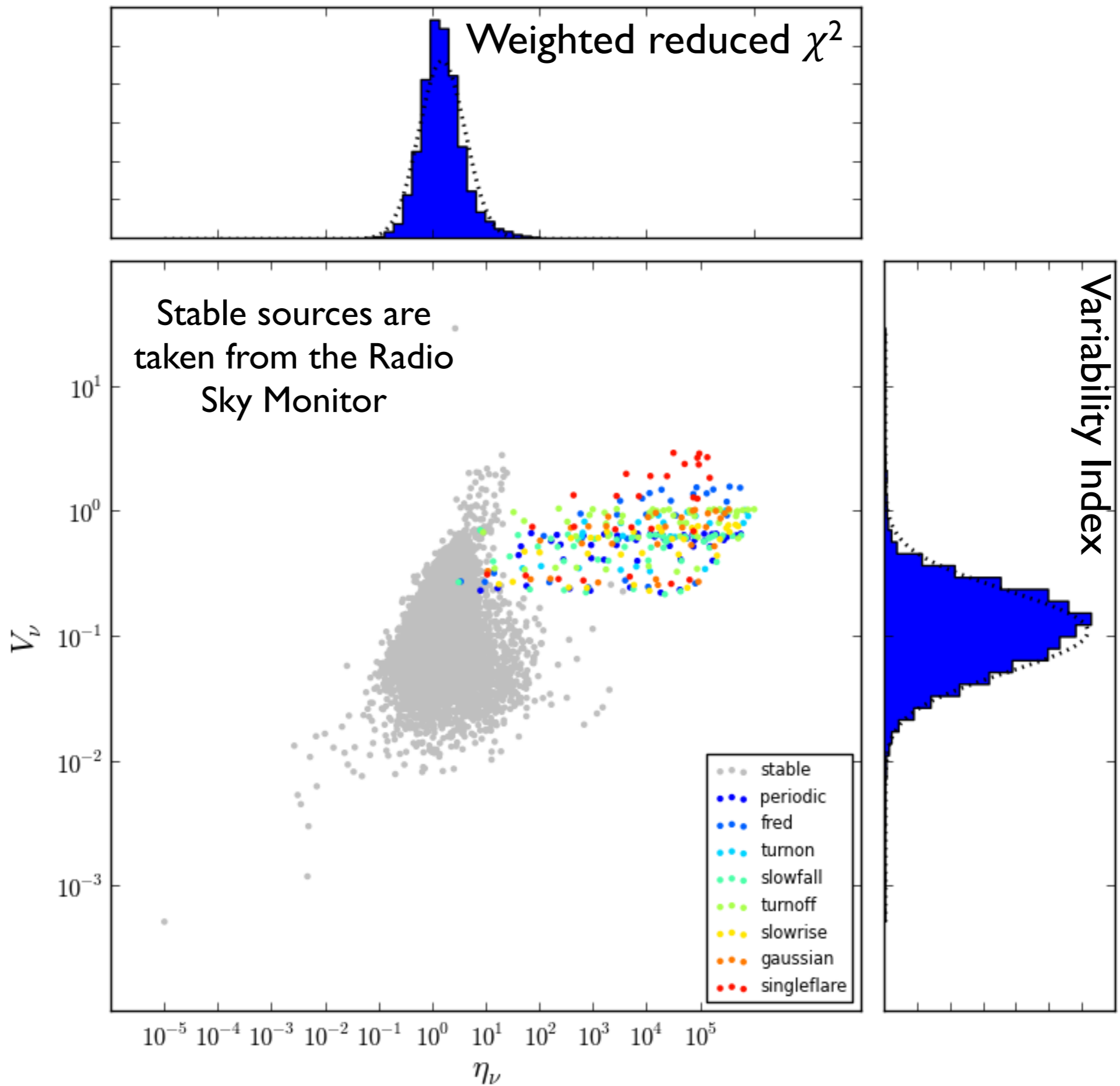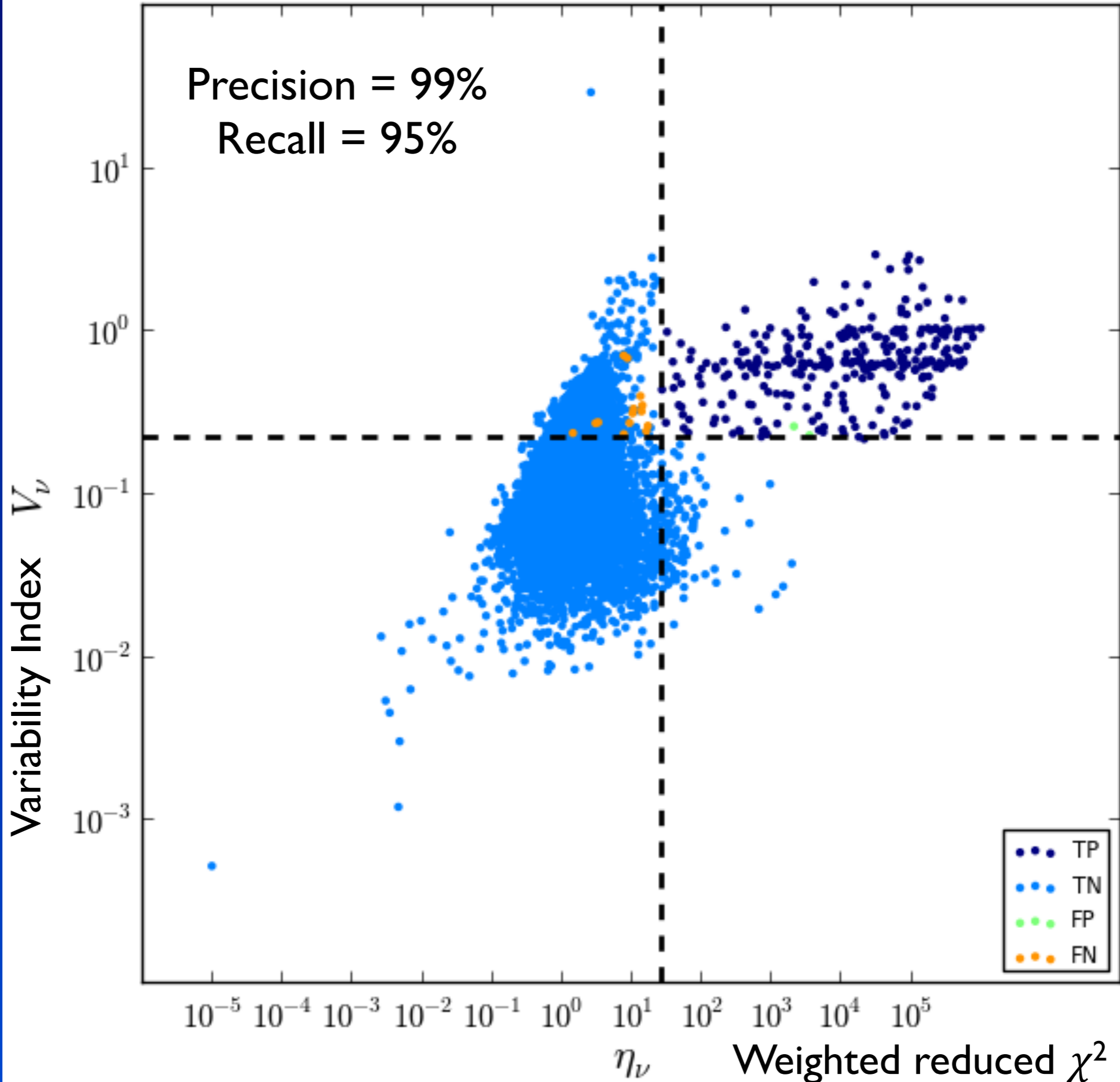
Choosing thresholds:

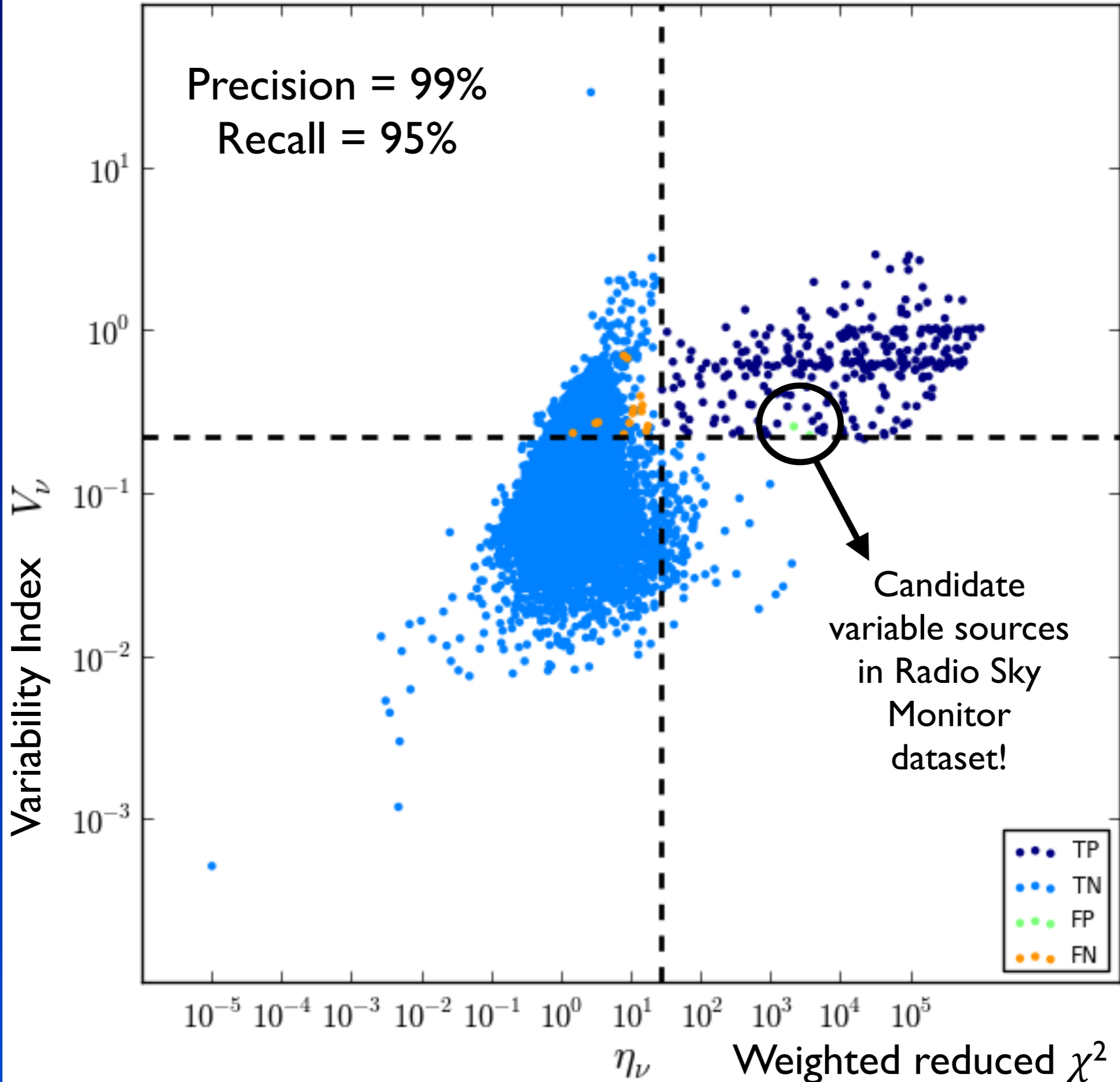- Trial different thresholds to classify known variable and stable sources

- Count the sources falling in these categories:

  - TP: True Positive

  - FN: False Negative

  - FP: False Positive

- Calculate precision and recall

- Choose the sigma thresholds that provide required precision and recall

$$\text{Precision} = \frac{\text{TP}}{\text{TP} + \text{FP}}$$

$$\text{Recall} = \frac{\text{TP}}{\text{TP} + \text{FN}}$$

Classification Results:

Precision = 99%
Recall = 95%

Variability Index V_ν

η_ν Weighted reduced χ^2

Legend:
- TP
- TN
- FP
- FN

Classification Results:

Precision = 99%
Recall = 95%

Variability Index V_ν

η_ν Weighted reduced χ^2

Candidate variable sources in Radio Sky Monitor dataset!

TP
TN
FP
FN

Candidate Transient:

Candidate Transient:

- Caused by a change in demixing settings

- "ignore target" option was changed from true to false

- Affects brightest sources

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Can we do better?

- Logistic Regression

- Linearly separate in multiple dimensional space

- Use multiple features for each source:

  - Weighted reduced χ^2 (η_ν)

  - Variability index (V_ν)

  - Maximum flux

  - Maximum flux ratio
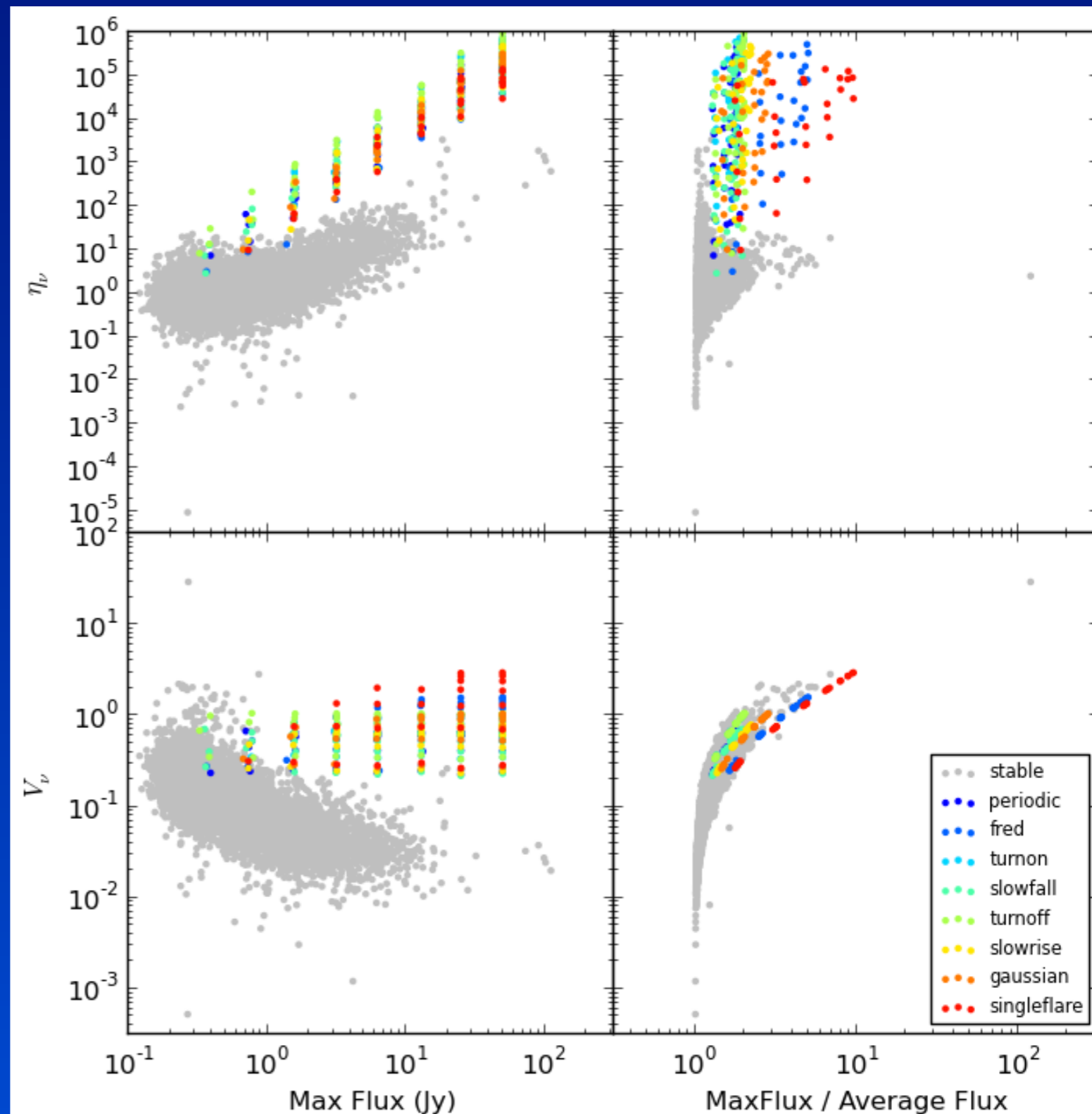
Conclusions:

- The Transients Pipeline (TraP) is performing well and we can confidently detect variable sources in the Radio Sky Monitor dataset if their fluxes are >0.6 Jy and max flux / average >2

- Tools in development to automatically train the TraP parameters

https://github.com/AntoniaR/scripts/tree/machine_learning/TraP_trans_tools

- Image reliability is essential. Work is ongoing to reduce calibration and imaging issues to prevent false transients. Scripts to train TraP quality control settings available:

https://github.com/transientskp/scripts/tree/master/TraP_QC_diagnostics