A Global Sky Model for LOFAR

What should it contain ?

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What is a GSM ?

- A model of the sky in terms of discrete sources and their frequency and resolution dependent properties.
- Capable of predicting the sky at a given frequency and resolution.
- Takes as input a set of catalogues of sources (described any which way).
- Set of catalogues : list of associations : predicted sky. Or, start with individual obs.

How will it be used ?

- Imaging : As an initial input to calibration.
- Surveys : To get a master source list, estimate spectral indices for each source.
- Transients : Look for variability in known sources and pick up new ones.
- Magnetism : polarisation and RM measurements of each source.
- EoR : To subtract foregrounds.

Inputs to the GSM

- Catalogues of sources, each at a given frequency-resolution value.
- Each source described by atleast a fiducial position, size (incl upper limits), flux(es), morphology code, morphology representation, polarisation props.
- Input maps to be decomposed first into such catalogues.

What do we do with the inputs

- All of the input catalogue sources are associated to produce a master source list.
- For sources with a single component at each frequency (a large fraction), it is easy to obtain flux, position, size as a function of freq, and pol.
- How do we deal with sources which are resolved into multiples at some frequencies ?

What the GSM delivers

- The model sky as a catalogue at a specified frequency and resolution.
- This catalogue can also incorporate various descriptions of a source (image, coeff in some basis eg shapelets, gaussians etc).
- Should be able to compare with the observed sky at that freq-resolution to look for anomalies.

GSM as a product of surveys

- Do not need to predict the sky at a given frequency-resolution.
- Need to produce a master source list.
- Need to incorporate information across the entire LOFAR band (+ external surveys).
- A source can be identified with a low resolution catalogue entry, and marked as having multiple components.
- Hence different resolution catalogues can be combined with some effort.

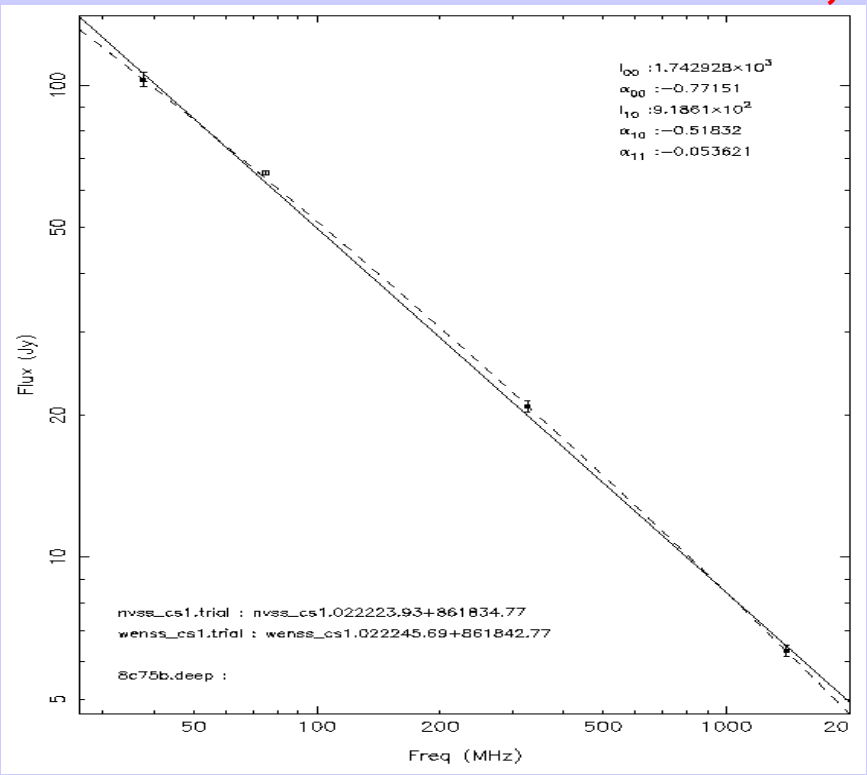
GSM as an input for calibration

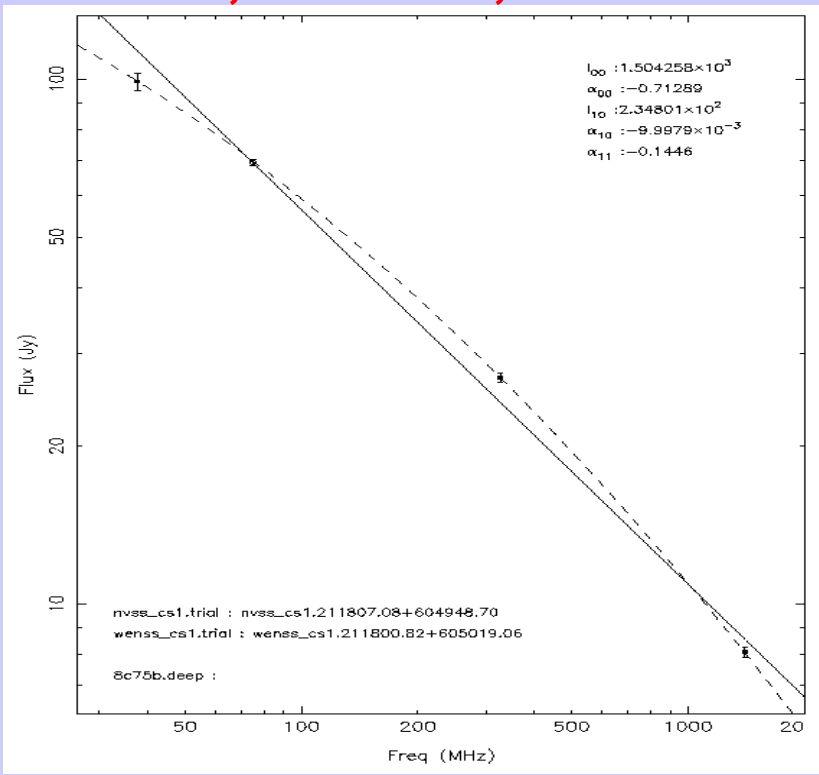
- No need to have a consistent GSM over the entire LOFAR band.
- Hence the problem of resolving a source into multiple components at higher freq may not be a big problem.
- Need to accurately describe the frequency variation of size, position, flux over a limited frequency range.
- Need to predict the sky at some nearby frequency.
- For MSSS, (8C-)VLSS-WENSS-FIRST will do as a starting point.

Optimised Radio Global Sky Model

- Select a number of gaussian lists (made by BDSM or imported from external catalogues)
- Select which ones to fit and which to predict for.
- Associates every pair of catalogues (to id bad ones).
- Associates all the catalogues together. Fits linear and curvature parts of spectrum of each association.
- Plots spectra of each association.
- Writes out the GSM table and also predicted flux for each.
- Plots observed/predicted flux for each catalogue vs RA, Dec, flux, distance from Cas A etc.
- Outputs image of observed/calculated flux.

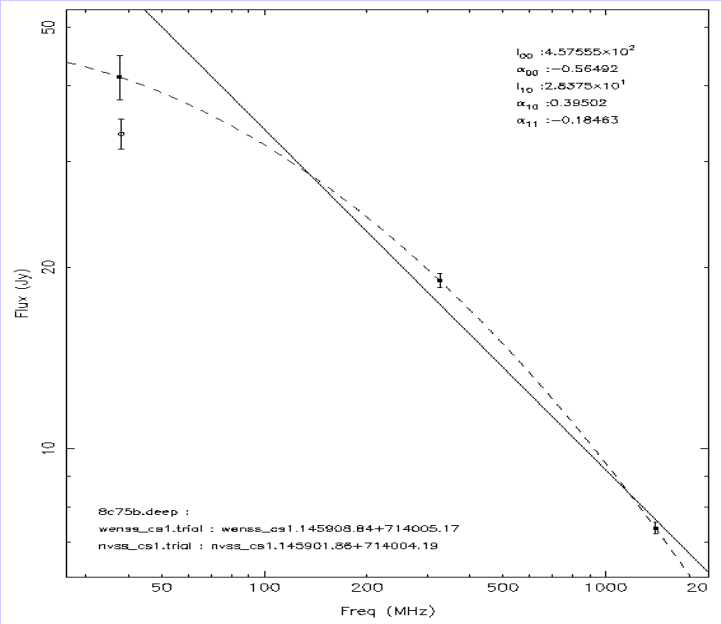
GSM : NVSS, WENSS, VLSS, 8C

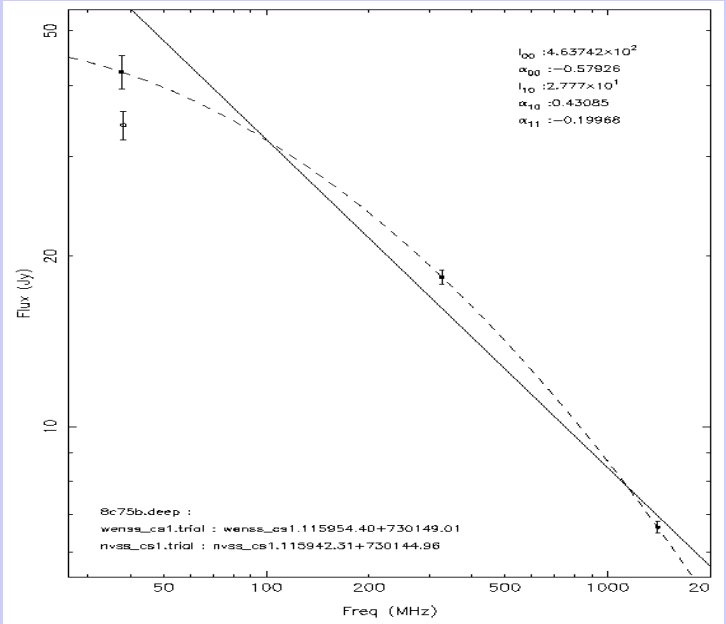


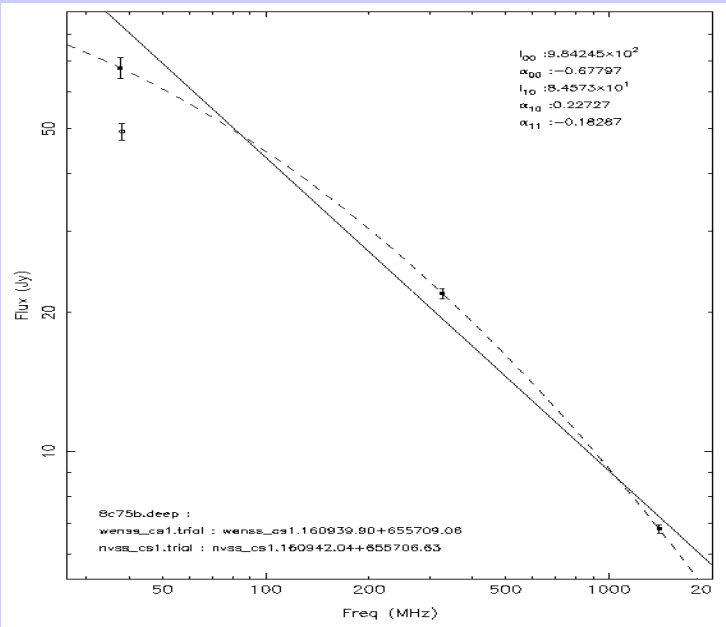


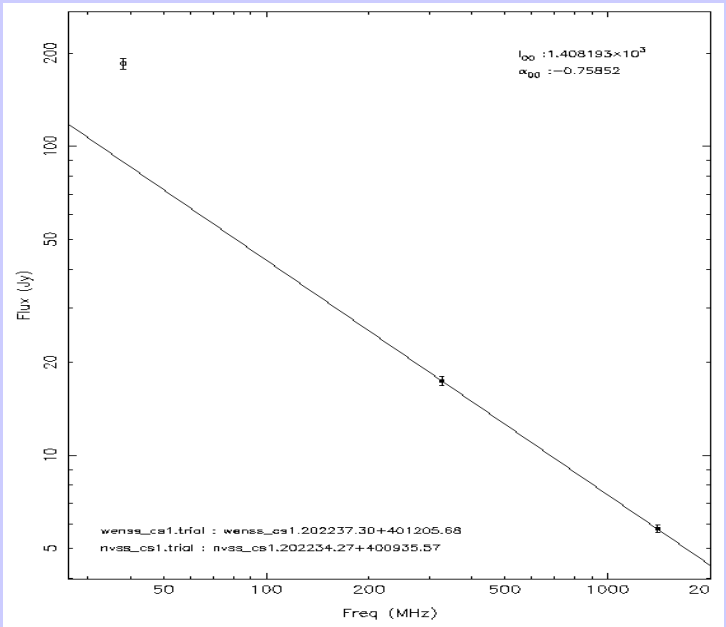
- Use maps convolved to CS1 resolution
- sp.ind : mean=-0.75; std=0.2
- Can observe curvature in certain sources.

GSM : NVSS, WENSS, 8C vs CS1

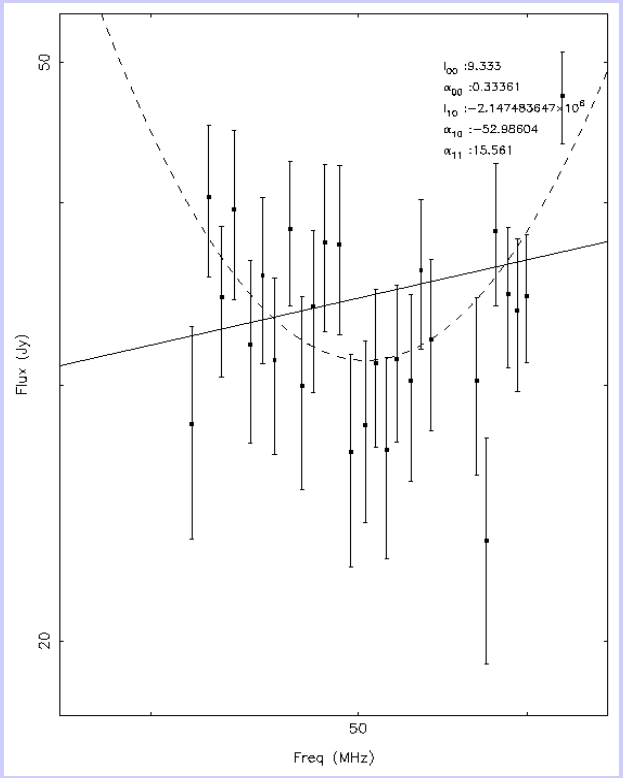


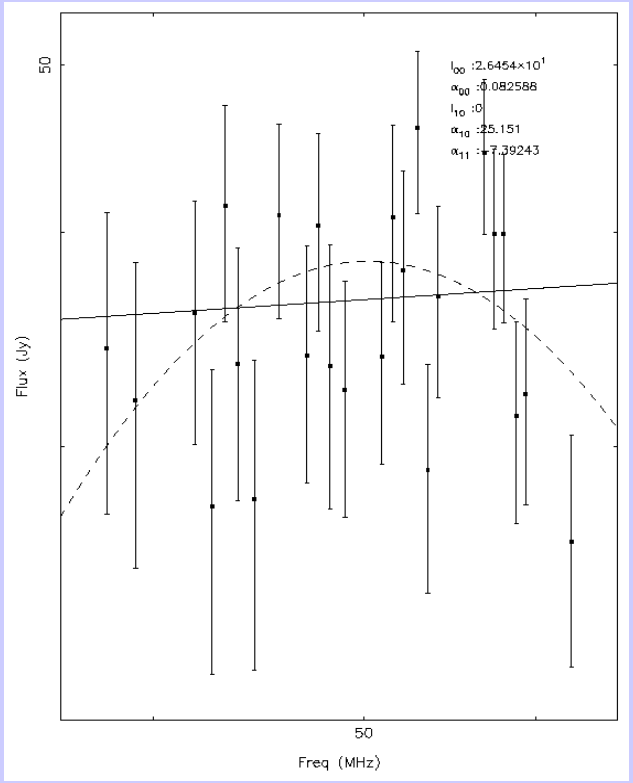


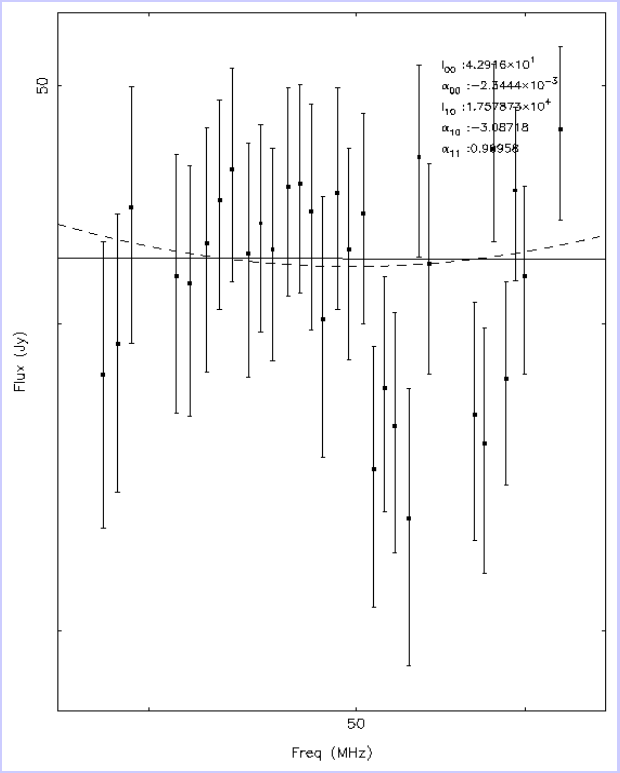




GSM : CS1 3565 multi-band







- Construct GSM with all 36 subbands of 3565 data.
- Spectra consistent with being flat.
- Due to assumed flat spectrum of Cas A and Cyg A.

GSM : all of them now ...