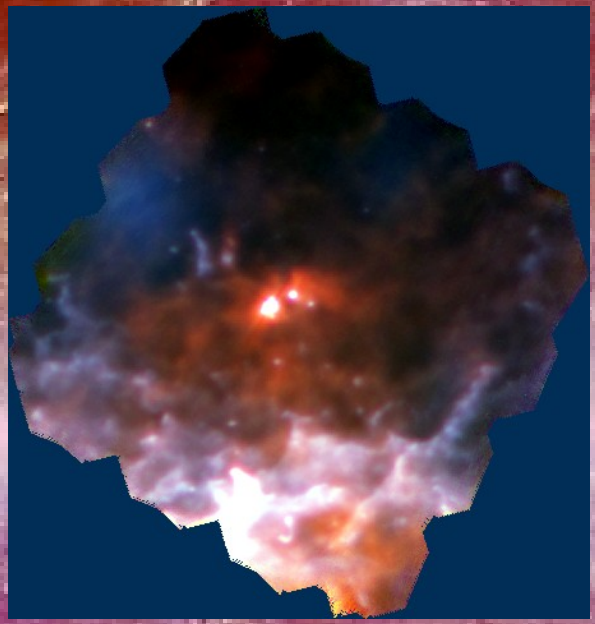
Galactic Cold Cores



Veli-Matti Pelkonen,
On behalf of the Planck and Herschel projects on cold cores

The Milky Way
- in dust emission

Star forming cloud
~$10^{1\text{-}2}$pc ~$10^{0\text{-}5}$ M_o

Clumps, cores
~0.1-1pc ~0.1-10 M_o

Galactic disc
~30 kpc

Planck – ESA and the HFI Consortium

Cold Cores & **Planck**

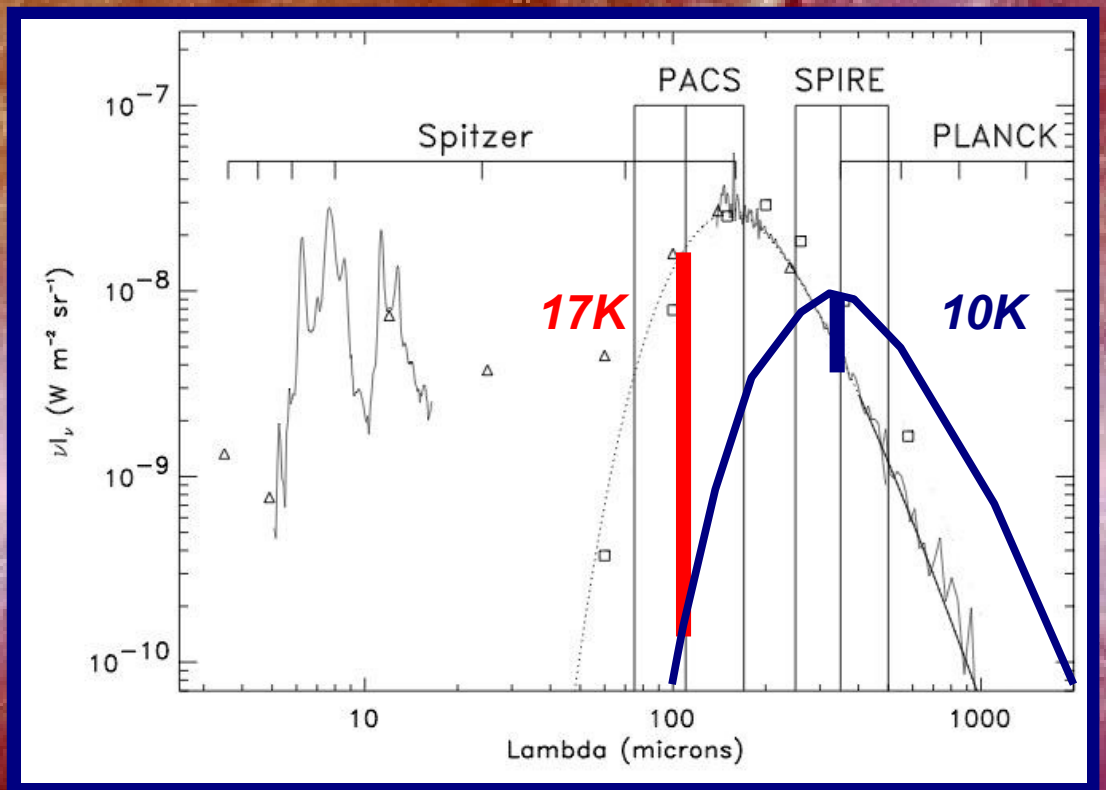
The Planck satellite mapped the sky at nine sub-millimetre and radio wavelengths

- **350μm, 550μm, 850μm**, ...,1cm
- **better than 5'** resolution in the sub-mm

This enables the **detection of cold clumps**!

Planck is also **the first** mission capable of a full survey

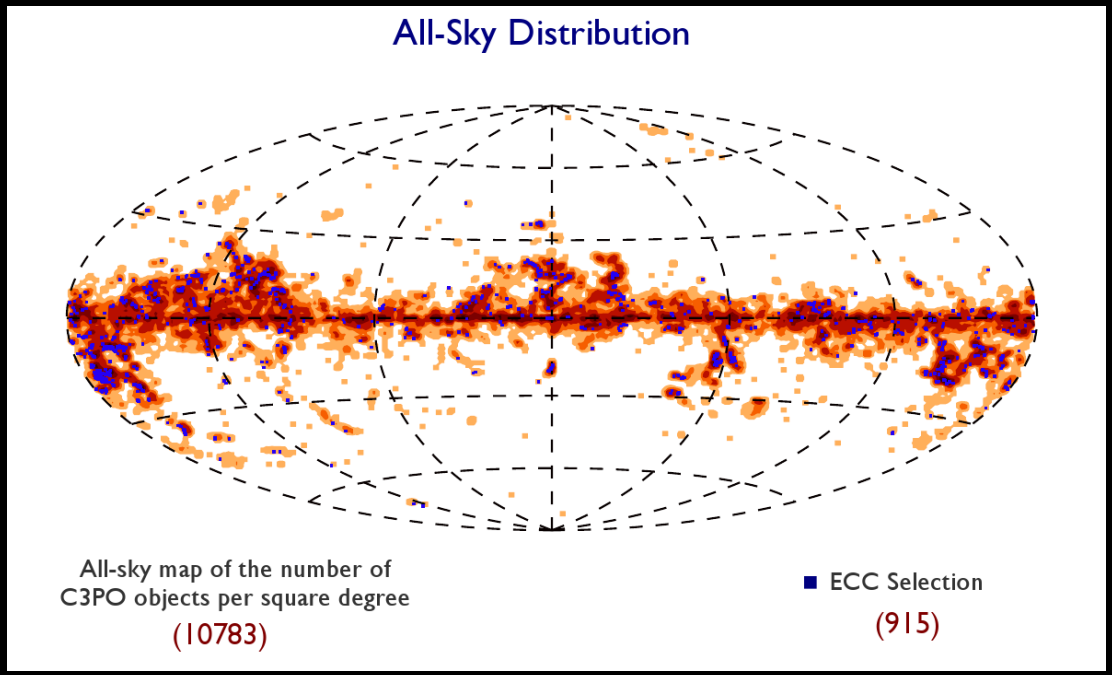
- full sky coverage
- sub-millimetre bands
- sufficient resolution
- excellent sensitivity



Planck Cold Cores (PIs: Mika Juvela & Isabelle Ristorcelli): Preliminary catalog contained over 10000 sources, some 900 of which were included in the Early Cold Clumps catalogue (Planck collaboration 2011)

- distances from 100pc to 8kpc, Galactic heights up to ± 400pc

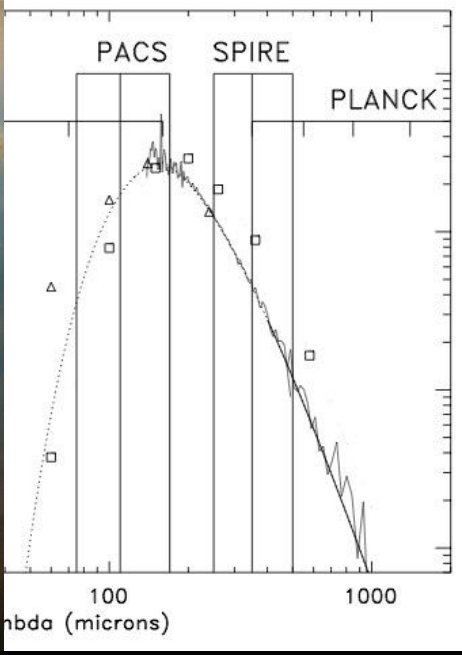
Planck Collaboration (2011)
Planck early results XXIII, A&A 536, A23

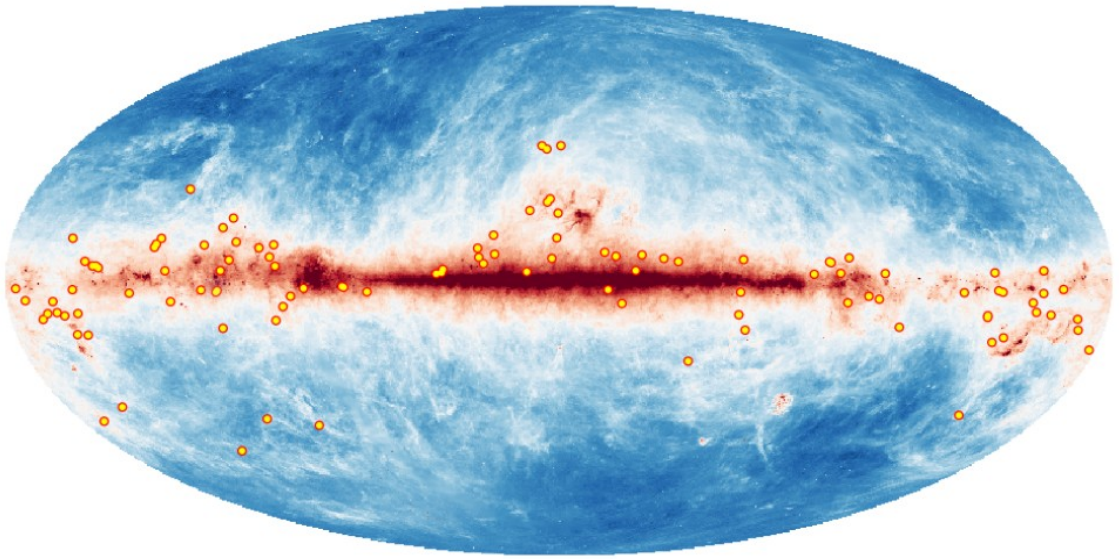


Cold Cores & **Herschel**

Key Programme ***Galactic Cold Cores*** (PI: Mika Juvela)

- to map ~120 fields containing cold Planck clumps
- a **cross-section** of the full population (T, M, n, R, l, b etc.)
- complementary to other programmes (Gould Belt Survey, HIGAL, EPoS, etc...) → includes high latitudes, outer regions of molecular cloud complexes, large distances
- Juvela et al. 2010, 2011, 2012





Data Reduction (HIPE 9.0.0)

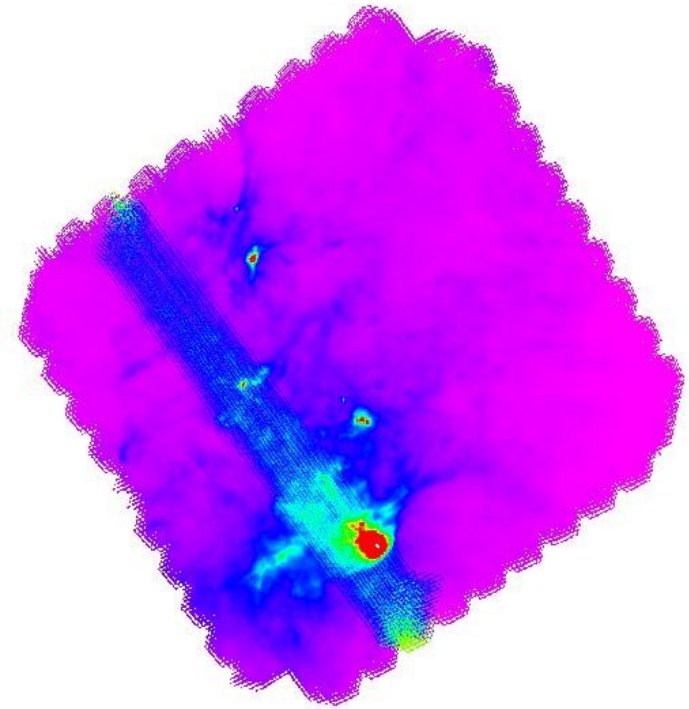
We observe the fields with PACS (100, 160 μm) and SPIRE (250, 350, 500 μm) photometers.

- Most of the maps are small: 15 – 30 arcmin in PACS, 20 – 40 arcmin in SPIRE. Four Parallel mode maps (~1 deg).
  - SPIRE maps and small PACS maps can be reduced with a laptop, but the bigger maps and Parallel mode maps need more computing resources (done mainly at IPAC).
- Targeting cold cores (~12 K): SEDs peak around 250μm.
  - So bright in SPIRE, less so in PACS (especially at 100μm)
- Different environments and morphologies: low-latitude / high-latitude clouds, star forming / quiescent clouds, filaments / clusters / isolated
  - Very variable 'backgrounds'

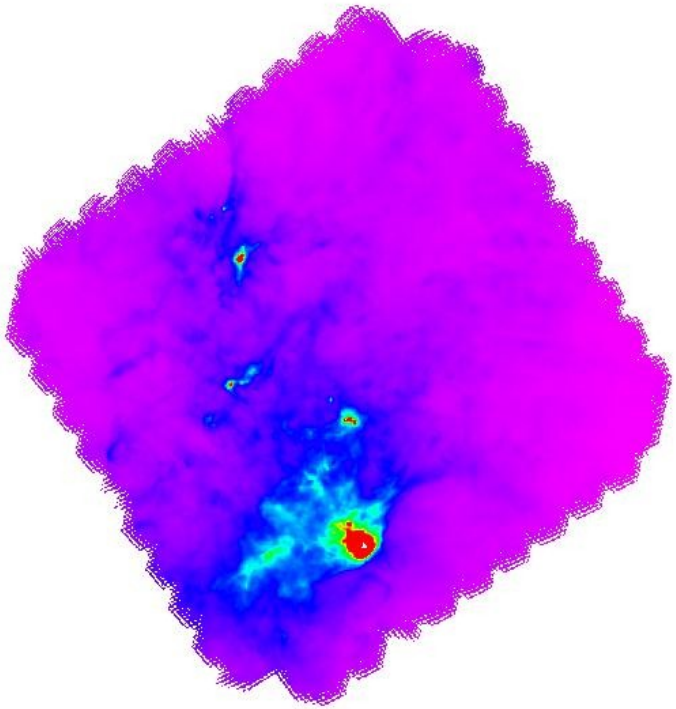
SPIRE Data Reduction

We use the SPIRE photometry Large Map pipeline with the destriper (Bernhard's talk on Monday).

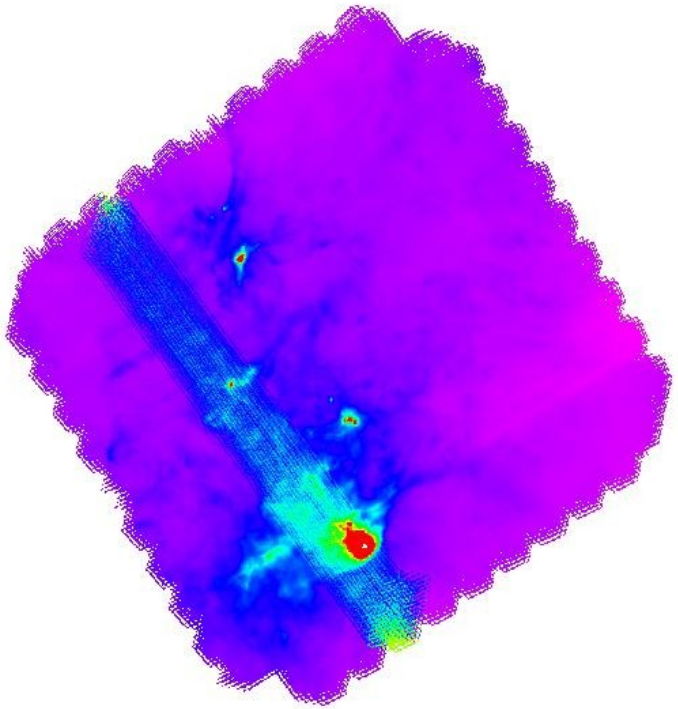
- Seems to work very well → very little residual stripes left
- Couple of individual cases (very bright sources, mistaken for a thermistor jump?) where destriper fails on a single scanleg



Brightmode=True



Without the problem scan



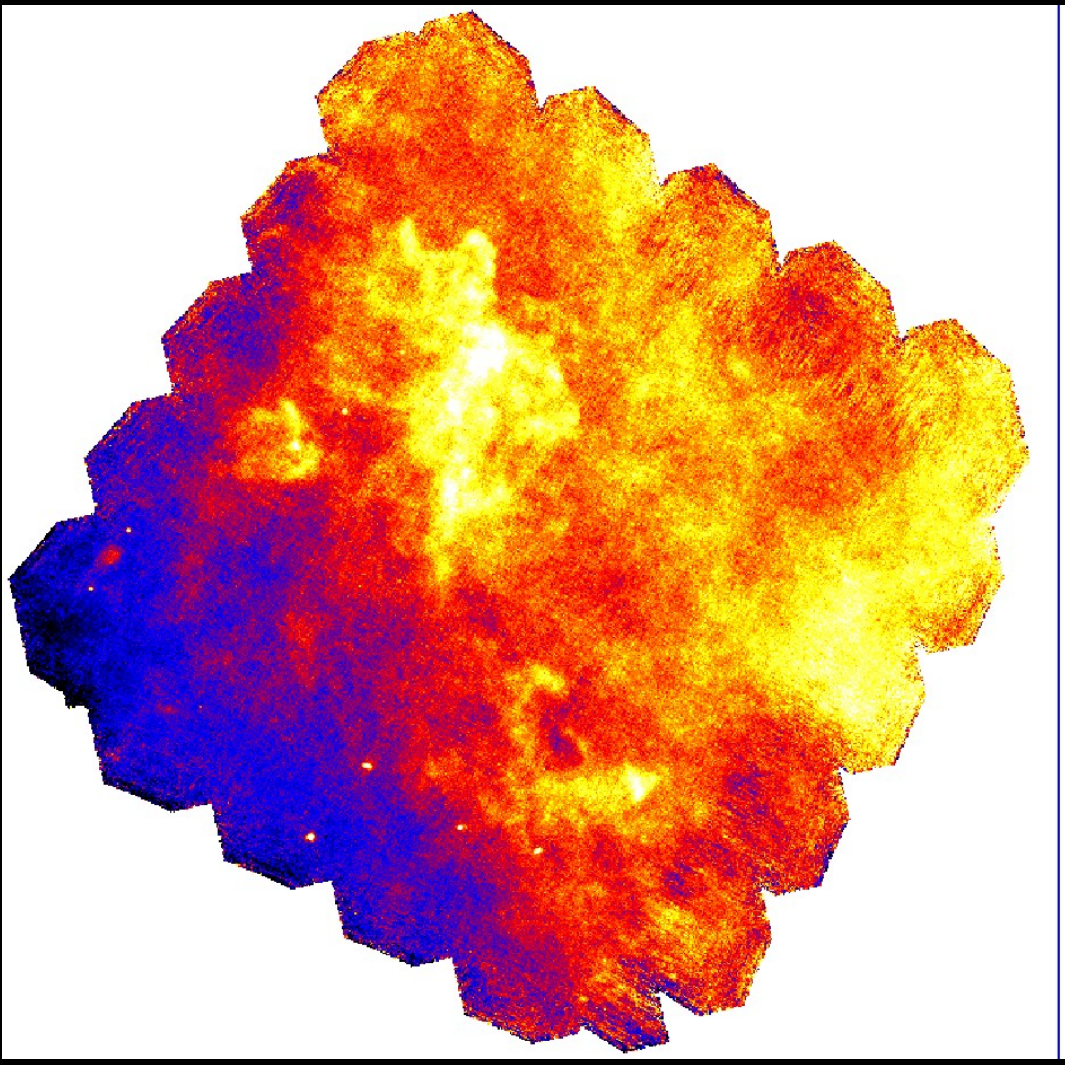
Brightmode=False

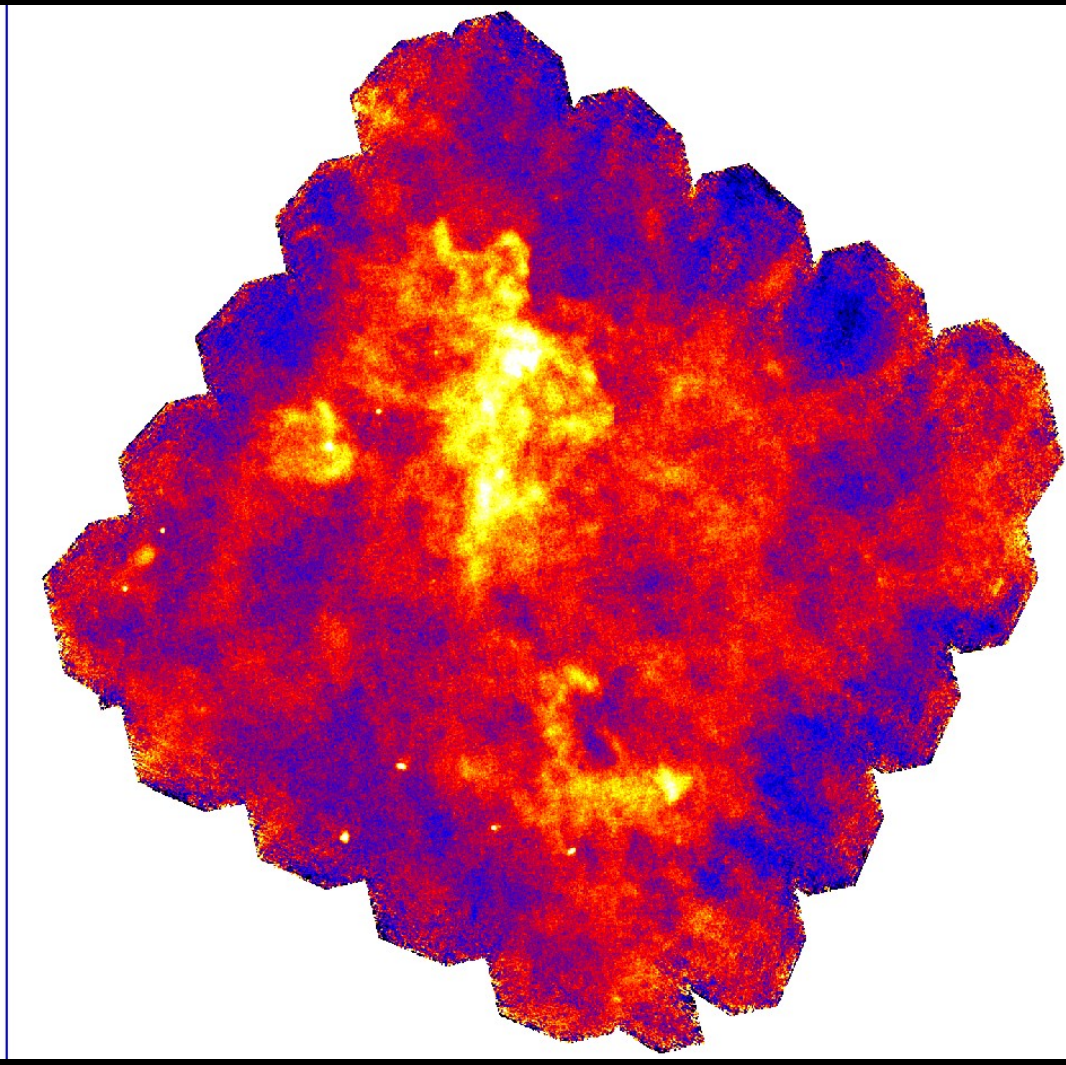
PACS Data Reduction

We use the PACS photometer extended source scanmap with Madmap and Scanamorphos (v 18.0).

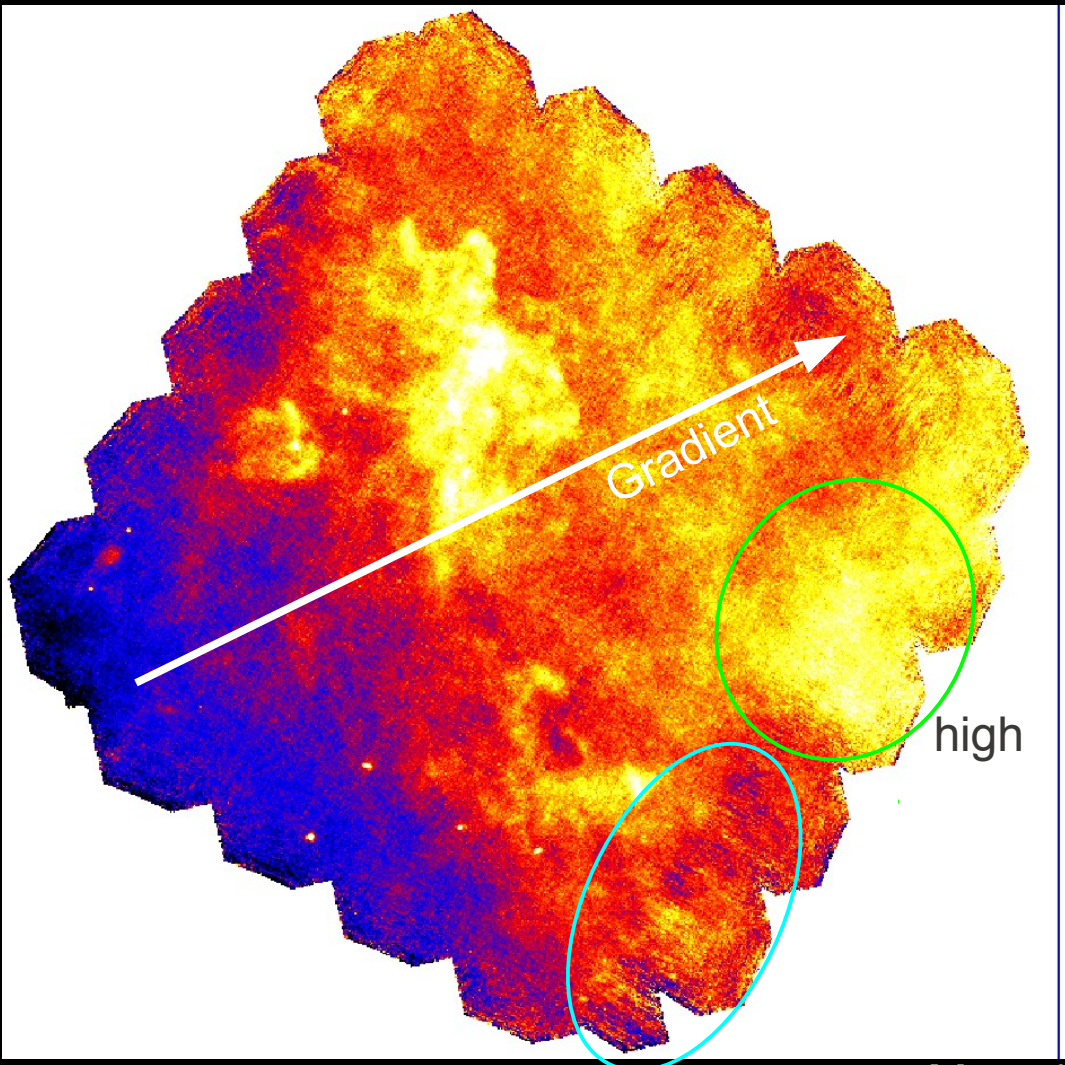
- Drift correction is of critical importance
  - BIG CAVEAT: we are using Madmap almost with default values, which are meant for big fields. We should tweak the values of the baseline drift correction to segment the timelines more finely, especially in the smaller fields.
    - Segment size 10000, bin size 1000
- Which mapmaker can you trust: differences between the resulting maps (especially at 100 μm)
  - Comparison with IRAS & Akari

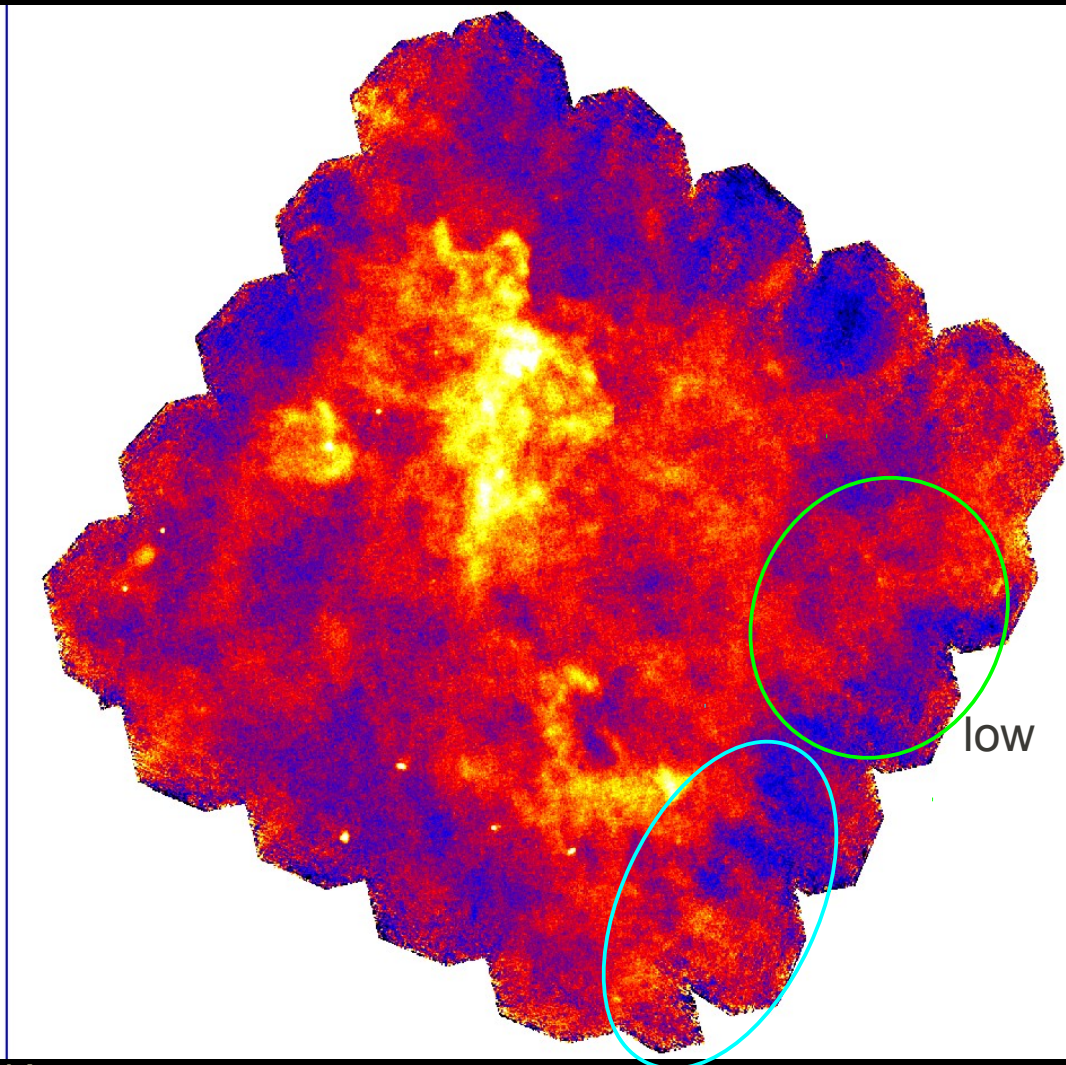
Madmap vs Scanamorphos





Madmap vs Scanamorphos



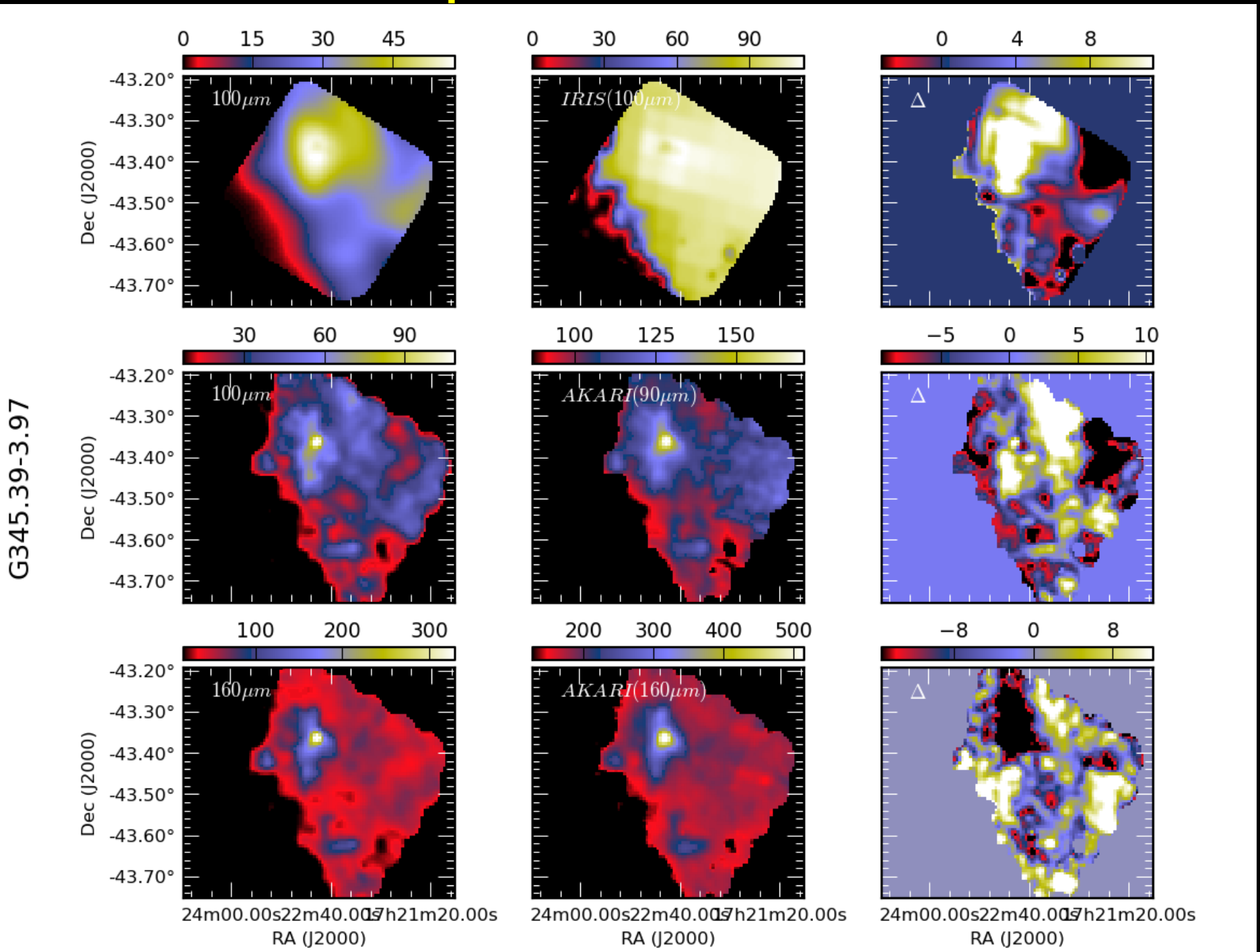


striped

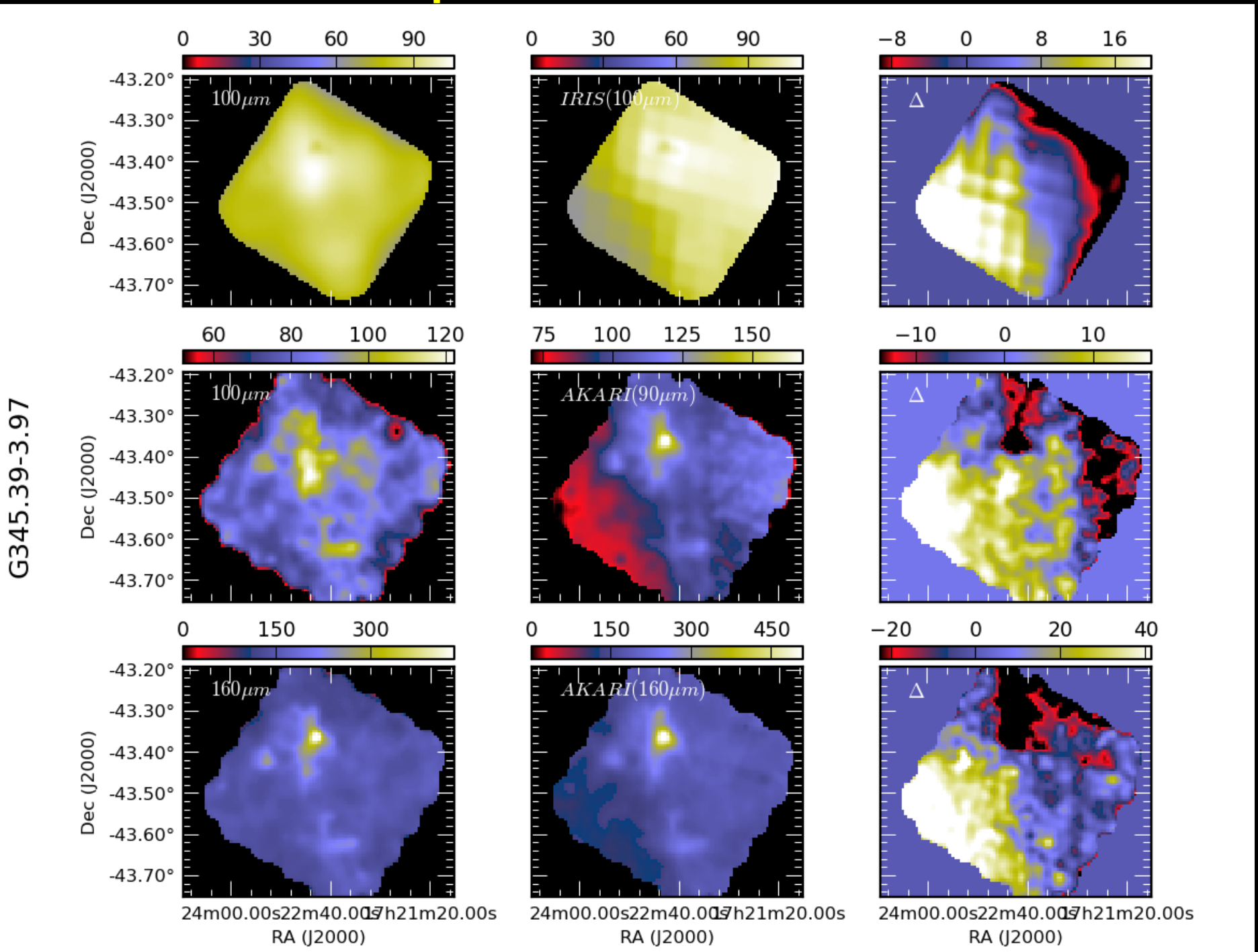
More / Less
large scale emission

not (or less) striped

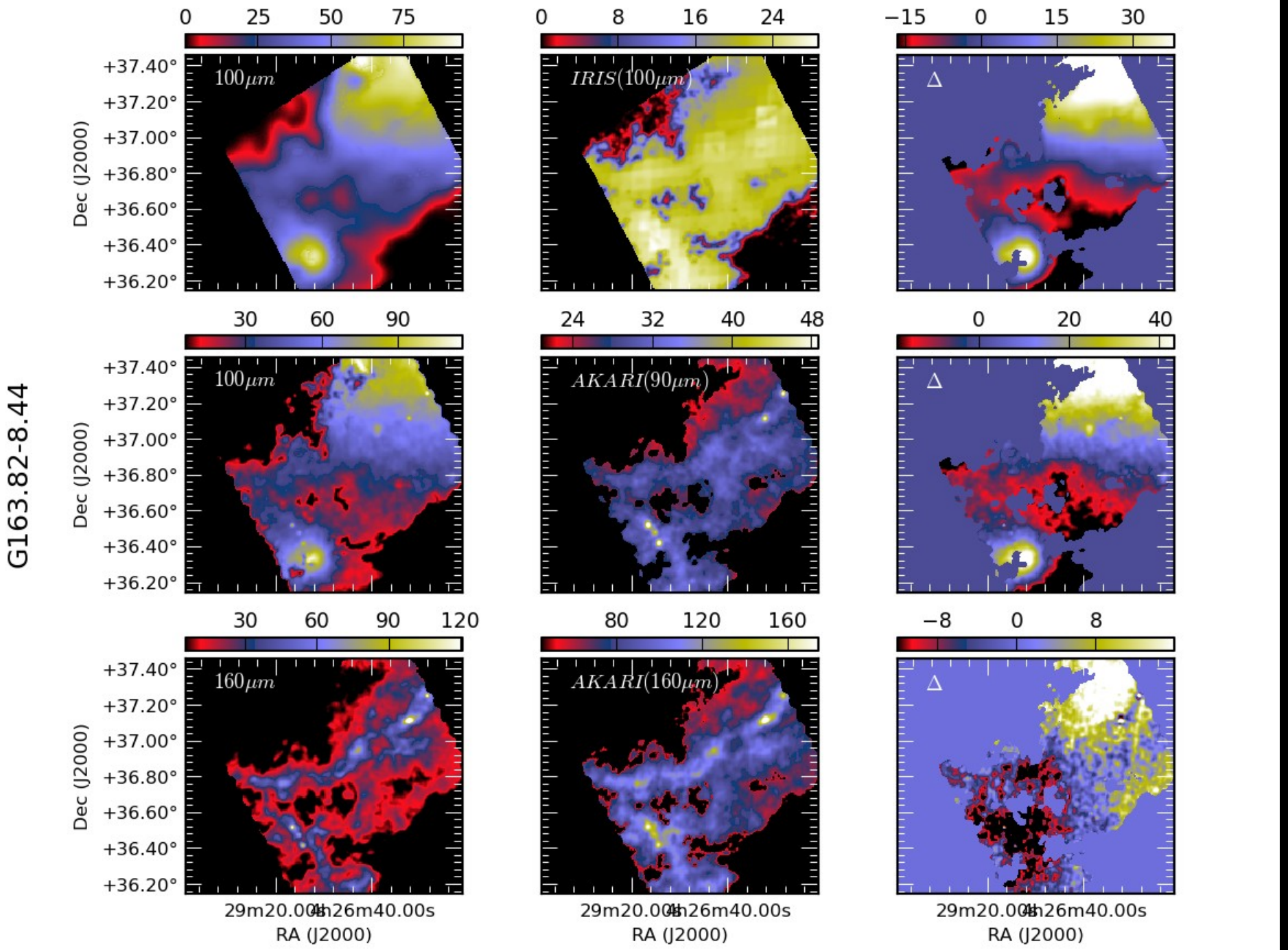
Madmap vs. IRAS & Akari



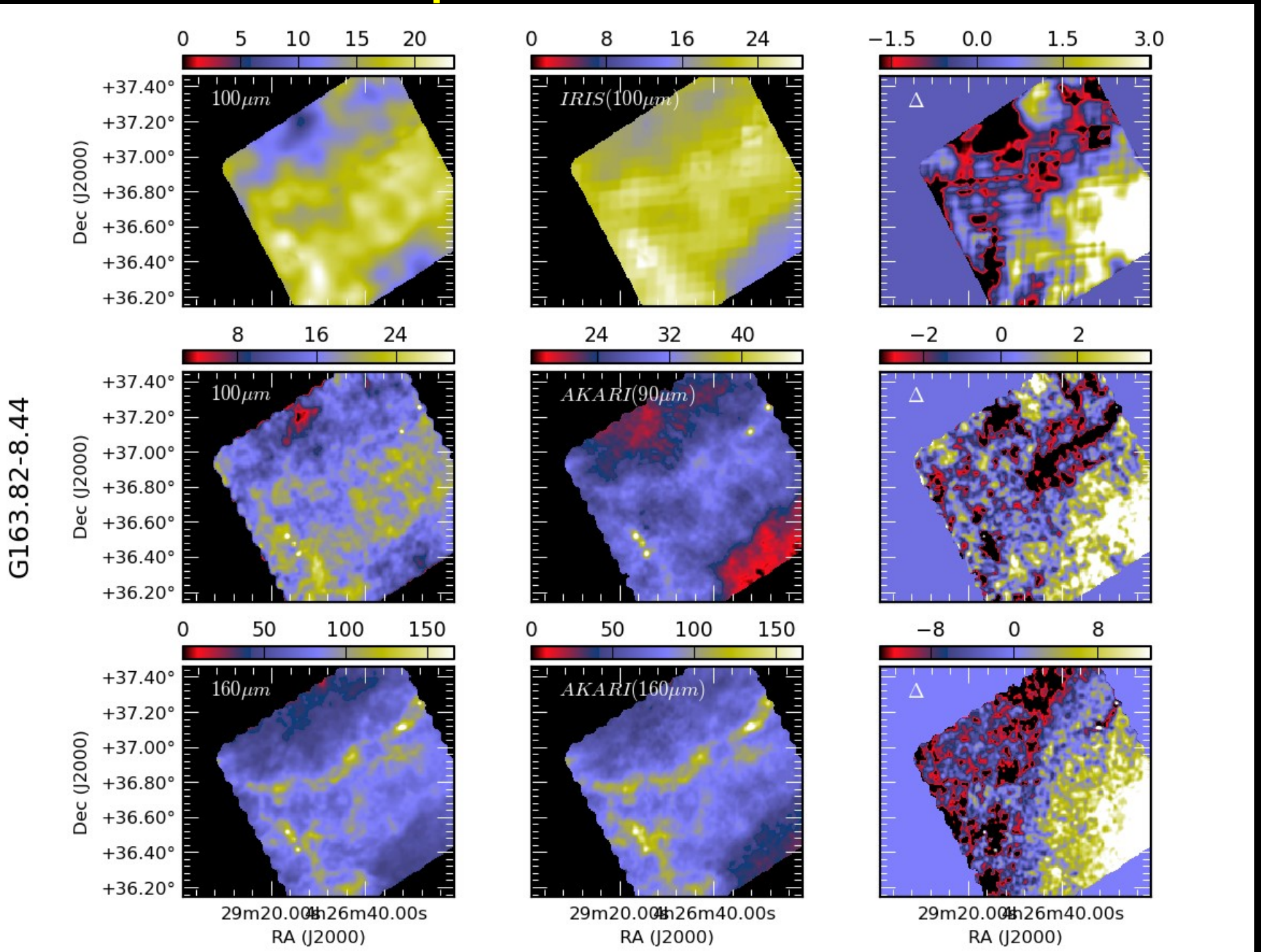
Scanamorphos vs. IRAS & Akari



Madmap vs. IRAS & Akari



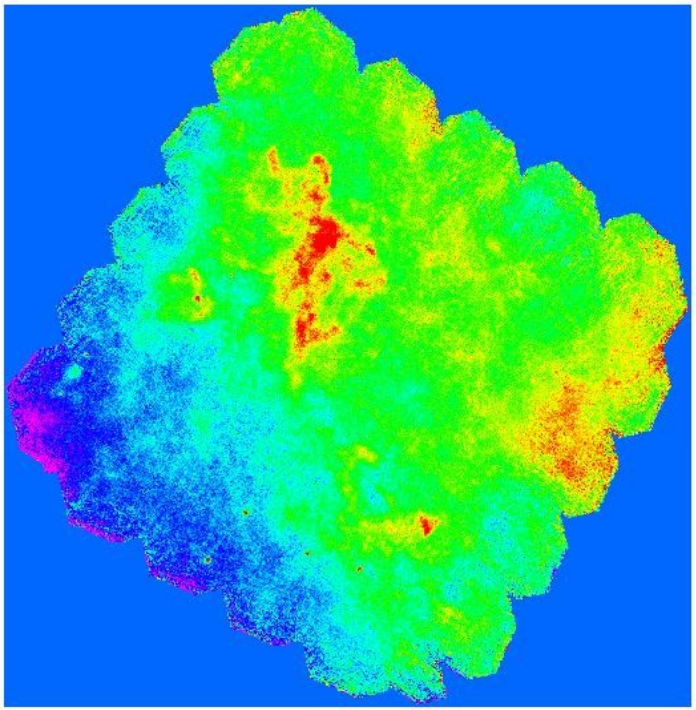
Scanamorphos vs. IRAS & Akari



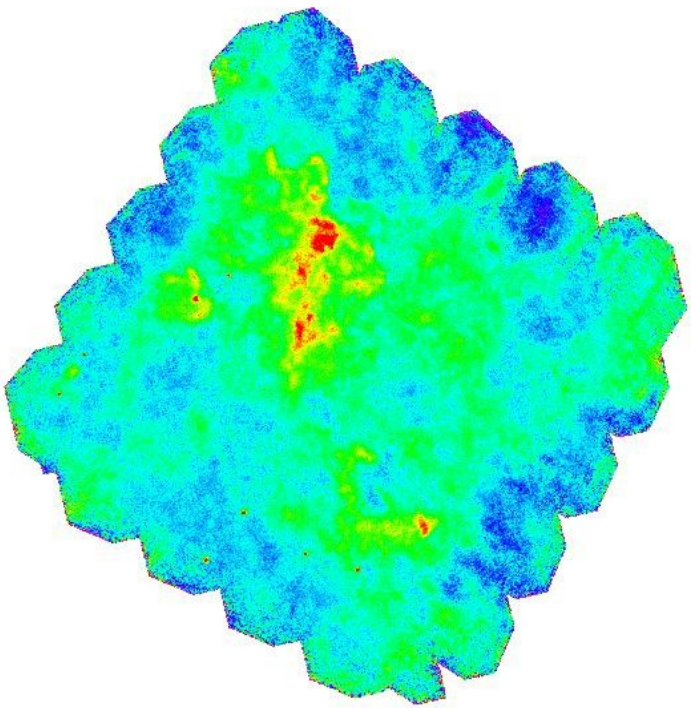
Scanamorphos: /galactic

Scanamorphos overcorrects the gradiant, but /galactic seems to fix this...

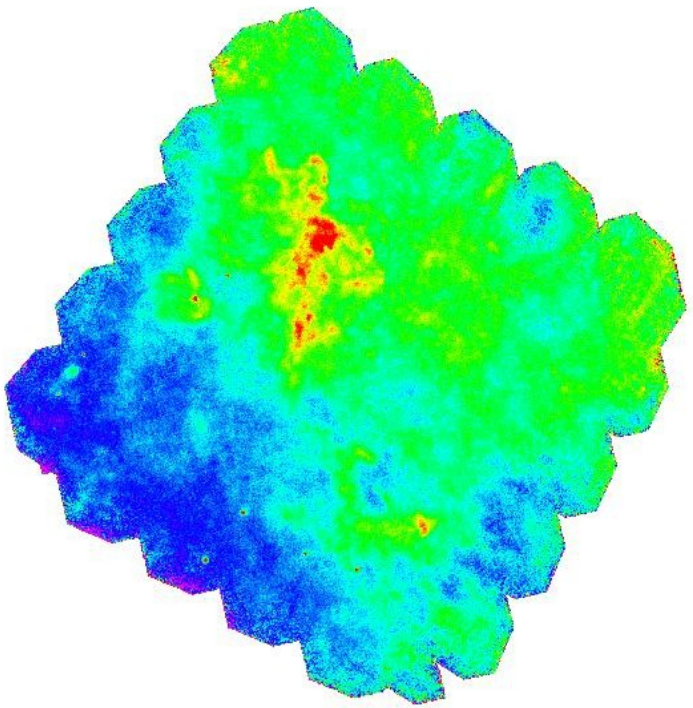
Madmap



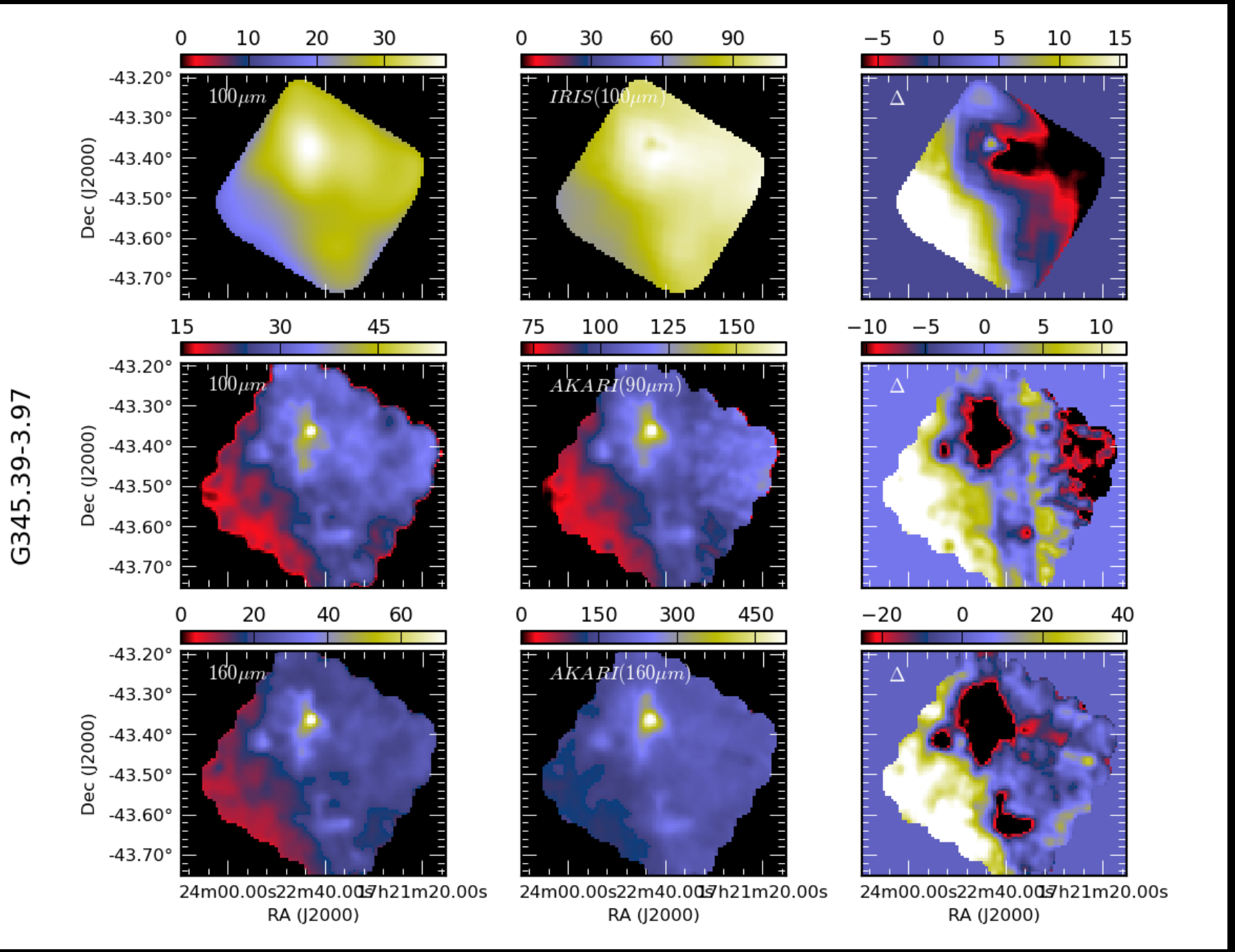
Scanamorphos



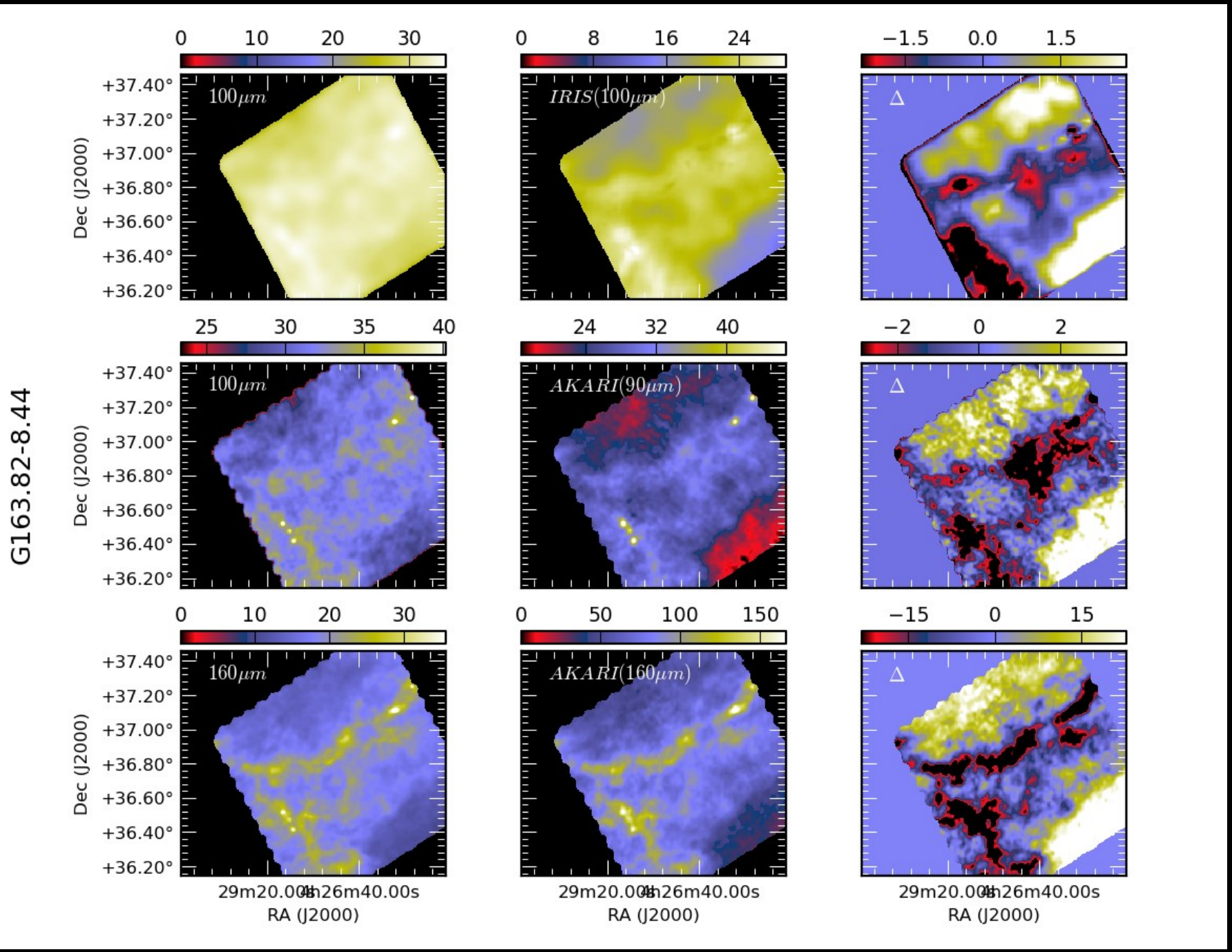
Scanam. /galactic



… or does it?


G345.39-3.97
100μm
IRIS(100μm)
Δ
100μm
AKARI(90μm)
Δ
160μm
AKARI(160μm)
Δ
Dec (J2000)
RA (J2000)
-43.20°
-43.30°
-43.40°
-43.50°
-43.60°
-43.70°
24m00.00s
22m40.00s
17h21m20.00s

… or does it? (part 2)

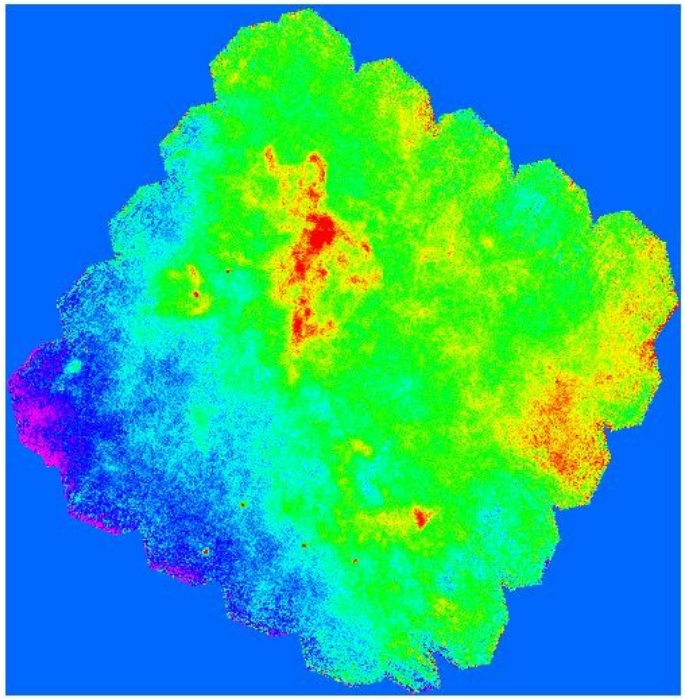


Madmap tweaked?

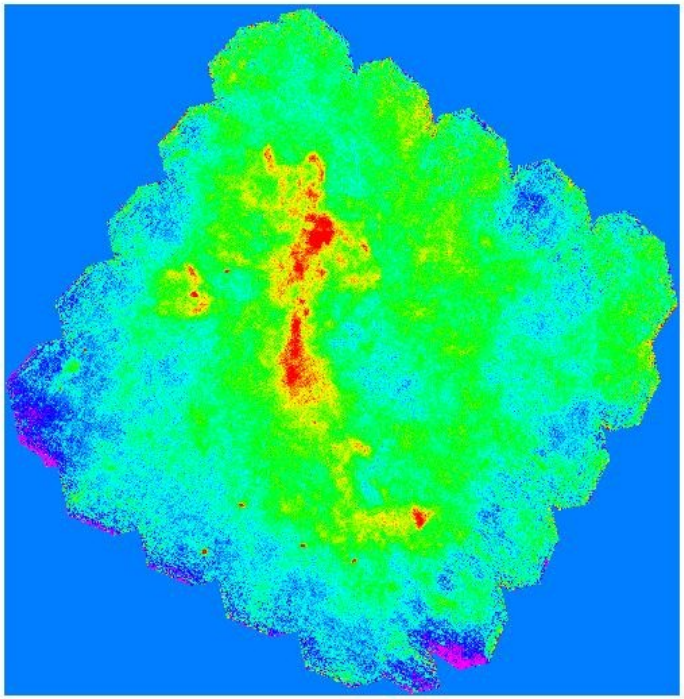
Changing the baseline drift correction values to segment size 2500 and bin size 500...

→ much better looking map

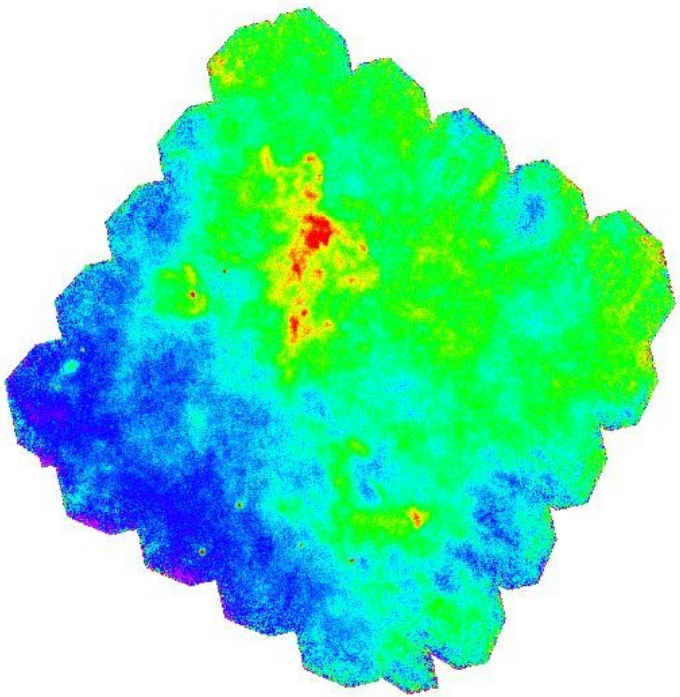
Madmap



Madmap 2500/500



Scanam. /galactic



Data Reduction: Summary

Comparison with ancillary data is important.

- Scanamorphos is better
  - It often subtracts the physical gradient, too
  - /galactic seems to help, but a problem with relative flux?
- Madmap tends to conserve the gradient better than Scanamorphos without /galactic
  - however, we get a poorer drift correction which leaves artifacts in the maps (especially on the edges) and/or remaining unphysical drift gradients
    - Some (small) maps at 100 μm are just artifacts
    - We should re-reduce the Madmaps with tweaked baseline drift correction values → better reduction
  - A problem with relative flux as well?
- SPIRE (D0) agrees very well with Planck

Science Results

The observations are done and reduced (however, we will re-reduce them using the latest versions). SPIRE results for 71 fields were published in Juvela et al. 2012.

- Confirmed the presence of cold dust with the color temperature of total intensity going to ~14 K or below.
- About 50% of the fields have a filamentary structure, often fragmented with clumps along the filaments
  - Descriptive of our target selection, not a global value!
- A few quiescent clouds but most show ongoing star formation. 22 μm YSOs co-exist with clumps having cold sub-mm spectra.
- Typical filament width is 0.2 – 0.3 pc, anticorrelated with the column density, as expected for isothermal, hydrostatic filaments, and for gravitationally bound spherical cores embedded in filaments.