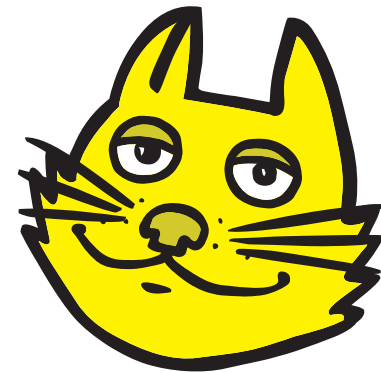


TOPCAT Latest

Mark Taylor (Bristol)

Applications WG session
IVOA Interop
Paris

14 May 2019



`$Id: topcat.tex,v 1.19 2019/05/13 20:29:29 mbt Exp $`

Outline

TOPCAT v4.6-3, STILTS v3.1-6 (9 May 2019):

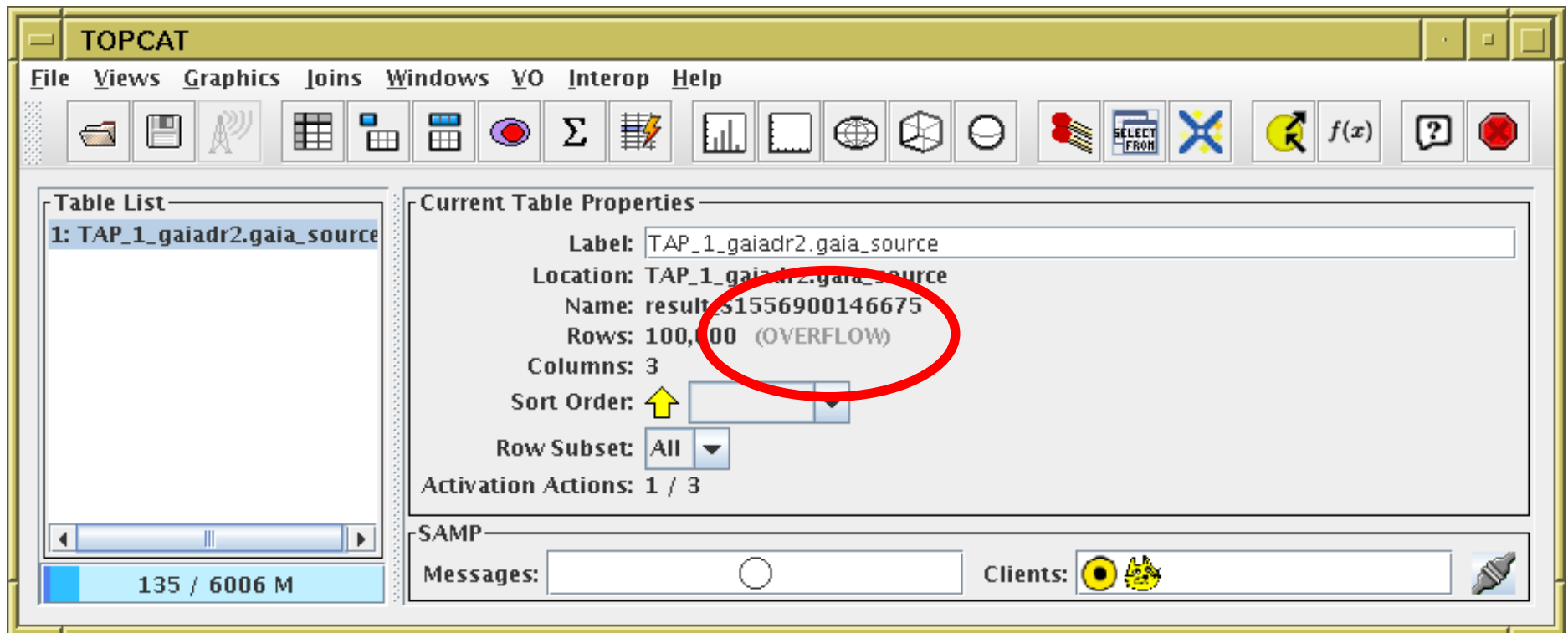
- DALI Overflow indicator
- VOTable 1.4 & TIMESYS
- Region selections & ADQL expressions
- Polygon plotting
- Plot measurements
- Adaptive colour map scaling
- HEALPix improvements

<http://www.starlink.ac.uk/topcat/>
<http://www.starlink.ac.uk/stilts/>

DALI Overflow

Give indication of row overflow (or error)

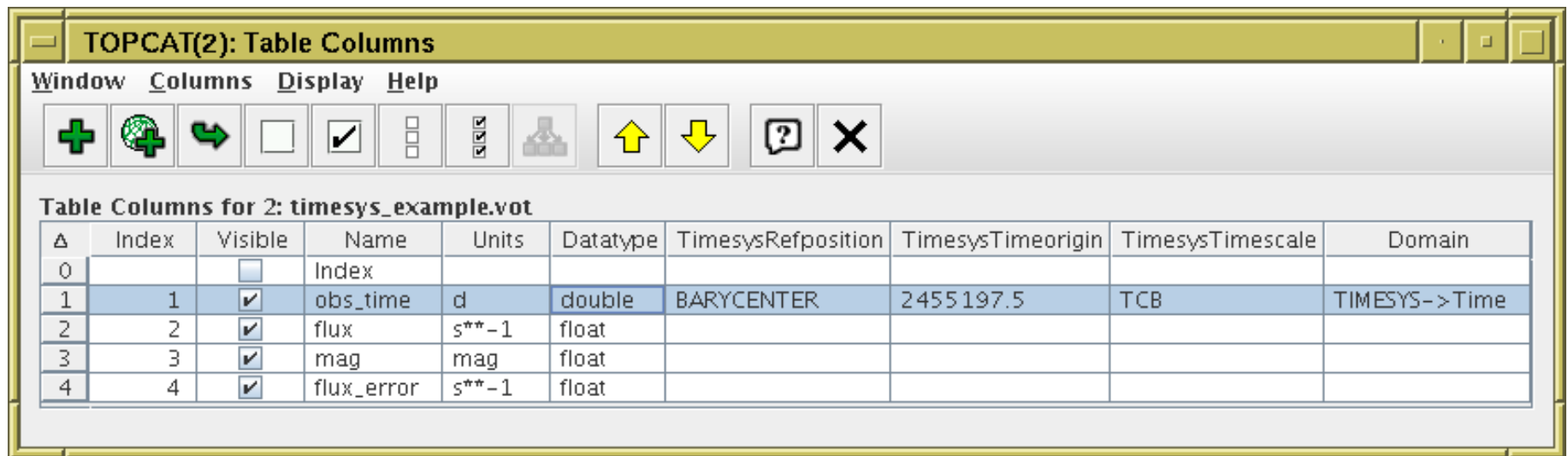
- DALI 1.1 sec 4.4.1: VO Table row count exceeding MAXREC or system-imposed limit:
`<INFO name="QUERY_STATUS" value="OVERFLOW"/>`
- This is now indicated by “**(OVERFLOW)**” label in TOPCAT control window



VO Table 1.4: TIMESYS Parsing

TIMESYS references mapped to STIL table model (StarTable)

- On input, **FIELD**→**TIMESYS** refs represented as column **Timesys*** metadata
- On output, column **Timesys*** metadata written as **FIELD**→**TIMESYS** refs, *but only if* `-Dvotable.version=1.4` (default output version is currently 1.3)
- **PARAM**→**TIMESYS** refs currently ignored (STIL deficiency; fix one day?)



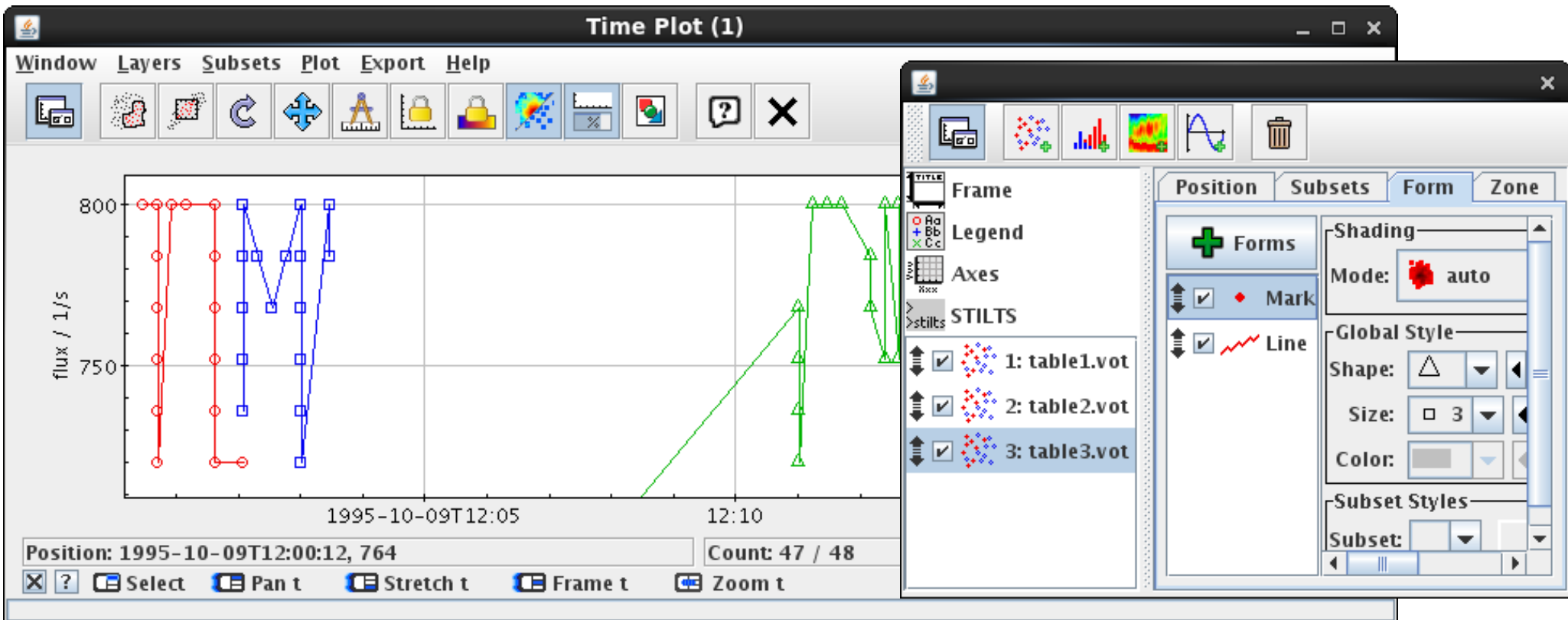
The screenshot shows the 'TOPCAT(2): Table Columns' window. The title bar reads 'TOPCAT(2): Table Columns'. Below the title bar is a menu bar with 'Window', 'Columns', 'Display', and 'Help'. A toolbar contains various icons for column management. The main area displays a table titled 'Table Columns for 2: timesys_example.vot'. The table has 10 columns: Δ, Index, Visible, Name, Units, Datatype, TimesysRefposition, TimesysTimeorigin, TimesysTimescale, and Domain. The table contains 5 rows of data.

Δ	Index	Visible	Name	Units	Datatype	TimesysRefposition	TimesysTimeorigin	TimesysTimescale	Domain
0		<input type="checkbox"/>	Index						
1	1	<input checked="" type="checkbox"/>	obs_time	d	double	BARYCENTER	2455197.5	TCB	TIMESYS->Time
2	2	<input checked="" type="checkbox"/>	flux	s**-1	float				
3	3	<input checked="" type="checkbox"/>	mag	mag	float				
4	4	<input checked="" type="checkbox"/>	flux_error	s**-1	float				

VOTable 1.4: TIMESYS Usage

TIMESYS values in TOPCAT/STILTS:

- Time origins/units understood
- ... but not currently much used
- So far, only used to align temporal axes in Time Plot
- No attempt to understand semantics of `reposition`, `timescale`
- Maybe more functionality in future releases



VOTable 1.4 Validation

`votlint`, hence `taplint`, updated to VOTable 1.4 WD

- Version is WD-VOTable-1.4-20190318, plus fixes to `reposition/timescale` URIs
- Knows (draft) VOTable 1.4 schema
- Checks TIMESYS attributes `reposition`, `timescale`
 - ▷ These attribute values are defined with reference to external *vocabularies* (e.g. `http://www.ivoa.net/rdf/timescale`)
 - ▷ Validator has hard coded list of known options (vocab contents at time of writing) (e.g. TAI, TT, UT, UTC, GPS, TCG, TCB, TDB, UNKNOWN)
 - ▷ Will read external URL at runtime in case of unrecognised value
- Warns if `TIMESYS` element is present but unreferenced

Region Selection

More options for selecting subsets graphically

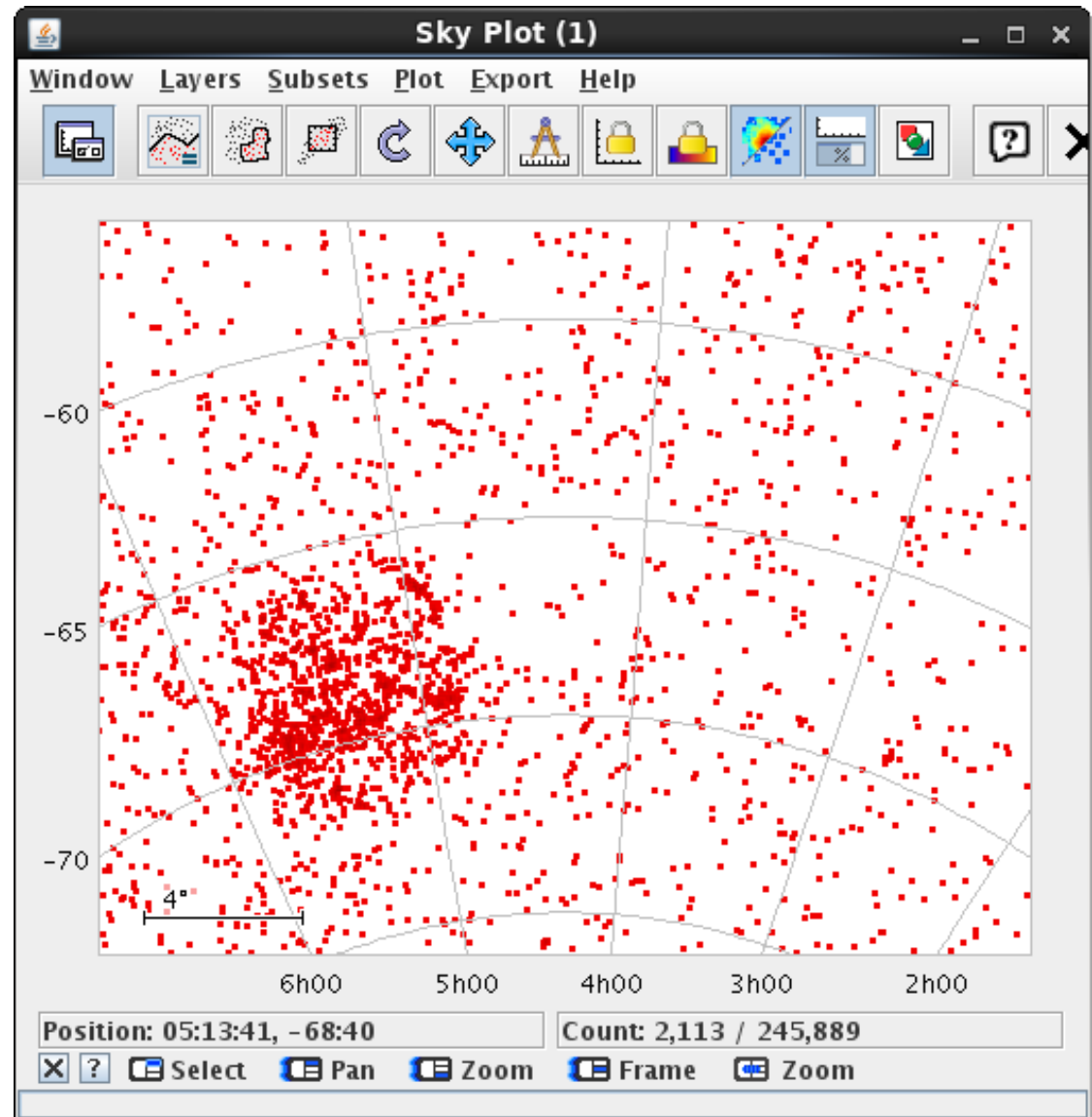


- Plane Plot: Polygon, Ellipse, Above, Below, Left, Right
- Sky Plot: Circle, Polygon

When drawing complete:

- Defines subsets
- Presents TOPCAT expression
- Presents ADQL expression
 - ▷ Sky: Circle, Polygon
 - ▷ Plane: Ellipse, Line
 - ▷ Easily pasted into TAP

Future plans:
better region support
(not just subset selections)



Region Selection

More options for selecting subsets graphically

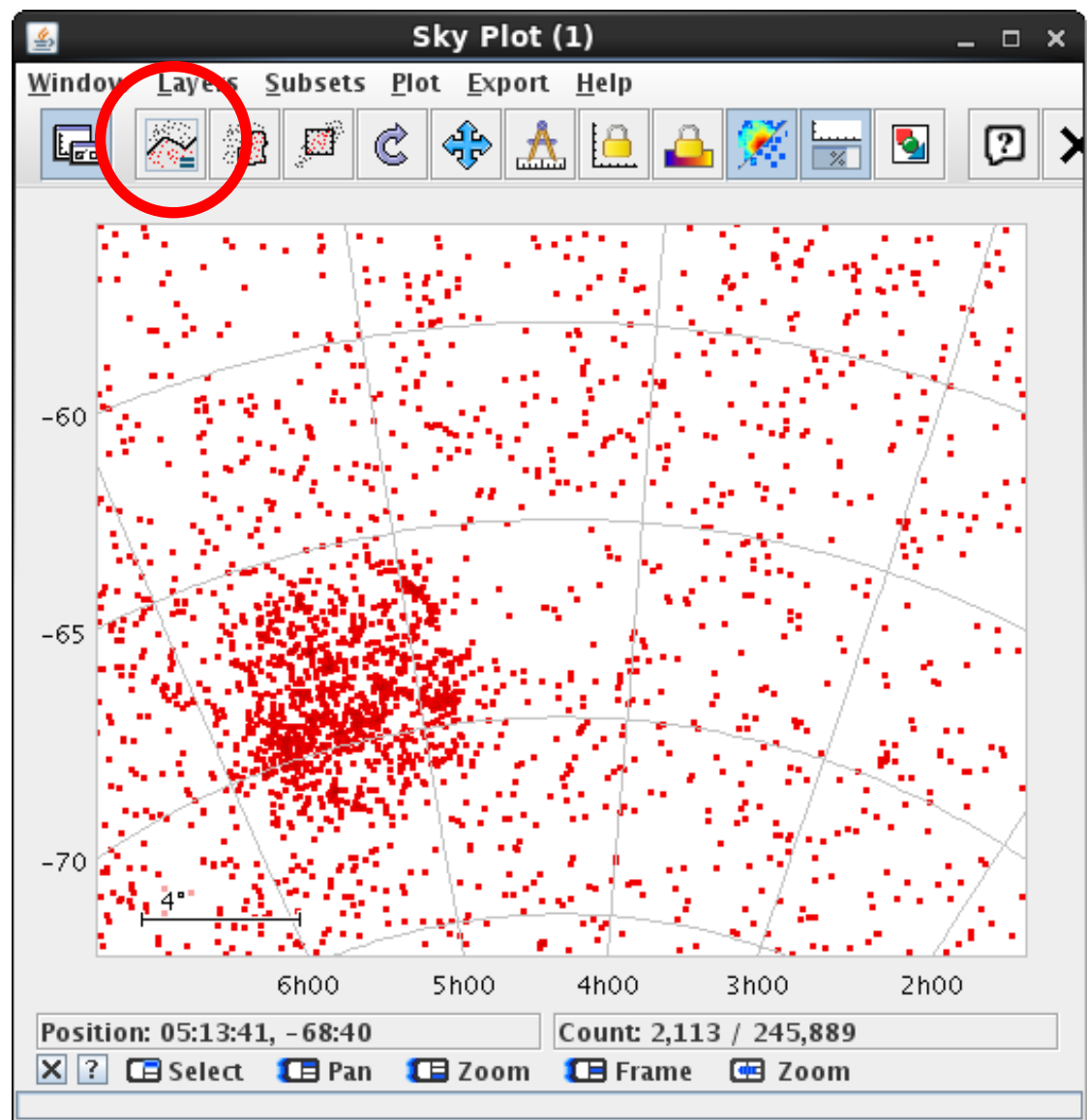


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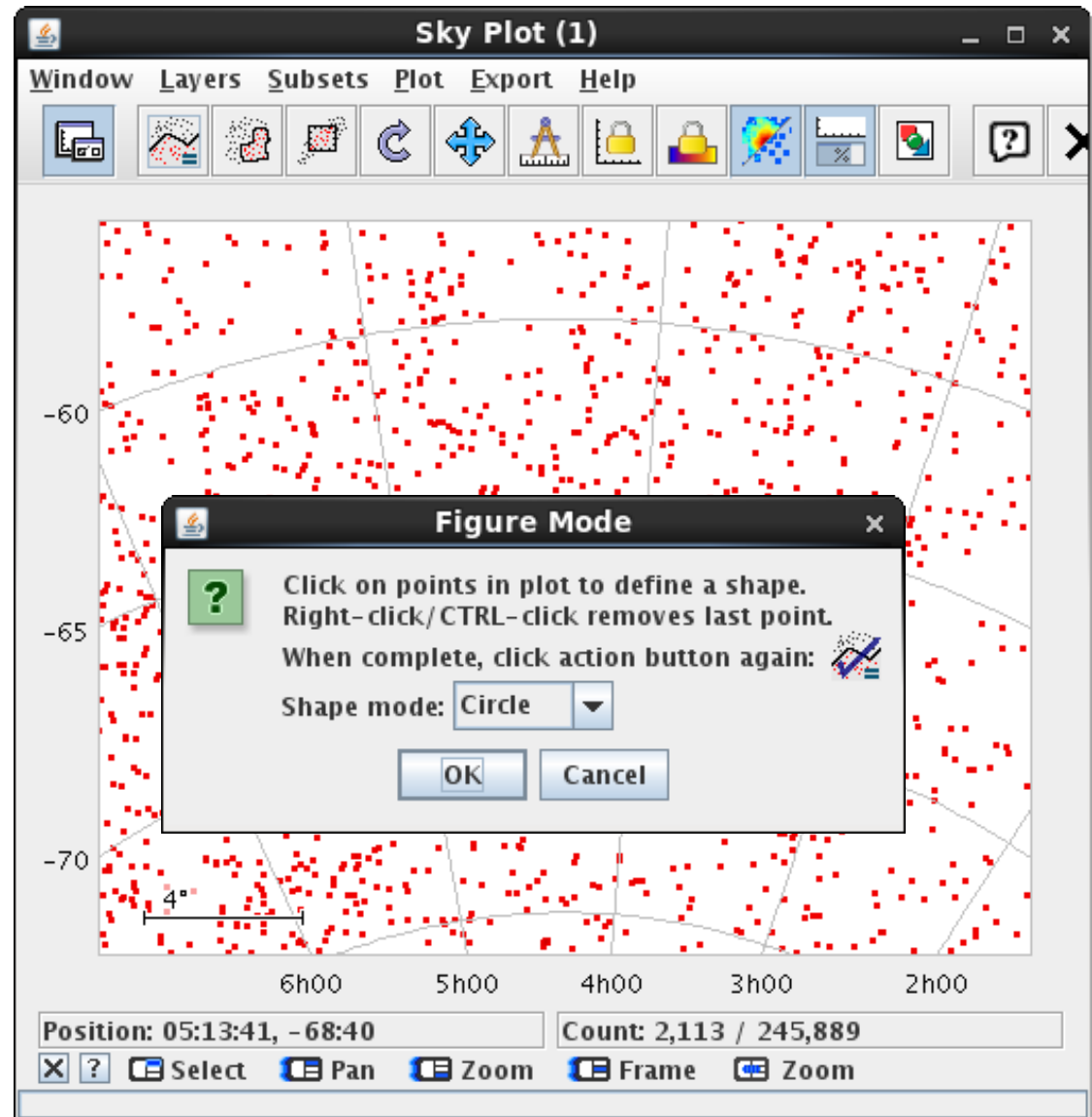


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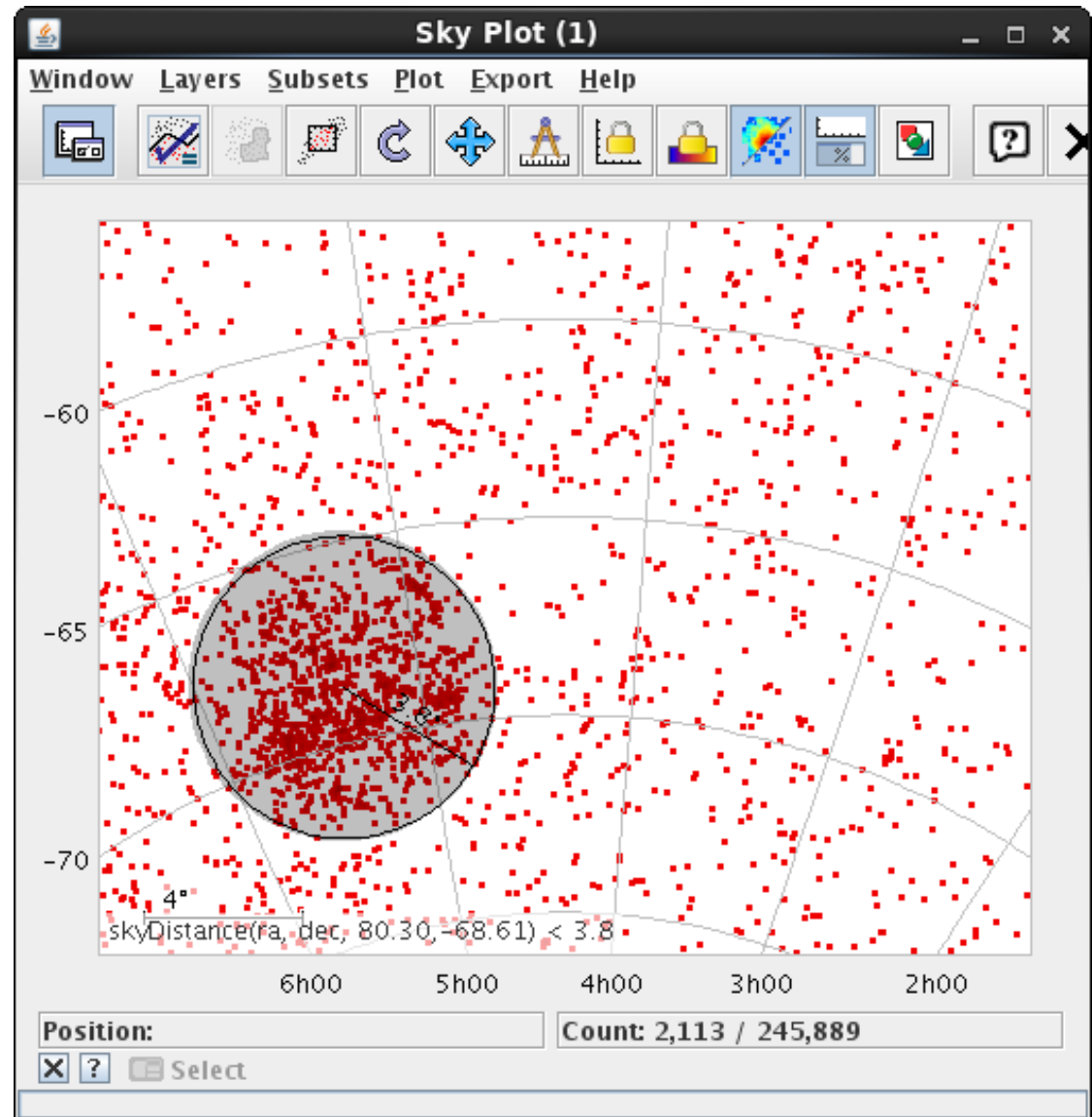


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Window Layers Subsets Plot Export Help

Window Help

$f(x)$? X

Expressions

TOPCAT: skyDistance(ra, dec, 80.30, -68.61) < 3.9

ADQL: 1=CONTAINS(POINT("", ra, dec), CIRCLE("", 80.30, -68.61, 3.9))

Subset Name: lmc

Create	Table	Expression
<input checked="" type="checkbox"/>	1: iras_psc.fits	skyDistance(ra, dec, 80.30, -68.61) < 3.9

OK Cancel

Position: Count: 2,113 / 245,889

X ? Select

Region Selection

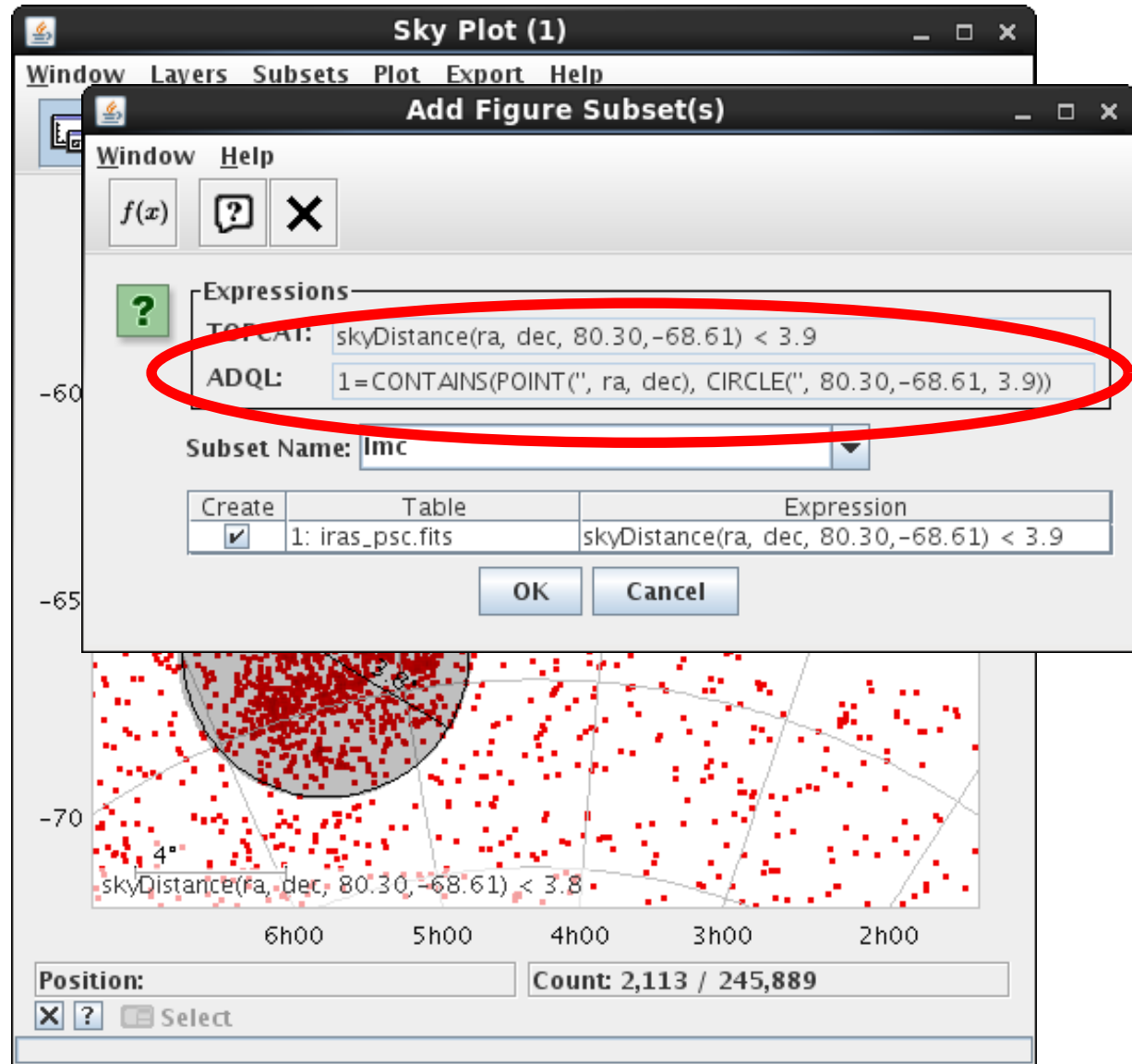
More options for selecting subsets graphically 

- Plane Plot: Polygon, Ellipse, Above, Below, Left, Right
- Sky Plot: Circle, Polygon

When drawing complete:

- Defines subsets
- Presents TOPCAT expression
- Presents ADQL expression
 - ▷ Sky: Circle, Polygon
 - ▷ Plane: Ellipse, Line
 - ▷ Easily pasted into TAP

Future plans:
better region support
(not just subset selections)



The screenshot displays the 'Sky Plot (1)' window with an 'Add Figure Subset(s)' dialog box open. The dialog box has a 'Window Help' menu and buttons for $f(x)$, a question mark, and a close button. It contains two text input fields for expressions: 'TOPCAT: skyDistance(ra, dec, 80.30, -68.61) < 3.9' and 'ADQL: 1=CONTAINS(POINT("", ra, dec), CIRCLE("", 80.30, -68.61, 3.9))'. The ADQL expression is circled in red. Below the expressions is a 'Subset Name' dropdown menu set to 'lmc'. At the bottom of the dialog is a table with columns 'Create', 'Table', and 'Expression'. The table contains one row:

Create	Table	Expression
<input checked="" type="checkbox"/>	1: iras_psc.fits	skyDistance(ra, dec, 80.30, -68.61) < 3.9

 Below the table are 'OK' and 'Cancel' buttons. The background shows a sky plot with a circular selection region and a status bar indicating 'Count: 2,113 / 245,889'.

Region Selection

More options for selecting subsets graphically

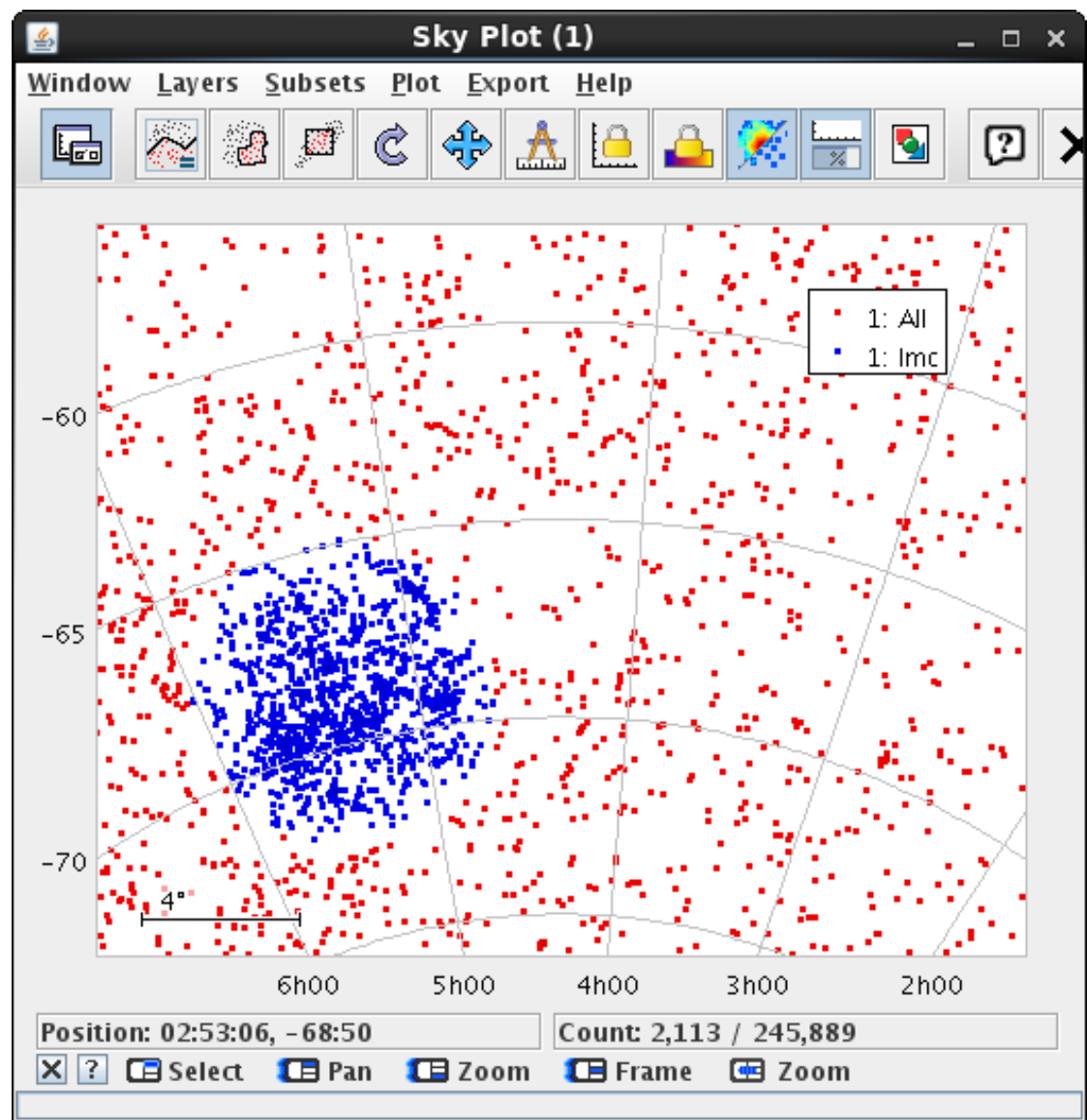


- Plane Plot: Polygon, Ellipse, Above, Below, Left, Right
- Sky Plot: Circle, Polygon

When drawing complete:

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- Presents ADQL expression
 - ▷ Sky: Circle, Polygon
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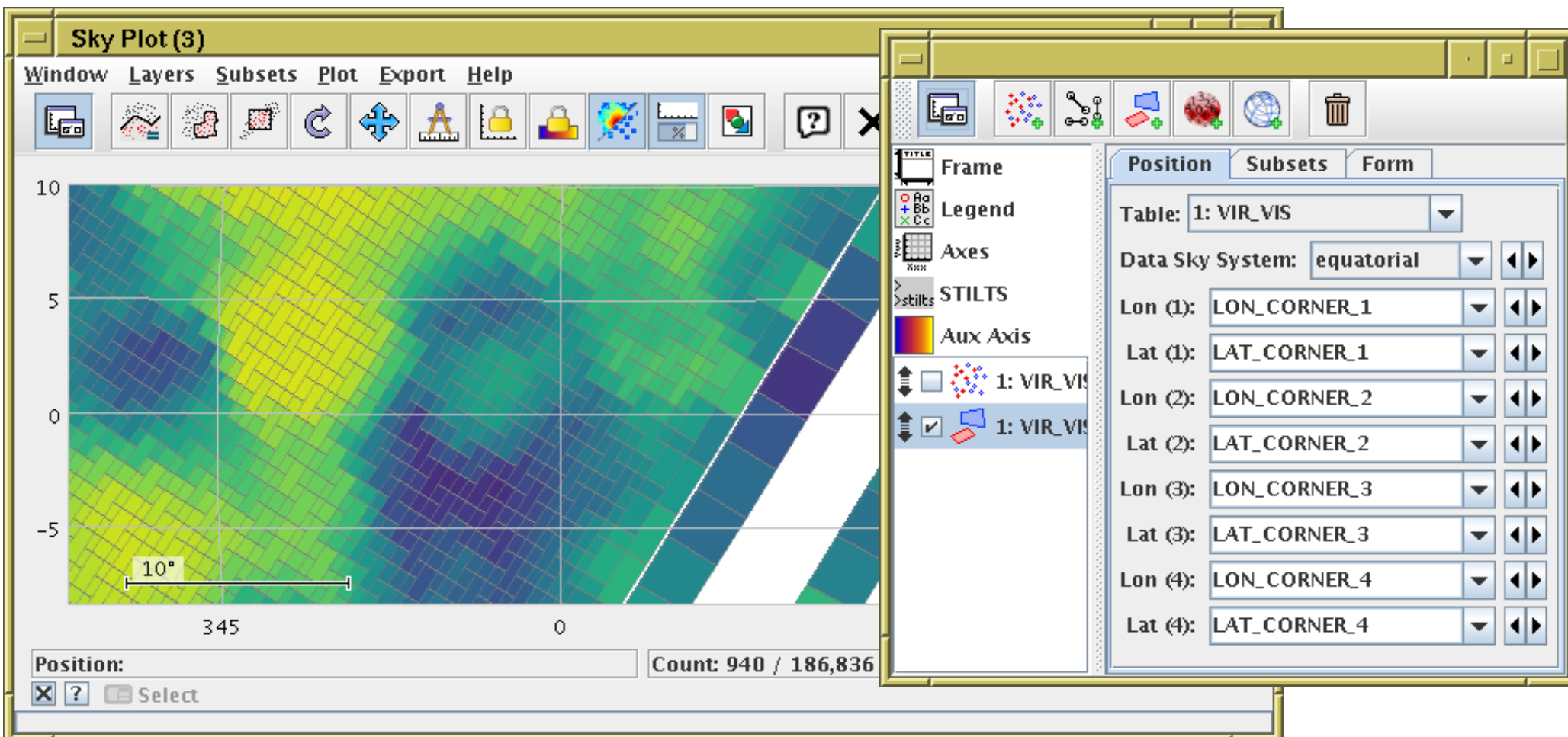
Future plans:
better region support
(not just subset selections)



Quadrilateral Plots

New Quad Position layer control

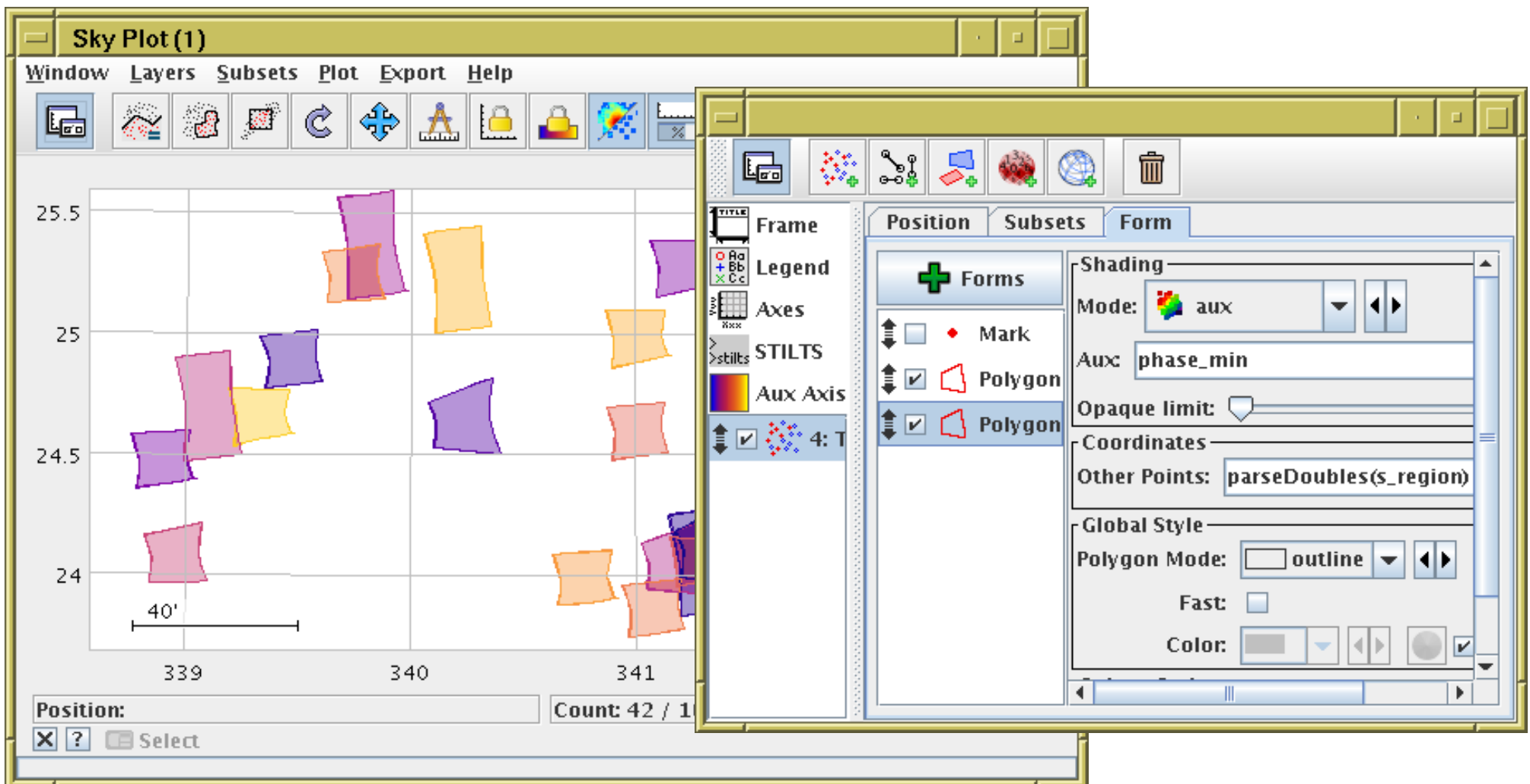
- Supply 4 coordinates to define quadrilateral (or 3 for triangle)
- Suitable for e.g. field of view of planetary observations
- Works for all plot types (sky, plane, 3d, ...)
- Improved use of UCDs for default vertex coordinate values



Polygon Plots

New Polygon plot form

- Plots array-valued cells (e.g. [lon1,lat1, lon2,lat2, lon3,lat3, ...])
- Function `parseDoubles` can be used to hack these out of STC-S (e.g. `s_region`)



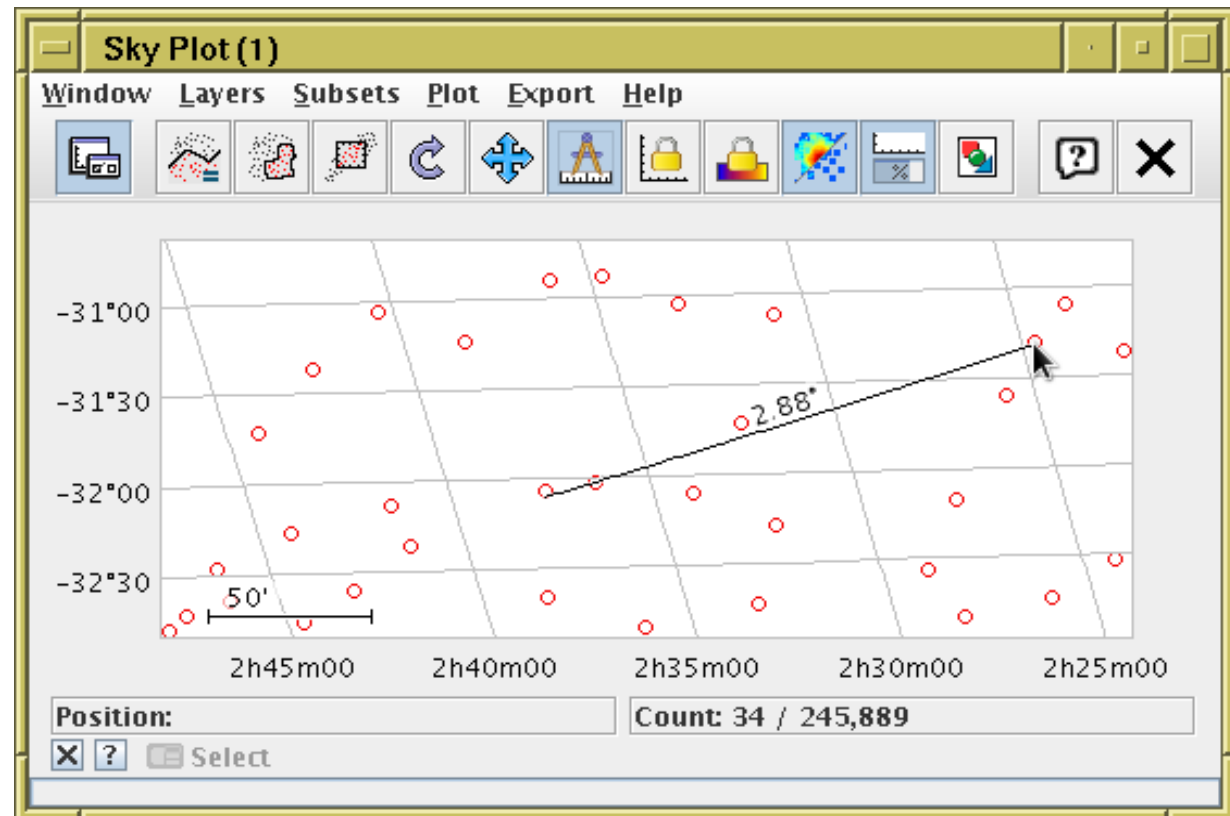
Sky Measurement

Sky plot now has **Scale Bar** labelled in degrees/arcmin/arcsec

- Present by default; can be turned off

New **Measure Distance** interactive tool 

- Displays length of interactively dragged line
- Similar functionality in Plane Plot as well



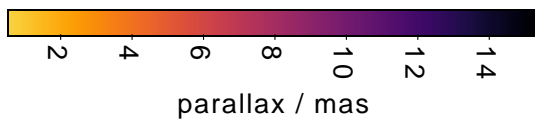
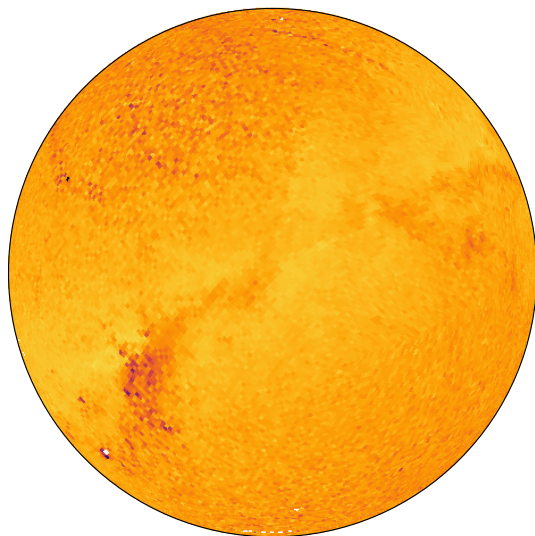
*Both ideas stolen from Aladin
— Thanks!*

Colour Map Scaling

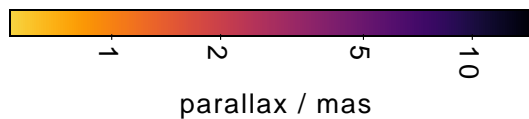
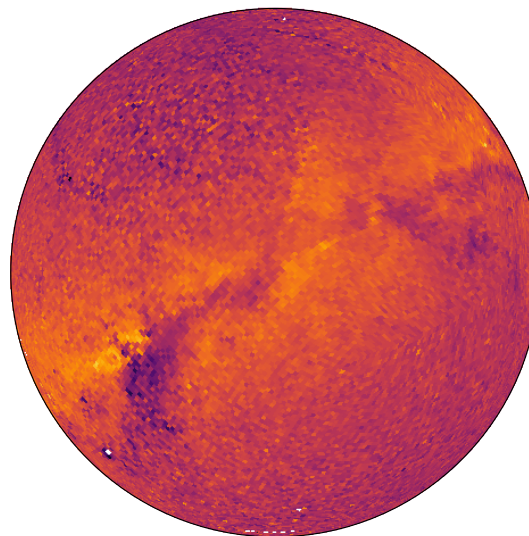
New adaptive colour map scaling option

- New **Scaling** option “**histogram**” / “**histolog**”
- Adapts to value distribution, not just linear/log/etc scaling over min–max range
- Easier to see structure for unevenly distributed data

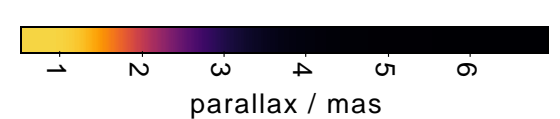
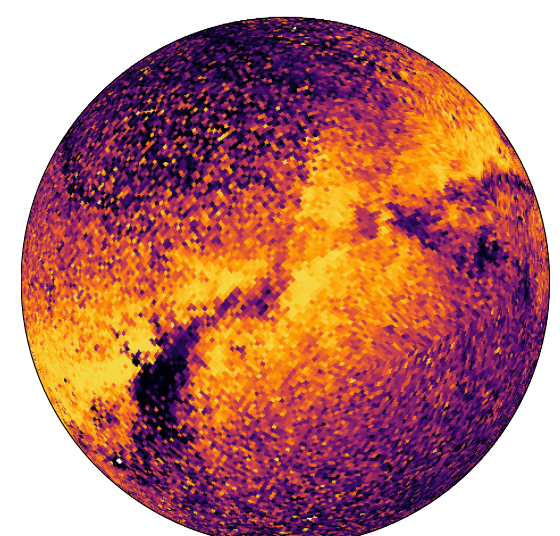
scaling=linear



scaling=log



scaling=histogram



Limited support for semi-standard **FITS-HEALPix** serialization format

- FITS-HEALPix format de facto standard for storing full/partial HEALPix maps in FITS
 - ▷ Already used in Aladin and official HEALPix libraries
- FITS-HEALPix metadata now mapped to STIL table model
- I/O handlers read/write FITS with standard HEALPix metadata
 - ▷ Round-tripping works
 - ▷ Can export 'standard' HEALPix maps from TOPCAT SkyDensity plot
- Support is not perfect
 - ▷ Best efforts for standard FITS output; new `healpix-fits` output format tries harder
 - ▷ Some things unsupported: `BAD_DATA` header, 1024-element array variant

Other HEALPix Plot improvements

- Now plots up to level 20 (was 13)
- Can now select pixels graphically, like points in marker plots

Future:

- Considering move to F-X Pineau's HEALPix library (from PixTools)

HEALPix

Aladin v10.1 *** BETA VERSION (based on v10.107) ***

Available data → 23231 / 23234
● in view ● out view

Command [] Frame Planet... Projection Spheric

DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Gaia Simbad NED +

Moon Kaguya-Evening-V04-474m

select pan dist phot draw tag moc spect filter cross x-y rgb assoc epoch size dens. crop opac. zoom

359.14544 -32.43.48

02:02.40636 +51:39:30.23
43.48° x 40.5°

0 sel / 0 src 608Mb

Credit: Stéphane Erard

Future Plans

Amongst other things...

- Authentication
 - ▷ In progress (see TAP 1.1 Auth experiments in DAL/GWS/Apps/Reg joint session)
- Regions
 - ▷ Some region functionality now introduced
 - Shape drawing produces algebraic/ADQL expressions
 - Quadrilateral and Polygon plotting modes
 - ▷ Hope to have better region manipulation in future releases
- Planetary Science
 - ▷ EuroPlanet 2024/VESPA involvement
 - ▷ Input already from Batiste Rousseau, Stéphane Erard (polygon plotting)
 - ▷ Investigate planetary applications/requirements for TOPCAT