Data Collection	VMC_PSF
Release Number	1
Data Provider	Maria-Rosa Cioni
Date	05.01.2015

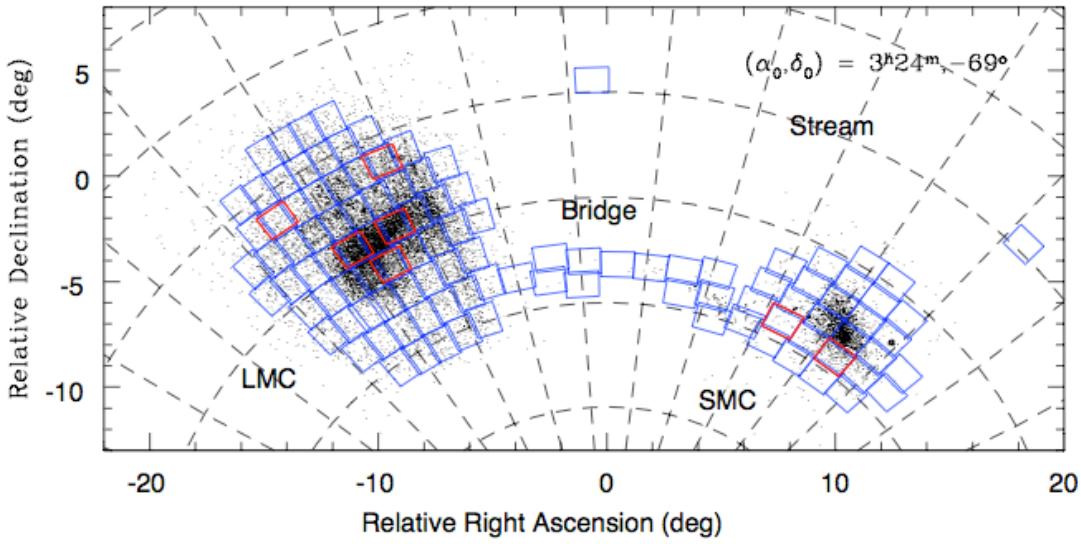
Abstract

Observations were obtained with the VISTA telescope as part of the VISTA survey of the Magellanic Cloud system (VMC; ESO program 179.B-2003) in three filters: Y, J and Ks. The main goals of the VMC survey are the determination of the spatially resolved star formation history and the three-dimensional geometry of the Magellanic system. The sensitivity of the data is designed to reach sources below the oldest main-sequence turn off point of the stellar population and the multi-epochs to measure accurate Ks mean magnitudes for pulsating variable stars, e.g. RR Lyrae stars and Cepheids.

This catalogue data release provides PSF photometry in addition to the aperture photometry, which has been made available in VMC_CAT, and refers to deep tile images for VMC tiles completed by October 2012 (tiles LMC 5_5, 6_4, 6_6, 8_3, 8_8 and tiles SMC 3_3, 3_5). The total sky coverage of this release is ~7.5 deg^2 in the LMC and ~3 deg^2 in the SMC.

Overview of Observations

The figure below shows the Magellanic system as tiled by the VMC survey (blue) and tiles for which catalogues are released (red). Underlying small dots indicate the distribution of carbon stars, stellar clusters and associations.



Tile numbering begins from the bottom right corner, increasing from right to left and from bottom to right. The first LMC tile is 2_3, the first SMC tile is 2_2, the first Bridge tile is 1_2 and Stream tile 1_1 is right above the Bridge while 2_1 is to the right of the SMC.

Release Content

This catalogue release covers five tiles in the Large Magellanic Cloud: LMC 5_5, 6_4, 6_6, 8_3 and 8_8, as well as two tiles in the Small Magellanic Cloud: SMC 3_3 and 3_5.

LMC tiles were oriented with the Y axis more or less along the declination direction while for SMC tiles the Y axis is along the right ascension direction. Each tile covers about 1.771 deg^2 where the central (1.475 x 1.017)=1.501 deg^2 corresponds to the nominal depth of the survey and the remaining area to half the exposure time in each band.

Tile identification, number of records, size in Mby, limiting magnitude (PSFMAG) in Y, J and K_s corresponding to sources with photometric errors PSFMAG3ERR<0.1 mag are listed below.

Tile	Records	Mby	Y	J	Ks
SMC 3_3	1631078	301.8	25.877	24.329	22.586
SMC 3_5	730556	135.2	26.844	23.311	23.217
LMC 5_5	2370316	438.6	23.325	23.607	22.012
LMC 6_4	2529499	468	22.775	23.236	22.463
LMC 6_6	2606518	482.3	23.387	23.138	21.775
LMC 8_3	1626833	301	23.606	22.966	22.348
LMC 8_8	1250668	231.5	24.679	23.782	22.313

Release Notes

The data for this release were prepared by the Wide Field Astronomy Unit (WFAU) and the VMC team from images initially processed by the Cambridge Astronomy Survey Unit (CASU). In particular, the PSF photometry was created at the INAF, Padova Observatory (Italy).

The main processing steps are described in Cross et al. (2012, A&A 548, A119) and Cross et al. (2009, MNRAS 399, 1730). Deep tiles are produced only from data that meet the observing criteria for the VMC survey using the SWARP tool (Bertin et al. 2002 ASP Conf. Ser., 281, 228) and the PSF photometry was made using IRAF Daophot packages (Stetson, P.B., PASP, 99, 191).

The point spread function (PSF) detection was made separately in each Y, J and K_s band, than the catalogues were correlated using a radial distance threshold of 1 arcsec. The uniformity of limited magnitude on the final deep tile is intrinsically dependent on differences in the detector sensitivity and stellar crowding.

The IAUNAME of sources in the PSF catalogues may not be unique. At this stage, sources in the overlap of tiles will appear with the same IAUNAME. Furthermore, the IAUNAME is rounded to two decimal points in arcsec, hence, it may be possible that two sufficiently close extractions result in two sources with the same IAUNAME.

The catalogues contain parameters that link the sources, extracted with PSF photometry, with those extracted with aperture photometry as in the VISTA Data Flow System pipeline. The SOURCEID parameter identifies sources in VMC_CAT that correspond to sources in VMC_PSF. Note that there can be more PSFIDs corresponding to the same SOURCEID. The DISTANCEMINS parameter indicates the distance in arcmin between the RA2000 and DEC2000 coordinates of a VMC_CAT source and similar coordinates for a VMC_PSF source.

The catalogues contain also the SHARP parameter for each band. SHARP is a measure of the difference between the observed width of the object and the width of the PSF model. Stars should have sharpness values of ~0.0, resolved objects sharpness values >0.0, and cosmic rays and similar blemishes sharpness values <0.0.

Data Reduction and Calibration

The procedures to reduce and calibrate the data are described in detail at: http://casu.ast.cam.ac.uk/surveys-projects/vista/technical/data-processing.

In particular, catalogues were created from pawprint images that were not filtered for nebulosity with size of the order of 30 arcsec (Irwin 2010, UKIRT Newsletter 26, 14). This filtering process is, instead, applied by CASU prior to the creation of tile images.

The calibrated pawprint images were combined using SWARP to generate a uniform sky subtracted final deep tile image. Artifacts in the pawprint images were removed masking contaminated regions during the co-addition. The PSF in each detector on each pawprint image was normalized to a constant PSF reference model using a Fourier deconvolution technique before to combine them.

The deep multi-filter YJK$_s$ PSF catalogues were generated correlating the three filters PSF catalogues using a 1 arcsec maximum radius. The magnitudes were not corrected for reddening.

Data Quality

The astrometric and photometric quality of the data is described in detail at *http://casu.ast.cam.ac.uk/surveys-projects/vista/technical*.

The SHARP parameter, listed in the catalogues, could be used to disentangle point-like sources. The efficiency of this parameter depends on the FWHM and S/N ratio of the image.

Compared to aperture photometry, the PSF photometry reaches sources on average 3 magnitudes fainter with uncertainties <0.1 mag. The magnitude difference may be larger in crowded stellar fields, especially in the Y-band, or smaller in less crowded fields and in the K$_s$-band.

The completeness of the catalogues was evaluated from artificial star tests.

Tile	Filter	95%	90%	75%	50%
SMC 3_3	Y	18.5	19.6	20.9	21.6
	J	18.4	19.5	20.8	21.5
	Ks	17.9	19.1	20.4	20.8
SMC 3_5	Y	21.1	21.6	21.9	22.3
	J	20.6	21.4	21.8	22.1
	Ks	19.8	20.4	20.7	20.8
LMC 5_5	Y	17.3	18.0	19.4	20.6
	J	16.9	17.6	19.1	20.3
	Ks	16.3	17.1	18.7	19.9
LMC 6_4	Y	17.0	17.6	18.8	20.0
	J	16.5	17.1	18.4	19.6
	Ks	15.8	16.5	17.9	19.3
LMC 6_6	Y	17.4	18.1	19.4	20.5
	J	16.9	17.6	19.0	20.2
	Ks	16.4	17.2	18.8	20.0
LMC 8_3	Y	19.3	20.2	21.2	21.9
	J	19.2	20.0	21.0	21.6
	Ks	18.5	19.5	20.3	20.5
LMC 8_8	Y	19.3	20.2	21.3	22.1
	J	19.2	20.0	21.1	21.7
	Ks	18.5	19.5	20.3	20.6

Known issues

These VISTA data may present the following issues, for which a full description is given in http://casu.ast.cam.ac.uk/surveys-projects/vista/technical/known-issues. A variable depth due to bad pixels in detectors #1, #4 and #16 as well as some bad rows. Point-like objects residuals of flatfielding, variable vignetting and spurious detections around bright stars. Some of these issues are recorded in the quality error bits flags assigned during post processing.

Data Format

Files Types

Seven PSF catalogues in YJK$_s$, one per tile, are released:

vmc_er3_00h44-074d12_yjks_psfCat_558345748487.fits
vmc_er3_01h27-074d00_yjks_psfCat_558345748486.fits
vmc_er3_05h04-066d15_yjks_psfCat_558345748481.fits
vmc_er3_05h12-069d16_yjks_psfCat_558345748483.fits
vmc_er3_05h24-070d48_yjks_psfCat_558345748485.fits
vmc_er3_05h37-069d22_yjks_psfCat_558345748484.fits
vmc_er3_05h59-066d20_yjks_psfCat_558345748482.fits

where the name is constructed as project_release_ra/dec_bands_typeofCat_framesetID.fits and framesetID uniquely identifies the tile as follows:

558345748487 SMC 3_3
558345748486 SMC 3_5
558345748481 LMC 8_3
558345748483 LMC 6_4
558345748485 LMC 5_5
558345748484 LMC 6_6
558345748482 LMC 8_8.

A MetaData file, vmc_er3_yjks_psfCatMetaData.fits, accompanies the release. Its name refers to project_release_bands_typeofCat.fits.

Catalogue Columns

PSF catalogues contain 33 columns listed below.

Number; name; format; description

1; IAUNAME; 29A; IAU Name (not unique)
2; SOURCEID; K; UID of this merged detection as assigned by merge algorithm
3; DISTANCEMINS; E; Angular separation between neighbours
4; PSFID; K; UID of VMC PSF extracted objects
5; FIELDID; 8A; ID of field
6; CUEVENTID; J; UID of curation event giving rise to this record
7; RAY; D; PSF fit RA centre Y filter
8; DECY; D; PSF fit Dec centre Y filter
9; YPSFMAG; E; 3 pixels PSF fitting magnitude Y filter
10; YSFMAGERR; E; PSF error Y filter
11; YSHARP; E; PSF fitting shape parameter Y filter
12; RAJ; D; PSF fit RA centre J filter
13; DECJ; D; PSF fit Dec centre J filter
14; JPSFMAG; E; 3 pixels PSF fitting magnitude J filter

15; JPSFMAGERR; E; PSF error J filter
16; JSHARP; E; PSF fitting shape parameter J filter
17; RAKS; D; PSF fit RA centre Ks filter
18; DECKS; D; PSF fit Dec centre Ks filter
19; KSPSFMAG; E; 3 pixels PSF fitting magnitude Ks filter
20; KSPSFMAGERR; E; PSF error Ks filter
21; KSSHARP; E; PSF fitting shape parameter Ks filter
22; RA2000; D; PSF Y,J,Ks average RA centre
23; DEC2000; D; PSF Y,J,Ks average Dec centre
24; LCOMPY; E; Local completeness in Y
25; LCOMPJ; E; Local completeness in J
26; LCOMPKS; E; Local completeness in Ks
27; NY; J; Number of stars used to calculate the completeness in Y
28; NJ; J; Number of stars used to calculate the completeness in J
29; NKS; J; Number of stars used to calculated the completeness in Ks
30; YMJPSF; E; Y-J 3 pixels PSF fitting colour
31; YMJPSFERR; E; Error on Y-J 3 pixels PSF fitting colour
32; JMKSPSF; E; J-K_s 3 pixels PSF fitting colour
33; JMKSPSFERR; E; Error on J-K_s 3 pixels PSF fitting colour

The format refers to the fits notation as follows:
A - string 32 characters; D - double floating point (8 bytes); E - real floating point (4 bytes); I - short integer (2 bytes); J - integer (4 bytes); K - long integer (8 bytes).

Acknowledgements

Please reference Rubele et al. 2012, A&A, 537, A106 and use the following statement in your articles when using these data: Based on data products from observations made with ESO Telescopes at the La Silla Paranal Observatory under programme ID 179.B-2003.