

Data Collection	VMC
Release Number	2
Data Provider	Maria-Rosa Cioni
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Abstract

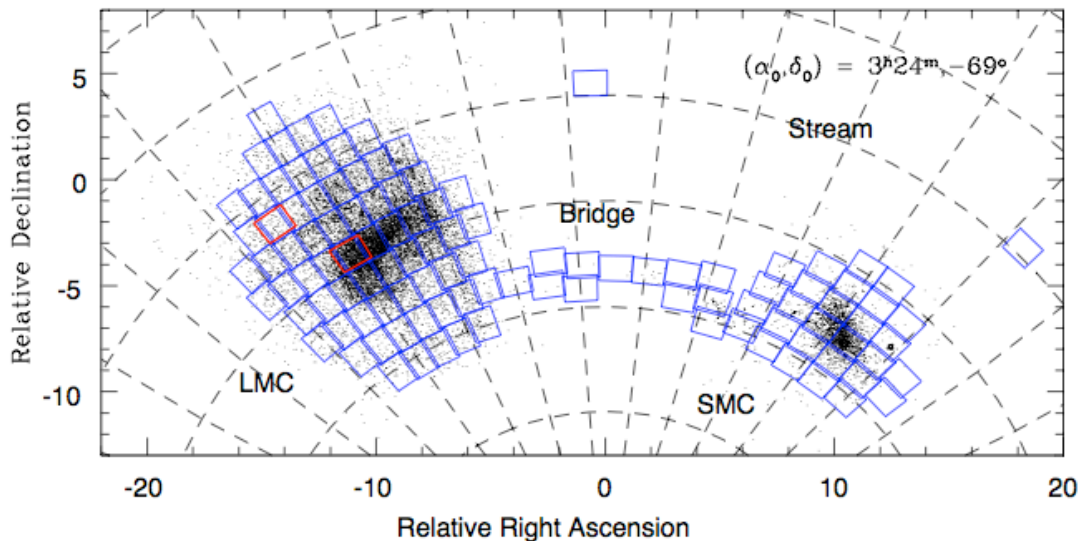
Observations were obtained with the VISTA telescope as part of the VISTA survey of the Magellanic Cloud system (VMC; ESO program 179.B-2003) in three filters: Y, J and K_s. The main goals of the VMC survey are the determination of the spatially resolved star formation history and the three-dimensional 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 K_s mean magnitudes for pulsating variable stars, e.g. RR Lyrae stars and Cepheids.

As well as the first VMC data release from 25.09.2011 (DR1), this data release is based on the same observations of the LMC 6_6 and the LMC 8_8 tiles, which were acquired between November 2009 and November 2010. This release provides 50 reduced and calibrated tile images belonging to individual observations ('single OBs'), in addition to the deep co-added images. This release is superseding the previous release, meaning that all files of the previous VMC release number 1 are being replaced by new versions. There are at least three tiles in Y and J filters and twelve tiles in K_s filter per field. The total sky coverage of this release is $\sim 3.5 \text{ deg}^2$ in the LMC.

Overview of Observations

The figure below shows the Magellanic system as tiled by the VMC survey (blue) and tiles for which data 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 release covers two tiles in the Large Magellanic Cloud: LMC 6_6 and LMC 8_8.

LMC tiles were oriented with the Y axis more or less along the declination direction and cover about 1.771 deg² each where the central (1.475 x 1.017)=1.501 deg² corresponds to the nominal depth of the survey and the remaining area to half the exposure time in each band.

Tile centres are listed below.

Tile	RA	Dec
LMC 6_6	05:37:40.008	-69:22:18.120
LMC 8_8	05:59:23.136	-66:20:28.680

Individual tile images and co-added tile images, with associated confidence maps and source lists, are released per band per field. Preview images in JPEG format are associated to each FITS image. They comprise observations obtained from November 2009 to November 2010 included.

Data Quality

Source lists were created from images that were filtered for nebulosity with size of the order of 30 arcsec, but to the images released here the filtering process was not applied. See Irwin (2010, UKIRT Newsletter 26, 14).

The average data quality per individual tile, observed within VMC constraints, is as follows.

Field	Filter	Time (s)	FWHM (arcsec)	Ellipticity (arcsec)	Zero Point (mag)
LMC 6_6	Y	800	1.1000	0.0725	23.690
	J	800	1.0140	0.0720	23.796
	K _s	750	0.9350	0.0586	23.054
LMC 8_8	Y	800	1.0675	0.0625	23.600
	J	800	0.9980	0.0600	23.802
	K _s	750	0.9140	0.0527	23.009

A few tiles outside VMC constraints are also released and their quality parameters are included in the headers, they refer to observations with higher seeing and/or ellipticity then those listed above. In total 4 images of tile 8_8 are affected. Furthermore, in K_s for tile 6_6, some detectors are affected by intermittency and were discarded in the making of tiles.

The average data quality per co-added tile is as follows.

Field	Filter	Time (s)	FWHM (arcsec)	Ellipticity (arcsec)	Mag.Lim AB (5 σ)	Mag. Sat. AB
LMC 6_6	Y	2400	1.0669	0.0586	21.377	13.056
	J	2800	1.0469	0.0570	21.284	13.070
	K _s	9372	0.9971	0.0438	21.693	13.136
LMC 8_8	Y	2400	1.1127	0.0401	22.579	12.834
	J	2800	1.0666	0.0431	22.595	13.031
	K _s	9400	0.9585	0.0364	22.623	13.368

The Times above correspond to the average exposure time per pixel. This is usually equal to the sum of the times indicated for single tiles but may be larger in case of good quality images (those that meet the VMC observing constraints) resulting from not completed tiles, i.e. tiles where only a subset of the paw-prints or of the images related to a given paw-print were observed.

The VMC constraints for the tiles in this release correspond to ellipticity <0.1 arcsec and seeing of 0.8 arcsec at K_s , 0.9 arcsec at J and 1.0 arcsec at Y, but good quality observations have a tolerance of $\sim 10\%$ on top of these values.

Release Notes

The data for this release were prepared by the Cambridge Astronomy Survey Unit (CASU), the Wide Field Astronomy Unit (WFAU) and the VMC team.

The main processing steps are described in Hambly et al. (2008, MNRAS 384, 637) and Cross et al. (2009, MNRAS 399, 1730). Images were reduced and source lists extracted from individual tile images using the software suite provided by CASU (v1.1). Co-added images were outgusted from the VISTA Science Archive by WFAU using data in the VMCv20120126 release and were produced only from data that meet the observing constraints for the VMC survey.

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>.

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

In addition, the quality error bit flags assigned during post processing are listed at <http://horus.roe.ac.uk/vsa/ppErrBits.html>. These flags refer to quality issues of varying severity such as it is a deblended source or it contains bad pixels in the default aperture. They also indicate if a source is located in the under-exposed area of a tile or in detector #16. They appear as ppErrBits in the catalogues and can be used to refine object samples.

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 in this release comprise observations obtained prior to 20 November 2009 when detector #6 had an intermittently bad channel. Note also that 15% of the tile, corresponding to two edges, has only half the total effective exposure time.

Missing K_s detections - There are missing K_s band detections in the VMC co-added tiles. The missing detections appear as a grid like distribution. This grid distribution matches the areas of overlap of all six paw-prints in the tile, where the confidence image should have maximal values. However, it was found that the confidence in these regions was negative, leading to non-detections. Further tests revealed the source of the problem: the science images had been scaled to store the floating-point data as integers so that the images could be losslessly compressed and this scaling was inadvertently applied to the confidence images. The BSCALE values depend on the NDIT and NJITTER. The NDIT values are particularly high for the VMC K_s band images, and the BSCALE is correspondingly lower, so it is only the VMC co-added K_s tiles that are affected.

Previous Releases

The present data release (2) refers to data that were reduced with the version of CASU software 1.1 while data from the previous release (1) were reduced with version 1.0. Differences between the two versions refer to just header updates, some changes to catalogue table contents and headers and no change to images. In particular the following processes were performed.

- Re-running the classifier on all pawprint catalogues to give improved estimates of aperture corrections and detector saturation levels.
- Re-running the photometry on all pawprint catalogues with updated colour equations, and extinction coeffs and more careful selection of 2MASS stars in high extinction regions.
- Generating monthly detector zero-point updates (and illumination corrections); detector level differences will be now routinely included for all VISTA data.
- FITS header updates on all pawprint catalogues and images.
- Running the grouting code on the tile catalogues; this fixes both PSF changes via the various apercors and magzpft changes at either detector level or whole pawprint. Note however that grouting tile catalogues pre-20101101 only have the effect of PSF changes fixed and not the detector-level magzpft changes.
- Computation of differential MJD column for all detected objects and output of optional map of differential MJD across tile.
- Tile catalogue re-classification and re-photometry.
- FITS header updates on all tile images.
- Updated ESO grades.
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Multi-band source lists that were included in release number 1 will become available, in the new version of these data, as a source catalogue under the new VMC_CAT release.

Data Format

Files Types

Fifty individual tile images and associated confidence maps and source lists with the adopted naming convention:

Tile images: `v???????_????_st_tl.fits.fz`

Associated confidence map: `v???????_????_st_tl_conf.fits.fz`

Source list per tile: `v???????_????_st_tl_cat.fits`

where the name is constructed as `observing-date_number_type.fits(.fz)`

Twelve co-added tile images/confidence maps, e.g.

`vmc_er1_05h37-069d22_tile_j_deepconf_1404043.fits.fz`

`vmc_er1_05h37-069d22_tile_j_deepimage_1403894.fits.fz`

where the name is constructed as `project_release_ra/dec_tile_band_type_multiframeID.fits` and `multiframeID` uniquely identifies each FITS image.

These have twelve associated JPEG images, e.g.

`vmc_er1_05h37-069d22_tile_j_jpeg_1404043.jpg`

`vmc_er1_05h37-069d22_tile_j_jpeg_1403894.jpg`

Then there are 72 (12x6) associated deep paw-prints and their confidence maps, e.g.

`vmc_er1_05h36-069d16_off0_j_deepconf_1402989.fits.fz`

`vmc_er1_05h36-069d16_off0_j_deepimage_1403616.fits.fz`

Then there are six individual tile base lists, e.g.

`vmc_er1_05h37-069d22_tile_j_cat_1403894.fits`

Acknowledgements

Please reference Cioni et al. 2011, A&A, 527, A116 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.