198.A.2005 VEILS: The VISTA Extragalactic Infrared Legacy Survey - Data Release 2

Abstract

The VISTA Extragalactic Infrared Legacy Survey (VEILS; Program ID:198.A-2005) is a deep J and Ks-band transient and wide-field survey conducted using the VIRCam camera with the primary goals of understanding the epoch of reionisation, the build-up of massive galaxies and constraining the cosmological equation of state using both Type 1a supernovae and AGN dust lag measurements.

VEILS has covered ~9 sq-deg of the extragalactic sky over three fields: ELAIS-S1 - ES for short - (RA=00h30m, Dec=-43d00m), CDFS (RA=03h36m, Dec=-28d00m) and XMM-LSS - XMM for short - (RA=02h22m, Dec=-06d00m). A total of 27-51 epochs of observations have been collected in the J and Ks-bands depending on the field.

Overview of Observations

The VIRCam camera on the VISTA telescope consists of a sparse-filled mosaic of 16 2k x 2k detectors with a mean celestial pixel scale of 0.339” per pixel. A full contiguous ‘tile’ is produced by the combination of six separate ‘pawprints’. Each of the three VEILS fields is constituted by two separate pointings or tilings of the camera. To achieve the single epoch depths required for the transient science case and ensure that each OB remains under an hour, each observing block for VEILS constitutes 3 rather than 6 pawprints producing a ‘half tile’ of 4 separate stripes of covered area. The 3 pawprints are labelled ‘p0’, ‘p1’ and ‘p2’ in the bandmerged catalogue files and the half-tiles in each pointing are labelled ‘3nx’ and ‘3px’ which reflects the tiling strategy adopted. The field layout is illustrated below. When combined with the VISTA VIDEO survey (Jarvis et al. 2013), VEILS is designed to provide near infra-red coverage in the J and Ks-bands over a total area of ~20 sq-deg.

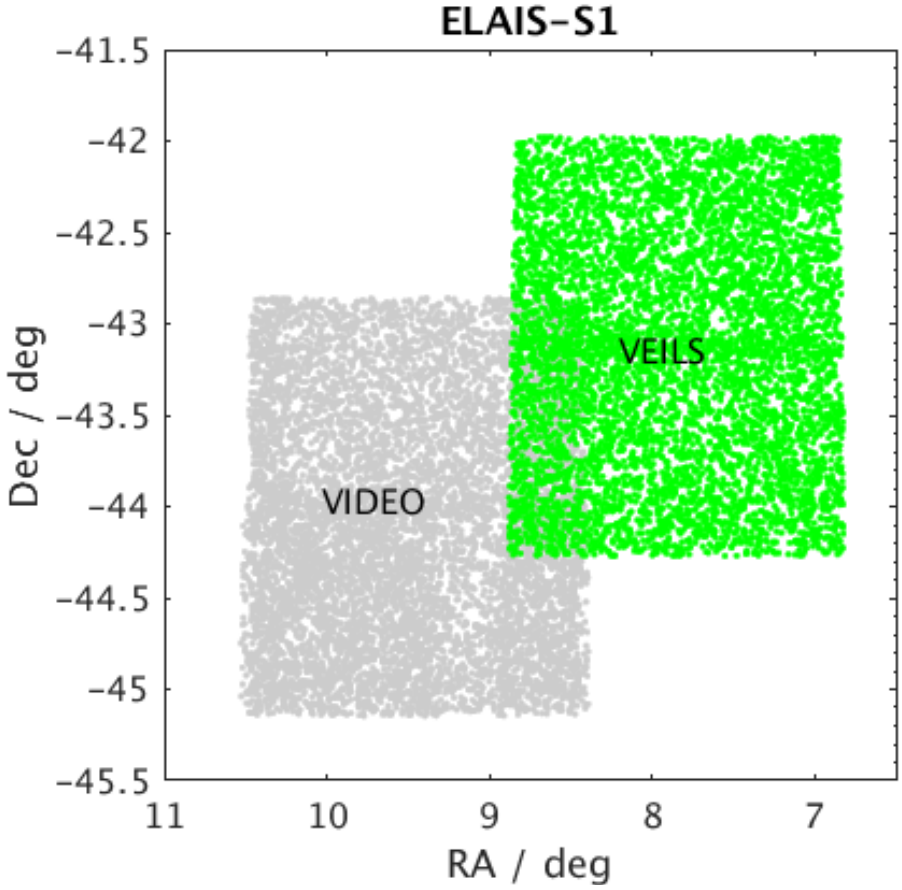

Figure 1: Coverage of VEILS and VIDEO in the ELAIS-S1 field

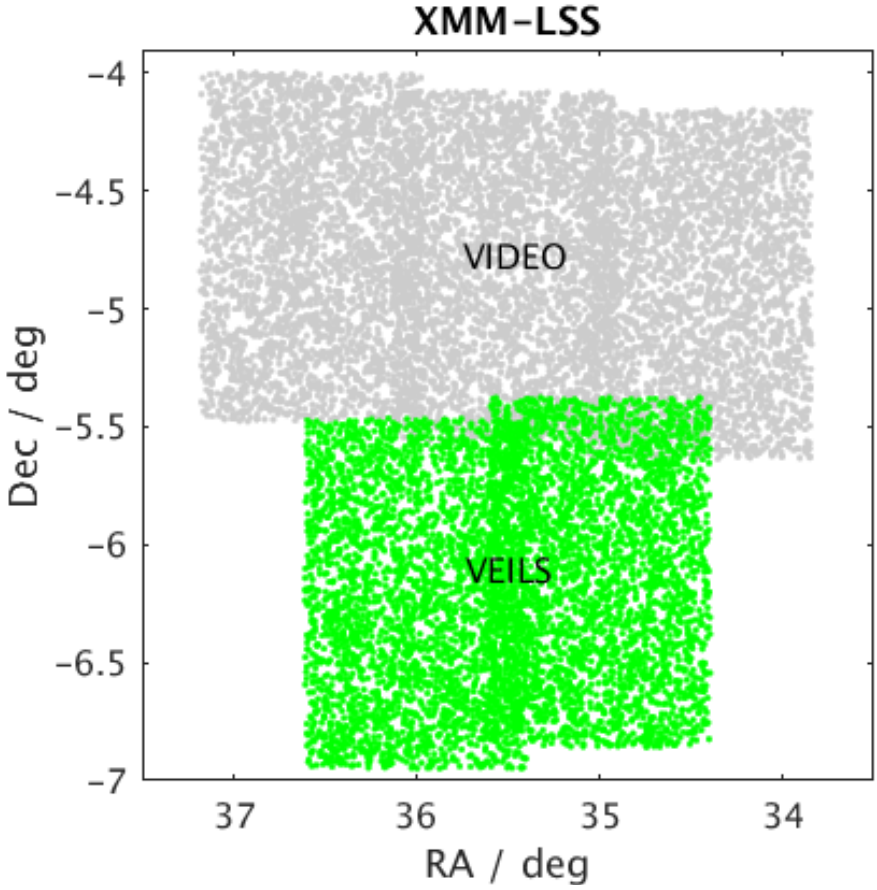

Figure 2: Coverage of VEILS and VIDEO in the XMM-LSS Field

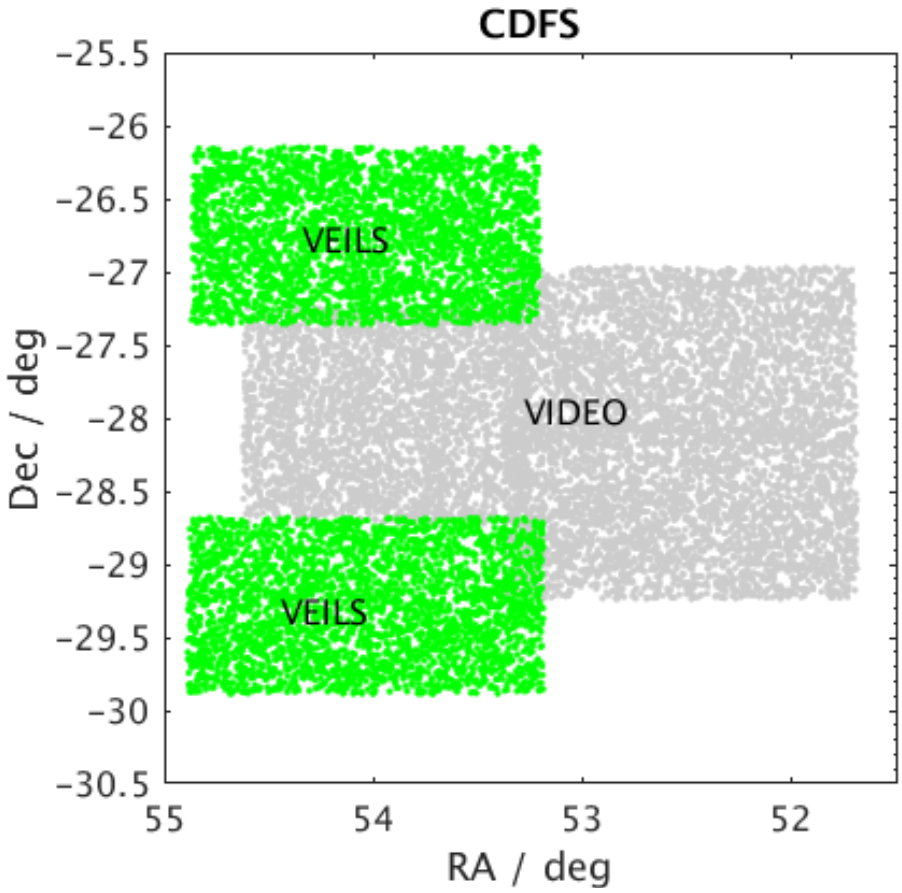

Figure 3:Coverage of VEILS and VIDEO in the CDFS Field

Release Content

The second data release of VEILS (DR2) consists of 3173 pawprints (1582 in the J-band, 1591 in the Ks-band). There are 36 stacked pawprint images and associated weight maps in each of the two filters, plus the corresponding 36 extracted source lists. The release includes all images taken as part of the VEILS survey between 20161022 and 20191230. DR2 corresponds to 100% of DR1 imaging data being updated, plus an incremental release of single epoch observations.

Table 1 summarises details of the stacked pawprints that are being released.

Table 1: Summary of the stacked pawprint images being released

Field	Stack	RA (deg)	Dec (deg)	Filt.	Epochs	Texp (s)
CDFS_Pointing_1	3px_p0	54.129716	-26.843618	J	32	30060
CDFS_Pointing_1	3px_p0	54.134316	-26.750045	Ks	34	32400
CDFS_Pointing_1	3px_p1	54.129682	-26.751937	J	31	29760
CDFS_Pointing_1	3px_p1	54.134164	-26.658520	Ks	33	31680

Field	Stack	RA (deg)	Dec (deg)	Filt.	Epochs	Texp (s)
CDFS_Pointing_1	3px_p2	54.129540	-26.660386	J	31	29760
CDFS_Pointing_1	3px_p2	54.134373	-26.841769	Ks	34	32640
CDFS_Pointing_1	3nx_p0	53.931204	-26.840942	J	36	34560
CDFS_Pointing_1	3nx_p0	53.927734	-26.846344	Ks	37	35520
CDFS_Pointing_1	3nx_p1	53.931298	-26.749312	J	36	34560
CDFS_Pointing_1	3nx_p1	53.977773	-26.754715	Ks	37	35520
CDFS_Pointing_1	3nx_p2	53.931496	-26.657699	J	36	34560
CDFS_Pointing_1	3nx_p2	53.927990	-26.663099	Ks	37	35520
CDFS_Pointing_2	3px_p0	54.132047	-29.380154	J	27	25920
CDFS_Pointing_2	3px_p0	54.142124	-29.379994	Ks	31	29760
CDFS_Pointing_2	3px_p1	54.131960	-29.288531	J	27	25920
CDFS_Pointing_2	3px_p1	54.142050	-29.288318	Ks	31	29760
CDFS_Pointing_2	3px_p2	54.131796	-29.196942	J	27	25920
CDFS_Pointing_2	3px_p2	54.141855	-29.196791	Ks	31	29760
CDFS_Pointing_2	3nx_p0	53.930757	-29.379741	J	30	28800
CDFS_Pointing_2	3nx_p0	53.927301	-29.380952	Ks	34	32000
CDFS_Pointing_2	3nx_p1	53.930853	-29.288076	J	30	28680
CDFS_Pointing_2	3nx_p1	53.927364	-29.289284	Ks	33	31600
CDFS_Pointing_2	3nx_p2	53.931048	-29.196486	J	30	28800
CDFS_Pointing_2	3nx_p2	53.927586	-29.197696	Ks	33	31680
ES_Pointing_1	3px_p0	7.717760	-42.497920	J	50	47700
ES_Pointing_1	3px_p0	7.728286	-42.489421	Ks	46	44160
ES_Pointing_1	3px_p1	7.717543	-42.589369	J	49	46740
ES_Pointing_1	3px_p1	7.728076	-42.580875	Ks	47	44240
ES_Pointing_1	3px_p2	7.717175	-42.680940	J	49	46740
ES_Pointing_1	3px_p2	7.727778	-42.672448	Ks	46	44160
ES_Pointing_1	3nx_p0	7.967783	-42.494099	J	51	48960

Field	Stack	RA (deg)	Dec (deg)	Filt.	Epochs	Texp (s)
ES_Pointing_1	3nx_p0	7.974527	-42.492399	Ks	48	46080
ES_Pointing_1	3nx_p1	7.967929	-42.585570	J	51	46680
ES_Pointing_1	3nx_p1	7.974721	-42.583851	Ks	48	46080
ES_Pointing_1	3nx_p2	7.968333	-42.677154	J	49	47040
ES_Pointing_1	3nx_p2	7.975147	-42.675426	Ks	48	46080
ES_Pointing_2	3px_p0	7.975275	-43.754427	J	43	41280
ES_Pointing_2	3px_p0	7.970073	-43.756047	Ks	43	41280
ES_Pointing_2	3px_p1	7.975044	-43.662650	J	43	41280
ES_Pointing_2	3px_p1	7.969848	-43.664280	Ks	43	41280
ES_Pointing_2	3px_p2	7.974665	-43.571082	J	43	41280
ES_Pointing_2	3px_p2	7.969482	-43.572731	Ks	43	41280
ES_Pointing_2	3nx_p0	7.722228	-43.753539	J	44	42240
ES_Pointing_2	3nx_p0	7.723001	-43.755747	Ks	43	41280
ES_Pointing_2	3nx_p1	7.722438	-43.661851	J	44	42240
ES_Pointing_2	3nx_p1	7.723158	-43.664034	Ks	43	41280
ES_Pointing_2	3nx_p2	7.722832	-43.570263	J	44	42240
ES_Pointing_2	3nx_p2	7.723521	-43.572459	Ks	43	41280
XMM_Pointing_1	3px_p0	35.905878	-6.119787	J	35	33600
XMM_Pointing_1	3px_p0	36.088700	-6.112375	Ks	34	32320
XMM_Pointing_1	3px_p1	36.088145	-6.113660	J	37	34860
XMM_Pointing_1	3px_p1	36.088700	-6.112375	Ks	33	31360
XMM_Pointing_1	3px_p2	35.997978	-6.119746	J	36	33660
XMM_Pointing_1	3px_p2	35.904436	-6.112381	Ks	33	31360
XMM_Pointing_1	3nx_p0	35.905878	-6.119787	J	35	33600
XMM_Pointing_1	3nx_p0	36.094092	-6.303227	Ks	38	36480
XMM_Pointing_1	3nx_p1	35.999400	-6.297302	J	33	31680
XMM_Pointing_1	3nx_p1	36.001944	-6.303205	Ks	38	35480

Field	Stack	RA (deg)	Dec (deg)	Filt.	Epochs	Texp (s)
XMM_Pointing_1	3nx_p2	35.907213	-6.297311	J	33	31680
XMM_Pointing_1	3nx_p2	35.909768	-6.302330	Ks	38	36480
XMM_Pointing_2	3px_p0	35.905878	-6.119787	J	36	33600
XMM_Pointing_2	3px_p0	35.091763	-6.030078	Ks	36	34400
XMM_Pointing_2	3px_p1	35.004838	-6.032263	J	36	34560
XMM_Pointing_2	3px_p1	34.999662	-6.030039	Ks	35	32720
XMM_Pointing_2	3px_p2	34.912736	-6.032294	J	36	34320
XMM_Pointing_2	3px_p2	34.907532	-6.030041	Ks	35	33600
XMM_Pointing_2	3nx_p0	35.094639	-6.208827	J	35	33600
XMM_Pointing_2	3nx_p0	35.095950	-6.206158	Ks	34	32640
XMM_Pointing_2	3nx_p1	35.002516	-6.206888	J	35	33600
XMM_Pointing_2	3nx_p1	35.003784	-6.206198	Ks	34	32640
XMM_Pointing_2	3nx_p2	34.910369	-6.208901	J	35	33600
XMM_Pointing_2	3nx_p2	34.911642	-6.206199	Ks	34	32640

Release Notes

Data Reduction and Calibration

This release is based on the CASU version v1.5 pipeline. The main changes to the pipeline since version 1.3 are as follows:

1. The nightly photometric calibration (based on the 2MASS Point Source Catalogue) benefits from new improved colour transformations from 2MASS to VIRCAM, including a better treatment of the effect of interstellar extinction on the transformations. (For full details see Gonzalez Fernandez et al., 2018, MNRAS, 474, 5459).
2. A bug in the illumination correction has been fixed.

Full details of the data pipeline procedure and the version changes can be found at: http://casu.ast.cam.ac.uk/surveys-projects/vista/technical

The photometric and astrometric calibrations are both derived from the 2MASS Point Source Catalogue. The photometric calibration includes an additional colour term designed to correct for the effect of interstellar extinction on the 2MASS to VISTA/VIRCAM photometric transformations, although for the lines-of-sight in this release, this effect is negligible. The typical photometric calibration precision in the J and Ks passbands is now 2% (see Gonzalez Fernandez et al. 2018).

Typical saturation limits for single epoch stacks are J=13.3 and Ks=14.2 magnitudes AB. The 5 sigma detection limit is around J=21.2 and Ks=22.3 magnitudes AB in the single epoch stacks.

Data Quality Control

All stacked pawprints were visually inspected for stacking errors and variations in sky background. The photometric consistency in the J and Ks-bands is expected to be of the order of 2% for the linear dynamic range of the instrument. Astrometric errors are around 50mas for the stacked pawprints. A list of known issues is detailed in Sutherland et al. 2015 including holes in chip#1 and anomalous response in the top half of chip#16. No other systematic errors are detected in the photometry and astrometry beyond these.

Comparison to VEILS DR1

VEILS DR2 represents a factor of 1.7 increase in the number of sources detected in the deep stacks relative to DR1. The 5-sigma limiting magnitudes for each stacked pawprint have increased between ~0.6-1.2 mags in the J-band and ~0.7-1.6 mags in the Ks-band depending on the field. Most notably, DR2 contains ~30-40 additional epochs of data in each field and in each of the two filters, which will be extremely valuable for time-domain studies.

Acknowledgements

Any publication making use of this data, whether obtained from the ESO archive or via third parties, must include the following acknowledgment:.

- Based on data obtained from the ESO Science Archive Facility with DOI: https://doi.org/10.18727/archive/NNN

Publications making use of data which have been assigned an archive request number (of the form XXXXXX) must include the following statement in a footnote or in the acknowledgement:

- *Based on data obtained from the ESO Science Archive Facility under request number <request_number>.*

References:

Gonzalez-Fernandez, C. et al. 2018, MNRAS, 474, 5459
Jarvis, M. et al. 2013, MNRAS, 428, 1281
Sutherland, W. et al. 2015, A&A, 575, A25.