

Public Surveys @ ESO

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EST (M. Hilker, G. Hussain, M. Petr-Gotzens, M. Rejkuba)

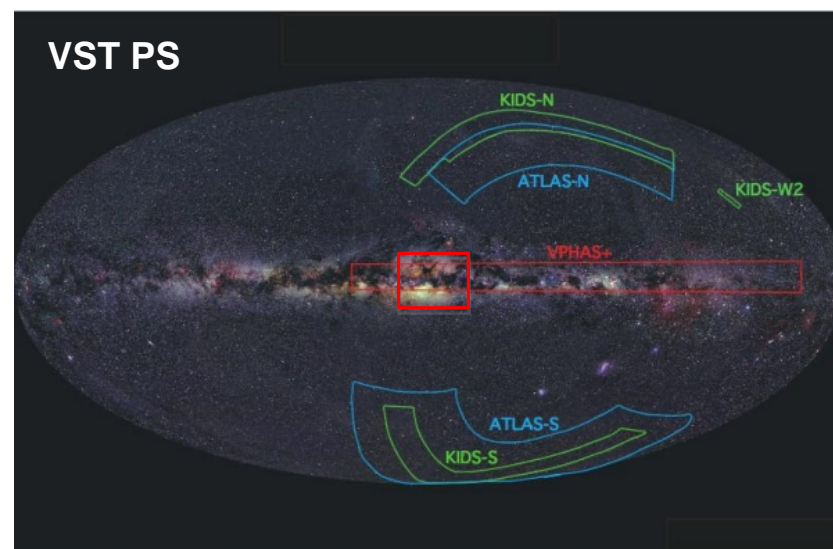
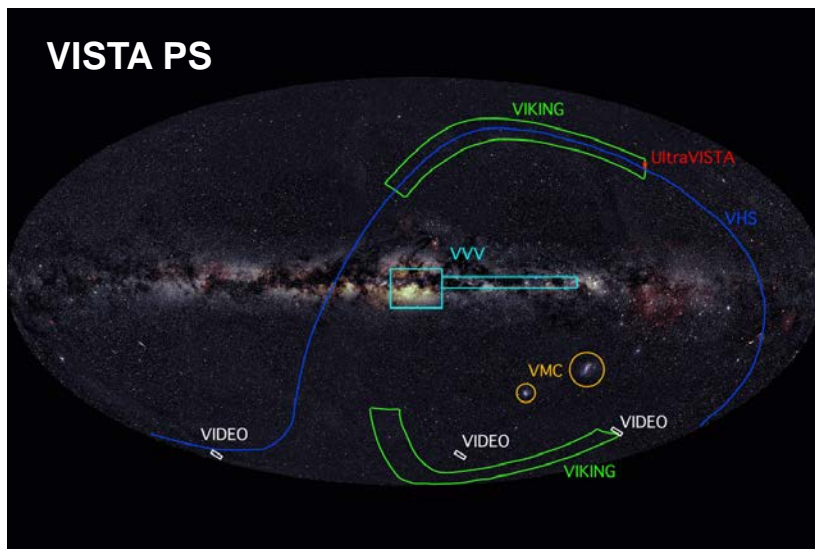
ASG (N. Delmotte, S. Geier, A. Micol, J. Retzlaff)

- **Why** (does ESO carry out Public Surveys) ?
- **What** (are the Public Survey projects @ESO) ?
- **When** (did ESO Public Surveys start) ?
- **How** (is it done)?
- **Highlights**

- ◆ Observational astronomy is in an era of surveys  SDSS, UKIDSS, Pan-STARRS, SkyMapper and LSST . These projects all entail large investment in survey “systems” which include dedicated telescopes and instruments to data distribution. **GOAL: target new science in a variety of fields and serve broad communities.**
- ◆ ESO has a strong background in survey projects (ESO/SERC southern sky survey 1974 - 1987, EIS).
- ◆ ESO operates dedicated telescopes, VST and VISTA , and organizes public surveys projects. Periodically ESO holds peer reviews to ensure legacy value and scientific excellence of the survey program.
- ◆ **Within current policies, the community carries out all those activities that go beyond those enlisted in the mission statement of ESO.**
- ◆ The ESO Science Archive Facility is the collection point for the survey products and the primary point of publication/availability of these products to the ESO community (as per ESO Council Meeting 104, 17–18 December 2004).

◆ Public Surveys

- ◆ Very large programmes (>2 years)
- ◆ Legacy value for astronomical community at large
- ◆ Synergy between optical and NIR surveys
- ◆ All raw observations are immediately public
- ◆ Survey teams commit to deliver reduced images/spectra and catalogues within ~yearly releases



What? VST Public Surveys

Survey	Area (deg ²)	Filters	Magnitude limits	Depth measure	Observation hours taken (Apr 2013)
KIDS(*)	1500	u' g' r' i'	24.1, 24.6, 24.4, 23.4	10 σ (AB)	559
ATLAS	4000	u' g' r' i' z'	22.0, 22.2, 22.2, 21.3, 20.5	10 σ (AB)	693
VPHAS+	~2000	u' g' H α r' i'	21.8, 22.5, 21.6, 22.5, 21.8	10 σ (AB)	231

Deep high z
 Whole Sky
 Galactic
 Extragalactic
 Resolved SFH
 (*) Same area as VIKING

Start of operations of VST + Ω cam 15.10.2011



What? VISTA Public Surveys

Surveys	Area (deg ²)	Tot Area Observed (Apr 2013)	Filters	Magnitude limit 5 σ (AB), 10 σ (AB) x VMC	Observation hours taken (Apr 2013)
Ultra-VISTA	1.7 deep 0.73 ultra-deep	1.7	Y J H K _s Y J H K _s NB118	25.7, 25.5, 25.1, 24.5 26.7, 26.6, 26.1, 25.6 26.0	765
VHS	17800	7006	Y J H K _s	21.2, 21.1, 20.6, 20.0	1892
VIDEO	12.0	10.2	Z Y J H K _s	25.7 24.6 24.5 24.0 23.5	773
VVV	560	562	Z Y J H K _s	21.9 21.1 20.2 18.2 18.1	816
VIKING	1500	595	Z Y J H K _s	23.1 22.3 22.1 21.5 21.2	823
VMC	180	81	Y J K _s	21.9, 21.4, 20.3	670

Deep high z Whole Sky Galactic Extragalactic Resolved SFH

What? Public Spectroscopic Surveys

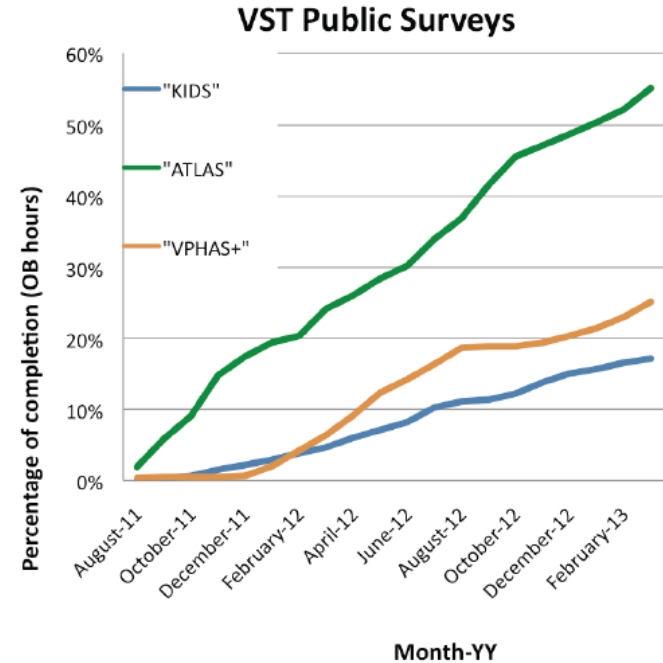
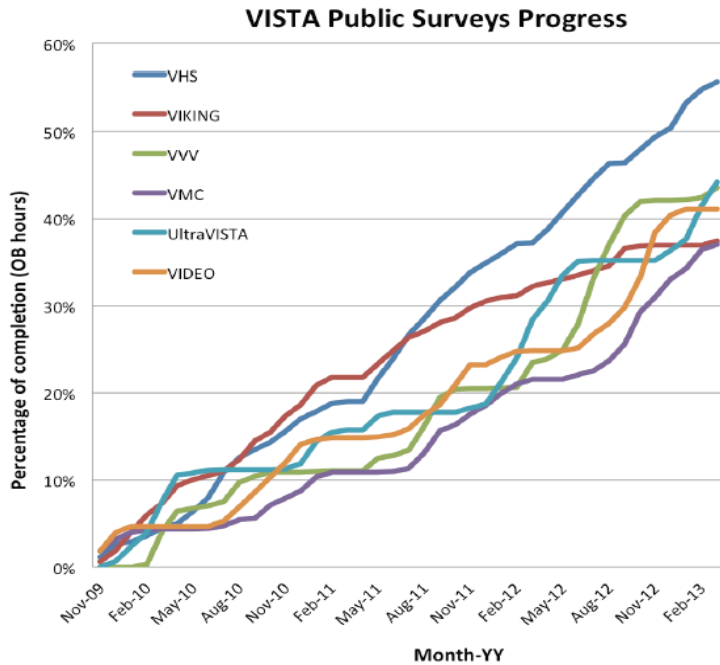
◆ Gaia - ESO (PIs: Gilmore, Randich)

- ◆ Time allocation 60n/yr over 4yr on UT2 FLAMES – [Start 01.2012](#)
 - extension to 5 yr (300n) pending formal review
- ◆ 10^5 stars in all major components of the MW, 100 open clusters
- ◆ Synergy with Gaia – phase space structure and abundances for Milky Way stellar populations
- ◆ Target selection: VHS, VVV, WFI and other optical photometry

◆ PESSTO (PI: S. Smartt)

- ◆ Time allocation 90n/yr over 4yr (+ 5th year pending formal review)
- ◆ EFOSC2 and SOFI on NTT – single target spectroscopy of Transient Universe: [start 04.2012](#)
- ◆ Follow up of ~150 transient objects in an unbiased sample of nearby galaxies drawn from ongoing surveys
- ◆ SN explosion physics, SN progenitors

What? Progress of VISTA and VST surveys



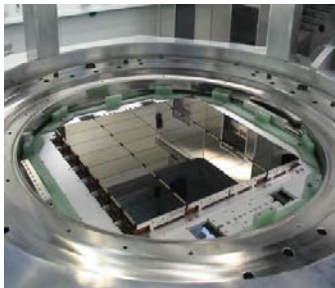
- ◆ VISTA surveys – VHS about 55% complete, other surveys in the range 37% to 45%
- ◆ VST surveys – ATLAS about 55% complete, KiDS and VPHAS+ about 20%

- ◆ Letters of intent and proposals for VST public surveys - 2005
- ◆ Letters of intent and proposals for VISTA public surveys -2006
- ◆ Letters of intent and proposals for Spectroscopic public surveys - 2010
- ◆ VISTA and VST – survey telescopes
 - ◆ Six VISTA Public Surveys **started on April 1, 2010**
 - ◆ Three VST Public Surveys **started on October 15, 2011**
- ◆ **In 2012: start** of two spectroscopic public surveys
 - ◆ VLT/FLAMES and NTT/EFOSC2+SOFI
- ◆ Letter of intent for VIMOS public surveys – deadline for submission October 15, 2013
- ◆ **There are 11 public survey projects currently on-going**
- ◆ **Future outlook: MOONS and 4MOST**

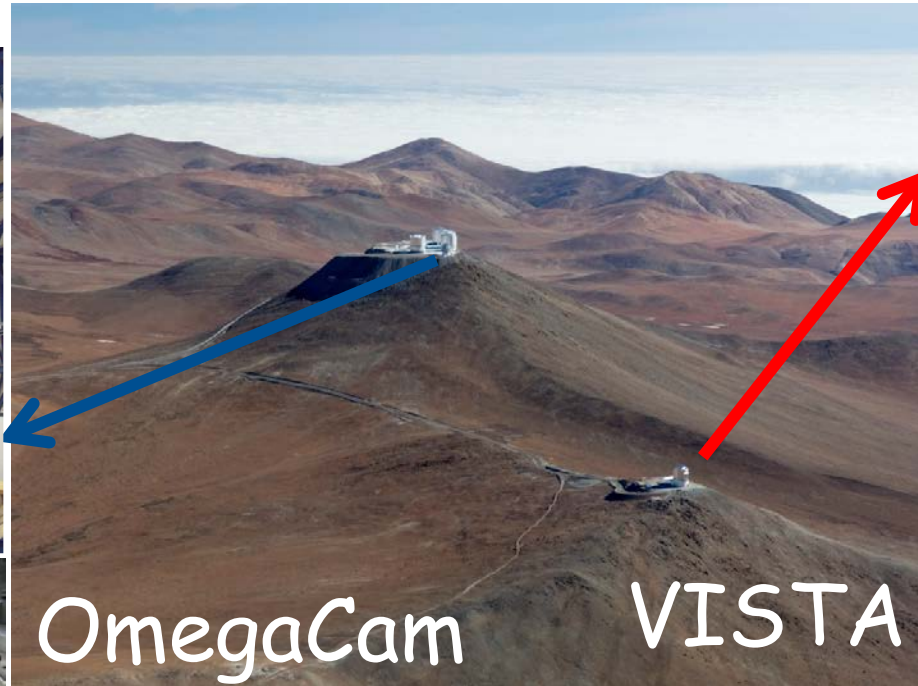
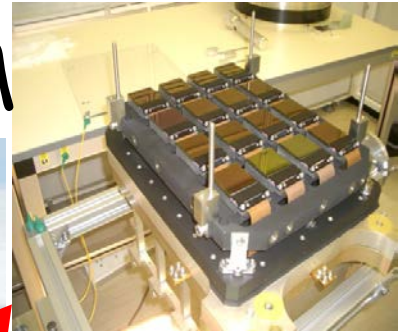
- ◆ ESO – operation, data delivery & archive
 - ◆ Provides & operates observing facilities: telescopes, instruments, SM & VM
 - ◆ Delivers raw data and makes them immediately public
 - ◆ Defines data product standard, archives data products and publishes them to the astronomical community
 - ◆ Organizes high level reviews for monitoring survey progress and ensure scientific excellence
- ◆ Public survey teams – obs. strategy, data reduction, analysis, and delivery of data products
 - ◆ Prepare and run the observations
 - ◆ Run final quality control and data reduction
 - ◆ Deliver reduced images, spectra, catalogues to ESO SAF
 - ◆ Yearly incremental releases + final release

How? Telescopes for surveys VISTA & VST

VST



VIRCAM



OmegaCam

VISTA

- Observations carried out in service mode
- 1800 – 3400h per programme, several thousands Obs each semester
- Expected to run ~6-8 yrs

How? Optical & NIR surveys and telescopes

	Telescope Diameter	FoV	Etendu [m ² deg ²]	Pixel size [arcsec/pixel]	Wavelength range [μm]
Ground					
SkyMapper	1.4	5.7 deg ²	6.6	0.500	0.32-0.95
Pan-STARRS 1	1.8	2.8 ^o x2.9 ^o	16.3	0.300	0.4-1.15
SDSS	2.5		6.0	0.394	0.33-1.0
MegaCam	3.6	0.96 ^o x 0.94 ^o	7.6	0.187	0.34-0.95
CTIO (DES)	4.0	4.0 deg ²	16.0	~0.20	0.6-1.0
VISTA	4.0	1.65 ^o deg circ	5.2	0.339	0.88-2.15
SuprimeCam	8.0	34'x27'	13.5	0.200	0.36-1
VLT HAWK-I	8.2	7.5'x7.5'	0.81	0.106	1-2.2
VLT-VIMOS	8.2	4 x 7'x8'	3.2	0.205	0.36-1
<i>LBC@LBT</i>	8.4	23'x23'	8.1	0.230	0.32-1.0
<i>VST</i>	2.6	1 deg ²	5.5	0.210	0.33-1.0
<i>Subaru HyperSuprime</i>	8.0	1.5 deg circ	94	0.17	0.36-1
LSST	8.4	3.5 deg circ	319	0.200	0.33-1.07

How? Telescopes for surveys: **Flames@UT2**, **VIMOS@UT3** and **EFOSC/SOFI@ NTT**



FLAMES@UT2
VIMOS@UT3



EFOSC&SOFI @ NTT

- Observations carried out in visitor mode
- Expected to run for 4-5 yrs



How? Phase 3, data releases and community access via ESO SAF

- Phase 3 – final step in the execution of PS (talk by J. Retzlaff). New Phase 3 infrastructure allows reception, validation and publication of data products from PS to the ESO SAF – <http://www.eso.org/sci/observing/phase3/>
- Data standards characterize level of data reduction & track provenance (see A. Micol - Poster # 19)
- User support to PIs and their teams (see N. Delmotte -Poster # 20)
- Data products (DPs) – images, spectra, weight maps, source lists and catalogues - talk by J. Retzlaff

Category	Query Forms	Data collection	Data Type	Instruments
LFO Data	Raw data query form (all instruments) Instrument specific query form Phase 3 Data Products (ESO Public Surveys)	All ESO raw data	Various	Many La Silla Paranal instruments
LFO Data Products	Phase 3 Data Products (ESO Public Surveys) Phase 3 imaging query form Phase 3 instrument specific query form	Phase 3 Data Products (ESO Public Surveys)	Currently: Imaging	Currently: VISTA/VIRCAM
Catalogues	Catalogues Facility query interface	Phase 3 Catalogues (ESO User Portal authentication required also when browsing)	Catalogues	Currently: VISTA/VIRCAM
Advanced Data Products	Advanced Data Products query form	Observation of Core astrometrically-selected stars (B. Jaffe) UVES reprocessed Time-domain survey of NGC 2547 (B. Jaffe)	Spectroscopy (line series) Spectroscopy Imaging	VIMOS FEROS FEROS
FEROS/HARPS pipeline processed data	FEROS/HARPS pipeline processed data query form	FEROS/HARPS pipeline processed data	Spectroscopy	FEROS, HARPS
Science Verification, Commissioning, etc.	Full list of available data packages	Full list of available data packages	Various	Many
APEX Quick Look Products	APEX query form	APEX	Heterodyne Bolometer	APEX-DA, LABOCA, SABOCA, SHARP
ALMA Data	ALMA Science Archive	All ALMA data	CUBE	ALMA

http://archive.eso.org/wdb/wdb/adp/phase3_main/form

How? Phase 3, data releases and community access via ESO SAF

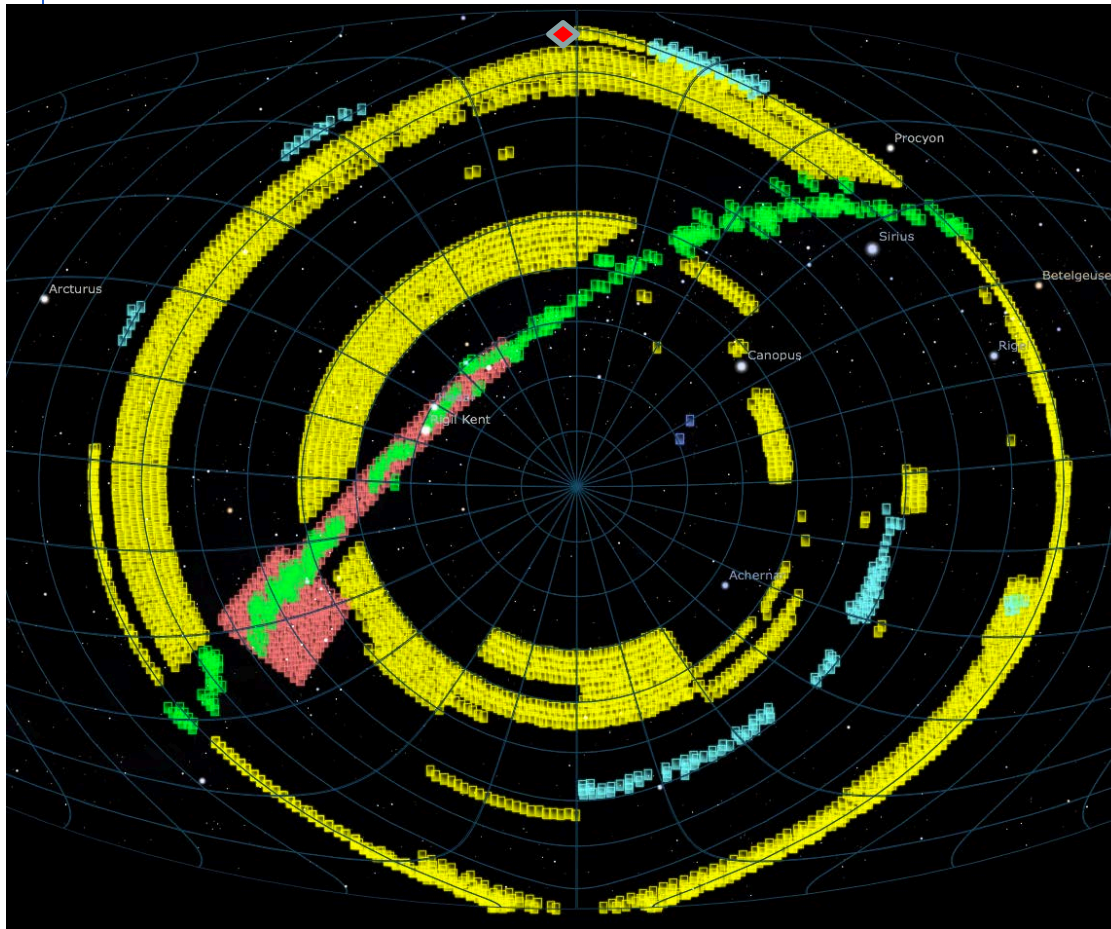
- VISTA DR2 – about 11.5 TB of data products (DPs)
- VST DR1 – about 1.5 TB of DPs – released on 03.09.2013
- Spectroscopic surveys DR1 – about 20 GB
- DPs available from the newly deployed query interfaces
- Announcements to community from ESO science page, ESO newsletter & Messenger

Data products are available for download by the astronomical community worldwide!

Product Name	Instrument	Survey Name	Survey Type	Survey Status
Transitless survey of NGC 3547 (S. Agner)	Imaging	FEROS		
FEROS/HARPS pipeline processed data (S. Agner)	Spectroscopy	FEROS, HARPS		
Science Verification, Commissioning, etc. (S. Agner)	Various	Many		
Full list of available data packages				
APEX Quick Look Products	APEX	Reddyline, Blazhko		
ALMA Data	ALMA	APEX-GA, LABOCA, SABOCA, SHARP		
		ALMA		

http://archive.eso.org/wdb/wdb/adp/phase3_main/form

How? Phase 3, data releases and community access via ESO SAF



The VISTA & VST public survey DPs released through the Phase 3 process in 2013 cover almost **5000 square degrees** of the Southern Hemisphere.

- VPHAS+ - green,
- VVV - pink,
- VHS- yellow,
- KiDS/VIKING - cyan,
- VMC - blue
- UltraVISTA - red

How? Phase 3, data releases and community access via ESO SAF

Survey	Submission Date	Date of Observations	Release Content	Pass-bands	Sky coverage (sq.deg)	Type of Data Products	Total volume	Total number of files	VST tile images	Pub. date
KIDS	28.06.2013	Oct 2011–Sep 2012	Non contiguous area in KiDS South and North	U, g,r,i	50	Tiles, weight maps and mask images, single-band source lists	700 GB	800	200	11.07.2013
VPHAS+	16.05.2013	Dec 2011 – Sep 2012	Bulge and disk of the MW	U, g,r,i Ha	334	Pawprints, single-band source lists	750 GB	291	3489	20.08.2013
VST ATLAS	17.05.2013	Oct 2011–Sep 2012	<i>Content Validation ongoing</i>				3.0 TB	32000		TBD

Survey	Submission Date	Date of Observations	Release Content	Type of Data Products	Total volume	Total number of files	Pub. date
Gaia ESO	15.08.2013	Dec 2011–Dec 2012	1d spectra	1d spectra and their weight maps	1.3GB		TBD
PESSTO	03.09.2013	Dec 2011–Dec 2012	1d spectra	1d spectra and their weight maps, images of SN candidates	~17GB		TBD

Content validation ongoing

Last update: 03.09.2013

Phase 3 start of operations: 10 March 2011

DPs available from http://archive.eso.org/wdb/wdb/adp/phase3_main/form

Release descriptions at http://www.eso.org/sci/observing/phase3/data_releases.html

Table 1: Overview of Phase 3 catalogue data deliveries from the ESO/VISTA public survey programmes

Catalogue data delivery from the ESO PS. High level DPs including light curves (VMC, VVV).

ESO SAF deploys a new query interface for the exploration of the catalogues' content and data download see J. Retzlaff poster # 26

Name	Title	Content	2012 Data Release
UVISTA_DEEP_CAT	Deep Near-Infrared Catalogue of the COSMOS Field	Aperture-matched source catalogue in YJHKs and NB118 based on the deep stacked images.	✓
UVISTA_UDEEP_CAT	Ultra-deep Near-Infrared Catalogue of the COSMOS Field	Aperture-matched source catalogue in the YJHKs and NB118 based on the stacked images of the ultra-deep part of the survey.	
VIKING_CAT	VIKING J-Band Selected ZYJHKs Source Catalogue	Merged multi-band source catalogue with aperture-matched photometry in ZYJHKs for all objects selected and defined in J-band.	✓
VMC_CAT	VISTA Magellanic Survey YJKs Source Catalogue	Homogeneous epoch-merged and band-merged master source catalogue in YJKs	✓
VMC_VAR	VISTA Magellanic Survey Catalogue of Variables	Mean magnitude, amplitude/likelihood of variation (when possible), variable type (i.e. RR Lyrae stars, Cepheids, late-type giants, eclipsing binaries).	✓
VMC_MPHOT	VISTA Magellanic Survey Multi-Epoch Photometry	Homogeneous catalogue of multi-epoch photometric data points listing the measured magnitude as a function of source ID and time of observation (also known as light curve).	✓
VVV_CAT	ZYJHKs Catalogue in the Via Lactea	Homogeneous source catalogue with aperture-matched photometry on the whole survey area (bulge and plane region) based on the first-epoch data.	✓
VVV_VAR	Catalogue of Variables in the Via Lactea	Mean magnitude, amplitude/likelihood of variation (when possible), variable type (i.e. RR Lyrae stars, Cepheids, late-type giants, eclipsing binaries).	
VVV_MPHOT	Multi-Epoch Ks-Band Photometry in the Via Lactea	One homogeneous catalogue of multi-epoch Ks photometry in the VVV bulge and plane region.	
VHS_DES_CAT	VHS-DES Source Catalogue	Merged multi-band source catalogue with aperture-matched photometry in JHKs.	✓
VHS_ATLAS_CAT	VHS-ATLAS Source Catalogue	Merged multi-band source catalogue with aperture-matched photometry in YJHKs.	✓
VHS_GPS_CAT	VHS-GPS Source Catalogue	Merged multi-band source catalogue with aperture-matched photometry in J and Ks.	✓
VIDEO_ELIAS_CAT	Deep ZYJHKs Catalogue of the ELIAS-S1 field	Combined multi-band source catalogue with aperture-matched photometry in ZYJHKs based on the deep (i.e. stacked) images.	
VIDEO_XMM_CAT	Deep ZYJHKs Catalogue of the XMM-LSS field	Combined multi-band source catalogue with aperture-matched photometry in ZYJHKs based on the deep (i.e. stacked) images.	✓
VIDEO_CDFS_CAT	Deep ZYJHKs Catalogue of the Chandra Deep Field South	Combined multi-band source catalogue with aperture-matched photometry in ZYJHKs based on the deep (i.e. stacked) images.	

- ◆ Eleven public survey projects ongoing – several hundreds astronomers involved as PIs, co-Is
- ◆ Ten ESO press releases based on VISTA data since 01/2010 (last one eso1339)
- ◆ Four ESO press releases based on VST data since 01/2011
- ◆ 71 refereed papers from ESO public surveys and 5 from archive users
- ◆ ESO workshop on “Science from the next generation imaging and spectroscopic surveys” Oct 2012.

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<http://www.eso.org/sci/meetings/2012/surveys2012.html>
- ◆ Second public data release from VISTA PS on 06/2013
- ◆ First public data release from VST PS on 09/2013
www.eso.org/sci
- ◆ More than 27000 files and ~ 6.8 TB of data products downloaded by the community.

- ◆ Thanks to the PS PIs and their collaborators for their hard work!