Summary of ALMA Cycle 3

November 2018

www.almascience.org

ALMA, an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile.

User Support:

For further information or to comment on this document, please contact your regional Helpdesk through the ALMA User Portal at **www.almascience.org**. Helpdesk tickets will be directed to the appropriate ALMA Regional Center at ESO, NAOJ or NRAO.

Revision History:

Version	Date	Editors
Ver. 0.2	November 30, 2018	R. Friesen, L. Nyman, P. Andreani, M. Fukagawa, A. Remijan, M. Zwaan, E. Humphreys
Ver. 0.1	June 6, 2017	L. Nyman, P. Andreani, K. Tatematsu, A. Remijan

Contributors

This document was produced by the Joint ALMA Observatory (JAO) with contribution from the North American, East Asian, and European ALMA Regional Centers (ARCs).

In publications, please refer to this document as:

Nyman et al. 2018, Summary of ALMA Cycle 3 ALMA Doc. XXXX, v0.2

Table of contents

1 Summary

The document reports the final ALMA Early Science Cycle 3 statistics as of November 2018.

Previous status documents about Cycle 3 can be found in the ALMA Science Portal, specifically:

1. A status update at https://almascience.eso.org/documents-and-tools/status-update-for-august-2015.
2. The proposal review process and outcome are described in detail in the report at https://almascience.org/news/alma-cycle-3-proposal-review-detailed-report.
3. The Cycle 3 User Survey, which was conducted soon after the proposal deadline. A summary of the results are found at https://almascience.org/news/alma-cycle-3-user-survey-3.

2 ALMA Cycle 3

ALMA Early Science Cycle 3 started in October 2015 and spanned 12 months; there were expected to be 2100 hours of 12-m Array time available to projects receiving a grade of A or B, and an additional ~600 h to those receiving a grade of C.

ALMA received 1578 unique proposals during the Cycle 3 call, estimated to require 8854 hours of 12-m Array (representing an over-subscription request of 4.1, similar to previous cycles) and 3640 hours of ACA time. By comparison, 1382 proposals were received in Cycle 2 and 1131 in Cycle 1. The ALMA Regional Centers handled a total of 345 helpdesk tickets between the issuing of the Call for Proposals and the proposal submission deadline.

A total of 1127 unique Principal Investigators and 3605 proposers (Principal and Co-investigators) were involved in the submitted proposals. Statistics of the submitted proposals can be found in the proposal review detailed report linked in the above Summary. The percentage of proposals that requested observations in various bands was 31% (Band 3), 9% (Band 4), 45% (Band 6), 40% (Band 7), 6% (Band 8), 5% (Band 9) and 2% (Band 10). The total time requested for standard observing modes was 6913h and for non-standard modes 2124h.

3 Observing Statistics

Table 1 gives the statistics of each observing block over Cycle 3 for the 12-m Array observations, beginning on Oct 12, 2015 and continuing through September 30, 2016. The table presents the following information: (1) the ES observing block number; (2) the dates of the observing block; (3) the time allocated for ES observing; (4) the time associated with successful executions of PI science observations; (5) the Science execution efficiency (the fraction of the scheduled time used for successful PI observations as opposed to calibrations or weather or technical downtime)); (6) the overall observing efficiency (time spent on successful PI observations and calibrations divided by the allocated time after excluding any weather downtime); (7) the average number of antennas available over the session; and (8) the approximate configuration[1] of the available 12-m antennas, using the naming convention given in the Cycle 3 Proposers Guide. The most compact configuration is called C36-1, and the most extended is called C36-8. Configurations listed with a slash indicate that the configuration contained sufficient baselines to approximate either configuration. From mid-May, Cycle 4 12-m Array configurations began to be used (C40-X). In Table 1, the equivalent Cycle 3 12-m Array configuration(s) are listed along with the Cycle 4 configuration formally used for the observing block.
Overall, more than 2500 h of successful 12-m Array executions were obtained. An additional 1274 h of successful executions were completed on the ACA (561 h with the 7-m Array and 713 with the TP Array). These values include some Cycle 3 C-graded proposals that were observed when no higher priority projects suited to the prevailing conditions were available. The overall science execution efficiency matches the number adopted for Cycle 3 planning (50%). As seen from the Table, during the first three months of

[1] The configurations are considered "representative", since the array is seldom exactly in one of the advertised Cycle 3 configurations (due to antenna or receiver maintenance or other issues). But at any given time the array should be in a configuration with similar imaging properties – resolution and Maximum Recoverable Scale – as one of the representative configurations.

observations the observing efficiency was mostly below the planned goal (over 50%). Lower observing efficiencies were a result of events such as poor weather, Extension and Optimization of Capabilities (EOC) campaigns, and other commissioning campaigns. For the rest of the cycle the situation was largely improved, with most observing blocks achieving efficiencies well above this value. Since the end of December, the average number of antennas used for 12-m Array observations consistently exceeded the number announced in the Call (36).

Table 1: Cycle 3 Observing Session summary for the 12-m Array through Sept 30, 2016

(1) Block	(2) Dates	(3) Allocated time (h)	(4) Successful Executions (h)	(5) Science Execution Efficiency (%)	(6) Overall Observing Efficiency (%)	(7) Average number of antennas	(8) Approx. 12-m Array config.
1	Oct 12-18	177.1	6.57	3.7	28.4	36.1	C36-8
2	Oct 19-25	127.8	8.70	6.8	18.8	36.7	C36-8/7
3	Oct 26-Nov 1	127.5	60.72	47.6	89.4	40.3	C36-8/7
4	Nov 2-8	117.4	27.45	23.4	37.6	44.4	C36-8/7
5	Nov 9-15	133.2	31.62	23.7	46.1	44.8	C36-8/7
6	Nov 16-22	108.4	5.60	5.2	20.2	42.7	C36-8/7
7	Nov 23-29	130.2	12.06	9.3	37.6	39.5	C36-8/7
8	Nov 30–Dec 6	104.0	30.48	29.3	49.5	34.9	C36-8/7
9	Dec 7-13	133.9	7.07	5.3	21.4	34.2	C36-1
10	Dec 14-20	82.6	13.33	16.1	24.5	31.9	C36-1
11	Dec 21-27	117.0	37.69	32.2	41.3	34.4	C36-1
12	Dec 28-Jan 3	141.9	73.93	52.1	67.2	39.6	C36-1
13	Jan 4-10	141.0	82.80	58.7	68.5	41.4	C36-1
14	Jan 11-17	147.5	89.39	60.6	68.9	44.0	C36-1
15	Jan 18-24	139.4	69.09	49.6	84.9	43.6	C36-1
16	Jan 25-30	102.0	58.84	57.7	81.6	45.5	C36-1
17	Mar 1-6	122.2	76.66	62.7	92.9	39.2	C36-1/2
18	Mar 7-13	112.5	71.99	64.0	87.6	38.8	C36-2/3
19	Mar 14-20	136.6	79.39	58.1	67.5	38.4	C36-2/3
20	Mar 21-27	115.3	62.01	53.8	86.2	39.3	C36-2/3
21	Mar 28-Apr 3	129.3	71.10	55.0	80.4	42.8	C36-2/3
22	Apr 4-10	138.6	47.68	34.4	44.6	40.6	C36-2/3
23	Apr 11-17	125.4	75.59	60.3	70.6	39.4	C36-2/3
24	Apr 18-24	132.7	37.73	28.4	37.9	40.1	C36-2/3
25	Apr 25-May 1	138.6	97.65	70.5	83.6	40.0	C36-2/3
26	May 2-8	138.4	52.88	38.2	47.0	39.8	C36-3
27	May 9-15	125.6	44.15	35.1	40.4	39.8	C36-3
28	May 16-22	109.7	49.66	45.3	66.2	38.1	C40-3 (C36-2/3)
29	May 23-29	115.4	40.80	35.3	41.0	38.0	C40-3 (C36-2/3)
30	May 30-Jun 4	125.5	51.08	40.7	51.1	39.0	C40-4 (C36-(3)/4/(5))
31	Jun 6-12	141.2	48.06	34.0	46.6	38.2	C40-4 (C36-(3)/4/(5))
32	Jun 13-19	130.7	77.63	59.4	72.5	38.0	C40-4 (C36-(3)/4/(5))
33	Jun 20-26	121.9	47.96	39.3	66.9	39.1	C40-4 (C36-(3)/4/(5))
34	Jun 27-Jul 3	139.8	49.36	35.3	59.1	40.7	C40-4 (C36-(3)/4/(5))
35	Jul 4-10	147.7	12.35	8.4	16.2	29.2	C40-4 (C36-(3)/4/(5))
36	Jul 11-18	94.0	52.08	55.4	67.4	38.6	C40-5 (C36-(4)/5)
37	Jul 18-24	117.7	82.40	70.0	96.1	41.0	C40-5 (C36-(4)/5)
38	Jul 25-31	126.8	83.87	66.1	80.0	40.6	C40-5 (C36-(4)/5)
39	Aug 1-8	96.9	34.71	35.8	40.8	40.8	C40-5 (C36-(4)/5)

40	Aug 8-14	123.6	75.45	61.0	74.3	38.7	C40-5 (C36-(4)/5)
41	Aug 15-21	139.3	74.87	53.7	66.4	39.7	C40-5 (C36-(4)/5)
42	Aug 22-28	129.2	39.44	30.5	45.0	39.2	C40-5 (C36-(4)/5)
43	Aug 29-Sep 4	118.1	74.41	63.0	97.9	39.0	C40-6 (C36-(5)/6)
44	Sep 6-12	115.8	84.61	73.1	80.9	38.4	C40-6 (C36-(5)/6)
45	Sep 12-19	117.7	95.61	81.2	91.5	38.7	C40-6 (C36-(5)/6)
46	Sep 19-25	137.3	92.99	67.7	103.5	38.7	C40-6 (C36-(5)/6)
47	Sep 26-30	58.7	32.12	54.7	68.1	40.5	C40-6 (C36-(5)/6)
1-47		**5853.1**	**2531.6**	**43.3**	**60.7**	**39.6**	

4 Completion Statistics

The completion statistics are given in Table 2 for Cycle 3 Projects as a function of their corresponding grade. Overall, most of the highly-ranked Cycle 3 projects (Grades A and B) were either fully completed, or had greater than 80% of their data taken. Only a small fraction of highly-ranked projects was not observed at all. Roughly half of the Grade C projects were completed or largely completed. At the end of the observing season, all incomplete Cycle 3 A-graded SBs were transferred to Cycle 4, while the incomplete Cycle 3 B-graded components were set to "ObservingTimedOut" and sent to the quality assurance process as described at http://almascience.org/processing/documents-and-tools/cycle3/ALMAQA2Products3.0.pdf.

Table 2: Cycle 3 Project Status Summary

State	Number of A Projects & DDT Projects	Number of B Projects	Number of C Projects
Accepted	104+12	299	237
Fully Completed	65 (56%)	145 (48%)	65 (27%)[2]
80% to 99% Completed	31 (27%)	65 (22%)	59 (25%)
Observed but < 80% Completed	10 (9%)	44 (15%)	66 (28%)
Not Observed[3]	10 (9%)	45 (15%)	57 (24%)

Each accepted Cycle 3 project contains one or more Science Goals, which contain one or more ObsUnitSets (OUS), which themselves contain one or more Member OUS (MOUS). The completion statistics of individual (MOUS) are given in Table 3 as a function of the parent project grade. Table 3 shows that MOUS were fully observed at a very high rate during Cycle 3. Only a small fraction of MOUS were observed but not completed.

Table 3: Cycle 3 MOUS Status Summary

MOUS State	A + DDT	B	C
Total	289	912	847
Fully Observed and Delivered	250 (86%)	751 (82%)	570 (67%)
Partially Observed and Delivered	12 (4%)	58 (6%)	49 (6%)
Not Observed	27 (9%)	103 (11%)	228 (27%)

[2] An unusually large number of grade C projects were observed due to the marginal weather conditions during Cycle 3.

[3] Includes some projects identified as resubmissions from Cycle 2.

5 Data reduction progress & timescales

As in previous cycles, the assessment of the quality of Cycle 3 data reduction is a work-intensive process done at the JAO and the three ARCs, and involves customizing standard data reduction scripts, identifying problematic data, conducting quality assurance checks, and packaging the data for delivery to PIs.

The goal of ALMA QA2 in Cycle 3 is a reliable and "science ready" calibration, but the imaging products may not be. A sufficient fraction of the possible imaging products is created to verify that the data meet the science goals set by the PI (resolution and sensitivity), within some tolerance, but the imaging may be incomplete. Investigators should expect to need to re-image their data using the provided scripts as guideline. In particular, care should be taken to optimize continuum subtraction (if relevant) and fine-tune the image deconvolution parameters (e.g. clean masks and thresholds).

About 70% of all data can be processed through the calibration pipeline.

There was still a number of projects that did not run through the calibration pipeline, including observing modes that are not yet implemented in the pipeline (e.g. polarization, high frequency, bandwidth switching) or projects that fail pipeline processing (e.g. low signal-to-noise calibrators, poor phase stability). These data are manually processed by experienced staff at the JAO and ARCs.

As a result, PIs received data that were calibrated either manually or by the pipeline. There are two methods for reproducing calibrated measurement sets: one for manually calibrated data, and another for pipeline calibrated data. To reproduce pipeline calibrated or manual calibrated data, users may follow the instructions provided at http://almascience.org/processing/documents-and-tools/cycle3/ALMAQA2Products3.0.pdf .

More information about the ALMA pipeline can be found at https://almascience.org/processing/science-pipeline.

We remind all researchers that there are opportunities to visit their regional ARCs or ARC nodes to work on proprietary or archival ALMA data. Visit requests should be submitted using the ALMA helpdesk (https://help.almascience.org). Researchers receiving assistance from an ARC or ARC node should add this to the standard ALMA acknowledgement (see https://almascience.org/alma-data) to be included in all publications making use of ALMA data.

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of the European Organization for Astronomical Research in the Southern Hemisphere (ESO), the U.S. National Science Foundation (NSF) and the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Republic of Chile. ALMA is funded by ESO on behalf of its Member States, by NSF in cooperation with the National Research Council of Canada (NRC) and the National Science Council of Taiwan (NSC) and by NINS in cooperation with the Academia Sinica (AS) in Taiwan and the Korea Astronomy and Space Science Institute (KASI).

ALMA construction and operations are led by ESO on behalf of its Member States; by the National Radio Astronomy Observatory (NRAO), managed by Associated Universities, Inc. (AUI), on behalf of North America; and by the National Astronomical Observatory of Japan (NAOJ) on behalf of East Asia. The Joint ALMA Observatory (JAO) provides the unified leadership and management of the construction, commissioning and operation of ALMA.