

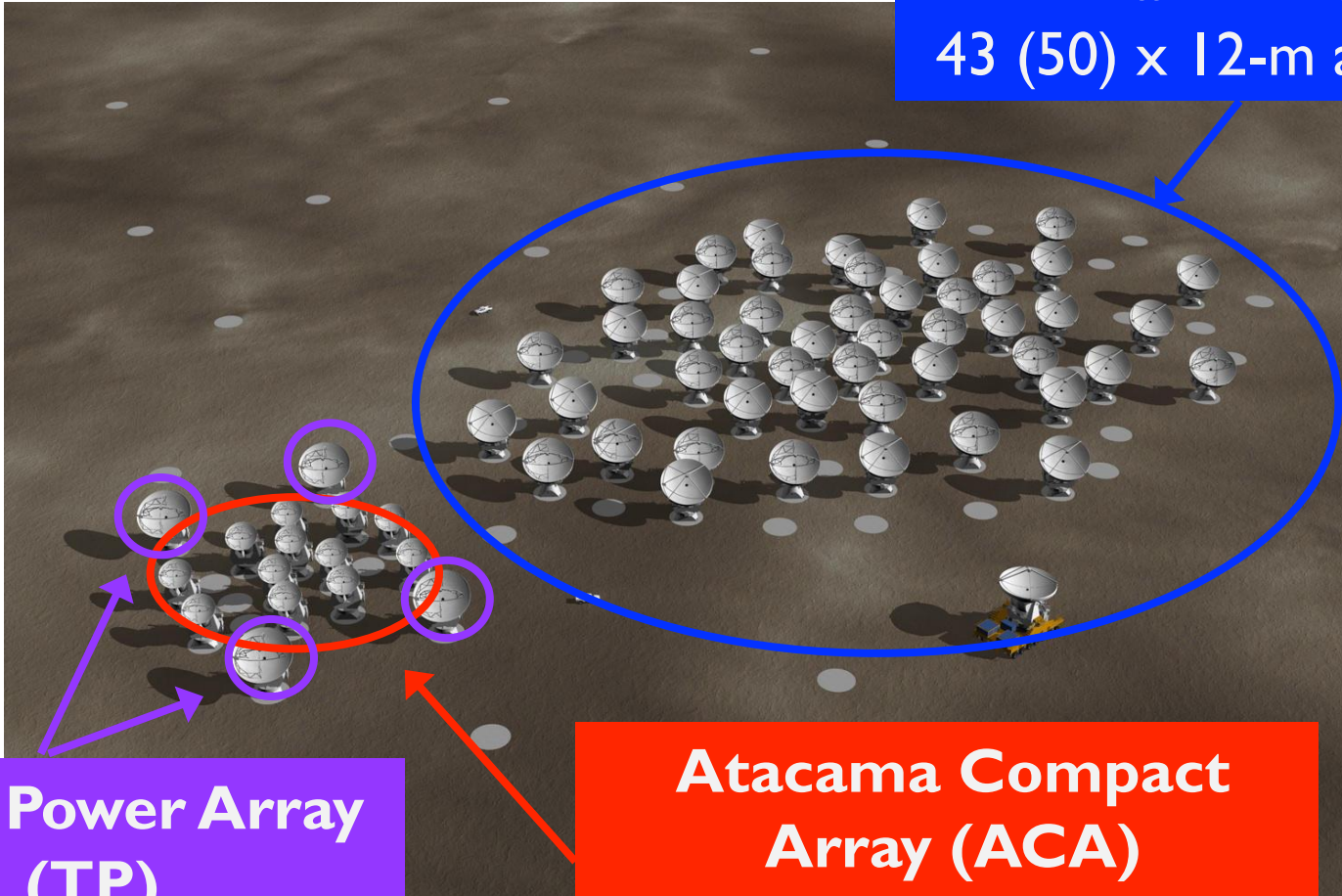


ALMA Capabilities



Composite of three arrays

Main Array
43 (50) x 12-m antennas



Total Power Array (TP)
3 (4) x 12-m antennas

Atacama Compact Array (ACA)
10 (12) x 7-m antennas

Three arrays

12-m Main Array

- For high angular resolution and sensitivity
- Moved through 10 spatial configurations during the cycle
- 4000 hours available for cycle 6

Atacama Compact Array (aka ACA, 7-m array)

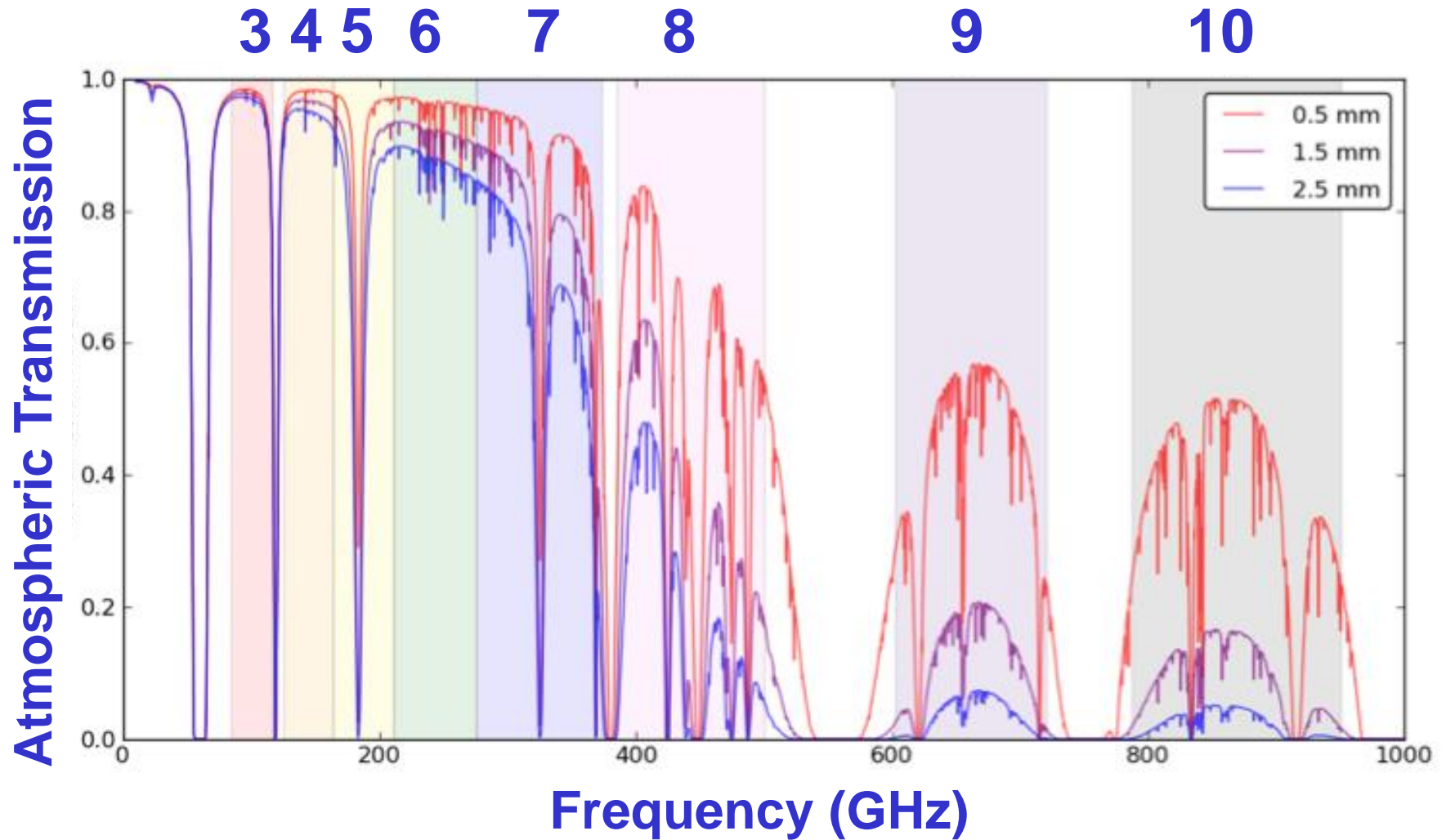
- Used in conjunction with 12-m array to acquire short baselines
- Can also do stand-alone ACA (plus TP if required). This is encouraged!
- 3000 hours available for cycle 6

Total Power Array (TP)

- Not actually an interferometer array (each dish is independent)
- Used along with 12-m and ACA arrays to get single dish measurements
- Only for spectral lines (not continuum observations), and only in bands 3-8
- Cannot be used alone
- 3000 hours available for cycle 6



ALMA receiver bands



ALMA receiver bands

Receiver band and array configuration set the resolution

Band:	3	4	5	6	7	8	9	10
Wavelength (mm)	3.1	2.1	1.6	1.3	0.87	0.74	0.44	0.35
Frequency (GHz)	100	150	183	230	345	460	650	870
Max Baseline (km)	16	16	16	16	8.5	3.6	3.6	3.6
Max Resolution (")	0.042	0.028	0.021	0.018	0.028	0.046	0.033	0.024

12 m array configuration schedule

Compact

Extended

Start date	Configuration	Longest Baseline	LST for best observing conditions
2018 October 1	C43-6	2.5 km	~ 22h – 10h
2018 October 15	C43-5	1.4 km	~ 0h – 12h
2018 November 25	C43-4	0.78 km	~ 2h – 14h
2018 December 15	C43-3	0.50 km	~ 4h – 15h
2019 January 5	C43-2	0.31 km	~ 5h – 16h
2019 January 20	C43-1	0.16 km	~ 6h – 17h
2019 February 1-28	No observations due to February shutdown		
2019 March 1	C43-1	0.16 km	~ 8h – 21h
2019 March 15	C43-2	0.31 km	~ 8h – 22h
2019 April 1	C43-3	0.50 km	~ 9h – 23h
2019 April 15	C43-4	0.78 km	~ 10h – 0h
2019 May 1-31	No observations due to major antenna relocation		
2019 June 1	C43-10	16.2 km	~ 13h – 3h
2019 June 20	C43-9	13.9 km	~ 14h – 5h
2019 July 10	C43-8	8.5 km	~ 16h – 6h
2019 August 1	C43-7	3.6 km	~ 18h – 8h
2019 September 5	C43-6	2.5 km	~ 20h – 9h

Best time of day is late night to early morning

LST (local sidereal time) = R.A. of source when it transits

Best Weather = Winter =

Table A-1: band / array configuration combos

“AR” =
angular
resolution

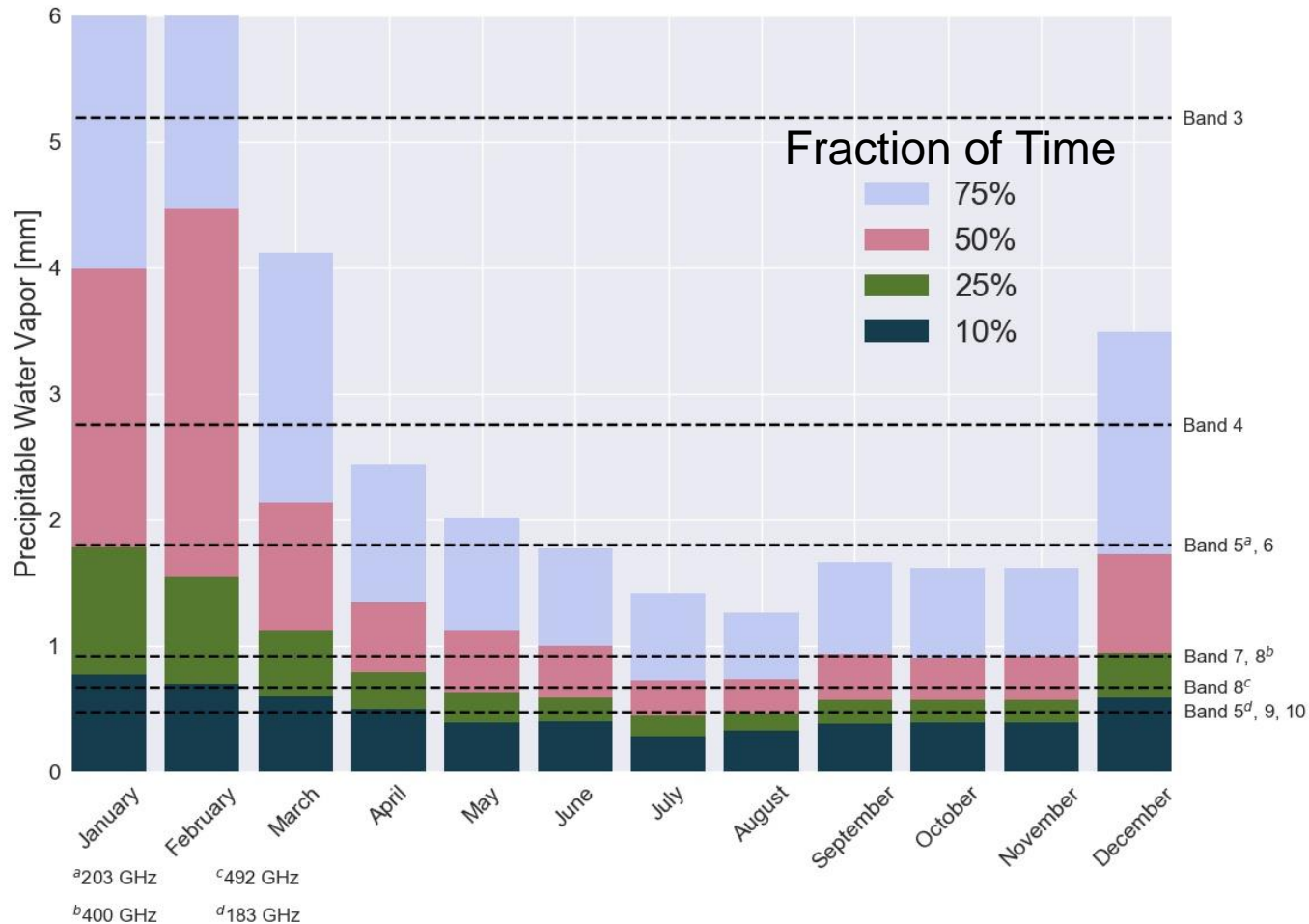
“MRS” =
maximum
recoverable
scale

Blue = non-
standard
mode

Config	Lmax		Band 3	Band 4	Band 5	Band 6	Band 7	Band 8	Band 9	Band 10
	Lmin		100 GHz	150 GHz	183 GHz	230 GHz	345 GHz	460 GHz	650 GHz	870 GHz
7-m Array	45 m	AR	12.5"	8.4"	6.8"	5.4"	3.6"	2.7"	1.9"	1.4"
	9 m	MRS	66.7"	44.5"	36.1"	29.0"	19.3"	14.5"	10.3"	7.7"
C43-1	161 m	AR	3.4"	2.3"	1.8"	1.5"	1.0"	0.74"	0.52"	0.39"
	15 m	MRS	28.5"	19.0"	15.4"	12.4"	8.3"	6.2"	4.4"	3.3"
C43-2	314 m	AR	2.3"	1.5"	1.2"	1.0"	0.67"	0.50"	0.35"	0.26"
	15 m	MRS	22.6"	15.0"	12.2"	9.8"	6.5"	4.9"	3.5"	2.6"
C43-3	500 m	AR	1.4"	0.94"	0.77"	0.62"	0.41"	0.31"	0.22"	0.16"
	15 m	MRS	16.2"	10.8"	8.7"	7.0"	4.7"	3.5"	2.5"	1.9"
C43-4	784 m	AR	0.92"	0.61"	0.50"	0.40"	0.27"	0.20"	0.14"	0.11"
	15 m	MRS	11.2"	7.5"	6.1"	4.9"	3.3"	2.4"	1.7"	1.3"
C43-5	1.4 km	AR	0.54"	0.36"	0.30"	0.24"	0.16"	0.12"	0.084"	0.063"
	15 m	MRS	6.7"	4.5"	3.6"	2.9"	1.9"	1.5"	1.0"	0.77"
C43-6	2.5 km	AR	0.31"	0.20"	0.16"	0.13"	0.089"	0.067"	0.047"	0.035"
	15 m	MRS	4.1"	2.7"	2.2"	1.8"	1.2"	0.89"	0.63"	0.47"
C43-7	3.6 km	AR	0.21"	0.14"	0.11"	0.092"	0.061"	0.046"	0.033"	0.024"
	64 m	MRS	2.6"	1.7"	1.4"	1.1"	0.75"	0.56"	0.40"	0.30"
C43-8	8.5 km	AR	0.096"	0.064"	0.052"	0.042"	0.028"	N/A	N/A	N/A
	110 m	MRS	1.4"	0.95"	0.77"	0.62"	0.41"			
C43-9	13.9 km	AR	0.057"	0.038"	0.031"	0.025"	N/A	N/A	N/A	N/A
	368 m	MRS	0.81"	0.54"	0.44"	0.35"				
C43-10	16.2 km	AR	0.042"	0.028"	0.023"	0.018"	N/A	N/A	N/A	N/A
	244 m	MRS	0.50"	0.33"	0.27"	0.22"				



ALMA Weather Conditions

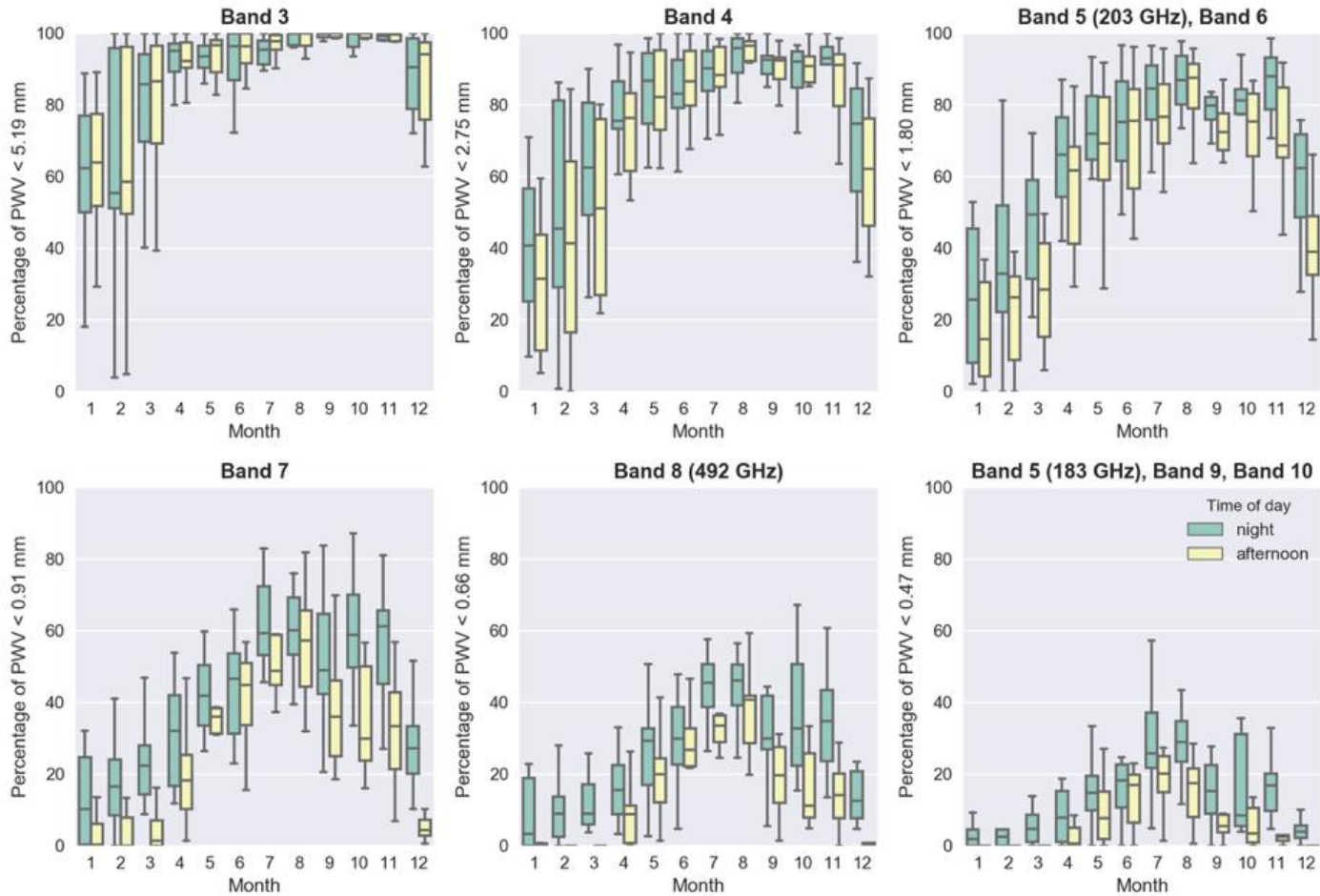


Best observing weather is in winter (June through August)



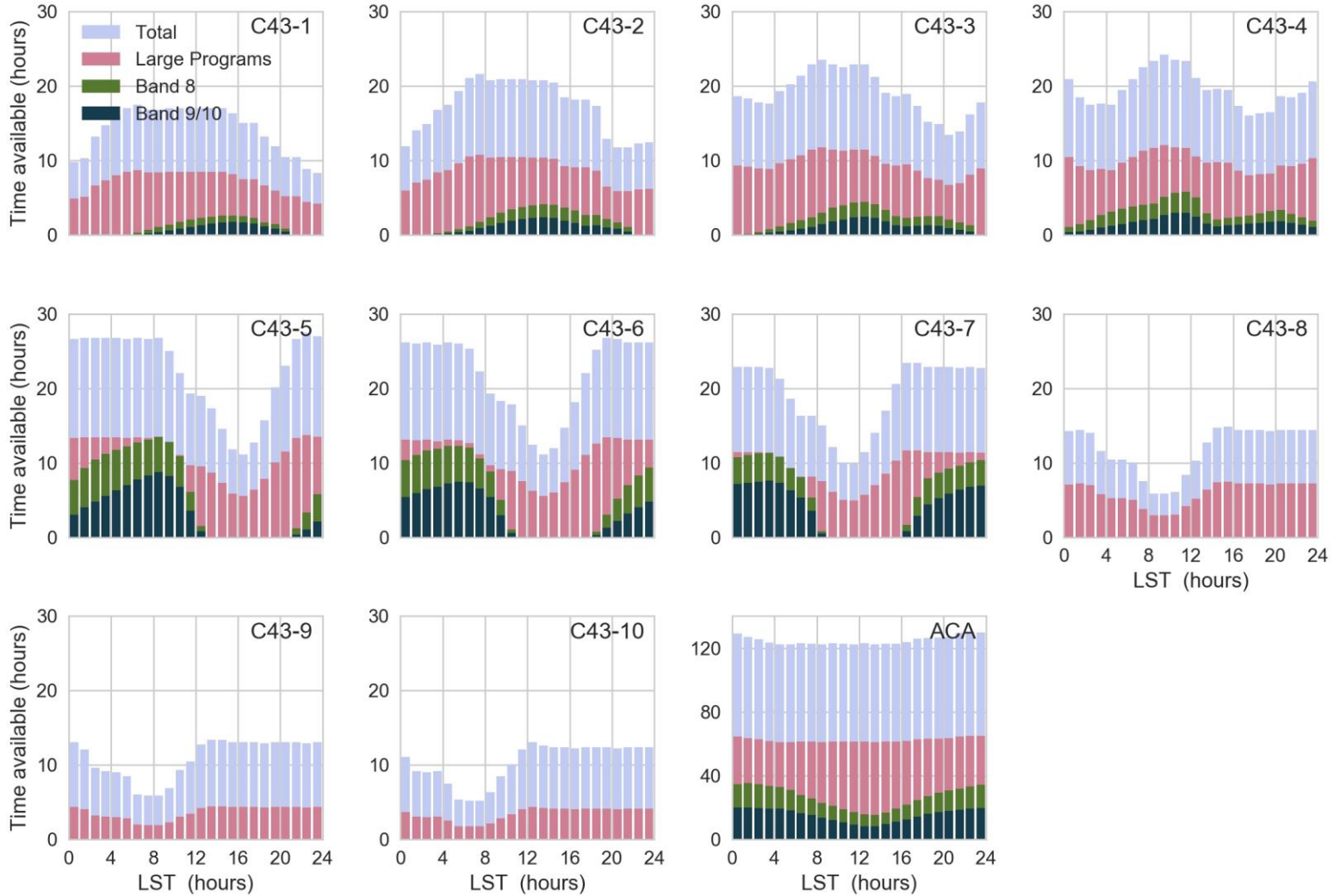
ALMA Weather Conditions

Fraction of time PWV is below the threshold for a given band

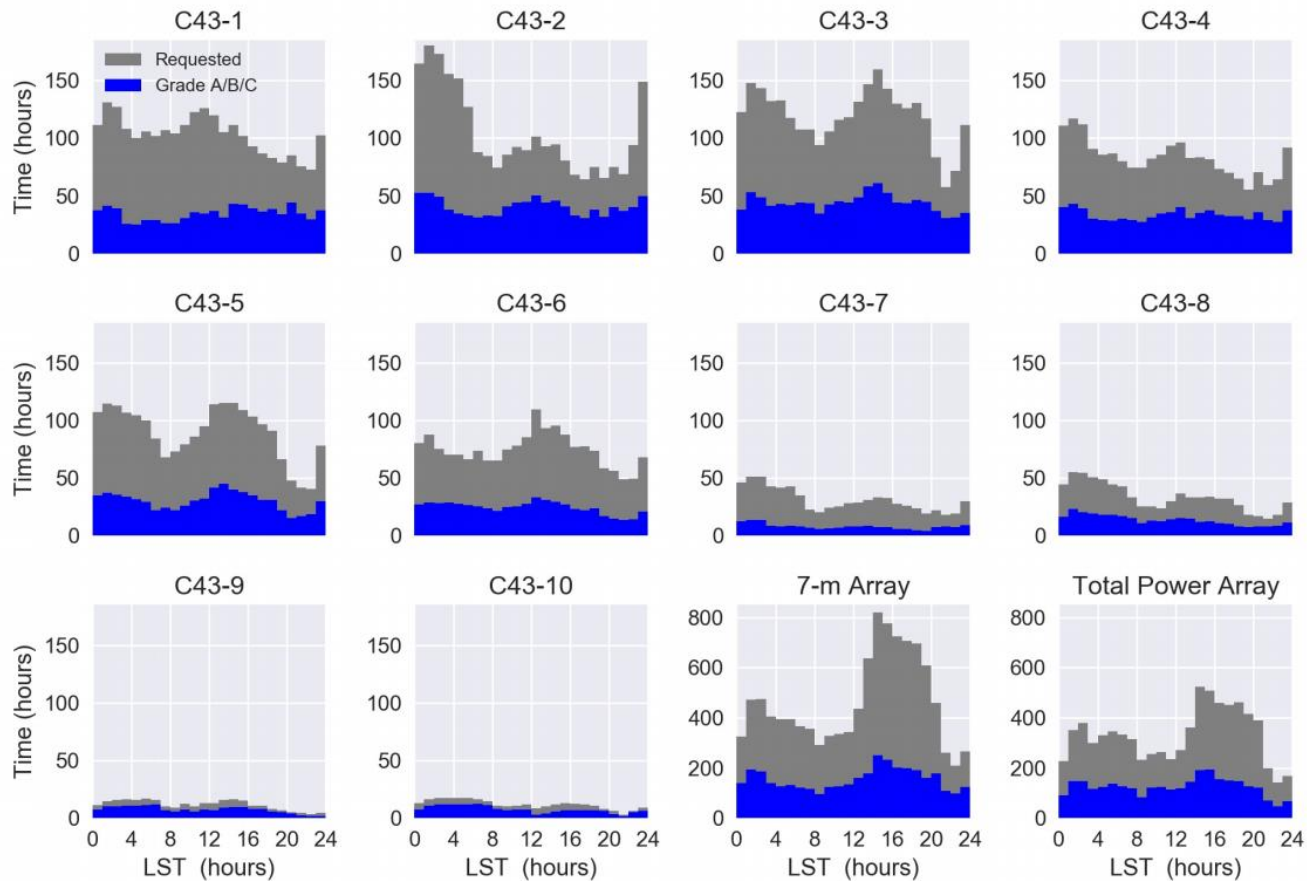


Can observe in Band 3 and 4 nearly all of the time
Band 5, 8, and 9 are *hard* nearly all of the time

Cycle 6 Available Observing Time



Observing Pressure (Cycle 5 Results)



Less time available in more extended configurations

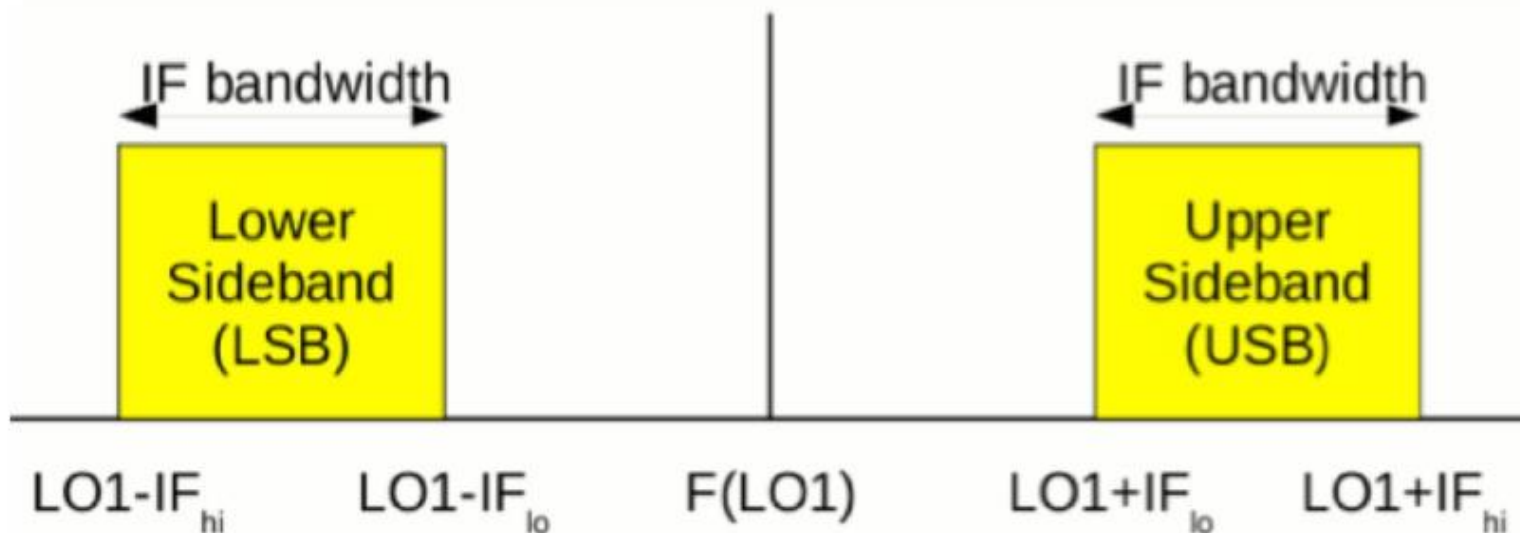
But, don't hesitate to ask for these configurations if you need them to achieve your science goals

Mosaics

- Can use 12-m, 7-m and TP arrays
- Only for bands 3-9 (not 10)
- Rectangular field, for which you specify
 - Location of field center
 - Length and width of the field
 - Orientation of the field
 - Spacing between pointings
 - Non-Nyquist spatial sampling of pointings must be justified
- Custom mosaic (not rectangular)
 - Pointings must overlap
- Same setup (sensitivity, etc.) for each pointing

Spectral Capabilities

- Continuum observable with 12-m and 7-m in all bands (never TP)
- Spectral lines observable with 12-m and 7-m in all bands, plus TP in bands 3-8
- A band has two sidebands, one on either side of the local oscillator frequency
- Place four 2 GHz-wide “basebands” within the sidebands (flexible, but some restrictions)

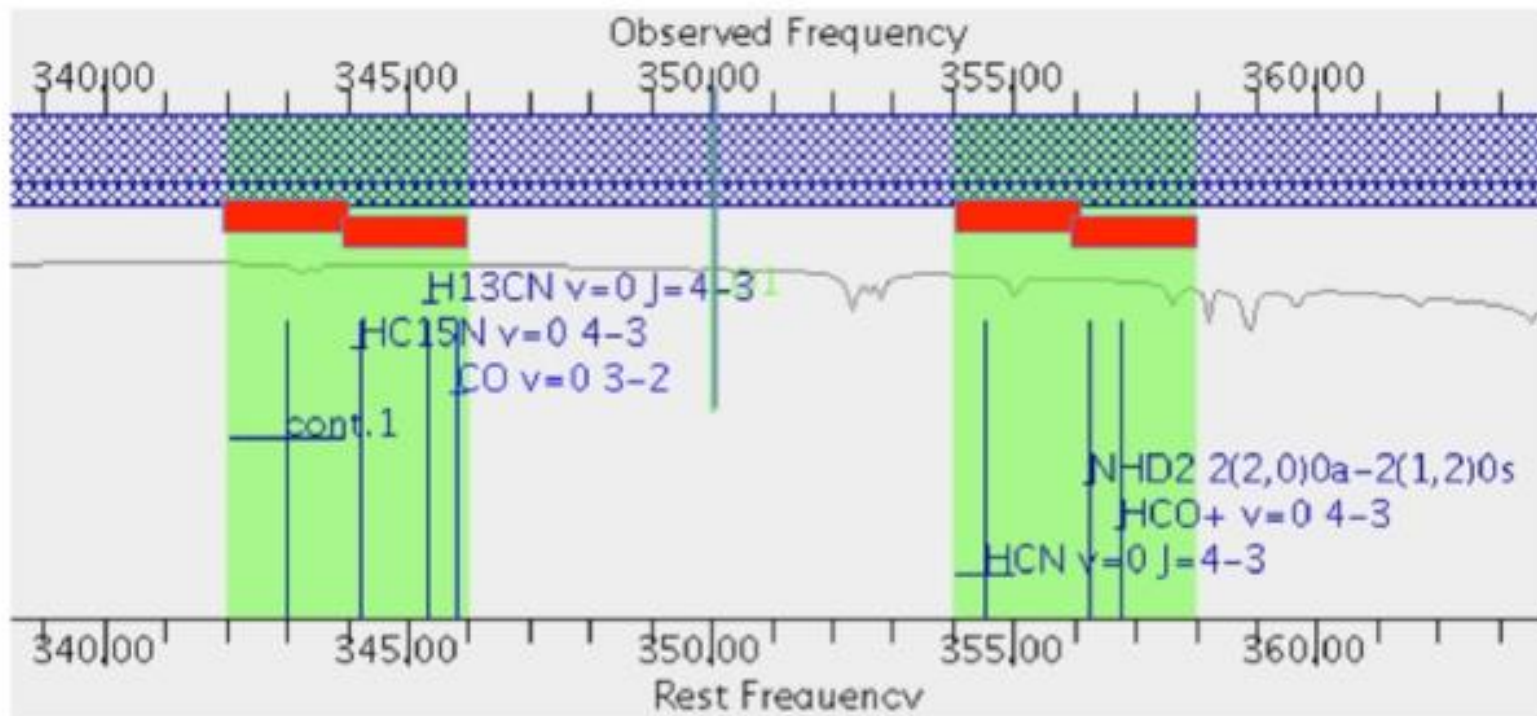


Spectral Capabilities

- Select a “correlator mode” for each baseband (sets bandwidth and spectral resolution)
- Allocate the available channels by defining up to 4 “spectral windows” in each baseband

Bandwidth (MHz)	Channel spacing ⁽³⁾ (MHz)	Spectral resolution (MHz)	Number of channels	Correlator mode ⁽⁴⁾
1875	15.6	31.2	120	TDM
1875	0.488	0.976	3840	FDM
938	0.244	0.488	3840	FDM
469	0.122	0.244	3840	FDM
234	0.061	0.122	3840	FDM
117	0.0305	0.061	3840	FDM
58.6	0.0153	0.0305	3840	FDM

Spectral Capabilities



Example of a Frequency Setup

Green areas: IF ranges

Blue hashed: tuning range

Red bars: basebands

Curved line: atmospheric transmission

Horizontal lines: spectral windows

Full Polarization

- Available for the 12-m array
- Available for continuum and lines (any spectral setting)
- Only available in bands 3, 4, 5, 6, and 7
- Not available for mosaics (single pointings only)
- Not available for spectral scans
- Source must be on-axis
 - Linear: FOV limited to 1/3 of primary beam size
 - Circular: FOV limited to 1/10 of primary beam size
- For circular polarization, minimum detectable degree of circular polarization = 1.8% of peak flux
- Requires minimum of 3 hours (for proper calibration)

Standard vs. Non-Standard Modes

What does 'non-standard' mean?

- No guarantee that observations can be reduced with the standard pipeline (additional observatory resources required to calibrate, image, and deliver data)
- Up to 20% of time in will go to non-standard modes in Cycle 6
- Don't hesitate to apply for non-standard mode if your science requires it
- Stand-alone ACA can only be done in standard modes

Non-standard observing modes include ...

- Bands 9 and 10 observations
- Band 7 observations with maximum baselines >5 km
- All polarization observations
- Spectral scans
- Bandwidth switching projects (<1 GHz aggregate bandwidth over all spectral windows)
- Solar observations
- VLBI observations
- Non-standard calibrations (user-defined calibrations selected in the OT)
- Astrometric Observations



New Capabilities for Cycle 6

Band 6 Bandwidth Increase

The Band 6 IF bandwidth has increased by 0.5 GHz to enable **simultaneous** observations of ^{12}CO , ^{13}CO and Cl^{18}O with broader spectral windows

Circular Polarization

Only for bands 3, 4, 5, 6, and 7

Time Simultaneous Observations

Between the 12-m array and ACA (and TP if required)

Not available for 12-m array long-baseline configurations

Band 8 as Standard Observing Mode

Allows for ACA-only observations in band 8





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