

ALMA simulators for Cycle 1

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The use of simulators

Proposers can use simulations to test their science case:

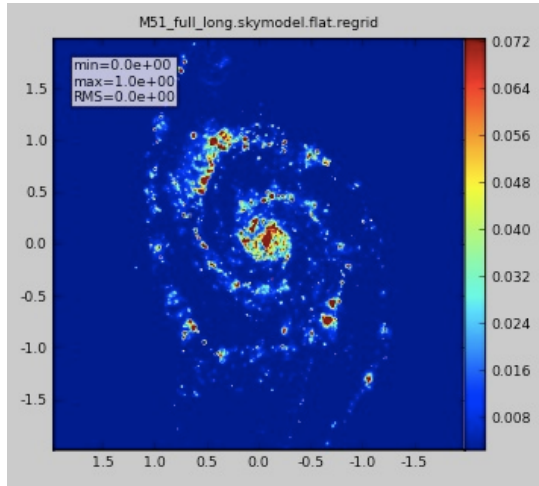
- can I do this with ALMA ? Do I need the ACA ?
- can I already do this during Cycle 1 ? Should I ?
- how to optimize my science goal ?

PIs can use simulations to interpret their (Cycle 0) data

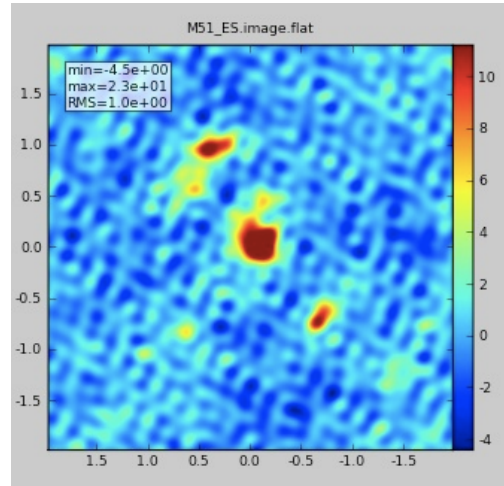
The simulation tools are also used by **the ALMA project** itself

An H-alpha image of M51 provided by D. Thilker (NRAO)

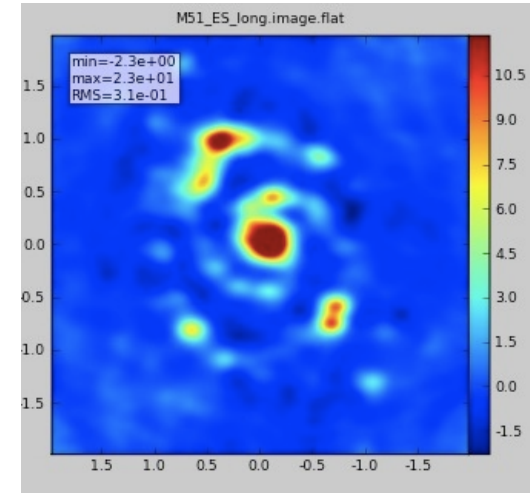
Nearby galaxy (ALMA band 9)



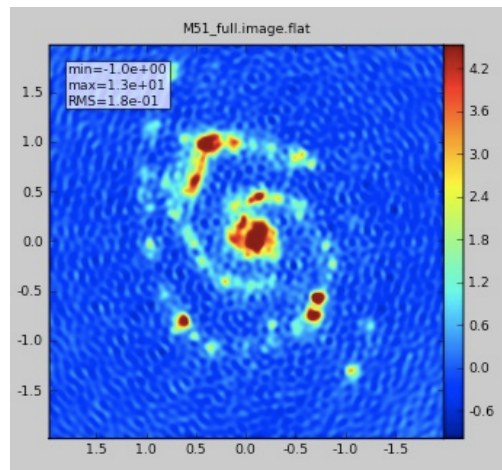
Skymodel



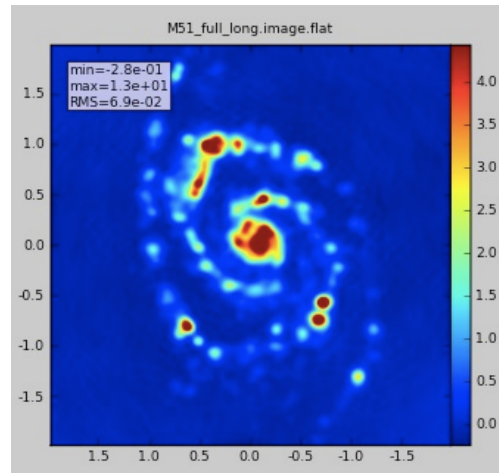
ES (30 min)



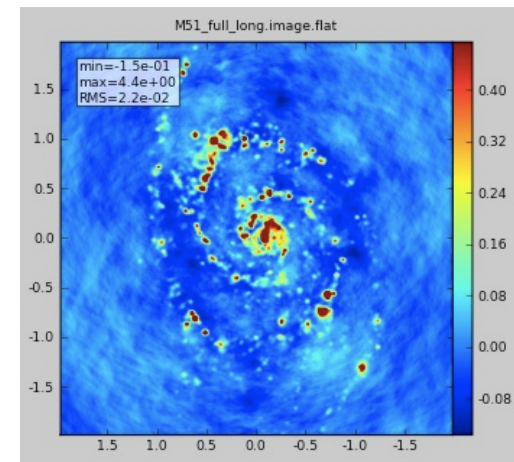
ES (4h)



Full 2 km array (30 min)



Full 2 km array (4h)



Full 6 km array (4h)

As it was for Cycle 0

Expert users: simdata (part of CASA)

Novice users: OST (webtool hosted by the UK ARC)

simdata is a CASA **task** used to produce mock ALMA data from an input sky model (theoretical model or previous observation).

The main work is done by the sm **tool**: the simdata task (a Python script) is a user-friendly interface to this tool with additional work done on plotting and analysis

The OST (Observation Support Tool) is a webtool that also uses the sm **tool** underneath the hood, but is much simplified (hence faster) and restricted, with a website acting as a simple GUI to set parameters and run the simulation



Main changes for Cycle 1

In CASA 3.3, *simdata* has been split into two parts: *sim_observe* and *sim_analyze*, although *simdata* is still there too (for the time being ...)

In CASA 3.4, these have been renamed *simobserve* and *simanalyze*, and Cycle 1 antenna configuration have been included in the release

- *simobserve* produces the mock data, but does not run *clean* or any image analysis
- *simanalyze* runs *clean* on the mock data and analyses the resulting images (including a comparison to the input model)

Maptype 'ALMA' included, to mimic what the Observing Tool (OT) does.

Much more help text in CASA.

Various other changes (filenames, etc.)




on-line guide to simulations using CASA

Simulating Observations in CASA 3.4 - CASA Guides

casaguides.nrao.edu/index.php?title=Simulating_Observations_in_CASA

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Simulating Observations in CASA 3.4

(Redirected from [Simulating Observations in CASA](#))

- This guide is applicable to CASA version 3.4. For older versions of CASA please see [Simulating Observations in CASA 3.3](#).

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Introduction

The task **simobserve** can be used to simulate an observation in CASA. **simobserve** turns a model of the sky (2 to 4 dimensions including frequency and polarization) into the visibilities that would be measured with ALMA, (E)VLA, CARMA, SMA, ATCA, PdB, et cetera. **simobserve** can also add thermal noise (from receiver, atmosphere, and ground) to the visibilities. **simobserve** uses the [aatm](#) atmospheric model, a thin wrapper of Juan Pardo's [ATM](#) library, to accurately calculate all atmospheric corruption terms (noise, phase delay) accurately as a function of frequency and site characteristics.

After creating the visibilities, task **simanalyze** will produce a cleaned image of the model visibilities, compare that image with your input convolved with the synthesized beam, and calculate a fidelity image.

simobserve and simanalyze were named sim_observe and sim_analyze, respectively, in CASA 3.3. In earlier versions of CASA the functionality of both tasks was contained in task simdata. simdata is still available in CASA 3.4 but is deprecated and will be removed in a future CASA release.

Simulating ALMA Observations

Although **simobserve** can simulate data for many instruments, this guide (and the tutorials linked below) focuses in particular on simulating ALMA observations. ALMA is still under construction. We will update CASA's simulation tasks and tools as ALMA commissioning proceeds. During this period, we expect the noise properties of the telescope to be increasingly better characterized, and its configurations to be refined.

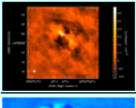
Users should be aware of the Observation Support Tool (OST) [1]. This is a web-based interface to an ALMA simulator hosted by the University of Manchester, UK. Like the **simobserve**, it is based on the CASA **sm** toolkit, but uses different wrapper scripts, and, in particular, has a different treatment of atmospheric effects. Comparisons to the [ALMA sensitivity calculator](#) made in March 2011 suggest that both **simobserve** and the OST give similar noises for observations in bands 3 to 8. However, the OST diverges in bands 9 and 10.

Since the **ALMA sensitivity calculator** will be used for the technical assessment of ALMA proposals, only values from it, not **simobserve** or the OST, should be used to estimate exposure times for ALMA Science Goals.

Tutorials

[Simulation Guide for New Users \(CASA 3.4\)](#)

A fully annotated tutorial that uses a Spitzer SAGE 8 micron continuum image of 30 Doradus and scales it to greater distance.




The OST (Observation Support Tool)

ALMA observation support tool

ALMA observation support tool

almaost.jb.man.ac.uk

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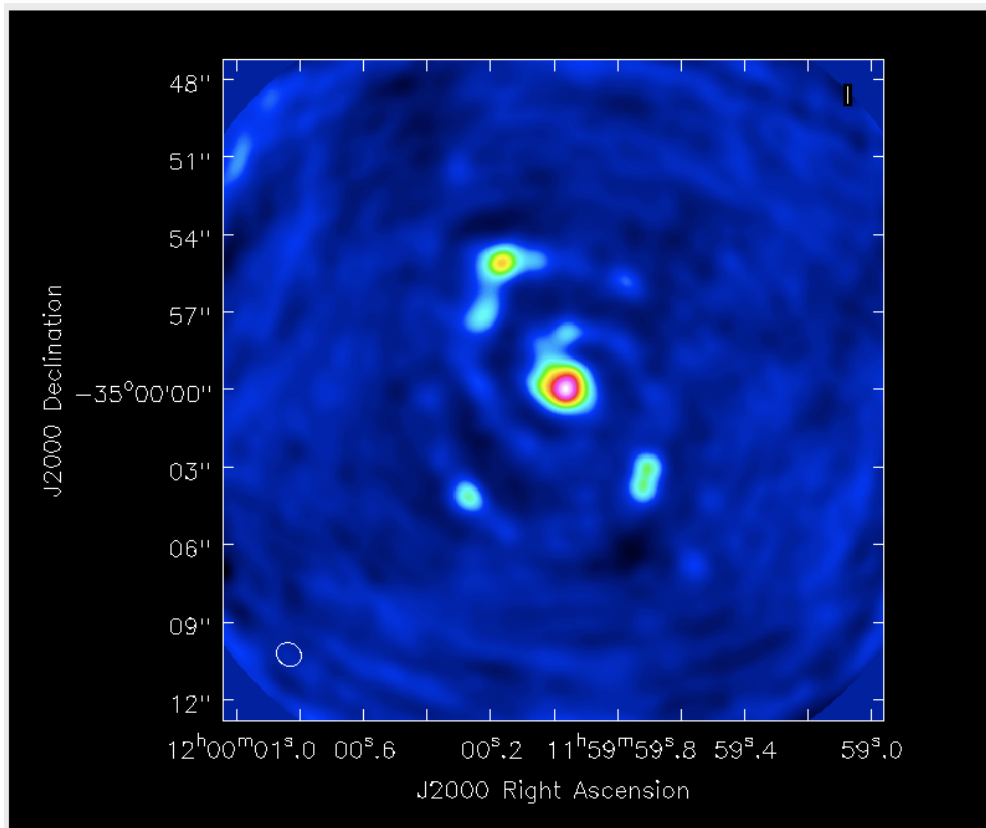
Version 1.2 (ALMA Cycle 1) [Important Message](#)

[Queue Status](#) • [Help](#) • [ALMA Helpdesk](#)
[OST Latest News](#)

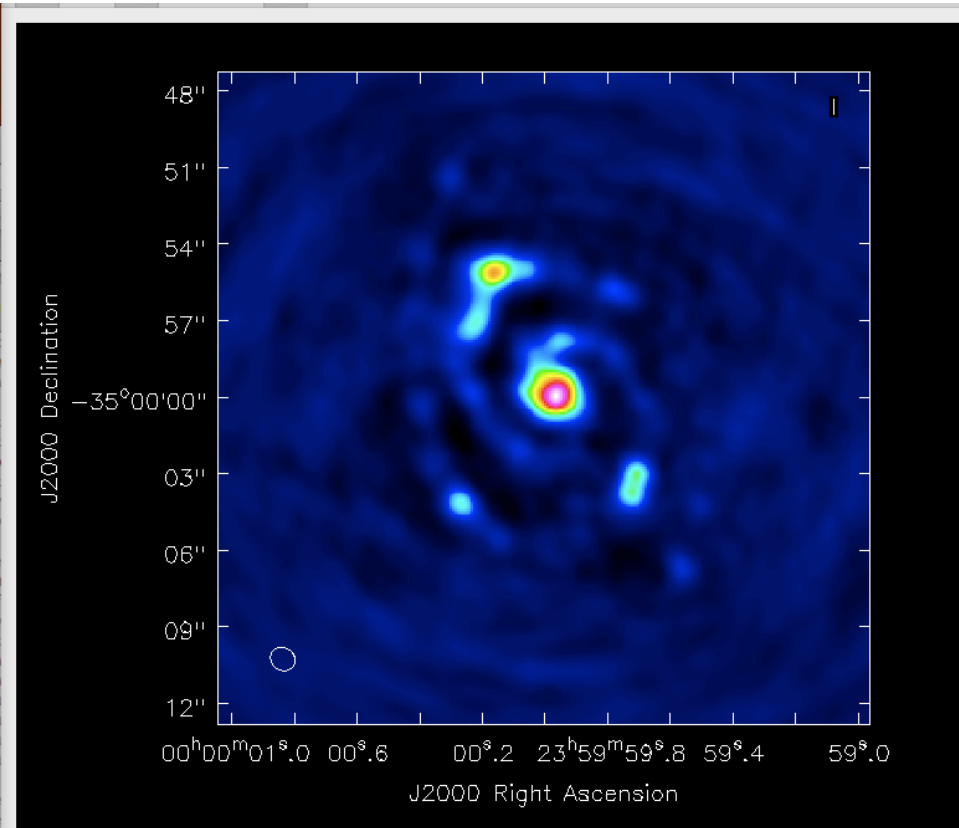
Array	Instrument	ALMA	
Sky Setup	Source model	OST Library: Central point source	Choose a library source model or supply your own
	Upload a FITS file	<input type="text"/> Browse...	You may upload your own model here (max 10MB)
	Declination	-35d00m00.0s	Ensure correct formatting of this string (+/-00d00m00.0s)
	Image peak / point flux in mJy	0.0	Set to 0.0 for no rescaling of source model
Observation Setup	Central frequency in GHz	90	The value entered must be within an ALMA band
	Bandwidth in GHz	32	Use broad for continuum, narrow for single channel
	Required resolution in arcseconds	1.0	OST will choose config if instrument is set to ALMA
	Pointing strategy	Mosaic	Selecting single will apply primary beam attenuation
	Start hour angle	0.0	Deviation of start of observation from transit
	Phase Cycle in seconds	0.0	The length of time between cutting to a phase calibrator (currently limited to either 0s or between 300s and 600s)
	On Phase Calibrator in seconds	0.0	The length of time spent observing phase calibrator (currently limited to either 0s or between 30s and 600s)
	On-source time in hours	3	Per pointing for Mosaics.
	Number of visits	1	How many times the observation is repeated
Number of polarizations	2	This affects the noise in the final map	
Corruption	Atmospheric conditions	PWV = 0.472 mm (1st Octile)	Determines level of noise due to water vapour
Imaging	Imaging weights	Natural	This allows a resolution / sensitivity trade-off
	Perform deconvolution?	No (Return dirty image)	Apply the CLEAN algorithm to deconvolve the image
	Output image format	FITS	CASA format images are returned as a tar file
	Your email address is	essential!	<input type="button" value="Submit"/>

simobserve versus OST: images

simobserve



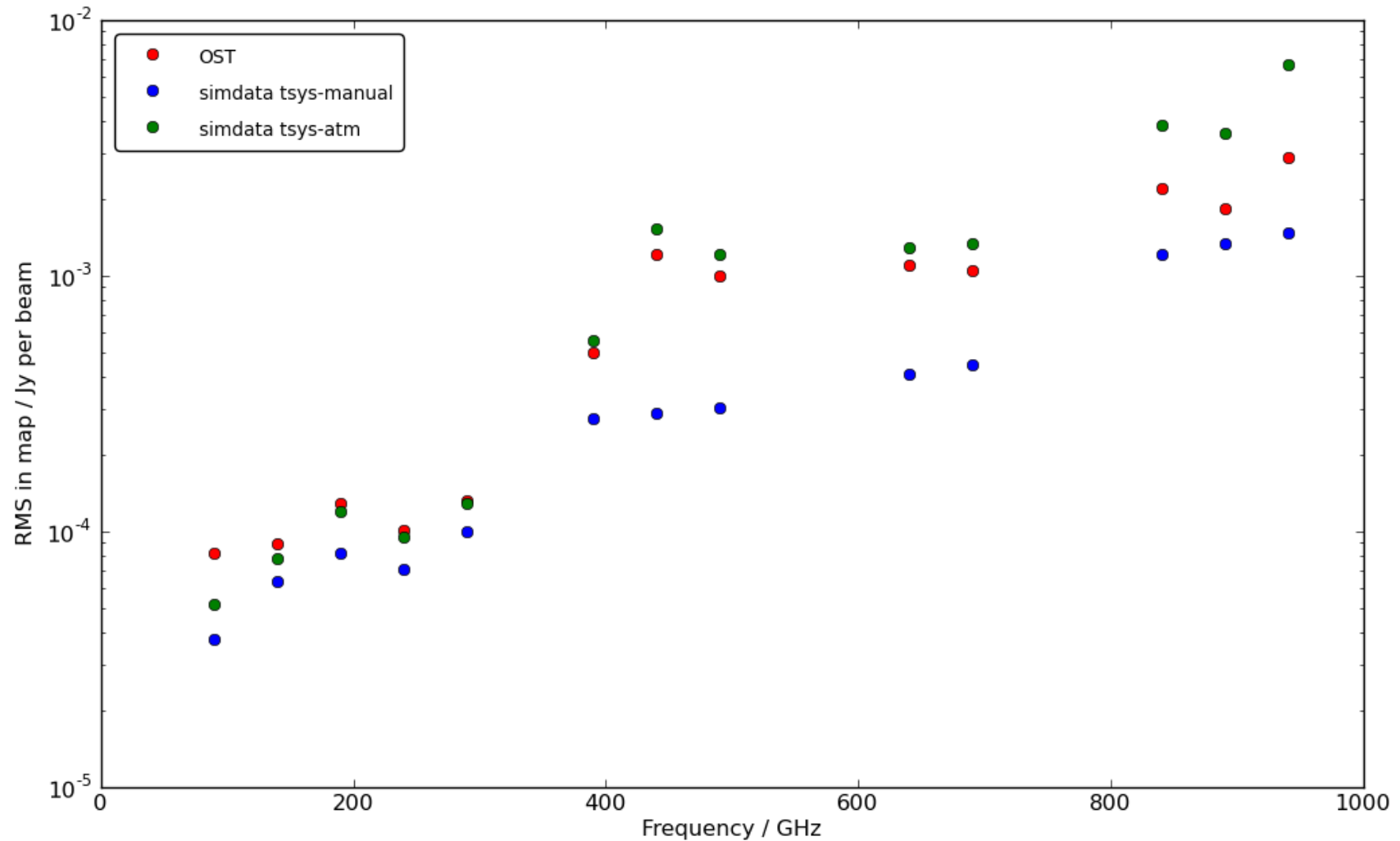
OST



M51@ $z=0.5$, Early Science configuration, band 6

simobserve versus OST: noise levels

rms noise comparison for all ALMA bands (using pure noise maps)



ALMA+ACA+TP

Deconvolving the predicted visibilities back into an image

Many ways of doing this, including:

- 1) use the total power image as a model when deconvolving the ACA image, and then use the result as a model when deconvolving the 12m interferometric image (this tends to give low weight to the large spatial scales)
- 2) use multiscale clean, in the clean task (again using the lower resolution image as a model when deconvolving the higher resolution one)
- 3) create each image independently, and then use the CASA feather task to combine them entirely in the image plane

Note for proposers

In general, because the ALMA Sensitivity Calculator (ASC) will be used for the technical assessment of ALMA proposals, only values from the ASC should be used to estimate exposure times in ALMA proposals.

Representative Cycle 1 antenna configurations are included in CASA 3.4 and the OST, but the actual configuration could differ somewhat when the observation is scheduled.

Plan for simulator tutorials tomorrow

- Introductions to simobserve and the OST, plus an interferometry introduction for the 'novice group'
- Running specific examples (including your own models), with six tutors at hand
- The 'novice group' session will focus a bit more on the OST, the 'advanced group' more on simobserve, but both will be covered during each session
- How to include the ACA in your simulations