

Simulating observations with ALMA

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simdata is a CASA task

- `simdata` replaces `simdata2`, starting from 3.1
- *`inp simdata`*, to list the parameters
- *`default simdata`*, to reset the parameters
- *`go simdata`*, to run, or simply *`go`* if active task
- *`tget simdata`*, to load parameters
- *`help simdata`*, to obtain the online help
- `simdata` is a wrapper to the `sm` tool

simdata is structured

- simdata has 6 subtasks, run in the order:
 1. modifymodel
 2. setpointings
 3. predict
 4. thermalnoise
 5. image
 6. analyze
- The output of each subtask can be re-used in subsequent runs.

modifymodel

skymodel # model image to observe or modify
inbright # set peak surface brightness e.g. "1.2Jy/pixel" or ""
indirection # "J2000 19h00m00 -40d00m00" or ""
incell # cell/pixel size e.g. "0.1arcsec" or ""
incenter # frequency of center channel e.g. "89GHz" or ""
inwidth # channel width e.g. "10MHz" or ""

setpointings

integration # integration (sampling) time
direction # "J2000 19h00m00 -40d00m00" or "" to center on model
mapsize # angular size of map or "" to cover model
maptype # hexagonal, square, etc
pointingspacing # spacing in between pointings or "" for 0.5 PB

predict

complist # optional componentlist to observe with skymodel
compwidth # optional bandwidth if simulating from components only
antennalist # antenna position file or "" for no interferometric MS
refdate # time/date of observation *see help
totaltime # total time of observation
caldirection # pt source calibrator [experimental]
calflux
sdantlist # single dish antenna pos. file or "" for no total power MS
sdant # single dish antenna index in file

thermalnoise

```
thermalnoise = 'tsys-atm'
```

```
user_pwv      # Precipitable Water Vapor in mm
```

```
t_ground     # ambient temperature
```

OR

```
thermalnoise = 'tsys-manual'
```

```
t_ground     # ambient temperature
```

```
t_sky        # atmospheric temperature
```

```
tau0         # zenith opacity
```

image

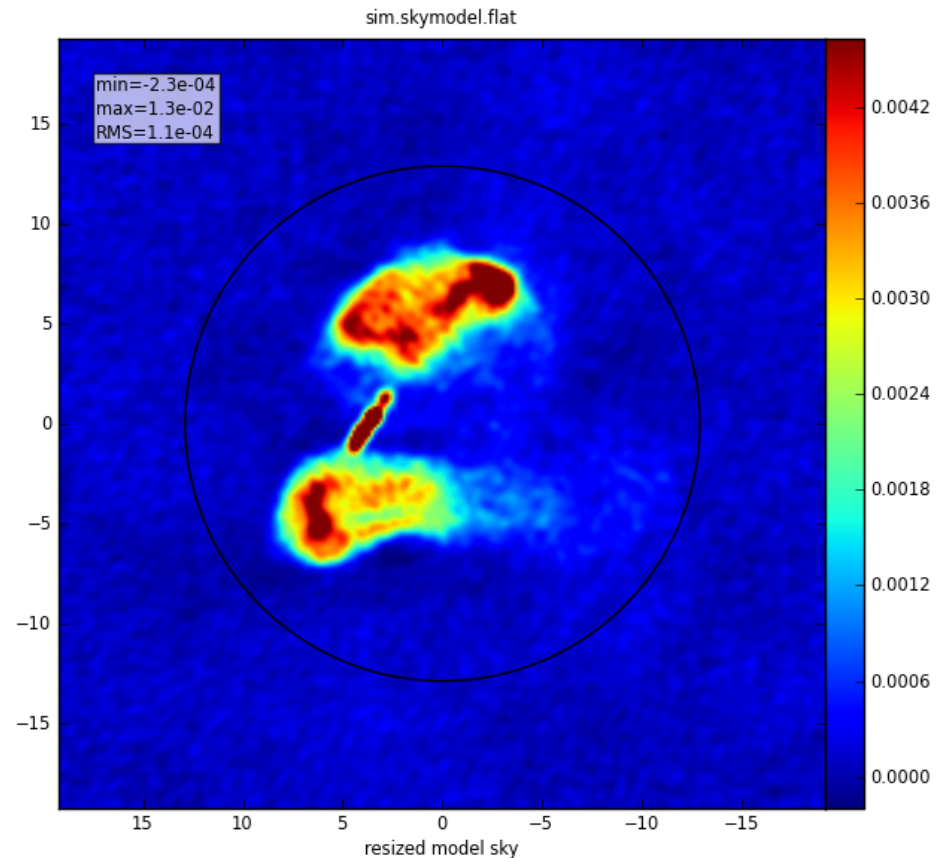
vis # Measurement Set(s) to image
modelimage # prior image to use in clean e.g. existing single dish image
imsize # output image size in pixels (x,y) or 0 to match model
cell # cell size with units or "" to equal model
niter # maximum number of iterations (0 for dirty image)
threshold # flux level (+units) to stop cleaning
weighting # weighting to apply to visibilities
mask # clean mask -- see help clean
outertaper # uv-taper on outer baselines in uv-plane
stokes # Stokes params to image

analyze

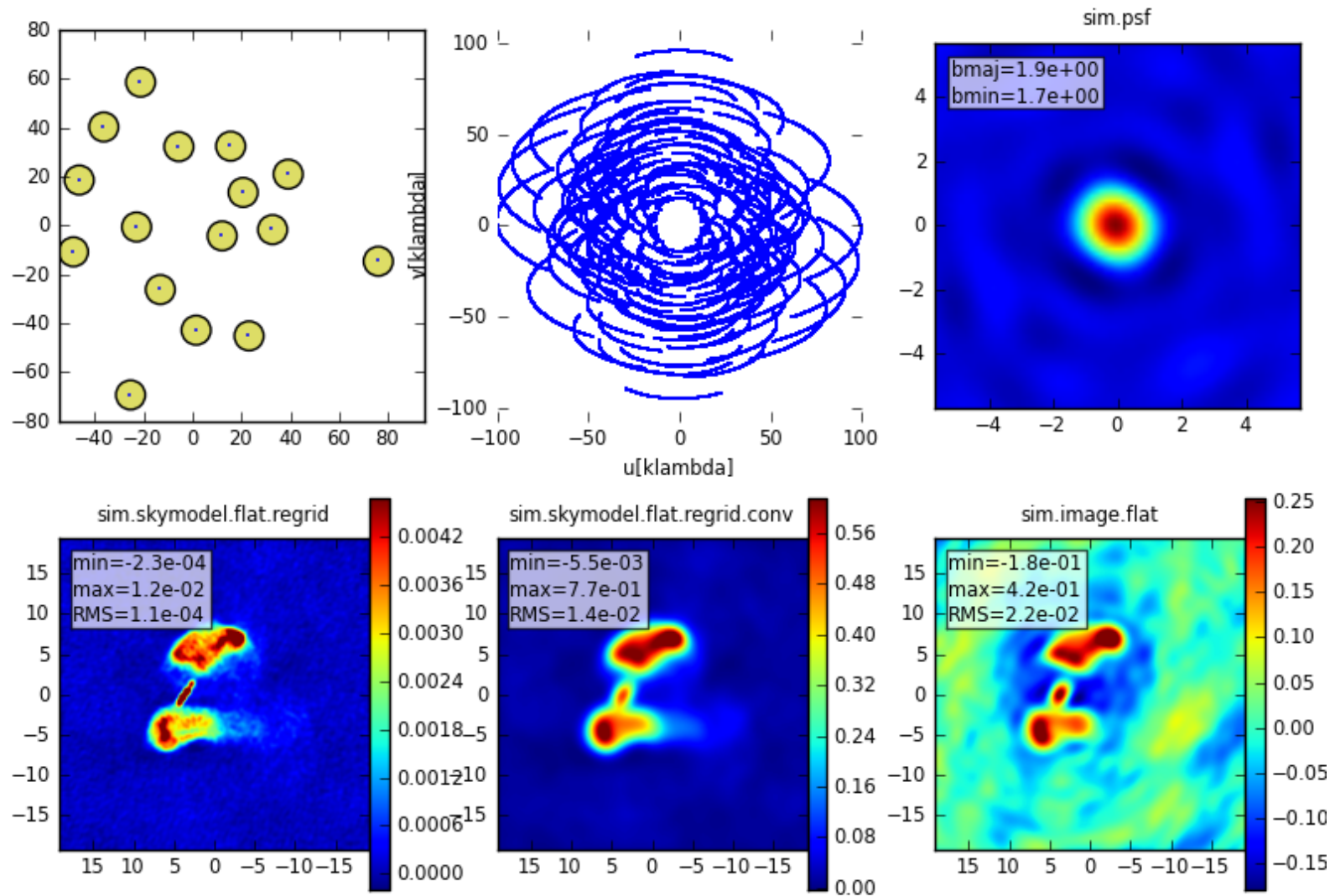
showarray	# like plotants
showuv	# display uv coverage
showpsf	# display synthesized (dirty) beam
showmodel	# display sky model at original resolution
showconvolved	# display sky model convolved with output beam
showclean	# display the synthesized image
showresidual	# display the clean residual image
showdifference	# display difference image
showfidelity	# display fidelity

3c288 at 240GHz (B6), with compact ES array (1)

```
taskname = 'simdata'  
default(taskname)  
project = 'sim'  
modifymodel = T  
skymodel = '3c288.fits'  
indirection = 'J2000 12h00m00 -23d00m00'  
incenter = '240GHz'  
inwidth = '2GHz'  
direction = 'J2000 12h00m00 -23d00m00'  
antennalist = 'CompactCycle0.txt'  
totaltime = '21600s'  
image = T  
niter = 0  
weighting = 'briggs'  
analyze = T  
showarray = T  
showconvolved = T  
showdifference = F  
showfidelity = F  
graphics = 'file'  
overwrite = T  
simdata()
```

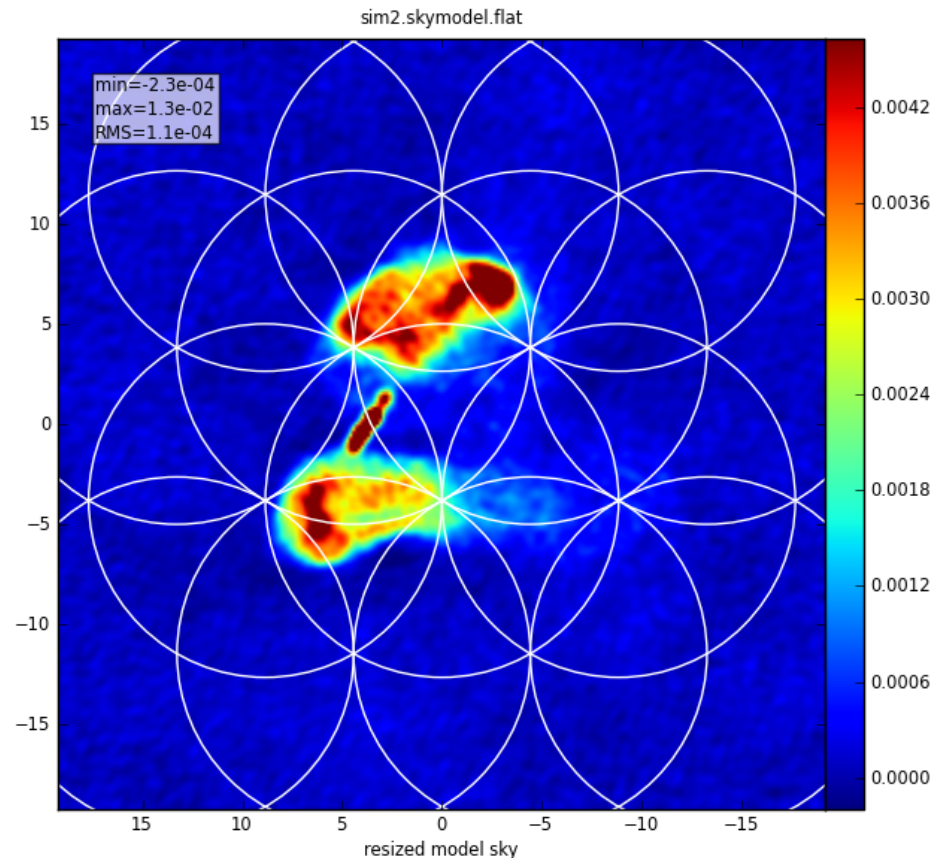


3c288 at 240GHz (B6), with compact ES array (2)

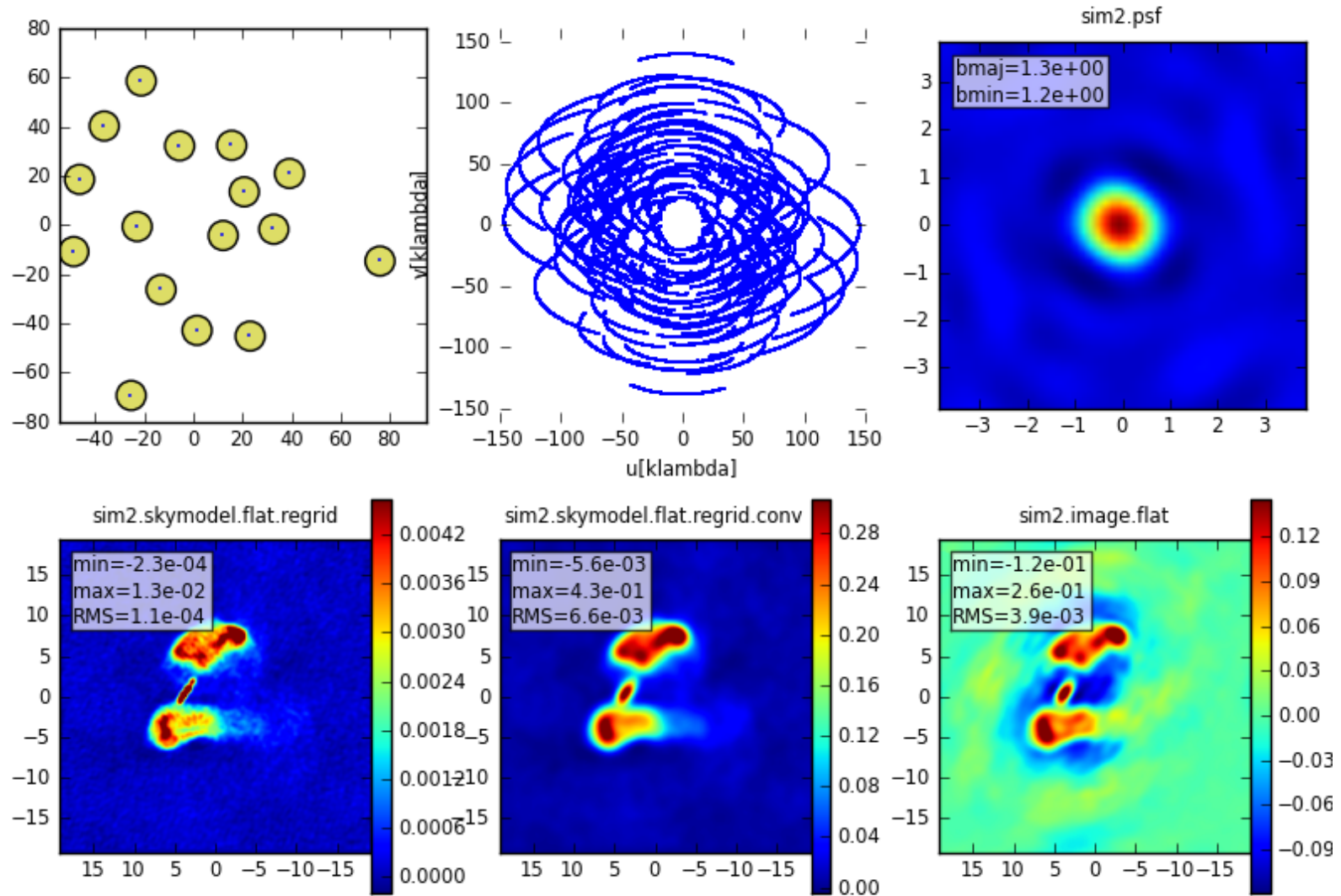


3c288 at 350GHz (B7), with compact ES array (1)

```
taskname = 'simdata'  
default(taskname)  
project = 'sim2'  
modifymodel = T  
skymodel = '3c288.fits'  
indirection = 'J2000 12h00m00 -23d00m00'  
incenter = '350GHz'  
inwidth = '2GHz'  
direction = 'J2000 12h00m00 -23d00m00'  
mapsize = ''  
pointingspacing = ''  
antennalist = 'CompactCycle0.txt'  
totaltime = '21600s'  
image = T  
niter = 0  
weighting = 'briggs'  
analyze = T  
showarray = T  
showconvolved = T  
showdifference = F  
showfidelity = F  
graphics = 'file'  
overwrite = T  
simdata()
```

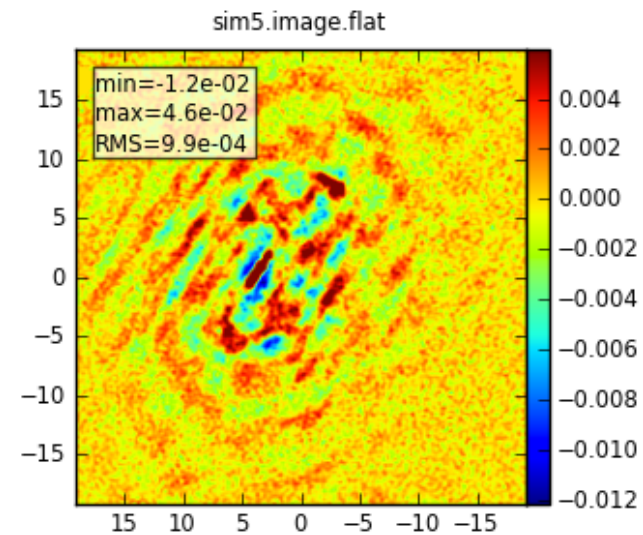
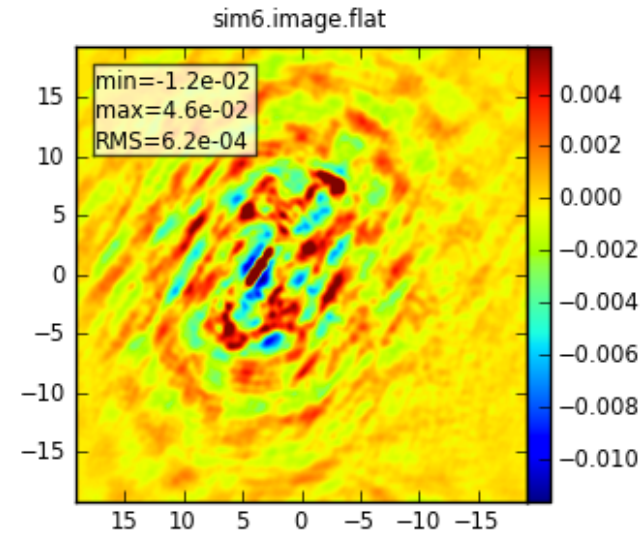


3c288 at 350GHz (B7), with compact ES array (2)



Corrupting data with thermal noise

```
taskname = 'simdata'  
default(taskname)  
project = 'sim3'  
modifymodel = T  
skymodel = '3c288.fits'  
indirection = 'J2000 12h00m00 -23d00m00'  
incenter = '350GHz'  
inwidth = '2GHz'  
direction = 'J2000 12h00m00 -23d00m00'  
mapsize = ''  
pointingspacing = ''  
antennalist = 'ExtendedCycle0.txt'  
totaltime = '21600s'  
thermalnoise = 'tsys-atm'  
user_pwv = 5  
image = T  
vis = '$project.noisy.ms'  
niter = 0  
weighting = 'briggs'  
analyze = T  
showarray = T  
showconvolved = T  
showdifference = F  
showfidelity = F  
graphics = 'file'  
overwrite = T  
simdata()
```



Other possible data corruptions

- Attenuation by the troposphere
- Atmospheric phase fluctuations
- Additive random noise
- Constant cross-polarization
- Fluctuations in complex receiver gain
- Bandpass shape
- Pointing errors
- Antenna-dependent feed position angle
- More information at:
<https://safe.nrao.edu/wiki/pub/ALMA/SimulatorCookbook/corruptguide.pdf>

Outputs of simdata

sim.diff/	Difference between 2d cleaned image and 2d input sky convolved with output synthesized beam
sim.absdiff/	Absolute of previous
sim.fidelity/	Fidelity image
sim.flux/	Clean flux image (clean components, not convolved with clean beam gaussian)
sim.image/	Clean image
sim.image.flat/	Clean image moment 0
sim.model/	Clean components
sim.ms/	Simulated visibilities
sim.psf/	Interferometric beam, full inversion with weighting
sim.ptg.txt	List of pointings
sim.quick.psf/	PSF from uv coverage, no weighting
sim.residual/	Clean residual
sim.residual.flat/	Clean residual moment 0
sim.skymodel/	Original sky model (4d)
sim.skymodel.flat/	Moment 0 of previous
sim.skymodel.flat.regrid/	Previous regridded
sim.skymodel.flat.regrid.conv/	Previous convolved by output synthesized beam
sim.absconv/	Absolute of previous

For more information:

[http://casaguides.nrao.edu/index.php?
title=Main Page#Simulating Observations](http://casaguides.nrao.edu/index.php?title=Main_Page#Simulating_Observations)