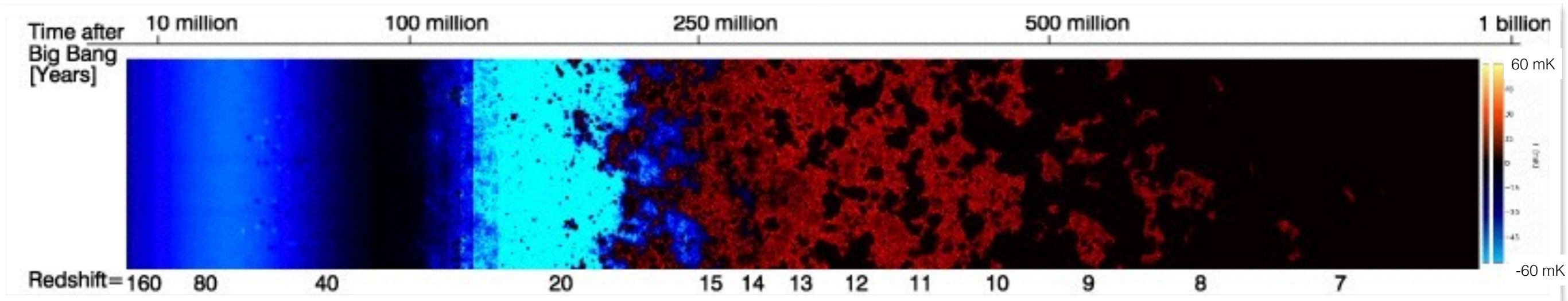


EoR simulation pipeline

1. Background: What is the Epoch of Reionisation (EoR).
2. Overview of the Epoch of Reionisation simulation pipeline.
3. Challenges that need to be overcome to improve the pipeline.
4. SDP applications.
5. Status of EoR pipeline, and of planned developments for the near future.

1. Background: The EoR signal

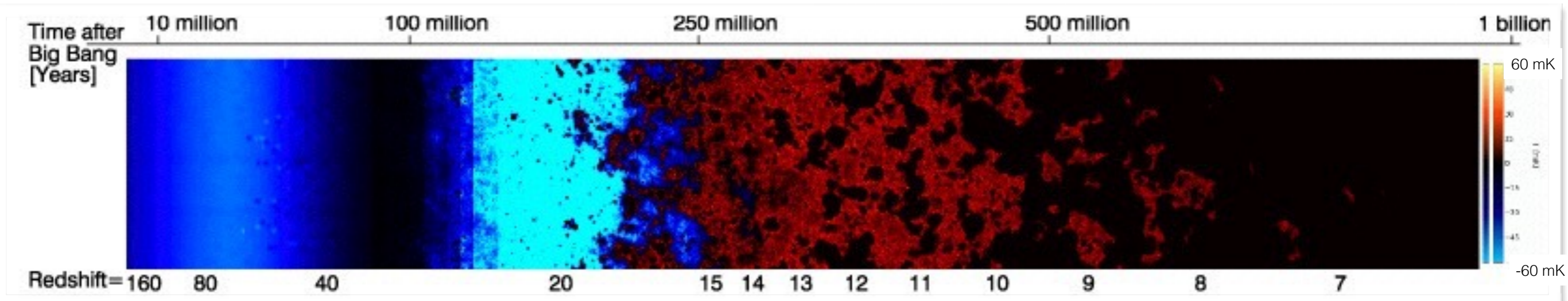
Frequency/ time



First stars form

1. Background: The EoR signal

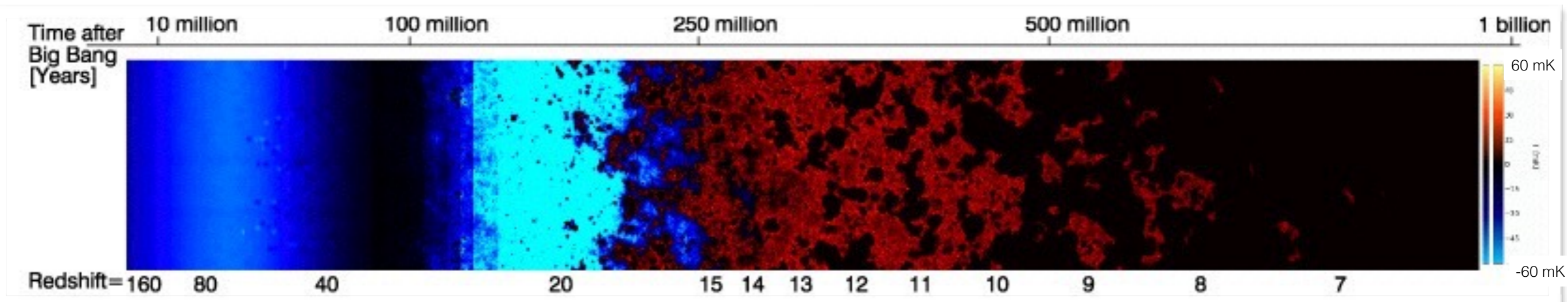
Frequency/ time



Coupling processes
drive 21-cm signal into absorption

1. Background: The EoR signal

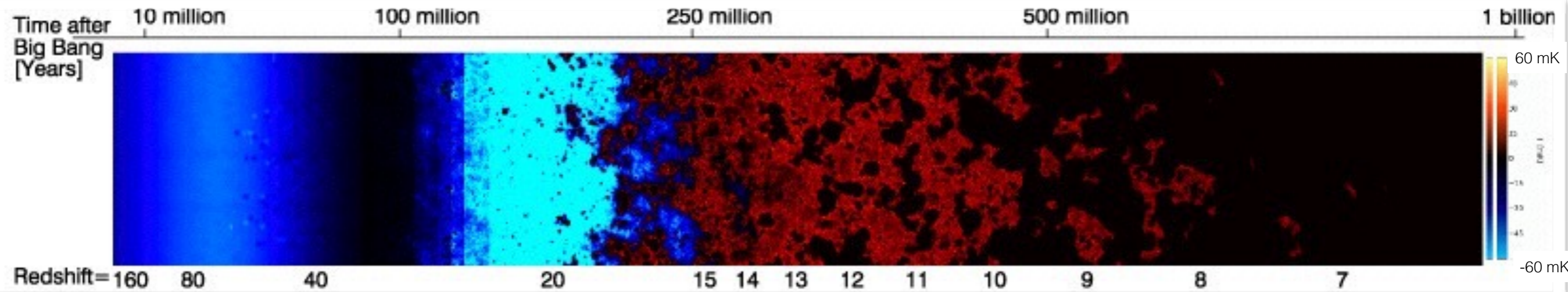
Frequency/ time



↑
Heating process
start to dominate

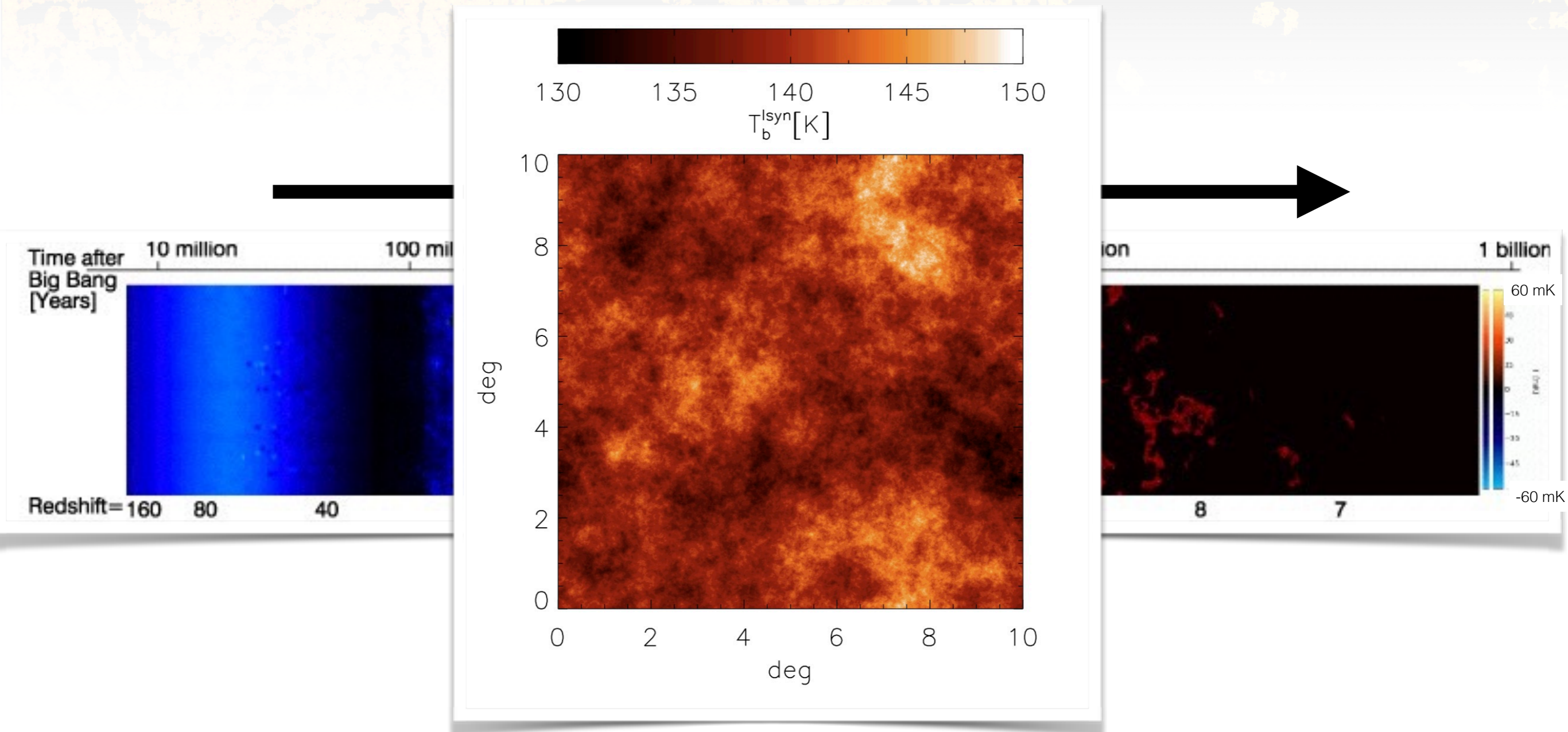
1. Background: The EoR signal

Frequency/ time



↑
Reionization of hydrogen forges holes in the 21-cm signal which grow with time

1. Background: The EoR signal



Challenge is to overcome foregrounds
3-4 orders of magnitude larger.

2. Overview of EoR pipeline

Simulated sky model

Telescope model

Visibility set

Image

2. Overview of EoR pipeline

Simulated sky model

Telescope model

OSKAR

B. Mort, F. Dulwich
(<http://www.oerc.ox.ac.uk/~ska/oskar2/>)

Visibility set

Image

2. Overview of EoR pipeline

Simulated sky model

Telescope model

OSKAR

B. Mort, F. Dulwich
(<http://www.oerc.ox.ac.uk/~ska/oskar2/>)

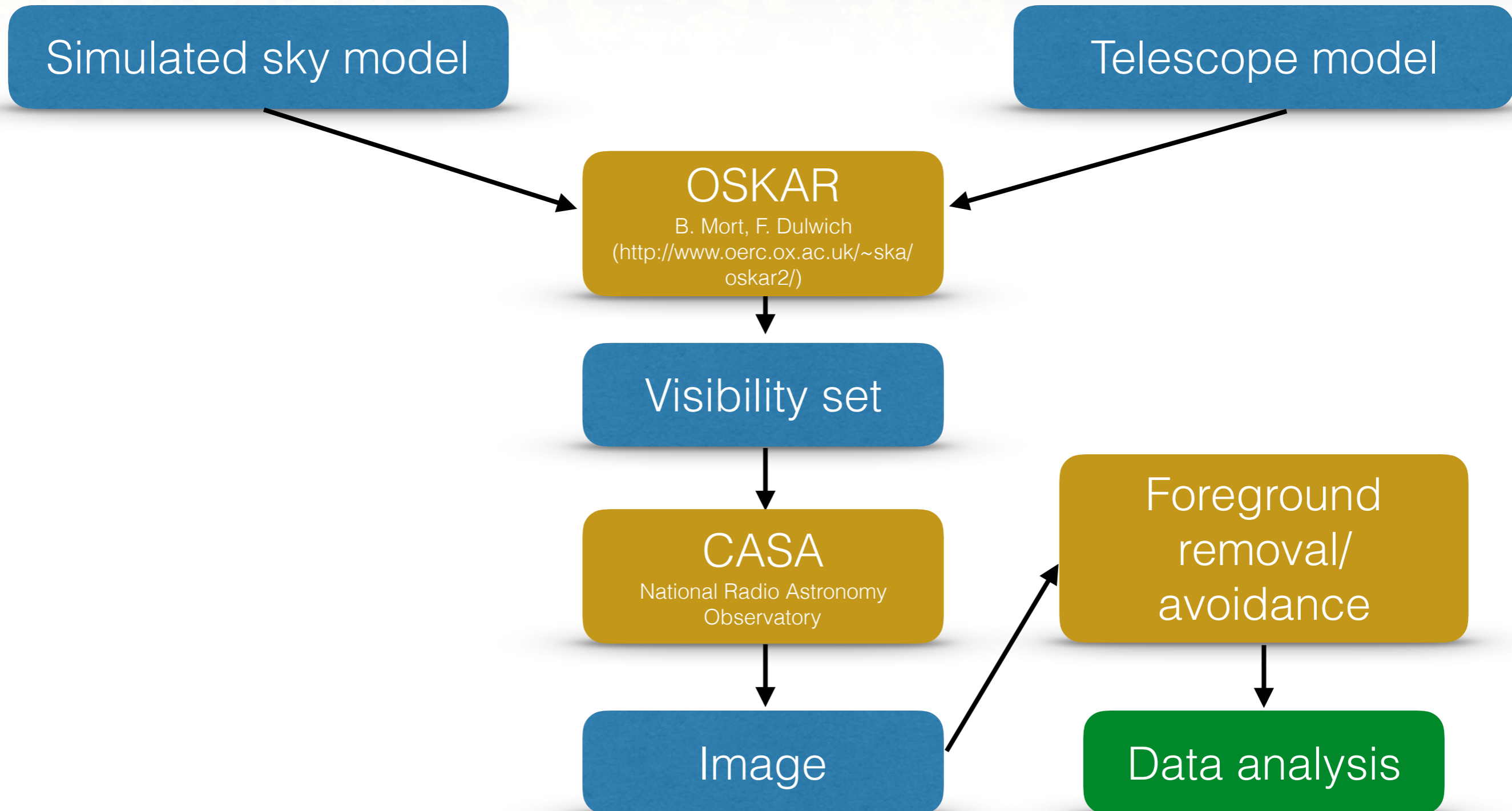
Visibility set

CASA

National Radio Astronomy
Observatory

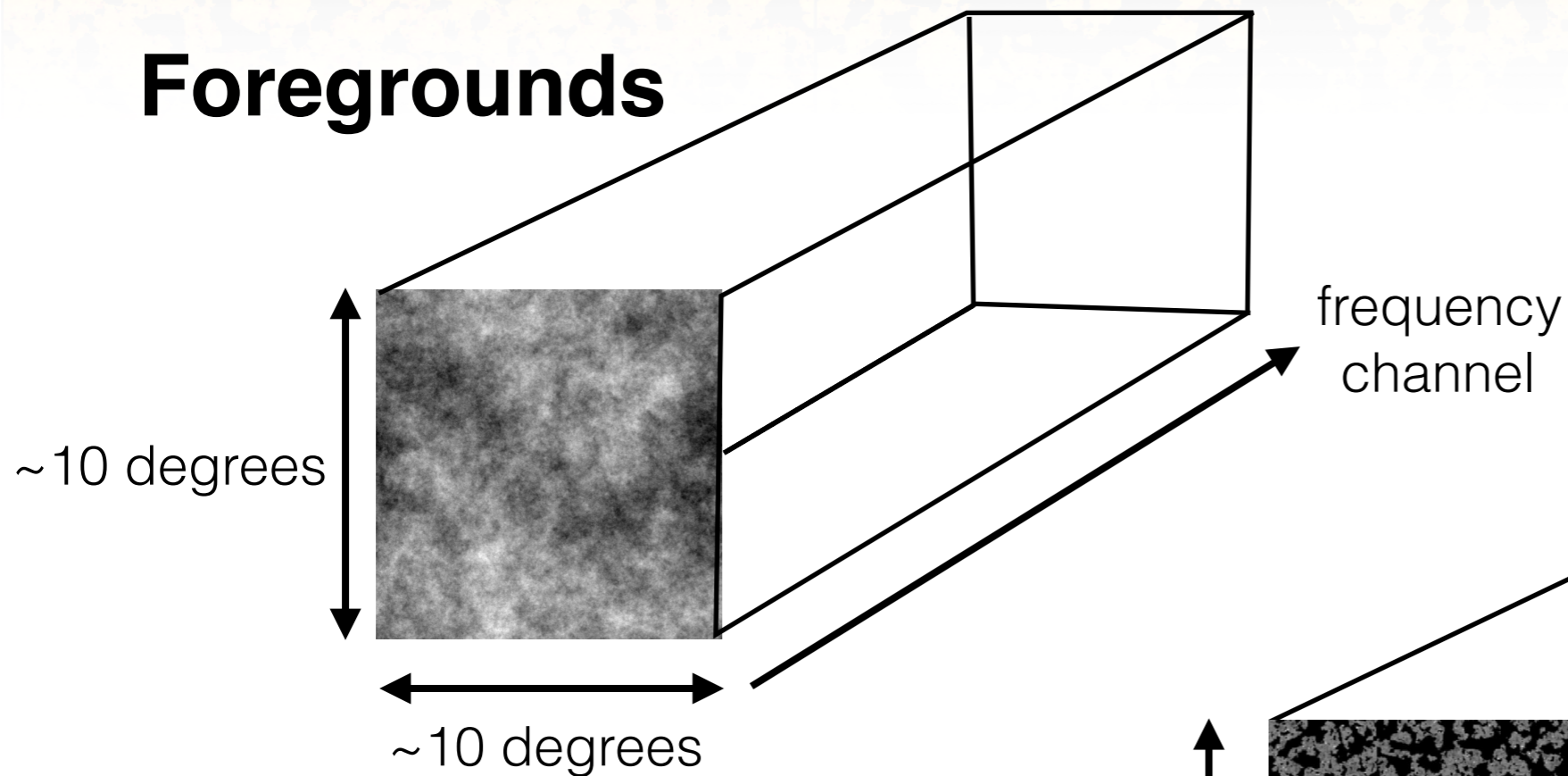
Image

2. Overview of EoR pipeline

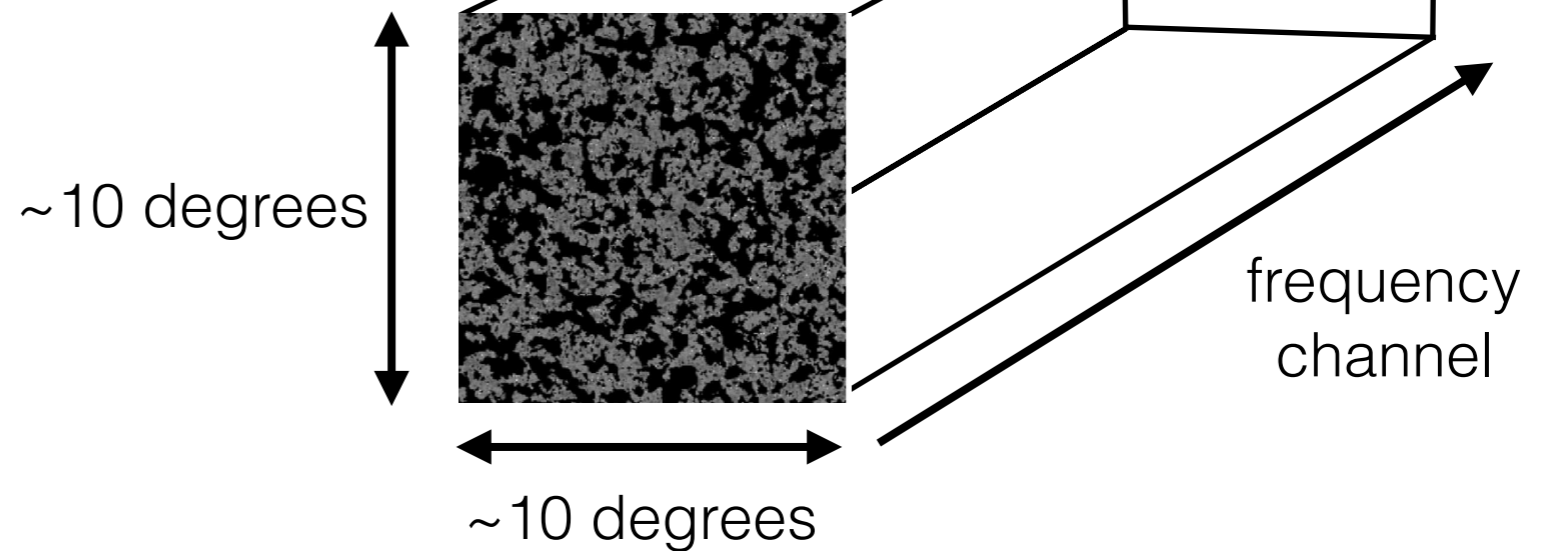


2. Input - sky model

Foregrounds



**Cosmological
signal**



3. Challenges to overcome

1. Modelling and mitigating point sources and ionospheric effects.
2. Radio Frequency Interference is not currently modelled within the pipeline.
3. Foreground removal techniques are not currently optimised to deal with the chromaticity of the instrument. Dealt to date by fixing the PSF at a fixed (lower) frequency, enforcing lower resolution for many frequencies. This is a poor approximation and throws information away.

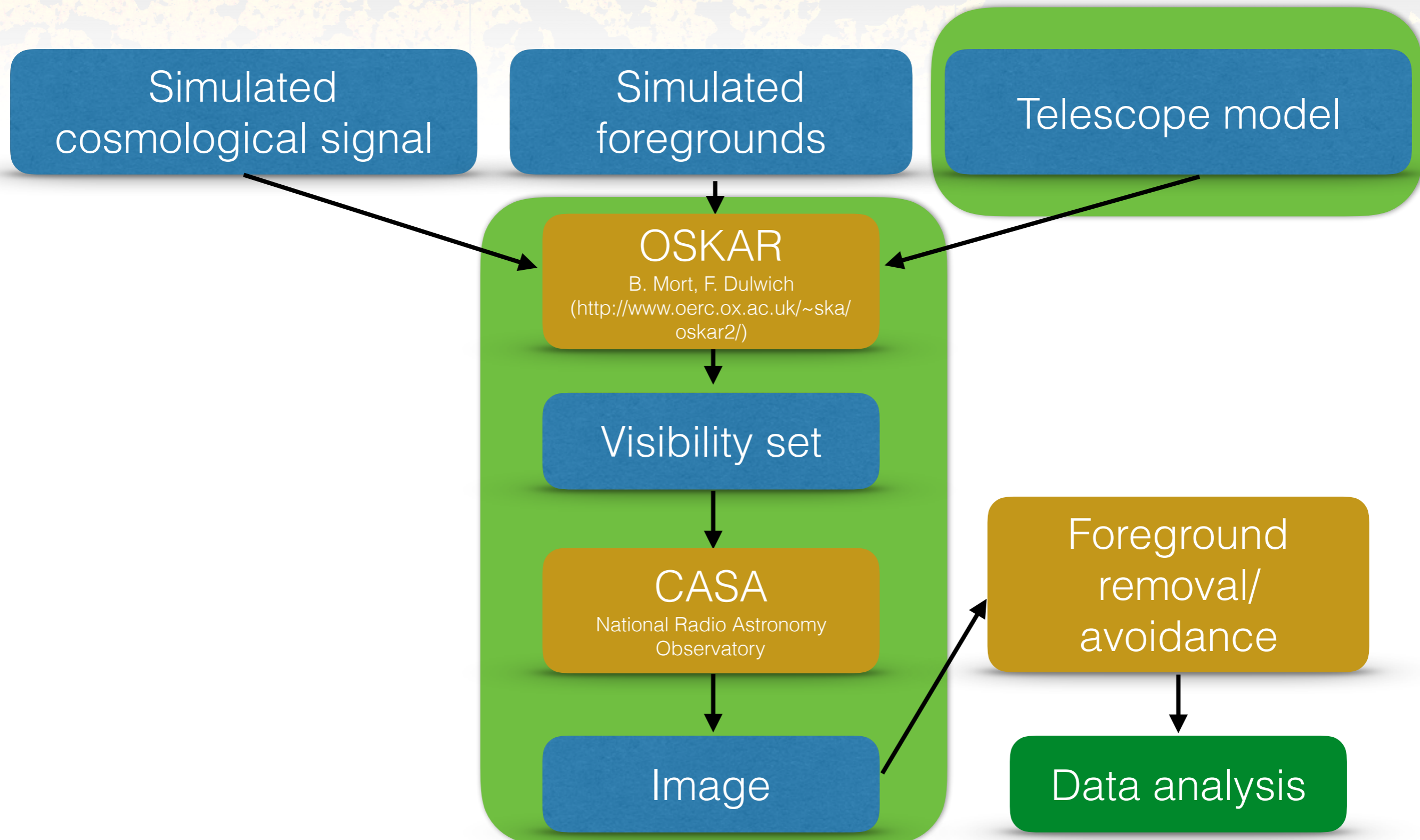
4. SDP application

Even assuming time (over ~ 10 s) and frequency averaging (~ 100 kHz) of visibilities and that analysis can be running at all times, *SKA-EoR will produce 22 Gb/s of data.*

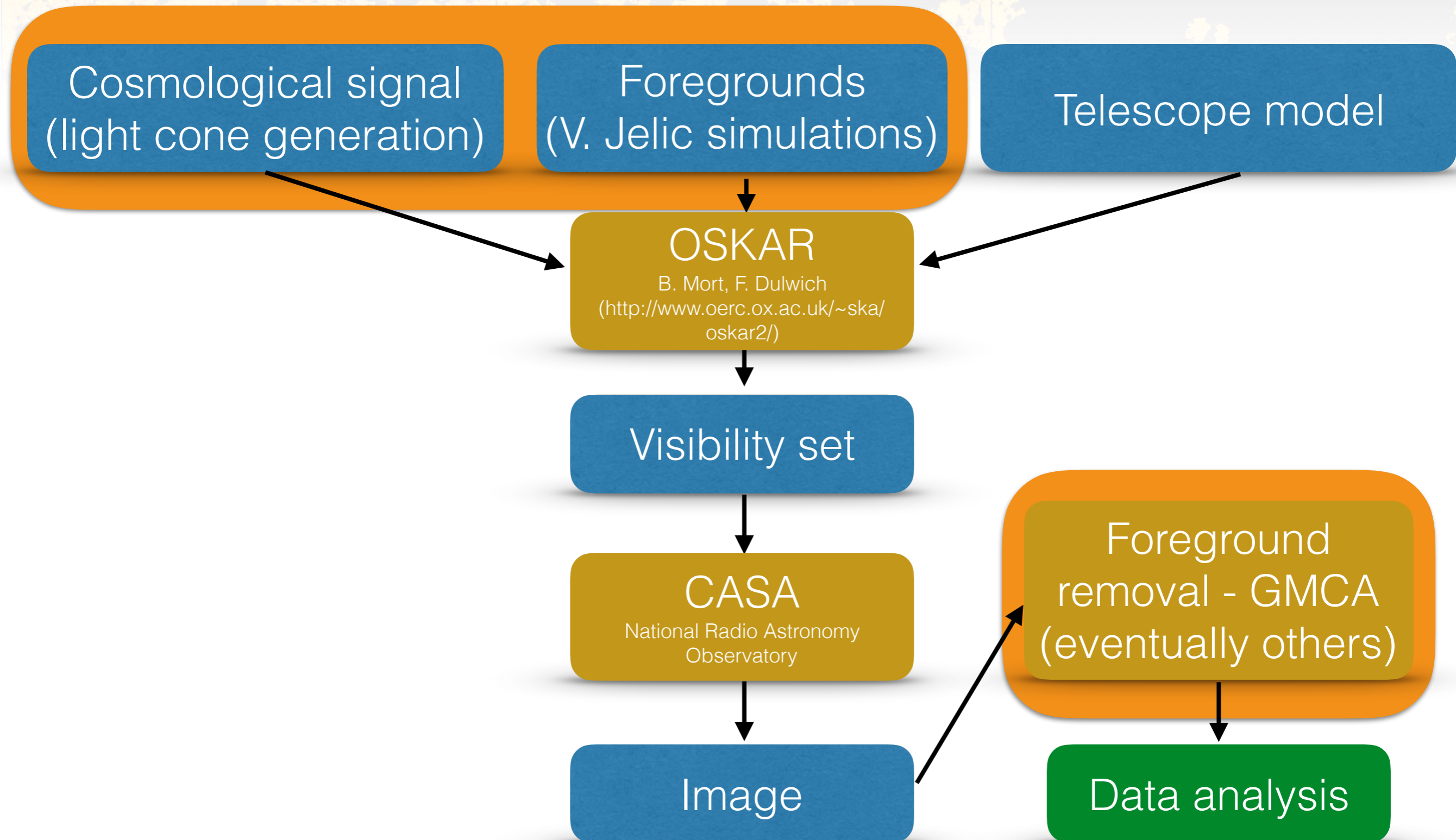
This quantity of data still requires the use of regional data centres for the community to access the data.

EoR pipeline can be used to establish the optimum time and frequency averaging for EoR science.

5. Status (imminent)



5. Status (imminent)



5. Status (planned)

Cosmological signal
(light cone generation)

Foregrounds
(V. Jelic simulations)

Telescope model

OSKAR

B. Mort, F. Dulwich
(<http://www.oerc.ox.ac.uk/~ska/oskar2/>)

Visibility set

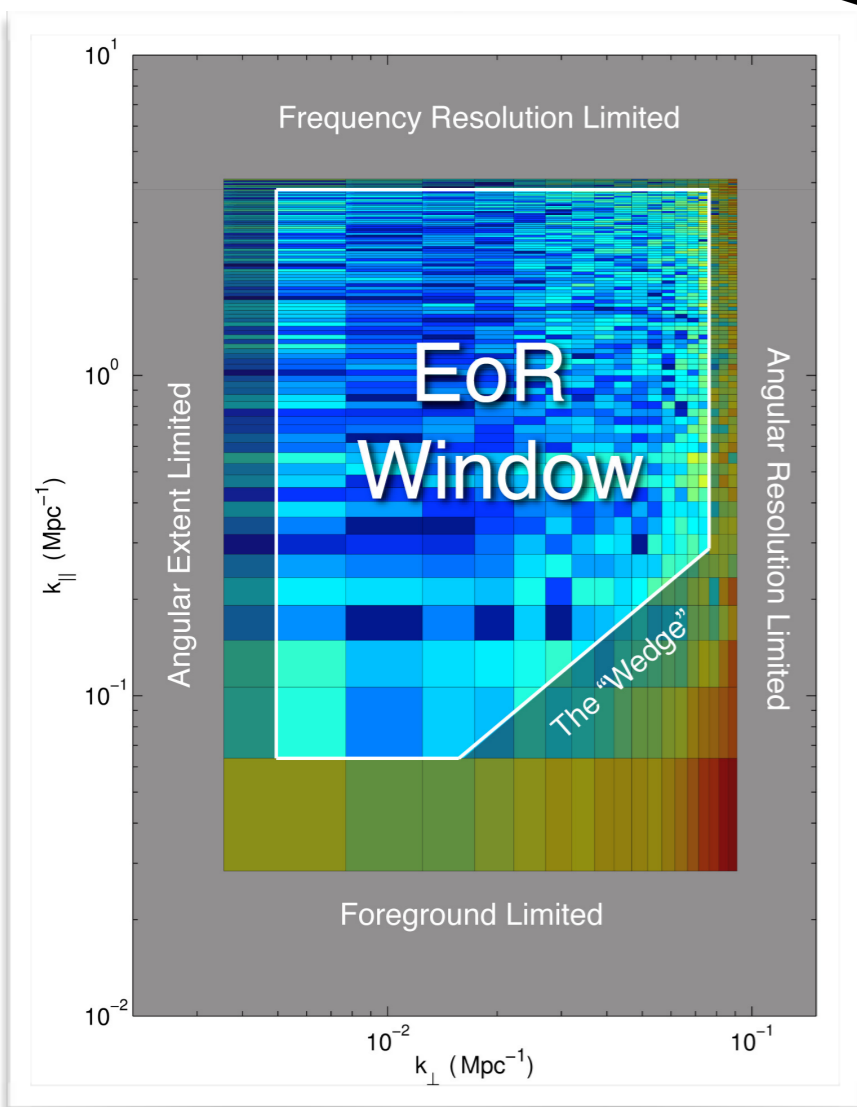
CASA

National Radio Astronomy
Observatory

Image

Foreground
removal - GMCA
(eventually others)

Data analysis



6. Conclusions

1. There is an *established EoR simulation* pipeline.
2. This will soon be consolidated to a point where the *community can submit simulated cubes* (cMpc³) directly from EoR simulations and be provided with a simulated observation of this.
3. Data compression is essential and an *EoR simulation pipeline will be useful to identify the optimal compression.*
4. However there are *still improvements that need to be made to the pipeline.*