LBWG memo 21

Clock-TEC separation parameter test

Atvars Nikolajevs, Kaspars Prūsis, 2019.04.24

During LOFAR Long-Baseline Busy Week in Dublin (15.04. - 18.04.), we been working on finding optimal Clock-TEC separation parameters. We tested both types (gaincal and ddecal) by changing some parameters, mostly solint (number of time slots on which a solution is assumed to be constant) and nchan (number of channels on which a solution is assumed to be constant). Results (.h5 files and plots) are stored on CEP3:

```
/data019/scratch/nikolajevs/
```

In our opinion the best results we acquired are using `gaincal_tec_solint5_nchan10`. Full parset file:

```
msin=L1327+5504.ms
msin.datacolumn=DATA
msout=.
steps=[gaincal]
gaincal.type=gaincal
gaincal.caltype=tec
gaincal.parmdb=gaincal_tec_solint5_nchan10.h5
gaincal.solint=5
gaincal.nchan=10
gaincal.sourcedb=L1327+5504.ms/sky
```

By using ddecal type, resulting plots with slightly different parameters significantly differed from each other - there was no common pattern. We did not observe a difference between using caltype tec and tecandphase.

List of parameters we tested (other parameters are default):

```
ddecal_tec_solint3_nchan10_propagate_all_approx_tec
ddecal_tec_solint3_nchan10_propagate_all
ddecal_tec_solint5_nchan10
ddecal_tec_solint5_nchan10_propagate_all
gaincal_tec_solint2_nchan10
gaincal_tec_solint2_nchan20
gaincal_tec_solint3_nchan10
gaincal_tec_solint3_nchan15
gaincal_tec_solint4_nchan10
gaincal_tec_solint5_nchan8
gaincal_tec_solint5_nchan10
gaincal_tec_solint5_nchan12
gaincal_tecandphase_solint5_nchan10
```

Background. The LOFAR stations have their own clocks which are not perfectly synchronized with the single clock that is used for all the core stations. This causes a strong phase delay across the frequency band for the remote-to-remote and core-to-remote baselines. The large clock offsets need to be corrected before calibration of the directional part. There is a method called "Clock-TEC separation" to derive the clock values from

an observation of a bright calibrator source. Once the clock values are determined the target field data for this effect can be corrected with BBS. Removing the time varying clock is equivalent to applying a frequency and time dependent phase correction to each station. (van Weeren et al. 2016)