Mixed-Mode Data Processing Overview

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Overview

Basic steps are roughly the same as VGOS

- Observation
- Correlation and phase-cal. extraction
- Post-processing (Fringe-fitting and calibration)
- Cable delay calibration (*proxy* cable-cal. if needed)
- Database Generation

★ However, there are important caveats at each step, to deal with:

- Correlating with zoom-bands
- Fringe-fitting two separate bands (S/X) rather than 4-bands combined.
- Forming mixed linear-circular polarization products.

Observation

Correlation

Cable Delay Calibration

Post-Correlation

Database Generation
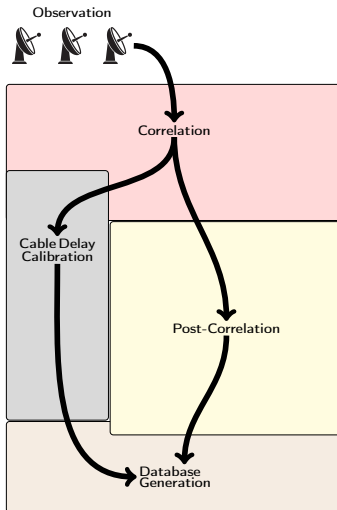
Correlation

Basic Elements

- Station data and logs
- Configuration (.vex)
- Configuration (.v2d)
- Zoom-bands are needed!
- Setting clocks
- No sampler delays*
- Running DiFX
- Running difx2mark4*
- Correlation products include 4-varieties:
  - Legacy-legacy baselines
  - Legacy-VGOS baselines
  - VGOS-VGOS baselines (as SX)
  - VGOS-VGOS baselines as full broad-band. (VGOS à la VGOS)

Data Flow
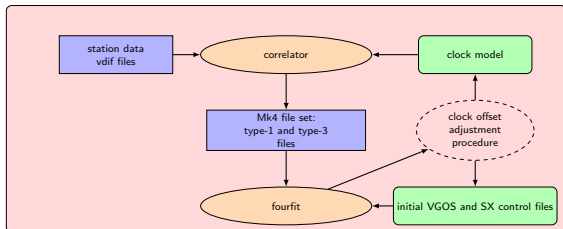
Post-correlation processing

Basic Elements

- Apply any pre-corrections needed (e.g. RFI notches, `pc_tonemask`, channel deletions.).
- Determine if/which stations need manual p-cal.
- Correct non-linear phases separately across S and X band.
- Compensate for phase/delay differences between Y-X polarizations at VGOS stations separately for both S and X band.
- Form the baseline-dependent polarization-products:
  - RR for legacy-legacy
  - RX+RY or XR+YR for VGOS-legacy (-P option order matters!)
  - Pseudo-Stokes-I for VGOS-VGOS (as SX)

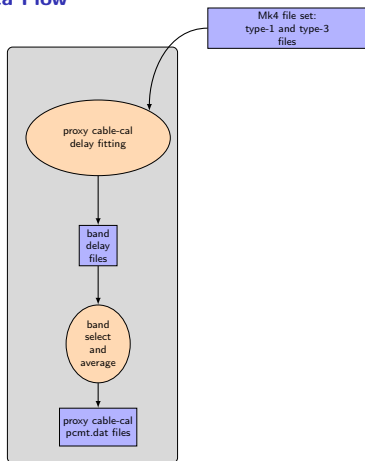### Data Flow - Done 2x (S and X band).
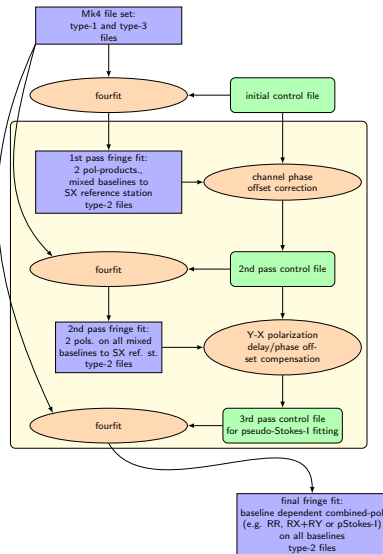
Cable-calibration (for VGOS stations)

Basic Elements

- Essentially the same as VGOS-processing.
- For stations with hardware cable-calibration
  - Extract cable-delay directly from station logs.
- For VGOS stations needing proxy-cable calibration
  - Best to extract cable delay estimates from VGOS (broad-band) data (more tones for fit).
  - Fit phase-cal. data to estimate delays for each band-polarization.
 - Select band-pol. and then average delays.

Data Flow

Mk4 file set: type-1 and type-3 files

proxy cable-cal delay fitting

band delay files

band select and average

proxy cable-cal pcmt.dat files

Database Generation

Basic Elements

- Legacy-SX and VGOS data differ in how dTEC is treated.
- For VGOS (broad-band), effect of dTEC is removed during fringe-fitting
- Whereas for legacy the X-band delay is corrected via the S-band delay (analysis).
- Full utilization of session data requires two separate DB's for the legacy-SX/mixed-mode data and VGOS (broad-band) data.
- In both cases: extract and convert Mk4 type-2 data: vgosDbMake.
- Append delay model: vgosDbCalc.
- Import station log and then (proxy) cable-calibration data: vgosDbProcLogs.

Data Flow
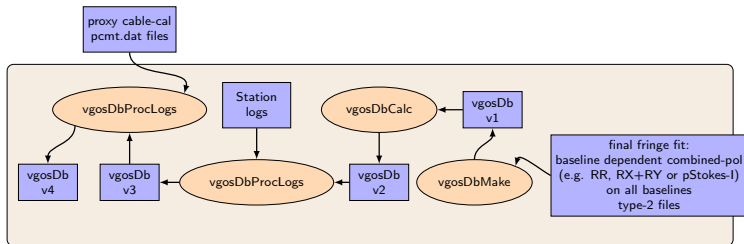
Data Quality

- Data quality needs to be monitored throughout the process.
- At the correlation stage, we are mainly concerned with:
  - Data format, configuration and frequency setup for zoom bands.
  - Station clocks
- At the post-processing stage, we are mainly concerned with:
  - tuning channel phase corrections (all stations)
  - station phase-cal behavior (manuals can be used when needed)
  - 'notching' out RFI and common p-cal tones on short baselines as needed.
  - phase/delay offsets between polarizations (only at VGOS-stations)

Putting it all together