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EUMETSAT Plans for GRAS Raw Sampling (Open Loop)
Data

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Outline

- GRAS raw sampling mode
- GRAS Level 1 data processing
- RS data in GRAS Level 1b data products
- EUMETSAT Plans for RS data processing
- Conclusions

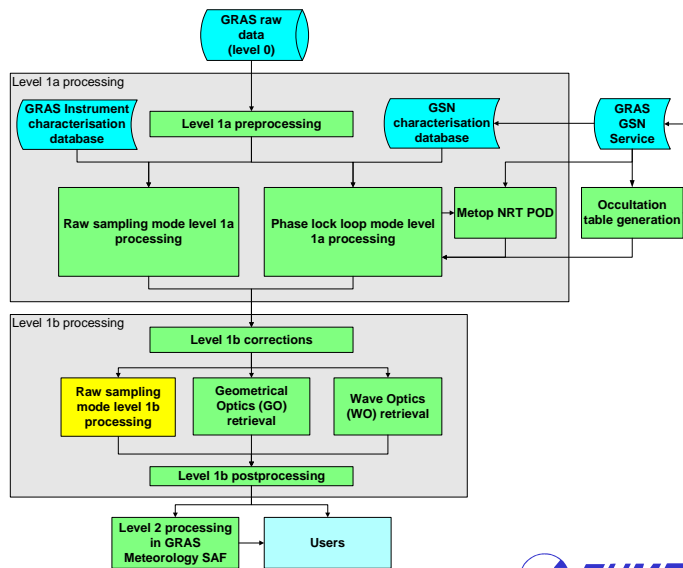


GRAS Raw Sampling mode

- GRAS Raw Sampling (RS) mode: 1 kHz sampling of the L1 C/A correlator output
- GRAS receiver will automatically enter raw sampling mode when:
 - L2 tracking is lost during setting occultations
 - C/A code has been acquired but L2 tracking is not yet available during rising occultations
- ⇒ lower troposphere is normally measured in raw sampling mode
- Algorithm for reassembling phase and amplitude from the raw RS data has been provided by the instrument manufacturer
- Defining the level 1 data processing is challenging due to 50 Hz navigation message bit stream modulation in the data
 - ground based monitoring of the GPS transmissions not feasible in GRAS GSN
 - statistical determination of the navigation message?



GRAS level 1 processing 1/3





GRAS level 1 processing 2/3

RS phase data reassembly in level 1a:

$$\varphi_{Ant}^{CA}[t(n, m)] = \Phi_{IP}^{CA} + \varphi_{DC}^{L1}(n, m) + \varphi_{HP}^{L1}(n, m) + \varphi_{IQ}^{CA}(n, m) + \Gamma_{Tot}^{CA}(n, m),$$

where

$$\varphi_{Ant}^{CA}[t(n, m)] = \text{L1-C/A carrier phase}$$

$$\Phi_{IP}^{CA} = \text{Phase delay between antenna phase centre and ADC}$$

$$\varphi_{DC}^{L1}(n, m) = \text{Phase of the total down conversion signal}$$

$$\varphi_{HP}^{L1}(n, m) = \text{Phase of the reference phase trajectory}$$

$$\varphi_{IQ}^{CA}(n, m) = \text{Residual I/Q phase}$$

$$\Gamma_{Tot}^{CA}(n, m) = \text{Navigation data modulation and phase ambiguity}$$



GRAS level 1 processing 3/3

RS amplitude data reassembly:

$$V_{Ant}^{CA}(n, m) = (I_{CA}^{Norm}(n, m) + jQ_{CA}^{Norm}(n, m)) \cdot e^{j2\pi\varphi[t(n, m)]},$$

where

$$V_{Ant}^{CA}(n, m) = \text{the complex carrier signal}$$

$$I_{CA}^{Norm}(n, m) = \text{the normalised I component of the signal}$$

$$Q_{CA}^{Norm}(n, m) = \text{the normalised Q component of the signal}$$

$$e^{j2\pi\varphi[t(n, m)]} = \text{the carrier phase}$$



Status of the level 1 RS data processing

- Currently only basic data processing as defined in the GRAS Measurement Data Interpretation and Description (MDID) document is implemented
 - => no instrument correction or filtering is performed to the data
- RS data are provided to the users as:
 - "raw" GRAS parameters from RS mode
 - re-assembled phase, amplitude, and SNR data (MDID)
- NRT users will receive the data via EUMETCast
 - => other users can download the data via UMARF
- All data will be permanently archived in UMARF and can be processed or re-processed later - if necessary



GRAS level 1b RS products

TIME_IMT_RS	IMT time stamp of the sample
TIME_UTC_GRAS_RS	UTC_GRAS time stamp of the sample
TIME_OBT_RS	OBT time stamp of the sample
TIME_REF_RS	Reference time of the sample
P_1_RS	L1 NCO phase of first sample
F1_1_RS	L1 NCO frequency setting for L1 carrier during sequence 1 in this packet
TINT1_RS	Total integration time from IMT when F1_1 is valid until F2_1 is set
F2_1_RS	L1 NCO frequency setting for L1 carrier during sequence 2 in this packet
TINT2_RS	Total integration time from IMT+TINT1 when F2_1 is valid until the last measurement of the packet
IQ_CA_EXP_RS	Exponent of I/Q samples
I_CA_RS	I sample of L1 carrier amplitude in terms of normalised counts of the C/A punctual correlation value
Q_CA_RS	Q sample of L1 carrier amplitude in terms of normalised counts of the C/A punctual correlation value
L1_PHASE_RS	RS L1 carrier phase
L1_AMPLITUDE_RS	RS L1 amplitude
L1_NOISE_RS	L1 noise estimate



EUMETSAT plans for RS data processing

- A suitable processing algorithm from phase residual to bending angles will be added into the level 1 processing (after the launch and commissioning of the first Metop)
- GRAS SAF has a “mandate” to study feasible RS data processing methods
- Processing of the RS data will include
 - navigation message demodulation
 - instrument correction
 - noise filtering
- Level 1b RS products should eventually look like the closed loop mode products (= bending angle, impact parameter)
=> should be “raw” data be still included?



Conclusions

EUMETSAT approach to RS data processing:

- Day 1:
 - GRAS RS data in raw format is included in the disseminated level 1b data (for research purposes)
 - All users (NRT and off-line) will have access to all RS data either via EUMETCast or through UMARF
 - Suitable level 1 processing methods are being investigated
- Day 2:
 - RS data processing will be implemented
 - RS data products will be included into GRAS level 1b products
 - For NRT users RS products and closed loop mode products should be very similar, but the error characteristics may be different
 - Raw RS data will be accessible at least via UMARF (dissemination TBD)
- All GRAS documentation available from: www.eumetsat.int