

ANITA-3 performance

Linda Cremonesi

Department of Physics and Astronomy
University College London

July 20, 2015

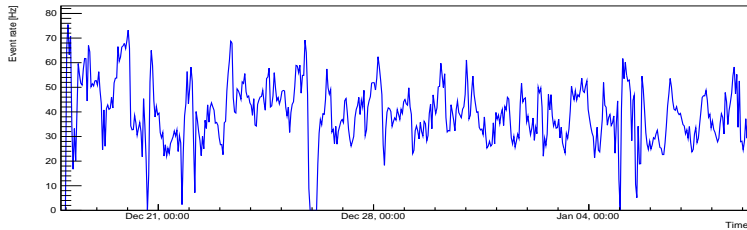
Event Rate

Features

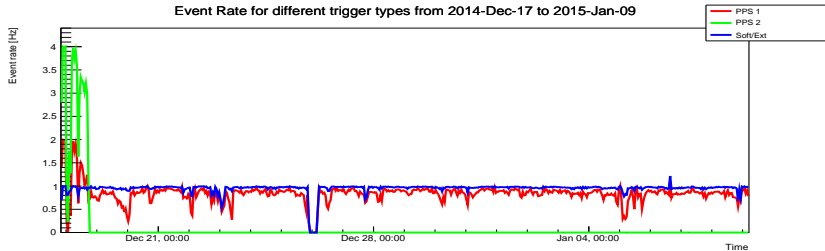
- Constant 7 Hz before launch → 7 Hz is a mix of GPS and software triggers
- After 1 day of flight (Dec 18, 17:25) PPS2 trigger was turned off. PPS1 and the software triggers stayed on for the whole flight (each contributing ≈ 1 Hz).
- No data written from Dec 25, 21:15 to Dec 26, 4:30 → instrument was in a bad state and had to be rebooted.
- Timestamps jump back in the past for Run 434 → more in this later.

Event Rate

Event Rate RF, from 2014-Dec-17 to 2015-Jan-09



Event Rate for different trigger types from 2014-Dec-17 to 2015-Jan-09



Run 434

What's going on?

- The first ≈ 25 k events in the headTree of Run 434 showed “old” timestamps (dating Jan 6 instead of Jan 8).
- Run 434 showed no discontinuity in eventNumber, timeOfDay, latitude, longitude etc when compared to other runs before or after → **only the timestamps are wrong**

Run 434

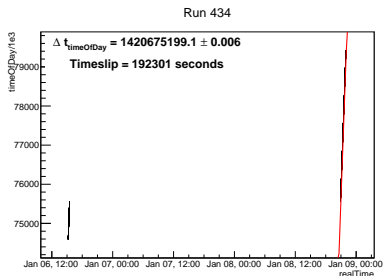
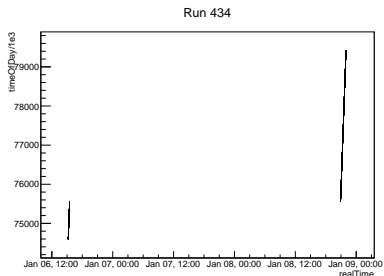
What's going on?

- The first ≈ 25 k events in the headTree of Run 434 showed “old” timestamps (dating Jan 6 instead of Jan 8).
- Run 434 showed no discontinuity in eventNumber, timeOfDay, latitude, longitude etc when compared to other runs before or after → **only the timestamps are wrong**
- I tried to recover the “right” timestamps by looking at the raw GPS data, but those also show the “wrong” timestamps.
- **Good news: we can use the timeOfDay or the triggerTime to figure out a correction.**

Run 434

Correcting realTime

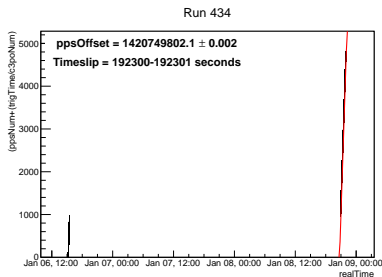
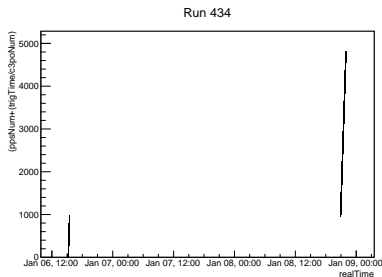
- realTime can be corrected by looking at timeOfDay
- timeOfDay is the time recorded by the GPS antennas usually from the midnight of every day.
- Linear fit to determine the Δt and the timeslip.



Run 434

Correcting triggerTime

- `triggerTime` is wrong for all events in Run 434, because it is calculated as: $ppsNum + (trigTime/c3poNum) + ppsOffset$.
- i.e. the wrong time offset (`ppsOffset`) was used at the beginning of the run.
- we can infer the right `ppsOffset` from the events in Run 434 that have the right `realTime` timestamps.



Run 434

Time corrections

- All files in Run 434 containing `realTime` and `triggerTime` have been corrected and uploaded on the UCL repository.
- The new files are in the directory `run434` and the old ones are in `run434old`.
- `payloadTime`, which is usually identical to `realTime` has not been corrected so that we can retrieve the “wrong” timestamps if needed.

Dynamic ϕ masking

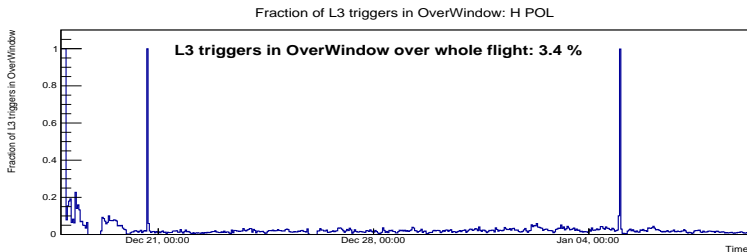
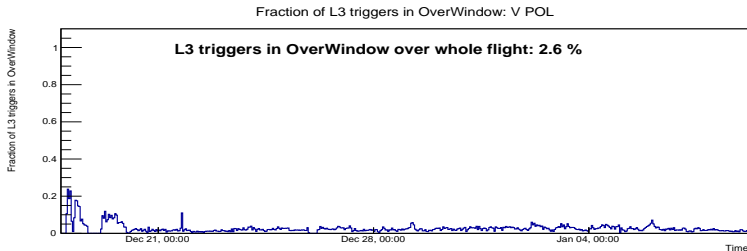
- Dynamic and static ϕ masking were employed during the ANITA-3 flight;
- Dynamic ϕ masking was used on L1/L3 triggers, and it's defined by 4 quantities (for L1/L3 separately):
 - OverRate;
 - OverWindow;
 - UnderRate;
 - UnderWindow;
- A ϕ -sector mask would switch on when L1/L3 rate is above OverRate for OverWindow.
- A ϕ -sector mask would switch off when L1/L3 rate is below UnderRate for UnderWindow.

Dynamic ϕ masking

BUT

- Trigger rate for masked ϕ sector was not read out once the masking was on \rightarrow Flight software would turn the masking off after `UnderWindow`;
- Shifters had to play with `UnderWindow` to guess the time taken by the payload to rotate away from the noise.

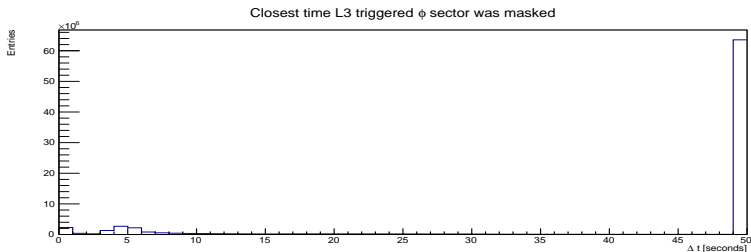
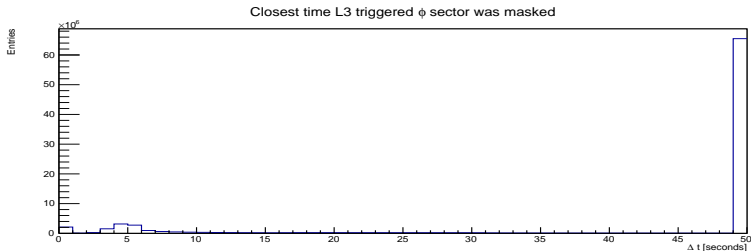
Fraction of L3 triggers in OFF/ON window



Fraction of L3 triggers in OFF/ON window

- Fraction is high for first 1-2 days because `overWindow` was set at 10-50 seconds.
- After that `overWindow` is generally 1 second for L1, 2 seconds for L3 trigger masking.
- Total fraction of L3 triggers in `overWindow`, V-POL: 2.6%
- Total fraction of L3 triggers in `overWindow`, H-POL: 3.4%
- Fraction slightly higher for H-POL, were we masking H-POL a little bit less? Why does this happen?

Closest time L3 triggered ϕ sector was masked



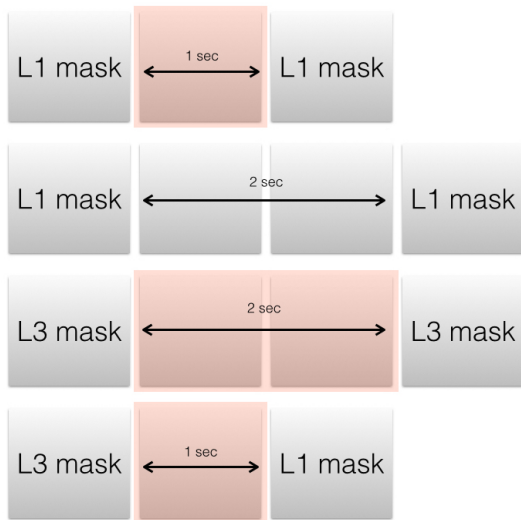
Closest time L3 triggered ϕ sector was masked

- L3 triggered ϕ sectors from `headTree`, L1/L3 masked ϕ sectors from `turfTree`.
- A few features need to be understood:
 - Bin at 0 is not 0, why? → I believe this is related to possible short delays in turning the masking on;
 - Peak around 4-5 seconds, why? → this might be related to whatever was the `overWindow` set for some periods.

Offline masking

- Started to develop a simple offline masking;
- If ϕ sector is not masked for a period which is equal to `overWindow` → turn masking on for that period (i.e. mask out the events shown in Slide 10.)
- When `overWindow` is larger than 10 seconds → set it to 10 seconds;
- This is done for L1 and L3 triggers together → mask ϕ sector if either L1 mask was on after `L1overWindow` or L3 mask was on after `L3overWindow`;

Offline masking: example



Example:

l1overWindow 1 sec
l3overWindow 2 sec

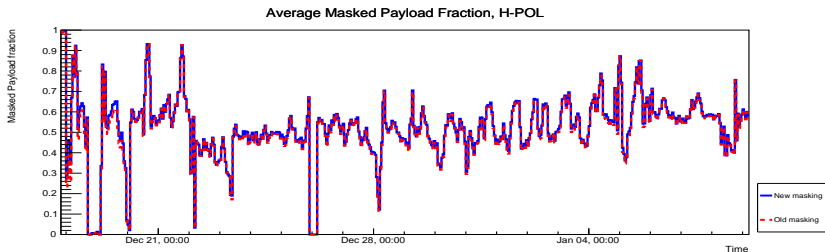
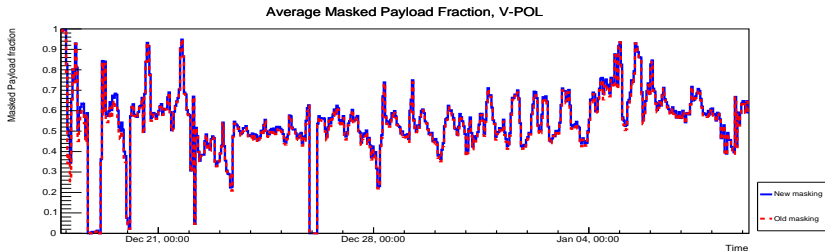
- Red shadow: offline masking

Offline masking

- The fraction of payload masked from Run 127 to Run 439 goes from 53.5% to 54.5% for V-POL and from 51.2% to 52.1% for H-POL.

	V-POL		H-POL	
	old	new	old	new
Facing North	80.5%	82.1%	78.7%	80.3%
Facing South	26.6%	27.0%	23.6%	24.0%

Fraction of masked payload with offline masking

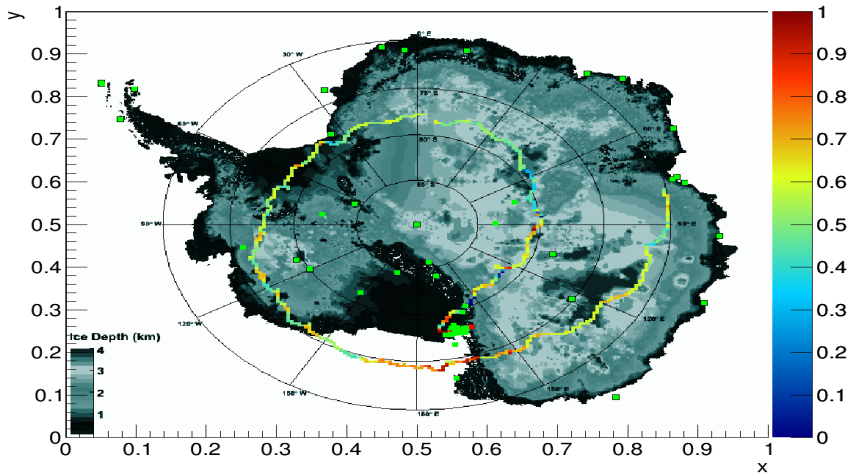


Fraction of masked payload with offline masking

- Only a small fraction of L3 triggers get masked from the offline ϕ masking, is this good enough?
- How can we evaluate the quality of our ϕ masking?

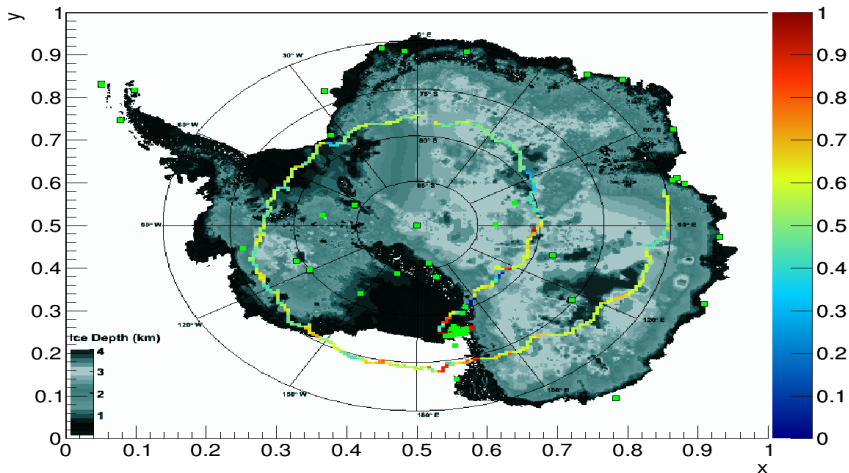
Fraction of masked payload vs position, V-POL

Fraction of masked payload, V-POL



Fraction of masked payload vs position, H-POL

Fraction of masked payload, H-POL

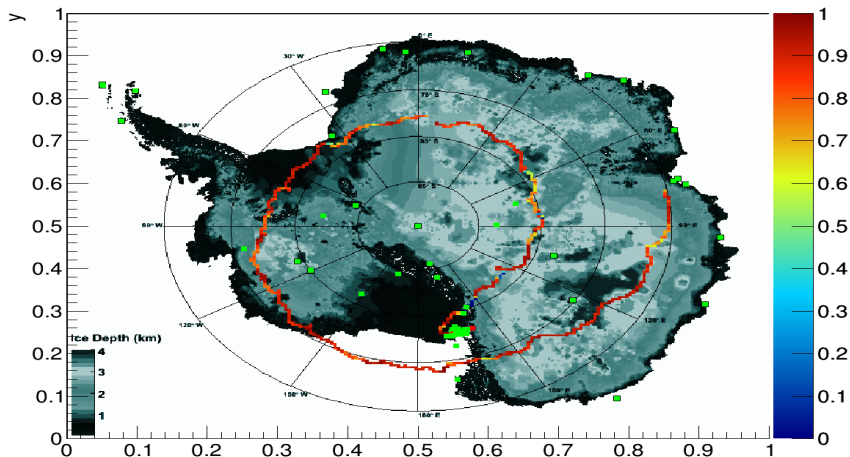


Summary

- Offline ϕ masking only masks out a small amount of L3 triggers \rightarrow was our dynamic ϕ masking better than we expected?
- H-POL is less masked than V-POL for some reason, as far as I know human background tend to be in both polarisation, so not sure why this happens.
- What happens next?
 - Look at how well we know the antenna position \rightarrow evaluate Δt and $\Delta \bar{x}$ from calibration data.
 - Look at how well the trigger thresholds were working.

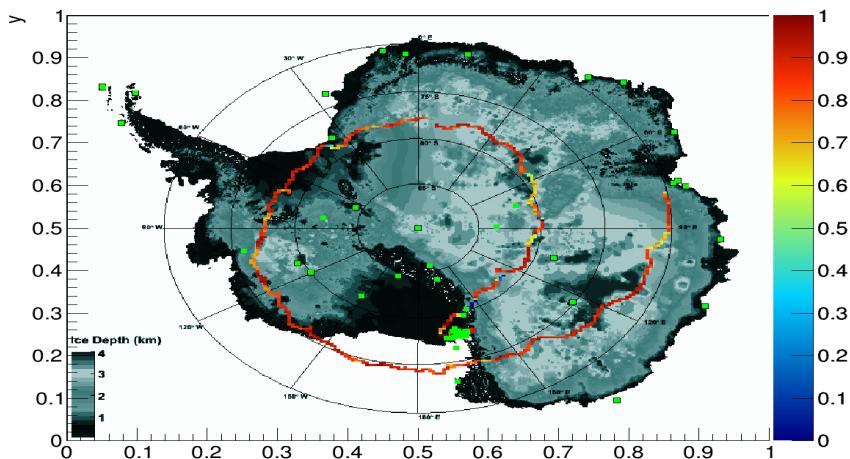
Fraction of masked payload vs position, NORTH Facing sectors, V-POL

Fraction of masked North-facing payload, V-POL



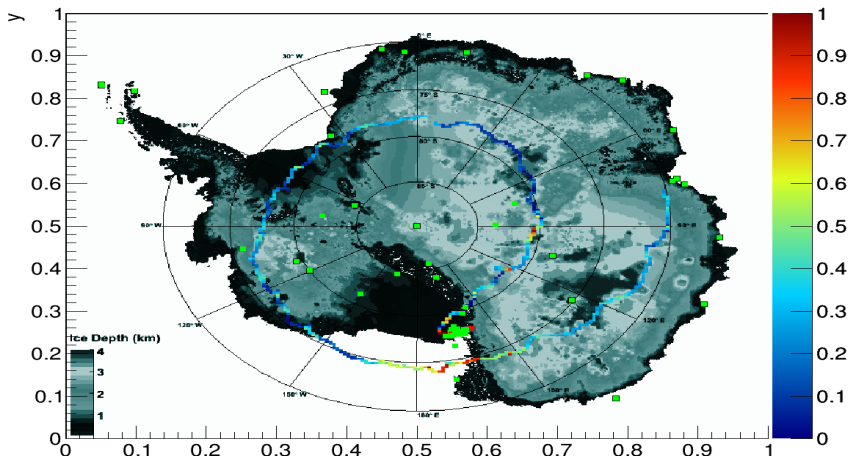
Fraction of masked payload vs position, NORTH Facing sectors, H-POL

Fraction of masked North-facing payload, H-POL



Fraction of masked payload vs position, SOUTH Facing sectors, V-POL

Fraction of masked South-facing payload, V-POL



Fraction of masked payload vs position, SOUTH Facing sectors, H-POL

Fraction of masked South-facing payload, H-POL

