ANALYSIS OF DORIS FREQUENCY ON-BOARD JASON

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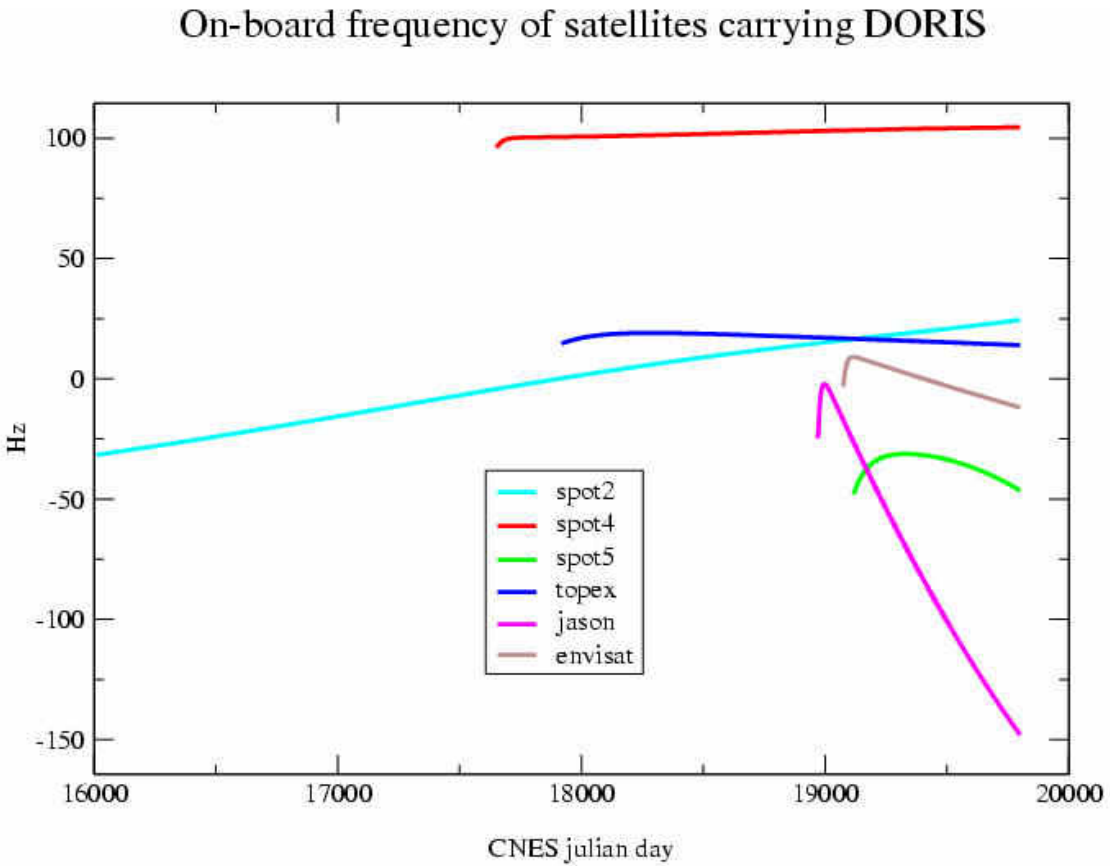
• Introduction

All receivers on-board the different satellites equipped with DORIS display fluctuations of their actual frequency with respect to their nominal frequency, at different time scales. The behaviour of these frequency offsets can be split in:

- Long term evolution (> 1 month) : max 150 Hz / 2 GHz
- Medium term evolution (1 day to 1 month) : max 0.5 Hz / 2 GHz
- Short term evolution (10 seconds to 1 day) : max 0.2 Hz / 2 GHz
- Very short term evolution (< 10 seconds)

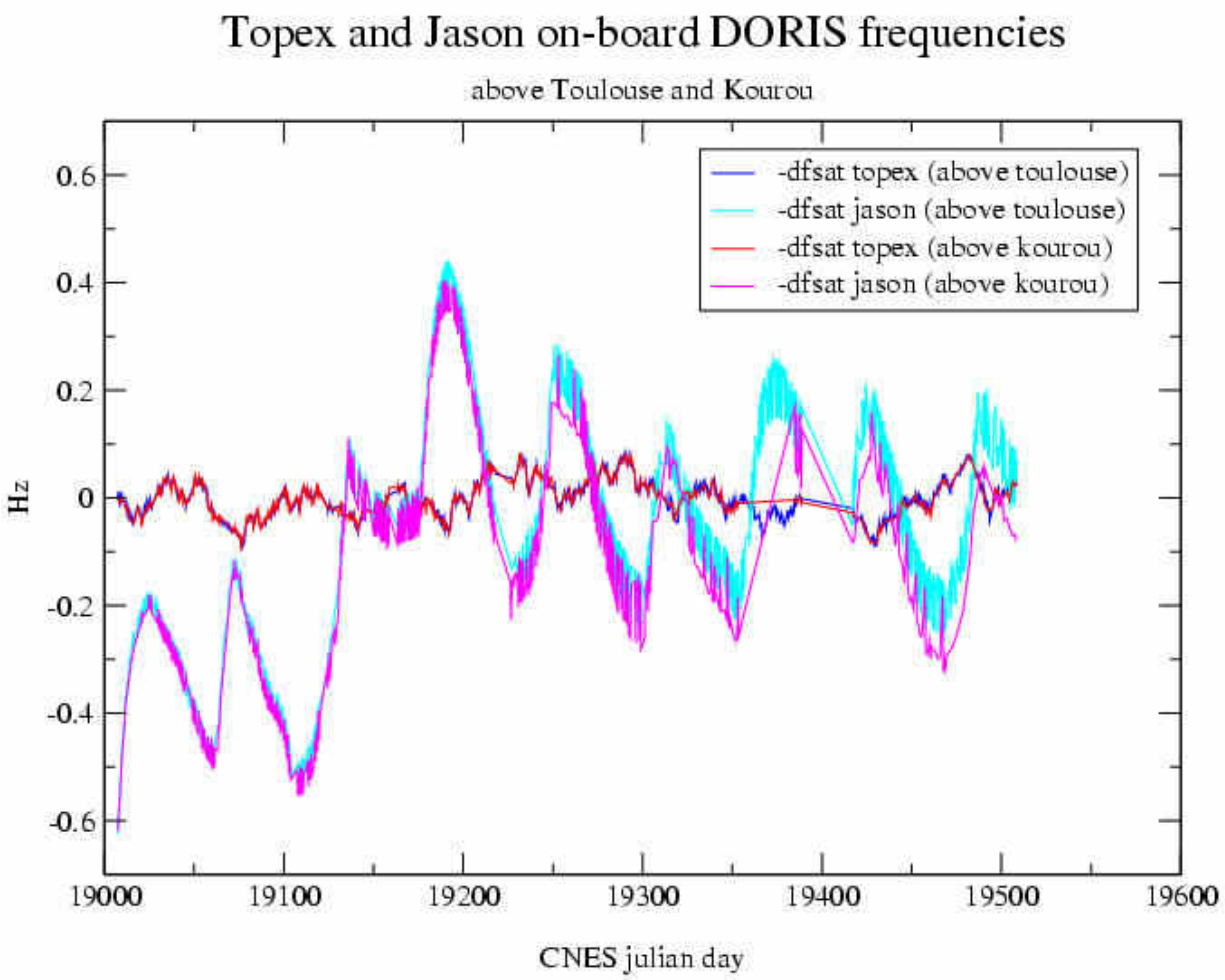
• Long term time evolution (> 1 month)

The frequency estimates are obtained from the passes over the 2 master beacons Toulouse and Kourou, piloted by caesium clocks.



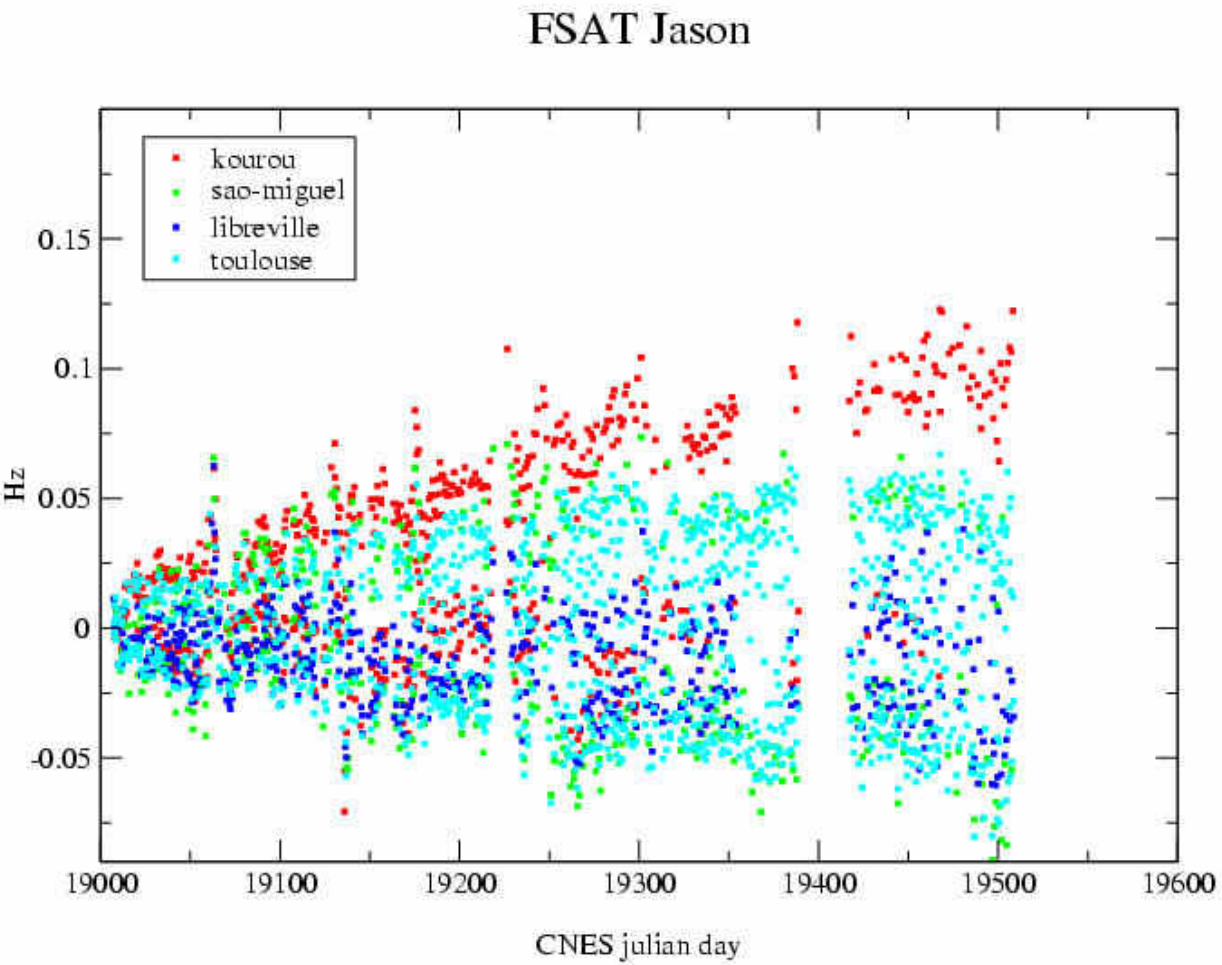
- the long term drift of Jason frequency is the strongest of all
- it is the only one to display a change of curvature

• Medium term time evolution (1 day to 1 month)



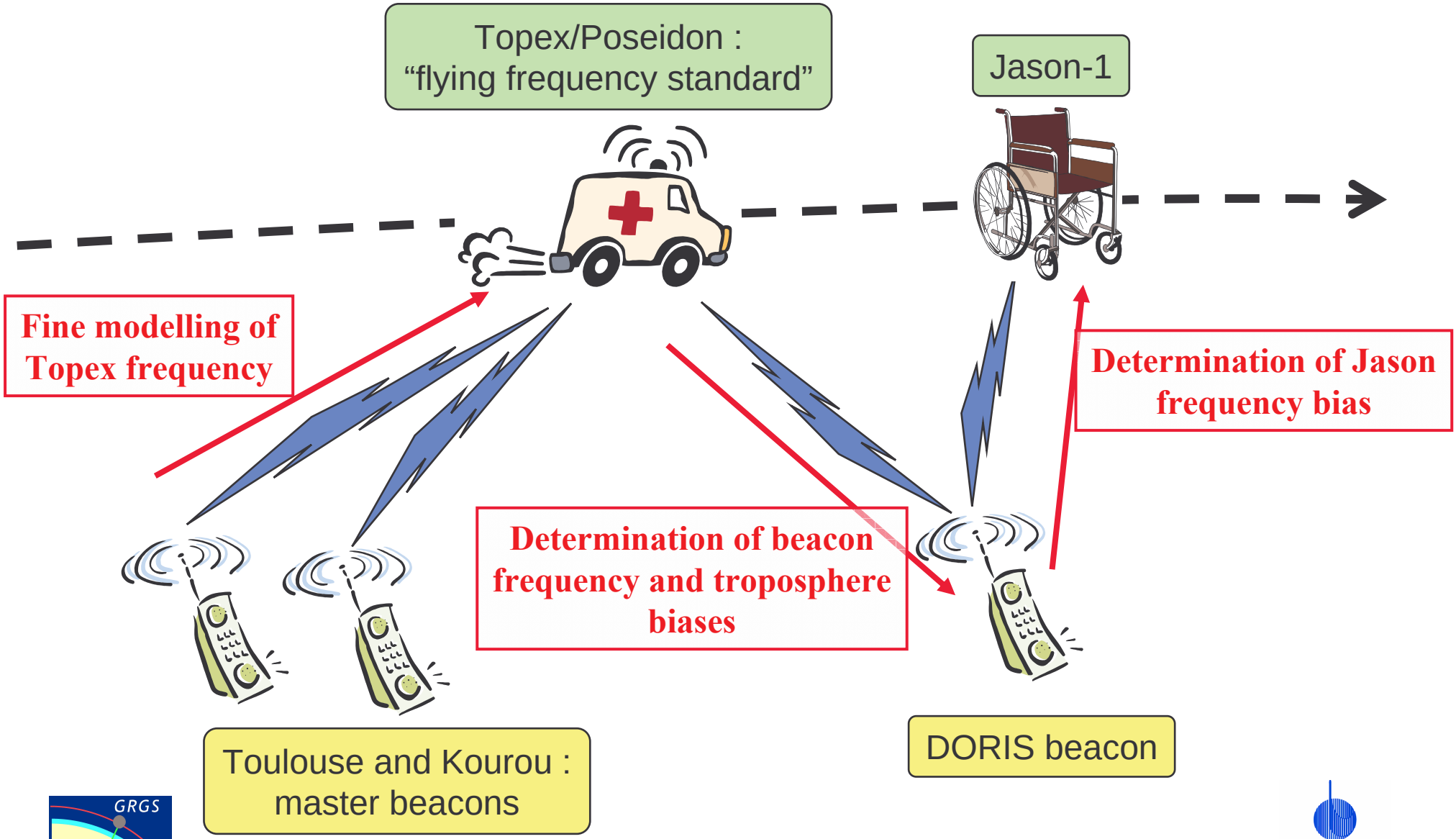
- bigger fluctuations for Jason
- 59 days period : rotation of the orbit plane w.r.t. the sun
- coherence between Toulouse & Kourou for Topex but not for Jason
- the discrepancy increases
- more and more passes are lost (in the pre-processing) over Kourou

• Frequency bias / pass for a few stations



The discrepancy between ascending and descending passes increases quasi-linearly

• Analysis of Jason on-board frequency : Principles (1)



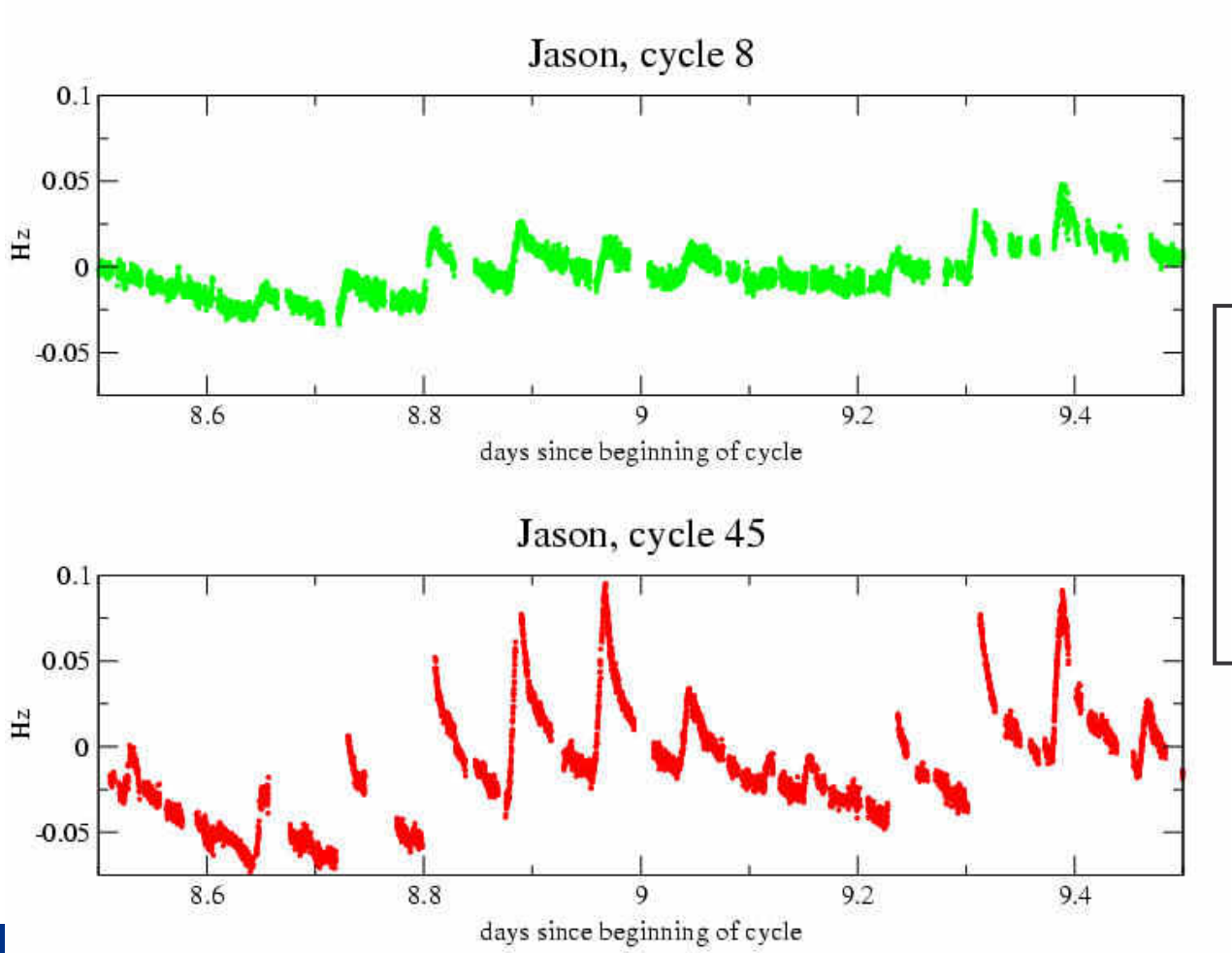
• Analysis of Jason on-board frequency : Principles (2)

The idea is to take advantage of the almost simultaneous presence of Topex and Jason over the same beacons, and to use Topex as “flying standard” in order to calibrate Jason. The procedure is the following:

1. Model the long and medium time evolution of Topex and Jason frequencies.
2. Compute an orbit arc of Topex, solving for one troposphere parameter and one frequency bias per pass for each station. Since the Topex frequency has been modelled to a high accuracy these parameters can be trusted as very close to the true station parameters.
3. Use a precise orbit of Jason, impose the station parameters determined by Topex and interpret the residuals as DORIS receiver frequency offsets.

•Analysis of Jason on-board frequency : First results

Jason on-board frequency variations, reconstructed per measurement

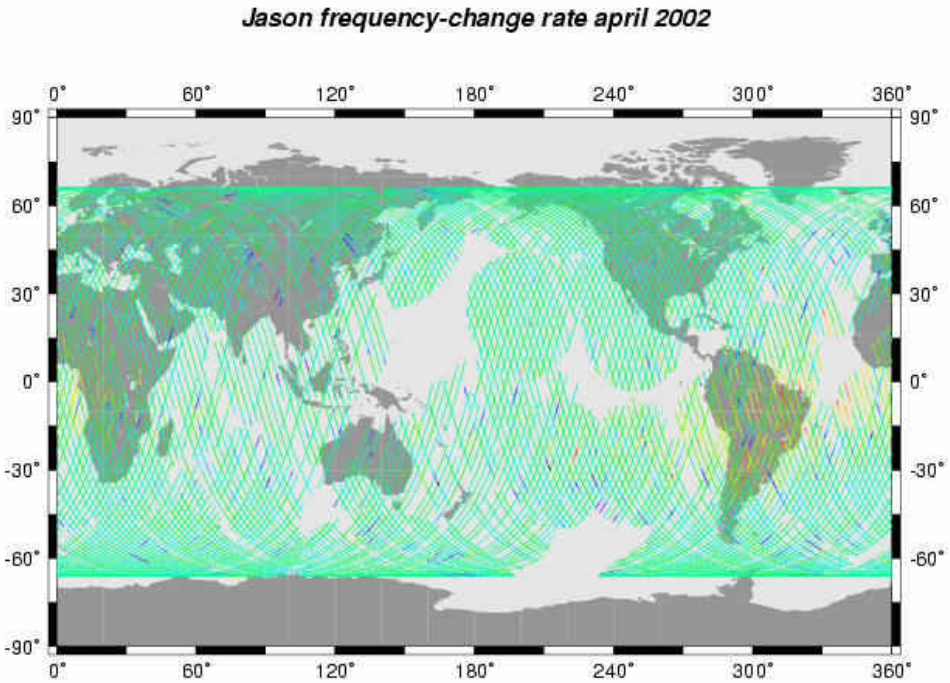


Conversion factor from residuals (in m/s) to Hz :

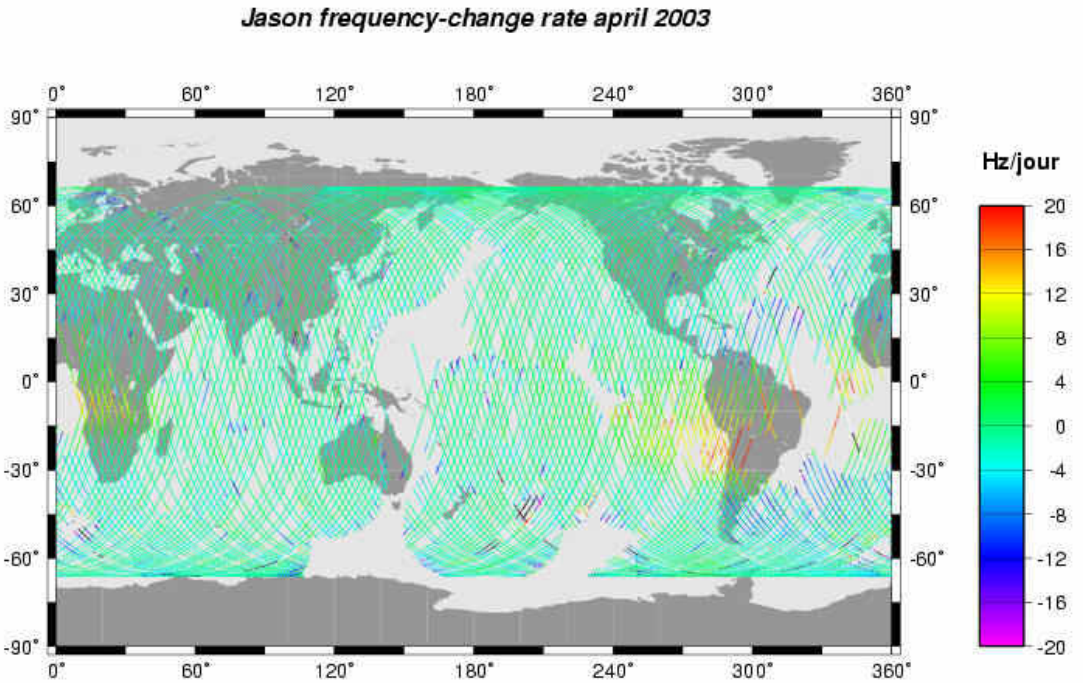
Hz ~ -6.7922 * Res

• Analysis of Jason on-board frequency : Modelling the signal

The signal (per measurement) can be derived time-wise and plots of the frequency-change rate can be drawn geographically. The South Atlantic Anomaly (SAA) is clearly at the origin of the Jason frequency variations.



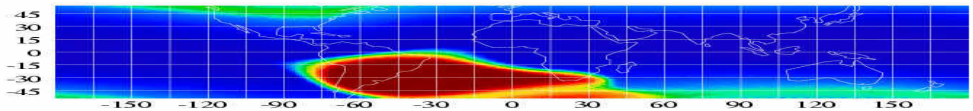
April 2002



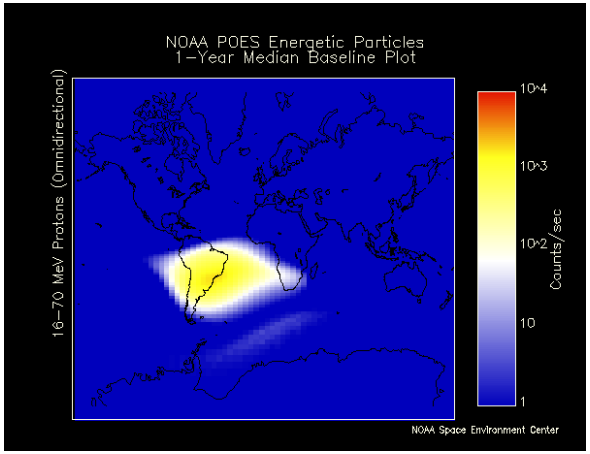
April 2003

• Analysis of Jason on-board frequency : different images of the SAA

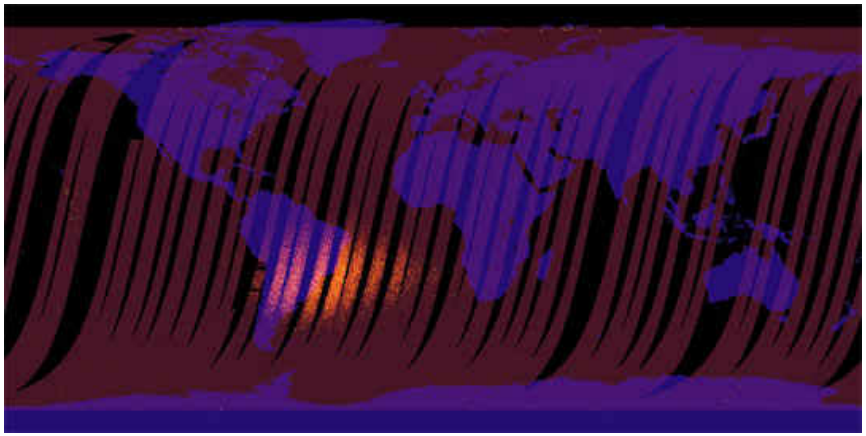
SAA from ROSAT satellite in 1996

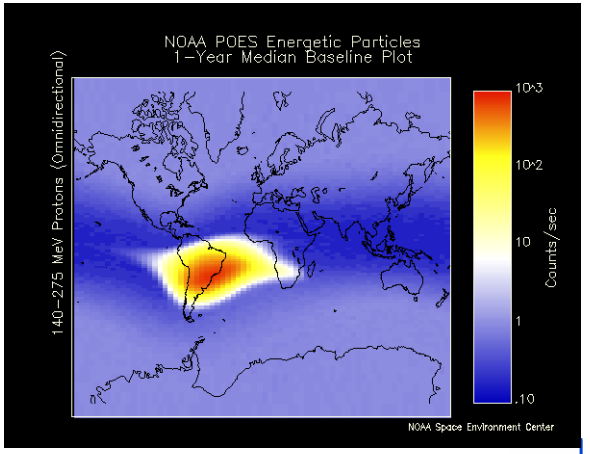


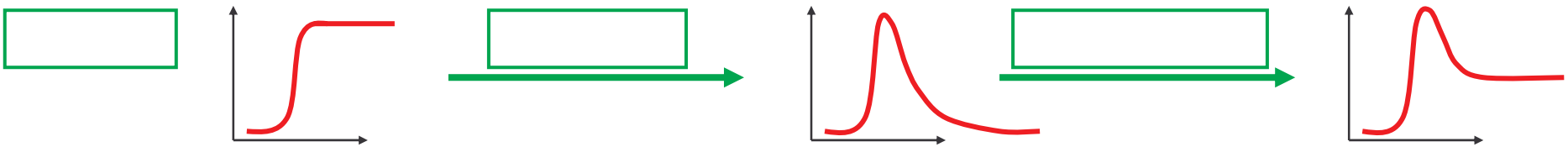
Energetic protons from MEPED particle sensors in different energy bands



SAA from MISR satellite in 2000







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