Sensitivity of the MSL calculation changing the orbit of the reference mission: Sentinel-3 instead of Jason missions

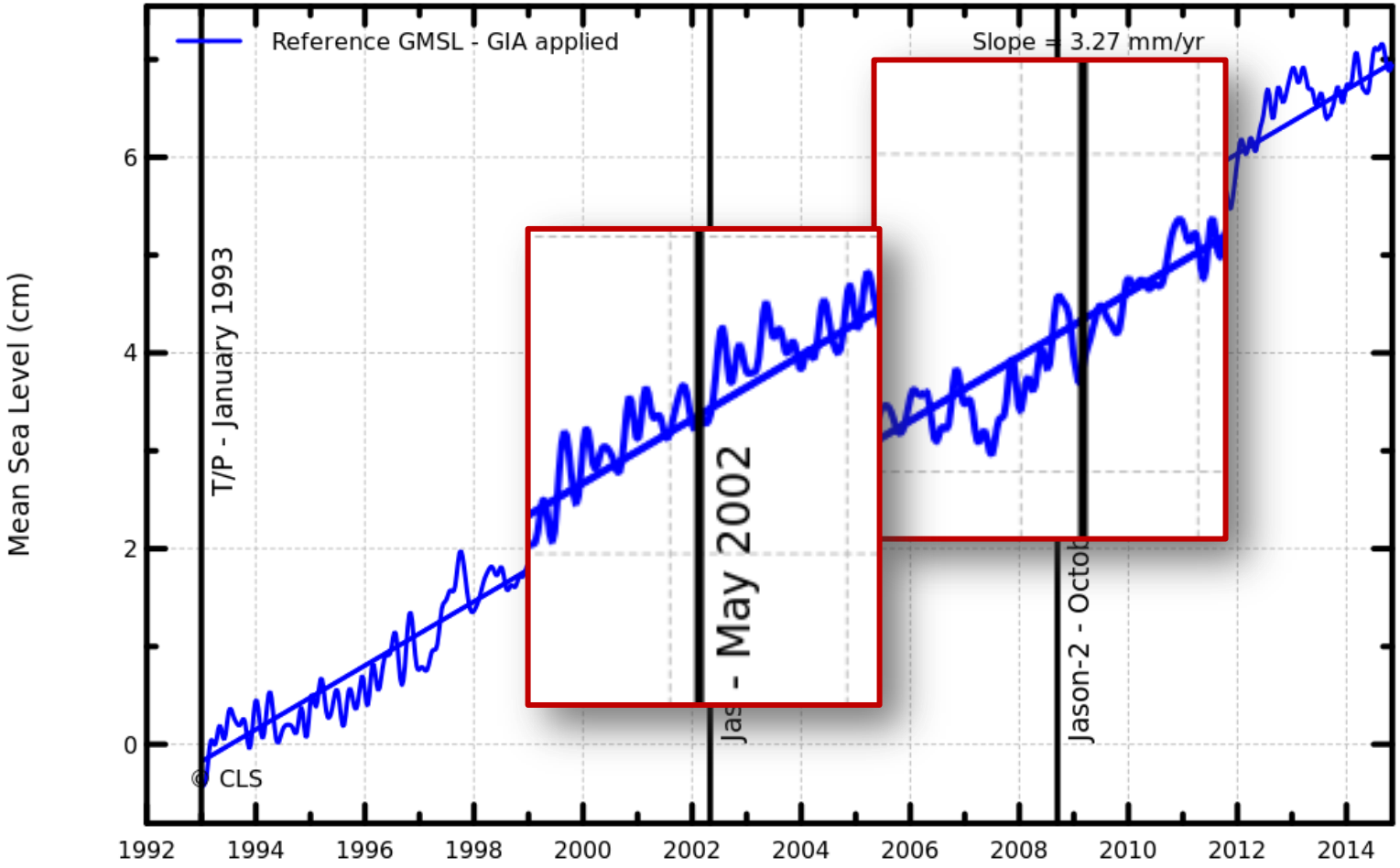
WP2520

L. Zawadzki, M. Ablain

Task Overview

Task	**Sensitivity of the MSL calculation changing the orbit of the reference mission: Sentinel-3 instead of Jason missions**
Work Package	WP2520
Authors	L. Zawadzki, M. Ablain (CLS)
State	Complete
Outputs	• SLCCI-Sensitivity_MSL_S3_WP2520 report: delivered to ESA • Error Characterization Report version 2.0: updated with this study and delivered to ESA • Publication (ongoing, April 2015): ”Estimation of the mean sea level continuous record accuracy with future altimetric missions: Jason-3 versus Sentinel-3”

Task Overview



Task Overview

1. Without a calibration phase between Jason and Sentinel-3, what would be the **accuracy of the MSL relative bias** between missions?

2. What would be the impact on the **MSL trend**?

3. What is the impact of **oceanic variability sampling** between the historical ground track and a different one?

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1. Impact on Global Mean Sea Level
    1. Impact on the MSL Relative Bias Uncertainty
    2. Impact on the Global Mean Sea Level evolution uncertainty

2. Impact on Regional Mean Sea Level
3. Conclusions

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1. Impact on Global Mean Sea Level

Reference Scenario	Working Scenario
2 missions with: • Calibration phase • Same ground tracks E.g. Jason-1/Jason-2, Jason-2/Jason-3,…	2 missions with: • No calibration phase • Different ground tracks E.g. Jason-1/Envisat, Jason-3/Sentinel-3,…

1. Impact on Global Mean Sea Level

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2 missions with: • Calibration phase • Same ground tracks E.g. Jason-1/Jason-2, Jason-2/Jason-3,…	2 missions with: • No calibration phase • Different ground tracks E.g. Jason-1/Envisat, Jason-3/Sentinel-3,…

<u>Same space-time sampling</u> ➔SSH errors positively correlated ➔Impact of oceanic variability neglected ➔Minimum Relative Bias Uncertainty (Leuliette et al., 2004)	<u>Differences in space-time sampling</u> ➔Decorrelation of SSH errors ➔Impact of oceanic variability

1. Impact on Global Mean Sea Level

Tab. Impact of the calibration phase on the Relative Bias

Missions	Relative Bias Uncertainty (mm)	Maximal Trend Uncertainty (mm/yr)
Jason-2/ Jason-3	Simulated data*: **0.9**	
Jason-2/ Sentinel-3	Simulated data*: 2.5+0.4=**2.9**	

*Simulated data: GLORYS (Ferry, 2012) bilinearly interpolated on ground tracks + correlated noise

1. Impact on Global Mean Sea Level

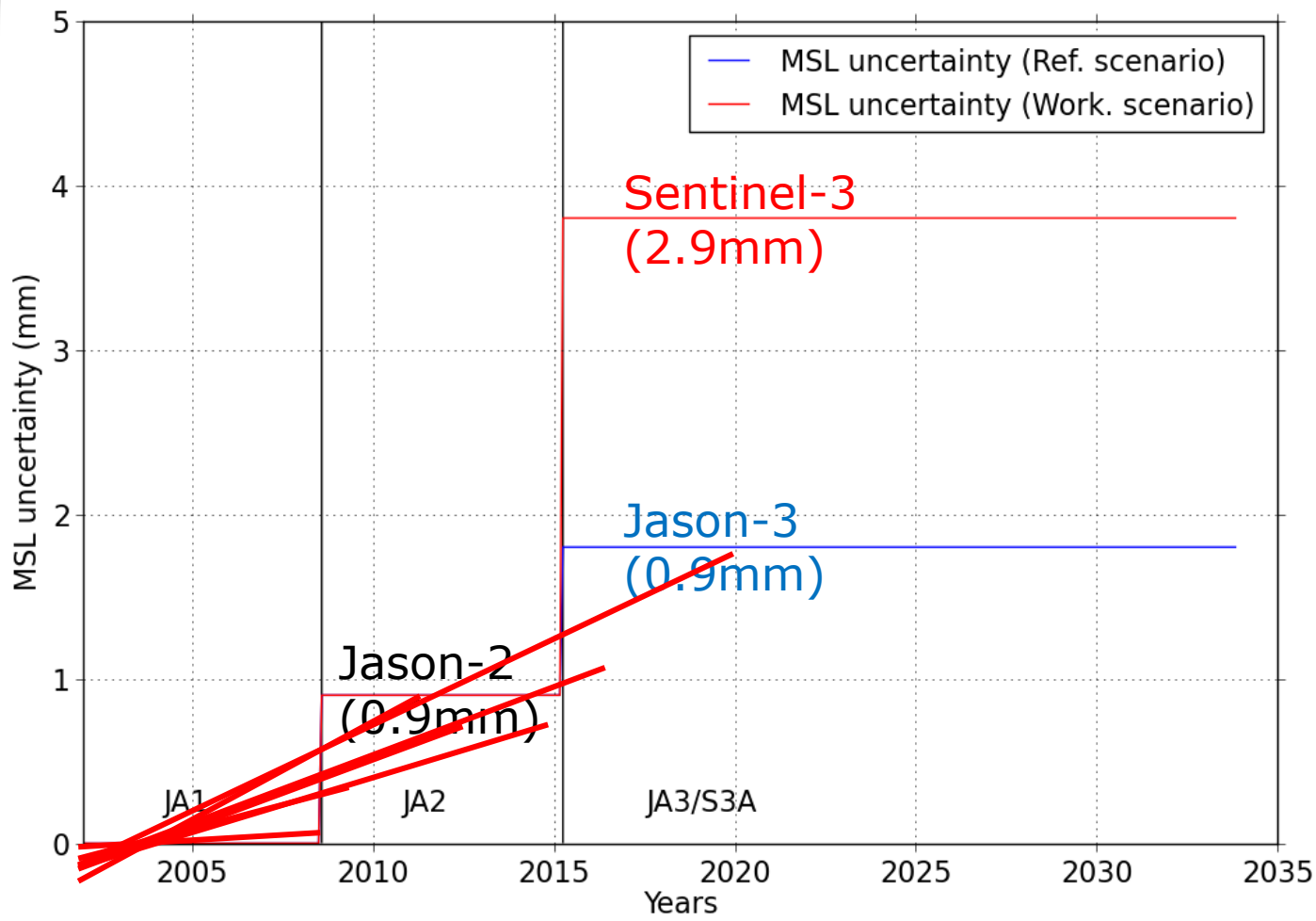

Fig. Impact of Relative Bias Uncertainty on Sea Level trend estimation (LS method)

1. Impact on Global Mean Sea Level

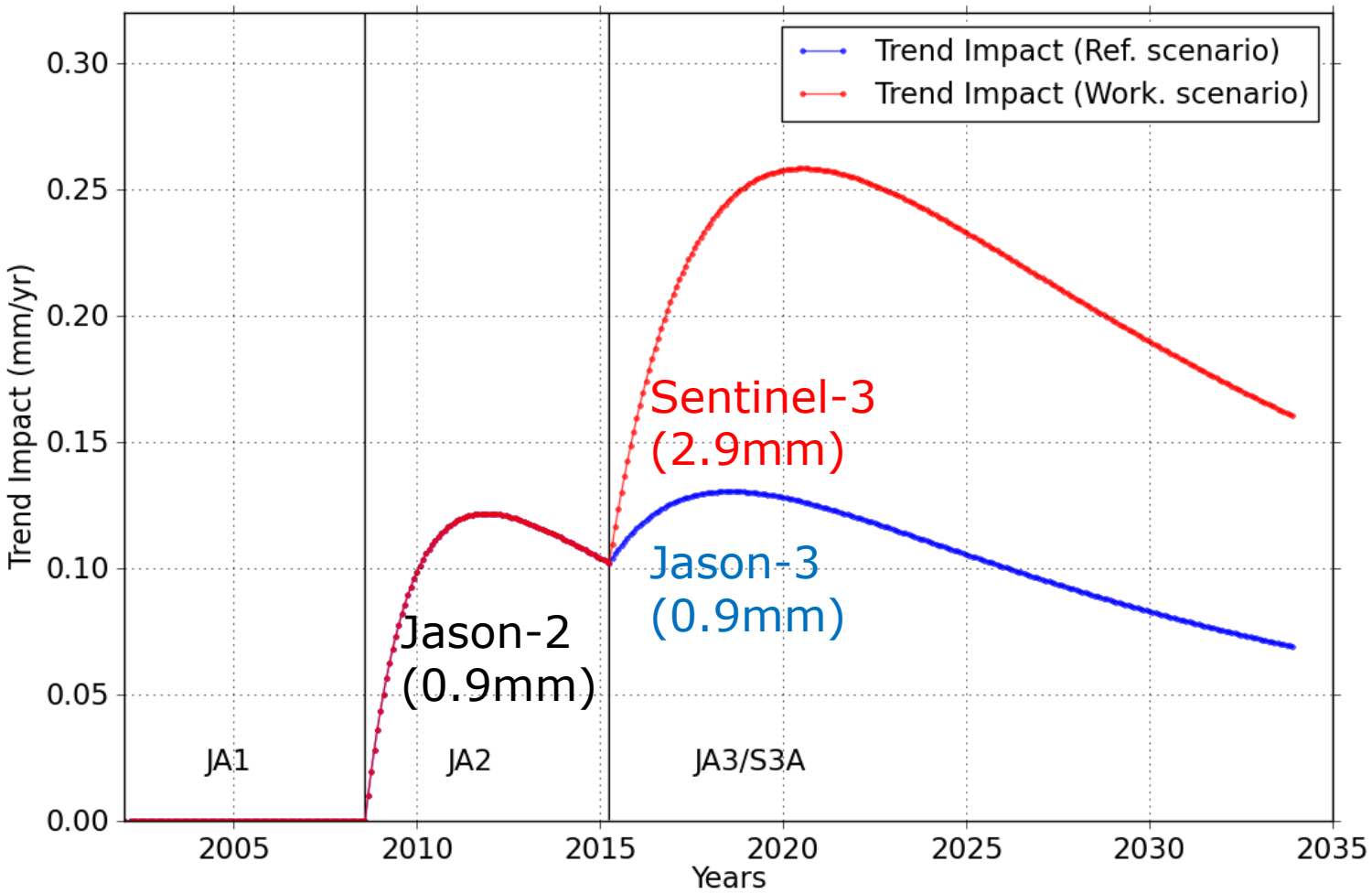

Fig. Impact of Relative Bias Uncertainty on Sea Level trend estimation (LS method)

1. Impact on Global Mean Sea Level

Tab. Impact of the calibration phase on the Relative Bias

Missions	Relative Bias Uncertainty (mm)	Maximal Trend Uncertainty (mm/yr)
Jason-2/ Jason-3	• Simulated data*: **0.9**	**0.13**
Jason-2/ Sentinel-3	• Simulated data*: 2.5+0.4=**2.9**	**0.26**

*Simulated data: GLORYS (Ferry, 2012) bilinearly interpolated on ground tracks + correlated noise

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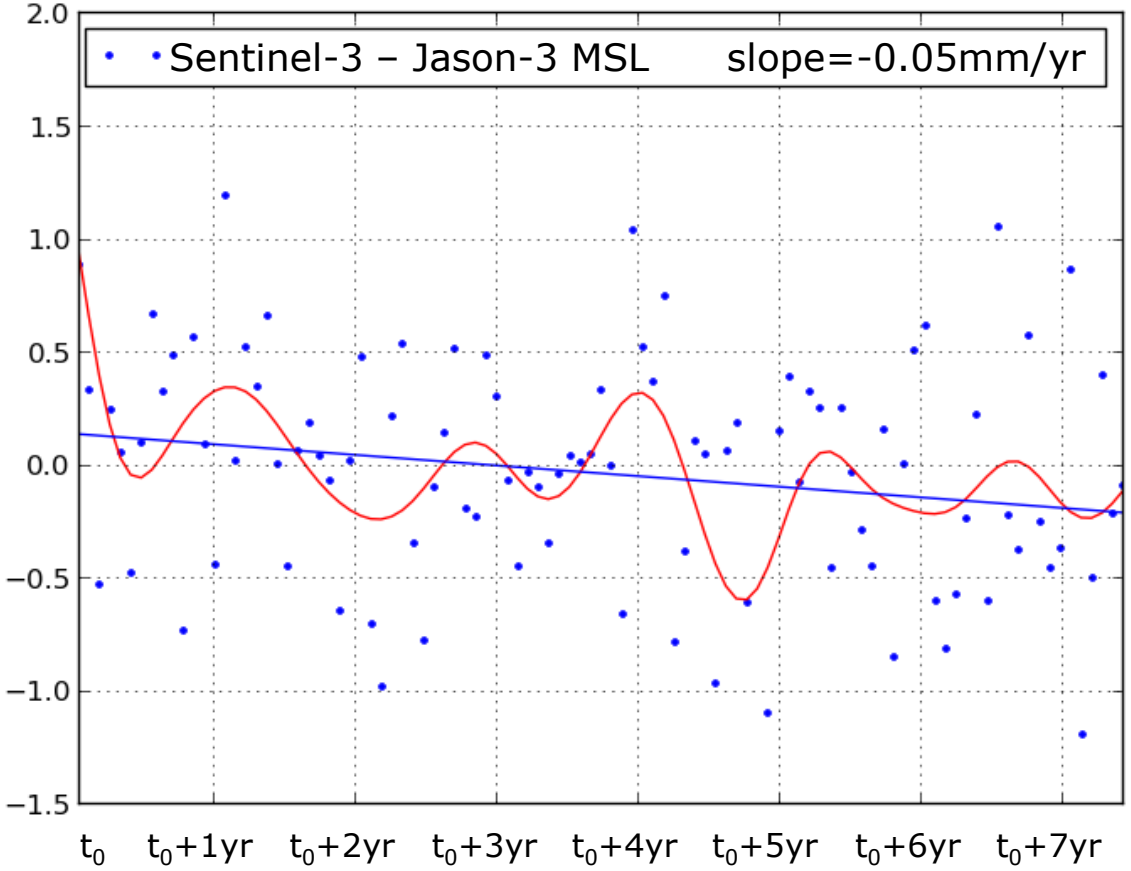
1. Impact on Global Mean Sea Level



Impact of oceanic variability sampling on long-term evolution: 0.05mm/yr over 8 yr

Fig. Difference between simulated Global MSL time series on Sentinel-3a and Jason-3 ground tracks

1. Impact on Global Mean Sea Level

Missions	Maximal Trend Uncertainty due to calibration phases (mm/yr)	Trend Uncertainty due to oceanic variability sampling
Jason-2/ Jason-3	0.13 mm/yr	-
Jason-2/ Sentinel-3	0.26 mm/yr	0.05mm/yr over 8 yr

SL-CCI URs (UR-SLCCI-SPC-01) on Global Mean Sea Level trend uncertainty: 0.3mm/yr over 10yr

1. Impact on Global Mean Sea Level

Using Sentinel-3 or Jason ground tracks has thus a very strong impact on the Global Mean Sea Level trend uncertainty

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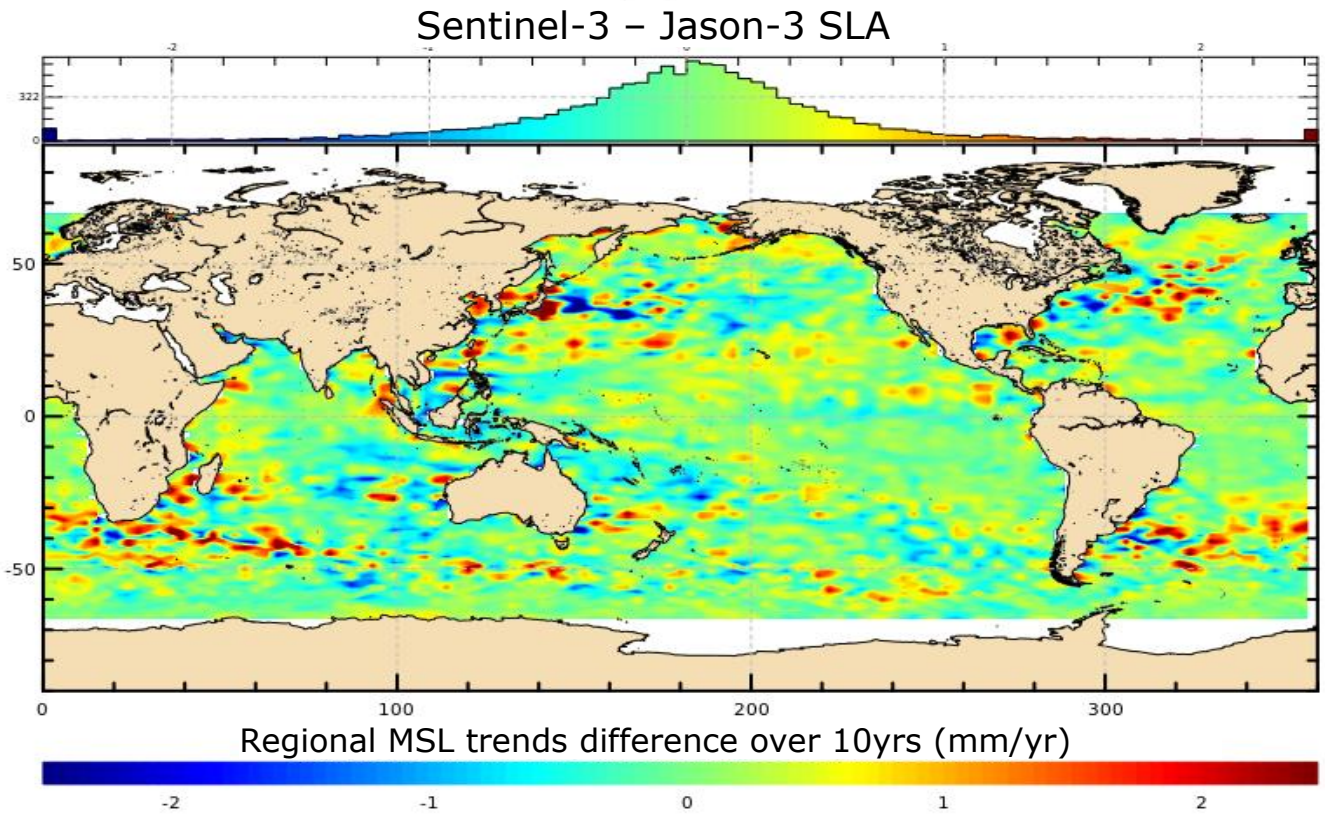
2. Impact on Regional Mean Sea Level

Tab. Impact of the calibration phase on the Relative Bias at a basin scale

Missions	Maximal Trend Uncertainty (mm/yr)	
Basin	Global	North Atlantic
Jason-2/ Jason-3	0.13	0.3
Jason-2/ Sentinel-3	0.26	0.76

2. Impact on Regional Mean Sea Level



SL-CCI URs (UR-SLCCI-GEN-02) on Local Mean Sea Level trend uncertainty: 1mm/yr

Fig. Difference between simulated MSL trends on Sentinel-3a and Jason-3 ground tracks

2. Impact on Regional Mean Sea Level

Using Sentinel-3 or Jason ground tracks has thus a very strong impact on the regional Mean Sea Level trend uncertainty

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3. Conclusions

1. Linking Sentinel-3 to the reference Global MSL record makes it impossible to meet gobal trend Urs: UR-SLCCI-SPC-01(<0.3mm/yr). It is important to remain consistent in the errors we commit to minimize sources of uncertainty.

2. The different sampling of oceanic variability –induced by the difference of ground tracks- prevents from meeting regional trend URs: UR-SLCCI-GEN-02 (<1mm/yr)

Recommendation:

It is necessary to conserve the historical TOPEX/Jason ground track to compute MSL time series and MSL trend maps.