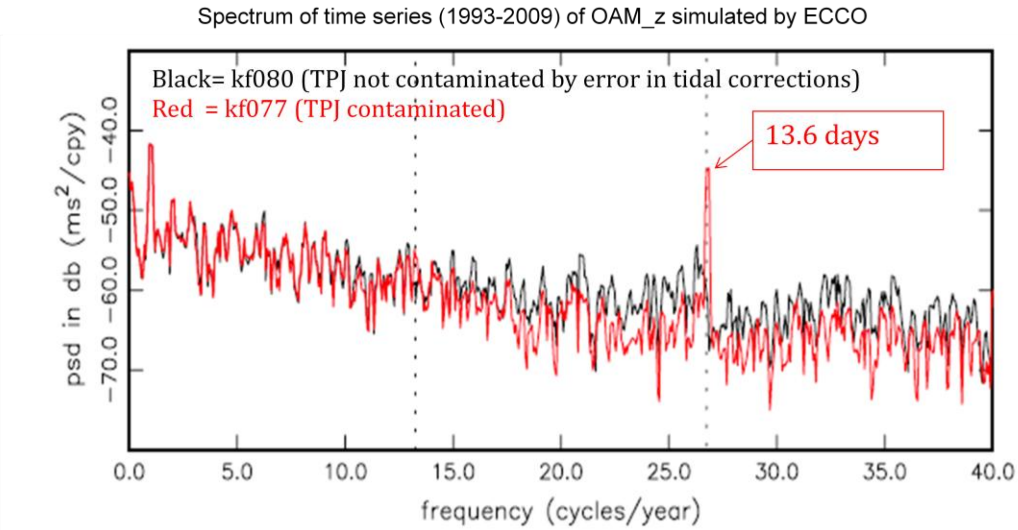
Example of Errors detected by OAMs simulated in the chain of satellite TPJ data processing and assimilation in a OGCM



For all TPJ assimilation experiments since 1993, the OAMs simulated by OGCM are computed with and without TPJ (Dr Gross, SBO / IERS) for the detection of possible errors in modeling or satellite data processing

(courtesy of Drs. I. Fukumori & R. Gross, JPL, 2009)

For **OAM, OGCM, TPJ** see list of Acronyms and Definitions

Frequency spectra of 1993-to-2009 time series of OAM_z computed from ECCO ocean model simulations in which TPJ along-track data are assimilated with two slightly different tidal corrections.

The red shows a peak at 13.6 days. These results obtained in spring 2009 are an example of how useful OAMs are for the communities involved in satellite processing and production of Geophysical Data Records (GDR) as well as for those involved in climate modeling with or without GDR assimilation. As soon as this 13.66 day peak appeared above the standard levels routinely produced by the Special Bureau for the Oceans (SBO) for Estimating the Circulation and Climate of the Ocean (ECCO), R. Gross alerted the communities in the USA and in France that are in charge of producing the altimetric GDRs. There was an error made before the GDRs had been assimilated in the ECCO experiments. The GDRs had been contaminated by small tidal errors called "long period tides" that no one from the GDR production teams could have detected because different software versions are used in different countries by teams in charge of producing and distributing GDRs on the World Wide Web. The hypotheses on how satellite data assimilation teams separate the "fast" signals (tides and atmospheric pressure anomalies) from the "slow" climate signals (oceanic responses to surface winds) in GDRs and in models differ from one team to another. It is because the Finite Element Solution of tidal correction (FES2004) was used with assumptions to remove the "fast" oceanic response to atmosphere that differ from one assimilation team to another, that a typo had been introduced in spring of 2009 and used without the proper FES2004 correction in both countries. Before assimilation, the ECCO teams apply the Inverse

Barometric hypothesis to remove the "fast" oceanic response to atmospheric pressure from the "slow" oceanic response to winds. *Other teams remove the "fast" oceanic responses to "fast" winds and pressure called MOG2D before assimilating the GDRs for ocean climate experiments. These differences made the ECCO assimilation experiment (kf077) produce errors every 13.6 days, which corresponds to the most energetic long-period tide that is properly removed in the FES2004 tidal corrections without typo (kf080). OAMs are efficient tools to diagnose errors in the planetary budgets of circulation and mass simulated by model experiments with satellite GDR assimilation. Once detected by the SBO, it took three months to identify the typo inadvertently introduced in one line of the software pieces in the chain producing GDRs that had created the OAM spectral peak in 2009. Computing OAM time series like the SBO does for the International Earth Rotation Service (IERS) brings an efficient service to the communities by preventing the chain of GDR and model productions from distributing errors on the WWW. Without this service, the climate modeling community of web users of altimetric GDRs and assimilation products would have had their daily work re-computed for much more than three months.*