Memo to: TIDI
From: W. R. Skinner
Date: 15 November 20013
Subject: Method for describing long-term drift

The instrument drift with time can be described with a two component model: 1) A short-term exponential drift, and 2) a piecewise linear variation that characterizes the long term. The drift then has the form:

$$u_{ltd}(m,t) = u_0(m) + u_e(m)\exp\left(-\frac{t}{t_e(m)}\right) + \sum_{i=1}^{I-1} F(t,t_i,t_{i+1}) \frac{\left(u_{l,i}(m)(t-t_{i+1}) - u_{l,i+1}(m)(t-t_i)\right)}{(t_i - t_{i+1})}$$

where

$$F(t,t_i,t_{i+1}) = 1 \quad \text{if} \quad t_i < t \le t_{i+1}$$
$$= 0 \quad \text{else}$$

and the variables are defined in Table 1. Time can be in any units (e.g. days, seconds, milliseconds) as long as the units are used consistently. The drift can be a function of wavelength and therefore the coefficients need to be a function of the filter wheel configuration. For the purposes of dimensioning, the number of intervals should be on the order of 10. This should be more than enough for the expected TIMED lifetime.

Table 1. Variable definitions

Variable	**Units**	**Description**
M	None	Filter wheel configuration id
T	Any	Time
u_e	ms^{-1}	Exponential drift amplitude
t_e	Same as t	1/e drift width
I-1	None	Number of intervals required to describe drift
t_i	Same as t	Start of interval i and end of interval i-1
t_{i+1}	Same as t	Start of interval i+1 and end of interval i
$u_{l,i}$	ms^{-1}	Long term drift value at time t_i
$u_{l,i+1}$	ms^{-1}	Long term drift value at time t_{i+1}
u_0	ms^{-1}	Instrument offset at initial time

u_{ltd}	ms^{-1}	Instrument drift with time
u	ms^{-1}	Uncorrected line of sight velocity
u_{atm}	ms^{-1}	Corrected line of sight velocity
u_{rot}	ms^{-1}	Component of the Doppler shift due to Earth rotation
u_{sc}	ms^{-1}	Component of the Doppler shift due to spacecraft motion
$u_{thermal}$	ms^{-1}	Component of the line of sight speed due to instrument thermal drift

The correction to be applied to raw measurement is then

$$u_{atm} = u + u_{rot} - u_{sc} - u_{ref} - u_{thermal} - u_{ltd}$$

with the other corrections discussed elsewhere.