Measuring the correlation time

Axel Brandenburg

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Compute

$$\tau_{\boldsymbol{u}^2}(t) = \int_0^t \langle \boldsymbol{u}(t) \cdot \boldsymbol{u}(t') \rangle \, \mathrm{d}t' / \langle \boldsymbol{u}^2 \rangle. \tag{1}$$

$$\tau_{\boldsymbol{\omega}\cdot\boldsymbol{u}}(t) = \int_0^t \langle \boldsymbol{\omega}(t) \cdot \boldsymbol{u}(t') \rangle \, \mathrm{d}t' / \langle \boldsymbol{\omega} \cdot \boldsymbol{u} \rangle. \tag{2}$$

$$\tau_{\boldsymbol{u}\cdot\boldsymbol{\omega}}(t) = \int_0^t \langle \boldsymbol{u}(t) \cdot \boldsymbol{\omega}(t') \rangle \, \mathrm{d}t' / \langle \boldsymbol{\omega} \cdot \boldsymbol{u} \rangle. \tag{3}$$

$$\tau_{\boldsymbol{u}\cdot\boldsymbol{\omega}}(t) = \left\langle \boldsymbol{u}(t) \cdot \int_0^t \boldsymbol{\omega}(t') \, \mathrm{d}t' \right\rangle / \langle \boldsymbol{\omega} \cdot \boldsymbol{u} \rangle. \tag{4}$$

see Figure 1 for a case where $k_\mathrm{f} = 10$ and $u_\mathrm{rms} = 0.1$. $\langle \boldsymbol{u}^2 \rangle$

$$\tau(t,k) = \int_0^t \mathrm{Sp}_k \left[\boldsymbol{u}(t), \boldsymbol{u}(t') \right] \, \mathrm{d}t' / \langle F(k) \rangle, \tag{5}$$

where $\mathrm{Sp}(a,b) = a_k b_b^* + \mathrm{c.c.}$ and $F(k)$ is the helicity spectrum.

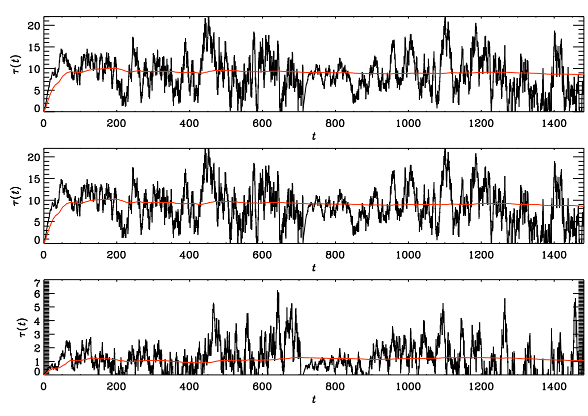

Figure 1: `pcortime`