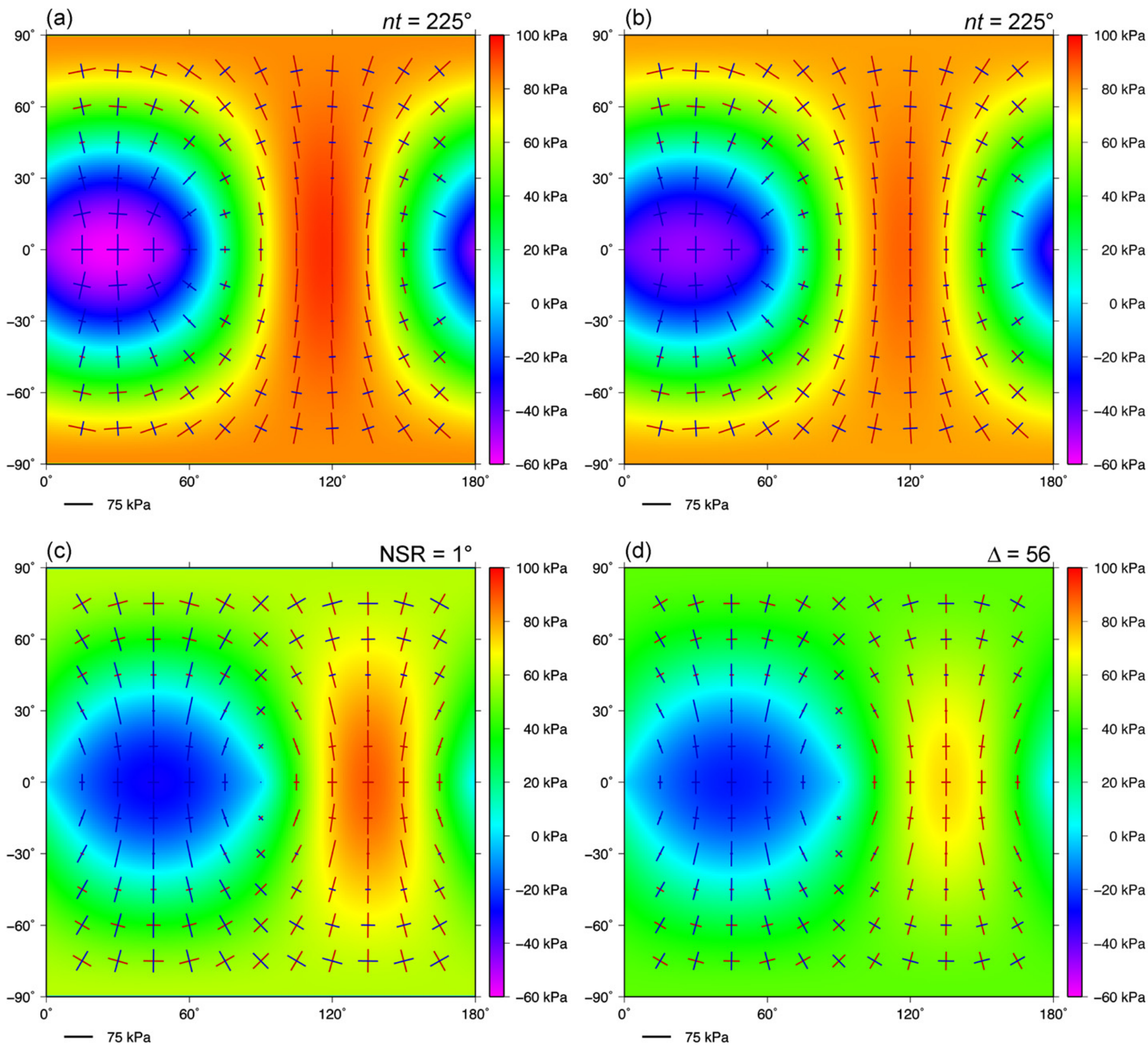

Fig. 5. Stresses computed using the "flattening" method (left) compared to those from our viscoelastic model (right) for a Europa-like satellite with similar physical properties. Table 4 lists the input parameters adopted for the flattening calculations (T. Hurford, personal communication, 2006). These parameters, excluding the real valued Love numbers, have also been adopted for the viscoelastic calculations. Because the viscoelastic model requires more information about the internal structure of the satellite in order to calculate the frequency-dependent Love numbers, those parameters in Table 1 not listed in Table 4 have been adopted in (b) and (d). (a) Flattening and (b) viscoelastic results for diurnal stresses at 225° after perijove (i.e. $nt = 225°$ in Eqs. (29)–(31)). (c) NSR stresses from the flattening method with 1° of accumulated NSR, compared to those calculated by the viscoelastic model (d) with $\Delta = 56$, at which point the two models each have a phase shift of 44.5°. See Section 9 for discussion.

Table 4
Flattening model parameters (Figs. 2 and 5).

Parameter	Symbol	Value
Elastic Love number	h	1.2753
Elastic Love number	ℓ	0.31882 ($\equiv \frac{h}{4}$)
Mass of Europa	M_E	4.80×10^{22} kg
Mass of Jupiter	M_p	1.8986×10^{27} kg
Radius of Europa	R_s	1.561×10^{6} m
Europa's orbital semi-major axis	a	6.709×10^{8} m
Eccentricity of orbit	ϵ	0.01
Bulk modulus of ice ($= \lambda_{\text{ice}} + \frac{2}{3}\mu_{\text{ice}}$)	κ_{ice}	9.1764×10^{9} Pa
Shear modulus of ice	μ_{ice}	3.5187×10^{9} Pa

Fig. 2b shows the same quantities for the flattening model, as a function of the rotation angle between the two elastic stress patterns (the "accumulated degrees of NSR," which in the flattening model is the parameter that describes how much stress is allowed to build up in the shell, similar to our Δ). Small values of the rotation angle result in large phase shifts and small amplitudes. This can be understood by considering, for example, $\tau_{\theta\theta}$. The elastic result (Eq. (12)) has a longitudinal dependence of $\cos(2\phi + 2bt)$. The difference between this cosine and the same cosine when ϕ has been rotated by the angle δ, is $\cos(2\phi + 2bt) - \cos(2\phi + 2\delta + 2bt) \approx$ (when δ is small) $\delta \sin(2\phi + 2bt)$. Thus, the difference decreases in amplitude as $\delta \to 0$, and lags $\cos(2\phi + 2bt)$ by 45° in ϕ. The difference between these cosines has an increasing amplitude and a decreasing phase shift as δ increases, consistent with the results shown in Fig. 2b.