stronger than the Ferrel cell.

3. Since large-scale flow is in quasi-geostrophic balance, $v \approx v_g = \partial \Psi_g / \partial x$ (Ψ_g : geostrophic streamfunction) with errors on the order of 10%. Noting that $[v_g] = [\partial \Psi_g / \partial x] = 0$, we find that [v] is ageostrophic, which is much smaller in magnitude ($\approx 1/10$) than the geostrophic flow. On the other hand, u* and v* are dominated by their geostrophic flow components, and then the product u*v* does not exhibit significant cancellation along the latitude circles. Therefore [u*v*] tends to be estimated much more accurately than [v].
4. In quasi-geostrophic scaling,
$[v^*\Phi^*] = [f^{-1}(\partial \Phi^*/\partial x)\Phi^*] = f^{-1}[\partial(0.5\Phi^{*2})/\partial x] = 0.$
5. $\overline{[uv]}$: time mean of zonally-averaged total poleward transport of zonal momentum.
$[\bar{u}][\bar{v}]$: poleward transport of zonal momentum associated with time-averaged, (zonal) mean meridional circulation.
$\overline{[u]'[v]'}$: time-mean poleward transport of zonal momentum associated with transient mean meridional circulation.
$\overline{[u^*v^*]}$: time-mean poleward transport of zonal momentum associated with steady and transient eddies.
6. (1) kinematic method:
After a direct measurement of [v], [ω] is inferred through the zonally averaged continuity equation. However, [v] is quite hard to measure accurately, because [v] is ageostrophic.
(2) momentum method:
In this method [v] is estimated as a residual of the zonally averaged momentum equation, i.e., $[v] = f^{-1}(\partial[u]/\partial t - G - F)$, where the convergence of poleward flux of zonal momentum, G, the external force, F, and the momentum tendency, $\partial[u]/\partial t$ have to be measured. Note that no direct measurement of ageostrophic quantities is required. Then the zonally averaged continuity equation is used for the estimation of [ω]. This method is not suitable for in-situ estimation, in which $\partial[u]/\partial t$ is unknown.
(3) thermodynamic method:
In this method [ω] is estimated as a residual of the zonally averaged thermodynamic equation, i.e., $[\omega] = \sigma^{-1}(\partial[\alpha]/\partial t - B - Q)$, where the convergence of poleward heat flux, B, the diabatic heating, Q, the stability parameter, σ, and the thermal tendency, $\partial[\alpha]/\partial t$ have to be measured. Note that no ageostrophic quantities are measured directly. Then the zonally averaged continuity equation is applied for the estimation of [v]. This method is not suitable for in-situ estimation either.
(4) ω-equation method:
First, form a diagnostic equation for the streamfunction, χ for [v] and [ω] by eliminating the tendency terms in the momentum and thermodynamic equations using thermal wind balance. The consequent equation is what is usually called the ω-equation, i.e., $\chi_{yy} + (f^2/\sigma)\chi_{pp} = \sigma^{-1}(B+Q)_y - (f/\sigma)(G+F)_p$, with $[v] = \chi_p$ and $[\omega] = -\chi_y$. No ageostrophic quantities are measured directly. Since no tendency terms appear explicitly, this method can be applied even to in-situ estimation.

月例会「第32回山の気象シンポジウム」のお知らせ

日　時　昭和63年6月18日（土）13：00から
場　所　気象庁第一会議室（5 F）
講演希望の方は演題に200字以内のアブストラクトをつけて，4月末日までに，気象庁通報課　岡野光也（〒100　千代田区大手町 1-3-4）まで郵送して下さい．