Isentropic diagnostics of mean circulation and water vapour budget for the Asian monsoon

Lee, Shao Yi

2012

Lee, S. Y. (2012). Isentropic diagnostics of mean circulation and water vapour budget for the Asian monsoon. Doctoral thesis, Nanyang Technological University, Singapore.

<https://hdl.handle.net/10356/50924>

<https://doi.org/10.32657/10356/50924>

Surface Fraction

Unweighted isentropic density

Surface fraction weighted isentropic density

Surface fraction weighted pressure

Jan 050-140 [p]₃ /10²Pa

Feb 050-140 [p]₃ /10²Pa

Surface fraction weighted zonal velocity

Mass weighted meridional velocity

Mass weighted diabatic heating

Jan 050-140 $\langle Q \rangle_3 / 10^{-6} \text{Ks}^{-1}$

Feb 050-140 $\langle Q \rangle_3 / 10^{-6} \text{Ks}^{-1}$

Change in meridional gradient of Montgomery function due to moisture correction

Jan 050-140 $[\partial(\delta M)/\partial x]_3 / 10^{-6} \text{ms}^{-2}$

Feb 050-140 $[\partial(\delta M)/\partial x]_3 / 10^{-6} \text{ms}^{-2}$

Lagrangian change of sec-mean circulation

Jan 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

Feb 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

Mar 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

Apr 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

May 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

Jun 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

Sep 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

Oct 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

Nov 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

Dec 050-140 $\langle v \rangle_3 / a \partial[L]_3 / \partial \lambda + \langle Q \rangle_3 \partial[L]_3 / \partial \theta / 10^{-5} \text{ms}^{-2}$

Time tendency

Jan 050-140 $[L_e^t]_3 / 10^{-6} \text{ms}^{-2}$

Feb 050-140 $[L_e^t]_3 / 10^{-6} \text{ms}^{-2}$

Mar 050-140 $[L_e t_e^t]_3 / 10^{-6} \text{ms}^{-2}$

Apr 050-140 $[L_e t_e^t]_3 / 10^{-6} \text{ms}^{-2}$

May 050-140 $[L_e^t]_3 / 10^{-6} \text{ms}^{-2}$

Jun 050-140 $[L_e^t]_3 / 10^{-6} \text{ms}^{-2}$

Jul 050-140 $[L_{e,t_e}^t]_3 / 10^{-6} \text{ms}^{-2}$

Aug 050-140 $[L_{e,t_e}^t]_3 / 10^{-6} \text{ms}^{-2}$

Sep 050-140 $[L_e t_e^t]_3 / 10^{-6} \text{ms}^{-2}$

Oct 050-140 $[L_e t_e^t]_3 / 10^{-6} \text{ms}^{-2}$

Nov 050-140 $[L_e^t]_3 / 10^{-6} \text{ms}^{-2}$

Dec 050-140 $[L_e^t]_3 / 10^{-6} \text{ms}^{-2}$

Sectoral mean-eddy interaction

Jan 050-140 $(a\delta)^{-1} [u]_3 \{ [L_e^s]_2 \}_s^e / 10^{-5} \text{ms}^{-2}$

Feb 050-140 $(a\delta)^{-1} [u]_3 \{ [L_e^s]_2 \}_s^e / 10^{-5} \text{ms}^{-2}$

Jul 050-140 $(a\delta)^{-1}[u]_3\{[L_e]_2^s\}'_s/10^{-5}\text{ms}^{-2}$

Aug 050-140 $(a\delta)^{-1}[u]_3\{[L_e]_2^s\}'_s/10^{-5}\text{ms}^{-2}$

Lateral Montgomery force

Jan 050-140 $-(\delta a[\Delta]_3^s)^{-1} \{ [B_e]_2^s \}'_s / 10^{-5} \text{ms}^{-2}$

Feb 050-140 $-(\delta a[\Delta]_3^s)^{-1} \{ [B_e]_2^s \}'_s / 10^{-5} \text{ms}^{-2}$

Mar 050-140 $-(\delta)a[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_{/s}^e/10^{-5}\text{ms}^{-2}$

Apr 050-140 $-(\delta)a[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_{/s}^e/10^{-5}\text{ms}^{-2}$

May 050-140 $-(\delta\lambda[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_s' / 10^{-5}\text{ms}^{-2}$

Jun 050-140 $-(\delta\lambda[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_s' / 10^{-5}\text{ms}^{-2}$

Jul 050-140 $-(\delta)a[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_{/s}^e/10^{-5}\text{ms}^{-2}$

Aug 050-140 $-(\delta)a[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_{/s}^e/10^{-5}\text{ms}^{-2}$

Sep 050-140 $-(\delta)a[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_{/s}^e/10^{-5}\text{ms}^{-2}$

Oct 050-140 $-(\delta)a[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_{/s}^e/10^{-5}\text{ms}^{-2}$

Nov 050-140 $-(\delta)a[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_s^j/10^{-5}\text{ms}^{-2}$

Dec 050-140 $-(\delta)a[\Delta]_3^s)^{-1}\{[B_e]_2^s\}_s^j/10^{-5}\text{ms}^{-2}$

total Eddy PV flux

Jan 050-140 $\sum_j^3 [c\xi^{\leftarrow} \nabla^{\rightarrow}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Feb 050-140 $\sum_j^3 [c\xi^{\leftarrow} \nabla^{\rightarrow}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Submonthly eddy PV flux

Jan 050-140 $[\overline{c\xi^{<1>}v^{<1>}}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Feb 050-140 $[\overline{c\xi^{<1>}v^{<1>}}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Mar 050-140 $[c\xi^{<1>}v^{<1>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Apr 050-140 $[c\xi^{<1>}v^{<1>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Jul 050-140 $[c\xi^{<1>v^{<1>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Aug 050-140 $[c\xi^{<1>v^{<1>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Sep 050-140 $[c\xi^{<1>}v^{<1>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Oct 050-140 $[c\xi^{<1>}v^{<1>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Nov 050-140 $[c\xi^{<1>v^{<1>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Dec 050-140 $[c\xi^{<1>v^{<1>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Interannual eddy PV flux

Mar 050-140 $[\langle c\xi \rangle \langle v \rangle]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Apr 050-140 $[\langle c\xi \rangle \langle v \rangle]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Sep 050-140 $[\langle c\xi \rangle \langle v \rangle]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Oct 050-140 $[\langle c\xi \rangle \langle v \rangle]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Nov 050-140 $[\langle c\xi \rangle \langle v \rangle]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Dec 050-140 $[\langle c\xi \rangle \langle v \rangle]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Stationary eddy PV flux

Jan 050-140 $[\overline{c\xi^{<3>}v^{<3>}}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Feb 050-140 $[\overline{c\xi^{<3>}v^{<3>}}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Mar 050-140 $[c\xi^{<3>}v^{<3>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Apr 050-140 $[c\xi^{<3>}v^{<3>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

May 050-140 $[\langle c_{\xi}^3 \rangle v^{\langle 3 \rangle}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Jun 050-140 $[\langle c_{\xi}^3 \rangle v^{\langle 3 \rangle}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Jul 050-140 $[c\xi^{<3>}\nu^{<3>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Aug 050-140 $[c\xi^{<3>}\nu^{<3>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Sep 050-140 $[c\xi^{<3>}v^{<3>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Oct 050-140 $[c\xi^{<3>}v^{<3>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Nov 050-140 $[c\xi^{<3>}v^{<3>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Dec 050-140 $[c\xi^{<3>}v^{<3>}]_3 \cos q / 10^{-5} \text{ms}^{-2}$

Total Montgomery surface drag

Mar 050-140 a⁻¹ [$\sum_j \{M^{ll}_j \partial t / \partial \lambda\}^t_{[e]}]_s / 10^{-5} \text{ms}^{-2}$

Apr 050-140 a⁻¹ [$\sum_j \{M^{ll}_j \partial t / \partial \lambda\}^t_{[e]}]_s / 10^{-5} \text{ms}^{-2}$

May 050-140 a⁻¹ [Σ_j{M^{III}∂t/∂λ_s}_e]₃ /10⁻⁵ ms⁻²

Jun 050-140 a⁻¹ [Σ_j{M^{III}∂t/∂λ_s}_e]₃ /10⁻⁵ ms⁻²

Jul 050-140 $\text{a}^{-1} [\sum_j \{M^{\text{ll}} \partial t / \partial \lambda\}_e^t]_s / 10^{-5} \text{ms}^{-2}$

Aug 050-140 $\text{a}^{-1} [\sum_j \{M^{\text{ll}} \partial t / \partial \lambda\}_e^t]_s / 10^{-5} \text{ms}^{-2}$

Nov 050-140 a⁻¹ [Σ_j{M^{III}at/∂λ_j}_e]_s /10⁻⁵ms⁻²

Dec 050-140 a⁻¹ [Σ_j{M^{III}at/∂λ_j}_e]_s /10⁻⁵ms⁻²

Submonthly Montgomery surface drag

Mar 050-140 a⁻¹ [M^[1]∂t/∂λ_e^t]_s /10⁻⁵ms⁻²

Apr 050-140 a⁻¹ [M^[1]∂t/∂λ_e^t]_s /10⁻⁵ms⁻²

May 050-140 a⁻¹ [M^[1]_s ∂v/∂λ]_e^t / 10⁻⁵ ms⁻²

Jun 050-140 a⁻¹ [M^[1]_s ∂v/∂λ]_e^t / 10⁻⁵ ms⁻²

Jul 050-140 a⁻¹ $\{[M^{[1]}_{\partial t/\partial \lambda}]^t_{\text{e}}\}_s / 10^{-5} \text{ms}^{-2}$

Aug 050-140 a⁻¹ $\{[M^{[1]}_{\partial t/\partial \lambda}]^t_{\text{e}}\}_s / 10^{-5} \text{ms}^{-2}$

Sep 050-140 a⁻¹ [M^[1]∂t/∂λ_e^t]_s /10⁻⁵ms⁻²

Oct 050-140 a⁻¹ [M^[1]∂t/∂λ_e^t]_s /10⁻⁵ms⁻²

Nov 050-140 a⁻¹ [KM^[1]∂t/∂λ]_e^t_s /10⁻⁵ms⁻²

Dec 050-140 a⁻¹ [KM^[1]∂t/∂λ]_e^t_s /10⁻⁵ms⁻²

Interannual Montgomery surface drag

Mar 050-140 a⁻¹ [M^[2]∂t/∂λ]_e^t_s / 10⁻⁵ ms⁻²

Apr 050-140 a⁻¹ [M^[2]∂t/∂λ]_e^t_s / 10⁻⁵ ms⁻²

May 050-140 a⁻¹ [M^[2]∂v/∂y]_e^t_s / 10⁻⁵ ms⁻²

Jun 050-140 a⁻¹ [M^[2]∂v/∂y]_e^t_s / 10⁻⁵ ms⁻²

Jul 050-140 a⁻¹ $\{[M^{[2]}_{\partial t/\partial \lambda}]^t_e\}_s / 10^{-5} \text{ms}^{-2}$

Aug 050-140 a⁻¹ $\{[M^{[2]}_{\partial t/\partial \lambda}]^t_e\}_s / 10^{-5} \text{ms}^{-2}$

Sep 050-140 a⁻¹ [M^[2]∂t/∂λ]_e^t_s / 10⁻⁵ ms⁻²

Oct 050-140 a⁻¹ [M^[2]∂t/∂λ]_e^t_s / 10⁻⁵ ms⁻²

Nov 050-140 a⁻¹ [KM^[2]∂t/∂λ]_e^t_s /10⁻⁵ms⁻²

Dec 050-140 a⁻¹ [KM^[2]∂t/∂λ]_e^t_s /10⁻⁵ms⁻²

Stationary Montgomery surface drag

Mar 050-140 a⁻¹ [M^[3]∂t/∂λ_e^t]_s /10⁻⁵ms⁻²

Apr 050-140 a⁻¹ [M^[3]∂t/∂λ_e^t]_s /10⁻⁵ms⁻²

May 050-140 a⁻¹ [M^[3]∂t/∂λ_e^t]_s / 10⁻⁵ms⁻²

Jun 050-140 a⁻¹ [M^[3]∂t/∂λ_e^t]_s / 10⁻⁵ms⁻²

Jul 050-140 a⁻¹ $\{[M^{[3]}_{\partial t/\partial \lambda}]_e^t\}_s / 10^{-5} \text{ms}^{-2}$

Aug 050-140 a⁻¹ $\{[M^{[3]}_{\partial t/\partial \lambda}]_e^t\}_s / 10^{-5} \text{ms}^{-2}$

Sep 050-140 a⁻¹ [KM^[3]∂t/∂λ^t]_e / 10⁻⁵ ms⁻²

Oct 050-140 a⁻¹ [KM^[3]∂t/∂λ^t]_s / 10⁻⁵ ms⁻²

Nov 050-140 a⁻¹ [M^[3]∂t/∂λ]_e^t₃ /10⁻⁵ms⁻²

Dec 050-140 a⁻¹ [M^[3]∂t/∂λ]_e^t₃ /10⁻⁵ms⁻²

Kinetic component of Bernoulli drag

Jan 050-140 $(2a[\Delta]_3^s)^{-1}[(u_e^2 + v_e^2)\partial t/\partial \lambda]_{t_s}^t / 10^{-6} \text{ms}^{-2}$

Feb 050-140 $(2a[\Delta]_3^s)^{-1}[(u_e^2 + v_e^2)\partial t/\partial \lambda]_{t_s}^t / 10^{-6} \text{ms}^{-2}$

Mar 050-140 $(2a[\Delta]_3^s)^{-1}[(u_e^2 + v_e^2)\partial t/\partial \lambda]_{t_s}^t / 10^{-6} \text{ms}^{-2}$

Apr 050-140 $(2a[\Delta]_3^s)^{-1}[(u_e^2 + v_e^2)\partial t/\partial \lambda]_{t_s}^t / 10^{-6} \text{ms}^{-2}$

May 050-140 $(2a[\Delta]_3^s)^{-1}[(u_e^2 + v_e^2)\partial t/\partial \lambda]_{t_s}^t / 10^{-6} \text{ms}^{-2}$

Jun 050-140 $(2a[\Delta]_3^s)^{-1}[(u_e^2 + v_e^2)\partial t/\partial \lambda]_{t_s}^t / 10^{-6} \text{ms}^{-2}$

$$\text{Jul 050-140 } (2a[\Delta]_3^s)^{-1} [\{ (u_e^2 + v_e^2) \partial t / \partial \eta \}_{t_e}^t]_3 / 10^{-6} \text{ms}^{-2}$$

$$\text{Aug 050-140 } (2a[\Delta]_3^s)^{-1} [\{ (u_e^2 + v_e^2) \partial t / \partial \eta \}_{t_e}^t]_3 / 10^{-6} \text{ms}^{-2}$$

Sep 050-140 $(2a[\Delta]_3^s)^{-1}[(u_e^2 + v_e^2)\partial t/\partial \lambda]_{t_s}^t / 10^{-6} \text{ms}^{-2}$

Oct 050-140 $(2a[\Delta]_3^s)^{-1}[(u_e^2 + v_e^2)\partial t/\partial \lambda]_{t_s}^t / 10^{-6} \text{ms}^{-2}$

Nov 050-140 $(2a[\Delta]_3^s)^{-1}[\{(u_e^2 + v_e^2)\partial t/\partial s\}_{t_s}^t]_3 / 10^{-6} \text{ms}^{-2}$

Dec 050-140 $(2a[\Delta]_3^s)^{-1}[\{(u_e^2 + v_e^2)\partial t/\partial s\}_{t_s}^t]_3 / 10^{-6} \text{ms}^{-2}$

Surface eddy advection

Jan 050-140 $[(U_e \cdot \nabla \Omega)L_e]_3 / 10^{-6} \text{ms}^{-2}$

Feb 050-140 $[(U_e \cdot \nabla \Omega)L_e]_3 / 10^{-6} \text{ms}^{-2}$

Interannual diabatic eddy flux

Jan 050-140 $[Q \langle \partial L / \partial \theta \rangle_3] / 10^{-5} \text{ms}^{-2}$

Feb 050-140 $[Q \langle \partial L / \partial \theta \rangle_3] / 10^{-5} \text{ms}^{-2}$

Sep 050-140 $-[Q \langle \partial L / \partial \theta \rangle]_3 / 10^{-5} \text{ms}^{-2}$

Oct 050-140 $-[Q \langle \partial L / \partial \theta \rangle]_3 / 10^{-5} \text{ms}^{-2}$

Nov 050-140 $-\langle Q \rangle \partial L / \partial \theta \rangle_3 / 10^{-5} \text{ms}^{-2}$

Dec 050-140 $-\langle Q \rangle \partial L / \partial \theta \rangle_3 / 10^{-5} \text{ms}^{-2}$

Stationary diabatic eddy flux

Jan 050-140 $[Q^{<3>\partial L/\partial\theta}]_3 / 10^{-5} \text{ms}^{-2}$

Feb 050-140 $[Q^{<3>\partial L/\partial\theta}]_3 / 10^{-5} \text{ms}^{-2}$

Jul 050-140 $[Q^{<3>\partial L/\partial\theta}]_3 / 10^{-5} \text{ms}^{-2}$

Aug 050-140 $[Q^{<3>\partial L/\partial\theta}]_3 / 10^{-5} \text{ms}^{-2}$

Sep 050-140 $[Q^{<3>\partial L/\partial\theta}]_3 / 10^{-5} \text{ms}^{-2}$

Oct 050-140 $[Q^{<3>\partial L/\partial\theta}]_3 / 10^{-5} \text{ms}^{-2}$

Nov 050-140 $[Q^{<3>\partial L/\partial\theta}]_3 / 10^{-5} \text{ms}^{-2}$

Dec 050-140 $[Q^{<3>\partial L/\partial\theta}]_3 / 10^{-5} \text{ms}^{-2}$

Frictional forces + submonthly diabatic eddy flux

Jan 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$

Feb 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$

Mar 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5} \text{ms}^{-2}$

Apr 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5} \text{ms}^{-2}$

May 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$

Jun 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$

Jul 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$

Aug 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$

Sep 050-140 Residue $[F_{\gamma}]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$

Oct 050-140 Residue $[F_{\gamma}]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$

Nov 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$

Dec 050-140 Residue $[F_\gamma]_3 + [Q'\partial L/\partial\theta]_3 / 10^{-5}\text{ms}^{-2}$