平成28年度JAXA/EORC水循環ワークショップ
日時：7月29日（金）13:00-17:00
会場：オフィス東京　T3会議室

地形性降雨推定の改良

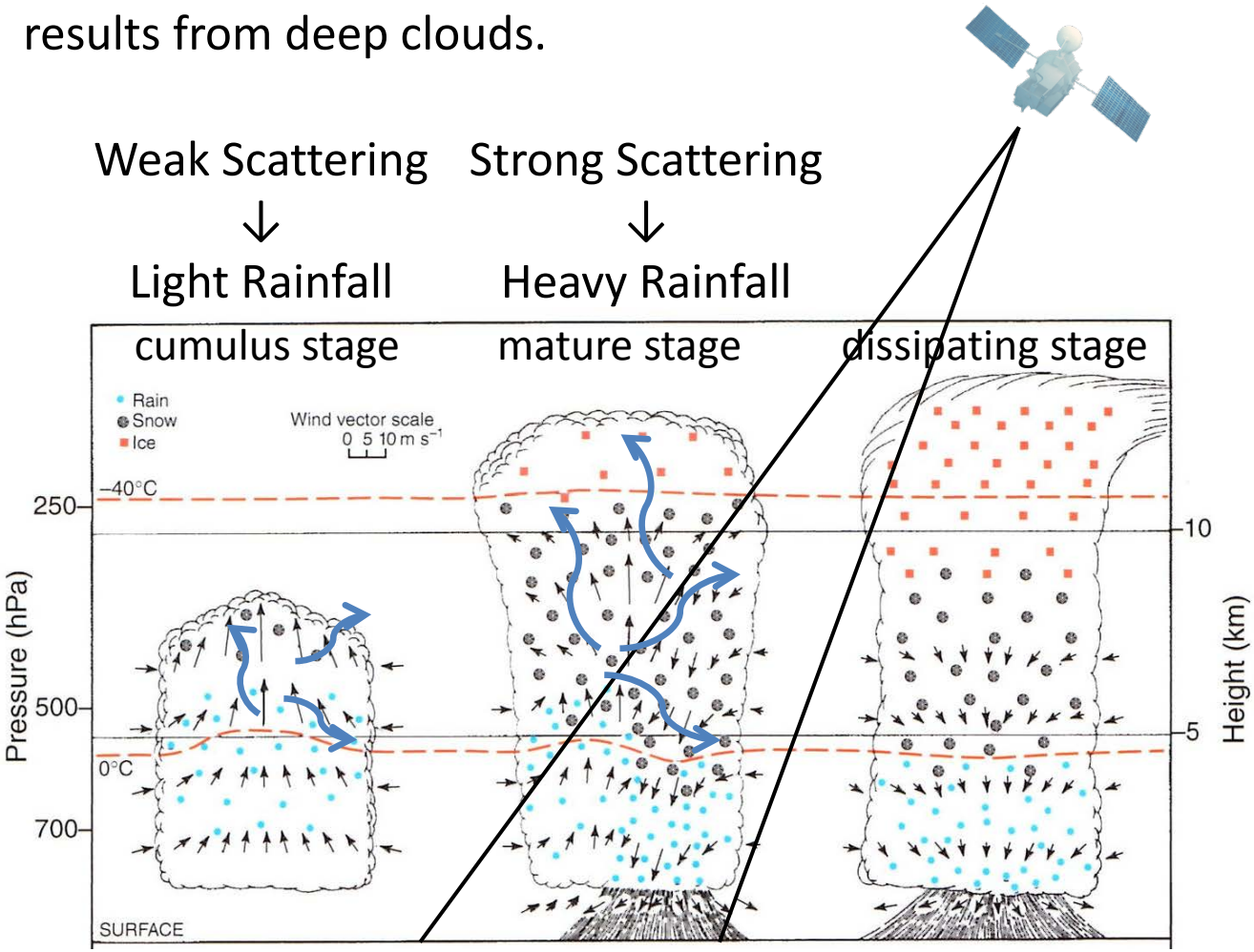
重　尚一

京都大学 大学院理学研究科

Microwave radiometer algorithms over land

Blustein (1999)

MWR rainfall algorithms assume that heavy rainfall results from deep clouds.



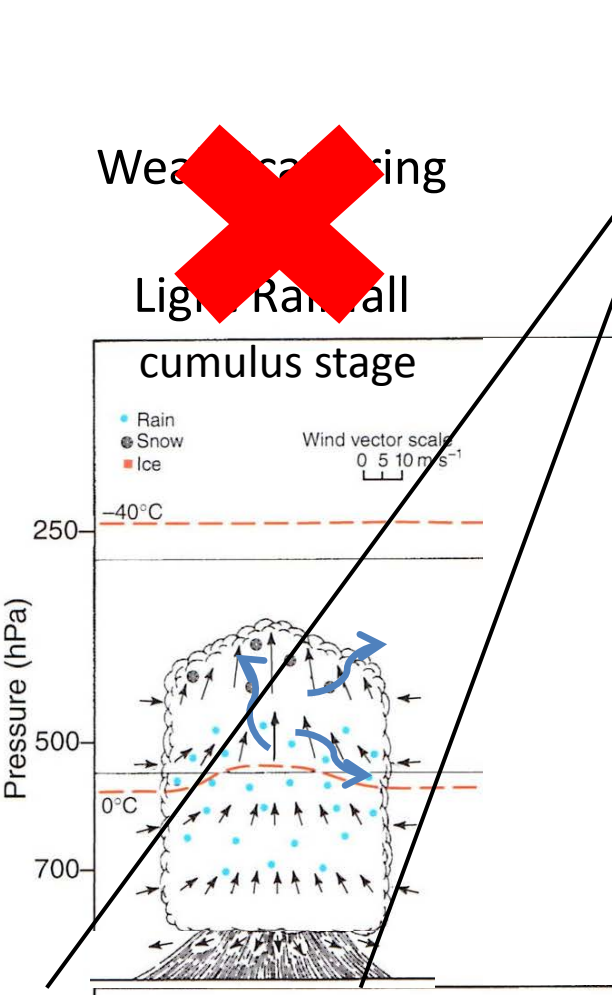
Wallace & Hobbs (2006) [Adapted from Byers and Braham (1949)]

(a) cumulus stage

(b) mature stage

(c) dissipating stage

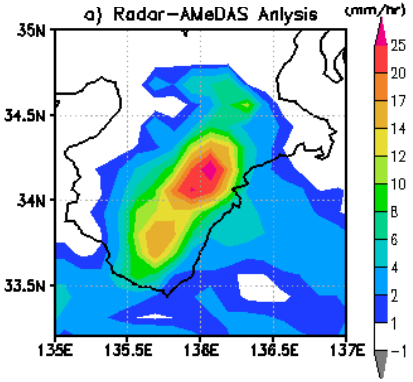
Microwave radiometer algorithms over land



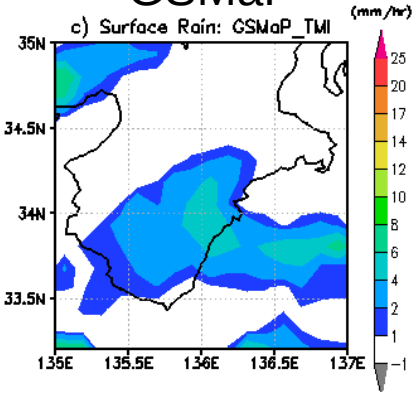
Wallace & Hobbs (2006) [Adapte

Typhoon Namtheun (2004) over Japan
(Kubota et al. 2009, JMSJ)

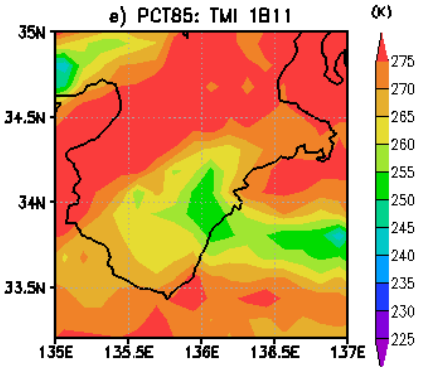
Radar-AMeDaS



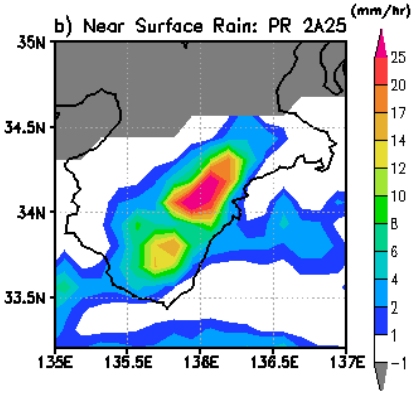
GSMaP



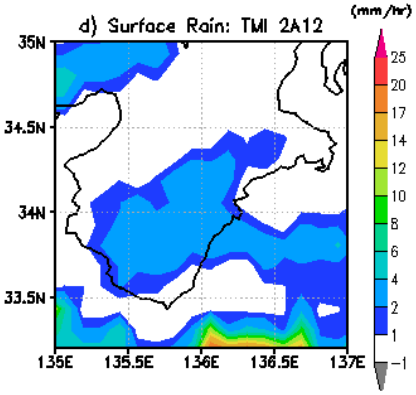
TMI PCT85



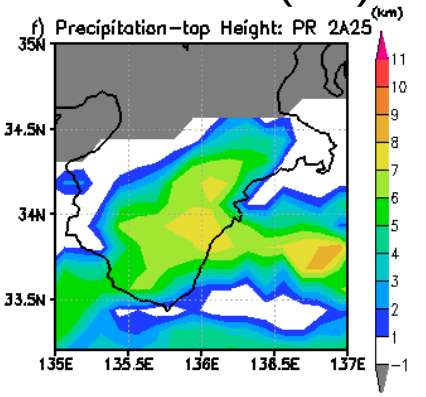
PR



GPROF

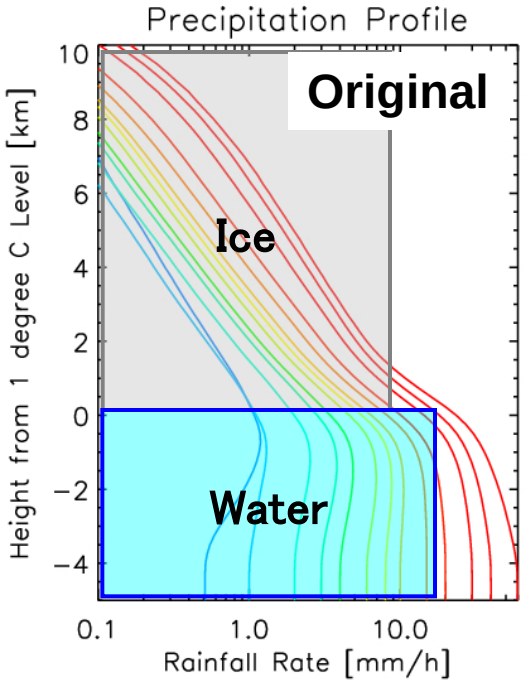


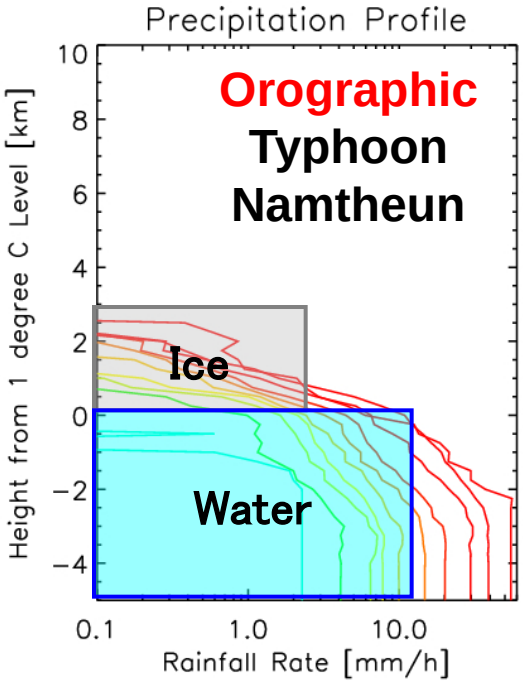
PR PTH (km)

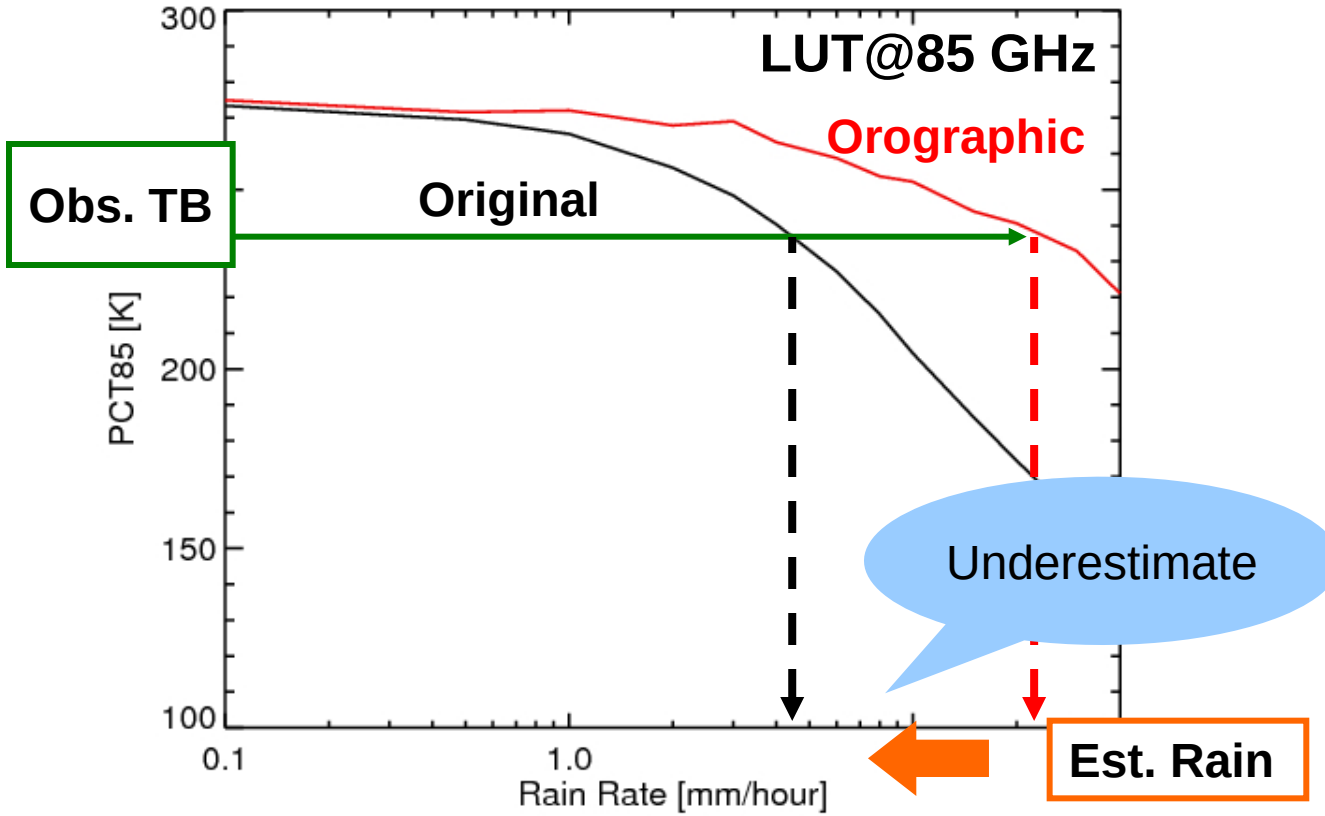


Look-up table: Relationship between *Tb*s and rain rates

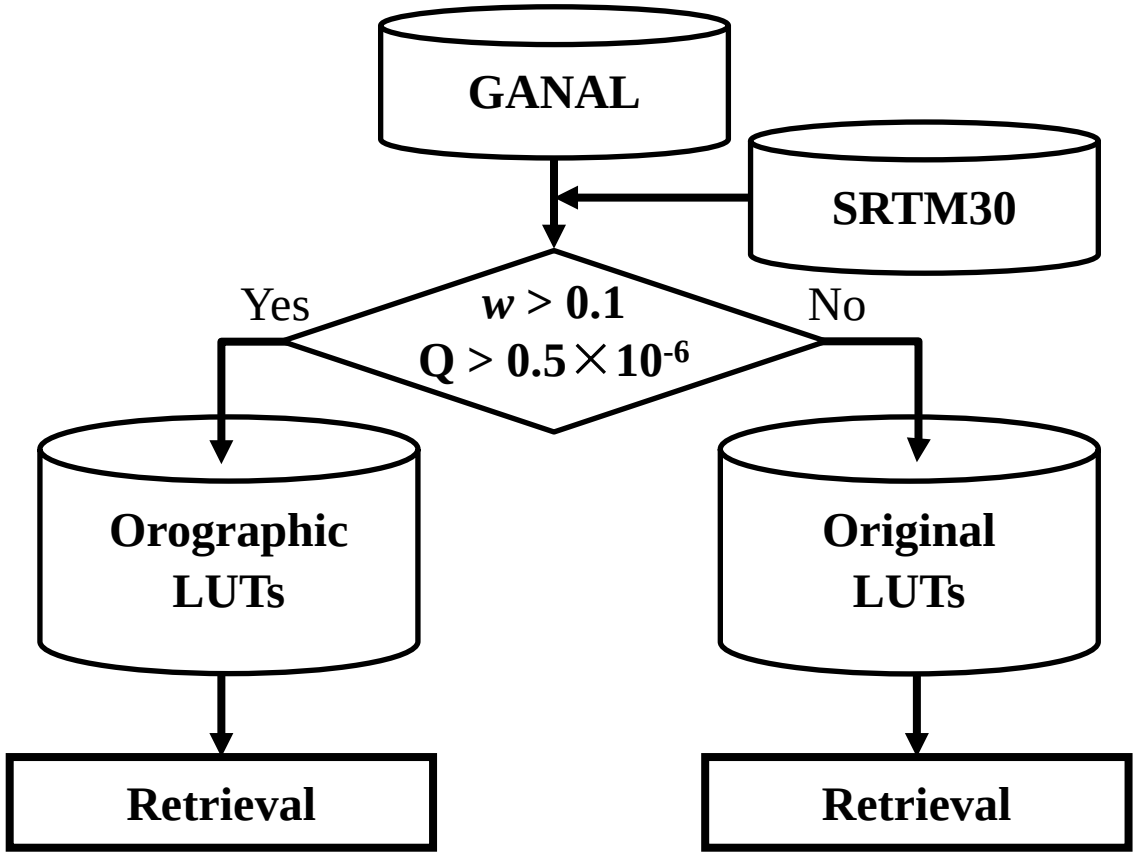
Shige et al. (2013, JAMC)

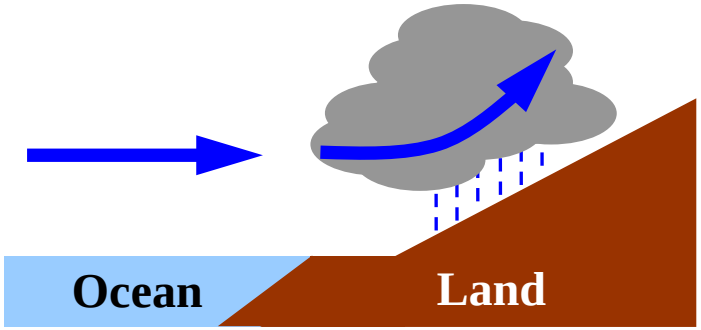






Orographic/Non-Orographic Rainfall Classification Scheme





Orographically Forced Upward Motion

$$w = \frac{Dh}{Dt} = u\frac{\partial h}{\partial x} + v\frac{\partial h}{\partial y}$$

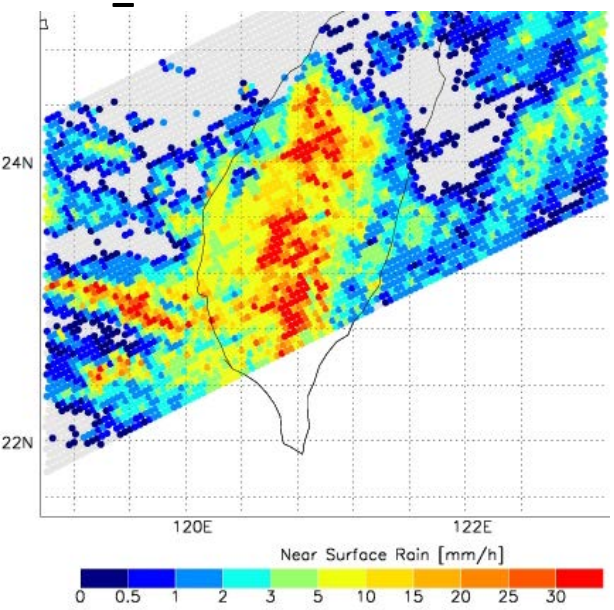
Convergence of Surface Moisture Flux

$$Q = -\left(\frac{\partial(uq)}{\partial x} + \frac{\partial(vq)}{\partial y}\right)$$

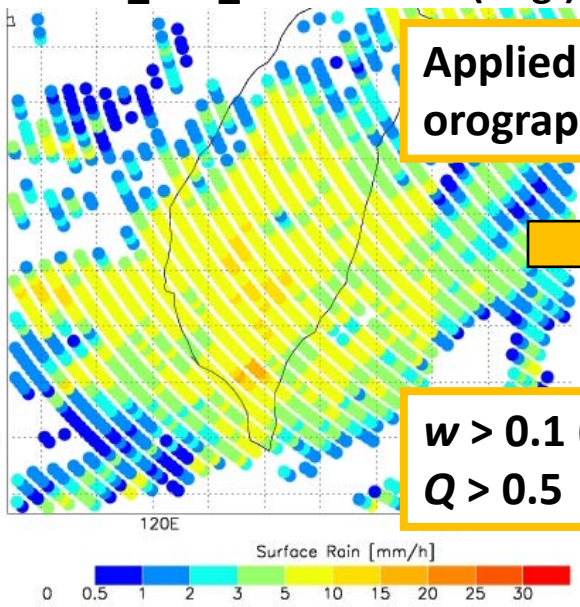
Shige et al. (2013, JAMC)
Taniguchi et al. (2013, JH)

Typhoon Morakot (2009) over Taiwan
Taniguchi et al. (2013, JHM)

PR _ Near Surface Rain



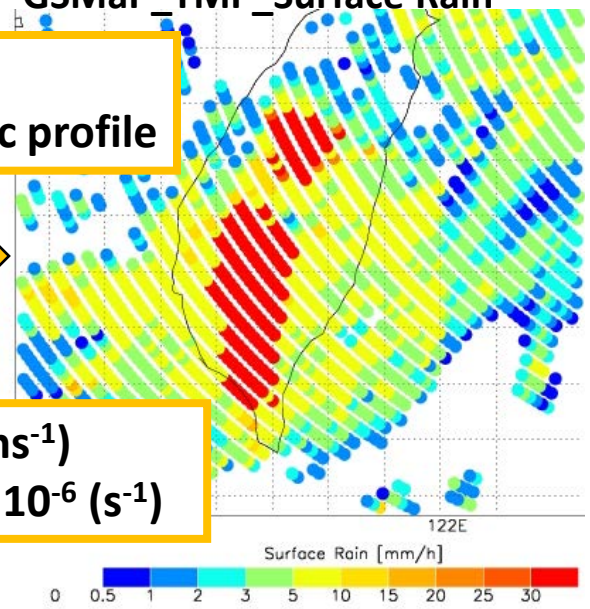
GSMaP_TMI_Surface Rain (orig.)



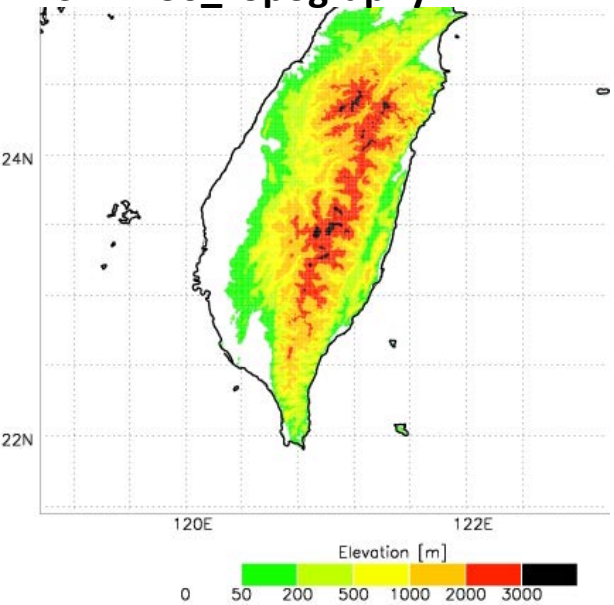
Applied orographic profile

$w > 0.1$ (ms^{-1})
$Q > 0.5 \times 10^{-6}$ (s^{-1})

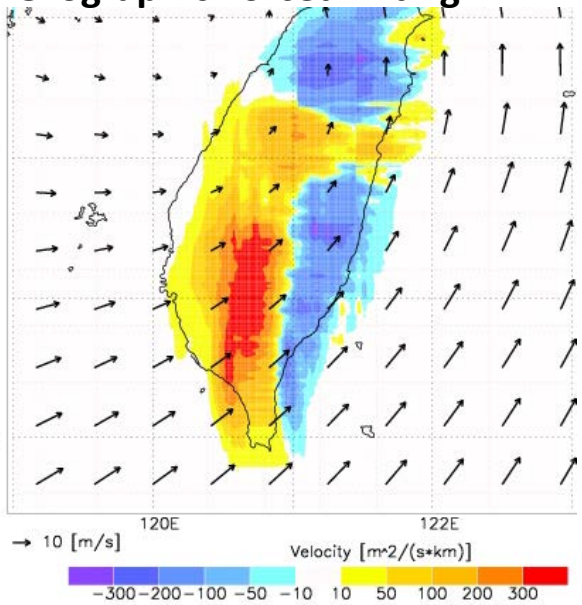
GSMaP_TMI _Surface Rain



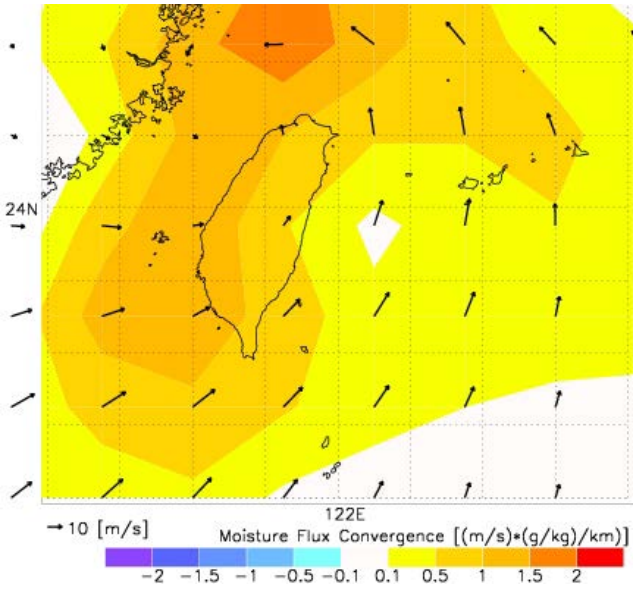
SRTM30_Topography



Orographic Forced Lifting



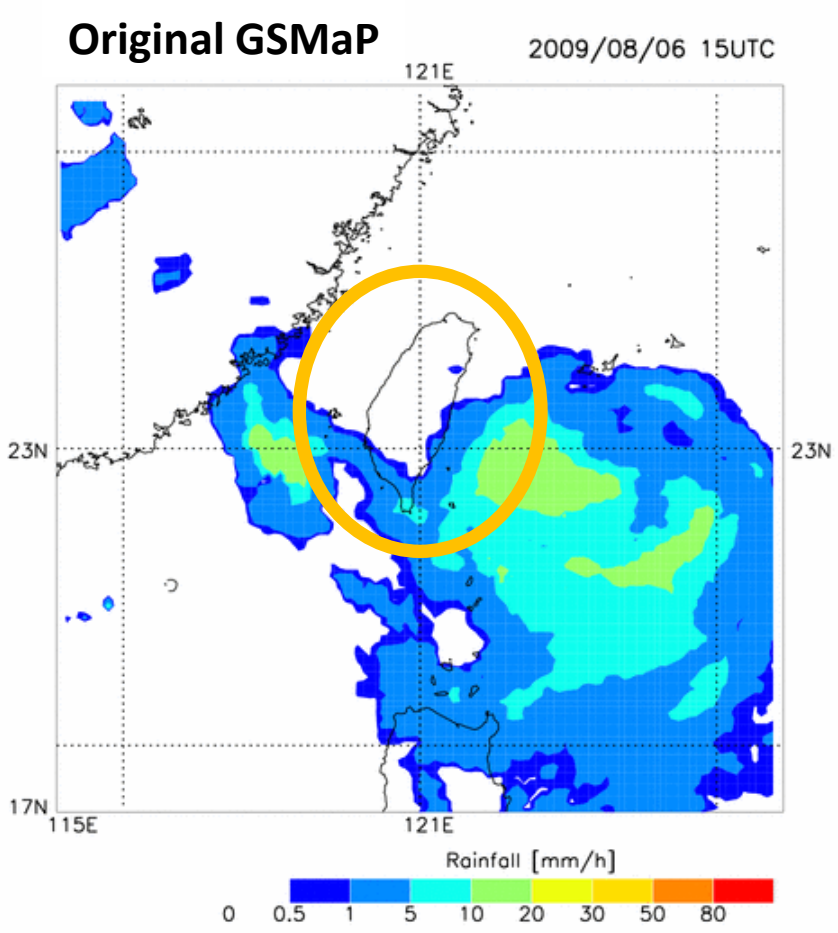
Convergence of Surface Moisture Flux

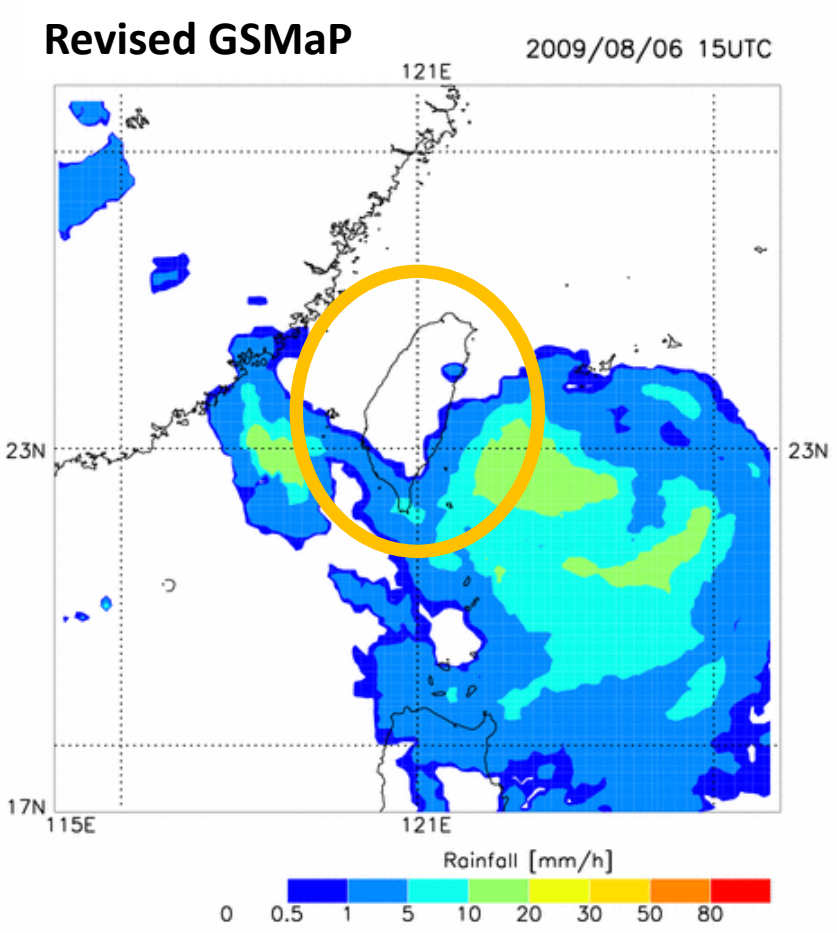


GSMaP_MVK

Original GSMaP vs. Revised GSMaP

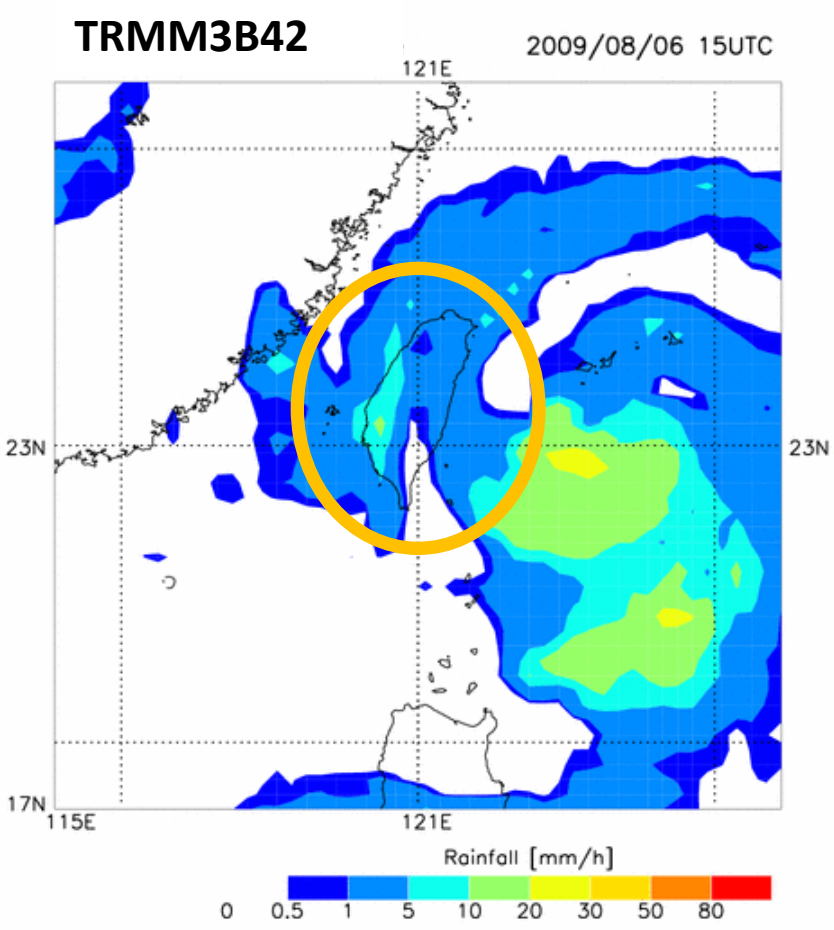
15UTC 6 August 2009 ～ 10UTC 9 August 2009

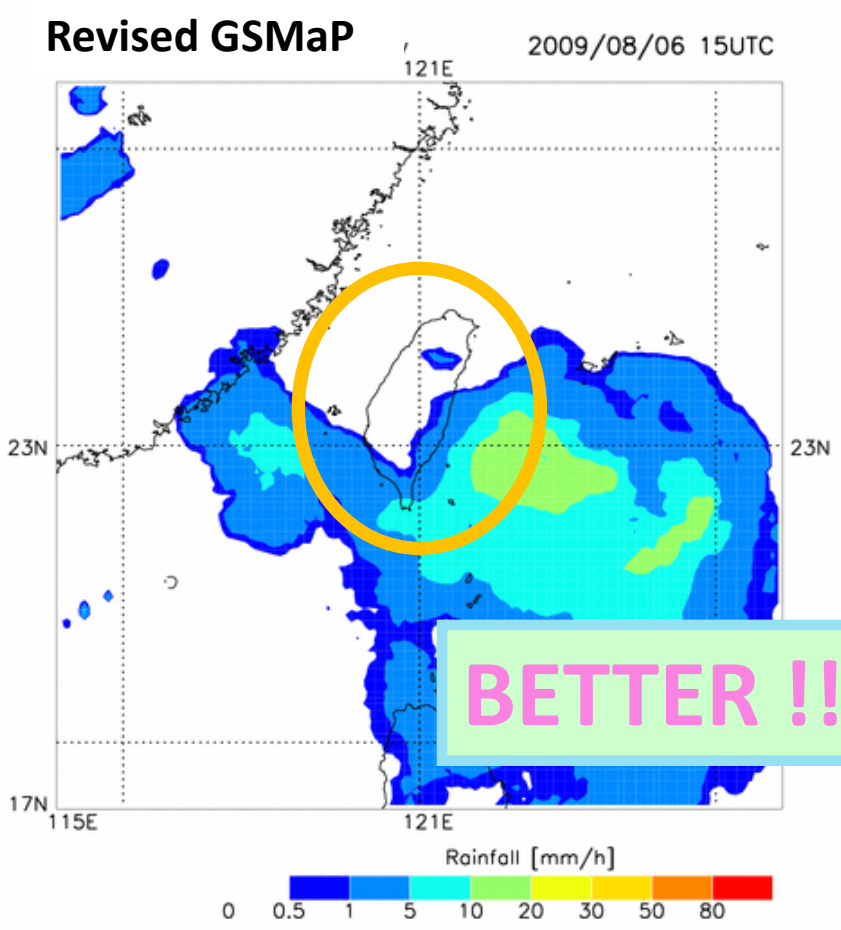




TRMM 3B42 vs. Revised GSMaP

15UTC 6 August 2009～ 15UTC 9 August 2009 3hourly



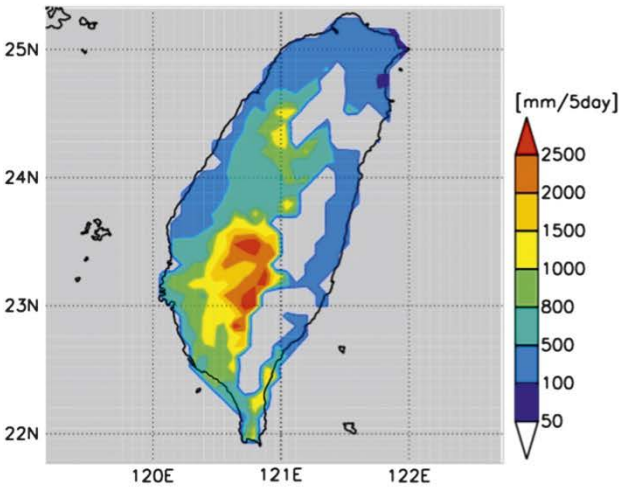


TMPA 3B42 vs. Old GSMaP vs. Revised GSMaP

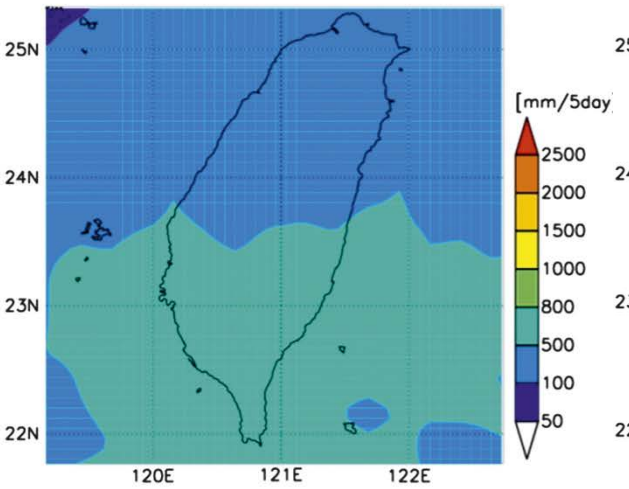
0000 UTC 6 Aug 2009 ～ 2400 UTC 10 Aug 2009

Accumulated Rainfall

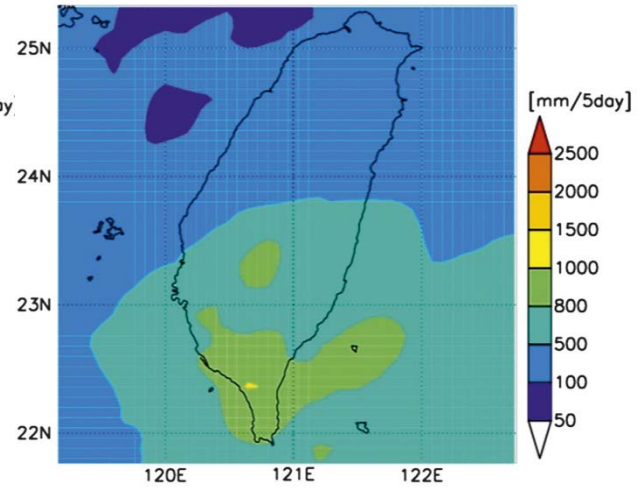
(a) Rain Gauge



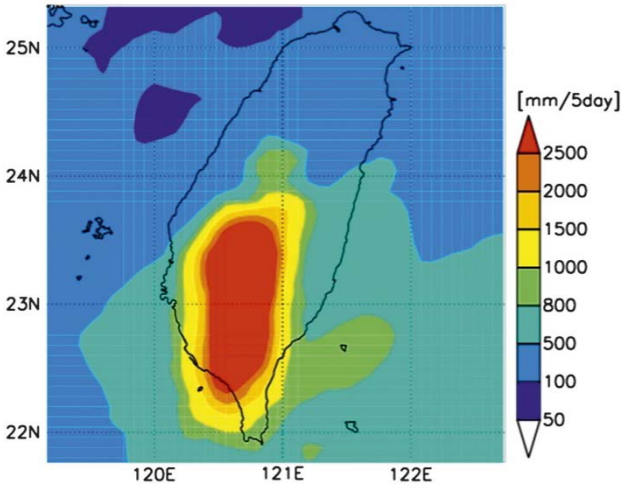
(b) TMPA 3B42



(c) Old GSMaP



(d) Revised GSMaP

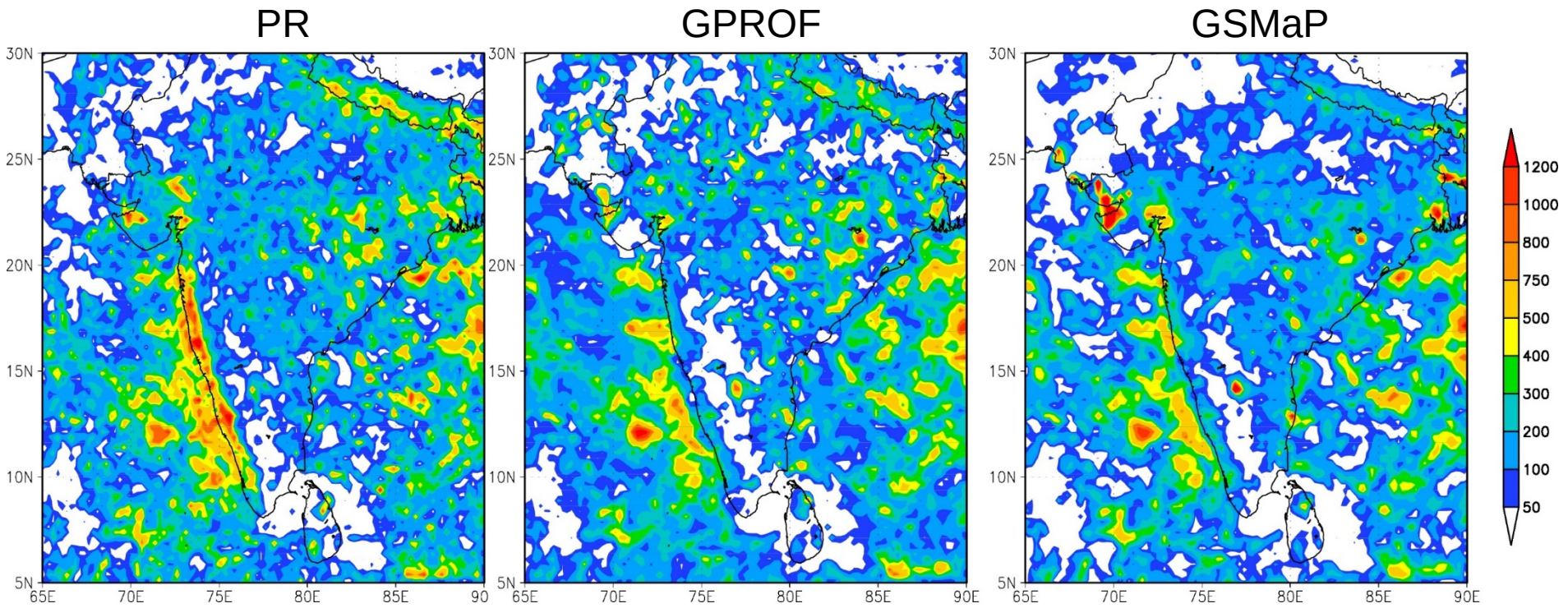


Better Ageement !!

Taniguchi et al. (2013, JHM)

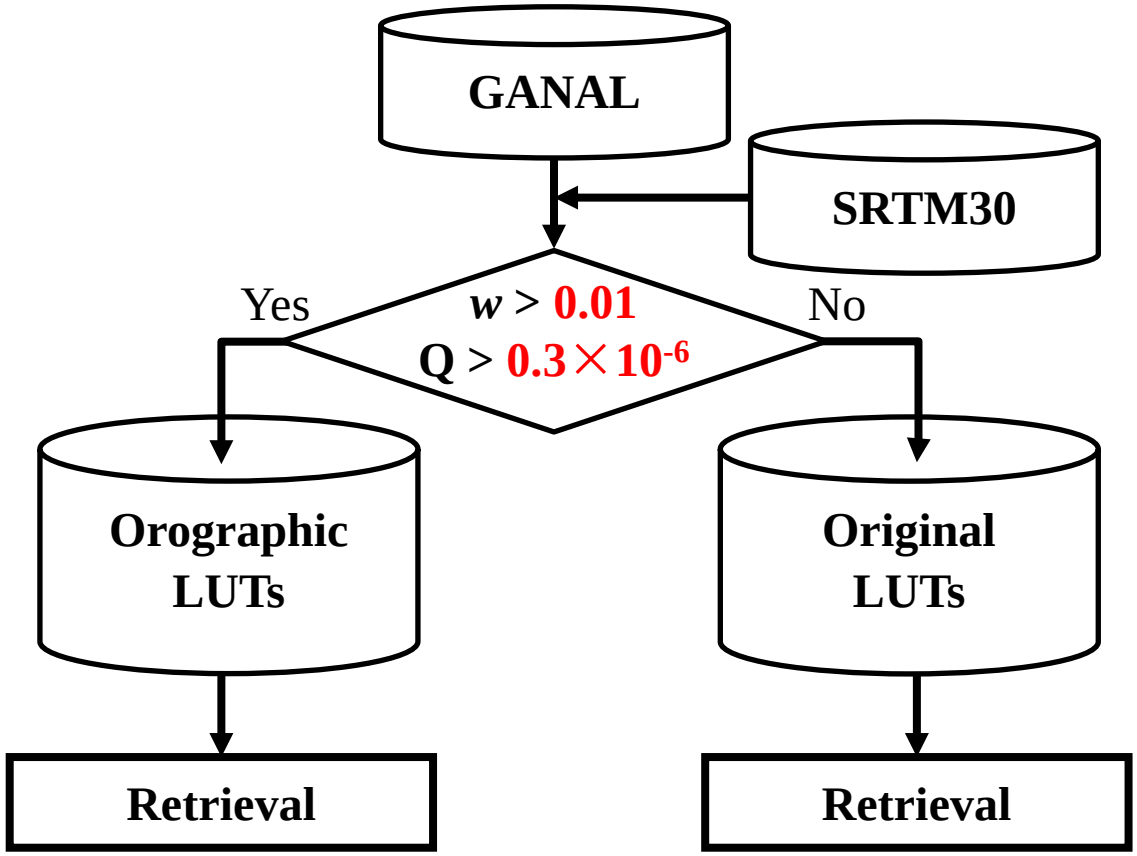
Indian Subcontinent

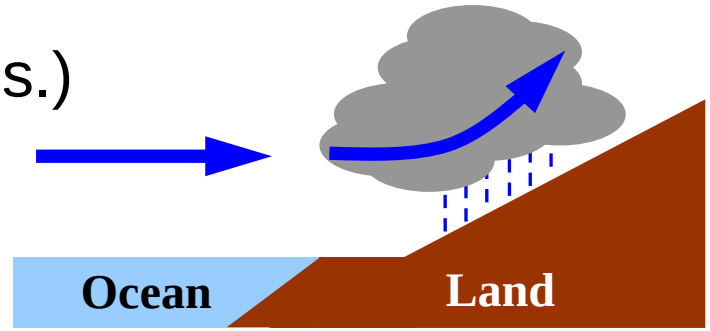
Shige et al. (2014, AGU monograph)



Orographic/Non-Orographic Rainfall Classification Scheme

Shige et al. (2014, AGU monograph)
Yamamoto and Shige (2015, Atoms. Res.)





Orographically Forced Upward Motion

$$w = \frac{Dh}{Dt} = u\frac{\partial h}{\partial x} + v\frac{\partial h}{\partial y}$$

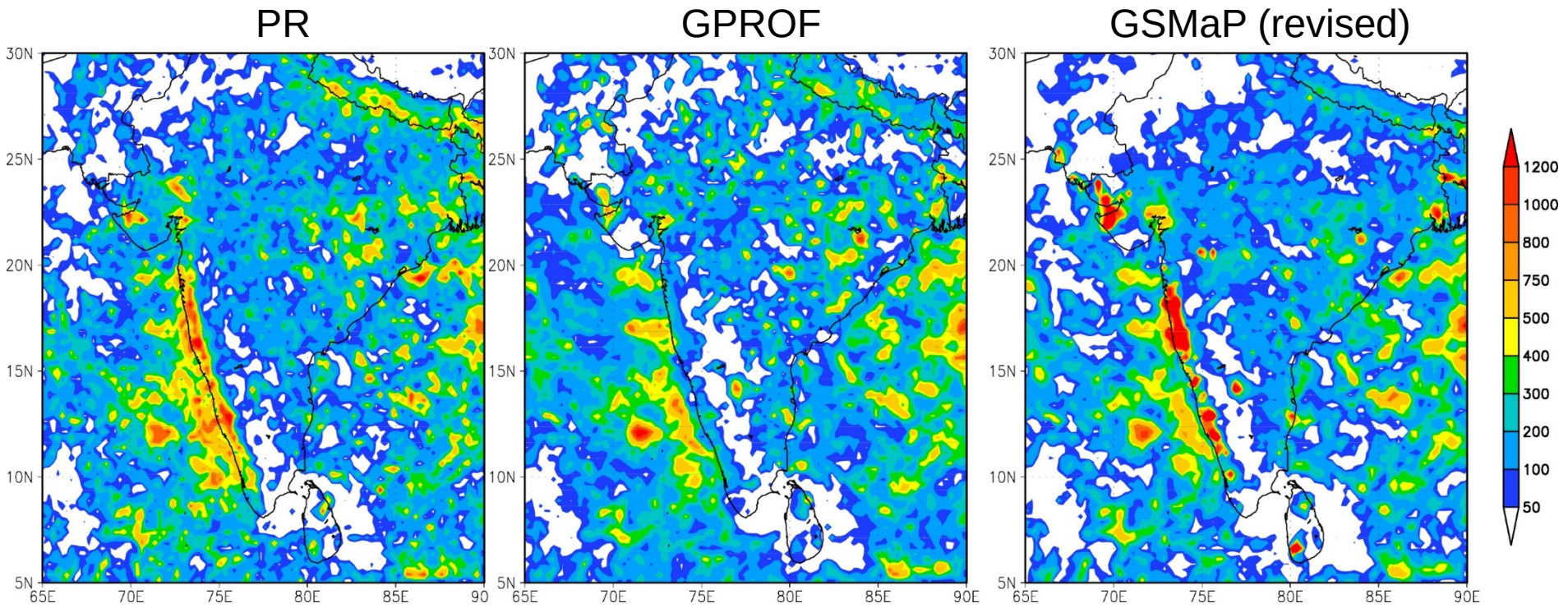
Convergence of Surface Moisture Flux

$$Q = -\left(\frac{\partial(uq)}{\partial x} + \frac{\partial(vq)}{\partial y}\right)$$

Thresholds are changed for detection of areas with weak upward motion.

Indian Subcontinent

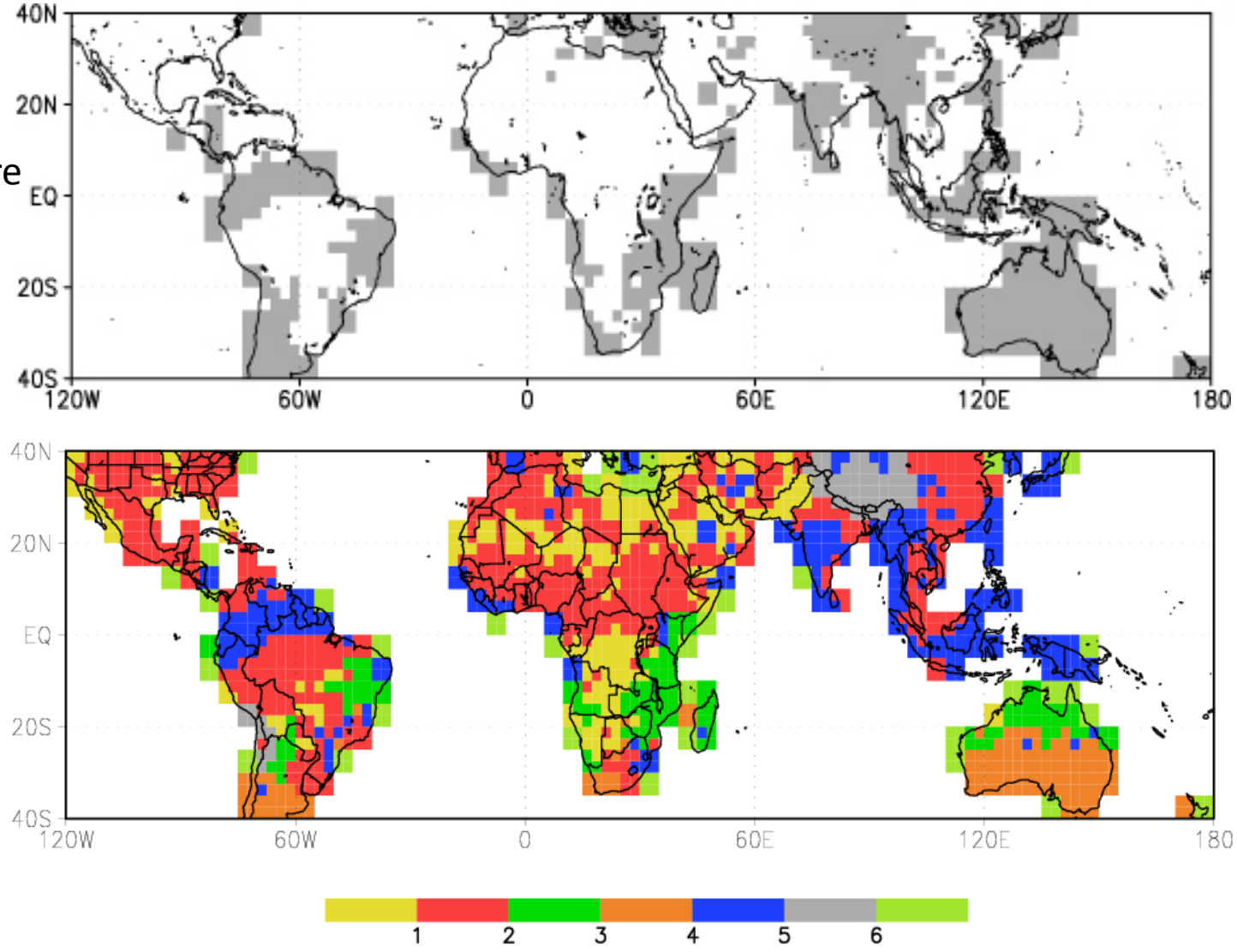
Shige et al. (2014, AGU monograph)



台風の豪雨事例を中心に開発してきた地形性／非地形性降雨判別を、閾値を緩めてGSMaPマイクロ波放射計アルゴリズムに導入した(Yamamoto and Shige 2015, Atoms. Res.)。
（雨の過大評価で、GSMaPの気候値に悪影響を与えるのではないかと心配した。）

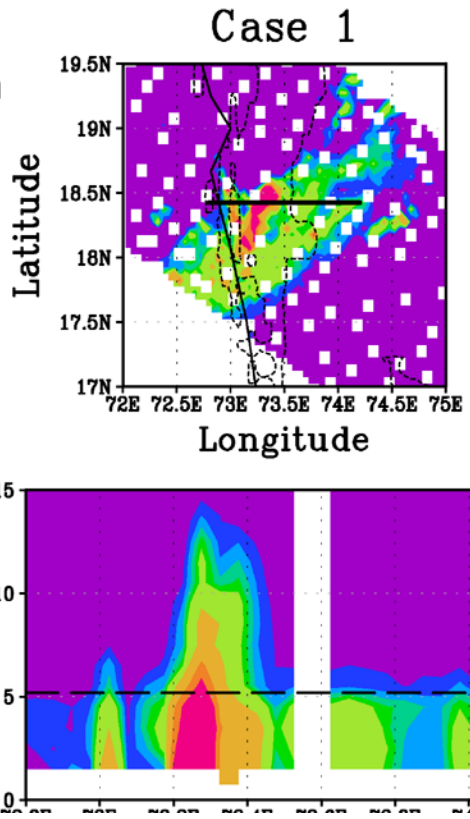
Distribution of the on (gray)/off (white) flag for June-August 2007 for the orographic/nonorographic rainfall classication scheme (Yamamoto and Shige 2015, Atoms. Res.)

Rain types for "severe thunderstorm" (#1) and "afternoon shower" (#2) are excluded.

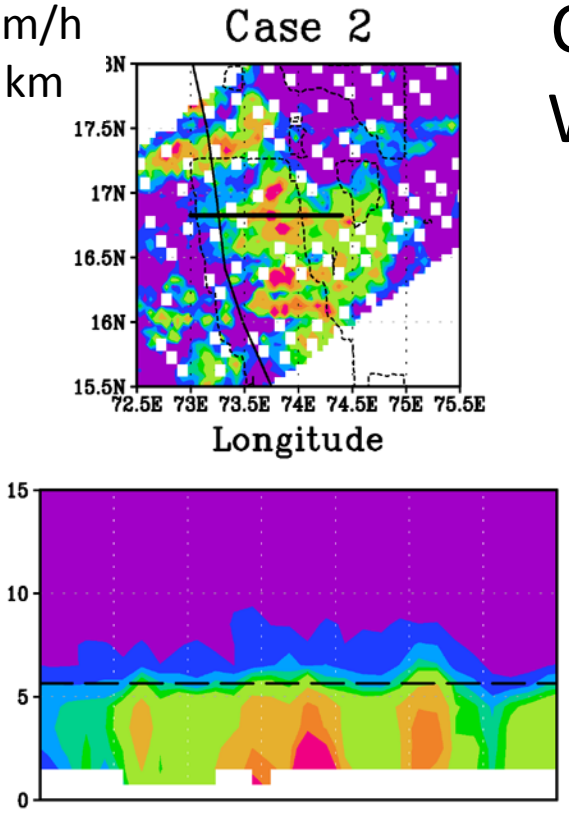


Cases over the Western Ghats

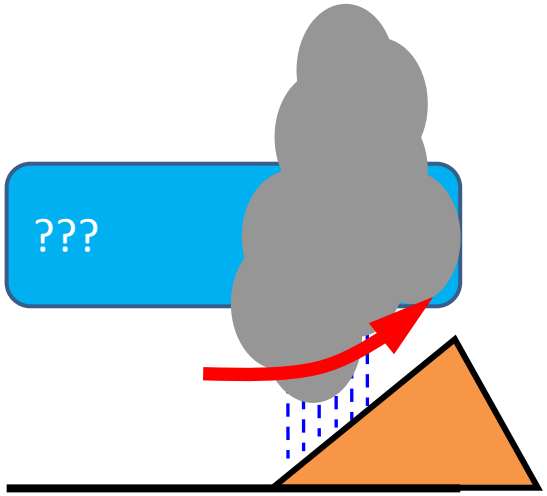
R = 80 m/h
PTH = 12 km

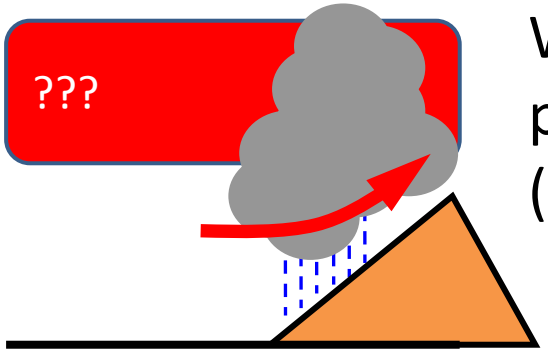


R = 110 m/h
PTH = 8 km



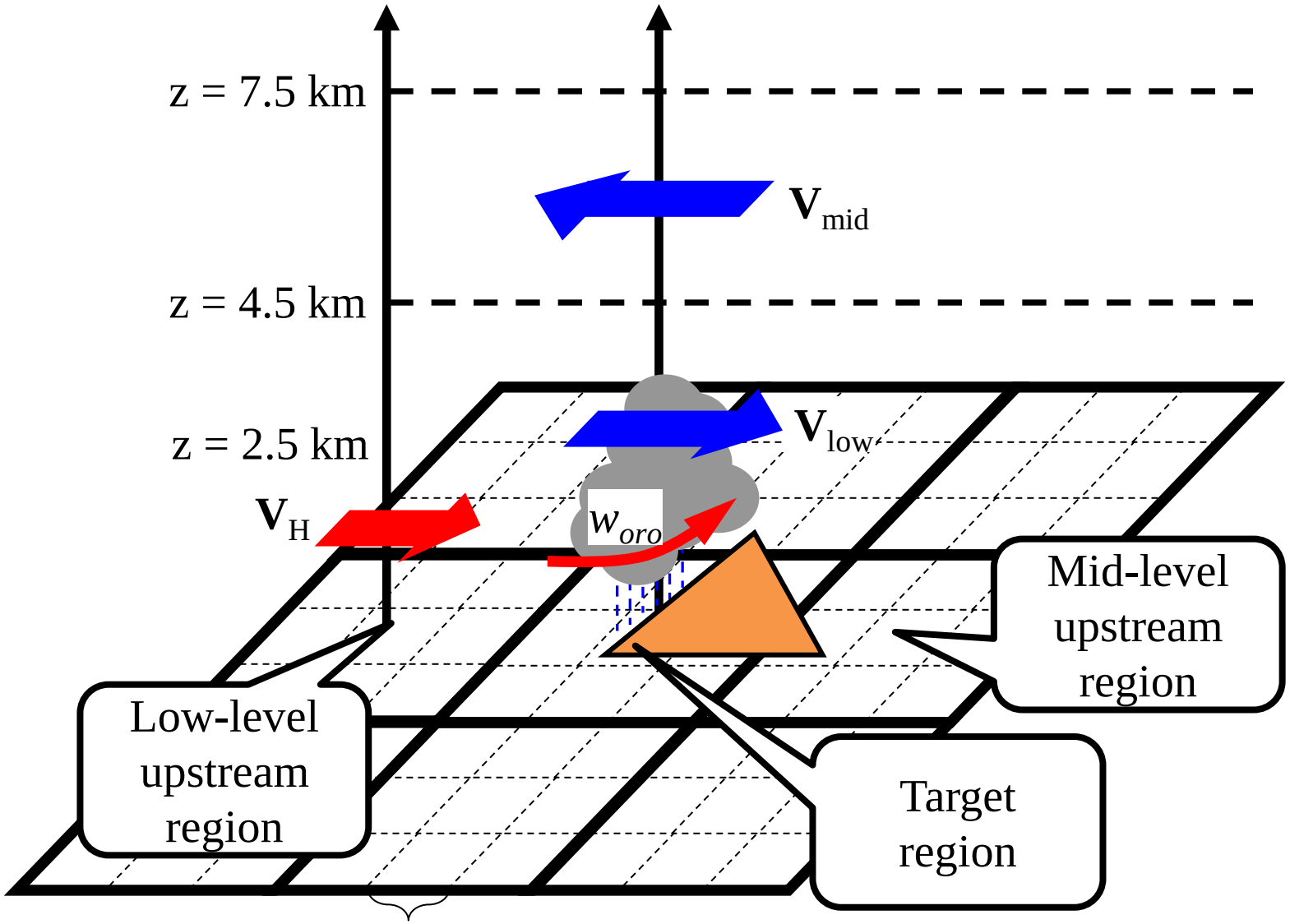
Shige and Kummerow (2016)





What determines precipitation top heights (PTHs)?

Schematic of the target region with low- and mid-level upstream regions.



Shige and Kummerow (2016)

まとめ

- 台風の豪雨事例を中心に開発してきた地形性／非地形性降雨判別を、閾値を緩めてGSMaPマイクロ波放射計アルゴリズムに導入した。
- 上昇流の閾値を風速の関数として導入し、台風の豪雨事例での地形性降雨域の過大判定を抑える。
- 熱力学的指標として、水蒸気収束量から降水トップに重要と考えられる下層の安定度に変更することを予定している。