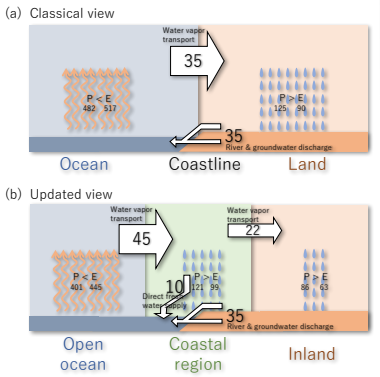
Tropical coastal dehydrator in global atmospheric water circulation: An overview

Shin-Ya Ogino[1](ogino-sy@jamstec.go.jp), Manabu D. Yamanaka[1]*, Shuichi Mori[1], and Jun Matsumoto[1,2]
*[1]Japan Agency for Marine-Earth Science and Technology, [2]Tokyo Metropolitan University, *Now at Research Institute for Humanity and Nature*

Summary

- A conceptual advance of the global water cycle
  - The precipitation concentrated in tropical coastlines
  - The role of an atmospheric dehydrator between the ocean and land
- New insights on
  - Climate maintenance and change
  - Direct freshwater supply over the coastal ocean



Publications

Ogino, S.-Y., M. D. Yamanaka, S. Mori, and J. Matsumoto (2016), How much is the precipitation amount over the tropical coastal region?, J. Clim., 29(3), 1231–1236, https://doi.org/10.1175/JCLI-D-15-0484.1

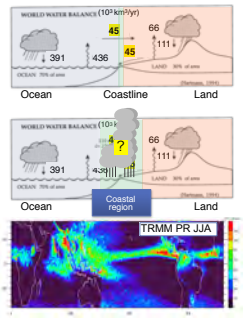
Yamanaka, M. D. (2016), Physical climatology of Indonesian maritime continent: An outline to comprehend observational studies, Atmospheric Research, 178-179, 231–259, https://doi.org/10.1016/j.atmosres.2016.03.017

Ogino, S.-Y., M. D. Yamanaka, S. Mori, and J. Matsumoto (2017), Tropical coastal dehydrator in global atmospheric water circulation. Geophys. Res. Lett., 44, 11,636–11,643, https://doi.org/10.1002/2017GL075760 (Selected as AGU Research Spotlight: Rethinking How Water Circulates Between the Oceans and Land, https://eos.org/research-spotlights/rethinking-how-water-circulates-between-the-oceans-and-land)

Yamanaka, M. D., S.-Y. Ogino, P.-M. Wu, J.-I. Hamada, S. Mori, J. Matsumoto, F. Syamsudin (2018), Maritime continent coastlines controlling Earth's climate. Prog. Earth Planet. Sci., 5:21, https://doi.org/10.1186/s40645-018-0174-9

Background and objectives

- Previous view of ocean-land water circulation: evaluated at the coastline alone
- Satellite observation revealed dominance of tropical coastal precipitation.
- Objectives
  1. How much is the precipitation amount over the tropical costal region?
  2. Re-examine the ocean–land water circulation taking into account tropical coastal precipitation



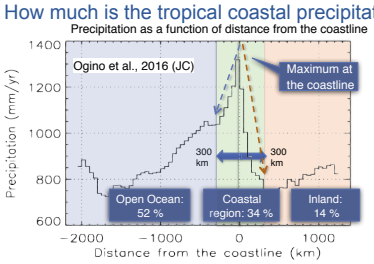
Methods

- Data
  - TRMM 3A25 Precipitation, 0.5°x0.5°, 37°S–37°N, 1997-2011 (13 years)
  - JRA-55 Column water vapor flux, Precipitation, Evaporation, 1.25°x1.25°, Global, 1981-2010 (30 years)
  - GLOBE elevation, 30"x30", Global
- Distance from the coastline (DFC)
  - Defined as a distance between each data cell and the nearest coastline
- Precipitation as a function of DFC
  - Calculated from TRMM precipitation at each 50-km DFC bin
- Landward water vapor transport T_L
  - calculated from JRA-55 column water vapor divergence assuming water budget relation (div$Q$=E-P)

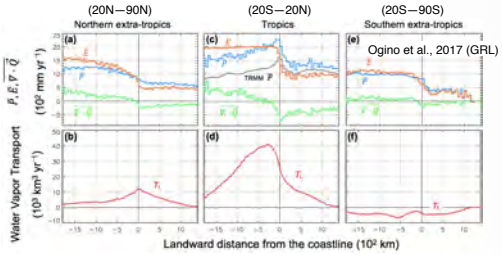
The DFC variations of precipitation agreed well between these independent data sets.

Results

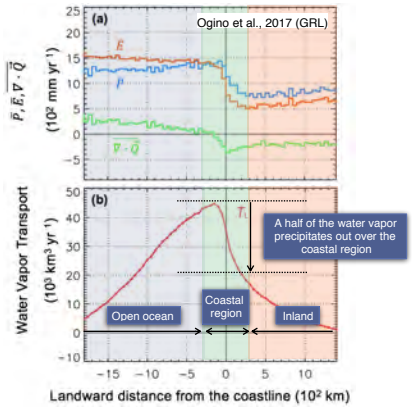
How much is the tropical coastal precipitation?



Comparison b/w tropics and extra-tropics



Ocean-land water circulation



Discussions

- **Climate maintenance and change**
  - Rainwater volume due to tropical coastal precipitation: 1 x 10^{14} m³/yr, which is corresponds to 20% of global total, and must considerably contribute the maintenance of global climate (Yamanaka et al., 2018).
  - The maritime continent with the world's longest coastlines may produce the largest precipitation on Earth, which sustains the current Earth's global climate (Yamanaka, 2016).
  - Coastline changes due to the sea level change, and continental aggregation and dispersal cause climate changes through the distribution and intensity changes in the coastal precipitation and the water circulation.
- **Direct freshwater supply over the coastal ocean**
  - Significant amount of net freshwater is supplied from the atmosphere to the coastal ocean, which is comparable to that of the land water discharge
  - A new insight on the ocean salinity distribution and its associated dynamics, and on the adulterants distribution.