熱帯の強い降雨時にSwarm衛星が東南アジア上空で観測した磁場変動

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Magnetic variations observed by the Swarm satellites over south-east Asia during strong tropical rainfall

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Cumulative convection is expected to generate acoustic mode atmospheric waves, and they are expected to generate Magnetic Ripples. They are observed as a small scale magnetic variation. That is, their typical amplitude is less than a few nT with period around 10-30 seconds. They are observed by low-altitude satellites almost always along the orbit in low and mid latitudes. From the Swarm satellite observation, it was confirmed that they are spatial structure of short scale field-aligned currents[(1)]. Various case studies and statistical analyses strongly suggest that the main source is the cumulative convection[(2),(3)] in lower atmosphere. However, it is still not yet very clear probably because the cumulative convection exists everywhere. To show the generation process of magnetic ripples more directly, we have been making geomagnetic and micro-barometric observations, GPS-TEC and meteorological observations such as rain-fall, wind velocity, temperature etc. in Phimai, north-east of Thailand and in Nakanoshima Island South-West Japan. In this paper, we show the results of Swarm satellite observation over South-East Asia, GPS-TEC and ground observations during conjunction events. The polar orbits of Swarm-A and –C satellites are shifted about 1.4 degree in longitude, i.e., Swarm-C flies about 1.4 degree East of Swarm-A with around 10 seconds delay, and hence, they fly parallel with maximum distance about 140 km near the equator.

[(1)] Iyemori et al. (2015), Geophys. Res. Lett., 41, doi:10.1002/2014GL062555.
[(2)] Nakanishi et al. (2014), Earth Planets Space, 66:40, doi:10.1186/1880-5981-66-40.
[(3)] Aoyama et al. (2017), Earth, Planets and Space, 69:89, DOI 10.1186/s40623-017-0679-2.

低高度極軌道衛星が中低緯度でほぼ常に観測する磁気リップルと名付けられた小振幅の短周期磁場変動は、微細な沿磁力線電流の空間構造であることが、2013年11月に打ち上げられたESAのSwarm-A,-B,-C 3機編隊による精密磁場観測データの解析から明らかになった[(1)]。振幅の地理的、季節的分布や緯度分布、Local Time依存性の統計的解析や、全球雲画像、台風との対応など、様々な状況証拠から、下層大気中の積雲対流から放射される音波モードの大気重力波動による電離層でのダイナモ作用が原因であると推測される[(2),(3)]。しかし、どの積雲対流が発生源となっているのかなど、より直接的な対応をつけることはできていない。そこで、この発表では、熱帯域でのスコールに伴うような急な激しい降雨現象が発生したときに上空を経度方向に約1.4度平行して飛翔したSwarm-AとSwarm-Cの磁場観測データ、タイ東北部Phimaiやトカラ中之島で同時観測した地磁気、微気圧、降雨、風速およびGPS-TECデータなどを相互に比較した結果を報告する。

[(1)] Iyemori et al. (2015), Geophys. Res. Lett., 41, doi:10.1002/2014GL062555.
[(2)] Nakanishi et al. (2014), Earth Planets Space, 66:40, doi:10.1186/1880-5981-66-40.
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