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2010年春季南极固定冰反照率变化特征及其影响因子

杨清华[1], 刘骥平[2], 孙启振[1], 雷瑞波[3], 张林[1], 孟上[1]*

1. 国家海洋环境预报中心国家海洋局海洋灾害预报技术研究重点实验室, 北京 100081;
2. 中国科学院大气物理研究所大气科学和地球流体力学数值模拟国家重点实验室, 北京 100029;
3. 中国极地研究中心国家海洋局极地科学重点实验室, 上海 200136

Surface albedo variation and its influencing factors over costal fast ice around Zhongshan station, Antarctica in austral spring of 2010

YANG Qing-Hua[1], LIU Ji-Ping[2], SUN Qi-Zhen[1], LEI Rui-Bo[3], ZHANG Lin[1], MENG Shang[1]*

1. Key Laboratory of Research on Marine Hazards Forecasting, National Marine Environmental Forecasting Center, Beijing 100081, China;
2. State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing 100029, China;
3. Key Laboratory for Polar Science of the State Oceanic Administration, Polar Research Institute of China, Shanghai 200136, China

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摘要

2010年春季至夏季在中山站附近的固定冰面开展了固定冰反照率观测.在春夏过渡期,观测期间的表面反照率呈下降趋势,平均反照率从9月的0.80下降到12月的0.62,整个观测期间的平均值为0.70.雪厚是影响反照率变化的重要因子,融化前期的反照率受表面温度影响较大,干雪期反照率对表面温度并不敏感.降雪可通过增加表面雪厚和减小表面积雪粒径显著增加反照率,云层则可通过吸收入射太阳光中的近红外波段增加反照率,降雪和阴天反照率可比晴天观测平均增加0.18和0.06;吹雪则可通过改变积雪光学厚度导致反照率发生显著变化.受太阳天顶角变化和积雪变性的共同影响,晴天或少云时的反照率在上午随太阳天顶角呈准线性递减,下午则几乎不发生变化;最高值、最低值分别出现在凌晨和下午.本文提出了一组分别表述厚干雪、薄干雪和湿雪反照率日变化的参数化方案,通过太阳天顶角的线性函数隐式考虑进了积雪变性的影响.相比常数反照率方案,该参数化方案能有效提高对反照率日变化的估算能力.

关键词 南极, 反照率, 固定冰, 海冰, 雪, 辐射

Abstract:

The snow/sea ice albedo over costal fast ice around Zhongshan Station, Antarctica was measured using a fixed radiation station in the austral spring and early summer of 2010. The mean albedo variation during the observation period varied from 0.80 in September to 0.62 in December with a decreasing trend, and the mean value among the observation period was 0.70. The snow thickness was found to be an important factor affecting albedo, the early melting albedo was also closely related to the surface temperature, while there seemed no relation between the two during the dry snow period. The falling snow could significantly increase albedo as the snow deepen and the surface snow particles refined, while clouds absorbed the incident near-infrared sunlight and increased albedo. The albedo increased by an average of 0.18 or 0.06 from clear days to days with falling snow or overcast sky, respectively, while drifting snow could result in either a significant increase or a significant decrease of albedo through changes on the snow optical thickness. In response to the zenith angle variation and snow metamorphism, the clear-sky albedo steadily liner decreased with the zenith angle during the morning, and had little variation in the afternoon; the highest and lowest value occurred in the early morning and in the afternoon, respectively. Three different daily albedo cycles over thick dry snow (>3 cm), thin dry snow (<3 cm), and melting snow had been observed. To represent these daily trends, 3 simple parameterizations which implicitly included the albedo dependence on zenith angle and crystal metamorphism were proposed, and had been proved with a better performance over the daily constant albedo treatments.

Keywords Antarctic, Albedo, Fast ice, Sea ice, Snow, Radiation

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About author: 杨清华,男,1983年生,副研究员,主要从事极地海冰和大气研究.E-mail:yqh@nmefc.gov.cn