

MODIS Quarterly Report
Reporting Period: July - September, 1995
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SUMMARY

Much of the period of July-September, 1995 was spent preparing for the First MODIS Snow and Ice Workshop which was held 13-14 September. Additionally, work continued on processing the passive microwave and MODIS Airborne Simulator (MAS) data that were acquired during the April 1995 field experiment in Alaska. At least two presentations were made at the workshop and two papers have been accepted for publication. Then snow and ice workshop proceedings is in press.

FIRST MODIS SNOW AND ICE WORKSHOP

The following is the draft of the Preface and the Executive Summary written for the Proceedings of the First MODIS Snow and Ice Workshop held on 13-14 September, 1995 in Reston, VA and Greenbelt, MD.

Preface

On 13-14 September 1995, a workshop was held in Reston, Virginia and Greenbelt, Maryland at which snow and ice scientists met to discuss the Earth Observing System (EOS) Moderate Resolution Imaging Spectroradiometer (MODIS) snow and ice products. The workshop was sponsored by NASA/Goddard Space Flight Center. The first morning of the workshop was held at the U.S. Geological Survey in Reston in conjunction with the Arctic Climate Systems Study (ACSYS) workshop which, on that day, was focusing on solid precipitation. On the second day, the MODIS snow and ice workshop was held at Goddard Space Flight Center. Thirty six people registered. Eighteen presentations were made dealing with various aspects of snow, ice and snow-cover mapping. During the remainder of the second day, attendees participated in one of four working groups, each of which discussed different aspects of MODIS snow and ice products. During the working group sessions, participants also discussed a set of questions provided to them at the beginning of the workshop. The chairperson of each working group summarized results at the end of the workshop in the closing plenary session.

Executive Summary

The objectives of the First MODIS Snow and Ice Workshop were to: inform the snow and ice scientific community of potential MODIS products, ensure that the snow and ice products meet the needs of future users, seek advice from the participants regarding the utility of the products, and determine the needs for future post-launch MODIS snow and ice products. From the point of view of the MODIS snow and ice team, the objectives were met.

After hearing descriptions of the algorithm-development efforts from the MODIS snow and ice algorithm-development team, discussions were held regarding the utility of the planned products. At the beginning of the workshop, the snow and ice maps were envisioned to be global, 1-km daily and weekly-composited maps, with snow and ice (both sea ice and ice on large, inland lakes) being identified using an algorithm that employs thresholding to identify snow or ice. Nearly everyone (both operational and research-oriented people) expressed the desire to have the snow maps at better than 1-km resolution). People who were involved in operational aspects of snow and ice monitoring expressed a desire to receive both snow and ice maps in 24 hours or less, but indicated that a 48-hour turnaround time to produce a product is still useful.

The MODIS snow and ice product development will be modified in the pre-launch time frame as a result of the workshop recommendations. Exact details of the changes will evolve over the next few months. However it has been decided that the snow map and the maps of the large, inland lakes will have 500-m spatial resolution instead of 1-km resolution. Additionally, a scheme will be devised wherein the user can select his/her own time period for compositing. In regard to the sea ice product, we will work to implement the sea ice algorithms that were identified during the workshop discussions. Interim results of the algorithm changes will be presented over the next year at scientific meetings.

Brief summaries of the working group recommendations are given below. One theme that was brought out in all of the group discussions was the importance of a good cloud mask. This is considered essential to the successful utilization of the MODIS data. The MODIS cloud mask can be validated with other EOS data, such as the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER).

MODIS At-Launch Snow Products Working Group

There was much discussion about the planned MODIS snow maps. It was generally agreed that daily maps would be useful as would composite maps. However, there was no agreement on the time period of the compositing. People involved in long-term climate studies were interested in monthly snow maps, while others wanted maps composited for a period of a few days or a week. There was also agreement that fractional snow cover is desirable and is possible to accomplish using some image-processing techniques today, in small basins. However, for the production of global maps, these advanced techniques are not yet available. In the pre-launch time frame, when the algorithm has to be finalized, no-one suggested a way to do fractional snow cover globally.

For operational studies, 250-500-m spatial resolution is optimal with a 24-48-hour turnaround time after data acquisition. However, 500-m resolution with 48-hour turnaround is acceptable. The daily snow map is necessary for operational use. A monthly product would be good for climatological studies. It was concluded that the user should decide the compositing period of the daily maps.

MODIS At-Launch Ice Products Working Group

In regard to the sea ice product, the participants concluded that a binary map of sea ice was only marginally useful because RADARSAT synthetic aperture radar (SAR) data are expected to be available in the near future. However MODIS will have better coverage of the Antarctic than will RADARSAT. Additionally, optical data are important and can provide information not available using microwave data. Furthermore, if RADARSAT data are not always available due to failure of the satellite or the sensor, it would be necessary to have other data available. The optical data can provide information that SAR data cannot, especially when the sea ice is wet. Thermal-infrared data, to be available on the MODIS, can also provide sea ice temperature, which cannot be obtained using microwave data.

While it was generally agreed that optical data were important for sea ice studies, it was concluded that ice type and concentration information was needed as well as information on the location of sea ice. The group identified a sea ice algorithm, developed by Koni Steffen, that may be useful for that purpose. The group concluded that 1-km spatial resolution is adequate for sea ice studies.

In regard to large inland lakes, discussion indicated that 500-m resolution daily maps would be useful and an important advance over the 1-km resolution data that are currently available.

Post-Launch MODIS Snow and Ice Products

For a post-launch snow product, subpixel snow mapping is needed at local and regional scales. Additionally, combining Multi-Angle Imaging Spectroradiometer (MISR) and MODIS data, and utilizing the pointing capabilities of the MISR, may increase accuracy of snow mapping in forests. In a post-launch product, albedo, temperature and wetness are also desired.

For sea ice, knowledge of albedo, surface temperature, open water fraction, ice type and ice motion are desired.

Utility of MODIS Snow and Ice Products

MODIS snow and ice products will be useful for input to snowmelt-runoff models, to validate other sources of snow data, for ice navigation, for ice-jam monitoring, and to study air/sea interaction among other things. A monthly snow or ice product would be useful for climatologists. MODIS data will likely be useful for operational needs especially if 250-m and 500-m resolution data are available within 48 hours.

Additionally, the MODIS data will be especially useful when combined with other data, such as passive-microwave data for determination of snow water equivalent.

Metadata that will be required with the snow and ice products include information on: georeferencing, ephemeris data, calibration and orbit parameters and information on quality of data.

RESEARCH RESULTS

Microwave Imaging Radiometer (MIR) data from the 8 flights over Alaska and the Beaufort Sea were processed and displayed. Currently, we are registering a DEM and SSMI data to the MIR data so that effective comparisons can be made between scenes. This will enable an analysis of the snowmelt patterns and changes in microwave brightness temperature throughout the month of April as the snow melted. The MODIS Airborne Simulator (MAS) data are still being calibrated by the Project. We have acquired one sample data set of one of the flights over the Fairbanks area. With those data we are in the process of registering a DEM to the MAS data.

PAPERS AND PRESENTATIONS

Papers:

Hall, D.K., J.L. Foster, A.T.C. Chang and K.S. Brown, in press: Mapping snow cover during the BOREAS winter experiment, Proceedings of the Eastern Snow Conference, 7-8 June 1995, Toronto, Canada.

Nolin, A., in press: Assessing spectral mixture analysis for global snowcover mapping, abstract for IUGG meeting, 5 July 1995, Boulder, CO.

Hall, D.K., G.A. Riggs and V.V. Salomonson, in press: Development of methods and analysis of errors for mapping snow cover using Moderate Resolution Imaging Radiometer (MODIS) data, accepted for publication in Remote Sensing of Environment.

Hall, D.K. (editor), in press: Proceedings of the First MODIS Snow and Ice Workshop, 13-14 September 1995, Reston, VA and Greenbelt, MD, sponsored by GSFC.

Presentations:

Nolin, A., "Assessing spectral mixture analysis for global snow cover mapping," presented at the IUGG meeting, 5 July 1995, Boulder, CO.

Hall, D.K., "Remote Sensing of Snow Cover," presented at the combined MODIS/ACSYS workshop, 13 September 1995, Reston, VA.

Riggs, G.A., "MODIS Snow and Ice Algorithm Development," presented at the combined MODIS/ACSYS workshop, 13 September 1995, Reston, VA.

Hall, D.K., "Results of the First MODIS Snow and Ice Workshop," at the Polar Oceans DAAC Advisory Group Meeting, 17 October 1995, Annapolis, MD.

Riggs, G.A., "MODIS Snow and Ice Algorithm Development," at the group meeting of the MODIS cloud-masking investigators, 18 October 1995, Madison, Wisconsin