AN IMPROVED ALGORITHM OF WILD FIRE DETECTION FOR MODIS IMAGERY

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1. INTRODUCTION

As well known, wildfire emits carbon into atmosphere for 1.7 to 4.1GtC/yr in entire earth (IPCC, Mack et al. 1996, Andreae et al. 2001). This is not negligible amount, corresponding to one quarter to one half of anthropogenic greenhouse gas emission. Thus, accurate wild fire detection is important in estimation of the impact of wild fire and in disaster management.

In fact, accuracy of wild fire detection algorithm was remarkably improved by MOD14 algorithm (Giglio et al. 2003). However, we still have many false alarm and omission errors in boreal forest. One of the reasons is mixture of reflection and emission in burning area in short wavelength infrared. Thus, considerations of a variable for stochastic test and of choice of candidate of fire pixels are very important.

At first, authors modified MOD14 algorithm to improve sensitivity using 2-dimensional stochastic test (Nakau et al. 2008). This algorithm detects about 15% more hotspots. Secondary, we propose an algorithm to detect wild fire using estimated radiation by wild fire. As a result of these improvement, these two improved algorithms detected 16% and 67% more hotspots in 408 MODIS imagery covering Alaska in 2004. Precise validation including in Africa using ASTER imagery will be presented in the presentation.

2. PROPOSED ALGORITHMS

5.1. Improvement from MOD14 v4 algorithm

In MOD14, contextual method takes a critical roll on detection of small fires. This contextual method contributed to improve sensitivity in fire detection switching from AVHRR to MODIS product. However, this part can be replaced to have more sensitivity. Ones of the reasons of limitation of sensitivity are use of 1 dimensional stochastic test and inefficient choice of variables. There is a trial to detect fire with multidimensional stochastic test (Ying et al, 2005). Therefore, we tried to replace this part with another conditions combine 2 dimensional stochastic test with efficient choice of variable to test.

5.2. An further improved algorithm

We are developing a farther improved algorithm using estimation of emission from wild fire. In this algorithm, we utilize the infrared emission anomaly with some reflective bands. To reject reflectance of short wavelength infrared, we utilize the NDSI for rejection of snow caps, split window for cloud mask as well as water masks, desert masks and sun glint masks.

3. RESULTS

To compare the performance of each algorithm, we used Terra and Aqua MODIS daytime imagery covering Alaska from Jun. 20 to Sep10 in 2004. Among hotspots of this imagery, we extracted hotspots in a rectangle 60N to 70N and 160W to 141W, and we measured distance between center of hotspot pixel and perimeter of burned area in 2004 reported by Alaska Fire Service. Then, we defined a hotspot is a correct hotspot and a false alarm if the distance is more and less than 3km respectively. As shown on table 1, the proposed algorithm detected more hotspots comparing to MOD14 v4.3.2 algorithm for 82%. On the other hand, the proposed algorithm detects fewer false alarms for 10%. This means the proposed algorithm detects hotspots with doubled signal to noise ratio comparing to MOD14 algorithm. For the proposed algorithm detects 82%

more hotspots, a distribution of hotspots in a wild fire showed a different shape as shown on figure 1 and 2. This means that use of the proposed algorithm should have an impact on the strategy of wild fire extinguishment, for weak or small fire are omitted by MOD14 algorithm.

Table 1. Number of hotspots

Algorithm	Detected HS		Correct HS		False Alarm	
MOD14 v4.3.1	34,647		34,599		48	
Nakau2008	40,143	+16%	40,089	+16%	54	+13%
Proposed	63,117	+82%	63,074	+82%	43	-10%

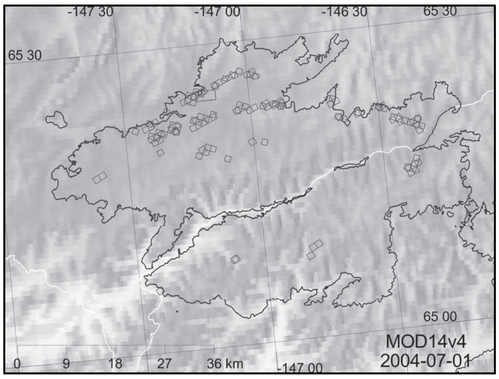

Figure 1. Hotspots detected by MOD14 v4.3.2

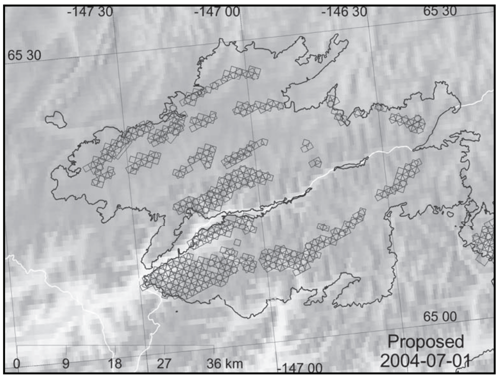

Figure 2. Hotspots detected by the proposed algorithm