8.8 GOES R Algorithm Working Group: Fire Detection – Elaine Prins

The primary focus of this effort is to evaluate the current GOES Wildfire Automated Biomass Burning Algorithm (WF_ABBA) and adapt the algorithm for application with the GOES-R ABI. This activity builds on historical and current expertise at CIMSS in fire algorithm development for the GOES Imager and the global geostationary fire observation network (MSG, MTSAT-1R, INSAT-3D, etc.). CIMSS will revise the WF_ABBA to address GOES-R ABI observational requirements utilizing the improved fire monitoring capabilities on GOES-R. This will include updating modules that identify and characterize sub-pixel fire activity, demonstrating and validating the prototype GOES-R ABI WF_ABBA using various GOES-R ABI proxy data sets, and providing a version of the algorithm for further evaluation by the AWG science team. This effort will involve collaborating with MODIS and NPOESS VIIRS fire product development experts to maximize future use of multiple data sources (geo and leo) that take advantage of the strengths of each system to create improved fused fire products. This activity will ensure enhanced future geostationary fire detection, diurnal monitoring, and characterization in the GOES-R era.

Summary of Accomplishments and Findings
UW-Madison CIMSS AWG GOES_R ABI fire detection efforts began in September 2006. Over the past four months CIMSS has focused on algorithm design review (ADR), test plan design and validation, and identification of possible proxy data sets.

WF-ABBA Algorithm Design Review
As part of the ADR process, the current WF_ABBA code was evaluated on a line-by-line basis and a flow chart was created to show areas where updates, modifications may be necessary. GOES-RRR funding is being used to investigate some of these areas and determine if updates are needed and/or beneficial for meeting GOES-R MRD requirements. CIMSS presented the GOES-R Algorithm Design Review via telecon on December 8, 2006. The ADR overview included a summary of high risk areas which include the following: (1) unknowns regarding sub-pixel fire characterization requirements; (2) lack of adequate proxy data for algorithm development/testing and the need for access to realistic fire data generated from higher resolution sensors as well as model simulated data; and (3) ABI sampling and re-gridding techniques and protocol for flagging saturated detectors are not entirely known and may impact fire detection and characterization, especially if there is no access to pre-gridded and/or level 1B flagged data in real time. Recent studies utilizing the MSG SEVIRI re-gridded data have shown that re-gridding techniques can affect the fire signature in such a way that it impacts the ability of the WF_ABBA to identify some fires and compromises sub-pixel fire characterization.

WF-ABBA Test Plan Design and Validation
In cooperation with the AWG Land Surface Team, CIMSS provided recommendations for the GOES-R ABI fire test plan and validation efforts. Ground truth validation of a fire algorithm is difficult. Although various fire databases exist for federal, state, native American, and private lands; many fires are not documented. There is no comprehensive database of all fire activity in the U.S. (e.g. wildfires and agricultural burning). CIMSS recommended a two phase approach for testing and validation. Phase 1 requires the availability of ABI simulated imagery and proxy data from models (CIRA) and other satellite sensors (MODIS, GOES, Met-8, MTSAT 2km data, etc.) that provide realistic examples and address issues that effect fire detection with ABI to the extent possible. Ideally the data set should consist of half-hourly data for two weeks in each season in a variety of biomes. Half of the simulated proxy data will be used for algorithm tuning. The remaining will be used for testing. Fires detected with the proposed algorithm(s) will be compared with the number of known/estimated fires in the simulated proxy data sets. The

number of fires in simulated data derived from existing data sets is not entirely known. Algorithms should detect at least 95% of the fires within the ABI detection capability, with a false alarm rate of 5-10% for highest confidence fires. The fire detection success/failure rates will be evaluated for each tested algorithm. In Phase 2 high resolution data (e.g. 30m resolution Terra/ASTER and Landsat 7/ETM+ data) will be used to validate the ABI fire algorithm in a variety of biomes. In addition ABI fire algorithm output will be compared with ground truth information in regional/local case study analyses and field programs.

Identification of Proxy Data Sets

The CIMSS biomass burning group has been working in conjunction with CIRA and the CIMSS AWG proxy data team to identify appropriate proxy data simulated from models and higher resolution satellite sensors (e.g. MODIS). Information regarding measurement ranges for sub-pixel fire temperature and area, 4 micron band saturation, band to band co-registration, oversampling issues, point spread functions, and emissivity were provided to CIRA to assist them in creating realistic proxy fire data sets. We suggested creating a test data set for Central America using 24 April 2004 as guidance for diurnal signals and fire activity in partially cloudy situations. The biomass burning group is also evaluating proxy data sets simulated from MODIS data.