**SatCam: An iPhone Application for Community Participation
in Satellite Cloud Product Validation**

Liam Gumley, Robert Holz, David Parker, Bruce Flynn, Bill Bellon

Space Science and Engineering Center
University of Wisconsin-Madison
1225 W. Dayton St., Madison WI 53706, USA
Liam.Gumley@ssec.wisc.edu

1. Introduction

The availability of smartphones with cameras, GPS sensors, 3D accelerometers, and fast Internet connections provides a new opportunity for the general public to participate in scientific research programs. We have built an iPhone application named "SatCam" to enable user-driven satellite cloud product validation. Why the iPhone, and not other phones?
- iPhone is the fastest growing smartphone in the World
- iPhone offers a unique application development and distribution environment
- iPhone offers a combination of technologies (camera, GPS, accelerometers, 3G network) which enable the application to be built

When SatCam is released in spring 2010, end users will download the application onto their iPhone from the App Store (it will be free). SatCam downloads Terra and Aqua satellite overpass schedules from SSEC using the position information reported by the phone. When the next satellite overpass occurs, the user goes outside and snaps a picture of (a) the sky conditions, and (b) the ground conditions. Then the user annotates the pictures with their assessment of the cloud conditions (clear, mostly clear, partly cloudy, overcast), and then uploads the pictures to the SatCam web server at SSEC. When they get back to their computer, they can login to the SatCam website, see their observations geocoded on a map, and we subset the satellite data at their location when it becomes available. Thus they get a combined ground/satellite observation of the cloud conditions at their location. Furthermore, when our automated cloud mask assessment of the scene agrees with their visual assessment, they score a point. SatCam users will then compete for being the best observer. We will use the user observations to conduct quantitative cloud product evaluations. So there is a cloud product benefit, but also a benefit to the global community who are able to learn more about satellite observations of the Earth, and engages the community by making them part of a large Earth observation mission. SSEC will develop the server side system to ingest the user observations, apply quality control, analyze the images for cloud cover, and collocate the observations with satellite products (e.g., cloud mask).

2. The iPhone Experience
I download the application named "SatCam" from the iTunes App Store (it's free). When I install the application, I enter a username and password (confirmed by return email), and confirm the geographic location detected by the iPhone as

my "Home" location. The application connects to the SatCam server at SSEC and downloads overpass schedules for polar orbiting satellites at my location. This should only take a couple of seconds. The application then tells me which satellites are available to acquire (initially Terra and Aqua), and when they will be flying over my location (local time). The application then lets me select which satellites I will track, and sets an alarm that will tell me when it is 5 minutes before overpass time. When the alarm goes off, I take my iPhone outside and get ready to point the camera at the sky. The application gives me spoken warning at 60 seconds, 10 seconds, then 5, 4, 3, 2, 1. At the moment when the satellite is at closest approach to my location, the application snaps a picture (the application will use the accelerometer to sense when the camera is pointed near zenith and nearly still). I then get to see my picture, and prepare to upload it to the SatCam server at SSEC. Before I do, the application asks me to rate the level of cloudiness in the sky (Completely clear, Mostly clear, Partly Cloudy, Overcast). Each choice would have a small graphic symbol next to it representing cloud amount. Then I hit a "Submit" button, and the picture is uploaded, along with my Cloudiness rating, to the SatCam server. Note that a picture is taken whether it is daytime or nighttime. The application will control the exposure setting of the camera to get the best quality image. The user will be able to set the phone down (especially at night) to get a stable image (in conjunction with the accelerometer).

3. The Website Experience
The SatCam website is the place where users go to see (a) what all the other SatCam users are seeing, and (b) what the satellite(s) saw. I will login using the username and password I created when I installed the application, and the server will show me all my pictures taken so far, along with the coincident satellite observations (visible, infrared, true color), and my hit rate statistics for the satellite products. The website will show a map (using the Google Earth API) to plot the locations of all observers in the last hour, day, and week. It will also keep score on who has submitted the most observations, and who has the best hit rate. It will also provide a space for the users to tag each picture with comments about the appearance of the clouds. There will be a user-forum where users can discuss different types of clouds they saw. There will also be background information, written by SSEC scientists, on different cloud types; on satellite remote sensing; and on satellite products, instruments, and programs. The website will also feature a blog where the SatCam developers keep the user community informed about new developments with the application, and also how the user observations are being used to help validate the satellite products.

This presentation will describe the SatCam application and website in detail, and provide a live demonstration of the application in use.