Summary of Breakout Session #1

Remote Sensing Providers

The remote sensing providers group tried to address the following questions:

1. What data is available now and what will be available in the near future?
2. Major differences between user needs and remote sensing products?
3. Major limiting factors to provide data? What are some solutions?

For question 1, the available data was classified as satellite, aircraft, and *in situ* data. Satellite data has the potential for a lot of color related products that can be derived from sensors including chlorophyll –a, fluorescence, turbidity, CDOM, and primary productivity, however, the group is not sure what the managers need. Current satellite sources include:

SeaWiFS - 1 km resolution, daily repeat
Normalized water leaving radiance (reflectance) – $(L_w)_N$
Chl – a
Light attenuation (K490)
Surface PAR

MODIS/AQUA - 1 km resolution, daily repeat
$(L_w)_N$
Chl – a
K490
Surface PAR
SST
*250 m resolution at the research product level

TERRA – older, revisited, provides same as AQUA, but different time, day and different dataset.

POES/AVHRR – 1 km resolution, 3 to 4 day repeat
SST

LandSAT – several different resolutions, 16 days/satellite repeat
Identification/classification/mapping
Thermal channel
TSS
*not functioning well, on life support, possibility of phyco/cyano ID @ 30 m/res

SPOT – 10 m resolution, fairly high repeat, no blue channel
Water quality parameters
Mapping
Turbidity

*expensive! Have to buy archives

ASTER – Unsure of availability to the general public, not on repeat cycle
200 – 300 m resolution
water quality parameters
medium resolution, thermal (90 m)

MERIS – unsure of availability to the general public.
200 – 300 m resolution, water quality parameters

MISR – (Terra) 250 m resolution, fairly good repeat (R&D product)
*substitute for MODIS, off axis, underutilized resource

IKONOS, Quickbird, OrbView3 (other satellites)

Byproducts of ocean color processing, i.e. atmospheric corrections, etc.

Aircraft data is necessary for the tributaries, and slowly changing areas such as wetlands, SAV beds, and shoreline. Data includes:

Photogrammetry

High resolution, multi & hyperspectral sensors (can put any sensor on plane)
Chl a
Temperature

LIDAR – Bathymetry

Pulsed LIDAR
Productivity
Potential for high concentration blooms
Potential for CDOM

Passive Microwave
Salinity
Temperature

In situ water quality data is available in the mainstem for chlorophyll, fluorescence, turbidity, DO, temperature, and salinity. There are also stations located throughout the tributaries. In a few locations, water quality measurements are simultaneous monitored with radiometers (platform). Optical property sensors are an option for data collection; however, it requires boat time for measurements instead of being deployed on a buoy due to the potential for fouling of the equipment.

With the time limitation, not all questions were addressed. For question 3, it was identified that the current algorithms are optimized for global use and not a regional or local level. As well, funding for data and time is always an issue.

<u>Analyst</u>

The analyst group addressed a series of practical concerns for use of remotely sensed data in the management decision support process. Daily data need to be in an analyst-friendly GIS format to compute real and temporal metrics that allow for its use with existing in situ data products. ESRI Grid or GeoTiff formats were deemed optimal, although GRID data can present storage problems. Remote sensing data that would be useful for analyses are chlorophyll-*a*, TSS or a turbidity equivalent, sea surface temperature and possibly surface salinity if data were reliable. Analysts stressed the need for metadata and most specifically a technical contact/advisor to help interpret imagery. An advisory committee needs to be established to set up standard operating protocols for data analysis amongst the states.

Another theme of discussion was the application of remote sensing into current modeling efforts. Although, remote sensing chl data has been collected in the Bay for 17 years, why hasn't it become incorporated into modeling efforts? Is it due to inflexibilities, poor communication/understanding or difficulties to incorporate it into existing models? If remote sensing is to be successful in the Bay we must find ways to incorporate these new data streams, including high frequency in situ data, into Bay Program models. Remote sensing and in situ monitoring complement each other, with remote sensing filling spatial and temporal gaps, while in situ data can be used to validate and improve remote sensing algorithms. The question is how do we select and implement various regional algorithms into a routine and operational remote sensing program?

Analysts liked Rick Stumpf's presentation on identification of chl anomalies in Florida waters and thought that an analogous approach would be useful in the Chesapeake for harmful algal bloom mapping, habitat suitability modeling, and adaptive sampling purposes. Additional discussion was held on appropriate scale and accuracy of measurement. General thoughts were that satellite remote sensing would be most useful in the main Bay, with supplement aerial sampling occurring in larger tributaries. At present, remote sensing may not provide the accuracy required for stringent TMDL and water quality criteria assessment, but could be useful for indicator development, model refinements and alert systems.

<u>Users</u>

The user group first identified the target audience in order to better assess what data and products were needed. The primary audience is the management community throughout the Bay region, which includes people who work in the field. It is this community that is driving the current monitoring efforts. The secondary audience is the general public, to whom the CBP has an obligation. As it is now, some of the available data is not very user friendly, such as DO data. All of the data needs to be better integrated and provided to the public in a more user friendly way. Monitoring data is currently provided to managers, but only recently has there been adjustments made for the non-managers interpretation. Another helpful tool would be to do better forecasting and predictive modeling. This would help the public have a better understanding and look ahead.

The discussion then turned to what data is available and the associated concerns. Efforts are currently ongoing to forecast DO, Chl –a, and water clarity. However, better data is needed at a higher resolution. It’s understood a variety of data exits at 1km, 500m, and 250m, but what is best for the bay? Including the remote sensing, high resolution data to forecasts would assist the CBP in getting the message to the public on how we are achieving our goals. In addition to monitoring stations, aircraft and satellites both cover the mainstem of the bay. Is this redundant? Aircraft imagery is very expensive and correction software is not always available. Efforts need to be made for NRL and CBRSP to work together, especially to resolve aircraft operation issues such as no-fly zones. As well, a company to create imagery software for corrections would be most useful. Then, there is chlorophyll and clarity data. How do we progress with these remotely sensed data? What about validation? Not only is there a need to validate the data, there also needs to be a strategy to do so. New algorithms need to be developed that are specific to the bay, which means dedicated analysts are needed. Though chl –a and clarity are primary data needs, another source was mentioned: LiDAR for detailed bathymetry and topography of the coastal areas. Army Corp of Engineers, Navy and NOAA are currently developing methodologies. Hyperspectral LiDAR works best in clear water and could be a potential for seagrass mapping.

The best way to serve up the data was decided upon a web based delivery. This would let the public and interested groups, as well as managers, know what is going on in a continuously updated environment. There is still that need for dedicated personnel to update the web and analyze the data for correctness. As well, need to be careful on how much imagery we put up for the public to analyze. Possibly set error percentage thresholds so the public doesn’t misinterpret the numbers.