**Tiger Team Idea:** Create an objective “AQAST Recommendations for AQ Satellite Missions” document to guide AQ mission planning, by B. Duncan

**Possible Activities:**

- Summarize uses of satellite data for AQ, including OMI, GOME, SCIAMACHY, GOME-2, etc.
- Summarize strengths and weaknesses (i.e., “lessons learned”) of Aura & other data for AQ.
- Consult EPA, state agencies, & other end users on usefulness of satellite data for their applications and ask what they need (e.g., GEO, better ground-based validation of satellite data, data continuity, etc.).

**Possible Recommendation:**

- A leaner, cheaper, earlier GEO mission - proof-of-concept for large missions, e.g., GEO-CAPE.
- Joint activities (e.g., validation, retrievals, etc.) with TROPOMI (launch 2015) – “super OMI”.
- How to better “package” satellite data for use by AQ agencies.
- Data validation activities (e.g., Pandora instruments in DISCOVER-AQ).

*148 OMI-related publications in 2009-10 with many on AQ.*
Short-Term Objective: Why do only some AQ agencies actively use satellite data products?

**Question:** Why is CARB a "success story" while MDE is not?
- politics (e.g., "red" v "blue" states; Texas govt. openly hostile)? But Maryland is very liberal.
- a number of states use data to identify "exceptional events", like wildfires, but why not to verify emission reductions?
- lack of "user-friendly" data products?
- lack of communication with NASA scientists and thus lack of knowledge regarding policy relevant NASA funded research?
- semi-quantitative to qualitative nature of data products don’t really provide AQ agencies what they need? No surface ozone data product?
“User-friendly data”: Comments from one data user

• “Single format of data files across instruments – AQ users of satellite data invest considerable effort into just reading the data – this is an onerous task. e.g., Aura/OMI NO$_2$ data from KNMI requires reading an entire orbit of data just to get a little piece; NASA NO$_2$ does not require this.”

• “Documentation of the instrument capabilities and operational modes. The websites devoted to instrument descriptions are often worse than useless.”

• “Make honest claims about the instrument’s capabilities (i.e. error and vertical resolution) and what data is actually available on the home site and provide an easy to find calendar of algorithm changes or other important info for data users.”

• “Create long term datasets for urban areas so that air quality managers can easily get a record of most used retrieval values. (i.e., user wants to generate a table of TropNO2, CFRAC, and Error for a predetermined urban airshed). This would allow web-based tools that summarize conditions for user-defined episodes, allowing reports to be generated. This would give air quality managers a basis for the region of interest and allow a standard for comparisons to surface measurements.”
“User-friendly data” (continued)

• Is the **learning curve associated with satellite data products too daunting** for many people at AQ agencies, who are not trained to process L2 products (i.e., swaths) that are required for science. (The L3 products are typically not of sufficient quality for use in a quantitative sense.)

• Are the people at AQ agencies **fluent in data processing** (e.g., idl, hdf) or are they more familiar with ascii and Excel?

**Benefit from NASA Data Workshop Written Surveys of Ana Prados & from Informal Oral Surveys**

• The NASA Applied Sciences Remote Sensing Training Program (Project Lead, Ana Prados) provide frequent workshops to help enable practical applications of NASA Earth Science.

• Ana is developing a survey to gauge the effectiveness of workshops which - in conjunction with the program's existing knowledge in applied end-user needs - can be used as a resource by AQAST.

We can make recommendations, but does AQAST have the influence to really make things change at NASA?
Workshop Questionnaires

• **Questionnaire housekeeping**: identify methodology for data collection (e.g., who will be surveyed and who will be interviewed, etc.), determine survey questions and tailor for this project, categorize end-users by level of expertise, etc.

• **Collaborate with other tiger teams?**

• **Questionnaire’s will help us:**
  • determine how the data are currently being used?
  • know what are the most pressing data needs based on regulatory, health, or other policy considerations.
  • understand barriers to data use.
  • recommend webtools.
  • Etc.
Long-Term Objective: Create an objective “AQAST Recommendations for Air Quality Satellite Missions” document for NASA mission planners

• Objective & “honest” summary of the strengths and weaknesses (i.e., “lessons learned”) of satellite data for AQ applications, including limitations of horizontal resolution, signal/noise, LEO, cloud interference, vertical resolution, etc.

• Summary of what components of an AQ mission would be desirable for AQ applications (e.g., better ground-based validation of satellite data, finer horizontal resolution, better temporal resolution (GEO), data continuity, etc.) – build on results of GEO-CAPE subgroups (e.g., Variability subgroup) and the DISCOVER-AQ field mission.

• Recommendations from AQAST to AQ mission planners. As examples, we may recommend a) a cheaper, earlier GEO mission to serve as a proof-of-concept for GEO-CAPE, b) analysis activities (e.g., validation, retrievals, etc.) of TROPOMI data (launch 2015, finer horizontal resolution, better signal/noise than OMI), and c) data validation activities (e.g., within DISCOVER-AQ).
Written & Informal Oral Surveys, for example ....

Comments from P.K. Bhartia’s (NASA) #1:
“I would like to see an “honest” evaluation of how useful existing satellite data have been for AQ AS research. It is not sufficient to show that satellite data correlate reasonably well with surface measurements or with models (these correlations are typically ~0.7, which I consider marginal), one need to show the impact of adding satellite data over and above what one can get using the models. Indeed EPA can benefit a lot by simply adapting GMI and GOCART for their use rather than using satellite data. One may find that satellite data are most useful for tracking transport of trace gases and aerosols in the free trop rather than for estimating BL concentrations. If that is the case it would make lot more sense to improve such retrievals from present sensors and to tailor the future sensors for such use. ....”

Work to the strengths of the data products!
Aura/OMI measurements show a decrease in SO$_2$ amounts over the Eastern United States.

The Ozone Monitoring Instrument (OMI) data confirm a substantial reduction in sulfur dioxide (SO$_2$) values around the largest US coal power plants as a result of the implementation of SO$_2$ pollution control measures. The figure shows average SO$_2$ values measured by OMI on the NASA Aura spacecraft for the periods 2005-2007 and 2008-2010 over the Eastern US where the majority of large SO$_2$ sources are located. Scientists use this information to identify anthropogenic sources of SO$_2$ and to estimate their emission rates. The greatest values are in violet; the lowest in green. Yellow to violet colors correspond to statistically significant enhancements in SO$_2$ pollution in the vicinity of the largest SO$_2$ emitting coal-burning power plants indicated by the black dots.

Previous use of space-based SO$_2$ retrievals has been limited to monitoring plumes from volcanic eruptions and detecting anthropogenic emissions from large source regions as in China. A new spatial filtration technique allows the detection of individual pollution sources in Canada and the US.

OMI shows that decreases in NO$_2$ columns over the 4 years 2005-2008 approach 40%, almost the same as the weekend decrease observed in 2005.

*Courtesy Ashley Russell and Ron Cohen, Univ. of California, Berkeley.*
Solid lines OMI, Dashed surface. The surface measurements underestimate weekend decreases.

The 4 year trend in the San Francisco Bay Area is a decrease of 7.3%/year. Similar trends are observed in the LA basin and Sacramento but trends in the central valley where the agricultural industry predominates are 50% slower.

Analysis by Ashley Russell and Ronald C. Cohen, UC Berkeley

Courtesy Ashley Russell and Ron Cohen, Univ. of California, Berkeley.
“I have been very concerned about the lack of significant interaction between the satellite algorithm developers and the applications community. With few exceptions, Shobha being one of them, the two communities do not interact. At NASA this problem is largely cultural. NASA’s official position has been and continues to be that our missions are designed for basic research and not for applied sciences (AS): “If AS can benefit from the data we produce that would be great but we will not spend any significant amount of money tailoring our sensors or algorithms for such use”. Yet, I cannot see how one could effectively utilize present satellite data or design future sensors/missions that would benefit AS without a close interaction between these two communities. This problem is most serious for AQ research since, as you know well, the Aura data are marginal for basic research in trop chemistry but they are proving useful for AS research. It would be more so for the GEO sensors. Perhaps your team can foster this interaction.”

Need to overcome institutional barriers!
"... the quality of aerosol data from satellites is far better than that for trace gases, so for future sensors it is more important to focus on other aerosol parameters that MODIS or GOES do not measure, such as SSA, or do not measure well over land, such as AE. GOES-NEXT will not improve the situation much."

GEO-CAPE: Focus on aerosols instead of trace gases?