

CSIRO EOC Travel Report

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Location: Pacific Forestry Research Center,
Canadian Forest Service, Victoria, Canada.

IGARSS02, Toronto, Canada.

[Hyperspectral section]

IGARSS02 was held in Toronto Canada from Monday 24th to Friday 28th 2002. The conference was held in a similar style to the one in Sydney in 2001. I attended sessions with a forestry or land / environmental base however there were two sessions dedicated to EO-1 and one to hyperspectral atmospheric correction. My report will cover these sessions primarily with some final notes on IGARSS02 towards the end. I have also included a brief paragraph on my research at the Canadian Forest Service.

IGARSS02

The First EO-1 session covered a general overview to EO-1. Dr Steve Ungar provided an overview of the EO-1 program which he declared an unequivocal success. Steve showed many images, some of Australian ASVT sites. At questions he was asked what NASA's plan for the satellite was in the short and long term. His response was essentially enjoy it whilst we have it, with no clear date for its termination. When asked about the maximum physical life of the satellite he quoted 4 years. I presented David Jupp's presentation covering the general overview of the AVST sites. There were no questions however it was clear from the discussions with the Hyperion folks and others afterwards, that they still regard the role of the Australian SVT in Hyperion very highly and the EOC staff, David in particular, as critical to the success of Hyperion. Melba Crawford (Uni. Texas) made positive comments as did Dianne Wickland from NASA headquarters who didn't realise the Australians were doing so much and was especially pleased to see the water applications by CLW. Clearly the database model completed by CSIRO EOC was also well received and was viewed as very successful in terms of getting HYPERION to the masses.

After that paper, the main issues concerning HYPERION involved corrections on either Level 1A or level 1B imagery. These issues can be broken into 4 main key areas:

- the georectification / alignment of the VNIR and SWIR,
- destreaking,
- spectral smile
- and atmospheric correction.

- Georectification / alignment

A group in the SVT (Goodenough, Pacific Forestry Centre) examined the registration of the VNIR and SWIR. They un-did the level 1B fix (calling it a quick fix, which I think simply involves shifting the swir to the left by one pixel and shifting lines of pixels on the right side of the centre line down one) and then registered each two spectrometers separately. They concluded the registration shift was as predicted and matched the results of CSIRO (McVicar et al.).

- Destreaking

The vertical streaks in the HYPERION imagery remained a constant topic throughout the meeting. Most presentations discussed it in their processing methodology. Virtually all of the presenters ended up using a mean and SD scaling method, the same as developed by EOC

and others at CSIRO. In fact, it was often called the OZ method or CSIRO method which made me feel better about my corrections. In fact, Alex Goetz indicated that he had tried a large number of methods and concluded the mean and sd scaling to be the best. The issue of streaks coming into and then leaving the image based on cover type was a serious issue which was raised by a number of researchers and left us all a bit worried. Steve Ungar indicated that the streaking may be (was?) non-linear indicating that the degree of streaking may end up depending on cover type making a universal correction impossible.

[Added Notes from DLBJ: Jay obviously did not sell the local de-streaking enough. It really is better for many cases and in the VNIR in particular, Streaking does not have to be non-linear to be land cover dependent. It can also mean the band-pass functions of individual detectors have odd shapes.]

- Atmospheric Correction

There was a complete section, chaired by Jay Pearlman, on atmospheric correction. Apparently Jay had wanted all the different methods to process the same sets of imagery and present the results with a forum afterwards for questions. Initially Goetz spoke about HATCH and immediately indicated he had not run any of the other packages due to the lack of data. He presented results at Coleambally showing processed imagery and spectra from the ASD and HYPERION and a few AVIRIS scenes. The majority of his talk however focussed on the degree of error which can occur when the input wavelengths and FWHM values don't match the actual radiance values (i.e. the spectral smile issue) when using atmospheric correction numbers. His results indicated a 3 to 5 nm shift in wavelength specification can result in a 5 to 30% error in prediction of reflectance.

Tom Cooley presented FLAASH and again didn't complete any comparison with other atmospheric processing routines. He discussed future developments including incorporation of new input models but did indicate that modifications of FLAASH required security clearances by AFRL and that the new additions to account for HYPERION will not necessarily be released to the public ENVI version.

There was also a presentation of an atmospheric correction routine developed by Karl Staenz from CCRS however it is not commercially available.

At the joint panel the discussion was dominated by spectral smile.

- Spectral Smile.

Given the Goetz presentation, as well as comments by Cooley, the discussion was dominated by spectral smile. There were comments by all 3 developers that the spectral smile specifications developed pre AND post launch were not exactly correct. Only Karl Staenz proposed there was a significant smile in the SWIR (as well as in the VNIR) which was opposed by Pamela Barry however both Cooley and Goetz seemed to think the VNIR smile was more than the published values. There was discussion on what to do about it. Some one proposed spectral re-sampling the values to common wavelength using one of the specifications before atmospheric correction which Goetz opposed vigorously. "Never resample radiance!" he said. Cooley's approach was to break the image into 4 column slithers and process every slither separately (around 50 different images!) and then recombine. For programs like Acorn however, which output reflectance at the same wavelengths as the input you will then need to resample the reflectance (which apparently is nowhere near as bad) for each strip and then recombine. Other than that approach there was no clear consensus apart from SWIR being generally okay as is and the smile in the VNIR being a real problem.

[Added Note from DLBJ: Not all atmospheric correction actions occur at each pixel independently so restricting to strips has problems (eg cloud masks, spatial smoothing of water vapour estimates etc). Spectral re-sampling has been tried here. The main problem is the lack of clear specification of the smile. Certainly, even if column-specific atmospheric correction is carried out, there is still a need to resample the reflectance. The smile does affect the red edge position but the full extent is not known. PS, Alex Goetz does not take his own advice for the ASD!]

In terms of applications and the use of atmospheric correction it was clear that ACORN was the most popular and its use was never criticised. The issue of smile and corrections was ultimately difficult to gauge especially for vegetation / water studies. With a 10nm bandwidth and then using derivatives and spectral smoothing in developing empirical relationships the degree of image smoothing would seem to overwhelm the effect of the smile however if the atmospheric correction is making significant errors due to input specifications then it needs to be addressed.

Other Issues:

- Jay mentioned the IEEE issue. Papers are due at the IEEE site by July 22nd. He emphasised put more efforts in the paper now and submit close to the date rather than submit early and get hammered by reviewers. A number of presenters indicated they had submitted already.
- Jay Pearlman has left TRW and is starting a job at Boeing so his role in Hyperion will diminish.
- There will be a final SVT meeting in Argentina later in the year
- There may be a special EO-1 session in IGARSS03 in Toulouse, France in 2003.
- No one was willing to predict the next hyperspectral sensor in space!

[DLBJ Added Comments:

IEEE: A significant number of papers have been submitted. As a sub-editor I feel it will often be the other way around ñ later papers will get a harder time.

Jay: Jay's role in EO1 will not diminish at Boeing. Boeing is happy for him to continue and TRW has already basically closed down its Hyperion activities so Jay is really carrying the flag that still flies.

Meetings: There will be a 'Constellation' meeting in Argentina maybe December ñ yet to be finalised. That is SAC-C, EO-1, Landsat, TERRA and maybe now AQUA. The final SVT meeting will be in Hawaii in November. I suspect Hawaii will be a (very good) science meeting (the last) and the Constellation meeting a more general NASA manager's meeting.]

Nicholas Coops

Wednesday, 3 July 2002