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Senator Michael D. Crapo
c/o Mr. Donald E. Dixon, State Director, Agriculture
490 Memorial Dr., Ste. 102
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Re: Urgency for a High Resolution Thermal Imager on the next Landsat Satellite System for Water Resources Management in Idaho

Dear Senator Crapo:

I wish to thank you for taking the time to converse with me last week in Burley regarding the critical need to include a thermal imager system on the next replacement Landsat system. As we discussed and as described in the 15 page writeup that I left with you, the thermal imager of past Landsat missions provides us with the very high resolution surface temperature maps from which we can determine the evapotranspiration (ET)[1] from irrigated crops across Idaho.

The Idaho Department of Water Resources has been using high resolution ET maps based on Landsat since 2001 that have been produced using the University of Idaho 'METRIC' image processing algorithm. These ET maps have been and will continue to be an important basis for developing mitigation plans for the Eastern Snake Plain Aquifer system, for managing water rights, for facilitating water transfers, and for managing diversions for endangered species enhancement because they show the actual impact of irrigation enterprises on consumption of water.

The University of Idaho METRIC process has used images from the two Landsat systems still flying (Landsat 5 and Landsat 7). However, Landsat 7 was damaged beyond use for ET processing in 2003 and Landsat 5 began to fail in December 2005. We urgently need at least one and preferably two new Landsat systems to be constructed and launched immediately.

A recent letter (attached) from Director Marburger of OSTP has announced that he has instructed NASA to launch a replacement Landsat satellite. However, it is unclear

[1]Evapotranspiration is the conversion of liquid water into vapor through the process of evaporation from soil and transpiration through vegetation. ET by irrigated agriculture is by far the largest consumer of water from rivers and ground water in the western U.S.

whether this new system will include a thermal imager that has been part of Landsat 5 and 7 systems. Previous communications from NASA have indicated that the thermal imager will be excluded from any future Landsat systems to reduce costs. The thermal imager measures temperature of the earth's surface and is an essential input to the METRIC process. The high resolution of the thermal imager on the injured Landsat 7 systems is unsurpassed by any other satellite system.

It is our understanding that a 2003 bid by the Resource-21 company of Santa Barbara, CA to build a follow-on Landsat satellite for the Landsat Data Continuity Mission (LDCM) that would have extended the Landsat system beyond Landsat 7 may have included optional specifications for a thermal imager. However, the bid by Resource-21 (and even the total LDCM program) was rejected by NASA and USGS (http://www.spaceref.com/news/viewsr.html?pid=10749). If this is the case, then perhaps a themal imager could be included in any rapid launch program since some advanced specifications are already developed.

I would like to request your assistance in drafting and sending a letter to the U.S. Office of Science and Technology Policy (OSTP) and to NASA urging the inclusion of a thermal imager on any and all future Landsat satellite launches, similar to the thermal imagers of past Landsat systems. You are free to use material from this letter.

Because of the large expanse of irrigated farmland and its diversity in Idaho, quantification of water consumption is possible only from satellite imagery. The resolution of the quantification of ET must be fine enough to identify water consumption on a field by field basis. Field sizes in irrigated agriculture are frequently smaller than 100 m. Therefore, the 'new' MODIS satellites by NASA that provide thermal data having 1000 m resolution are not usable, since this minimum 'pixel' size is larger than many Idaho fields (thus field shapes are 'invisible'). The high spatial resolution of Landsat, with short-wave resolution of 30 m and thermal resolution of 60 m (Landsat 7) and 120 m (Landsat 5), provides the capability to identify water consumption by individual fields and land holdings. In addition, the 16-day return time of Landsat and consistency of image procurement is critical for following trends and changes in ET during the course of the growing season. For this reason, the single 'ASTER' satellite that is currently flying, although it has a high resolution (90 m) thermal imager, is unsatisfactory, because of its irregular data acquisition and storage. We can obtain, at best, three ASTER images per year for a set location in southern Idaho, whereas we need ten or more image dates to adequately estimate annual ET.

In addition to needs in Idaho, other states, as indicated in the 15-page white paper, are poised to adopt the METRIC or similar processes to create high resolution ET maps for their states. Outside the U.S., high resolution thermal image information is essential for managing and planning food production in developing countries. The internationally known and respected Dutch scientist Dr. Wim Bastiaanssen of Wageningen, Netherlands has applied thermal Landsat data in more than 30 countries between 1984 and 2006. In

Dr. Bastiaanssen's words[2]: "It (Landsat) is the best product ever made, simply because the spatial resolution is good, and also the swath size is ideal so that we can investigate 'water management regions'. Quality wise, the data is also excellent. The developing countries facing water scarcity need the thermal band on Landsat the most. ….. With Landsat data, we can map out soil moisture, water consumption, water stress, crop yield etc. Not science, but real applications together with poor organizations in recipient donor countries."

I am enclosing the December 23, 2005 letter from Director Marburger that is directing the launch of a replacement Landsat system. I am also enclosing the fifteen page description that I provided you last week explaining why evapotranspiration maps are critical to Idaho's water management and why we need a high resolution thermal imager on the replacement Landsat system.

In addition to the enclosed documents, information on the Idaho Dept. Water Resources/University of Idaho ET mapping program is available at http://www.idwr.idaho.gov/gisdata/et.htm and at http://www.kimberly.uidaho.edu/water/metric/index.html .

It appears that decisions are likely to be made relatively quickly regarding the composition and design of the replacement Landsat system or systems, including whether a thermal imager will be included. Therefore, if possible, it would be valuable to have letters sent to OSTP and NASA by the end of January. The following sheet lists the addresses for OSTP and NASA. In addition to the letters, I think it would be highly effective for Senator Crapo to make telephone calls to the administrators of OSTP and NASA about one week following the letters to inquire what actions are being taken.

I wish to thank you for your support in urging the Office of Science and Technology Policy and NASA to include the critical thermal imager on future Landsat missions so that Idaho can continue to construct the annual evapotranspiration maps. I will be happy to answer any questions that you have or supply additional information.

Sincerely,

Dr. Richard G. Allen
Professor of Water Resources Engineering
University of Idaho

enc.

cc Rep. Scott Bedke, Oakley, Idaho
Director Karl Dreher, Idaho Dept. Water Resources

[2] Email from Dr. Wim Bastiaanssen to Dr. Ann Krause of the U.S. Geological Survey akrause@usgs.gov, 18 Jan 2006, Subject:Landsat thermal data continuity.

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