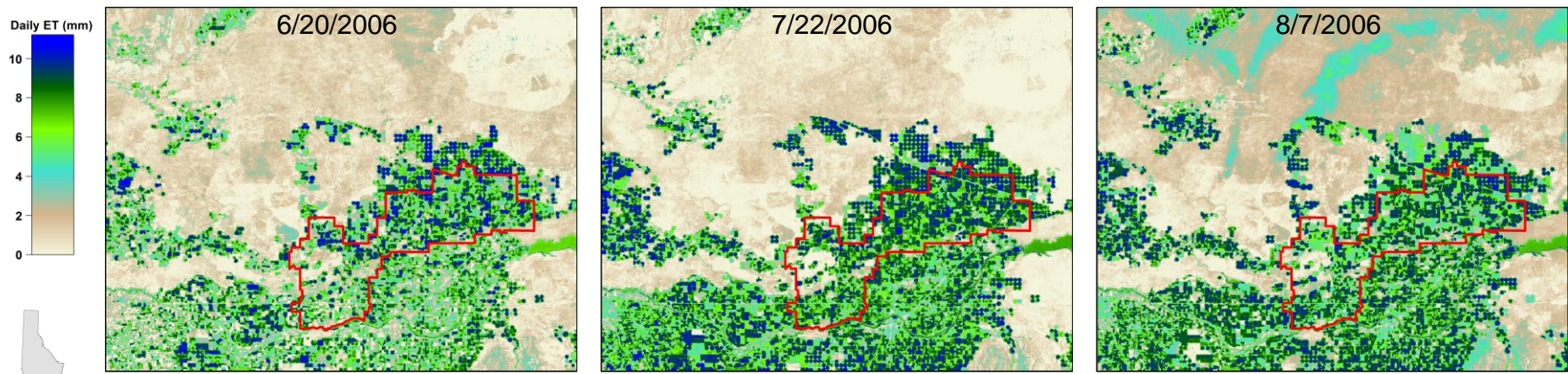
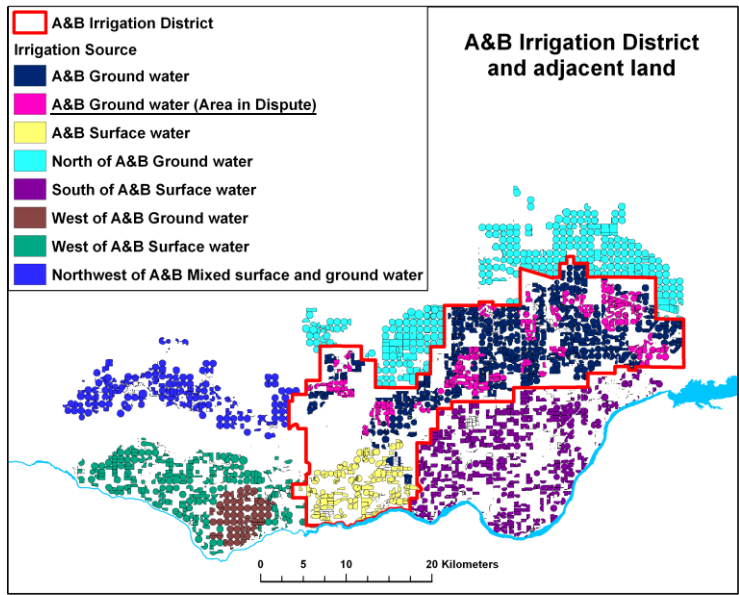
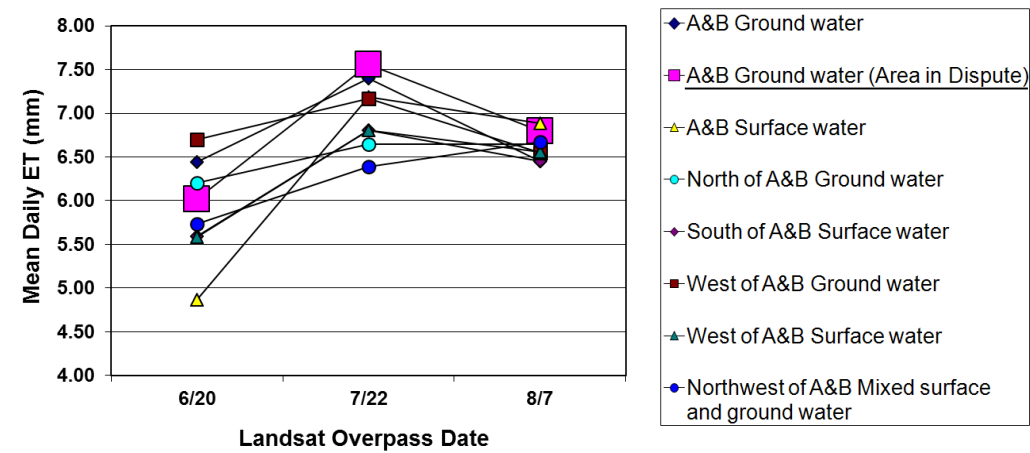


## Delivery Call Appealed to Idaho Supreme Court



Landsat-based ET images for three days during summer of 2006.

### Year 2006: Mean Daily Evapotranspiration (ET)



Idaho water law is based on the prior appropriation doctrine, "first in time is first in right". A water right is the authorization to use water and includes a priority date. When a senior water right holder experiences a water shortage a delivery call may be placed against junior water right holders. If the state finds the senior holder has experienced a shortage, the state can respond with a curtailment order, which defines how the junior water right holders must respond so that the senior holder can get their water.

The A&B Irrigation District (A&B) filed a delivery call with the Director of IDWR claiming that certain fields were short of water in 2006 due to diversions from junior ground water users. Analysis showed that the area in dispute had ET rates as high as surrounding fields that were not identified as short of water. The ET analysis was a "legal finding of fact" in the Director's order denying the delivery call and it was referred to in a water rights hearing and subsequent appeals to the District Court and the Idaho Supreme Court where the Director's decision was upheld.

## Curtailment Order Impacts 9,000 Acres of Farmland

Idaho [Business News](#)

### Water curtailment ordered in Magic Valley

POSTED: 11:13 MDT Thursday, July 23, 2009  
By IBR Staff



Ground water outflows at Thousand Springs supply water to fish farms that produce 70% of the trout raised in the United States. The curtailment order was in response to a delivery call by Clear Springs Foods; the largest fish farm in the area.

### State goes ahead with first large-scale well closure of more than 300 water rights in M.V.

7/31/2009

Water districts have limited options, could file a stay

By Nate Poppino

Times-News writer

The Idaho Department of Water Resources will go forward this morning with a plan to shut off more than 300 water rights irrigating just less than 9,000 acres of Magic Valley farmland, the first wide-scale well curtailment to actually be carried out by the state.

### Curtailment on hold for now

8/24/2009

By Nate Poppino

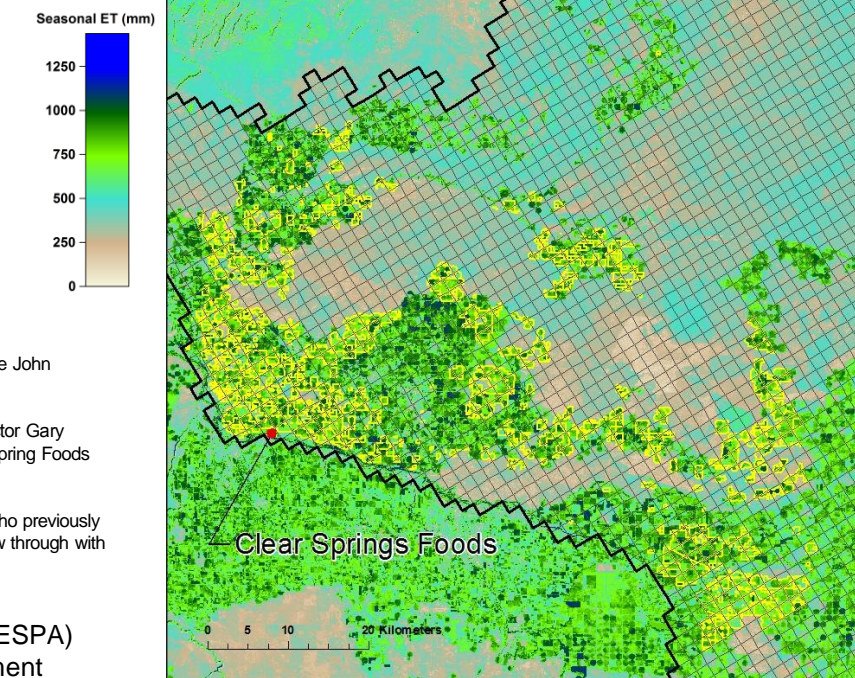
Staff writer

The well closures currently imposed on about 150 water rights in the Magic Valley were lifted today, when 5th District Judge John Melanson conditionally granted a stay sought by two area groundwater districts.

The closures, known as "curtailment," were put in place last month by Idaho Department of Water Resources Interim Director Gary Spackman when he concluded the districts had not followed through with part of an agreement to provide water to Clear Spring Foods in Butte.

Attorneys for the various parties shared their thoughts on the proposed stay at a hearing Friday in Twin Falls. Melanson, who previously denied a temporary stay of the closures, wrote in today's decision that he would grant the stay as long as the districts follow through with proposed late-season recharge.

Landsat-based ET data were used to calibrate the Eastern Snake Plain Aquifer (ESPA) ground water model and to select junior water rights to curtail. The initial curtailment order impacted 9,000 acres of land irrigated by ground water. On March 24, 2011, the Idaho Supreme Court ruled in favor of senior water right holder Clear Springs Foods.



Seasonal 2006 ET data with ESPA Model cells. Junior water rights affected by curtailment are highlighted yellow.

# Managing Idaho's Waters with Landsat-based Evapotranspiration Data



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Acknowledgments: Anthony Morse, IDWR ret.; Dr. M. Tasumi, Univ. Miyazaki, Japan; Dr. Jeppe Kjaersgaard, SDSU; Dr. Magali Garcia, Univ. LaPaz, Bolivia; Dr. Allan Wylie, IDWR; Morgan Case, IDWR.



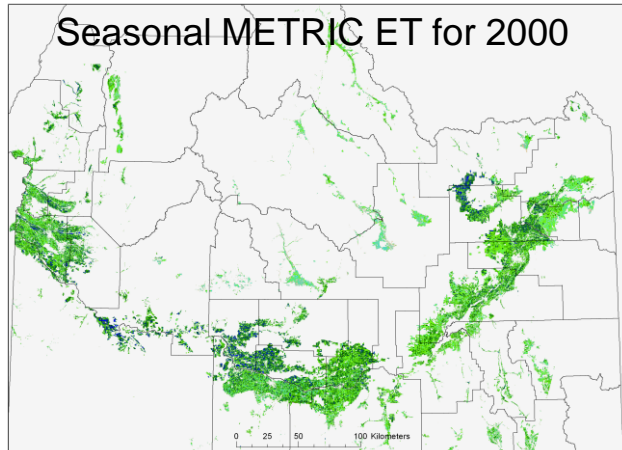
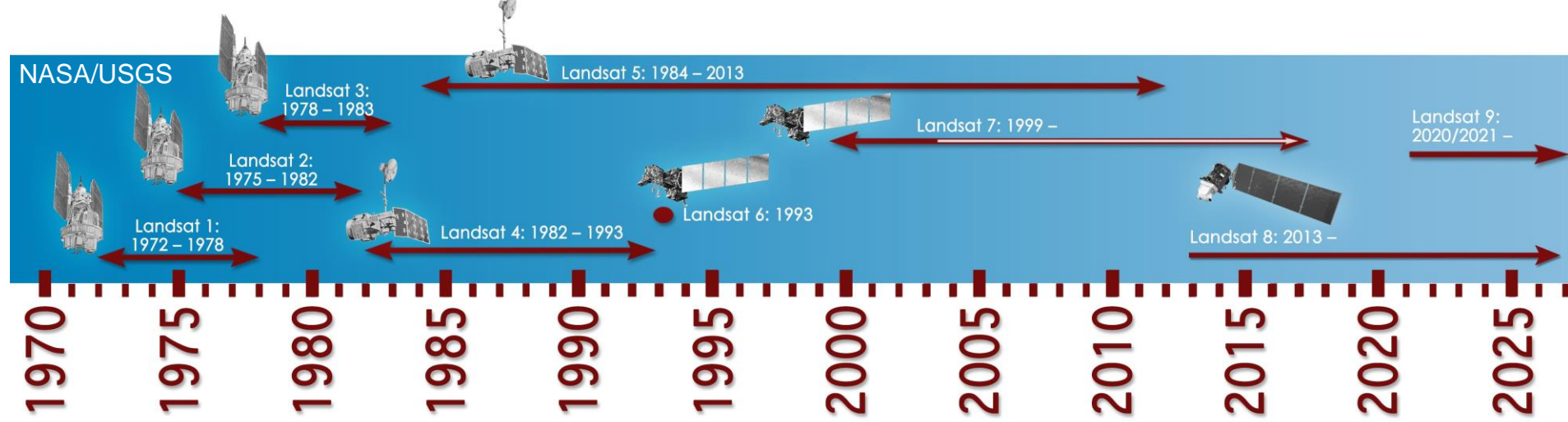
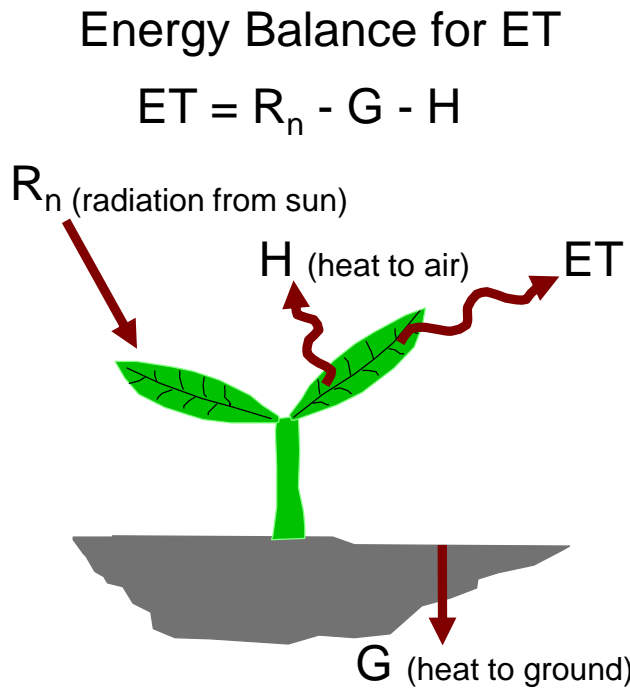
## Developing Evapotranspiration Data

The Idaho Department of Water Resources (IDWR) is responsible for the management of Idaho's waters. IDWR's responsibilities include measurement and accounting of consumptive water use. Idaho has 3.4 million acres of irrigated agriculture that account for over 90% of the consumptive water use. Evapotranspiration (ET) from irrigated agriculture is synonymous with consumptive water use.

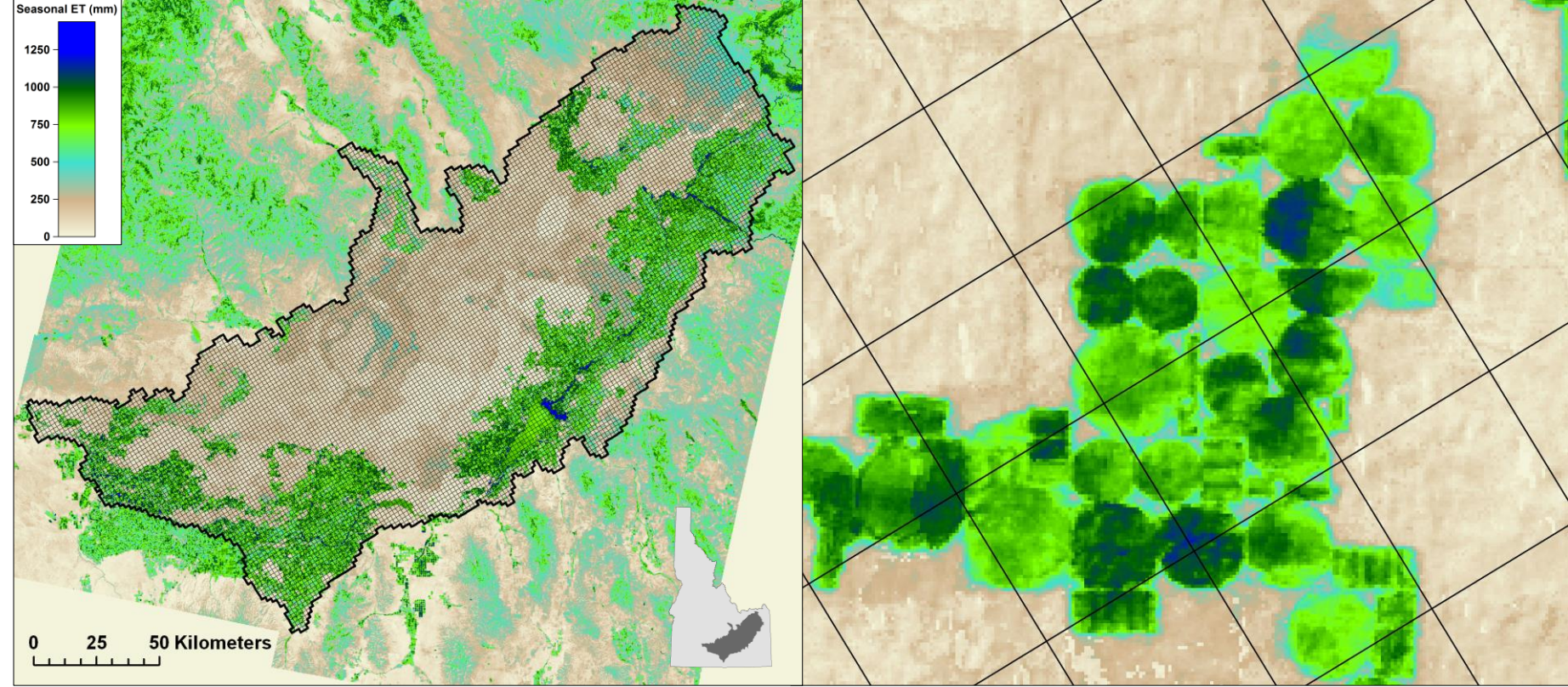
The University of Idaho developed METRIC (Mapping EvapoTranspiration at high Resolution with Internalized Calibration) to compute and map ET. METRIC is a satellite-based energy balance model for computing ET as a residual of the energy balance at the earth's surface using the equation  $ET = R_n - G - H$ , where  $R_n$  is net radiation,  $G$  is sensible heat flux conducted into the ground, and  $H$  is sensible heat flux convected into the air.

IDWR uses Landsat because it is the only operational satellite with a thermal sensor that can map ET at the field level. Landsat is a joint NASA and USGS mission that offers an archive of over 7 million images that are free. Landsat 7 and Landsat 8 are currently in operation. Landsat 9 is being built and is expected to launch in 2020.

ArcGIS Zonal Statistics as Table computes ET statistics used in delivery calls, curtailment orders, ground water models, endangered species and water demand analysis. More information is on the IDWR ET Website, <http://www.idwr.idaho.gov/GIS/mapping-evapotranspiration/>



## Ground Water Model for Conjunctive Management

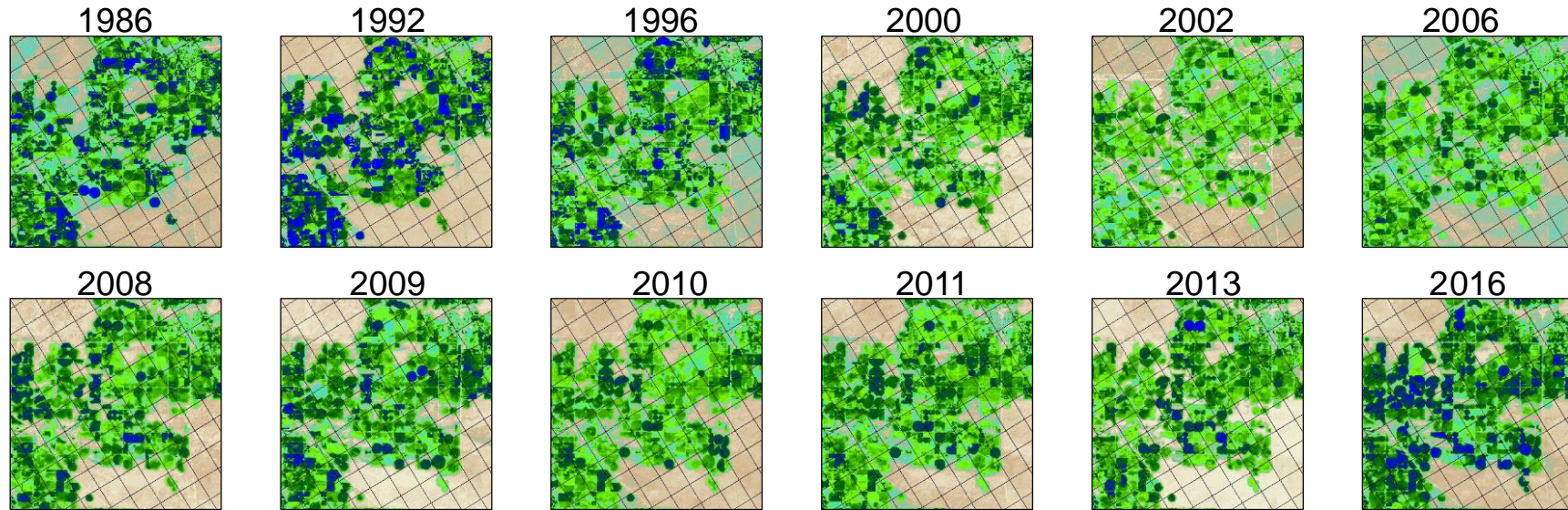


Seasonal 2000 Landsat-based ET with ESPA model cells (close up on the right). Model grid cells are one square mile.

Monthly Landsat-based ET data calibrate the MODFLOW ground water model of the Eastern Snake Plain Aquifer (ESPA). This improves the accuracy of estimated distribution and depletion caused by pumping and improves estimates of incidental recharge to the aquifer from irrigation of 2 million acres of farmland. The ground water model is used in litigation involving conjunctive use of ground water and surface water resources.

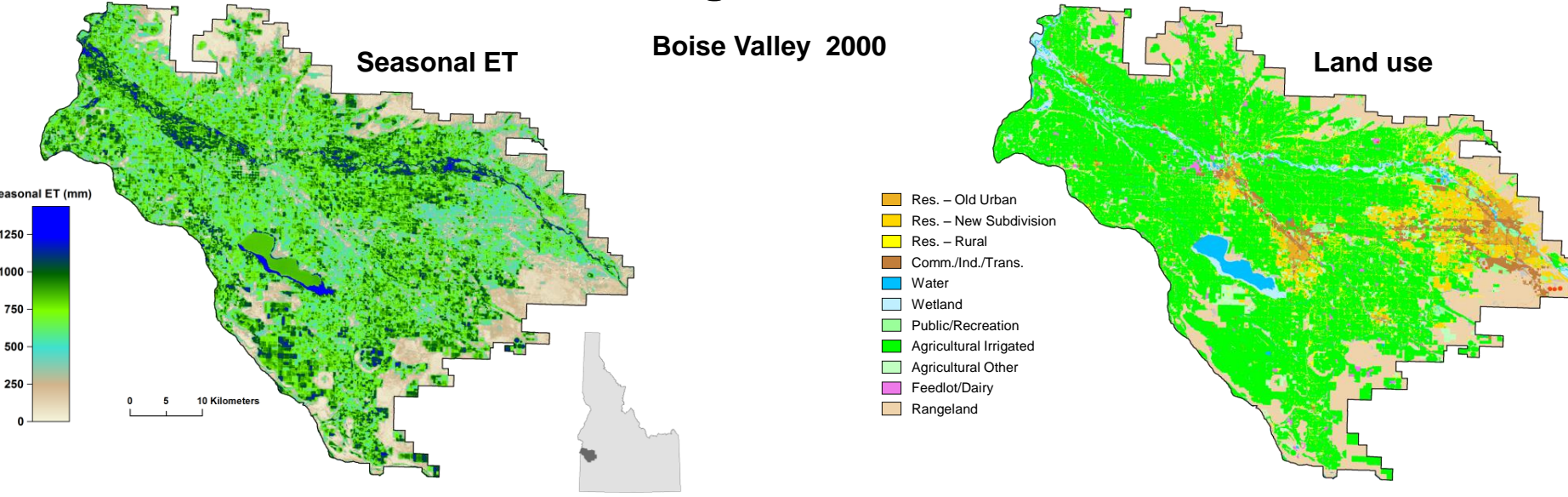
Landsat-based monthly and seasonal ET data are being developed for all years having sufficient cloud-free imagery from the mid 1980s to the present. This allows analysis of long term trends in ET and the resulting impact on the aquifer. The table shows mean seasonal ET from irrigated land by model cell and source. The sources are surface water (SW), ground water (GW), and Mixed (both surface water and ground water).

		Mean Seasonal ET (mm)											
Cell ID	Source	1986	1992	1996	2000	2002	2006	2008	2009	2010	2011	2013	2016
SP032016	SW	8	1,038	728	886	845	736	946	801	709	726	943	674
SP031015	SW	90	804	960	944	870	764	936	943	1,080	863	867	917
SP031016	SW	35	543	852	829	872	714	917	782	1,003	823	832	912
SP032014	SW	6	942	778	794	804	675	709	833	786	840	822	799
SP032015	Mixed	104	679	1,200	1,058	776	735	977	1,034	1,040	925	940	975
SP032015	SW	294	918	982	968	794	795	782	947	903	908	852	841
SP032016	GW	162	982	1,066	904	959	867	947	1,102	1,091	989	970	1,074
SP032016	SW	79	466	702	996	821	674	867	1,046	1,049	918	977	887
SP032017	GW	71	822	1,010	917	916	848	854	987	986	890	910	972
SP032017	SW	23	929	1,238	1,053	957	850	952	1,019	1,112	955	1,025	1,014
SP033015	SW	241	1,030	960	992	859	804	889	1,014	981	983	861	916
SP033016	GW	285	911	972	960	925	880	843	1,074	1,027	906	982	1,019
SP033016	SW	136	914	981	996	874	943	858	934	941	906	799	935
SP033017	GW	321	478	906	927	731	770	736	902	859	800	920	933



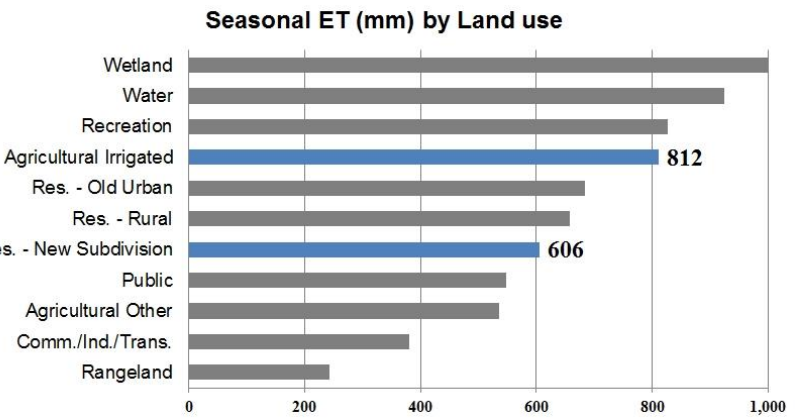
Trends in seasonal ET on the ESPA from 1986 to 2016.

## Forecasting Water Demand

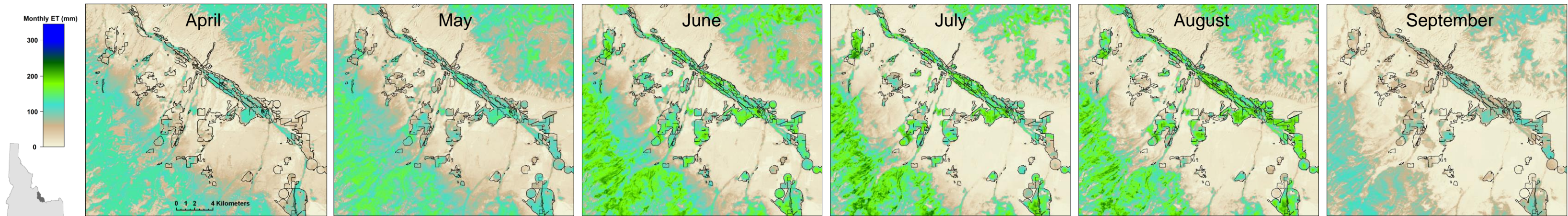


Water resources planners needed ET by land use to forecast water demand in the Boise Valley where new subdivisions were being built on agricultural land. Landsat-based ET data and land use data developed from aerial photographs were analyzed to develop ET by land use for the year 2000. Results showed that new subdivisions have lower ET than irrigated agriculture.

Additional ET data is being developed for eight of the most cloud-free years from 1987 to 2015 for a ground water model similar to that in the ESPA.



## Increasing Stream Flow for Endangered Fish



Monthly Landsat-based ET images for the Lemhi Valley within the Upper Salmon River basin in 2000.



There are times of the year when stream flow is low in some basins and there is not enough water to meet the needs of irrigation and fish. This is especially true during drought years, and in some areas irrigation can divert all the flow in a stream (photo at left).

IDWR developed a conservation plan for the Upper Salmon River Basin that put in place measures that increase stream flow for endangered fish. Data about the consumptive use (ET) of irrigated land was needed for this process. Monthly Landsat-based ET data were developed for the year 2000. The data showed that irrigation consumed 33,520 acre-feet (11 billion gallons) of water.

The ET data were also used to assess the consumptive use of water rights that may be leased under the Columbia Basin Water Transactions Program to improve stream flows. IDWR identified stream reaches that would benefit from flow enhancement and worked with willing irrigators through leases, agreements not to divert, and other transaction methods. The ET data allowed negotiations with irrigators to be based on the consumptive use (table at right) instead of the maximum diversion allowed for the water rights.

Water Right	Acres	Mean ET (mm)	ET acre-feet
74-1008	83	297	81
74-1016	41	506	68
74-1090	24	332	26
74-1096	51	350	59
74-1058	51	629	105
74-1061	14	796	34
74-1063	22	490	36
74-1103	53	599	104
74-1106	198	343	223
74-1114	42	422	59
74-1140	27	960	85