SPoRT-SERVIR Collaborations

Science Advisory Committee Meeting

26 – 28 August, 2014

National Space Science and Technology Center, Huntsville, AL

NASA's SERVIR Project

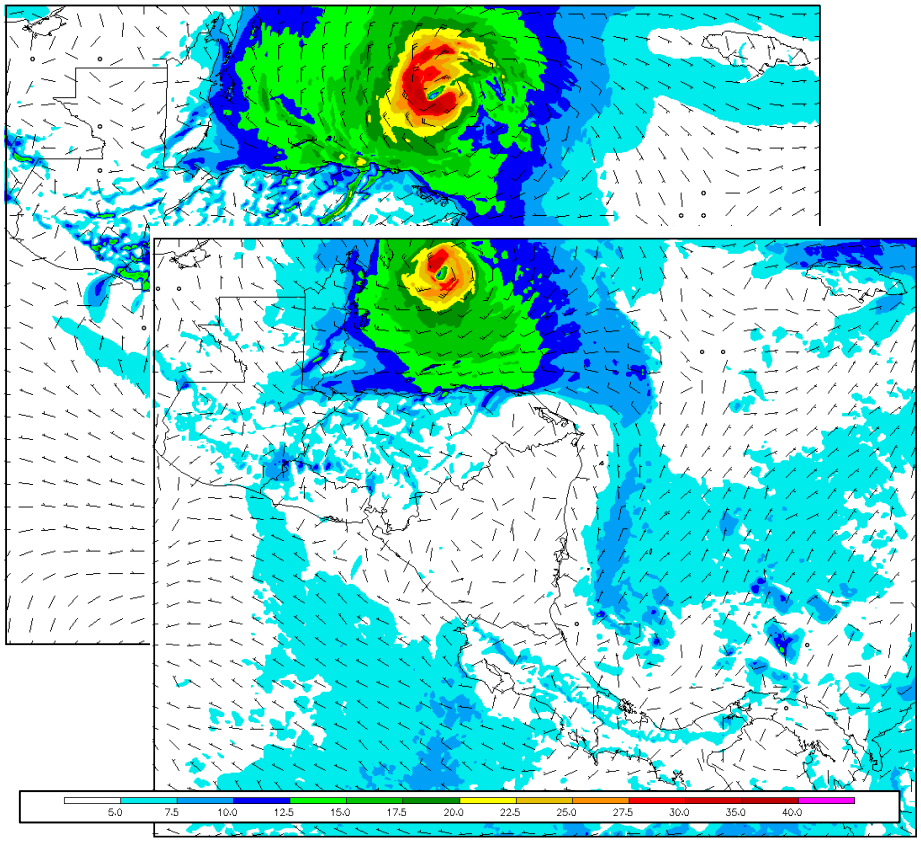
- The NASA SERVIR Project focuses on "Connecting Space to Village"
  - SERVIR emphasizes capacity-building projects within developing nations focused on the use of NASA capabilities to improve environmental decision making.
  - Overall SERVIR project goals are led by Dan Irwin and his team at Marshall Space Flight Center (1st floor, NSSTC)
- SERVIR is a joint venture between NASA and USAID, currently operating in:
  - Mesoamerica (Panama)
  - Eastern Africa (Kenya)
  - Himalayas (Nepal)
  - Upcoming expansion areas include Southeast Asia

SPoRT-SERVIR Collaboration

- SPoRT and SERVIR have common interests and goals in the “research to operations” transition of unique NASA capabilities
- SERVIR approached SPoRT, realizing that they had specific needs and goals that can be supported through our expertise
  - SERVIR provides support to SPoRT team members who, in turn, help to transition new capabilities of interest to the SERVIR hubs and regions
- Collaborations have been ongoing since 2011

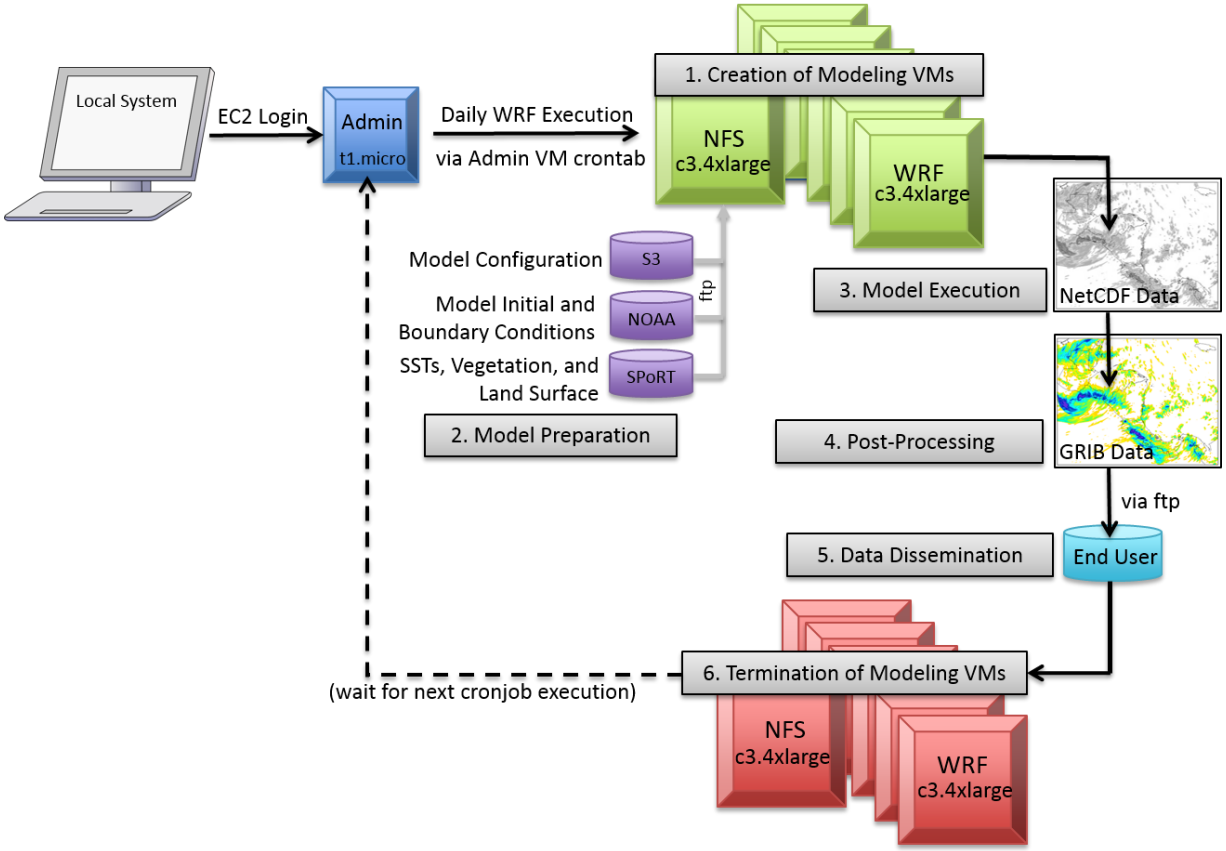
Cloud-Based NWP Guidance

- Many developing countries lack supercomputing resources to support higher-resolution NWP.
- Without higher-resolution details, many are covered only by publically available, relatively coarse global models that lack sufficient detail for high-impact events.
- Cloud-based resources (e.g. Amazon EC2) allow for generation of higher resolution forecasts for a hub area and other spinoff applications.



Cloud-generated forecasts of hourly maximum wind speeds during Hurricane Rina, October 2011, which affected portions of Mesoamerica.

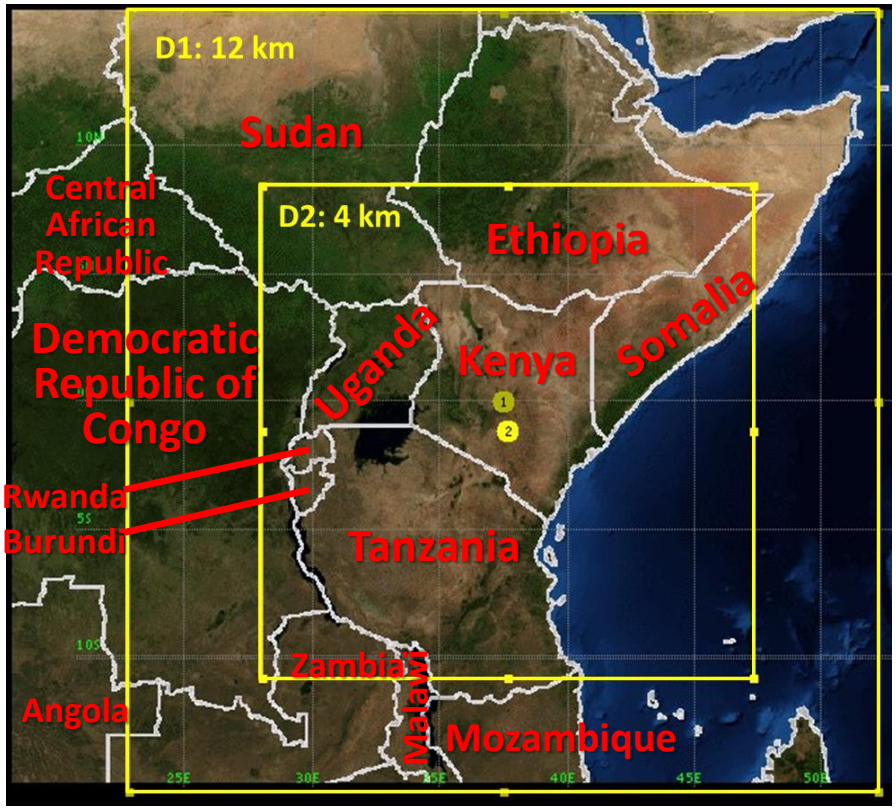
Cloud-Based NWP Guidance



Overview of scripted, Amazon EC2-based capability for generating WRF-EMS forecasts using "Infrastructure as a Service", or IaaS capabilities, reproduced from upcoming publication Molthan et al. (2014), in review.

Land Information System

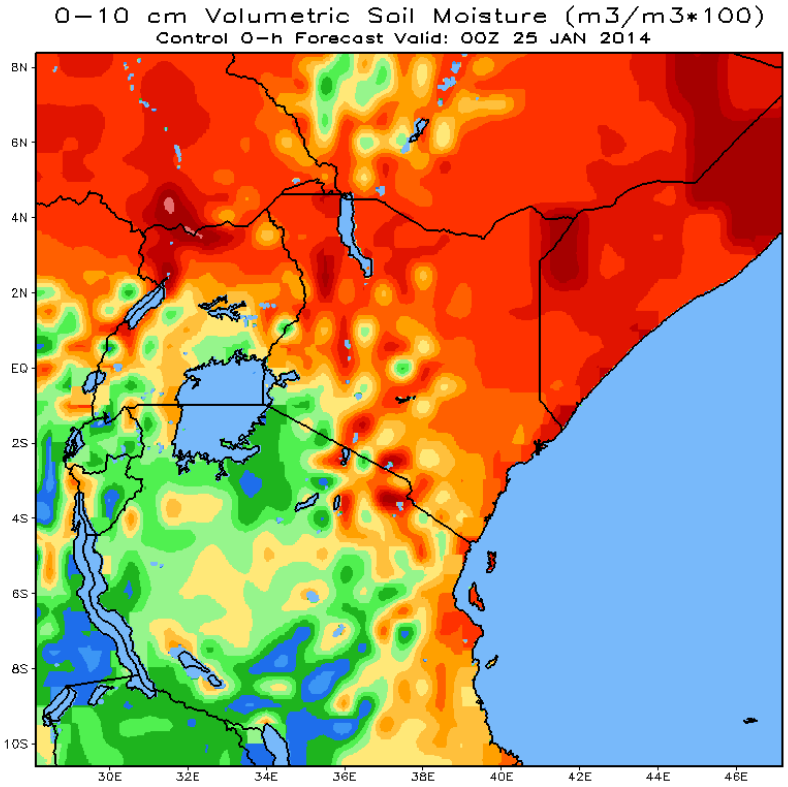
- SPoRT has previously demonstrated the value of LIS outputs for situational awareness and improved model simulations
- SPoRT has established a LIS domain specific to eastern Africa, supporting WRF runs managed by the Kenya Meteorological Service
  - Used to improve initialization of local WRF-EMS simulation
  - Future applications to improve hydrological simulations for water resources / flooding
- These capabilities can eventually be incorporated within EC-2 cloud based NWP support for SERVIR regions.



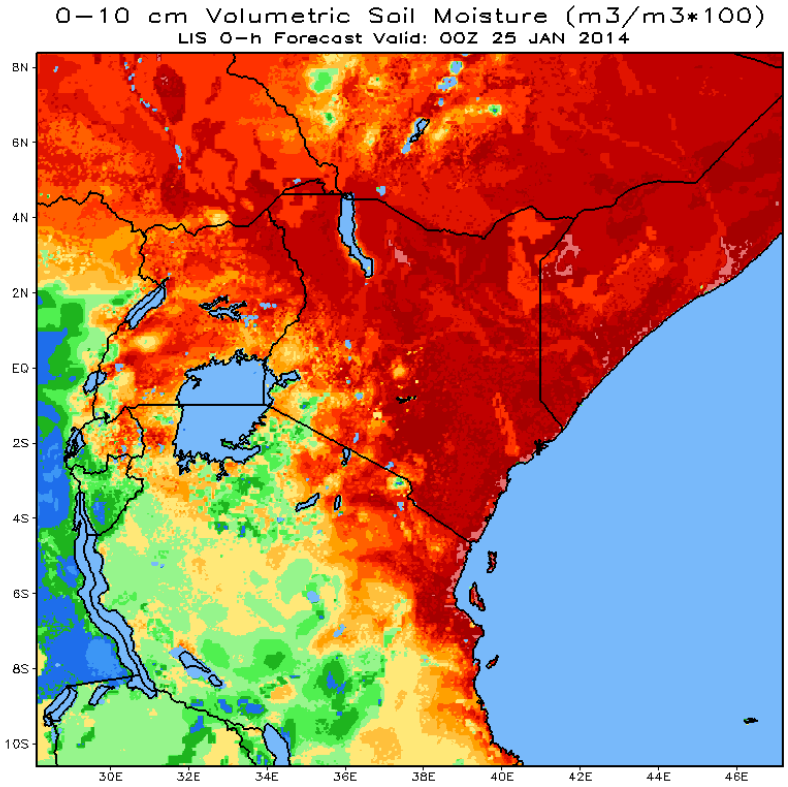
WRF-EMS configuration and daily simulations tested by the SPoRT team and suggested to KMS meteorologists for use with initial conditions from near real-time LIS information.

Land Information System

4-km domain Control (GFS)



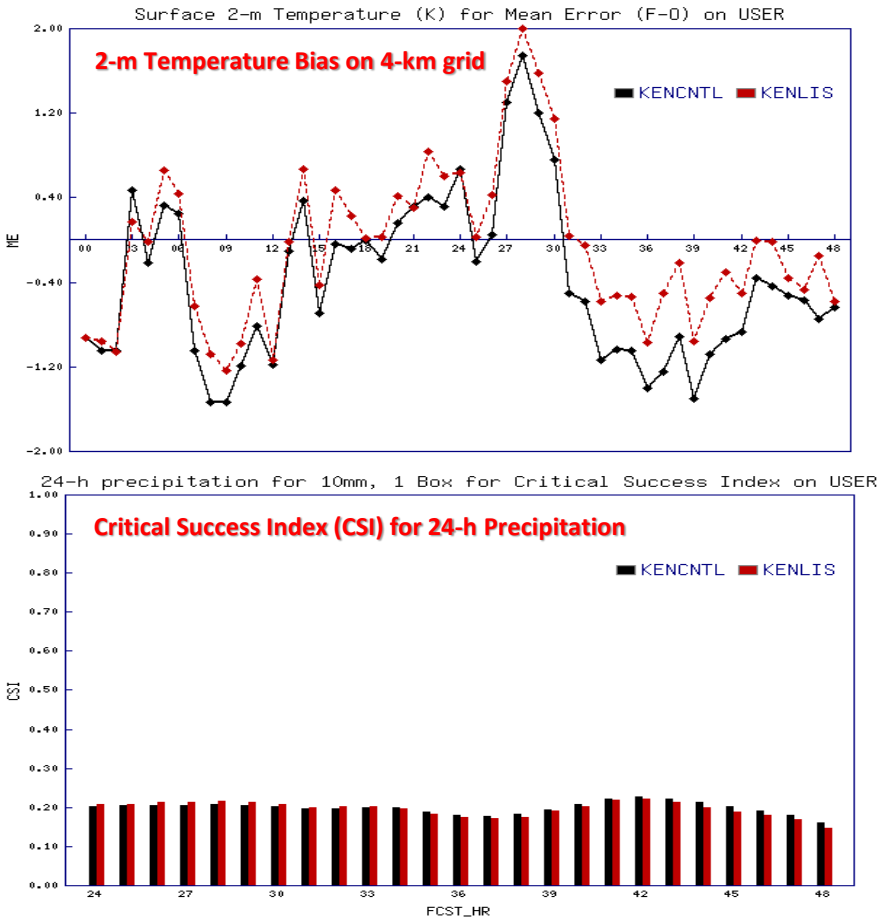
4-km domain Experiment (LIS)



Comparison of land surface details provided to the Kenya Meteorological Services WRF-EMS via the default, coarser GFS input data sets (left) and higher resolution depiction of soil moisture and other characteristics via LIS (right).

Model Verification

- Meteorological services want to make sure that their model simulations are reasonably accurate.
- The SPoRT team developed a scripting package that uses the NCAR MET tools to perform validation against various temperature and precipitation data sets.
- Jon Case traveled to Kenya to help KMS incorporate verification scripts to aid in the evaluation of model output.



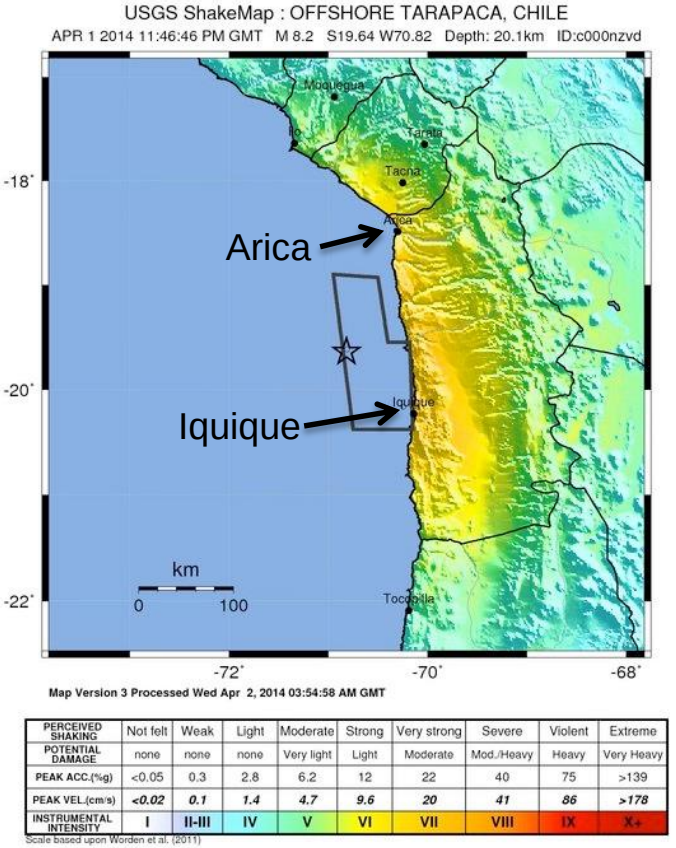
Model verification statistics and graphics produced from SPoRT scripts showing overall forecast improvements by including LIS data.

VIIRS DNB and ISERV Collaborations

- The SPoRT team leverages their experience with satellite data sets to aid SERVIR
  - Leverages our interest in Disasters, as SERVIR participates in the "International Charter on Space and Major Disasters"
  - The international charter is executed when partnering nations request support for imagery in response to a major disaster event
- Collaborative activities focus on:
  - Use of the DNB to support disaster assessments, continuing and expanding previous CONUS efforts
  - Assistance to the SERVIR team with products derived from their ISERV instrument. ISERV is provided in support of domestic applications and during International Charter events.
    - ISERV is a true color imager aboard the ISS that provides imagery at 5 m spatial resolution, requested in response to disaster events.
    - SPoRT requested and disseminated ISERV imagery from major tornado events in 2013 (Moore, OK) and 2014 (Louisville, MS)

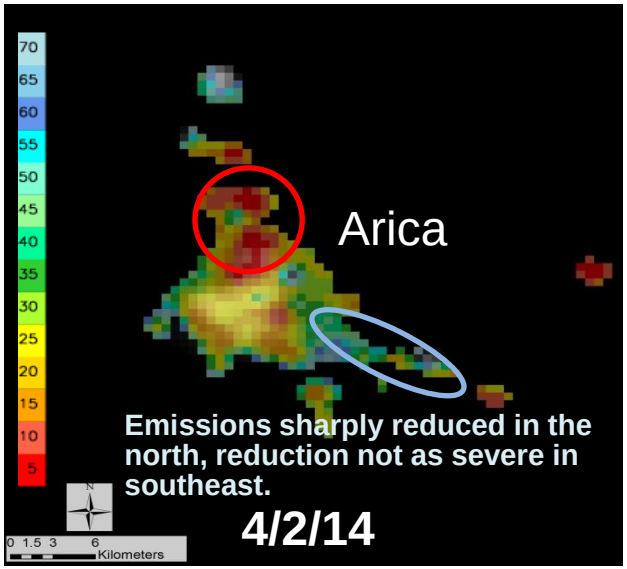
Chilean Earthquake of April 2014

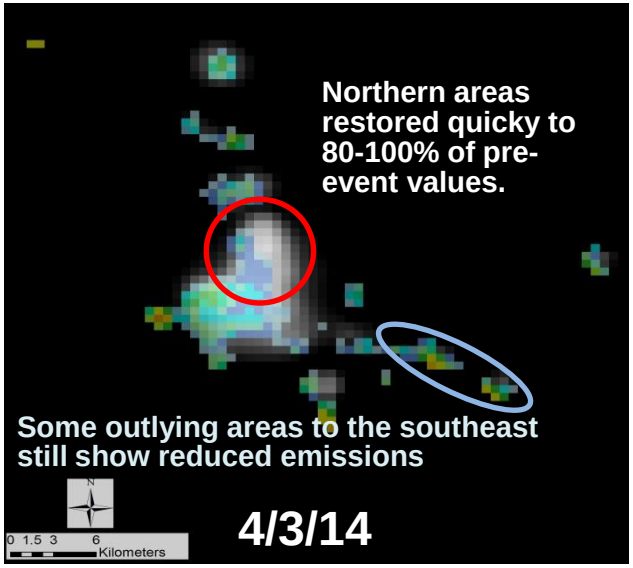
- SPoRT performed DNB analysis of outages experienced following the Chilean earthquake of April 2014.
- Magnitude 8.2 quake, occurred just offshore of the coast of Chile.
- Cities of Arica and Iquique reported widespread utility outages.

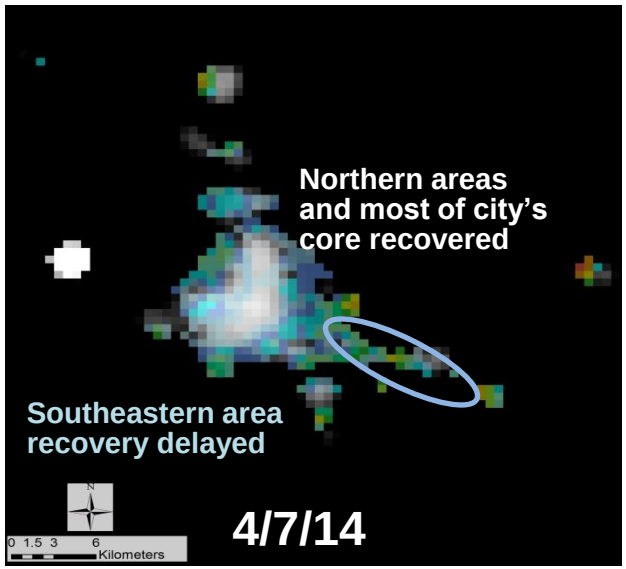


USGS ShakeMap identifies range of measured intensities and earthquake extent.

Chilean Earthquake of April 2014



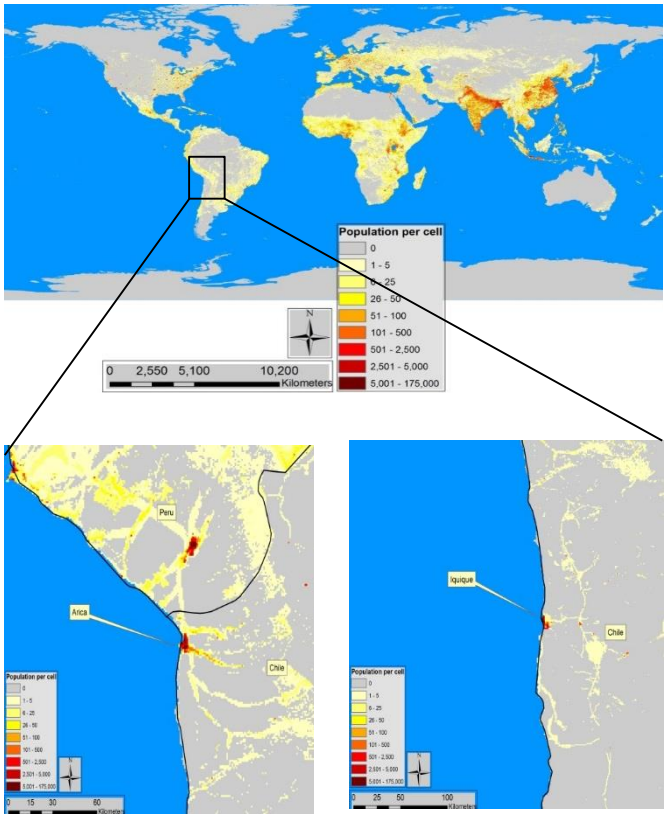




Observations of reduced light in the city of Arica following the Chilean earthquake of April 2014. As with CONUS applications, recovery can be noted by overall increases in light and restoration of near-normal values. Some areas displayed reduced light emission more than five days after the event.

Quantifying Impacts

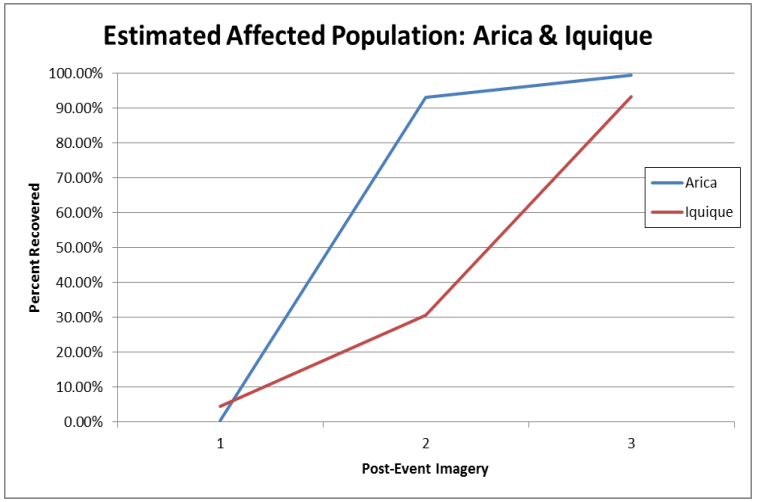
- To expand the value of DNB use in disaster assessment, we propose to include measures of populations and infrastructure affected.
- Currently exploring use of gridded population for global applications.
- Infrastructure for CONUS available through Homeland Security / DoD databases (future work)



Gridded population from Oak Ridge National Laboratory, globally, and focused on the region of the Chilean earthquake.

Quantifying Impacts

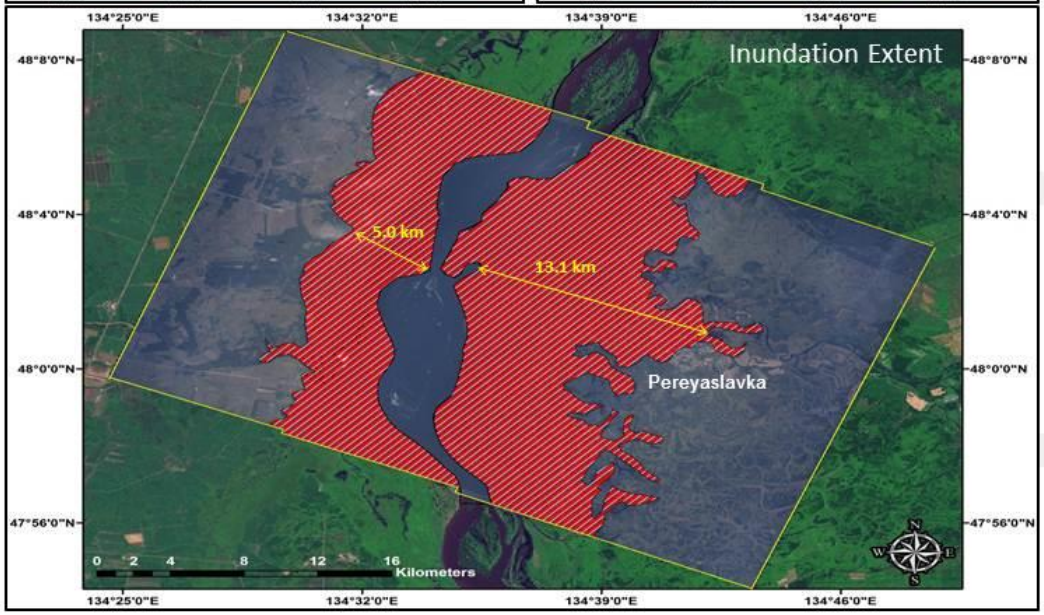
- By analyzing the number of pixels with reduced light and tracking the affected population, applications of DNB data can be used to identify initial impacts and monitor overall recovery.
- Through automation of DNB-derived products and other geospatial data, additional information can be provided to disaster managers.



	4/2/2014		4/3/2014		4/7/2014	
	Arica % Affected	Iquique % Affected	Arica % Affected	Iquique %Affected	Arica % Affected	Iquique % Affected
Total Population	204,933	285,541	204,933	285,541	204,933	285,541
0 - 25% of Normal	54.27%	71.38%	0.16%	40.68%	0.03%	0.11%
26 - 50% of Normal	45.33%	24.06%	6.65%	28.60%	0.53%	6.49%
51 - 100% of Normal	0.40%	4.56%	93.19%	30.72%	99.44%	93.40%

Evolution of the outage-affected population as measured by DNB change products.

Khabarovsk - RUSSIA
Flood – 9/8/2013
Inundation map



Cartographic Information

Scale - 1:200,000 Resolution - 5 m

Coordinate System: WCS WGS 1984

Legend
- Inundation Extent
- Normal Ussuri River Bank Level
- i-cubed 15m eSAT imagery
- ISERV Image 9/8/2013

Map Information

Starting in July 2013, excessive rainfall led to the worst flash flooding in 100 years along the Ussuri river near Pereyaslavka, Russia. Water levels peaked on 8/21 around 8.1 m above normal, displacing more than 17,000 people throughout the Khabarovsk region. ISERV captured three images which show the extent of flooding. This map, if provided in a timely manner, may be used to assist first responders or to provide general information regarding estimated impact.

Estimated Impacts	
Flooded Area (km²)	410
Population (inhabitants within inundation extent)	1,163

Science & Application

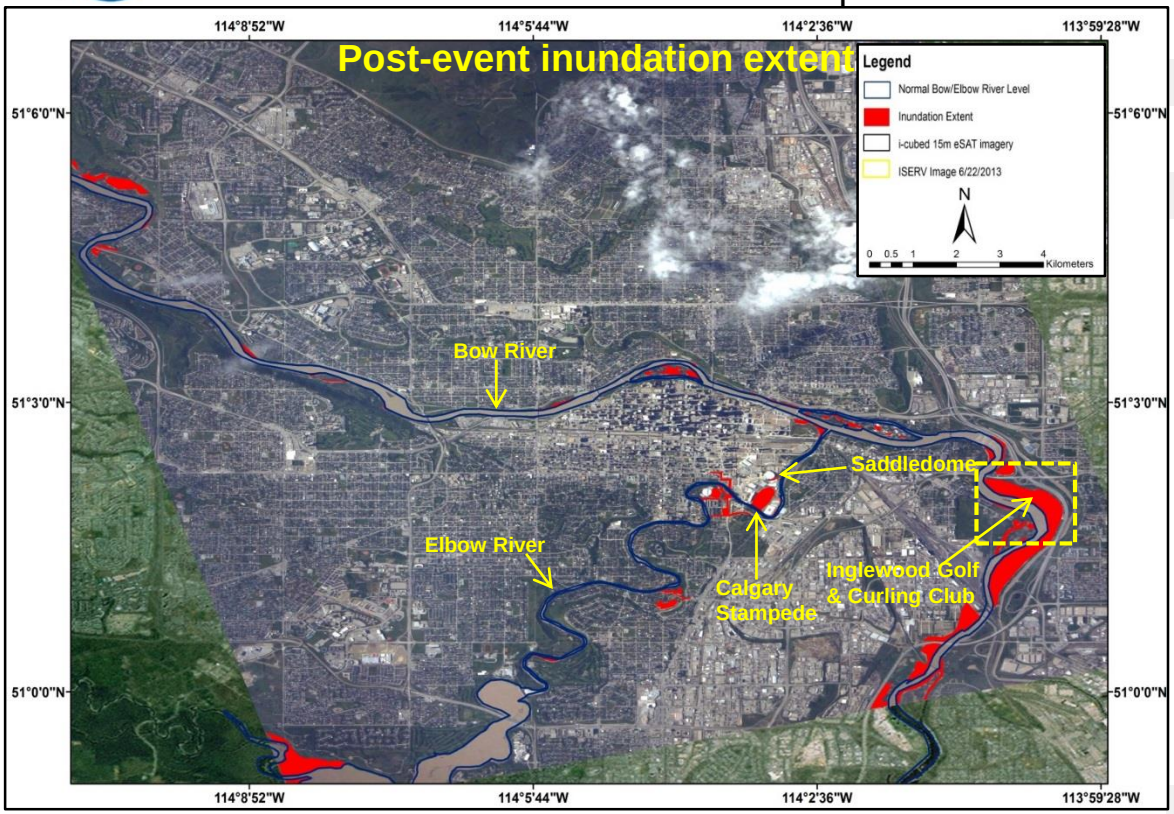
The ISERV image was flat field corrected and georeferenced using i-cubed 15m eSAT imagery (est. image offset 70 m) prior to analysis. A pre-event river bank extent was then digitized using ArcMap 10.0. Lastly, areas of inundation were digitized using an ISERV image captured 17 days after the peak of flooding. The Ussuri river expanded laterally following heavy rainfall, roughly 5 km to the northwest and 13 km to the southeast. Islands within the river appear mostly inundated in the ISERV image. Also, Pereyaslavka appears to have sections impacted by the water. It should be noted the analysis does not show inundation depth, only lateral extent of flooding.

Data Sources/Map Production

- Pre-event imagery: i-cubed 15m eSAT imagery
- Post-event imagery: ISS SERVIR Environmental Research and Visualization System (ISERV) (acquired on 9/8/13 03:43:49 GMT, minimal cloud coverage)
- Population data: Oak Ridge National Laboratory Landscan 2012
- Map produced on 6/8/14 by Tony Cole. (tony.a.cole@nasa.gov)

SPoRT team member Tony Cole (UAH) has helped to establish disaster response templates, using ISERV and pre-event ESRI imagery to generate products of interest to the international disaster response community.

Calgary - CANADA
Flood – 6/22 - 6/24/2013
Inundation map



Cartographic Information

Scale - 1:55,000 Resolution – 3.45 m

Coordinate System: WCS WGS 1984

Event Information

On June 20, 2013, Calgary broke its own record for rainfall received in a single day with 45 mm (1.77 in). Combine that with an estimated overall total of 200 mm (7.87 in) in some places and flooding in the area was inevitable. By June 22, 2013, when ISERV began capturing images of flooding that put much of Calgary underwater, 75,000 people had become flood evacuees, with 1,500 of those turning to emergency shelters for protection. The Saddledome, home ice arena for the Calgary Flames, had water up to its 10th row while much of the Calgary Stampede was also submerged.

Estimated Impacts	
Flooded Area (km^2)	4.1
Population (inhabitants within inundation extent)	108,000
Affected city amenities	15
Affected hardscapes, parking lots, promenades	108
Affected attractions, schools, community centres	10
Affected natural & anthropogenic habitats	168
Affected streets and roads	14
ENMAX electric customers without power	30,000
Number of people rescued via helicopter by the Royal Canadian Mounted Police	800

Science & Application

Three ISERV images were flat field corrected and georeferenced using i-cubed 15m eSAT imagery (est. image offset 20 m) prior to analysis. A normal conditions river bank shapefile was then downloaded from Calgary's website. Lastly, the extent of inundation for each date was digitized in a GIS environment (ArcMap 10.0) using information in each ISERV image. The Bow and Elbow rivers expanded laterally following heavy rainfall, roughly 300 m near the golf course and 200 m surrounding the Calgary Stampede. Islands within each river also appear mostly inundated in the imagery. Most importantly, flooding near the Inglewood Golf and Curling club, located on the eastern bank of the Bow, can be monitored using our time series of ISERV images. On 6/22, most of the fairways were inundated but recession can be seen by 6/23 and almost full recovery in the 6/24 image.

Mostly inundated from river bank to highway

Some fairways back to normal, many still submerged

Near full recovery and return to normal conditions

Data Sources/Map Production

- Pre-event imagery: i-cubed 15m eSAT imagery
- Post-event imagery: ISS SERVIR Environmental Research and Visualization System (ISERV) (acquired on 6/22/13 23:43:49 GMT, 6/23/13 01:20:35 GMT and 6/24/13 00:31:51 GMT, minimal cloud coverage)
- Population data: Oak Ridge National Laboratory Landscan 2012
- Ancillary city data: https://cityonline.calgary.ca/Pages/Home.aspx
- Event Information: http://www.huffingtonpost.com/2013/06/22/calgary-floods_n_3482600.html and http://www.cbc.ca/news/canada/calgary/why-alberta-s-floods-hit-so-hard-and-fast-1.1328991
- Map produced on 6/16/14 by Tony Cole. (tony.a.cole@nasa.gov)

Summary

- SPoRT and SERVIR are natural partners given their mutual interest in research to operations and capacity building activities
- SERVIR provides support to SPoRT team members, leveraging our capabilities to meet the needs of their regional hubs and disaster response activities
- We expect this partnership to grow through new opportunities with SERVIR, the SERVIR Applied Science Team, and other international activities