AIRS Applications

Status, Applications vs. Traditional Science

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Session Objectives

educate and inspire

program NASA Applied Sciences

definition applications, different from traditional science

exposure examples of how science is being applied

support services, tools

feedback

AIRS Applications: where we're at

Level 4 Products	• **Drought Indicator, JPL** • **Drought Indicator, UCI** • **Vector Borne Disease** • **SO2 concentration** • **Volcanic Ash Burden/Ash, Dust Height** • **Volcanic, Algorithm comparisons** • **Temperature Inversions**
Tools	• **Applications Browse Tool** • **AIRS Data Explorer (local GIBS instance)**
Map-making infrastructure	• **L3 map prototyping** • **L2 maps, GIBS format** • **Operational production: LANCE** (NRT) & **GES DAAC, both send to GIBS** (DAAC supports Big Earth Data Initiative)
Internships	• **NASA Applied Sciences DEVELOP program** • **summer intern**
Partners	• **NASA Applied Sciences, LANCE, GES DAAC, SPoRT** • **SCAQMD, NOAA Oxnard Field Office**
Conferences	• **AGU, AMS**

AIRS contribution to BEDI

BEDI Big Earth Data Initiative

- Obama Admin effort to make earth data and applications accessible
- improve discoverability, accessibility, usability
- open access and machine readable
- support societal benefit areas

NASA's role:
provide accessibility, tools

EOSDIS approach:

- enhance GIBS *Global Imagery Browse Services* capability (provides pre-generated full resolution browse imagery of NASA Earth data)
  - links to the underlying data
  - greatly expand number of data sets
  - each image has companion GIS version
- access NASA browse images & data through **search.earthdata.nasa.gov** (images from GIBS)

EARTHDATA Powered by EOSDIS + GIBS

EARTHDATA Data Discovery DAACs Community Science Disciplines

EARTHDATA Search

carbon monoxide

Feedback Earthdata Login

Browse Collections

Features

- Map Imagery
- Near Real Time
- Subsetting Services

Keywords

- AGRICULTURE 6
- ATMOSPHERE 206
- BIOLOGICAL CLASSIFICATI… 3
- BIOMASS 1
- BIOSPHERE 20
- CLIMATE INDICATORS 4
- CRYOSPHERE 6
- HUMAN DIMENSIONS 41
- LAND SURFACE 35
- OCEANS 35
- PALEOCLIMATE 2
- SOLID EARTH 6
- SPECTRAL/ENGINEERING 12
- TERRESTRIAL HYDROSPHE… 5

Project

Processing level

Organization

Platform

Instrument

229 Matching Collections

Add collections to your project to compare and retrieve their data.

Learn More

Search Time: 1.2s

Report a metadata problem

No image available

LBA-ECO CD-10 CO, CO2 and Meteorological Data, Maxaranguape, Brazil

doi:10.3334/ORNLDAAC/1012 v1 - ORNL_DAAC

2003-01-04 to 2006-12-27 | 1 Granule

No image available

NAMMA CARBON MONOXIDE BY ATTENUATED LASER TRANSMISSION (COBALT) V1

namcobalt v1 - GHRC

2006-08-07 to 2006-09-12 | 16 Granules

No image available

SAFARI 2000 MOPITT Tropospheric Carbon Monoxide, Southern Africa, Dry Season 2000

doi:10.3334/ORNLDAAC/835 v1 - ORNL_DAAC

2000-08-01 to 2000-09-30 | 1 Granule

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MLS/Aura L2 Carbon Monoxide (CO) Mixing Ratio V003

ML2CO v003 - GESDISC

2004-08-08 ongoing | 3935 Granules

NRT

No image available

MLS/Aura Near-Real-Time L2 Carbon Monoxide (CO) Mixing Ratio V003

ML2CO_NRT v003 - GESDISC

2016-01-08 ongoing | 644 Granules

AIRS imagery, operational production

BEDI → NASA → EOSDIS → GIBS

AIRS near real-time
L2 images
LANCE-to-GIBS

- Land Atmosphere Near real-time Capability for EOS
- NRT image-making pipeline to GIBS
- New visualization algorithm from AIRS Project ready for delivery

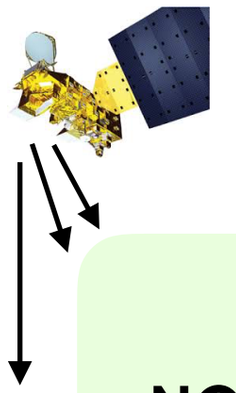
AIRS non-NRT
L3 images
Goddard DAAC-to-GIBS

- images created operationally in GIOVANNI
- GIOVANNI-to-GIBS pipeline

***BEDI Deliverable*:**
By end of FY, all AIRS standard products represented in GIBS

- **AIRS Project supplies colorbar, mins, maxes**
- **Coordination: AIRS imagery in GIBS has consistent colorbar/ scaling in GIBS, whether from L2 or L3**

AIRS pathway to GIBS



NOAA → **L1B** → **National Weather Service**

GES DAAC *operational* → **L1B** **L2** **L3** → **GIOVANNI** create imagery of all standard products → **L3 images**

LANCE *near real-time* → **L1B** **L2** → **LANCE image making code** select products only → **L2 images**

new JPL visualization code inserted here → **LANCE image making code**

GIBS image repository images available via service requests only

Public Access

Earthdata gateway (BEDI reqt)

Worldview

AIRS Browse Tool

ArcGIS

more…

Defining “Applications”

it’s not research

“our data could be used in a model that shows…”

it’s not PR

“NASA Earth scientists gave a hyperwall presentation to members of the World Bank Agricultural delegation to inform them that NASA has several data products that can be used to determine agricultural yields…”

NASA Applied Sciences Program

"Welcome to the NASA Applied Sciences Program. The Program *funds projects that enable innovative uses of NASA Earth science data in an organizations' policy, business, and management decisions.* The project results and enhanced decision making improve the quality of life and strengthen the economy."

"Discovering innovative and practical uses of Earth observations"

Applications

Science products **that are**

used by decision makers

or are in a

decision making pipeline

Converting science information into products for use by decision makers

But now, a
NEW ORDER OF BUSINESS:

For every application we consider, we *first* identify decision making pipelines

decision-making pipeline

the path that starts at data and ends with a decision-maker

the task is to identify those steps in between

Why know the pipeline?

We can identify where our product would have relevancy and who might be interested in it. *Discuss product concept with this group, get feedback, guidance*

We can ask people in the know about the M.O. of decision makers—*d.m. needs may be less refined than what we assume*

Can determine if we're going to step on toes

see the conduits to the appropriate organizations

gain trust—when introduce product it shows we've done our homework, we know the context

benefits

save time and money

make a better product

cultivate partners, advocates

improve chance of successful outcome

Applications

(it ain't traditional science)

When it comes to applications,

“The perfect is the enemy of the good”

Mike Wimberly & EPIDEMIA

An applications development model

EPIDEMIA —
South Dakota State's integrated system for surveillance and forecasting of malaria epidemics

EPIDEMIA system includes:

public health interface
uploading and querying weekly surveillance reports

algorithms
automatically validate incoming environmental and epidemiological data and update database

surveillance database

Michael Wimberly, Michael Devos, Geoffrey Henebry, Yi Liu, Chris Merkord

South Dakota State University

Gabriel Senay

USGS Earth Resources Observation and Science Center, Sioux Falls SD

Estifanos Bayabil, Mekonnen Bishaw, Alemayehu Lemma, Abere Mihretie

Health, Development, and Anti-Malaria Association, Addis Ababa Ethiopia

Belay Beyenne

Amhara Regional Health Bureau, Bahir Dar Ethiopia

Worku Yalew

College of Medical and Health Sciences, Bahir Dar University Ethiopia

First —

Saw the need and had the contacts in Ethiopia

Second —

Talked about idea with Ethiopian contacts

determine if they were interested

Third —

Requirements workshop

Ethiopia collaborators and scientists

- Nonprofit executive director helped identify key players
- Participants: scientists, programmers, Ethiopian university collaborators, doctors, and health workers

Hashed out requirements/needs/issues

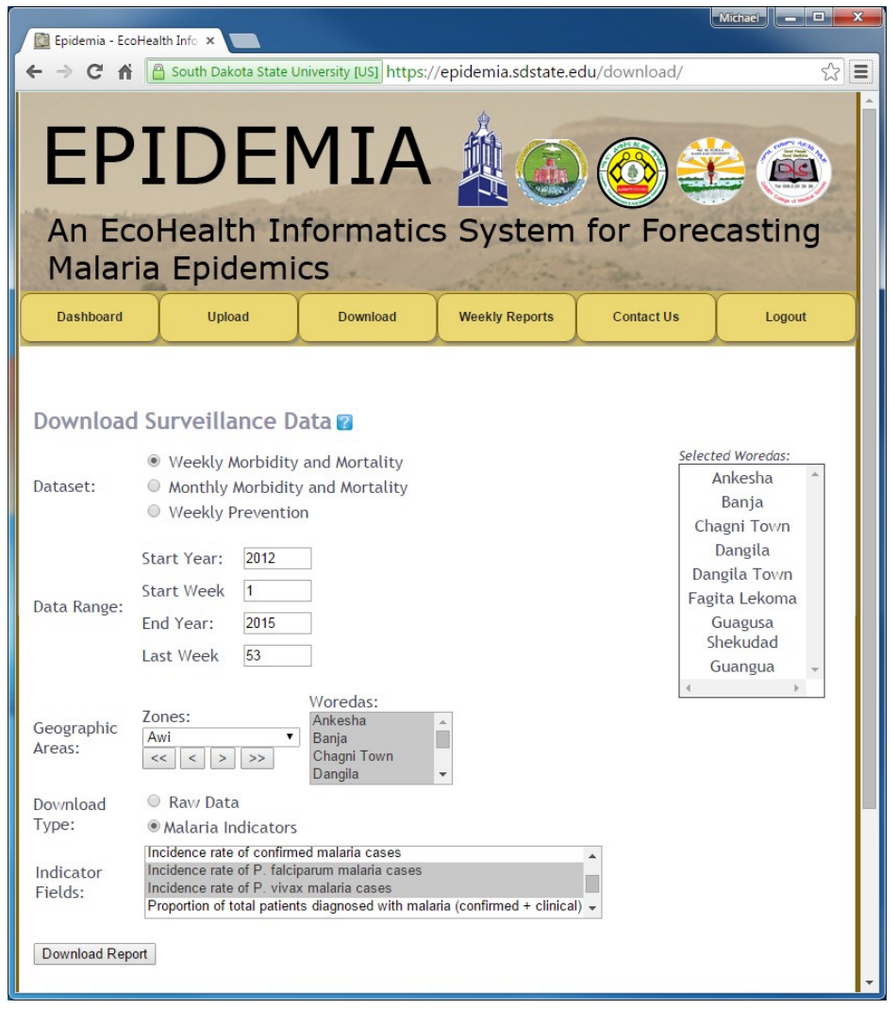
- Ignorance from both sides
- **Ethiopians didn't know what was possible**
- **scientists didn't know what was needed**

Post workshop

- "kept in touch all the time"
- first year, live forecasting
- Chris Merkord (SDSU) sent messages about epidemiological data, then sent reports every week during malaria season

Validation data

- get data directly from regional health bureau (weekly data at the district level)
- Health bureau uploads data into their outbreak prediction system
- "It aint perfect, there are time lags (1 week latency), and problems with spatial points

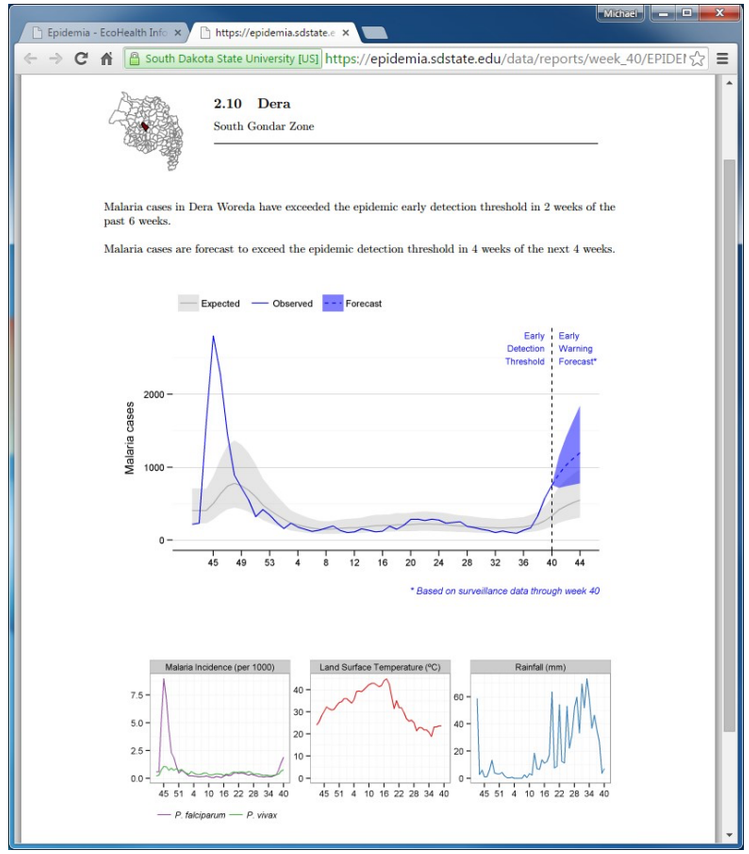


How do we deal with uncertainty?

- Don't give error estimates. "We don't give error estimates with weather forecasts, but people are comfortable with that"
- Pushed out the forecast. "We knew it wasn't good but we linked it to validation"
- Every week model was validated

Product refinement

- Misinterpretations with the forecast reports
- Solicited feedback—it turned out reports were confusing to end users
- Worked with end users to hone forecast reports so text and graphics made sense to recipients

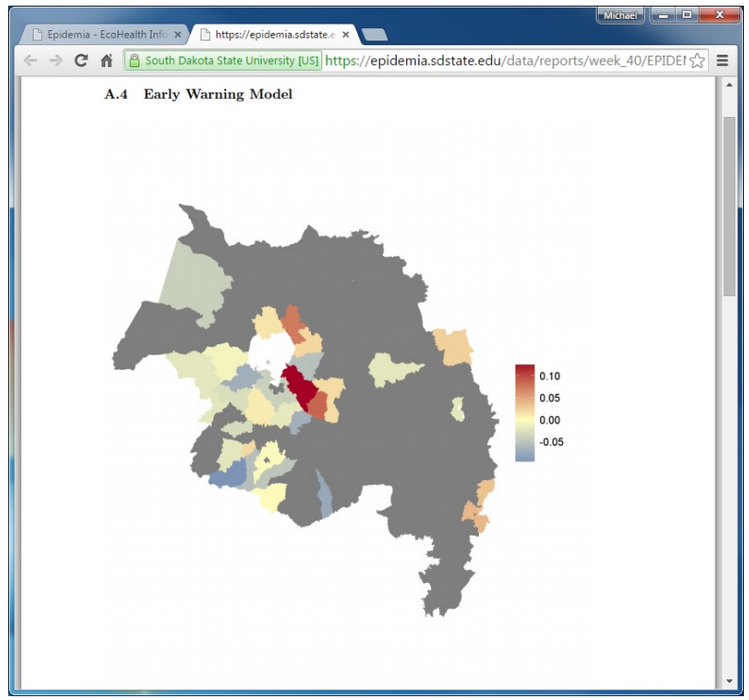


Transition Plan

- Ultimately the idea is to transfer the technique to Ethiopia.
- This needs capacity building, (example: they need a statistician in Addis Ababa)
- Possible that NIH continues funding the research and USAID runs the tool
- "My thought in our own planning, we need to brainstorm what the transition plan is"

Labor

- 1 PI and 2 Co-I's, 1FTE programmer, 1FTE post-doc analyst
- Paid colleagues in Ethiopia via NGO Health, Development, and Anti-Malaria Association, Addis Ababa Ethiopia
- Funding from NIH (5 years), currently at start of year 2



“Ultimately you just gotta start doing something. At a certain point you just have to blunder in and do this. If you wait until you have a perfected model, you end up not doing anything. The perfect being the enemy of the good. Look at the history of weather forecasting, they just jumped in and did it.”

— Mike Wimberly

A chat with David Green—
Program Manager, NASA Applied Sciences Natural Hazards

rethink "end user"
intermediary groups or brokers often better suited to reach decision makers
NGOs, commercial companies…

new types of partners
think about non-traditional partners that deal with economic impacts, social impacts, or 2nd or 3rd order effects that result from the actual environmental event

collaborate from the get-go
stressed the importance of including brokers or end users at the beginning of the process to inform how the application is developed

ROSES
Working on a ROSES call that will require a broker or end-user be a partner
that doesn't mean just having a letter of partnership

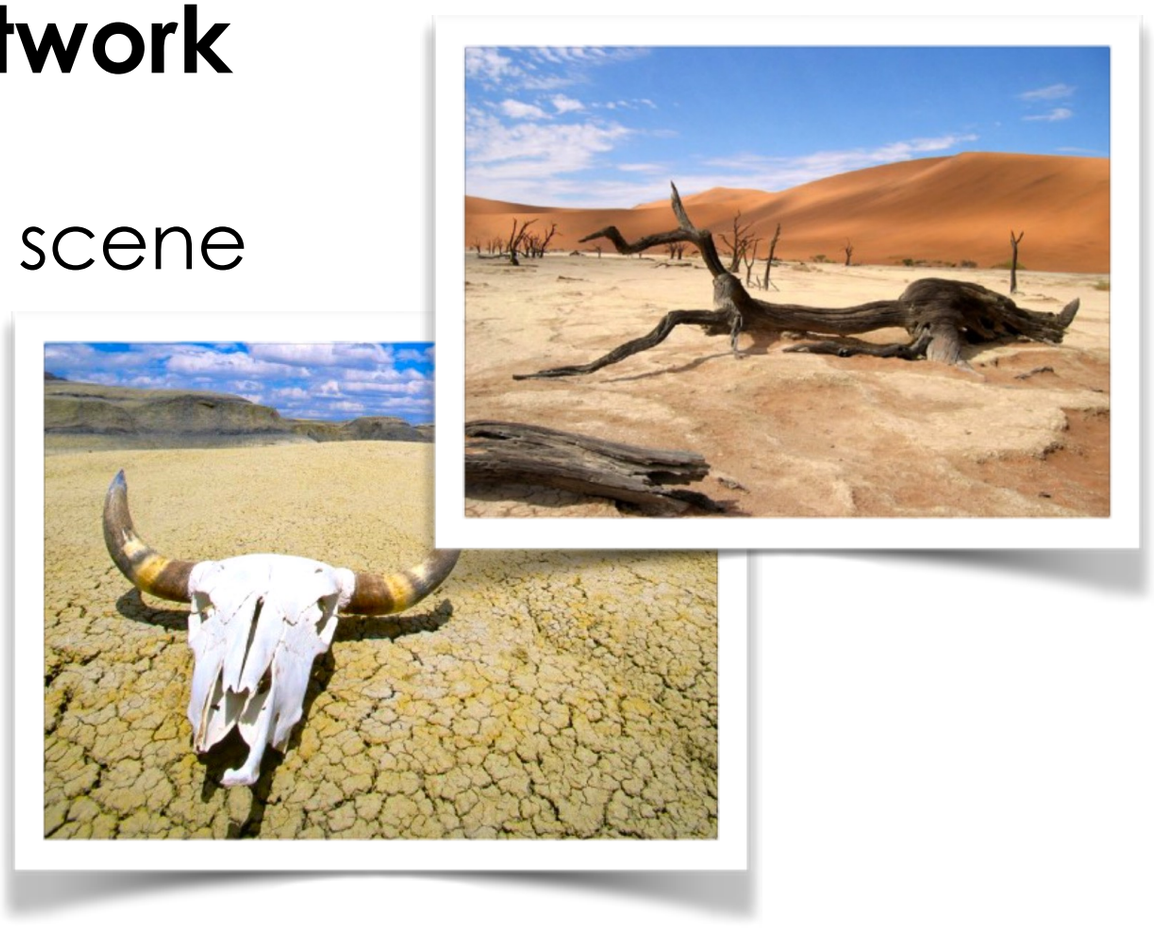
good enough is ok

Applications do not need perfect products. Make a messy demonstration product and get in the dirt with it. This is where the fun is.

RELATIONSHIPS MATTER

and they must be cultivated

- **organization/groups along a decision pipeline are often a tight knit community**
- **people know each other, trust is key**
- **trusted workflow and network**
  they won't necessarily use a product that appears on the scene *(if you build it, it's likely to be ignored)*



Example: Volcano Decision Pipeline

Potential AIRS Volcano Products

SO2 Flag

SO2 Retrieval

Dust Flag

Dust Plume Height Retrieval

SO2 Flag

SO2 Retrieval

Dust Flag

Dust Plume Height

T

q

Spectral Analysis Tool

Volcano Decision Pipelines

standard product

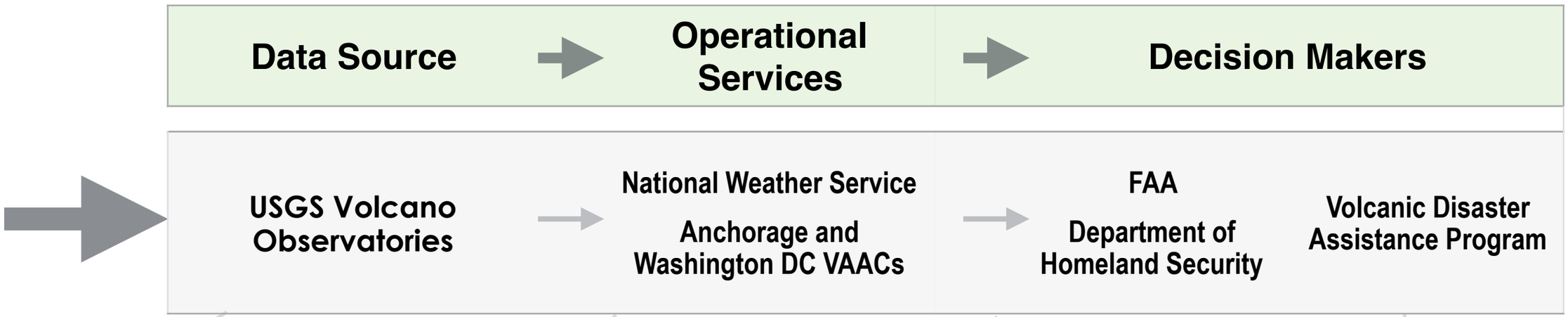
L4 product or tool

Multiple Volcano Decision Pipelines*

	Data Source	Operational Services	Decision Makers
U.S.	USGS Volcano Observatories	National Weather Service Anchorage and Washington DC VAACs	FAA Department of Homeland Security VDAP
U.S.	*USGS* *UK Met Office* *other data suppliers*	USAF Air Weather Service	DOD Agencies
U.K.	*Data suppliers*	UK Met Office London VAAC	CAA & NATS Airline SRAs
Int'l	ICAO & WMO		

**Note:*
These pipelines are used to understand the pathway to decision-makers. AIRS products are not currently in these pipelines.

U.S. Volcanic Emissions Decision Pipeline



VOs

- 5 observatories monitor/report on eruptive behavior
- Develop research models of ash dispersion and ashfall
- Sends reports to the NWS

NOAA NWS

- Run operational ash dispersion models
- Formal guidance about what to do comes from the NWS
- NWS gets *its* guidance and information from the USGS

NOAA Volcanic Ash Advisory Centers

- Only deal with ash—they report the extent and movement of ash
- The National Weather Service is really the VAAC

FAA

Looks at NWS products and makes aviation-related decisions

Department of Homeland Security

Decides on whether there should be an evacuation

VDAP

- USGS + Office of Foreign Disaster Assistance partnership, developed/ funds VDAP
- Developing countries contact US State Dept which contacts VDAP
- Responds to select volcanic crises worldwide, works to reduce fatalities, economic loss
- Works through USAID, USGS scientists rapidly respond with consultation, forecasting, remote sensing data, monitoring equipment
- Between crises VDAP works with international partners to build/ improve volcano monitoring systems; conducts joint activities to reduce volcanic risk and improve understanding of volcanic hazards
- Jewel in the crown of the USGS

U.S. Volcanic Emissions Decision Pipeline - *Military*

Data Source	Operational Services	Decision Makers	
Data Suppliers: USGS, UK Met Office, others?	Air Force Weather Agency	Air Force Directorate of Weather	DOD agencies

Collaboration in the U.S. for volcanic emissions

- USGS, NOAA, FAA, and Air Force Weather Agency collaborate according to International Civil Aviation Organization (ICAO) guidelines
- Share data and refine communication protocols so that necessary information reaches commercial and military pilots, dispatchers, and air-traffic controllers quickly

AFWA at Offut AFB, Nebraska

- provides terrestrial and space weather products necessary to effectively plan and conduct military operations at all levels of war.
- operates satellite data processing center and centralized climatology center with largest military archive of meteorological data in the world
- AFWA's meteorological satellite applications branch generates volcano summaries and monitors volcanic emissions for Department of Defense agencies
- operational backup for Washington VAAC

U.K. Volcanic Emissions Decision Pipeline

Data

- A combination of volcano data; satellite-based, ground-based and aircraft observations; weather forecast models and dispersion models
- The advisory is public

UK Met Office

- Issues reports on contamination products

London Volcanic Ash Advisory Center

- Run by Met Office, reports extent and movement of ash
- Gives evidence of what models and data say; does not make decisions
- Produces volcanic ash advisories and guidance products for eruptions originating in Iceland and north-east corner of North Atlantic
- Only northeast regions use concentration charts (due to Icelandic volcano)
- London VAAC provides reciprocal back-up facility with Toulouse VAAC operated by Meteo France

CAA + NATS (UK region)

- CAA is the statutory corporation which oversees and regulates all aspects of civil aviation in the UK
- CAA is a public corporation of the Dept. for Transportation
- NATS is the main air navigation service provider in the United Kingdom
- CAA + NATS are the decision-makers. They determine where it's safe to fly.

Individual Airline Safety Risk Assessments (UK region)

- Individual airlines make the call on whether they fly
- Different airlines may have different ideas about how to implement a safety risk assessment. Example, if British Airways says their planes can fly through X amount of ash, they can do so
- SRAs are not consistent

Aviation and Weather World Governance: *The ICAO and the WMO*

- **ICAO and WMO maintain close and constant cooperation**
- **review requirements of meteorological services for aviation and oversee adoption of procedures for the provision of these services**

ICAO

International Civil Aviation Organization

- United Nations specialized agency
- Manages the administration and governance of the Convention on International Civil Aviation
- Is the governing body over the WMO
- The ICAO is very strong now because of the Icelandic volcano

WMO

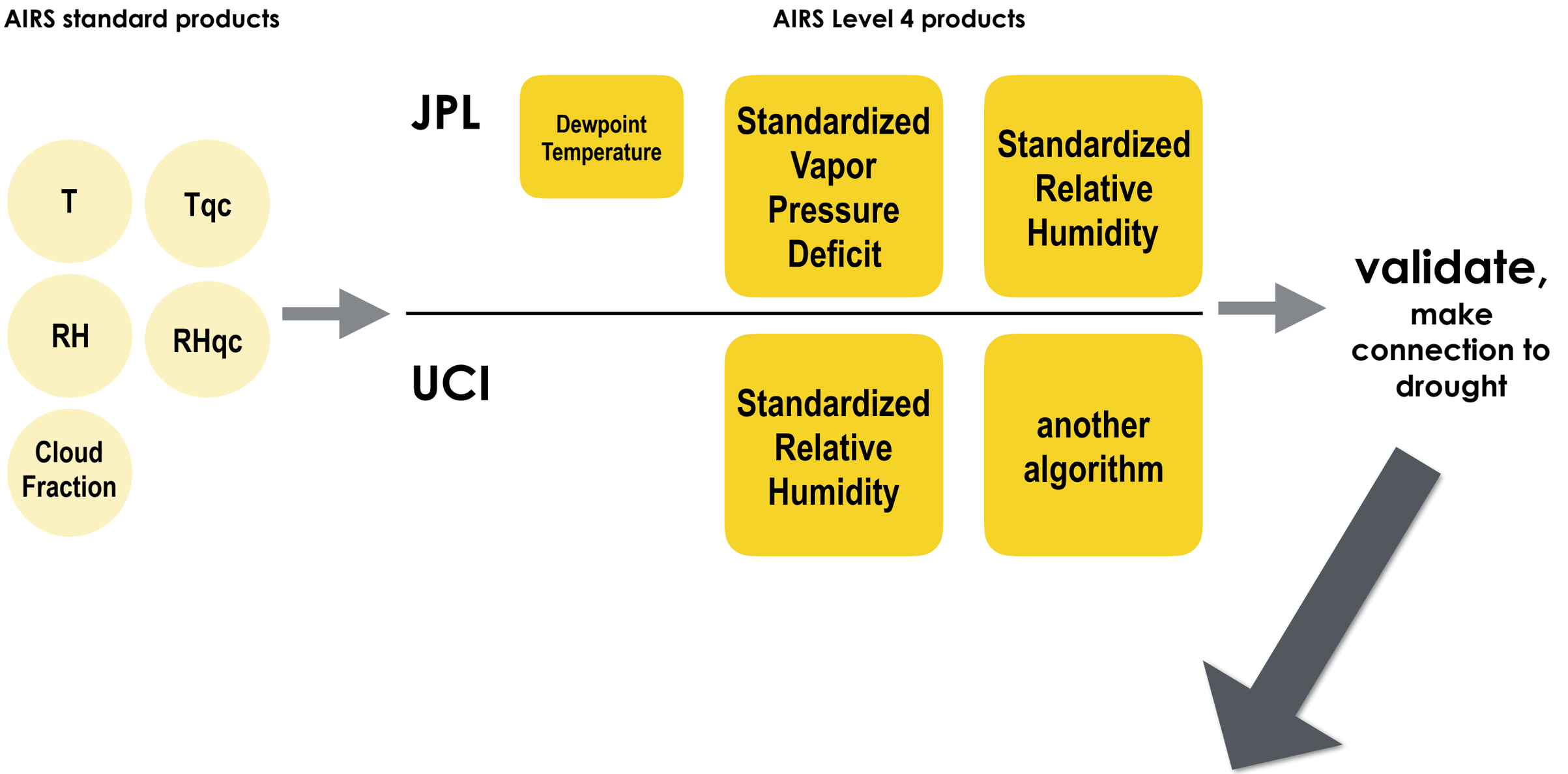
World Meteorological Association

- The WMO includes all the VAACS in the world, 9 VAACS meet once a year
- Kristi Wallace USGS suggested WMO would be interested in any products we have

Volcanic Ash Scientific Advisory Group

- Organized by WMO in cooperation with ICAO, created in 2011 after Icelandic volcano with goal of defining levels of ash concentration that are dangerous to aircraft
- Emphasis both on meteorological (remote sensing and in-situ observations, transport and dispersion modeling) & geophysical/volcanological such as eruption source parameters, ash characteristics, ash fallout and aggregation

AIRS Path to a Drought Application



Drought Decision Pipelines

DRAFT

U.S. and North America Drought Decision Pipelines*

	Data Source	→	Operational Services	→	Decision Makers
U.S. →	National Weather Service National Integrated Climate Prediction Center National Drought Mitigation Center	→	United States Drought Monitor	→	USDA State Agencies
U.S. →	National Weather Service	→	U.S. Drought Portal	→	State Agencies
North America →		→	North American Drought Information System	→	

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ELSEVIER

Remote Sensing Applications: Society and Environment

M.E. Brown

Editor-in-Chief, Remote Sensing Applications: Society and Environment
University of Maryland, College Park, Maryland, USA

The journal *'Remote Sensing Applications: Society and Environment'* (RSASE) focuses on remote sensing studies that address specific topics with an emphasis on environmental and societal issues - regional / local studies with global significance.

http://www.journals.elsevier.com/remote-sensing-applications-society-and-environment/

1

Good enough is OK

2

Decision pipelines for each AIRS application will be a necessary component