# THE NAMIBIA FLOOD DASHBOARD

Jill Hardy and Race Clark

# THE NATIONAL WEATHER CENTER

AND MANY MORE…

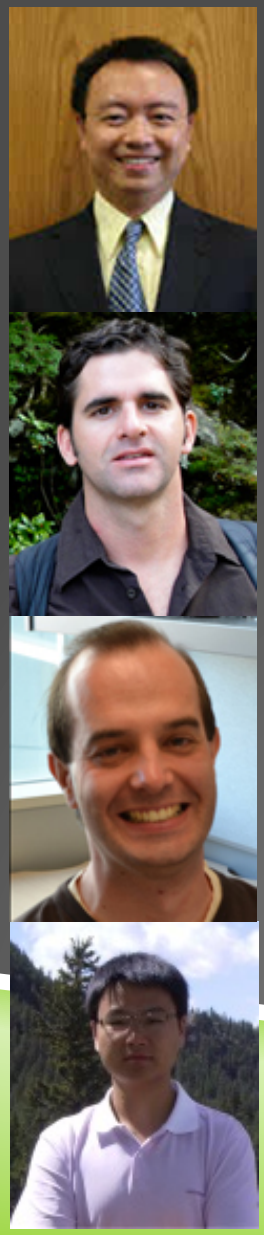
# HYDROMETEOROLOGY AND REMOTE SENSING LABORATORY

- Data Assimilation
- Quantitative Precipitation Estimation
- Flash Flooding and Landslides
- Remote Sensing

- 29 researchers
- Over 100 publications
- Product development
  - Global
  - National
- Partners around the world

# WORKING TOGETHER IN WATER, WEATHER, AND CLIMATE

**Faculty and Scientists**



**Postdocs and Visitors**

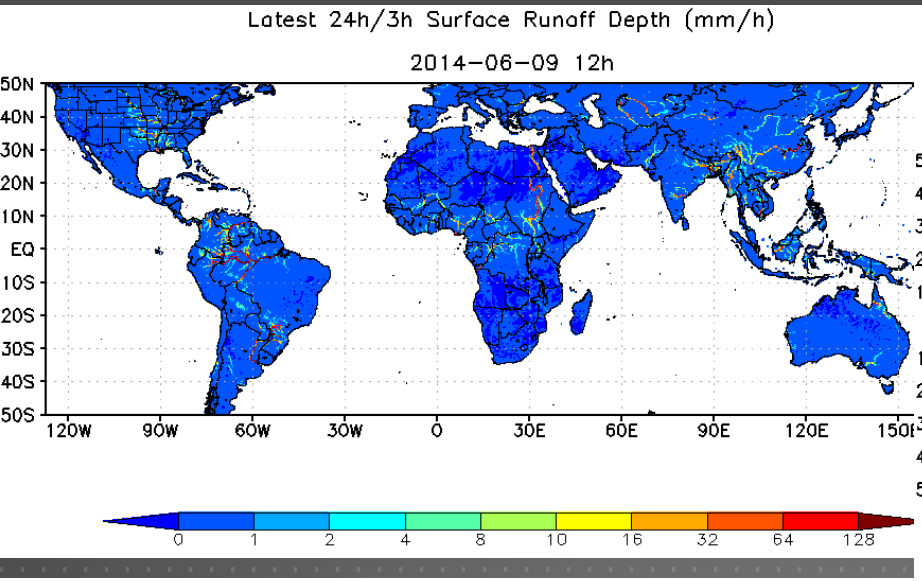
**Graduate Students**

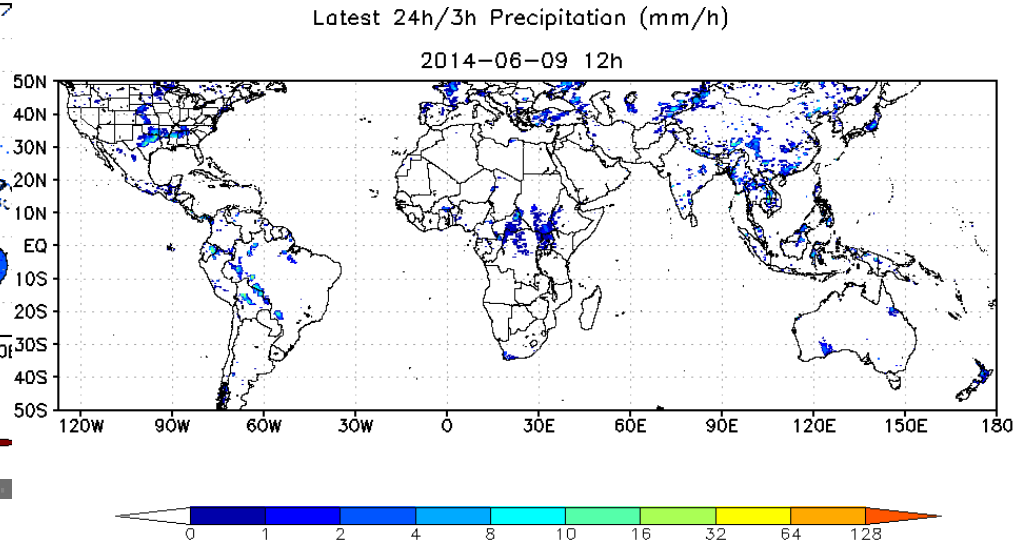
**Plus several undergraduate students and over 40 alumni…..**

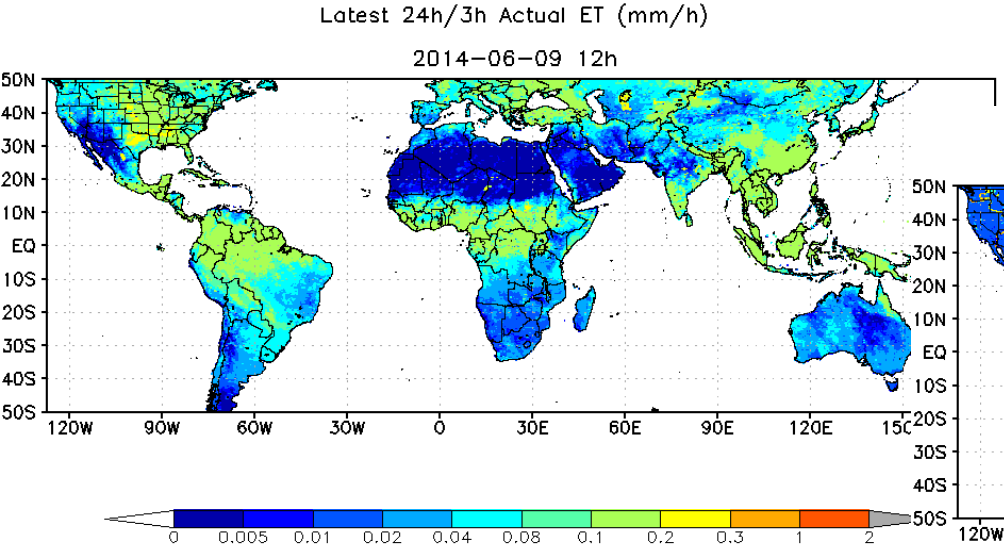
# PROJECT BACKGROUND

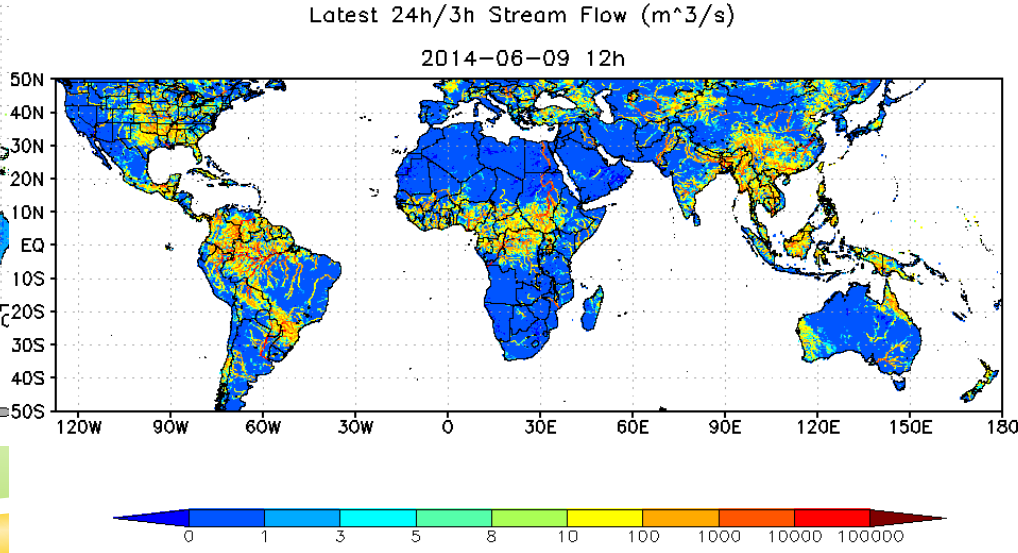
- NASA SERVIR - project with USAID to use satellites to help developing nations improve "environmental decision making"
  - Weather forecasts, flood forecasts, drought monitoring…
- CREST is a joint development between NASA and OU
- Namibia has highly variable climate; mostly arid or semi-arid; lots of floods and droughts

# GLOBAL HYDROLOGIC MODELING



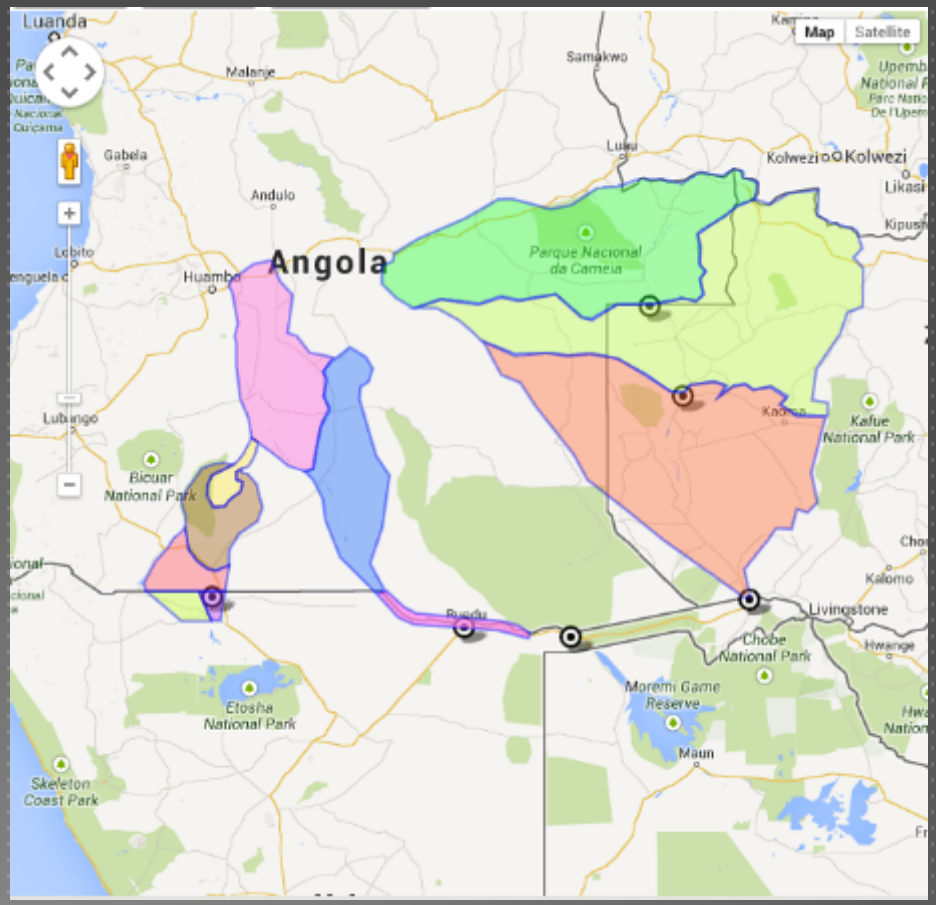



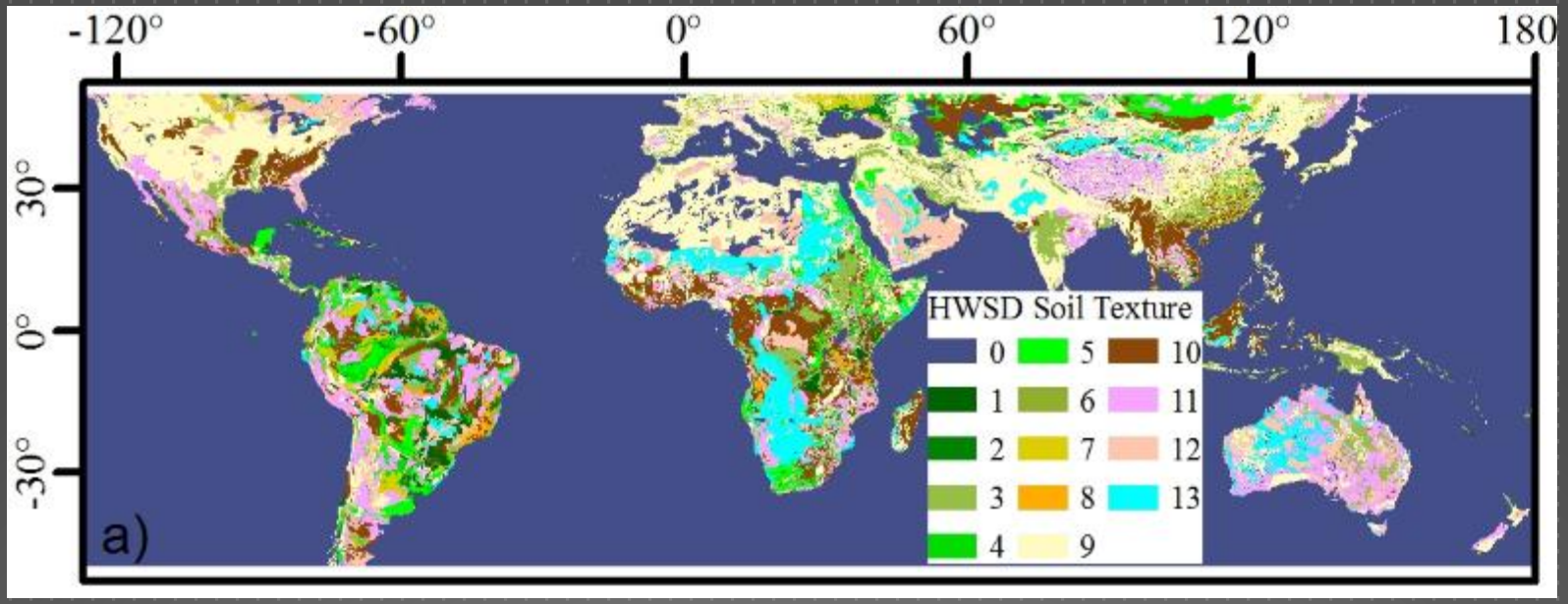



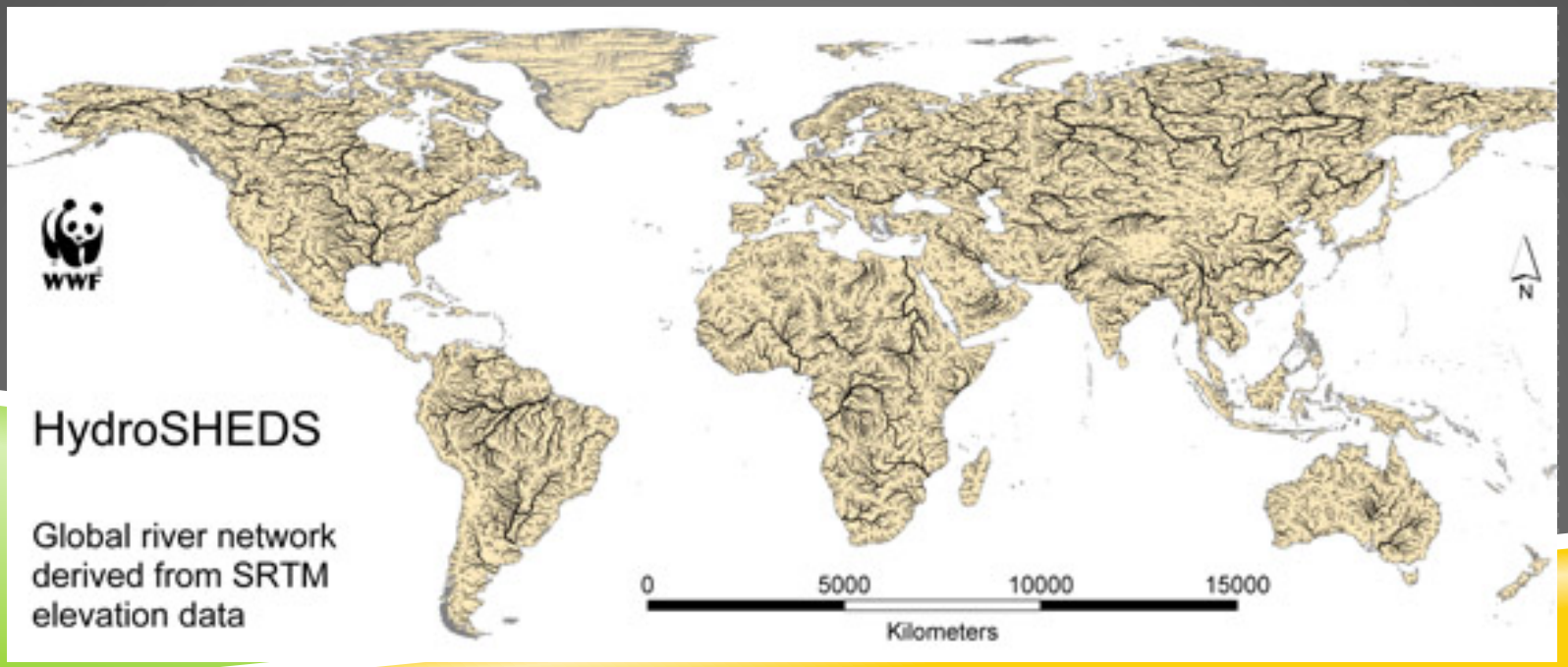
# CHALLENGES

- Resolution
  - Temporal: every 3 hours
  - Spatial: 0.25 deg latitude and longitude (~110 km at equator)
- Background data missing or incomplete
- Lack of observations (only six gauges) →
- No rain gauges
- Ephemeral rivers
- Endorheic rivers



# EXAMPLE DATA FOR MODELS

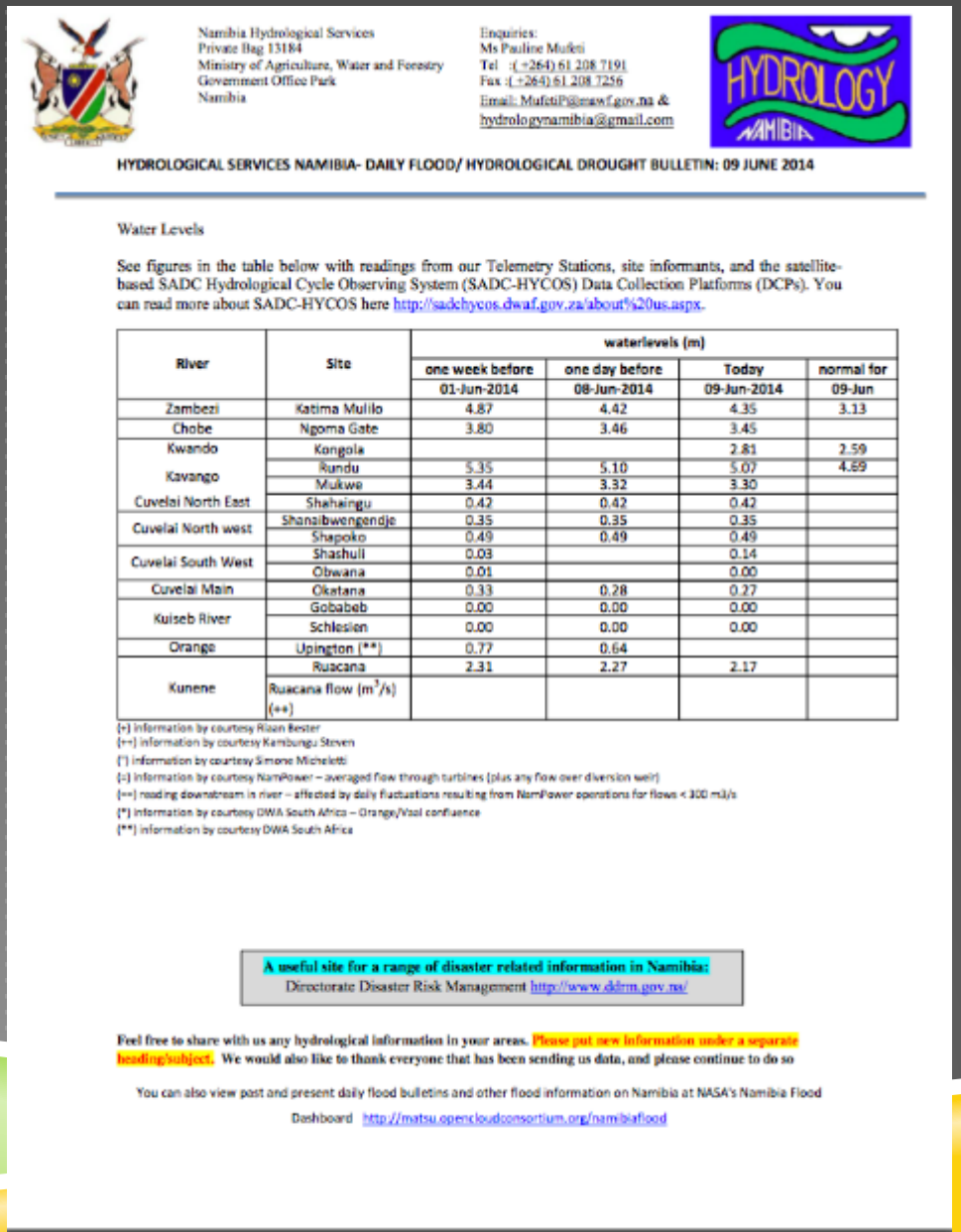


# NAMIBIA FLOOD DASHBOARD

matsu.opencloudconsortium.org/namibiaflood

Daily Flood Bulletin from the Namibia Hydrological Services →



Namibia Hydrological Services
Private Bag 13184
Ministry of Agriculture, Water and Forestry
Government Office Park
Namibia

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Ms Pauline Mufeti
Tel :(+264) 61 208 7191
Fax :(+264) 61 208 7256
Email: MufetiP@mawf.gov.na &
hydrologynamibia@gmail.com

HYDROLOGY NAMIBIA

**HYDROLOGICAL SERVICES NAMIBIA- DAILY FLOOD/ HYDROLOGICAL DROUGHT BULLETIN: 09 JUNE 2014**

Water Levels

See figures in the table below with readings from our Telemetry Stations, site informants, and the satellite-based SADC Hydrological Cycle Observing System (SADC-HYCOS) Data Collection Platforms (DCPs). You can read more about SADC-HYCOS here http://sadchycos.dwaf.gov.za/about%20us.aspx.

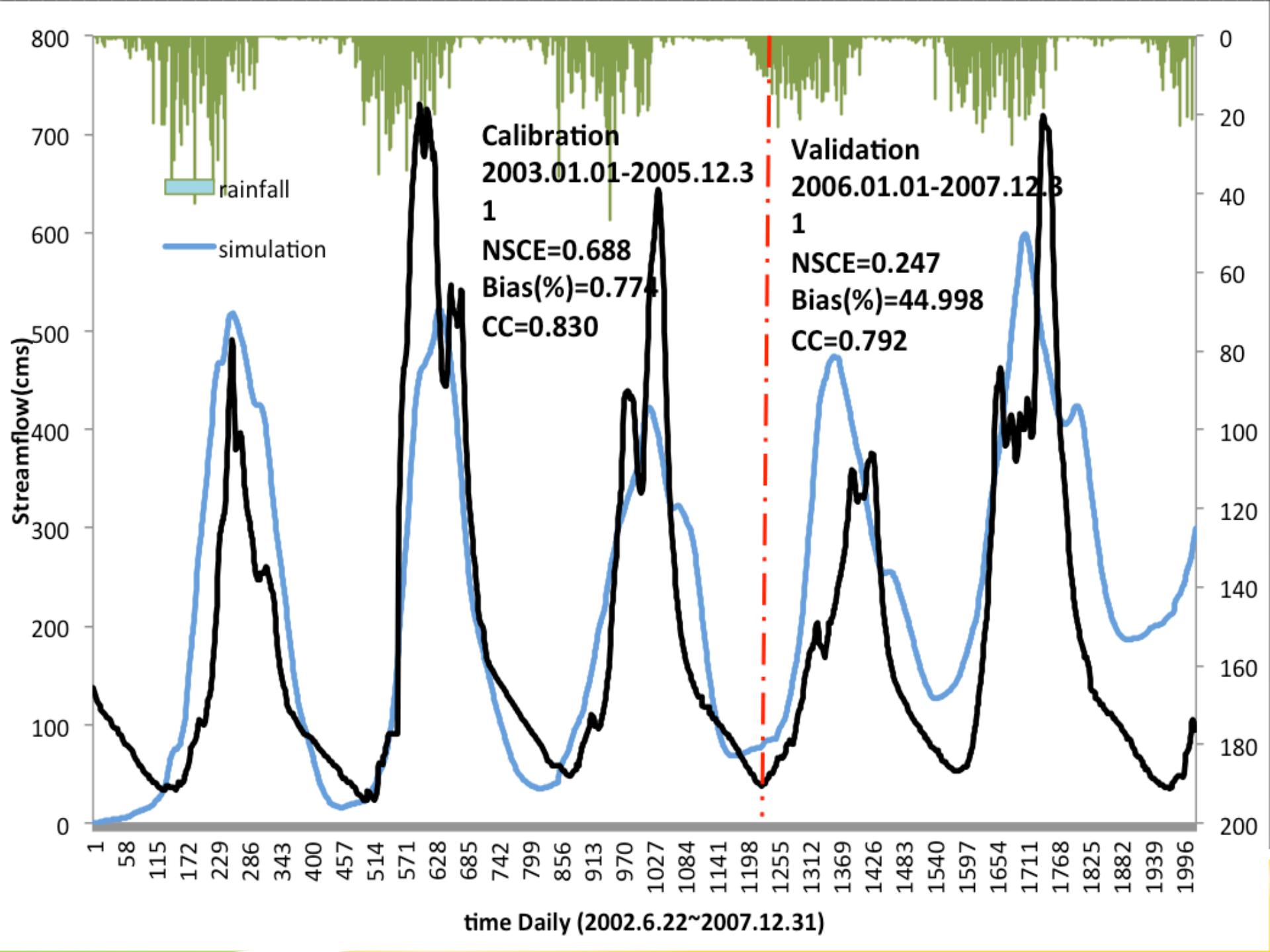
| River | Site | waterlevels (m) | | | |
|---|---|---|---|---|---|
| | | one week before | one day before | Today | normal for |
| | | 01-Jun-2014 | 08-Jun-2014 | 09-Jun-2014 | 09-Jun |
| Zambezi | Katima Mulilo | 4.87 | 4.42 | 4.35 | 3.13 |
| Chobe | Ngoma Gate | 3.80 | 3.46 | 3.45 | |
| Kwando | Kongola | | | 2.81 | 2.59 |
| Kavango | Rundu | 5.35 | 5.10 | 5.07 | 4.69 |
| | Mukwe | 3.44 | 3.32 | 3.30 | |
| Cuvelai North East | Shahaingu | 0.42 | 0.42 | 0.42 | |
| Cuvelai North west | Shanalbwengendje | 0.35 | 0.35 | 0.35 | |
| | Shapoko | 0.49 | 0.49 | 0.49 | |
| Cuvelai South West | Shashuli | 0.03 | | 0.14 | |
| | Otwana | 0.01 | | 0.00 | |
| Cuvelai Main | Okatana | 0.33 | 0.28 | 0.27 | |
| Kuiseb River | Gobabeb | 0.00 | 0.00 | 0.00 | |
| | Schlesien | 0.00 | 0.00 | 0.00 | |
| Orange | Upington (**) | 0.77 | 0.64 | | |
| Kunene | Ruacana | 2.31 | 2.27 | 2.17 | |
| | Ruacana flow ($m^3/s$) (++) | | | | |

(+) information by courtesy Riaan Bester
(++) information by courtesy Kambungu Steven
(') information by courtesy Simone Micheletti
(=) information by courtesy NamPower – averaged flow through turbines (plus any flow over diversion weir)
(==) reading downstream in river – affected by daily fluctuations resulting from NamPower operations for flows < 300 m3/s
(*) information by courtesy DWA South Africa – Orange/Vaal confluence
(**) information by courtesy DWA South Africa

**A useful site for a range of disaster related information in Namibia:**
Directorate Disaster Risk Management http://www.ddrm.gov.na/

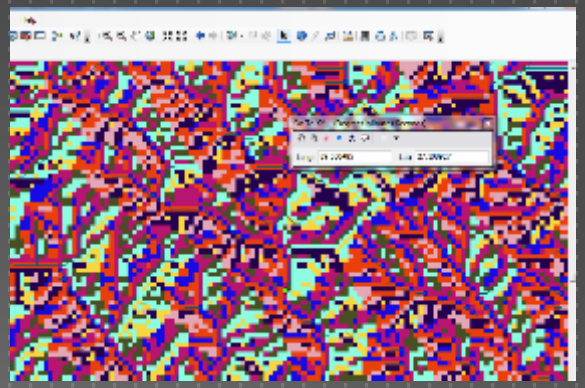
**Feel free to share with us any hydrological information in your areas. Please put new information under a separate heading/subject. We would also like to thank everyone that has been sending us data, and please continue to do so**

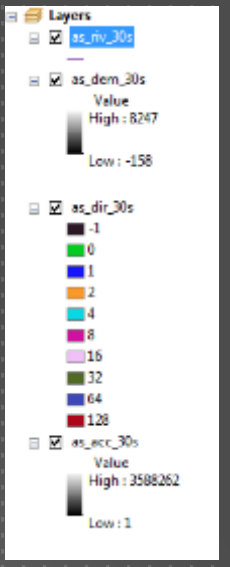
You can also view past and present daily flood bulletins and other flood information on Namibia at NASA's Namibia Flood Dashboard http://matsu.opencloudconsortium.org/namibiaflood

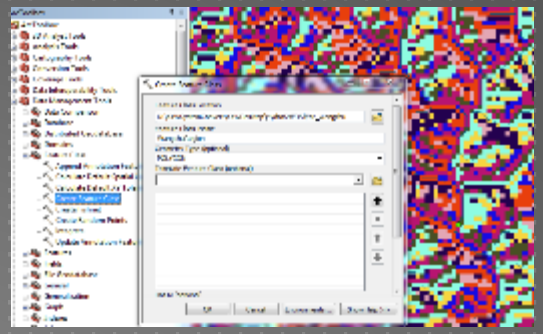

Calibration
2003.01.01-2005.12.31
NSCE=0.688
Bias(%)=0.774
CC=0.830
Validation
2006.01.01-2007.12.31
NSCE=0.247
Bias(%)=44.998
CC=0.792
rainfall
simulation
Streamflow(cms)
time Daily (2002.6.22~2007.12.31)
800
700
600
500
400
300
200
100
0
0
20
40
60
80
100
120
140
160
180
200
1
58
115
172
229
286
343
400
457
514
571
628
685
742
799
856
913
970
1027
1084
1141
1198
1255
1312
1369
1426
1483
1540
1597
1654
1711
1768
1825
1882
1939
1996

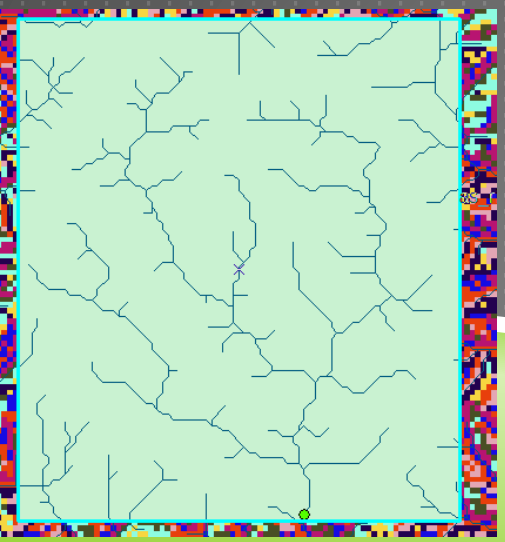
# NAMIBIA FLOOD DASHBOARD

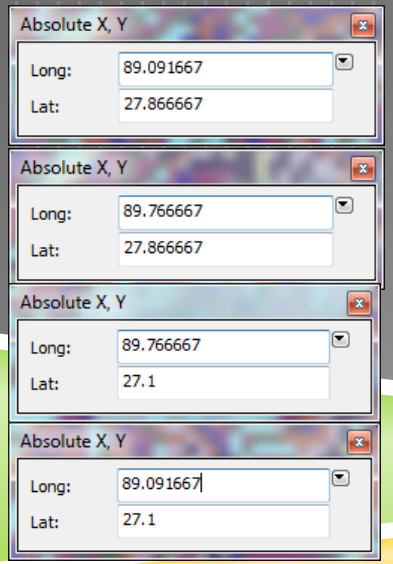
- Next steps include
  - CREST near-real-time forecasts for major river basins (6-12 hours)
  - Remote training (MOOC)
  - Higher-resolution distributed CREST over all of northern Namibia
  - Develop CREST examples in the cloud →

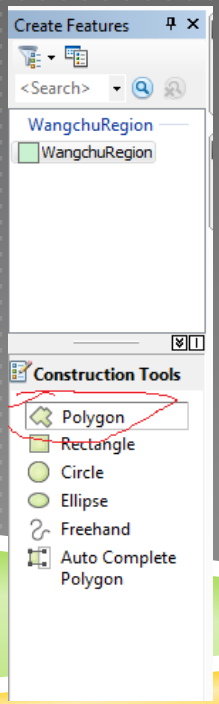


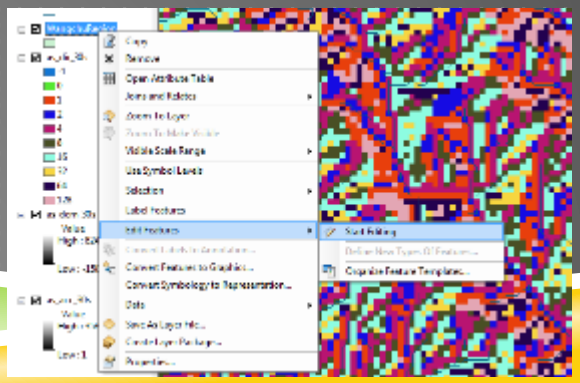




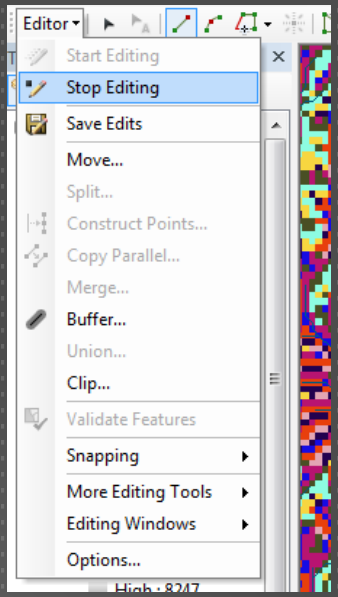


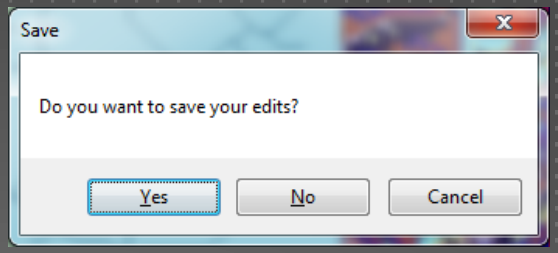



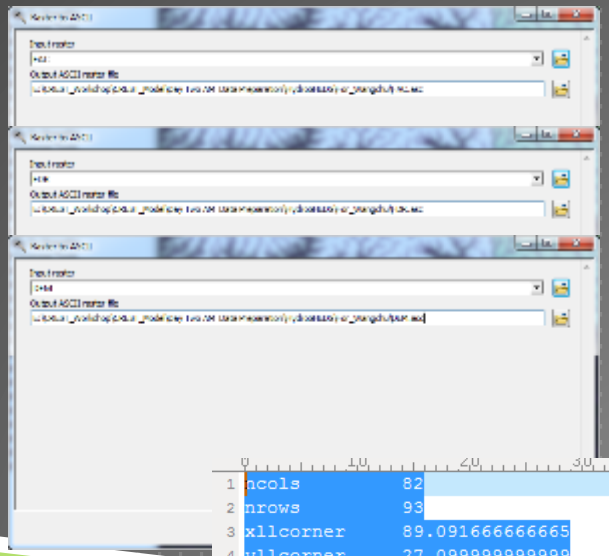



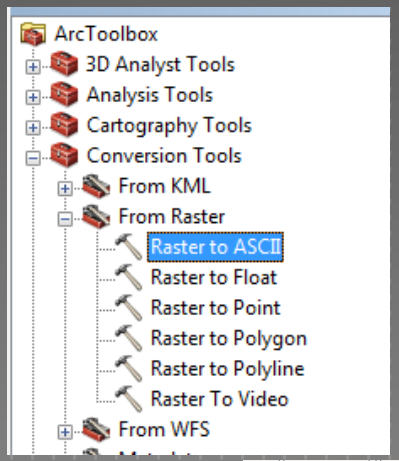
# NAMIBIA FLOOD DASHBOARD

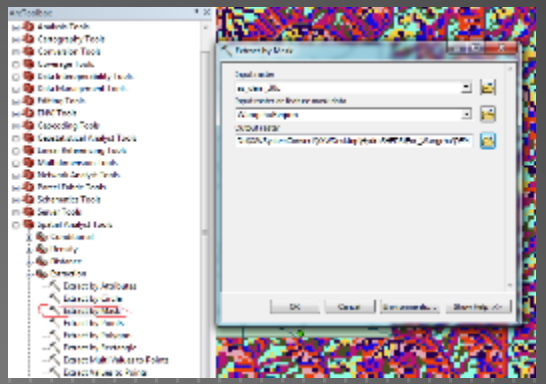
- Reduce all these steps (and those on previous slide!) to 2 or 3 that can be executed free of charge on the Web

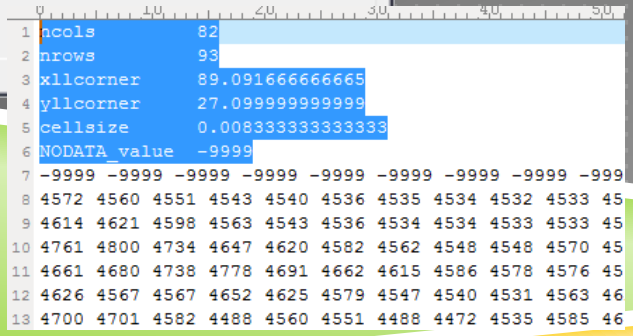






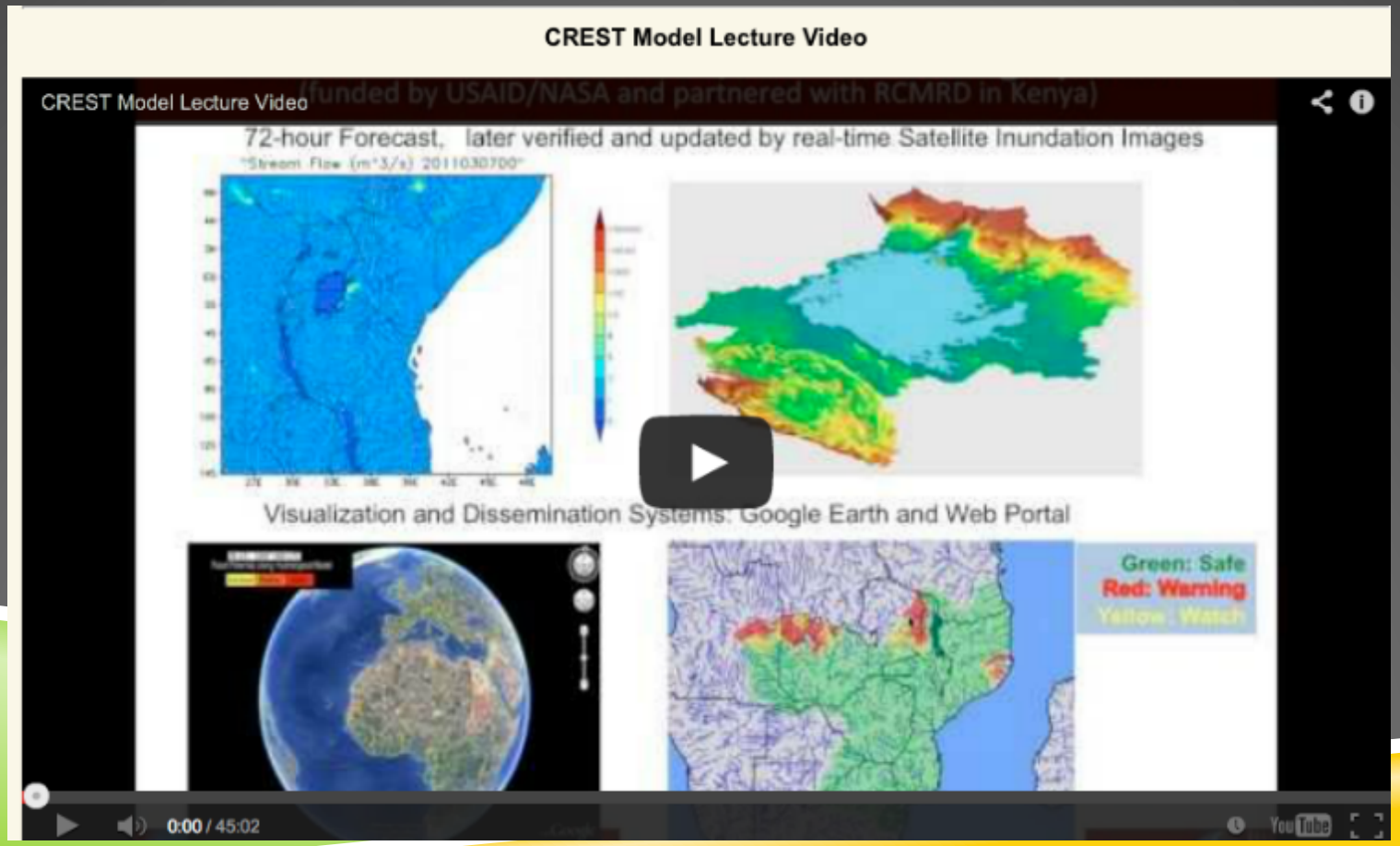
# CREST TRAINING

- May use OU MOOC system
- Post materials on Dashboard
- Will also use manuals and journal articles

- Multiple courses
  - Each roughly 40 hours or one week of full days
  - Lectures, practical examples, field work (?), worksheets, videos
- Course I completed February 2014 Namibia
- Course II tentatively planned January 2015 Namibia
- Course I may be re-taught (partially) at University of Oklahoma – Spring 2015

# CREST TRAINING

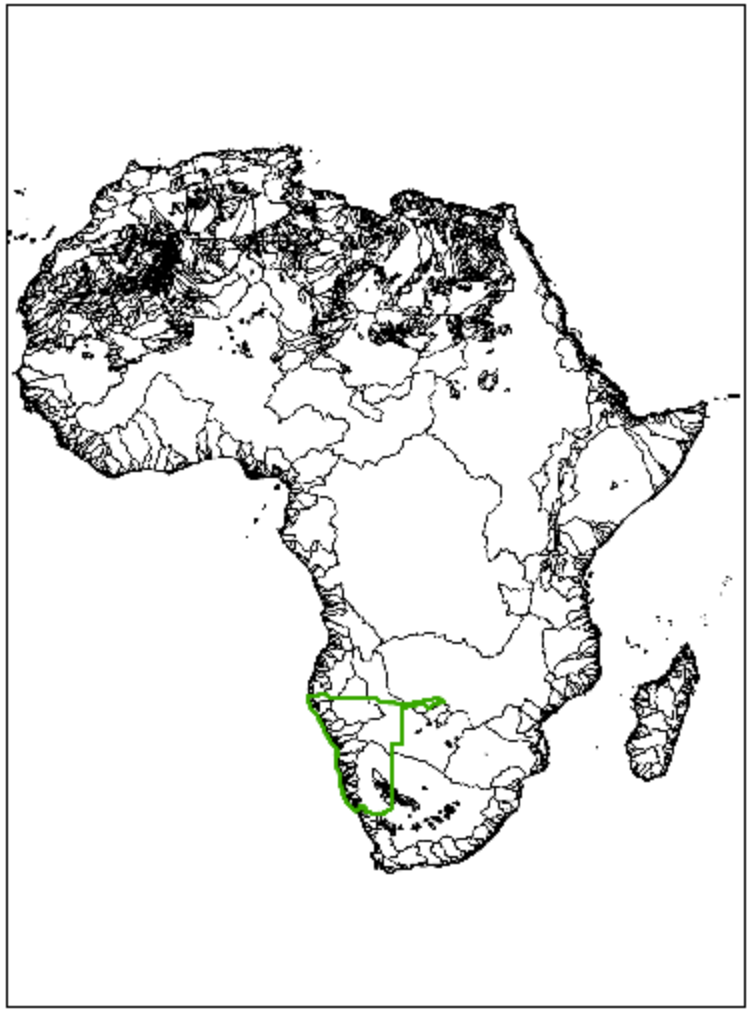
- Some areas aren't amenable to in-person training
  - Pakistan
- Alternative is a training video or YouTube
- Easier to use with slow Internet connections in some countries

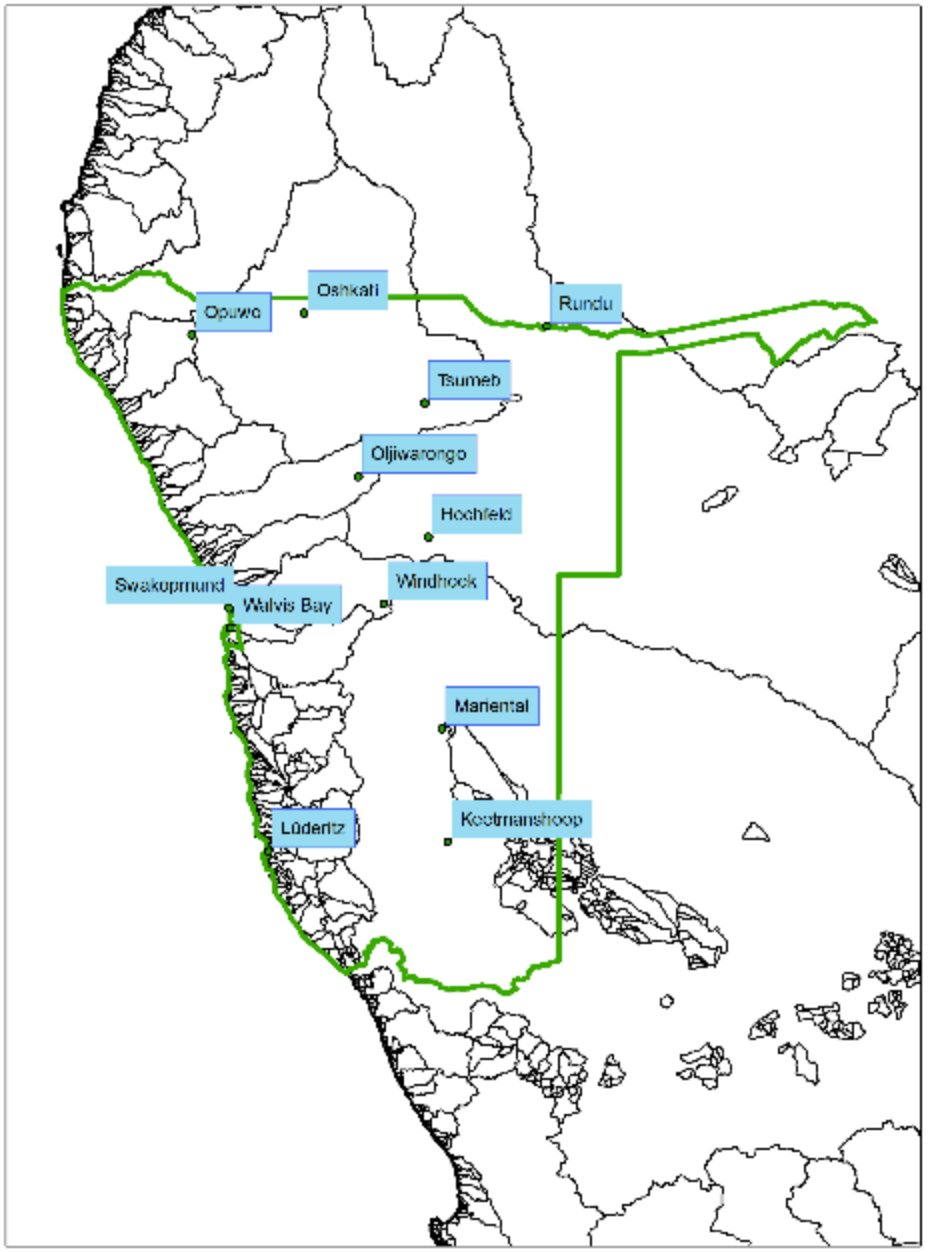


# SCHEDULE

- Day 1 & 2 Flood and Drought Risk Management Workshop
- Day 3
  - Overview of CREST and hydrologic modeling
- Day 4
  - Data used in CREST
  - CREST applications (US, globally, other regions)
  - Running CREST (Wangchu basin, China)
  - Using CREST with relative referencing and batch files
  - Manual and automatic calibration
- Day 5
  - Visualization in Microsoft Excel (hydrographs)
  - Visualization in ArcGIS
  - Downloading/using DEMs, FACs, and FDRs
  - Running Okavango calibrated example
- Day 6
  - Field Campaign to update EO-1 images for gauges in Kuiseb River Basin

# NAMIBIA

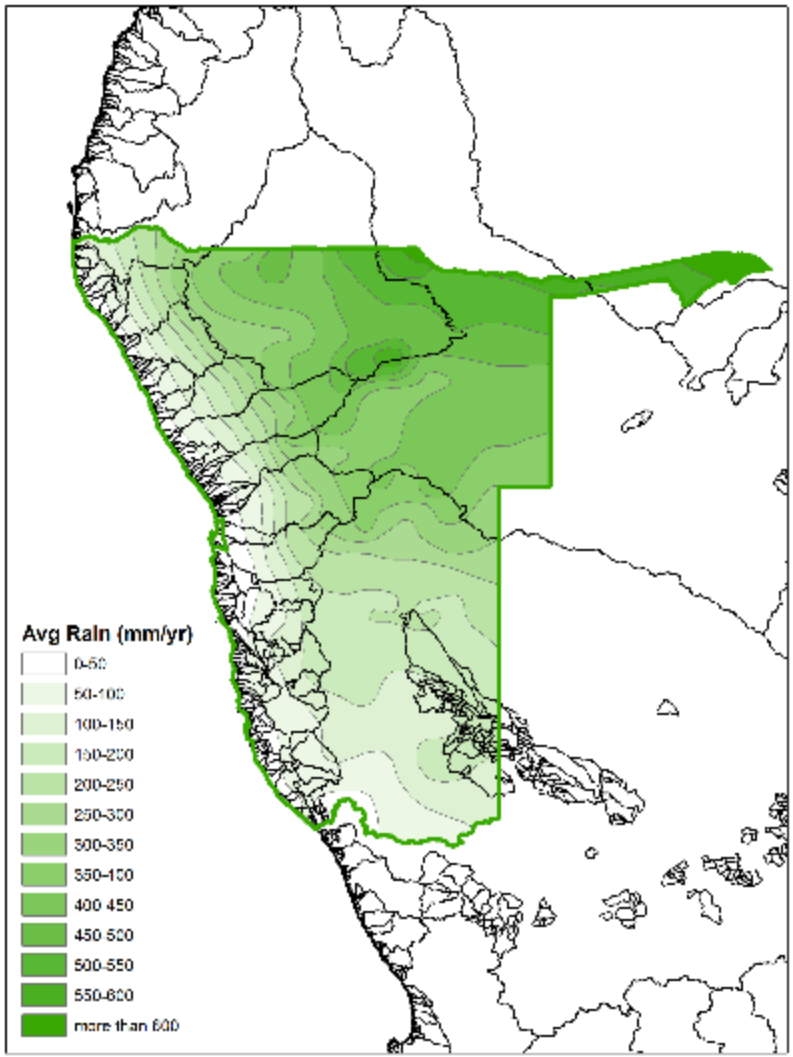


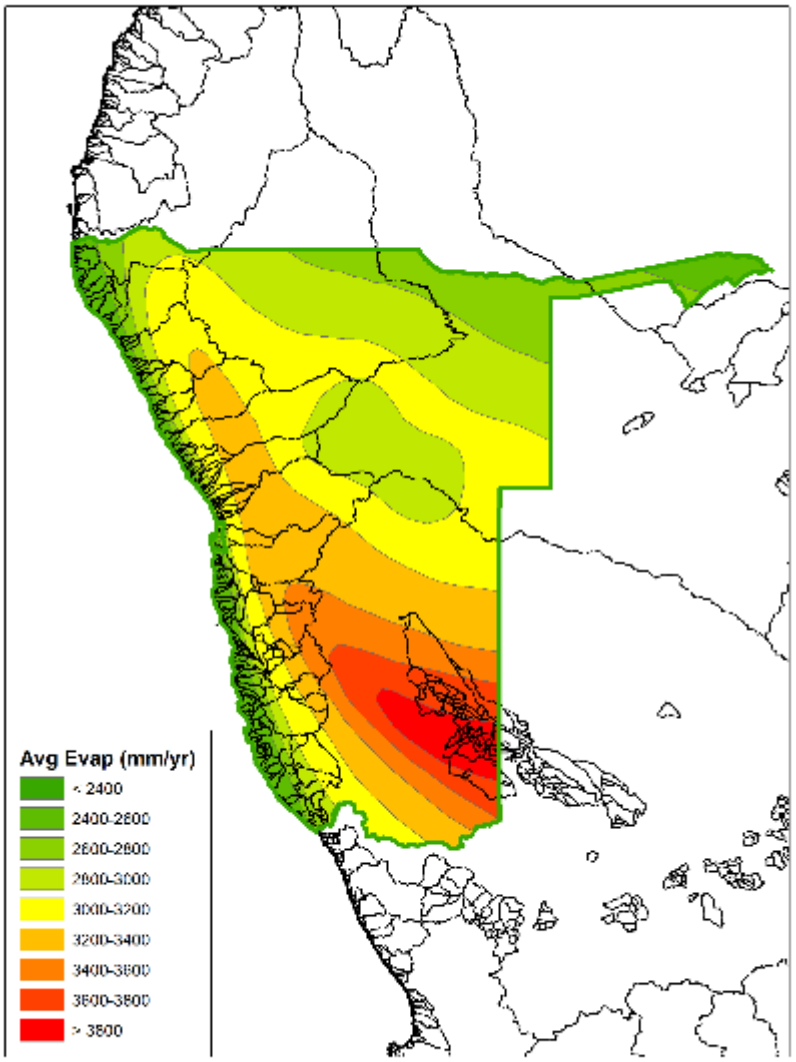

Opuwo
Oshikati
Rundu
Tsumeb
Otjiwarongo
Hochfeld
Swakopmund
Walvis Bay
Windhoek
Mariental
Lüderitz
Keetmanshoop

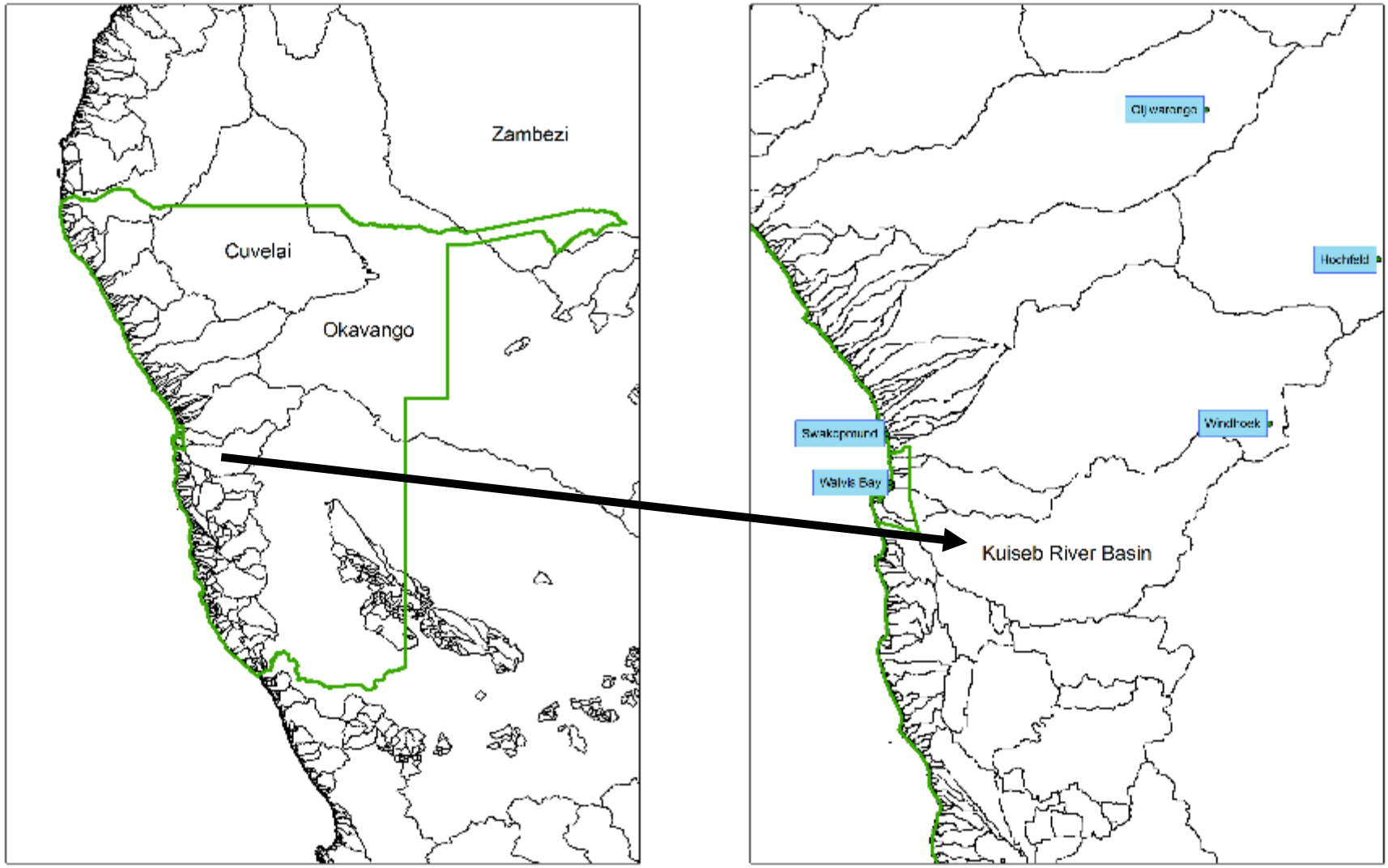
# WHY NAMIBIA?

- Independence from South Africa in 1990
- Ministry of Agriculture, Water, and Forestry
  - Department of Hydrology (~50 employees?)
  - Part of the Directorate of Resource Management
- Past head, Guido Van Langenhove, recently passed away
- Loss of institutional knowledge
- Good time to learn CREST?

# NAMIBIA'S HYDROCLIMATE




Zambezi
Cuvelai
Okavango
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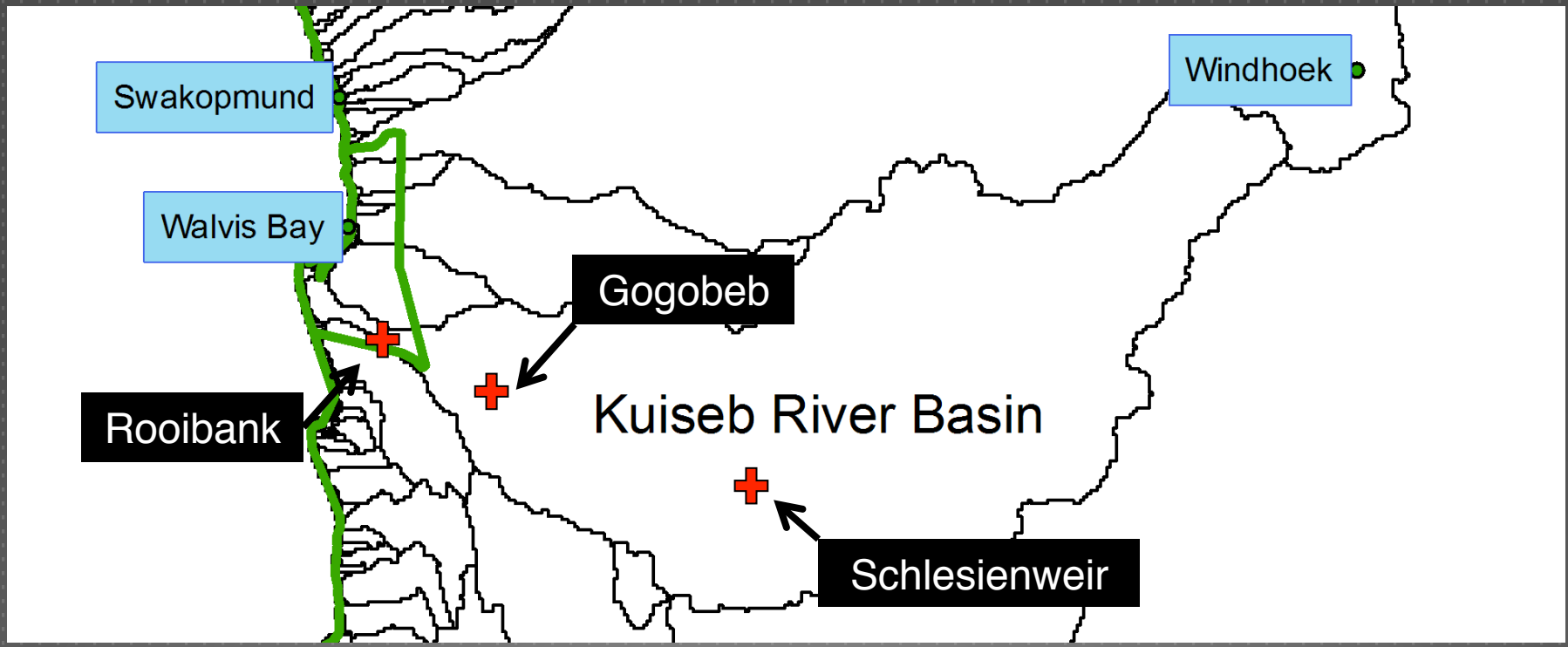
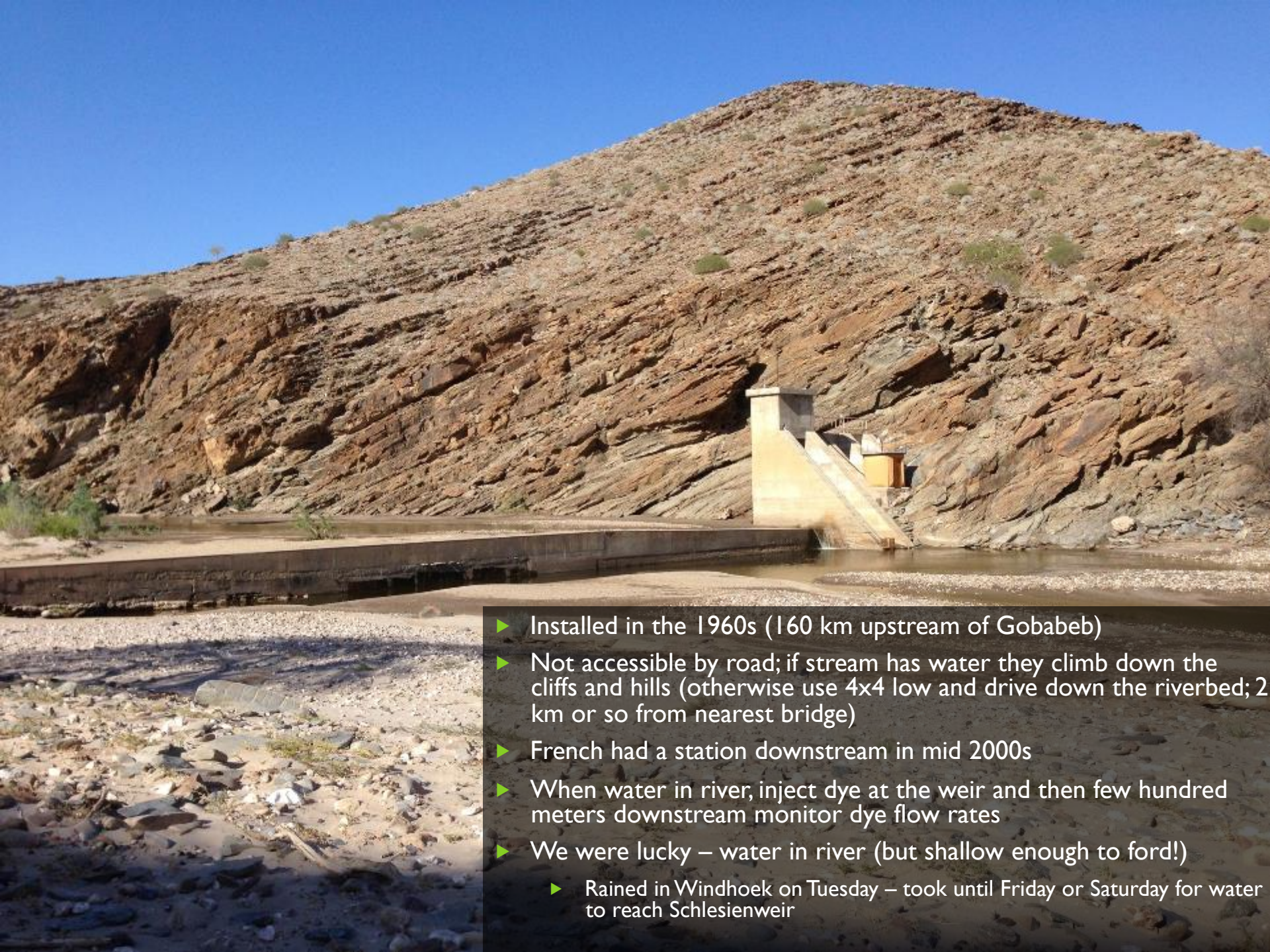
Walvis Bay
Kuiseb River Basin


Swakopmund
Windhoek
Walvis Bay
Gogobeb
Rooibank
Kuiseb River Basin
Schlesienweir

- Gauge station along typically dry river bed (has water usually less than 10 days per year)
- Middle of Namib Desert but near coast
- Source of groundwater for Walvis Bay
- Namwater operates a station, tanks, and several boreholes
- Inhabited by Topnaars – live in desert, speak click language, sell nara seeds

- In case you get lost in the desert, signage is always available

- 120 km SE of Walvis Bay
- A river gauge station operated by Hydrology Dept (and another for Namwater)
- Gauge installed in the 1970s; telemetry since 2012
- Communicates via EUMETSAT
- Water has not ever reached the gauge house but record gauge datum is over 3 meters
- Tourism Dept/Desert Research Foundation has a research station nearby



- Installed in the 1960s (160 km upstream of Gobabeb)
- Not accessible by road; if stream has water they climb down the cliffs and hills (otherwise use 4x4 low and drive down the riverbed; 2 km or so from nearest bridge)
- French had a station downstream in mid 2000s
- When water in river, inject dye at the weir and then few hundred meters downstream monitor dye flow rates
- We were lucky – water in river (but shallow enough to ford!)
  - Rained in Windhoek on Tuesday – took until Friday or Saturday for water to reach Schlesienweir

# TECHNOLOGICAL CHALLENGES

- Outdated equipment (I had never seen *actual* hydrograph paper)
- Old calibrations
- Hard-to-reach stations
- Sandy stream channels

Kuiseb Pass

Gamsberg Pass