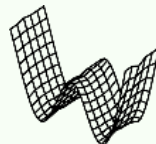




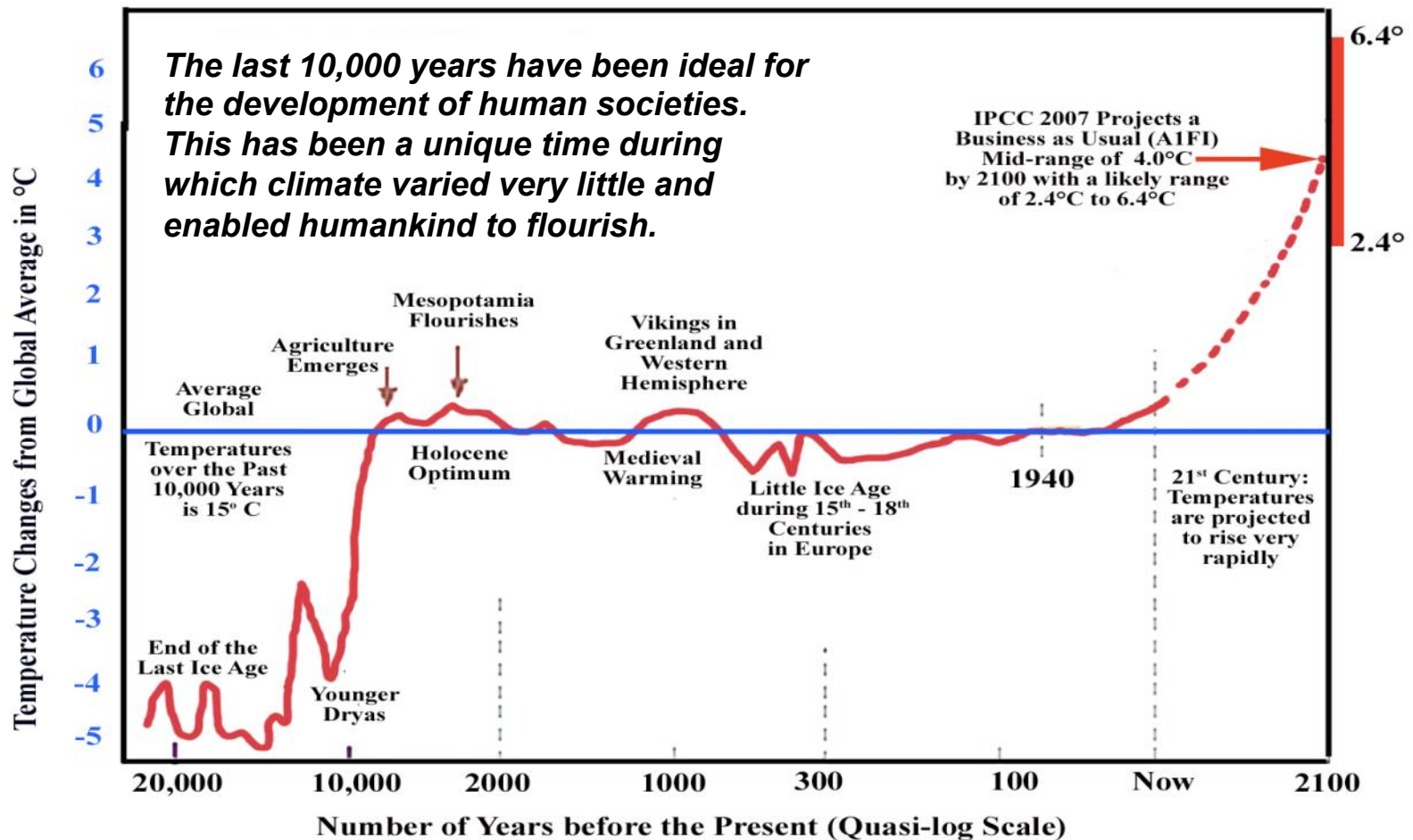
Water into Wine: Condor, PEST, and Hydrologic Modeling



Mike Fienen and Randy Hunt
Research Hydrologists

USGS Wisconsin Water Science Center

Sea Level Rise



Source: Adapted from "Climate change and human health - risks and responses" published by WHO in collaboration with UNEP and WMO 2003 and more recent data from IPCC 2007.

Piping Plover—vulnerable to Sea Level Rise

Among the impacts on Plover habitat is depth to groundwater.

Small islands off the Atlantic Coast like Assateague Island, are a great early-warning system.

Have we always lived in this neighborhood?



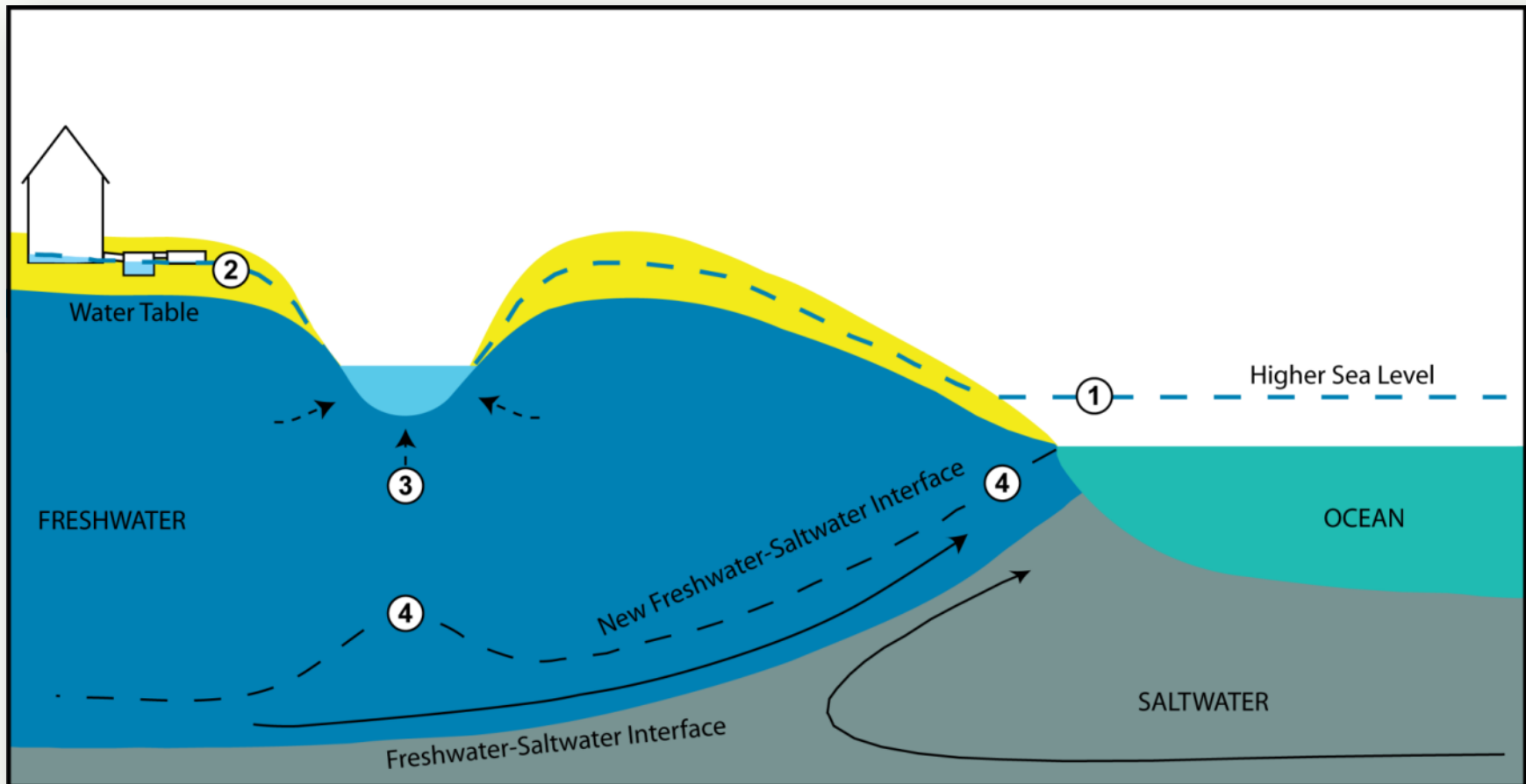
1998



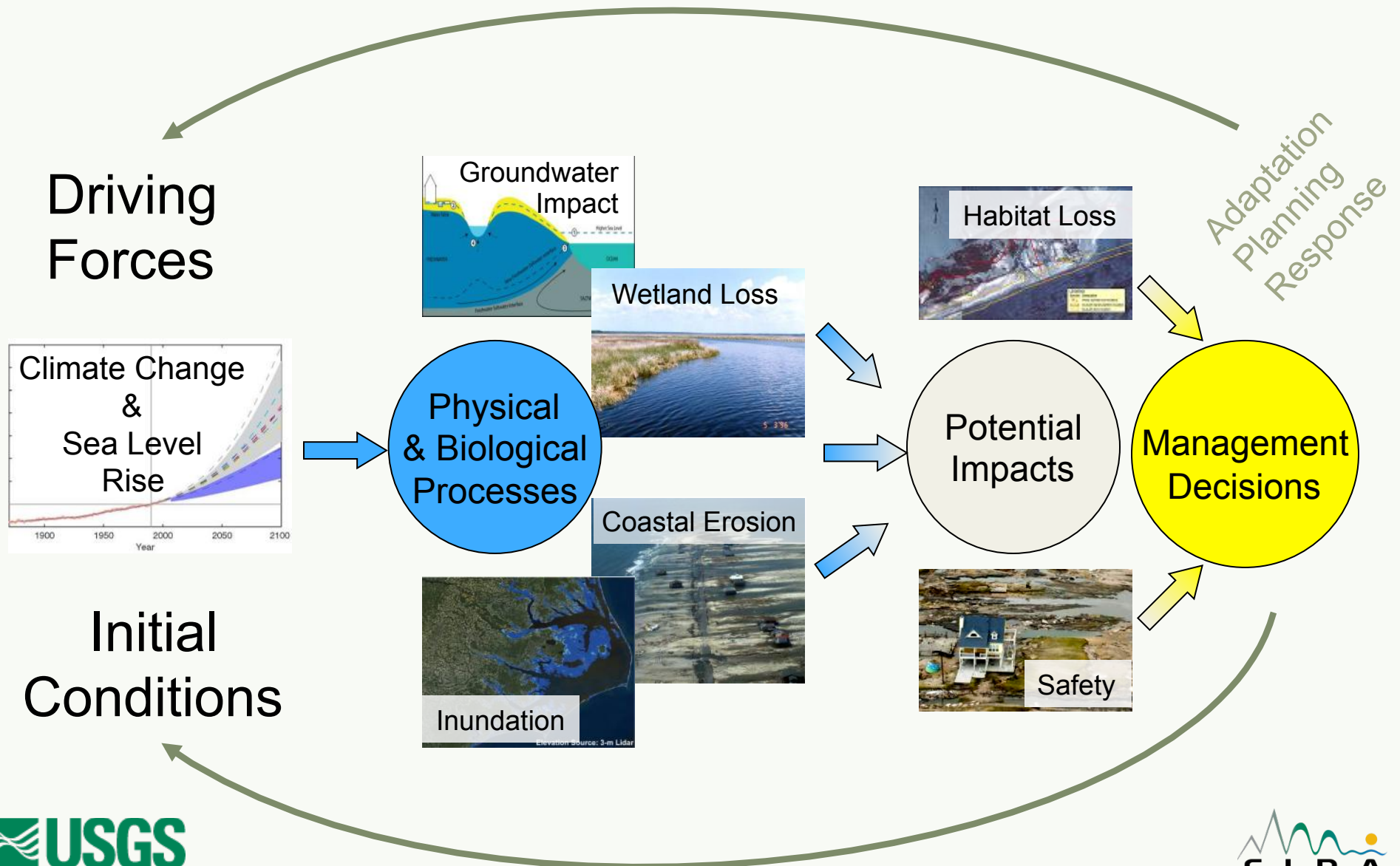
2006



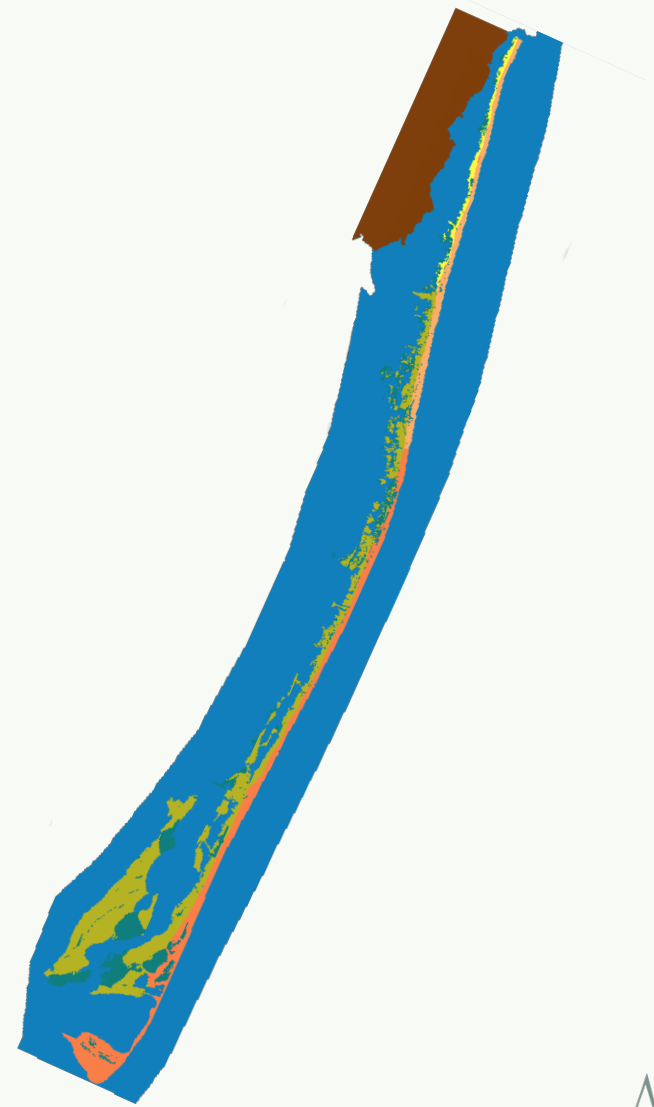
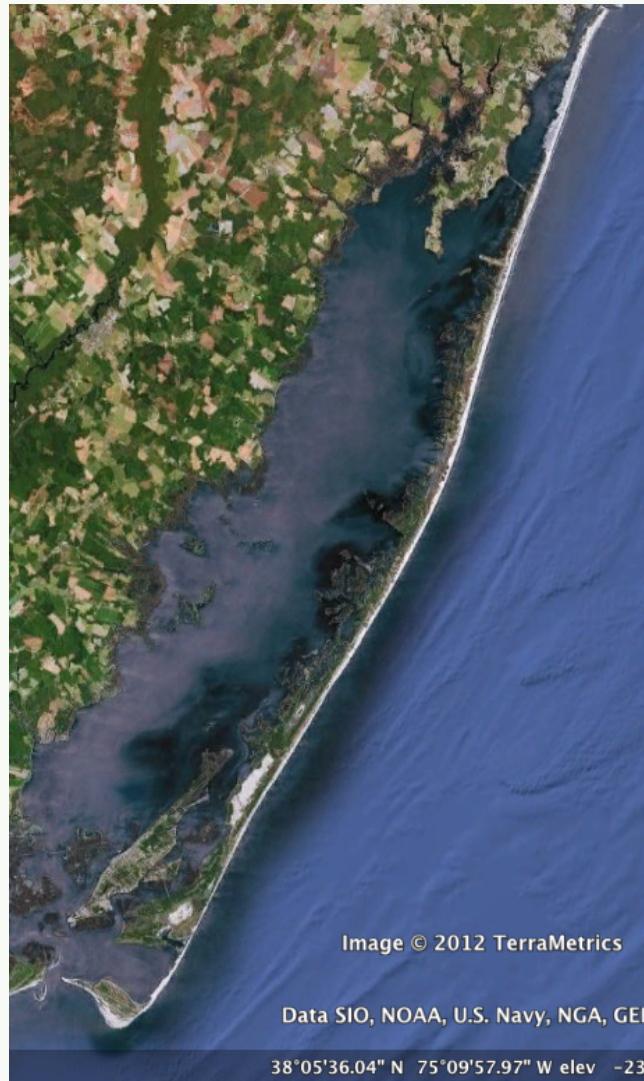
Groundwater Impacts—Important for Plovers and People



Sea-level rise impacts: A multivariate problem full of uncertainties



Assateague Island Groundwater Model



Groundwater Model Calibration



Calibration and Uncertainty

More complex models → many parameters

Model must be run a multiple of ~~number of~~ parameters

Uncertainty analysis has similar computational needs

Can be run in parallel on many computers (~~embarrassingly~~)

pleasingly



What is PEST?

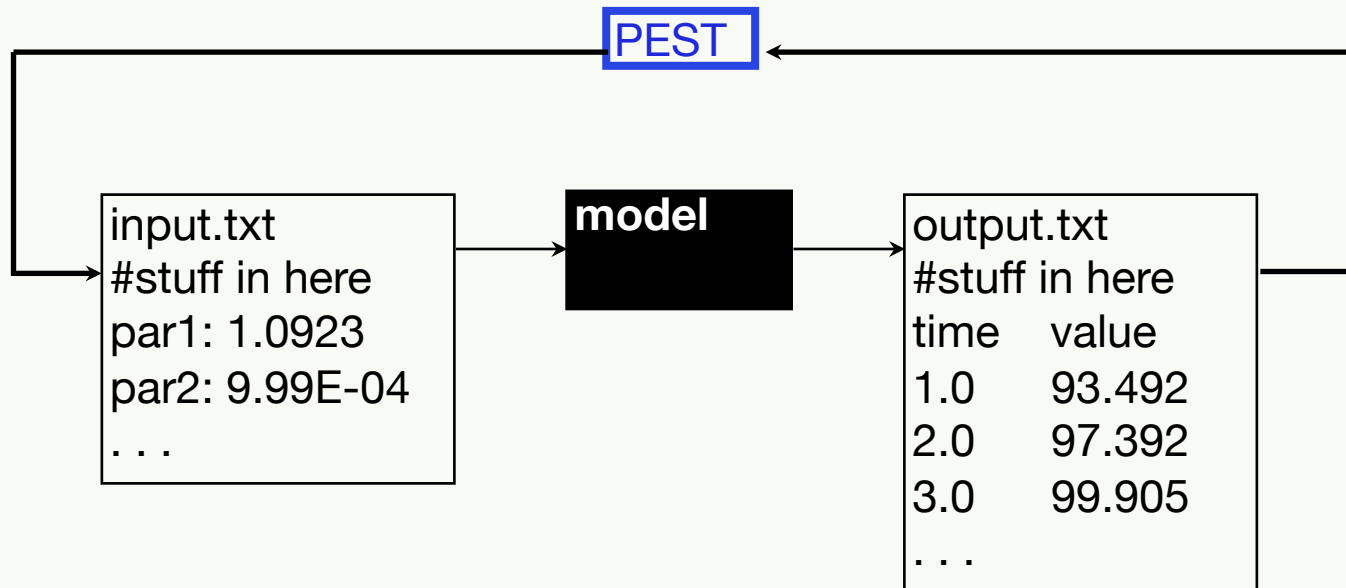
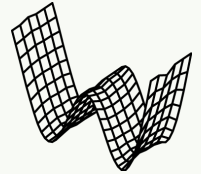
Written by John Doherty/Watermark Numerical Computing

Model-independent parameter estimation code

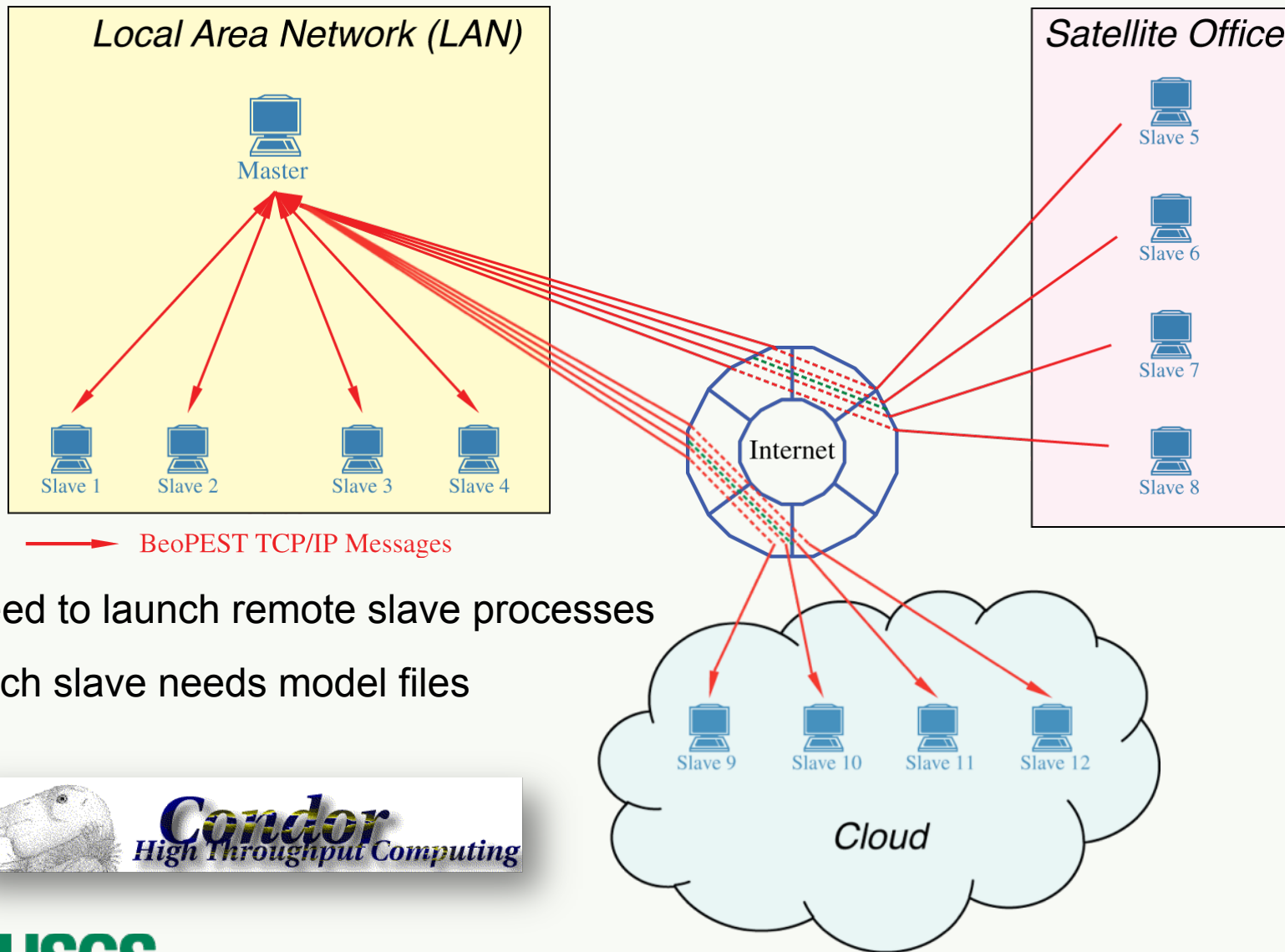
Writes ASCII model input, **reads** ASCII model output

Takes control of a model and runs it many, many times

Pleasingly parallel



beoPEST is an ideal tool for model calibration



Need to launch remote slave processes

Each slave needs model files



Condor with beoPEST

Condor Advantages:

Move data to each worker machine

Automate starting of worker machines

Provide monitoring

Allow us to accommodate Linux and Windows user base

Started out with about 100 Linux and 450 Windows cores

Windows Issues:

Very expensive to access
more than 32GB RAM/blade

TCP/IP related memory trouble

Our parent agency proposed
\$600/year/machine Windows license surcharge.



winsock.dll Sings the Blues—120 Workers

The screenshot displays a Windows Remote Desktop Connection window titled "130.11.177.73 - Remote Desktop Connection". The desktop background is blue. A command prompt window titled "Administrator: z_DD5 box" is open, showing a list of 120 nodes and their completion status. The text "BeoPEST finished" is overlaid on the command prompt. Below the command prompt, a file explorer window shows the path "C:\WIN-1Data\rjhunt\LKM_Mar12_Condor\BeoPE".

The Windows Task Manager window is open, showing the Performance tab. The CPU Usage graph shows 7% usage. The Physical Memory Usage History graph shows 1.07 GB usage. The text "Run done/slaves stopped" is overlaid on the Physical Memory Usage History graph. The System information section shows:

Physical Memory (MB)		System	
Total	32768	Handles	20305
Cached	113	Threads	716
Available	31671	Processes	59
Free	31559	Up Time	17:02:25:56
		Commit (GB)	1 / 33

The bottom status bar shows: Processes: 59, CPU Usage: 7%, Physical Memory: 3%. The system tray shows the time as 3:15 PM on 4/9/2012.

winsock.dll Sings the Blues—60 Workers

The screenshot displays a Windows Remote Desktop Connection to a machine named 'z_D05 box'. A command prompt window shows the output of a command listing 60 worker nodes. Each node entry includes a Node ID, a numerical value, and a file path. The total CPU time is 284717.1 and the total elapsed time is 5394.2. Below the command prompt, the Windows Task Manager Performance tab is open, showing system resource usage. The CPU usage is 1%, and the physical memory usage is 4%. The task manager also displays system statistics such as Total Physical Memory (32768 MB), Available (31447 MB), and Free (30353 MB).

Node	Value	Path
42	64.865	72 130.11.177.127\\D:\condor\execute\dir_1252
43	53.633	86 130.11.177.114\\D:\condor\execute\dir_656
44	73.196	64 130.11.177.83\\C:\Condor\execute\dir_3160
45	79.057	59 130.11.177.85\\C:\Condor\execute\dir_2244
46	53.945	85 130.11.177.111\\D:\condor\execute\dir_2032
47	53.898	86 130.11.177.103\\D:\condor\execute\dir_1524
48	53.648	85 130.11.177.124\\D:\condor\execute\dir_3592
49	53.961	86 130.11.177.106\\D:\condor\execute\dir_2144
50	53.946	85 130.11.177.115\\D:\condor\execute\dir_996
51	84.693	55 130.11.177.91\\C:\Condor\execute\dir_2244
52	85.410	55 130.11.177.96\\C:\Condor\execute\dir_2104
53	53.571	87 130.11.177.128\\D:\condor\execute\dir_916
54	57.455	75 130.11.177.118\\D:\condor\execute\dir_1936
55	53.976	86 130.11.177.107\\D:\condor\execute\dir_2460
56	53.664	86 130.11.177.110\\D:\condor\execute\dir_1392
57	53.696	86 130.11.177.113\\D:\condor\execute\dir_1028
58	53.774	84 130.11.177.101\\D:\condor\execute\dir_1156
59	53.618	84 130.11.177.100\\D:\condor\execute\dir_1672
60	58.438	78 130.11.177.109\\D:\condor\execute\dir_1536

Total CPU time: 284717.1
Total elapsed time: 5394.2
Speedup: 52.782

C:\WIN-1Data\rjhunt\LKM_Mar12_Condor\BeoPEST_Master>beopest64 step4u_reg_svda2.p
st zh :4042 /pl

Integer "2" written to file
C:\WIN-1Data\rjhunt\LKM_Mar
Integer "2" written to file
C:\WIN-1Data\rjhunt\LKM_Mar

Physical Memory (MB)	System
Total: 32768	Handles: 18569
Cached: 1162	Threads: 706
Available: 31447	Processes: 58
Free: 30353	Up Time: 17:04:07:41
	Commit (GB): 1 / 33

Kernel Memory (MB)
Paged: 222
Nonpaged: 126

Processes: 58 | CPU Usage: 1% | Physical Memory: 4%



Deflectrshld

<Away> Zenariah the Light of Dawn
<Stromgarde Militia>

Edaline
<Tavern Tipplers>

1564
Deflectrshld

Antitoxin
<Midnight Mafia>

ys: You disgust me.
Away.

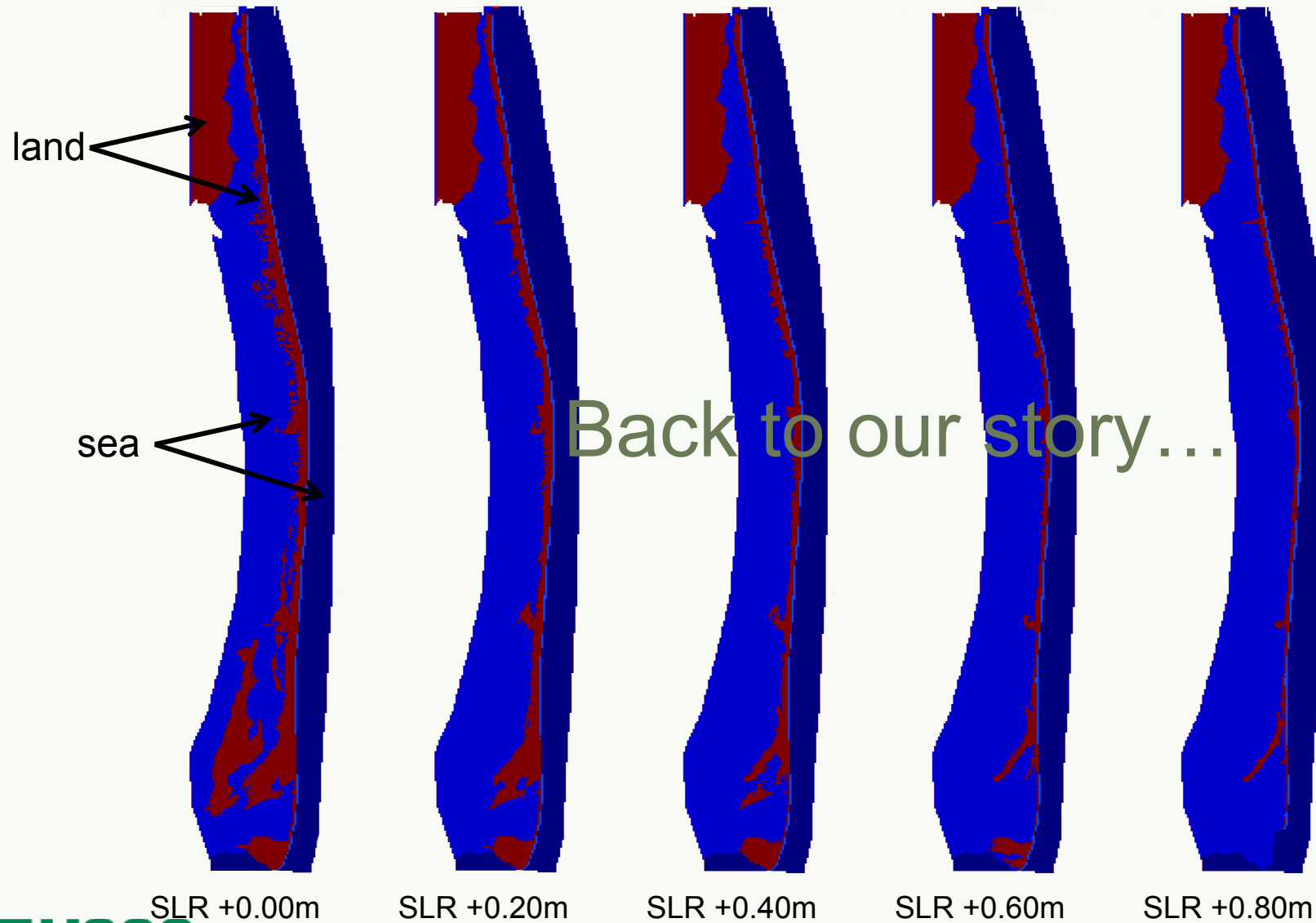


Making Wine Fine

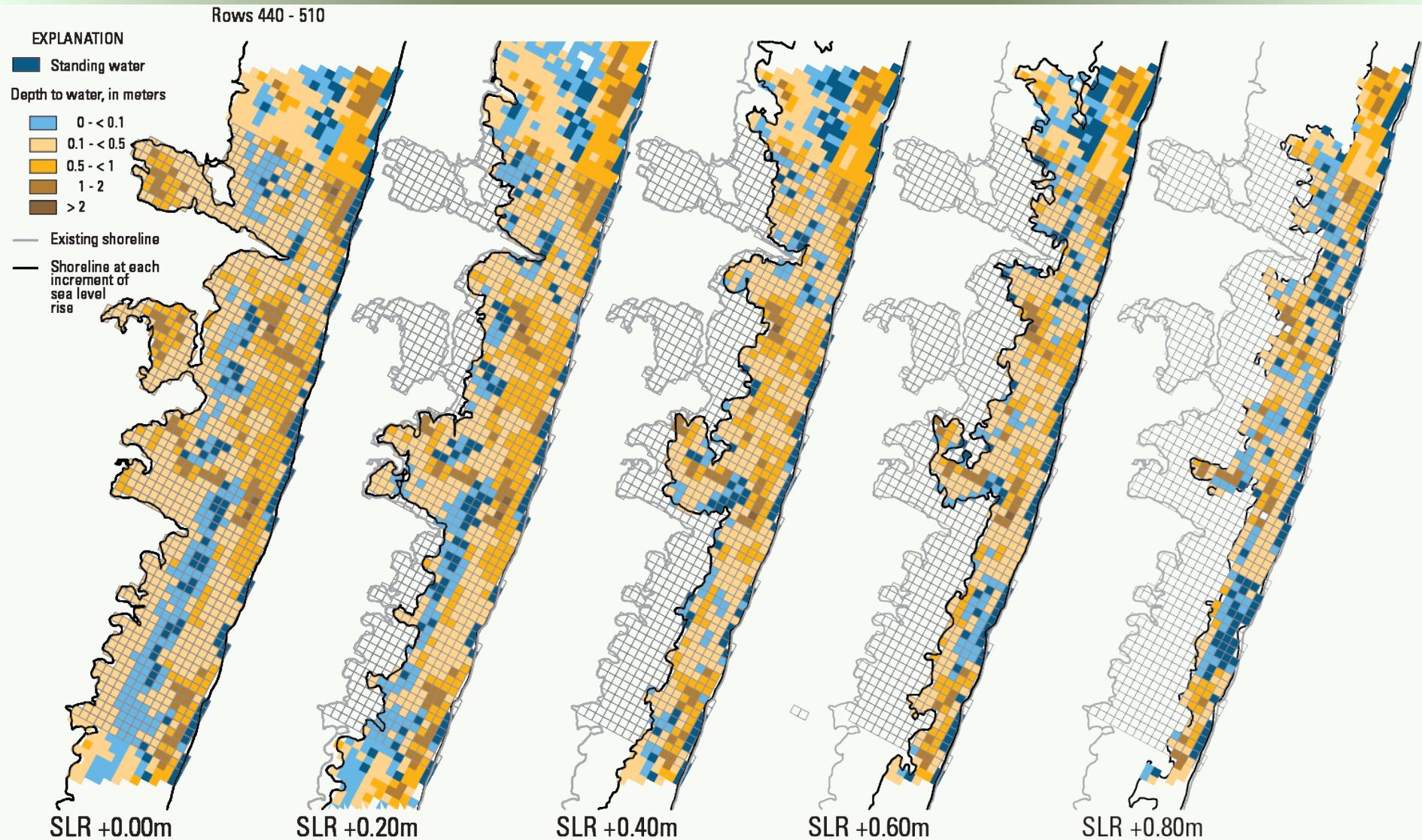
```
WINEPREFIX=$_CONDOR_SCRATCH_DIR
```

*Thanks Ian Chesal and
Rich Pieri via [condor-users]!!!*

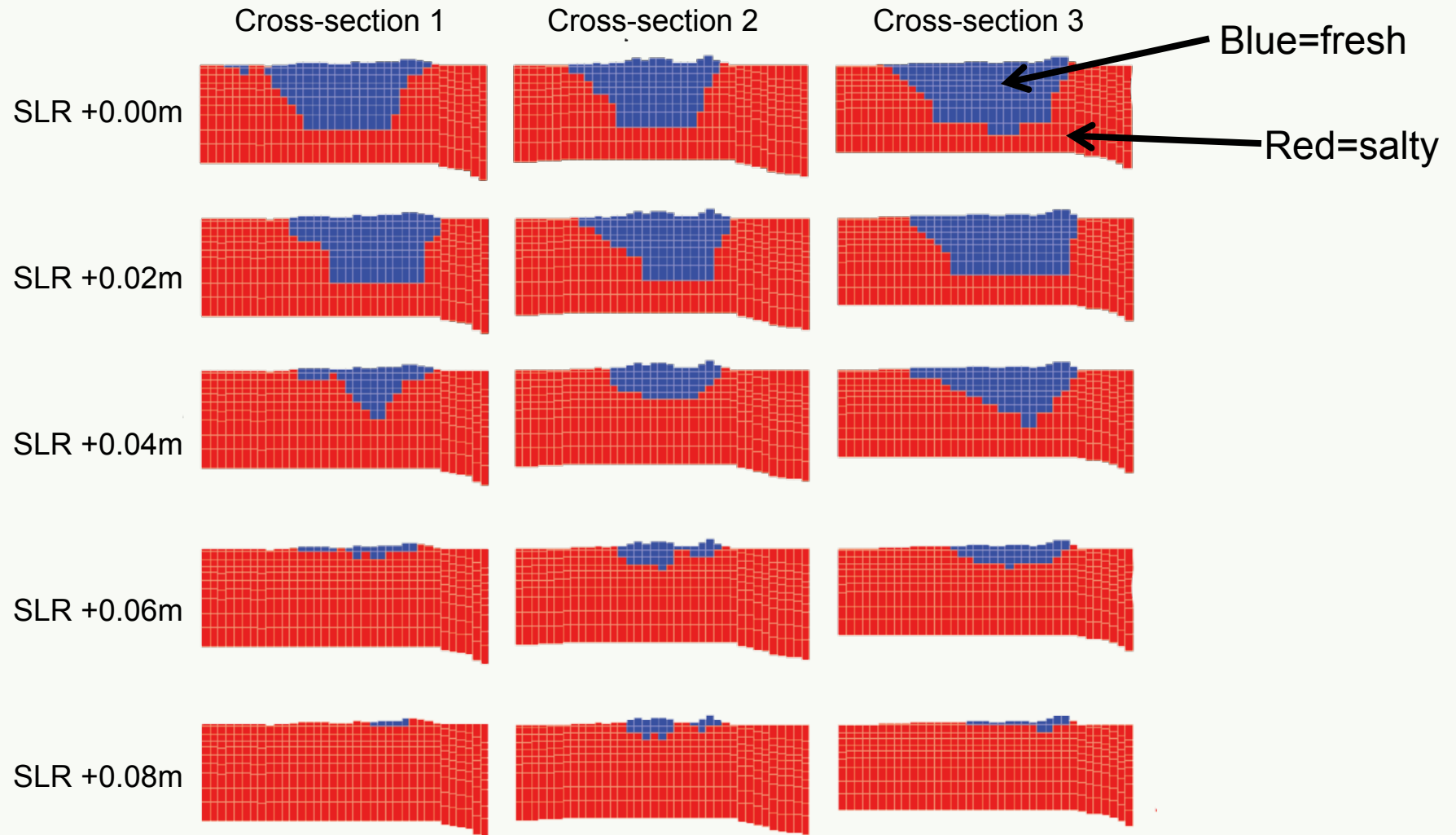
Sea Level Rise Impacts on Island Geometry—DRAFT



Groundwater Results of Sea Level Rise Simulations—DRAFT



Salinity Results of Sea Level Rise Simulations—DRAFT



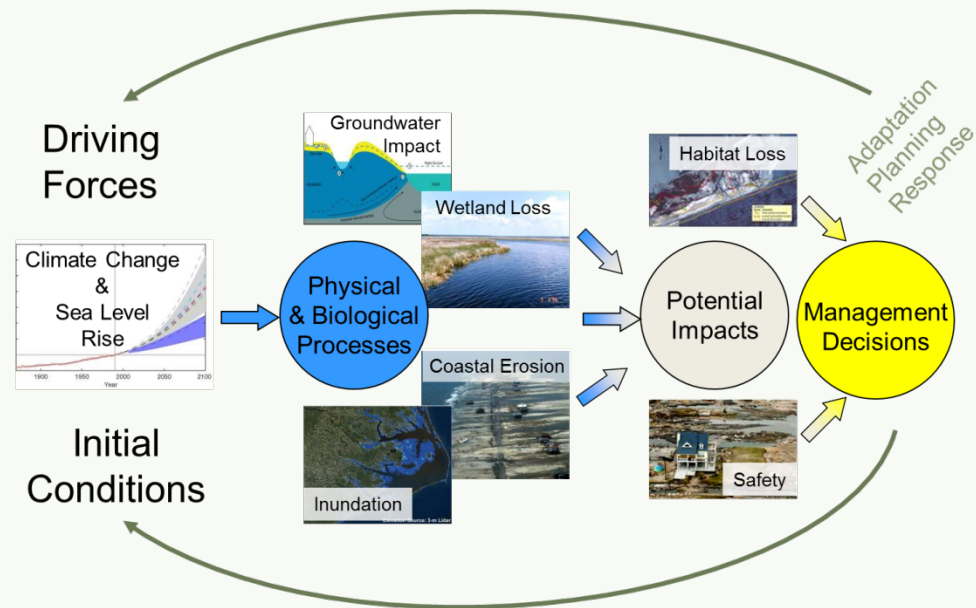
What's next?

Continue refining how beoPEST and Condor interact.

More hardware.

Incorporate GW results into a Bayesian Decision Network along with other processes.

Start linking the process models explicitly which will require much more computational power and more adventures with Condor.





Thanks to:

John Doherty: Watermark Numerical Computing, Flinders University (Australia)

Willem Schreüder: Principia Mathematica

Miron Livny, Brooklin Gore, Todd Tannenbaum, Vladimir Brik, Cathrin Weiss: CHTC

Harry House, Daniel Kester, Ben Feinstein, Shirley Stephan: USGS—CIDA

Ryan Heath, John Masterson, Rob Thieler, Nathaniel Plant: USGS

