

Meteorology of January 1997 Floods

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Today, we're going to talk about the winter a little bit, the heavy rain period. Wettest back-to-back months of the century in most of the Northern Sierra (not everywhere in California). You can take a look here, and we're talking about the recent Water Year 1997. Here's the big month of December, and there's January. The other years, as you see, Water Year 1996 in, kind of this rust, and then Water Year 1995 in the green.

We're going to be talking about the major storm first of all. You had the eight day period we talk about historically as one of the big ones of the century. 26 December through 2 January, and then also, very briefly, about the one later on in the month, 20-29 January. That was bigger in the valley as Maury Roos mentioned. The first one, obviously, is the one of great interest.

The first 8 day period, that's the Big One. We compare that to December 1955, December 1964, February 1986. So we sort of put those in those categories. We're going to examine the development of the storm and look at Purdue GOES satellite shots, kind of walk us through that each day. Also, I'm going to show you the spread sheets which I used each day in my weather briefing. This was the first year we tried that, but it was bold. We put numbers down. I might mention the numbers were developed with a lot of coordination. I worked, I work, all the time with Owen Rhea, Mike Ekrim, Rob Dornvoss, and the other people in the River Forecast Center (RFC). These are the meteorologists that belong in the RFC. So the numbers you see aren't just Bill Mork. They might look like it, as later on we'll look at it, but it's well coordinated numbers. Obviously, the Owen Rhea or graphic stuff goes out to about 4-1/2 days, so when you see stuff marching out past that to hit 5 or 6 or 7, then it's mostly Bill Mork. And there's a lot of real shaggy guesswork involved there, just using the models. Anyway, we'll be looking at that and looking at both spreadsheets.

And also mention the coordination, the fact that each day we have a weather brief and at 10:00 in the morning in the Flood Center. We're lucky where we are right now because we have the Corps people began to drop in, I guess, (didn't they, Paul?) and then we have Bureau of Reclamation people are right upstairs - they come down as well. I have other briefings as well. I was involved in the daily briefing up and down the valley to the San Joaquin group. So a lot of things happen, and the reason I tell you this is, I'm not in a vacuum. If you hear my name, and you hear, "He forecasts this," it's all of us kind of in this thing together. We'll all do well together or sometimes we all sink together. Let me just tell you, the models, once they began working right (they didn't work right at first), we all did well. And that's the way this thing is. We all work together.

OK, then after we look at the storm, we're going to talk about a question I already heard: "How dry has it been?" Well, I worked real hard this week to put some stuff together on that. How warm has it been? It's warm, a little bit on that. A little bit on El Niño, and than Jan Null will do

a lot more on El Niño after that. I'm mainly looking at the 8-station Northern Sierra Index and how might that be effected by an El Niño year or a La Nina year? We'll look at that kind of stuff, and Jan will sort of broadly focus across the whole state. So that's about it, and let's take a look at the first slide here.

Up in here, I just wrote this down this morning. Yesterday I looked at some 200-year events and tried to find some in the Sierra from the two months. Sixty days 200-year return on December and January, that's a 60 day, 200-year event. Sure enough, there's Four Trees with 90.5 inches. Lake Spaulding 76.6, Blue Canyon 75.4, Bowman Dam 71.2, Portola 23.3 and Vinton 15.4. What's in common with all that? American, Yuba, Feather, right? That's the grouping. And so, massive storm, looking at this thing, as Maury said earlier in a shorter vein, but also let's expand it into a 60 days so you can see what a storm it was. That was literally the whole winter, right there. And then, a quick look here, and later on I'll talk about this, you check the last wet month and look what happened. Here's February, March, April and May, and then of course, June is above normal. But we had a real dry period. So we'll get a chance to look at that.

To just remind you, the average for the 8-station Northern Sierra Index is 49.8. What are the eight stations? Eight stations begin in the Pacific House, South Fork of the American, March it right up, and the farthest north one is Mt. Shasta City. We have eight stations in that breadth. So that's the Upper Sacramento, down through the South Fork of the American. And it's sort of this average, and that started, I think, in 1922, 1921. What we're saying is the record sets starts with there. We have good records from the early 20's.

Just to show you the orography model here, and the areas that Owen Rhea's orographic model spits out, as well as, you might look at this, as areas up and down the coast here; north coast, central coast, up and down the Sierra. The HAZ forecasters in the River Forecast Center, they not only - I just go up there about once a day and I try to update. Maybe just concentrate on the Feather, because that's what I'm paid to do. However, I talk over the next two days for a 48-hour period generally what's going to happen. Those guys up there at the River Forecast Center, continually have to make forecasts for any of these rivers that are flowing heavily and flowing hard. What is up, every six hour update, Mike? And that's around the clock, for many, many days.

Don't forget there's a whole lot of people in the background. I get PR, I get on the stage, I get on TV, some of us get lucky. But a lot of folks in the back office, let's say, working very hard to make sure that everybody gets the numbers the Corps needs, the Bureau needs, the National Weather Service has to have those numbers. Anyway, this is for Mike Ekrim - Mike, that's a beautiful slide, and I don't have that kind of computer. I can't that kind of slide. But anyway, a lot of basins, and a lot of forecasts. The Owen Rhea model, by the way, superimposes on the other models, and gives us returns from all these basins that you're looking at.

Let's look at 23 December, two days before Christmas. What kind of thing do we have here? Wow, look at that good weather coming up. That's Monday, 23 December. I sent an E-mail out, by the way, during the storm to about a hundred customers. On the 23rd of December, here's what I said. "Two days before Christmas. No rain is expected from Saturday through New Year's Day. I am through, but look out for valley tule fog."

I just want to be human enough to tell you, this is what you have to face. This is the long-range forecast, 6-10 day forecast, valid on Tuesday 31 December. That's what I had in my

hands on the last briefing I gave, and I had two days off. On the 23rd of December, two days before Christmas, this is what it was. Full latitude ridge, great weather, right? Anyway, so that night I heard the weather guy talk about well, there's been a little change to mottling. I said, "OK, I can take that."

And the next day, Christmas Day, or the 24th, it got a little worse, my day off. Christmas Day we're off, a little worse. And then I walked in and Owen grabs me and says, "You should see the numbers, Bill."

So anyway, I came back to work on the 26th, and let's go from there. Here's what the 500 millibar looked like. The TERC people, you remember TERC a few years ago? You're looking for blocking and various things in specific. We look at this and say, "Well, my God, there it is. It's signaling."

Strong block in western Alaska. What you're looking at here, folks, would be Thursday 26 December. The analysis: Strong, short wave offshore, and already the rains are beginning. So we have a good system with fairly low, moderately low snow lines on Thursday, December 26th. Unforecast on Monday, except maybe a weak system, I thought. But this block is important. Why? Because it allows storms to go underneath. So here's one storm we could count, that's the one we're looking at. Then we could see maybe one, and maybe two, and these were a lot warmer. The models were showing a rise in snow line. So that's what we faced on Thursday. To show you what the spreadsheet, each day I'll show you something: either a chart or a satellite. We didn't archive the first two days, but here's the first spreadsheet.

What's the bottom line? This means what's fallen so far. So each day I show all the customers what's happened, here's the snow level, actual in the morning on the 26th. Predicted all the way out through Wednesday, the 1st. You can see the amounts we're looking at. Our first day, we looked at everything. We came out with a total of 16.6 in the Feather for the run of the storm. The other locations here were because we had various activities happening, construction, a lot of area ventures stuff for those other places.

First day back, off Christmas, 16.6 bottom line for the storm. But we said, "It looks pretty interesting." OK, Friday 27 December, getting more interesting. The block's retrograding, but look underneath at a very powerful flow. First storm is on us, we're getting good amounts: 1-3 inches with snow lines of about 6,000 feet. And here's the first subtropical looking thing. We knew there was one more there, and maybe a third, but we weren't quite sure. That was Friday the 27th.

So, let's take a look at our spreadsheet. Here's what the spreadsheet looked like. Oh-oh, 20.8, increasing. So we've had by Friday morning briefing time; 24 hours we had 2.9, pretty decent storm, not bad, fairly cool. We're predicting a sizeable storm we saw Sunday into Monday as one potential storm. So by Sunday morning 3.4, Monday morning 4.1. You can see there's a big something on Tuesday. We didn't see the last or the third storm yet on Wednesday because we couldn't look that far. The models didn't carry it, nor could we see the satellite really including that. So 20.8, that's the update as of that day.

OK, let me tell you what we did on that day though. We looked and saw enough there, remember what the chart looked like. This thing had a historical look of something we'd seen

before. I asked Owen Ray to show me some charts, show me some things. Owen said, "OK, let's look at 1963. Here's 31 January 1963."

The storm WORRY saw one, two, three things coming. Blue Canyon in 24 hours had 8.70, so we said, "Well, that's a possibility, something near that." I'm trying to show you what we looked at when we see these things coming. Then I pulled out my stuff, and we had a copy from an old forecast study, and this was actually something the DDBR did, Bill Lavarolla. This was the 22 December 1964 storm. How about some signatures? Blocking high, polar air down through here, subtropical mix, heavy precip Northern California. Storm of probably several centuries on the north coast. But the signature's about the same. So we said, "OK, we've got that one."

And then let's look at one for 1986. These are my drawings. We put this into publication. What is different about this, this would be February 17th of 1986. A little further south, and all the way down to San Luis Obispo, Santa Barbara. You can see the thing's high-pressure blocking here. A strong flow of cold air way out west, and mixing with the very subtropical, and a very strong jet that turned out to be 190 knots. Anyway, the look is similar, so we saw that. We thought well, what does this look like on a real weather map? Well, we had this back in 1986 and it scared the hell out of us. This was a 500 millibar prediction on Friday, for Sunday afternoon at 1600. That would be Sunday the 16th, and then this would begin a 36-hour siege in the northern Sierra where we had 20 inches of precip in 36 hours. So the look, 7500 foot snow line, at 35,000 feet we had 190 knot ship. Here's your block. We didn't, of course, want it to look like that, and it never quite did. But this was the miss of the big storm in 1986. We're showing you what storms look like, though.

The satellite we had back in 1986 looks like this. That's a visual massive subtropical connection out of Hawaii. This is the beginning of 36 hours of very heavy precip. So what did that do? I have to remind people what these storms do. It did this. In 10 days we had 49.6 inches, and you see we had heavy precip up and down the Sierra north coast. Then I reminded people if, in the short term, don't forget that back in 1986 Four Trees and Buck's Lake had this kind of production.

Four Trees, in 24 hours 16.40. Take a look at the one inches here and there. Also over here at Buck's Lake nearby 13.12 and here's your totals for the whole month. Both of these stations are very close to 49 inches for a ten day period. So if we have something similar, and these are people in my briefing, who were not educated especially as far as what we had in the past. I said, we can't predict this will happen, but if we have a similar storm, realize in 24 hour periods, you can get 12 inches plus.

??? DISPLACES. That's what you want to tell them. And they say OK. Yet I said, "We're not predicting this, but let's see how it develops."

Let's go on to the 28th. So now we're on to Sunday. Sunday, the first storm is in. Here comes the, let's see, the 28th, that would be, excuse me - Saturday. Saturday, the other storm is dissipating and here comes the next storm for Sunday. We thought, here's the first subtropical one, Sunday and early Monday. The second one is here and there's a third one out here someplace. Rob Durnboss, who works with Mike and Owen Ray, I asked Rob, "Can you get me some stuff out way and west of the Pacific?" He said yes. So we tied a looper into our briefing for the Japanese satellite, and we could count one, two, and the third one was tied into a tropical storm or former typhoon Fran. So now we count three. The third one was Wednesday, and we didn't know yet, but we thought maybe Wednesday might be the peak,

kind of a climactic event. We needed more information but we had three counted, three tropical systems. Then we had a better idea what to predict.

On the 28th, here's what we have. On the 28th, on Saturday, we got our numbers up to 25.6. On that day we should have stopped, because it ended up to be 25.0. We had a winter right there, didn't we? Except we sort of front-loaded it. We had too much in here, the way it turns out, and not enough later on. By Saturday morning 1.4, we forecasted 3.2 on Sunday, and we'll find out in a minute that it wasn't quite that much.

So the satellite then we had on Sunday the 29th. The storm is in on us on Sunday. On Sunday night, I had a call from a woman at church and she said, "Where's the storm?" Well, we had about 1/4 inch in Fairfield, but we began to get large orographic amounts on the north coast as well as the northern Sierra by late Sunday. So anyway, I said, "It's still coming, Margaret, just don't worry about it so much." She was really upset that, you know, if you live in Fairfield, that's your whole life, right? She's lived there 40-50 years, and she sings in the choir in the Lutheran church, and that's the whole life, is what happened to Fairfield. That's the storm, and it wasn't much of a storm. Lot of wind. I said it's still coming. We're going to be consistent, we're still going to get this thing. Anyway, the first storm, talking to Dave Reynolds - Dave thought that part of this energy went up into Washington and Oregon and, you know, wasn't as much of a storm as we thought in the valley but certainly we began to perk up with some recent numbers here and there. But we could see offshore that here comes the second one and the third one's visible. So be consistent; over the long run we're still going to get big amounts.

Ok, the 29th. This is where we predicted, you can see by Sunday morning we didn't get as much as we thought so we're coming up short there. But we're predicting some heavy stuff by Monday morning, 4 inches, and you can see the amounts all the way up through Thursday morning pretty heavy. The total is 26.3 so it's increasing a bit. Monday the 30th looks like this. Very heavy amounts occurring throughout northern California, so it be the second storm is quite good. This one here is looking quite interesting because you can see the hose starting to develop here, and this would be the guide that would be developing on to the north coast by New Year's Eve and then down over us on New Year's day, we thought. So we were kind of sizing up that last one as quite a storm.

We were finally starting to get some good numbers. By Monday morning 2.6 inches in the can, raining heavily throughout the area. You can see the amounts: 5 inches in two days, and the total is up to, or down to 24.2. Ok, a little bit, because of the underproduction there we're down to 24.2. Satellite on the 31st ominous as hell. That's the kind your knees start shaking. That's the 31st, that's 9:00 in the morning, local time, so subtract eight hours. At that time on Tuesday, the 31st, beginning to get heavy and you can see the stuff here. These are old occlusions out in here, but the tropical hoses are setting up so we're really wet. We've had heavy precip and this last event is really setting up to be quite a thing, we think. We had used the term by Saturday "potential extreme rain event mid-week," and then Monday and Tuesday we kept emphasizing that, the last part, it will be an extreme event.

Satellite also on 31 December. This would be an enhanced satellite and you can see again, this is what 179 knot jet does. These ripples just moving right up very rapidly and, again, precip beginning on the north coast there. This is where we predicted them, and we're up to 27.7, looks like, on 31 December. Look at this: 5.3 in the can. Now every time you look at this - this is a generic average across all the stations in the Feather. When you see 5.3 you

might mean that 10 inches would have fallen at Buck's Lake and Four Trees, almost double, something like that. That's an average. We're forecasting 5, and here's the biggest day. Each of these forecasts and - by the way, the next morning, on Thursday morning at 12 Zulu, and so that's mainly whatever we see here would fall on New Year's Day, on Wednesday. So this is the real peak going on there.

And so what is the surface chart finally get a weather chart you can understand, I guess. New Year's morning, driving to work from Fairfield, the windiest and roughest drive I've ever had at six in the morning. Very tough because of strong flow into the slow moving front. Very strong low level flow, and it's really, really honking, that's quite a storm. It's there and it's peak production. Again, I get into work and everyone has that worried look.

This is Wednesday, this is the peak day in the Feather, by the way. Follow the middle of our pattern. The 564 line we always look for; that means 5640 meters above sea level. We like to see that line nearest to get precip and, obviously, everything else is there. So this is a 90% RH with 104% right there. It's nearly saturated, very strong subtropical hose and everything's there. We're peaking in the morning on the Feather and it's slipping southward, the heavy stuff, during the day.

This is from Owen Ray, the next one. Owen picked off a 60-hour forecast at 700 millibars, that's about 10,000 feet with the moisture overlaid. And that's a marvelous verification because literally two days previous this is what it predicted. This prediction then is for New Year's Day. And 90% hose, this is 10,000 feet. We're getting 75 knots, or graphics, and then this model. Isn't that about a peak? You can't do much better than that, can you, Owen? Not much. Seldom seen, 75 knots. or graphics perfect and it's howling. So this prediction was 60 hours. This is what you call a real subtropical hose. That's the relative humidity, that would be integration between surface and 500 millibars, on average. It's just saturated.

So that was the peak day. And here's what the satellite looks like on January 1st. Strong hose and just raining like crazy at nine in the morning. We're worried, everybody's concerned about what's happened to the Feather at that time as Maury explained to you all.

A bit of a close up. Same shot pretty much, but more detail and it's beautiful. Beautiful to a weather man. Right there we're peaking. This is 9:00 in the morning and the heaviest values are right there in the Yuba and Feather at that time, and that's a hell of a storm. What does my sheet look like? Well, 27.7 we're up to for the storm. Now we're getting some big numbers. This is truth in numbers. You're telling everybody each day how you did good or bad because there it is. A 4.6, and so we had two big days, forecasting 6.8. There was some time in the morning that we thought the number might be larger so there was just some real doubt, and Maury might have mentioned to you that it was a particularly tough day on the 1st, trying to predict the next 24 hours, how much that value would be.

By the 2nd, thankfully the stuff is slipping southward, but not thankfully for the central and southern Sierra. By the morning of the 2nd, on Thursday, you can see the heavy stuff is here, Stanislaus on southward, and it's backed off, obviously, up in the north. And by that time, how about our 6.8 forecast? Well, it was close; it came in at 6.2 and our total was 26.8, we expect 2.9 more. Let's see how that works out.

Satellite chart for the 3rd. It's all over, folks! It's done. This thing literally fell apart before it did anything in the Southland. This doesn't have any meaning here so the storm's over.

The last day, bottom line, 25.0. And isn't that amazing, we hit the number on Saturday the 28th. That was our best day as far as trying to forecast the overall number. So what it tells you is that a lot of times you have a sense of the whole size of the storm. You may get the details wrong, but be consistent. If it doesn't produce up front and you still have confidence that this thing has to play itself out in some wet way, just hang on. We did have confidence that finally we'd come in and overall I thought the result was quite good.

Again, it's a lot of people and beyond a few days I had to make some projections, but Owen's modeling worked excellent. Mostly we used the medium-range forecast model and his modeling goes out to 4-1/2 days on, and then we'd update with the 8-inch model which comes in each morning to give us a 72-hour quick update before the briefing, or sometimes after the briefing, for other customers during the day. And then we'd look at the European models and they all said "wet" obviously.

Ok, what did this thing amount to? This is my analysis of it, and this will appear in a lot of publications. If you want a copy I did bring a hard copy which people here can make copies of if you'd like, or it will appear in the proceedings. You can see up here, Buck's Lake with 42.2 and here's peaks upper north of Shasta, and you can see on the north coast, also down south. What's occurring there, Yosemite Valley itself didn't get much but the mountains on either side got drowned and then, of course, we had a lot of water into the valley. So there is some ? right there but not in the mountains adjacent to Yosemite. It was very, very wet.

In the Valley? As Maury said, not a big deal, 3.7. And there was a second series of storms which - I have a copy here to show you. Here's a series, folks, from 20 through 29 January and you can see that we did pretty well. In the valley, here, we had 5 inches near Sacramento and we had two different periods, one of those second ones got water in Maury's garage and I don't think Maury's ever seen water in his garage. Have you? First time, it was so wet. So the valley and also the South Bay, I think Jan Knowle will probably confirm, I think we had more trouble in the Santa Clara area, Jan, with that second series, didn't we, than we did with the first.

Want to see some real pretty slides from Dave Curtis? I used these in a talk I gave. This is what you can do with some good computerization. This would be the max 8-day rainfall period, 26 December through January 4th. The 40 inches here, just to let you know what's happening, here's 80 Tahoe, here would be Oroville complex, the water, and this is the wet area and the Feather. And the 40 inches up there we said was, what, Buck's Lake, Four Trees and La Porte, and then heavy stuff - Blue Canyon and the American.

And then another nice Dave Curtis slide. Looks like this, preliminary max one day, 14.04 and if you picked the wettest period for 24 hours that's what you got. That was either Buck's Lake or Four Trees. Down here in the American, the wettest period was, I guess, we thought Blue Canyon at one 24 hours was 9.4, probably pick a wetter period is a bit more. You get the idea.

Jim Goodridge slide coming up. Jim did analysis, a 15-day analysis, the kind that fit the National Weather Service look at this thing. December 20 through January 3rd, this picked up the very heavy snowstorm, you remember, the weekend before, and here are the returns over that period of time. Check out La Porte, 1300 year return, Pilot Peak 5.40. So we're 500 year return for that period of time in the Feather. And this outline, this is a 10 year here, this must be - let's see what we got here. Jim is this a 50 here? That's a 10 again, isn't it. That's a 10

year. Here's a 50, that's it. Ten years through this whole thing and then 50. Inside the 50, here, you have this really big jobber right here, a 500 year return. Lake Spaulding 240, and you can see the numbers, Nevada City 100 year return. La Porte's the biggest. So just some monster numbers.

Another Goodridge analysis for the New Year's Day storm, 24-hour period, 50 year return line here within 4.70 for La Porte, Antelope Lake 7.80, 780 years for a one-day storm. And you can see the amounts there, 11.30 at La Porte so just monster returns.

An Owen Ray slide here. Just simply a quick look. Owen did this one and I want to point out. Here's your peak numbers, folks, for the whole storm: 3.40 inches in the Feather, and then let's look down south. I want to point out Chilcook Meadow was about the biggest we could find south of Yosemite, 19.29 for the storm. And then just a quick look at - within the wettest places, or places we like to look at. Buck's Lake, max six hours, 3.48; twelve hours, 6.64; and here's 24 hours at 12.16. Two days, 20.72; three days, 27.56. You can see why you had a problem with the Feather, a three day rain of 27.56, that's a lot of water. Blue Canyon three day total you can see is 17.96; Shasta, 16.78. And this part deals with the orographic nature and Maury mentioned that, very orographic. Eight times instead of the expected roughly 3.4 times between the valley and Blue Canyon. Extraordinarily orographic storm.

Okay. Off the storm, and how dry is it? I worked hard this week to get these numbers. Jim Goodrich, first of all, had done some work and found 32 locations in the state which had the driest February through May. I went ahead and picked some out that I was familiar with and USDA at Santa Maria had called me up and asked me to take a look at the central coast, so I did. I looked at Paso Robles, Santa Barbara and San Luis Obispo.

So what this slide tells you is the precip February through May of this year, the total precip during that period for each of these places, previous record, how much was it, what year was it, here's the normal and here's the percent of normal. So what I did was I listed from the driest and lowest percent of normal to the heaviest. All these places now the driest February through May. You asked about Sacramento. It was driest from February through April but then we had a little thunderstorm which screwed it up. Fourth driest in 140 years of records but it doesn't make this list. This is the number one list, folks.

Here's what's amazing. I looked at the sheets from Paso Robles. Zero precip for four months in a row; it's just amazing. No precip at Paso Robles. You can imagine the irrigation concerns and just the tip over from an amazingly wet pattern to one of no rain for four months. And that's, of course, zero. Santa Barbara 700. So I checked out Grant Grove, .93. And here's what's amazing about this. Previous record "dry" - now, this is the closest driest period - 4.37 in 1972. Their normal is 18.25 and they had about nine-tenths, so that's 5%. Blue Canyon on the northern end, 8.98, and that's followed by 10.91.

Take a look also. You can tell what the real dry periods have been, folks. Nineteen sixty-six shows up at Calaveras in the past as well as Paso Robles. How about 1875? Right there at San Luis, as well as San Francisco, as well as Merced. Nineteen seventy-seven, a few of those years show up here and there, 1966. Anyway, very, very dry. So what we're saying is from the I-80 corridor southward, most stations probably had close to the driest February through May, and that will be in the proceedings or I can make copies. Just holler at me and I can send you something in mail if you need that for other purposes, law suits, whatever. And it'll cost you.

Okay. How warm are we? Quick look, Sacramento temperatures. These are average monthly temperatures at a very warm location, post office, so you got remember there's some urban heat pollution. But it does tell you something, I think. We could go a year earlier. We haven't had a below normal month downtown since about June of '95. But in September of '96, it was within one-tenth of normal so let's start with October. Why October? That's the first month we had some warm temperatures showing up offshore in the oceans so we think there's some tie-in. So here's the normal. That's close to normal, but then you got really warm December, second warmest, and then more second warmest, April 5th warmest, warmest ever May, and then June through the 26th we're 2.8 ahead. What does this tell you? Well, what you can't see is the previous summer was the warmest summer ever, last summer '96, warmest summer ever in Sacramento. This winter you're looking at, third warmest winter ever. This spring you're looking at - spring is March, April, May - warmest spring ever. So within the last year we've had two seasons which were the warmest ever. So a lot of things to think about. Some urban pollution, urban heat pollution, it's a warm location. Jim Goodrich has always told us that warm ocean water has a direct tie-in to warm temperatures in California, and that I think we need to look at. We will in just a minute. So that's quite a warm run. If you look at San Francisco, you know, maybe not quite as extreme as far as anomalies but Jan warm, right?

Let's look back at sea surface temperatures given to us by the Climate Diagnostic Bulletin, and this would be back in October '96. Sea surface normal, departure from normal, along the equatorial region, the El Niño area. We don't have El Niño, we have La Niña, cold, below normal, continuing from the last winter and also through this past winter and then changing after February. Going to what? El Niño and warm. Look at here, though. Offshore we had a warm part, we had a little warm area. These plus one cell system anomalies show up from this month, October '96, all the way to now, and now they're about a +3. I don't think they're connected to a El Niño. Jim and I talked about it and I talked to other people. It's a disconnect; it's just there, we don't know why and it does have an impact. Obviously, the flow if from that direction. It certainly makes for warmer California temperatures, no doubt about it.

Let's jump all the way to April '97 and we turn this thing over and obviously the La Niña's gone. We're starting to get warm temperatures there, and here's a one and here's a two inside. And then the El Niño explodes last month with our latest analysis, and Jan will show you some slides for he has the really pretty stuff and these are just out of the *Bulletin*. He dumped his out of the computer and they're in color. You get the idea.

This is May '97. Folks, this is just explosive. We have an average in this area here of +2.9. These are the warmest surface temperatures we've had since August '83, August of 1983. And Jan and I talked and we talked with other people, none of us had seen an El Niño explode this early. So what does that mean? Some things to talk about, either after my talk or after Jan's, we're not sure. But take a look offshore here. We have a +3 in sight here so the waters are very warm off of California. What does it do? Means a warm California. We should be warm.

What about 1983? I brought this in to show you in Fahrenheit, in January of '83 this was the El Niño of the century. It peaked in December, okay? The prediction that Jan has would infer that the peaking of this one will be October, November. So maybe earlier than the classic December, which is the target you always think about. So maybe that will be different.

But let's also look at '82-'83, and just quickly mention that what it does with El Niño, you get a deeper elution low in this area. And then between the increased highest you have near Hawaii, the subtropical high builds, you have westerlies. For '82-'83 Jerry Inmias from SCRIPPS indicated that the average 700 millibar flow, Japan to California, was twice. What was the precip? Twice normal, wettest year of the century through this area right here. So it tied in a lot. Is this year going to be like that? I would bet that it's going to be something different than '82-'83; I just have a feeling. People are talking about '82-'83. Why would it necessarily be the same? Have we all of the sudden gotten really good at forecasting? I'm very cautious, and we'll talk about bottom lines in just a minute on that.

This is from Bill Gray, this is right out of *USA Today* and I didn't have another slide on it. But just let me quickly show you. El Niño effects for summertime, inner mountain area wet, and June has been like that. We talked about dry, drought in Eastern Australia, it's that way already. Late monsoon in India, yes, very late, just starting in here. Southeast Asia, I checked and I was there in Viet Nam and, Jan, did you say you were there, too? Anyway, by this time we should start having monsoons in Southeast Asia. It hasn't arrived. So one of the signals you see is late monsoons or none, disruption of the monsoon activity through here, Indonesia as well, dry in Eastern Australia. So those signals are not only Bill raised but others we know of. This one here is the only one I've seen.

Bill Gray also says more hurricanes than normal because he had done this research ahead of this explosion. Now the question is, will that change Bill Gray's forecast for a big hurricane year? I think it might; it's just a feeling. Because this thing is really, he made his forecast based on the fact we had a cold water, we had a carry over from La Niña, and this thing has really exploded since then. So I just wonder if we are going to get the number of hurricanes, I'm just tossing that out.

Work I did centers on La Niña. I think there's a tie in for wet Northern California, extreme storm events, or at least wet years. These are the last - La Niña means "cold event." These are the last ten we have and showing the bottom line, the average 112% in the northern Sierra. What unusual about that? Out of this ten, the three big storms of the century we talked about - December '55, December '64 and January '97 - we think we have a tendency to more often than not maybe during these cold episodes have a chance. It isn't going to happen all the time because you see a few dry years, but you have to look at those. Three of ten with a big three of the century we talked about.

Nineteen eighty-six was a nothing. It wasn't La Niña or El Niño, either one. And a few things to think about with El Niño years. How about temperatures? The Climate Prediction Center gives us analogs which, I think, this year compare to - we look back and we see '57-'58, '72, '73 to 2/83. Average summer Sacramento temperatures, the average for those three years, folks, is 74.9, the normal 75.4. What does that tell you? Maybe a comfortable summer, maybe more of this stuff outside than we see. In other words, depressed westerlies possibly, we'll see. It infers that we might have a more comfortable summer than normal, not such a hot one. Could be wrong.

How about northern Sierra precip? The wettest year is in 1982-83; '72-'73 only 104%; and the average is 143 so that infers maybe wet. My take on that would be maybe we'll have a good chance of above normal precip, but I don't think we have enough going for us right now to say it's a '82-'83. I'd be very careful about that.

From the University of Illinois we looked at 22 warm episode years for the northern Sierra. It comes out the same as 14 cold episode years, almost normal. Jan Knowle will talk about different types. This is by Shoener & Nicholson from Florida State. They have three types. Let me just tell you briefly. Type I is a big one, that the one where you have the strongest signals above 2 Celsius and here's what we have, 123%. And then lesser varieties. What do you think Type III event is? How about Water Year '77. We don't want that one, do we? We don't think we have that, that's a minor one and it's just quite different. And for all the types together you get 106%, 52.9, a little bit above normal.

What's happening right now, and then we're done. Deep trough this weekend, I want you see what pattern we have. This is an extraordinarily deep trough that's very much out of season. The 5.64 line forecast for Sunday afternoon is down in Northern California with a chance of showers on the north coast. Jan, has that changed any, still there? Okay, I pulled this out yesterday too. Let me just tell you, this is deeper than normal and there is some tie in. We talked about the Wimbledon. When you have a trough in a west coast of rain in England and if you figure out the weather 88 years ago, that the good analog. Because they said it's the wettest it's been in England for this tournament in 88 years.

So what's the forecast coming up? Forecast for six to ten days still has this big high in this area and has kind of a trough just off the coastline and still raining at Wimbledon. That's still nice weather, by the way, for California. So that's six to ten days. Are we getting signals? I had E-mails from several places and I just talked to Jan. Jan's not convinced, I'm not either, but we could be seeing some signaling from El Niño possibly. What it could do is increase westerlies because of what we call baroclinicity. That means we have very warm water here, not so warm here. The difference in water temperature should transmit some of this energy to the air, giving you a stronger jet stream, stronger westerly flow. That's just the basic stuff. And maybe lower heights in here. So lower heights and troughing means maybe cooler summer.

What else? How about an early rain in September? All three years we looked at earlier I showed you had September rains. Raisin crop was impacted in September '82. That's something to think about. We don't know, this is not a forecast, we're just tossing stuff out. And maybe a better than normal year, precip wise. I think I hit them all, Jan will hit a couple others. And just to make sure you really believe me, we'll finish up with that. You have to be able to laugh at yourself in this business, let me tell you.

A couple of things to talk about. I threw stuff out fast, but I want to keep you awake. I only saw two or three who dozed off, and I know who you are. I teach a class and they don't dare do that much.

Q: Where is Four Trees exactly?

Within a few miles of Buck's Lake, within a few miles of Buck's Lake. Four Trees would be within 10 miles. It's just the top and very strong upslope into Four Trees and Buck's Lake, a huge, monster lift. Those are two really wettest stations that we know of. I think that, Maury and I talked, those have to be close to 90 inch annual average stations, 85-90, in that area.