### 地球科学学院大气科学系《诊断分析与绘图实验》报告

### 实验十一 EOF分析及站点数据的使用

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1. **目的：**

掌握EOFUNC函数的使用；能正确理解EOF分析的结果；掌握用站点数据绘制等值线图的方法；了解其他数据分析函数的使用方法；掌握图形展板的使用。

1. **方法：（见实验指导书）**
2. **回答习题（可逐题回答，也可以把执行的命令或脚本一次写完，把要说明的内容加成注释或在最后说明）：**

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| 读入云南省124站1961-2011年的月平均降水资料，求出1961-2011年的年降水量，保存成文件yr\_rain.txt |
| begin  ;;dataread;;;  data\_m = new((/12,124,52/),"float")  month = (/"01","02","03","04","05","06","07","08","09","10","11","12"/)  do i =0,11,1  file\_path = "nc/0606/data/r" + month(i) + "-1961.dat"  data\_m(i,:,:) = asciiread(file\_path,(/124,52/), "float")  end do  ;print(data\_m)  data = dim\_sum\_n(data\_m(:,:,1:51), 0)  printVarSummary(data)  write\_table("yr\_rain.txt", "w", [/data/], "%4.0f") |
| 这里没有过多设置，因为主要还是为了后面自己用。 |
| 根据文献《云南近40年降水量的时空分布特征》的分析方法，对云南省124站1961-2011年的年降水量进行EOF分析，取前4个特征向量场，并给出对应的时间系数，同时进行North检验； |
| ;;;;;;;;;;;;;  opt = True  opt@jopt = 0  eof = eofunc(data\_de, 4, opt)  printVarSummary(eof)  north = eofunc\_north(eof@pcvar, 51, False)  print(north)  l\_tim = eofunc\_ts(data\_de,eof , opt)  ;printVarSummary(l\_tim)  l\_tim\_stn = dim\_standardize\_n(l\_tim,1,1)  ;print(l\_tim\_stn)  wks = gsn\_open\_wks("x11", "picture")  res = True  res@gsnFrame = False  res@gsnXYBarChart = True  res@gsnYRefLine = 0  res@tiMainString = "Time Factor(standardized)"  res@tiMainFontHeightF = 0.02  res@gsnXYBarChartBarWidth = 0.25  res@trYMaxF = 2.5  res@trYMinF = -2.5  res@trXMaxF = 51.75  res@trXMinF = 0  res@tiXAxisString = "Years"  res@tiXAxisFontHeightF = 0.016  res@gsnXYBarChartColors = (/"red"/)  plot1 = gsn\_csm\_xy(wks, fspan(0.5,50.5,51), l\_tim\_stn(0,:), res)  res@gsnXYBarChartColors = (/"yellow"/)  plot2 = gsn\_csm\_xy(wks, fspan(0.75,50.75,51), l\_tim\_stn(1,:), res)  res@gsnXYBarChartColors = (/"blue"/)  plot3 = gsn\_csm\_xy(wks, fspan(1,51,51), l\_tim\_stn(2,:), res)  res@gsnXYBarChartColors = (/"green"/)  plot4 = gsn\_csm\_xy(wks, fspan(1.25,51.25,51), l\_tim\_stn(3,:), res)  lbres = True  lbres@vpWidthF = 0.3 ; labelbar width  lbres@vpHeightF = 0.1 ; labelbar height  lbres@lbBoxMajorExtentF = 0.36 ; puts space between  lbres@lbFillColors = (/"red","yellow","blue","green"/)  lbres@lbMonoFillPattern = True ; Solid fill pattern  lbres@lbLabelFontHeightF = 0.035 ; font height. default  lbres@lbLabelJust = "CenterLeft" ; left justify labels  lbres@lbPerimOn = False  lbres@lgPerimColor = "white"  lbres@lbLabelFontHeightF = 0.012  labels = (/"Field 1","Field 2","Field 3","Field 4"/)  gsn\_labelbar\_ndc(wks,4,labels,0.55,0.13,lbres)  frame(wks)  end |
| 这里时间系数给的是类似前面实验的多个直方图叠加的形式，后来做后面的题才想到完全可以做成下一题那种等值线图的形式，感觉那样更有利于实际分析，而且这个图随便给的颜色看起来花里胡哨的XD，但是我的精力都耗在后面了，这里就也没改了… |
| 用前4个特征向量场数据绘制等值线图，如文献中图3所示。参考文献2.2.2节，分析云南降水量距平的分布特征。 |
| ;;;;;;;;;;;;;  opt = True  opt@jopt = 0  eof = eofunc(data\_de, 4, opt)  ;print(eof)  sta = asciiread("nc/0606/data/yn\_station.txt", -1, "string")  ; printVarSummary(sta)  delim = " ";copy not space  lats = tofloat(str\_get\_field(sta,4,delim))  lons = tofloat(str\_get\_field(sta,3,delim))  print(lats)  lats@units = "degrees\_north"  lons@units = "degrees\_east"  ;print(lons)  latf = fspan(21, 29, 81)  lonf = fspan(97,107,101)  latf@units = "degrees\_north"  lonf@units = "degrees\_east"  ;print(latf)  printVarSummary(latf)  ;print(eof(0,:))  ;print(eof(0,:))  ;grid = natgrid(lats, lons, eof(0,:), latf, lonf)  grid = obj\_anal\_ic(lons, lats, eof, lonf, latf, (/10,7,4,1/), False)  ;grid = triple2grid(lons, lats, eof(0,:), lonf, latf, False)  ;grid = cssgrid(lats, lons, eof(0,:), latf, lonf)  printVarSummary(grid)  grid!1 = "lat"  grid!2 = "lon"  grid&lat = latf  grid&lon = lonf  ;print(grid)  wks = gsn\_open\_wks("png", "name11")  res = True  res@gsnAddCyclic = False  res@gsnFrame=False  res@gsnDraw=False  res@pmTickMarkDisplayMode = "Always"  res@mpMaxLatF = 29  res@mpMaxLonF = 107  res@mpMinLatF = 21  res@mpMinLonF = 97  res@mpDataBaseVersion = "Ncarg4\_1"  res@mpDataSetName = "Earth..4"  ;res@mpOutlineSpecifiers = (/"China:Yunnan"/)  res@cnLinesOn=True  res@mpOutlineOn=True  res@cnInfoLabelOn = False  res@mpAreaMaskingOn=True  res@mpFillAreaSpecifiers=(/"land","water"/)  res@mpSpecifiedFillColors=(/"gray70","gray70"/)  res@mpMaskAreaSpecifiers=(/"China:Yunnan"/)  res@cnLineDrawOrder = "PreDraw"  res@cnLabelDrawOrder = "PreDraw"  ;res@cnLineLabelDensityF = 1  res@cnLineLabelAngleF = 0  res@cnLevelSelectionMode = "ManualLevels"  res@cnMinLevelValF = -0.16  res@cnMaxLevelValF = 0.16  res@cnLevelSpacingF = 0.01  res@cnExplicitLineLabelsOn = True  res@cnLineLabelStrings = tostring\_with\_format(fspan(-0.16,0.16,33),"%3.2f")  res@cnLineLabelPlacementMode = "Computed"  res@cnLineLabelDensityF = 1.5  plot = new(4,graphic)  plot(0) = gsn\_csm\_contour\_map(wks,grid(0,:,:),res)  plot(1) = gsn\_csm\_contour\_map(wks,grid(1,:,:),res)  plot(2) = gsn\_csm\_contour\_map(wks,grid(2,:,:),res)  plot(3) = gsn\_csm\_contour\_map(wks,grid(3,:,:),res)  resp = True  resp@txString = "The First 4 eigenvector fields of EOF Annual ~C~rainfall anomaly Field from 1961 to 2011 (a-d)"  res@gsnPanelLabelBar = True  resp@gsnPanelFigureStrings = (/"a","b","c","d"/)  gsn\_panel(wks, plot, (/2,2/), resp)  end |
| 这里主要是尝试了那四种插值方法，其实区别都不大，可能因为数据是一维的关系，在多维数据插值上可能会有区别。  还值得一说的是labeldensityF，去看了官网发现很有意思的是，在0-1之间表示疏密度（百分比那种？），在大于1的情况会变成每条线的个数？反正如果需要很多等值线label的话可以调大这个数值。  还有补充的是…要注意插值的lat和lon不要反…那几个插值函数有部分不是先lat后lon，在这里找了很久的bug……最后意识到是lat和lon反了..心累    第一个特征向量的解释方差占比较大，后面三个就都比较小，前4个特征向量累计方差贡献为56.74%。从图可知，第一向量场全省基本为正，且由南向北递减，东西变化相对较弱；第二向量场主要为东西分布，西部为正东部为负；第三向量场在西南部有一个等值线密集区，且为最大正值中心，全省除东西边界部分为负其他地区均为正；第四向量场主要为东北-西南分布，东北为正西南为负。 |
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| 绘制第一模态年雨量距平的空间分布和时间系数图。 |
| wks = gsn\_open\_wks("x11", "name11")  res = True  res@gsnAddCyclic = False  res@gsnFrame=False  ;res@gsnDraw=False  res@pmTickMarkDisplayMode = "Always"  res@mpMaxLatF = 29  res@mpMaxLonF = 107  res@mpMinLatF = 21  res@mpMinLonF = 97  res@vpXF = 0.3  res@vpYF = 0.9  res@vpWidthF=0.4  res@vpHeightF=0.4  res@mpDataBaseVersion = "Ncarg4\_1"  res@mpDataSetName = "Earth..4"  res@cnLinesOn=True  res@mpOutlineOn=True  res@cnInfoLabelOn = False  res@mpAreaMaskingOn=True  res@mpFillAreaSpecifiers=(/"land","water"/)  res@mpSpecifiedFillColors=(/"gray70","gray70"/)  res@mpMaskAreaSpecifiers=(/"China:Yunnan"/)  res@cnLineDrawOrder = "PreDraw"  res@cnLabelDrawOrder = "PreDraw"  ;res@cnLineLabelDensityF = 1  res@cnLineLabelAngleF = 0  res@cnLevelSelectionMode = "ManualLevels"  res@cnMinLevelValF = -0.16  res@cnMaxLevelValF = 0.16  res@cnLevelSpacingF = 0.01  res@cnExplicitLineLabelsOn = True  res@cnLineLabelStrings = tostring\_with\_format(fspan(-0.16,0.16,33),"%3.2f")  res@cnLineLabelPlacementMode = "Computed"  res@cnLineLabelDensityF = 1.5  res@tiMainString = "First mode anomaly field"  plot = new(2,graphic)  plot(0) = gsn\_csm\_contour\_map(wks,grid,res)  res2=True  ;res2@gsnFrame = False  res2@vpXF = 0.2  res2@vpYF = 0.4  res2@vpWidthF=0.6  res2@vpHeightF=0.3  res2@gsnYRefLine=0.0  res2@xyLineThicknessF=1.5  res2@tiXAxisString="Year"  res2@tiYAxisString=""  res2@tmXBMode = "Explicit"  res2@tmXBValues = (/1,6,11,16,21,26,31,36,41,46,51/)  res2@tmXBLabels=(/"1961","1966","1971","1976","1981","1986","1991","1996","2001","2006"," 2011"/)  res2@tiMainString = "First mode time coefficient(standardized)"  res2@tiMainFontHeightF = 0.015  res2@tmXBLabelFontHeightF=0.015  res2@tmYLLabelFontHeightF=0.01  plot(1)=gsn\_csm\_xy(wks, fspan(0,50,51), l\_tim\_std, res2)  resp = True  ;resp@gsnPanelRowSpec = True  resp@gsnPanelFigureStrings = (/"a","b"/)  ;gsn\_panel(wks, plot, (/2,1/), resp)  end |
| 这里不放数据处理部分了也，图像位置的处理主要是vpXF和vpWidthF，纵向同理，需要多次调试能达到较好效果。 |

1. **实验小结（本次实验收获的经验、教训、感受等）：**

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| 这次主要说的是第四问，开始的理解是要进行原距平重构，正好也搜到了一下内容（https://renqlsysu.github.io/2018/01/31/ncl-significance-test-EOF/）    于是开始纠结…最后结合论文探索出来的应该是将EOF所得特征向量场E(124)和时间系数T(51)（E和T都是第一模态的）分别conform成E(124,124)和T(124,51)，然后再叉乘(ncl中叉乘为#)所得为第一模态重构所得降雨量距平场，虽然最后才知道4题的重点应该是手动叠加图形并调整位置… |