**PREDICCIÓN DE   
TEMPERATURA/GRAVEDAD/METALICIDAD   
EN ESPECTROS DE ESTRELLAS IPAC   
A PARTIR DE DATOS CONTRAÍDOS DE ESPECTROS BT-SETTLE**

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INTRODUCCIÓN

El objetivo del trabajo es producir un modelo de T, log(t), log(g) y Fe/H, con los espectros sintéticos BT-Settle y aplicarlo sobre los espectros de las estrellas IPAC.

Tanto los datos de entrenamiento como los de test se dan en tres tramos distintos de longitud de onda todos ellos con paso de 3.6 Å:

* 8450 – 8680 Å para el primer conjunto
* 8700 – 8900 Å para el segundo
* 8980 – 9270 Å para el tercero

Los tramos del espectro han sido normalizados para tener área unidad de flujo de energía y no tener que normalizar.

Inicialmente hay 2395 registros para cada conjunto de entrenamiento, aunque una vez eliminados los registros con valores NA se dispone de 2223 registros.

Como en los estudios previos se asumen las buenas características de la técnica de análisis de componentes independientes (ICA) y las buenas propiedades exhibidas por SVM.

Todos los estudios se han realizado para cada tramo individual y para todas sus posibles combinaciones. Además, todos los resultados numéricos se recogen en un fichero Excel denominado resultados.

VALIDACIÓN CRUZADA DE 10 CONJUNTOS

Se ha realizado una validación cruzada de los espectros empleados como entrenamiento que no presentan valores NA (2223 registros).

El proceso se ha desarrollado en dos etapas:

Primero, se crean de forma aleatoria los 10 conjuntos de referencia para 6, 10, 14, 18 y 22 dimensiones del espacio de compresión/proyección que se van a analizar. Procediendo en esta misma etapa a la proyección de los datos mediante el algoritmo JADE. Los resultados contenidos en el espacio de trabajo de R se guardan para su posterior estudio mediante la creación de las imágenes de cada uno de los casos.

La segunda etapa se encarga del cálculo de los errores de reconstrucción para los espectros del grupo de control (NIDX) que no se han tenido en cuenta en la compresión/proyección previa, basada en los otros 9 grupos (IDX). Este proceso de repite para cada uno de los 10 conjuntos en los que se ha dividido la muestra y para cada una de las dimensiones de compresión analizadas.

Los resultados numéricos de todo este proceso se recogen en un fichero de texto para su posterior representación gráfica.

**Análisis de resultados**:

En el análisis de un único tramo para dimensiones menores el mejor comportamiento lo presenta el tramo 03 sin embargo cuando se aumenta el número de dimensiones se comporta mejor el tramo 02. En cualquier caso, el tramo 01 es el que peor se comporta.

La combinación de los tramos de dos en dos, muestra un mejor comportamiento para la suma de los tramos 02+03 y la peor con el 01+03. Sin embargo, la combinación 02+03 siempre presenta una reconstrucción peor que para el tramo 02 individual.

Lo mismo se puede decir de la suma de los tramos (01 + 02 +03) que presenta valores de errores superiores al tramo 02.

En cualquier caso el comportamiento de los datos de entrenamiento y los de test son muy próximos, existiendo algunas pequeñas diferencias en el estudio de desviaciones en los tramos 01, 01+02, 01+03, 01+02+03 principalmente.

**Código empleado:**

#CREACIÓN DE IMÁGENES DE FICHEROS

nel = dim(dtr\_01)[1]

cv <- 10

for (ndim in c(6, 10)) {

rv <- sample(1:nel)

for (nsamp in c(1:cv)) {

ini <- (nsamp-1)\*nel/cv

end <- ini + nel/cv

nidx = rv[ini:end]

idx<-(1:nel)[!(1:nel %in% nidx)]

fname=sprintf("d%02d\_e%02d.Rdata", ndim, nsamp)

if (! file.exists(fname)) {

cat(paste(fname,"\n"))

X2<-dtr\_01[idx,]

# hacemos todos los numeros

res2<-JADE(X2,ndim,maxiter=15000)

# output workspcae in filename

save.image(file = fname)

}}}

#CÁLCULO DE ESTADÍSTICAS

for (ndim in c(6, 10)){

for (nsamp in c(1:10)){

fname=sprintf("d%02d\_e%02d.txt", ndim, nsamp)

# ponemos a cero las variables de salida

mederr = NA

varerr = NA

# errores para el conjunto de entrenamiento (X2)

t(apply(res2$S,1,FUN="%\*%",t(res2$A))) -> nns

t(apply(nns,1,FUN="+",res2$Xmu)) -> nns1

error<- 100\*abs(X2-nns1)/X2

error[error==Inf]<-NA

t(apply(error,1,mean,na.rm=T))->mederr\_training

t(apply(error,1,sd,na.rm=T))->varerr\_training

# errores para el conjunto de test (nX2)

nX2<-dtr\_01[nidx,]

t(apply(nX2,1,FUN="-",res2$Xmu)) -> ns1

t(apply(ns1,1,FUN="%\*%",t(res2$W))) -> pns

t(apply(pns,1,FUN="%\*%",t(res2$A))) -> nns

t(apply(nns,1,FUN="+",res2$Xmu)) -> nns1

error<- 100\*abs(nX2-nns1)/nX2

error[error==Inf]<-NA

t(apply(error,1,mean,na.rm=T))->mederr\_test

t(apply(error,1,sd,na.rm=T))->varerr\_test

salida = sprintf("%02d %02d", ndim, nsamp)

# sacar los indices globales para conjunto entrenamiento

avg\_med\_err <- mean(as.vector(mederr\_training),na.rm=T)

sd\_med\_err <- sd(as.vector(mederr\_training),na.rm=T)

avg\_var\_err <- mean(as.vector(varerr\_training),na.rm=T)

sd\_var\_err <- sd(as.vector(varerr\_training),na.rm=T)

salida = paste(salida, sprintf(" %12.6f %12.6f %12.6f %12.6f",

avg\_med\_err, sd\_med\_err, avg\_var\_err, sd\_var\_err))

# sacar los indices globales para conjunto test

avg\_med\_err <- mean(as.vector(mederr\_test),na.rm=T)

sd\_med\_err <- sd(as.vector(mederr\_test),na.rm=T)

avg\_var\_err <- mean(as.vector(varerr\_test),na.rm=T)

sd\_var\_err <- sd(as.vector(varerr\_test),na.rm=T)

salida = paste(salida, sprintf(" %12.6f %12.6f %12.6f %12.6f",

avg\_med\_err, sd\_med\_err, avg\_var\_err, sd\_var\_err))

fo <- file(fname, "w") # open an output file connection

cat(paste(salida, "\n"), file = fo)

close(fo)

}}

#LECTURA DE LOS FICHEROS DE VALIDACIÓN

ndim\_max<-5

nsamp\_max<-10

numero\_filas<-((ndim\_max)\*nsamp\_max)

datos\_validacion<-matrix(nrow=numero\_filas, ncol=10)

for (ndim in c(6, 10, 14, 18, 22)) {

for (nsamp in c(1:10)) {

fname=sprintf("d%02d\_e%02d.txt", ndim, nsamp)

j<-((ndim-6)\*(2.5))+nsamp

prueba<-read.table(file=fname)

for (i in 1:10) datos\_validacion[j,i]<-prueba[,i]

}}

write.table(datos\_validacion, file = "genstats\_validacion.txt", sep = " ", eol = "\n", dec = ".", col.names = c("ND", "NS", "avg\_med\_err\_tr", "sd\_med\_err\_tr", "avg\_var\_err\_tr", "sd\_var\_err\_tr", "avg\_med\_err\_t", "sd\_med\_err\_t", "avg\_var\_err\_t", "sd\_var\_err\_t"), qmethod = c("escape", "double"))

err<-read.table(file="genstats\_validacion.txt", header=T)

apply(err,2,range)

#DIBUJO DATOS VALIDACIÓN

#Dibujado de los errores medios (MEAN)

par(mfrow=c(2,2))

plot(unique(err$ND),tapply(as.matrix(err[,3]),err$ND,mean),type="l",col=2,main="Err medio (x-validation 10-fold)",ylab="%",ylim=c(0,5),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,7]),err$ND,mean),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,4]),err$ND,mean),type="l",col=2,main="Desv Err Medio (x-validation 10-fold)",ylab="%",ylim=c(0,5),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,8]),err$ND,mean),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,5]),err$ND,mean),type="l",col=2,main="Media del la SD(Error) (x-validation 10-fold)",ylab="SD(error)",ylim=c(0,20),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,9]),err$ND,mean),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,6]),err$ND,mean),type="l",col=2,main="SD del la SD(Error) (x-validation 10-fold)",ylab="SD(error)",ylim=c(0,50),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,10]),err$ND,mean),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

#Dibujado de los errores con mediana(MEDIAN)

par(mfrow=c(2,2))

plot(unique(err$ND),tapply(as.matrix(err[,3]),err$ND,median),type="l",col=2,main="Mediana Err (x-validation 10-fold)",ylab="%",ylim=c(0,5),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,7]),err$ND,median),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,4]),err$ND,median),type="l",col=2,main="Desv Mediana Err (x-validation 10-fold)",ylab="%",ylim=c(0,5),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,8]),err$ND,median),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,5]),err$ND,median),type="l",col=2,main="Mediana del la SD(Error) (x-validation 10-fold)",ylab="SD(error)",ylim=c(0,20),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,9]),err$ND,median),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,6]),err$ND,median),type="l",col=2,main="SD del la SD(Error) (x-validation 10-fold)",ylab="SD(error)",ylim=c(0,50),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,10]),err$ND,median),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

#Dibujado de los errores con min(MIN)

par(mfrow=c(2,2))

plot(unique(err$ND),tapply(as.matrix(err[,3]),err$ND,min),type="l",col=2,main="Min Err (x-validation 10-fold",ylab="%",ylim=c(0,5),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,7]),err$ND,min),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,4]),err$ND,min),type="l",col=2,main="Desv Min( Err) (x-validation 10-fold)",ylab="%",ylim=c(0,5),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,8]),err$ND,min),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,5]),err$ND,min),type="l",col=2,main="Min del la SD(Error) (x-validation 10-fold)",ylab="SD(error)",ylim=c(0,20),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,9]),err$ND,min),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,6]),err$ND,min),type="l",col=2,main="Min SD del la SD(Error) (x-validation 10-fold)",ylab="SD(error)",ylim=c(0,50),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,10]),err$ND,min),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

#Dibujado de los errores con max(MAX)

par(mfrow=c(2,2))

plot(unique(err$ND),tapply(as.matrix(err[,3]),err$ND,max),type="l",col=2,main="Max Err (x-validation 10-fold)",ylab="%",ylim=c(0,5),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,7]),err$ND,max),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,4]),err$ND,max),type="l",col=2,main="Desv Max( Err) (x-validation 10-fold)",ylab="%",ylim=c(0,5),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,8]),err$ND,max),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,5]),err$ND,max),type="l",col=2,main="Max del la SD(Error) (x-validation 10-fold)",ylab="SD(error)",ylim=c(0,20),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,9]),err$ND,max),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$ND),tapply(as.matrix(err[,6]),err$ND,max),type="l",col=2,main="Max SD del la SD(Error) (x-validation 10-fold)",ylab="SD(error)",ylim=c(0,100),xlab="Dimensión del espacio de contracción", cex.main=1.1)

lines(unique(err$ND),tapply(as.matrix(err[,10]),err$ND,max),type="l",col=3)

legend("topright",col=c(2,3),legend=c("Training","Test"),text.col=c(2,3),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

Conjunto de entrenamiento 01

errores_medios_01errores_con_mediana_01

errores_con_min_01errores_con_max_01

Conjunto de entrenamiento 02

errores_medios_02errores_con_mediana_02

errores_con_min_02errores_con_max_02

Conjunto de entrenamiento 03

errores_medios_03errores_con_mediana_03

errores_con_min_03errores_con_max_03

Conjunto de entrenamiento 01 + 02

errores_medios_01_02errores_con_mediana_01_02

errores_con_min_01_02errores_con_max_01_02

Conjunto de entrenamiento 01 + 03

errores_medios_01_03errores_con_mediana_01_03

errores_con_min_01_03errores_con_max_01_03

Conjunto de entrenamiento 02 + 03

errores_medios_02_03errores_con_mediana_02_03

errores_con_min_02_03errores_con_max_02_03

Conjunto de entrenamiento 01 + 02 + 03

errores_medios_01_02_03errores_con_mediana_01_02_03

errores_con_min_01_02_03errores_con_max_01_02_03

PREDICCIÓN DE T, log(T), log(g) y [Fe/H] PARA LOS DATOS DE ENTRENAMIENTO

Se ha llevado a cabo la predicción de la T, log(T), log(g) y [Fe/H], para los datos de entrenamiento con valores no NA (de 2223 registros), empleando las compresiones, valores de coste y valores de épsilon indicados a continuación:

* Compresiones de los datos a 2, 6, 10, 14, 18 y 22 dimensiones
* Valores de coste de 0.1, 0.45, 0.5, 0.55, 0.6, 1, 2, 5, 0, 100, 1000
* Valores épsilon de 0.000001, 0.00001, 0.0001, 0.001, 0.01, 0.05, 0.1, 0.5, 1

Y se recogen:

* AVG: mean(abs(predicted - actual))
* SD: sqrt(sum((predicted - actual)^2)/n)
* REL: mean((abs(predicted-actual))/actual)

**Análisis de resultados:**

Como en el caso de la reconstrucción, en las predicciones de los parámetros el mejor comportamiento se obtiene cuando se trabaja con el tramo 02 de forma individual.

Es muy clara la mejora de comportamiento cuando se predice log(T) frente a la T. Incluso con mejores comportamientos que en la predicción de log(g) y [Fe/H].

Tanto la desviación como la media presenta los valores más bajos con 6 y/ó 10dimensiones, un coste de 1000 y un valor de épsilon de 0,00001 – 0,000001, con la excepción del conjunto de tramos 01 + 03 que tanto para la temperatura como para la gravedad los valores mínimos se obtienen con 14 dimensiones, y el conjunto de 01 + 02 + 03 en la predicción de log(T) aunque muy próximos a estos valores se encuentran los resultados obtenidos con 6 y 10 dimensiones respectivamente.

**Código empleado:**

#CARGA DE LAS FUNCIONES A UTILIZAR

jade\_off <- function (jade\_obj,orig\_data) {

if ( dim(jade\_obj$S)[1] != dim(orig\_data)[1]) {

return(NULL)

}

if ( dim(jade\_obj$W)[2] != dim(orig\_data)[2]) {

return(NULL)

}

off<-(((as.matrix(orig\_data) %\*% t( jade\_obj$W ))[1,]) - jade\_obj$S[1,])

return(as.numeric(off))

}

# Compute some useful error metrics

modelErrors <- function(predicted, actual) {

sal <- vector(mode="numeric", length=3)

names(sal) <- c( "MAE", "RMSE", "RELE")

meanPredicted <- mean(predicted)

meanActual <- mean(actual)

sumPred <- sum((predicted - meanPredicted)^2)

sumActual <- sum((actual - meanActual)^2)

n<- length(actual)

p3<-vector(mode="numeric", length=n)

for (i in c(1:n)) {

if (actual[i]==0) {p3[i]<-abs(predicted[i])

} else { p3[i]<-((abs(predicted[i]-actual[i]))/actual[i])

}}

sal[1] <- mean(abs(predicted - actual))

sal[2] <- sqrt(sum((predicted - actual)^2)/n)

sal[3] <- mean(p3)

sal

}

# Procedure to select the best parameters for each kernel

tuneksvm <- function (x, data, ranges = list(), kernel="rbfdot", type="eps-svr", nfolders=10, C, epsilon) {

call <- match.call()

resp <- function(formula, data) model.response(model.frame(formula, data))

n <- nrow(data)

perm.ind <- sample(n)

if (nfolders > n) stop(sQuote("nfolders"), " must not exceed sampling size!")

if (nfolders <= 1) stop(sQuote("nfolders"), " must be greater than 1!")

train.ind <- tapply(1:n, cut(1:n, breaks = nfolders), function(x) perm.ind[-x])

parameters <- expand.grid(ranges)

p <- nrow(parameters)

model.variances <- model.errors <-

matrix(0, nrow=max(1,p), ncol=3, dimnames=list(NULL, c("MAE", "RMSE", "RELE")))

for (para.set in 1:max(1,p)) {

sampling.errors <- matrix(0, nrow=length(train.ind), ncol=3)

for (sample in 1:length(train.ind)) {

pars <- if (p==0) list()

else lapply(parameters[para.set, , drop = FALSE], unlist)

message("Parameters: [",paste(pars,collapse=","),"] Sample: ", sample)

model <- ksvm(x = x,

data = data[train.ind[[sample]],],

type = type,

kernel = kernel,

C=C,

tol=0.001,

epsilon=epsilon,

kpar = pars,

scaled = TRUE)

# Prediction phase

pred <- predict(model, data[-train.ind[[sample]], , drop = FALSE])

true.y <- resp(x, data[-train.ind[[sample]], ])

sampling.errors[sample,] = modelErrors(pred, true.y)

print(paste("Sample:",sample))

print(sampling.errors[sample,])

}

model.errors[para.set,] <- apply(sampling.errors, 2, mean)

model.variances[para.set,] <- apply(sampling.errors, 2, sd)

}

best <- if (p==0) 1

else which.min(model.errors[,"RMSE"])

pars <- if (p==0) list()

else lapply(parameters[best, , drop = FALSE], unlist)

structure(

list(

best.parameters = if (p==0) list()

else parameters[best, , drop = FALSE],

best.performance = model.errors[best,],

method = if (!is.character(kernel)) deparse(substitute(kernel)) else kernel,

nparcomb = nrow(parameters),

train.ind = train.ind,

sampling = paste(nfolders,"-fold cross validation", sep = ""),

performances = if (p==0) cbind(errors = model.errors,

dispersion = model.variances)

else cbind(parameters,

errors = model.errors,

dispersion = model.variances),

best.model = ksvm(x = x,

data = data,

type = type,

kernel = kernel,

C=C,

tol=0.001,

epsilon=epsilon,

kpar = pars,

scaled = TRUE,

cross=nfolders),

call = call),

class = "tune")

}

ndim<-6

for (ndim in c(6, 10, 14, 18, 22)) {

resp1<-NULL

if (ndim==6) resp1<-res\_br\_06

if (ndim==10) resp1<-res\_br\_10

if (ndim==14) resp1<-res\_br\_14

if (ndim==18) resp1<-res\_br\_18

if (ndim==22) resp1<-res\_br\_22

jade\_off(resp1,dtr\_01\_03)->jade\_offset1

#CREACIÓN DE LOS CONJUNTOS DE DATOS A TRABAJAR

cont\_coef\_train\_1 <- NULL

cont\_coef\_test\_1 <- NULL

if ( is.null(cont\_coef\_train\_1) ) {

data\_train1<-as.data.frame(cbind(resp1$S))

} else {

data\_train1<-as.data.frame(cbind(resp1$S,cont\_coef\_train\_1))

}

colnames(data\_train1)<- c(paste("C",1:ndim,sep=""))

if ( is.null(cont\_coef\_test\_1) ) {

data\_test1<-as.data.frame(cbind(t(apply((as.matrix(dte\_01\_03) %\*% t( resp1$W )),1,FUN="-",t(as.matrix(jade\_offset1))))))

} else {

data\_test1<-as.data.frame(cbind(t(apply((as.matrix(dte\_01\_03) %\*% t( resp1$W )),1,FUN="-",t(as.matrix(jade\_offset1)))), cont\_coef\_test\_1))

}

colnames(data\_test1)<-c(paste("C",1:ndim,sep=""))

tr01gdf1\_T <- data.frame(logg=I(Gtrain01\_T), data\_train1)

tr01gdf1\_logT <- data.frame(logT=I(Gtrain01\_logT), data\_train1)

tr01gdf1\_G <- data.frame(logg=I(Gtrain01\_G), data\_train1)

tr01gdf1\_M <- data.frame(logg=I(Gtrain01\_M), data\_train1)

for (coste in c(0.1, 0.45, 0.5, 0.55, 0.6, 1, 2, 5, 10, 100, 1000)){

for (epsilon in c(0.000001, 0.00001, 0.0001, 0.001, 0.01, 0.05, 0.1, 0.5, 1)){

tuneLap1g1\_T<-tuneksvm(

x=logg~.,

data=tr01gdf1\_T,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_T <- predict(tuneLap1g1\_T$best.model, data\_train1)

vartr41\_T<-modelErrors(prede1gtr1\_T, Gtrain01\_T)[1]

vartr51\_T<-modelErrors(prede1gtr1\_T, Gtrain01\_T)[2]

vartr61\_T<-modelErrors(prede1gtr1\_T, Gtrain01\_T)[3]

tuneLap1g1\_logT<-tuneksvm(

x=logt~.,

data=tr01gdf1\_logT,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_logT <- predict(tuneLap1g1\_logT$best.model, data\_train1)

vartr41\_logT<-modelErrors(prede1gtr1\_logT, Gtrain01\_logT)[1]

vartr51\_logT<-modelErrors(prede1gtr1\_logT, Gtrain01\_logT)[2]

vartr61\_logT<-modelErrors(prede1gtr1\_logT, Gtrain01\_logT)[3]

tuneLap1g1\_G<-tuneksvm(

x=logg~.,

data=tr01gdf1\_G,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_G <- predict(tuneLap1g1\_G$best.model, data\_train1)

vartr41\_G<-modelErrors(prede1gtr1\_G, Gtrain01\_G)[1]

vartr51\_G<-modelErrors(prede1gtr1\_G, Gtrain01\_G)[2]

vartr61\_G<-modelErrors(prede1gtr1\_G, Gtrain01\_G)[3]

tuneLap1g1\_M<-tuneksvm(

x=logg~.,

data=tr01gdf1\_M,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_M <- predict(tuneLap1g1\_M$best.model, data\_train1)

vartr41\_M<-modelErrors(prede1gtr1\_M, Gtrain01\_M)[1]

vartr51\_M<-modelErrors(prede1gtr1\_M, Gtrain01\_M)[2]

vartr61\_M<-modelErrors(prede1gtr1\_M, Gtrain01\_M)[3]

if (ndim==6 & coste == 0.1 & epsilon == 0.000001) {

fname=sprintf("resultados\_primer\_tercer\_tramo.txt")

salida0 = sprintf("ND COSTE EPS T\_AVG T\_SD T\_REL logT\_AVG logT\_SD logT\_REL G\_AVG G\_SD G\_REL M\_AVG M\_SD M\_REL")

fo <- file(fname, "wt") # open an output file connection

cat(paste(salida0, "\n"), file = fo)

}

salida1 = sprintf("%g %12.6f %12.6f", ndim, coste, epsilon)

salida1 = paste(salida1, sprintf(" %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f" , vartr41\_T, vartr51\_T, vartr61\_T, vartr41\_logT, vartr51\_logT, vartr61\_logT vartr41\_G, vartr51\_G, vartr61\_G, vartr41\_M, vartr51\_M, vartr61\_M))

cat(paste(salida1, "\n", sep=" "), file = fo)

}}}

close(fo)

Conjunto de entrenamiento 01

|  |  |  |
| --- | --- | --- |
| Temperatura | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 10 | 100 | 0.000001 | 0.074097 | | 10 | 1000 | 0.000001 | 0.074097 | | 6 | 100 | 0.000001 | 0.078771 | | 10 | 100 | 0.00001 | 0.080426 | | 10 | 1000 | 0.00001 | 0.080426 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 10 | 100 | 0.000001 | 0.090183 | | 10 | 1000 | 0.000001 | 0.090183 | | 18 | 100 | 0.000001 | 0.097703 | | 18 | 1000 | 0.000001 | 0.097703 | | 6 | 1000 | 0.000001 | 0.099035 | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 10 | 100 | 0,000001 | 0,000026 | | 10 | 1000 | 0,000001 | 0,000026 | | 6 | 100 | 0,000001 | 0,000028 | | 6 | 1000 | 0,00001 | 0,000029 | | 10 | 100 | 0,00001 | 0,000029 | |
| Log Temperatura |  |  |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 100 | 0.00001 | 0.00001163 | | 6 | 1000 | 0.00001 | 0.00001163 | | 6 | 100 | 0.000001 | 0.00001167 | | 6 | 1000 | 0.000001 | 0.00001167 | | 10 | 100 | 0.00001 | 0.00001167 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 6 | 100 | 0.00001 | 0.00001427 | | 6 | 1000 | 0.00001 | 0.00001427 | | 10 | 100 | 0.00001 | 0.00001437 | | 10 | 1000 | 0.00001 | 0.00001437 | | 6 | 1000 | 0.000001 | 0.00001443 | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 100 | 0.00001 | 0.00000337 | | 6 | 1000 | 0.00001 | 0.00000337 | | 10 | 100 | 0.00001 | 0.00000338 | | 10 | 1000 | 0.00001 | 0.00000338 | | 6 | 1000 | 0.000001 | 0.00000339 | |
| Log Gravedad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 1000 | 0.000001 | 0.000202 | | 14 | 100 | 0.00001 | 0.000218 | | 14 | 1000 | 0.00001 | 0.000218 | | 14 | 100 | 0.000001 | 0.000219 | | 14 | 1000 | 0.000001 | 0.000219 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 6 | 1000 | 0.000001 | 0.00025 | | 14 | 100 | 0.000001 | 0.000266 | | 14 | 1000 | 0.000001 | 0.000266 | | 14 | 100 | 0.00001 | 0.000266 | | 14 | 1000 | 0.00001 | 0.000266 | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 18 | 0.1 | 0.0001 | 0.000018 | | 18 | 0.1 | 0.000001 | 0.000031 | | 18 | 0.1 | 0.00001 | 0.000033 | | 18 | 0.1 | 0.001 | 0.000038 | | 14 | 100 | 0.000001 | 0.000048 | |
| Metalicidad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 1000 | 0.00001 | 0.000173 | | 10 | 100 | 0.00001 | 0.000184 | | 10 | 1000 | 0.00001 | 0.000184 | | 18 | 100 | 0.00001 | 0.000188 | | 18 | 1000 | 0.00001 | 0.000188 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 6 | 1000 | 0.00001 | 0.000214 | | 10 | 100 | 0.00001 | 0.000224 | | 10 | 1000 | 0.00001 | 0.000224 | | 18 | 100 | 0.00001 | 0.000227 | | 18 | 1000 | 0.00001 | 0.000227 | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 14 | 0.55 | 0.1 | 0.00001 | | 6 | 1000 | 0.00001 | 0.000019 | | 10 | 100 | 0.00001 | 0.000019 | | 10 | 1000 | 0.00001 | 0.000019 | | 18 | 100 | 0.000001 | 0.000023 | |

Conjunto de entrenamiento 02

|  |  |  |
| --- | --- | --- |
| Temperatura | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 1000 | 0.000001 | 0.065241 | | 14 | 1000 | 0.000001 | 0.075093 | | 6 | 1000 | 0.00001 | 0.076609 | | 10 | 1000 | 0.00001 | 0.080144 | | 14 | 1000 | 0.00001 | 0.081171 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 6 | 1000 | 0.000001 | 0.082611 | | 14 | 1000 | 0.000001 | 0.091287 | | 6 | 1000 | 0.00001 | 0.095814 | | 10 | 1000 | 0.00001 | 0.099145 | | 14 | 1000 | 0.00001 | 0.100435 | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.000024 | | 14 | 1000 | 0.000001 | 0.000027 | | 6 | 1000 | 0.00001 | 0.000028 | | 10 | 1000 | 0.00001 | 0.000029 | | 14 | 1000 | 0.00001 | 0.000029 | |
| Log Temperatura |  |  |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 1000 | 0.000001 | 0.00001023 | | 14 | 1000 | 0.00001 | 0.00001039 | | 6 | 1000 | 0.00001 | 0.00001042 | | 10 | 1000 | 0.00001 | 0.00001215 | | 14 | 1000 | 0.000001 | 0.00001228 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 14 | 1000 | 0.00001 | 0.00001278 | | 6 | 1000 | 0.000001 | 0.00001291 | | 6 | 1000 | 0.00001 | 0.000013 | | 10 | 1000 | 0.00001 | 0.00001489 | | 14 | 1000 | 0.000001 | 0.00001501 | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.00000297 | | 14 | 1000 | 0.00001 | 0.00000301 | | 6 | 1000 | 0.00001 | 0.00000303 | | 10 | 1000 | 0.00001 | 0.00000352 | | 14 | 1000 | 0.000001 | 0.00000356 | |
| Log Gravedad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 1000 | 0.000001 | 0.000187 | | 10 | 100 | 0.000001 | 0.000216 | | 6 | 1000 | 0.00001 | 0.000224 | | 10 | 1000 | 0.00001 | 0.000234 | | 14 | 1000 | 0.000001 | 0.000235 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 6 | 1000 | 0.000001 | 0.000235 | | 10 | 100 | 0.000001 | 0.000271 | | 6 | 1000 | 0.00001 | 0.000282 | | 14 | 1000 | 0.000001 | 0.000287 | | 10 | 1000 | 0.00001 | 0.000289 | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.000051 | | 10 | 100 | 0.000001 | 0.000054 | | 6 | 1000 | 0.00001 | 0.000057 | | 10 | 1000 | 0.00001 | 0.00006 | | 18 | 100 | 0.000001 | 0.000064 | |
| Metalicidad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 1000 | 0.000001 | 0.00017 | | 10 | 100 | 0.00001 | 0.000176 | | 10 | 1000 | 0.00001 | 0.000176 | | 14 | 100 | 0.000001 | 0.000185 | | 14 | 1000 | 0.000001 | 0.000185 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 6 | 1000 | 0.000001 | 0.000214 | | 10 | 100 | 0.00001 | 0.000215 | | 10 | 1000 | 0.00001 | 0.000215 | | 14 | 100 | 0.000001 | 0.000227 | | 14 | 1000 | 0.000001 | 0.000227 | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 18 | 0.55 | 0.00001 | 0.000001 | | 18 | 5 | 0.001 | 0.000001 | | 14 | 0.6 | 0.001 | 0.000002 | | 18 | 0.45 | 0.000001 | 0.000002 | | 18 | 0.45 | 0.00001 | 0.000002 | |

Conjunto de entrenamiento 03

|  |  |  |
| --- | --- | --- |
| Temperatura | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 10 | 1000 | | 0.00001 | | 0.073881 | | | 6 | 1000 | | 0.000001 | | 0.073951 | | | 6 | 1000 | | 0.00001 | | 0.084353 | | | 10 | 1000 | | 0.000001 | | 0.086075 | | | 6 | 1000 | | 0.0001 | | 0.103121 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 10 | 1000 | | 0.00001 | | 0.091266 | | | 6 | 1000 | | 0.000001 | | 0.093415 | | | 6 | 1000 | | 0.00001 | | 0.102972 | | | 10 | 1000 | | 0.000001 | | 0.107328 | | | 6 | 1000 | | 0.0001 | | 0.123633 | | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0,000001 | 0,000027 | | 10 | 1000 | 0,00001 | 0,000027 | | 6 | 1000 | 0,00001 | 0,00003 | | 10 | 1000 | 0,000001 | 0,000031 | | 6 | 1000 | 0,0001 | 0,000037 | |
| Log Temperatura |  |  |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.000001 | | 0.00001135 | | | 10 | 1000 | | 0.000001 | | 0.00001138 | | | 10 | 1000 | | 0.00001 | | 0.00001156 | | | 10 | 100 | | 0.000001 | | 0.00001158 | | | 14 | 1000 | | 0.00001 | | 0.00001188 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 10 | 1000 | | 0.000001 | | 0.00001395 | | | 10 | 1000 | | 0.00001 | | 0.00001415 | | | 6 | 1000 | | 0.000001 | | 0.00001422 | | | 14 | 100 | | 0.00001 | | 0.00001468 | | | 14 | 1000 | | 0.00001 | | 0.00001468 | | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.00000329 | | 10 | 1000 | 0.000001 | 0.0000033 | | 10 | 100 | 0.000001 | 0.00000334 | | 10 | 1000 | 0.00001 | 0.00000335 | | 14 | 1000 | 0.00001 | 0.00000344 | |
| Log Gravedad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.000001 | | 0.000222 | | | 6 | 1000 | | 0.00001 | | 0.000236 | | | 10 | 1000 | | 0.00001 | | 0.000246 | | | 10 | 1000 | | 0.000001 | | 0.000256 | | | 10 | 1000 | | 0.0001 | | 0.000312 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 10 | 1000 | | 0.00001 | | 0.0003 | | | 10 | 1000 | | 0.000001 | | 0.000315 | | | 10 | 1000 | | 0.0001 | | 0.000373 | | | 6 | 1000 | | 0.000001 | | 0.000381 | | | 6 | 1000 | | 0.00001 | | 0.000397 | | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.000055 | | 6 | 1000 | 0.00001 | 0.000058 | | 10 | 1000 | 0.000001 | 0.000067 | | 10 | 1000 | 0.00001 | 0.000069 | | 10 | 1000 | 0.0001 | 0.000085 | |
| Metalicidad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 10 | 1000 | | 0.000001 | | 0.000175 | | | 6 | 1000 | | 0.000001 | | 0.000185 | | | 10 | 1000 | | 0.00001 | | 0.000203 | | | 6 | 1000 | | 0.00001 | | 0.000217 | | | 6 | 1000 | | 0.0001 | | 0.000243 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 10 | 1000 | | 0.000001 | | 0.000219 | | | 6 | 1000 | | 0.000001 | | 0.000228 | | | 10 | 1000 | | 0.00001 | | 0.000248 | | | 6 | 1000 | | 0.00001 | | 0.000268 | | | 6 | 1000 | | 0.0001 | | 0.000294 | | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 10 | 1000 | 0.000001 | 0.000008 | | 6 | 1000 | 0.00001 | 0.00001 | | 10 | 1000 | 0.00001 | 0.000011 | | 6 | 1000 | 0.000001 | 0.000015 | | 6 | 1000 | 0.0001 | 0.00002 | |

Conjunto de entrenamiento 01 + 02

|  |  |  |
| --- | --- | --- |
| Temperatura | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.000001 | | 0.070992 | | | 10 | 100 | | 0.000001 | | 0.078303 | | | 10 | 1000 | | 0.000001 | | 0.078303 | | | 14 | 100 | | 0.000001 | | 0.078966 | | | 14 | 1000 | | 0.000001 | | 0.078966 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 6 | 1000 | | 0.000001 | | 0.08731 | | | 10 | 100 | | 0.000001 | | 0.095696 | | | 10 | 1000 | | 0.000001 | | 0.095696 | | | 10 | 100 | | 0.00001 | | 0.096352 | | | 10 | 1000 | | 0.00001 | | 0.096352 | | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.000026 | | 10 | 100 | 0.000001 | 0.000028 | | 10 | 1000 | 0.000001 | 0.000028 | | 10 | 100 | 0.00001 | 0.000029 | | 10 | 1000 | 0.00001 | 0.000029 | |
| Log Temperatura |  |  |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 100 | | 0.00001 | | 0.00001027 | | | 6 | 100 | | 0.000001 | | 0.0000106 | | | 6 | 1000 | | 0.00001 | | 0.00001062 | | | 10 | 100 | | 0.00001 | | 0.00001174 | | | 10 | 1000 | | 0.00001 | | 0.00001174 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 6 | 1000 | | 0.00001 | | 0.00001319 | | | 10 | 100 | | 0.00001 | | 0.00001425 | | | 10 | 1000 | | 0.00001 | | 0.00001425 | | | 10 | 100 | | 0.000001 | | 0.00001452 | | | 10 | 1000 | | 0.000001 | | 0.00001452 | | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 100 | 0.00001 | 0.00000298 | | 6 | 100 | 0.000001 | 0.00000307 | | 6 | 1000 | 0.00001 | 0.00000308 | | 10 | 100 | 0.00001 | 0.0000034 | | 10 | 1000 | 0.00001 | 0.0000034 | |
| Log Gravedad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.000001 | | 0.0002 | | | 6 | 100 | | 0.000001 | | 0.000212 | | | 6 | 1000 | | 0.00001 | | 0.000215 | | | 10 | 100 | | 0.000001 | | 0.000216 | | | 10 | 1000 | | 0.000001 | | 0.000216 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 6 | 1000 | | 0.000001 | | 0.000251 | | | 10 | 100 | | 0.000001 | | 0.000262 | | | 10 | 1000 | | 0.000001 | | 0.000262 | | | 6 | 1000 | | 0.00001 | | 0.000265 | | | 6 | 100 | | 0.000001 | | 0.000268 | | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 10 | 100 | 0.000001 | 0.00005 | | 10 | 1000 | 0.000001 | 0.00005 | | 6 | 100 | 0.00001 | 0.000051 | | 6 | 1000 | 0.000001 | 0.000052 | | 6 | 1000 | 0.00001 | 0.000055 | |
| Metalicidad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.000001 | | 0.000174 | | | 10 | 100 | | 0.000001 | | 0.000189 | | | 10 | 1000 | | 0.000001 | | 0.000189 | | | 14 | 100 | | 0.00001 | | 0.00019 | | | 14 | 1000 | | 0.00001 | | 0.00019 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 6 | 1000 | | 0.000001 | | 0.000219 | | | 10 | 100 | | 0.000001 | | 0.000232 | | | 10 | 1000 | | 0.000001 | | 0.000232 | | | 14 | 100 | | 0.00001 | | 0.000235 | | | 14 | 1000 | | 0.00001 | | 0.000235 | | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 10 | 0.0001 | 0.000002 | | 6 | 1000 | 0.000001 | 0.00001 | | 10 | 100 | 0.000001 | 0.000011 | | 10 | 1000 | 0.000001 | 0.000011 | | 6 | 10 | 0.000001 | 0.000012 | |

Conjunto de entrenamiento 01 + 03

|  |  |  |
| --- | --- | --- |
| Temperatura | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 14 | 100 | | 0.000001 | | 0.077597 | | | 14 | 1000 | | 0.000001 | | 0.077597 | | | 10 | 100 | | 0.00001 | | 0.079179 | | | 10 | 1000 | | 0.00001 | | 0.079179 | | | 6 | 1000 | | 0.00001 | | 0.081137 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 14 | 100 | | 0.000001 | | 0.093209 | | | 14 | 1000 | | 0.000001 | | 0.093209 | | | 10 | 100 | | 0.00001 | | 0.095515 | | | 10 | 1000 | | 0.00001 | | 0.095515 | | | 6 | 1000 | | 0.00001 | | 0.100355 | | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 10 | 100 | 0.00001 | 0.000028 | | 10 | 1000 | 0.00001 | 0.000028 | | 14 | 100 | 0.000001 | 0.000028 | | 14 | 1000 | 0.000001 | 0.000028 | | 6 | 1000 | 0.00001 | 0.000029 | |
| Log Temperatura |  |  |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.000001 | | 0.00001051 | | | 14 | 100 | | 0.000001 | | 0.00001167 | | | 14 | 1000 | | 0.000001 | | 0.00001167 | | | 14 | 100 | | 0.00001 | | 0.00001182 | | | 14 | 1000 | | 0.00001 | | 0.00001182 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.000001 | | 0.00001311 | | | 14 | 100 | | 0.000001 | | 0.00001425 | | | 14 | 1000 | | 0.000001 | | 0.00001425 | | | 14 | 100 | | 0.00001 | | 0.00001441 | | | 14 | 1000 | | 0.00001 | | 0.00001441 | | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.000001 | | 0.00000305 | | | 14 | 100 | | 0.000001 | | 0.00000338 | | | 14 | 1000 | | 0.000001 | | 0.00000338 | | | 14 | 100 | | 0.00001 | | 0.00000343 | | | 14 | 1000 | | 0.00001 | | 0.00000343 | | |
| Log Gravedad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 14 | 100 | | 0.000001 | | 0.000209 | | | 14 | 1000 | | 0.000001 | | 0.000209 | | | 6 | 1000 | | 0.00001 | | 0.000223 | | | 6 | 1000 | | 0.000001 | | 0.000227 | | | 10 | 100 | | 0.000001 | | 0.000245 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 14 | 100 | | 0.000001 | | 0.000253 | | | 14 | 1000 | | 0.000001 | | 0.000253 | | | 6 | 1000 | | 0.00001 | | 0.000278 | | | 6 | 1000 | | 0.000001 | | 0.000288 | | | 10 | 100 | | 0.000001 | | 0.000301 | | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.000035 | | 6 | 1000 | 0.00001 | 0.000059 | | 6 | 1000 | 0.0001 | 0.000083 | | 6 | 1000 | 0.001 | 0.00055 | | 6 | 100 | 0.000001 | 0.000706 | |
| Metalicidad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.000001 | | 0.000157 | | | 6 | 100 | | 0.000001 | | 0.000177 | | | 14 | 100 | | 0.000001 | | 0.000184 | | | 14 | 1000 | | 0.000001 | | 0.000184 | | | 18 | 10 | | 0.000001 | | 0.000187 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 6 | 1000 | | 0.000001 | | 0.000198 | | | 6 | 100 | | 0.000001 | | 0.000224 | | | 18 | 10 | | 0.000001 | | 0.000226 | | | 18 | 100 | | 0.000001 | | 0.000226 | | | 18 | 1000 | | 0.000001 | | 0.000226 | | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.000015 | | 6 | 100 | 0.000001 | 0.000016 | | 6 | 100 | 0.00001 | 0.000019 | | 6 | 1000 | 0.00001 | 0.000022 | | 6 | 10 | 0.01 | 0.00003 | |

Conjunto de entrenamiento 02 + 03

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| --- | --- | --- |
| Temperatura | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.00001 | | 0.076222 | | | 6 | 1000 | | 0.000001 | | 0.076275 | | | 10 | 1000 | | 0.000001 | | 0.077654 | | | 18 | 1000 | | 0.000001 | | 0.077822 | | | 10 | 1000 | | 0.00001 | | 0.078093 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 6 | 1000 | | 0.000001 | | 0.094861 | | | 18 | 1000 | | 0.000001 | | 0.09507 | | | 10 | 1000 | | 0.00001 | | 0.095521 | | | 6 | 1000 | | 0.00001 | | 0.095943 | | | 10 | 1000 | | 0.000001 | | 0.096077 | | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.000028 | | 6 | 1000 | 0.00001 | 0.000028 | | 10 | 1000 | 0.000001 | 0.000028 | | 10 | 1000 | 0.00001 | 0.000028 | | 18 | 1000 | 0.000001 | 0.000028 | |
| Log Temperatura |  |  |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 10 | 1000 | | 0.000001 | | 0.00000982 | | | 10 | 1000 | | 0.00001 | | 0.00001058 | | | 14 | 1000 | | 0.000001 | | 0.0000109 | | | 14 | 1000 | | 0.00001 | | 0.00001133 | | | 6 | 1000 | | 0.00001 | | 0.00001139 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 10 | 1000 | | 0.000001 | | 0.00001238 | | | 10 | 1000 | | 0.00001 | | 0.00001315 | | | 14 | 1000 | | 0.000001 | | 0.00001351 | | | 6 | 1000 | | 0.00001 | | 0.00001386 | | | 14 | 1000 | | 0.00001 | | 0.00001389 | | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 10 | 1000 | 0.000001 | 0.00000284 | | 10 | 1000 | 0.00001 | 0.00000307 | | 14 | 1000 | 0.000001 | 0.00000316 | | 14 | 1000 | 0.00001 | 0.00000329 | | 6 | 1000 | 0.00001 | 0.0000033 | |
| Log Gravedad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 10 | 1000 | | 0.00001 | | 0.000208 | | | 14 | 1000 | | 0.000001 | | 0.00021 | | | 10 | 1000 | | 0.000001 | | 0.000223 | | | 6 | 1000 | | 0.000001 | | 0.000229 | | | 18 | 1000 | | 0.000001 | | 0.000238 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 14 | 1000 | | 0.000001 | | 0.000255 | | | 10 | 1000 | | 0.00001 | | 0.000258 | | | 10 | 1000 | | 0.000001 | | 0.000278 | | | 22 | 100 | | 0.000001 | | 0.00029 | | | 22 | 1000 | | 0.000001 | | 0.00029 | | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 10 | 1000 | 0.00001 | 0.000052 | | 14 | 1000 | 0.000001 | 0.000053 | | 6 | 1000 | 0.000001 | 0.000062 | | 10 | 1000 | 0.000001 | 0.000064 | | 18 | 1000 | 0.000001 | 0.000064 | |
| Metalicidad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | AVG | | 6 | 1000 | | 0.00001 | | 0.000166 | | | 6 | 1000 | | 0.000001 | | 0.000178 | | | 14 | 100 | | 0.00001 | | 0.000189 | | | 14 | 1000 | | 0.00001 | | 0.000189 | | | 10 | 100 | | 0.000001 | | 0.000192 | | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ND | | coste | | épsilon | | SD | | 6 | 1000 | | 0.00001 | | 0.000209 | | | 6 | 1000 | | 0.000001 | | 0.000219 | | | 14 | 100 | | 0.00001 | | 0.000232 | | | 14 | 1000 | | 0.00001 | | 0.000232 | | | 10 | 100 | | 0.000001 | | 0.000236 | | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.00001 | 0.000004 | | 10 | 100 | 0.000001 | 0.000011 | | 10 | 1000 | 0.000001 | 0.000011 | | 14 | 100 | 0.000001 | 0.000016 | | 14 | 1000 | 0.000001 | 0.000016 | |

Conjunto de entrenamiento 01 + 02 + 03

|  |  |  |
| --- | --- | --- |
| Temperatura | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 1000 | 0.000001 | 0.068426 | | 10 | 100 | 0.00001 | 0.074643 | | 10 | 1000 | 0.00001 | 0.074643 | | 14 | 100 | 0.00001 | 0.078419 | | 14 | 1000 | 0.00001 | 0.078419 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 6 | 1000 | 0.000001 | 0.084333 | | 10 | 100 | 0.00001 | 0.092246 | | 10 | 1000 | 0.00001 | 0.092246 | | 14 | 100 | 0.00001 | 0.095266 | | 14 | 1000 | 0.00001 | 0.095266 | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.000025 | | 10 | 100 | 0.00001 | 0.000027 | | 10 | 1000 | 0.00001 | 0.000027 | | 6 | 1000 | 0.00001 | 0.000028 | | 14 | 100 | 0.00001 | 0.000028 | |
| Log Temperatura |  |  |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 14 | 100 | 0.000001 | 0.00001064 | | 14 | 1000 | 0.000001 | 0.00001064 | | 10 | 100 | 0.000001 | 0.0000113 | | 10 | 1000 | 0.000001 | 0.0000113 | | 6 | 1000 | 0.00001 | 0.00001139 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 14 | 100 | 0.000001 | 0.00001294 | | 14 | 1000 | 0.000001 | 0.00001294 | | 10 | 100 | 0.000001 | 0.00001372 | | 10 | 1000 | 0.000001 | 0.00001372 | | 6 | 1000 | 0.00001 | 0.00001386 | | Combinaciones con los valores del error relativo más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 14 | 100 | 0.000001 | 0.00000309 | | 14 | 1000 | 0.000001 | 0.00000309 | | 10 | 100 | 0.000001 | 0.00000328 | | 10 | 1000 | 0.000001 | 0.00000328 | | 6 | 1000 | 0.00001 | 0.0000033 | |
| Log Gravedad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 1000 | 0.00001 | 0.000207 | | 6 | 1000 | 0.000001 | 0.00022 | | 10 | 100 | 0.00001 | 0.000228 | | 10 | 1000 | 0.00001 | 0.000228 | | 18 | 100 | 0.000001 | 0.000229 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 6 | 1000 | 0.00001 | 0.000261 | | 6 | 1000 | 0.000001 | 0.000273 | | 10 | 100 | 0.00001 | 0.000279 | | 10 | 1000 | 0.00001 | 0.000279 | | 18 | 100 | 0.000001 | 0.000281 | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 6 | 1000 | 0.000001 | 0.000049 | | 6 | 1000 | 0.00001 | 0.000049 | | 10 | 100 | 0.00001 | 0.000056 | | 10 | 1000 | 0.00001 | 0.000056 | | 10 | 100 | 0.000001 | 0.000061 | |
| Metalicidad | | |
| Combinaciones con los valores de la media más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | AVG | | 6 | 100 | 0.000001 | 0.000167 | | 10 | 100 | 0.000001 | 0.000182 | | 10 | 1000 | 0.000001 | 0.000182 | | 6 | 1000 | 0.00001 | 0.000184 | | 6 | 1000 | 0.000001 | 0.000189 | | Combinaciones con los valores de la desviación estándar más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | SD | | 6 | 100 | 0.000001 | 0.000207 | | 10 | 100 | 0.000001 | 0.000223 | | 10 | 1000 | 0.000001 | 0.000223 | | 6 | 1000 | 0.00001 | 0.000227 | | 6 | 1000 | 0.000001 | 0.000232 | | Combinaciones con los valores del error relativo (en valor absoluto) más bajos   |  |  |  |  | | --- | --- | --- | --- | | ND | coste | épsilon | REL | | 22 | 5 | 0.00001 | 0.000001 | | 22 | 5 | 0.000001 | 0.000005 | | 10 | 100 | 0.000001 | 0.000011 | | 10 | 1000 | 0.000001 | 0.000011 | | 6 | 1000 | 0.00001 | 0.000016 | |

ANÁLISIS DEL ERROR DE ENTRENAMIENTO Y EL ERROR DE CROSS VALIDATION

Se han analizado los errores de entrenamiento (error) y los errores de cross validation (cross) para los espectros de entrenamiento. Estos cálculos se han llevado a cabo para la T, log(T), log(g), [Fe/H].

Se han empleado los siguientes parámetros:

* Dimensiones: 6, 10, 14, 18
* Coste: .1, 0.45, 0.5, 0.55, 0.6, 1, 2, 5, 10, 100, 1000
* Épsilon: 0.000001, 0.00001, 0.0001, 0.001, 0.01, 0.05, 0.1, 0.5, 1

A continuación se recogen los resultados:

* Obtenidos con la combinación: valores de dimensión 6 y 10, valor de coste 1000 y valores épsilon 0.00001 y 0.000001, teniendo en cuenta los resultados obtenidos en el apartado anterior.
* Los valores mínimos para el cross validation y cada parámetro analizado.

De cualquier manera los resultados completos se recogen en el fichero Excel. Los valores nulos indican que el valor registrado es inferior a 10-8.

**Análisis de los resultados:**

Se observa que en el primer caso, análisis con 6 y 10 dimensiones, los errores de entrenamiento para todos los parámetros tiene valores bajísimos. Mientras que el error de cross validation varía.

Para todos los parámetros el cross, en general, disminuye cuando se aumenta el número de dimensiones:

* Para T, la combinación de tramos 01+02, y 6 dimensiones presenta el menor valor del cross entorno a 1600.
* Para log(T), el mínimo es con la combinación 01+02 y 6 dimensiones entorno a 4 10-5.
* Para log(g), el mínimo es con la combinación 01+02 y 10 dimensiones entorno a 3 10-2.
* Para [Fe/H], el mínimo es con la combinación 01+02+03 y 10 dimensiones entorno a 9 10-3.

Cuando se calculan los mínimos se ve que para el caso de log(T), log(g) y [Fe/H], estos valores no difieren mucho de los encontrados en el primer caso:

* Para log(T), el mínimo es con la combinación 02+03 y 18 dimensiones entorno a 3 10-5.
* Para log(g), el mínimo es con la combinación 01+02+03 y 18 dimensiones entorno a 2.5 10-2.
* Para [Fe/H], el mínimo es con la combinación 02+03 y 18 dimensiones entorno a 7 10-3.

El **código empleado**:

ndim<-6

for (ndim in c(6, 10, 14, 18)) {

resp1<-NULL

if (ndim==6) resp1<-res\_br\_06

if (ndim==10) resp1<-res\_br\_10

if (ndim==14) resp1<-res\_br\_14

if (ndim==18) resp1<-res\_br\_18

jade\_off(resp1,dtr\_01\_03)->jade\_offset1

#CREACIÓN DE LOS CONJUNTOS DE DATOS A TRABAJAR

cont\_coef\_train\_1 <- NULL

cont\_coef\_test\_1 <- NULL

if ( is.null(cont\_coef\_train\_1) ) {

data\_train1<-as.data.frame(cbind(resp1$S))

} else {

data\_train1<-as.data.frame(cbind(resp1$S,cont\_coef\_train\_1))

}

colnames(data\_train1)<- c(paste("C",1:ndim,sep=""))

tr01gdf1\_T <- data.frame(temp=I(Gtrain01\_T), data\_train1)

tr01gdf1\_logT <- data.frame(logt=I(Gtrain01\_logT), data\_train1)

tr01gdf1\_G <- data.frame(logg=I(Gtrain01\_G), data\_train1)

tr01gdf1\_M <- data.frame(meta=I(Gtrain01\_M), data\_train1)

for (coste in c(0.1, 0.45, 0.5, 0.55, 0.6, 1, 2, 5, 10, 100, 1000)){

for (epsilon in c(0.000001, 0.00001, 0.0001, 0.001, 0.01, 0.05, 0.1, 0.5, 1)){

tuneLap1g1\_T<-tuneksvm(

x=temp~.,

data=tr01gdf1\_T,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

var1\_T<-error(tuneLap1g1\_T$best.model)

var2\_T<-cross(tuneLap1g1\_T$best.model)

tuneLap1g1\_logT<-tuneksvm(

x=logt~.,

data=tr01gdf1\_logT,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

var1\_logT<-error(tuneLap1g1\_logT$best.model)

var2\_logT<-cross(tuneLap1g1\_logT$best.model)

tuneLap1g1\_G<-tuneksvm(

x=logg~.,

data=tr01gdf1\_G,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

var1\_G<-error(tuneLap1g1\_G$best.model)

var2\_G<-cross(tuneLap1g1\_G$best.model)

tuneLap1g1\_M<-tuneksvm(

x=meta~.,

data=tr01gdf1\_M,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

var1\_M<-error(tuneLap1g1\_M$best.model)

var2\_M<-cross(tuneLap1g1\_M$best.model)

if (ndim==6 & coste == 0.1 & epsilon == 0.000001) {

fname=sprintf("resultados\_errores\_primer\_tercer\_tramo.txt")

salida0 = sprintf("ND COSTE EPS Err\_T Cross\_T Err\_logT Cross\_logT Err\_G Cross\_G Err\_M Cross\_M")

f1 <- file(fname, "wt") # open an output file connection

cat(paste(salida0, "\n"), file = f1)

}

salida1 = sprintf("%g %12.6f %12.6f", ndim, coste, epsilon)

salida1 = paste(salida1, sprintf(" %12.8f %12.8f %12.8f %12.8f %12.8f %12.8f %12.8f %12.8f" , var1\_T, var2\_T, var1\_logT, var2\_logT, var1\_G, var2\_G, var1\_M, var2\_M))

cat(paste(salida1, "\n", sep=" "), file = f1)

}}}

close(f1)

Resultados para 6 y 10 dimensiones, coste 1000 y épsilon 0.00001 y 0.000001

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Tramo 01** | | | | | | | | | |
| ND | E | Err\_T | Cross\_T | Err\_logT | Cross\_logT | Err\_G | Cross\_G | Err\_M | Cross\_M |
| 6 | 0.000001 | 0 | 5609.19909 | 0 | 0.000136 | 0 | 0.078354 | 0 | 0.02581 |
| 6 | 0.00001 | 0 | 5583.60191 | 0 | 0.000138 | 0 | 0.077854 | 0 | 0.025535 |
| 10 | 0.000001 | 0 | 3812.07314 | 0 | 0.000094 | 0 | 0.041939 | 0 | 0.017327 |
| 10 | 0.00001 | 0 | 3854.4173 | 0 | 0.000092 | 0 | 0.041461 | 0 | 0.016942 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Tramo 02** | | | | | | | | | |
| ND | E | Err\_T | Cross\_T | Err\_logT | Cross\_logT | Err\_G | Cross\_G | Err\_M | Cross\_M |
| 6 | 0.000001 | 0 | 3686.27171 | 0 | 0.0001 | 0 | 0.103151 | 0 | 0.026782 |
| 6 | 0.00001 | 0 | 3621.98296 | 0 | 0.000096 | 0 | 0.106998 | 0 | 0.028547 |
| 10 | 0.000001 | 0 | 2517.5924 | 0 | 0.00007 | 0 | 0.060483 | 0 | 0.014815 |
| 10 | 0.00001 | 0 | 2630.78568 | 0 | 0.000069 | 0 | 0.060071 | 0 | 0.015128 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Tramo 03** | | | | | | | | | |
| ND | E | Err\_T | Cross\_T | Err\_logT | Cross\_logT | Err\_G | Cross\_G | Err\_M | Cross\_M |
| 6 | 0.000001 | 0 | 4077.00455 | 0 | 0.000111 | 0 | 0.131742 | 0 | 0.030539 |
| 6 | 0.00001 | 0 | 4084.70539 | 0 | 0.000113 | 0 | 0.129181 | 0 | 0.03039 |
| 10 | 0.000001 | 0 | 2822.00654 | 0 | 0.000065 | 0 | 0.106543 | 0 | 0.019584 |
| 10 | 0.00001 | 0 | 2832.98509 | 0 | 0.000067 | 0 | 0.100489 | 0 | 0.020157 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Tramo 01 + 02** | | | | | | | | | |
| ND | E | Err\_T | Cross\_T | Err\_logT | Cross\_logT | Err\_G | Cross\_G | Err\_M | Cross\_M |
| 6 | 0.000001 | 0.00000002 | 1596.95586 | 0.00000003 | 0.00004448 | 0.00000002 | 0.0500447 | 0.00000002 | 0.01602311 |
| 6 | 0.00001 | 0.00000003 | 1596.46335 | 0.00000002 | 0.00004421 | 0.00000002 | 0.04868825 | 0.00000003 | 0.01569585 |
| 10 | 0.000001 | 0.00000003 | 2175.26558 | 0.00000003 | 0.0000558 | 0.00000002 | 0.03043764 | 0.00000003 | 0.01375116 |
| 10 | 0.00001 | 0.00000003 | 2172.47817 | 0.00000003 | 0.00005454 | 0.00000003 | 0.03103405 | 0.00000003 | 0.01423856 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Tramo 01 + 03** | | | | | | | | | |
| ND | E | Err\_T | Cross\_T | Err\_logT | Cross\_logT | Err\_G | Cross\_G | Err\_M | Cross\_M |
| 6 | 0.000001 | 0.00000003 | 5115.73868 | 0.00000002 | 0.00013482 | 0.00000003 | 0.06471941 | 0.00000002 | 0.02988206 |
| 6 | 0.00001 | 0.00000003 | 4998.10451 | 0.00000003 | 0.00013683 | 0.00000002 | 0.06635733 | 0.00000003 | 0.03054542 |
| 10 | 0.000001 | 0.00000003 | 3343.9976 | 0.00000003 | 0.00008017 | 0.00000003 | 0.03580487 | 0.00000003 | 0.01260773 |
| 10 | 0.00001 | 0.00000003 | 3118.67438 | 0.00000003 | 0.00007878 | 0.00000003 | 0.03554445 | 0.00000003 | 0.01231276 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Tramo 02 + 03** | | | | | | | | | |
| ND | E | Err\_T | Cross\_T | Err\_logT | Cross\_logT | Err\_G | Cross\_G | Err\_M | Cross\_M |
| 6 | 0.000001 | 0.00000002 | 2787.08444 | 0.00000003 | 0.00007029 | 0.00000004 | 0.10410562 | 0.00000002 | 0.02361423 |
| 6 | 0.00001 | 0.00000003 | 2852.67016 | 0.00000002 | 0.0000694 | 0.00000004 | 0.10160144 | 0.00000002 | 0.02375461 |
| 10 | 0.000001 | 0.00000003 | 2233.85568 | 0.00000002 | 0.00005791 | 0.00000002 | 0.05924602 | 0.00000003 | 0.01612379 |
| 10 | 0.00001 | 0.00000003 | 2250.32475 | 0.00000002 | 0.00005998 | 0.00000002 | 0.06056855 | 0.00000003 | 0.01569432 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Tramo 01 + 02 + 03** | | | | | | | | | |
| ND | E | Err\_T | Cross\_T | Err\_logT | Cross\_logT | Err\_G | Cross\_G | Err\_M | Cross\_M |
| 6 | 0.000001 | 0.00000002 | 3795.92426 | 0.00000002 | 0.00009992 | 0.00000002 | 0.10496349 | 0.00000002 | 0.0274164 |
| 6 | 0.00001 | 0.00000003 | 3665.42068 | 0.00000002 | 0.00009926 | 0.00000002 | 0.10268463 | 0.00000002 | 0.02735338 |
| 10 | 0.000001 | 0.00000003 | 2791.11011 | 0.00000002 | 0.0000576 | 0.00000003 | 0.03474545 | 0.00000002 | 0.00978926 |
| 10 | 0.00001 | 0.00000002 | 2533.23189 | 0.00000003 | 0.0000578 | 0.00000002 | 0.03260755 | 0.00000003 | 0.00920698 |

Valores de cross validation mínimos en cada combinación

|  |  |
| --- | --- |
| **Tramo 01** |  |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_T | Cross\_T | | 22 | 100 | 0.001 | 0.000001 | 3198.542192 | | ND | coste | epsilon | Err\_logT | Cross\_logT | | 22 | 100 | 0.0001 | 0 | 0.000073 | | |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_G | Cross\_G | | 14 | 1000 | 0.000001 | 0 | 0.039688 | | ND | coste | epsilon | Err\_M | Cross\_M | | 14 | 100 | 0.0001 | 0 | 0.014188 | |

|  |  |
| --- | --- |
| **Tramo 02** |  |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_T | Cross\_T | | 10 | 1000 | 0.001 | 0.000001 | 2424.553299 | | ND | coste | epsilon | Err\_logT | Cross\_logT | | 14 | 1000 | 0.000001 | 0 | 0.000065 | | |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_G | Cross\_G | | 18 | 100 | 0.0001 | 0 | 0.056221 | | ND | coste | epsilon | Err\_M | Cross\_M | | 14 | 100 | 0.000001 | 0 | 0.014565 | |

|  |  |
| --- | --- |
| **Tramo 03** |  |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_T | Cross\_T | | 14 | 100 | 0.000001 | 0.00000172 | 2054.69721 | | ND | coste | epsilon | Err\_logT | Cross\_logT | | 14 | 1000 | 0.0001 | 0.00000005 | 0.00005319 | | |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_G | Cross\_G | | 22 | 100 | 0.00001 | 0.00002838 | 0.04909262 | | ND | coste | epsilon | Err\_M | Cross\_M | | 14 | 100 | 0.000001 | 0.00000203 | 0.01186175 | |

|  |  |
| --- | --- |
| **Tramo 01 + 02** |  |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_T | Cross\_T | | 6 | 100 | 0.0001 | 0.00000129 | 1538.538461 | | ND | coste | epsilon | Err\_logT | Cross\_logT | | 18 | 100 | 0.00001 | 0.00000004 | 0.00004119 | | |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_G | Cross\_G | | 18 | 1000 | 0.001 | 0.00000112 | 0.02930275 | | ND | coste | epsilon | Err\_M | Cross\_M | | 18 | 1000 | 0.0001 | 0.00000005 | 0.01052669 | |

|  |  |
| --- | --- |
| **Tramo 01 + 03** |  |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_T | Cross\_T | | 18 | 1000 | 0.0001 | 0.00000005 | 1621.190417 | | ND | coste | epsilon | Err\_logT | Cross\_logT | | 18 | 100 | 0.0001 | 0.00000005 | 0.00004113 | | |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_G | Cross\_G | | 18 | 10 | 0.001 | 0.00070347 | 0.0268975 | | ND | coste | epsilon | Err\_M | Cross\_M | | 18 | 100 | 0.000001 | 0.00000002 | 0.00869543 | |

|  |  |
| --- | --- |
| **Tramo 02 + 03** |  |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_T | Cross\_T | | 18 | 1000 | 0.000001 | 0.00000003 | 1461.416804 | | ND | coste | epsilon | Err\_logT | Cross\_logT | | 18 | 1000 | 0.0001 | 0.00000004 | 0.00003643 | | |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_G | Cross\_G | | 18 | 100 | 0.0001 | 0.00000226 | 0.03955751 | | ND | coste | epsilon | Err\_M | Cross\_M | | 18 | 10 | 0.00001 | 0.00009549 | 0.00726834 | |

|  |  |
| --- | --- |
| **Tramo 01 + 02 + 03** |  |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_T | Cross\_T | | 18 | 1000 | 0.00001 | 0.00000003 | 1486.32151 | | ND | coste | epsilon | Err\_logT | Cross\_logT | | 18 | 1000 | 0.001 | 0.00000111 | 0.0000393 | | |  |  |  |  |  | | --- | --- | --- | --- | --- | | ND | coste | epsilon | Err\_G | Cross\_G | | 18 | 100 | 0.00001 | 0.00000003 | 0.02570052 | | ND | coste | epsilon | Err\_M | Cross\_M | | 18 | 1000 | 0.0001 | 0.00000005 | 0.0079365 | |

Predicción de T, logT, logg, [Fe/H] considerando las jades con 9/10 de los espectros de entrenamiento y el test con el 1/10 restante

A partir de los espectros con valores no NA (2223 registros) de los conjuntos de entrenamiento se ha llevado a cabo un análisis de predicción.

El proceso se ha desarrollado en dos etapas:

Se cargan los ficheros RData guardados en el estudio de la validación cruzada. En dichos ficheros se ha guardado el idx de los 9/10 de los espectros. Estos espectros se consideran datos de entrenamiento, mientras el resto (1/10) se consideran datos tipo test.

Se calcula tanto para los datos entrenamiento como test la media, desviación estándar y error relativo de la T, log(T), log(g) y [Fe/H].

Los resultados numéricos de todo este proceso se recogen en un fichero de texto.

En la representación gráfica la escala x, representa la combinación de coste y épsilon utilizada:

* 1 coste = 10; épsilon = 0.000001
* 2 coste = 10; épsilon = 0.00001
* 3 coste = 10; épsilon = 0.0001
* 4 coste = 100; épsilon = 0.000001
* 5 coste = 100; épsilon = 0.00001
* 6 coste = 100; épsilon = 0.0001
* 7 coste = 1000; épsilon = 0.000001
* 8 coste = 1000; épsilon = 0.00001
* 9 coste = 1000; épsilon = 0.0001

**Análisis de resultados**:

* Para T y log(T), el mejor comportamiento lo presenta la combinación de tramos 01+02 con menores diferencias entre los resultados de entrenamiento y de test. Aunque es muy similar al resultado obtenido con la combinación 02+03 y la 01+02+03
* Para log(g), el mejor comportamiento lo presenta la combinación de tramos 01+02 con menores diferencias entre los resultados de entrenamiento y de test. En este caso el resultado es muy similar a la combinación 01+02+03 aunque en este caso los resultados para los datos de entrenamiento con 6 dimensiones son en general peores.
* Para [Fe/H], el mejor comportamiento lo presenta la combinación de tramos 01+02 con menores diferencias entre los resultados de entrenamiento y de test. En este caso existen mayores diferencias con la combinación 01+02+03.
* Los valores obtenidos con los datos de entrenamiento se minimizan, en general para un valor de coste de 1000.

**Código empleado**:

for (nsamp in c(1:10)){

res2<-NULL

if (nsamp==1) load("d06\_e01\_01\_03.RData")

if (nsamp==2) load("d06\_e02\_01\_03.RData")

if (nsamp==3) load("d06\_e03\_01\_03.RData")

if (nsamp==4) load("d06\_e04\_01\_03.RData")

if (nsamp==5) load("d06\_e05\_01\_03.RData")

if (nsamp==6) load("d06\_e06\_01\_03.RData")

if (nsamp==7) load("d06\_e07\_01\_03.RData")

if (nsamp==8) load("d06\_e08\_01\_03.RData")

if (nsamp==9) load("d06\_e09\_01\_03.RData")

if (nsamp==10) load("d06\_e10\_01\_03.RData")

#creación de los conjuntos de training y test

#conjunto de entrenamiento es X2

#X2<-dtr\_01\_03[idx,]

# conjunto de test es nX2

nX2<-dtr\_01\_03[nidx,]

#conjunto de variables de entreno

Gtrain01\_T<-tr\_01[idx,65]

Gtrain01\_logT<-log10(tr\_01[idx,65])

Gtrain01\_G<-tr\_01[idx,66]

Gtrain01\_M<-tr\_01[idx,67]

#conjunto de variables de test

Gtest01\_T<-tr\_01[nidx,65]

Gtest01\_logT<-log10(tr\_01[nidx,65])

Gtest01\_G<-tr\_01[nidx,66]

Gtest01\_M<-tr\_01[nidx,67]

jade\_off(res2,X2)->jade\_offset1

#CREACIÓN DE LOS CONJUNTOS DE DATOS A TRABAJAR

cont\_coef\_train\_1 <- NULL

cont\_coef\_test\_1 <- NULL

if ( is.null(cont\_coef\_train\_1) ) {

data\_train1<-as.data.frame(cbind(res2$S))

} else {

data\_train1<-as.data.frame(cbind(res2$S,cont\_coef\_train\_1))

}

colnames(data\_train1)<- c(paste("C",1:ndim,sep=""))

if ( is.null(cont\_coef\_test\_1) ) {

data\_test1<-as.data.frame(cbind(t(apply((as.matrix(nX2) %\*% t( res2$W )),1,FUN="-",t(as.matrix(jade\_offset1))))))

} else {

data\_test1<-as.data.frame(cbind(t(apply((as.matrix(nX2) %\*% t( res2$W )),1,FUN="-",t(as.matrix(jade\_offset1)))), cont\_coef\_test\_1))

}

colnames(data\_test1)<-c(paste("C",1:ndim,sep=""))

tr01gdf1\_T <- data.frame(temp=I(Gtrain01\_T), data\_train1)

tr01gdf1\_logT <- data.frame(logt=I(Gtrain01\_logT), data\_train1)

tr01gdf1\_G <- data.frame(logg=I(Gtrain01\_G), data\_train1)

tr01gdf1\_M <- data.frame(meta=I(Gtrain01\_M), data\_train1)

for (coste in c(10, 100, 1000)){

for (epsilon in c(0.000001, 0.00001, 0.0001)){

tuneLap1g1\_T<-tuneksvm(

x=temp~.,

data=tr01gdf1\_T,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_T <- predict(tuneLap1g1\_T$best.model, data\_train1)

prede1g1\_T <- predict(tuneLap1g1\_T$best.model, data\_test1)

vartr41\_T<-modelErrors(prede1gtr1\_T, Gtrain01\_T)[1]

vartr51\_T<-modelErrors(prede1gtr1\_T, Gtrain01\_T)[2]

vartr61\_T<-modelErrors(prede1gtr1\_T, Gtrain01\_T)[3]

var41\_T<-modelErrors(prede1g1\_T, Gtest01\_T)[1]

var51\_T<-modelErrors(prede1g1\_T, Gtest01\_T)[2]

var61\_T<-modelErrors(prede1g1\_T, Gtest01\_T)[3]

tuneLap1g1\_logT<-tuneksvm(

x=logt~.,

data=tr01gdf1\_logT,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_logT <- predict(tuneLap1g1\_logT$best.model, data\_train1)

prede1g1\_logT <- predict(tuneLap1g1\_logT$best.model, data\_test1)

vartr41\_logT<-modelErrors(prede1gtr1\_logT, Gtrain01\_logT)[1]

vartr51\_logT<-modelErrors(prede1gtr1\_logT, Gtrain01\_logT)[2]

vartr61\_logT<-modelErrors(prede1gtr1\_logT, Gtrain01\_logT)[3]

var41\_logT<-modelErrors(prede1g1\_logT, Gtest01\_logT)[1]

var51\_logT<-modelErrors(prede1g1\_logT, Gtest01\_logT)[2]

var61\_logT<-modelErrors(prede1g1\_logT, Gtest01\_logT)[3]

tuneLap1g1\_G<-tuneksvm(

x=logg~.,

data=tr01gdf1\_G,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_G <- predict(tuneLap1g1\_G$best.model, data\_train1)

prede1g1\_G <- predict(tuneLap1g1\_G$best.model, data\_test1)

vartr41\_G<-modelErrors(prede1gtr1\_G, Gtrain01\_G)[1]

vartr51\_G<-modelErrors(prede1gtr1\_G, Gtrain01\_G)[2]

vartr61\_G<-modelErrors(prede1gtr1\_G, Gtrain01\_G)[3]

var41\_G<-modelErrors(prede1g1\_G, Gtest01\_G)[1]

var51\_G<-modelErrors(prede1g1\_G, Gtest01\_G)[2]

var61\_G<-modelErrors(prede1g1\_G, Gtest01\_G)[3]

tuneLap1g1\_M<-tuneksvm(

x=meta~.,

data=tr01gdf1\_M,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_M <- predict(tuneLap1g1\_M$best.model, data\_train1)

prede1g1\_M <- predict(tuneLap1g1\_M$best.model, data\_test1)

vartr41\_M<-modelErrors(prede1gtr1\_M, Gtrain01\_M)[1]

vartr51\_M<-modelErrors(prede1gtr1\_M, Gtrain01\_M)[2]

vartr61\_M<-modelErrors(prede1gtr1\_M, Gtrain01\_M)[3]

var41\_M<-modelErrors(prede1g1\_M, Gtest01\_M)[1]

var51\_M<-modelErrors(prede1g1\_M, Gtest01\_M)[2]

var61\_M<-modelErrors(prede1g1\_M, Gtest01\_M)[3]

if (nsamp==1 & coste == 10 & epsilon == 0.000001) {

fname=sprintf("resultados\_diezmo\_primer\_tercer\_tramo\_06.txt")

salida0 = sprintf("ND NSAMP COSTE EPS T\_AVG\_tr T\_SD\_tr T\_REL\_tr T\_AVG\_test T\_SD\_test T\_REL\_test logT\_AVG\_tr logT\_SD\_tr logT\_REL\_tr logT\_AVG\_test logT\_SD\_test logT\_REL\_test G\_AVG\_tr G\_SD\_tr G\_REL\_tr G\_AVG\_test G\_SD\_test G\_REL\_test M\_AVG\_tr M\_SD\_tr M\_REL\_tr M\_AVG\_test M\_SD\_test M\_REL\_test")

f2 <- file(fname, "wt") # open an output file connection

cat(paste(salida0, "\n"), file = f2)

}

salida1 = sprintf("%g %g %12.6f %12.6f", ndim, nsamp, coste, epsilon)

salida1 = paste(salida1, sprintf(" %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f %12.6f" , vartr41\_T, vartr51\_T, vartr61\_T, var41\_T, var51\_T, var61\_T, vartr41\_logT, vartr51\_logT, vartr61\_logT, var41\_logT, var51\_logT, var61\_logT, vartr41\_G, vartr51\_G, vartr61\_G, var41\_G, var51\_G, var61\_G, vartr41\_M, vartr51\_M, vartr61\_M, var41\_M, var51\_M, var61\_M))

cat(paste(salida1, "\n", sep=" "), file = f2)

}}}

close(f2)

#LECTURA DE LOS FICHEROS DE VALIDACIÓN

nsamp\_max<-10

datos<-9

numero\_filas<-datos\*nsamp\_max

datos\_validacion<-matrix(nrow=numero\_filas, ncol=29)

fname=sprintf("resultados\_diezmo\_tres\_tramos\_10.txt")

prueba<-read.table(file=fname)

nsamp<-1

k<-1

i<-1

for (nsamp in 1:9){

for (k in 1:10){

j<-((k-1)\*9)+nsamp

s<-((nsamp-1)\*nsamp\_max)+k

datos\_validacion[s,1]<-nsamp

for (i in 2:29) datos\_validacion[s,i]<-prueba[j,i-1]

}

nsamp<-nsamp+1

}

write.table(datos\_validacion, file = "resultados\_diezmo\_tres\_tramos\_ordenado\_10.txt", sep = " ", eol = "\n", dec = ".", col.names = c("N", "ND", "NS", "Coste", "Eps", "T\_AVG\_tr", "T\_SD\_tr", "T\_REL\_tr", "T\_AVG\_test", "T\_SD\_test", "T\_REL\_test", "logT\_AVG\_tr", "logT\_SD\_tr", "logT\_REL\_tr", "logT\_AVG\_test", "logT\_SD\_test", "logT\_REL\_test", "G\_AVG\_tr", "G\_SD\_tr", "G\_REL\_tr", "G\_AVG\_test", "G\_SD\_test", "G\_REL\_test", "M\_AVG\_tr", "M\_SD\_tr", "M\_REL\_tr", "M\_AVG\_test", "M\_SD\_test", "M\_REL\_test"), qmethod = c("escape", "double"))

err<-read.table(file="resultados\_diezmo\_segundo\_tramo\_ordenado\_06.txt", header=T)

err1<-read.table(file="resultados\_diezmo\_segundo\_tramo\_ordenado\_10.txt", header=T)

#DIBUJO DATOS VALIDACIÓN

####T

#Dibujado de los errores medios (MEAN)

par(mfrow=c(1,2))

plot(unique(err$N),tapply(as.matrix(err[,6]),err$N,mean),type="l",col=2,main="T\_AVG mean (10-fold)",ylab="%",ylim=c(0,80), xlab="Parameters combinations", cex.main=1.1)

lines(unique(err$N),tapply(as.matrix(err[,9]),err$N,mean),type="l",col=3)

lines(unique(err1$N),tapply(as.matrix(err1[,6]),err1$N,mean),type="l",col=4)

lines(unique(err1$N),tapply(as.matrix(err1[,9]),err1$N,mean),type="l",col=5)

legend("topright",col=c(2,3,4,5),legend=c("Tr\_06","Test\_06","Tr\_10", "Test\_10"),text.col=c(2,3,4,5),merge=TRUE,bg='white',lty=c(1,1), ncol=2)

plot(unique(err$N),tapply(as.matrix(err[,7]),err$N,mean),type="l",col=2,main="T\_SD mean (10-fold)",ylab="%",ylim=c(0,80),xlab="Parameters combinations", cex.main=1.1)

lines(unique(err$N),tapply(as.matrix(err[,10]),err$N,mean),type="l",col=3)

lines(unique(err1$N),tapply(as.matrix(err1[,7]),err1$N,mean),type="l",col=4)

lines(unique(err1$N),tapply(as.matrix(err1[,10]),err1$N,mean),type="l",col=5)

legend("topright",col=c(2,3,4,5),legend=c("Tr\_06","Test\_06", "Tr\_10", "Test\_10"),text.col=c(2,3,4,5),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

#Dibujado de los errores con mediana(MEDIAN)

par(mfrow=c(1,2))

plot(unique(err$N),tapply(as.matrix(err[,6]),err$N,median),type="l",col=2,main="T\_AVG median (10-fold)",ylab="%",ylim=c(0,80),xlab="Parameters combinations", cex.main=1.1)

lines(unique(err$N),tapply(as.matrix(err[,9]),err$N,median),type="l",col=3)

lines(unique(err1$N),tapply(as.matrix(err1[,6]),err1$N,median),type="l",col=4)

lines(unique(err1$N),tapply(as.matrix(err1[,9]),err1$N,median),type="l",col=5)

legend("topright",col=c(2,3,4,5),legend=c("Tr\_06","Test\_06", "Tr\_10", "Test\_10"),text.col=c(2,3,4,5),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$N),tapply(as.matrix(err[,7]),err$N,median),type="l",col=2,main="T\_SD median (10-fold)",ylab="%",ylim=c(0,80),xlab="Parameters combinations", cex.main=1.1)

lines(unique(err$N),tapply(as.matrix(err[,10]),err$N,median),type="l",col=3)

lines(unique(err1$N),tapply(as.matrix(err1[,7]),err1$N,median),type="l",col=4)

lines(unique(err1$N),tapply(as.matrix(err1[,10]),err1$N,median),type="l",col=5)

legend("topright",col=c(2,3,4,5),legend=c("Tr\_06","Test\_06","Tr\_10", "Test\_10"),text.col=c(2,3,4,5),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

#Dibujado de los errores con mínimo(Min)

par(mfrow=c(1,2))

plot(unique(err$N),tapply(as.matrix(err[,6]),err$N,min),type="l",col=2,main="T\_AVG min (10-fold)",ylab="%",ylim=c(0,80),xlab="Parameters combinations", cex.main=1.1)

lines(unique(err$N),tapply(as.matrix(err[,9]),err$N,min),type="l",col=3)

lines(unique(err1$N),tapply(as.matrix(err1[,6]),err1$N,min),type="l",col=4)

lines(unique(err1$N),tapply(as.matrix(err1[,9]),err1$N,min),type="l",col=5)

legend("topright",col=c(2,3,4,5),legend=c("Tr\_06","Test\_06", "Tr\_10", "Test\_10"),text.col=c(2,3,4,5),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$N),tapply(as.matrix(err[,7]),err$N,min),type="l",col=2,main="T\_SD min (10-fold)",ylab="%",ylim=c(0,80),xlab="Parameters combinations", cex.main=1.1)

lines(unique(err$N),tapply(as.matrix(err[,10]),err$N,min),type="l",col=3)

lines(unique(err1$N),tapply(as.matrix(err1[,7]),err1$N,min),type="l",col=4)

lines(unique(err1$N),tapply(as.matrix(err1[,10]),err1$N,min),type="l",col=5)

legend("topright",col=c(2,3,4,5),legend=c("Tr\_06","Test\_06","Tr\_10", "Test\_10"),text.col=c(2,3,4,5),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

#Dibujado de los errores con max(MAX)

par(mfrow=c(1,2))

plot(unique(err$N),tapply(as.matrix(err[,6]),err$N,max),type="l",col=2,main="T\_AVG max (10-fold)",ylab="%",ylim=c(0,80),xlab="Parameters combinations", cex.main=1.1)

lines(unique(err$N),tapply(as.matrix(err[,9]),err$N,max),type="l",col=3)

lines(unique(err1$N),tapply(as.matrix(err1[,6]),err1$N,max),type="l",col=4)

lines(unique(err1$N),tapply(as.matrix(err1[,9]),err1$N,max),type="l",col=5)

legend("topright",col=c(2,3,4,5),legend=c("Tr\_06","Test\_06", "Tr\_10", "Test\_10"),text.col=c(2,3,4,5),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

plot(unique(err$N),tapply(as.matrix(err[,7]),err$N,max),type="l",col=2,main="T\_SD max (10-fold)",ylab="%",ylim=c(0,80),xlab="Parameters combinations", cex.main=1.1)

lines(unique(err$N),tapply(as.matrix(err[,10]),err$N,max),type="l",col=3)

lines(unique(err1$N),tapply(as.matrix(err1[,7]),err1$N,max),type="l",col=4)

lines(unique(err1$N),tapply(as.matrix(err1[,10]),err1$N,max),type="l",col=5)

legend("topright",col=c(2,3,4,5),legend=c("Tr\_06","Test\_06","Tr\_10", "Test\_10"),text.col=c(2,3,4,5),merge=TRUE,bg='white',lty=c(1,1),ncol=2)

Tramo 01

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Tramo 02

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Tramo 03

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Tramo 01 + 02

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Tramo 01 + 03

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Tramo 02 + 03

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| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\02_03_tramo_logg_mean.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\02_03_tramo_logg_median.emf |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\02_03_tramo_logg_max.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\02_03_tramo_logg_min.emf |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\02_03_tramo_meta_mean.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\02_03_tramo_meta_median.emf |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\02_03_tramo_meta_max.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\02_03_tramo_meta_min.emf |

Tramo 01 + 02 + 03

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| --- | --- |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_T_mean.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_T_median.emf |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_T_max.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_T_min.emf |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_logT_mean.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_logT_median.emf |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_logT_max.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_logT_min.emf |

|  |  |
| --- | --- |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_logg_mean.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_logg_median.emf |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_logg_max.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_logg_min.emf |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_meta_mean.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_meta_median.emf |
| C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_meta_max.emf | C:\Users\belen\Belen_datos\investigacion\estrellas\v06_tercer_trabajo\tarea_03_13\resultados_diezmo\01_02_03_tramo_meta_min.emf |

PREDICCIÓN DE T, log(T), log(g) y [Fe/H] para los datos test.

Se han predicho los valores de T, log(T), log(g) y [Fe/H] tanto para los datos de entrenamiento como los de test.

En el caso de los datos de entrenamiento los resultados se comparan con los valores reales del parámetro.

En este cálculo se han considerado las dimensiones, costes y épsilon que mejores resultados daban en el estudio de predicción de los datos de entrenamiento realizado previamente.

**Análisis de resultados:**

La comparación de las predicciones realizadas con los diferentes tramos y las combinaciones de estos muestra una variación muy grande cuando se trabaja con la T, mientras que al usar log(T), los valores obtenidos son muy parecidos.

En cuanto al comportamiento de las predicciones de log(g) y [Fe/H], también muestras variaciones importantes. De nuevo se vuelve a predecir mejor lo(T) que el resto de parámetros.

**Código empleado:**

ndim<-6

for (ndim in c(6)) {

resp1<-NULL

if (ndim==6) resp1<-res\_br\_06

if (ndim==10) resp1<-res\_br\_10

jade\_off(resp1,dtr\_01\_02)->jade\_offset1

#CREACIÓN DE LOS CONJUNTOS DE DATOS A TRABAJAR

cont\_coef\_train\_1 <- NULL

cont\_coef\_test\_1 <- NULL

if ( is.null(cont\_coef\_train\_1) ) {

data\_train1<-as.data.frame(cbind(resp1$S))

} else {

data\_train1<-as.data.frame(cbind(resp1$S,cont\_coef\_train\_1))

}

colnames(data\_train1)<- c(paste("C",1:ndim,sep=""))

if ( is.null(cont\_coef\_test\_1) ) {

data\_test1<-as.data.frame(cbind(t(apply((as.matrix(dte\_01\_02) %\*% t( resp1$W )),1,FUN="-",t(as.matrix(jade\_offset1))))))

} else {

data\_test1<-as.data.frame(cbind(t(apply((as.matrix(dte\_01\_02) %\*% t( resp1$W )),1,FUN="-",t(as.matrix(jade\_offset1)))), cont\_coef\_test\_1))

}

colnames(data\_test1)<-c(paste("C",1:ndim,sep=""))

tr01gdf1\_T <- data.frame(temp=I(Gtrain01\_T), data\_train1)

tr01gdf1\_logT <- data.frame(logt=I(Gtrain01\_logT), data\_train1)

tr01gdf1\_G <- data.frame(logg=I(Gtrain01\_G), data\_train1)

tr01gdf1\_M <- data.frame(meta=I(Gtrain01\_M), data\_train1)

for (coste in c(1000)){

for (epsilon in c(0.00001)){

tuneLap1g1\_T<-tuneksvm(

x=temp~.,

data=tr01gdf1\_T,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_T <- predict(tuneLap1g1\_T$best.model, data\_train1)

prede1g1\_T <- predict(tuneLap1g1\_T$best.model, data\_test1)

tuneLap1g1\_logT<-tuneksvm(

x=logt~.,

data=tr01gdf1\_logT,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_logT <- predict(tuneLap1g1\_logT$best.model, data\_train1)

prede1g1\_logT <- predict(tuneLap1g1\_logT$best.model, data\_test1)

tuneLap1g1\_G<-tuneksvm(

x=logg~.,

data=tr01gdf1\_G,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_G <- predict(tuneLap1g1\_G$best.model, data\_train1)

prede1g1\_G <- predict(tuneLap1g1\_G$best.model, data\_test1)

tuneLap1g1\_M<-tuneksvm(

x=meta~.,

data=tr01gdf1\_M,

kernel="laplacedot",

type="eps-svr",

ranges=list(sigma=2^(-4:0)),

C=coste,

epsilon=epsilon)

prede1gtr1\_M <- predict(tuneLap1g1\_M$best.model, data\_train1)

prede1g1\_M <- predict(tuneLap1g1\_M$best.model, data\_test1)

training\_06\_1000\_4\_12 <- data.frame(prede1gtr1\_T, Gtrain01\_T, prede1gtr1\_logT, Gtrain01\_logT, prede1gtr1\_G, Gtrain01\_G, prede1gtr1\_M, Gtrain01\_M)

test\_06\_1000\_4\_12 <- data.frame(prede1g1\_T, prede1g1\_logT, prede1g1\_G, prede1g1\_M)

save(training\_06\_1000\_4\_12, test\_06\_1000\_4\_12, file="prediccion\_06\_1000\_4\_12.RData")

}}}

Tramo 01

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | dim=10; coste=1000; epsilon=0.000001 | dim=6; coste=1000; epsilon=0.00001 | dim=6; coste=1000; epsilon=0.000001 | dim=6; coste=1000; epsilon=0.00001 |
|  | Temperatura | Log(T) | Log(g) | Fe/H |
| 1 | 2206.255 | 3.340036 | -3.1623597 | -3.517496 |
| 2 | 2248.96 | 3.332731 | -2.4708602 | -3.467417 |
| 3 | 2384.69 | 3.331395 | -0.2096841 | -4.249548 |
| 4 | 2143.104 | 3.378613 | -5.3379197 | -1.675932 |
| 5 | 1913.735 | 3.270831 | -2.61878 | -3.894711 |
| 6 | 2395.398 | 3.406398 | -1.0480985 | -1.34494 |
| 7 | 2554.048 | 3.427967 | -1.7620381 | -1.162209 |
| 8 | 2711.185 | 3.431693 | -1.2945906 | -1.133662 |
| 9 | 2528.475 | 3.406064 | -1.5908531 | -1.613622 |
| 10 | 2516.334 | 3.410015 | -1.6927224 | -1.499391 |
| 11 | 2464.306 | 3.403213 | -1.4565199 | -1.696764 |
| 12 | 2689.776 | 3.406474 | -1.5594628 | -1.677152 |
| 13 | 2817.638 | 3.423128 | -1.8212144 | -1.295689 |
| 14 | 2443.448 | 3.380703 | -4.4790699 | -2.884306 |
| 15 | 2643.473 | 3.426794 | -3.7005639 | -2.417608 |
| 16 | 2737.502 | 3.374238 | -1.0560258 | -3.399324 |
| 17 | 2440.374 | 3.333303 | -4.4899156 | -1.277222 |
| 18 | 2672.538 | 3.403783 | -2.3995497 | -1.993399 |
| 19 | 2448.012 | 3.36053 | -5.1194013 | -3.512927 |
| 20 | 2690.303 | 3.417681 | -3.3697911 | -2.070299 |
| 21 | 2572.103 | 3.4141 | -2.8040654 | -1.896549 |
| 22 | 3006.011 | 3.468711 | -3.2051478 | -1.171756 |
| 23 | 2821.027 | 3.427824 | -3.0817811 | -1.970365 |
| 24 | 2786.649 | 3.436404 | -4.5598244 | -2.534366 |
| 25 | 2759.798 | 3.435343 | -3.4055187 | -2.179224 |
| 26 | 2666.773 | 3.415085 | -3.4952181 | -2.168743 |
| 27 | 2788.232 | 3.440192 | -4.0758465 | -2.012614 |
| 28 | 2431.725 | 3.370397 | -5.3463948 | -3.303671 |
| 29 | 2296.663 | 3.375259 | -3.0232302 | -2.478503 |
| 30 | 2610.593 | 3.391457 | -5.3668617 | -3.883557 |
| 31 | 3049.398 | 3.490365 | -5.7436283 | -3.124363 |
| 32 | 2699.367 | 3.464392 | -5.6863411 | -3.086096 |
| 33 | 2767.265 | 3.475574 | -5.5411617 | -2.899674 |
| 34 | 2248.24 | 3.343536 | -2.8547879 | -2.994282 |
| 35 | 2797.795 | 3.464029 | -5.6596645 | -3.769747 |
| 36 | 3106.317 | 3.502728 | -4.777246 | -2.317817 |
| 37 | 2513.481 | 3.333215 | -5.5922924 | -2.876429 |
| 38 | 3048.638 | 3.467628 | -4.7861172 | -2.634957 |
| 39 | 2564.234 | 3.435988 | -5.4001129 | -3.112862 |
| 40 | 3068.139 | 3.477282 | -5.6093399 | -3.255941 |
| 41 | 2663.836 | 3.396245 | -2.4018135 | -2.327133 |
| 42 | 3079.095 | 3.47956 | -5.5893305 | -3.130257 |
| 43 | 2624.548 | 3.424582 | -5.4830067 | -3.874806 |
| 44 | 3083.569 | 3.474493 | -5.5450562 | -3.313586 |
| 45 | 2548.77 | 3.378561 | -5.0131248 | -2.871559 |
| 46 | 2533.158 | 3.401796 | -5.3591744 | -3.49858 |
| 47 | 3081.096 | 3.457015 | -4.8843203 | -2.752918 |
| 48 | 2751.771 | 3.419915 | -3.7279265 | -2.266919 |
| 49 | 2577.015 | 3.398367 | -5.7405105 | -3.232471 |
| 50 | 3135.811 | 3.498707 | -5.8484462 | -3.187365 |
| 51 | 2811.803 | 3.452139 | -5.192633 | -3.112796 |
| 52 | 2850.202 | 3.425605 | -2.2442758 | -1.890107 |
| 53 | 2634.228 | 3.427646 | -5.4652976 | -3.659991 |
| 54 | 2989.308 | 3.457151 | -5.2016235 | -2.977197 |
| 55 | 2823.111 | 3.436809 | -5.4099631 | -3.50556 |
| 56 | 2712.293 | 3.417131 | -3.1885231 | -1.913429 |
| 57 | 2567.636 | 3.412433 | -5.3485767 | -3.430197 |
| 58 | 2309.747 | 3.348384 | -2.6323036 | -2.908039 |
| 59 | 2325.063 | 3.34957 | -2.6136671 | -2.976861 |
| 60 | 2374.074 | 3.366193 | -2.7488465 | -2.943362 |
| 61 | 2842.654 | 3.504115 | -5.8609733 | -3.657834 |
| 62 | 2609.067 | 3.444965 | -5.631196 | -3.645303 |
| 63 | 2545.349 | 3.412678 | -5.4622172 | -3.647587 |
| 64 | 2418.141 | 3.364652 | -5.5001978 | -3.758208 |
| 65 | 2478.998 | 3.384233 | -4.6509092 | -2.765487 |
| 66 | 2290.911 | 3.374342 | -5.3993078 | -3.485467 |
| 67 | 2322.26 | 3.36467 | -4.8614954 | -2.640174 |
| 68 | 2458.551 | 3.404836 | -4.4514035 | -2.458122 |
| 69 | 2888.814 | 3.476326 | -5.6871503 | -3.234286 |
| 70 | 2985.94 | 3.483838 | -5.6163566 | -3.139131 |
| 71 | 2569.261 | 3.360379 | -5.4363425 | -2.561577 |
| 72 | 2696.23 | 3.424456 | -5.5141368 | -2.573233 |
| 73 | 2644.221 | 3.376866 | -5.1999856 | -2.288181 |
| 74 | 2816.296 | 3.444975 | -5.1060798 | -2.066587 |
| 75 | 2583.166 | 3.426724 | -5.582342 | -3.582291 |
| 76 | 2871.647 | 3.473356 | -5.5370198 | -3.127282 |
| 77 | 2288.59 | 3.35106 | -2.6876869 | -2.742416 |
| 78 | 2356.439 | 3.362132 | -2.7683444 | -2.779319 |
| 79 | 2494.12 | 3.392278 | -4.7000575 | -2.782392 |
| 80 | 2905.08 | 3.497617 | -5.9571202 | -3.407766 |
| 81 | 3006.244 | 3.499766 | -6.0793052 | -2.726935 |
| 82 | 2666.274 | 3.392723 | -4.4384961 | -1.633101 |
| 83 | 2879.111 | 3.48568 | -5.9634095 | -3.549112 |
| 84 | 2519.072 | 3.390538 | -4.1470825 | -2.417706 |
| 85 | 3013.681 | 3.462801 | -3.865007 | -1.043939 |
| 86 | 2683.481 | 3.442189 | -5.8009284 | -3.410288 |
| 87 | 2916.115 | 3.528389 | -6.0755055 | -3.489927 |
| 88 | 2511.73 | 3.452594 | -5.8023059 | -3.460947 |
| 89 | 2726.313 | 3.442483 | -4.9259123 | -2.733873 |
| 90 | 2492.275 | 3.403997 | -2.5870128 | -2.544333 |
| 91 | 2760.519 | 3.444827 | -5.3722814 | -2.854825 |
| 92 | 2568.596 | 3.414574 | -4.8599276 | -2.882203 |
| 93 | 3047.635 | 3.481 | -5.7386316 | -3.091472 |
| 94 | 2453.778 | 3.414335 | -5.770195 | -3.508105 |
| 95 | 2385.035 | 3.369283 | -5.5507137 | -3.041454 |
| 96 | 2826.262 | 3.460844 | -5.7369748 | -3.166467 |
| 97 | 2462.995 | 3.349771 | -2.7585378 | -2.525064 |
| 98 | 2137.455 | 3.335726 | -2.9829454 | -3.021053 |
| 99 | 1870.993 | 3.297514 | -4.5048469 | -2.363504 |
| 100 | 2439.62 | 3.370847 | -3.1779743 | -1.967888 |
| 101 | 2345.344 | 3.357987 | -2.4664624 | -2.767578 |
| 102 | 2221.126 | 3.340552 | -2.6847179 | -3.112054 |
| 103 | 2884.84 | 3.444517 | -5.6900808 | -3.030672 |
| 104 | 2354.224 | 3.358449 | -2.7415496 | -3.326724 |
| 105 | 2012.778 | 3.336996 | -1.9071613 | -3.376114 |
| 106 | 2862.113 | 3.446477 | -4.7558882 | -2.620648 |
| 107 | 2897.412 | 3.415458 | -4.5082979 | -2.450224 |
| 108 | 2538.51 | 3.414611 | -3.8007108 | -2.097591 |
| 109 | 2513.772 | 3.38449 | -5.5636681 | -3.075327 |
| 110 | 2248.38 | 3.334205 | -3.33317 | -3.165365 |
| 111 | 2757.097 | 3.411236 | -3.9299833 | -2.301318 |
| 112 | 2880.714 | 3.46606 | -3.8048997 | -2.267712 |
| 113 | 2775.461 | 3.410718 | -3.9237212 | -2.241352 |
| 114 | 2571.476 | 3.389079 | -2.0896998 | -2.551462 |
| 115 | 2907.043 | 3.310952 | -4.8469265 | -3.869862 |
| 116 | 2747.365 | 3.405598 | -4.6508013 | -2.934506 |
| 117 | 3193.035 | 3.545973 | -5.4103553 | -2.473815 |
| 118 | 2738.799 | 3.4145 | -4.5124207 | -2.347886 |
| 119 | 2349.971 | 3.379478 | -5.1808505 | -3.21473 |
| 120 | 2466.753 | 3.392236 | -3.3108098 | -2.409247 |
| 121 | 2646.529 | 3.410067 | -2.8171395 | -2.217456 |
| 122 | 2672.851 | 3.371596 | -2.6697637 | -2.47373 |
| 123 | 2310.51 | 3.356048 | -2.258908 | -2.827218 |
| 124 | 2850.783 | 3.450464 | 0.6881335 | -3.693556 |
| 125 | 2171.024 | 3.336995 | -2.7623674 | -3.071534 |
| 126 | 2457.759 | 3.420612 | -5.2503413 | -3.183105 |
| 127 | 2656.571 | 3.341557 | -5.5527076 | -2.872388 |
| 128 | 2565.173 | 3.390815 | -5.8451171 | -2.732358 |
| 129 | 2771.447 | 3.450644 | -4.5151476 | -2.284957 |
| 130 | 2188.353 | 3.341261 | -2.4577912 | -3.331356 |
| 131 | 2165 | 3.313927 | -2.87015 | -3.48623 |
| 132 | 2992.577 | 3.598023 | -6.4514893 | -2.381516 |
| 133 | 2904.261 | 3.486619 | -5.2706389 | -2.813343 |
| 134 | 2605.815 | 3.386921 | -2.4454165 | -2.693028 |
| 135 | 2545.426 | 3.397528 | -3.8925302 | -2.416669 |
| 136 | 2794.939 | 3.433063 | -2.4072026 | -1.725426 |
| 137 | 2592.532 | 3.412962 | -4.6825602 | -2.824015 |

Tramo 02

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | dim=6; coste=1000; epsilon=0.000001 | | | |
|  | Temperatura | Log(T) | Log(g) | Fe/H |
| 1 | 3589.941 | 3.537962 | 1.317262536 | -1.9743438 |
| 2 | 2433.252 | 3.375233 | -4.24138599 | -1.6453019 |
| 3 | 3189.305 | 3.477813 | 0.779077957 | -1.9505356 |
| 4 | 2593.235 | 3.395208 | 0.129776598 | -2.2583498 |
| 5 | 2326.049 | 3.344433 | -1.704866184 | -1.6781699 |
| 6 | 2606.616 | 3.390012 | -3.625738337 | -1.0161729 |
| 7 | 2171.377 | 3.320482 | -4.130038764 | -0.7303966 |
| 8 | 2592.669 | 3.391764 | -3.840144676 | -1.001267 |
| 9 | 2457.765 | 3.373458 | -3.700768798 | -1.2750762 |
| 10 | 2329.566 | 3.351991 | -4.287604394 | -1.1752801 |
| 11 | 2484.709 | 3.378037 | -4.115972587 | -1.1758254 |
| 12 | 2727.598 | 3.426277 | -4.116007391 | -1.2348252 |
| 13 | 2723.458 | 3.426473 | -3.941341252 | -1.1826052 |
| 14 | 2476.736 | 3.388113 | -4.531268942 | -2.3139883 |
| 15 | 2673.789 | 3.417286 | -2.132964259 | -2.5657633 |
| 16 | 2336.723 | 3.34729 | -3.644665087 | -1.566477 |
| 17 | 2202.357 | 3.339808 | -1.846503463 | -1.732915 |
| 18 | 2377.019 | 3.369543 | -4.59470815 | -1.8092856 |
| 19 | 2594.322 | 3.41082 | -4.417174243 | -2.4053776 |
| 20 | 2560.873 | 3.402422 | -4.224709248 | -2.0133975 |
| 21 | 2491.454 | 3.386855 | -4.007084913 | -1.8359783 |
| 22 | 2770.047 | 3.43377 | -5.437761357 | -1.8257712 |
| 23 | 2482.907 | 3.39155 | -3.320040647 | -2.1672244 |
| 24 | 2486.59 | 3.384751 | -0.537996007 | -3.0961339 |
| 25 | 2519.898 | 3.391901 | -1.037883748 | -2.6899874 |
| 26 | 2499.825 | 3.395689 | -4.819712936 | -2.0515722 |
| 27 | 2555.26 | 3.394853 | -5.066369199 | -1.8579897 |
| 28 | 2584.487 | 3.403813 | -3.862949006 | -2.771826 |
| 29 | 2421.463 | 3.37394 | -4.04786132 | -1.7675362 |
| 30 | 2284.505 | 3.354786 | -3.576926705 | -3.7073775 |
| 31 | 3320.084 | 3.512248 | 0.004457017 | -3.8713342 |
| 32 | 2074.817 | 3.311951 | -1.853071136 | -4.3656419 |
| 33 | 2259.095 | 3.342558 | -1.039548366 | -3.695615 |
| 34 | 2340.044 | 3.35899 | -4.141468346 | -1.7072379 |
| 35 | 3314.604 | 3.509679 | -4.571879841 | -2.3415203 |
| 36 | 3573.772 | 3.548891 | -5.756013113 | -2.0478089 |
| 37 | 3177.417 | 3.505867 | -5.587873155 | -1.8202144 |
| 38 | 3114.749 | 3.492954 | -4.669938463 | -1.9299839 |
| 39 | 3194.984 | 3.495957 | -1.316768134 | -3.5279532 |
| 40 | 3239.381 | 3.508514 | -1.540201812 | -3.4971645 |
| 41 | 2285.68 | 3.356641 | -4.037966606 | -1.8248274 |
| 42 | 2901.511 | 3.448248 | 0.806289922 | -3.9582831 |
| 43 | 2580.716 | 3.403749 | -2.384682785 | -3.6745678 |
| 44 | 3231.511 | 3.505581 | -1.319306491 | -3.419898 |
| 45 | 3291.843 | 3.525382 | -5.013278125 | -1.3882573 |
| 46 | 2304.436 | 3.35793 | -3.679165613 | -3.1355377 |
| 47 | 3589.84 | 3.56092 | -4.753010238 | -1.3830039 |
| 48 | 2474.351 | 3.387858 | -2.429790974 | -2.5260112 |
| 49 | 3949.863 | 3.600974 | -7.093126815 | -1.642817 |
| 50 | 3060.624 | 3.475396 | 0.941168867 | -4.3425096 |
| 51 | 2390.255 | 3.369252 | 1.678502511 | -4.3478867 |
| 52 | 2386.789 | 3.375893 | -4.601220038 | -2.0376073 |
| 53 | 2856.561 | 3.445798 | -3.403 | -2.4008222 |
| 54 | 2667.75 | 3.415169 | -0.540571734 | -3.0616152 |
| 55 | 2547.517 | 3.404754 | -2.940289886 | -3.0625848 |
| 56 | 2437.687 | 3.388958 | -5.319385582 | -2.0862909 |
| 57 | 2339.296 | 3.365572 | -4.014221187 | -3.0841033 |
| 58 | 2298.996 | 3.351244 | -4.040067233 | -1.7951189 |
| 59 | 2202.766 | 3.339566 | -5.020864072 | -1.8731074 |
| 60 | 2227.475 | 3.342984 | -3.77887824 | -1.7151654 |
| 61 | 2957.814 | 3.46513 | -4.393169422 | -3.1578912 |
| 62 | 2631.02 | 3.409184 | -2.90864967 | -3.0135918 |
| 63 | 2393.366 | 3.374101 | -3.262180979 | -3.1379909 |
| 64 | 4022.598 | 3.599281 | -1.449961729 | -1.3585003 |
| 65 | 2679.04 | 3.42234 | -4.493864631 | -2.2203772 |
| 66 | 2538.741 | 3.395033 | -4.19778429 | -2.9314314 |
| 67 | 2567.558 | 3.39735 | -3.896885433 | -2.5419576 |
| 68 | 2536.897 | 3.390073 | -0.03689994 | -3.3942887 |
| 69 | 3065.267 | 3.473256 | 0.526582534 | -4.1104772 |
| 70 | 2920.123 | 3.451448 | 0.531141062 | -4.1576081 |
| 71 | 3948.292 | 3.591462 | -5.22419426 | -3.4843871 |
| 72 | 3684.412 | 3.555899 | -0.148762399 | -3.8229397 |
| 73 | 3470.145 | 3.533947 | -5.979095447 | -3.8620342 |
| 74 | 3241.507 | 3.493387 | 1.219460998 | -4.3071837 |
| 75 | 2969.838 | 3.461511 | -3.089381204 | -2.2495389 |
| 76 | 2674.588 | 3.416299 | 0.863540141 | -4.0620478 |
| 77 | 2161.4 | 3.32956 | -4.975584679 | -1.731452 |
| 78 | 2174.022 | 3.331908 | -4.12953244 | -1.706553 |
| 79 | 2659.094 | 3.420356 | -4.761035407 | -2.0707139 |
| 80 | 3637.814 | 3.5534 | -4.117330142 | -3.0519701 |
| 81 | 3121.072 | 3.479489 | 1.359929724 | -4.3949301 |
| 82 | 2827.153 | 3.439819 | -3.331590933 | -2.3858929 |
| 83 | 3606.437 | 3.550431 | -2.654024579 | -3.7692261 |
| 84 | 2438.009 | 3.381629 | -4.594706793 | -2.296885 |
| 85 | 2704.58 | 3.419185 | -4.290467094 | -2.0239634 |
| 86 | 2968.813 | 3.460962 | -3.928940733 | -2.7635431 |
| 87 | 3164.385 | 3.492037 | -3.417430897 | -2.5197041 |
| 88 | 2780.116 | 3.433387 | -4.076552975 | -3.1476238 |
| 89 | 2561.984 | 3.393295 | 1.284326724 | -3.8979019 |
| 90 | 2384.552 | 3.36972 | -2.170622566 | -1.856903 |
| 91 | 2797.204 | 3.431608 | 1.313531004 | -4.2678371 |
| 92 | 2269.654 | 3.346382 | 1.361751437 | -3.9678837 |
| 93 | 2852.555 | 3.445102 | -3.569614583 | -1.9214155 |
| 94 | 3317.069 | 3.513254 | -1.465881794 | -3.2481317 |
| 95 | 2774.927 | 3.43097 | -4.262279572 | -4.0163024 |
| 96 | 2651.897 | 3.411011 | 1.63258792 | -4.5148197 |
| 97 | 2204.105 | 3.335827 | -4.944650488 | -1.6688146 |
| 98 | 2154.757 | 3.325822 | -4.867546612 | -1.7235021 |
| 99 | 2266.444 | 3.339184 | -3.491087061 | -1.5649762 |
| 100 | 2218.787 | 3.337902 | -4.920875953 | -1.6504684 |
| 101 | 2287.612 | 3.345913 | -3.937779128 | -1.6067599 |
| 102 | 2296.332 | 3.346109 | -3.966702471 | -1.6022287 |
| 103 | 3698.205 | 3.560679 | -5.14879577 | -1.0601231 |
| 104 | 2217.611 | 3.340084 | -3.485173664 | -1.6306837 |
| 105 | 2235.078 | 3.334082 | -2.982310436 | -1.5793241 |
| 106 | 2651.506 | 3.411552 | -1.498928344 | -3.1815441 |
| 107 | 3067.051 | 3.487085 | -5.37789475 | -1.4216384 |
| 108 | 2741.654 | 3.433986 | -4.240709358 | -2.0755173 |
| 109 | 3302.903 | 3.528064 | -5.850679894 | -2.290111 |
| 110 | 2269.602 | 3.34239 | -3.413814055 | -1.7106202 |
| 111 | 2366.967 | 3.370438 | -5.677163558 | -2.1162309 |
| 112 | 2500.241 | 3.382361 | 0.729998228 | -3.5962696 |
| 113 | 2990.27 | 3.471298 | -2.572245507 | -2.0367371 |
| 114 | 2467.595 | 3.377872 | -3.659820471 | -1.6184185 |
| 115 | 3092.892 | 3.487452 | -2.880048973 | -0.6566333 |
| 116 | 2580.642 | 3.410552 | -5.00605233 | -2.0703973 |
| 117 | 2986.413 | 3.45825 | 0.536532371 | -4.2898311 |
| 118 | 2548.669 | 3.390442 | 0.717198823 | -3.500738 |
| 119 | 2507.089 | 3.390976 | -4.240702887 | -2.6151051 |
| 120 | 2363.226 | 3.367112 | -4.540390293 | -2.0968988 |
| 121 | 2458.931 | 3.383289 | -4.278848101 | -1.9061104 |
| 122 | 2190.064 | 3.335582 | -5.220622026 | -1.9097157 |
| 123 | 2308.052 | 3.349613 | -3.946426678 | -1.5875578 |
| 124 | 2373.705 | 3.34986 | -1.032949438 | -1.2682794 |
| 125 | 2238.117 | 3.334909 | -4.027528153 | -1.5027123 |
| 126 | 1828.871 | 3.263068 | -2.522514748 | -3.3835662 |
| 127 | 3225.475 | 3.51247 | -5.650763722 | -1.6174127 |
| 128 | 3612.33 | 3.562335 | -6.064793432 | -1.5258277 |
| 129 | 3444.813 | 3.540154 | -3.408939663 | -0.476742 |
| 130 | 2334.404 | 3.350499 | -3.326534992 | -1.4632847 |
| 131 | 2199.314 | 3.328966 | -3.915477167 | -1.5387773 |
| 132 | 4199.347 | 3.62206 | 4.314279414 | -3.7434147 |
| 133 | 2742.498 | 3.42593 | 0.29425632 | -3.5603068 |
| 134 | 2317.977 | 3.361678 | -4.156593662 | -1.9175685 |
| 135 | 2443.311 | 3.386664 | -4.781948949 | -2.1873647 |
| 136 | 2436.887 | 3.380575 | -4.2863545 | -1.8502499 |
| 137 | 2401.071 | 3.367412 | 0.860638349 | -3.7500193 |

Tramo 03

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | dim=10; coste=1000; epsilon=0.00001 | dim=6; coste=1000; epsilon=0.000001 | dim=10; coste=1000; epsilon=0.00001 | dim=10; coste=1000; epsilon=0.000001 |
|  | Temperatura | Log(T) | Log(g) | Fe/H |
| 1 | 2424.631 | 3.344994 | -1.750770926 | -0.72734933 |
| 2 | 2428.714 | 3.387606 | -2.160819117 | -0.76681178 |
| 3 | 2456.79 | 3.432545 | -1.646816583 | -0.2455408 |
| 4 | 2516.51 | 3.457876 | -1.567457824 | -0.3391685 |
| 5 | 2471.168 | 3.427579 | -1.303168806 | -0.29074793 |
| 6 | 2292.422 | 3.395412 | -1.054602133 | -0.57999737 |
| 7 | 2243.297 | 3.383529 | -0.814292686 | -0.5349774 |
| 8 | 2339.47 | 3.418746 | -0.85898645 | -0.58245669 |
| 9 | 2280.031 | 3.401128 | -0.677746767 | -0.64893844 |
| 10 | 2204.086 | 3.392012 | -0.777186868 | -0.51589022 |
| 11 | 2210.516 | 3.394438 | -0.760004096 | -0.46394953 |
| 12 | 2314.164 | 3.422963 | -0.978761538 | -0.50571149 |
| 13 | 2351.411 | 3.436619 | -0.907066041 | -0.52466203 |
| 14 | 2320.005 | 3.388033 | -1.098374414 | -1.45720269 |
| 15 | 2192.886 | 3.325604 | -0.561269497 | -1.82241095 |
| 16 | 2685.304 | 3.419883 | -2.485582302 | -0.01999424 |
| 17 | 2307.959 | 3.371955 | -1.24755841 | -0.43526008 |
| 18 | 2263.691 | 3.396048 | -1.483956615 | -0.79815081 |
| 19 | 2203.435 | 3.326247 | -0.370591419 | -2.54189687 |
| 20 | 2244.224 | 3.376647 | -0.943626766 | -1.59590918 |
| 21 | 2266.122 | 3.400389 | -1.165951154 | -1.06585639 |
| 22 | 2480.766 | 3.37494 | -1.094155191 | -1.68931399 |
| 23 | 2218.815 | 3.364528 | -0.7033447 | -1.80820114 |
| 24 | 2213.224 | 3.353205 | -0.376051746 | -2.32354627 |
| 25 | 2157.982 | 3.347112 | -0.595509242 | -1.67273883 |
| 26 | 2266.558 | 3.380932 | -0.987723104 | -1.52929812 |
| 27 | 2216.942 | 3.360431 | -0.828222628 | -1.24777724 |
| 28 | 2309.157 | 3.362377 | -0.153713868 | -2.51043801 |
| 29 | 2265.521 | 3.402322 | -1.44496373 | -0.77514409 |
| 30 | 2472.583 | 3.400793 | -1.38791771 | -1.15782646 |
| 31 | 2196.759 | 3.329881 | 0.194457309 | -2.96952384 |
| 32 | 2662.635 | 3.473258 | 0.495378155 | -2.30893708 |
| 33 | 2772.665 | 3.489442 | 0.482273352 | -2.33341228 |
| 34 | 2250.598 | 3.394345 | -1.505709116 | -0.70291382 |
| 35 | 2321.203 | 3.337283 | 0.190697722 | -2.87196495 |
| 36 | 2904.669 | 3.367458 | -1.141410234 | -1.81793313 |
| 37 | 2560.026 | 3.337184 | -0.37102594 | -2.38369359 |
| 38 | 2333.269 | 3.343784 | 0.342856978 | -2.9413797 |
| 39 | 2193.15 | 3.33008 | -0.186015702 | -2.55706697 |
| 40 | 2227.324 | 3.324284 | 0.228602666 | -3.17985771 |
| 41 | 2201.689 | 3.372963 | -1.399576273 | -0.93646687 |
| 42 | 2237.98 | 3.333235 | 0.131053149 | -3.10943956 |
| 43 | 2422.875 | 3.381932 | -0.970751659 | -1.73907405 |
| 44 | 2224.114 | 3.31618 | 0.048408633 | -2.79976659 |
| 45 | 2442.852 | 3.354695 | -0.095525338 | -2.6381394 |
| 46 | 2369.921 | 3.382118 | -0.823633776 | -1.8435382 |
| 47 | 2306.372 | 3.312991 | 0.442659552 | -3.28315872 |
| 48 | 2201.207 | 3.352893 | -0.624727534 | -2.2427851 |
| 49 | 3007.913 | 3.36486 | 0.486607211 | -3.06872718 |
| 50 | 2213.898 | 3.327165 | 0.07837983 | -2.82733862 |
| 51 | 2223.883 | 3.360388 | -0.355154115 | -1.93309528 |
| 52 | 2293.661 | 3.394536 | -1.482337207 | -0.96495827 |
| 53 | 2346.662 | 3.366569 | -0.496379481 | -2.2568502 |
| 54 | 2189.183 | 3.338738 | -0.046062238 | -2.50867746 |
| 55 | 2349.703 | 3.365786 | -0.458297744 | -2.35834262 |
| 56 | 2251.013 | 3.373445 | -1.283443707 | -1.63925215 |
| 57 | 2321.782 | 3.372527 | -0.879546738 | -1.84621375 |
| 58 | 2377.155 | 3.400883 | -1.619053493 | -0.92507429 |
| 59 | 2295.947 | 3.388294 | -1.949661778 | -0.47334688 |
| 60 | 2251.279 | 3.385383 | -1.298972557 | -0.61741631 |
| 61 | 2366.035 | 3.341427 | 0.273882686 | -3.03056841 |
| 62 | 2247.247 | 3.332591 | 0.214116858 | -3.01069904 |
| 63 | 2303.069 | 3.34508 | -0.064476696 | -2.8272563 |
| 64 | 2414.682 | 3.488945 | -0.640606977 | -1.67890154 |
| 65 | 2243.105 | 3.36041 | -0.588470847 | -2.07228755 |
| 66 | 2287.519 | 3.353252 | -0.342802708 | -2.32945118 |
| 67 | 2284.772 | 3.353659 | -0.602517908 | -1.9463582 |
| 68 | 2182.16 | 3.330197 | -0.16104588 | -2.19707252 |
| 69 | 2157.486 | 3.329542 | -0.246853533 | -2.47229036 |
| 70 | 2206.381 | 3.330654 | -0.106517498 | -2.76627737 |
| 71 | 2618.296 | 3.381172 | 0.922081331 | -3.25419119 |
| 72 | 2242.764 | 3.305083 | 1.013410581 | -3.77765881 |
| 73 | 2387.38 | 3.316057 | 0.707593018 | -3.17363684 |
| 74 | 2154.158 | 3.340289 | 0.351182945 | -3.11342059 |
| 75 | 2388.65 | 3.357427 | 0.151519759 | -2.81914649 |
| 76 | 2278.571 | 3.365355 | -0.121500326 | -2.26214867 |
| 77 | 2308.706 | 3.385479 | -2.047603441 | -0.34807446 |
| 78 | 2245.27 | 3.373077 | -1.575727041 | -0.66297925 |
| 79 | 2217.366 | 3.357399 | -0.460242418 | -2.20256489 |
| 80 | 2705.406 | 3.42798 | 0.883816785 | -2.96715483 |
| 81 | 2565.735 | 3.408303 | 0.724534938 | -3.2419552 |
| 82 | 2236.404 | 3.340873 | -0.122985413 | -2.32706801 |
| 83 | 2437.589 | 3.389044 | -0.061793839 | -2.75015302 |
| 84 | 2234.752 | 3.375816 | -0.575296091 | -2.10900349 |
| 85 | 2285.662 | 3.376127 | -1.01561085 | -1.727259 |
| 86 | 2370.3 | 3.362563 | 0.404982998 | -3.16423062 |
| 87 | 2615.207 | 3.456083 | 0.353352162 | -3.21875729 |
| 88 | 2404.209 | 3.355948 | 0.357650951 | -2.94651606 |
| 89 | 2222.348 | 3.357117 | -0.355598612 | -1.94357379 |
| 90 | 2235.842 | 3.392314 | -0.995162474 | -0.75355426 |
| 91 | 2237.842 | 3.349494 | -0.254017186 | -2.49806761 |
| 92 | 2224.132 | 3.361172 | -0.463918617 | -1.65866368 |
| 93 | 2326.926 | 3.364155 | 0.314414848 | -2.96318914 |
| 94 | 2522.492 | 3.375251 | 0.611687036 | -3.23922236 |
| 95 | 2441.696 | 3.324183 | -0.003285878 | -2.58353835 |
| 96 | 2244.615 | 3.357623 | -0.032060178 | -2.50847153 |
| 97 | 2229.853 | 3.382152 | -1.551959967 | -0.42781621 |
| 98 | 2269.286 | 3.378382 | -2.219740678 | -0.29085328 |
| 99 | 2283.923 | 3.380517 | -1.907217233 | -0.1848867 |
| 100 | 2230.895 | 3.379434 | -1.614525388 | -0.55074578 |
| 101 | 2275.889 | 3.39731 | -1.445264872 | -0.51087234 |
| 102 | 2305.696 | 3.392848 | -1.936140164 | -0.2924561 |
| 103 | 2726.699 | 3.347399 | -0.459972891 | -2.32186404 |
| 104 | 2249.493 | 3.380266 | -1.413989515 | -0.50303758 |
| 105 | 2367.091 | 3.381975 | -2.00213242 | -0.22307778 |
| 106 | 2181.276 | 3.326434 | -0.173330242 | -2.14655976 |
| 107 | 2449.527 | 3.359682 | -0.067770583 | -2.44708306 |
| 108 | 2262.242 | 3.356272 | -0.624706849 | -1.85898829 |
| 109 | 2762.923 | 3.378829 | -0.27725973 | -2.68801075 |
| 110 | 2353.82 | 3.400401 | -2.035751413 | -0.55283299 |
| 111 | 2385.941 | 3.391826 | -1.612656883 | -0.89866404 |
| 112 | 2212.306 | 3.320784 | 0.26142421 | -2.28608269 |
| 113 | 2227.517 | 3.338579 | -0.118370319 | -2.27171982 |
| 114 | 2292.732 | 3.415264 | -1.674685191 | -0.46051739 |
| 115 | 2407.256 | 3.376184 | -1.050907917 | -1.62491985 |
| 116 | 2353.111 | 3.385055 | -1.272895838 | -1.29199962 |
| 117 | 2313.545 | 3.364681 | 0.382892858 | -2.66018661 |
| 118 | 2190.967 | 3.33932 | -0.073066925 | -2.53594719 |
| 119 | 2283.399 | 3.365459 | -0.450586931 | -2.1356449 |
| 120 | 2252.47 | 3.38577 | -1.174276245 | -1.53943951 |
| 121 | 2268.518 | 3.392115 | -1.170523883 | -1.17477547 |
| 122 | 2498.991 | 3.386428 | -2.088230829 | -0.50193157 |
| 123 | 2286.314 | 3.392558 | -1.737070173 | -0.3593258 |
| 124 | 2547.457 | 3.346811 | -1.085833512 | -0.79277402 |
| 125 | 2288.936 | 3.378331 | -2.022189979 | -0.10131282 |
| 126 | 2519.163 | 3.488237 | -0.185328221 | -1.56950408 |
| 127 | 2610.695 | 3.360559 | -0.97713122 | -1.86785628 |
| 128 | 2700.939 | 3.344574 | 0.082120264 | -2.80354624 |
| 129 | 2360.103 | 3.431738 | -0.770486815 | -0.97067256 |
| 130 | 2271.128 | 3.393372 | -1.700286999 | -0.23175456 |
| 131 | 2292.617 | 3.381495 | -2.100946659 | -0.1729941 |
| 132 | 2325.796 | 3.329856 | -0.588464592 | -1.93143651 |
| 133 | 2178.696 | 3.32521 | -0.262431747 | -2.30754912 |
| 134 | 2240.275 | 3.382005 | -1.536024032 | -1.05707244 |
| 135 | 2237.782 | 3.374899 | -0.95843044 | -1.62332531 |
| 136 | 2279.989 | 3.403088 | -1.263084621 | -0.95352153 |
| 137 | 2264.189 | 3.361692 | -0.198895091 | -1.7055903 |

Tramo 01 + 02

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | dim=6; coste=1000; epsilon=0.000001 | dim=6; coste=1000; epsilon=0.00001 | dim=6; coste=1000; epsilon=0.000001 | dim=6; coste=1000; epsilon=0.000001 |
|  | Temperatura | Log(T) | Log(g) | Fe/H |
| 1 | 3060.195 | 3.483784 | 0.4481359 | -1.10928556 |
| 2 | 2749.652 | 3.435754 | -1.9895566 | -0.71862484 |
| 3 | 2990.344 | 3.472309 | 1.1122865 | -1.1442455 |
| 4 | 3095.831 | 3.492592 | -0.8073039 | -1.14466537 |
| 5 | 2835.235 | 3.453937 | -4.0948601 | -0.97633682 |
| 6 | 2392.949 | 3.378493 | -1.3820148 | -0.32756658 |
| 7 | 1873.028 | 3.280435 | -2.5313395 | 0.07104225 |
| 8 | 2685.414 | 3.426585 | -1.4357278 | 0.11977161 |
| 9 | 2552.901 | 3.405161 | -1.2301772 | -0.26933503 |
| 10 | 2452.083 | 3.385918 | -1.7647714 | -0.14037706 |
| 11 | 2542.901 | 3.40168 | -1.5930512 | -0.17150901 |
| 12 | 2779.122 | 3.437055 | -1.539248 | -0.39903727 |
| 13 | 2888.012 | 3.456116 | -1.4991338 | -0.20020485 |
| 14 | 2959.146 | 3.459832 | -4.1388263 | -1.2592423 |
| 15 | 3430.635 | 3.529427 | -2.1612594 | -0.76229029 |
| 16 | 1859.299 | 3.274448 | -4.1669168 | -1.74210364 |
| 17 | 2630.748 | 3.41558 | -3.0856555 | -0.45931008 |
| 18 | 2622.44 | 3.409552 | -3.5353083 | -0.65327999 |
| 19 | 3017.111 | 3.470699 | -5.3761931 | -1.72805123 |
| 20 | 3225.976 | 3.499657 | -3.0197864 | -0.15786041 |
| 21 | 2863.163 | 3.445035 | -2.6083658 | -0.78038727 |
| 22 | 3236.352 | 3.499401 | -3.1003732 | -0.42168935 |
| 23 | 3188.486 | 3.497907 | -3.322211 | -0.03616221 |
| 24 | 3546.421 | 3.548643 | -3.2740284 | -0.76874773 |
| 25 | 3566.027 | 3.552011 | -1.859907 | 0.06236597 |
| 26 | 2918.234 | 3.453669 | -3.7426454 | -0.76976619 |
| 27 | 3112.854 | 3.480483 | -3.2371438 | -0.82600537 |
| 28 | 3232.611 | 3.500602 | -4.7491165 | -1.84234387 |
| 29 | 2756.519 | 3.429088 | -2.8859679 | -0.68443906 |
| 30 | 2720.922 | 3.432405 | -5.6366384 | -3.52863901 |
| 31 | 3685.898 | 3.565923 | -4.9553149 | -2.85950631 |
| 32 | 1967.95 | 3.30249 | -3.0361147 | -5.01176707 |
| 33 | 1989.017 | 3.310753 | -2.7666249 | -4.92151484 |
| 34 | 2435.512 | 3.382215 | -3.7321887 | -0.76310751 |
| 35 | 3365.077 | 3.526063 | -6.2727834 | -3.01602338 |
| 36 | 3993.498 | 3.606193 | -3.714911 | -2.08535373 |
| 37 | 3259.684 | 3.501252 | -4.2860874 | -1.42838878 |
| 38 | 3738.074 | 3.572265 | -3.9604608 | -1.19734441 |
| 39 | 3332.324 | 3.516092 | -4.1868937 | -2.8665731 |
| 40 | 3709.175 | 3.570421 | -5.4634254 | -2.34659527 |
| 41 | 2664.061 | 3.419396 | -3.4196851 | -0.60027403 |
| 42 | 3925.415 | 3.597098 | -4.5435012 | -2.21425423 |
| 43 | 2734.752 | 3.435695 | -5.4299962 | -3.78332723 |
| 44 | 3587.215 | 3.55418 | -5.5784991 | -2.5387864 |
| 45 | 3655.566 | 3.560348 | -3.5822422 | -0.09593785 |
| 46 | 2775.539 | 3.438783 | -5.4202204 | -3.02660833 |
| 47 | 3909.625 | 3.597436 | -3.7559907 | -0.48479671 |
| 48 | 3330.207 | 3.517465 | -3.3131339 | -0.13588442 |
| 49 | 3816.937 | 3.581787 | -5.2595894 | -1.52713487 |
| 50 | 3751.745 | 3.576182 | -5.3447069 | -2.60323147 |
| 51 | 3652.138 | 3.562709 | -3.3874988 | -1.93172008 |
| 52 | 2768.448 | 3.430549 | -3.1273858 | -0.72511086 |
| 53 | 3390.955 | 3.527052 | -6.0957136 | -2.46567542 |
| 54 | 3607.755 | 3.557781 | -4.4401815 | -1.4932706 |
| 55 | 3207.74 | 3.504487 | -6.0037862 | -2.41326294 |
| 56 | 2747.988 | 3.429234 | -4.4025381 | -0.77659199 |
| 57 | 2796.156 | 3.442543 | -5.4756604 | -2.89617181 |
| 58 | 2426.927 | 3.37924 | -3.6915792 | -1.08644024 |
| 59 | 2334.45 | 3.364994 | -4.3391678 | -1.06788288 |
| 60 | 2502.496 | 3.394136 | -3.4315159 | -0.88008006 |
| 61 | 3171.028 | 3.501078 | -6.0127359 | -3.27024986 |
| 62 | 3135.896 | 3.494546 | -6.019362 | -3.08962396 |
| 63 | 3007.678 | 3.474775 | -5.9668995 | -2.84267726 |
| 64 | 3598.199 | 3.548601 | -5.5521461 | -3.60137493 |
| 65 | 3343.361 | 3.515134 | -3.8003722 | -0.68935814 |
| 66 | 2940.35 | 3.458515 | -5.1163466 | -2.74272353 |
| 67 | 3000.551 | 3.460979 | -3.3834786 | -2.59587004 |
| 68 | 3448.337 | 3.531082 | -2.1664691 | -1.37874221 |
| 69 | 3653.722 | 3.562825 | -4.8876501 | -2.54570355 |
| 70 | 3703.314 | 3.56868 | -4.7385887 | -2.62966874 |
| 71 | 3312.164 | 3.50252 | -3.3931377 | -3.21011208 |
| 72 | 3998.458 | 3.608377 | -3.2319162 | -2.09728336 |
| 73 | 3164.533 | 3.479836 | -3.5669745 | -3.31941096 |
| 74 | 3812.159 | 3.584164 | -2.5117839 | -2.84240804 |
| 75 | 3425.068 | 3.532405 | -6.1589352 | -2.51962857 |
| 76 | 3690.961 | 3.567655 | -4.7685604 | -2.20279362 |
| 77 | 2274.667 | 3.355751 | -4.3478283 | -0.89494696 |
| 78 | 2441.035 | 3.384925 | -3.8446946 | -0.73278054 |
| 79 | 3241.503 | 3.502435 | -4.1735528 | -0.78511061 |
| 80 | 3217.682 | 3.500538 | -5.6052098 | -3.83086676 |
| 81 | 4006.258 | 3.607152 | -5.7136271 | -2.71535827 |
| 82 | 3676.584 | 3.560645 | -1.3439675 | -1.27494266 |
| 83 | 3472.796 | 3.5341 | -5.9807828 | -3.41748491 |
| 84 | 2909.032 | 3.45106 | -4.0719212 | -1.16406324 |
| 85 | 3618.002 | 3.557087 | -2.4915037 | -0.32752316 |
| 86 | 3193.591 | 3.498149 | -6.1285159 | -3.03448205 |
| 87 | 3306.413 | 3.517062 | -6.0621086 | -3.35911379 |
| 88 | 3120.266 | 3.489791 | -6.0136496 | -3.27331191 |
| 89 | 3642.05 | 3.560569 | -2.2843662 | -1.72087935 |
| 90 | 2958.851 | 3.462967 | -1.7569659 | -0.68143797 |
| 91 | 3595.633 | 3.553601 | -3.141524 | -2.2849068 |
| 92 | 3238.428 | 3.503301 | -2.7315601 | -2.02199668 |
| 93 | 3493.716 | 3.54484 | -6.1442286 | -2.02810226 |
| 94 | 3296.254 | 3.507902 | -5.8478766 | -3.46992823 |
| 95 | 2510.324 | 3.385466 | -4.6793491 | -4.12671142 |
| 96 | 3737.508 | 3.574467 | -4.485352 | -2.28600988 |
| 97 | 2348.302 | 3.368045 | -4.2435487 | -0.6871463 |
| 98 | 2247.672 | 3.347795 | -4.209691 | -1.06685746 |
| 99 | 2208.031 | 3.338184 | -3.5463299 | -1.14247906 |
| 100 | 2386.941 | 3.37652 | -4.3575168 | -0.61237291 |
| 101 | 2401.797 | 3.375922 | -3.3513742 | -0.74175665 |
| 102 | 2388.103 | 3.373038 | -3.482591 | -0.89012622 |
| 103 | 3742.846 | 3.570468 | -5.4041982 | -2.46085298 |
| 104 | 2415.605 | 3.37995 | -3.5074958 | -1.02149379 |
| 105 | 2391.768 | 3.375053 | -3.4823923 | -0.88424079 |
| 106 | 3352.122 | 3.522179 | -3.8879173 | -0.97929615 |
| 107 | 3586.326 | 3.551013 | -3.8048942 | -0.11210197 |
| 108 | 3457.914 | 3.533114 | -2.8318372 | 0.02270009 |
| 109 | 3277.161 | 3.506035 | -4.7320546 | -2.0802796 |
| 110 | 2436.765 | 3.381216 | -3.8329973 | -1.04236366 |
| 111 | 2493.624 | 3.3905 | -4.4877053 | -1.52096654 |
| 112 | 3828.885 | 3.588346 | -1.5403442 | -0.18316431 |
| 113 | 3492.752 | 3.537487 | -2.5435774 | -0.38766378 |
| 114 | 2683.887 | 3.420767 | -2.1935385 | -0.7194803 |
| 115 | 3833.002 | 3.588408 | -4.7641764 | -0.2186498 |
| 116 | 2901.24 | 3.454962 | -4.8240871 | -1.54565103 |
| 117 | 3809.436 | 3.582576 | -3.7424771 | -2.8934991 |
| 118 | 3619.904 | 3.556217 | -1.489157 | -1.34254002 |
| 119 | 2993.181 | 3.465509 | -4.8046297 | -2.0934301 |
| 120 | 2691.969 | 3.417306 | -3.7144604 | -1.10438373 |
| 121 | 2815.467 | 3.437174 | -3.086988 | -0.77112338 |
| 122 | 2229.387 | 3.346192 | -4.7253905 | -1.28016197 |
| 123 | 2470.239 | 3.387344 | -2.9958488 | -0.7156165 |
| 124 | 2748.836 | 3.424172 | -2.7092213 | -0.54225971 |
| 125 | 2306.56 | 3.359796 | -3.8068594 | -0.71059587 |
| 126 | 1548.66 | 3.223818 | -2.063527 | -4.23203425 |
| 127 | 3398.251 | 3.521099 | -4.160459 | -0.86097652 |
| 128 | 3583.318 | 3.548749 | -4.5991909 | -1.38498965 |
| 129 | 3301.232 | 3.518154 | -3.0819492 | -0.41899548 |
| 130 | 2484.697 | 3.388716 | -2.7524601 | -0.65763452 |
| 131 | 2277.622 | 3.353192 | -3.827413 | -0.85801217 |
| 132 | 3770.333 | 3.574774 | -1.6568342 | -4.49834608 |
| 133 | 3649.983 | 3.562595 | -3.7496359 | -1.89995319 |
| 134 | 2753.793 | 3.431165 | -3.51997 | -0.56312564 |
| 135 | 2727.341 | 3.424707 | -4.2455216 | -1.20917131 |
| 136 | 2814.941 | 3.439018 | -2.9655371 | -0.62047164 |
| 137 | 3311.741 | 3.512845 | -2.5194161 | -1.7631031 |

Tramo 01 + 03

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | dim=14; coste=1000; epsilon=0.000001 | dim=6; coste=1000; epsilon=0.000001 | dim=14; coste=1000; epsilon=0.000001 | dim=6; coste=1000; epsilon=0.000001 |
|  | Temperatura | Log(T) | Log(g) | Fe/H |
| 1 | 2125.812 | 3.352997 | -2.83362 | -3.0335849 |
| 2 | 2324.364 | 3.318135 | -2.374288 | -3.0787252 |
| 3 | 2325.768 | 3.369636 | -1.367497 | -2.8084853 |
| 4 | 2242.114 | 3.369959 | -1.857855 | -2.8296444 |
| 5 | 2197.595 | 3.318513 | -2.057361 | -2.9648953 |
| 6 | 2316.333 | 3.376852 | -1.641045 | -2.2231251 |
| 7 | 2096.189 | 3.422654 | -2.400731 | -0.6228665 |
| 8 | 2472.049 | 3.380552 | -2.178597 | -2.3993708 |
| 9 | 2298.392 | 3.378774 | -2.145552 | -2.3983934 |
| 10 | 2218.28 | 3.389995 | -2.333187 | -1.6372849 |
| 11 | 2254.725 | 3.382692 | -2.059666 | -1.834512 |
| 12 | 2554.621 | 3.371425 | -2.110381 | -2.5401836 |
| 13 | 2674.083 | 3.367563 | -2.355392 | -2.6428895 |
| 14 | 2951.026 | 3.441303 | -3.536827 | -2.0416725 |
| 15 | 2857.283 | 3.437606 | -3.87061 | -2.7329179 |
| 16 | 2693.941 | 3.380022 | -1.331109 | -1.8030799 |
| 17 | 2513.831 | 3.310083 | -2.374567 | -2.7120514 |
| 18 | 2664.424 | 3.36476 | -2.731394 | -2.3239608 |
| 19 | 3072.363 | 3.499137 | -4.284252 | -2.1117815 |
| 20 | 2962.679 | 3.424103 | -3.253983 | -2.2064595 |
| 21 | 2757.506 | 3.377031 | -2.67388 | -2.5905013 |
| 22 | 3070.586 | 3.434398 | -2.687564 | -2.001176 |
| 23 | 2855.956 | 3.379144 | -3.623312 | -2.6122247 |
| 24 | 2950.736 | 3.430311 | -4.436946 | -3.0222708 |
| 25 | 2860.768 | 3.411907 | -3.905864 | -2.8251497 |
| 26 | 2939.451 | 3.415061 | -3.341124 | -2.217367 |
| 27 | 2681.82 | 3.456268 | -2.861527 | -2.3920166 |
| 28 | 3116.808 | 3.524121 | -4.248467 | -2.1843992 |
| 29 | 2555.92 | 3.352083 | -2.486612 | -2.698087 |
| 30 | 3025.425 | 3.531687 | -4.099443 | -1.4179722 |
| 31 | 3131.134 | 3.475396 | -5.222678 | -3.1949354 |
| 32 | 3088.228 | 3.441484 | -4.602516 | -4.0087661 |
| 33 | 3183.798 | 3.375783 | -4.824081 | -4.595263 |
| 34 | 2506.982 | 3.332998 | -2.339857 | -2.6975132 |
| 35 | 3286.999 | 3.552878 | -5.197606 | -2.689033 |
| 36 | 3159.53 | 3.57726 | -3.676001 | -3.9459107 |
| 37 | 3165.354 | 3.52813 | -3.433474 | -1.660488 |
| 38 | 3231.777 | 3.498503 | -4.462264 | -2.9231269 |
| 39 | 3011.428 | 3.486316 | -4.583588 | -2.9142515 |
| 40 | 3206.759 | 3.476322 | -5.275771 | -3.009504 |
| 41 | 2588.916 | 3.336124 | -2.90583 | -2.7680781 |
| 42 | 3159.636 | 3.463568 | -5.344429 | -3.6424016 |
| 43 | 3132.544 | 3.537116 | -4.724854 | -1.6502374 |
| 44 | 3141.426 | 3.45429 | -5.30107 | -3.9412156 |
| 45 | 3204.472 | 3.499326 | -3.70924 | -1.8165295 |
| 46 | 3066.489 | 3.507858 | -4.279903 | -1.8653796 |
| 47 | 3210.909 | 3.474374 | -4.767956 | -2.77936 |
| 48 | 2893.124 | 3.403808 | -4.010613 | -2.5238585 |
| 49 | 3238.503 | 3.534124 | -4.751105 | -1.5770877 |
| 50 | 3106.079 | 3.477298 | -5.332356 | -3.4668813 |
| 51 | 2947.802 | 3.43751 | -4.626916 | -3.4788835 |
| 52 | 2764.507 | 3.379708 | -2.846741 | -2.1450794 |
| 53 | 3207.11 | 3.52615 | -4.825104 | -2.2043232 |
| 54 | 3057.409 | 3.399313 | -5.160355 | -3.9816586 |
| 55 | 3237.573 | 3.499767 | -4.934214 | -2.3944518 |
| 56 | 2869.406 | 3.3862 | -3.232682 | -2.1979549 |
| 57 | 3099.466 | 3.488909 | -4.350213 | -2.1938379 |
| 58 | 2533.932 | 3.325986 | -2.18796 | -2.7281796 |
| 59 | 2457.328 | 3.332503 | -2.32169 | -2.5889923 |
| 60 | 2434.975 | 3.327282 | -2.424094 | -3.0657329 |
| 61 | 3329.774 | 3.562947 | -5.506659 | -2.5984945 |
| 62 | 3246.294 | 3.519894 | -5.0671 | -3.1495014 |
| 63 | 3190.324 | 3.503999 | -4.8484 | -2.6592835 |
| 64 | 3251.589 | 3.527391 | -4.464367 | -2.3571651 |
| 65 | 3025.998 | 3.491433 | -3.750258 | -1.8313076 |
| 66 | 3043.531 | 3.532435 | -4.113864 | -2.4364206 |
| 67 | 2922.147 | 3.493031 | -3.476464 | -2.224559 |
| 68 | 2837.242 | 3.441987 | -3.904102 | -3.247482 |
| 69 | 2992.735 | 3.452562 | -4.963196 | -3.0010145 |
| 70 | 3025.07 | 3.449731 | -5.133158 | -3.7358878 |
| 71 | 3078.848 | 3.555923 | -4.113011 | -1.6205417 |
| 72 | 3045.035 | 3.515669 | -4.629182 | -2.313433 |
| 73 | 3020.971 | 3.575352 | -3.973122 | -1.6812543 |
| 74 | 2945.688 | 3.50849 | -4.266397 | -3.0118703 |
| 75 | 3247.822 | 3.518792 | -4.981071 | -2.6616569 |
| 76 | 3055.729 | 3.450532 | -4.839114 | -3.6281805 |
| 77 | 2452.537 | 3.333152 | -2.286065 | -2.4900698 |
| 78 | 2392.356 | 3.321141 | -2.370519 | -2.8718175 |
| 79 | 3048.931 | 3.467392 | -3.985172 | -2.2011577 |
| 80 | 3274.158 | 3.61397 | -5.367964 | -2.0113085 |
| 81 | 2982.318 | 3.5371 | -5.495149 | -3.0607877 |
| 82 | 2940.743 | 3.518969 | -3.32285 | -2.2452515 |
| 83 | 3268.608 | 3.614931 | -4.964952 | -1.7431372 |
| 84 | 3040.712 | 3.449497 | -3.691105 | -2.0650047 |
| 85 | 3099.422 | 3.459022 | -3.750055 | -1.4810906 |
| 86 | 3251.904 | 3.566132 | -5.138723 | -2.0302257 |
| 87 | 3374.665 | 3.602237 | -5.795046 | -1.9290766 |
| 88 | 3208.944 | 3.536664 | -5.005621 | -3.0363396 |
| 89 | 2960.792 | 3.459831 | -4.448604 | -3.1288385 |
| 90 | 2562.349 | 3.342711 | -2.775668 | -3.2655206 |
| 91 | 3003.844 | 3.469408 | -4.908363 | -2.8175525 |
| 92 | 2784.675 | 3.428178 | -4.285002 | -3.4677822 |
| 93 | 3314.097 | 3.483431 | -5.174072 | -2.8196558 |
| 94 | 3172.849 | 3.534128 | -4.937741 | -2.5381385 |
| 95 | 2976.041 | 3.549077 | -3.988555 | -2.446781 |
| 96 | 3005.135 | 3.432266 | -4.888746 | -3.7684895 |
| 97 | 2504.171 | 3.328738 | -2.421405 | -2.3788607 |
| 98 | 2348.658 | 3.324707 | -2.314464 | -2.4963401 |
| 99 | 2279.8 | 3.313085 | -2.331658 | -2.2785492 |
| 100 | 2612.82 | 3.320109 | -2.509436 | -2.6729606 |
| 101 | 2479.681 | 3.334192 | -2.14834 | -2.742384 |
| 102 | 2405.848 | 3.328666 | -2.21948 | -2.6523878 |
| 103 | 3292.064 | 3.53435 | -4.140389 | -2.0990319 |
| 104 | 2386.866 | 3.324644 | -2.695161 | -3.0784928 |
| 105 | 2284.556 | 3.344885 | -1.75281 | -2.5192037 |
| 106 | 2970.269 | 3.388655 | -4.701205 | -3.7746319 |
| 107 | 3244.747 | 3.486442 | -3.768308 | -2.219561 |
| 108 | 3022.263 | 3.437309 | -3.320089 | -2.5673757 |
| 109 | 3224.632 | 3.498425 | -4.272947 | -2.3365513 |
| 110 | 2451.367 | 3.31769 | -2.721379 | -3.0402999 |
| 111 | 2889.393 | 3.368339 | -3.358308 | -2.6683834 |
| 112 | 2782.249 | 3.433481 | -4.236255 | -4.1295254 |
| 113 | 2781.565 | 3.448797 | -3.768213 | -2.8417896 |
| 114 | 2611.389 | 3.350985 | -2.06292 | -2.6764599 |
| 115 | 2939.432 | 3.505975 | -3.876438 | -2.5942045 |
| 116 | 3012.985 | 3.437337 | -3.864072 | -2.0143495 |
| 117 | 2950.441 | 3.488009 | -5.172473 | -5.4678146 |
| 118 | 2872.861 | 3.43821 | -4.145235 | -3.5194263 |
| 119 | 3047.674 | 3.517785 | -3.963311 | -2.1848382 |
| 120 | 2792.031 | 3.38479 | -3.008572 | -2.4986198 |
| 121 | 2808.539 | 3.384962 | -2.904747 | -2.4623176 |
| 122 | 2659.375 | 3.356908 | -2.599451 | -2.1743488 |
| 123 | 2451.881 | 3.333977 | -2.051621 | -2.652114 |
| 124 | 2337.514 | 3.425685 | -1.46624 | -3.1180195 |
| 125 | 2388.146 | 3.331924 | -2.263029 | -2.3738059 |
| 126 | 2963.569 | 3.330074 | -3.952236 | -5.6000763 |
| 127 | 3121.855 | 3.518129 | -3.43634 | -1.3394484 |
| 128 | 3152.769 | 3.524164 | -3.748631 | -1.493523 |
| 129 | 2967.977 | 3.3755 | -3.284994 | -3.7228602 |
| 130 | 2412.25 | 3.330467 | -1.909763 | -2.784468 |
| 131 | 2353.143 | 3.32933 | -2.305661 | -2.2836492 |
| 132 | 2616.194 | 3.501755 | -4.16022 | -2.0567965 |
| 133 | 2998.316 | 3.407326 | -5.097181 | -3.569996 |
| 134 | 2611.713 | 3.345018 | -2.993864 | -2.5712434 |
| 135 | 2928.547 | 3.413907 | -3.463492 | -2.3168962 |
| 136 | 2780.835 | 3.380404 | -2.684755 | -2.3648993 |
| 137 | 2884.904 | 3.431567 | -4.029481 | -3.4370108 |

Tramo 02 + 03

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | dim=6; coste=1000; epsilon=0.000001 | dim=10; coste=1000; epsilon=0.000001 | dim=10; coste=1000; epsilon=0.00001 | dim=6; coste=1000; epsilon=0.00001 |
|  | Temperatura | Log(T) | Log(g) | Fe/H |
| 1 | 3391.165 | 3.443159 | -1.6275128 | -1.2917041 |
| 2 | 2927.317 | 3.440179 | -3.9344907 | -0.24146669 |
| 3 | 3134.562 | 3.441115 | -2.0791615 | -0.6031367 |
| 4 | 3303.918 | 3.430753 | -2.6733206 | -0.61613616 |
| 5 | 3001.918 | 3.363266 | -2.7621798 | -0.21451808 |
| 6 | 2766.149 | 3.438118 | -3.2833061 | -0.27205666 |
| 7 | 2254.499 | 3.352049 | -3.5580921 | 0.21027846 |
| 8 | 2832.778 | 3.440996 | -3.0725632 | -0.27000697 |
| 9 | 2722.956 | 3.427301 | -3.2781291 | -0.49991888 |
| 10 | 2309.55 | 3.395328 | -3.6573406 | -0.72413039 |
| 11 | 2477.668 | 3.416734 | -3.3850679 | -0.66912043 |
| 12 | 2980.118 | 3.461365 | -3.3094586 | -0.36765765 |
| 13 | 3012.127 | 3.464665 | -3.1066845 | -0.30150892 |
| 14 | 2950.328 | 3.45606 | -3.4850952 | -0.8148767 |
| 15 | 2789.582 | 3.450952 | -2.81582 | -1.65694344 |
| 16 | 2894.851 | 3.377636 | -3.1588305 | 0.08296468 |
| 17 | 2924.948 | 3.432611 | -4.0037486 | -0.18544378 |
| 18 | 2943.079 | 3.431299 | -3.9255688 | -0.26215114 |
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| 20 | 2846.371 | 3.444855 | -3.4614004 | -1.03988674 |
| 21 | 2974.979 | 3.443419 | -3.6418925 | -0.53121138 |
| 22 | 2931.576 | 3.45619 | -3.5499048 | -1.06471675 |
| 23 | 2860.219 | 3.429717 | -3.5733068 | -0.90989577 |
| 24 | 2702.976 | 3.441635 | -2.6017064 | -1.82749518 |
| 25 | 2868.531 | 3.450822 | -2.881801 | -1.42510309 |
| 26 | 2892.036 | 3.44523 | -3.5968636 | -0.78098516 |
| 27 | 2960.896 | 3.448499 | -3.3768083 | -0.58168868 |
| 28 | 2615.115 | 3.465649 | -2.6455059 | -2.28601209 |
| 29 | 2970.346 | 3.435666 | -3.7623234 | -0.37231533 |
| 30 | 3056.786 | 3.494855 | -3.5564396 | -0.90113441 |
| 31 | 2670.391 | 3.521821 | -2.1744417 | -2.87088605 |
| 32 | 3114.707 | 3.498271 | -1.2215293 | -1.34329067 |
| 33 | 3086.444 | 3.489614 | -1.0540253 | -1.44168271 |
| 34 | 2872.457 | 3.415746 | -3.8687212 | -0.2963344 |
| 35 | 2607.136 | 3.513669 | -3.1176252 | -2.88077401 |
| 36 | 3109.936 | 3.557949 | -4.0482926 | -2.83363462 |
| 37 | 2765.253 | 3.499822 | -3.785801 | -2.31296397 |
| 38 | 2753.687 | 3.481531 | -2.7149685 | -2.04423863 |
| 39 | 2659.276 | 3.485933 | -2.6468541 | -2.43109894 |
| 40 | 2609.838 | 3.494516 | -2.2318587 | -2.71671035 |
| 41 | 2875.025 | 3.416241 | -3.9120023 | -0.3650912 |
| 42 | 2708.625 | 3.500992 | -1.8752335 | -2.91420361 |
| 43 | 2807.12 | 3.496043 | -3.2609013 | -1.84079403 |
| 44 | 2606.526 | 3.492153 | -2.2388996 | -2.66437745 |
| 45 | 2833.204 | 3.480956 | -3.1864169 | -1.83980743 |
| 46 | 2829.45 | 3.465288 | -3.1190649 | -1.46135481 |
| 47 | 2846.397 | 3.50316 | -2.7934571 | -1.95133694 |
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| 49 | 3066.164 | 3.573803 | -3.7818836 | -2.54603515 |
| 50 | 2581.841 | 3.51813 | -2.3272916 | -2.99767141 |
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| 53 | 2647.43 | 3.496312 | -3.1625836 | -2.26933477 |
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| 57 | 2821.215 | 3.456896 | -3.2206332 | -1.46258003 |
| 58 | 2902.813 | 3.405037 | -3.7410428 | -0.23168942 |
| 59 | 2862.372 | 3.407254 | -4.0307226 | -0.10096088 |
| 60 | 2893.428 | 3.413834 | -3.8565267 | -0.18906026 |
| 61 | 2568.69 | 3.512353 | -3.23274 | -3.24787004 |
| 62 | 2479.628 | 3.469757 | -2.7179287 | -3.0192462 |
| 63 | 2521.587 | 3.446787 | -2.7537244 | -2.53696845 |
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| 65 | 2750.042 | 3.462231 | -3.3188495 | -1.63233909 |
| 66 | 2653.156 | 3.465974 | -2.8815118 | -2.23153941 |
| 67 | 2809.848 | 3.455513 | -2.9592168 | -1.75816951 |
| 68 | 2746.173 | 3.473695 | -2.6165573 | -2.19187393 |
| 69 | 2659.474 | 3.512303 | -2.7006524 | -2.43579122 |
| 70 | 2611.563 | 3.514147 | -2.4760552 | -2.87406735 |
| 71 | 3277.69 | 3.584268 | -3.2794148 | -3.53912197 |
| 72 | 3423.605 | 3.550775 | -2.3029788 | -3.16401892 |
| 73 | 2895.197 | 3.545069 | -3.6568256 | -3.47890655 |
| 74 | 3027.723 | 3.546136 | -1.9755405 | -3.33562003 |
| 75 | 2572.13 | 3.50014 | -3.2938869 | -2.74855541 |
| 76 | 2657.955 | 3.504138 | -2.5626053 | -2.33567054 |
| 77 | 2806.875 | 3.400537 | -3.9289625 | -0.08926211 |
| 78 | 2815.663 | 3.399451 | -3.8891262 | -0.20820069 |
| 79 | 2737.86 | 3.448794 | -3.2809268 | -1.55722678 |
| 80 | 3303.059 | 3.596157 | -1.9469389 | -3.0402114 |
| 81 | 3519.827 | 3.529644 | -0.5669523 | -2.72089211 |
| 82 | 2866.473 | 3.469124 | -2.607584 | -2.36522817 |
| 83 | 2752.89 | 3.508275 | -3.028732 | -2.9267817 |
| 84 | 2777.409 | 3.432004 | -3.1665408 | -1.25507709 |
| 85 | 2746.824 | 3.457885 | -3.2870367 | -1.69957779 |
| 86 | 2553.033 | 3.507946 | -3.4919094 | -3.2186066 |
| 87 | 2986.154 | 3.540933 | -3.5962449 | -3.30508756 |
| 88 | 2537.992 | 3.517118 | -3.3119527 | -3.24615448 |
| 89 | 2673.876 | 3.486169 | -2.4839019 | -2.29821925 |
| 90 | 2985.784 | 3.440981 | -3.393032 | -0.54253572 |
| 91 | 2560.134 | 3.50226 | -2.2367425 | -2.82426457 |
| 92 | 2697.301 | 3.45826 | -2.257666 | -1.9548199 |
| 93 | 2531.045 | 3.471098 | -2.9066128 | -2.66693452 |
| 94 | 3025.032 | 3.565911 | -3.1672443 | -3.52916851 |
| 95 | 2670.475 | 3.505256 | -2.6042247 | -2.96067707 |
| 96 | 2669.654 | 3.510442 | -2.4438557 | -2.61375891 |
| 97 | 2779.092 | 3.400739 | -4.0204724 | -0.14964683 |
| 98 | 2797.475 | 3.396908 | -4.0413666 | -0.10109715 |
| 99 | 2844.111 | 3.397764 | -3.7153259 | -0.14128509 |
| 100 | 2785.771 | 3.399936 | -3.91936 | -0.19064892 |
| 101 | 2847.128 | 3.406322 | -3.7081403 | -0.22603193 |
| 102 | 2870.121 | 3.404931 | -3.6887797 | -0.10067999 |
| 103 | 2894.97 | 3.534021 | -3.5593967 | -2.24614154 |
| 104 | 2913.843 | 3.415077 | -3.8224973 | -0.0609219 |
| 105 | 2871.274 | 3.385651 | -3.3238364 | -0.02067608 |
| 106 | 2580.161 | 3.460607 | -3.1702636 | -2.1836274 |
| 107 | 2820.666 | 3.467343 | -3.5002199 | -1.68318654 |
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| 110 | 2867.181 | 3.399084 | -3.7801747 | -0.26869706 |
| 111 | 2970.444 | 3.444011 | -4.0857636 | -0.38049676 |
| 112 | 2903.621 | 3.471851 | -2.1874234 | -2.22985537 |
| 113 | 2797.44 | 3.445641 | -2.6336689 | -1.76073356 |
| 114 | 2987.152 | 3.434033 | -3.6198221 | -0.25974469 |
| 115 | 3152.687 | 3.484485 | -3.0989477 | -0.44980507 |
| 116 | 2953.73 | 3.454919 | -3.6389411 | -0.74554327 |
| 117 | 2947.399 | 3.547554 | -3.0154247 | -3.70224177 |
| 118 | 2820.311 | 3.474568 | -1.9402395 | -2.72218474 |
| 119 | 2702.961 | 3.443917 | -2.7823139 | -1.88786418 |
| 120 | 2900.95 | 3.433264 | -3.7172821 | -0.65903239 |
| 121 | 2962.34 | 3.442747 | -3.7280214 | -0.53126459 |
| 122 | 2884.001 | 3.407578 | -4.0516883 | -0.02408689 |
| 123 | 2880.532 | 3.411074 | -3.660888 | -0.13147304 |
| 124 | 2571.662 | 3.348822 | -1.8812868 | -0.69878853 |
| 125 | 2803.923 | 3.396204 | -3.6396916 | -0.05231929 |
| 126 | 2972.517 | 3.45391 | -2.6030775 | -0.879796 |
| 127 | 2871.962 | 3.485613 | -3.6891896 | -1.77782274 |
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| 129 | 3186.891 | 3.507399 | -3.2009423 | -0.46268465 |
| 130 | 2866.029 | 3.404188 | -3.4543905 | -0.16572404 |
| 131 | 2798.922 | 3.393738 | -3.6751662 | -0.10097265 |
| 132 | 3280.333 | 3.584778 | 1.1342866 | -3.35418914 |
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| 134 | 2910.611 | 3.422521 | -3.9867016 | -0.37030863 |
| 135 | 2839.223 | 3.432899 | -3.5702488 | -0.90599966 |
| 136 | 2969.678 | 3.444413 | -3.7905197 | -0.39897403 |
| 137 | 2750.186 | 3.464626 | -2.2688356 | -1.97804138 |

Tramo 01+02+03

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | dim=6; coste=1000; epsilon=0.000001 | dim=14; coste=1000; epsilon=0.000001 | dim=6; coste=1000; epsilon=0.00001 | dim=6; coste=100; epsilon=0.000001 |
|  | Temperatura | Log(T) | Log(g) | Fe/H |
| 1 | 3100.439 | 3.459787 | -1.1294365 | -0.932475551 |
| 2 | 2799.454 | 3.371993 | -3.8663126 | -0.721803578 |
| 3 | 2990.782 | 3.422803 | -0.3099426 | -0.996243344 |
| 4 | 3066.928 | 3.414042 | -1.2192297 | -1.104687022 |
| 5 | 2850.776 | 3.361492 | -3.2068283 | -0.919409515 |
| 6 | 2398.726 | 3.349607 | -2.6326609 | -0.450821043 |
| 7 | 2012.462 | 3.291472 | -2.1593055 | 0.280988437 |
| 8 | 2697.544 | 3.37532 | -3.836044 | 0.067091917 |
| 9 | 2559.18 | 3.385319 | -3.5140556 | -0.263314743 |
| 10 | 2432.632 | 3.346237 | -2.3261065 | -0.103168099 |
| 11 | 2513.174 | 3.365412 | -2.1881518 | -0.295303874 |
| 12 | 2784.212 | 3.397763 | -2.8539902 | -0.627602877 |
| 13 | 2918.262 | 3.42138 | -3.4764451 | -0.310765697 |
| 14 | 3397.475 | 3.419401 | -3.6167014 | -0.168672092 |
| 15 | 3436.336 | 3.432055 | -2.4103324 | -0.638622075 |
| 16 | 2340.938 | 3.340714 | -4.8400661 | -1.115091433 |
| 17 | 2690.158 | 3.416508 | -4.6693435 | -0.594119285 |
| 18 | 2864.037 | 3.36703 | -4.282774 | -0.482691955 |
| 19 | 3564.25 | 3.455572 | -4.115324 | -0.085750885 |
| 20 | 3357.77 | 3.428275 | -3.111738 | -0.1448312 |
| 21 | 3040.324 | 3.390286 | -3.0983984 | -0.569492274 |
| 22 | 3420.573 | 3.451923 | -2.9142383 | -0.334841737 |
| 23 | 3274.473 | 3.426084 | -3.913553 | -0.149933052 |
| 24 | 3594.658 | 3.451726 | -3.4810928 | -0.220142121 |
| 25 | 3518.88 | 3.453164 | -2.8346365 | -0.254949956 |
| 26 | 3229.134 | 3.409351 | -3.5354328 | -0.177581063 |
| 27 | 3340.263 | 3.381355 | -3.4033768 | -0.099021991 |
| 28 | 3749.871 | 3.461809 | -3.416018 | -0.382609684 |
| 29 | 2923.817 | 3.365959 | -3.8363011 | -0.607463736 |
| 30 | 3878.032 | 3.455467 | -4.9437769 | -0.252571326 |
| 31 | 3900.487 | 3.492625 | -4.1797777 | -0.825613079 |
| 32 | 2246.513 | 3.414251 | -3.5623306 | -4.809140901 |
| 33 | 2241.682 | 3.415872 | -3.2545953 | -4.641941721 |
| 34 | 2633.725 | 3.349621 | -4.5859573 | -0.708529718 |
| 35 | 4107.348 | 3.505731 | -5.063872 | -0.348514031 |
| 36 | 4256.405 | 3.520251 | -2.2607633 | -1.346537289 |
| 37 | 3731.366 | 3.501357 | -2.7246365 | -0.649139993 |
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| 40 | 3939.636 | 3.490358 | -4.2899552 | -0.322458149 |
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| 45 | 3778.92 | 3.493699 | -2.9496777 | -0.035347436 |
| 46 | 3639.018 | 3.453061 | -4.3672813 | -0.291242523 |
| 47 | 3914.929 | 3.503126 | -3.3815645 | 0.199978602 |
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| 49 | 4170.636 | 3.528151 | -4.0114192 | -0.132523546 |
| 50 | 3948.293 | 3.490972 | -4.6499446 | -0.706911244 |
| 51 | 3761.601 | 3.463289 | -3.6824199 | -0.266547821 |
| 52 | 2992.301 | 3.383782 | -3.8254834 | -0.512515286 |
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| 59 | 2617.954 | 3.338601 | -5.3111656 | -0.805675909 |
| 60 | 2682.929 | 3.348936 | -4.6245332 | -0.804455751 |
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| 67 | 3408.927 | 3.434775 | -2.3289429 | -1.361755679 |
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| 69 | 3844.671 | 3.472797 | -4.4470916 | -0.482370575 |
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| 77 | 2542.72 | 3.338894 | -5.406502 | -0.697524737 |
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| 79 | 3526.06 | 3.453019 | -3.377415 | -0.051648983 |
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| 84 | 3310.464 | 3.420317 | -3.4856838 | -0.289347279 |
| 85 | 3626.576 | 3.467539 | -2.6368188 | -0.267723244 |
| 86 | 4009.278 | 3.488584 | -4.747444 | -0.614299215 |
| 87 | 4104.317 | 3.502 | -6.4004049 | -1.394259995 |
| 88 | 3935.66 | 3.488839 | -4.6238626 | -0.751132547 |
| 89 | 3699.173 | 3.465299 | -2.5242289 | -0.690571549 |
| 90 | 2984.077 | 3.380033 | -3.1755394 | -0.767854977 |
| 91 | 3713.944 | 3.459147 | -3.4723175 | -0.910434744 |
| 92 | 3415.589 | 3.430546 | -3.0159439 | -0.932240965 |
| 93 | 3903.813 | 3.500845 | -4.8774727 | -0.013597628 |
| 94 | 4072.355 | 3.504295 | -4.5685514 | -1.441373657 |
| 95 | 3493.073 | 3.465906 | -3.5679706 | -2.659258074 |
| 96 | 3889.577 | 3.492382 | -4.233507 | -0.516415873 |
| 97 | 2552.322 | 3.344541 | -5.2204816 | -0.532051366 |
| 98 | 2511.405 | 3.330897 | -5.3250483 | -0.793116549 |
| 99 | 2465.402 | 3.334441 | -4.8229794 | -0.911851571 |
| 100 | 2573.907 | 3.353207 | -5.5407358 | -0.546935389 |
| 101 | 2587.146 | 3.344982 | -4.7428565 | -0.708446124 |
| 102 | 2597.386 | 3.339895 | -4.8552562 | -0.775862653 |
| 103 | 4124.717 | 3.521525 | -3.1155728 | -0.230422674 |
| 104 | 2633.569 | 3.341243 | -4.7834052 | -0.8897153 |
| 105 | 2624.07 | 3.339321 | -4.4093146 | -0.73856169 |
| 106 | 3444.827 | 3.460005 | -3.852875 | -0.356080079 |
| 107 | 3740.273 | 3.498477 | -2.9356586 | 0.085622088 |
| 108 | 3519.935 | 3.448546 | -2.9252694 | -0.246347467 |
| 109 | 3806.84 | 3.509279 | -3.1362084 | -0.826124993 |
| 110 | 2639.955 | 3.351979 | -4.8268534 | -0.870372482 |
| 111 | 3009.197 | 3.399514 | -4.5164412 | -0.51473664 |
| 112 | 3722.297 | 3.485576 | -2.0533665 | -0.468992591 |
| 113 | 3535.939 | 3.457337 | -2.5789266 | -0.528560013 |
| 114 | 2788.959 | 3.365569 | -3.4802988 | -0.744461332 |
| 115 | 3924.739 | 3.472849 | -4.4957364 | 0.711582356 |
| 116 | 3411.905 | 3.433417 | -4.1316326 | 0.015850815 |
| 117 | 3891.596 | 3.477863 | -3.2173459 | -1.72493631 |
| 118 | 3546.123 | 3.483755 | -1.7239974 | -1.365738556 |
| 119 | 3639.306 | 3.446749 | -3.2975251 | -0.375609306 |
| 120 | 3027.56 | 3.375295 | -3.8867184 | -0.559491614 |
| 121 | 3051.358 | 3.383779 | -3.4612521 | -0.457601543 |
| 122 | 2666.99 | 3.351372 | -5.4861261 | -0.73816985 |
| 123 | 2630.349 | 3.346038 | -4.5959083 | -0.704924961 |
| 124 | 2634.817 | 3.349775 | -4.3871455 | -0.875112717 |
| 125 | 2536.794 | 3.336478 | -5.0619086 | -0.570055908 |
| 126 | 1613.553 | 3.373344 | -1.8294536 | -4.953108391 |
| 127 | 3780.052 | 3.495116 | -2.8625011 | -0.317555485 |
| 128 | 3949.713 | 3.516096 | -2.9192495 | -0.346643064 |
| 129 | 3291.984 | 3.464212 | -3.3740149 | -0.3037703 |
| 130 | 2617.103 | 3.340548 | -4.4271023 | -0.657856644 |
| 131 | 2515.257 | 3.333075 | -5.2124487 | -0.687391641 |
| 132 | 4197.235 | 3.480333 | -3.7793392 | -3.156235378 |
| 133 | 3712.829 | 3.484127 | -3.5877475 | -0.235632973 |
| 134 | 2915.749 | 3.364222 | -4.6974625 | -0.529088941 |
| 135 | 3147.28 | 3.403924 | -3.8532529 | -0.304306939 |
| 136 | 3022.815 | 3.387836 | -3.4854423 | -0.398133144 |
| 137 | 3453.019 | 3.450145 | -2.4536711 | -0.847177904 |

Comparación de la predicción T

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | tramo 01 | tramo 02 | tramo 03 | tramo 01+02 | tramo 01+03 | tramo02+03 | tramo 01+02+03 |
| 1 | 2206.255 | 3589.941 | 2424.631 | 3060.195 | 2125.812 | 3391.165 | 3100.439 |
| 2 | 2248.96 | 2433.252 | 2428.714 | 2749.652 | 2324.364 | 2927.317 | 2799.454 |
| 3 | 2384.69 | 3189.305 | 2456.79 | 2990.344 | 2325.768 | 3134.562 | 2990.782 |
| 4 | 2143.104 | 2593.235 | 2516.51 | 3095.831 | 2242.114 | 3303.918 | 3066.928 |
| 5 | 1913.735 | 2326.049 | 2471.168 | 2835.235 | 2197.595 | 3001.918 | 2850.776 |
| 6 | 2395.398 | 2606.616 | 2292.422 | 2392.949 | 2316.333 | 2766.149 | 2398.726 |
| 7 | 2554.048 | 2171.377 | 2243.297 | 1873.028 | 2096.189 | 2254.499 | 2012.462 |
| 8 | 2711.185 | 2592.669 | 2339.47 | 2685.414 | 2472.049 | 2832.778 | 2697.544 |
| 9 | 2528.475 | 2457.765 | 2280.031 | 2552.901 | 2298.392 | 2722.956 | 2559.18 |
| 10 | 2516.334 | 2329.566 | 2204.086 | 2452.083 | 2218.28 | 2309.55 | 2432.632 |
| 11 | 2464.306 | 2484.709 | 2210.516 | 2542.901 | 2254.725 | 2477.668 | 2513.174 |
| 12 | 2689.776 | 2727.598 | 2314.164 | 2779.122 | 2554.621 | 2980.118 | 2784.212 |
| 13 | 2817.638 | 2723.458 | 2351.411 | 2888.012 | 2674.083 | 3012.127 | 2918.262 |
| 14 | 2443.448 | 2476.736 | 2320.005 | 2959.146 | 2951.026 | 2950.328 | 3397.475 |
| 15 | 2643.473 | 2673.789 | 2192.886 | 3430.635 | 2857.283 | 2789.582 | 3436.336 |
| 16 | 2737.502 | 2336.723 | 2685.304 | 1859.299 | 2693.941 | 2894.851 | 2340.938 |
| 17 | 2440.374 | 2202.357 | 2307.959 | 2630.748 | 2513.831 | 2924.948 | 2690.158 |
| 18 | 2672.538 | 2377.019 | 2263.691 | 2622.44 | 2664.424 | 2943.079 | 2864.037 |
| 19 | 2448.012 | 2594.322 | 2203.435 | 3017.111 | 3072.363 | 2614.035 | 3564.25 |
| 20 | 2690.303 | 2560.873 | 2244.224 | 3225.976 | 2962.679 | 2846.371 | 3357.77 |
| 21 | 2572.103 | 2491.454 | 2266.122 | 2863.163 | 2757.506 | 2974.979 | 3040.324 |
| 22 | 3006.011 | 2770.047 | 2480.766 | 3236.352 | 3070.586 | 2931.576 | 3420.573 |
| 23 | 2821.027 | 2482.907 | 2218.815 | 3188.486 | 2855.956 | 2860.219 | 3274.473 |
| 24 | 2786.649 | 2486.59 | 2213.224 | 3546.421 | 2950.736 | 2702.976 | 3594.658 |
| 25 | 2759.798 | 2519.898 | 2157.982 | 3566.027 | 2860.768 | 2868.531 | 3518.88 |
| 26 | 2666.773 | 2499.825 | 2266.558 | 2918.234 | 2939.451 | 2892.036 | 3229.134 |
| 27 | 2788.232 | 2555.26 | 2216.942 | 3112.854 | 2681.82 | 2960.896 | 3340.263 |
| 28 | 2431.725 | 2584.487 | 2309.157 | 3232.611 | 3116.808 | 2615.115 | 3749.871 |
| 29 | 2296.663 | 2421.463 | 2265.521 | 2756.519 | 2555.92 | 2970.346 | 2923.817 |
| 30 | 2610.593 | 2284.505 | 2472.583 | 2720.922 | 3025.425 | 3056.786 | 3878.032 |
| 31 | 3049.398 | 3320.084 | 2196.759 | 3685.898 | 3131.134 | 2670.391 | 3900.487 |
| 32 | 2699.367 | 2074.817 | 2662.635 | 1967.95 | 3088.228 | 3114.707 | 2246.513 |
| 33 | 2767.265 | 2259.095 | 2772.665 | 1989.017 | 3183.798 | 3086.444 | 2241.682 |
| 34 | 2248.24 | 2340.044 | 2250.598 | 2435.512 | 2506.982 | 2872.457 | 2633.725 |
| 35 | 2797.795 | 3314.604 | 2321.203 | 3365.077 | 3286.999 | 2607.136 | 4107.348 |
| 36 | 3106.317 | 3573.772 | 2904.669 | 3993.498 | 3159.53 | 3109.936 | 4256.405 |
| 37 | 2513.481 | 3177.417 | 2560.026 | 3259.684 | 3165.354 | 2765.253 | 3731.366 |
| 38 | 3048.638 | 3114.749 | 2333.269 | 3738.074 | 3231.777 | 2753.687 | 3884.501 |
| 39 | 2564.234 | 3194.984 | 2193.15 | 3332.324 | 3011.428 | 2659.276 | 3736.387 |
| 40 | 3068.139 | 3239.381 | 2227.324 | 3709.175 | 3206.759 | 2609.838 | 3939.636 |
| 41 | 2663.836 | 2285.68 | 2201.689 | 2664.061 | 2588.916 | 2875.025 | 2803.897 |
| 42 | 3079.095 | 2901.511 | 2237.98 | 3925.415 | 3159.636 | 2708.625 | 4002.508 |
| 43 | 2624.548 | 2580.716 | 2422.875 | 2734.752 | 3132.544 | 2807.12 | 3831.839 |
| 44 | 3083.569 | 3231.511 | 2224.114 | 3587.215 | 3141.426 | 2606.526 | 3877.262 |
| 45 | 2548.77 | 3291.843 | 2442.852 | 3655.566 | 3204.472 | 2833.204 | 3778.92 |
| 46 | 2533.158 | 2304.436 | 2369.921 | 2775.539 | 3066.489 | 2829.45 | 3639.018 |
| 47 | 3081.096 | 3589.84 | 2306.372 | 3909.625 | 3210.909 | 2846.397 | 3914.929 |
| 48 | 2751.771 | 2474.351 | 2201.207 | 3330.207 | 2893.124 | 2817.285 | 3407.067 |
| 49 | 2577.015 | 3949.863 | 3007.913 | 3816.937 | 3238.503 | 3066.164 | 4170.636 |
| 50 | 3135.811 | 3060.624 | 2213.898 | 3751.745 | 3106.079 | 2581.841 | 3948.293 |
| 51 | 2811.803 | 2390.255 | 2223.883 | 3652.138 | 2947.802 | 2726.653 | 3761.601 |
| 52 | 2850.202 | 2386.789 | 2293.661 | 2768.448 | 2764.507 | 2950.94 | 2992.301 |
| 53 | 2634.228 | 2856.561 | 2346.662 | 3390.955 | 3207.11 | 2647.43 | 3975.729 |
| 54 | 2989.308 | 2667.75 | 2189.183 | 3607.755 | 3057.409 | 2609.799 | 3717.516 |
| 55 | 2823.111 | 2547.517 | 2349.703 | 3207.74 | 3237.573 | 2598.451 | 3817.046 |
| 56 | 2712.293 | 2437.687 | 2251.013 | 2747.988 | 2869.406 | 2850.165 | 3080.931 |
| 57 | 2567.636 | 2339.296 | 2321.782 | 2796.156 | 3099.466 | 2821.215 | 3605.374 |
| 58 | 2309.747 | 2298.996 | 2377.155 | 2426.927 | 2533.932 | 2902.813 | 2665.672 |
| 59 | 2325.063 | 2202.766 | 2295.947 | 2334.45 | 2457.328 | 2862.372 | 2617.954 |
| 60 | 2374.074 | 2227.475 | 2251.279 | 2502.496 | 2434.975 | 2893.428 | 2682.929 |
| 61 | 2842.654 | 2957.814 | 2366.035 | 3171.028 | 3329.774 | 2568.69 | 3951.06 |
| 62 | 2609.067 | 2631.02 | 2247.247 | 3135.896 | 3246.294 | 2479.628 | 3880.542 |
| 63 | 2545.349 | 2393.366 | 2303.069 | 3007.678 | 3190.324 | 2521.587 | 3783.207 |
| 64 | 2418.141 | 4022.598 | 2414.682 | 3598.199 | 3251.589 | 3156.028 | 4341.642 |
| 65 | 2478.998 | 2679.04 | 2243.105 | 3343.361 | 3025.998 | 2750.042 | 3610.072 |
| 66 | 2290.911 | 2538.741 | 2287.519 | 2940.35 | 3043.531 | 2653.156 | 3737.624 |
| 67 | 2322.26 | 2567.558 | 2284.772 | 3000.551 | 2922.147 | 2809.848 | 3408.927 |
| 68 | 2458.551 | 2536.897 | 2182.16 | 3448.337 | 2837.242 | 2746.173 | 3452.386 |
| 69 | 2888.814 | 3065.267 | 2157.486 | 3653.722 | 2992.735 | 2659.474 | 3844.671 |
| 70 | 2985.94 | 2920.123 | 2206.381 | 3703.314 | 3025.07 | 2611.563 | 3862.284 |
| 71 | 2569.261 | 3948.292 | 2618.296 | 3312.164 | 3078.848 | 3277.69 | 3847.572 |
| 72 | 2696.23 | 3684.412 | 2242.764 | 3998.458 | 3045.035 | 3423.605 | 4093.581 |
| 73 | 2644.221 | 3470.145 | 2387.38 | 3164.533 | 3020.971 | 2895.197 | 3780.791 |
| 74 | 2816.296 | 3241.507 | 2154.158 | 3812.159 | 2945.688 | 3027.723 | 3797.471 |
| 75 | 2583.166 | 2969.838 | 2388.65 | 3425.068 | 3247.822 | 2572.13 | 4005.475 |
| 76 | 2871.647 | 2674.588 | 2278.571 | 3690.961 | 3055.729 | 2657.955 | 3910.478 |
| 77 | 2288.59 | 2161.4 | 2308.706 | 2274.667 | 2452.537 | 2806.875 | 2542.72 |
| 78 | 2356.439 | 2174.022 | 2245.27 | 2441.035 | 2392.356 | 2815.663 | 2618.061 |
| 79 | 2494.12 | 2659.094 | 2217.366 | 3241.503 | 3048.931 | 2737.86 | 3526.06 |
| 80 | 2905.08 | 3637.814 | 2705.406 | 3217.682 | 3274.158 | 3303.059 | 3937.844 |
| 81 | 3006.244 | 3121.072 | 2565.735 | 4006.258 | 2982.318 | 3519.827 | 4063.481 |
| 82 | 2666.274 | 2827.153 | 2236.404 | 3676.584 | 2940.743 | 2866.473 | 3710.698 |
| 83 | 2879.111 | 3606.437 | 2437.589 | 3472.796 | 3268.608 | 2752.89 | 4359.183 |
| 84 | 2519.072 | 2438.009 | 2234.752 | 2909.032 | 3040.712 | 2777.409 | 3310.464 |
| 85 | 3013.681 | 2704.58 | 2285.662 | 3618.002 | 3099.422 | 2746.824 | 3626.576 |
| 86 | 2683.481 | 2968.813 | 2370.3 | 3193.591 | 3251.904 | 2553.033 | 4009.278 |
| 87 | 2916.115 | 3164.385 | 2615.207 | 3306.413 | 3374.665 | 2986.154 | 4104.317 |
| 88 | 2511.73 | 2780.116 | 2404.209 | 3120.266 | 3208.944 | 2537.992 | 3935.66 |
| 89 | 2726.313 | 2561.984 | 2222.348 | 3642.05 | 2960.792 | 2673.876 | 3699.173 |
| 90 | 2492.275 | 2384.552 | 2235.842 | 2958.851 | 2562.349 | 2985.784 | 2984.077 |
| 91 | 2760.519 | 2797.204 | 2237.842 | 3595.633 | 3003.844 | 2560.134 | 3713.944 |
| 92 | 2568.596 | 2269.654 | 2224.132 | 3238.428 | 2784.675 | 2697.301 | 3415.589 |
| 93 | 3047.635 | 2852.555 | 2326.926 | 3493.716 | 3314.097 | 2531.045 | 3903.813 |
| 94 | 2453.778 | 3317.069 | 2522.492 | 3296.254 | 3172.849 | 3025.032 | 4072.355 |
| 95 | 2385.035 | 2774.927 | 2441.696 | 2510.324 | 2976.041 | 2670.475 | 3493.073 |
| 96 | 2826.262 | 2651.897 | 2244.615 | 3737.508 | 3005.135 | 2669.654 | 3889.577 |
| 97 | 2462.995 | 2204.105 | 2229.853 | 2348.302 | 2504.171 | 2779.092 | 2552.322 |
| 98 | 2137.455 | 2154.757 | 2269.286 | 2247.672 | 2348.658 | 2797.475 | 2511.405 |
| 99 | 1870.993 | 2266.444 | 2283.923 | 2208.031 | 2279.8 | 2844.111 | 2465.402 |
| 100 | 2439.62 | 2218.787 | 2230.895 | 2386.941 | 2612.82 | 2785.771 | 2573.907 |
| 101 | 2345.344 | 2287.612 | 2275.889 | 2401.797 | 2479.681 | 2847.128 | 2587.146 |
| 102 | 2221.126 | 2296.332 | 2305.696 | 2388.103 | 2405.848 | 2870.121 | 2597.386 |
| 103 | 2884.84 | 3698.205 | 2726.699 | 3742.846 | 3292.064 | 2894.97 | 4124.717 |
| 104 | 2354.224 | 2217.611 | 2249.493 | 2415.605 | 2386.866 | 2913.843 | 2633.569 |
| 105 | 2012.778 | 2235.078 | 2367.091 | 2391.768 | 2284.556 | 2871.274 | 2624.07 |
| 106 | 2862.113 | 2651.506 | 2181.276 | 3352.122 | 2970.269 | 2580.161 | 3444.827 |
| 107 | 2897.412 | 3067.051 | 2449.527 | 3586.326 | 3244.747 | 2820.666 | 3740.273 |
| 108 | 2538.51 | 2741.654 | 2262.242 | 3457.914 | 3022.263 | 2834.512 | 3519.935 |
| 109 | 2513.772 | 3302.903 | 2762.923 | 3277.161 | 3224.632 | 2819.111 | 3806.84 |
| 110 | 2248.38 | 2269.602 | 2353.82 | 2436.765 | 2451.367 | 2867.181 | 2639.955 |
| 111 | 2757.097 | 2366.967 | 2385.941 | 2493.624 | 2889.393 | 2970.444 | 3009.197 |
| 112 | 2880.714 | 2500.241 | 2212.306 | 3828.885 | 2782.249 | 2903.621 | 3722.297 |
| 113 | 2775.461 | 2990.27 | 2227.517 | 3492.752 | 2781.565 | 2797.44 | 3535.939 |
| 114 | 2571.476 | 2467.595 | 2292.732 | 2683.887 | 2611.389 | 2987.152 | 2788.959 |
| 115 | 2907.043 | 3092.892 | 2407.256 | 3833.002 | 2939.432 | 3152.687 | 3924.739 |
| 116 | 2747.365 | 2580.642 | 2353.111 | 2901.24 | 3012.985 | 2953.73 | 3411.905 |
| 117 | 3193.035 | 2986.413 | 2313.545 | 3809.436 | 2950.441 | 2947.399 | 3891.596 |
| 118 | 2738.799 | 2548.669 | 2190.967 | 3619.904 | 2872.861 | 2820.311 | 3546.123 |
| 119 | 2349.971 | 2507.089 | 2283.399 | 2993.181 | 3047.674 | 2702.961 | 3639.306 |
| 120 | 2466.753 | 2363.226 | 2252.47 | 2691.969 | 2792.031 | 2900.95 | 3027.56 |
| 121 | 2646.529 | 2458.931 | 2268.518 | 2815.467 | 2808.539 | 2962.34 | 3051.358 |
| 122 | 2672.851 | 2190.064 | 2498.991 | 2229.387 | 2659.375 | 2884.001 | 2666.99 |
| 123 | 2310.51 | 2308.052 | 2286.314 | 2470.239 | 2451.881 | 2880.532 | 2630.349 |
| 124 | 2850.783 | 2373.705 | 2547.457 | 2748.836 | 2337.514 | 2571.662 | 2634.817 |
| 125 | 2171.024 | 2238.117 | 2288.936 | 2306.56 | 2388.146 | 2803.923 | 2536.794 |
| 126 | 2457.759 | 1828.871 | 2519.163 | 1548.66 | 2963.569 | 2972.517 | 1613.553 |
| 127 | 2656.571 | 3225.475 | 2610.695 | 3398.251 | 3121.855 | 2871.962 | 3780.052 |
| 128 | 2565.173 | 3612.33 | 2700.939 | 3583.318 | 3152.769 | 2879.047 | 3949.713 |
| 129 | 2771.447 | 3444.813 | 2360.103 | 3301.232 | 2967.977 | 3186.891 | 3291.984 |
| 130 | 2188.353 | 2334.404 | 2271.128 | 2484.697 | 2412.25 | 2866.029 | 2617.103 |
| 131 | 2165 | 2199.314 | 2292.617 | 2277.622 | 2353.143 | 2798.922 | 2515.257 |
| 132 | 2992.577 | 4199.347 | 2325.796 | 3770.333 | 2616.194 | 3280.333 | 4197.235 |
| 133 | 2904.261 | 2742.498 | 2178.696 | 3649.983 | 2998.316 | 2558.183 | 3712.829 |
| 134 | 2605.815 | 2317.977 | 2240.275 | 2753.793 | 2611.713 | 2910.611 | 2915.749 |
| 135 | 2545.426 | 2443.311 | 2237.782 | 2727.341 | 2928.547 | 2839.223 | 3147.28 |
| 136 | 2794.939 | 2436.887 | 2279.989 | 2814.941 | 2780.835 | 2969.678 | 3022.815 |
| 137 | 2592.532 | 2401.071 | 2264.189 | 3311.741 | 2884.904 | 2750.186 | 3453.019 |

Comparación de la predicción Log(T)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | tramo 01 | tramo 02 | tramo 03 | tramo 01+02 | tramo 01+03 | tramo02+03 | tramo 01+02+03 |
| 1 | 3.340036 | 3.537962 | 3.344994 | 3.483784 | 3.352997 | 3.443159 | 3.459787 |
| 2 | 3.332731 | 3.375233 | 3.387606 | 3.435754 | 3.318135 | 3.440179 | 3.371993 |
| 3 | 3.331395 | 3.477813 | 3.432545 | 3.472309 | 3.369636 | 3.441115 | 3.422803 |
| 4 | 3.378613 | 3.395208 | 3.457876 | 3.492592 | 3.369959 | 3.430753 | 3.414042 |
| 5 | 3.270831 | 3.344433 | 3.427579 | 3.453937 | 3.318513 | 3.363266 | 3.361492 |
| 6 | 3.406398 | 3.390012 | 3.395412 | 3.378493 | 3.376852 | 3.438118 | 3.349607 |
| 7 | 3.427967 | 3.320482 | 3.383529 | 3.280435 | 3.422654 | 3.352049 | 3.291472 |
| 8 | 3.431693 | 3.391764 | 3.418746 | 3.426585 | 3.380552 | 3.440996 | 3.37532 |
| 9 | 3.406064 | 3.373458 | 3.401128 | 3.405161 | 3.378774 | 3.427301 | 3.385319 |
| 10 | 3.410015 | 3.351991 | 3.392012 | 3.385918 | 3.389995 | 3.395328 | 3.346237 |
| 11 | 3.403213 | 3.378037 | 3.394438 | 3.40168 | 3.382692 | 3.416734 | 3.365412 |
| 12 | 3.406474 | 3.426277 | 3.422963 | 3.437055 | 3.371425 | 3.461365 | 3.397763 |
| 13 | 3.423128 | 3.426473 | 3.436619 | 3.456116 | 3.367563 | 3.464665 | 3.42138 |
| 14 | 3.380703 | 3.388113 | 3.388033 | 3.459832 | 3.441303 | 3.45606 | 3.419401 |
| 15 | 3.426794 | 3.417286 | 3.325604 | 3.529427 | 3.437606 | 3.450952 | 3.432055 |
| 16 | 3.374238 | 3.34729 | 3.419883 | 3.274448 | 3.380022 | 3.377636 | 3.340714 |
| 17 | 3.333303 | 3.339808 | 3.371955 | 3.41558 | 3.310083 | 3.432611 | 3.416508 |
| 18 | 3.403783 | 3.369543 | 3.396048 | 3.409552 | 3.36476 | 3.431299 | 3.36703 |
| 19 | 3.36053 | 3.41082 | 3.326247 | 3.470699 | 3.499137 | 3.447571 | 3.455572 |
| 20 | 3.417681 | 3.402422 | 3.376647 | 3.499657 | 3.424103 | 3.444855 | 3.428275 |
| 21 | 3.4141 | 3.386855 | 3.400389 | 3.445035 | 3.377031 | 3.443419 | 3.390286 |
| 22 | 3.468711 | 3.43377 | 3.37494 | 3.499401 | 3.434398 | 3.45619 | 3.451923 |
| 23 | 3.427824 | 3.39155 | 3.364528 | 3.497907 | 3.379144 | 3.429717 | 3.426084 |
| 24 | 3.436404 | 3.384751 | 3.353205 | 3.548643 | 3.430311 | 3.441635 | 3.451726 |
| 25 | 3.435343 | 3.391901 | 3.347112 | 3.552011 | 3.411907 | 3.450822 | 3.453164 |
| 26 | 3.415085 | 3.395689 | 3.380932 | 3.453669 | 3.415061 | 3.44523 | 3.409351 |
| 27 | 3.440192 | 3.394853 | 3.360431 | 3.480483 | 3.456268 | 3.448499 | 3.381355 |
| 28 | 3.370397 | 3.403813 | 3.362377 | 3.500602 | 3.524121 | 3.465649 | 3.461809 |
| 29 | 3.375259 | 3.37394 | 3.402322 | 3.429088 | 3.352083 | 3.435666 | 3.365959 |
| 30 | 3.391457 | 3.354786 | 3.400793 | 3.432405 | 3.531687 | 3.494855 | 3.455467 |
| 31 | 3.490365 | 3.512248 | 3.329881 | 3.565923 | 3.475396 | 3.521821 | 3.492625 |
| 32 | 3.464392 | 3.311951 | 3.473258 | 3.30249 | 3.441484 | 3.498271 | 3.414251 |
| 33 | 3.475574 | 3.342558 | 3.489442 | 3.310753 | 3.375783 | 3.489614 | 3.415872 |
| 34 | 3.343536 | 3.35899 | 3.394345 | 3.382215 | 3.332998 | 3.415746 | 3.349621 |
| 35 | 3.464029 | 3.509679 | 3.337283 | 3.526063 | 3.552878 | 3.513669 | 3.505731 |
| 36 | 3.502728 | 3.548891 | 3.367458 | 3.606193 | 3.57726 | 3.557949 | 3.520251 |
| 37 | 3.333215 | 3.505867 | 3.337184 | 3.501252 | 3.52813 | 3.499822 | 3.501357 |
| 38 | 3.467628 | 3.492954 | 3.343784 | 3.572265 | 3.498503 | 3.481531 | 3.490988 |
| 39 | 3.435988 | 3.495957 | 3.33008 | 3.516092 | 3.486316 | 3.485933 | 3.468405 |
| 40 | 3.477282 | 3.508514 | 3.324284 | 3.570421 | 3.476322 | 3.494516 | 3.490358 |
| 41 | 3.396245 | 3.356641 | 3.372963 | 3.419396 | 3.336124 | 3.416241 | 3.361731 |
| 42 | 3.47956 | 3.448248 | 3.333235 | 3.597098 | 3.463568 | 3.500992 | 3.498556 |
| 43 | 3.424582 | 3.403749 | 3.381932 | 3.435695 | 3.537116 | 3.496043 | 3.468419 |
| 44 | 3.474493 | 3.505581 | 3.31618 | 3.55418 | 3.45429 | 3.492153 | 3.485922 |
| 45 | 3.378561 | 3.525382 | 3.354695 | 3.560348 | 3.499326 | 3.480956 | 3.493699 |
| 46 | 3.401796 | 3.35793 | 3.382118 | 3.438783 | 3.507858 | 3.465288 | 3.453061 |
| 47 | 3.457015 | 3.56092 | 3.312991 | 3.597436 | 3.474374 | 3.50316 | 3.503126 |
| 48 | 3.419915 | 3.387858 | 3.352893 | 3.517465 | 3.403808 | 3.434312 | 3.433076 |
| 49 | 3.398367 | 3.600974 | 3.36486 | 3.581787 | 3.534124 | 3.573803 | 3.528151 |
| 50 | 3.498707 | 3.475396 | 3.327165 | 3.576182 | 3.477298 | 3.51813 | 3.490972 |
| 51 | 3.452139 | 3.369252 | 3.360388 | 3.562709 | 3.43751 | 3.488778 | 3.463289 |
| 52 | 3.425605 | 3.375893 | 3.394536 | 3.430549 | 3.379708 | 3.446341 | 3.383782 |
| 53 | 3.427646 | 3.445798 | 3.366569 | 3.527052 | 3.52615 | 3.496312 | 3.481732 |
| 54 | 3.457151 | 3.415169 | 3.338738 | 3.557781 | 3.399313 | 3.451083 | 3.479177 |
| 55 | 3.436809 | 3.404754 | 3.365786 | 3.504487 | 3.499767 | 3.450235 | 3.481278 |
| 56 | 3.417131 | 3.388958 | 3.373445 | 3.429234 | 3.3862 | 3.429998 | 3.393904 |
| 57 | 3.412433 | 3.365572 | 3.372527 | 3.442543 | 3.488909 | 3.456896 | 3.454953 |
| 58 | 3.348384 | 3.351244 | 3.400883 | 3.37924 | 3.325986 | 3.405037 | 3.349451 |
| 59 | 3.34957 | 3.339566 | 3.388294 | 3.364994 | 3.332503 | 3.407254 | 3.338601 |
| 60 | 3.366193 | 3.342984 | 3.385383 | 3.394136 | 3.327282 | 3.413834 | 3.348936 |
| 61 | 3.504115 | 3.46513 | 3.341427 | 3.501078 | 3.562947 | 3.512353 | 3.498629 |
| 62 | 3.444965 | 3.409184 | 3.332591 | 3.494546 | 3.519894 | 3.469757 | 3.484925 |
| 63 | 3.412678 | 3.374101 | 3.34508 | 3.474775 | 3.503999 | 3.446787 | 3.47164 |
| 64 | 3.364652 | 3.599281 | 3.488945 | 3.548601 | 3.527391 | 3.602152 | 3.492727 |
| 65 | 3.384233 | 3.42234 | 3.36041 | 3.515134 | 3.491433 | 3.462231 | 3.454963 |
| 66 | 3.374342 | 3.395033 | 3.353252 | 3.458515 | 3.532435 | 3.465974 | 3.45952 |
| 67 | 3.36467 | 3.39735 | 3.353659 | 3.460979 | 3.493031 | 3.455513 | 3.434775 |
| 68 | 3.404836 | 3.390073 | 3.330197 | 3.531082 | 3.441987 | 3.473695 | 3.452421 |
| 69 | 3.476326 | 3.473256 | 3.329542 | 3.562825 | 3.452562 | 3.512303 | 3.472797 |
| 70 | 3.483838 | 3.451448 | 3.330654 | 3.56868 | 3.449731 | 3.514147 | 3.483498 |
| 71 | 3.360379 | 3.591462 | 3.381172 | 3.50252 | 3.555923 | 3.584268 | 3.51873 |
| 72 | 3.424456 | 3.555899 | 3.305083 | 3.608377 | 3.515669 | 3.550775 | 3.524859 |
| 73 | 3.376866 | 3.533947 | 3.316057 | 3.479836 | 3.575352 | 3.545069 | 3.509921 |
| 74 | 3.444975 | 3.493387 | 3.340289 | 3.584164 | 3.50849 | 3.546136 | 3.501873 |
| 75 | 3.426724 | 3.461511 | 3.357427 | 3.532405 | 3.518792 | 3.50014 | 3.496541 |
| 76 | 3.473356 | 3.416299 | 3.365355 | 3.567655 | 3.450532 | 3.504138 | 3.485382 |
| 77 | 3.35106 | 3.32956 | 3.385479 | 3.355751 | 3.333152 | 3.400537 | 3.338894 |
| 78 | 3.362132 | 3.331908 | 3.373077 | 3.384925 | 3.321141 | 3.399451 | 3.343554 |
| 79 | 3.392278 | 3.420356 | 3.357399 | 3.502435 | 3.467392 | 3.448794 | 3.453019 |
| 80 | 3.497617 | 3.5534 | 3.42798 | 3.500538 | 3.61397 | 3.596157 | 3.481775 |
| 81 | 3.499766 | 3.479489 | 3.408303 | 3.607152 | 3.5371 | 3.529644 | 3.482169 |
| 82 | 3.392723 | 3.439819 | 3.340873 | 3.560645 | 3.518969 | 3.469124 | 3.485077 |
| 83 | 3.48568 | 3.550431 | 3.389044 | 3.5341 | 3.614931 | 3.508275 | 3.516001 |
| 84 | 3.390538 | 3.381629 | 3.375816 | 3.45106 | 3.449497 | 3.432004 | 3.420317 |
| 85 | 3.462801 | 3.419185 | 3.376127 | 3.557087 | 3.459022 | 3.457885 | 3.467539 |
| 86 | 3.442189 | 3.460962 | 3.362563 | 3.498149 | 3.566132 | 3.507946 | 3.488584 |
| 87 | 3.528389 | 3.492037 | 3.456083 | 3.517062 | 3.602237 | 3.540933 | 3.502 |
| 88 | 3.452594 | 3.433387 | 3.355948 | 3.489791 | 3.536664 | 3.517118 | 3.488839 |
| 89 | 3.442483 | 3.393295 | 3.357117 | 3.560569 | 3.459831 | 3.486169 | 3.465299 |
| 90 | 3.403997 | 3.36972 | 3.392314 | 3.462967 | 3.342711 | 3.440981 | 3.380033 |
| 91 | 3.444827 | 3.431608 | 3.349494 | 3.553601 | 3.469408 | 3.50226 | 3.459147 |
| 92 | 3.414574 | 3.346382 | 3.361172 | 3.503301 | 3.428178 | 3.45826 | 3.430546 |
| 93 | 3.481 | 3.445102 | 3.364155 | 3.54484 | 3.483431 | 3.471098 | 3.500845 |
| 94 | 3.414335 | 3.513254 | 3.375251 | 3.507902 | 3.534128 | 3.565911 | 3.504295 |
| 95 | 3.369283 | 3.43097 | 3.324183 | 3.385466 | 3.549077 | 3.505256 | 3.465906 |
| 96 | 3.460844 | 3.411011 | 3.357623 | 3.574467 | 3.432266 | 3.510442 | 3.492382 |
| 97 | 3.349771 | 3.335827 | 3.382152 | 3.368045 | 3.328738 | 3.400739 | 3.344541 |
| 98 | 3.335726 | 3.325822 | 3.378382 | 3.347795 | 3.324707 | 3.396908 | 3.330897 |
| 99 | 3.297514 | 3.339184 | 3.380517 | 3.338184 | 3.313085 | 3.397764 | 3.334441 |
| 100 | 3.370847 | 3.337902 | 3.379434 | 3.37652 | 3.320109 | 3.399936 | 3.353207 |
| 101 | 3.357987 | 3.345913 | 3.39731 | 3.375922 | 3.334192 | 3.406322 | 3.344982 |
| 102 | 3.340552 | 3.346109 | 3.392848 | 3.373038 | 3.328666 | 3.404931 | 3.339895 |
| 103 | 3.444517 | 3.560679 | 3.347399 | 3.570468 | 3.53435 | 3.534021 | 3.521525 |
| 104 | 3.358449 | 3.340084 | 3.380266 | 3.37995 | 3.324644 | 3.415077 | 3.341243 |
| 105 | 3.336996 | 3.334082 | 3.381975 | 3.375053 | 3.344885 | 3.385651 | 3.339321 |
| 106 | 3.446477 | 3.411552 | 3.326434 | 3.522179 | 3.388655 | 3.460607 | 3.460005 |
| 107 | 3.415458 | 3.487085 | 3.359682 | 3.551013 | 3.486442 | 3.467343 | 3.498477 |
| 108 | 3.414611 | 3.433986 | 3.356272 | 3.533114 | 3.437309 | 3.452293 | 3.448546 |
| 109 | 3.38449 | 3.528064 | 3.378829 | 3.506035 | 3.498425 | 3.526427 | 3.509279 |
| 110 | 3.334205 | 3.34239 | 3.400401 | 3.381216 | 3.31769 | 3.399084 | 3.351979 |
| 111 | 3.411236 | 3.370438 | 3.391826 | 3.3905 | 3.368339 | 3.444011 | 3.399514 |
| 112 | 3.46606 | 3.382361 | 3.320784 | 3.588346 | 3.433481 | 3.471851 | 3.485576 |
| 113 | 3.410718 | 3.471298 | 3.338579 | 3.537487 | 3.448797 | 3.445641 | 3.457337 |
| 114 | 3.389079 | 3.377872 | 3.415264 | 3.420767 | 3.350985 | 3.434033 | 3.365569 |
| 115 | 3.310952 | 3.487452 | 3.376184 | 3.588408 | 3.505975 | 3.484485 | 3.472849 |
| 116 | 3.405598 | 3.410552 | 3.385055 | 3.454962 | 3.437337 | 3.454919 | 3.433417 |
| 117 | 3.545973 | 3.45825 | 3.364681 | 3.582576 | 3.488009 | 3.547554 | 3.477863 |
| 118 | 3.4145 | 3.390442 | 3.33932 | 3.556217 | 3.43821 | 3.474568 | 3.483755 |
| 119 | 3.379478 | 3.390976 | 3.365459 | 3.465509 | 3.517785 | 3.443917 | 3.446749 |
| 120 | 3.392236 | 3.367112 | 3.38577 | 3.417306 | 3.38479 | 3.433264 | 3.375295 |
| 121 | 3.410067 | 3.383289 | 3.392115 | 3.437174 | 3.384962 | 3.442747 | 3.383779 |
| 122 | 3.371596 | 3.335582 | 3.386428 | 3.346192 | 3.356908 | 3.407578 | 3.351372 |
| 123 | 3.356048 | 3.349613 | 3.392558 | 3.387344 | 3.333977 | 3.411074 | 3.346038 |
| 124 | 3.450464 | 3.34986 | 3.346811 | 3.424172 | 3.425685 | 3.348822 | 3.349775 |
| 125 | 3.336995 | 3.334909 | 3.378331 | 3.359796 | 3.331924 | 3.396204 | 3.336478 |
| 126 | 3.420612 | 3.263068 | 3.488237 | 3.223818 | 3.330074 | 3.45391 | 3.373344 |
| 127 | 3.341557 | 3.51247 | 3.360559 | 3.521099 | 3.518129 | 3.485613 | 3.495116 |
| 128 | 3.390815 | 3.562335 | 3.344574 | 3.548749 | 3.524164 | 3.53429 | 3.516096 |
| 129 | 3.450644 | 3.540154 | 3.431738 | 3.518154 | 3.3755 | 3.507399 | 3.464212 |
| 130 | 3.341261 | 3.350499 | 3.393372 | 3.388716 | 3.330467 | 3.404188 | 3.340548 |
| 131 | 3.313927 | 3.328966 | 3.381495 | 3.353192 | 3.32933 | 3.393738 | 3.333075 |
| 132 | 3.598023 | 3.62206 | 3.329856 | 3.574774 | 3.501755 | 3.584778 | 3.480333 |
| 133 | 3.486619 | 3.42593 | 3.32521 | 3.562595 | 3.407326 | 3.472015 | 3.484127 |
| 134 | 3.386921 | 3.361678 | 3.382005 | 3.431165 | 3.345018 | 3.422521 | 3.364222 |
| 135 | 3.397528 | 3.386664 | 3.374899 | 3.424707 | 3.413907 | 3.432899 | 3.403924 |
| 136 | 3.433063 | 3.380575 | 3.403088 | 3.439018 | 3.380404 | 3.444413 | 3.387836 |
| 137 | 3.412962 | 3.367412 | 3.361692 | 3.512845 | 3.431567 | 3.464626 | 3.450145 |

Comparación de la predicción de log(g)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | tramo 01 | tramo 02 | tramo 03 | tramo 01+02 | tramo 01+03 | tramo02+03 | tramo 01+02+03 |
| 1 | -3.1623597 | 1.31726254 | -1.75077093 | 0.4481359 | -2.83362 | -1.6275128 | -1.1294365 |
| 2 | -2.4708602 | -4.24138599 | -2.16081912 | -1.9895566 | -2.374288 | -3.9344907 | -3.8663126 |
| 3 | -0.2096841 | 0.77907796 | -1.64681658 | 1.1122865 | -1.367497 | -2.0791615 | -0.3099426 |
| 4 | -5.3379197 | 0.1297766 | -1.56745782 | -0.8073039 | -1.857855 | -2.6733206 | -1.2192297 |
| 5 | -2.61878 | -1.70486618 | -1.30316881 | -4.0948601 | -2.057361 | -2.7621798 | -3.2068283 |
| 6 | -1.0480985 | -3.62573834 | -1.05460213 | -1.3820148 | -1.641045 | -3.2833061 | -2.6326609 |
| 7 | -1.7620381 | -4.13003876 | -0.81429269 | -2.5313395 | -2.400731 | -3.5580921 | -2.1593055 |
| 8 | -1.2945906 | -3.84014468 | -0.85898645 | -1.4357278 | -2.178597 | -3.0725632 | -3.836044 |
| 9 | -1.5908531 | -3.7007688 | -0.67774677 | -1.2301772 | -2.145552 | -3.2781291 | -3.5140556 |
| 10 | -1.6927224 | -4.28760439 | -0.77718687 | -1.7647714 | -2.333187 | -3.6573406 | -2.3261065 |
| 11 | -1.4565199 | -4.11597259 | -0.7600041 | -1.5930512 | -2.059666 | -3.3850679 | -2.1881518 |
| 12 | -1.5594628 | -4.11600739 | -0.97876154 | -1.539248 | -2.110381 | -3.3094586 | -2.8539902 |
| 13 | -1.8212144 | -3.94134125 | -0.90706604 | -1.4991338 | -2.355392 | -3.1066845 | -3.4764451 |
| 14 | -4.4790699 | -4.53126894 | -1.09837441 | -4.1388263 | -3.536827 | -3.4850952 | -3.6167014 |
| 15 | -3.7005639 | -2.13296426 | -0.5612695 | -2.1612594 | -3.87061 | -2.81582 | -2.4103324 |
| 16 | -1.0560258 | -3.64466509 | -2.4855823 | -4.1669168 | -1.331109 | -3.1588305 | -4.8400661 |
| 17 | -4.4899156 | -1.84650346 | -1.24755841 | -3.0856555 | -2.374567 | -4.0037486 | -4.6693435 |
| 18 | -2.3995497 | -4.59470815 | -1.48395662 | -3.5353083 | -2.731394 | -3.9255688 | -4.282774 |
| 19 | -5.1194013 | -4.41717424 | -0.37059142 | -5.3761931 | -4.284252 | -3.1891643 | -4.115324 |
| 20 | -3.3697911 | -4.22470925 | -0.94362677 | -3.0197864 | -3.253983 | -3.4614004 | -3.111738 |
| 21 | -2.8040654 | -4.00708491 | -1.16595115 | -2.6083658 | -2.67388 | -3.6418925 | -3.0983984 |
| 22 | -3.2051478 | -5.43776136 | -1.09415519 | -3.1003732 | -2.687564 | -3.5499048 | -2.9142383 |
| 23 | -3.0817811 | -3.32004065 | -0.7033447 | -3.322211 | -3.623312 | -3.5733068 | -3.913553 |
| 24 | -4.5598244 | -0.53799601 | -0.37605175 | -3.2740284 | -4.436946 | -2.6017064 | -3.4810928 |
| 25 | -3.4055187 | -1.03788375 | -0.59550924 | -1.859907 | -3.905864 | -2.881801 | -2.8346365 |
| 26 | -3.4952181 | -4.81971294 | -0.9877231 | -3.7426454 | -3.341124 | -3.5968636 | -3.5354328 |
| 27 | -4.0758465 | -5.0663692 | -0.82822263 | -3.2371438 | -2.861527 | -3.3768083 | -3.4033768 |
| 28 | -5.3463948 | -3.86294901 | -0.15371387 | -4.7491165 | -4.248467 | -2.6455059 | -3.416018 |
| 29 | -3.0232302 | -4.04786132 | -1.44496373 | -2.8859679 | -2.486612 | -3.7623234 | -3.8363011 |
| 30 | -5.3668617 | -3.57692671 | -1.38791771 | -5.6366384 | -4.099443 | -3.5564396 | -4.9437769 |
| 31 | -5.7436283 | 0.00445702 | 0.19445731 | -4.9553149 | -5.222678 | -2.1744417 | -4.1797777 |
| 32 | -5.6863411 | -1.85307114 | 0.49537816 | -3.0361147 | -4.602516 | -1.2215293 | -3.5623306 |
| 33 | -5.5411617 | -1.03954837 | 0.48227335 | -2.7666249 | -4.824081 | -1.0540253 | -3.2545953 |
| 34 | -2.8547879 | -4.14146835 | -1.50570912 | -3.7321887 | -2.339857 | -3.8687212 | -4.5859573 |
| 35 | -5.6596645 | -4.57187984 | 0.19069772 | -6.2727834 | -5.197606 | -3.1176252 | -5.063872 |
| 36 | -4.777246 | -5.75601311 | -1.14141023 | -3.714911 | -3.676001 | -4.0482926 | -2.2607633 |
| 37 | -5.5922924 | -5.58787316 | -0.37102594 | -4.2860874 | -3.433474 | -3.785801 | -2.7246365 |
| 38 | -4.7861172 | -4.66993846 | 0.34285698 | -3.9604608 | -4.462264 | -2.7149685 | -3.09649 |
| 39 | -5.4001129 | -1.31676813 | -0.1860157 | -4.1868937 | -4.583588 | -2.6468541 | -3.1912218 |
| 40 | -5.6093399 | -1.54020181 | 0.22860267 | -5.4634254 | -5.275771 | -2.2318587 | -4.2899552 |
| 41 | -2.4018135 | -4.03796661 | -1.39957627 | -3.4196851 | -2.90583 | -3.9120023 | -4.6130555 |
| 42 | -5.5893305 | 0.80628992 | 0.13105315 | -4.5435012 | -5.344429 | -1.8752335 | -3.8163253 |
| 43 | -5.4830067 | -2.38468279 | -0.97075166 | -5.4299962 | -4.724854 | -3.2609013 | -5.2196182 |
| 44 | -5.5450562 | -1.31930649 | 0.04840863 | -5.5784991 | -5.30107 | -2.2388996 | -4.313373 |
| 45 | -5.0131248 | -5.01327813 | -0.09552534 | -3.5822422 | -3.70924 | -3.1864169 | -2.9496777 |
| 46 | -5.3591744 | -3.67916561 | -0.82363378 | -5.4202204 | -4.279903 | -3.1190649 | -4.3672813 |
| 47 | -4.8843203 | -4.75301024 | 0.44265955 | -3.7559907 | -4.767956 | -2.7934571 | -3.3815645 |
| 48 | -3.7279265 | -2.42979097 | -0.62472753 | -3.3131339 | -4.010613 | -3.3049545 | -3.8163803 |
| 49 | -5.7405105 | -7.09312682 | 0.48660721 | -5.2595894 | -4.751105 | -3.7818836 | -4.0114192 |
| 50 | -5.8484462 | 0.94116887 | 0.07837983 | -5.3447069 | -5.332356 | -2.3272916 | -4.6499446 |
| 51 | -5.192633 | 1.67850251 | -0.35515412 | -3.3874988 | -4.626916 | -2.4417841 | -3.6824199 |
| 52 | -2.2442758 | -4.60122004 | -1.48233721 | -3.1273858 | -2.846741 | -3.9898809 | -3.8254834 |
| 53 | -5.4652976 | -3.403 | -0.49637948 | -6.0957136 | -4.825104 | -3.1625836 | -4.5703872 |
| 54 | -5.2016235 | -0.54057173 | -0.04606224 | -4.4401815 | -5.160355 | -2.2388985 | -3.8194156 |
| 55 | -5.4099631 | -2.94028989 | -0.45829774 | -6.0037862 | -4.934214 | -3.0113939 | -4.630904 |
| 56 | -3.1885231 | -5.31938558 | -1.28344371 | -4.4025381 | -3.232682 | -4.0612035 | -4.5249719 |
| 57 | -5.3485767 | -4.01422119 | -0.87954674 | -5.4756604 | -4.350213 | -3.2206332 | -4.4227541 |
| 58 | -2.6323036 | -4.04006723 | -1.61905349 | -3.6915792 | -2.18796 | -3.7410428 | -4.7659407 |
| 59 | -2.6136671 | -5.02086407 | -1.94966178 | -4.3391678 | -2.32169 | -4.0307226 | -5.3111656 |
| 60 | -2.7488465 | -3.77887824 | -1.29897256 | -3.4315159 | -2.424094 | -3.8565267 | -4.6245332 |
| 61 | -5.8609733 | -4.39316942 | 0.27388269 | -6.0127359 | -5.506659 | -3.23274 | -5.7568925 |
| 62 | -5.631196 | -2.90864967 | 0.21411686 | -6.019362 | -5.0671 | -2.7179287 | -4.863294 |
| 63 | -5.4622172 | -3.26218098 | -0.0644767 | -5.9668995 | -4.8484 | -2.7537244 | -4.6453834 |
| 64 | -5.5001978 | -1.44996173 | -0.64060698 | -5.5521461 | -4.464367 | -3.7602708 | -3.1237369 |
| 65 | -4.6509092 | -4.49386463 | -0.58847085 | -3.8003722 | -3.750258 | -3.3188495 | -3.0432743 |
| 66 | -5.3993078 | -4.19778429 | -0.34280271 | -5.1163466 | -4.113864 | -2.8815118 | -3.3283893 |
| 67 | -4.8614954 | -3.89688543 | -0.60251791 | -3.3834786 | -3.476464 | -2.9592168 | -2.3289429 |
| 68 | -4.4514035 | -0.03689994 | -0.16104588 | -2.1664691 | -3.904102 | -2.6165573 | -2.404174 |
| 69 | -5.6871503 | 0.52658253 | -0.24685353 | -4.8876501 | -4.963196 | -2.7006524 | -4.4470916 |
| 70 | -5.6163566 | 0.53114106 | -0.1065175 | -4.7385887 | -5.133158 | -2.4760552 | -4.211187 |
| 71 | -5.4363425 | -5.22419426 | 0.92208133 | -3.3931377 | -4.113011 | -3.2794148 | -2.3449973 |
| 72 | -5.5141368 | -0.1487624 | 1.01341058 | -3.2319162 | -4.629182 | -2.3029788 | -2.9817546 |
| 73 | -5.1999856 | -5.97909545 | 0.70759302 | -3.5669745 | -3.973122 | -3.6568256 | -2.2108527 |
| 74 | -5.1060798 | 1.219461 | 0.35118295 | -2.5117839 | -4.266397 | -1.9755405 | -2.7765273 |
| 75 | -5.582342 | -3.0893812 | 0.15151976 | -6.1589352 | -4.981071 | -3.2938869 | -4.4292109 |
| 76 | -5.5370198 | 0.86354014 | -0.12150033 | -4.7685604 | -4.839114 | -2.5626053 | -4.0698425 |
| 77 | -2.6876869 | -4.97558468 | -2.04760344 | -4.3478283 | -2.286065 | -3.9289625 | -5.406502 |
| 78 | -2.7683444 | -4.12953244 | -1.57572704 | -3.8446946 | -2.370519 | -3.8891262 | -5.224096 |
| 79 | -4.7000575 | -4.76103541 | -0.46024242 | -4.1735528 | -3.985172 | -3.2809268 | -3.377415 |
| 80 | -5.9571202 | -4.11733014 | 0.88381679 | -5.6052098 | -5.367964 | -1.9469389 | -6.4157775 |
| 81 | -6.0793052 | 1.35992972 | 0.72453494 | -5.7136271 | -5.495149 | -0.5669523 | -6.1410614 |
| 82 | -4.4384961 | -3.33159093 | -0.12298541 | -1.3439675 | -3.32285 | -2.607584 | -1.5105859 |
| 83 | -5.9634095 | -2.65402458 | -0.06179384 | -5.9807828 | -4.964952 | -3.028732 | -4.7926087 |
| 84 | -4.1470825 | -4.59470679 | -0.57529609 | -4.0719212 | -3.691105 | -3.1665408 | -3.4856838 |
| 85 | -3.865007 | -4.29046709 | -1.01561085 | -2.4915037 | -3.750055 | -3.2870367 | -2.6368188 |
| 86 | -5.8009284 | -3.92894073 | 0.404983 | -6.1285159 | -5.138723 | -3.4919094 | -4.747444 |
| 87 | -6.0755055 | -3.4174309 | 0.35335216 | -6.0621086 | -5.795046 | -3.5962449 | -6.4004049 |
| 88 | -5.8023059 | -4.07655298 | 0.35765095 | -6.0136496 | -5.005621 | -3.3119527 | -4.6238626 |
| 89 | -4.9259123 | 1.28432672 | -0.35559861 | -2.2843662 | -4.448604 | -2.4839019 | -2.5242289 |
| 90 | -2.5870128 | -2.17062257 | -0.99516247 | -1.7569659 | -2.775668 | -3.393032 | -3.1755394 |
| 91 | -5.3722814 | 1.313531 | -0.25401719 | -3.141524 | -4.908363 | -2.2367425 | -3.4723175 |
| 92 | -4.8599276 | 1.36175144 | -0.46391862 | -2.7315601 | -4.285002 | -2.257666 | -3.0159439 |
| 93 | -5.7386316 | -3.56961458 | 0.31441485 | -6.1442286 | -5.174072 | -2.9066128 | -4.8774727 |
| 94 | -5.770195 | -1.46588179 | 0.61168704 | -5.8478766 | -4.937741 | -3.1672443 | -4.5685514 |
| 95 | -5.5507137 | -4.26227957 | -0.00328588 | -4.6793491 | -3.988555 | -2.6042247 | -3.5679706 |
| 96 | -5.7369748 | 1.63258792 | -0.03206018 | -4.485352 | -4.888746 | -2.4438557 | -4.233507 |
| 97 | -2.7585378 | -4.94465049 | -1.55195997 | -4.2435487 | -2.421405 | -4.0204724 | -5.2204816 |
| 98 | -2.9829454 | -4.86754661 | -2.21974068 | -4.209691 | -2.314464 | -4.0413666 | -5.3250483 |
| 99 | -4.5048469 | -3.49108706 | -1.90721723 | -3.5463299 | -2.331658 | -3.7153259 | -4.8229794 |
| 100 | -3.1779743 | -4.92087595 | -1.61452539 | -4.3575168 | -2.509436 | -3.91936 | -5.5407358 |
| 101 | -2.4664624 | -3.93777913 | -1.44526487 | -3.3513742 | -2.14834 | -3.7081403 | -4.7428565 |
| 102 | -2.6847179 | -3.96670247 | -1.93614016 | -3.482591 | -2.21948 | -3.6887797 | -4.8552562 |
| 103 | -5.6900808 | -5.14879577 | -0.45997289 | -5.4041982 | -4.140389 | -3.5593967 | -3.1155728 |
| 104 | -2.7415496 | -3.48517366 | -1.41398952 | -3.5074958 | -2.695161 | -3.8224973 | -4.7834052 |
| 105 | -1.9071613 | -2.98231044 | -2.00213242 | -3.4823923 | -1.75281 | -3.3238364 | -4.4093146 |
| 106 | -4.7558882 | -1.49892834 | -0.17333024 | -3.8879173 | -4.701205 | -3.1702636 | -3.852875 |
| 107 | -4.5082979 | -5.37789475 | -0.06777058 | -3.8048942 | -3.768308 | -3.5002199 | -2.9356586 |
| 108 | -3.8007108 | -4.24070936 | -0.62470685 | -2.8318372 | -3.320089 | -3.309951 | -2.9252694 |
| 109 | -5.5636681 | -5.85067989 | -0.27725973 | -4.7320546 | -4.272947 | -4.3931164 | -3.1362084 |
| 110 | -3.33317 | -3.41381406 | -2.03575141 | -3.8329973 | -2.721379 | -3.7801747 | -4.8268534 |
| 111 | -3.9299833 | -5.67716356 | -1.61265688 | -4.4877053 | -3.358308 | -4.0857636 | -4.5164412 |
| 112 | -3.8048997 | 0.72999823 | 0.26142421 | -1.5403442 | -4.236255 | -2.1874234 | -2.0533665 |
| 113 | -3.9237212 | -2.57224551 | -0.11837032 | -2.5435774 | -3.768213 | -2.6336689 | -2.5789266 |
| 114 | -2.0896998 | -3.65982047 | -1.67468519 | -2.1935385 | -2.06292 | -3.6198221 | -3.4802988 |
| 115 | -4.8469265 | -2.88004897 | -1.05090792 | -4.7641764 | -3.876438 | -3.0989477 | -4.4957364 |
| 116 | -4.6508013 | -5.00605233 | -1.27289584 | -4.8240871 | -3.864072 | -3.6389411 | -4.1316326 |
| 117 | -5.4103553 | 0.53653237 | 0.38289286 | -3.7424771 | -5.172473 | -3.0154247 | -3.2173459 |
| 118 | -4.5124207 | 0.71719882 | -0.07306693 | -1.489157 | -4.145235 | -1.9402395 | -1.7239974 |
| 119 | -5.1808505 | -4.24070289 | -0.45058693 | -4.8046297 | -3.963311 | -2.7823139 | -3.2975251 |
| 120 | -3.3108098 | -4.54039029 | -1.17427625 | -3.7144604 | -3.008572 | -3.7172821 | -3.8867184 |
| 121 | -2.8171395 | -4.2788481 | -1.17052388 | -3.086988 | -2.904747 | -3.7280214 | -3.4612521 |
| 122 | -2.6697637 | -5.22062203 | -2.08823083 | -4.7253905 | -2.599451 | -4.0516883 | -5.4861261 |
| 123 | -2.258908 | -3.94642668 | -1.73707017 | -2.9958488 | -2.051621 | -3.660888 | -4.5959083 |
| 124 | 0.6881335 | -1.03294944 | -1.08583351 | -2.7092213 | -1.46624 | -1.8812868 | -4.3871455 |
| 125 | -2.7623674 | -4.02752815 | -2.02218998 | -3.8068594 | -2.263029 | -3.6396916 | -5.0619086 |
| 126 | -5.2503413 | -2.52251475 | -0.18532822 | -2.063527 | -3.952236 | -2.6030775 | -1.8294536 |
| 127 | -5.5527076 | -5.65076372 | -0.97713122 | -4.160459 | -3.43634 | -3.6891896 | -2.8625011 |
| 128 | -5.8451171 | -6.06479343 | 0.08212026 | -4.5991909 | -3.748631 | -4.349048 | -2.9192495 |
| 129 | -4.5151476 | -3.40893966 | -0.77048682 | -3.0819492 | -3.284994 | -3.2009423 | -3.3740149 |
| 130 | -2.4577912 | -3.32653499 | -1.700287 | -2.7524601 | -1.909763 | -3.4543905 | -4.4271023 |
| 131 | -2.87015 | -3.91547717 | -2.10094666 | -3.827413 | -2.305661 | -3.6751662 | -5.2124487 |
| 132 | -6.4514893 | 4.31427941 | -0.58846459 | -1.6568342 | -4.16022 | 1.1342866 | -3.7793392 |
| 133 | -5.2706389 | 0.29425632 | -0.26243175 | -3.7496359 | -5.097181 | -2.4994948 | -3.5877475 |
| 134 | -2.4454165 | -4.15659366 | -1.53602403 | -3.51997 | -2.993864 | -3.9867016 | -4.6974625 |
| 135 | -3.8925302 | -4.78194895 | -0.95843044 | -4.2455216 | -3.463492 | -3.5702488 | -3.8532529 |
| 136 | -2.4072026 | -4.2863545 | -1.26308462 | -2.9655371 | -2.684755 | -3.7905197 | -3.4854423 |
| 137 | -4.6825602 | 0.86063835 | -0.19889509 | -2.5194161 | -4.029481 | -2.2688356 | -2.4536711 |

Comparación de la predicción de [Fe/H]

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | tramo 01 | tramo 02 | tramo 03 | tramo 01+02 | tramo 01+03 | tramo02+03 | tramo 01+02+03 |
| 1 | -3.517496 | -1.9743438 | -0.72734933 | -1.10928556 | -3.0335849 | -1.2917041 | -0.93247555 |
| 2 | -3.467417 | -1.6453019 | -0.76681178 | -0.71862484 | -3.0787252 | -0.24146669 | -0.72180358 |
| 3 | -4.249548 | -1.9505356 | -0.2455408 | -1.1442455 | -2.8084853 | -0.6031367 | -0.99624334 |
| 4 | -1.675932 | -2.2583498 | -0.3391685 | -1.14466537 | -2.8296444 | -0.61613616 | -1.10468702 |
| 5 | -3.894711 | -1.6781699 | -0.29074793 | -0.97633682 | -2.9648953 | -0.21451808 | -0.91940952 |
| 6 | -1.34494 | -1.0161729 | -0.57999737 | -0.32756658 | -2.2231251 | -0.27205666 | -0.45082104 |
| 7 | -1.162209 | -0.7303966 | -0.5349774 | 0.07104225 | -0.6228665 | 0.21027846 | 0.28098844 |
| 8 | -1.133662 | -1.001267 | -0.58245669 | 0.11977161 | -2.3993708 | -0.27000697 | 0.06709192 |
| 9 | -1.613622 | -1.2750762 | -0.64893844 | -0.26933503 | -2.3983934 | -0.49991888 | -0.26331474 |
| 10 | -1.499391 | -1.1752801 | -0.51589022 | -0.14037706 | -1.6372849 | -0.72413039 | -0.1031681 |
| 11 | -1.696764 | -1.1758254 | -0.46394953 | -0.17150901 | -1.834512 | -0.66912043 | -0.29530387 |
| 12 | -1.677152 | -1.2348252 | -0.50571149 | -0.39903727 | -2.5401836 | -0.36765765 | -0.62760288 |
| 13 | -1.295689 | -1.1826052 | -0.52466203 | -0.20020485 | -2.6428895 | -0.30150892 | -0.3107657 |
| 14 | -2.884306 | -2.3139883 | -1.45720269 | -1.2592423 | -2.0416725 | -0.8148767 | -0.16867209 |
| 15 | -2.417608 | -2.5657633 | -1.82241095 | -0.76229029 | -2.7329179 | -1.65694344 | -0.63862208 |
| 16 | -3.399324 | -1.566477 | -0.01999424 | -1.74210364 | -1.8030799 | 0.08296468 | -1.11509143 |
| 17 | -1.277222 | -1.732915 | -0.43526008 | -0.45931008 | -2.7120514 | -0.18544378 | -0.59411929 |
| 18 | -1.993399 | -1.8092856 | -0.79815081 | -0.65327999 | -2.3239608 | -0.26215114 | -0.48269196 |
| 19 | -3.512927 | -2.4053776 | -2.54189687 | -1.72805123 | -2.1117815 | -1.9769615 | -0.08575089 |
| 20 | -2.070299 | -2.0133975 | -1.59590918 | -0.15786041 | -2.2064595 | -1.03988674 | -0.1448312 |
| 21 | -1.896549 | -1.8359783 | -1.06585639 | -0.78038727 | -2.5905013 | -0.53121138 | -0.56949227 |
| 22 | -1.171756 | -1.8257712 | -1.68931399 | -0.42168935 | -2.001176 | -1.06471675 | -0.33484174 |
| 23 | -1.970365 | -2.1672244 | -1.80820114 | -0.03616221 | -2.6122247 | -0.90989577 | -0.14993305 |
| 24 | -2.534366 | -3.0961339 | -2.32354627 | -0.76874773 | -3.0222708 | -1.82749518 | -0.22014212 |
| 25 | -2.179224 | -2.6899874 | -1.67273883 | 0.06236597 | -2.8251497 | -1.42510309 | -0.25494996 |
| 26 | -2.168743 | -2.0515722 | -1.52929812 | -0.76976619 | -2.217367 | -0.78098516 | -0.17758106 |
| 27 | -2.012614 | -1.8579897 | -1.24777724 | -0.82600537 | -2.3920166 | -0.58168868 | -0.09902199 |
| 28 | -3.303671 | -2.771826 | -2.51043801 | -1.84234387 | -2.1843992 | -2.28601209 | -0.38260968 |
| 29 | -2.478503 | -1.7675362 | -0.77514409 | -0.68443906 | -2.698087 | -0.37231533 | -0.60746374 |
| 30 | -3.883557 | -3.7073775 | -1.15782646 | -3.52863901 | -1.4179722 | -0.90113441 | -0.25257133 |
| 31 | -3.124363 | -3.8713342 | -2.96952384 | -2.85950631 | -3.1949354 | -2.87088605 | -0.82561308 |
| 32 | -3.086096 | -4.3656419 | -2.30893708 | -5.01176707 | -4.0087661 | -1.34329067 | -4.8091409 |
| 33 | -2.899674 | -3.695615 | -2.33341228 | -4.92151484 | -4.595263 | -1.44168271 | -4.64194172 |
| 34 | -2.994282 | -1.7072379 | -0.70291382 | -0.76310751 | -2.6975132 | -0.2963344 | -0.70852972 |
| 35 | -3.769747 | -2.3415203 | -2.87196495 | -3.01602338 | -2.689033 | -2.88077401 | -0.34851403 |
| 36 | -2.317817 | -2.0478089 | -1.81793313 | -2.08535373 | -3.9459107 | -2.83363462 | -1.34653729 |
| 37 | -2.876429 | -1.8202144 | -2.38369359 | -1.42838878 | -1.660488 | -2.31296397 | -0.64913999 |
| 38 | -2.634957 | -1.9299839 | -2.9413797 | -1.19734441 | -2.9231269 | -2.04423863 | 0.00087396 |
| 39 | -3.112862 | -3.5279532 | -2.55706697 | -2.8665731 | -2.9142515 | -2.43109894 | -0.81803189 |
| 40 | -3.255941 | -3.4971645 | -3.17985771 | -2.34659527 | -3.009504 | -2.71671035 | -0.32245815 |
| 41 | -2.327133 | -1.8248274 | -0.93646687 | -0.60027403 | -2.7680781 | -0.3650912 | -0.61295727 |
| 42 | -3.130257 | -3.9582831 | -3.10943956 | -2.21425423 | -3.6424016 | -2.91420361 | -0.39820536 |
| 43 | -3.874806 | -3.6745678 | -1.73907405 | -3.78332723 | -1.6502374 | -1.84079403 | -0.72784826 |
| 44 | -3.313586 | -3.419898 | -2.79976659 | -2.5387864 | -3.9412156 | -2.66437745 | -0.36458173 |
| 45 | -2.871559 | -1.3882573 | -2.6381394 | -0.09593785 | -1.8165295 | -1.83980743 | -0.03534744 |
| 46 | -3.49858 | -3.1355377 | -1.8435382 | -3.02660833 | -1.8653796 | -1.46135481 | -0.29124252 |
| 47 | -2.752918 | -1.3830039 | -3.28315872 | -0.48479671 | -2.77936 | -1.95133694 | 0.1999786 |
| 48 | -2.266919 | -2.5260112 | -2.2427851 | -0.13588442 | -2.5238585 | -1.22992763 | -0.14197431 |
| 49 | -3.232471 | -1.642817 | -3.06872718 | -1.52713487 | -1.5770877 | -2.54603515 | -0.13252355 |
| 50 | -3.187365 | -4.3425096 | -2.82733862 | -2.60323147 | -3.4668813 | -2.99767141 | -0.70691124 |
| 51 | -3.112796 | -4.3478867 | -1.93309528 | -1.93172008 | -3.4788835 | -1.97313967 | -0.26654782 |
| 52 | -1.890107 | -2.0376073 | -0.96495827 | -0.72511086 | -2.1450794 | -0.39481905 | -0.51251529 |
| 53 | -3.659991 | -2.4008222 | -2.2568502 | -2.46567542 | -2.2043232 | -2.26933477 | 0.00958994 |
| 54 | -2.977197 | -3.0616152 | -2.50867746 | -1.4932706 | -3.9816586 | -2.4016163 | -0.05952 |
| 55 | -3.50556 | -3.0625848 | -2.35834262 | -2.41326294 | -2.3944518 | -2.24348452 | -0.05579201 |
| 56 | -1.913429 | -2.0862909 | -1.63925215 | -0.77659199 | -2.1979549 | -0.67024663 | -0.28470106 |
| 57 | -3.430197 | -3.0841033 | -1.84621375 | -2.89617181 | -2.1938379 | -1.46258003 | -0.27402159 |
| 58 | -2.908039 | -1.7951189 | -0.92507429 | -1.08644024 | -2.7281796 | -0.23168942 | -0.88663006 |
| 59 | -2.976861 | -1.8731074 | -0.47334688 | -1.06788288 | -2.5889923 | -0.10096088 | -0.80567591 |
| 60 | -2.943362 | -1.7151654 | -0.61741631 | -0.88008006 | -3.0657329 | -0.18906026 | -0.80445575 |
| 61 | -3.657834 | -3.1578912 | -3.03056841 | -3.27024986 | -2.5984945 | -3.24787004 | -0.92076247 |
| 62 | -3.645303 | -3.0135918 | -3.01069904 | -3.08962396 | -3.1495014 | -3.0192462 | -0.6068022 |
| 63 | -3.647587 | -3.1379909 | -2.8272563 | -2.84267726 | -2.6592835 | -2.53696845 | -0.2973323 |
| 64 | -3.758208 | -1.3585003 | -1.67890154 | -3.60137493 | -2.3571651 | -2.68133162 | -1.07940801 |
| 65 | -2.765487 | -2.2203772 | -2.07228755 | -0.68935814 | -1.8313076 | -1.63233909 | -0.17153388 |
| 66 | -3.485467 | -2.9314314 | -2.32945118 | -2.74272353 | -2.4364206 | -2.23153941 | -0.61965127 |
| 67 | -2.640174 | -2.5419576 | -1.9463582 | -2.59587004 | -2.224559 | -1.75816951 | -1.36175568 |
| 68 | -2.458122 | -3.3942887 | -2.19707252 | -1.37874221 | -3.247482 | -2.19187393 | -1.14234942 |
| 69 | -3.234286 | -4.1104772 | -2.47229036 | -2.54570355 | -3.0010145 | -2.43579122 | -0.48237058 |
| 70 | -3.139131 | -4.1576081 | -2.76627737 | -2.62966874 | -3.7358878 | -2.87406735 | -0.67832773 |
| 71 | -2.561577 | -3.4843871 | -3.25419119 | -3.21011208 | -1.6205417 | -3.53912197 | -2.32917929 |
| 72 | -2.573233 | -3.8229397 | -3.77765881 | -2.09728336 | -2.313433 | -3.16401892 | -1.70876172 |
| 73 | -2.288181 | -3.8620342 | -3.17363684 | -3.31941096 | -1.6812543 | -3.47890655 | -2.07837973 |
| 74 | -2.066587 | -4.3071837 | -3.11342059 | -2.84240804 | -3.0118703 | -3.33562003 | -2.46121829 |
| 75 | -3.582291 | -2.2495389 | -2.81914649 | -2.51962857 | -2.6616569 | -2.74855541 | -0.12847692 |
| 76 | -3.127282 | -4.0620478 | -2.26214867 | -2.20279362 | -3.6281805 | -2.33567054 | -0.18026621 |
| 77 | -2.742416 | -1.731452 | -0.34807446 | -0.89494696 | -2.4900698 | -0.08926211 | -0.69752474 |
| 78 | -2.779319 | -1.706553 | -0.66297925 | -0.73278054 | -2.8718175 | -0.20820069 | -0.69837675 |
| 79 | -2.782392 | -2.0707139 | -2.20256489 | -0.78511061 | -2.2011577 | -1.55722678 | -0.05164898 |
| 80 | -3.407766 | -3.0519701 | -2.96715483 | -3.83086676 | -2.0113085 | -3.0402114 | -2.46344708 |
| 81 | -2.726935 | -4.3949301 | -3.2419552 | -2.71535827 | -3.0607877 | -2.72089211 | -2.08757514 |
| 82 | -1.633101 | -2.3858929 | -2.32706801 | -1.27494266 | -2.2452515 | -2.36522817 | -1.29319931 |
| 83 | -3.549112 | -3.7692261 | -2.75015302 | -3.41748491 | -1.7431372 | -2.9267817 | -0.84597722 |
| 84 | -2.417706 | -2.296885 | -2.10900349 | -1.16406324 | -2.0650047 | -1.25507709 | -0.28934728 |
| 85 | -1.043939 | -2.0239634 | -1.727259 | -0.32752316 | -1.4810906 | -1.69957779 | -0.26772324 |
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