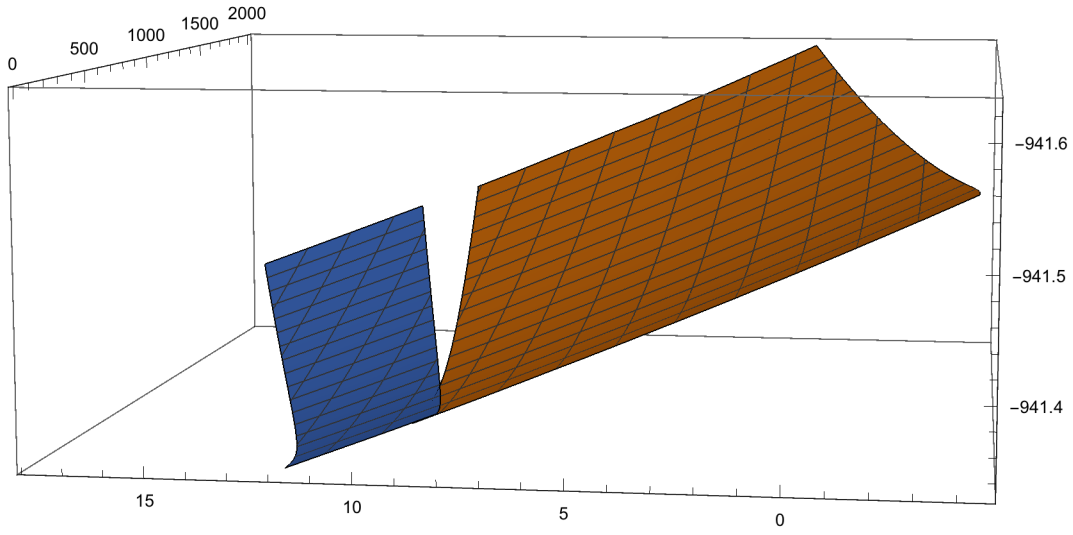
In[206]:=
```
SetDirectory["/Volumes/MicroSD/Dropbox/PostDoc_SD/mathematica/David/surf"];
fileSurfs = {"surf_1_P_T_G.dat", "surf_2_P_T_G.dat"};
cacSurf = Table[ReadList[fileSurfs[[i]], {Number, Number, Number}],
   {i, 1, Length[fileSurfs]}];
```

In[306]:=
```
(*Plot data for two surfaces*)
ListPlot3D[cacSurf]
```

Out[306]=




```
(*Guess a quadratic form*)
eqnForm = aaa + bbb * T + ccc * p + ddd * T ^ 2 + eee * p ^ 2 + fff * p * T;
```

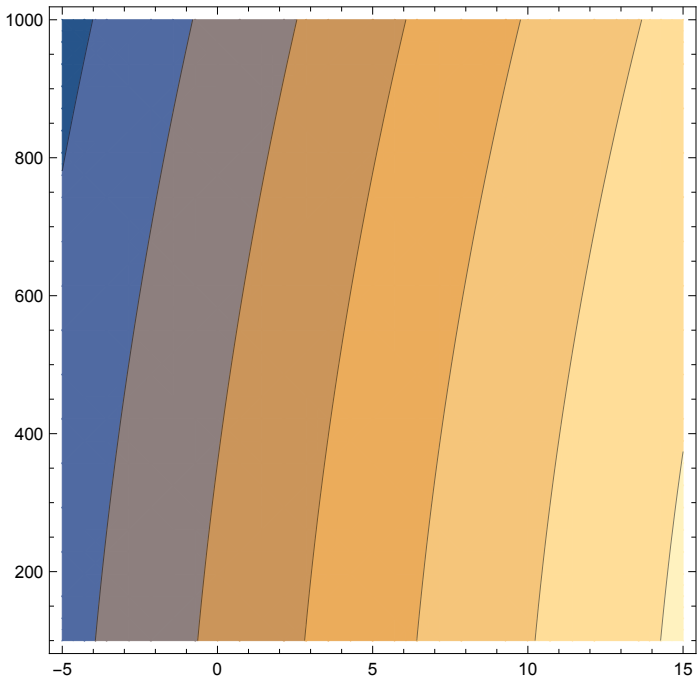
In[307]:=
```
(*Fit quadrativ form to data*)
fittedSurf1 =
 NonlinearModelFit[cacSurf[[1]], eqnForm, {aaa, bbb, ccc, ddd, eee, fff}, {p, T}]
fittedSurf2 = NonlinearModelFit[cacSurf[[2]],
  eqnForm, {aaa, bbb, ccc, ddd, eee, fff}, {p, T}]
```

Out[307]= FittedModel[$-941.488 + 0.0146882\,p - \ll 23 \gg p^2 - \ll 23 \gg T + 3.77171 \times 10^{-7}\,p\,T - 2.4741 \times 10^{-8}\,T^2$]

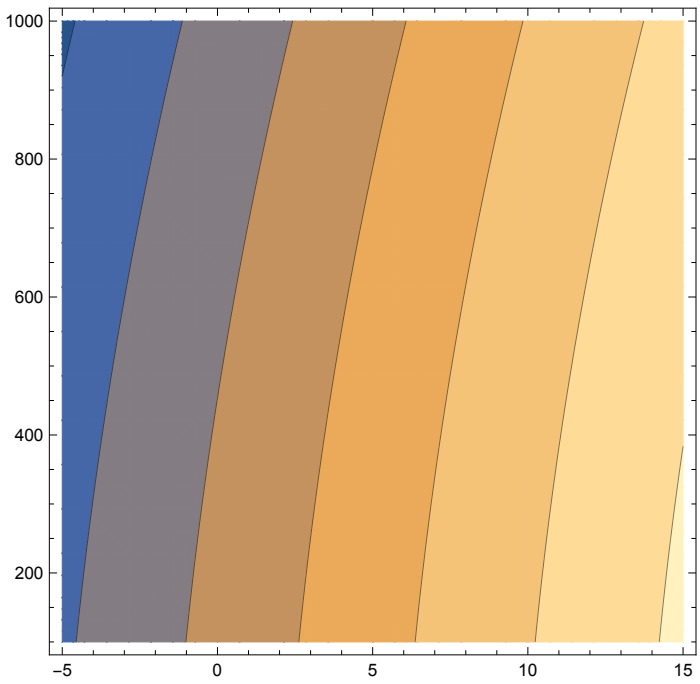
Out[308]= FittedModel[$-941.483 + 0.0137978\,p - \ll 23 \gg p^2 - \ll 24 \gg T + 3.44166 \times 10^{-7}\,p\,T - 2.46611 \times 10^{-8}\,T^2$]

In[309]:=
```
(*Contour plot quadratic form*)
ContourPlot[fittedSurf1[p, T], {p, -5, 15}, {T, 100, 1000}]
ContourPlot[fittedSurf2[p, T], {p, -5, 15}, {T, 100, 1000}]
```

Out[309]=



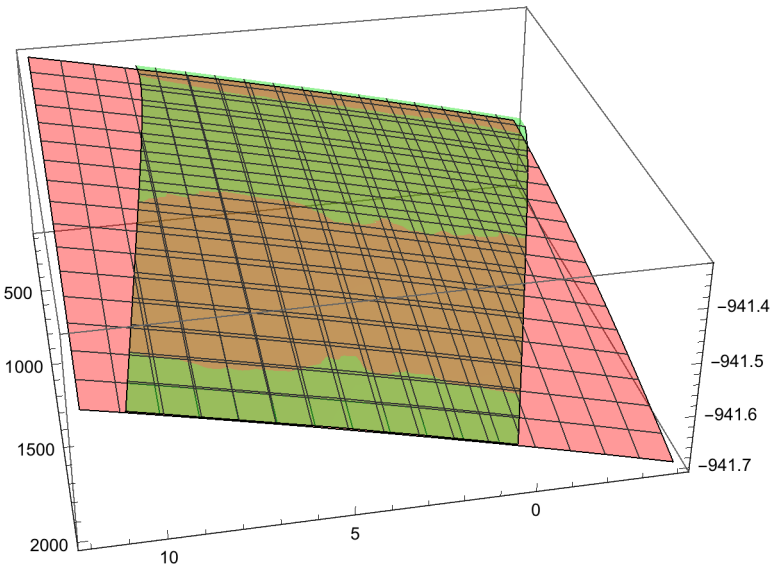
Out[310]=



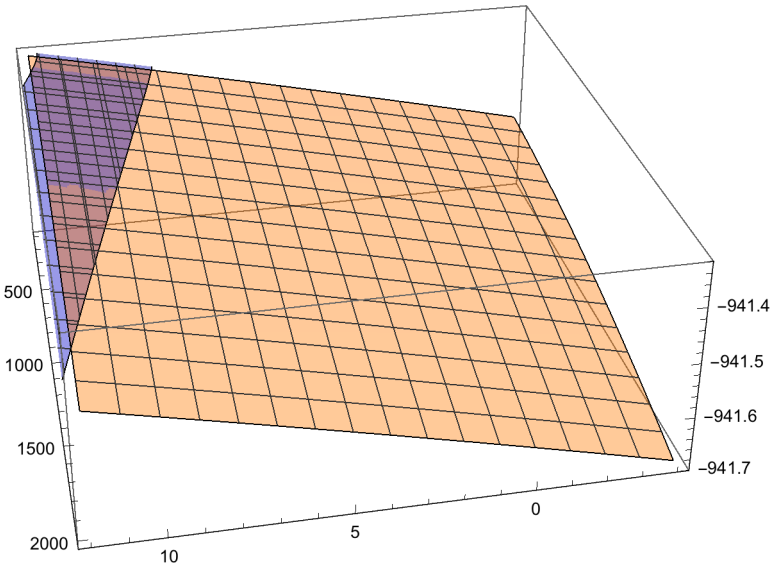
In[311]:=
```
(*Plot in 3D*)
p1 = Plot3D[fittedSurf1[p, T], {p, -4, 12},
    {T, 100, 2000}, PlotStyle → {Red, Directive[Opacity[0.4]]}];
p2 = ListPlot3D[cacSurf[[1]], PlotStyle → {Green, Directive[Opacity[0.4]]}];
p3 = Plot3D[fittedSurf2[p, T], {p, -4, 12},
    {T, 100, 2000}, PlotStyle → {Orange, Directive[Opacity[0.4]]}];
p4 = ListPlot3D[cacSurf[[2]], PlotStyle → {Blue, Directive[Opacity[0.4]]}];
```

In[315]:=
```
(*Show plots*)
Show[{p1, p2}]
Show[{p3, p4}]
```

Out[315]=



Out[316]=



In[317]:=
```
(*Inspect equations*)
surf1 = eqnForm /. fittedSurf1[[1]][[2]]
surf2 = eqnForm /. fittedSurf2[[1]][[2]]
```

Out[317]=
$$-941.488 + 0.0146882\,p - 0.0000964396\,p^2 - 0.0000253548\,T + 3.77171\times10^{-7}\,p\,T - 2.4741\times10^{-8}\,T^2$$

Out[318]=
$$-941.483 + 0.0137978\,p - 0.0000543645\,p^2 - 0.0000262425\,T + 3.44166\times10^{-7}\,p\,T - 2.46611\times10^{-8}\,T^2$$

In[319]:=
```
(*Solve intersections*)
surfDiff = surf1 - surf2
intersection = Solve[surfDiff == 0, {T, p}][[1]]
```

Out[319]=
$$-0.00477935 + 0.00089033\,p - 0.0000420751\,p^2 + 8.87745\times10^{-7}\,T + 3.30044\times10^{-8}\,p\,T - 7.98877\times10^{-11}\,T^2$$

Solve: Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result.

Solve: Equations may not give solutions for all "solve" variables.

Out[320]=
$$\left\{p \to 1.62708\times10^{-57}\left(6.50259\times10^{57} + 2.4105\times10^{53}\,T - 2.06788\times10^{20}\sqrt{-1.4568\times10^{73} + 2.5969\times10^{71}\,T - 1.54133\times10^{67}\,T^2}\right)\right\}$$

In[321]:=
```
intersection[[1]][[2]]
```

Out[321]=
$$1.62708\times10^{-57}\left(6.50259\times10^{57} + 2.4105\times10^{53}\,T - 2.06788\times10^{20}\sqrt{-1.4568\times10^{73} + 2.5969\times10^{71}\,T - 1.54133\times10^{67}\,T^2}\right)$$

```
(*Plot the intersection - note it won't be value for this whole range*)
```

In[322]:=
```
Plot[intersection[[1]][[2]], {T, 500, 1200},
 AxesLabel → {"Temperature (K)", "Pressure"}]
```

Out[322]=