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APPENDIX A

CREATING SIMPLE WINDOWS APPLICATION WITH VISUAL BASIC FOR WINDOWS

Visual Basic is a Windows adaption of the popular Microsoft QuickBasic compiler. Visual Basic is designed to work in the versatile Windows graphics interface. By this language, users can create single and multiple windows, each with visual control objects.

A-1 How Visual Basic Works

Visual Basic offers an interface shown in Figure A-1. As the figure shows, the Visual Basic interface is made up of multiple window components, or tools. These windows can be moved around, resized, closed, and opened. The windows are as follow:

A-1.1 The Menu Window

That is the top window in Figure A-1 and contains the pull-down menu options (namely File, Edit, View, Run, Debug, Window, Options, and Help) that enable users to manage the design of Visual Basic application, manage the Visual Basic interface windows, and obtain on-line help.

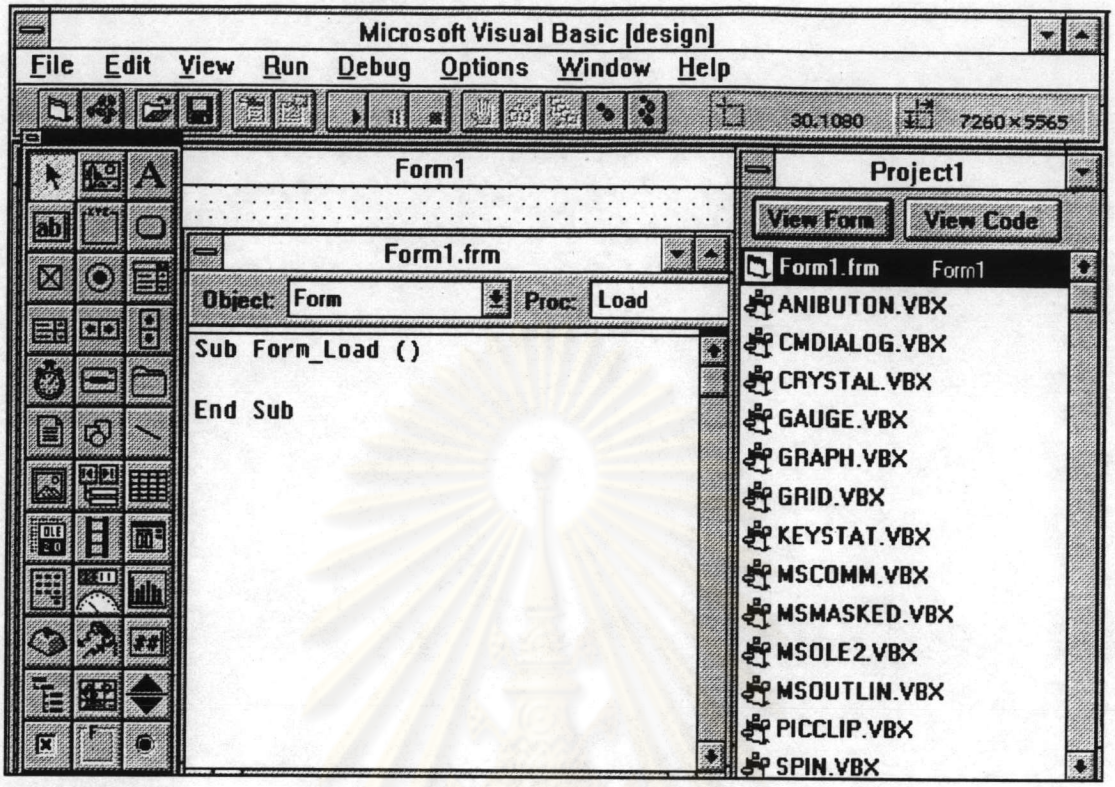

Figure A-1 Interface of Visual Basic

A-1.2 The Toolbar Window

This window contains a set of icons. Clicking on these icons performs some of the same tasks offered by the menu selections, such as opening a new project and invoking the Properties window. The Visual Basic toolbar provides shortcuts for many common design and debugging commands.

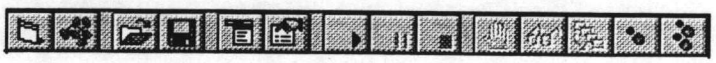

Figure A-2 Toolbar Window

A-1.3 The Project Window

This is the window with the title Project1, located on the right side in Figure A-1. A project is the collection of forms, modules, and custom controls that make up an application. The Project window lists all the files in an application.

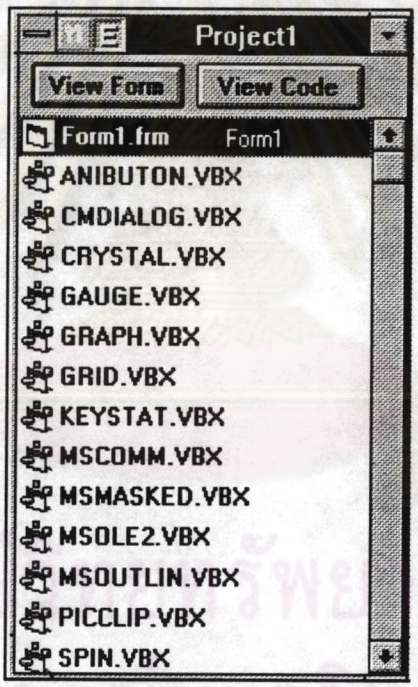

Figure A-3 Project Window

A-1.4 The Form Window

This is the window with the title Form1, located immediately below the Properties bar in Figure A-1. Users create Forms to serve as the interface of their application, each form is a window that displays controls, graphics, or other forms. When a Visual Basic application is executed, the form window and its control objects become center stage. A Visual Basic project must have at least one form.

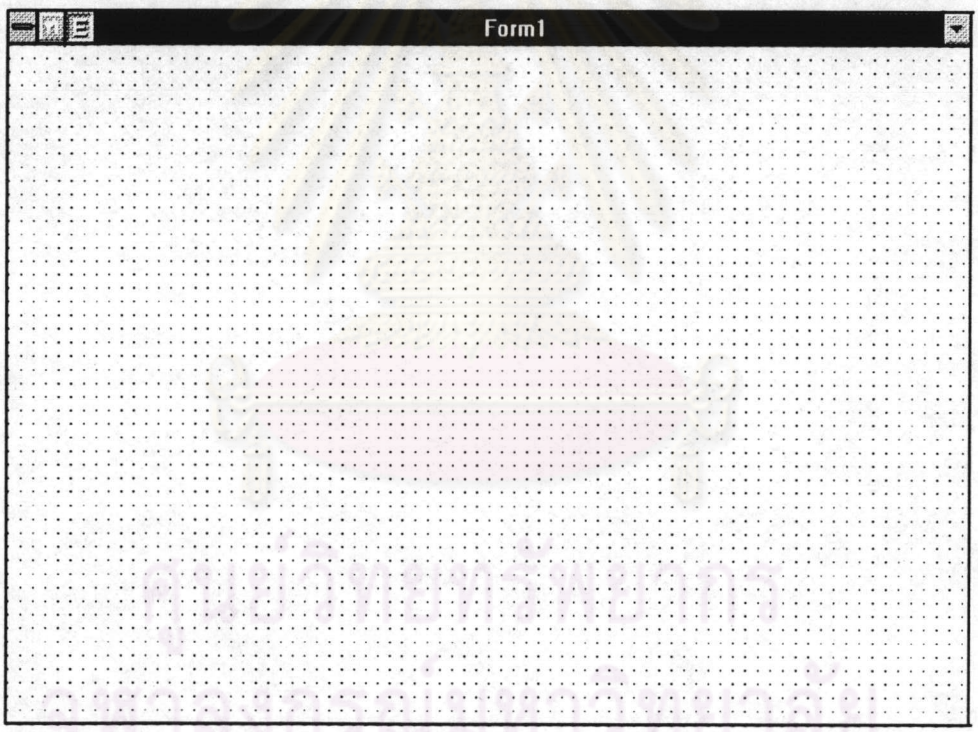

Figure A-4 Form Window

A-1.5 The Toolbox Window

This is the tall and narrow window located at the left of Figure A-1. The Toolbox contains two columns of tool icons. These icons (except the arrow icon) represent control objects that are inserted in the form object. Controls are tools such as boxes, buttons, and labels that users draw on a form to get input or to display output. They also add visual appeal to their forms.

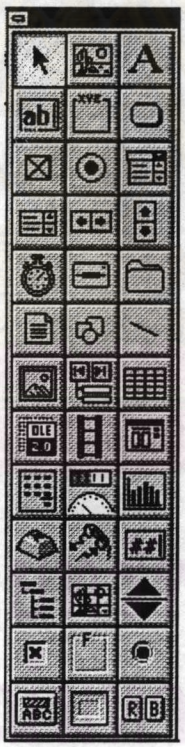

Figure A-5 Toolbox Window

A-1.6 The Properties Window

This window contains a scrollable list of properties and setting. From this window, users can set the properties of forms and controls. Properties specify the initial values for such characteristic as size, name, and position.

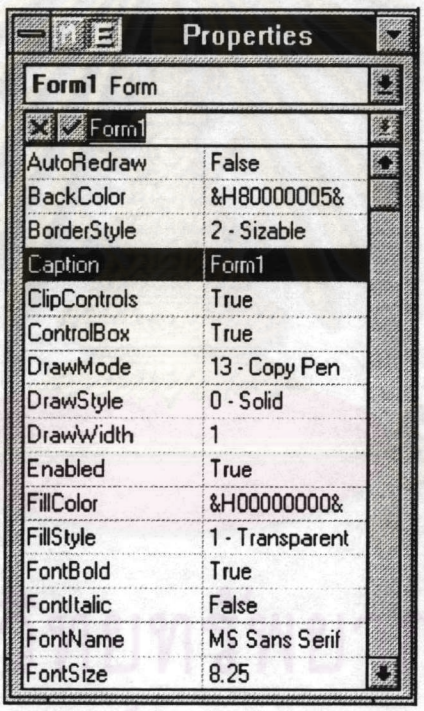

Figure A-6 Properties Window

A-1.7 The Code Window

This is the window with the title window.make that is overlaying the Form window in Figure A-1. This window allows users to write and edit the code associated with the various control objects.

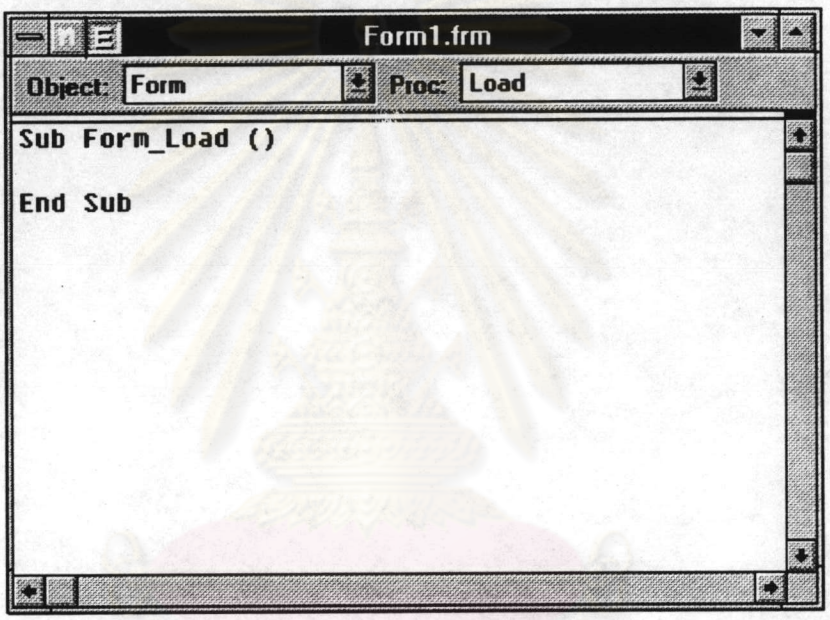

Figure A-7 Code Window

Visual Basic includes an easy-to-use language that is compatible with Visual Basic for MS-DOS, Qbasic, Basic Compiler 7.1, and other Microsoft Basic products. Language features include:

- If...Then...Else blocks
- Loops
- Seven data types
- Numerous math and string functions

To help users review the code quickly, Visual Basic provides:

- Automatic syntax checking
- Debugging tools
- A debug window

By combinding the Visual Basic forms, tools, and programming language, users can build powerful applications quickly and easily.

A-2 Creating an Application

This section demonstrates how to build a Visual Basic application. The application estimates the sea-surface temperature by considering the greenhouse gas simulation factor in the main menu and display only the simulation results in numerical form. There are three steps to creating an application:

- Create the interface
- Set properties
- Write code

A-2.1 Create the Interface

To create an application, users first need to open a new project by choosing the New Project command from the File menu. A project includes:

- Forms-background, windows, and dialog boxes.
- Controls-graphical objects placed on forms.
- Code-procedures and declarations.

Every new project contains one form. Users can add many additional forms as application needs. The Climatic Temperature Change (CTC) Simulation

application requireds five forms (simulation factor menu, simulation variables and parameters data menu, simulation greenhouse gas concentration data menu, simulation result form and display menu, and simulation result menu). Each form is the background of the application. Users can change the size and location of the form to fit the application's design.

Next, we'll select the tools we need from the Toolbox to draw the controls we want on the form. To create a control, select the tool from the Toolbox, and then hold down the left mouse button while dragging out an area on the form. Users can creates a control in the default size by double-clicking the tool or selecting a tool and pressing ENTER. The CTC simulation program consists of these elements:

A-2.1.1 Simulation factor menu interface

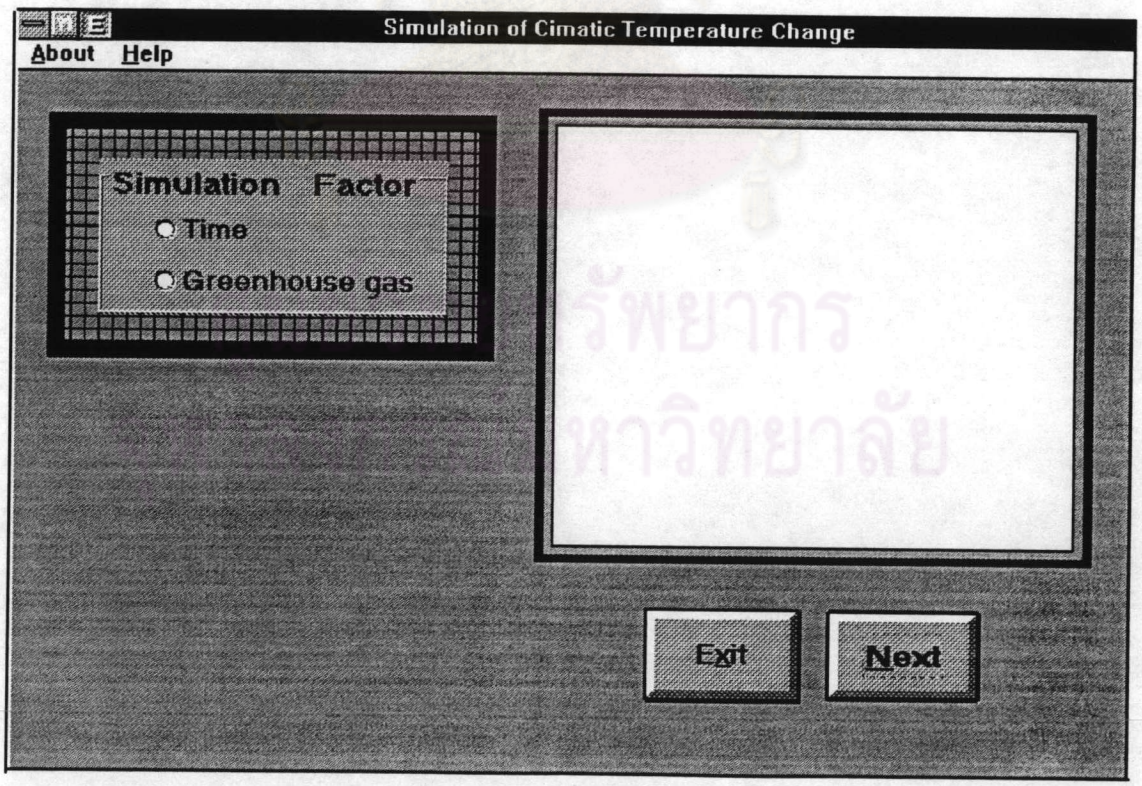

Figure A-8 Simulation Factor Menu Interface

A-2.1.2 Simulation variables and parameters data menu interface

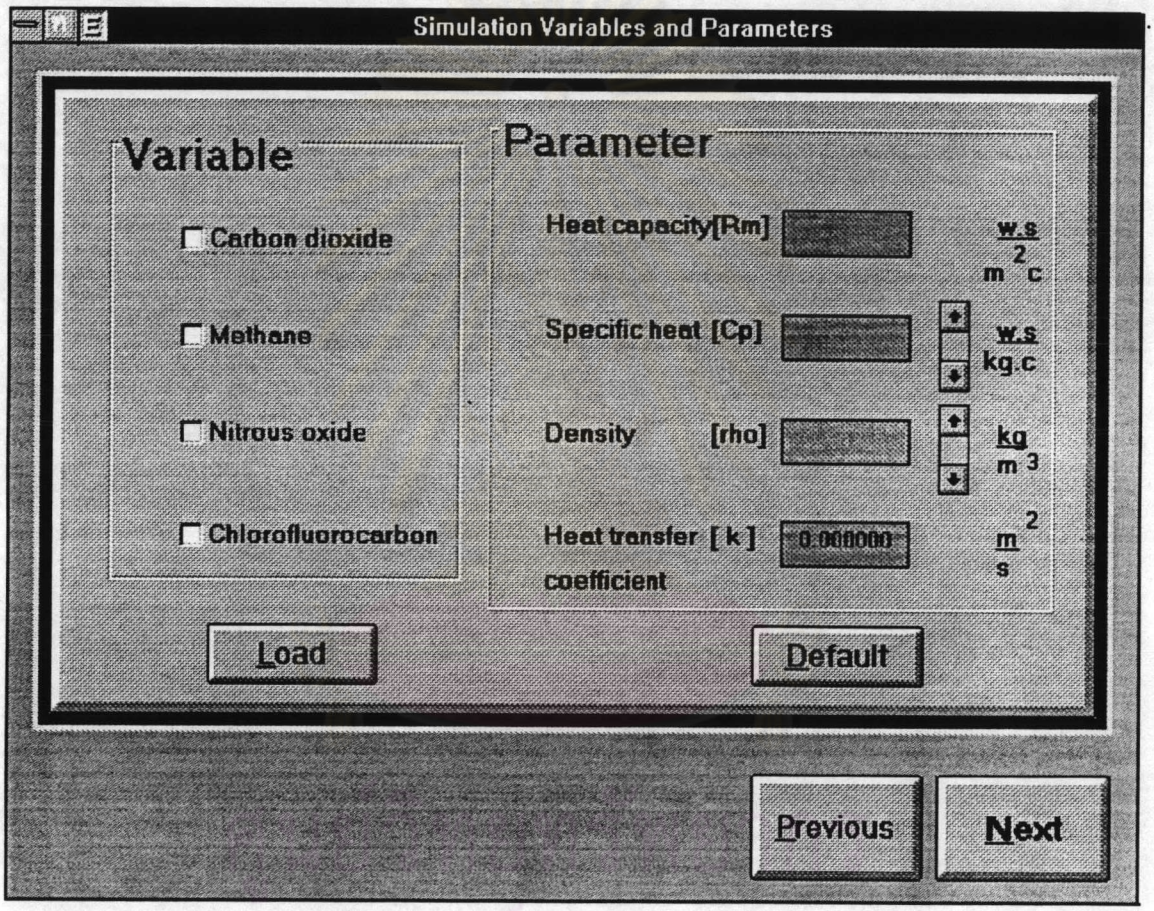

Figure A-9 Simulation Variables and Parameters Data Menu Interface

A-2.1.3 Simulation greenhouse gas concentration data menu interface

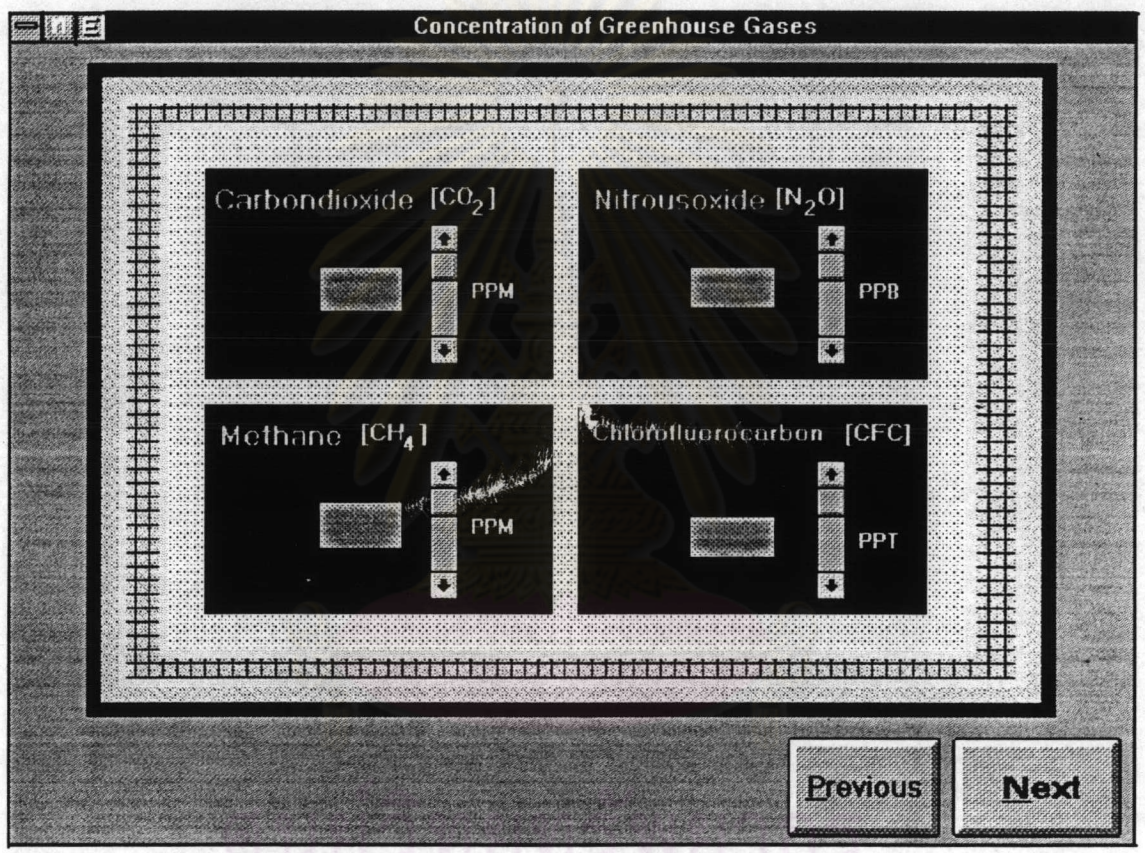

Figure A-10 Simulation Greenhouse Gas Concentration Data Menu Interface

A-2.1.4 Simulation result form and display menu interface

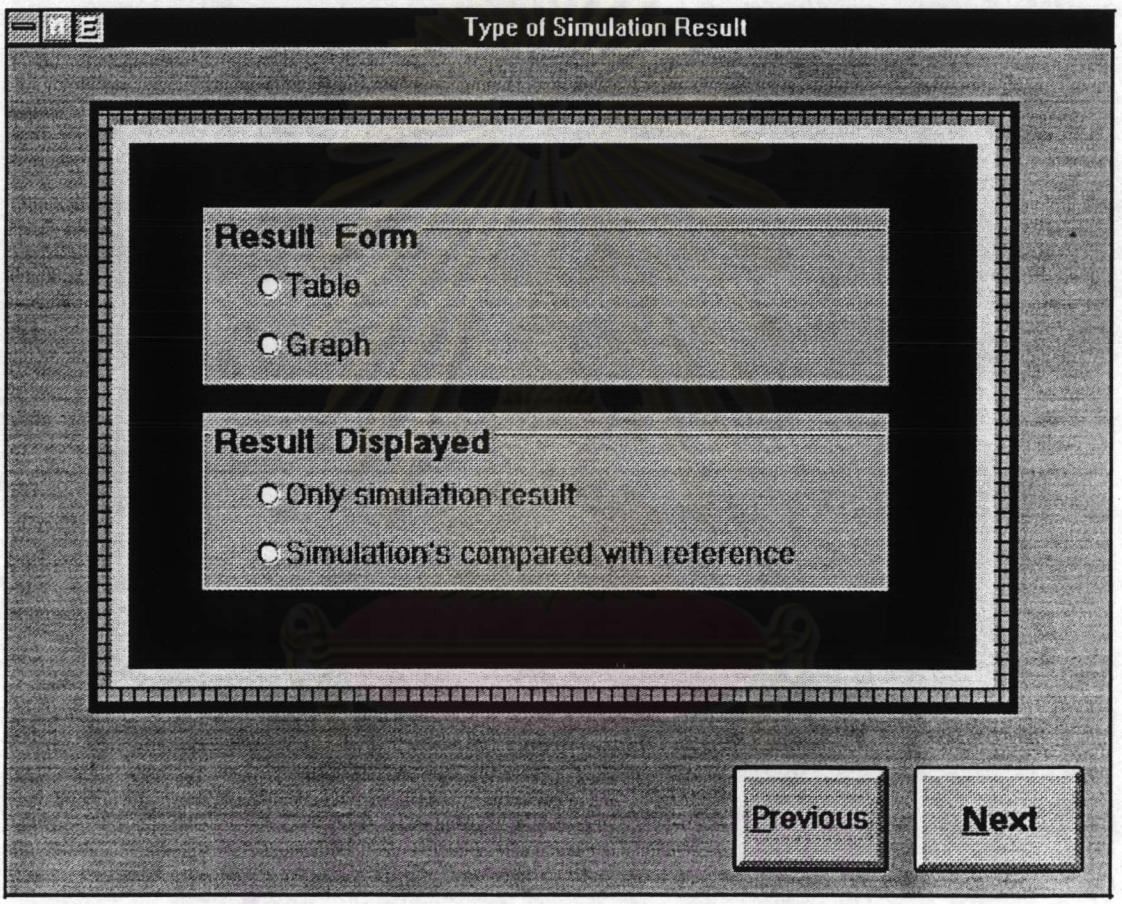

Figure A-11 Simulation Result Form and Display Menu Interface

A-2.1.5 Simulation result menu interface

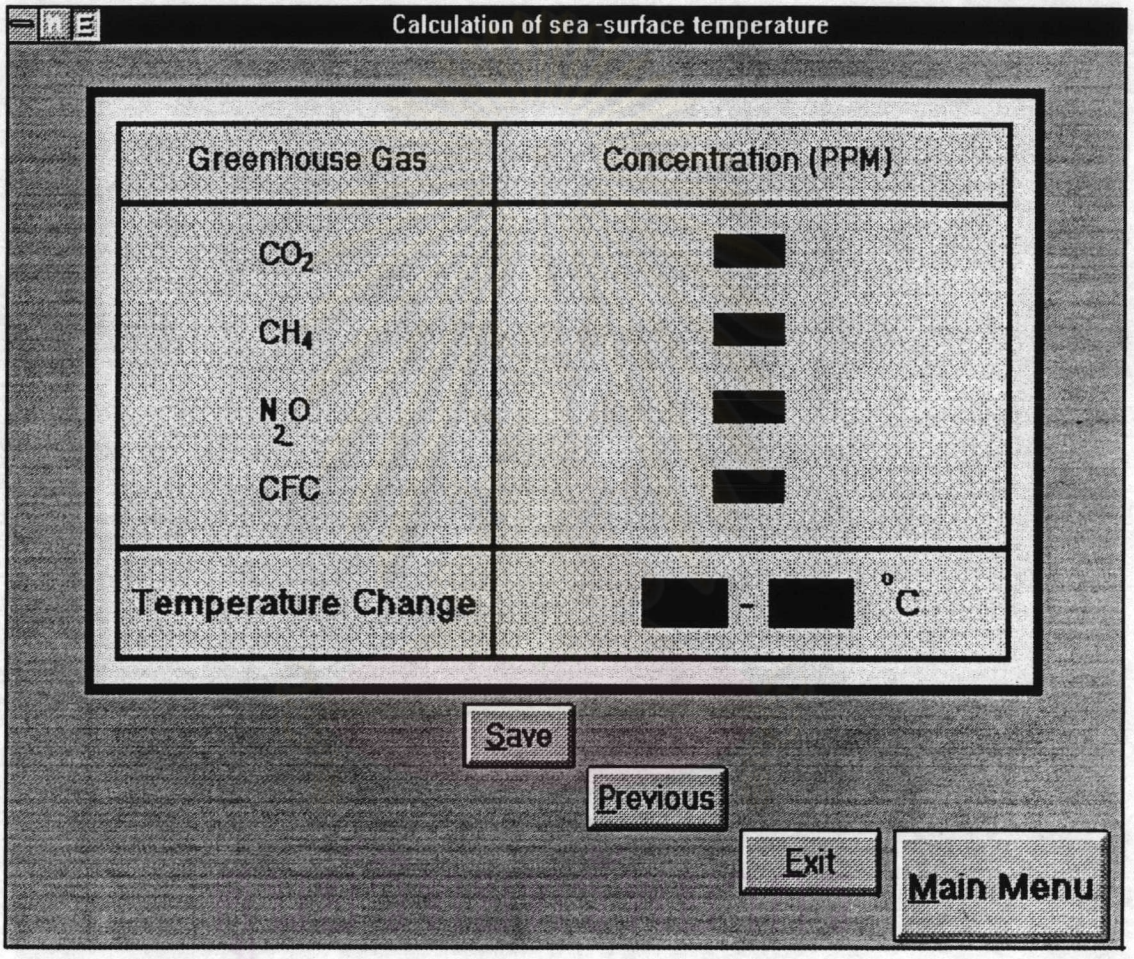

Figure A-12 Simulation Result Menu Interface

A-2.2 Set properties

Users set the properties of a control in the Properties window. When users select a form or control, its properties and their settings are displayed in the Properties window. For example, users use the Name properties to refer to a control in code. The Caption properties specifies the text that is displayed in the control.

A-2.2.1 Simulation Factor Menu Properties

- Form

Properties	Setting
BackColor	&H00FFFF00&
Caption	Simulation of Climatic Temperature Change
MaxButton	False
MinButton	False
Name	Main
WindowState	2-Maximized

- Shape1

Properties	Setting
BackColor	0-Transparent
BorderColor	&H00FF0000&
BorderWidth	10
FillColor	&H00FF0000&
FillStyle	6-Cross
Shape	0-Rectangle

- Frame3D1

Properties	Setting
Caption	Simulation Factor
Font3D	2-Raise w/heavy shading
FontSize	13.5
ForeColor	&H000000FF&

- Option3D1/2

Properties	Setting
Caption	Time/Greenhouse gas
Font3D	1-Raise w/light shading
FontSize	12
ForeColor	&H00FF0000&

- Command3D1/2

Properties	Setting
BevelWidth	5
Caption	E&xit/&Next
Font3D	1-Raise w/light shading
FontSize	12/13.5
ForeColor	&H00000000&/&H00FF0000&

A-2.2.2 Simulation Variables and Parameters Data Menu Properties

- Form1

Properties	Setting
BackColor	&H00FFFF00&
Caption	Simulation Variables and Parameters
MaxButton	False
MinButton	False
WindowState	Maximized

- Frame3D1/2

Properties	Setting
Caption	Variable/Parameter
Font3D	2-Raise w/heavy shading
FontSize	18
ForeColor	&H000000FF&
ShadowColor	0-Dark Grey
ShadowStyle	0-Inset/1-Raise

- Shape1

Properties	Setting
BorderColor	&H00FF0000&
BorderWidth	3
FillColor	&H00FF0000&
FillStyle	0-solid
Shape	0-Rectangle

- Check3D1/2/3/4

Properties	Setting
Caption	Carbon dioxide/Methane/ Nitrous oxide/ Chlorofluorocarbon
FontSize	9.75
ForeColor	&H00FF0000&

- Text1/2/3

Properties	Setting
BackColor	&H0000FF00&
ForeColor	&H000000FF&
MaxLength	0/4/4
MultiLine	False

- MhrealInput1

Properties	Setting
Alignment	2-Center
DecimalPlaces	6
FillColor	&H0000FF00&
Text	0.000000
TextColor	&H000000FF&

- Label1

Properties	Setting
Caption	Heat capacity
FontSize	9.75

- Command3D1/2/3/4

Properties	Setting
BevelWidth	4/4/3/3
Caption	&Previous/&Next/ &Load/&Default
Font3D	1-Raise w/light shading
FontSize	12/13.5/12/12
ForeColor	Default (1,3-4) &H00FF0000& (2)

- VScroll2/3

Properties	Setting
LargeChange	500/100
Max	0
Min	5000/1000
SmallChange	100/10

A-2.2.3 Simulation Greenhouse Gas Concentration Menu Properties

- Form

Properties	Setting
BackColor	&H00FFFF00&
Caption	Concentration of Greenhouse Gases
MaxButton	False
MinButton	False
Name	W_GHG_conc
WindowState	2-Maximized

- Shape6/7/8

Properties	Setting
BorderColor	&H0000CC0&/&H0000C0C0& /&H00FF0000&
BorderWidth	5/5/8
FillColor	&H00FF0000&/H00C0E0FF& /&H0080FF80&
FillStyle	6-Cross/O-Solid/O-Solid
Shape	O-Rectangle

- Shape1/2/3/4

Properties	Setting
BackStyle	1-Opaque
Shape	O-Rectangle

- Text1/2/3

Properties	Setting
BackColor	&H0000FF00&
FontSize	9.75
ForeColor	&H000000FF&

- Label1

Properties	Setting
Caption	Carbon dioxide
FontSize	12
ForeColor	&H00FF00FF&

- Vscroll 1/2/3/4

Properties	Setting
LargeChange	20/20/100/100
Max	288/0/0/0
Min	353/100/400/1300
SmallChange	1

- Command3D 1/2

Properties	Setting
BevelWidth	4
Caption	&Next/&Previous
Font3D	1-Raise w/light shading
FontSize	13.5/12
ForeColor	Default/&H00FF0000&

A-2.2.4 Simulation Result Form and Display Menu Properties

- Form

Properties	Setting
BackColor	&H00FFFF00&
Caption	Type of Simulation Result
MaxButton	False
MinButton	False
Name	W_Resu2_Typ
WindowState	2-Maximized

- Shape4/5

Properties	Setting
BorderColor	&H0000FFFF&/&H00FF0000&
BorderWidth	10/5
FillColor	&H00FF0000&/&H00FF0000& /&H0080FF80&
FillStyle	0-Solid/6-Cross
Shape	0-Rectangle

- Frame3D1/2

Properties	Setting
Caption	Result Form/Result Display
Font3D	2-Raise w/heavy shading
FontSize	13.5
ForeColor	&H00FF0000&
ShadowColor	0-Dark Grey
ShadowStyle	1-Raise

- Option3D1/2/3/4

Properties	Setting
Caption	Table/Graph /Only simulation result /Simulation's compared with reference
Font3D	2-Raise w/heavy shading
FontSize	12
ForeColor	&H000000C0&

- Command3D1/2

Properties	Setting
BevelWidth	4
Caption	&Next/&Previous
Font3D	1-Raise w/light shading
FontSize	12/13.5
ForeColor	Default/&H00FF0000&

A-2.2.5 Simulation Result Properties

- Form

Properties	Setting
BackColor	&H00FFFF00&
Caption	Calculation of Sea-Surface Temperature
MaxButton	False
MinButton	False
Name	W_Table2_Temp
WindowState	2-Maximized

- Shape1/2

Properties	Setting
BorderColor	&H000000FF&/&H00FF0000&
BorderWidth	3/5
FillColor	&H0080FF80&/&H0000FFFF&
FillStyle	0-Solid
Shape	0-Rectangle

- Text1/2/3/4/5/6

Properties	Setting
BackColor	&H000000FF&(1-4)
	&H00FF0000&(5-6)
BorderStyle	O-None
FontSize	9.75
ForeColor	&H0000FFFF&(1-4)
	&H0000FFFF&(5-6)
Name	CO2/CH4/N2O_2/CFC_2
	/Delta_T(0)/Delta_T(1)

- Label2

Properties	Setting
Caption	Concentration(PPM)
FontSize	12
ForeColor	&H00FF0000&

- Command3D1/2/3/4

Properties	Setting
BevelWidth	3/3/4/3
Caption	&Previous/&Exit
	/&Save/&Main Menu
Font3D	1-Raise w/light shading
FontSize	12/12/13.5/12
ForeColor	Default(1-2,4)
	&H00FF0000&(3)

A-3 Write code

To make the application respond to the user's actions, we looks at the third general step involved in developing a Visual Basic application. In this section, we attach the code to the various controls to bring the application to life.

Every control that users draw on the form, as well as the form itself, can response to a specific set of events. The number and types of events vary for each kind of control. In coding a Visual Basic, users must associate the different controls (the number varies between one control to all of the controls on the form if users have a very sophisticated application) to the events they should handle. The association between a control and an event is called code attachment.

Developing and attaching code for your Visual Basic application occurs in the Code window. This is a special window that makes it easier to write event-handling procedures. The features of the Code window include providing templates for the event-handling procedures and offering comboboxes that list the various objects and their events.

To access the Code window, users can perform one of the following:

- Double-click on the form or a control
- Press the F7 function
- Select the View Code option from the Code menu

A-3.1 Simulation Factor Menu Code

The program starts from Main menu as shown in Figure A-7. There are two types of simulation factors in this menu. Select greenhouse gas factor and then click Next button to continue to input data for calculation.

Coding 1 source code for continue to the next window after selecting the greenhouse gas simulation factor

```
Sub Command3D2_Click ()
'Declare variables
    Dim DgDef, Msg, Response, Title
'Describe dialog
    DgDef = MB_OK + MB_ICONEXCLAMATION + MB_DEFBUTTON1
    Msg = " Please select the simulation factor ! "
    Title = " Alert!!! "
If (Option3D1 = False And Option3D2 = False) Then
    Response = MsgBox(Msg, DgDef, Title)'Get user response
        If Response = IDOK Then
            main.Show
        End If
        Else
            If (Option3D1 = True) Then
                main.Hide
                Fact_Var_T.Show
            Else
            If (Option3D2 = True) Then
                main.Hide
                Fact_Var.Show
```

```
                End If
            End If
        End If
End Sub
```

A-3.2 Simulation Variables and Parameters Data Menu Code

The calculation of this simulation will be started from selecting the considered greenhouse gas type, at least carbon dioxide, inputing heat capacity, specific heat, and heat transfer coefficient of sea water. When all data in this menu is selectd and inputed, click Next button to continue.

Coding2 source code for continue to the greenhouse gas data menu after selecting, and inputing all of simulation variables and parameters already.

```
Sub Command3D2_Click ()
'Declare variables
    Dim DgDef
    Dim Msg
    Dim Response
    Dim Title
Title = "Alert!!!"
DgDef = MB_OK + MB_DEFBUTTON1   'Describe dialog
Msg2 = "You must consider CO2 !"
Msg2 = Msg2 & " Please select "

'1. Make user response when condiser GHG factor but does not select type
'of GHG.
```

```
        If (Check3D1 = False) Then
            Response = MsgBox(Msg2, DgDef, Title)'Get user response
        End If

'2. Make user response when insert wrong value(0,"") on simulation parameter.
        If Val(Fact_Var.Text1) = 0 Or Val(Fact_Var.Text2) = 0 Or Val
        (Fact_Var.Text3) = 0 Or Val(Fact_Var.MhRealInput1) = 0 Then
            MsgBox ("Wrong input on simulation parameter ! Please insert new
            value :")
        End If

'3. When select simulation factor and parameter aready ,go to next window
        If Val(Fact_Var.Text1) > 0 And Val(Fact_Var.Text2) > 0 And Val
        (Fact_Var.Text3) > 0 And Val(Fact_Var.MhRealInput1) > 0 And (Check3D1
        = True) Then

'1.When users consider only CO2
        If (Check3D1 = True) And (Check3D2 = False) And (Check3D3 = False)
            And (Check3D4 = False) Then
            W_GHG_conc.Panel3D1.Visible = False
            W_GHG_conc.Panel3D2.Visible = True
            W_GHG_conc.Panel3D3.Visible = True
            W_GHG_conc.Panel3D4.Visible = True

'2.When usesr consider CO2, and CH4
        Else
            If (Check3D1 = True) And (Check3D2 = True) And (Check3D3 =
            False) And (Check3D4 = False) Then
```

```
                W_GHG_conc.Panel3D1.Visible = False
                W_GHG_conc.Panel3D2.Visible = False
                W_GHG_conc.Panel3D3.Visible = True
                W_GHG_conc.Panel3D4.Visible = True

'3.When users consider CO2, CH4, and N2O
        Else
                If (Check3D1 = True) And (Check3D2 = True) And (Check3D3 =
                True) And (Check3D4 = False) Then
                        W_GHG_conc.Panel3D1.Visible = False
                        W_GHG_conc.Panel3D2.Visible = False
                        W_GHG_conc.Panel3D3.Visible = False
                        W_GHG_conc.Panel3D4.Visible = True

'4.When users consider CO2, CH4, N2O, and CFC
        Else
                If (Check3D1 = True) And (Check3D2 = True) And (Check3D3 =
                True) And     (Check3D4 = True) Then
                        W_GHG_conc.Panel3D1.Visible = False
                        W_GHG_conc.Panel3D2.Visible = False
                        W_GHG_conc.Panel3D3.Visible = False
                        W_GHG_conc.Panel3D4.Visible = False

'5.When users consider CO2, and N2O
        Else
                If (Check3D1 = True) And (Check3D2 = False) And (Check3D3 =
                True) And (Check3D4 = False) Then
                        W_GHG_conc.Panel3D1.Visible = False
```

```
W_GHG_conc.Panel3D2.Visible = True
W_GHG_conc.Panel3D3.Visible = False
W_GHG_conc.Panel3D4.Visible = True
```

6.When users consider CO_2, N_2O, and CFC

```
Else
    If (Check3D1 = True) And (Check3D2 = False) And (Check3D3 =
    True) And (Check3D4 = True) Then
        W_GHG_conc.Panel3D1.Visible = False
        W_GHG_conc.Panel3D2.Visible = True
        W_GHG_conc.Panel3D3.Visible = False
        W_GHG_conc.Panel3D4.Visible = False
```

'7.When users consider CO_2, and CFC

```
Else
    If (Check3D1 = True) And (Check3D2 = False) And (Check3D3 =
    False) And (Check3D4 = True) Then
        W_GHG_conc.Panel3D1.Visible = False
        W_GHG_conc.Panel3D2.Visible = True
        W_GHG_conc.Panel3D3.Visible = True
        W_GHG_conc.Panel3D4.Visible = False
    End If
    End If
    End If
    End If
    End If
    End If
    End If
```

```
        W_GHG_conc.Show
End If
End Sub
```

A-3.3 Simulation Greenhouse Gas Concentration Data Menu Code

In this menu, when users inputing the selected atmospheric greenhouse gas concentration as Figure A-10 already, click Next button to continue.

Coding3 source code for get data from Vscrollbar and continue to select the type of simulation result in the next window

```
Sub Command3D1_Click ()
'Declare variables
        Dim DgDef
        Dim Msg
        Dim Response
        Dim Title
Title = "Alert!!!"
Msg = "You did't input the concentration of selected greenhouse gas!"
Msg = Msg & " Please select "
DgDef = MB_OK + MB_DEFBUTTON1   'Describe dialog

If (Panel3D1.Visible = False) And (Panel3D2.Visible = False) And (Panel3D3.Visible
= False) And (Panel3D4.Visible = False) Then
        If Val(W_GHG_conc.Text1) = 0 Or Val(W_GHG_conc.Text2) = 0 Or Val
        (W_GHG_conc.Text3) = 0 Or Val(W_GHG_conc.Text4) = 0 Then
                Response = MsgBox(Msg, DgDef, Title)'Get user response
                W_GHG_conc.SetFocus
```

```
        Else
            W_Resu2_Typ.Show
        End If
End If

If (Panel3D1.Visible = False) And (Panel3D2.Visible = False) And (Panel3D3.Visible
= False) And (Panel3D4.Visible = True) Then
        If Val(W_GHG_conc.Text1) = 0 Or Val(W_GHG_conc.Text2) = 0 Or Val
        (W_GHG_conc.Text3) = 0 Then
            Response = MsgBox(Msg, DgDef, Title)'Get user response
            W_GHG_conc.SetFocus
        Else
            W_Resu2_Typ.Show
        End If
End If

If (Panel3D1.Visible = False) And (Panel3D2.Visible = False) And (Panel3D3.Visible
= True) And (Panel3D4.Visible = False) Then
        If Val(W_GHG_conc.Text1) = 0 Or Val(W_GHG_conc.Text2) = 0 Or Val
        (W_GHG_conc.Text4) = 0 Then
            Response = MsgBox(Msg, DgDef, Title)'Get user response
            W_GHG_conc.SetFocus
        Else
            W_Resu2_Typ.Show
        End If
End If
```

```
If (Panel3D1.Visible = False) And (Panel3D2.Visible = True) And (Panel3D3.Visible
= False) And (Panel3D4.Visible = False) Then
        If Val(W_GHG_conc.Text1) = 0 Or Val(W_GHG_conc.Text3) = 0 Or Val
        (W_GHG_conc.Text4) = 0 Then
                Response = MsgBox(Msg, DgDef, Title)'Get user response
                W_GHG_conc.SetFocus
        Else
                W_Resu2_Typ.Show
        End If
End If

If (Panel3D1.Visible = False) And (Panel3D2.Visible = False) And (Panel3D3.Visible
= True) And (Panel3D4.Visible = True) Then
        If Val(W_GHG_conc.Text1) = 0 Or Val(W_GHG_conc.Text2) = 0 Then
                Response = MsgBox(Msg, DgDef, Title)'Get user response
                W_GHG_conc.SetFocus
        Else
                W_Resu2_Typ.Show
        End If
End If

If (Panel3D1.Visible = False) And (Panel3D2.Visible = True) And (Panel3D3.Visible
= False) And (Panel3D4.Visible = True) Then
        If Val(W_GHG_conc.Text1) = 0 Or Val(W_GHG_conc.Text3) = 0 Then
                Response = MsgBox(Msg, DgDef, Title)'Get user response
                W_GHG_conc.SetFocus
        Else
                W_Resu2_Typ.Show
```

```
        End If
End If

If (Panel3D1.Visible = False) And (Panel3D2.Visible = True) And (Panel3D3.Visible
= True) And (Panel3D4.Visible = False) Then
        If Val(W_GHG_conc.Text1) = 0 Or Val(W_GHG_conc.Text4) = 0 Then
                Response = MsgBox(Msg, DgDef, Title)'Get user response
                W_GHG_conc.SetFocus
        Else
                W_Resu2_Typ.Show
        End If
End If

If (Panel3D1.Visible = False) And (Panel3D2.Visible = True) And (Panel3D3.Visible
= True) And (Panel3D4.Visible = True) Then
        If Val(W_GHG_conc.Text1) = 0 Then
                Response = MsgBox(Msg, DgDef, Title)'Get user response
                W_GHG_conc.SetFocus
        Else
                W_Resu2_Typ.Show
        End If
End If
End Sub
```

A-3.4 Simulation Result Form and Display Menu Code

In this stage, we choose form of results to be displayed as only numerical results. Then, the change of sea-surface temperature was estimate, and to be displayed in simulation result menu after clicking the Next command button.

Coding4 source code for selection the type of simulation result

```
Sub Command3D2_Click ()
'Declare variables
        Dim DgDef
        Dim Msg
        Dim Response
        Dim Title
        Dim Temp
        Dim Interval As Double
        Dim mam As Double
Title = "Alert!!!"
Msg = "You did't select form of simulation result !"
Msg = Msg & " Please select "
DgDef = MB_OK + MB_DEFBUTTON1   'Describe dialog
Msg1 = "You did't select simulation displayed !"
Msg1 = Msg1 & " Please select

'1.Get user response when doesn't select the result form.
If (Option3D1.Value) = False And (Option3D2.Value) = False Then
        Response = MsgBox(Msg, DgDef, Title)'Get User Response
End If

'2. Get user response when doesn't select the result displayed.
If (Option3D3.Value) = False And (Option3D4.Value) = False Then
```

```
        Response = MsgBox(Msg1, DgDef, Title)'Get User Response
End If

'3. Go to the next window when user selected both result form and result
'displayed already.
If ((Option3D1.Value = True) Or (Option3D2.Value = True)) And
((Option3D3.Value = True) Or (Option3D4.Value = True)) Then

'4. *****Calculation of Sea Surface Temperature (celcius)*****
'Define all constants and dimension
'       tc1 = 33 Years = 1.0407*10^9 Second
'       tc2 = 33.3 Years
        Const tc1 = 1040700000#
        Const tc2 = 33.3
        Const CO2_GWP = 1
        Const CH4_GWP = 21
        Const N2O_GWP = 290
        Const CFC_GWP = 5400
        Dim D1_1, D1_2, D1_3, D1_4, D2_1, D2_2, D2_3, D2_4 As Double
        Dim D11, D21, D3, D4, D51, D61, D71, D81, D91, D10, D13 As Double
        Dim D12, D22, D52, D62, D72, D82, D92 As Double
        Dim DF As Double

'Define model parameters
        k = Val(Fact_Var.MhRealInput1)
        rho = Val(Fact_Var.Text3)
        Cp = Val(Fact_Var.Text2)
        Rm = Val(Fact_Var.Text1)
```

```
'Define GHG concentration
        CO2 = Val(W_GHG_conc.Text1.Text)
        CH4 = Val(W_GHG_conc.Text2.Text)
        N2O_1 = Val(W_GHG_conc.Text3.Text)
        CFC_1 = Val(W_GHG_conc.Text4.Text)
        N2O_2 = N2O_1 / 1000          'change PPB to PPM
        CFC_2 = CFC_1 / 1000000       'change PPT to PPM

'Concentration Index (D1_1,D1_2,D1_3,D1_4)
'Temperature Change Index(D2_1,D2_2,D2_3,D2_4)
If Fact_Var.Check3D1.Value = True Then
        D1_1 = CO2 / CO2
        D2_1 = CO2_GWP / D1_1

If Fact_Var.Check3D2.Value = True Then
        D1_2 = CO2 / CH4
        D2_2 = CH4_GWP / D1_2
Else
        D1_2 = 0
        D2_2 = 0

If Fact_Var.Check3D3.Value = True Then
        D1_3 = CO2 / N2O_2
        D2_3 = N2O_GWP / D1_3
Else
        D1_3 = 0
        D2_3 = 0
```

```
If Fact_Var.Check3D4.Value = True Then
        D1_4 = CO2 / CFC_2
        D2_4 = CFC_GWP / D1_4
Else
        D1_4 = 0
        D2_4 = 0
End If
End If
End If
End If

'Increasing heat flux(DF)
        DF = .0277 + (D2_2 * .0277) + (D2_3 * .0277) + (D2_4 * .0277)
        A1_GHG = DF / .71      'H.T.Coeff = infinite
        B1_GHG = 1.7746478     'H.T.Coeff = infinite
        A2_GHG = DF / .71      'H.T.Coeff = 0 (adjust)
        B2_GHG = 1.26          'H.T.Coeff = 0
        D3 = (k * tc1) ^ .5
        D4 = k * rho * Cp

'Case H.T.Coeff = infinite
'       D51 = B1_CO2 * D3
        D51 = B1_GHG * D3
        D61 = D51 / D4
        D71 = 1 + D61
'       D81 = A1_CO2 * D3
        D81 = A1_GHG * D3
        D91 = D81 / D4
```

```
        D11 = D91 / D71              '***C1
        D10 = Rm * D3
        D13 = D10 / D4
        D21 = D13 / D71              '***C2

'Case H.T.Coeff = 0
'       D52 = B2_CO2 * D3
        D52 = B2_GHG * D3
        D62 = D52 / D4
        D72 = 1 + D62
'       D82 = A2_CO2 * D3
        D82 = A2_GHG * D3
        D92 = D82 / D4
        D12 = D92 / D72              '***C1
        D22 = D13 / D72              '***C2

'******* Define Interval ********
'1.Consider CO2 (CO2_conc from World Resources,1992-93)
If (Fact_Var.Check3D1.Value = True) Then
        If (CO2 <= 287) Then
                Interval = 0
                Ref = 1860
        Else
                ...
        Else
                If (CO2 >= 352.2) And (CO2 <= 353.4) Then
                        Interval = 165
                        Ref = 2025
```

```
                End If
                ...
        End If
End If

'Go to the next window
'1.select table, display only simulation result
If (W_resu2_Typ.Option3D1.Value = True) And (W_resu2_Typ.Option3D3.Value =
True) Then
        'W_resu2_Typ.Hide
        Unload Me
        W_Table2_Temp.Show
        W_Table2_Temp.CO2.SetFocus
        W_Table2_Temp.CO2 = CO2
        W_Table2_Temp.CH4.SetFocus
        W_Table2_Temp.CH4 = CH4
        W_Table2_Temp.N2O_2.SetFocus
        W_Table2_Temp.N2O_2 = N2O_2
        W_Table2_Temp.CFC_2.SetFocus
        W_Table2_Temp.CFC_2 = CFC_2

'case H.T.Coeff = infinite
        W_Table2_Temp.Delta_T(0) = Format((D11 * (Exp(Interval / tc2) - 1)) / (1 +
                                        D21 / tc1)), "#0.0000")

'case H.T.Coeff = 0
        W_Table2_Temp.Delta_T(1) = Format((D12 * (Exp(Interval / tc2) - 1)) / (1 +
                                        (D22 / tc1)), "#0.0000")
```

```
'2.select table, display simulation result compared with reference
Else
If(W_resu2_Typ.Option3D1.Value=True)And(W_resu2_Typ.Option3D4.Value =True)
Then
        'W_resu2_Typ.Hide
        Unload Me
        W_Table2_R_Temp.Show
        W_Table2_R_Temp.CO2.SetFocus
        W_Table2_R_Temp.CO2 = CO2
        W_Table2_R_Temp.CH4.SetFocus
        W_Table2_R_Temp.CH4 = CH4
        W_Table2_R_Temp.N2O_2.SetFocus
        W_Table2_R_Temp.N2O_2 = N2O_2
        W_Table2_R_Temp.CFC_2.SetFocus
        W_Table2_R_Temp.CFC_2 = CFC_2

'case H.T.Coeff = infinite
        W_Table2_R_Temp.Delta_T(0) = Format(((D11 * (Exp(Interval / tc2) - 1)) / (1
                                    + (D21 / tc1)) + 13.7846), "#0.0000")

'case H.T.Coeff = 0
        W_Table2_R_Temp.Delta_T(1) = Format(((D12 * (Exp(Interval / tc2) - 1)) / (1
                                    + (D22 / tc1)) + 13.7846), "#0.0000")

'Reference Temperature
If Ref = 1860 Then
        W_Table2_R_Temp.R = 13.78
Else
```

```
...
If Ref = 1988 Then
        W_Table2_R_Temp.R = 14.5
...
End If

'3.select graph, display only simulation results
Else
If(W_resu2_Typ.Option3D2.Value=True)And(W_resu2_Typ.Option3D3.Value= True)
Then
        'W_resu2_Typ.Hide
        Unload Me
        W_Graph2_Temp.Show

'4.select graph, simulation results compare with reference
Else
If (W_resu2_Typ.Option3D2.Value=True)And(W_resu2_Typ.Option3D4.Value =
True) Then
        'W_resu2_Typ.Hide
        Unload Me
        W_Graph2_R_Temp.Show
End If          'Case1
End If          'Case2
End If          'Case3
End If          'Case4
End Sub
```

A-3.5 Simulation Result Menu Code

The last menu indicates the change of sea-surface temperature from 1860 's as a function of greenhouse gas concentration .

Coding5..source code for saving the simulation result in database

```
Sub Command3D4_Click ()
        Dim DB As Database
        Dim TB As Table
Set DB = OpenDatabase("C:\VB\CTC\CTC.mdb")
Set TB = DB.OpenTable("W_Table2_Temp")
Do Until TB.EOF
TB.Edit
        TB("CO2") = W_Table2_Temp.CO2
        TB("CH4") = W_Table2_Temp.CH4
        TB("N2O") = W_Table2_Temp.N2O_2
        TB("CFC") = W_Table2_Temp.CFC_2
        TB("Heat Capacity") = Val(Fact_Var.Text1.Text)
        TB("Specific Heat") = Val(Fact_Var.Text2.Text)
        TB("Density") = Val(Fact_Var.Text3.Text)
        TB("Heat Transfer Coefficient") = Val(Fact_Var.MhRealInput1.Text)
        TB("Result Form") = "Numerical"
        TB("Result Display") = "Only simulation result"
        TB("Min_Temp") = W_Table2_Temp.Delta_T(0)
        TB("Max_Temp") = W_Table2_Temp.Delta_T(1)
TB.Update
TB.MoveNext
Loop
```

```
TB.Close
DB.Close
End Sub
```

When users finish working on their application, users'll want to save the project. Choosing Save Project from the File menu prompts users to assign a name to the project. Once users save a project, users can go back and change its appearance or operation at any time.

APPENDIX B

HELP FILE DEVELOPMENT

In this research, Hypertext technique was used in developed theory section. Hypertext is a term for information that has been divides into separate modules and richly connected by electronic pathway. Windows Help is one form of hypertext. This section, ForeHelp was used for developing Help files, the Help topics are created in indepently usuable modules and provide numerous forms of access to those topics.

B-1 Tools for Development

In order to develop Windows Help files, it required several tools. These tools are listed as follows.

1. ForeHelp (FOREHELP.EXE) : It is used for creates topics, keywords, jump, popup, and so on in Windows Help files.
2. Windows Help (WINHELP.EXE) : It is used to run your .HLP file created by ForeHelp.
3. Help Compiler (HC.EXE, HC30.EXE, HC31.EXE) : This compiler used for converts your topic file (.RTF) into a binary file that is readable by Windows Help.
4. A various packages for develop graphic image (Photoshop, and so on) : It used for create pictures that required by your Help file.

B-2 The Development Cycle in Creating a Help System

The creation of a Help system for a Windows application comprises the following major tasks:

1. Collecting all information required by the Help system (ForeHelp)
2. Planning the Help system.
3. Create pictures if required.
4. Create topic.
5. Entering all required control codes into the text files in each topic.
6. Creating the Help Project file and the Rich Text files by the Build process.
7. Creating the Help file from the Help Project file and Rich Text file by the Compile process.
8. Programming the application so that it can access Windows Help.

B-3 Introduction to ForeHelp

ForeHelp lets you create Windows Help files quickly and easily, taking full advantage of all the Windows WinHelp system-placing hypertext hot spots on the text or graphics, creating browse sequences, embedding data from other applications in Windows.

All you need to create Help files is ForeHelp-it contains a full-featured WYSIWYG word processor, with spelling checking, a thesaurus, an advanced search and replace system, and the ability to create tables and use styles to format text. But ForeHelp will also let you work with existing files. You can import Help Project files you created with other help-authoring products (the .HPJ and .RTF files), import text files in the .RTF format, and import simple ASCII text files.

ForeHelp will even help you find problems from imported help projects while other programs make you "build" the Help file before you can check for mistakes, ForeHelp's test mode lets you immediately test a component!. It takes no more than a few seconds to go from the mode in which you create your project to the test mode. And when you do decide to build, you'll find that ForeHelp has error checking capabilities that will warn you of broken links, missing graphics file, special characters that might not be available on other people's computers, and other problems.

B-4 Creating a Topics

The topic is the basic unit of your Help Project. Think of a project as the equivalent of a book's chapter. A topic may range from just a few words, to many thousands of words. It may also include pictures.

To create a new topic

1. select Topic | New, or press Alt-N. The Topic Properties dialog box appears.
2. Type a name into the Topic Title text box (up to 127 characters). This Topic Title is used in the Help system's Search dialog box to identify a title while searching for keyword entries. It's also used while you are creating your project, to help you find your topics-for instant when you are creating popups and jumps, or using the Goto dialog box, you'll see a list of topic titles.
3. Accept new topic by OK

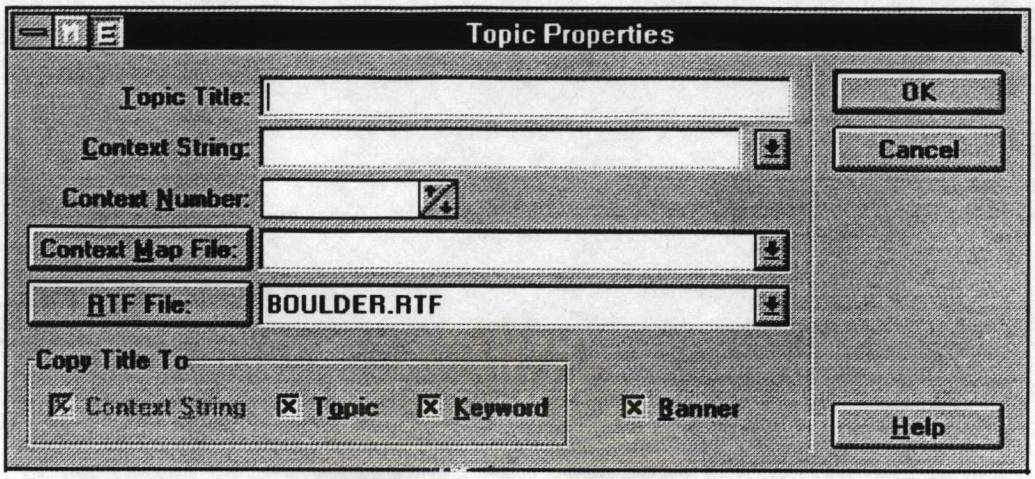

Figure B-1 Topic Properties Dialog box

B-5 Creating Text Files

You may want to import files from your word processor if you have an existing document that you want to turn into a hypertext document. ForeHelp contains its own word processor. This allows you to enter text, format characters and paragraphs, search and replace, spell check, use a thesaurus, and so on. Some users may want to create large projects in their primary word processor which will let them create tables of contents and indexes for the paper output, for instance-and then create an .RTF file and import the file into ForeHelp.

Text File (.TXT)

Almost every word processor lets you create text ASCII file. ForeHelp can import these directly. Once in ForeHelp you can use Forehelp's text formatting features to modify the appearance of the text.

If you want to use this form of import, you should create a text file with no line breaks. That is, paragraph marks should only appear at the end of paragraph, not at the end of each line. The Help system automatically wraps text, so you don't need to add line breaks. In fact, if you do add line breaks ForeHelp won't be able to wrap paragraphs cleanly, and you will end up with that looks ragged and disorganized.

Rich Text Format (.RTF)

Most Windows word processors can create Rich Text Format (.RTF) files. This lets you create documents and export the text with the text formatting and graphics. When you import an .RTF file into ForeHelp, your document will include the original character formats (bold, italic, underline, and so on), paragraph styles, tables, and pictures.

Importing Files

To import an .RTF or .TXT files, select Text|Insert file, or use toolbar button. When the Insert File dialog box appears, select the directory that contains the File, and select the format you want from the List Files of Type drop-down list box. (If you want to import an ASCII text file that has not been saved using the .TXT file extension, type that file's extension in place of .TXT and press Enter so you can see file in the list box.) Select the file you want to import, then click on the OK button. If the file you selected is a text file, the text is imported directly into the current topic (however, if it's a very large text file ForeHelp may not be able to import all of it).

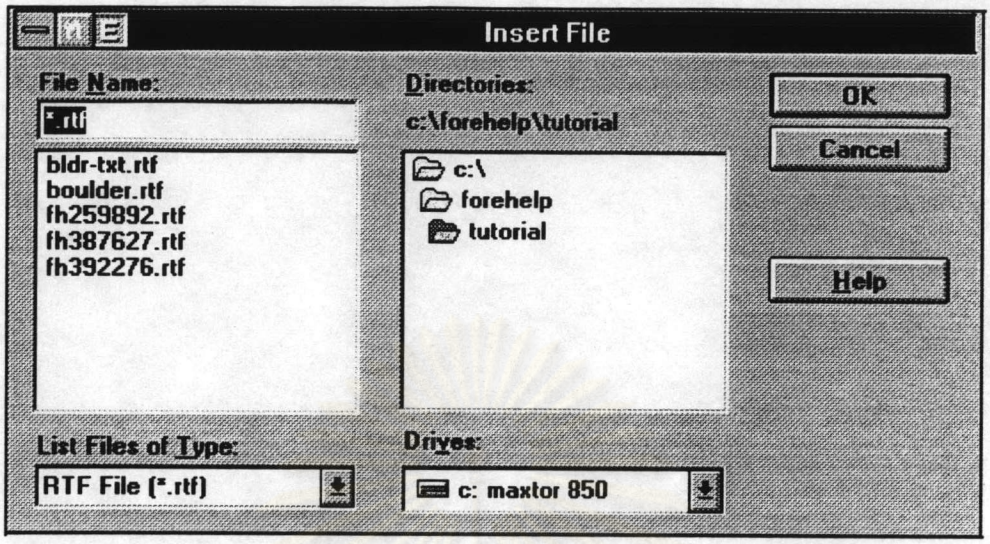

Figure B-2 Insert File Dialog Box

Copy and Paste

You can also copy text and graphics from other applications and paste them directly into a topic. Most Windows applications support the Clipboard's copy and paste features. Paper documents and Help Projects are very different things-they are organized in a different way, and importing a paper document straight into a Help Project will usually not create the best Help file. Instead you might want to consider creating all your topics in ForeHelp, and using the Clipboard to transfer information from the word processing files into the appropriate topics.

B-6 Entering Control Code into the Text File

In this section, you will see the specific information on using some control codes that used in this reserch.

Creating a Keyword

When the users use WinHelp's Search function, they sees a dialog box that lists, in alphabetical order, all the file's keywords. Each keyword is associated with one or more topics. Keywords are WinHelp's equivalent of index entries, and Search is its equivalent of the index. Topic keywords take the user to the top of the topic.

Creating topic keywords

1. Go to Modified Atmospheric-Oceanic Model topic
2. To create keywords associated with the Modified Atmospheric-Oceanic model topic. Select Topic | Keywords. The Topic Keywords dialog box appears. The current is displayed in the Topic box.
3. To create keywords associated with this topic, type Atmospheric Model in the All Keywords edit box, and press Enter.
4. Continue adding keywords for the Modified Atmospheric-Oceanic Model. Add: Oceanic Model.
5. Accept keywords by OK

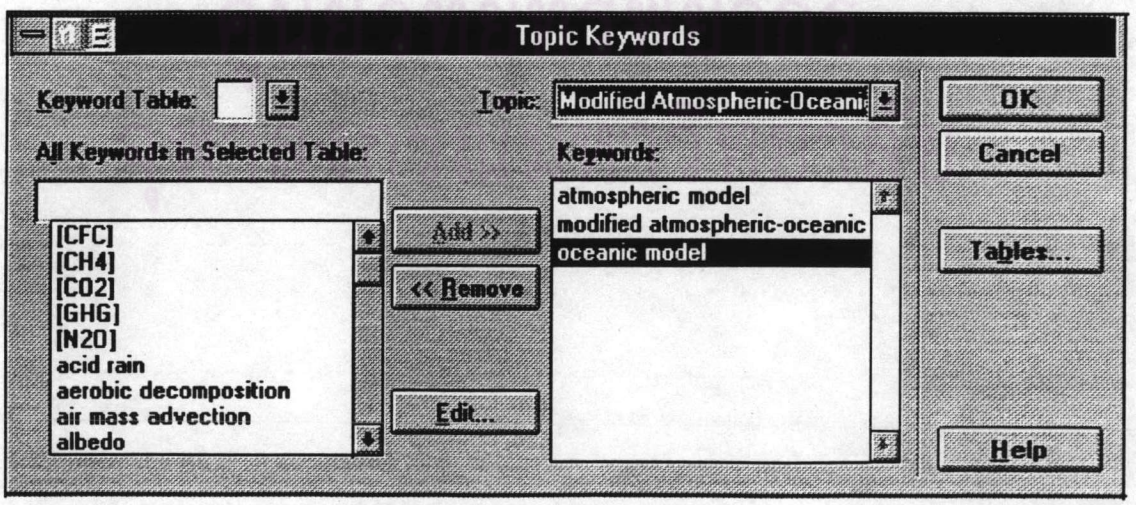

Figure B-3 Topic Keywords

Creating Jumps and Popup

Jumps and popups are areas of text or graphics which-when the user click on them or positions the highligth on them and press Enter-display additional information. In the case of a jump, the information replaces the current information. In the case of a popup, the information is placed in a small box on top of the current information.

For instance, popup are often used to display descriptions of key terms. When users assign a popup to the term parameters, the word will appear in the Help File with a dotted underline, and it will be a different color from the rest of the text. When the users point at the word and clicks the mouse button, a small box containing a description of the term will popup over the Help window.

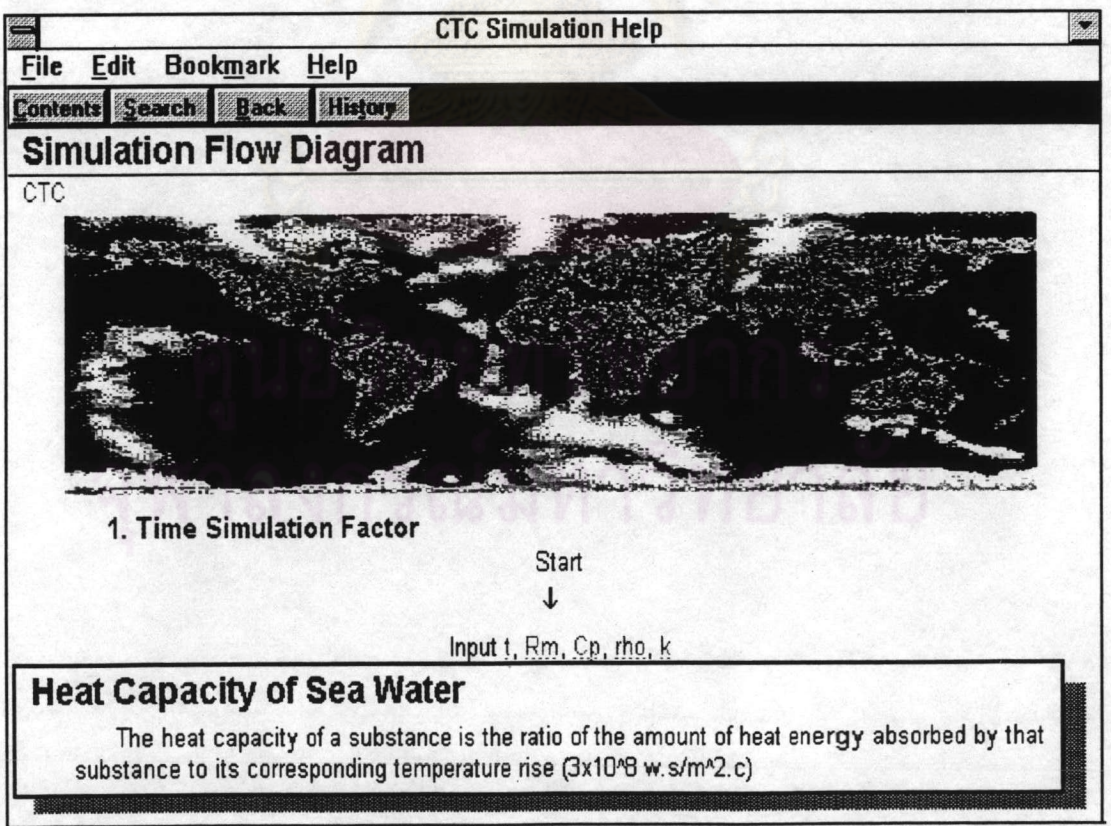

Figure B-4 Popup Example

When you point to a hotspot in WinHelp or in ForeHelp's test mode, the mouse pointer turns into a small hand. In ForeHelp's edit mode you must press Ctrl while you point. Also, in WinHelp or in foreHelp's test mode, a user can move the highlight from hotspot to hotspot by pressing Tab.

Creating a jump or popup in text

1. Highlight the text you want to apply the hotspot to, and then select Text make Jump (Ctrl-J) or Text | Make Popup (Ctrl-P)
2. Select the topic title or target that you want to use. The dialog box will list each topic, with the name of the topic's targets indented below each topic.
3. OK to accept the jump or popup process.

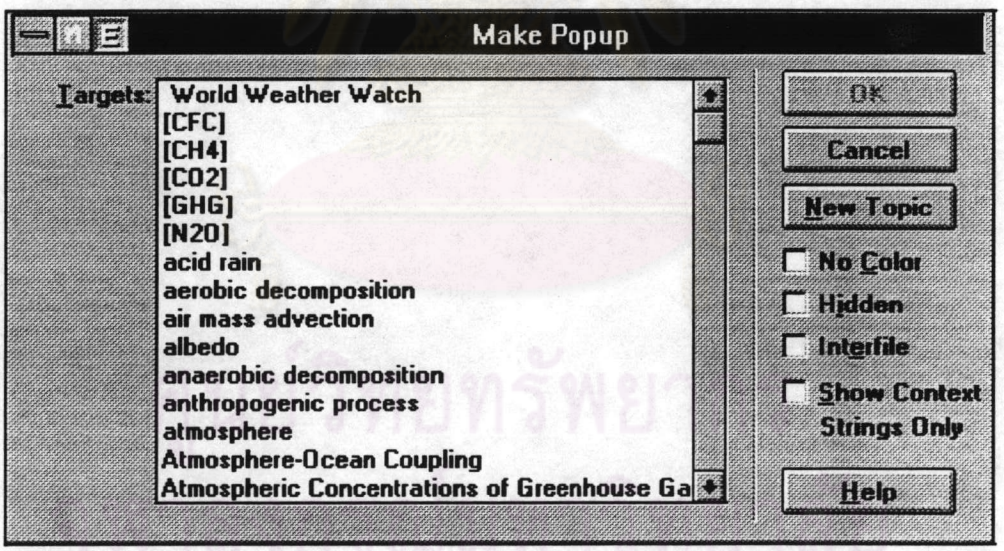

Figure B-5 Make Popup Dialog Box

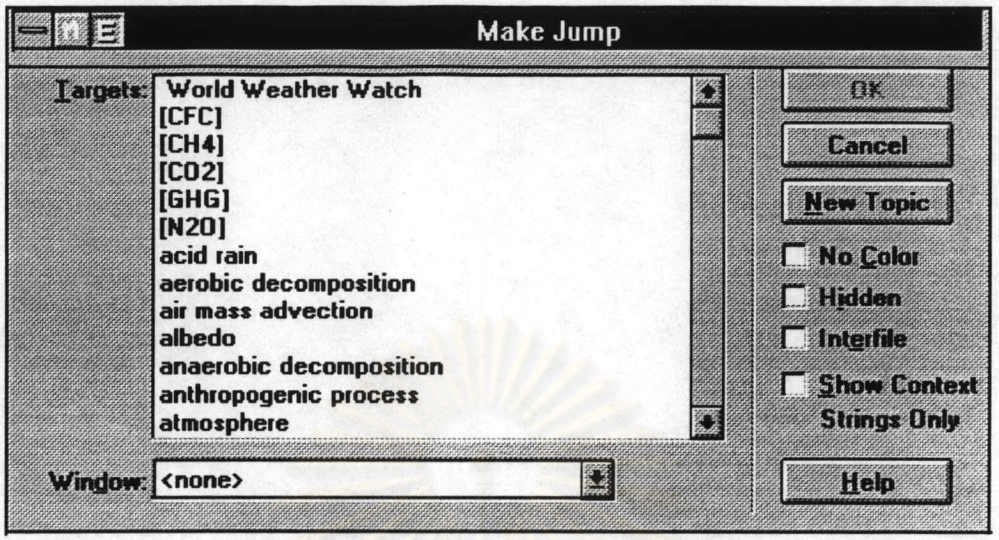

Figure B-6 Make Jump Dialog Box

B-7 Inserting Graphic Image

ForeHelp lets you insert pictures into a topics main or the banner. You can paste a graphic from the Clipboard or insert using the Text | Insert Picture command, or click on the Insert Picture toolbar button. You can insert bitmaps (.BMP or .DIB), Windows Metafiles (.WMF), Multi-resolution bitmap (.MRB), or hypergraphics (.SHG) files.

Inserting a graphic file

1. Select Text | Insert Picture.
2. Use the Drives, Directories, and File Name boxes to find the file you want to insert. You can use the List Files of Type drop-down list box to automatically select bitmaps (.BMP and .DIB), metafiles (.WMF), or Multi-Resolution files. When you click on a filename in the File Name list box, you'll see a sample of the picture in the box below the buttons.

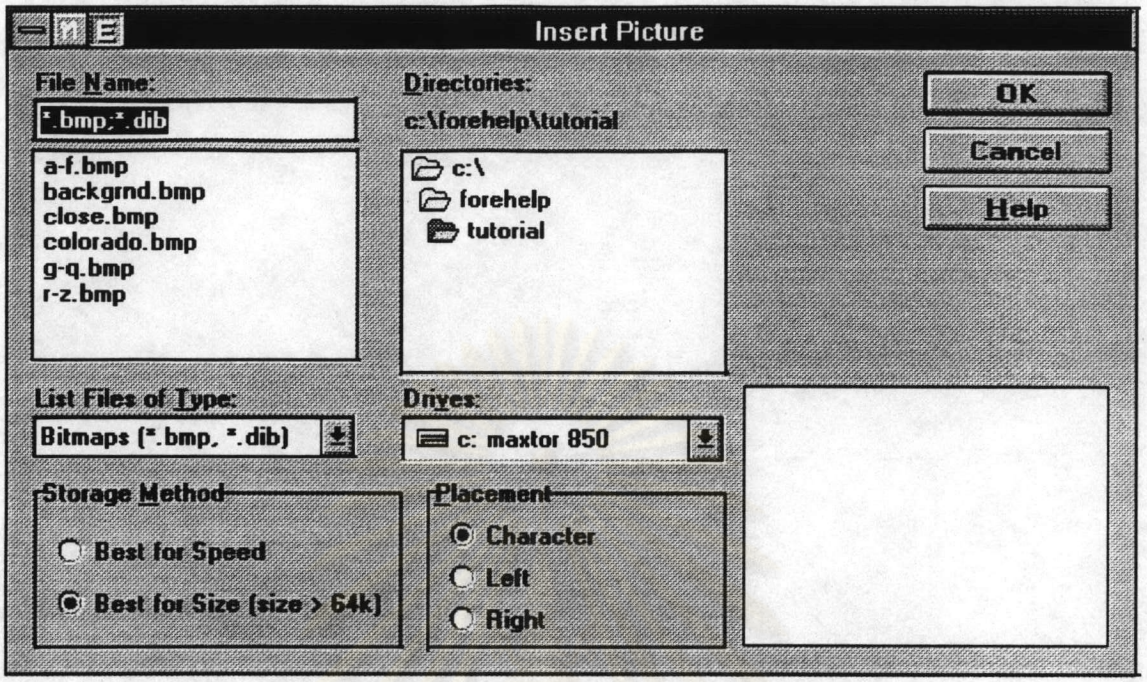

Figure B-7 Insert Picture Dialog Box

Copy and Paste Pictures

If you copy a picture from another application and paste it into ForeHelp (using Edit|Paste, Ctrl-V, or the Paste toolbar button), ForeHelp has to decide how to store the picture. If its less than 64 Kbytes in size, it will store it "inline," actually copying the picture into the Help-Project database files. If it is over 64 Kbytes in size it will store it in a temporary file in the Graphic directory, creating a reference in the Project Files for each time the picture is used.

B-8 Creating The Rich Text File (.RTF), Help Project File (.HPF), and Help File (.HLP)

Unlike most help-authoring tool, ForeHelp doesn't make you create your Help file until you are sure everything is correct. ForeHelp's test mode lets you

check that your hypertext links are correct before you spend the time it takes to create the final product.

There are actually two stages in creating a Help file. In the first stage, ForeHelp will build an .HPJ file and an .RTF file. The .HPJ file contains information about how your Help file will be created-which .RTF files to use, the copyright notice to use, a list of context numbers, wheter the .HLP file should be compressed, and so on. The .RTF files contain the topic data your text and inline graphics. In the second stage these files and the extenal graphic files are compiled into the final .HLP file, the file that can be opened by WinHelp.

ForeHelp lets you create your final Help file in two ways: you can do both stages at once, or you can do it in two separate stages. ForeHelp has some error-checking features that work during the Build phase. So if any errors occur you can fix them, then rebuild, and then compile, once you know everything's working correctly.

Also, you may want to create your .HLP file in two stages if you intend to add features that ForeHelp doesn't d support. In the first stage you will build the .HPJ and .RTF files-you can then edit these files in a word processor. Then you will take those files and use them to compile the final .HLP file.

In order to compile a .HLP file, you will need one of the Microsoft Help Compilers. ForeHelp can use any of these compilers:

- HCP.EXE
- HC.EXE
- HC31.EXE

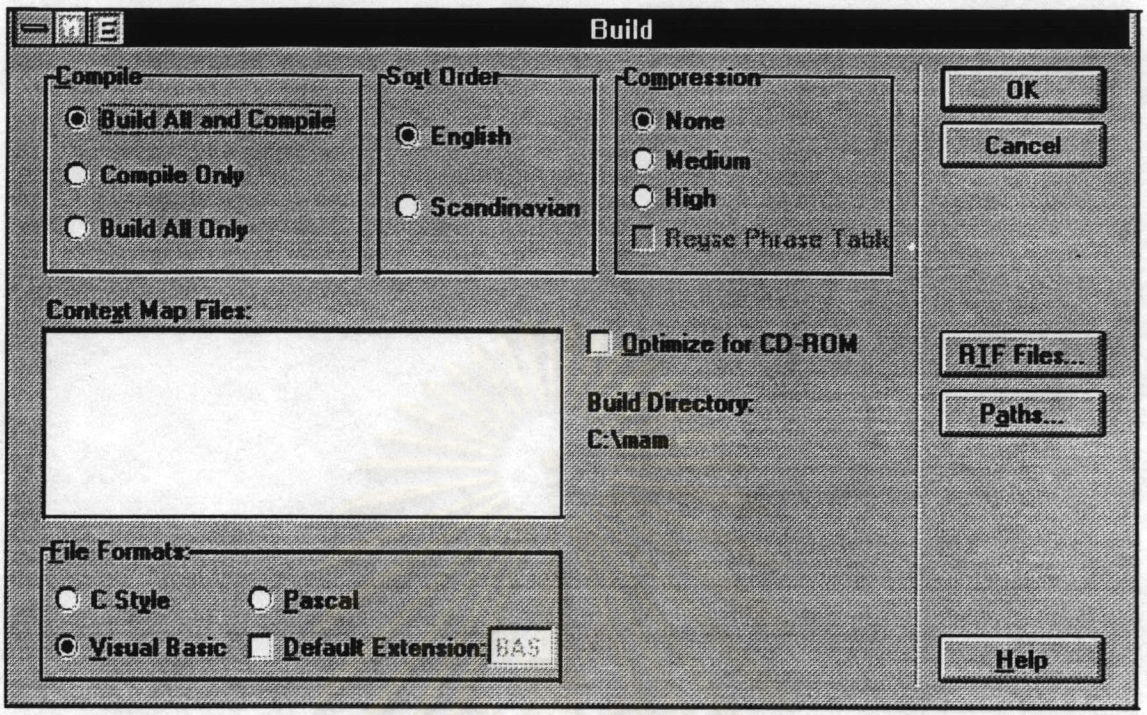

Figure B-8 Build Dialog Box

B-9 Programming the Application to Access the Help File

This research used Visual Basic for Windows as a compiler to access this application. It can access the Help resource file by calling "boulder.hlp" that uses the following syntax:

```
Sub Form_Load( )
        App.HelpFile = "boulder.hlp"
End Sub
```

After you have created a Microsoft Windows Help File for your application and set the application's Help File property, Visual Basic automatically calls Help when a user presses the F1 key. If there is a context number in the HelpContextID property for either the active control or the active form, Help

displays a topic corresponding to the current Help context, otherwise it displays the main contents screen.

```
Sub Form_Load( )
        Main.HelpContextID  =  105
End Sub
```

B-10 Help File Example

After compile the Help Project File, you will receive the Help File with hotspots and hypertext link as shown in Figure B-9.

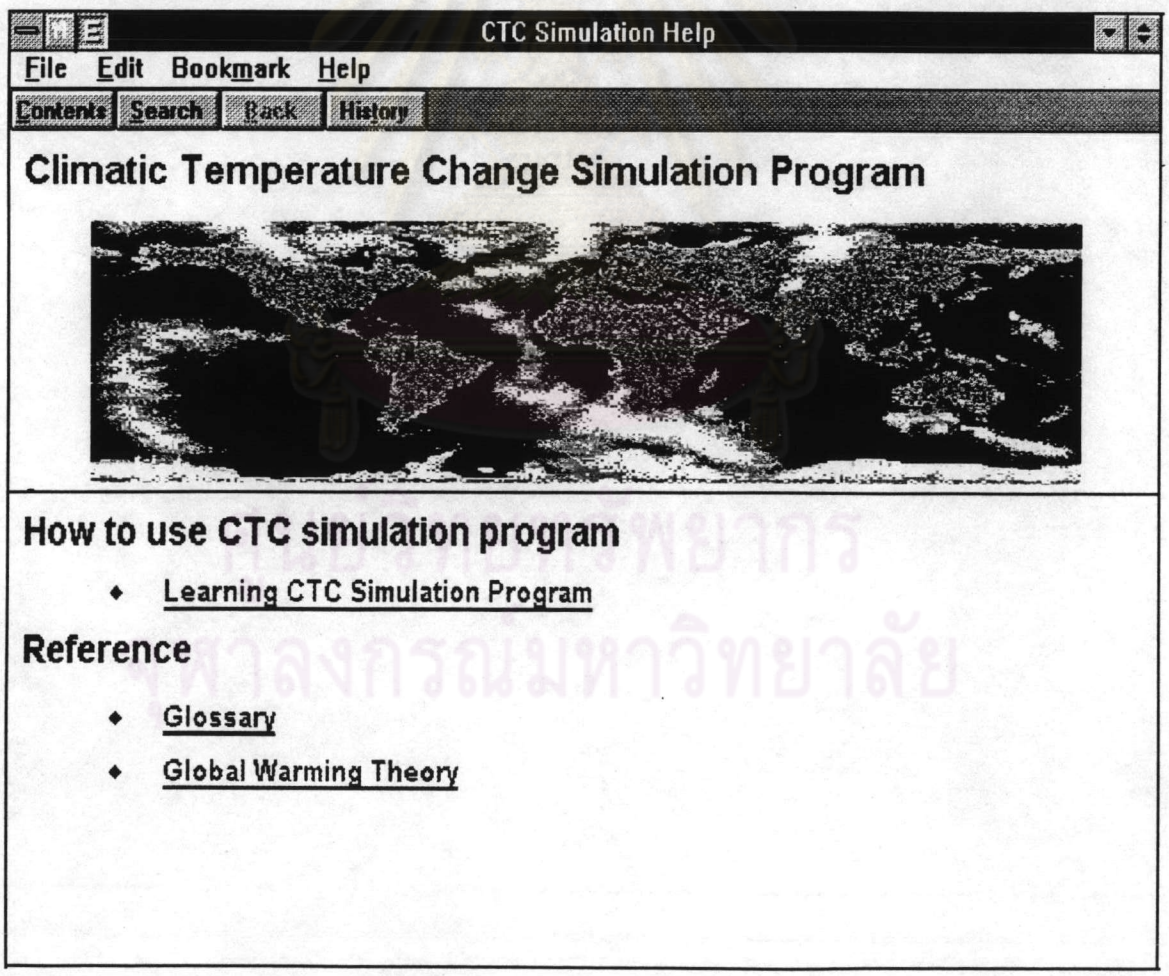

Figure B-9 Help File Example

APPENDIX C

ESTIMATION OF GREENHOUSE GAS CONCENTRATION

To estimate the heat flux of the surface-troposphere system due to increasing atmospheric greenhouse gas, not only the global warming potential index but also the concentration of carbon dioxide, methane, nitrous oxide, and chlorofluorocarbon is applied. In this work, greenhouse gas concentration is estimated using regression technique.

C-1 Carbon dioxide

Carbon dioxide has been recognised as a greenhouse gas for almost a century. It has received the most attention in discussions on the greenhouse effect, but impact due to other trace gases is also recognised and discussed later.

The slow, historical accumulation of buried organic matter is the source of our fossil fuels-oil, gas and coal. When these are burned, carbon in the form of carbon dioxide is returned to the atmosphere. The rather rapid accumulation of carbon dioxide in the atmosphere takes place due in part to combustion of fossil fuels and to the return of carbon during deforestation. It is the cause of our concern for future global warming.

Table C-1 Atmospheric Concentration of Carbon Dioxide (Cess, R.D. and Goldenberg, S.D., 1981, World Resources, 1992-93)

Year	Concentration (ppm)
1860	287.0
1865	287.2
1870	287.5
1875	287.8
1880	288.3
1885	288.8
1890	289.1
1895	289.2
1900	289.4
1905	290.3
1910	291.4
1915	293.0
1920	294.5
1925	296.9
1930	297.7
1935	300.0
1940	301.8
1945	304.2
1950	306.1
1955	309.1
1959	315.8
1960	316.8
1961	317.5
1962	318.3

Table C-1 Atmospheric Concentration of Carbon Dioxide (Continue)

Year	Concentration (ppm)
1963	318.8
1965	319.9
1966	321.2
1967	322.0
1968	322.8
1969	323.9
1970	325.3
1971	326.2
1972	327.3
1973	329.5
1974	330.1
1975	331.0
1976	332.0
1977	333.7
1978	335.3
1979	336.7
1980	338.5
1981	339.8
1982	341.0
1983	342.6
1984	344.3
1985	345.7
1986	347.0
1987	348.8

Table C-1 Atmospheric Concentration of Carbon Dioxide (Continue)

Year	Concentration (ppm)
1988	351.4
1989	352.8
1990	354.0

From the above data of concentrations of carbon dioxide since 1860, we found its regression as exponential characterization (correlation coefficient = 0.88) (as shown in Equation (C-1) and Figure C-1).

$$[CO2] = 17.605\, e^{0.0015t} \qquad \text{(C-1)}$$

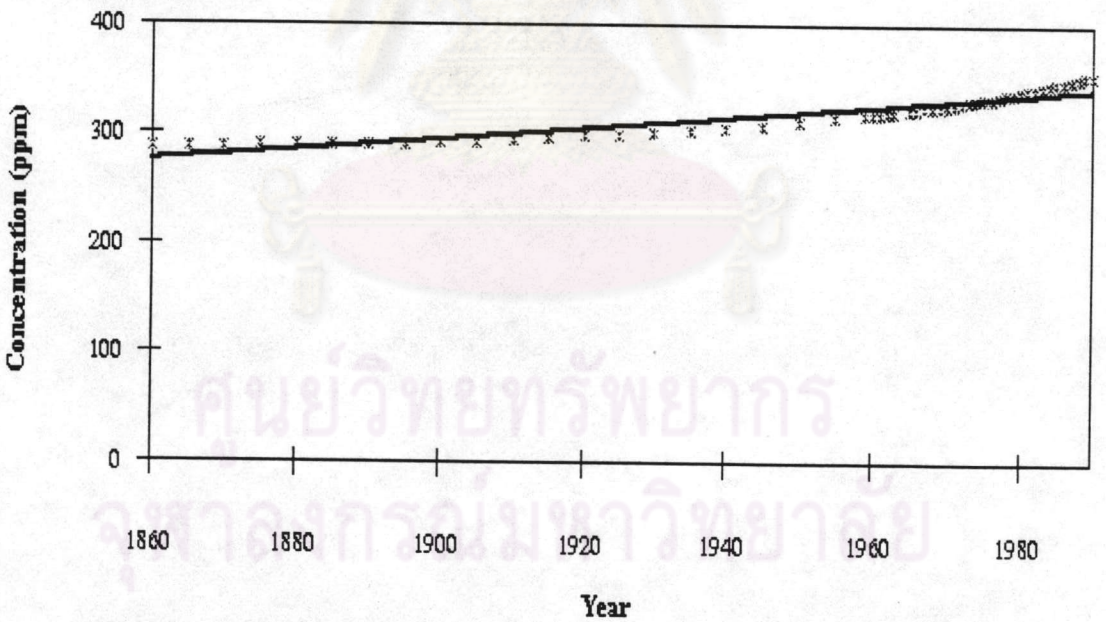

Figure C-1 Regression of Carbon Dioxide Concentration

As we known, the main source of carbon dioxide in the atmosphere is the fossil fuels combustion, therefore we can estimate the future concentration of

carbon dioxide from Equation (C-2) compared with the 1985's after assuming each of factors that affects emission is growing (or decreasing) exponentially.

$$r = r_{pop} + r_{\frac{GNP}{cap}} + r_{\frac{energy}{GNP}} + r_{\frac{emission}{energy}} \qquad \text{(C-2)}$$

where

r = Overall growth rate of carbon emissions (Gt./yr.)

r_{pop} = Population growth rate (1.0%)

$r_{GNP/cap}$ = Per capita GNP growth rate (1.2%)

$r_{energy/GNP}$ = Growth rate in energy per unit of GNP (-0.8%)

$r_{emission/energy}$ = Emission per unit of energy consumed growth rate (-0.2%)

By adding the individual rates of growth, as Equation (C-2), an overall growth rate can be obtained to use in the following equation.

$$\text{Emission rate (t)} = \text{Emission rate (0)}\ e^{rt} \qquad \text{(C-3)}$$

To find the additional carbon in the atmosphere at any given time, we need to find the amount of carbon released up until that time, and multiply that by the airborne fraction. We can find the total amount of carbon released by integrating the exponential function (C-3)

$$Q_c = \frac{P_0}{r}(e^{rt} - 1) \qquad \text{(C-4)}$$

where

Q_c = Total carbon added between up until time t (Gt.C)

P_0 = Initial emission rate at time t=0

r = Rate of growth of emissions

To find the added carbon remaining in the atmosphere, we need to multiply emissions by the airborne fraction, 0.58. To convert that to carbon dioxide, we can use the conversion of 1 ppm = 2.12 Gt.C. Finally, the concentration added to the initial condition of 1985's is acquired.

Furthermore, deforestation affects carbon emission by one-fourth of all. In this work, we assume that the future deforestation rate is constant as 0.1 percent. Applying the same method as the case of fossil fuel combustion, the future concentration of carbon dioxide occurring from deforestation can be estimated.

C-2 Methane

Methane is a naturally occurring gas that is increasing in concentration as a result of human activities. It is produced by bacteria fermentation under anaerobic conditions, such as in swamps, marshes, rice paddies, as well as in the digestive systems of ruminants and termites. Significant contributions of methane to the atmosphere are the result of human food-growing activities, such as cattle production and increases in area planted in rice paddies. It is also released during the production, transportation, and consumption of fossil fuels as well as when biomass fuels are burned.

After its release, methane is thought to have an atmospheric residence time of around 8-11 years. It is eventually removed thought oxidation with various OH radicals. The best evidence of long-term trends in methane concentration has been obtained from the analysis of air bubbles trapped in ice. In the most recent years, methane concentration has been increasing in the range of 1-2 percent per year. It absorbs on the edge of the atmospheric window

(7-12 μm) at 7.66 μm, yielding a global warming impact of about 25 times that of carbon dioxide.

Table C-2 Atmospheric Concentration of Methane (World Resources, 1992-93)

Year	Concentration (ppb)
1860	700
1962	1354
1965	1386
1966	1338
1967	1480
1968	1373
1969	1385
1970	1431
1971	1436
1972	1500
1973	1624
1974	1596
1975	1541
1976	1490
1977	1471
1978	1531
1979	1545
1980	1554
1981	1569
1982	1591
1983	1615

Table C-2 Atmospheric Concentration of Methane (Continue)

Year	Concentration (ppb)
1984	1629
1985	1643
1986	1656
1987	1667
1988	1681
1989	1694
1990	1704

After defining the trend of the observed data of methane concentration in many forms, it was found that 2nd polynomial curve (correlation coefficient = 0.95) was the most suitable as displayed in Figure C-2 and as a equation of time:

$$[CH_4] = 0.0481t^2 - 177.52t + 164482 \qquad \text{(C-5)}$$

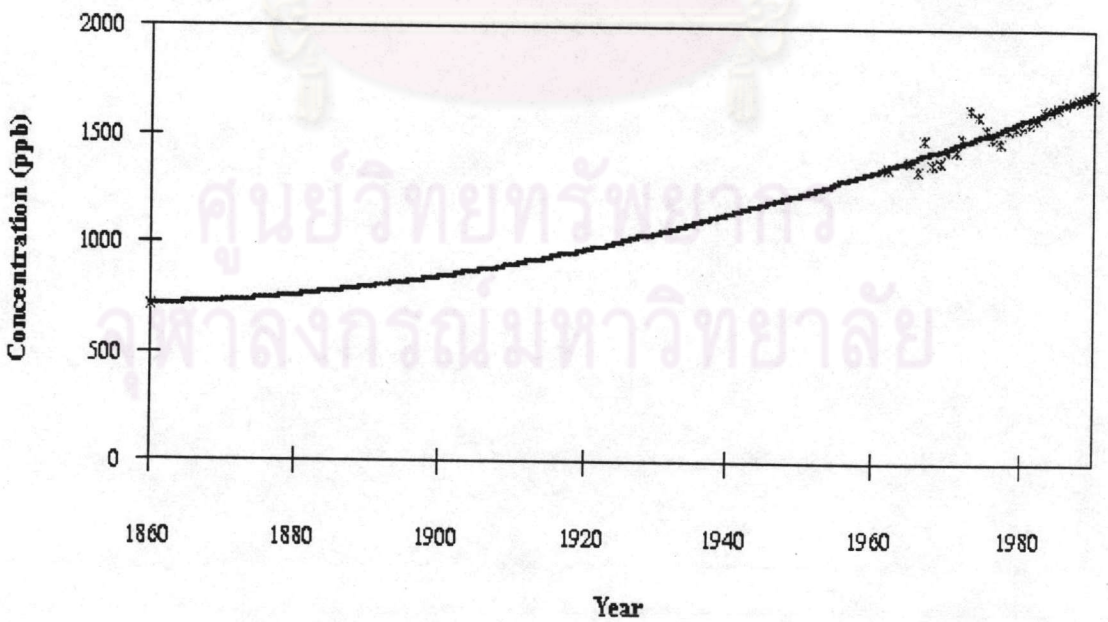

Figure C-2 Regression of Methane Concentration

C-3 Nitrous Oxide

Nitrous oxide is another naturally occurring greenhouse gas that has been increasing in concentration due to human activities. It is released into the atmosphere mostly during the nitrification portion of the nitrogen cycle. The reverse reaction of denitrification is no longer considered a significant source of atmospheric N_2O. Combustion of fossil fuels and nitrogen fertiliser consumption are thought to be the two most important human activities leading to an increase in nitrous oxide levels. Nitrous oxide has an extremely long residence time of the order of 150 years in the atmosphere. Its means perturbations in the natural cycle will have long-lasting repercussions. Its concentration is growing at about 0.2 percent per year. It has strong absorption bands at 4.5, 7.8, and 17 μm, and it is thought to be about 230 times carbon dioxide in causing global warming.

Table C-3 Atmospheric Concentration of Nitrous Oxide (World Resources, 1992-93)

Year	Concentration (ppb)
1975	291.4
1976	293.3
1977	294.6
1978	296.4
1979	296.3
1980	297.6
1981	298.5
1982	301.0
1983	300.9
1984	300.4

Table C-3 Atmospheric Concentration of Nitrous Oxide (Continue)

Year	Concentration (ppb)
1985	301.5
1986	302.5
1987	304.5
1988	306.3

In case of nitrous oxide, its concentration depends on time as linear relation (correlation coefficient = 0.96) as, shown by Equation (C-6) and Figure C-3.

$$[N2O] = 1.0035\ t - 1689.5 \qquad \text{(C-6)}$$

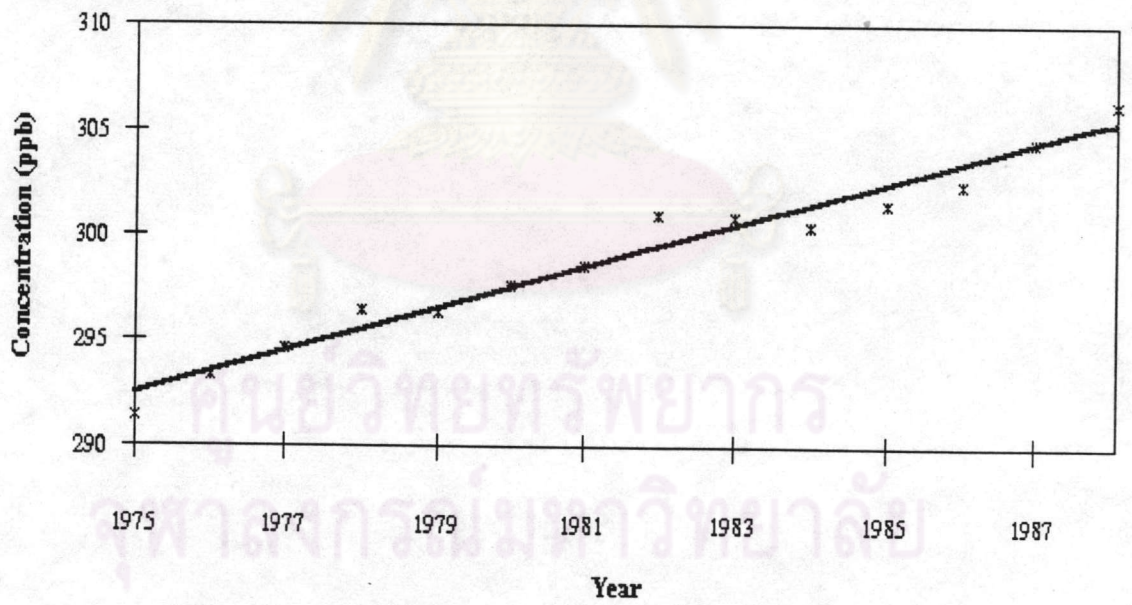

Figure C-3 Regression of Nitrous Oxide Concentration

C-4 Chlorofluorocarbon

Chlorofluorocarbons (CFCs) are molecules that contain chlorine, fluorine, and carbon. As opposed to the other greenhouse gases, CFCs do not occur naturally and their presence in the atmosphere is due entirely to human activities. CFCs absorb strongly in the atmospheric window and tend to have long atmospheric residence times. The CFCs that have received the most attention are trichlorofluoromethane, $CFCl_3$ (CFC-11), and dichlorofluoromethane, CF_2Cl_2 (CFC-12).

Fully halogenated CFCs having long atmospheric lifetimes contain relatively large amounts of chloride, and absorb strong within the 7-to 13 μm atmospheric window. They have considerably potential to affect both global warming and stratospheric ozone depletion. For example, CFC-11 is 77 percent chlorine, has strong absorption bands at 9.22 and 11.82 μm, and its atmospheric residence time is estimated at between 60 and 110 years. CFC-12 is 59 percent chlorine, absorbs at 8.68, 9.13, and 19.93 μm, and its atmospheric residence time is between 55 and 400 years.

Table C-4 Atmospheric Concentration of Chlorofluorocarbon (World Resources, 1992-93)

Year	Concentration (ppt)
1975	320
1976	350
1977	387
1978	425
1979	450

Table C-4 Atmospheric Concentration of Chlorofluorocarbon (Continue)

Year	Concentration (ppt)
1980	486
1981	500
1982	523
1983	555
1984	579
1985	607
1986	636
1987	654
1988	672
1989	698
1990	741

Because of significant effect on the stratospheric ozone problem, CFC more regulatory attention is paid for emissions. The 1987 Montreal Protocol on Substances depleting the Ozone Layer requires a 20-percent reduction in CFCs emissions below the 1986 level by 1994, and a total reduction of 50 percent by 1988. The Protocol was signed by representatives of more than 35 countries, including the United States.

Even if the Montreal Protocol is completely successful, the concentration of CFCs is expected to increase. In this work, we also extrapolate the trend to approximate CFCs concentration similar to those of methane, and nitrous oxide (correlation coefficient = 0.97).

$$[CFC] = 4x10^{-43} e^{0.0524t} \qquad (C\text{-}7)$$

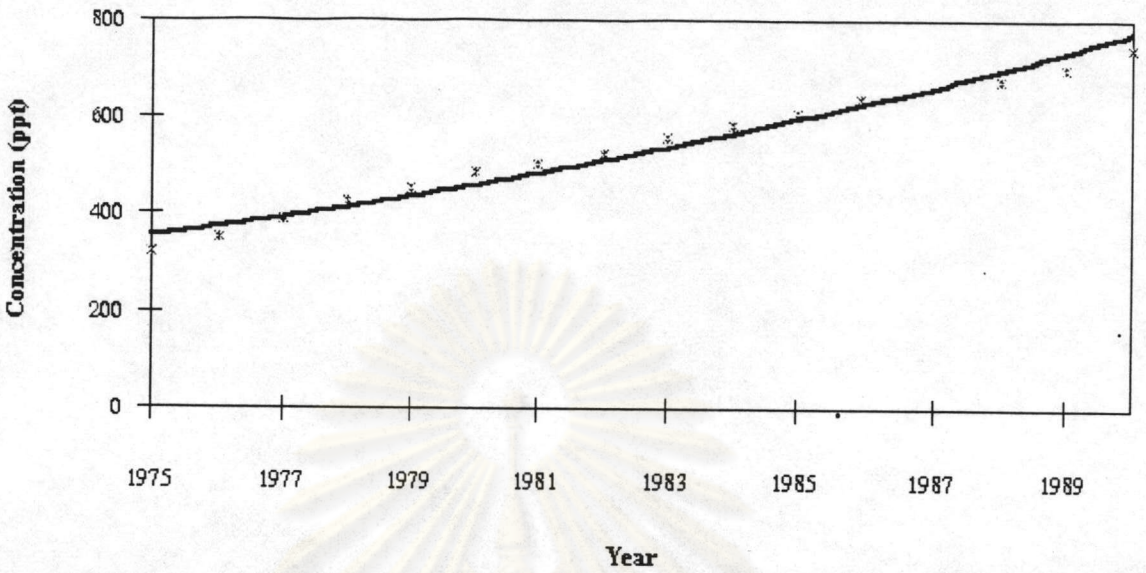

Figure C-4 Regression of Chlorofluorocarbon Concentration

VITA

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