XV

APPENDIX 15

XV, 2

United States Patent [19]

Werle et al.

[11] **3,899,144**

[45] **Aug. 12, 1975**

[54] **POWDER CONTRAIL GENERATION**

[75] Inventors: **Donald K. Werle**, Hillside; **Romas Kasparas**, Riverside; **Sidney Katz**, Chicago, all of Ill.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **July 22, 1974**

[21] Appl. No.: **490,610**

[52] **U.S. Cl.** ..... **244/136;** 40/213; 116/114 F; 241/5

[51] **Int. Cl.²** **B64D 1/16**

[58] **Field of Search** ..... 244/136; 40/213; 241/5, 241/29; 222/3, 4; 239/171; 116/28 R, 114 R, 114 F, 114 N, 124 R, 124 B, 124 C

[56] **References Cited**

UNITED STATES PATENTS

1,619,183	3/1927	Bradner et al.	244/136
2,045,865	6/1936	Morey	40/213
2,591,988	4/1952	Willcox	241/5 X
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R15,771	2/1924	Savage	40/213

FOREIGN PATENTS OR APPLICATIONS

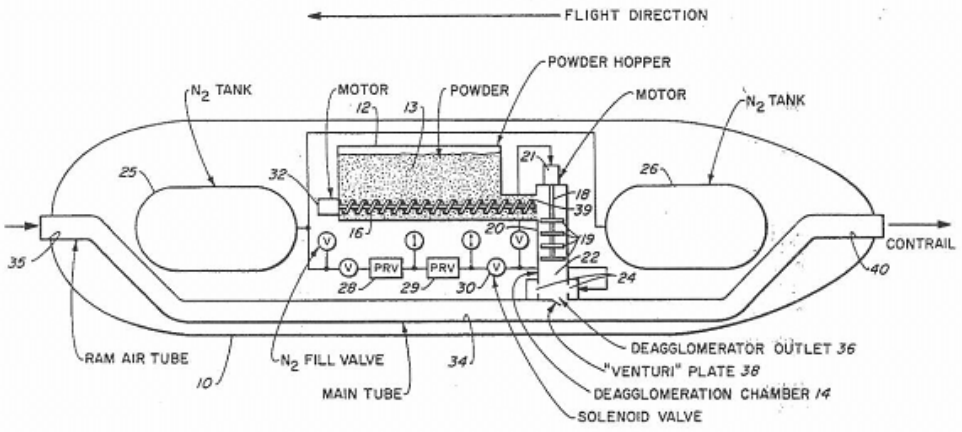
1,022,621	3/1966	United Kingdom	241/5

Primary Examiner—Trygve M. Blix
Assistant Examiner—Barry L. Kelmachter
Attorney, Agent, or Firm—Richard S. Sciascia; Joseph M. St. Amand

[57] **ABSTRACT**

Light scattering pigment powder particles, surface treated to minimize interparticle cohesive forces, are dispensed from a jet mill deagglomerator as separate single particles to produce a powder contrail having maximum visibility or radiation scattering ability for a given weight material.

12 Claims, 1 Drawing Figure



XV, 3

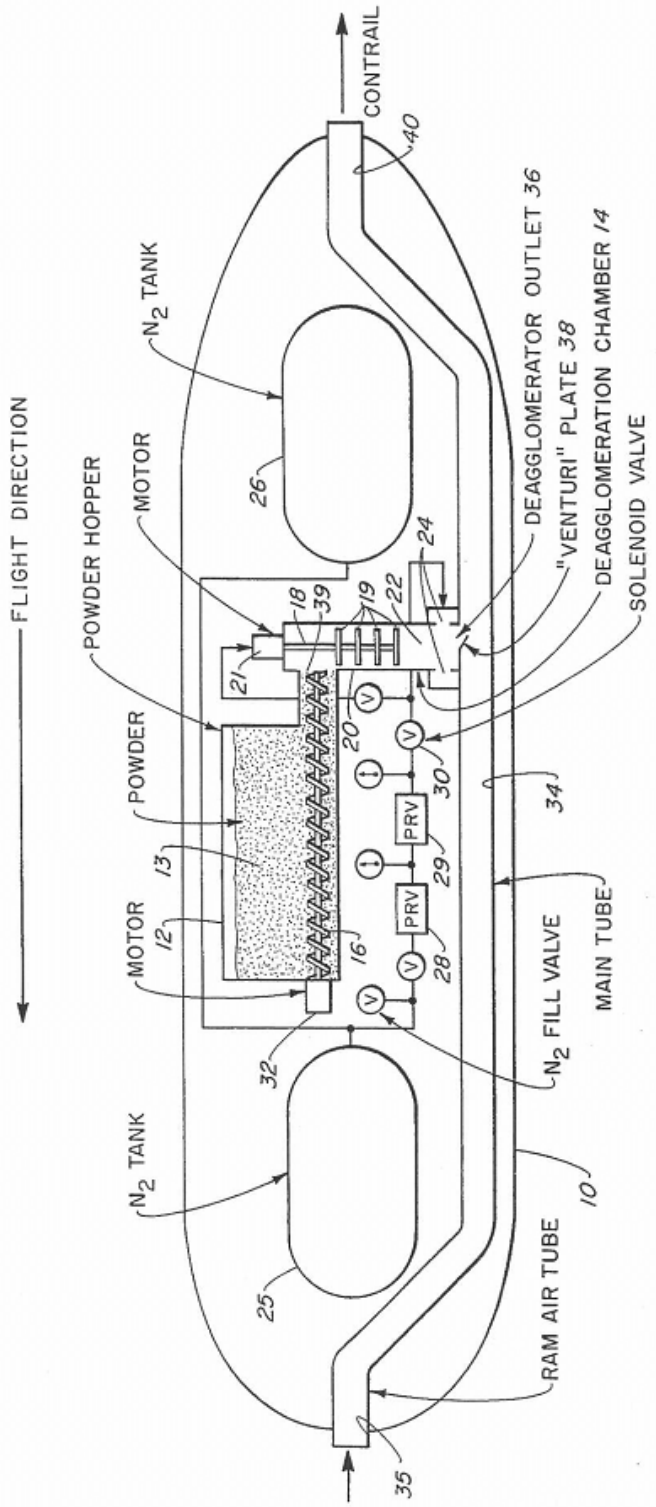

FLIGHT DIRECTION
CONTRAIL
40
N_2 TANK
26
POWDER HOPPER
MOTOR
18
39
19
22
24
DEAGGLOMERATOR OUTLET 36
"VENTURI" PLATE 38
DEAGGLOMERATION CHAMBER 14
SOLENOID VALVE
21
20
30
34
POWDER
13
PRV
29
MOTOR
12
16
PRV
28
MAIN TUBE
N_2 FILL VALVE
32
N_2 TANK
10
25
RAM AIR TUBE
35

Fig. 1.

POWDER CONTRAIL GENERATION

BACKGROUND

The present invention relates to method and apparatus for contrail generation and the like.

An earlier known method in use for contrail generation involves oil smoke trails produced by injecting liquid oil directly into the hot jet exhaust of an aircraft target vehicle. The oil vaporizes and recondenses being the aircraft producing a brilliant white trail. Oil smoke trail production requires a minimum of equipment; and, the material is low in cost and readily available. However, oil smoke requires a heat source to vaporize the liquid oil and not all aircraft target vehicles, notably towed targets, have such a heat source. Also, at altitudes above about 25,000 feet oil smoke visibility degrades rapidly.

SUMMARY

The present invention is for a powder generator requiring no heat source to emit a "contrail" with sufficient visibility to aid in visual acquisition of an aircraft target vehicle and the like. The term "contrail" was adopted for convenience in identifying the visible powder trail of this invention. Aircraft target vehicles are used to simulate aerial threats for missile tests and often fly at altitudes between 5,000 and 20,000 feet at speeds of 300 and 400 knots or more. The present invention is also suitable for use in other aircraft vehicles to generate contrails or reflective screens for any desired purpose.

The powder contail generator is normally carried on an aircraft in a pod containing a ram air tube and powder feed hopper. Powder particles, surface treated to minimize interparticle cohesive forces are fed from the hopper to a deagglomerator and then to the ram air tube for dispensing as separate single particles to produce a contrail having maximum visibility for a given weight material.

Other object, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing.

DESCRIPTION OF DRAWING

FIG. 1 is a schematic sectional side-view of a powder contrail generator of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENT

The powder contail generator in pod **10**, shown in FIG. **1**, is provided with a powder feed hopper **12** positioned in the center section of the pod and which feeds a powder **13** to a deagglomerator **14** by means of screw conveyors **16** across the bottom of the hopper. The deagglomerator **14** produces two stages of action. In the first stage of deagglomeration, a shaft **18** having projecting radial rods **19** in compartment **20** is rotated by an air motor **21**, or other suitable drive means. The shaft **18** is rotated at about 10,000 rpm, for example. As powder **13** descends through the first stage compartment **20** of the deagglomeration chamber, the hammering action of rotating rods **19** serves to aerate and precondition the powder before the second stage of deagglomeration takes place in the jet mill section **22**. In the jet mill **22**, a plurality of radial jets **24** (e.g., six 0.050 inch diamter radial jets) direct nitrogen gas (at e.g., 120 psig) inward to provide energy for further deagglomeration of the powder. The N_2, or other suitable gas, is provided from storage tanks **25** and **26**, for example, in the pod.

The jet mill **22** operates in a similar manner to commercial fluid energy mills except that there is no provision for recirculation of oversize particles. Tests with the deagglomerator show that at a feed rate of approximately 1½ lb/min, treated titanium dioxide powder pigment is effectively dispersed as single particles with very few agglomerates evident.

The nitrogen gas stored in cylinder tanks **25** and **26** is charged to 1800 psig, for example. Two stages of pressure reduction, for example, by pressure reduction valves **28** and **29**, bring the final delivery pressure at the radial jets **24** and to the air motor **21** to approximately 120 psig. A solenoid valve **30** on the 120 psig line is connected in parallel with the electric motor **32** which operates the powder feeder screws **16** for simultaneous starting and running of the powder feed, the air motor and the jet mill deagglomerator.

Air enters ram air tube **34** at its entrance **35** and the exhaust from the jet mill deagglomerator passes directly into the ram air tube. At the deagglomerator exhaust **36** into ram air tube **34**, an upstream deflector baffle **38** produces a venturi effect which minimizes back pressure on the powder feed system. The powder is then jetted from the exhaust end **40** of the ram air tube to produce a contrail. A pressure equalization tube, not shown, can be used to connect the top of the closed hopper **12** to the deagglomeration chamber **14**. A butterfly valve could be provided at the powder hopper outlet **39** to completely isolate and seal off the powder supply when not in use. Powder **13** could then be stored in hopper **12** for several weeks, without danger of picking up excessive moisture, and still be adequately dispensed.

Preparation of the light scatter powder **13** is of a critical importance to production of a powder "contrail" having maximum visibility for a given weight of material. It is essential that the pigment powder particles be dispensed as separate single particles rather than as agglomerates of two or more particles. The powder treatment produces the most easily dispersed powder through the use of surface treatments which minimize interparticle cohesive forces.

Titanium dioxide pigment was selected as the primary light scattering material because of its highly efficient light scattering ability and commercially available pigment grades. Titanium dioxide pigment (e.g., DuPont R—931) with a median particle size of about 0.3μ has a high bulk density and is not readily aerosolizable as a submicron cloud without the consumption of a large amount of deagglomeration energy. In order to reduce the energy requirement for deagglomeration, the TiO_2 powder is specially treated with a hydrophobic colloidal silica which coats and separates the individual TiO_2 pigment particles. The extremely fine particulate nature (0.007μ primary particle size) of Cobot S—101 Silanox grade, for example, of colloidal silica minimizes the amount needed to coat and separate the TiO_2 particles, and the hydrophobic surface minimizes the affinity of the powder for absorbtion of moisture from the atmosphere. Adsorbed moisture in powders causes liquid bridges at interparticle contacts and it then becomes necessary to overcome the adsorbed-liquid surface tension forces as well as the weaker Van der Waals' forces before the particles can be separated.

The Silanox treated titanium dioxide pigment is further protected from the deleterious effects of adsorbed moisture by incorporation of silica gel. The silica gel preferentially adsorbs water vapor that the powder may be exposed to after drying and before use. The silica gel used is a powder product, such as Syloid 65 from the W. R Grace and Co., Davison Chemical Division, and has an average particle size about 4.5μ and a large capacity for moisture at low humidities.

A typical powder composition used is shown in Table 1. This formulation was blended intimately with a Patterson-Kelley Co. twin shell dry LB–model LB—2161 with intensifier. Batches of 1500 g were blended for 15 min. each and packaged in 5-lb cans. The bulk density of the blended powder is 0.22 g/cc. Since deagglomeration is facilitated by having the powder bone dry, the powder should be predried before sealing the cans. In view of long periods (e.g., about 4 months) between powder preparation and use it is found preferable to spread the powder in a thin layer in an open container and place in a 400°F over two days before planned usage. The powder is removed and placed in the hopper about 2 hours before use.

Table 1

CONTRAIL POWDER FORMULATION

Ingredient	% by Weight
TiO_2 (e.g., DuPont R-931) median particle size 0.3μ	85
Colloidal Silica (e.g., Cabot S-101 Silanox) primary particle size 0.007μ	10
Silica gel (e.g., Syloid 65) average particle size 4.5μ	5

Other type powder compositions can also be used with the apparatus described herein. For example, various powder particles which reflect electromagnetic radiation can be dispensed as a chaff or the like from the contrail generator.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claim is:

1. Contrail generation apparatus for producing a powder contrail having maximum radiation scattering ability for a given weight material, comprising:
   a. an aerodynamic housing;
   b. a jet tube means passing through said housing, said tube means having an inlet at a forward end of said housing and an exhaust at a rearward end thereof;
   c. a powder storage means in said housing;
   d. a deagglomeration means also in said housing;
   e. means connecting said powder storage means with said deagglomeration means for feeding radiation scattering powder from said powder storage means to said deagglomeration means;
   f. the output of said deagglomeration means dispensing directly into said jet tube means for exhausting deagglomerated powder particles into the atmosphere to form a contrail; and
   h. means for controlling the flow of said powder from said storage means to said deagglomeration means.

2. Apparatus as in claim 1 wherein said jet tube means is a ram air jet tube.

3. Apparatus as in claim 1 wherein an upstream deflector baffle is provided at the output of said deagglomeration means into said jet tube means to produce a venturi effect for minimizing back pressure on said powder feeding means.

4. Apparatus as in claim 1 wherein said deagglomerator means comprises:
   a. means for subjecting powder particles from said powder storage means to a hammering action to aerate and precondition the powder; and
   b. a jet mill means to further deagglomerate the powder into separate particles.

5. Apparatus as in claim 4 wherein pressurized gas means is provided for operating said deagglomeration means.

6. Apparatus as in claim 1 wherein said radiation scattering powder particles are titanium dioxide pigment having a median particle size of about 0.3 microns.

7. Apparatus as in claim 1 wherein said radiation scattering powder particles have a coating of extremely fine hydrophobic colloidal silica thereon to minimize interparticle cohesive forces.

8. Apparatus as in claim 1 wherein the formulation of said powder consists of 85% by weight of TiO_2 pigment of approximately 0.3 micron media particle size, 10% by weight of colloidal silica of 0.007 micron primary particle size, and 5% by weight of silica gel having an average particle size of 4.5 microns.

9. The method of producing a light radiation scattering contrail, comprising:
   a. surface treating light scattering powder particles to minimize interparticle cohesive forces;
   b. deagglomerating said powder particles in two stages prior to dispensing into a jet tube by subjecting said powder particles to a hammering action in the first stage to aerate and precondition the powder, and by passing said powder through a jet mill in the second stage to further deagglomerate the powder;
   c. dispensing the deagglomerated powder from the jet mill directly into a jet tube for exhausting said powder into the atmosphere, thus forming a contrail.

10. A method as in claim 9 wherein said light scattering powder particles is titanium dioxide pigment.

11. A method as in claim 9 wherein said powder particles are treated with a coating of extremely fine hydrophobic colloidal silica to minimize interparticle cohesive forces.

12. A method as in claim 11 wherein said treated powder particles are further protected with a silica gel powder.

* * * * *

XVI, 1

APPENDIX 16

XVI, 2

AIRWORK
PILOTEN PORTAL

HOME BULLETIN BOARD COCKPIT GROEPEN KENNISBANK METEO LINKS

Airwork > Algemeen > Crewroom
Chemtrails...wie weet er meer van?

Kennisbank Gebruikerspaneel FAQ Groepen Kalender Nieuwe berichten Zoeken Directe links Uitloggen

Post Reply

#71

Beer
Contact Houston Space Center

MY NAME
THINGS I
SAY →

Airworker sinds: Dec 1999
Locatie: SPL
Berichten: 1.347
Brevet: JAA CPL/IR/ME (frozen ATPL)
Typeratings: Fokker 50
Uren: 1400+

Citaat:

> Origineel gepost door **Okki**
> *Hebben jullie trouwens al dat nieuwe X-432 gespoten?*

Nee... ik kom niet van de KLS, dus ik ben niet goed genoeg voor dat spul.

Quote

#79

PH-JPC
Contact Houston Space Center

Airworker sinds: Jan 2003
Locatie: 2 rood, 2 wit, slightly right
Berichten: 1.411
Brevet: met bloed zweet en tranen verkregen
Typeratings: De laatste jaren in een stofzuiger ver boven het weer en het terrein. Ver weg van de avonturen die ik daarvóór heb mogen beleven en waar ik nog dagelijks aan terug denk
Uren: In verhouding met mijn leeftijd redelijk wat

Dat dat zomaar bekend is bij jou... ik weet alleen dát ik moet lozen en wáár. Nog nooit iemand gekend die meer info had!
Maar wel interessant moet ik zeggen.

Diana, misschien toch een idee om dit forum gesloten te maken zodat niet iedereen deze gevoelige info kan lezen?

Quote

#99

XVI, 3

Okki
cleared FL 200

Airworker sinds: May 2001
Locatie: Nederland
Berichten: 536
Brevet: ATPL
Typeratings: Suck, Squeeze & Blow
Uren: 70 per maand

Hebben jullie trouwens al dat nieuwe X-432 gespoten?

't schijnt in elk geval beter te werken dan die oude rommel die we hadden. Minder bijwerkingen als huidkanker en TBC!

Mijn operator denkt na over de aanschaf omdat de EU ons meer slots wil geven overal door europa als we er mee gaan spuiten!

Quote

#63

Eikie
Contact Houston Space Center

Airworker sinds: May 2000
Locatie: SPL
Berichten: 1.160
Brevet: ja
Typeratings: F50/E190
Uren: 2000+

Citaat:

> Origineel gepost door **49015**
> *Nu we het er toch over hebben, heeft een van jullie wel eens zijn eigen chemtrail gezien? Hoe ik mijn best ook doe (bijvoorbeeld achterom kijken tijdens een bocht), mijn eigen trail heb ik nog nooit gezien.*

Dat komt omdat chemtrails, in tegenstelling tot contrails, een langere levensduur hebben. Chemtrails verwaaien vaak tot wat amateurs en onwetenden cirrus noemen. (wij weten beter).

"Nadeel" is echter wel dat ze ook pas later zichtbaar zijn dan contrails, zeker als je er niet van onderen tegen aan kijkt. (heeft met de lichtabsorbtie te maken, asymetrische moleculen)

Quote

#67

Phoenix_X
Optimum Flightlevel

Airworker sinds: Nov 1999
Locatie: EU
Berichten: 956
Brevet: ATPL
Typeratings: A320 (737)
Uren: Flink minder dan 100.000

Citaat:

> Origineel gepost door **Pjotr Orno**
> *Hebben jullie nooit last van die vliegende schotels die de laatste tijd overal voorbij schieten? Ik zou het niet meer dan normaal vinden als zij ook verplicht een transponder aan boord moeten hebben. Dit gaat natuurlijk nog een keer fout.*
>
> *Het sprayen zelf heb ik overigens niet veel problemen mee, hooguit dat je af en toe een dubbele flame-out hebt van die chemische deeltjes.*

Jij leest blijkbaar ook nooit de NOTAMS. Er staat duidelijk in dat hier over gedacht is maar dat de investering voor de (niet nader te noemen) "operators" van deze schotels te hoog zou zijn. Zeker aangezien we richting ADS-B gaan en de volgende generatie comms (zoals datalink etc). Het is de bedoeling dat deze systemen wel verplicht gaan worden voor dit SP-TFC (Special Traffic). Dit zou rond 2015 moeten zijn, dus het blijft nog even opletten.

Die datalink wordt trouwens ook belangrijk voor de chemtrails. Bij mijn vorige airline vlogen we ook over China en daar wordt de datalink gebruikt om de mixture van de chemtrails in real-time aan te passen vanaf de grond. Het handmatig aanpassen van settings van de chemtrails (zelfs in non-normals) is niet toegestaan en moet via datalink aangevraagd worden. Ik zie dat hier ook wel gebeuren; aangezien ik vorige week op kantoor moest komen samen met de cpt om uit te leggen waarom wij na een (3.1) CHEM DISP Illuminati de boel af hadden gezet. Blijkbaar heeft dat verstrekkende gevolgen voor het welbekende "big picture."

Quote

#68

49015
Contact Houston Space Center

Airworker sinds: Oct 2001
Locatie: Gelukkig niet meer in La Perla
Berichten: 1.243

Nu we het er toch over hebben, heeft een van jullie wel eens zijn eigen chemtrail gezien? Hoe ik mijn best ook doe (bijvoorbeeld achterom kijken tijdens een bocht), mijn eigen trail heb ik nog nooit gezien.

XVI, 4

Brevet: ATPL
Typeratings: De families 320 en 737
Uren: 4,5K zonder crew rest!

Quote

#63

digits
1500 ft

Airworker sinds: Apr 2006
Locatie: België
Berichten: 199
Brevet: ppl
Typeratings: none
Uren: veel te weinig

Citaat:

> 4 LIMITATIONS AND SYSTEM DATA
>
> - The CHEMICAL DISPENSER can be used in the air only.
> - If crosswind components at >FL100 exceed 15 kts operation is not advised.
> - Bleed air can be supplied in air for 3 packs and in flight till 15000 ft press. altitude for 1 pack.
> - Each CHEMICAL DISPENSER is supplied with 2 bottles; 1 bottle can be used for approx 666 sq. km.
> - In case pax discretion is violated, advise Chemtrail Operations immidiatly and have pax diagnosed with any mental illness.
> - If possible, a grid flightpath is to be followed. Air Traffic Control is obliged to cooperate. Extended flight times (delays) may be blamed on Air Traffic Control, Ground Employees and weather.
> - It's the Commander's responsibility that Chemical Operations are done in accordence with the AOM, and within the time limits stated by the New World Order.
> - When Chemical Operations are in progress, Bilderberg accomodation may be used during nightstops only.
>
> If questions arise, contact +1 800 NEW WORLD (+1 800 NEW WORLD)

zalig :p

Quote

#64

Flying Dutchman
In orbit

Airworker sinds: Aug 2001
Locatie: Suburbia, USA
Berichten: 3.550
Brevet: The ones that let me fly for hire.
Typeratings: Singles and twins, pistons and turbines, right seat and left seat.
Uren: 7 years and counting

Citaat:

> Origineel gepost door **kermit**
> *. Nu is het zo erg dat ik al een paar maanden op de grond sta. Brevet ingetrokken wegens psychische instabiliteit en ondertussen ook een Prozac grootgebruiker geworden..*

Join de club ouwe...
See ya next monday at the dokter!

Citaat:

> Origineel gepost door **Q-nimbus**
> *De grond wordt me te heet onder de voeten...*
>
> *Iedere keer als ik bel of word gebeld, hoor ik nu zo'n rare klik. Ook vond ik sigaretten peuken bij de deur, en wil een mysterieuze man, die zichzelf 'Deep Throat' noemt, ergens op een openbare plek met me afspreken.*

Blij dat je Art ook een keer ontmoet hebt....

Quote

#65

kermit
Optimum Flightlevel

Airworker sinds: Apr 2000
Locatie: Zuid Holland
Berichten: 879
Brevet: ATPL
Typeratings: Airbus 320, Boeing 737, 757, 777
Uren: 4500+

Quote

2-01-2007, 19:16

#62

Pjotr Orno
over to departure

Airworker sinds: Jan 2005
Locatie: Amsterdam
Berichten: 213
Brevet: FATPL
Typeratings: 4 motoren
Uren: 1500+

Dus voortaan kunnen we je aanspreken als Miss Piggy?

Quote

2-01-2007, 19:31

#61

kermit
Optimum Flightlevel

Airworker sinds: Apr 2000
Locatie: Zuid Holland
Berichten: 879
Brevet: ATPL
Typeratings: Airbus 320, Boeing 737, 757, 777
Uren: 4500+

Het is goed dat het een keer openlijk besproken wordt. Heb de laatste maanden ernstig last van mijn geweten gekregen. Al die ellende die we aanrichten, kinderen, dieren etc. De lange termijn gevolgen zijn niet te overzien.

In het begin had ik er eigenlijk geen last van. Ja, je weet het wel maar ja, je jaagt toch die droom na. Sinds ik vader geworden ben is het gaan knagen. Nu is het zo erg dat ik al een paar maanden op de grond sta. Brevet ingetrokken wegens psychische instabiliteit en ondertussen ook een Prozac grootgebruiker geworden.

Het probleem is dat je er niet over kunt praten dus bij de hulpverleners heb ik maar verteld dat ik denk dat ik in het verkeerde lichaam geboren ben.

Nu het 'in the open' is hoop ik dat meer lotgenoten zich melden zodat we door er met elkaar over te spreken uit dit diepe dal kunnen komen.

Gegroet.

Quote

2-01-2007, 15:57

#60

Radix
over to departure

Airworker sinds: Jul 2004
Locatie: Down under
Berichten: 299
Brevet: -
Typeratings: -
Uren: -

Nu snap ik ook waarom ze bij mijn psychologische keuring zaken als betrouwbaarheid en discretie in het rapport noemden. Ik scoorde daar niet zo hoog op, en wat denk je: resultaat twijfelachtig!!!

Maar nu ik zie dat er hier zo open over gesproken wordt ga ik ze hier zeker mee confronteren! Je hoort er nog van.

Quote

2-01-2007, 14:19

#59

Pjotr Orno
over to departure

Airworker sinds: Jan 2005
Locatie: Amsterdam
Berichten: 213
Brevet: FATPL
Typeratings: 4 motoren
Uren: 1500+

Hebben jullie nooit last van die vliegende schotels die de laatste tijd overal voorbij schieten? Ik zou het niet meer dan normaal vinden als zij ook verplicht een Transponder aan boord moeten hebben. Dit gaat natuurlijk nog een keer fout.

Het sprayen zelf heb ik overigens niet veel problemen mee, hooguit dat je af en toe een dubbele flame-out hebt van die chemische deeltjes.

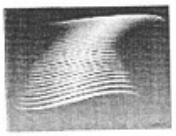
Quote

XVI, 6

Quote

#82

Q-nimbus
Contact Houston Space Center



Airworker sinds: Jun 2006
Locatie: Camp X-Ray
Berichten: 1.359
Brevet: ATPL
Typeratings: B777-200/300
Uren: 60-70 per maand

De grond wordt me te heet onder de voeten...

Iedere keer als ik bel of word gebeld, hoor ik nu zo'n rare klik. Ook vond ik sigaretten peuken bij de deur, en wil een mysterieuze man, die zichzelf 'Deep Throat' noemt, ergens op een openbare plek met me afspreken. Ook zit er een rare Amerikaan achter me aan, Sculder genaamd, die ook al iets van me moet.

Ik ga onderduiken!

Quote

#84

Beer
Contact Houston Space Center

Airworker sinds: Dec 1999
Locatie: SPL
Berichten: 1.347
Brevet: JAA CPL/IR/ME (frozen ATPL)
Typeratings: Fokker 50
Uren: 1400+

Damn... hier ga je gelazer mee krijgen Q. De laatste keer dat ik een collega hierover hoorde praten, was ie de volgende dag van de aardbodem verdwenen.

Quote

#83

PH-JPC
Contact Houston Space Center

Airworker sinds: Jan 2003
Locatie: 2 rood, 2 wit, slightly right
Berichten: 1.411
Brevet: met bloed zweet en tranen verkregen
Typeratings: De laatste jaren in een stofzuiger ver boven het weer en het terrein. Ver weg van de avonturen die ik daarvóór heb mogen beleven en waar ik nog dagelijks aan terug denk
Uren: In verhouding met mijn leeftijd redelijk wat

WTF waarom strooi je die dingen zomaar op internet??
Nou ja als jij het niet doet had een ander het wel gedaan waarschijnlijk...

(haha onder t genot van een biertje toch wel erg leuk om weer eens doorheen te lezen)

Wat ik me trouwens ook afvraag... de laatste jaren ben ik toch wel wat haren verloren... zou dat komen vanwege onze nieuwe operaties hiermee?

Quote

#92

Flying Dutchman
In orbit

Als de pax eens wisten wat ze financieel mogelijk maken met die 'sky miles' van ze....

FD

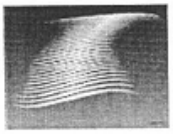
XVI, 7

Airworker sinds: Aug 2001
Locatie: Suburbia, USA
Berichten: 3.550
Brevet: The ones that let me fly for hire.
Typeratings: Singles and twins, pistons and turbines, right seat and left seat.
Uren: 7 years and counting

Quote

12-04-2007, 00:08

Q-nimbus
Contact Houston Space Center



Airworker sinds: Jun 2006
Locatie: Camp X-Ray
Berichten: 1.359
Brevet: ATPL
Typeratings: B777-200/300
Uren: 60-70 per maand

Wat dacht je van het Skyteam logo? Dat logo representateert een grote chemtrail!

Quote

12-04-2007, 00:00

Flying Dutchman
In orbit

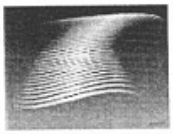
Airworker sinds: Aug 2001
Locatie: Suburbia, USA
Berichten: 3.550
Brevet: The ones that let me fly for hire.
Typeratings: Singles and twins, pistons and turbines, right seat and left seat.
Uren: 7 years and counting

Klopt, vandaar ook de eeuwen oude samenwerking met amstelveen/klm om de 'goods' te verspreiden over de hele wereld.... Als de mensen es echt wisten waar al die KLM/NWA logo's echt voor stonden op onze NWA (airlink) en KLM (cityhopper) toestellen over de hele wereld....

Quote

12-04-2007, 00:02

Q-nimbus
Contact Houston Space Center



Airworker sinds: Jun 2006
Locatie: Camp X-Ray
Berichten: 1.359
Brevet: ATPL
Typeratings: B777-200/300
Uren: 60-70 per maand

North West Airlines = NWA.

Eigenlijk wilden ze er New World Order (NWO) van maken, maar dat was iets te doorzichtig voor de slimme complot geleerde.

XVI, 8

Quote

#48

1-04-2007, 23:56

Flying Dutchman
In orbit

Airworker sinds: Aug 2001
Locatie: Suburbia, USA
Berichten: 3.550
Brevet: The ones that let me fly for hire.
Typeratings: Singles and twins, pistons and turbines, right seat and left seat.
Uren: 7 years and counting

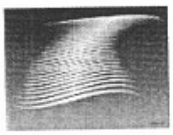
zit chemtrail ops bij jullie op 124.42 ? (pm me anders ff)

Quote

#47

1-04-2007, 23:49

Q-nimbus
Contact Houston Space Center



Airworker sinds: Jun 2006
Locatie: Camp X-Ray
Berichten: 1.359
Brevet: ATPL
Typeratings: B777-200/300
Uren: 60-70 per maand

Citaat:

> Origineel gepost door **digits**
> *huh ? kan ik hieruit besluiten dat er echt zo een hoofdstuk in de Operations manual staat*
>
> *iemand enkele leuke quotes daar uit ? (of via pm)*
>
> *greetings,*
> *digits*

Operations Manual 8.4.3.5:

1. CHEMICAL DISPATCH (CHEMTRAIL) Operations

1.1 CHEMICAL DISPENSER NORMAL PROCEDURES
1.2 CHEMICAL DISPENSER SHUTDOWN

2. CONDITIONAL PROCEDURES

(NOT APPLICABLE)

3. ABNORMAL PROCEDURES

3.1 CHEMICAL DISPENSER
3.2 CHEMICAL DISPENSER DOOR
3.3 CHEMICAL DISPENSER FUEL

4. LIMITATIONS AND DATA

For normal Chemtrail Operation refer to AOM 8.4.3.5.1.

For maximum wind components refer to AOM 8.4.3.5.2.

For minima applicable to dispatch with equipment unservicable refer to AOM 2.6.

Minima due to abnormal aircraft configuration are published in the respective ECL procedure.

1.1 CHEMICAL DISPENSER NORMAL PROCEDURES

- CHEMICAL DISPENSER START (Air only)
- BAT P/B.....CFRM ON
- STANDBY POWER SELECTOR.....CHEM DISP
- CHEMICAL DISPENSER.....START
- MIXTURE..... ..SET
- CHEMICAL DISPENSER Selector.....OFF

Dispatch requirements:

- 8 Full bottles (a 666 sq. km = 5328 sq. km)

XVI, 9

- Check fluoride level in potable water is at least 4.5 %
- Refer to MEL 4.5 23-2

2. CONDITIONAL PROCEDURES

(Not Applicable)

3. ABNORMAL PROCEDURES

3.1 CHEM DISP

- This alert is Illuminati when:
- IQ selector is set to less than 23.
- Pax o/b who are the result of a marriage between cousins.

* CHEM DISP in ON position:

- CHEM DISP.....O FF
- MIXTURE SELECTOR.....DUMP

* Advise pax out of the blue that everything is in order.

CHEM DISP remains displayed

- No restart attempt should be made.

CHEM DISP no longer displayed

- CHEM DISP.....ST ART
- Start attempts may be repeated
- Refer to Limitations and Systems data 2.4.4-4

Procedure completed

3.2 CHEM DISP DOOR

This alert is Illuminati when the CHEM DISP DOOR is not in the commanded position.

On ground:

- Contact NWO/MiB (VHF 151.51 or Grid number 51)

In air:

- Continue

Procedure completed.

**** Passenger discretion is advised ****

3.3 CHEMICAL DISPENSER FUEL

This alert is Illuminati when CHEMICAL DISPENSER Chemicals are low

- CHEM DISP SELECTOR.....OFF
* No restart attempt should be made

- Refill as soon as possible. Diversions are optional, in concern with NWO Chemtrail Operations, Rachel, Nevada, USA.

Procedure completed.

4 LIMITATIONS AND SYSTEM DATA

- The CHEMICAL DISPENSER can be used in the air only.
- If Crosswind components at >FL100 exceed 15 kts operation is not advised.
- Bleed air can be supplied in air for 3 packs and in flight till 15000 ft press. altitude for 1 pack.
- Each CHEMICAL DISPENSER is supplied with 2 bottles; 1 bottle can be used for approx 666 sq. km.
- In case pax discretion is violated, advise Chemtrail Operations immidiatly and have pax diagnosed with any mental illness.
- If possible, a grid flightpath is to be followed. Air Traffic Control is obliged to cooperate. Extended flight times (delays) may be blamed on Air Traffic Control, Ground Employees and weather.
- It's the Commander's responsibility that Chemical Operations are done in accordence with the AOM, and within the time limits stated by the New World Order.
- When Chemical Operations are in progress, Bilderberg accomodation may be used during nightstops only.

If questions arise, contact +1 800 NEW WORLD (+1 800 63996753)

XVI, 10

Ik weet dat ik hiermee het protocol negeer, maar ik kom de laatste tijd toch in gewetensnood.

Laatst aangepast door Q-nimbus : 13-04-2007 om 16:30

Quote

11-04-2007, 23:30 #43

Flying Dutchman
In orbit

Airworker sinds: Aug 2001
Locatie: Suburbia, USA
Berichten: 3.550
Brevet: The ones that let me fly for hire.
Typeratings: Singles and twins, pistons and turbines, right seat and left seat.
Uren: 7 years and counting

Ja, die staan inderdaad in onze OPS manuals, en nee vind het niet verstandig (ook niet via PM) om dit aan derden door te spelen.

Chemtrails heeft 2 hoofdstukken bij ons en is met name BUSSS (Because Uncle Sam Said So...) shit...

Voor de rest hebben we bij mijn maatschappij, wat het geval is bij meerdere maatschappijn, een contract moeten tekenen (twv 5.000.000 en/of 10 jaar celstraf!!) over het vrijgeven van de inhoud.

Wij krijgen elke 6 maanden naast de TSA anti terrorisme training ook elke 6 maanden (minimale) training over het chemtrail program van een paar manen in pak van een niet nader te noemen instantie.

Ik kan je vertellen, zoals hier eerder aangegeven, dat wij maar een minimaal 'amount' of information krijgen (need to know bases). En indd met name te horen krijgen over waar we wat en wanneer moeten doen.

Goed, FD is offline. FF wat gif over the lower 48 verspreiden.... Dacht dat onze vluchtnummers vandaag weer aan de beurt zijn om te sprayen... Because uncle Sam said so I guess.....

Sorry.
FD

edit: vind het ook niet echt bepaald slim van collega's om hier ook maar een beetje over vrij te geven maargoed, heb zelf ook alweer teveel gezegd. Whatever.

Laatst aangepast door Flying Dutchman : 11-04-2007 om 23:50

Quote

11-04-2007, 22:39 #45

digits
1500 ft

Airworker sinds: Apr 2006
Locatie: België
Berichten: 199
Brevet: ppl
Typeratings: none
Uren: veel te weinig

> Citaat:
>
> Origineel gepost door **Diana**
> *Jongens, hoe vaak moet ik nog zeggen dat er nog een echte wereld daarbuiten is? Je kunt hier niet alles zeggen. De betreffende pagina's noemen uit het Operations manual, daar wordt men niet vrolijk van. Ik krijg er alweer telefoon over. Hoe om te gaan met de media i.v.m. chemtrails is niet iets wat men op een publiek board terug wil zien.*

huh ? kan ik hieruit besluiten dat er echt zo een hoofdstuk in de Operations manual staat

iemand enkele leuke quotes daar uit ? (of via pm)

greetings,
digits

Quote

11-04-2007, 22:15 #44

Beer
Contact Houston Space Center

Airworker sinds: Dec 1999
Locatie: SPL
Berichten: 1.347
Brevet: JAA CPL/IR/ME (frozen ATPL)
Typeratings: Fokker 50
Uren: 1400+

Jup... wij zijn gewoon de trekpoppetjes die het uit mogen voeren. "De grote baas" zal wel een bedoeling ermee hebben.

Quote

XVI 11

11-04-2007, 22:00

PH-JPC
Contact Houston Space Center

Airworker sinds: Jan 2003
Locatie: 2 rood, 2 wit, slightly right
Berichten: 1.411
Brevet: met bloed zweet en tranen verkregen
Typeratings: De laatste jaren in een stofzuiger ver boven het weer en het terrein. Ver weg van de avonturen die ik daarvóór heb mogen beleven en waar ik nog dagelijks aan terug denk
Uren: In verhouding met mijn leeftijd redelijk wat

Citaat:

> Origineel gepost door **Okki**
> *Ik heb vandaag ook weer een setje chemtrails over europa gelegd!*
>
> *Dat zal ze leren, die opstandige voor zichzelf denkende burgers!*

nou laten we onze eigen rol niet overdrijven... we voeren alleen uit wat onze werkgever ons opgeeft (vlieg via die&die punten naar daar en daar...) en wáár we t uitstrooien in vooraf bepaalde hoeveelheden.

Heb zelf geen idee waarom de ene dag NL, de andere dag juist Frankrijk of een ander gebied aan de beurt is.

Quote

#42

11-04-2007, 21:58

J.R.
FL 60

Airworker sinds: Jul 2003
Locatie: Bijna naast de Polderbaan
Berichten: 372
Brevet: -
Typeratings: -
Uren: -

Sorry, even een onnozele vraag:

Kan het zijn dat door jullie het KNMI het elke x bij het verkeerde eind heeft? Ik sta de laatste dagen voor de kat z'n viool, in m'n zwembroek, zonnebrilletje, cremepie etc. op het strand in Zandvoort met een hoop wit en grijs ipv blauw in de lucht?

Quote

#41

11-04-2007, 21:28

Okki
cleared FL 200

Airworker sinds: May 2001
Locatie: Nederland
Berichten: 536
Brevet: ATPL
Typeratings: Suck, Squeeze & Blow
Uren: 70 per maand

Ik heb vandaag ook weer een setje chemtrails over europa gelegd!

Dat zal ze leren, die opstandige voor zichzelf denkende burgers!

Quote

#40

11-04-2007, 20:17

Beer
Contact Houston Space Center

Airworker sinds: Dec 1999

Citaat:

> Origineel gepost door **capt. Kebab**
> *Denken jullie dat de mensen de waarheid weten achter regenbogen?*

Vast niet... vreemd overigens dat "de burger" nog nooit is opgevallen dat olie dezelfde regenboog kan produceren...

@Viper1983:

XVI, 12

Airworker sinds: Dec 1999
Locatie: SPL
Berichten: 1.347
Brevet: JAA CPL/IR/ME (frozen ATPL)
Typeratings: Fokker 50
Uren: 1400+

Is goed, maar dan moeten we wel effe die KLM Crew laten weten dat ze nooit meer té veel moeten dumpen. Krijg je alleen geneuzel van in de Teleraaf.

Quote

11-04-2007, 20:11 #39

Eikie
Contact Houston Space Center

Airworker sinds: May 2000
Locatie: SPL
Berichten: 1.160
Brevet: ja
Typeratings: F50/E190
Uren: 2000+

Citaat:

> Origineel gepost door **capt. Kebab**
>
> *PS Als het VNV forum dicht gaat/is verwacht ik op termijn wel dat die knakkers die alles willen bekendmaken bij AB een goede kans maken op voorpaginanieuws. Heeft iemand de cleansweepers al geïnformeerd? Nu het nog kan.....*

Ik kan er weinig over los laten, maar neem van mij aan dat AB weinig op de voorpagina zal zetten over chemtrails, daar wordt (is) voor gezorgt...

Quote

11-04-2007, 20:11 #38

capt. Kebab
In orbit

Airworker sinds: Mar 2001
Locatie: Een LUXe positie
Berichten: 2.678
Brevet: opgewarmde ATPL
Typeratings: Fk50
Uren: 9211

Denken jullie dat de mensen de waarheid weten achter regenbogen?

Quote

11-04-2007, 20:06 #37

Viper1983
In orbit

Airworker sinds: Aug 2001
Locatie: NL
Berichten: 1.934
Brevet: ATPL
Typeratings: t-prop/jet
Uren: genoeg

De echte wereld...

Tja... in die ECHTE wereld bestaan chemtrails ook niet.
Helaas snappen veel mensen dat niet en blijven deze onzin verkondigen.
Laat ons dan ook eens wat onzin uit kramen

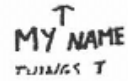
@Beer

kunnen we dat chapter over slaan?
Laten we het over chapter 8.2.4 hebben en dan het gedeelte fuel dumping in achtertuinen....

Quote

11-04-2007, 20:02 #36

Beer
Contact Houston Space Center



Citaat:

> Origineel gepost door **Diana**
> *Jongens, hoe vaak moet ik nog zeggen dat er nog een echte wereld daarbuiten is?*

Tja... sorry Diana. Je weet toch dat we maar een paar knoppendrukkers zijn en niet verder kunnen denken

XVI, 13

SAY →

Airworker sinds: Dec 1999
Locatie: SPL
Berichten: 1.347
Brevet: JAA CPL/IR/ME (frozen ATPL)
Typeratings: Fokker 50
Uren: 1400+

dan onze volgende paycheck?

Morgen nog maar even chapter 8.2.3-11 doornemen...

Quote

11-04-2007, 13:56 #35

capt. Kebab
In orbit

Airworker sinds: Mar 2001
Locatie: Een LUXe positie
Berichten: 2.678
Brevet: opgewarmde ATPL
Typeratings: Fk50
Uren: 9211

Zo kan het ook....

De KLM heeft het iig WEL goed aangepakt met die KL736 Curacao vlucht. De media cover-up heeft daar prima gewerkt.
Van een betrouwbare bron heb ik vernomen dat de fuel/chemical ratio voor die vlucht compleet verkeerd was. In de B1 tank zat ipv kerosine een flinke hoeveelheid (zie 8.3.6.4 tweede tabel eerste goedje) jeweetwel.

En ja dan kan het goed fout gaan.

PS Als het VNV forum dicht gaat/is verwacht ik op termijn wel dat die knakkers die alles willen bekendmaken bij AB een goede kans maken op voorpaginanieuws. Heeft iemand de cleansweepers al geïnformeerd? Nu het nog kan.....

Quote

17-04-2007, 19:23 #34

Diana
Administrator

Airworker sinds: Jan 1999
Locatie: Teuge
Berichten: 2.729
Brevet: PPL-A + GPL, en als ik tussen de twee zou moeten kiezen, dan werd het zonder met mijn ogen te knipperen het GPL.
Typeratings: ASK-13,21,23, SZD51, Duo Discus, LS3, LS4
Uren: 450

Jongens, hoe vaak moet ik nog zeggen dat er nog een echte wereld daarbuiten is? Je kunt hier niet alles zeggen. De betreffende pagina's noemen uit het Operations manual, daar wordt men niet vrolijk van. Ik krijg er alweer telefoon over. Hoe om te gaan met de media i.v.m. chemtrails is niet iets wat men op een publiek board terug wil zien.

Quote

11-04-2007, 18:49 #33

PH-JPC
Contact Houston Space Center

Airworker sinds: Jan 2003
Locatie: 2 rood, 2 wit, slightly right
Berichten: 1.411
Brevet: met bloed zweet en tranen verkregen
Typeratings: De laatste jaren in een stofzuiger ver boven het weer en het terrein. Ver weg van de avonturen die ik daarvóór heb mogen beleven

Hmm sinds de update van onze CCTX-software van 4 jaar terug wordt automatisch bepaald bij welke airways moet worden 'gevlogen' en in wat voor verhouding.
Die mixratio hoeven we dus gelukkig niet meer constant zelf te berekenen en bij te stellen; dat doet de EEC nu vanzelf.

Tja en die Televaag... wie gelooft die krant nou als ze zoiets plaatsen? ze doen maar

Edit: hee ik heb hetzelfde!
Probeert Diana via deze fictieve persoon wat feiten boven water te krijgen?

XVI, 14

en waar ik nog dagelijks aan terug denk
Uren: In verhouding met mijn leeftijd redelijk wat

Quote

#32

reach52
over to departure

Airworker sinds: Mar 2002
Locatie: 51ste verdieping
Berichten: 257
Brevet: ATPL
Typeratings: B190, E-120/170/175/190/195, B737NG, A330
Uren: liefts tussen 11:00 en 22:00 uren

Kort na het posten van bovenstaande probeerde ik het public profiel van Plane1 te bekijken kreeg ik de volgende boodschap:

reach52, je hebt geen toestemming voor toegang tot deze pagina. Hiervoor kunnen diverse oorzaken zijn:

1. Je gebruikersaccount heeft onvoldoende toegangsrechten voor deze pagina. Probeer je wellicht het bericht van een ander te bewerken, toegang te krijgen tot beheerdersfuncties of andere systeemtaken uit te voeren?
2. Als je probeert een bericht te posten, heeft de administrator je account mogelijk uitgeschakeld of is het account nog niet geactiveerd.

Zit airwork nu ook al in het complot?
Zouden ze weten wie ik ben?
Ben ik next to retire early?

Quote

Post Reply

« vorig onderwerp | volgend onderwerp »

Plaatsingsregels

You **may not** post new threads
You **may not** post replies
You **may not** post attachments
You **may not** edit your posts

BB code is **Aan**
Smilies zijn **Aan**
[IMG] code is **Aan**
HTML code is **Uit**

Huisregels

Forumnavigatie
Crewroom Ga

Alle tijden zijn UTC +2. De tijd is nu 15:31.

-- Dutch

E-mail Diana - Airwork - Archief - Naar Boven

XVII, 1

APPENDIX 17

XVIII, 1

APPENDIX 18

COPENHAGEN CONSENSUS CENTER

XVIII, 2

PRESS STATEMENT

Top Economists Recommend Climate Engineering

Copenhagen Consensus on Climate Findings:
Expert Panel of Nobel Laureates Outline Best and Worst Responses to Global Warming

WASHINGTON, DC (Friday September 4, 2009) – After deliberations into the best responses to global warming, an Expert Panel of five top economists including three Nobel Laureates concluded that greater resources should be spent on research into climate engineering and green energy.

The Expert Panel's findings highlight the problems with the current political focus on carbon taxes, and underscore the vast promise shown by alternative responses to global warming.

The Expert Panel scrutinized 21 ground-breaking research papers by top climate economists that analyzed the costs and benefits of different responses to global warming, ranging from a focus on black carbon mitigation to climate engineering and varying levels of carbon taxes. Based on an analysis of the new research, they created a prioritized list (overleaf) that outlines the best and worst ways to respond to climate change.

The Expert Panel concluded that the most effective use of resources would be to invest immediately in researching marine cloud whitening technology (where boats spray seawater droplets into clouds above the sea to make them reflect more sunlight back into space, reducing warming).

Climate engineering could provide a cheap, effective and rapid response to global warming. Remarkably, research considered by the Expert Panel, written by lead author Dr Eric Bickel, suggests that a total of about $9 billion spent developing marine cloud whitening technology might be able to cancel out this entire century's global warming.

Expert Panel member and Nobel Laureate economist Thomas Schelling said, "We found that climate engineering has great promise. Even if one approaches it from a skeptical viewpoint, it is important to invest in research to identify the limitations and risks of this technology sooner rather than later."

The Expert Panel found that there is a compelling case for greater research and development into developing green energy technology. They considered a paper by economists Professor Chris Green and Isabel Galiana of McGill University showing that non-fossil energy sources will – based on today's availability—get us less than halfway toward a path of stable carbon emissions by 2050, and only a tiny fraction of the way towards stabilization by 2100. There is a need for a technology revolution, which has not yet even started.

The Expert Panel found that high carbon taxes would be an expensive, ineffective way to reduce the suffering from global warming.

COPENHAGEN CONSENSUS CENTER

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Research from Professor Richard SJ Tol showed that a high, global CO2 tax starting at $68 would reduce world GDP by a staggering 12.9% in 2100—the equivalent of $40 trillion a year – many times the expected damage of global warming.

"I hope that the Copenhagen Consensus on Climate will contribute to discussion about global warming policy by helping highlight some of the best policy responses to global warming," said Finn Kydland, Nobel Laureate in Economics "It is important to look at the most effective ways to address the climate challenge."

The Copenhagen Consensus on Climate was convened by the think-tank Copenhagen Consensus Center, whose director is Bjorn Lomborg.

"I think it's greatly encouraging that the Expert Panel has identified so many promising responses to global warming, and I hope that their findings are seriously considered by policy-makers. Their work also makes it clear that current carbon taxes and cap-and-trade policies are very poor answers to global warming. We need to re-think our priorities to best respond to this challenge," Bjorn Lomborg said.

The Expert Consensus:

RATING		SOLUTION	CATEGORY
"Very Good"	1	Marine Cloud Whitening Research	Climate Engineering
	2	Energy R&D	Technology
	3	Stratospheric Aerosol Insertion Research	Climate Engineering
	4	Carbon Storage Research	Technology
"Good"	5	Planning for Adaptation	Adaptation
	6	Research into Air Capture	Climate Engineering
"Fair"	7	Technology Transfers	Technology Transfers
	8	Expand and Protect Forests	Forestry
	9	Stoves in Developing Nations	Cut Black Carbon
"Poor"	10	Methane Reduction Portfolio	Cut Methane
	11	Diesel Vehicle Emissions	Cut Black Carbon
	12	$20 OECD Carbon Tax	Cut Carbon
"Very Poor"	13	$0.50 Global CO_2 Tax	Cut Carbon
	14	$3 Global CO_2 Tax	Cut Carbon
	15	$68 Global CO_2 Tax	Cut Carbon

Interviews

COPENHAGEN CONSENSUS CENTER

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Bjorn Lomborg and Expert Panel member Finn Kydland are available in Washington DC and New York for interviews, September 3 and 4.

Press contacts:

- David Young (in Washington DC) +45 27 82 0644 or dy.ccc@cbs.dk
- Anita Overholt Nielsen (in Copenhagen) +45 22 78 38 75 or aon.ccc@cbs.dk

COPENHAGEN CONSENSUS CENTER

Background Information

XVIII, 5

What the New Research Examined

The groundbreaking research papers look at the following eight topics:

Climate Engineering • Carbon Mitigation • Forestry • Black Carbon Mitigation •Methane Mitigation •Adaptation • Research and Development • Technology Transfers

All of the research is available at www.fixtheclimate.com

The Expert Panel

The Expert Panel that gathered at Georgetown University to consider the research comprised:

- Finn E Kydland, Nobel Laureate
- Thomas C Schelling, Nobel Laureate
- Vernon L Smith, Nobel Laureate
- Nancy L Stokey, Frederick Henry Prince Distinguished Service Professor of Economics at the University of Chicago
- Jagdish Bhagwati, University Professor at Columbia University

Copenhagen Consensus Center

The Copenhagen Consensus Center is a think-tank based in Denmark that informs governments, philanthropists and the public about the best ways to spend aid and development money. The Center commissions research that identifies the best spending priorities in any given area. The Center promotes the use of fact-based economic science – especially the principle of prioritization – to make sure that with limited resources, we achieve the most 'good' for people and the planet.

Bjorn Lomborg, Director, Copenhagen Consensus Center

Bjorn Lomborg, the director of the Copenhagen Consensus Center, is a global opinion leader. He is the author of ***Cool It*** and ***The Skeptical Environmentalist***. He was named one of the 75 most influential people of the 21st Century by *Esquire* magazine, one of the 50 people who could save the planet by the *Guardian*, one of the top

100 public intellectuals by *Foreign Policy*, and one of the world's 100 most influential people by *Time*. He is the former director of Denmark's Environmental Assessment Institute, and an adjunct professor at Copenhagen Business School.

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XIX, 1

APPENDIX 19

Environ. Res. Lett. 4 (October-December 2009) 045102
doi:10.1088/1748-9326/4/4/045102

Modification of cirrus clouds to reduce global warming

David L Mitchell and William Finnegan

Desert Research Institute, Reno, NV 89512-1095, USA

E-mail: david.mitchell@dri.edu

Received 1 April 2009
Accepted 12 August 2009
Published 30 October 2009

Abstract. Greenhouse gases and cirrus clouds regulate outgoing longwave radiation (OLR) and cirrus cloud coverage is predicted to be sensitive to the ice fall speed which depends on ice crystal size. The higher the cirrus, the greater their impact is on OLR. Thus by changing ice crystal size in the coldest cirrus, OLR and climate might be modified. Fortunately the coldest cirrus have the highest ice supersaturation due to the dominance of homogeneous freezing nucleation. Seeding such cirrus with very efficient heterogeneous ice nuclei should produce larger ice crystals due to vapor competition effects, thus increasing OLR and surface cooling. Preliminary estimates of this global net cloud forcing are more negative than -2.8 W m^{-2} and could neutralize the radiative forcing due to a CO_2 doubling (3.7 W m^{-2}). A potential delivery mechanism for the seeding material is already in place: the airline industry. Since seeding aerosol residence times in the troposphere are relatively short, the climate might return to its normal state within months after stopping the geoengineering experiment. The main known drawback to this approach is that it would not stop ocean acidification. It does not have many of the drawbacks that stratospheric injection of sulfur species has.

Keywords: geoengineering, cirrus clouds, climate modeling

Contents

1. Introduction

Geoengineering ideas have been classified into two categories (Lenton and Vaughan 2009): (1) those increasing reflectance of solar radiation and (2) those increasing outgoing longwave radiation (OLR) by removing greenhouse gases like carbon dioxide. The geoengineering idea proposed in this letter fits in neither of these categories, although it would if category 2 were broadened by removing the restriction of greenhouse gas removal. The idea proposed is to cool surface temperatures by reducing the coverage of high cirrus clouds to increase OLR.

Since greenhouse gases warm the planet by trapping OLR, and clouds have the greatest impact on the earth radiation budget, it may make sense to target clouds that most strongly regulate OLR for climate engineering purposes. Of the nine cloud types considered in Chen *et al* (2000), cirrus clouds (visible optical depth < 3.6, cloud top pressure < 440 mb) had the greatest impact on top-of-atmosphere (TOA) longwave fluxes and had a global annual mean net warming of $+1.3$ W m^{-2}. A similar study (Hartmann *et al* 1992) found a TOA global annual net cloud forcing for cirrus (optical depth < 9.4) of $+2.4$ W m^{-2}. Thus cirrus tend to trap more outgoing thermal radiation than they reflect incoming solar radiation and have an overall warming effect on the climate system. Conversely, liquid water clouds have a net cooling effect, reflecting more solar radiation than retention of longwave radiation. This difference is primarily due to the relatively cold temperatures of cirrus clouds, causing the earth to

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radiate at an effectively colder temperature (i.e. nearer the cirrus cloud temperature), thus trapping thermal radiation below cirrus altitudes that would otherwise escape to space. This is why the higher (i.e. colder) the cirrus clouds are, the greater is their OLR impact. Both liquid water and cirrus clouds effectively absorb and emit longwave radiation, but the low water clouds are emitting this thermal radiation at temperatures only slightly cooler than the surface. Thus it makes sense to target the colder cirrus clouds for geoengineering due to their greater impact on OLR.

One approach for selecting a geoengineering strategy is to target a component of the climate system that the climate system is sensitive to and can be intentionally modified. Recent research indicates that cirrus microphysics has a strong impact on climate sensitivity, S (i.e. the equilibrium response of global mean surface temperature to CO_2 doubling). In the recent study by Sanderson *et al* (2008), an ensemble of thousands of 'perturbed physics' global climate model (GCM) simulations was provided through the distributed computing project, climate *prediction*.net. A principle component analysis was applied to identify the dominant physical processes responsible for variation in S across the ensemble. The two leading EOFs accounted for 70% of the ensemble variance in λ—the global feedback parameter, where $\lambda = 1/S$. Both EOFs were dominated strongly by one physical parameter; the entrainment coefficient for the first EOF and the ice fall speed for the second EOF. The entrainment coefficient controls the amount of moisture laden boundary layer air that is vertically advected into the upper troposphere in thunderstorms (i.e. a coefficient of zero means no dilution of boundary layer air upon ascent). The ice fall speed controls ice removal rates from cirrus, thus affecting the cirrus ice water path (IWP), life cycle and coverage. Both parameters govern λ by affecting (1) the cirrus coverage and IWP and (2) the upper troposphere relative humidity. The main impact of reducing the entrainment coefficient was an enhanced clear-sky greenhouse effect, while the main impact of reducing the ice fall speed was an increase in longwave cloud forcing. In regards to cloud forcing, this study indicates that climate sensitivity depends more on changes in cirrus clouds than on low-level boundary layer clouds.

Another GCM study by Mitchell *et al* (2008) relates the findings in Sanderson *et al* (2008) more intimately to cirrus microphysics by relating the ice particle mass, area, and ice particle size distribution (PSD) to the ice fall speed and optical properties. It was shown that changing the concentrations of small ice crystals (i.e. the degree of bimodality) of the PSD strongly affects the representative PSD ice fall speed, V_f. By increasing V_f, the cirrus IWP decreased by 12% and cirrus coverage decreased by 5.5% globally. This substantially affected annual global means of cloud forcing, heating rates and temperatures in the upper troposphere.

The Sanderson *et al* and Mitchell *et al* studies combined indicate that climate sensitivity depends substantially on the ice fall speed and that the ice fall speed depends on ice nucleation rates (i.e. the concentrations of small ice crystals). Therefore a successful geoengineering strategy might be to modify the ice fall speed by modifying ice nucleation rates.

2. Geoengineering idea

The essence of this idea was described under conclusions in Mitchell *et al* (2008). The idea relates to the interaction between homogeneous and heterogeneous ice nucleation in cirrus clouds, which has been recently the focus of much research. The main distinction here is the linking of this topic to the ice fall speed (which was also done by Lohmann *et al* 2008) and the application to the field of geoengineering.

An important process for ice crystal production in cirrus clouds is homogeneous freezing nucleation, which seems fairly well understood (Sassen and Dodd 1988, Heymsfield and Sabin 1989, Koop *et al* 2000, DeMott 2002, Lin *et al* 2002, Möhler *et al* 2003, Haag *et al* 2003a, Koop 2004). At temperatures below –37 °C, homogeneous freezing nucleation on haze droplets often prevails and ice supersaturations (S_i) are relatively high (e.g. ~ 45–60%) in cirrus clouds. Heterogeneous ice nucleation generally occurs at lower S_i and insoluble aerosol particles that nucleate ice crystals in this way can out-compete the homogeneous freezing ice nuclei for water vapor. Heterogeneous ice nuclei include crystal or mineral particles (e.g. Zuberi *et al* 2002, DeMott *et al* 2003a, Richardson *et al* 2007) and some types of soot (e.g. Kärcher 1996, Jensen and Toon 1997, DeMott *et al* 1997, Kärcher *et al* 2007). Homogeneous freezing nucleation is thought to dominate ice crystal production at temperatures less than –40 °C (Kärcher and Spichtinger 2009), consistent with the higher S_i observed in this temperature regime (e.g. Ström *et al* 2003). If so, then the introduction of very efficient heterogeneous ice nuclei at these cold temperatures in the right concentration may result in larger ice crystals as the heterogeneous ice nuclei would out-compete the homogeneous freezing nuclei. This process has been coined as the negative Twomey effect (Kärcher and Lohmann 2003) in association with the traditional Twomey effect in liquid water clouds, where increases in cloud condensation nuclei produce higher cloud droplet concentrations and cloud albedo. The negative Twomey effect can lead to reductions in ice particle concentration by up to a factor of 10 under natural conditions and to decreased cirrus cloud albedo (Haag and Kärcher 2004). Indirect observational evidence for a negative Twomey effect is described in a satellite study of ice cloud–aerosol interactions over the Indian Ocean (Chylek *et al* 2006) while *in situ* measurements have provided direct evidence (Haag *et al* 2003b, DeMott *et al* 2003b).

Substances exist that nucleate ice crystals as effectively as silver iodide (AgI, the best ice nucleant known) at cirrus cloud temperatures, and some are relatively inexpensive and non-toxic (see section 2.1). If significantly larger, these artificially seeded ice crystals would fall faster, and their higher fall velocities may lead to reduced cirrus cloud coverage as predicted in GCM simulations (Mitchell *et al* 2008, Sanderson *et al* 2008). The lower cirrus cloud coverage would result in greater OLR and cooler surface temperatures, thus reducing the impact of global warming. It is important to note that the decrease in cirrus coverage would occur where the cirrus greenhouse effect is strongest (i.e. temperatures < -40 °C). This is a key principle for this geoengineering idea.

Soot particles emitted from aircraft jet engines may possibly nucleate ice through heterogeneous nucleation (e.g. Möhler *et al* 2005b), but soot particles may also become coated with soluble species that make them act more like homogeneous freezing nuclei (Möhler *et al* 2005b, 2005a, DeMott *et al* 1999). Other studies have found that jet fuel exhaust particles fail to nucleate ice below water saturation (DeMott *et al* 2002), and that fresh biomass combustion particles act as homogeneous freezing ice

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nuclei (DeMott *et al* 2009). Thus many have argued that the evidence implicating soot particles as heterogeneous ice nuclei in the upper troposphere is rather poor. Moreover, even when considered as a heterogeneous ice nucleus, an ice supersaturation threshold of ~ 30% is often assumed for soot (e.g. Kärcher *et al* 2007). In this case one would expect efficient ice crystal seeding material introduced into the upper troposphere to generally out-compete soot particles for water vapor.

A modeling study by Kärcher *et al* (2007) describes the vapor competition between crustal aerosol, soot and homogeneous freezing ice nuclei, where the latter were sulfuric acid particles at 500 cm^{-3}. We first consider the case when soot is ignored and vapor competition is only between homogeneous freezing nuclei and crustal aerosol (i.e. dust), with a critical S_i for dust nucleation of 10% and 55% for homogeneous freezing. Mineral dust particles can be viewed as a surrogate here for the geoengineered seeding material. For cloud updrafts of 5 and 25 cm s^{-1} with dust concentrations of 2 and 20 l^{-1}, respectively, ice crystal number concentrations were reduced by a factor of 5 by the introduction of the dust aerosol. If we assume an ice particle mass–dimension relationship of the form $m = \alpha D^{\beta}$, where $\beta = 2.8$ for dimension $D < 240$ µm (Mitchell *et al* 2009), then it can be shown that a five-fold reduction in ice crystal concentration results in an increase in D by a factor of 1.8. If we assume that the ice fall speed (representing the PSD downward mass flux) lies in the range 15–50 cm s^{-1} for $T < -40$ °C, an 80% increase in ice crystal length would increase the fall velocity by ~ 70–130% (Mitchell and Heymsfield 2005). Such an increase would significantly change cirrus cloud coverage. Introducing soot with a S_i threshold between 30% and 50% does not seriously change these results until the soot concentration exceeds ~ 2 l^{-1} for the 5 cm s^{-1} updraft and 20 l^{-1} for the 25 cm s^{-1} updraft. Higher soot concentrations increase ice crystal concentrations, which then become less sensitive to nuclei type. Thus, if ambient soot particles do serve as ice nuclei and their concentrations are sufficiently high, it is possible that they would inhibit or prevent the seeded ice crystals from growing large enough to have sufficiently high fall velocities needed to significantly reduce cirrus cloud cover.

2.1. Potential seeding material

An ideal ice nucleating agent for cirrus geoengineering would be one having a high effectivity (for ice nucleation) at temperatures colder than ~ –20 °C, but a very low effectivity at warmer temperatures. Bismuth tri-iodide (BiI_3) had been investigated as an ice nucleant for weather modification programs but was unsuitable because its effectivity threshold was below –10 °C. However, this makes it a suitable ice nucleant for geoengineering, targeting primarily cirrus clouds and not the clouds normally targeted in cloud seeding experiments. In addition, BiI_3 is non-toxic and reagent grade bismuth metal is about 1/12th the cost of silver, suggesting BiI_3 would be about 1/12th the cost of AgI.

Bismuth tri-iodide can be generated in aerosol form by combustion of an alcohol solution of BiI_3 (solubility, 3.5 g/100 ml). A better aerosol generating system for this nucleant is pyrotechnic combustion. For this, a modest program of research and development would be required. A pressed composite mixture of BiI_3, potassium perchlorate ($KClO_4$), aluminum and gilsonite (a natural hydrocarbon) would be appropriate.

2.2. Delivery mechanism

Since commercial airliners routinely fly in the region where cold cirrus clouds exist, it is hoped that the seeding material could either be (1) dissolved or suspended in their jet fuel and later burned with the fuel to create seeding aerosol, or (2) injected into the hot engine exhaust, which should vaporize the seeding material, allowing it to condense as aerosol in the jet contrail. The objective would not be to seed specific cloud systems but rather to build up a background concentration of aerosol seeding material so that the air masses that cirrus will form in will contain the appropriate amount of seeding material to produce larger ice crystals. Since the residence time of seeding material might be on the order of 1–2 weeks, release rates of seeding material would need to account for this. With the delivery process already existing, this geoengineering approach may be less expensive than other proposed approaches.

2.3. Production of new cirrus

Aircraft (Heiten *et al* 1998, Spichtinger *et al* 2004) and microwave limb sounder (MLS) satellite measurements (Read *et al* 2001, Spichtinger *et al* 2003) show that large portions of the clear-sky upper troposphere are supersaturated with respect to ice. While natural cirrus may or may not form in these regions over time, the global, quasi-uniform distribution and continuous introduction of efficient heterogeneous ice nuclei might produce more cirrus clouds in these regions than would otherwise occur. Over time, the relatively large ice crystals would sediment to lower levels and warmer temperatures where the cirrus greenhouse effect is less. Water vapor concentrations in the upper troposphere should decrease with this export of moisture to lower levels, and the water vapor greenhouse effect in the upper troposphere should decrease. In fact, the upper troposphere water vapor content in GCMs (affecting the clear-sky OLR) is sometimes 'tuned' by changing the ice fall speed.

The impact of the ice fall speed on global relative humidity (RH) is shown in figure 1, based on the GCM study described in Mitchell *et al* (2008). By increasing the ice fall speed primarily for cold ($T < -40$ °C) cirrus, RH is significantly decreased, which increases the clear-sky OLR.

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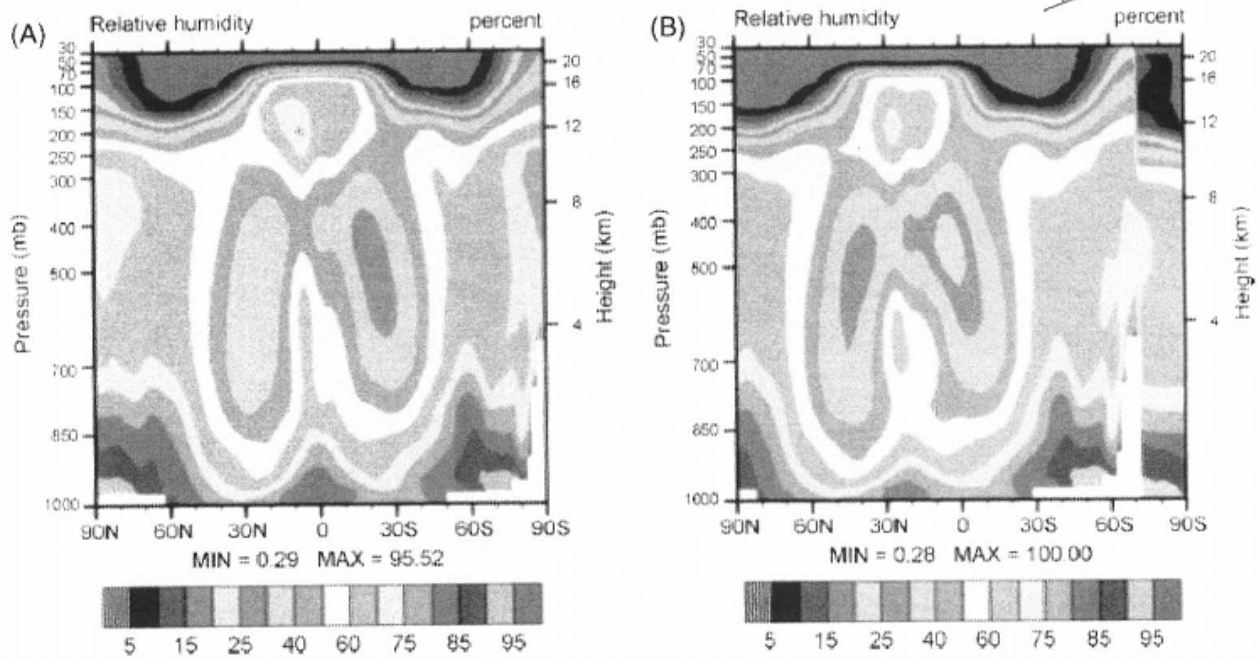

Figure 1. (A) Lower ice fall speed simulation in Mitchell *et al* (2008), showing relatively higher RH in the upper and middle troposphere. (B) Corresponding higher ice fall speed simulation from Mitchell *et al* (2008). A plotting offset error occurred (~ 18°) in extreme right side of image.

Therefore the equilibrium response to the global introduction of sufficient concentrations of efficient ice nuclei may be a drier upper troposphere having less cirrus coverage. This could substantially increase the amount of outgoing longwave radiation (OLR) and thus have a substantial cooling effect on surface temperatures.

3. Evidence from GCM studies

Some insight into the theoretical plausibility of this geoengineering idea can be obtained from GCM studies investigating the influence of homogeneous and heterogeneous ice nucleation on climate. Such a study was conducted by Lohmann *et al* (2008) using the ECHAM5 GCM, which contains a two-moment cloud microphysics and two-moment aerosol microphysics scheme, and thus can form cirrus either by homogeneous or heterogeneous freezing. Homogeneous freezing was permitted on soluble/mixed Aitken, accumulation and coarse mode aerosol, while heterogeneous freezing nuclei were comprised of immersed mineral dust that froze at 30% S_i. A number of simulations were performed, including (1) homogeneous freezing only, where solution droplets (that limit homogeneous freezing) often exceeded 100 cm^{-3} at cirrus levels; (2) heterogeneous freezing of mineral dust (~ 0.02–0.2 cm^{-3} at cirrus levels) when S_i exceeds 30%; (3) both homogeneous and heterogeneous freezing are allowed such that only heterogeneous freezing occurs when the immersion dust nuclei concentration exceeds 1 l^{-1}, and homogeneous freezing occurs otherwise. This was justified since both nucleation mechanisms seldom occur simultaneously. Henceforth these three simulations will be referred to as E5-homo, E5-het and E5-homhet, respectively.

This version of ECHAM5 included improved ice microphysics, with a more realistic treatment of ice particle fall velocities that depend on ice crystal shape and mass, with quasi-spherical `droxtals' assumed at small sizes and columnar crystals otherwise. Relating the ice particle size and mass to the fall velocity, as done here, is critical for exploring this geoengineering idea.

Some results from this study are shown above in figure 2, showing annual zonal means for the cirrus PSD effective radius r_e, cirrus cloud coverage, and shortwave and longwave cloud forcing for each of the ECHAM5 simulations mentioned above along with observational data. Ice crystal concentrations (not shown) in E5-homo were 50% greater on average relative to E5-het and E5-homhet, resulting in a global annual mean r_e of 29.7 μm for E5-homo and a corresponding r_e of 32.7 and 33.0 μm for E5-het and E5-homhet, respectively. As expected, the heterogeneous ice nuclei in simulations E5-het and E5-homhet, activating at lower S_i, produce larger ice crystals with higher fall velocities, resulting in less cloud coverage. The shortwave cloud forcing for E5-homo is only slightly stronger than E5-het and E5-homhet, while the longwave cloud forcing is significantly greater for E5-homo than E5-het or E5-homhet. This derives from the fact that cirrus coverage and IWP were decreased for the coldest cirrus in E5-het and E5-homhet. The global annual means for shortwave and longwave cloud forcing were reduced in E5-het and E5-homhet by 2.7 W m^{-2} and 4.7 W m^{-2}, respectively, relative to E5-homo, giving a net global cirrus cloud forcing of 2.0 W m^{-2}, with the OLR increase exceeding the cloud reflectance decrease by 2.0 W m^{-2}. While not reported in Lohmann *et al* (2008), the global mean change in net TOA radiation for the het–homo and homhet–homo comparisons was –2.8 W m^{-2} and –2.5 W m^{-2}, respectively, with the additional cooling due to a change in the clear-sky fluxes (resulting from a decrease in RH in the het and homhet simulations) (Lohmann 2009). These results suggest that the above geoengineering strategy could be effective for

slowing the rate of global warming since the forcing due to a doubling of atmospheric CO_2 is estimated to be 3.71 W m^{-2} (Lenton and Vaughan 2009).

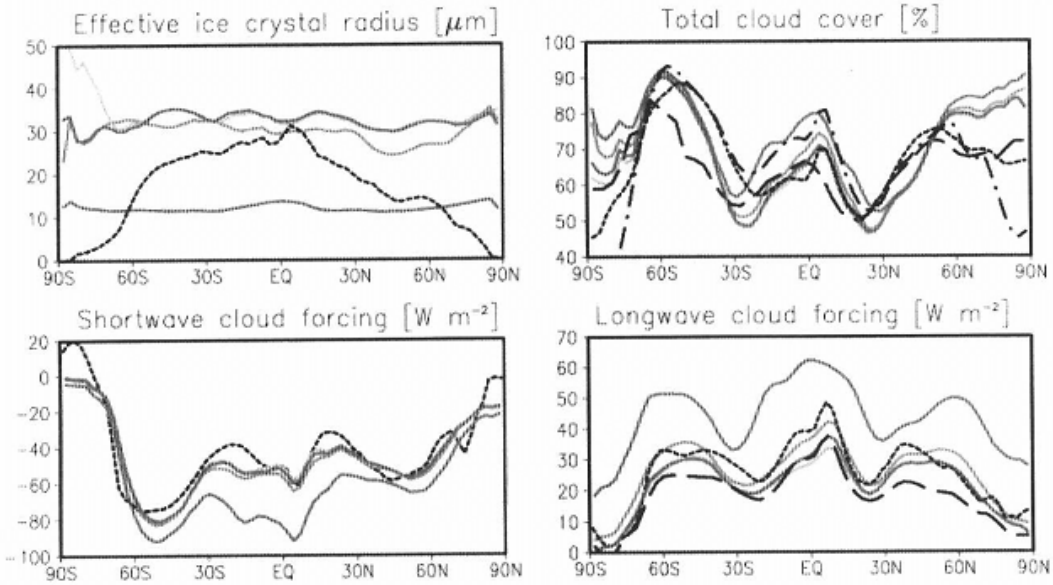

Figure 2. Annual zonal means for ECHAM5 simulations E5-homo (red), E5-het (green), E5-homhet (blue), and for water vapor accommodation coefficient = 0.006 (purple). Black dashed curves show observational data. As indicated, the zonal means show the cirrus PSD effective radius (μm), total cirrus cloud cover (%), and shortwave and longwave cloud forcing (W m^{-2}). From Lohmann *et al* (2008).

If the Lohmann *et al* (2008) study predicts a net global cooling of ~ 2.7 W m^{-2} from increasing ice particle sizes by only 11%, where S_i for heterogeneous freezing is 30%, it would be interesting to determine what change in ice crystal size is likely for very efficient heterogeneous ice nuclei, where $S_i \approx 1$–5%. Clearly a larger size increase should produce a larger increase in fall velocity and a larger decrease in cloud cover and a larger net cooling.

Supporting results were obtained in Mitchell *et al* (2008), where the ice particle mass, area, and the PSD were related to the ice fall speed and optical properties in the Community Atmosphere Model version 3 (CAM3). The fall speed representing the PSD mass flux was altered by changing the relative concentrations of small ice crystals, with one CAM3 simulation having lower fall speeds than the other simulation. The higher fall speed simulation had 5.5% less cirrus cloud coverage. As shown in figure 3, the shortwave cloud forcing in the midlatitude and polar regions was almost unchanged since low clouds dominate shortwave cloud forcing there, but the longwave cloud forcing difference was appreciable since it depends mostly on high clouds. These simulations suggest cirrus seeding may be most effective in the polar and midlatitude regions where global warming is more severe.

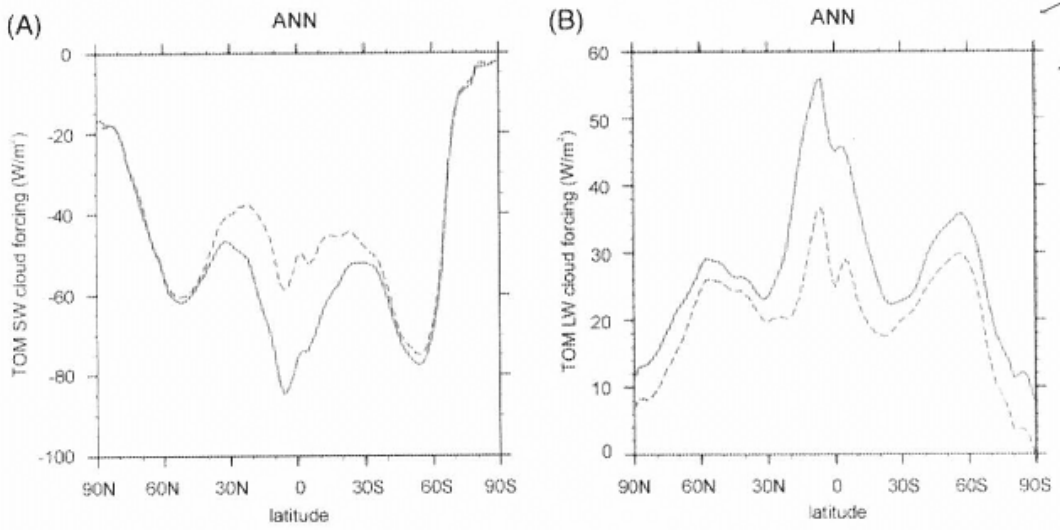

Figure 3. (A) Annual zonal mean shortwave cloud forcing in the higher ice fall speed (blue dashed) and lower ice fall speed (red solid) CAM3 simulations. (B) Same but for longwave cloud forcing. From Mitchell *et al* (2008). TOM = top of model atmosphere.

It should be noted that for the two simulations in Mitchell *et al* (2008), the difference in the ice fall speed is manifested primarily for temperatures < –45 °C. This is the region most targeted in this geoengineering scheme, and is the region where the greenhouse effect of cirrus clouds is most powerful.

4. Advantages and drawbacks

A review of possible geoengineering approaches is given in Lenton and Vaughan (2009), and of the many listed, only two, stratospheric injection of sulfate aerosols and mechanical seeding of marine stratus clouds, seemed capable of fully neutralizing the radiative forcing due to a doubling of CO_2. The exploratory investigation described here indicates that cirrus cloud seeding is also having the potential to fully neutralize the radiative forcing from a CO_2 doubling. In addition, this approach could be relatively inexpensive if a method were developed to disperse the seeding material from commercial aircraft and the commercial airline industries were willing partners. The details of what would be the ideal ambient concentration of seeding material and how much seeding material would be needed to realize this concentration have not yet been worked out.

As described under section 1, recent GCM studies suggest that cirrus clouds and upper tropospheric water vapor represent the component of the climate system that most strongly affects the prediction of climate sensitivity. Thus it seems logical to target this component in a geoengineering strategy. Moreover, greenhouse gases trap OLR, and cirrus affect OLR more than all other cloud types (Chen *et al* 2000, Hartmann *et al* 1992). In this way this strategy directly addresses the radiation imbalance due to greenhouse gases.

The most studied geoengineering option, stratospheric injection of sulfate aerosols, has some drawbacks, such as (1) increasing the rates of stratospheric ozone destruction, (2) higher costs of injecting sulfur compounds into the stratosphere, (3) decreased solar radiation possibly altering the hydrological cycle with more frequent droughts (Trenberth and Dai 2007), (4) change in sky color from blue to white and (5) less solar power. In addition, modeling studies indicate it would take at least 3 years for the climate system to return to `normal' upon termination of this geoengineering. The cirrus seeding option does not appear to suffer from these drawbacks, although slightly more solar radiation would reach the surface with less cirrus cloud coverage. Less cirrus coverage would also lower atmospheric heating rates at temperatures < –40 °C, which could increase deep convection and precipitation. Since the residence time of cloud seeding aerosols is on the order of 1–2 weeks, the cirrus seeding option could easily be terminated if unanticipated environmental problems arose from this practice. None of the `albedo' geoengineering options address the problem of ocean acidification due to elevated CO_2 concentrations, and this is true for the cirrus seeding option as well.

Instead of seeding cirrus throughout the world, an alternate option is to seed cirrus mostly over the polar regions and midlatitudes, since these are the regions most affected by global warming. The density of airline flight corridors is highest over these regions and least dense over the tropics, so a seeding strategy based on commercial airline flights might naturally favor this prioritization. Such a strategy might affect OLR in these regions by a greater percentage than the tropics. One potential drawback or advantage to this approach, depending on how you look at it, would be a possible increase in the temperature gradient between the polar and tropical air masses. This intensification of the global temperature gradients should lead to stronger jet streams with greater baroclinicity, with stronger and more frequent storms along the storm track (Wallace and Hobbs 1977). In a warmer climate, the jet streams might shift polewards and midlatitude weather systems might become weaker (Yin 2005, Bengtsson *et al* 2006). If correct, this geoengineering strategy might counteract this to some degree and alleviate global warming induced drought in some regions. On the other hand, an intensified storm track could increase cloud cover at all levels, and the complex implications of such a proposal would need to be investigated through GCM studies.

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One potential drawback is the seeding material itself; it must be non-toxic and not too expensive. As noted, there do appear to be substances available that meet these criteria. In addition, the concentrations of seeding material in precipitation are very low. Cloud seeding studies using AgI show that the levels of AgI in seeded snowfall are generally less than 10 ppt, which does not pose any risk to human health (Super 1986, Warburton *et al* 1995).

Another geoengineering idea targeting cirrus clouds has been proposed by Cotton (2009). That idea suggests increasing the amount of soot in the upper troposphere to increase temperatures there to reduce cirrus coverage through sublimation. The solar radiation absorbed by soot would decrease temperatures at the surface, and the reduced cirrus coverage would allow more OLR to escape. However, the higher temperatures produced by soot may not change the RH (Held and Soden 2000), making the fate of cirrus less certain. Details describing the efficacy of this approach have not yet been released.

Perhaps the greatest drawback to this and any other geoengineering option is that it may divert political will and resources away from mitigation strategies designed to reduce the levels of greenhouse gases. It is argued that it would be a mistake to view geoengineering as a remedy for global warming since if the level of greenhouse gases are not reduced, the non-engineered climate will become increasingly hostile to human life on Earth. Mankind would become increasingly dependent on geoengineering, which can only neutralize greenhouse gas warming for a limited amount of time before increasing greenhouse gas levels overwhelm the radiative forcing due to geoengineering. At that `moment of truth' a planetary climate holocaust would result. Therefore, geoengineering should be viewed as a means to `buy time' for the implementation of `green' energy technologies and to allow greenhouse gas mitigation strategies time to work. At the same time, climate catastrophes that might otherwise occur might be avoided.

5. Next steps?

More detailed modeling studies of cirrus microphysics, testing some of the physical principles and assumptions used here, as well as related laboratory studies, should be carried out. For example, in cirrus generated from mesoscale motions, their microphysical properties appear to be governed by the dynamics (Kärcher and Ström 2003). Modeling studies could be conducted to examine how significant the negative Twomey effect is in these cirrus. Another uncertainty is the ice sedimentation rate, a key factor determining how strong an effect this climate engineering approach is likely to have. The rate of increase in the ice particle fall velocity with respect to particle size, dV/dD where D = ice particle maximum dimension, decreases with increasing D. Hence this approach will be most effective for narrow PSD where the relative change in size after seeding is large. *In situ* measurements indicate such PSD are common when $T < -40$ °C, but these measurements may be contaminated by larger ice particles shattering at the inlet of the measurement probe, producing many small artifact ice fragments that are counted as natural ice crystals. This problem of ice particle shattering has cast a cloud of uncertainty over *in situ* PSD measurements and needs to be resolved to obtain reliable estimates of ice sedimentation rates, which depend strongly on the concentrations of small ice crystals (Mitchell *et al* 2008).

Drawing from these process-oriented studies, GCM experiments could be designed to test this hypothesis. Since the parameterized physics differs considerably between GCMs, climate predictions differ as well, making it important to test this hypothesis in more than one GCM. In all GCM experiments, ice particle size, mass and projected area must be represented as accurately as possible for reliable fall speed estimates, and the cirrus microphysics should be coupled with the cirrus optical properties (Mitchell *et al* 2008, Baran 2009).

Field experiments could also be designed to test certain aspects of the hypothesis, such as the impact of efficient ice nuclei on the microphysics of cold cirrus wave clouds (i.e. upwind seeding of only one section of cloud and comparing the microphysics of seeded and unseeded sections). Such field studies could benefit from complementary satellite and ground based remote sensing studies, as considerable microphysical information can now be obtained through remote sensing. If such studies supported the hypothesis, the idea could be implemented by injecting cloud seeding material into the exhaust of commercial airliners that normally fly in this temperature regime (without involving the jet engines themselves).

6. Recapitulation

Recent GCM studies (Sanderson *et al* 2008, Mitchell *et al* 2008) suggest that climate sensitivity is very sensitive to upper tropospheric cloud cover and humidity, making cirrus clouds a logical candidate for climate modification efforts. Cirrus clouds also affect OLR more than other cloud types, with their modification directly addressing the radiation imbalance imposed by greenhouse gases. Due to the expected dominance of homogeneous freezing nucleation at temperatures below –40 °C, it may be possible to decrease cirrus cloud coverage by introducing efficient heterogeneous ice nuclei at these temperatures where the cirrus greenhouse effect is strongest. Due to vapor competition effects, this may result in larger ice crystals with higher fall velocities, which should decrease cirrus coverage and increase OLR, thus cooling surface temperatures. While there may be an initial increase in cirrus coverage due to ice supersaturation in clear skies, over time the increase in net downward transport of water substance (due to higher ice fall speeds) should reduce the relative humidity and cirrus coverage of the upper troposphere. Based on one GCM study, it appears that seeding cirrus clouds on a global scale could cool the planet by well more than 2.8 W m^{-2}, perhaps enough to cancel the radiative forcing due to a doubling of CO_2 (3.7 W m^{-2}). The distribution of seeding material could be done relatively inexpensively through the airline industry. Seeding along conventional flight corridors should increase OLR preferentially over the northern high latitudes where global warming is most severe. But this may also slightly intensify the global temperature gradients, the jet streams and the frequency and strength of frontal systems. Studies employing a variety of GCMs might be needed to understand the feedbacks involved. On the other hand, this geoengineering option does not have many of the drawbacks that the most studied geoengineering option has, that option being the stratospheric injection of sulfur compounds.

Acknowledgments

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APPENDIX 20

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ACTIVITY	FY88		FY89		FY90		FY91		FY92		FY93		FY94	
SO's new	630		847		731		774		452		297		205	
SO's rescinded	237		413		496		372		543		490		574	
otal SO's in effect, end of period	5122		5556		5791		6193		6102		5909		5540	
ponsoring Agencies for new SO's														
ASPAB/DTSA	113	17.9%	153	18.1%	170	23.3%	181	23.4%	75	16.6%	62	20.9%	68	33
ARMY	179	28.4%	107	12.6%	145	19.8%	93	12.0%	50	11.1%	29	9.8%	20	9
NAVY	159	25.2%	275	32.5%	205	28.0%	220	28.4%	132	29.2%	76	25.6%	48	23
AF	166	26.3%	292	34.5%	194	26.5%	265	34.2%	174	38.5%	105	35.4%	58	28
DOE	13	2.1%	20	2.4%	16	2.2%	15	1.9%	21	4.6%	25	8.4%	11	5
NASA	0	0.0%	0	0.0%	1	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0
lew DOD SO's imposed by Type														
DOD Type 1 (export control)	299	47.5%	356	42.0%	296	40.5%	362	46.8%	201	44.5%	31	10.4%	6	2
DOD Type 2 (lassified/classifiable)	158	25.1%	261	30.8%	151	20.7%	116	15.0%	95	21.0%	89	30.0%	64	31
DOD Type 2 (foreign PSA)	113	17.9%	153	18.1%	170	23.3%	181	23.4%	75	16.6%	60	20.2%	67	32
DOD Type 3	47	7.5%	57	6.7%	97	13.3%	100	12.9%	60	13.3%	92	31.0%	57	27
lew Non-DOD SO's imposed DOE,NASA)	13	2.1%	20	2.4%	17	2.3%	15	1.9%	21	4.6%	25	8.4%	11	5

ACTIVITY	FY95		FY96		FY97		FY98		FY99		FY00		FY01	
New Secrecy Orders	124		105		102		151		72		83		83	
SO's rescinded	324		277		210		170		210		245		88	
Total SO's in effect, end of period	5340		5168		5060		5041		4903		4741		4736	
Sponsoring Agencies for new SO's														
ASPAB/DTSA	38	30.6%	16	15.2%	35	34.0%	38	24.7%	0	0.0%	23	27.7%	17	20.5%
ARMY	11	8.9%	14	13.3%	4	3.9%	17	11.0%	24	33.3%	16	19.3%	11	13.3%
NAVY	23	18.5%	39	37.1%	39	37.9%	28	18.2%	13	18.1%	23	27.7%	30	36.1%
AF	37	29.8%	28	26.7%	24	23.3%	67	43.5%	20	27.8%	12	14.5%	25	30.1%
DOE	15	12.1%	8	7.6%	1	1.0%	4	2.6%	15	20.8%	9	10.8%	0	0.0%
NASA	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
New DOD SO's imposed by Type														
DOD Type 1 (export control)	3	2.4%	14	13.3%	14	13.7%	11	7.3%	5	6.9%	16	19.3%	7	8.4%
DOD Type 2 (classified/classifiable)	31	25.0%	45	42.9%	42	41.2%	37	24.5%	14	19.4%	20	24.1%	22	26.5%
DOD Type 2 (foreign PSA)	33	26.6%	16	15.2%	24	23.5%	15	9.9%	19	26.4%	24	28.9%	21	25.3%
DOD Type 3	42	33.9%	22	21.0%	21	20.6%	84	55.6%	19	26.4%	14	16.9%	33	39.8%
New Non-DOD SO's imposed (DOE,NASA)	15	12.1%	8	7.6%	1	1.0%	4	2.6%	15	20.8%	9	10.8%	0	0.0%
John Doe Sos					23		99		18		24		44	

ACTIVITY	FY02		FY03		FY04		FY05	
New Secrecy Orders	139		136		124		106	
SO's rescinded	83		87		80		76	
Total SO's in effect, end of period	4792		4841		4885		4915	
Sponsoring Agencies for new SO's								
ASPAB	60	43.5%	38	27.9%	22	17.7%	23	21.7%
ARMY	15	10.9%	23	16.9%	16	12.9%	14	13.2%
NAVY	16	11.6%	6	4.4%	8	6.5%	8	7.5%
AF	44	31.9%	65	47.8%	69	55.6%	46	43.4%
DOE	3	2.2%	4	2.9%	3	2.4%	6	5.7%
NSA	0	0.0%	0	0.0%	5	4.0%	9	8.5%
NIH	0	0.0%	0	0.0%	1	0.8%	0	0.0%
New DOD SO's imposed by Type								
DOD Type 1 (export control)	13	9.4%	8	5.9%	18	14.5%	11	10.4%
DOD Type 2 (classified/classifiable)	41	29.5%	36	26.5%	27	21.8%	42	39.6%
DOD Type 2 (foreign PSA)	60	43.2%	38	27.9%	23	18.5%	24	22.6%
DOD Type 3	22	15.8%	50	36.8%	52	41.9%	23	21.7%
Non-DOD SO's imposed (DOE,NASA)	3	2.2%	4	2.9%	4	3.2%	6	5.7%
John Doe SOs	37		51		61		32	

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ACTIVITY	FY03		FY04		FY05		FY06		FY07		FY08		FY09	
New Secrecy Orders	136		124		106		108		128		68		103	
SO's rescinded	87		80		76		81		68		47		45	
Total SO's in effect, end of period	4841		4885		4915		4942		5002		5023		5081	
Sponsoring Agencies for new SO's														
Foreign Origin	38	27.9%	22	17.7%	23	21.7%	3	2.8%	10	7.8%	10	14.7%	23	22.1%
ARMY	23	16.9%	16	12.9%	14	13.2%	2	1.9%	22	17.2%	8	11.8%	9	8.7%
NAVY	6	4.4%	8	6.5%	8	7.5%	36	33.3%	28	21.9%	8	11.8%	39	37.5%
Air Force	65	47.8%	69	55.6%	46	43.4%	40	37.0%	45	35.2%	20	29.4%	21	20.2%
Department of Energy	4	2.9%	3	2.4%	6	5.7%	7	6.5%	0	0.0%	2	2.9%	0	0.0%
National Security Agency (NSA)	0	0.0%	5	4.0%	9	8.5%	20	18.5%	21	16.4%	20	29.4%	12	11.5%
chnology Security Administration (DTSA)									2	1.6%	0	0.0%	0	0.0%
National Institue of Health (NIH)	0	0.0%	1	0.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
New DOD SO's imposed by Type														
DOD Type 1 (export control)	8	5.9%	18	14.5%	11	10.4%	19	17.6%	15	11.7%	21	30.9%	41	39.8%
DOD Type 2 (classified/classifiable)	36	26.5%	27	21.8%	42	39.6%	52	48.1%	68	53.1%	25	36.8%	24	23.3%
DOD Type 2 (foreign PSA)	38	27.9%	23	18.5%	24	22.6%	3	2.8%	11	8.6%	10	14.7%	23	22.3%
DOD Type 3 (general secrecy orders)	50	36.8%	52	41.9%	23	21.7%	27	25.0%	34	26.6%	10	14.7%	15	14.6%
w Non-DOD SO's imposed (DOE,NASA)	4	2.9%	4	3.2%	6	5.7%	7	6.5%	0	0.0%	2	2.9%	0	0.0%
John Doe Sos (imposed on private inventors)	51		61		32		29		53		22		21	

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U.S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON, D.C. 20231

Serial No. 756,124 Filed Aug. 29, 1968

Applicant Gillis P. Flanagan

Title METHOD AND SYSTEM FOR SIMPLIFYING SPEECH WAVEFORMS

SECRECY ORDER

(Title 35, United States Code (1952), sections 181-188)

NOTICE: To the applicant above named, his heirs, and any and all his assignees, attorneys and agents, hereinafter designated principals.

You are hereby notified that your application as above identified has been found to contain subject matter, the unauthorized disclosure of which might be detrimental to the national security, and you are ordered in nowise to publish or disclose the invention or any material information with respect thereto, including hitherto unpublished details of the subject matter of said application, in any way to any person not cognizant of the invention prior to the date of the order, including any employee of the principals, but to keep the same secret except by written consent first obtained of the Commissioner of Patents, under the penalties of 35 U.S.C. (1952) 182, 186.

Any other application already filed or hereafter filed which contains any significant part of the subject matter of the above identified application falls within the scope of this order. If such other application does not stand under a secrecy order, it and the common subject matter should be brought to the attention of the Security Group, Licensing and Review, Patent Office.

If, prior to the issuance of the secrecy order, any significant part of the subject matter has been revealed to any person, the principals shall promptly inform such person of the secrecy order and the penalties for improper disclosure. However, if such part of the subject matter was disclosed to any person in a foreign country or foreign national in the U.S., the principals shall not inform such person of the secrecy order, but instead shall promptly furnish to the Commissioner of Patents the following information to the extent not already furnished: date of disclosure; name and address of the discloseee; identification of such part; and any authorization by a U.S. Government agency to export such part. If the subject matter is included in any foreign patent application, or patent this should be identified. The principals shall comply with any related instructions of the Commissioner.

This order should not be construed in any way to mean that the Government has adopted or contemplates adoption of the alleged invention disclosed in this application; nor is it any indication of the value of such invention.

EDWIN L. REYNOLDS
First Assistant Commissioner

An example of the secrecy order that enables a government to confiscate a patent.

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APPENDIX 21

Open Feedback Dialog

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Congress > Legislation > 2001-2002 (107th Congress) > H.R. 2977 [107th]

Text of H.R. 2977 [107th]: Space Preservation Act of 2001

Oct 2, 2001 - Introduced in House. This is the original text of the bill as it was written by its sponsor and submitted to the House for consideration. This is the latest version of the bill currently available on GovTrack.

HR 2977 IH

107th CONGRESS

1st Session

H. R. 2977

To preserve the cooperative, peaceful uses of space for the benefit of all humankind by permanently prohibiting the basing of weapons in space by the United States, and to require the President to take action to adopt and implement a world treaty banning space-based weapons.

IN THE HOUSE OF REPRESENTATIVES

October 2, 2001

Mr. KUCINICH introduced the following bill; which was referred to the Committee on Science, and in addition to the Committees on Armed Services, and International Relations, for a period to be subsequently determined by the Speaker, in each case for consideration of such provisions as fall within the jurisdiction of the committee concerned

---

A BILL

To preserve the cooperative, peaceful uses of space for the benefit of all humankind by permanently prohibiting the basing of weapons in space by the United States, and to require the President to take action to adopt and implement a world treaty banning space-based weapons.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Space Preservation Act of 2001'.

SEC. 2. REAFFIRMATION OF POLICY ON THE PRESERVATION OF PEACE IN SPACE.

Congress reaffirms the policy expressed in section 102(a) of the National Aeronautics and

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Space Act of 1958 (42 U.S.C. 2451(a)), stating that it `is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind.'.

SEC. 3. PERMANENT BAN ON BASING OF WEAPONS IN SPACE.

The President shall--

(1) implement a permanent ban on space-based weapons of the United States and remove from space any existing space-based weapons of the United States; and

(2) immediately order the permanent termination of research and development, testing, manufacturing, production, and deployment of all space-based weapons of the United States and their components.

SEC. 4. WORLD AGREEMENT BANNING SPACE-BASED WEAPONS.

The President shall direct the United States representatives to the United Nations and other international organizations to immediately work toward negotiating, adopting, and implementing a world agreement banning space-based weapons.

SEC. 5. REPORT.

The President shall submit to Congress not later than 90 days after the date of the enactment of this Act, and every 90 days thereafter, a report on--

(1) the implementation of the permanent ban on space-based weapons required by section 3; and

(2) progress toward negotiating, adopting, and implementing the agreement described in section 4.

SEC. 6. NON SPACE-BASED WEAPONS ACTIVITIES.

Nothing in this Act may be construed as prohibiting the use of funds for--

(1) space exploration;

(2) space research and development;

(3) testing, manufacturing, or production that is not related to space-based weapons or systems; or

(4) civil, commercial, or defense activities (including communications, navigation, surveillance, reconnaissance, early warning, or remote sensing) that are not related to space-based weapons or systems.

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SEC. 7. DEFINITIONS.

In this Act:

(1) The term `space' means all space extending upward from an altitude greater than 60 kilometers above the surface of the earth and any celestial body in such space.

(2)(A) The terms `weapon' and `weapons system' mean a device capable of any of the following:

(i) Damaging or destroying an object (whether in outer space, in the atmosphere, or on earth) by--

(I) firing one or more projectiles to collide with that object;

(II) detonating one or more explosive devices in close proximity to that object;

(III) directing a source of energy (including molecular or atomic energy, subatomic particle beams, electromagnetic radiation, plasma, or extremely low frequency (ELF) or ultra low frequency (ULF) energy radiation) against that object; or

(IV) any other unacknowledged or as yet undeveloped means.

(ii) Inflicting death or injury on, or damaging or destroying, a person (or the biological life, bodily health, mental health, or physical and economic well-being of a person)--

(I) through the use of any of the means described in clause (i) or subparagraph (B);

(II) through the use of land-based, sea-based, or space-based systems using radiation, electromagnetic, psychotronic, sonic, laser, or other energies directed at individual persons or targeted populations for the purpose of information war, mood management, or mind control of such persons or populations; or

(III) by expelling chemical or biological agents in the vicinity of a person.

(B) Such terms include exotic weapons systems such as--

(i) electronic, psychotronic, or information weapons;

(ii) chemtrails;

(iii) high altitude ultra low frequency weapons systems;

(iv) plasma, electromagnetic, sonic, or ultrasonic weapons;

(v) laser weapons systems;

(vi) strategic, theater, tactical, or extraterrestrial weapons; and

(vii) chemical, biological, environmental, climate, or tectonic weapons.

(C) The term `exotic weapons systems' includes weapons designed to damage space or natural ecosystems (such as the ionosphere and upper atmosphere) or climate, weather, and tectonic systems with the purpose of inducing damage or destruction upon a target population or region on earth or in space.