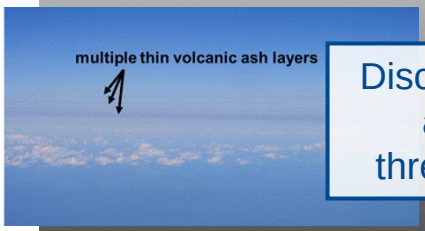
Challenges in Managing Aviation Risk from Ash Hazards – An Engineer's View

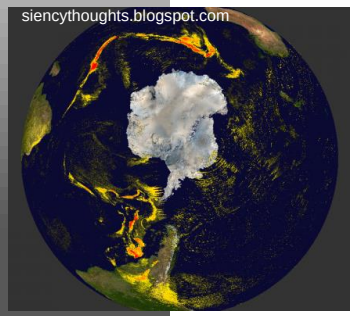
- Clear blue sky (i.e. homeopathic concentrations of ash) – no problem flying in this

- EASA, OEMs – Avoid discernible or visible ash

Visible ash threshold



Discernible ash threshold



- Is there an ash concentration/dose that incurs minimal economic damage?
- Is there an ash concentration/dose that represents a flight safety threshold?
- Thick ash plume – definitely wouldn't fly in this

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- Is there a justification for exploring where the economically acceptable or safety threshold is in visible or discernible ash?

- Because EASA are requiring aircraft/engine OEMs to define VA susceptibility – CS-25 1593 and CS-E 1050

1. **Engines are susceptible to 'visible' ash**
   - So ash is only damaging if it has actually been seen…..?
2. **Engines are susceptible to ash that could, or would, be 'visible' to the human eye in good light**
   - Ash at 0.01 mg/m^3 can be seen, but is it damaging to engines?
3. **Engines are susceptible to ash that can be discerned by satellite based IR imagery**
   - Effectively ash concentrations >0.2 mg/m^3 – probably still a little conservative
4. **Engines are not susceptible to ash that is not discernible nor visible**
   - Almost certainly true, but not terribly useful
5. **Engines are susceptible above an actual concentration of z mg/m^3, a or a dose equivalent to x mg/m^3 for y minutes**
   - Noting that engines see the actual ash concentration, they don't know about predicted concentrations
6. **Relate new engines to susceptibility of in-service engine types**
   - e.g. 2015 engine is x% more/less susceptible than an engine from 1990

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- Is there a justification for exploring the possibility of operating in visible or discernible ash?

- What cost to aviation and society for avoiding discernible/visible ash?

$1M /yr ?
$10M /yr ?
>$20M /yr ?

- Is there an ash concentration/dose up to which safe flight operations can be conducted that would reduce this cost to say <$5M /yr?
  - Combined cost of flight disruption and slight engine deterioration
- What would it cost to establish such a concentration/dose?

$3M ?
$30M ?
>$300M ?

- Could such a concentration/dose be of practical operational use?