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Surface wind estimate from satellite pictures of sunglint

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ABSTRACT. Satellite pictures of sunglint show a promise of providing a means of estimating wind over sea areas. A calm to light wind may give comparatively small but bright glint; whereas a stronger wind, generating waves, may cause a diffuse reflection of sunlight and hence a diffused wider glint.

1. Sunglint is the reflection of the disc of the sun as seen by a satellite camera, on a water surface such as the sea surface, or large lakes. A smooth surface acts like a mirror and produces a small bright reflection. A rough surface produces a less bright, but larger reflection. The change in area and change in brightness of sunglint gives same indications of the surface wind.

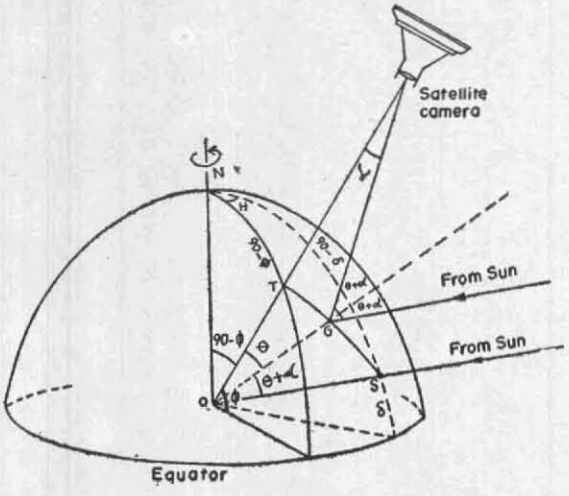
The geometry of formation of a sunglint may be seen at Fig. 1.

2. Sunglint is observed by a satellite camera over oceanic region, if the 'pass' of the satellite is during the day hours and only when the difference in the hour angles of the sun and the satellite does not exceed a certain value $H°$, given by the formula—

$$\cos H = \frac{\cos(2\theta + \alpha) - \sin\phi \sin\delta}{\cos\phi . \cos\delta}$$

where, ϕ = the latitude of the sub-satellite point
δ = the declination of the sun
θ = the angle subtended by the radius of the field of view of the satellite with the centre of the earth.
α = angle subtended by the radius of the field of view at the satellite camera.

3. Glint pictures are therefore obtained only under some favourable conditions when sun's rays reflected from the water surface come within the satellite field of view. Often successive passes of the satellite, show sunglints shifting from one longitude to the other. Day after day, corresponding passes show sunglints in nearly the same localities. When the speed of the wind is greater, the area of the sunglint increases and the glint becomes very diffuse. As the satellite pictures gradually fade with time and lose the details, only latest



T. SUB SATELLITE POINT
G GLIND
O. CENTRE OF EARTH

Fig. 1

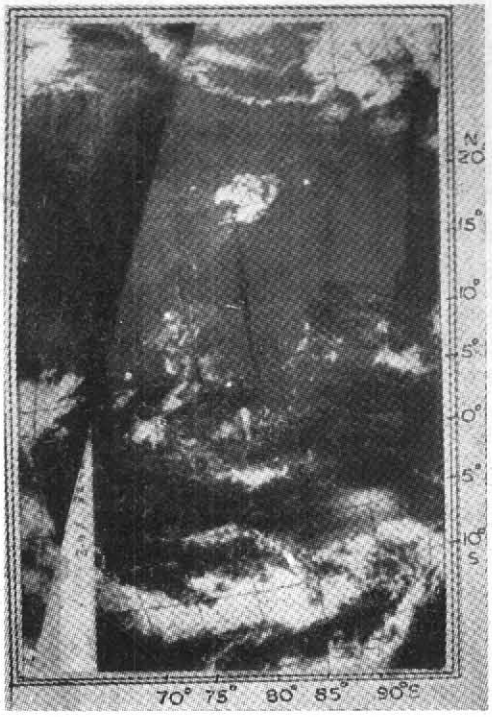
Geometry of formation of a sunglint

pictures obtained by ESSA-8 during February and March 1970 were studied. The data is shown in Table 1. In the last column are given the wind speeds as estimated from 0600 GMT surface charts. Some of the glint pictures and corresponding synoptic situations are also given (Fig. 2 to Fig. 4).

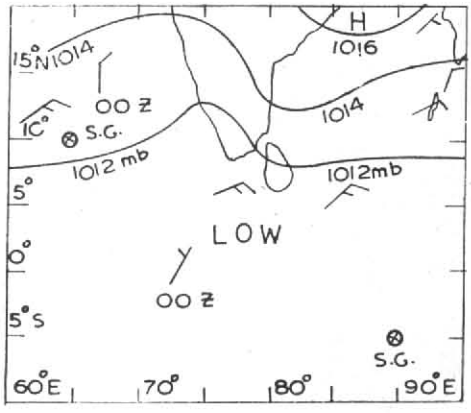
4. It is found that for ESSA-8 when the diameter of sunglint area is less than about 5° of latitude and the glint is bright, surface wind speed is less than 5 kt. When the diameter of the glint is 5° or more and the glint is diffuse, the speeds are greater than 5 kt.

Acknowledgement

I wish to thank Shri Y. P. Rao for his encouragement in the study.



(a)

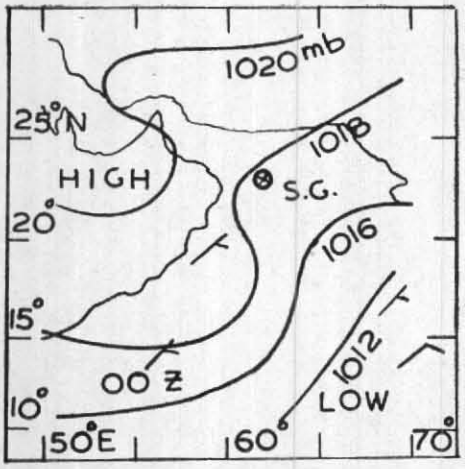


(b)

Fig. 1

Sunglint picture at (a) and (b) the corresponding synoptic situations at 0600 GMT on 7 February 1971

(a)

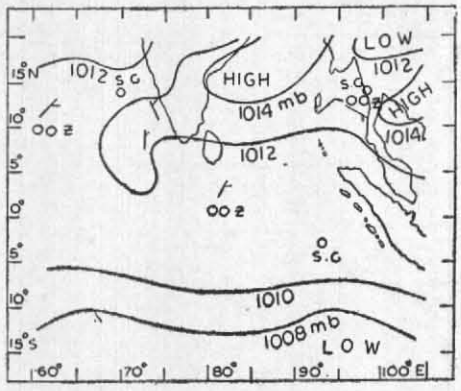


(b)

Fig. 3

(a) Sunglint picture and (b) the corresponding synoptic situation at 0600 GMT on 8 February 1970

(a)



(b)

Fig. 4

(a) Sunglint picture and (b) the corresponding synoptic situation at 0600 GMT on 18 February 1970

TABLE 1

Date (1970)	ESSA-8 Orbit No.	Sub-satellite point		Picture time (IST)	Glint position		Glint diameter (deg) and description	Surface wind speed (kt) estimated from synoptic charts
		Lat. (Deg)	Long. (Deg)		Long. (Deg)	Lat. (Deg)		
7 Feb	5253	3·0 S	82·6 E	091700	90 E	·5 S	5 Bright	5*
	5254	15·6 N	59·4 E	110621	65 E	10 N	5 Diffuse	10*
8 Feb	5267	34·1 N	53·1 E	115130	62 E	25 N	8 Diffuse	10
12 Feb	5317	16·2 N	53·2 E	113225	60 E	11 N	8 Diffuse	10
13 Feb	5329	1·8 S	63·7 E	103442	70 E	4 S	5 Little diffuse	5
	5329	16·3 N	69·1 E	102850	75 E	12 N	3 Bright	5
15 Feb	5354	16·7 N	72·3 E	101609	75 E	5 S	5 Diffuse	10
16 Feb	5360	16·8 N	88·3 E	091241	90 E	5 S	5 Diffuse	10
	5360	17·4 N	59·8 E	110713	65 E	14 N	3 Bright	5
18 Feb	5391	0·8 S	86·2 E	090557	93 E	3 S	5 Bright	5*
	5391	17·4 N	91·6 E	090005	98 E	14 N	3 Bright	5*
19 Feb	5404	0·6 S	73·6 E	095703	82 E	3 S	3 Bright	5
	5405	0·6 S	73.6 E	095703	61 E	15 N	Very diffuse	10
24 Feb	5467	0·4 N	67·3 E	102300	76 E	2 S	3 Bright	5
1 Mar	5530	5·0 N	62·1 E	104748	69 E	3 N	5 Diffuse	10
2 Mar	5543	3·9 N	49·0 E	113970	57 E	2 S	2·5 Bright	5
	5543	21·1 N	54·5 E	113325	52 E	17 N	2·5 Bright	5

*From ships' observations in the neighbourhood

DISCUSSION

SHRI G. GURUNADHAM remarked that the sunglints tend to be elliptical in shape when they occur at the edge of the frame.

PROF. K. R. RAMANATHAN remarked that just as mud particles change the colour of the sea near deltaic areas, their effect on sunglint also should be studied.